WATER QUALITY SECTION

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

Water Quality in British Columbia

Objectives Attainment in 1996 and 1997

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SUMMARY

The setting of water quality objectives in priority basins in British Columbia began in 1982. By the end of 1997, the Ministry of Environment, Lands and Parks had set water quality objectives in 46 bodies of water, both fresh and marine, throughout the Province. Annual monitoring to check the attainment of objectives started in 1987. This report presents the results of monitoring done in 1996 and 1997 to check the attainment of objectives in 15 basins (1996) and 14 basins (1997). Due to budgetary restraints, the program has been considerably as compared to previous years.

The results are summarized in a series of tables. For all Ministry Regions the objectives were met 81 percent of the time in 1996 and 77 percent of the time in 1997. The findings in 1996 and 1997 are slightly less than the 1995 figure (83%), and also less than previous years when attainment ranged from 94 percent in 1987 to 83 percent in 1995. The declining attainment is in part due to the fact that the reduced sampling effort is focused in areas where a problem is expected or uncovered.

There was not 100 percent attainment because objectives are set in areas where water quality problems may occur. Monitoring results therefore reflect the state of water quality in areas affected by human activity rather than in the Province as a whole.

Variables for which objectives were sometimes not met in three or more basins in each of the 1996 and 1997 basins included; fecal coliforms, *E.coli*, suspended solids, chlorophyll-*a* (a measure of algal growth in lakes and streams), total phosphorus in lakes, and dissolved oxygen. The objective for dioxins and furans in fish to protect fish from chronic toxic effects was also not met in the Columbia River. In addition, the guideline for human consumption was not met in one of the sampled fish, although it is estimated that this fish was not representative of the river due to its age.

In 1995, the Ministry developed a water quality index to help interpret objectives attainment data. The index reduces the water quality information, as tabulated in this report, to a simple category or rank describing the state of water quality in a body of water. The index is applied to the 1996 and 1997 data to rank some of the water bodies in this report (where there is sufficient data to do so).

ACKNOWLEDGEMENTS

The regional staff of Pollution Prevention and Remediation carried out most of the monitoring, either directly or by using co-op students and contractors. The Pacific Environmental Science Centre analyzed the samples for most variables except for microbiological indicators measured by J.R. Laboratories and biological communities measured by Fraser Environmental Services.

Additional data found in this report were also obtained from regional offices of B.C Environment, from the federal Department of Fisheries and Oceans (DFO), RL & L Environmental Services on behalf of B.C. Hydro, Celgar Pulp Company, the Greater Vancouver Regional District and from the Cariboo Health Unit.

An additional acknowledgment goes to R.J. Rocchini, who wrote the past *Objectives Attainment Reports*, forming the basis to this document.

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INTRODUCTION

In 1981, the Auditor General recommended that the Ministry develop a method of measuring its performance in safeguarding water quality. To fulfil this recommendation, the Ministry undertook to set water quality objectives for fresh and marine surface waters of British Columbia.

Water quality objectives are safe conditions or threshold levels of a substance which will protect the most sensitive water use of a specific body of water. They establish a reference against which the state of water quality at a specific site is checked, as recommended by the Auditor General. They are also used to prepare Waste Management Permits or Plans and to measure their effectiveness. They are thus a basic tool for use in maintaining a healthy aquatic environment.

We began work on water quality objectives in 1982. The Ministry has now published objectives on bodies of water in 46 areas or basins and updated them in two. In addition, objective-setting and updating is proceeding in a number of other basins. In each basin considered, we expected some type of water quality problem due to human activity. We set objectives for lakes, rivers, creeks, and marine areas covering all seven Environment Regions of the Ministry.

This report for 1996 and 1997 is the eleventh in a series of annual reports which began in 1986. Since 1987, the Ministry has been monitoring ambient water specifically to check the attainment of objectives. As a result, we have obtained an annual picture of how well objectives are being met since 1987. Each report is a condensation of monitoring data for use by managers of the water resource. It indicates where conditions are acceptable and provides a warning of where further evaluation may be needed to solve water quality problems. In order to reduce publication costs and increase convenience of data management, both the 1996 and 1997 attainment reports are included in one document. To keep this report to a reasonable length, we assume some reader familiarity with the detailed background reports on water quality objectives for each basin. Copies of these background reports may be obtained from the Water Management Branch of the Ministry in Victoria.

We usually choose the basins for setting water quality objectives on the basis of perceived water quality problems. Thus, results presented here indicate conditions in likely problem areas, but do not reflect the state of water quality in the Province as a whole. There are many bodies of water where water quality is relatively unaffected by humans and likely to remain so for the foreseeable future. Thus, reports in this series are a measure of the state of water quality in areas of British Columbia influenced by human activity.

To help the public and resource managers interpret the large amount of attainment data presented in this type of report, we developed a water quality index in 1995. This is a system of ranking which assigns a number and grade to a body of water to indicate its quality. The B.C. index is based on factors which measure the success of meeting water quality objectives. It thus compresses large quantities of data into a statement on the quality of water and its uses. A brochure describing this index is available from the Ministry, as is a more detailed report explaining how to calculate the index from the monitoring data on objectives attainment.

In 1995 the index was applied in 33 water basins plus 5 groundwater aquifers in the Province to produce a *B.C. Water Quality Status Report*. This report, the first of its kind, is intended to show the public in non-technical terms how suitable the water is, in specific areas, for a variety of uses. The *Status Report*, which is based on objectives attainment data collected between 1987 and 1993, was released in April, 1996, and is available from the Ministry.

METHODS OF PRESENTING AND INTERPRETING THE DATA

Reports on Objectives

At the present time, the Ministry of Environment has completed 46 reports on water quality objectives. The complexity and size of the reports varies considerably, depending upon the body of water considered. These reports are distributed among the Environmental Regions of the Ministry as follows:

Vancouver Island	7
Skeena	5
Omineca-Peace	9
Cariboo	2
Southern Interior	11
Kootenay	4
Lower Mainland	8
Total	46

Work is in progress on a number of other water basins where objectives are either being set or updated.

Tables of Results

We have summarized the data collected in 1996 in Tables 1 to 16, and for 1997 in Tables 17 to 31, with a separate table for each of the water basins monitored. Because of funding limitations, fewer basins were monitored than in previous years.

In each table we list all the objectives that have been set, as they appear in the summary table of each report on objectives. We have updated a few of the objectives to reflect new water quality guidelines and procedures. For example, we are now using chlorophyll-a instead of periphyton biomass and total ammonia-N instead of un-ionized ammonia-N. The 90th percentile of 400/100 mL for fecal coliform values is used when high fecal coliform values are recorded at bathing beaches. In some cases, such as Kitimat Arm, we have added some generalized water quality guidelines to allow for the fact that threats to water quality have changed or are better understood since publication of the objectives reports.

Four different concluding statements are used: objective met, objective not met, indefinite result, and omitted 1996 or 1997. We consider the objective to have been met if the monitoring result equaled or was within the objective limit. We report the result as indefinite if there were insufficient data to check the objective, the data were suspect, or the minimum detectable concentration was too high. We report the objective as omitted if, for some reason, planned data collection did not take place or was excluded because of low priority, taking into account past results. These tables are the most important part of this report since they summarize where, when, and by how much objectives were met in 1996 and 1997.

Text

In the next section, the text briefly explains the quality assurance program and its status in the 1996 and 1997 monitoring years. We then give a provincial overview of the monitoring results. Finally, we describe briefly the tabulated data for each body of water, by Region, mentioning the highlights and sometimes drawing some general conclusions. At this stage, we avoid qualifying statements such as: "...the objectives were nearly met, slightly exceeded or probably met..." . We consider them to be too speculative without the support of further evidence to explain them. Thus objectives not met by a wide margin are categorized equally with apparent borderline cases. Although a more detailed interpretation is desirable, this is not done here because it would require the presentation of much more data, which is beyond the scope of this attainment report.

For the same reason, we do not attempt to explain what may have caused the results or to comment on the effect of objectives not being met. Such assessments would entail consideration of river flows, effluent discharges, whether objectives are long-term or short-term, the degree to which objectives are exceeded, quality assurance, and other factors.

In addition to a brief description of the tabulated data, we present the 1996 and 1997 water quality index and rank for the bodies of water in each basin - when there are sufficient data to do so. The calculation of the index and rank for 1996 and 1997 helps highlight those variables which had a detrimental effect on water quality in a particular water body.

The 1996 and 1997 Attainment Report guides those involved in managing water quality by focusing on areas of concern where further assessment or inspection may be needed. Since monitoring to check water quality objectives covers only a short time span, usually at most 30 days, we believe that any instance when objectives were not met could be significant and is worth a more detailed look. Further study could show whether objectives were not met because of natural phenomena or because there is a human cause to the problem.

Figures

A location map in Figure 1 shows the 46 basins where objectives have been set. Separate maps, Figures 2 to 16, illustrate the 15 water basins monitored in 1996/1997 and show the sampling sites referred to in the tables. Each figure number corresponds to the table of the same number.

Guide to Ranking Future Monitoring

Due to limited funds, we cannot monitor all basins where objectives have been set each year. We have therefore proposed the following scheme to rank monitoring:

- **1st priority**: any basin with less than three years of complete monitoring or any basin the Ministry considers provincially or internationally significant. Examples of significant basins are the Fraser River due to fisheries, the Okanagan Valley lakes due to recreation, the lower Columbia River due to trans-boundary effects, and Burrard Inlet due to a federal-provincial plan.

- **2nd priority**: any basin in which, after at least three years monitoring, a number of objectives are not regularly attained and there is either a local expression of concern or a plan for short-term action.

- **3rd priority**: any basin as for the 2nd priority above, but where there is no known concern or plan of action.

- **4th priority**: any basin in which, after at least three years monitoring, most objectives are either being met or the situation is fairly well documented with no change in status expected in the short term.

QUALITY ASSURANCE PROGRAM

Due to fiscal restraints, the Quality Assurance Program was suspended in 1996 and 1997. Prior to this, the Quality Assurance Program ran over a five-year period from 1991 to 1995. This program described the accuracy and precision of the test results to assess the reliability of the results, and was specific to the variable and levels measured for objectives attainment. In its place the Ministry conducts a more general quality assurance program to ensure that contract laboratories are producing results that meet Ministry data quality standards.

PROVINCIAL OVERVIEW OF RESULTS

Presentation of Results

In the tables summarizing the monitoring data, there are four kinds of concluding statement. These are: objective met, objective not met, omitted 1996 or 1997, and indefinite result.

To get an overview of performance for the Province, we totaled the number of occurrences of each conclusion for each water basin from the summary tables. In compiling these totals, we counted each instance of a maximum (or minimum) objective being met or not met plus all average and percentile values being met or not met.

Table 1 shows the results of this compilation in 1996, and Table 18 presents its 1997 equivalent. For each Region we give the sum of occurrences for each kind of conclusion and then total them for the whole Province. We also express the occurrences as a percent of the total of all occurrences, both by Region and for the Province as a whole. A graphical representation of the provincial attainment results are found in Table 2 (for 1996 results) and Table 19 (for the 1997 results).

Discussion of Results

Although the results apply to specific occurrences, we assume for this analysis that they are representative of the whole year. This simplification is a conservative approach to describing the state of water quality since we usually attempt to collect data during worst-case conditions.

- 1996 -

Table 1 and Figure 3 show that the objectives were met 70% of the time in the Province as a whole in 1996. This result varied according to Region (Figure 1) from 52% to 86%. Objectives were not met from between 1% to 23% of the time, with an overall average of 17%.

The occurrence of objectives omitted in 1996, or indefinite results averaged 3%, and 10%, respectively. If we subtract these instances of no result from the total, then the number of instances (or percent of time) that objectives were met overall becomes 81% and the number not met 19%. By subtracting the instances of no results, we speculate that if all objectives had yielded results, then the above trend would continue.

We can therefore generalize that, in the Province as a whole, the objectives were met about 81% of the time in 1996.

- 1997 -

Table 18 and Figure 3 indicate that the objectives were met 67% of the time in the Province as a whole in 1997. This result varied according to Region (Figure 2) from 53% to 87%. The objectives were not met from between 3% to 31% of the time, with an overall average of 19%.

The occurrence of objectives omitted in 1997, or indefinite results averaged 3% and 11%, respectively. If we subtract these instances of no result from the total, then the number of instances (or percent of time) that objectives were met overall becomes 77% and the number not met 23%.

We can again generalize that, in the Province as a whole, the objectives were met about 77% of the time in 1997.

This is an approximate general statement at the best of times, but is especially so for 1996 and 1997 because of the reduced monitoring in those years. Factors which can affect the overall outcome include the frequency at which particular objectives in any region are monitored, the completeness of monitoring in a basin, and the inclusion or omission of water basins with either serious or minor water quality problems.

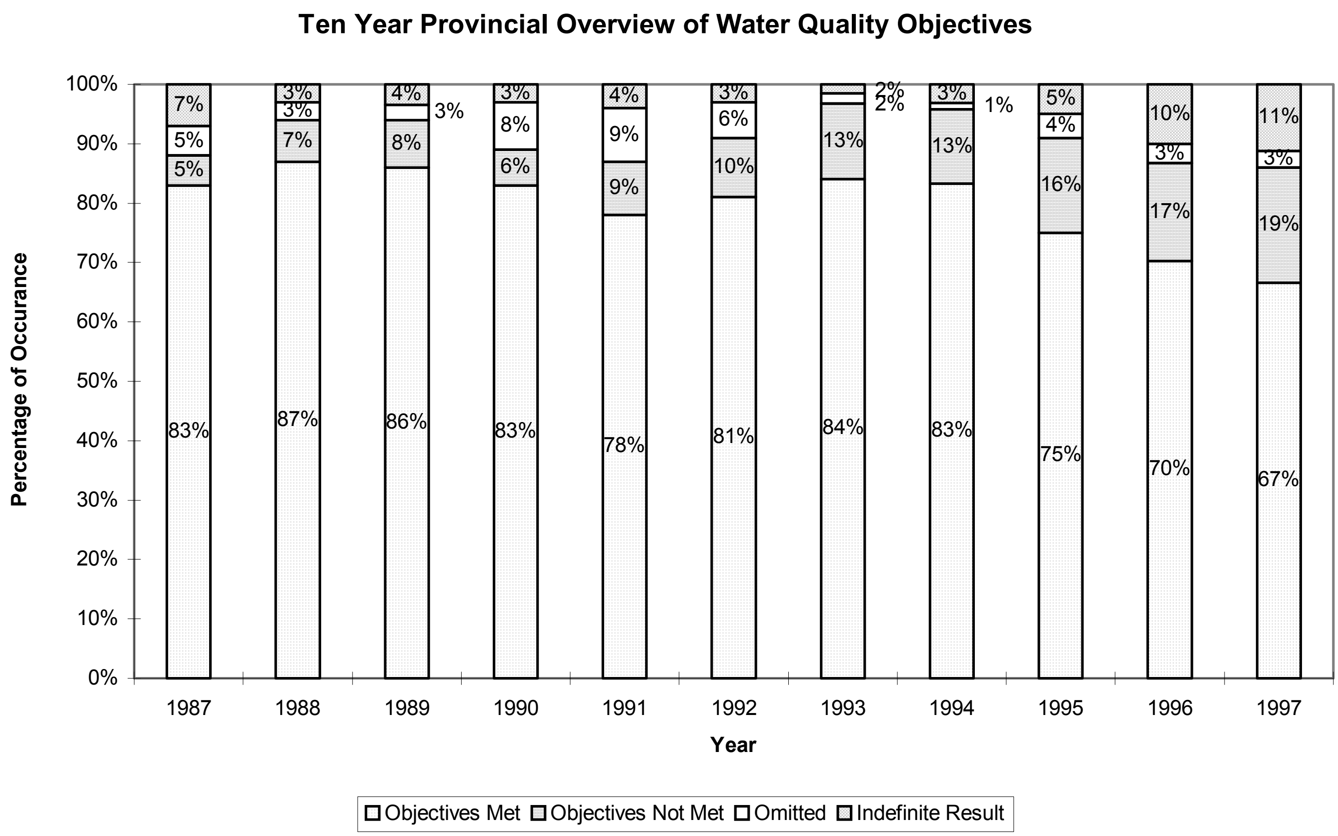
When comparing the data from past years, a downward trend in % of objectives met is evident (as seen in the table below and Figure 3). As the monitoring program is repeated in future years, it is speculated that a downward trend could continue. This is because new basins with known problems will be added and, as monitoring costs increase, there will be a tendency to cease monitoring in areas where objectives are being met to free-up funding for areas that have persistent water quality concerns.

	Year of Objective Monitoring										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Percent of the Time Objectives Were Met	94%	93%	92%	93%	90%	89%	87%	87%	83%	81%	77%
Number of Basins Sampled	20	22	24	30	34	33	32	21	16	15	14

If we wish to use objectives attainment data to describe the general state of water quality in developed areas, we will need to maintain monitoring in all areas where objectives have been set. If, as is likely, monitoring resources are scarce, we will need to concentrate on areas where the worst water quality problems occur. This will produce an increasingly negative general result, although we would expect the situation to improve in subsequent years as corrective action is taken. The goal, of course, is for water quality objectives to be met 100% of the time in all areas. Monitoring in future years, followed by corrective action where required, will show how close we can get to this ideal situation.

Ten Year Water Quality Attainment Overview

This report marks the ten year anniversary of the *Water Quality Objectives Attainment Report* series. Included below is a graph representing the findings from the past ten years of attainment reporting, this graph shows trends in each of the four concluding statements (objectives met, objectives not met, omitted 1996 and 1997 and indefinite results).



VANCOUVER ISLAND REGION

Cowichan-Koksilah Rivers

The Cowichan River is the most important river on Vancouver Island for recreational and commercial fisheries. The Koksilah River is a major tributary of the Cowichan River near its mouth. Possible sources of contamination include treated municipal sewage, agriculture, urban development, and effluents from a fish hatchery and abandoned metal mines.

Objectives were not checked from 1994 to 1997. Monitoring carried out from 1988 to 1993 gave fairly consistent results, with water quality ratings of fair for both rivers (Cowichan River index = 30; Koksilah River index = 36). It showed that objectives were not met for microbiological contaminants in both rivers and for algal growth in the lower part of the Cowichan River. Monitoring to check objectives attainment resumed in 1998.

Middle Quinsam Lake, and Quinsam River Basin

Middle Quinsam Lake drains via the Quinsam River into the Campbell River just upstream from the Campbell River estuary (Figure 2[A,B]). The Middle Quinsam Lake sub-basin is a valuable habitat for trout and salmon, but could be impacted by an open-pit coal mine operating in the area. It was noted as having excellent water quality (index = 3) based on measurements between 1989 and 1993 while the Quinsam River had good water quality (index = 8).

Table 2 lists results for 1996, Table 18 presents results for 1997, and Figure 2[A,B] shows site locations.

- 1996 -

Objective monitoring resumed in 1996 and objectives were met in all samples collected (Table 2).

⇒ In 1996, the water quality index ranked Quinsam River (index = 0), Long Lake (index = 0) and No Name Lake (index = 0) as excellent.

- 1997 -

Objectives were met in all collected samples except downstream from the Middle Quinsam River where the objectives for suspended solids, total iron, and total manganese were not met (Table 18).

⇒ In 1997, the water quality index gave a ranking of good (index = 5) for Quinsam River, and excellent (index = 0) for both Long Lake and No Name Lake.

Oyster River

The Oyster River flows from the Forbidden Plateau area into the Strait of Georgia, south from Campbell River. The river and its tributaries are important habitat for several species of trout and salmon. The main threats to water quality are logging, agriculture, and mine exploration. We expect the latter to lead to active mining in the future, especially for coal.

Between 1990 and 1993, the objectives were usually always met, with a water quality rating of good (index = 16)...Since the situation is stable, we did not monitor from 1994 to 1997 and no further work to check objectives is planned at this time unless development occurs in the watershed.

Elk and Beaver Lakes

Located near Victoria, these are the most important recreational fisheries lakes on southern Vancouver Island. Water-contact recreation is also very important in the lakes. Residential and agricultural development and the release of phosphorus from lake sediments are responsible for the present eutrophic state of the lakes.

Prior to this report, Elk and Beaver Lakes where monitored from 1993 to 1995. During the 1993 to 1995 study period, objectives for dissolved oxygen, chlorophyll-a, and the phytoplankton community were consistently not met, reflecting the eutrophic nature of the lakes. The water quality ratings were borderline, (index =54), for Elk Lake and poor, (index =72), for Beaver Lake.

Monitoring in the future will be a lower priority until action is taken to improve water quality conditions.

Tsolum River

The Tsolum River flows from Mount Washington to the Puntledge River at Comox on Georgia Strait (Figure 3). Acid-mine drainage from a closed copper mine in the headwaters creates high copper levels which are deleterious to fish. The river has the potential to support significant populations of salmonids.

Table 3 lists results in 1996, Table 19 presents results in 1997, and Figure 3 shows site locations.

Objectives for the Tsolum River were checked for the first time in 1994 in the river just downstream from the mine site. Since then, the objectives for dissolved copper were often not met.

- 1996 -

The dissolved copper values exceeding objectives continued in 1996, indicating a continued potential threat to fish (Table 3). The objective for percent steelhead survival will not be checked until water quality conditions improve substantially.

⇒ The water quality index gave a rating of borderline (index = 58) for the Tsolum River in 1996 due to high levels of dissolved copper.

- 1997 -

The objective for dissolved copper was not met again in 1997 even though the results improved from 1996 (Table 19). The percent steelhead survival objective will not be checked until there are further water quality improvements.

⇒ Due to the high but improving levels of dissolved copper, the water quality index gave a rating of fair (index = 30), for the Tsolum River in 1997.

We recommend continued objectives monitoring to track the progress of reclamation work at the mine.

Holland Creek and Stocking Lake

The Holland Creek and Stocking Lake watersheds, located near Ladysmith, are used mainly as a source of drinking water with some use for recreation and fisheries. Water quality objectives were prepared and approved recently as part of a watershed management plan for the area. Logging and road-building are the main influences on water quality.

Monitoring to check the attainment of water quality objectives has not yet been carried out.

Quatse Lake

Quatse Lake is located on the north-eastern end of Vancouver Island, approximately three kilometres north of Coal Harbour. In addition to a source of drinking water for Coal Harbour, Quatse Lake is also an important aquatic habitat for both fish and wildlife. A substantial portion of the watershed has been logged, which in turn has raised concerns that water quality may be affected.

Monitoring to check the attainment of water quality objectives has not yet been carried out, and is not planned in the immediate future.

SKEENA REGION

Bulkley River

The Bulkley River is a major tributary to the Skeena River. It is an important river for fisheries and has some drinking water use. The main influences on water quality are treated municipal effluent from Houston and Smithers, agriculture, urban runoff, and possible contamination in the headwaters from mining.

We have monitored the attainment of objectives from 1988 to 1992 and obtained consistent data, with a water quality rating of good, (index = 15). Given these results, we consider objectives checking to be a relatively low priority at this time and have not monitored the Bulkley River since 1992.

Kathlyn, Seymour, Round, and Tyhee Lakes

These four small lakes, in the Smithers area, are used for recreation, domestic water supply, and irrigation. The main influences on water quality are agriculture and residential development around the lakes.

Monitoring between 1987 and 1993 showed objectives for turbidity, colour, and phosphorus not being met due to the eutrophic nature of the lakes. Routine monitoring to check objectives ended after 1993 while plans to rehabilitate lake water quality were being prepared. Once corrective action starts, more complete monitoring for objectives attainment should resume to document progress. Water quality was reported as fair for Kathlyn, (index = 34), and Tyhee, (index = 21), Lakes

Lower Kitimat River and Arm

The river and arm are an important migration route for salmonids, and the water is also used for recreation and for industrial and municipal supplies. A kraft pulp mill and a municipal treatment plant discharge to the river and an aluminum smelter and methanol plant discharge at the head of the arm. The existing water quality objectives are being updated.

We recommend continued monitoring as the Ministry works with dischargers to upgrade effluent treatment facilities.

Lakelse Lake

Lakelse Lake drains into the Skeena River and is important for salmon spawning and rearing and for recreation. It is also used as a domestic water supply. The only threats to water quality are septic tanks around the shoreline, agriculture, and logging in watersheds that drain into the lake.

The objectives were last checked in 1992 and all were met, with a water quality rating of good (index = 9). We have not monitored since then as we presently consider such monitoring to be a low priority.

Yakoun River

The Yakoun River is on Graham Island in the Queen Charlotte Islands. It flows north from the Queen Charlotte Ranges into Masset Inlet. An open pit gold mine within the drainage has been proposed and water quality objectives have been set accordingly. The river has valuable fish resources, contributing all five species of salmon. It is also important for wildlife and recreation.

The development of the gold mine is on hold. We recommend monitoring to check the attainment of water quality objectives when the project proceeds.

OMINECA-PEACE REGION

Charlie Lake

Charlie Lake is used as a drinking water supply and for recreation. Agriculture, residential development around the lake, and nutrients from lake sediments are factors affecting water quality.

Monitoring from 1987 to 1993 showed the main problem to be high phosphorus levels causing eutrophic conditions, with a water quality rating of borderline (index = 46). Studies are underway to determine how to reduce nutrient input. Routine monitoring to check objectives should resume when corrective measures are undertaken.

Bullmoose Creek

Bullmoose Creek and its tributaries (West and South Bullmoose creeks) are important recreational fish habitat. The creeks are adjacent to an open pit coal mine.

The attainment of water quality objectives was documented by monitoring between 1987 and 1993 and there were no serious impacts, with a water quality ratings of fair for both Bullmoose Creek (index = 22), and West Bullmoose Creek (index = 23), and good for South Bullmoose Creek (index = 10). Further monitoring is a low priority at this time.

Nechako River

The Nechako River, a major tributary to the Fraser River at Prince George, has its flow controlled by dams for power generation (Figure 4). The river is an important route for migrating salmon. Water quality can be affected by treated municipal sewage and diffuse sources such as forestry and agriculture. Water temperature is influenced by the flow of water released from the dams and by the manner in which it is released.

In past years, the fecal coliform objectives were met in the Nechako River except immediately downstream from Vanderhoof. The temperature objectives immediately downstream from Cheslatta Falls were often not met in the summer. We have obtained similar results since 1987. For the period, 1987 to 1993, water quality was considered as fair (index = 22). Temperature objectives might be met if a cold-water release structure, proposed for the Kenney Dam upstream from Cheslatta Falls, is installed. The attainment of the temperature objectives further downstream on the Nechako at Vanderhoof and upstream from the Stuart River has improved due to water temperature management by the Nechako Fisheries Conservation Program.

Table 4 lists results in 1996, Table 20 presents results in 1997, and Figure 4 shows site locations.

- 1996 -

Only temperature data, it has been included. The objective for temperature was not met at times 10 km downstream from Cheslatta Falls in the summer months of 1996 (Table 4). However, the temperature objectives further downstream of Vanderhoof were met.

⇒ The water quality index could not be calculated in 1996 since only one of the objectives was checked.

- 1997 -

As in previous years, the temperature objective downstream from Cheslatta Falls was not met in the summer months of 1997 (Table 20). A limited amount of temperature data was collected at the DFO’s Cheslatta site in 1997, due to the vandalism of the monitoring station. After a lengthy repair period the monitoring station was again operational late in December. The temperature objectives further downstream at Vanderhoof were met.

⇒ The water quality index could not be calculated in 1997 due to limited data.

Given the importance of the river, we recommend continued monitoring to check objectives; especially water temperature.

Pine River

The Pine River, a tributary to the Peace River, supplies water to Chetwynd and supports significant sport fish populations. The water quality is considered to be mostly in a natural state with the major influence coming from forestry and from treated sewage from the Village of Chetwynd.

We presently consider monitoring to be a low priority for this basin and none was carried out after 1992. Past results show all objectives being met fairly consistently, with a water quality rating of good (index = 5).

Pouce Coupe River and Dawson Creek

The Pouce Coupe River enters the Peace River inside the Alberta Border. Dawson Creek is its major tributary. The waters are impacted mainly by municipal discharges and agriculture.

The exact causes for objectives not being met need to be found. Water quality ratings were fair for the Pouce Coupe River (index = 33; period of record: 1987 to 1990), and borderline for Dawson Creek (index = 56; period of record: 1987 to 1989). Since objectives were consistently not met up to 1992, we will not resume monitoring to check their attainment until measures are taken to correct the problem.

However, considering Alberta's increasing interest in the quality of the water crossing the provincial border, we recommend that objectives monitoring of the Pouce Coupe River and Dawson Creek be resumed.

Peace River

We have set objectives for the Peace River between the Bennett Dam and the B.C.-Alberta Border. The water is important for aquatic life and irrigation and can be affected by municipal discharges, forestry, agriculture, a gas plant, and a pulp mill built in 1988 after the objectives were set. We first checked the objectives in 1988. Water quality for the Peace River was judged as fair (index = 22), for the period of record from 1988 to 1993.

Objectives not met at times in 1994 included those for turbidity, suspended solids, temperature, and chromium. No monitoring was conducted in 1995, 1996 and 1997 to check objectives.

Considering Alberta's interest in the quality of the water crossing the provincial border, we recommend that objectives monitoring of the Peace River be resumed.

Upper Finlay River Sub-Basin

The Finlay River, located in the north east part of the Province, drains into the north end of Williston Lake. This river is broken into two sub-basins, the upper and the lower Finlay.

The drainage area of the upper Finlay sub-basin includes portions of the Skeena Mountains, Spatsizi Plateau, Omineca Mountains, and the Rocky Mountains. The upper Finlay was the site of a gold and silver mine and mill, now closed. The upper Finlay system is an important aquatic habitat for sports fishery species such as Dolly Varden (*Salvelinus malma*), and Rainbow Trout (*Oncorhynchus mykiss*). In addition, other water uses are related to recreational activities and as a source of drinking water for the community of Ware. Objectives apply to Jock and Galen creeks which eventually flow into the upper Finlay River.

The objectives were checked in 1987. Since the area is remote and the operation is closed, no further monitoring has been carried out. Future monitoring or new objectives may be needed if development re-occurs in the area.

Lower Finlay River Sub-Basin

The lower Finlay sub-basin drains a portion of the Rocky Mountains, and the Finlay Range about 8000 km^2 in size. Even though the lower Finlay is an important fish habitat, other water use is minimal due to low development and population in the area. Water quality concerns stem from logging and potential mineral extraction in the region.

No water quality monitoring is recommended at this time, but as development increases an assessments may show that monitoring is needed in the future.

Fraser River from the Source to Hope

This is the most important river in the Province for fisheries. Most of the contamination to the river between Moose Lake (the source of the river) and Hope is from pulp and paper mills and municipal treatment plants at Prince George and places downstream. Water quality objectives have been prepared to protect aquatic life, wildlife, irrigation, livestock watering, and drinking water supplies.

Table 5 lists results in 1996, Table 21 presents results in 1997, and Figure 5 shows site locations.

- 1996 -

The objective for fecal coliforms was not met at Stoner, Longbar or Marguerite sampling sites, similar to results from the 1995 monitoring year at both the Stoner and Marguerite sites (Table 5). In addition, objectives not met at times included those for suspended solids, dioxin and furan levels in sediment, and colour. Objectives that were met included those for *E.coli*, temperature, ammonia, nitrite, nitrate, pH, dissolved oxygen, chlorophenols, and resin acids.

⇒ The water quality index gave a rating of fair (index = 22) for 1996, due mainly to the objectives for fecal coliforms and suspended solids not being met.

- 1997 -

Objectives not met in 1997 included fecal coliforms and *E. coli* (at Stoner), suspended solids (at Stoner, Marguerite, and Hope sites), turbidity and AOX (both at Prince George). The objectives that were met included fecal coliforms (except at Stoner), colour, temperature, ammonia, nitrite, nitrate, pH, dissolved oxygen, chlorophenols, and resin acids.

⇒ The water quality index gave a rating of good (index = 16) for 1997, due to the objectives that were not met at times.

We recommend continued monitoring to check objectives in this section of the Fraser River.

CARIBOO REGION

Williams Lake

Williams Lake drains to the Fraser River and is important for drinking water, recreation, and aquatic life (Figure 6). The water quality is affected by phosphorus which comes from lake sediments and traditional farming practices in the San Jose River drainage, the main inlet to the lake, and to a lesser extent from residential septic systems around the lake. For the period from 1987 to 1993, the water quality was rated as borderline (index = 55).

Table 6 lists results in 1996, Table 22 presents results in 1997, and Figure 6 shows site locations.

- 1996 -

The only objective that was met at all times in the 1996 sampling period was that for turbidity. Objectives not met included those for total phosphorus at spring overturn, chlorophyll-a, dissolved oxygen, and water clarity (Table 6). These results reflect the current eutrophic state of the lake.

⇒ The water quality index rated the quality of the lake as fair (index = 30) in 1996 due to a high phosphorus level at spring overturn and several objectives not being met.

-1997 -

Objectives not met in 1997 included those for total phosphorus at spring overturn, turbidity, and water clarity (Table 22). Unlike 1996, the objective for dissolved oxygen was met in 1997. These results reflect the current eutrophic state of the lake.

⇒ The water quality index was calculated to be fair (index = 29) in Williams Lake due again to the high levels of phosphorus and other objectives not being met.

We recommend continued monitoring of objectives to track the progress of corrective measures being undertaken in the watershed.

San Jose River

The San Jose River originates at Lac La Hache and is the main inlet to Williams Lake (Figure 7). It is used mainly for irrigation, livestock watering, and water storage. Ranching is the activity with the most influence on water quality.

The Ministry set only one objective for the San Jose River, namely the total annual loading of dissolved phosphorus entering Williams Lake. The Region has measured this loading since the seventies.

The annual load was based on a calendar year. It was derived by adding daily stream flows in Borland Creek and the San Jose River just upstream, multiplying the total daily flow by the dissolved phosphorus daily concentrations measured in the San Jose downstream from Borland, plotting these daily loads against time, and measuring the area under the curve to obtain annual load.

Table 7 lists results in 1996, Table 23 presents results in 1997, and Figure 7 shows site locations.

- 1996 -

The objective for total annual loading of dissolved phosphorus, was not met in 1996 (Table 7).

⇒ Since only one objective was monitored, the water quality index could not be calculated for the San Jose basin.

- 1997 -

The objectives for total annual loading of dissolved phosphorus could not be calculated in 1997 (Table 23). This is due to the omission of sampling for dissolved phosphorus downstream from Borland Creek, even though flow data were available from the Water Survey of Canada.

⇒ As in the past year, the water quality index could not be calculated for the San Jose basin in 1997.

Monitoring in the future will be a lower priority until action is taken to improve dissolved phosphorus levels entering this system.

SOUTHERN INTERIOR REGION

Bonaparte River

The Bonaparte River is a tributary to the Thompson River. It is an important trout habitat and is affected by agricultural operations and municipal discharges. Its main tributaries are Clinton Creek and Loon Creek.

The water quality objectives were last checked in 1994. Objectives not met at times included those for fecal coliforms, suspended solids, turbidity, chlorophyll-a, and the objective for dissolved oxygen in Loon Lake. The water quality rating for the time period 1987 to 1993 was fair.

There are plans to improve water quality and correct problems. Routine monitoring to check attainment of objectives should resume after improvements are made.

Okanagan Valley Lakes

To date, objectives have only been set in the five main lakes for phosphorus, which is the major factor controlling the trophic state of the lakes (Figure 8). The lakes are highly valued for recreation, fisheries, and as a source of drinking and irrigation water. The major inputs of phosphorus are from treated municipal sewage and from diffuse sources that include septic tanks, agriculture, and forestry. Phosphorus release from sediments also occurs in Wood Lake and Osoyoos Lake.

Table 8 lists results in 1996, Table 24 presents results in 1997, and Figure 8 shows site locations.

- 1996 -

The phosphorus objective was met in all of the tested lakes in 1996, except for Kalamalka Lake, and the Armstrong Arm of Okanagan Lake (Table 8). This continues an improving trend which saw Skaha Lake meet its Objectives for the second consecutive year, while Osoyoos Lake met its Objective for the third year in a row.

⇒ In 1996, the water quality index gave a rating of excellent (index = 0) for all the lakes except for Kalamalka Lake which had a rating of poor (index = 69) and for Okanagan Lake which had a rating of fair (index = 21).

- 1997 -

As in 1996, the phosphorus objectives attainment was checked, showing that objectives were met again in Skaha and Osoyoos Lakes (Table 24). In addition, conditions in the central, north and south basins of Okanagan Lake also met objectives. However, the phosphorus objectives were not met in Wood Lake and in the Armstrong Arm of Okanagan Lake.

⇒ In 1997, the water quality index gave a rating of excellent (index = 0) for all the lakes except for Wood Lake which had a rating of poor (index = 69) and for Okanagan Lake which had a rating of fair (index = 22).

Because there is only the single phosphorus objective for each lake, the index gives only a rough idea of the state of water quality. Better estimates will be provided when a few more pertinent objectives have been set and checked.

Given the environmental importance of these lakes, we recommend continued monitoring of phosphorus at spring overturn.

Similkameen River

The Similkameen River flows from Manning Park, east through the south Okanagan, then south across the U.S. border (Figure 9). It is important for fisheries, drinking water, and irrigation. Water quality can be affected by mining and municipal discharges. We updated the water quality objectives in 1990 because of an increase in mining activity in the Hedley Creek area.

Monitoring between 1987 and 1993 has given consistent results with water quality ranked as good (index = 14), and was suspended in 1994 as low priority. The main problem has been with fecal coliforms, possibly from agricultural operations, which did not always meet the drinking water objective requiring disinfection only.

Table 9 lists results in 1996, Table 25 presents results in 1997, and Figure 9 shows the various site locations.

- 1996 -

Objectives monitoring resumed in 1996 and showed that all of the monitored objectives were met (Table 9). However, it should be noted that fecal coliforms were not sampled, meaning that objective attainment for this variable could not be determined.

⇒The water quality index could not be calculated since only 26% of the objectives were monitored.

- 1997 -

As in 1996, fecal coliforms and *E.coli* were not monitored (Table 25). In 1997, the only data that were collected from the Similkameen River was that for dissolved oxygen, whereas a larger amount of data was collected for the Hedley Creek system. The only objective not met in this region in 1997 was total lead in Hedley Creek.

⇒ The water quality index could not be calculated for the Similkameen River, but was found to be good (index = 15) for Hedley Creek. This is virtually the same result (index = 13), as was calculated for the period from 1990 to 1993.

We recommend continued monitoring of fecal coliforms to track attainment of objectives.

Cahill Creek

Cahill Creek, its tributaries (Nickel Plate Mine Creek and Sunset Creek), and a parallel stream (Red Top Gulch Creek) enter the Similkameen River near Hedley (Figure 10). Fish from the Similkameen River use the creek near its mouth and the water is also used for irrigation. This watershed is the site of a gold mine and mill which began operating in 1987. Monitoring to check objectives began the same year, with water quality for 1987 to 1993 being rated as good (index =13).

Table 10 lists results in 1996, Table 26 presents results in 1997, and Figure 10 shows site locations.

- 1996 -

Objectives not met in 1996 included turbidity, dissolved solids, sulphate, cyanide (weak-acid dissociable), and nitrate (Table 10). Among objectives met were those for cyanide, ammonia, pH, and dissolved iron.

⇒ In 1996, the water quality index gave a ranking of fair (index = 21) for Cahill Creek, fair (index = 21) for Sunset Creek, borderline (index = 58) for Nickel Plate Mine Creek, and fair (index = 33) for Red Top Gulch Creek. Rankings for all these sites had been rated as good for the period from 1987 to 1993.

- 1997 -

Objectives not met in 1997 included turbidity, dissolved solids, sulphate, cyanide (weak-acid dissociable at the Nickel Plate Mine Creek site), and nitrate. The objectives that met water quality objectives included ammonia, pH, total aluminum, total cadmium and total molybdenum.

⇒ In 1997, the water quality index gave a ranking of fair (index = 23) for Cahill Creek, fair (index = 22) for Sunset Creek, poor (index = 70) for Nickel Plate Mine Creek, and fair (index = 36) for Red Top Gulch Creek. The index values are lower than in 1996, and as compared to the values initially reported in 1993.

We recommend continuing routine monitoring to check objectives while work proceeds to improve the mine operation.

Bessette Creek

Bessette Creek, which flows into the Shuswap River, is formed by the confluence of Harris and Duteau creeks near the town of Lumby (Figure 11). Lawson Creek, and its tributary Spider Creek, flow into Duteau Creek. These creeks provide spawning habitat for trout and four species of salmon. Activities that can affect water quality include a telephone pole treatment plant near Harris Creek, a wood-waste landfill along Duteau Creek, and agricultural operations in the area generally. Based on data from1990 to 1993, water quality was rated as fair for Bessette Creek (index = 33), Lawson Creek (index = 40), and Spider Creek (index = 40), but good in Harris Creek (index = 17).

Table 11 lists results in 1996, Table 27 presents results in 1997, and Figure 11 shows site locations.

- 1996 -

Objectives not met at times in 1996 included those for microbiological indicators (fecal coliforms, *E.coli*), dissolved solids, and colour (Table 11). The objectives that were met included those for suspended solids, turbidity, nitrate, pH, and resin acids.

⇒ In 1996, the water quality index gave a ranking of fair (index = 29) for Bessette Creek, fair (index = 42) for Lawson Creek and fair (index = 22) for Spider Creek.

- 1997 -

Objectives were not met in 1997 for fecal coliforms, enterococci, and turbidity (Table 27). The objectives that were met included *E.coli*, dissolved solids, nitrate, pH, and tetra and penta chlorophenols.

⇒ In 1997, the water quality index ranked both Bessette Creek (index = 30) and Harris Creek (index = 18) as fair.

Continued monitoring is recommended as measures to improve water quality are carried out.

Tributaries to Okanagan Lake near Westbank

We set objectives for Peachland, Trepanier, and Westbank creeks, which flow into Okanagan Lake in the Peachland-Westbank area. Peachland and Trepanier creeks support spawning populations of kokanee or trout, and all three creeks are used for irrigation and domestic water supplies. Peachland and Trepanier creeks can be affected by seepage from a molybdenum mine which closed recently. Westbank Creek is now influenced by urban runoff and agriculture.

The objectives have been checked for three years with results showing generally good water quality, with water quality rating of fair to good. Further monitoring was considered a low priority and was discontinued in 1994.

Since that time, concerns have been raised about possible discharges from the closed Brenda Mines Operations. Hearings of the Environmental Appeal Board have resulted in the region re-assessing current objectives for Trepanier Creek.

Tributaries to Okanagan Lake near Kelowna

Mission, Kelowna, and Brandt's creeks are tributaries to Okanagan Lake on its east shore near Kelowna. Mission and Kelowna creeks support salmonids and the water is also used for irrigation and domestic supply. Brandt's Creek is used mainly for irrigation. The creeks can be affected by urban storm-water runoff in their lower reaches and by logging or agriculture further upstream. Treated wastewater is discharged to Brandt's Creek.

The objectives were last checked in 1994. Then, as in previous years, the objectives for bacteriological indicators (fecal coliforms, *E.coli*, and enterococci) were generally not met. Continued monitoring will depend on action taken in the future to control storm-water and other diffuse sources of contamination.

Tributaries to Okanagan Lake near Vernon

Lower Vernon Creek and Deep Creek are tributaries to Okanagan Lake at its north end (Figure 12). The water is used for domestic and irrigation purposes and has some fisheries values, especially in lower Vernon Creek. Potential sources of contamination are a municipal sewage discharge, agricultural operations, and groundwater affected by spray irrigation of treated sewage.

Table 12 lists results in 1996. Objectives were not monitored in 1997. Figure 12 shows the various site locations.

- 1996 -

In 1996, our fourth year of monitoring to check objectives, those not met at times were objectives for suspended solids and turbidity (Table 12). In addition, objectives for fecal coliforms, and *E.coli* were not met on the Lower Vernon Creek (at Okanagan Lake outlet). Among the objectives met were those for ammonia, chlorophyll-a, and pH.

> ⇒ The water quality index rated the Lower Vernon Creek (index = 29) and Deep Creek (index = 20) as fair, due mainly to high fecal coliform levels.

- 1997 -

No monitoring was conducted in this basin in 1997.

Further monitoring of these creeks should be considered as measures to improve water quality are carried out.

Hydraulic Creek

Hydraulic Creek flows into Okanagan Lake via Mission Creek about 10 km upstream from the lake. Hydraulic Creek is an important source of drinking water relying on disinfection only. The creek

also supports a recreational fishery and is used for irrigation. Commercial logging in the watershed can affect these water uses.
Monitoring between 1991 and 1993 to check objectives showed that fecal coliform contamination was the main problem, with at water quality rating of fair (index =35). Monitoring was discontinued in 1994 as results were fairly predictable.

Thompson River

We set objectives in 1992 for the South Thompson which drains Little Shuswap Lake, the North Thompson which joins the South Thompson at Kamloops, Kamloops Lake, and the lower Thompson which is a major tributary to the Fraser River (Figure 13). This river system is very important for fish, especially salmon and trout. It is used extensively for recreation and is also a source of water for drinking, irrigation, and industrial use.

Between the North Thompson River and Kamloops Lake, the river receives treated effluents from a bleached kraft pulp mill and the from the City of Kamloops. There are also diffuse discharges from agriculture and forestry. All these discharges can affect Kamloops Lake and the Thompson River downstream.

Table 13 lists results in 1996, Table 28 presents results in 1997, and Figure 13 shows site locations.

- 1996 -
The majority of objectives that were checked met the objectives in 1996, and included those for colour, and resin acids (Table 13). However, the dioxin and furan objectives in sediments were not met.

⇒ The water quality index gave a ranking of good (index = 10) for the lower Thompson River in 1996, due to the objective for dioxin and furan in sediments not being met.

- 1997 -
As in 1996, all the objectives that were tested were met, including those for colour and resin acids (Table 28). The dioxin and furan levels in sediments were not monitored in 1997.

⇒ In 1997 the water quality index gave a ranking of excellent (index = 0) for the lower Thompson River.

We recommend continued monitoring to check Thompson River objectives.

Christina Lake

Christina Lake, located in south central B.C., drains into the Kettle River which joins the Columbia River in Washington State. The lake is important for recreation, domestic water supply and sport fish. The potential sources of contamination are residential development, agriculture, and logging.

Objectives were not checked in 1995. Objectives were checked for the first time in 1994 and those not met included objectives for phytoplankton distribution, periphyton distribution, dissolved oxygen, and periphyton chlorophyll-a.

We recommend resuming sampling until objectives have been checked for at least two more years to obtain a reasonable data base.

KOOTENAY REGION

Columbia and Windermere Lakes

The two lakes are important for fisheries, recreation, and as a source of drinking water. Residential development around the lakes is the main potential influence on water quality.

We monitored to check objectives between 1987 and 1992. Since the objectives have been met fairly consistently, with a water quality rating of good (index = 5 for Columbia Lake and 4 for Windermere Lake), monitoring was discontinued in 1993.

Toby Creek and Upper Columbia River

Toby Creek enters the Upper Columbia River just downstream from Windermere Lake. Both streams are important for aquatic life and recreation. Toby Creek can be affected by indirect discharges of domestic sewage and by drainage from an abandoned mine. The Upper Columbia River receives an indirect discharge of treated sewage from Radium Hot Springs.

All objectives have generally been met except, on occasion, those for fecal coliforms. We did not monitor after 1989 in Toby Creek and 1992 in the Upper Columbia River. We consider future monitoring a low priority at this time.

Columbia River from Keenleyside to Birchbank

The Columbia River is one of the major rivers in British Columbia and in Washington State further downstream (Figure 14). In B.C., this section of the river is important for aquatic life, sport fishing, recreation and, to a lesser extent, as a drinking water supply. In the U.S., it supports a food fishery, major salmon runs, and irrigation and drinking water supplies. Between the Hugh Keenleyside Dam and Birchbank, the main influence is a kraft pulp mill which recently expanded production and upgraded its effluent treatment to secondary. There are also small discharges of secondary-treated municipal effluent and urban runoff. Water quality was rated as fair (index = 35), but appears to be improving based on data review from 1991 to 1993.

Table 14 lists results in 1996, Table 29 presents results in 1997, and Figure 14 shows site locations.

- 1996 -

The objectives for this section of the Columbia River were generally met, with the exception of dissolved gasses and dioxin/furan levels in fish (Table 14). The dioxin and furan objective to protect aquatic life against chronic effects was not met in three out of the four fish sampled. In addition, one of these fish failed the criterion for human consumption. However, it should be noted that the age of this fish (thirteen years) suggests that the bulk of the dioxin/furan levels may have bio-accumulated in the sample prior to recent improved changes in the pulp and paper industry. Preliminary fish samples from 1998 shows that levels of dioxins and furans have dropped well below water quality objectives, suggesting that this high sample was not representative of this section of the Columbia River. Objectives met in 1996 included those for pH, colour, suspended solids, turbidity, and resin acids.

⇒ The water quality index gave a rating of fair (index = 25) for this section of the Columbia River in 1996, mainly due to the objectives for dissolved gases not being met. This is an improvement over the ranking from 1991 to 1993.

- 1997 -

As in 1996, most objectives that were checked, were met with the exception of dissolved gases (Table 29). The monitoring of the Columbia River was significantly reduced (only 35% of objectives were sampled), meaning that the data presented in this report may not be representative of the river basin in 1997. The objectives that were met in 1997 included pH, colour and fecal coliforms.

⇒ The water quality index was found to be fair (index = 24) for this section of the Columbia River (however, due to the limited data the index gives only a rough overview).

Considering the international significance of the river and its importance to aquatic life, continued monitoring to check the attainment of objectives is recommended.

Elk River

The Elk River and its main tributaries, the Fording River, Line Creek and Michel Creek, are located in the south-eastern part of the province. The Elk River is a tributary to Lake Koocanusa on the east side. We have set provisional objectives for suspended solids and substrate sedimentation to protect aquatic life against the potential effects of coal mining operations in the basin.

The objectives for suspended solids apply to base flow, or the non-freshet period, in the Elk River basin. They were generally met at all sites in 1993. Further monitoring to check these objectives was considered a low priority.

LOWER MAINLAND REGION

Fraser River from Hope to Kanaka Creek

We have set objectives for the Fraser River between Hope and Kanaka Creek, for tributaries entering from the south, and for all major water courses between the Fraser River and the International Border. The Fraser River is a major salmon migration route and the tributaries are important spawning areas. The major discharges to the Fraser River in this section are of treated municipal sewage.

Monitoring to check objectives was carried out in 1987, 1988, 1990, 1992, and 1993. The objectives were updated in 1998 and we recommend checking the revised objectives when they are finalized. Overall water quality was rated as good (index = 7).

Fraser River from Kanaka Creek to the Mouth

The river downstream from Kanaka Creek and the outer estuary are very important for salmon migration and rearing (Figure 15). The water is used for irrigation and certain beaches are heavily used for recreation. Water quality can be affected by industry, treated sewage, and agriculture.

Water quality was rated as good (index = 4), in the Main Stem, fair (index = 28), in the Main Arm, and fair (index = 18), in the North Arm.

We have monitored to check objectives annually since 1987. Due to the provincial importance of this river and the threats to water quality that exist in this section, we recommend that such monitoring be continued annually. Updated objectives were released in 1998.

Table 15 lists results in 1996, Table 30 presents results in 1997, and Figure 15 shows site locations.

- 1996 -

The only objective not met in this section of the Fraser River was the one for fecal coliforms in the Main Arm in 1996 (Table 15). This result continues a negative trend which saw the same outcome in 1995. Objectives met included those for fecal coliforms at all bathing beaches, ammonia, dissolved oxygen, and pH.

⇒ In 1996, the water quality index gave a ranking of fair (index = 21) for the Main Arm, fair (index = 23) for the Main Stem and excellent (index = 0) for the North Arm, Middle Arm, and Tsawwassen Beach. The major influence was high levels of fecal coliforms in the Main Arm, and high total copper levels in the Main Stem.

- 1997 -

As in 1996, the only objective that was not met in this section of the Fraser River was the one for fecal coliforms in the Main Arm (Table 30). The objectives that were met in 1997 included those for fecal coliforms at all bathing beaches, ammonia, dissolved oxygen, pH, and metals (copper, lead and zinc).

⇒ In 1997, the water quality index gave a ranking of good (index = 5) for the Main Arm and excellent (index = 0) for Tsawwassen Beach. The major influence was high levels of fecal coliforms in the Main Arm.

While these results indicate an improvement in water quality compared to previous years, we cannot be certain they are truly representative because monitoring was incomplete.

Boundary Bay

Boundary Bay sustains a crab and herring fishery and is important for recreation. The Little Campbell River, the Serpentine River, and the Nicomekl River are tributaries to Boundary Bay on the east side. They provide important habitat for trout and salmon and are used for irrigation. The main influences on water quality are from sewage pumping stations, storm-water, and septic tanks in Boundary Bay and from agriculture in the tributaries.

Objectives were checked from 1988 to 1993 giving consistent results, with a water quality rating of fair (index = 40). Since the situation is stable and fairly well documented, further monitoring was considered a low priority except where required at bathing beaches for human health reasons.

Burrard Inlet

Burrard Inlet includes Port Moody Arm, Indian Arm, Vancouver Harbour, False Creek, and English Bay (Figure 16). The water is designated for aquatic life and wildlife in all areas and for primary-contact recreation in most areas, except in False Creek. There are several municipal and industrial discharges to Burrard Inlet which can affect water quality. These include primary-treated sewage, combined sewer overflows, storm-water, bulk-loading terminals, a sugar refinery, a sodium chlorate plant, a chlor-alkali plant, and oil depots. Water quality was ranked as fair in Port Moody Arm (index = 40), Indian Arm (index = 18), Second Narrows to Roche Point (index = 31), First to Second Narrows (index = 42), and outer Burrard Inlet (index = 20), but borderline in False Creek (index = 44).

Table 16 lists results in 1996, Table 31 presents results in 1997, and Figure 16 shows site locations.

- 1996 -

The only objective checked was the one for fecal coliforms at bathing beaches (Table 16). This objective was not met at times at Deep Cove, Cates Park, and Brockton Point (Table 15).

⇒ Since only one objective was checked in 1996, there was insufficient data to calculate the water quality index.

- 1997 -

The only objective checked in 1997 was for fecal coliforms at bathing beaches (Table 31). Fecal coliforms were not met at times at Deep Cove and Brockton Point.

⇒ As only one objective was checked in 1997, there was insufficient data to calculate the water quality index.

In the past, objectives have not been met for a number of other variables, including metals in sediments, phenol in water, and PCBs and PAHs in sediments. Considering the importance of Burrard Inlet and the number of instances that objectives have not been met, we recommend continued monitoring to check all objectives.

Burrard Inlet Tributaries

We have set objectives for the following three tributaries to Burrard Inlet: School House Brook, which discharges to Port Moody Arm and could be influenced by a chemical polymer plant, Lynn Creek, which discharges to Vancouver Harbour and could be affected by a municipal landfill, and the

Capilano River, which discharges to outer Burrard Inlet and may also be affected by a municipal landfill. The main uses of these tributaries are recreation, aquatic life, and wildlife.

The water quality objectives were not checked in 1995. In 1994, objectives were not met at times for phenols, water temperature, chromium, iron, zinc, and chlorophenols in water. Water quality was ranked as fair in School House Brook (index = 38), good in Lynn Creek (index = 12), and good in the Capilano River (index = 16).

Although we have data for four years, we recommend resuming monitoring because the past record is rather incomplete.

North Shore Lower Fraser Tributaries

Objectives have been set for the following four tributaries to the north shore of the lower Fraser River in the Lower Mainland: Kanaka Creek, the Pitt River, the Coquitlam River, and the Brunette River. All these streams, and their tributary streams and lakes, support salmon and trout fisheries to varying degrees. Most are important for recreation and some are sources of drinking water requiring treatment. Discharges which can affect water quality include storm-water, agricultural runoff, treated sewage, landfill leachates, wastewaters from gravel operations, and a wood preservation plant.

Objectives were not checked in 1995 or 1994. Monitoring from 1990 to 1993 gave fairly consistent results, and we consider future monitoring to be a relatively low priority until some of the water quality problems, caused mainly by non-point sources, are addressed. Water quality was ranked as fair in Kanaka Creek (index = 41), good in the Pitt River (index = 16), and Pitt Lake (index = 4), fair in the Alouette (index = 24) and North Alouette (index = 22) rivers, and excellent (index = 3) in Alouette Lake. Coquitlam River water quality was ranked as fair (index = 34), while the Brunette River was good (index = 14).

Pender Harbour

Pender Harbour, a small coastal inlet on the Sechelt Peninsula, is important for recreational boating and fishing. It also supports commercial fishing and some commercial shellfish harvesting. The main influences on water quality are from diffuse sources such as septic tanks, some agriculture, and sewage discharges from boats.

Objectives were not checked in 1995. In 1994, the third year of monitoring, objectives were often not met for copper, lead, and zinc in both water and sediments and for iron in water. Objectives for tri-butyl tin in water and PAHs in sediments were also not met. These results were similar to those of past years. Since the situation is stable and reasonably well defined, monitoring is a lower priority in the immediate future.

Sechelt Inlet

Sechelt Inlet is located on the mainland coast about 80 km northwest of Vancouver. It is important for fisheries, especially fish farming, and recreation and has potential for shellfish harvesting. Potential sources of contamination include residential development, marinas, logging and minor discharges from gravel washing, a fish hatchery, and mariculture.

Objectives were not checked in 1995. Monitoring for the second time in 1994 showed that objectives for suspended solids, copper, lead, and zinc were not met at times, mostly near a dock in Porpoise Bay at the south end of the inlet.

We recommend continuing the program for at least one more year to obtain a reasonable data base.

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