BC Environment

# NECHAKO RIVER SUB-BASIN
# WATER QUALITY OBJECTIVES DATA REVIEW

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ENVIRONMENTAL PROTECTION BRANCH
NORTHERN INTERIOR REGION

August 1993

MINISTRY OF ENVIRONMENT, LANDS AND PARKS
PROVINCE OF BRITISH COLUMBIA

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## ABSTRACT

Objectives data on the Nechako River sub-basin dating back to Sept. 21, 1987 up to Feb. 13, 1992 were compiled and reviewed relative to ambient water quality objectives. Ten parameters were included in the study. Fecal coliforms were found to exceed objectives at points in the Nechako River. Nitrite levels in the Nechako and Stuart Rivers did not exceed the objective, and were not generally detectable at a normal detection level of 0.005 mg/L. Nitrite did, however, exceed the objective in the Necoslie River. Nitrate levels were well within acceptable ranges. Ammonia exceeded the objectives criteria in the Necoslie River as well. Ortho-phosphorus at Fort Fraser was detectable in only a few cases at the normal detection level of 0.003 mg/L. Ortho-phosphorus levels were found to be considerably higher downstream from Vanderhoof and in the Necoslie River. Total dissolved phosphorus levels were consistently but not significantly higher than ortho-phosphorus. No objective had been determined for phosphorus, but concentrations usually remained within desirable limits. Pulp mill-related data collected from the Nechako River downstream of Vanderhoof were generally consistent and showed that most parameters existed in very low concentrations. No abnormal temperature or pH values were recorded. Total gas pressure was not reviewed because of the questionable data quality.

# ACKNOWLEDGEMENTS

There were a number of people who contributed to the culmination of this report and we would like to extend our appreciation to those individuals. Thanks to Mr. Jim Simonson, who spent many long hours on the river, collecting samples and taking readings. Thanks also to Mr. Les Swain, P.Eng., B.C. Environment, Victoria, for his valuable comments and technical support.

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## INTRODUCTION

The Water Quality Objectives Program is a fairly recent project developed by the provincial Ministry of Environment as an attempt to quantify the Ministry's success in protecting water quality. The program was launched in 1982, and by 1990, specific objectives were set for 24 separate water basins throughout the province. Included among these were a diverse array of lakes, rivers, creeks and tidal waters. Located within each basin was a human activity that was thought to be a possible source of impact to local water quality. Water quality objectives were determined for parameters related to that development. The objectives are safe levels of contaminants that will protect the most sensitive use of a water body, usually aquatic life or drinking water. Funding for testing these sites was allocated by Victoria's Water Quality Branch, with each region of Environmental Protection expected to maintain a water quality monitoring program to determine if the objectives are achieved.

The Northern Interior Region presently has eight bodies of water included under its objectives monitoring program. With such a large amount of testing, it is important for the region to do detailed, periodic reviews of each basin to maximize efficiency of the objectives program. Such reviews should compile all data, discuss water quality impacts and trends, and recommend modifications, whether it be deletions of unneeded parameters or parameter additions.

This report will review the objectives data collected for the Nechako River basin from September of 1987 to February of 1992.

The Nechako River is a major tributary of the Fraser. The Nechako's flow is controlled by Alcan's Skins Lake spillway, as well as flows from Fraser and Stuart Lakes. The spillway allows excess water from the Nechako Reservoir to form the Nechako River, which flows north to Fort Fraser, then east towards Prince George where it joins the Fraser River. Much of the water from the reservoir is directed westward to Kemano where it is used to drive turbines supplying power to Alcan's aluminum plant.

Alcan is presently planning its "Kemano Completion" project. This project's main goal is to increase power provided to their aluminum plant located at Kitimat, B.C. This is to be accomplished, in part, by diverting more water from the Nechako Reservoir westward to Kemano, thereby decreasing flow to the Nechako River. Flows in the Nechako River may be dramatically reduced. The Kemano Completion project has been postponed, but if it does continue, the impact of present waste discharges could be significantly increased. This possibility should be considered when recommending changes to the Water Quality Objectives Program.

The Nechako River basin water quality objectives program has two main purposes. Firstly, a number of municipal sewage lagoons discharge into the basin. Both Fort Fraser and Vanderhoof discharge municipal sewage into the Nechako. Fort St. James discharges municipal sewage into the Necoslie River, just above the Stuart River (Fig.1). All three sewage discharges undergo secondary treatment before release to the waterway. Tertiary treatment is being considered for the Vanderhoof effluent (1). These effluents have potential to increase bacterial, nitrogen and phosphorus forms to varying degrees. Monitoring adjacent to these discharges will determine how and to what extent the water quality is impacted. The second goal of the program was established in 1990, and involves collection of background data relevant to the non-chlorinating wood pulping industry. Vanderhoof Pulp and Paper Ltd. is presently planning a BCTMP mill with discharge to the Nechako River downstream of Vanderhoof and site E207451. Two years of data on phenols, resin acids and various metals have been collected at this site, to serve as a temporal control for comparison to any future pulp mill activities.

Objectives for seven parameters were established in 1987 (2), as follows:

Fecal coliforms

< 100/100 mL, 90th percentile, in the Stuart River, east side, from the Necoslie River to 200 m downstream of hwy. 27 bridge;
< 10/100 mL, 90th percentile, in all other parts of the Stuart River.
< 400/100 mL, 90th percentile, in the Necoslie River, and
< 200/100 mL, geometric mean, in the Necoslie River (Apr. through Oct.) and in the Nechako River 1 km downstream of Fort Fraser discharge to the confluence of the Nautley River;

| | |
|---|---|
| | < 100/100 mL, 90th percentile, in the rest of the Nechako River. |
| Nitrite | < 0.02 mg/L average;<br>0.06 mg/L maximum. |
| Ammonia | Dependent on pH and temperature.<br>As per provincial criteria (2) and (3). |
| pH | 6.5 minimum;<br>8.5 maximum. |
| Dissolved oxygen | 11.2 mg/L minimum when fish eggs are in the eye to hatch stage;<br>8.0 mg/L minimum when fish eggs and/or larvae or alevin exist;<br>7.75 mg/L minimum at all other times. |
| Temperature | 15° C maximum in the Nechako River at Cheslatta Falls;<br>20° C maximum in the Nechako River 100 m upstream of Stuart River confluence (July to Aug.);<br>18° C maximum in the Nechako River 100 m upstream of Stuart River confluence (all other months). |
| Total gas pressure | 109% |

The established chlorine objective (6) has not been checked at Fort Fraser and Vanderhoof as those discharges are not chlorinated. Nor has the established objective of <50 mg/m² for periphyton chlorophyll a been checked, this because of the lack of suitable natural substrate (large gravels and cobbles) necssary for this type of monitoring.

This report will examine data collected for various parameters to determine if Nechako River water quality is modified by municipal discharges. It will also identify which parameters may act as indicators of water quality changes in the receiving environment. Results for each parameter will be tabulated, summarized and compared to the established water quality objective. Exceedences will be noted and changes to the program may be suggested based on visible trends in the data. The pulp mill-related data will also be compiled and summarized. Temporal variability of these data over time will be examined to assess their value as a control.

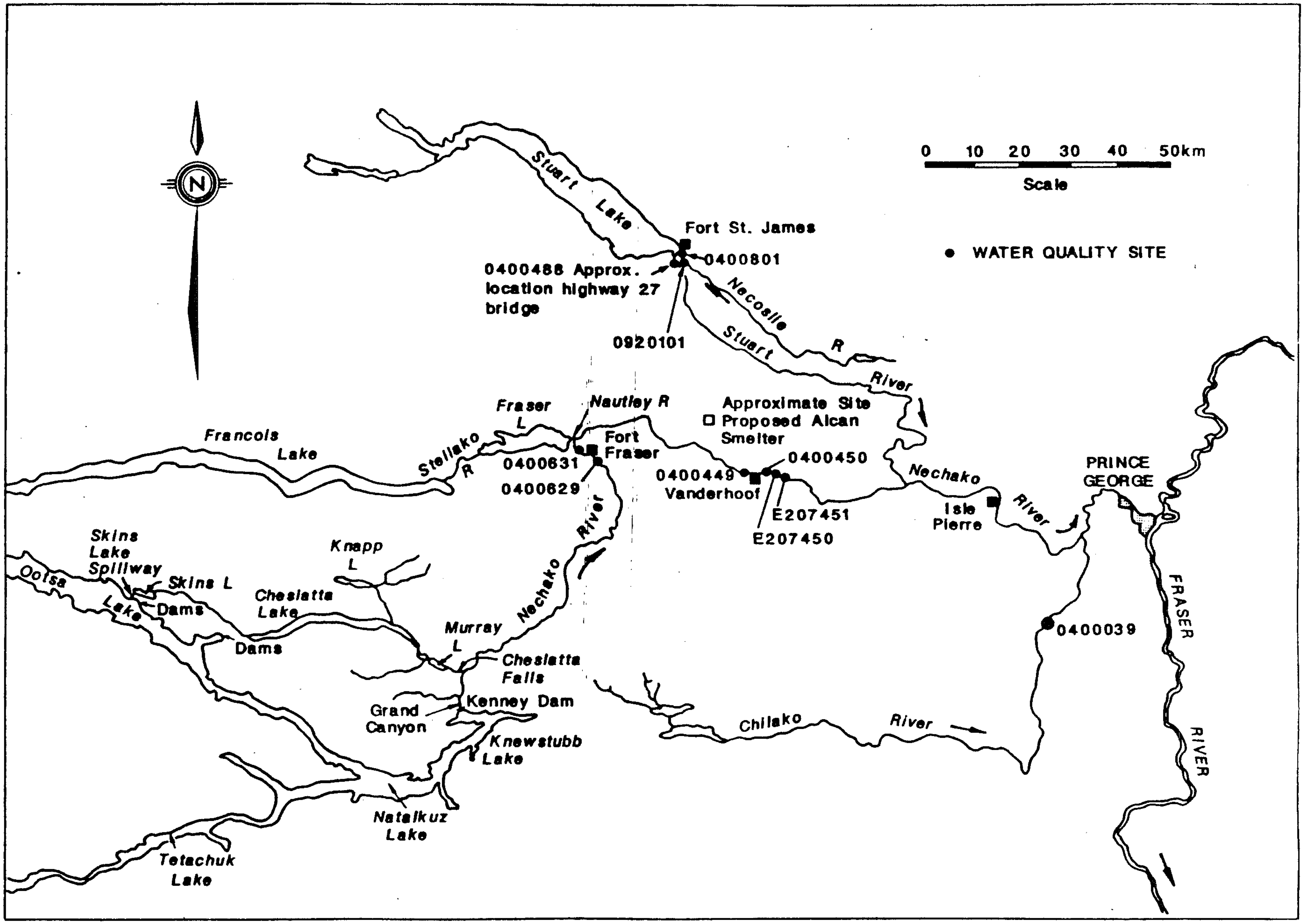


FIGURE 1 Nechako River

## METHODS

Water quality objectives monitoring has been conducted during summer and winter low flow periods on the Nechako River and during summer low flow on the Stuart River system. Nine sites near the three municipal discharges were monitored, as follows (Fig.1):

| Site # | Description |
|---|---|
| 0400629 | Nechako River 200 m u/s from Fort Fraser discharge |
| 0400631 | Nechako River 200 m d/s from Fort Fraser discharge |
| 0400449 | Nechako River 200 m u/s from Vanderhoof discharge |
| 0400450 | Nechako River 100 m d/s from Vanderhoof discharge |
| E207450 | Nechako River 500 m d/s from Vanderhoof discharge |
| E207451 | Nechako River 2 km d/s from Vanderhoof discharge |
| 0400801 | Necoslie River 20 m u/s from hwy. 27 - midstream |
| 0400488 | Stuart River at hwy. 27 bridge - east shore |
| 0920101 | Stuart River at hwy. 27 bridge - west shore |

Ten main parameters have been studied as a part of this program: fecal coliforms; nitrite; ammonia; nitrite plus nitrate; ortho-phosphorus; total dissolved phosphorus; pH; dissolved oxygen; temperature and total gas pressure. Limited chloride data exists but will not be reviewed. Total gas pressure was measured several times in the summer programs of 1989 and 1990. However, reports by the sampler that the recording instrument (Novatech Tensionometer/300 C) was giving rapidly fluctuating readings in response to depth threw the validity of the data into doubt. This apparent malfunction was also observed in the summer of 1992 (not included in this report), although the machine had presumably been fixed. Therefore, given the questionable accuracy of the available data, total gas pressure will not be reviewed at this time.

Dissolved oxygen was measured using modified field Winkler titration. Temperature was measured using a pocket thermometer. As required by the objective process, five samples were collected at each site over a 30-day period. Water samples were collected at arm's length below the surface and kept at approximately 4° C during 24-hour shipment to Zenon Environmental Ltd. where analyses were undertaken as per McQuaker (5).

Lab data quality assurance was limited to the regular internal QA in place during the program.

All water chemistry data are contained in Appendix 1 of this report and summarized in tables. Water quality data are stored in B.C. Environment's SEAM database. Field data are stored in regional B.C. Environment paper files.

Averages and 90th percentiles for comparison to objectives were determined using a minimum of 5 values obtained over a 30-day period. It should be noted that in the calculations of means and standard deviations, less-than values are taken to be one-half of that value (eg. $<2$ is taken to equal 1 ). By this method, all statistics based on a large number of less-than values must be considered approximate. Standard deviation is calculated using the (n-1) method and significant differences between data sets are calculated using a two tailed t-test as described in Zar (6).

Most of the discussion and recommendations will be based on the summary statistics. Raw data may be referenced to illustrate seasonal or recent fluctuations. Variables without established objectives are compared to provincial or federal criteria. An important aspect of this review is that spatial comparisons are made regardless of the objectives.

All parameters are measured in mg/L, except the following:
Temperature is measured in ° C,
pH is measured in pH units,
and fecal coliforms are measured in either MPN/100 mL or CFU/100 mL.

## DISCUSSION OF RESULTS

### Water Quality at Fort Fraser

Fecal coliforms both upstream (Table 1) and downstream (Table 2) from Fort Fraser are well below the objective level of 100/100 mL, 90th percentile. The maximum concentration downstream from Fort Fraser (60/100 mL) indicates that impact from the municipal sewage discharge on bacterial contamination of this section of the river is low. Out of 47 pairs of samples, fecal coliforms increased downstream of the discharge only 22 times, and only 7 of these involved an increase of greater than 10/100 mL (Table 11). Recent downstream measurements from the winter of 1992, however, show a significant increase in fecal coliforms over previous winters when a two-tailed t-test is run, $P << 0.001$. The mean for these five samples is 27/100 mL, while the mean for the other 25 winter downstream samples is 2.1/100 mL. Although there is no data available for 1 km downstream of Fort Fraser to the confluence of the Nautley River, the objective for 400 fecal coliforms/100 mL, 90th percentile, will most certainly be met if the more stringent objective immediately downstream of the discharge is met.

Ammonia at Fort Fraser does not pose a water quality problem. Out of 48 sample pairs, detectable ammonia increased downstream only nine times (Table 12). The highest recorded value in this program was 0.025 mg/L (Table 2). At a site where the objective for a 30-day average (1.31 mg/L) is over 50 times this level, based on most critical temperature and pH data of 7.9 and 14 °C, this parameter will not become a threat to water quality at the present flows. The continued sampling of ammonia near Fort Fraser should be reconsidered.

Nitrite was monitored a total of 23 times at the upstream site. All were below the detection level of 0.005 mg/L, and therefore well below the aquatic life average objective of 0.02 mg/L. All except one of the 36 downstream concentrations were also below the detection level. Low-level nitrite analyses of both sites (0.001 mg/L) were detectable only 62% of the 40 measurements (Table 13). The maximum low-level nitrite concentration was 0.014 mg/L. Increases downstream at the 0.001 mg/L MDC were rare.

Maximum acceptable levels of nitrate for the protection of drinking water have been reported as 10 mg/L (7). The maximum recorded concentration of nitrite plus nitrate was 0.045 mg/L. Small increases downstream of the discharge were found to occur two-thirds of the time, with no increase exceeding 0.01 mg/L. Average concentrations of nitrite plus nitrate at both sites are roughly 0.010 mg/L (Tables 1,2), or 0.001 times the maximum for drinking water. Nitrate appears to have only a limited trend value given the minimal increases.

Detectable ortho-phosphorus increased downstream of the discharge only four times, while total dissolved phosphorus increased 11 times out of 38 sample pairs (Table 14). Both total dissolved (0.003 mg/L) and ortho-phosphorus (0.001 mg/L) exist at or near detection-level concentrations. No provincial criteria have been established for stream phosphorus levels, although an objective for total phosphorus of less than 0.1 mg/L in flowing water has been proposed for the protection of recreational areas (7).

pH was in an optimum range between 7.0 and 7.9. The municipal discharge does not affect downstream pH levels since there was no noticeable variation between the two sites.

There was some question as to whether the stringent dissolved oxygen objectives of 8.0 mg/L (to protect fish eggs) and 11.2 mg/L (to protect fish eggs in the eyed to hatch stage) were relevant to this section of river, as well as the section near Vanderhoof. The riverbed in these areas is composed mainly of fine sand and mud, which are not considered optimal spawning substrates for salmonids. However, fisheries biologists in Prince George (8) believe that salmonid spawning is occurring in these sections of the river, and that rigorous objectives to protect fish eggs are justified.

Salmon life patterns are reported in the Nechako River objectives document (2): chinook salmon spawn in September and October. Hatching occurs until December, and fry emergence starts in March. From this schedule, it can be presumed that fish eggs will be present during the summer sampling program, which is generally performed in late September, October or early November. During the winter sampling program, usually performed in January and February, most eggs will have hatched, and larvae will be present. Therefore, since fish eggs or larvae will be present during both sampling programs, a value of 8.0 mg/L, minimum, will be used as the objective for dissolved oxygen at Fort Fraser and Vanderhoof.

Dissolved oxygen levels did not drop below 9.0 mg/L near Fort Fraser, a level sufficient to protect salmonid eggs and larvae. There was no discernible change in dissolved oxygen downstream as compared to upstream of the Fort Fraser discharge.

Temperature objectives have been set in the Nechako River 100 m downstream from Cheslatta Falls and 100 m upstream from the Stuart River confluence, but nowhere in between. In view of this fact, temperature data for Fort Fraser and Vanderhoof will be compared to the provincial criteria (9). These state that temperature must not exceed a 1° C change from the natural level. Winter temperatures upstream and downstream of Fort Fraser averaged 0.5° C. Out of a total of 20 sample pairs, no downstream reading exceeded a 1° C shift from the natural level. Summer temperatures averaged 7.3° C, again with no change greater than 1° C out of 19 sample pairs.

It is important to note that at no time during the five years of objectives monitoring was any water quality objective exceeded at the two Fort Fraser sites.

Table 1.
Summary of data collected from the Nechako River upstream of Fort Fraser (site 0400629) from September, 1987 to February, 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 47 | 2 < | 79 | 7.4 | 2 | 13.9 |
| Ammonia | 48 | 0.005 < | 0.016 | 0.004 | 0.005 < | 0.003 |
| NO2 | 23 | 0.005 < | 0.005 < | 0.002 | 0.005 < | 0.000 |
| LL NO2 | 25 | 0.001 < | 0.014 | 0.003 | 0.001 | 0.004 |
| LLNO2+NO3 | 25 | 0.005 < | 0.045 | 0.015 | 0.009 | 0.013 |
| O.Phos. | 31 | 0.003 < | 0.003 < | 0.001 | 0.003 < | 0.000 |
| LL O.Phos | 12 | 0.001 < | 0.003 | 0.001 | 0.001 | 0.008 |
| D.Phos. | 38 | 0.003 < | 0.006 | 0.003 | 0.003 | 0.001 |
| pH | 50 | 7.0 | 7.9 | 7.57 | 7.6 | 0.18 |
| Diss. Oxygen * | 40 | 9.0 | 15.0 | 11.93 | | |
| Temperature * | 39 | 0.0 | 14.0 | N/A | N/A | N/A |

Table 2.
Summary of data collected from the Nechako River downstream of Fort Fraser (site 0400631) from September, 1987 to February, 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 47 | 2 < | 60 | 10.6 | 5 | 14.0 |
| Ammonia | 48 | 0.005 < | 0.025 | 0.005 | 0.005 < | 0.005 |
| NO2 | 36 | 0.005 < | 0.005 | 0.003 | 0.005 < | 0.0004 |
| LL NO2 | 15 | 0.001 < | 0.006 | 0.002 | 0.001 | 0.002 |
| LL NO2+NO3 | 15 | 0.005 < | 0.021 | 0.011 | 0.011 | 0.005 |
| O.Phos. | 31 | 0.003 < | 0.007 | 0.002 | 0.003 < | 0.001 |
| LL O.Phos | 10 | 0.001 < | 0.002 | 0.001 | 0.0007 | 0.0007 |
| D.Phos. | 38 | 0.003 < | 0.010 | 0.003 | 0.003 | 0.002 |
| pH | 49 | 7.1 | 7.9 | 7.58 | 7.6 | 0.15 |
| Diss. Oxygen * | 40 | 9.0 | 15.0 | 11.74 | | |
| Temperature * | 39 | 0.0 | 14.0 | N/A | N/A | N/A |

* Dissolved oxygen and temperature data were not obtained in fiscal 1987-1988.

Water Quality at Vanderhoof

The District of Vanderhoof contributes large numbers of fecal coliforms to the river, greatly increasing concentrations immediately downstream from the discharge, as can be seen in Table 4. Out of 50 samples, 26 exceeded the objective concentration of 100/100 mL. The objective is met if the 90th percentile of a group of five samples taken over a 30-day period does not exceed 100/100 mL (2). This objective was exceeded in four out of five winter programs and in one out of four summer programs at site 0400450, 100 m downstream of the discharge (Table 15). At site E207450, 500 m downstream from the discharge, the mean fecal coliform concentration was lower. Nonetheless, 18 of 49 samples still exceeded 100/100 mL (Table 5). Exceedences occurred to the 90th percentile objective 500 m downstream during the winters of 1988, 1989, 1991 and 1992 (Table 15), and during the summer of 1987. Data obtained 2 km d/s of the discharge also indicated detectable fecal coliforms during almost all monitoring. Although a maximum of 2000/100 mL was measured, indicating the 90th percentile objective was exceeded during the winter program of 1989, only five of 41 samples exceeded the 100/100 mL objective. The remaining five complete programs 2 km downstream met the objective (Table 15).

Seasonal patterns were observed. At the control site, fecal coliforms averaged 26.6/100 mL in the summer and 7.2/100 mL in winter. However, at site 0400450, the situation was reversed with fecal coliforms averaging 96.3/100 mL in the summer and 3780/100 mL in winter. Some winter averages were worse than others. For example, in the winter of 1990, fecal coliforms averaged only 14.4/100 mL 100 m downstream of the discharge. Nevertheless, the impact of the discharge is normally much greater during winter than summer. This could be due to a number of factors, most likely snow and ice cover (which affect light penetration in the lagoon and limit photodecompostion of bacteria (1)). Of 48 summer values measured either 500 m or 2 km downstream of the discharge, only 2 exceeded 100/100 mL.

Ammonia concentrations also increased downstream from the discharge. Median concentrations of <0.005 mg/L upstream (Table 3) gave way to a mean of 0.349 mg/L 100 m downstream from the discharge (Table 4). The maximum concentration during any program was 1.73 mg/L.

Despite this significant increase, ammonia levels never reached the maximum aquatic life objective. Using critical temperature and pH values of 15° C and 8.2 respectively, the maximum acceptable concentration at any time was 3.64 mg/L, well above any measured concentrations. High ammonia averages were obtained 100 m downstream during the winters of 1989 and 1991 (0.807 mg/L and 0.905 mg/L, respectively), however, the 30-day average objective to protect aquatic life was not overstepped. Average pH was 7.6 during both of these periods and the maximum temperature was 1 °C. Reduced flows expected as a result of KCP will likely cause the ammonia objective to be exceeded with the present sewage treatment system. No individual concentrations measured either 500 m or 2 km downstream of the discharge exceeded the 30-day average objective.

The effect of the sewage discharge on ammonia levels in the river is much greater during winter than summer. The mean for 23 summer samples collected 100 m downstream of the discharge is 0.201 mg/L, while the mean for 26 winter samples is 0.479 mg/L (Table 16). The overall median concentration was 0.008 mg/L 500 m downstream (Table 5) and 0.005 mg/L 2 km downstream from the discharge (Table 6). Ammonia concentrations at both of these sites were higher in winter.

Neither nitrite nor nitrate increased notably downstream from the discharge (Table 18). Regular detection-level analysis (0.005 mg/L) of nitrite produced only 11 detectable values out of a total of 105 samples. No substantial downstream increase was observed when concurrent samples were taken. Low-level analyses (0.001 mg/L), however, allowed the detection of 39 of 50 samples. No low-level analysis was done for site 0400450, 100 m downstream of the discharge, but when values obtained for this site are compared to low-level values for the control site (0400449), only seven out of 23 comparable sample pairs show an increase downstream. At site E207450, 500 m downstream, nitrite had returned to background levels.

Nitrate exists in relatively low concentrations. The maximum recorded value of nitrite plus nitrate in five years of testing was 0.14 mg/L. This is well below the maximum allowable concentration of 10 mg/L to protect drinking water supply (7). Minor increases downstream of the discharge have been observed, but are not serious enough to warrant further scrutiny. All averages for these parameters are at or near detection level.

Ortho-phosphorous and total dissolved phosphorous increased significantly 100 m downstream from the discharge, $P << 0.001$. Although single-day maxima 100 m downstream reach as high as 0.357 mg/L of total dissolved phosphorus (Table 4), mean values of 0.094 mg/L ortho-P and 0.113 mg/L TDP are still within acceptable limits (7). Concentrations of both phosphorus forms returned to background levels 500 m downstream of the discharge (Table 5).

pH ranged from 7.0 to 7.9 upstream from the discharge. Downstream, pH varied from 6.9 to 8.2, still well within the water quality objective. Significant differences between upstream and downstream sites were not observed.

Dissolved oxygen showed a temporal range from 8.5 to 15.0 mg/L. It also showed a significant decrease from site 0400449 to site 0400450 using a two tailed t-test, $P < 0.02$. Nonetheless, the minimum objective of 8.0 mg/L to protect fish eggs and larvae was met at both sites. Dissolved oxygen returned to near control levels at sites E207450 and E207451.

Temperature readings in the winter averaged 0.4° C at site 0400449, and 0.5° C 100 m downstream, not a significant change. Summer readings averaged 6.5° C upstream and 6.5° C 100 m downstream. There was no apparent change in temperature at the other two downstream sites. At no time did any downstream reading change by more than 1° C from the natural level.

Table 3.

Summary of data collected from the Nechako River upstream of Vanderhoof discharge (site 0400449) from September, 1987 to February, 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 47 | 2 < | 94 | 16.7 | 9.5 | |
| Ammonia | 50 | 0.005 < | 0.079 | 0.008 | 0.005 < | 0.014 |
| NO2 | 29 | 0.005 < | 0.005 < | 0.002 | 0.005 < | 0.000 |
| LL NO2 | 25 | 0.001 < | 0.010 | 0.003 | 0.002 | 0.002 |
| NO2+NO3 | 19 | 0.02 < | 0.04 | 0.02 | 0.02 | 0.010 |
| LL NO2+NO3 | 25 | 0.005 < | 0.051 | 0.018 | 0.018 | 0.013 |
| O.Phos. | 32 | 0.003 < | 0.014 | 0.003 | 0.003 < | 0.003 |
| D.Phos | 39 | 0.003 | 0.020 | 0.005 | 0.005 | 0.003 |
| pH | 50 | 7.0 | 7.9 | 7.6 | 7.6 | 0.15 |
| Diss. Oxygen * | 40 | 8.90 | 15.0 | 11.77 | | |
| Temperature * | 39 | 0.0 | 14. | N/A | N/A | N/A |

Table 4.

Summary of data collected from the Nechako River 100 m downstream Vanderhoof discharge (site 0400450) from September, 1987 to February, 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 50 | 2 < | 24000 > | 1939 | 154 | 4002 |
| Ammonia | 49 | 0.005 < | 1.730 | 0.349 | 0.259 | 0.400 |
| NO2 | 43 | 0.005 < | 0.021 | 0.004 | 0.005 < | 0.004 |
| NO2+NO3 | 37 | 0.02 < | 0.14 | 0.03 | 0.03 | 0.032 |
| O.Phos. | 37 | 0.003 < | 0.342 | 0.094 | 0.070 | 0.088 |
| D.Phos. | 39 | 0.003 | 0.357 | 0.113 | 0.085 | 0.101 |
| pH | 50 | 7.0 | 8.2 | 7.6 | 7.6 | 0.23 |
| Diss. Oxygen * | 40 | 8.5 | 14.0 | 10.87 | | |
| Temperature * | 39 | 0.0 | 14. | N/A | N/A | N/A |

* Dissolved oxygen and temperature data were not obtained in fiscal 1987-1988.

Table 5.

Summary of data collected from the Nechako River 500 m downstream Vanderhoof discharge (site E207450) from Sept. 1987 to Feb. 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 49 | 2 | 2000 > | 203.9 | 33 | 427.0 |
| Ammonia | 49 | 0.005 < | 0.069 | 0.013 | 0.008 | 0.014 |
| NO2 | 29 | 0.005 < | 0.006 | 0.003 | 0.005 < | 0.001 |
| LL NO2 | 20 | 0.001 < | 0.009 | 0.003 | 0.001 | 0.003 |
| NO2+NO3 | 19 | 0.02 < | 0.04 | 0.02 | 0.02 | 0.010 |
| LL NO2+NO3 | 25 | 0.005 < | 0.046 | 0.017 | 0.013 | 0.013 |
| O.Phos. | 32 | 0.003 < | 0.008 | 0.004 | 0.003 | 0.002 |
| D.Phos. | 39 | 0.003 | 0.015 | 0.006 | 0.006 | 0.003 |
| pH | 50 | 6.9 | 8.0 | 7.6 | 7.6 | 0.19 |
| Diss. Oxygen * | 40 | 8.80 | 15.0 | 11.56 | | |
| Temperature * | 39 | 0.0 | 15. | N/A | N/A | N/A |

Table 6.

Summary of fecal coliform and nutrient data collected from the Nechako River 2 km downstream Vanderhoof discharge (site E207451) from Sept. 1987 to Feb. 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coli. | 43 | 2 < | 2000 | 100 | 31 | 309 |
| Ammonia | 46 | 0.005 < | 0.057 | 0.009 | 0.005 | 0.01 |
| NO2 | 42 | 0.005 < | 0.007 | 0.003 | 0.005 < | 0.001 |
| NO2+NO3 | 37 | 0.005 | 0.068 | 0.021 | 0.020 | 0.014 |
| O. Phos. | 36 | 0.003 | 0.013 | 0.004 | 0.003 | 0.003 |
| D. Phos. | 35 | 0.003 | 0.022 | 0.006 | 0.006 | 0.003 |
| pH | 45 | 7.3 | 7.9 | 7.6 | 7.6 | 0.15 |
| Diss.Oxygen | 40 * | 8.9 | 15.0 | 11.65 | | |
| Temperature | 39 * | 0.0 | 15. | N/A | N/A | N/A |

* Dissolved oxygen and temperature data were not obtained in fiscal 1987-1988.

The pulp mill related data collected at site E207451 are summarized in Table 7. Ten winter and ten summer low-flow samples were collected between Sept. of 1990 and Feb. of 1992. The objective of this review is to determine which parameters are variable in nature and therefore require continued measurement to establish a realistic temporal background. Refer to Table 7 for mean concentrations and respective standard deviations.

Results for chemical oxygen demand are quite variable, even over a short time period. The maximum value of 26 mg/L indicates a relatively low concentration. Phenols have been at or less than the detection level of 0.002 mg/L during the last year of testing. The previous year showed some higher readings, however, up to a maximum of 0.007 mg/L. Concentrations of carbon, colour, suspended solids, chloride and sodium are all relatively stable and low. Only three of the 140 measurements of various resin acids showed detectable amounts (Tables 21,22), well below the aquatic life criteria. However, stability of the resin acids cannot be ascertained as most of the values were below the MDC. Barium, calcium, iron and magnesium have generally stable concentrations and did not exceed their respective water quality criteria to protect aquatic life. Manganese, molybdenum and vanadium also remained within water quality criteria. Zinc appeared to be the only metal which was proven to exceed its aquatic life criterion. The maximum allowable concentration of 0.03 mg/L was exceeded three times, twice in the fall of 1990 and once in the fall of 1991 (Tables 21 and 22). High detection levels for all other metals including aluminum, cadmium, cobalt, chromium, copper, nickel and lead prevented comparison with provincial criteria. Such comparison is an important aspect of this monitoring program. Fortunately, the detection level for most of the metals was lowered with the 1992 metals package introduced by Zenon. This will allow the measurement of real concentrations of low-level metals for comparison with provincial criteria. The MDC for cadmium, chromium and lead must be further lowered to check their criteria. Provincial criteria for all metals tested can be found in the criteria document written by L. Pommen (9).

Table 7.

Summary of pulp mill-related background data collected from the Nechako River 2 km downstream Vanderhoof discharge (site E207451) from Sept. 1990 to Feb. 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| C.O.D. | 20 | < 10 | 26 | 16.6 | 15.5 | 5.49 |
| Phenols | 20 | < 0.002 | 0.007 | 0.0019 | < 0.002 | 0.0015 |
| C IO:T | 20 | 7 | 10 | 8.6 | 9 | 0.69 |
| C:T | 20 | 11 | 17 | 13.3 | 13 | 1.63 |
| Color | 18 | 5 | 11 | 7.2 | 7 | 1.4 |
| Susp. Sol. | 14 | < 1 | 3 | 1.6 | 2 | 0.63 |
| Chlrid:D | 20 | < 0.5 | 0.8 | 0.51 | 0.5 | 0.16 |
| Sodium:D | 20 | 2.2 | 2.8 | 2.5 | 2.5 | 0.16 |
| pH | 20 | 7.3 | 7.8 | 7.6 | 7.6 | 0.15 |
| AbietAcd | 20 | < 0.001 | < 0.001 | 0.0005 | < 0.001 | 0 |
| DAbietAc | 20 | < 0.001 | 0.001 | 0.0005 | < 0.001 | 0.0002 |
| NAbietAc | 20 | < 0.001 | < 0.001 | 0.0005 | < 0.001 | 0 |
| PimaricA | 20 | < 0.001 | < 0.001 | 0.0005 | < 0.001 | 0 |
| IPimrcAc | 20 | < 0.001 | < 0.001 | 0.0005 | < 0.001 | 0 |
| LPimrcAc | 20 | < 0.001 | < 0.001 | 0.0005 | < 0.001 | 0 |
| SPimrcAc | 20 | < 0.001 | 0.001 | 0.0005 | < 0.001 | 0.0001 |
| Hardness | 20 | 30.2 | 40.9 | 34.9 | 34.2 | 2.72 |
| Aluminum | 20 | 0.04 | 0.11 | 0.056 | < 0.1 | 0.018 |
| Barium | 20 | 0.009 | 0.03 | 0.012 | 0.01 | 0.006 |
| Calcium | 20 | 8.76 | 12.0 | 10.1 | 9.90 | 0.811 |
| Cadmium | 20 | < 0.002 | < 0.01 | 0.004 | < 0.01 | 0.002 |
| Cobalt | 20 | < 0.003 | < 0.1 | 0.038 | < 0.1 | 0.021 |
| Chromium | 20 | < 0.002 | < 0.01 | 0.004 | < 0.01 | 0.002 |
| Copper | 20 | 0.002 | < 0.01 | 0.004 | < 0.01 | 0.001 |
| Iron | 20 | 0.057 | 0.29 | 0.126 | 0.101 | 0.070 |
| Magnesium | 20 | 2.01 | 2.70 | 2.32 | 2.31 | 0.179 |
| Manganese | 20 | 0.005 | 0.03 | 0.008 | < 0.01 | 0.006 |
| Molybden | 20 | < 0.004 | < 0.01 | 0.004 | < 0.01 | 0.001 |
| Nickel | 20 | < 0.008 | < 0.05 | 0.02 | < 0.05 | 0.009 |
| Lead | 20 | < 0.02 | < 0.1 | 0.04 | < 0.1 | 0.02 |
| Vanadium | 20 | < 0.003 | 0.01 | 0.004 | < 0.01 | 0.002 |
| Zinc | 20 | < 0.002 | 0.09 | 0.02 | 0.007 | 0.025 |

<u>Water Quality at Fort St. James</u>

Fecal coliforms in the Necoslie River are well below the objective level of 200/100 mL, with a low mean of 11.4/100 mL (Table 8). The Stuart River at site 0400488 has slightly higher fecal coliform levels, with a mean increasing to 16.6/100 mL (Table 9). Although the Stuart River should dilute fecal coliforms coming from the Necoslie, this increase downstream from the Necoslie suggests that other sources may be contaminating the east side of the Stuart with fecal coliforms. (Site number 0400488 is on the east side of Stuart River; the same side that the Necoslie enters, while site number 0920101 is on the west side of the Stuart). Nevertheless, the objective of 100 fecal coliforms/100 mL, 90th percentile over 30 days, for the east shore of Stuart River, has not been exceeded at site 0400488 (Table 23). Nor was the more stringent objective of 10 fecal coliforms/100 mL, 90th percentile, set for the rest of the Stuart River exceeded at site 0920101 near the west shore.

A recent increase in fecal coliform counts was noticed for all three sites. The five samples from October of 1991 were found to average significantly higher than the 22 samples from previous years, using a two tailed t-test. At site 0400801, the mean for October, 1991 is 34.2/ 100 mL while the mean for all other years is 6.2/100 mL, $P < 0.02$. At site 0400488, the mean for October, 1991 is 40.2/100 mL while the mean for all other years is 11.2/100 mL, $P < 0.05$. At site 0920101, the mean for October, 1991 is 5.0/100 mL, while the mean for all other years is 1.6/100 mL, $P < 0.005$.

Ammonia, nitrite and nitrate levels in the Necoslie River are quite high (Table 8). Daily temperature and pH data showed that ammonia neared the daily maximum objective. The 30-day average objective was exceeded during the fall periods of 1988 and 1989. Ammonia levels decrease considerably at site 0400488 (Table 9), and are nearly undetectable at site 0920101 (Table 10) as would be expected given the west side is not effected by the Necoslie. The west is essentially a control site. Ammonia does not appear to be a water quality problem in the Stuart River.

Nor is nitrite a problem in the Stuart River, with maximum concentrations reaching 0.006 mg/L. However, in the Necoslie River the objective for a one-day maximum of 0.06 mg/L was exceeded seven out of 25 times, while the objective for a 30-day average of 0.02 mg/L was exceeded in all four years of fall testing (Table 25). Nitrite has been shown to be toxic to both humans and salmonids (3). Any existing fisheries use (2) in the lower Necoslie River may be significantly affected by the measured high nitrite concentrations.

Nitrate has been shown to be toxic to rainbow trout eggs at concentrations as low as 10 mg/L (10), therefore high nitrate concentrations may also be a concern in the Necoslie River. Nitrate has been recorded at levels up to 1.39 mg/L. The maximum Stuart River nitrate concentration was 0.34 mg/L, downstream of the Necoslie River.

Phosphorus levels in the Stuart River are quite low, particularly at site 0920101, where ortho-phosphorus was detected only twice out of 24 samples and total dissolved phosphorus never exceeded 0.005 mg/L (Table 26). Phosphorus testing in the Necoslie stopped in 1988 after only six samples were taken. Three out of the six samples were very high in both ortho-phosphorus and total dissolved phosphorus, with maxima reaching 0.639 and 0.664 mg/L, respectively (Table 26).

pH values in the Necoslie River ranged from 7.8 to 8.8 pH units. In the Stuart River, pH ranged from 7.3 to 8.1 pH units. A significant difference between the two Stuart River sites was not found ($P > 0.05$). Relevant criteria were not exceeded.

Dissolved oxygen readings varied from 9.2 to 14.0 mg/L in the Necoslie River, and between 10.0 and 15.0 mg/L in the Stuart River. All dissolved oxygen readings were at sufficient levels to protect salmonid eggs and larvae.

Temperature records averaged 3.7° C for the Necoslie River, and 4.8° C for the Stuart River. There was no significant difference between the Stuart River sites.

Table 8.

Summary of data collected from the Necoslie River downstream Fort St. James discharge (site 0400801) from Sept. 1987 to Feb. 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 27 | 2 < | 110 | 11.4 | 3 | 23.0 |
| Ammonia | 25 | 0.005 < | 4.080 | 1.146 | 1.110 | 0.983 |
| NO2 | 25 | 0.005 < | 0.200 | 0.045 | 0.025 | 0.053 |
| NO2+NO3 | 18 | 0.02 < | 1.39 | 0.64 | 0.66 | 0.395 |
| O.Phos. | 6 | 0.012 | 0.639 | 0.259 | 0.220 | 0.269 |
| D.Phos. | 6 | 0.024 | 0.664 | 0.280 | 0.248 | 0.276 |
| pH | 25 | 7.8 | 8.8 | 8.16 | 8.1 | 0.21 |
| Diss. Oxygen * | 15 | 9.2 | 14.0 | 11.49 | 11.4 | |
| Temperature * | 15 | 0.0 | 11.0 | | | |

Table 9.

Summary of data collected from the Stuart River at hwy. 27 east shore (site 0400488) from Sept. 1987 to Feb. 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 27 | 2 < | 138 | 16.6 | 8 | 26.9 |
| Ammonia | 25 | 0.005 < | 0.210 | 0.041 | 0.023 | 0.050 |
| NO2 | 25 | 0.005 < | 0.006 | 0.003 | 0.005 < | 0.0007 |
| NO2+NO3 | 25 | 0.02 < | 0.34 | 0.04 | 0.03 | 0.065 |
| O.Phos. | 24 | 0.003 < | 0.026 | 0.007 | 0.005 | 0.007 |
| D.Phos. | 24 | 0.003 < | 0.042 | 0.011 | 0.009 | 0.009 |
| pH | 23 | 7.7 | 8.1 | 7.93 | 7.9 | 0.12 |
| Diss. Oxygen * | 15 | 10.0 | 15.0 | 11.64 | 11.0 | |
| Temperature * | 15 | 1.0 | 11.0 | | | |

* Dissolved oxygen and temperature readings were not obtained in 1987.

Table 10.

Summary of data collected from the Stuart River at hwy. 27 west shore (site 0920101) from Sept. 1987 to Feb. 1992.

| | N | Min | Max | Mean | Median | SD |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fecal coliforms | 27 | 1 | 8 | 2.3 | 2 < | 2.4 |
| Ammonia | 25 | 0.005 < | 0.037 | 0.005 | 0.005 < | 0.007 |
| NO2 | 25 | 0.005 < | 0.005 | 0.003 | 0.005 < | 0.0007 |
| NO2+NO3 | 25 | 0.02 < | 0.04 | 0.02 | 0.02 < | 0.009 |
| O.Phos. | 24 | 0.003 < | 0.003 | 0.002 | 0.003 < | 0.0004 |
| D.Phos. | 24 | 0.003 < | 0.005 | 0.002 | 0.003 | 0.001 |
| pH | 24 | 7.3 | 8.1 | 7.85 | 7.9 | 0.21 |
| Diss. Oxygen * | 15 | 10.0 | 14.0 | 11.54 | 10.9 | |
| Temperature * | 15 | 1.0 | 11.0 | | | |

* Dissolved oxygen and temperature readings were not obtained in 1987.

## CONCLUSIONS/RECOMMENDATIONS

**Fort Fraser** (sites 0400629, 0400631):

1. Although all fecal coliform counts to date have been well below the objective standard of <100/100 mL, the potential health threat of fecal coliforms remains. Also, regarding the increase observed in the latest five measurements from the winter of 1992, it is recommended that this parameter remain in the objectives program. Summer 1992 and winter 1993 data should be reviewed to determine if the rise observed in 1992 continues.

2. All nitrogen and phosphorus forms measured at Fort Fraser have been shown to exist near detection-level concentrations. After five years of monitoring, average values have not increased, nor have any significant outlying data been produced. Although all objectives have been met, it is felt that continued nutrient monitoring at Fort Fraser will be of considerable value, given the relatively low cost and the possible impacts of flow reductions related to Kemano Completion. An uninterrupted background database is desirable for future impact assessment related to the KCP. Therefore, assuming the KCP is allowed to proceed, it is recommended that low-level nutrient monitoring be conducted at both Fort Fraser sites. This should include ammonia, low-level nitrite and nitrate, low-level ortho-phosphorus, and total dissolved phosphorus.

**Vanderhoof** (sites 0400449, 0400450, E207450, E207451):

1. The objective for fecal coliforms has not been met during five out of nine programs. Recent measurements from the winter of 1992 show that the situation is not improving. Although fecal coliforms appear to be highest in the winter months when water uses in that area are limited, high levels have also been recorded in summer during the recreational period. In any case, these fecal counts cannot be overlooked. System upgrade and continued testing is recommended.

2. Ammonia has not exceeded its aquatic life objectives at any site during the five years of sampling. However, levels nearing these objectives have been recorded in some years, particularly during the winter months. The potential for ammonia toxicity within the effluent's initial dilution zone, particularly in light of the proposed Kemano Completion Project, should

be considered as justification for system upgrade. Continued ammonia testing is also recommended for Vanderhoof.

3. Nitrite was at or below the normal detection level of 0.005 mg/L for the first two years of testing. Recent fluctuations in the summer of 1991 may raise concerns over the stability of this parameter, however. It is recommended that low-level analysis be carried out at all four Vanderhoof sites.

4. Nitrate monitoring should continue using low levels at all sites other than 0400450. Regular nitrate detection levels are adequate at site 0400450. The measurement of nitrate is useful to determine current nitrogen to phosphorus ratios in this reach of the Nechako River.

5. Phosphorus levels are significantly higher downstream of Vanderhoof than downstream of Fort Fraser. It would be advisable to keep both total dissolved and ortho-phosphorus as objectives parameters. Low-level analysis of ortho-phosphorus could be used at sites 0400449, E207450 and E207451 while normal detection level analysis should be carried out at site 0400450.

6. Much of the pulp mill-related data may be eliminated from the program. Inorganic carbon, total carbon, colour, suspended solids, chloride and sodium are all stable with a sufficiently large sample size. These parameters may be deleted. Resin acids have rarely been detected and may also be deleted. COD and phenols are at relatively low levels, although historical fluctuations in the database have been noted. It is recommended that these two parameters continue to be monitored. The metals package was recently improved, analyzing more metals at lower levels. Continued monitoring of metals using these detection levels will greatly improve the value of the database and allow better comparison to criteria if the need should arise. Low-level cadmium, chromium, and lead should be requested. Hardness and pH should also continue to be monitored since the criteria levels of several metals depend on these data (9).

7. System upgrading is required for the Vanderhoof sewage treatment facility if the water quality objective for fecal coliforms is to be met. Future upgrades should also attain ammonia and phosphorus removal.

**Fort St. James**:

Necoslie River (site 0400801):

1. Average fecal coliform counts in the Necoslie are quite low. However, due to the increase observed in the last group of measurements from the summer of 1991, fecal coliform monitoring should remain at this site to determine if this upward trend continues.

2. Both ammonia and nitrite testing should continue. Ammonia has exceeded its objective in the past, and high levels continue to be recorded. Nitrite has exceeded the objective a number of times. Since nitrite toxicity varies inversely with chloride concentration (3), it is recommended that chloride be added to the monitoring program at this site. Given this regular water quality exceedence by nitrite and the potential impact to aquatic life, an assessment of habitat value and utilization of the lower Necoslie River is required as recommended by Carmichael (11).

3. Although nitrate has been shown toxic to rainbow trout eggs, the limited fisheries value of the Necoslie combined with the fact that nitrate levels are well below toxic levels suggests that further nitrate testing is unnecessary.

4. Previous testing in late 1987 and early 1988 showed indications of very high phosphorus levels in the Necoslie. No phosphorus data are available since April of 1988. It would be advantageous to learn what phosphorus levels exist. Therefore, testing for both ortho-phosphorus and total dissolved phosphorus should resume.

Stuart River (sites 0400488 and 0920101):

1. Fecal coliform counts at site 0400488 have not exceeded the objective of 100/100 mL for the Stuart River, east shore. However, given the presence of private water intakes on the Stuart River in this area, the extent of the influence of the Necoslie River on this section of the Stuart River should continue to be examined. It is also recommended that fecal testing continue at site 0920101 to allow for comparison between the two sites.

2. Although ammonia readings during the past two years have been relatively low, some data fluctuations have occurred, especially at site 0400488. Ammonia must continue to be monitored so that the influence from high readings in the Necoslie River may be studied.

3. Out of a total of 50 samples taken for nitrite, only three showed detectable concentrations

at a detection level of 0.005 mg/L. In order to improve the precision of the database, low-level nitrite analyses should be performed at the two Stuart River sites.

4. Nitrate and phosphorus have been shown to exist at very low levels in the Stuart River. As both of these parameters play a role in the trophic status of the Nechako River, their continued assessment is recommended.

**General Recommendations:**

1. Since there is neither an objective nor a provincial criterion established for phosphorus concentrations in flowing water, the Region with the aid of the Water Quality Branch should seriously examine options of periphyton collection to determine chlorophyll-a concentrations. The areas of the Nechako River in question do not contain suitable natural substrates on which to base this type of study. Most of the natural periphyton in these areas grow on macrophytes. An efficient method for collecting this type of growth is lacking. However, artificial substrates such as styrofoam, clay tiles and glass have been used with a great deal of success. Artificial substrates are generally easier to sample because of the smoother surfaces, but may harbour species that would not normally grow on a natural substrate. Although not generally recommended as a sampling tool (12), artificial substrate sampling may be the only way to obtain biomass data on the Nechako River. Periphyton collection can be a time-consuming and somewhat tedious process but the rewards of having data which are comparable to a confirmed criteria greatly outweigh any field inconvenience.

2. Data collected downstream from the Vanderhoof sewage discharge show that fecal coliforms and ammonia tend to exist at significantly higher concentrations in the winter than in the summer. It is possible that a similar situation exists downstream of the Fort St. James discharge. Therefore, it is recommended that a winter sampling component be added to the normal monitoring program for the Necoslie and Stuart Rivers.

3. A simple quality assurance component should be included in the objectives plan. In the past, replicate sampling or submission of blank samples was not done. Data quality could not be verified. The data presented in this report has had virtually no related quality assurance (other than the regular lab QA, as described in the methods section). Ensuring the accuracy of the data is an important part of every monitoring program. Duplicate or triplicate sampling of

a wide variety of parameters should be performed during each seasonal program. The Region should be responsible for examining the QA data and determining their legitimacy.

4. Temperature, pH, dissolved oxygen and dissolved gas pressure are parameters that can be tested relatively quickly and inexpensively in the field and can give important information about the quality of any given waterbody. As well, the toxicity of several other parameters, such as ammonia and some metals, depend on daily temperature and/or pH readings. Therefore, these parameters should continue to be field tested at all monitoring sites.

5. As a result of Kemano Completion, flows throughout the Nechako River will be significantly decreased. This may have a serious effect on the impact of waste discharges discussed in this report. If Kemano Completion proceed, testing of all deleted parameters should resume to determine to what extent lower flows affect the compliance of established objectives.

6. The importance of nutrient loading to the Nechako River infers the need for regular nutrient monitoring of all municipal effluents discharged to the drainage basin.

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# APPENDIX

Table 11.

Fecal coliforms collected from the Nechako River u/s (site 0400629) and d/s (site 0400631) of Fort Fraser discharge from Sept. 1987 to Feb. 1992.

| Date | | Site number | | |
|---|---|---|---|---|
| | | 0400629 | | 0400631 |
| | | | | |
| 87/09/21 | | 33 | | 23 |
| 87/09/28 | | 79 | | 31 |
| 87/09/30 | | 2.2< | | 2.2< |
| 87/10/05 | | 17 | | 49 |
| 87/10/13 | | 13 | | 13 |
| 87/10/19 | | 5 | | 2.2< |
| 88/01/14 | | 2< | | 2< |
| 88/01/20 | | 2< | | 2< |
| 88/01/26 | | 2< | | 2< |
| 88/02/02 | | 2< | | 2 |
| 88/02/08 | | 2 | | 2< |
| 88/03/24 | | 2 | | 2 |
| 88/09/07 | | 34 | | 20 |
| 88/09/12 | | 10 | | 14 |
| 88/09/27 | | 38 | | 60 |
| 88/10/03 | | 4 | | 6 |
| 89/01/17 | | 2 | | 4 |
| 89/01/23 | | 4 | | 5 |
| 89/01/30 | | 2< | | 2< |
| 89/02/06 | ** | 2000> | | 350 |
| 89/02/13 | | 2< | | 2< |
| 89/11/01 | | 2 | | 2 |
| 89/11/06 | | 6 | | 9 |
| 89/11/09 | | 4 | | 2 |
| 89/11/13 | | 2 | | 2 |

| Date | | Site number | | |
|---|---|---|---|---|
| | | 0400629 | | 0400631 |
| 89/11/16 | | 2 | | 2 |
| 90/02/22 | | 2 | | 2 |
| 90/03/05 | | 5 | | 5 |
| 90/03/08 | | 2 | | 1 |
| 90/03/12 | | 1 | | 2 |
| 90/09/26 | | 22 | | 12 |
| 90/10/18 | | 5 | | 7 |
| 90/10/22 | | 9 | | 5 |
| 91/01/30 | | 1 | | 2 |
| 91/02/04 | | 2 | | 2 |
| 91/02/12 | | 2< | | 2< |
| 91/02/19 | | 1 | | 2 |
| 91/02/26 | | 2 | | 4 |
| 91/09/30 | | 6 | | 8 |
| 91/10/09 | | 10 | | 10 |
| 91/10/17 | | 5 | | 9 |
| 91/10/24 | | 2 | | 10 |
| 91/10/31 | | 2 | | 27 |
| 92/01/16 | | 1 | | 49 |
| 92/01/20 | | 2< | | 29 |
| 92/01/27 | | 1 | | 26 |
| 92/02/05 | | 2< | | 22 |
| 92/02/12 | | 2< | | 9 |

** Data for this date is not to be included in the summary statistics.
Results one week before and one week after 89/02/06 show values of <2.
Results of >2000 for the upstream site and 350 for the downstream site will be counted as anomalous and discarded.

Table 12.
Ammonia and nitrite collected from the Nechako River u/s and d/s of Fort Fraser discharge from Sept. 1987 to Feb. 1992.

| Date | Ammonia:D mg/L | | | Nitrite:D mg/L | |
|---|---|---|---|---|---|
| | 0400629 | 0400631 | | 0400629 | 0400631 |
| | | | | | |
| 87/09/21 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 87/09/28 | 0.005 < | 0.005 | | 0.005 < | 0.005 < |
| 87/09/30 | 0.005 < | 0.005 < | | | |
| 87/10/05 | 0.005 | 0.005 < | | 0.005 < | 0.005 < |
| 87/10/13 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 87/10/19 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 88/01/14 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 88/01/20 | 0.006 | 0.006 | | 0.005 < | 0.005 < |
| 88/01/26 | 0.005 | 0.006 | | 0.005 < | 0.005 < |
| 88/02/02 | 0.005 | 0.005 < | | 0.005 < | 0.005 < |
| 88/02/08 | 0.010 | 0.013 | | 0.005 < | 0.005 < |
| 88/03/24 | 0.005 < | 0.005 < | | | |
| 88/09/07 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 88/09/12 | 0.005 | 0.005 | | 0.005 < | 0.005 < |
| 88/09/27 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 88/10/03 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 89/01/17 | 0.005 | 0.005 < | | 0.005 < | 0.005 < |
| 89/01/23 | 0.005 | 0.005 < | | 0.005 < | 0.005 < |
| 89/01/30 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 89/02/06 | 0.005 | 0.005 < | | 0.005 < | 0.005 < |
| 89/02/13 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 89/11/01 | 0.008 | 0.008 | | | |
| 89/11/06 | 0.005 < | 0.005 < | | | |
| 89/11/09 | 0.005 < | 0.005 < | | | |
| 89/11/13 | 0.005 | 0.005 < | | | |

| Date | Ammonia mg/L | | | Nitrite mg/L | |
|---|---|---|---|---|---|
| | 0400629 | 0400631 | | 0400629 | 0400631 |
| | | | | | |
| 89/11/16 | 0.005 < | 0.005 < | | | |
| 90/02/22 | 0.010 | 0.018 | | 0.005 < | 0.005 < |
| 90/03/05 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 90/03/08 | 0.005 < | 0.005 < | | 0.005 < | 0.005 < |
| 90/03/12 | 0.005 | 0.005 | | 0.005 < | 0.005 < |
| 90/09/26 | 0.007 | 0.008 | | | 0.005 < |
| 90/10/18 | 0.005 < | 0.005 < | | | 0.005 < |
| 90/10/22 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/01/30 | 0.005 < | 0.006 | | | 0.005 < |
| 91/02/04 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/02/12 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/02/19 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/02/26 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/09/30 | 0.008 | 0.005 < | | | 0.005 |
| 91/10/09 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/10/17 | 0.005 < | 0.005 < | | | 0.005 < |
| 91/10/24 | 0.010 | 0.009 | | | 0.005 < |
| 91/10/31 | 0.005 < | 0.011 | | | 0.005 < |
| 92/01/16 | 0.005 < | 0.005 < | | | |
| 92/01/20 | 0.005 < | 0.005 < | | | |
| 92/01/27 | 0.016 | 0.005 < | | | |
| 92/02/05 | 0.005 | 0.025 | | | |
| 92/02/12 | 0.011 | 0.024 | | | |

Table 13.

Low-level nitrite plus nitrate and low-level nitrite collected from the Nechako River u/s and d/s of Fort Fraser discharge from Sept. 1987 to Feb. 1992.

| Date | LL NO2+NO3 mg/L | | LL NO2 mg/L | |
|---|---|---|---|---|
| | 0400629 | 0400631 | 0400629 | 0400631 |
| | | | | |
| 87/09/30 | 0.005 < | 0.005 < | 0.001 | 0.001 < |
| 88/03/24 | 0.035 | 0.011 | 0.001 | 0.001 < |
| 89/11/01 | 0.005 < | 0.006 | 0.001 < | 0.001 < |
| 89/11/06 | 0.005 < | 0.007 | 0.001 < | 0.001 |
| 89/11/09 | 0.006 | 0.008 | 0.001 < | 0.001 |
| 89/11/13 | 0.007 | 0.010 | 0.001 < | 0.002 |
| 89/11/16 | 0.009 | 0.017 | 0.001 | 0.001 < |
| 90/09/26 | 0.005 | | 0.001 | |
| 90/10/18 | 0.005 < | | 0.001 < | |
| 90/10/22 | 0.009 | | 0.003 | |
| 91/01/30 | 0.020 | 0.021 | 0.001 | 0.001 < |
| 91/02/04 | 0.018 | 0.020 | 0.001 | 0.001 |
| 91/02/12 | 0.019 | 0.012 | 0.001 < | 0.001 < |
| 91/02/19 | 0.013 | | 0.001 < | |
| 91/02/26 | 0.008 | | 0.001 < | |
| 91/09/30 | 0.045 | | 0.012 | |
| 91/10/09 | 0.037 | | 0.014 | |
| 91/10/17 | 0.043 | | 0.010 | |
| 91/10/24 | 0.005 < | | 0.001 | |
| 91/10/31 | 0.022 | | 0.001 < | |
| 92/01/16 | 0.007 | 0.008 | 0.006 | 0.001 |
| 92/01/20 | 0.016 | 0.015 | 0.004 | 0.004 |
| 92/01/27 | 0.006 | 0.012 | 0.001 | 0.004 |
| 92/02/05 | 0.033 | 0.013 | 0.002 | 0.001 |
| 92/02/12 | 0.006 | 0.009 | 0.004 | 0.006 |

Table 14.
Phosphorous levels in the Nechako River u/s and d/s of Fort Fraser discharge collected from Sept. 1987 to Feb. 1992.

| Date | Phos.O:D mg/L | | LL Phos.O mg/L | | Phos.:D mg/L | |
|---|---|---|---|---|---|---|
| | 0400629 | 0400631 | 0400629 | 0400631 | 0400629 | 0400631 |
| | | | | | | |
| 87/09/30 | | | 0.001 < | 0.001 < | 0.004 | 0.003 < |
| 88/03/24 | | | 0.001 | 0.001 | 0.003 < | 0.003 |
| 88/09/07 | 0.003 < | 0.003 < | | | 0.005 | 0.005 |
| 88/09/12 | 0.003 < | 0.003 < | | | 0.003 | 0.004 |
| 88/09/27 | 0.003 < | 0.003 < | | | 0.004 | 0.003 < |
| 88/10/03 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 89/01/17 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 89/01/23 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 89/01/30 | 0.003 < | 0.003 < | | | 0.004 | 0.004 |
| 89/02/06 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 89/02/13 | 0.003 < | 0.007 | | | 0.004 | 0.010 |
| 89/11/01 | | | 0.001 < | 0.001 < | 0.003 | 0.003 < |
| 89/11/06 | | | 0.001 < | 0.001 < | 0.003 < | 0.003 < |
| 89/11/09 | | | 0.001 < | 0.001 < | 0.003 < | 0.003 < |
| 89/11/13 | | | 0.001 < | 0.001 < | 0.003 < | 0.003 |
| 89/11/16 | | | 0.001 | 0.002 | 0.003 | 0.003 |
| 90/02/22 | 0.003 < | 0.003 < | | | 0.003 < | 0.004 |
| 90/03/05 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 90/03/08 | 0.003 < | 0.003 < | | | 0.003 | 0.003 |
| 90/03/12 | 0.003 < | 0.003 < | | | 0.003 < | 0.004 |
| 90/09/26 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 90/10/18 | 0.003 < | 0.003 < | | | 0.003 | 0.004 |
| 90/10/22 | 0.003 < | 0.003 < | | | 0.003 | 0.003 |

| Date | O.Phos. mg/L | | LL O.Phos. mg/L | | D.Phos. mg/L | |
|---|---|---|---|---|---|---|
| | 0400629 | 0400631 | 0400629 | 0400631 | 0400629 | 0400631 |
| | | | | | | |
| 91/01/30 | 0.003 < | 0.003 < | 0.001 | 0.002 | 0.003 | 0.003 |
| 91/02/04 | 0.003 < | 0.003 < | 0.002 | 0.002 | 0.003 | 0.003 |
| 91/02/12 | 0.003 < | 0.003 < | 0.002 | 0.002 | 0.003 | 0.003 |
| 91/02/19 | 0.003 < | 0.003 < | 0.002 | | 0.003 | 0.004 |
| 91/02/26 | 0.003 < | 0.003 < | 0.003 | | 0.003 | 0.003 |
| 91/09/30 | 0.003 < | 0.003 < | | | 0.005 | 0.003 |
| 91/10/09 | 0.003 < | 0.003 < | | | 0.004 | 0.004 |
| 91/10/17 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 91/10/24 | 0.003 < | 0.004 | | | 0.004 | 0.007 |
| 91/10/31 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 92/01/16 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 92/01/20 | 0.003 < | 0.003 < | | | 0.003 | 0.003 |
| 92/01/27 | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 92/02/05 | 0.003 < | 0.003 < | | | 0.003 < | 0.007 |
| 92/02/12 | 0.003 < | 0.003 < | | | 0.006 | 0.007 |

Table 15.

Fecal coliforms collected from the Nechako River u/s (site 0400449) and d/s (sites 0400450, E207450, E207451) of Vanderhoof discharge from Sept. 1987 to Feb. 1992.

| Date | Site number | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | | 0400450 | | E207450 | | E207451 |
| 87/09/21 | 79 | | 33 | | 70 | | 49 |
| 87/09/28 | 94 | | 33 | | 23 | | 49 |
| 87/09/30 | | | 2.2< | | 2.2< | | |
| 87/10/05 | 49 | | 79 | | 140 | | 130 |
| 87/10/13 | 31 | | 8 | | 33 | | 23 |
| 87/10/19 | 14 | | 27 | | 33 | | 2.2< |
| 88/01/14 | 2 | | 430 | | | | |
| 88/01/20 | 22 | | 2400> | | 920 | | 220 |
| 88/01/26 | 14 | | 1600> | | | | |
| 88/02/02 | 2 < | | 24000> | | 170 | | 110 |
| 88/02/08 | 8 | | 5400 | | 1600 | | |
| 88/03/24 | | | | | 1600> | | |
| 88/09/07 | 6 | | 20 | | 8 | | 12 |
| 88/09/12 | 7 | | 42 | | 10 | | 8 |
| 88/09/27 | 18 | | 108 | | 20 | | 32 |
| 88/10/03 | 24 | | 360 | | 26 | | 22 |
| 89/01/17 | 11 | | 2000> | | 2000> | | 2000> |
| 89/01/23 | 14 | | 2000> | | 220 | | |
| 89/01/30 | 8 | | 1600> | | 350 | | |
| 89/02/06 | 2 < | | 2< | | 220 | | 2< |
| 89/02/13 | 4.5 | | 920 | | 350 | | |
| 89/11/01 | 20 | | 9 | | 18 | | 22 |
| 89/11/06 | 4 | | 60 | | 10 | | 13 |
| 89/11/09 | 9 | | 213 | | 8 | | 8 |
| 89/11/13 | 7 | | 86 | | 10 | | 7 |
| 89/11/16 | 24 | | 34 | | 2 | | 4 |

| Date | Site number | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | | 0400450 | | E207450 | | E207451 |
| | | | | | | | |
| 90/02/22 | 1200 | | 5 | | 7 | | 8 |
| 90/02/27 | 43 | | 40 | | 7 | | 12 |
| 90/03/05 | 6 | | 5 | | 3 | | 8 |
| 90/03/08 | 5 | | 20 | | 6 | | |
| 90/03/12 | 2 < | | 2 | | 2 | | 3 |
| 90/09/26 | 25 | | 89 | | 37 | | 32 |
| 90/10/03 | 66 | | 211 | | 74 | | 52 |
| 90/10/11 | 28 | | 200 | | 29 | | 40 |
| 90/10/18 | 11 | | 380 | | 12 | | 11 |
| 90/10/22 | 16 | | 255 | | 13 | | 31 |
| 91/01/29 | 4 | | 3630 | | 116 | | 60 |
| 91/02/05 | 3 | | 8200 | | 149 | | 79 |
| 91/02/11 | 2 | | 7100 | | 86 | | 54 |
| 91/02/18 | 3 | | 8600 | | 85 | | 71 |
| 91/02/25 | 3 | | 6650 | | 143 | | 91 |
| 91/09/30 | 25 | | 30 | | 38 | | 31 |
| 91/10/09 | 17 | | 20 | | 17 | | 14 |
| 91/10/17 | 27 | | 57 | | 14 | | 18 |
| 91/10/24 | 10 | | 24 | | 7 | | 7 |
| 91/10/31 | | | 28 | | 17 | | |
| 92/01/15 | 5 | | 705 | | 225 | | 67 |
| 92/01/21 | 3 | | 3170 | | 210 | | 89 |
| 92/01/28 | 5 | | 4950 | | 248 | | 81 |
| 92/02/06 | 2 | | 4700 | | 340 | | 102 |
| 92/02/13 | 3 | | 6400 | | 265 | | 79 |

Table 16.
Ammonia levels (mg/L) in the Nechako River u/s and d/s of Vanderhoof discharge collected from Sept. 1987 to Feb. 1992.

| Date | Site number | | | |
|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | E207451 |
| | | | | |
| 87/09/21 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 87/09/28 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 87/09/30 | 0.005 < | 0.005 < | 0.005 < | |
| 87/10/05 | 0.005 < | 0.005 < | | 0.006 |
| 87/10/13 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 87/10/19 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 88/01/14 | 0.005 < | 0.332 | 0.013 | 0.013 |
| 88/01/20 | 0.005 < | 0.466 | 0.033 | 0.019 |
| 88/01/26 | 0.005 | 0.266 | 0.030 | 0.013 |
| 88/02/02 | 0.007 | 0.965 | 0.032 | 0.010 |
| 88/02/08 | 0.012 | 0.218 | 0.039 | 0.022 |
| 88/03/24 | 0.008 | 0.118 | 0.033 | |
| 88/09/07 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 88/09/12 | 0.005 < | 0.027 | 0.008 | 0.005 |
| 88/09/27 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 88/10/03 | 0.026 | 0.028 | 0.005 < | 0.005 < |
| 89/01/17 | 0.012 | 0.401 | 0.027 | 0.028 |
| 89/01/23 | 0.008 | 0.352 | 0.027 | 0.014 |
| 89/01/30 | 0.023 | 0.280 | 0.005 < | |
| 89/02/06 | 0.008 | 1.270 | 0.024 | 0.014 |
| 89/02/13 | 0.005 < | 1.730 | 0.021 | 0.011 |
| 89/11/01 | 0.009 | 0.672 | 0.023 | |
| 89/11/06 | 0.005 < | 0.560 | 0.009 | 0.007 |
| 89/11/09 | 0.005 < | 0.655 | 0.006 | 0.006 |
| 89/11/13 | 0.006 | 0.693 | 0.010 | 0.006 |

| Date | Site number | | | |
|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | E207451 |
| | | | | |
| 89/11/16 | 0.006 | 0.085 | 0.010 | 0.012 |
| 90/02/22 | 0.059 | 0.007 | 0.010 | 0.007 |
| 90/02/27 | 0.008 | 0.028 | 0.005 | 0.006 |
| 90/03/05 | 0.005 < | 0.005 < | 0.005 < | 0.005 < |
| 90/03/08 | 0.005 < | 0.005 < | 0.005 < | |
| 90/03/12 | 0.005 < | 0.006 | 0.005 | 0.007 |
| 90/09/26 | 0.007 | 0.223 | 0.015 | 0.005 < |
| 90/10/11 | 0.005 < | | 0.005 < | 0.005 < |
| 90/10/18 | 0.005 < | 0.367 | 0.005 | 0.005 < |
| 90/10/22 | 0.005 < | 0.500 | 0.005 | 0.005 < |
| 91/01/29 | 0.005 < | 0.430 | 0.018 | 0.021 |
| 91/02/05 | 0.005 < | 1.170 | 0.005 < | 0.005 < |
| 91/02/11 | 0.024 | 1.020 | 0.030 | 0.025 |
| 91/02/18 | 0.079 | 1.070 | 0.069 | 0.057 |
| 91/02/25 | 0.008 | 0.834 | 0.021 | 0.012 |
| 91/09/30 | 0.008 | 0.085 | 0.005 < | 0.005 < |
| 91/10/09 | 0.005 < | 0.259 | 0.005 < | 0.005 < |
| 91/10/17 | 0.005 < | 0.380 | 0.005 < | 0.005 < |
| 91/10/24 | 0.011 | 0.072 | 0.014 | 0.005 < |
| 91/10/31 | 0.005 < | 0.005 < | 0.006 | 0.005 |
| 92/01/15 | 0.006 | 0.427 | 0.018 | 0.009 |
| 92/01/21 | 0.005 | 0.171 | 0.005 < | 0.005 < |
| 92/01/28 | 0.005 < | 0.329 | 0.011 | 0.005 < |
| 92/02/06 | 0.005 < | 0.228 | 0.005 < | 0.005 < |
| 92/02/13 | 0.009 | 0.342 | 0.009 | 0.009 |

Table 17.

Ortho-phosphorous and total dissolved phos. collected from the Nechako River u/s and d/s of Vanderhoof discharge from Sept. 1987 to Feb. 1992.

| Date | O. Phos. mg/L | | | | D. Phos. mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | | 0400449 | 0400450 | E207450 |
| | | | | | | | |
| 87/09/30 | | 0.003 < | | | 0.003 | 0.003 | 0.003 |
| 88/03/24 | | 0.025 | | | 0.007 | 0.029 | 0.015 |
| 88/09/07 | 0.003 < | 0.012 | 0.003 < | | 0.006 | 0.017 | 0.006 |
| 88/09/12 | 0.003 < | 0.043 | 0.003 < | | 0.004 | 0.050 | 0.005 |
| 88/09/27 | 0.003 < | 0.064 | 0.003 < | | 0.003 | 0.074 | 0.003 |
| 88/10/03 | 0.003 < | 0.070 | 0.003 < | | 0.003 | 0.077 | 0.004 |
| 89/01/17 | 0.003 < | 0.087 | 0.004 | | 0.005 | 0.101 | 0.010 |
| 89/01/23 | 0.003 < | 0.076 | 0.004 | | 0.005 | 0.085 | 0.010 |
| 89/01/30 | 0.004 | 0.063 | 0.004 | | 0.008 | 0.079 | 0.008 |
| 89/02/06 | 0.004 | 0.245 | 0.008 | | 0.004 | 0.260 | 0.008 |
| 89/02/13 | 0.005 | 0.342 | 0.007 | | 0.009 | 0.357 | 0.010 |
| 89/11/01 | | 0.279 | | | 0.003 | 0.285 | 0.005 |
| 89/11/06 | | 0.245 | | | 0.004 | 0.269 | 0.005 |
| 89/11/09 | | | | | 0.004 | 0.293 | 0.005 |
| 89/11/13 | | | | | 0.005 | 0.316 | 0.005 |
| 89/11/16 | | 0.020 | | | 0.006 | 0.031 | 0.009 |
| 90/02/22 | 0.014 | 0.003 < | 0.003 | | 0.020 | 0.005 | 0.005 |
| 90/02/27 | 0.003 < | 0.004 | 0.003 < | | 0.005 | 0.009 | 0.006 |
| 90/03/05 | 0.005 | 0.005 | 0.005 | | 0.006 | 0.007 | 0.005 |
| 90/03/08 | 0.003 < | 0.003 < | 0.003 < | | 0.004 | 0.003 | 0.003 |
| 90/03/12 | 0.003 < | 0.003 < | 0.003 < | | 0.004 | 0.004 | 0.003 |
| 90/09/26 | 0.003 < | 0.121 | 0.003 < | | 0.003 | 0.121 | 0.003 |
| 90/10/18 | 0.003 < | 0.135 | 0.003 < | | 0.003 | 0.141 | 0.005 |

| Date | O. Phos. mg/L | | | | D. Phos. mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | | 0400449 | 0400450 | E207450 |
| | | | | | | | |
| 90/10/22 | 0.003 < | 0.186 | 0.003 < | | 0.003 | 0.196 | 0.004 |
| 91/01/29 | 0.005 | 0.098 | 0.008 | | 0.008 | 0.105 | 0.010 |
| 91/02/05 | 0.005 | 0.159 | 0.006 | | 0.007 | 0.176 | 0.008 |
| 91/02/11 | 0.005 | 0.193 | 0.008 | | 0.008 | 0.200 | 0.010 |
| 91/02/18 | 0.004 | 0.146 | 0.003 | | 0.006 | 0.197 | 0.009 |
| 91/02/25 | 0.006 | 0.185 | 0.007 | | 0.009 | 0.198 | 0.010 |
| 91/09/30 | 0.003 < | 0.114 | 0.003 < | | 0.004 | 0.126 | 0.004 |
| 91/10/09 | 0.003 < | 0.108 | 0.003 < | | 0.004 | 0.122 | 0.005 |
| 91/10/17 | 0.003 < | 0.159 | 0.003 < | | 0.003 | 0.162 | 0.004 |
| 91/10/24 | 0.003 < | 0.020 | 0.003 | | 0.005 | 0.024 | 0.006 |
| 91/10/31 | 0.003 < | 0.003 < | 0.004 | | 0.004 | 0.003 | 0.006 |
| 92/01/15 | 0.003 < | 0.074 | 0.005 | | 0.005 | 0.076 | 0.006 |
| 92/01/21 | 0.003 < | 0.029 | 0.003 | | 0.003 | 0.030 | 0.003 |
| 92/01/28 | 0.004 | 0.052 | 0.006 | | 0.004 | 0.052 | 0.007 |
| 92/02/06 | 0.003 < | 0.042 | 0.005 | | 0.007 | 0.045 | 0.007 |
| 92/02/13 | 0.003 < | 0.056 | 0.004 | | 0.010 | 0.087 | 0.012 |

Table 18.

Nitrite plus nitrate and low-level nitrite plus nitrate collected from the Nechako River u/s and d/s of Vanderhoof discharge from Sept. 1987 to Feb. 1992.

| Date | NO2+NO3 mg/L | | | | LL NO2+NO3 mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | | 0400449 | 0400450 | E207450 |
| | | | | | | | |
| 87/09/30 | | 0.02 < | | | 0.005 < | | 0.005 < |
| 88/03/24 | | 0.02 < | | | 0.011 | | 0.045 |
| 88/09/07 | 0.02 < | 0.02 < | 0.02 < | | | | |
| 88/09/12 | 0.02 < | 0.02 | 0.02 < | | | | |
| 88/09/27 | 0.02 < | 0.02 < | 0.02 < | | | | |
| 88/10/03 | 0.04 | 0.02 | 0.02 < | | | | |
| 89/01/17 | 0.02 < | 0.02 | 0.02 < | | | | |
| 89/01/23 | 0.02 < | 0.03 | 0.02 | | | | |
| 89/01/30 | 0.02 | 0.03 | 0.02 | | | | |
| 89/02/06 | 0.02 | 0.04 | 0.03 | | | | |
| 89/02/13 | 0.02 | 0.04 | 0.02 | | | | |
| 89/11/01 | | 0.11 | | | 0.005 < | | 0.010 |
| 89/11/06 | | 0.13 | | | 0.010 | | 0.006 |
| 89/11/09 | | | | | 0.018 | | 0.016 |
| 89/11/13 | | | | | 0.006 | | 0.005 < |
| 89/11/16 | | 0.05 | | | 0.005 | | 0.005 < |
| 90/02/22 | 0.04 | 0.03 | 0.04 | | | | |
| 90/02/27 | 0.03 | 0.03 | 0.03 | | | | |
| 90/03/05 | 0.02 | 0.02 | 0.02 | | | | |
| 90/03/08 | 0.02 < | 0.02 < | 0.02 < | | | | |
| 90/03/12 | 0.02 | 0.03 | 0.02 | | | | |
| 90/09/26 | | 0.06 | | | 0.006 | | 0.005 < |
| 90/10/18 | | 0.05 | | | 0.005 | | 0.005 < |

| Date | NO2+NO3 mg/L | | | | LL NO2+NO3 mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | | 0400449 | 0400450 | E207450 |
| | | | | | | | |
| 90/10/22 | | 0.14 | | | 0.006 | | 0.013 |
| 91/01/29 | 0.02 | 0.04 | 0.02 | | 0.025 | | 0.022 |
| 91/02/05 | 0.03 | 0.04 | 0.03 | | 0.034 | | 0.036 |
| 91/02/11 | 0.02 | 0.03 | 0.04 | | 0.039 | | 0.046 |
| 91/02/18 | 0.02 | 0.02 < | 0.02 < | | 0.020 | | 0.006 |
| 91/02/25 | 0.02 < | 0.02 | 0.02 < | | 0.014 | | 0.012 |
| 91/09/30 | | 0.07 | | | 0.045 | | 0.014 |
| 91/10/09 | | 0.02 | | | 0.051 | | 0.031 |
| 91/10/17 | | 0.05 | | | 0.028 | | 0.036 |
| 91/10/24 | | 0.05 | | | 0.014 | | 0.011 |
| 91/10/31 | | 0.02 < | | | 0.019 | | 0.021 |
| 92/01/15 | | 0.02 < | | | 0.025 | | 0.021 |
| 92/01/21 | | 0.02 < | | | 0.021 | | 0.010 |
| 92/01/28 | | 0.02 < | | | 0.020 | | 0.017 |
| 92/02/06 | | 0.02 < | | | 0.019 | | 0.019 |
| 92/02/13 | | 0.02 < | | | 0.014 | | 0.013 |

Table 19.

Nitrite and low-level nitrite collected from the Nechako River u/s and d/s of Vanderhoof discharge from Sept. 1987 to Feb. 1992.

| Date | Nitrite mg/L | | | | LL NO2 mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | | 0400449 | 0400450 | E207450 |
| | | | | | | | |
| 87/09/21 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 87/09/28 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 87/09/30 | | 0.005 < | | | 0.001 | | 0.001 < |
| 87/10/05 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 87/10/13 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 87/10/19 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/01/14 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/01/20 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/01/26 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/02/02 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/02/08 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/03/24 | | 0.005 < | | | 0.001 | | 0.004 |
| 88/09/07 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/09/12 | 0.005 < | 0.005 | 0.005 < | | | | |
| 88/09/27 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 88/10/03 | 0.005 < | 0.005 | 0.005 < | | | | |
| 89/01/17 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 89/01/23 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 89/01/30 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 89/02/06 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 89/02/13 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 89/11/01 | | 0.009 | | | 0.001 < | | 0.001 < |
| 89/11/06 | | 0.007 | | | 0.001 | | 0.001 |
| 89/11/09 | | | | | 0.001 | | 0.001 < |
| 89/11/13 | | | | | 0.002 | | 0.001 < |

| Date | Nitrite mg/L | | | | LL NO2 mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400449 | 0400450 | E207450 | | 0400449 | 0400450 | E207450 |
| | | | | | | | |
| 89/11/16 | | 0.005 < | | | 0.001 < | | 0.001 < |
| 90/02/22 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 90/02/27 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 90/03/05 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 90/03/08 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 90/03/12 | 0.005 < | 0.005 < | 0.005 < | | | | |
| 90/09/26 | | 0.010 | | | 0.001 | | 0.001 |
| 90/10/18 | | 0.005 < | | | 0.001 | | 0.001 < |
| 90/10/22 | | 0.011 | | | 0.003 | | 0.003 |
| 91/01/29 | 0.005 < | 0.005 < | 0.005 < | | 0.002 | | 0.001 < |
| 91/02/05 | 0.005 < | 0.005 < | 0.006 | | 0.002 | | 0.004 |
| 91/02/11 | 0.005 < | 0.005 < | 0.005 < | | 0.002 | | 0.009 |
| 91/02/18 | 0.005 < | 0.005 < | 0.005 < | | 0.002 | | 0.001 |
| 91/02/25 | 0.005 < | 0.005 < | 0.005 < | | 0.001 | | 0.002 |
| 91/09/30 | | 0.021 | | | 0.006 | | 0.009 |
| 91/10/09 | | 0.014 | | | 0.008 | | 0.006 |
| 91/10/17 | | 0.009 | | | 0.010 | | 0.008 |
| 91/10/24 | | 0.005 < | | | 0.002 | | 0.002 |
| 91/10/31 | | 0.005 < | | | 0.001 < | | 0.001 < |
| 92/01/15 | | | | | 0.003 | | |
| 92/01/21 | | | | | 0.004 | | |
| 92/01/28 | | 0.005 < | | | 0.005 | | |
| 92/02/06 | | | | | 0.005 | | |
| 92/02/13 | | | | | 0.003 | | |

Table 20.

Nitrite, nitrite plus nitrate, ortho-phosphorus and total dissolved phosphorus (mg/L) collected from the Nechako River 2 km d/s Vanderhoof discharge (site E207451) from Sept. 1988 to Oct. 1992.

| Date | NO2 | NO2+NO3 | | O. Phos. | | D. Phos. |
|---|---|---|---|---|---|---|
| | | | | | | |
| 88/09/07 | 0.005 < | 0.02 < | | 0.003 < | | 0.007 |
| 88/09/12 | 0.005 < | 0.02 < | | 0.003 < | | 0.004 |
| 88/09/27 | 0.005 < | 0.02 < | | 0.003 < | | 0.004 |
| 88/10/03 | 0.005 < | 0.02 < | | 0.003 < | | 0.004 |
| 89/01/17 | 0.005 < | 0.02 | | 0.013 | | 0.022 |
| 89/01/23 | 0.005 < | 0.02 | | 0.003 < | | 0.007 |
| 89/02/06 | 0.005 < | 0.02 | | 0.005 | | 0.006 |
| 89/02/13 | 0.005 < | 0.02 | | 0.005 | | 0.008 |
| 89/11/01 | | 0.005 * | | 0.003 * | | |
| 89/11/06 | | 0.009 * | | 0.003 * | | 0.005 |
| 89/11/09 | | 0.008 * | | 0.003 * | | 0.005 |
| 89/11/13 | | 0.026 * | | 0.004 * | | 0.006 |
| 89/11/16 | | 0.032 * | | 0.008 * | | 0.009 |
| 90/03/12 | 0.005 < | 0.03 | | 0.003 < | | 0.003 |
| 90/02/22 | 0.005 < | 0.03 | | 0.003 < | | 0.006 |
| 90/02/27 | 0.005 < | 0.03 | | 0.003 < | | 0.005 |
| 90/03/05 | 0.005 < | 0.02 < | | 0.005 | | 0.005 |
| 90/09/26 | 0.001 * | 0.02 < | | 0.003 < | | 0.003 |
| 90/10/03 | 0.002 * | 0.02 < | | 0.003 < | | 0.003 < |
| 90/10/11 | 0.002 * | 0.02 < | | 0.003 < | | 0.004 |
| 90/10/18 | 0.001 * | 0.02 < | | 0.003 < | | 0.008 |
| 90/10/22 | 0.001 <* | 0.02 | | 0.003 < | | 0.004 |
| 91/01/29 | 0.002 * | 0.029 * | | 0.006 * | | 0.008 |

| Date | NO2 | NO2+NO3 | | O. Phos. | | D. Phos. |
|---|---|---|---|---|---|---|
| | | | | | | |
| 91/02/05 | 0.002 * | 0.039 * | | 0.007 * | | 0.008 |
| 91/02/11 | 0.007 * | 0.028 * | | 0.007 * | | 0.008 |
| 91/02/18 | 0.005 * | 0.013 * | | 0.007 * | | 0.009 |
| 91/02/25 | 0.002 * | 0.011 * | | 0.007 * | | 0.008 |
| 91/09/30 | 0.007 * | 0.061 * | | 0.003 < | | 0.003 |
| 91/10/09 | 0.004 * | 0.039 * | | 0.003 < | | 0.005 |
| 91/10/17 | 0.005 * | 0.068 * | | 0.003 < | | 0.003 |
| 91/10/24 | 0.001 * | 0.011 * | | 0.003 | | 0.006 |
| 91/10/31 | 0.001 <* | 0.009 * | | 0.004 | | 0.006 |
| 92/01/15 | 0.002 * | 0.021 * | | 0.003 | | 0.007 |
| 92/01/21 | 0.003 * | 0.016 * | | | | |
| 92/01/28 | 0.001 * | 0.017 * | | 0.005 | | 0.005 |
| 92/02/06 | 0.004 * | 0.030 * | | 0.003 | | 0.006 |
| 92/02/13 | 0.006 * | 0.019 * | | 0.003 < | | 0.010 |

* Low-level analysis

Table 21.

Pulp mill-related background data collected from the Nechako River 2 km d/s Vanderhoof discharge (site E207451) during fiscal year 1990-1991.

| Date | 1990 | | | | | 1991 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 09/26 | 10/03 | 10/22 | 10/18 | 10/11 | 01/29 | 02/05 | 02/11 | 02/18 | 02/25 |
| C.O.D. | 16 | 14 | 13 | 13 | 17 | 13 | 13 | 15 | 11 | <10 |
| Phenols | 0.003 | <0.002 | <0.002 | 0.007 | 0.003 | 0.002 | 0.004 | 0.003 | <0.002 | <0.002 |
| C IO:T | 8 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 |
| C:T | 14 | 13 | 13 | 13 | 13 | 11 | 15 | 17 | 15 | 15 |
| Color * | 5 | 6 | 7 | 7 | 6 | 6 | 9 | 6 | | |
| Susp.Sol | 1 | 2 | 2 | <1 | 2 | | | | | |
| Chlrid:D | 0.5 | 0.5 | <0.5 | <0.5 | 0.5 | 0.5 | <0.5 | <0.5 | 0.6 | 0.5 |
| Sodium:D | 2.5 | 2.4 | 2.4 | 2.2 | 2.5 | 2.6 | 2.4 | 2.6 | 2.7 | 2.8 |
| pH ** | 7.6 | 7.8 | 7.7 | 7.4 | 7.8 | 7.6 | 7.4 | 7.5 | 7.6 | 7.7 |
| AbietAcd | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| DAbietAc | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| NAbietAc | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| PimaricA | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| IPimrcAc | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| LPimrcAc | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| SPimrcAc | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Hardness | 30.2 | 36.2 | 37.1 | 38.1 | 36.0 | 33.0 | 34.3 | 35.4 | 40.9 | 34.7 |
| Aluminum | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.11 | <0.10 |
| Barium | 0.03 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Calcium | 8.76 | 10.5 | 10.9 | 11.3 | 10.5 | 9.60 | 9.94 | 10.2 | 12.0 | 9.96 |
| Cadmium | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Cobalt | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Chromium | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Copper | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Iron | 0.08 | 0.12 | 0.24 | 0.26 | 0.14 | 0.29 | 0.10 | 0.11 | 0.14 | 0.10 |
| Magnsium | 2.03 | 2.42 | 2.41 | 2.40 | 2.37 | 2.20 | 2.30 | 2.41 | 2.66 | 2.38 |
| Mangnese | <0.01 | <0.01 | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 | 0.01 | 0.03 | 0.01 |
| Molybden | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Nickel | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Lead | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Vanadium | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc | 0.08 | 0.09 | 0.02 | 0.03 | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |

All measurements are in mg/L except as noted.
* Colour is measured in SWU.
** pH (lab.) is measured in pH units.

Table 22.

Pulp mill-related background data collected from the Nechako River 2 km d/s Vanderhoof discharge (site E207451) during fiscal year 1991-1992.

| Date | | 1991 | | | | | 1992 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 09/30 | 10/09 | 10/17 | 10/31 | 10/24 | 01/15 | 01/21 | 01/28 | 02/06 | 02/13 |
| | | | | | | | | | | | |
| C.O.D. | | 17 | 17 | 17 | 26 | 26 | 14 | 14 | 25 | 22 | 24 |
| Phenols | | <0.002 | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.002 | <0.002 |
| C IO:T | | 9 | 9 | 9 | 10 | 9 | 9 | 8 | 9 | 9 | 9 |
| C:T | | 14 | 13 | 13 | 14 | 13 | 12 | 11 | 11 | 11 | 15 |
| Color * | | 7 | 11 | 8 | 7 | 8 | 8 | 8 | 6 | 6 | 8 |
| Susp.Sol | | 1 | 1 | 3 | 2 | 2 | 1 | | 1 | 2 | 2 |
| Chlrid:D | | 0.7 | 0.6 | 0.5 | 0.7 | 0.5 | 0.6 | 0.6 | 0.5 | 0.5 | 0.8 |
| Sodium:D | | 2.5 | 2.3 | 2.5 | 2.6 | 2.4 | 2.6 | 2.3 | 2.4 | 2.4 | 2.8 |
| pH ** | | 7.7 | 7.8 | 7.7 | 7.3 | 7.4 | 7.5 | 7.6 | 7.7 | 7.6 | 7.7 |
| AbietAcd | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| DAbietAc | | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| NAbietAc | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| PimaricA | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| IPimrcAc | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| LPimrcAc | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| SPimrcAc | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Hardness | | 33.5 | 33.2 | 30.6 | 33.3 | 33.0 | 33.0 | 34.1 | 37.8 | 34.1 | 39.1 |
| Aluminum | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.04 | 0.05 | 0.04 | 0.06 | 0.07 |
| Barium | | 0.01 | 0.01 | <0.01 | <0.01 | 0.01 | 0.009 | 0.009 | 0.010 | 0.010 | 0.011 |
| Calcium | | 9.80 | 9.70 | 8.94 | 9.79 | 9.59 | 9.51 | 9.87 | 11.0 | 9.84 | 11.2 |
| Cadmium | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Cobalt | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.004 | <0.003 | <0.003 | <0.003 | <0.003 |
| Chromium | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Copper | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.002 | 0.004 | 0.002 | 0.002 | 0.002 |
| Iron | | 0.07 | 0.08 | 0.08 | 0.11 | 0.22 | 0.057 | 0.061 | 0.081 | 0.080 | 0.102 |
| Magnsium | | 2.20 | 2.18 | 2.01 | 2.16 | 2.20 | 2.24 | 2.29 | 2.50 | 2.32 | 2.70 |
| Mangnese | | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | 0.005 | 0.005 | 0.006 | 0.006 | 0.007 |
| Molybden | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 |
| Nickel | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.008 | <0.008 | <0.008 | <0.008 | <0.008 |
| Lead | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Zinc | | <0.01 | 0.04 | 0.02 | 0.03 | 0.02 | <0.002 | 0.003 | <0.002 | 0.004 | 0.003 |

All measurements are in mg/L except as noted.
* Colour is measured in SWU.
** pH (lab.) is measured in pH units.

Table 23.

Fecal coliforms collected from the Necoslie (site 0400801) and Stuart (sites 0400488, 0920101) Rivers from May 1987 to Oct. 1991.

| Date | Site number | | | | |
|---|---|---|---|---|---|
| | 0400801 | | 0400488 | | 0920101 |
| | | | | | |
| 87/05/14 | | | | | 2 < |
| 87/06/24 | 2 < | | 2 < | | 2 < |
| 87/07/29 | 33 | | 46 | | |
| 87/07/30 | 8 | | 8 | | 7 |
| 87/08/18 | 2 < | | 2 < | | 2 < |
| 87/10/27 | 2 < | | 2 | | 2 < |
| 87/12/16 | 2 | | 23 | | 2 < |
| 88/02/24 | 2 < | | 14 | | 2 < |
| 88/04/11 | 49 | | 23 | | 2 < |
| 88/11/08 | 4 | | 2 < | | 2 < |
| 88/11/14 | 2 < | | 12 | | 2 < |
| 88/11/21 | 2 < | | 2 | | 2 < |
| 88/11/29 | 2 < | | 8 | | 2 < |
| 88/12/06 | 4 | | 2 | | 2 < |
| 89/10/31 | 4 | | 7 | | 2 < |
| 89/11/08 | 9 | | 12 | | 2 < |
| 89/11/15 | 2 | | 24 | | 2 |
| 89/11/20 | 2 < | | 13 | | 2 < |
| 89/11/23 | 2 < | | 7 | | 2 < |
| 90/09/27 | 2 < | | | | |
| 90/10/04 | | | 19 | | 7 |
| 90/10/10 | 3 | | 9 | | 2 |
| 90/10/16 | 2 | | 8 | | 1 |

| Date | Site number | | | | |
|---|---|---|---|---|---|
| | 0400801 | | 0400488 | | 0920101 |
| | | | | | |
| 90/10/24 | 6 | | 5 | | 2 < |
| 91/10/03 | 110 | | 10 | | 8 |
| 91/10/08 | 7 | | 2 | | 2 |
| 91/10/16 | 17 | | 44 | | 8 |
| 91/10/21 | 33 | | 138 | | 6 |
| 91/10/29 | 4 | | 7 | | 1 |

Table 24.
Ammonia levels (mg/L) in the Necoslie and Stuart Rivers from May 1987 to Oct. 1992.

| Date | Site number | | | | |
|---|---|---|---|---|---|
| | 0400801 | | 0400488 | | 0920101 |
| | | | | | |
| 87/05/14 | 0.038 | | 0.014 | | 0.005 < |
| 87/07/30 | 0.008 | | 0.005 < | | 0.005 < |
| 87/10/27 | 2.160 | | 0.023 | | 0.005 |
| 87/12/16 | 2.670 | | 0.057 | | 0.005 < |
| 88/02/24 | 4.080 | | 0.131 | | 0.005 < |
| 88/04/11 | 0.232 | | 0.210 | | 0.006 |
| 88/11/08 | 0.825 | | 0.031 | | 0.005 < |
| 88/11/14 | 1.390 | | 0.011 | | 0.005 < |
| 88/11/21 | 1.280 | | 0.035 | | 0.008 |
| 88/11/29 | 1.680 | | 0.065 | | 0.006 |
| 88/12/06 | 1.280 | | 0.035 | | 0.005 < |
| 89/10/31 | 1.880 | | 0.039 | | 0.005 < |
| 89/11/08 | 1.440 | | 0.095 | | 0.008 |
| 89/11/15 | 2.110 | | 0.098 | | 0.005 |
| 89/11/20 | 1.110 | | 0.086 | | 0.008 |
| 89/11/23 | 1.640 | | 0.020 | | 0.005 < |
| 90/09/27 | 0.024 | | | | |
| 90/10/04 | | | 0.005 < | | 0.005 < |
| 90/10/10 | 0.193 | | 0.005 < | | 0.037 |
| 90/10/16 | 0.775 | | 0.005 < | | 0.005 < |
| 90/10/24 | 0.870 | | 0.020 | | 0.005 < |
| 91/10/03 | 0.160 | | 0.005 < | | 0.005 < |
| 91/10/08 | 0.282 | | 0.005 < | | 0.005 < |
| 91/10/16 | 0.005 < | | 0.007 | | 0.007 |
| 91/10/21 | 0.989 | | 0.011 | | 0.005 < |
| 91/10/29 | 1.530 | | 0.025 | | 0.005 < |

Table 25.

Nitrite plus nitrate and nitrite collected from the Necoslie and Stuart Rivers from May 1987 to Oct. 1991.

| Date | NO2+NO3 mg/L | | | | Nitrite mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400801 | 0400488 | 0920101 | | 0400801 | 0400488 | 0920101 |
| | | | | | | | |
| 87/05/14 | 0.02 < | 0.02 < | 0.02 < | | 0.005 | 0.005 < | 0.005 < |
| 87/07/30 | 0.02 < | 0.02 < | 0.02 < | | 0.005 < | 0.005 < | 0.005 < |
| 87/10/27 | 0.80 | 0.02 | 0.02 < | | 0.079 | 0.005 < | 0.005 < |
| 87/12/16 | 0.28 | 0.02 | 0.02 | | 0.011 | 0.005 < | 0.005 < |
| 88/02/24 | 0.22 | 0.05 | 0.03 | | 0.008 | 0.005 < | 0.005 < |
| 88/04/11 | 0.47 | 0.34 | 0.02 | | 0.006 | 0.005 < | 0.005 < |
| 88/11/08 | | 0.03 | 0.02 | | 0.110 | 0.005 < | 0.005 < |
| 88/11/14 | | 0.02 | 0.02 < | | 0.016 | 0.005 < | 0.005 < |
| 88/11/21 | | 0.02 | 0.02 | | 0.200 | 0.005 < | 0.005 < |
| 88/11/29 | | 0.03 | 0.03 | | 0.017 | 0.005 < | 0.005 < |
| 88/12/06 | | 0.02 | 0.02 < | | 0.010 | 0.005 < | 0.005 < |
| 89/10/31 | 0.81 | 0.03 | 0.02 < | | 0.031 | 0.005 < | 0.005 < |
| 89/11/08 | 0.62 | 0.07 | 0.02 | | 0.025 | 0.005 < | 0.005 < |
| 89/11/15 | 0.71 | 0.07 | 0.03 | | 0.026 | 0.005 < | 0.005 < |
| 89/11/20 | | 0.06 | 0.03 | | 0.011 | 0.005 < | 0.005 < |
| 89/11/23 | | 0.05 | 0.02 | | 0.019 | 0.005 < | 0.005 < |
| 90/09/27 | 0.23 | | | | 0.021 | | |
| 90/10/04 | | 0.02 < | 0.02 < | | | 0.005 < | 0.005 < |
| 90/10/10 | 1.39 | 0.02 | 0.02 < | | 0.188 | 0.005 < | 0.005 < |
| 90/10/16 | 1.08 | 0.03 | 0.02 < | | 0.062 | 0.005 < | 0.005 < |
| 90/10/24 | 0.82 | 0.07 | 0.04 | | 0.026 | 0.005 < | 0.005 < |
| 91/10/03 | 0.84 | 0.02 < | 0.02 < | | 0.043 | 0.005 < | 0.005 < |
| 91/10/08 | 1.20 | 0.02 < | 0.02 < | | 0.060 | 0.005 < | 0.005 |
| 91/10/16 | 1.01 | 0.02 < | 0.02 < | | 0.094 | 0.005 < | 0.005 < |
| 91/10/21 | 0.59 | 0.04 | 0.02 | | 0.033 | 0.006 | 0.005 |
| 91/10/29 | 0.52 | 0.03 | 0.02 < | | 0.025 | 0.005 < | 0.005 < |

Table 26.

Ortho-phosphorous and total dissolved phosphorous collected from the Necoslie and Stuart Rivers from May 1987 to Oct. 1991.

| Date | O.Phos. mg/L | | | | D.Phos. mg/L | | |
|---|---|---|---|---|---|---|---|
| | 0400801 | 0400488 | 0920101 | | 0400801 | 0400488 | 0920101 |
| 87/05/14 | 0.012 | 0.005 | 0.003 < | | 0.024 | 0.016 | 0.005 |
| 87/07/30 | 0.027 | 0.003 < | 0.003 < | | 0.036 | 0.003 | 0.003 < |
| 87/10/27 | 0.405 | 0.005 | 0.003 < | | 0.440 | 0.005 | 0.003 < |
| 87/12/16 | 0.438 | 0.010 | 0.003 < | | 0.462 | 0.012 | 0.003 |
| 88/02/24 | 0.639 | 0.020 | 0.003 < | | 0.664 | 0.025 | 0.003 |
| 88/04/11 | 0.036 | 0.026 | 0.003 < | | 0.056 | 0.042 | 0.003 |
| 88/11/08 | | 0.007 | 0.003 | | | 0.007 | 0.003 |
| 88/11/14 | | 0.006 | 0.003 | | | 0.010 | 0.003 |
| 88/11/21 | | 0.006 | 0.003 < | | | 0.008 | 0.003 |
| 88/11/29 | | 0.009 | 0.003 < | | | 0.011 | 0.003 < |
| 89/10/31 | | 0.003 < | 0.003 < | | | 0.006 | 0.003 < |
| 89/11/08 | | 0.003 < | 0.003 < | | | 0.018 | 0.003 < |
| 89/11/15 | | 0.018 | 0.003 < | | | 0.020 | 0.003 |
| 89/11/20 | | 0.015 | 0.003 < | | | 0.015 | 0.004 |
| 89/11/23 | | 0.005 | 0.003 < | | | 0.015 | 0.003 |
| 90/10/04 | | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 90/10/10 | | 0.004 | 0.003 < | | | 0.004 | 0.003 < |
| 90/10/16 | | 0.004 | 0.003 < | | | 0.005 | 0.003 |
| 90/10/24 | | 0.008 | 0.003 < | | | 0.011 | 0.003 |
| 91/10/03 | | 0.003 < | 0.003 < | | | 0.004 | 0.003 |
| 91/10/08 | | 0.003 < | 0.003 < | | | 0.003 | 0.003 |
| 91/10/16 | | 0.003 < | 0.003 < | | | 0.003 < | 0.003 < |
| 91/10/21 | | 0.004 | 0.003 < | | | 0.007 | 0.003 < |
| 91/10/29 | | 0.008 | 0.003 < | | | 0.010 | 0.003 < |