

**THE 1998 SUMMER WATER TEMPERATURE
AND FLOW MANAGEMENT PROJECT**

*NECHAKO FISHERIES CONSERVATION PROGRAM
Technical Report No. RM98-1*

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ABSTRACT

The 1998 Nechako River Summer Water Temperature and Flow Management Project (the Project) was undertaken to attempt to prevent mean daily water temperatures in the Nechako River above the Stuart River confluence (at Finmoore) from exceeding 20.0°C (68.0°F) between July 15 to August 20. This water temperature control period is typically from July 20 to August 20. However, following a request by the Department of Fisheries and Oceans and the Nechako Fisheries Conservation Program Technical Committee in response to an earlier than normal sockeye migration, the Project was initiated early, and started on July 6. Water temperatures were managed by regulating Skins Lake Spillway releases to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof. In 1998, mean daily water temperatures in the Nechako River above Stuart River exceeded 20.0°C (68.0°F) on ten days (July 26 to August 4) during July 15 to August 20, with a maximum mean daily temperature of 21.8°C (71.2°F) recorded on July 31. During the period of July 26 to August 4, flow in the Nechako River below Cheslatta Falls was at or near the maximum allowable level of 283 m³/s (10,000 cfs), and thus no further action could be taken.

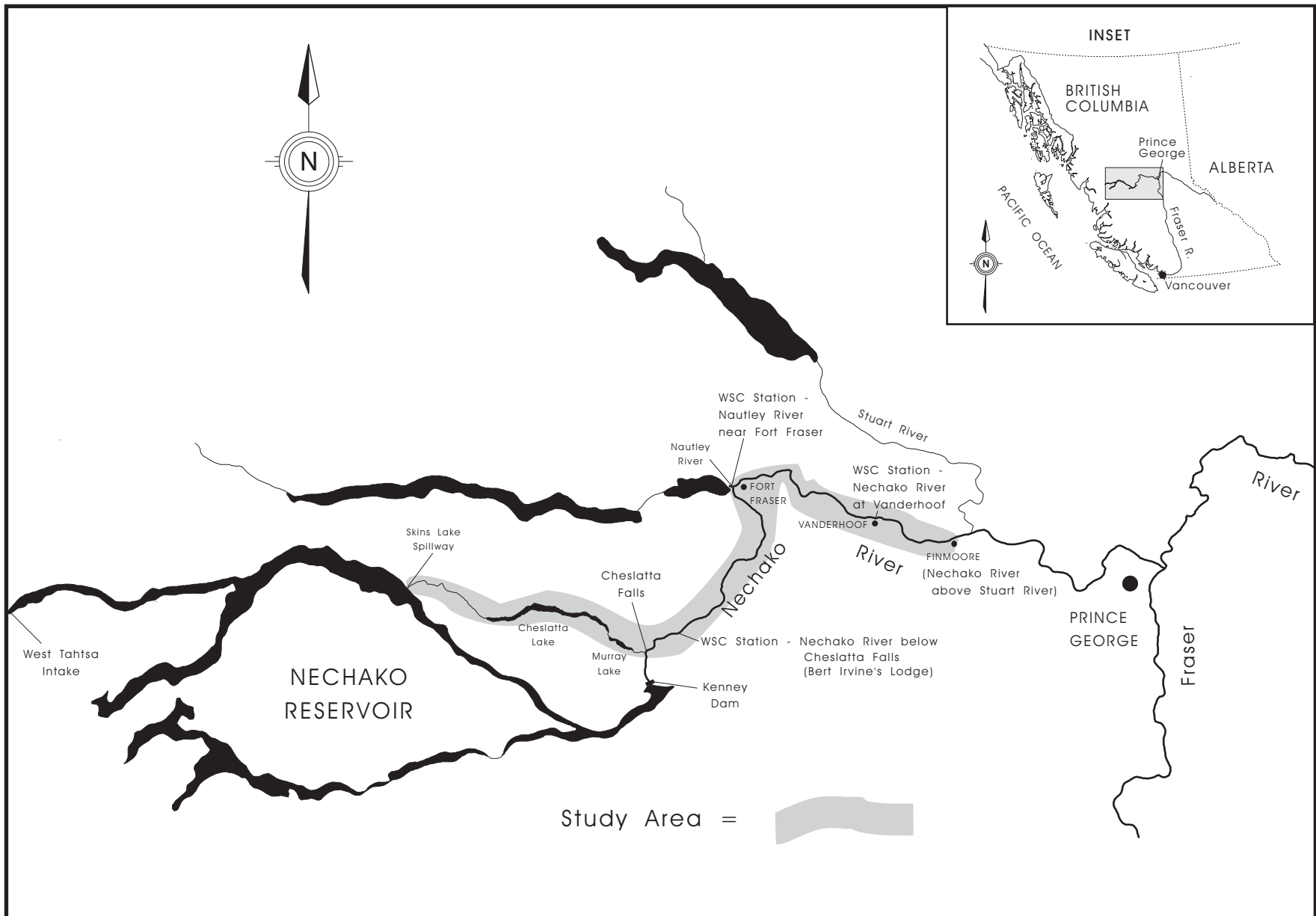
The total volume of water released was 9,801.7 m³/s-d (346,144 cfs-d) and the average release was 213.1 m³/s (7,525 cfs) over the duration of the 1998 Summer Water Temperature and Flow Management Project (July 6 to August 20).

INTRODUCTION

Control of the Nechako River water temperature for protection of fish resources is a concern of both government agencies and Alcan Smelters and Chemicals Ltd. Each summer between 1981 and 1984, Alcan, Triton Environmental Consultants Ltd. (Triton, formerly Envirocon Pacific Ltd.), and the Department of Fisheries and Oceans (DFO) undertook a joint water temperature monitoring and control project. In 1985, no water temperature monitoring and control project was implemented as Alcan maintained a constant Skins Lake Spillway (SLS) release of 283 m³/s (10,000 cfs) providing the maximum allowable flow in the Nechako River below Cheslatta Falls for the entire period of concern. In 1986 and 1987, an independent water temperature and flow management project similar to the one used during the summer of 1984 (Envirocon 1985) was carried out. Since 1988, similar water temperature and flow management projects (Triton 1995a through 1995h, Triton 1996, Triton 1997) have been carried out under the auspices of the Nechako Fisheries Conservation Program (NFCP).

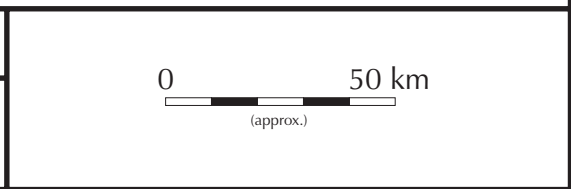
The Nechako River Summer Water Temperature and Flow Management Project (the Project) currently in place was designed and developed in 1982 and has been successfully implemented since 1983. The objective of the Project is to attempt to prevent mean daily water tem-

peratures in the Nechako River above the Stuart River confluence (at Finmoore) from exceeding 20.0°C (68.0°F). This objective is met by regulating releases from the Skins Lake Spillway to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof. The project typically operates from July 10 to August 20 (the operational period) with the goal of managing water temperatures in the Nechako River at Finmoore between July 20 and August 20 (the water temperature control period, hereafter referred to as the control period). However, based on a request by the DFO and the NFCP Technical Committee in response to an earlier than normal sockeye migration, the Project was initiated early, commencing on July 6. As such, the operational period and the control period for the 1998 Project are July 6 to August 20, and July 15 to August 20, respectively. Flows in the Nechako River at Cheslatta Falls are also to be reduced to fall spawning flows by early September. These dates may vary as directed by the NFCP in accordance with the timing of sockeye runs in the system as was the case this year. The Project study area is shown in Figure 1. Unless otherwise stated, references to water temperatures, flows (including releases) and meteorological data are mean daily values, and the location of the Nechako River above the Stuart River confluence refers to the Nechako River at Finmoore.



Nechako Fisheries Conservation Program Map # RM98-1-1

FIGURE 1. NECHAKO RIVER STUDY AREA



This report reviews the 1998 Summer Water Temperature and Flow Management Project and includes an outline of Triton's method for determining Skins Lake Spillway releases, a summary of Triton's 1998 Skins Lake Spillway release recommendations for the period July 6 to September 6 inclusively, and a summary of observed flows (July 6 to September 6) and water temperatures (July 6 to August 20) at various locations along the Nechako River. Also discussed is the volume of cooling water used in the 1998 Summer Water Temperature and Flow Management Project.

METHODS

The management of the Nechako River flows and water temperatures was accomplished using water temperature predictions based on five-day meteorological forecasts to determine the schedule of Skins Lake Spillway releases required to meet the project's objectives. The Summer Water Temperature and Flow Management Project uses an unsteady-state flow routing model and an unsteady-state water temperature prediction model designed to compute the conditions in the Nechako River defined by the meteorological conditions. Numerical modelling of flows and water temperatures in the Nechako River was performed daily during the entire operational period.

Daily operations followed the protocol defined in the Settlement Agreement (Anon. 1987), and involved collection of water temperature and river stage data from several locations in the study area, and development of five-day meteorological forecasts. Water temperatures were obtained daily from recorders maintained in the Nechako River below Cheslatta Falls (at Bert Irvine's Lodge), in the Nechako River at Fort Fraser (upstream of the Nautley River), in the Nechako River above the Stuart River confluence and in the Nautley River. River stages were obtained daily from recorders maintained in the Nechako River below Cheslatta Falls, in the Nechako River at Vanderhoof and from a staff gauge in the Nautley River. Five-day meteorological forecasts were obtained from World Weatherwatch, a subconsultant to Triton.

River stage and minimum and maximum water temperature data were obtained daily by Triton (staff member resident in Vanderhoof) for each location identified except the Nechako River below Cheslatta Falls. Each morning, hourly water temperature and river stage data

recorded by the data collection platform located on the Nechako River below Cheslatta Falls were obtained via computer link to Water Survey of Canada (WSC), Vancouver. In addition, spot and corresponding recorded water temperatures were collected at each location during these daily site visits and used to adjust the recorded water temperatures. The adjustment provided an ongoing check of each thermograph, and was performed in the following manner. If the spot temperature was higher than the thermograph record, the thermograph record was adjusted to agree with the observed spot temperature for that day. If the thermograph record was higher than the spot temperature, the thermograph record was not adjusted. This procedure was implemented as a conservative measure.

Skins Lake Spillway releases reported are as requested by Triton. All Nechako River and Nautley River flow data reported are preliminary data, and are part of the database utilized in the daily operation of the Summer Water Temperature and Flow Management Project. These data are not updated as they were used in real-time modelling of the Nechako River system. Therefore, values presented may differ slightly from those reported by WSC.

The first 10 days of the operational period, from July 6 to July 15, were utilized for system start up, for initialization of the database required to schedule Skins Lake Spillway releases necessary to meet project water temperature objectives during the control period commencing July 16, and to increase flows in the Nechako River from spring flows to the minimum cooling flow of 170 m³/s (6,000 cfs) required below Cheslatta Falls. The 1998 Skins Lake Spillway spring base release, as determined by the NFCP, was 49.0 m³/s (1,730 cfs). Upon commencement of the operational period on July 6, the observed flow in the Nechako River below Cheslatta Falls was 54.3 m³/s (1,918 cfs). On July 6, 1998, the Skins Lake Spillway release was increased from the spring base release to 227 m³/s (8,000 cfs) to ensure that flows in the Nechako River below Cheslatta Falls reached the minimum cooling flow of 170 m³/s (6,000 cfs) by July 16 (the beginning of the water temperature control period).

Throughout the operational period, water temperatures in the Nechako River were calculated daily for the previous day, the current day and each of the next 4 days. These calculations were based on observed and five-day

forecast meteorological data, observed water temperature and computed flow data. Forecast water temperature predictions were tabulated and reviewed daily to identify trends in water temperature changes. These trends are the same as those used in the water temperature and flow management projects since 1984 (Envirocon Ltd. 1985), and are best explained through reference to Table 1. Assuming the current day is July 16, entries corresponding to the current day's operation are represented by the letter c. Entries co and cs represent the observed and calculated water temperatures, respectively, for the previous day (July 15). Entries c1 through c5 represent predicted water temperatures computed using the current day's five-day meteorological forecast and an assumed current day's flow regime. The

entry rc represents the current day Skins Lake Spillway release required to meet project objectives.

The following three trends in water temperature changes were reviewed daily:

1. Observed trend: developed from mean daily water temperatures measured in the Nechako River above the Stuart River confluence each day (bo and co in Table 1). The difference in observed water temperatures for the previous two days is extrapolated over the next 5 days to determine the observed water temperature trend.

Table 1 Daily Operations to Manage Water Temperatures in the Nechako River Above Stuart River										
Date	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul
Fifth Day's Predicted Water Temperature @ Date + 4 Days								a5	b5	c5
Fourth Day's Predicted Water Temperature @ Date + 3 Days							a4	b4	c4	
Third Day's Predicted Water Temperature @ Date + 2 Days						a3	b3	c3		
Second Day's Predicted Water Temperature @ Date + 1 Day					a2	b2	c2			
Current Day's Predicted Water Temperature @ Date				a1	b1	c1				
Previous Day's Calculated Water Temperature @ Date - 1 Day			as	bs	cs					
Previous Day's Observed Water Temperature @ Date - 1 Day			ao	bo	co					
Current Day's Release @ Date				ra	rb	rc				

* the current day (e.g., the day of operation) for this example is July 16.

2. Predicted trend: developed from the predicted water temperatures for the previous day and the following five days (cs,c1,c2,c3,c4,c5, in Table 1). These data represent the predicted trend.
3. Forecast trend: developed from the difference between the current five-day and previous five-day predictions for the same calendar days (c3 and b4, c2 and b3, c1 and b2 in Table 1). Differences between forecasted data on coincident dates for the current day and the next 2 days only are averaged and added to the 5th day predicted temperature to determine the trend in forecasted temperatures.

A numerical example of how the trends are calculated is presented in Appendix A.

Each day predicted water temperatures for the five-day forecast period were checked and the three trends were calculated. If two of the three trends indicated that the water temperature in the Nechako River above Stuart River could potentially exceed 19.4°C (67.0°F) then an increase in the Skins Lake Spillway release was required. When this occurred the current day's release was revised and the flow and temperature models were rerun using the modified flow regime. The results of each day's final computer run were subsequently used to initialize water temperatures for the following day's computations. Entries in Table 1 represent each day's final cooling water release and resultant predicted water temperatures.

The following release criteria were used with the three trends identified above to determine the timing and magnitude of Skins Lake Spillway releases:

1. When two of the three trends show an increase in water temperature in the Nechako River above Stuart River, and these trends show that the water temperature could potentially exceed 19.4°C (67.0°F), increase the Skins Lake Spillway release according to criteria 2 and 3 below.
2. Operate Skins Lake Spillway such that the flow in the Nechako River below Cheslatta Falls ranges between 170 m³/s (6,000 cfs) and 283 m³/s (10,000 cfs) as required, and flow in the Nechako River above Stuart River does not exceed 340 m³/s (12,000 cfs). It is understood

that the flow in the Nechako River below Cheslatta Falls is not to be less than 170 m³/s (6,000 cfs) by the beginning of the control period, and is to be reduced to approximately 31.2 m³/s (1,100 cfs) by September 6.

3. At any time of release, increase Skins Lake Spillway releases from the current level to 453 m³/s (16,000 cfs) to achieve the flow changes in the Nechako River as fast as possible.
4. During cooling periods when two of three trends in forecasted water temperatures are decreasing and these trends indicate that the water temperature could potentially drop below 19.4°C (67.0°F) within the forecast period (5 days), reduce the Skins Lake Spillway release from the current level to 14.2 m³/s (500 cfs).

RESULTS

Predicted and observed mean daily water temperatures for the Nechako River above Stuart River, Skins Lake Spillway releases and changes in Skins Lake Spillway releases over the duration of the Project operational period are summarized in Table 2.

Observed mean daily water temperatures in the Nechako River above Stuart River are tabulated in Table 3 and plotted in Figure 2. The respective maximum and minimum mean daily water temperatures recorded during the control period were 21.8°C (71.2°F) on July 31 and 17.2°C (63.0°F) on August 18. The maximum mean daily water temperature recorded during the operational period was 22.4°C (72.3°F) on July 6. A summary of mean daily water temperatures recorded during the Project in the Nechako River below Cheslatta Falls, near Fort Fraser and above the Stuart River confluence, and in the Nautley River near Fort Fraser is presented in Appendix B.

As outlined in the Methods section, Skins Lake Spillway releases required for water temperature control were regulated during the control period to ensure that flows in the Nechako River below Cheslatta Falls were to range between 170 m³/s (6,000 cfs) and 283 m³/s (10,000 cfs) and that flows at Vanderhoof were not to exceed 340 m³/s (12,000 cfs).

Skins Lake Spillway releases and their corresponding flows in the Nechako River below Cheslatta Falls and

Table 2 (continued)
 Predicted and Observed Mean Daily Water Temperatures in the Nechako River Above Stuart River, July 6 to August 20, 1998

Date	AUGUST																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
5th Day's Predicted Water Temperature at Date + 4 Days	21.1	20.8	20.8	20.8	21.4	20.0	19.8	19.7	19.7	19.2	19.2	18.9	18.9	19.4	19.2	19.4	19.4	19.3	18.8	18.6
4th Day's Predicted Water Temperature at Date + 3 Days	20.5	21.3	21.0	21.8	20.6	19.9	19.5	19.5	19.4	19.0	18.3	18.2	18.8	18.7	19.2	19.7	18.9	18.4	18.3	17.7
3rd Day's Predicted Water Temperature at Date + 2 Days	21.9	21.4	21.8	21.1	20.6	19.8	19.4	19.2	19.0	18.2	17.7	18.5	18.5	19.1	20.2	18.9	17.8	17.8	17.1	17.5
2nd Day's Predicted Water Temperature at Date + 1 Day	22.2	22.0	21.3	21.4	20.5	19.9	19.3	19.0	18.9	17.9	18.6	18.9	19.0	20.3	19.9	18.2	17.9	16.9	17.2	19.3
Current Day's Predicted Water Temperature at Date	22.4	21.3	21.5	20.9	20.4	19.8	19.0	19.2	18.4	18.4	19.2	18.6	19.4	20.3	19.1	18.5	17.5	17.3	18.6	19.3
Previous Day's Calculated Water Temperature at Date - 1 Day	22.1	21.2	21.1	20.8	20.3	19.6	19.0	18.8	18.4	18.6	18.9	18.6	19.4	19.9	19.2	18.4	17.8	17.8	18.6	
Previous Day's Observed Water Temperature at Date - 1 Day	21.3	20.4	20.4	20.2	19.9	19.2	18.8	18.6	18.1	18.3	18.0	18.0	18.8	19.1	18.3	18.0	17.4	17.2	17.7	18.2
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	283	283	283	283	283	283	14.2	14.2	14.2	14.2	170	170	170	453	14.2	170	170	14.2	14.2	14.2
							to				to			to	to		to			
							14.2				170			453	14.2	170		14.2		
							@				@			@	@	@		@		
							1600				800			1600	1600	1600		1600		
							hrs				hrs			hrs	hrs	hrs		hrs		

Table 3
Observed Mean Daily Water Temperatures
in the Nechako River Above Stuart River,
July 6 to August 20, 1998

Date	Water Temperature (°C)	Date	Water Temperature (°C)
06-Jul	22.4	01-Aug	21.3
07-Jul	21.5	02-Aug	20.4
08-Jul	21.3	03-Aug	20.4
09-Jul	21.4	04-Aug	20.2
10-Jul	21.7	05-Aug	19.9
11-Jul	21.0	06-Aug	19.2
12-Jul	19.6	07-Aug	18.8
13-Jul	18.3	08-Aug	18.6
14-Jul	17.8	09-Aug	18.1
15-Jul	18.0	10-Aug	18.3
16-Jul	18.3	11-Aug	18.0
17-Jul	18.3	12-Aug	18.0
18-Jul	18.6	13-Aug	18.8
19-Jul	18.9	14-Aug	19.1
20-Jul	18.7	15-Aug	18.3
21-Jul	18.8	16-Aug	18.0
22-Jul	19.1	17-Aug	17.4
23-Jul	19.6	18-Aug	17.2
24-Jul	19.7	19-Aug	17.7
25-Jul	19.8	20-Aug	18.2
26-Jul	20.1		
27-Jul	20.7		
28-Jul	20.9		
29-Jul	21.3		
30-Jul	21.6		
31-Jul	21.8		

at Vanderhoof are plotted in Figure 3. Daily Skins Lake Spillway releases, Nautley River flows and flows in the Nechako River below Cheslatta Falls and at Vanderhoof are tabulated in Appendix C. A record of Skins Lake Spillway release changes during the Project and their implementation is presented in Table 4.

During the control period, measured flows in the Nechako River below Cheslatta Falls (based on preliminary WSC data from the WSC data collection platform at Bert Irvine's Lodge) ranged between a maximum of 297 m³/s (10,489 cfs) on August 5-6 and a minimum of 138 m³/s (4,873 cfs) on August 20. Flows measured in the Nechako River at Vanderhoof ranged from a maximum of 367 m³/s (12,961 cfs) on August 7 to a minimum of 213 m³/s (7,522 cfs) on August 20. Following

the control period, the mean daily flow in the Nechako River below Cheslatta Falls was reduced to approximately 31.2 m³/s (1,100 cfs) by September 6. The recorded maximum mean daily flow in the Nechako River at Vanderhoof exceeded the previously stated limit for flood control by 8% due to high tributary inflow.

DISCUSSION

The decision criteria used to determine Skins Lake Spillway releases during the 1998 Summer Water Temperature and Flow Management Project were identical to those used during summer water temperature and flow management projects since 1984. The discussion of the 1998 Summer Water Temperature and Flow Management Project has been divided into four sections. The first section reviews the collection and use of observed field data. Variables measured include water temperature, flow, and meteorological data (observed and forecast). The second section discusses occurrences of mean daily water temperatures in excess of 20.0°C (68.0°F) in the Nechako River above the Stuart River confluence. The third section discusses the volume of water used during the 1998 Summer Water Temperature and Flow Management Project. The fourth section discusses instances when judgement was exercised during the application of these criteria. This was based on experience gained in previous years' operation of the Summer Water Temperature and Flow Management Project.

Observed Data

Triton's modelling procedure is based on the premise that the best way to forecast water temperatures is to initialize computations with observed conditions. For this reason, the quality of the field data used in the modelling process directly affects the accuracy of the computed water temperatures. Therefore, data must be collected accurately and consistently to ensure that random errors are kept to a minimum. Consistency in data collection techniques also ensures a constant bias throughout the project.

In 1998, flow data obtained from gauging stations in the Nechako River below Cheslatta Falls, in the Nechako River at Vanderhoof and in the Nautley River near Fort Fraser appeared to be accurate. Flows in the Nechako River below Cheslatta Falls and at Vanderhoof responded as expected in response to Skins Lake Spillway releases. The Nautley River flow regime was below average for the time of year. The ability to obtain hourly stage data from the gauging station located on

Figure 2
Observed Mean Daily Temperatures in the Nechako River Above the Stuart River Confluence,
July 6 to August 20, 1998

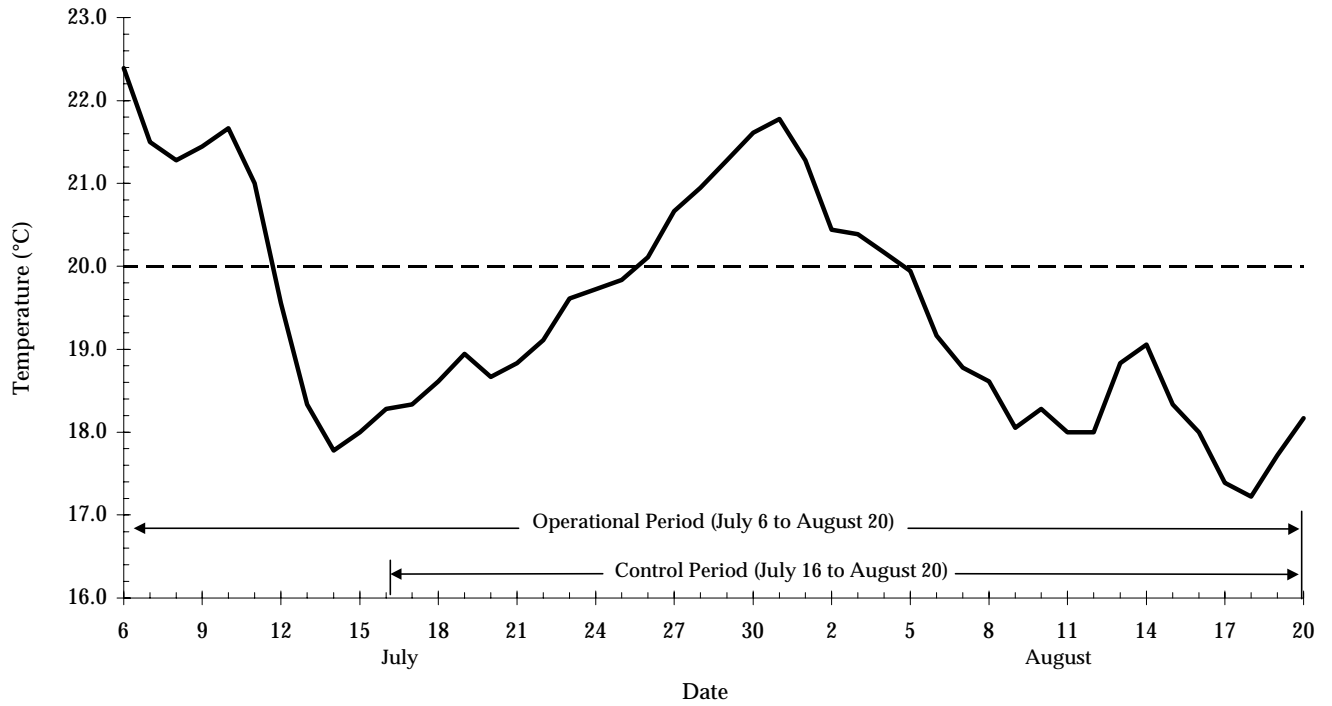


Figure 3
Skins Lake Spillway Release and Flows in the Nechako River Below Cheslatta Falls and at Vanderhoof,
July 6 to September 6, 1998

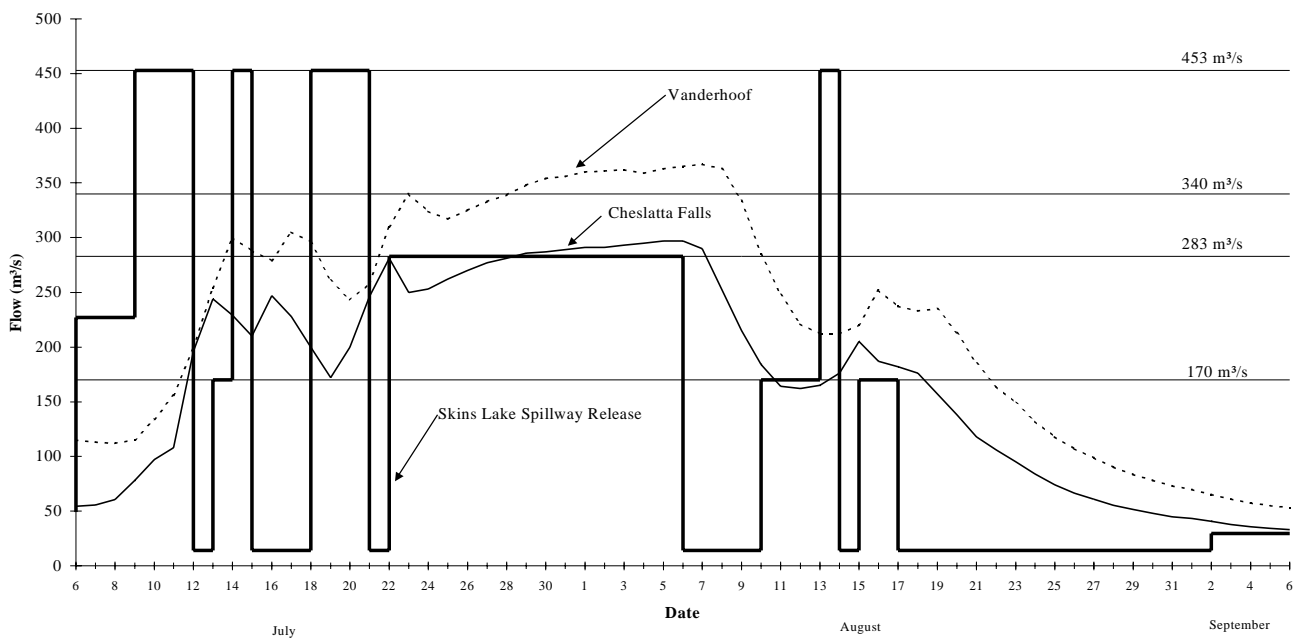


Table 4
Rationale for Skins Lake Spillway Release Changes, July 6 to September 6, 1998

Date 1998	Old Setting (m ³ /s)	New Setting (m ³ /s)	Time of Change (hrs)	Reason for Changing SLS Release Setting
06-Jul	49.0	227	1600	In response to early warm conditions identified in the Nechako River
09-Jul	227	453	1630	In response to a predicted warming trend
12-Jul	453	14.2	1600	In response to a predicted cooling trend
13-Jul	14.2	170	1600	To maintain base flow of 170 m ³ /s
14-Jul	170	453	1600	In response to a predicted warming trend
15-Jul	453	14.2	1600	In response to a predicted cooling trend
18-Jul	14.2	453	1630	In response to a predicted warming trend
21-Jul	453	283	1200	To avoid exceedence of 283 m ³ /s in the Nechako River below Cheslatta Falls
21-Jul	283	14.2	1600	In response to a predicted cooling trend
22-Jul	14.2	283	1600	In response to a predicted warming trend
06-Aug	283	14.2	1600	In response to a predicted cooling trend
10-Aug	14.2	170	0800	To maintain base flow of 170 m ³ /s
13-Aug	170	453	1600	In response to a predicted warming trend
14-Aug	453	14.2	1600	In response to a predicted cooling trend
15-Aug	14.2	170	1600	To maintain base flow of 170 m ³ /s
17-Aug	170	14.2	1600	In response to a predicted cooling trend
02-Sep	14.2	29.5	1600	To achieve spawning flow in the Nechako River below Cheslatta Falls by September 6

the Nechako River below Cheslatta Falls proved very useful to verify the daily predictions of the flow model and to account for changes in the local inflow to the Cheslatta/Murray Lakes system.

As previously stated, spot and corresponding recorder (thermograph) water temperatures were collected in the Nechako River at Fort Fraser (upstream of the Nautley River), in the Nechako River above the Stuart River confluence and in the Nautley River during each site visit. The thermograph water temperatures were not consistently higher or lower than their associated spot temperatures. These data were used to adjust water temperatures and the method applied was that outlined in the Methods section of this report.

Observed and forecasted meteorological data were obtained daily from World Weatherwatch, a subconsultant to Triton. These forecasted weather data were developed from observed weather data acquired from the Atmospheric Environmental Service (AES) station at Prince George Airport and from the meteorological monitoring station installed by Triton at Fort Fraser. The observed and forecasted weather data were used to estimate water temperatures in the Nechako River below Cheslatta Falls and in the Nautley River for the current day and the following four days. A list of the observed and forecasted meteorological data is provided in Appendix D.

Occurrences of Water Temperatures in the Nechako River above Stuart River Exceeding Water Temperature Criterion

Mean daily water temperatures in the Nechako River above the Stuart River confluence exceeded 20.0°C (68.0°F) on ten days (July 26 to August 4) during the control period, with a maximum mean daily temperature of 21.8°C (71.2 °F) recorded on July 31. During this period, flow in the Nechako River below Cheslatta Falls was at or near the maximum allowable level of 283 m³/s (10,000 cfs), and thus no further action could be taken. Prior to the water temperature control period, mean daily water temperatures in the Nechako River above Stuart River exceeded 20.0°C (68.0°F) on six days.

Volume of Water Used

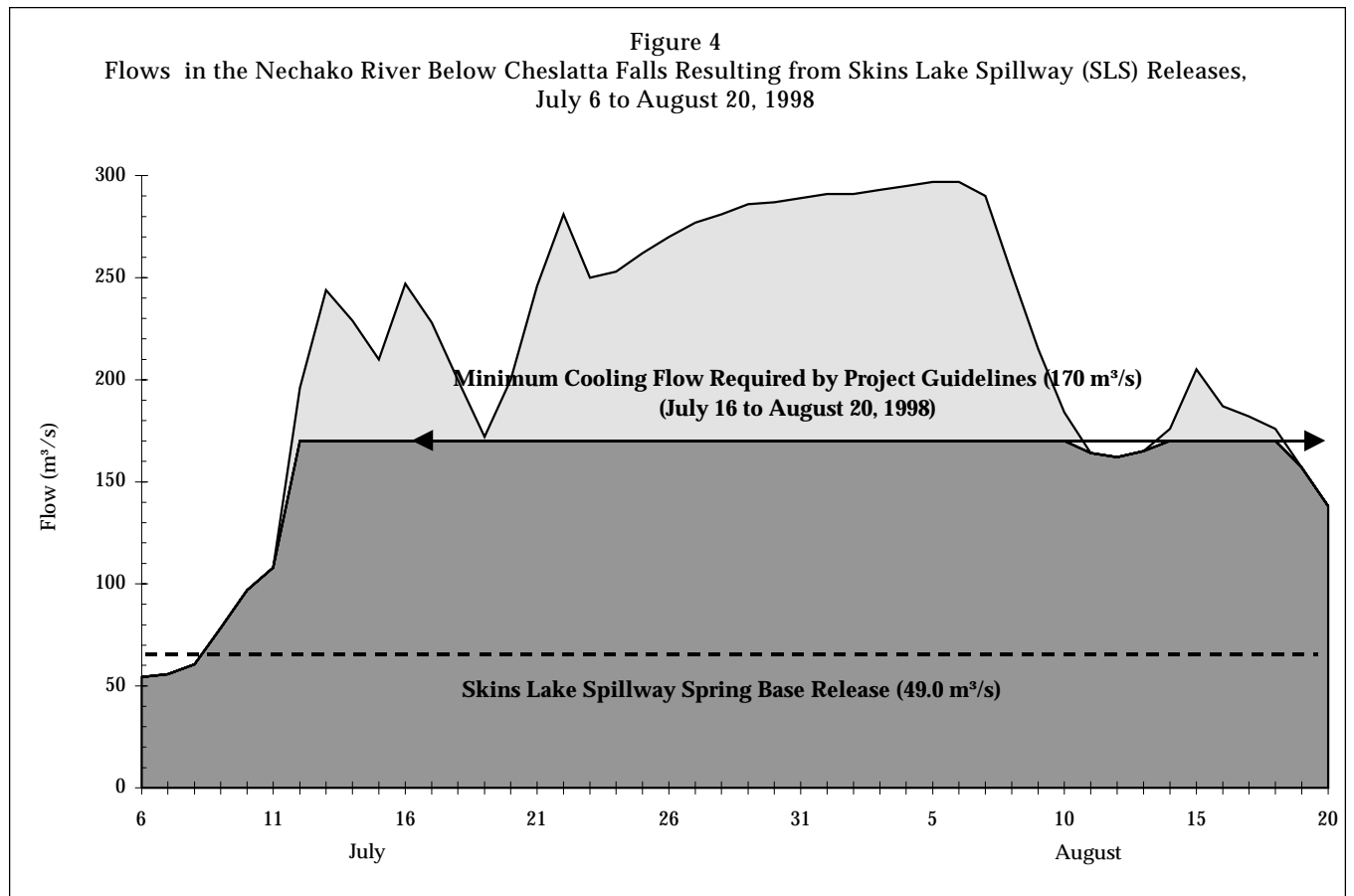
Figure 4 presents the observed flows in the Nechako River below Cheslatta Falls for the 1998 Summer Water Temperature and Flow Management Project. Also indicated are the minimum cooling flow of 170 m³/s (6,000 cfs) in the Nechako River below Cheslatta Falls, and the Skins Lake Spillway release of 49.0 m³/s (1,730 cfs) as determined by the NFCP Technical Committee as part

of the “Annual Water Allocation” defined in the Settlement Agreement. Skins Lake Spillway releases in excess of 49.0 m³/s (1,730 cfs) are considered releases used for cooling purposes.

The total volume of water released during the 1998 Summer Water Temperature and Flow Management Project operational period was 9,801.7 m³s-d (346,144 cfs-d). The volume released for cooling purposes was 7,547.7 m³s-d (266,545 cfs-d), and is based on an assumed Skins Lake Spillway release of 49.0 m³/s (1,730 cfs) for the period of July 6 to August 20, inclusively. The average release during the operational period was 213.1 m³/s (7,525 cfs). Volume calculations are presented in Appendix E.

Application of the Summer Water Temperature and Flow Management Project Release Criteria

The Summer Water Temperature and Flow Management Project is very sensitive to the accuracy of meteorological forecasting. If an increase or decrease in temperature occurs over a prolonged period of time (3 or 4 days), inaccurate meteorological forecasts may predict the wrong temperature. In these instances, it may be re-



quired to exercise judgement when applying the release criteria used with the three water temperature trends. Experience gained in the operation of the Summer Water Temperature and Flow Management Project since 1984 has helped to develop the judgement required to make exceptions to the release criteria during such events, and this has proven beneficial in the management of downstream water temperatures.

There were two occasions during the operational period when judgement was applied and exceptions to the release criteria were made. These occurred when meteorological forecasts and/or the three water temperature trends did not clearly indicate which Skins Lake Spillway release should be implemented.

The first exception occurred on July 13, when two of three water temperature trends indicated that the water temperature could exceed 19.4°C (67.0°F) in the Nechako River above the Stuart River confluence within the forecast period (5 days). The predicted trend and the forecasted trend showed that the water temperature could reach 19.9°C (67.8°F) and 19.5°C (67.1°F), respectively. The remaining trend, the observed trend, indicated that the water temperature could drop to 12.3°C (54.2°F). Following the release criteria under these conditions, the release from Skins Lake Spillway should have been increased from the current release of 170 m³/s (6,000 cfs) to 453 m³/s (16,000 cfs). However, the observed temperature was down significantly and there was no indication of a strong warming trend forming. Based on these considerations and to allow for a clear temperature trend to materialize, it was decided to maintain the Skins Lake Spillway release at 170 m³/s (6,000 cfs).

The second exception occurred on August 2, when one of three water temperature trends (forecast trend) indicated that the water temperature could exceed 19.4°C (67.0°F) in the Nechako River above the Stuart River confluence within the forecast period (5 days). The remaining two trends showed that the water temperature could either reach 19.3°C (66.8°F) or 18.8°C (65.8°F). Following the release criteria under these conditions, the release from Skins Lake Spillway should have been decreased from the current release of 283 m³/s (10,000 cfs) to 14.2 m³/s (500 cfs). However, there was only an indication of a cooling trend forming. Therefore, as a conservative measure, it was decided to maintain the Skins Lake Spillway release at 283 m³/s (10,000 cfs) until a cooling trend was clearly established.

REFERENCES

- Envirocon Limited. 1985. Review of the 1984 Nechako River Hydrothermal Monitoring and Control Program. Technical Memorandum 1941/C. Chapter 2.0, Methods. Prepared for Alcan Smelters and Chemicals Ltd.*
- Anon. 1987. The 1987 Settlement Agreement between Alcan Aluminium Ltd. and Her Majesty the Queen in Right of Canada, represented by the Minister of Fisheries and Oceans, and her Majesty the Queen in Right of the Province of British Columbia, represented by the Ministry of Energy, Mines and Petroleum Resources.*
- Triton Environmental Consultants Ltd. 1995a. The 1988 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM88-5.*
- Triton Environmental Consultants Ltd. 1995b. The 1989 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM89-2.*
- Triton Environmental Consultants Ltd. 1995c. The 1990 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM90-2.*
- Triton Environmental Consultants Ltd. 1995d. The 1991 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM91-2.*
- Triton Environmental Consultants Ltd. 1995e. The 1992 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM92-2.*
- Triton Environmental Consultants Ltd. 1995f. The 1993 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM93-2.*
- Triton Environmental Consultants Ltd. 1995g. The 1994 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM94-1.*
- Triton Environmental Consultants Ltd. 1995h. The 1995 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM95-2.*
- Triton Environmental Consultants Ltd. 1996. The 1996 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM96-1.*
- Triton Environmental Consultants Ltd. 1997. The 1997 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM97-1.*
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Appendix A

Numerical Example of Water Temperature Trend Calculation

APPENDIX A
Numerical Example of Water Temperature Trend Calculation

From data for July 16 date of operation (Table A1).

1. Observed Trend

The observed trend is up by 0.2°C from 17.8°C (J14) to 18.0°C (J15). Take the previous day's observed temperature 18.0°C (J15) and extrapolate the trend for 5 days at $+0.2^{\circ}\text{C}$.

The observed trend shows that the water temperature could potentially reach $18.0^{\circ}\text{C} + 5(+0.2^{\circ}\text{C}) = 19.0^{\circ}\text{C}$.

2. Predicted Trend

The predicted trend is the difference between the previous day's calculated water temperature (J15) and the fifth day predicted water temperature (J20). The predicted trend is down from 18.7°C to 19.3°C with the potential to reach 19.3°C .

3. Forecasted Trend

The forecasted trend for the current day of July 16 is based on the first, second and third day forecasts.

July 16	$18.9 - 18.8$	=	down 0.1°C
July 17	$19.1 - 18.2$	=	down 0.9°C
July 18	$19.3 - 18.1$	=	down 1.2°C

Mean of 3 differences = down 0.7°C

This mean of -0.7°C is added to the fifth day predicted water temperature to give $19.3^{\circ}\text{C} + (-0.7^{\circ}\text{C}) = 18.6^{\circ}\text{C}$.

APPENDIX A
Numerical Example of Water Temperature Trend Calculation

Date	JULY											
	10	11	12	13	14	15	16	17	18	19	20	21
5th Day's Predicted Water Temperature at Date + 4 Days					18.8	19.6	19.8	19.9	19.9	18.5	19.3	
4th Day's Predicted Water Temperature at Date + 3 Days				19.5	19.2	19.4	19.3	19.6	18.1	19.6		
3rd Day's Predicted Water Temperature at Date + 2 Days			21.1	19.8	19.1	18.7	19.1	18.2	19.3			
2nd Day's Predicted Water Temperature at Date + 1 Day		22.3	21.1	19.5	18.8	18.7	18.8	19.1				
Current Day's Predicted Water Temperature at Date	22.4	21.9	20.3	19.2	18.5	18.7	18.9					
Previous Day's Calculated Water Temperature at Date - 1 Day	22.0	21.8	20.0	18.9	18.6	18.7						
Previous Day's Observed Water Temperature at Date - 1 Day	21.7	21.0	19.6	18.3	17.8	18.0						
Current Day's Skins Lake Spillway Release at Date (m ³ /s)	453	453	453	14.2	170	453	14.2					
			to	to	to	to						
			14.2	170	453	14.2						
			@	@	@	@						
			1600	1600	1600	1600						
			hrs	hrs	hrs	hrs						

Appendix B

Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 1998

APPENDIX B
Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 1998

Date	Nechako River			Nautley	Date	Nechako River			Nautley
	Cheslatta Falls (°C)	Fort Fraser (°C)	above Stuart River (°C)	Fort Fraser (°C)		Cheslatta Falls (°C)	Fort Fraser (°C)	above Stuart River (°C)	Fort Fraser (°C)
06-Jul	19.7	21.6	22.4	19.7	01-Aug	19.6	21.2	21.3	21.3
07-Jul	19.3	20.4	21.5	19.4	02-Aug	19.2	20.8	20.4	22.6
08-Jul	19.1	19.2	21.3	19.5	03-Aug	19.1	20.4	20.4	21.7
09-Jul	18.8	21.3	21.4	20.3	04-Aug	18.9	20.7	20.2	21.2
10-Jul	18.8	20.7	21.7	19.8	05-Aug	18.7	19.8	19.9	20.7
11-Jul	18.5	20.2	21.0	19.3	06-Aug	18.4	19.2	19.2	19.2
12-Jul	18.2	19.4	19.6	18.7	07-Aug	18.2	19.3	18.8	19.2
13-Jul	17.7	18.7	18.3	18.3	08-Aug	17.9	18.8	18.6	19.1
14-Jul	17.1	18.4	17.8	17.9	09-Aug	17.8	18.8	18.1	19.0
15-Jul	17.1	18.4	18.0	17.8	10-Aug	17.7	19.0	18.3	19.2
16-Jul	17.0	18.1	18.3	17.8	11-Aug	17.5	18.7	18.0	18.4
17-Jul	17.1	18.5	18.3	18.2	12-Aug	17.7	18.9	18.0	19.3
18-Jul	17.3	19.1	18.6	18.4	13-Aug	17.8	19.4	18.8	19.7
19-Jul	17.3	19.2	18.9	18.3	14-Aug	17.8	19.6	19.1	19.8
20-Jul	16.9	18.7	18.7	17.8	15-Aug	17.4	18.7	18.3	19.3
21-Jul	16.6	18.8	18.8	18.6	16-Aug	17.2	17.8	18.0	18.3
22-Jul	16.6	18.9	19.1	19.3	17-Aug	17.1	17.7	17.4	18.8
23-Jul	17.1	19.1	19.6	19.5	18-Aug	17.2	18.6	17.2	18.9
24-Jul	17.3	19.2	19.7	20.0	19-Aug	17.2	18.6	17.7	19.1
25-Jul	17.8	19.5	19.8	20.0	20-Aug	17.3	19.3	18.2	19.4
26-Jul	18.1	20.1	20.1	20.3					
27-Jul	18.6	20.8	20.7	20.8					
28-Jul	18.8	21.0	20.9	21.2					
29-Jul	19.2	21.2	21.3	21.0					
30-Jul	19.3	21.1	21.6	21.7					
31-Jul	19.6	21.1	21.8	22.3					

Appendix C

Mean Daily Skins Lake Spillway Releases and Flows in the Nechako and Nautley Rivers, 1998

APPENDIX C
Mean Daily Skins Lake Spillway Releases and Flows in the Nechako and Nautley Rivers, 1998

Date	Skins Lake Spillway Release (m ³ /s)	Nechako River		Nautley Fort Fraser (m ³ /s)
		Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	
06-Jul	49.0 to 227 @ 1600 hrs	54.3	115	44.3
07-Jul	227	55.7	113	43.3
08-Jul	227	60.6	112	42.3
09-Jul	227 to 453 @ 1630 hrs	78.3	115	41.4
10-Jul	453	97.0	134	41.4
11-Jul	453	108	156	41.4
12-Jul	453 to 14.2 @ 1600 hrs	196	199	41.4
13-Jul	14.2 to 170 @ 1600 hrs	244	254	41.4
14-Jul	170 to 453 @ 1600 hrs	229	300	39.5
15-Jul	453 to 14.2 @ 1600 hrs	210	288	37.7
16-Jul	14.2	247	279	36.8
17-Jul	14.2	228	305	37.7
18-Jul	14.2 to 453 @ 1630 hrs	200	296	35.9
19-Jul	453	172	261	35.9
20-Jul	453	200	243	34.1
21-Jul	453 to 283 to 14.2 @ 1200 hrs & 1600 hrs	246	258	34.1
22-Jul	14.2 to 283 @ 1600 hrs	281	310	34.1
23-Jul	283	250	340	34.1
24-Jul	283	253	324	33.2
25-Jul	283	262	317	32.4
26-Jul	283	270	325	31.5
27-Jul	283	277	333	30.7
28-Jul	283	281	339	29.8
29-Jul	283	286	348	29.6
30-Jul	283	287	354	28.8
31-Jul	283	289	356	28.8
01-Aug	283	291	360	28.8
02-Aug	283	291	361	28.1
03-Aug	283	293	362	27.3
04-Aug	283	295	359	27.3

APPENDIX C (continued)
Mean Daily Skins Lake Spillway Releases and Flows in the Nechako and Nautley Rivers, 1998

Date	Skins Lake Spillway Release (m ³ /s)	Nechako River		Nautley Fort Fraser (m ³ /s)
		Cheslatta Falls (m ³ /s)	At Vanderhoof (m ³ /s)	
05-Aug	283	297	363	26.6
06-Aug	283 to 14.2 @ 1600 hrs	297	365	25.9
07-Aug	14.2	290	367	24.5
08-Aug	14.2	252	363	23.1
09-Aug	14.2	215	334	23.1
10-Aug	14.2 to 170 @ 1800 hrs	184	285	21.3
11-Aug	170	164	248	21.8
12-Aug	170	162	221	20.7
13-Aug	170 to 453 @ 1600 hrs	165	212	21.2
14-Aug	453 to 14.2 @ 1600 hrs	176	212	20.5
15-Aug	14.2 to 170 @ 1600 hrs	205	220	21.8
16-Aug	170	187	252	21.8
17-Aug	170 to 14.2 @ 1600 hrs	182	237	20.7
18-Aug	14.2	176	233	21.3
19-Aug	14.2	157	235	20.5
20-Aug	14.2	138	213	19.9
21-Aug	14.2	118	185	19.3
22-Aug	14.2	106	164	19.2
23-Aug	14.2	95	149	18.6
24-Aug	14.2	84	132	17.9
25-Aug	14.2	74.1	118	17.9
26-Aug	14.2	66.5	107	17.8
27-Aug	14.2	61.1	99	17.3
28-Aug	14.2	55.3	90	16.6
29-Aug	14.2	51.4	83	16.5
30-Aug	14.2	48.0	78	15.9
31-Aug	14.2	44.7	73	15.2
01-Sep	14.2	43.4	70	15.2
02-Sep	14.2 to 29.5 @ 1600 hrs	40.8	65.0	15.5
03-Sep	29.5	37.9	61.0	14.1
04-Sep	29.5	35.8	57.4	13.7
05-Sep	29.5	34.4	55.1	13.2
06-Sep	29.5	33.2	53.2	13.2

Appendix D

Observed and Forecast Meteorological Data

APPENDIX D
Observed and Forecasted Meteorological Data

16.60	429.30	0.64	13.50	6.30	93.70	82.90	6 07 98
16.30	500.00	0.57	9.60	7.50	93.90	67.00	7 07 98
17.60	450.00	0.65	10.50	5.00	93.70	64.00	
17.20	340.00	0.72	12.50	6.00	93.20	74.00	
16.20	320.00	0.75	12.00	9.00	93.10	77.00	
15.80	320.00	0.75	12.00	9.00	93.10	78.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 7/98							

16.50	374.30	0.43	9.00	10.10	93.90	64.10	7 07 98
15.90	590.00	0.45	7.30	4.90	93.90	60.00	8 07 98
17.90	460.00	0.67	12.00	6.00	93.40	69.00	
16.40	340.00	0.73	12.00	8.00	93.10	76.00	
15.80	340.00	0.73	11.50	9.00	93.10	76.00	
15.20	520.00	0.62	8.50	10.00	93.50	66.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 8/98							

16.00	626.90	0.31	6.90	2.90	93.80	58.30	8 07 98
17.80	590.00	0.32	10.90	4.60	93.40	66.00	9 07 98
17.00	310.00	0.75	12.80	8.00	93.00	76.00	
15.80	340.00	0.73	10.80	9.50	93.30	74.00	
15.20	520.00	0.62	8.50	10.00	93.50	66.00	
15.50	450.00	0.68	9.50	7.00	92.90	69.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 9/98							

18.50	696.10	0.29	8.70	4.60	93.30	57.10	9 07 98
19.00	525.00	0.58	12.70	6.30	93.10	69.00	10 07 98
16.80	440.00	0.68	12.00	9.50	93.40	74.00	
15.00	300.00	0.79	12.00	9.00	93.20	83.00	
14.20	180.00	0.95	12.00	9.00	92.80	87.00	
15.50	500.00	0.60	8.00	6.00	93.30	64.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 10/98							

18.90	425.50	0.60	12.80	5.00	93.10	70.10	10 07 98
17.00	520.00	0.68	12.30	4.00	93.20	74.00	11 07 98
14.50	290.00	0.85	12.00	9.00	93.00	87.00	
13.80	360.00	0.80	11.50	9.00	93.20	86.00	
15.00	518.00	0.65	9.50	7.00	93.40	70.00	
15.00	560.00	0.60	9.00	6.00	93.40	67.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 11/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

15.00	636.40	0.76	11.80	3.80	93.20	83.00	11 07 98
14.00	370.00	0.89	8.40	11.00	93.20	70.00	12 07 98
13.80	480.00	0.78	8.00	9.00	93.20	68.00	
14.00	520.00	0.65	8.50	6.00	93.40	69.00	
15.00	565.00	0.60	9.00	5.00	93.60	67.00	
16.30	620.00	0.45	8.00	4.50	93.80	58.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 12/98							

13.20	409.70	0.84	8.90	11.00	93.10	76.30	12 07 98
12.00	480.00	0.70	6.60	11.00	93.16	70.00	13 07 98
13.00	500.00	0.70	8.00	4.00	93.10	72.00	
14.00	520.00	0.65	9.00	6.00	93.40	72.00	
15.50	563.00	0.60	8.50	5.00	93.60	63.00	
17.50	563.00	0.40	8.00	4.50	93.80	54.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 13/98							

13.00	396.00	0.55	4.70	15.80	93.10	62.00	13 07 98
13.70	600.00	0.42	4.80	7.00	93.40	55.00	14 07 98
16.00	550.00	0.60	7.50	6.00	93.30	57.00	
16.00	495.00	0.70	8.50	5.00	93.30	63.00	
17.00	565.00	0.40	8.00	4.00	93.60	54.00	
17.00	487.00	0.70	8.50	6.00	93.40	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 14/98							

14.00	654.09	0.40	4.50	7.50	93.40	54.40	14 07 98
18.00	545.00	0.59	8.00	8.00	93.50	52.00	15 07 98
15.00	290.00	0.85	10.50	10.00	93.40	74.00	
16.50	415.00	0.70	8.50	10.00	93.60	59.00	
17.00	515.00	0.60	8.00	6.00	93.80	55.00	
16.50	415.00	0.70	8.50	8.00	93.50	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 15/98							

17.80	654.09	0.67	8.10	13.20	93.50	55.30	15 07 98
16.50	370.00	0.87	13.00	4.50	93.60	80.00	16 07 98
16.70	531.00	0.70	10.00	8.50	93.70	64.00	
17.00	655.00	0.45	9.00	5.50	93.60	58.00	
15.50	480.00	0.70	10.80	8.50	93.40	74.00	
16.00	380.00	0.70	11.00	7.50	93.30	72.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 16/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

17.90	550.00	0.92	13.60	8.50	93.40	77.50	16 07 98
19.90	490.00	0.55	9.20	13.90	93.50	51.50	17 07 98
17.50	620.00	0.40	8.00	6.00	93.30	54.00	
17.00	480.00	0.70	10.80	8.50	93.20	67.00	
16.00	380.00	0.70	11.00	7.50	93.30	72.00	
17.00	660.00	0.30	7.50	6.00	93.60	54.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 17/98							

19.70	273.05	0.49	8.60	13.80	93.50	50.80	17 07 98
17.00	668.00	0.30	8.90	5.00	93.60	59.00	18 07 98
16.50	400.00	0.70	10.00	12.50	93.40	65.00	
15.00	410.00	0.65	9.00	11.00	93.70	67.00	
16.50	665.00	0.35	7.50	5.00	93.80	54.00	
17.00	540.00	0.65	9.00	8.50	93.50	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 18/98							

17.00	581.94	0.27	7.60	4.30	93.40	59.50	18 07 98
15.80	390.00	0.76	10.50	14.00	93.20	71.00	19 07 98
15.50	430.00	0.68	9.00	10.00	94.00	65.00	
17.30	665.00	0.35	8.00	4.50	94.20	54.00	
17.50	540.00	0.55	9.50	6.50	93.90	60.00	
17.30	445.00	0.70	10.50	8.00	93.40	66.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 19/98							

17.00	560.30	0.63	8.80	14.30	93.20	60.90	19 07 98
15.60	590.00	0.38	5.30	8.20	94.00	51.50	20 07 98
16.50	665.00	0.32	7.00	4.00	94.10	56.00	
17.50	530.00	0.54	9.00	6.00	93.90	59.00	
17.50	400.00	0.70	10.50	8.00	93.40	64.00	
16.50	500.00	0.58	8.50	9.00	93.60	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 20/98							

15.30	693.80	0.37	5.40	6.80	94.00	53.00	20 07 98
15.20	680.00	0.21	7.30	4.30	94.20	63.00	21 07 98
17.50	600.00	0.38	8.20	4.50	93.90	57.00	
17.50	450.00	0.65	10.00	7.00	93.40	61.00	
17.00	500.00	0.58	9.50	6.00	93.60	61.00	
16.80	490.00	0.60	9.50	7.00	93.50	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 21/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

15.30	591.50	0.22	7.70	3.90	94.10	65.30	21 07 98
18.20	610.00	0.29	10.00	3.50	93.70	62.00	22 07 98
18.20	460.00	0.62	11.50	6.00	93.50	67.00	
17.90	500.00	0.58	11.00	6.00	93.60	66.00	
17.00	510.00	0.55	9.50	7.00	93.70	63.00	
18.20	610.00	0.32	9.50	5.00	94.00	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 22/98							

18.20	661.00	0.16	9.70	1.80	93.70	62.00	22 07 98
19.90	440.00	0.65	12.00	5.00	93.10	62.00	23 07 98
18.90	600.00	0.40	10.00	6.00	93.70	59.00	
18.50	665.00	0.25	9.00	6.00	94.30	57.00	
18.80	670.00	0.20	9.00	5.00	94.00	56.00	
18.40	665.00	0.20	8.50	5.00	94.00	55.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 23/98							

21.00	648.59	0.63	12.30	3.50	93.30	60.30	23 07 98
20.20	610.00	0.39	9.80	10.40	93.70	54.00	24 07 98
19.60	667.00	0.20	10.00	6.50	94.30	57.00	
20.20	663.00	0.20	10.00	5.00	94.40	55.00	
20.20	661.00	0.20	2.00	10.00	94.20	55.00	
19.00	600.00	0.35	10.20	6.00	94.00	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 24/98							

20.60	613.00	0.44	9.50	10.40	93.70	51.30	24 07 98
19.30	669.00	0.20	9.70	4.00	94.20	54.00	25 07 98
20.30	664.00	0.20	10.00	4.50	94.40	52.00	
20.80	655.00	0.28	10.30	5.00	94.00	51.00	
19.50	590.00	0.38	10.50	6.50	93.50	55.00	
17.80	510.00	0.50	9.00	7.50	93.90	58.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 25/98							

19.80	620.16	0.16	10.10	5.80	94.10	57.50	25 07 98
20.60	660.00	0.09	10.70	4.50	94.30	55.00	26 07 98
20.80	658.00	0.15	10.50	4.50	94.20	54.00	
20.30	645.00	0.35	10.50	6.50	93.90	55.00	
18.70	570.00	0.45	11.00	7.00	93.50	61.00	
17.80	520.00	0.55	9.50	8.50	93.30	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 26/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

21.70	639.00	0.04	9.70	4.30	94.10	53.20	26 07 98
22.50	660.00	0.05	10.50	3.00	94.10	53.00	27 07 98
21.00	620.00	0.30	10.80	6.50	93.80	57.00	
19.00	590.00	0.35	11.00	7.00	93.60	63.00	
18.50	520.00	0.50	10.80	7.00	93.40	67.00	
18.50	600.00	0.30	10.00	7.00	93.60	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 27/98							

22.70	674.90	0.04	9.30	3.90	93.80	49.10	27 07 98
22.70	640.00	0.27	10.00	10.00	93.50	52.00	28 07 98
22.00	600.00	0.40	10.50	7.00	93.30	56.00	
20.00	550.00	0.55	11.00	6.00	93.30	63.00	
19.50	620.00	0.35	10.00	7.00	93.40	58.00	
19.00	540.00	0.50	10.80	8.00	93.40	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 28/98							

23.20	585.80	0.21	10.20	7.30	93.50	48.00	28 07 98
22.50	560.00	0.40	12.00	6.00	93.20	57.00	29 07 98
21.50	560.00	0.40	11.00	6.00	93.20	57.00	
20.50	520.00	0.55	11.00	6.00	93.30	62.00	
19.50	540.00	0.50	10.40	8.00	93.40	58.00	
19.50	520.00	0.55	11.00	6.00	93.30	63.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 29/98							

24.20	658.00	0.42	12.00	9.30	93.10	50.60	29 07 98
24.00	590.00	0.46	12.00	5.00	93.10	54.00	30 07 98
22.50	610.00	0.42	11.00	10.00	93.30	53.00	
20.00	570.00	0.48	10.50	8.00	93.40	57.00	
18.00	540.00	0.50	9.50	6.00	93.30	60.00	
17.50	540.00	0.50	8.80	7.00	93.30	58.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 30/98							

22.50	624.60	0.51	12.10	5.30	93.10	54.00	30 07 98
21.20	620.00	0.35	11.00	4.00	93.30	58.00	31 07 98
19.00	620.00	0.35	8.80	10.00	93.50	55.00	
18.00	600.00	0.38	8.00	7.00	93.40	55.00	
17.50	570.00	0.45	8.40	6.00	93.20	59.00	
17.50	540.00	0.50	8.80	6.00	93.10	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED JUL 31/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

21.50	624.20	0.41	11.80	4.00	93.20	56.50	31 07 98
21.00	640.00	0.27	8.00	10.00	94.00	45.00	01 08 98
20.00	590.00	0.35	9.00	7.00	94.40	51.00	
20.80	621.00	0.30	10.00	6.50	94.10	52.00	
20.30	510.00	0.50	11.00	7.00	93.60	57.00	
17.00	520.00	0.55	9.00	12.50	93.70	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 01/98							

19.90	668.50	0.14	5.30	7.80	94.00	43.10	01 08 98
17.00	665.00	0.05	4.00	3.00	94.50	44.00	02 08 98
20.00	650.00	0.20	6.50	6.50	94.20	44.00	
18.00	510.00	0.45	8.50	8.00	93.90	56.00	
16.00	480.00	0.55	9.00	11.50	93.70	65.00	
15.00	420.00	0.54	8.50	9.50	93.40	67.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 02/98							

17.60	656.00	0.05	1.70	2.60	94.40	41.50	02 08 98
20.00	610.00	0.30	7.40	4.50	94.10	46.00	03 08 98
18.50	500.00	0.60	9.50	8.00	93.90	58.00	
15.50	440.00	0.65	8.00	11.50	93.70	63.00	
15.50	480.00	0.55	8.00	10.00	93.70	63.00	
16.00	480.00	0.55	8.00	7.00	93.50	61.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 03/98							

19.70	425.50	0.40	6.70	5.00	93.90	47.00	03 08 98
19.50	565.00	0.42	7.90	6.50	93.80	51.00	04 08 98
15.70	440.00	0.65	8.40	11.00	93.70	64.00	
15.50	480.00	0.55	8.00	10.00	93.70	63.00	
16.50	480.00	0.55	8.00	7.00	93.50	60.00	
17.00	520.00	0.50	8.00	6.00	93.30	58.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 04/98							

19.60	484.80	0.56	7.00	5.10	93.70	49.30	04 08 98
16.20	360.00	0.73	9.10	6.50	93.40	65.00	05 08 98
16.00	500.00	0.53	8.20	10.00	93.80	63.00	
16.30	420.00	0.68	8.00	7.00	93.50	60.00	
17.00	520.00	0.50	8.00	6.00	93.40	58.00	
17.00	500.00	0.54	8.50	6.00	93.20	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 05/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

16.60	375.40	0.68	8.70	6.00	93.30	61.80	05 08 98
15.50	480.00	0.52	6.10	13.00	93.80	56.00	06 08 98
16.30	460.00	0.58	7.70	7.00	93.70	60.00	
17.00	520.00	0.50	8.00	6.00	93.40	58.00	
15.80	400.00	0.65	8.00	7.00	93.30	62.00	
15.50	400.00	0.65	8.00	7.00	93.30	63.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 06/98							

15.60	361.50	0.56	5.60	13.50	93.70	53.90	06 08 98
16.60	475.00	0.61	6.80	7.80	93.60	54.00	07 08 98
16.50	450.00	0.60	7.50	6.00	93.60	58.00	
15.80	380.00	0.70	8.50	7.00	93.40	65.00	
15.50	400.00	0.65	8.00	7.00	93.40	64.00	
16.00	520.00	0.45	7.50	6.00	93.80	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 07/98							

15.80	421.80	0.57	7.00	5.10	93.50	58.00	07 08 98
15.30	420.00	0.54	7.40	2.80	93.40	62.00	08 08 98
15.50	270.00	0.80	9.50	7.00	93.40	69.00	
15.50	400.00	0.62	7.50	11.00	93.80	62.00	
16.00	520.00	0.45	7.50	6.00	94.00	60.00	
16.50	520.00	0.45	7.50	6.00	94.00	58.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 08/98							

15.30	203.80	0.56	7.20	3.20	93.40	61.40	08 08 98
15.30	340.00	0.71	8.40	5.00	93.40	65.00	09 08 98
14.60	260.00	0.88	8.50	8.50	93.80	70.00	
14.50	430.00	0.70	7.50	4.50	94.00	65.00	
15.20	490.00	0.60	7.00	4.00	94.00	61.00	
16.50	510.00	0.55	8.00	5.00	93.80	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 09/98							

15.40	220.20	0.80	9.10	3.40	93.40	68.80	09 08 98
15.10	372.00	0.86	8.60	8.50	93.90	68.00	10 08 98
14.50	430.00	0.70	7.50	4.00	94.10	65.00	
16.50	430.00	0.68	9.00	5.50	94.30	63.00	
16.50	500.00	0.60	8.50	7.00	94.00	61.00	
17.30	530.00	0.55	9.00	7.50	93.70	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 10/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

15.50	490.10	0.78	9.50	5.40	93.90	70.50	10 08 98
14.50	330.00	0.72	9.50	3.00	93.90	73.00	11 08 98
15.50	380.00	0.68	9.00	5.50	94.10	67.00	
16.00	450.00	0.64	8.50	7.00	94.00	63.00	
16.50	500.00	0.60	8.80	7.50	94.00	61.00	
17.00	530.00	0.55	9.00	6.00	94.10	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 11/98							

15.50	230.70	0.73	11.30	2.30	93.90	78.00	11 08 98
18.50	430.00	0.68	11.40	7.00	94.10	65.00	12 08 98
17.00	370.00	0.75	10.50	5.50	94.00	70.00	
16.50	500.00	0.60	9.00	7.50	94.00	63.00	
17.00	500.00	0.60	9.00	8.00	94.00	62.00	
17.50	530.00	0.55	9.00	10.00	94.10	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 12/98							

19.40	392.70	0.64	10.90	8.20	94.30	61.80	12 08 98
19.00	580.00	0.44	9.50	4.00	94.40	58.00	13 08 98
18.50	450.00	0.65	10.00	4.00	93.80	64.00	
17.50	500.00	0.60	9.00	8.00	93.90	61.00	
17.00	450.00	0.65	9.50	10.00	93.80	66.00	
17.50	530.00	0.55	9.00	6.00	94.00	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 13/98							

19.10	541.70	0.33	9.70	2.10	94.40	57.30	13 08 98
17.00	350.00	0.61	11.70	5.00	93.50	75.00	14 08 98
15.00	400.00	0.68	7.50	6.00	93.30	65.00	
16.00	450.00	0.65	8.50	10.00	93.60	64.00	
16.50	530.00	0.55	8.50	6.00	93.80	62.00	
17.00	450.00	0.65	9.20	8.00	93.70	65.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 14/98							

16.30	299.60	0.60	12.50	8.80	93.50	78.80	14 08 98
13.00	250.00	0.70	8.50	3.00	93.20	78.00	15 08 98
14.00	350.00	0.68	7.50	6.00	93.10	69.00	
15.50	530.00	0.55	7.50	6.00	93.50	62.00	
16.00	450.00	0.65	8.80	8.00	93.40	68.00	
15.00	450.00	0.55	7.20	8.00	93.50	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 15/98							

APPENDIX D (continued)
Observed and Forecasted Meteorological Data

12.80	374.40	0.74	9.50	1.30	93.20	80.80	15 08 98
13.50	220.00	0.85	9.60	5.00	93.00	79.00	16 08 98
15.20	377.00	0.68	8.50	8.50	93.20	67.00	
15.70	510.00	0.50	8.00	11.50	93.40	62.00	
16.80	410.00	0.65	9.00	8.50	93.30	62.00	
17.30	400.00	0.65	9.50	5.00	93.40	62.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 16/98							

12.60	241.60	0.87	9.50	8.30	93.10	81.80	16 08 98
12.00	230.00	0.92	8.80	14.00	93.30	83.00	17 08 98
15.00	348.00	0.75	8.50	11.50	93.70	67.00	
15.50	390.00	0.68	8.00	8.50	93.90	63.00	
16.00	400.00	0.65	8.00	5.00	93.80	61.00	
17.00	490.00	0.50	8.50	6.00	93.80	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 17/98							

11.60	386.80	0.98	9.30	15.40	93.20	86.00	17 08 98
14.50	225.00	0.90	8.80	15.00	93.40	75.00	18 08 98
15.00	490.00	0.55	7.80	6.00	93.80	62.00	
15.50	390.00	0.68	8.00	8.50	93.70	63.00	
16.00	400.00	0.65	8.00	5.00	93.80	61.00	
17.00	490.00	0.50	8.50	6.00	93.90	59.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 18/98							

13.80	540.50	0.88	9.40	14.60	93.30	75.40	18 08 98
16.50	530.00	0.50	9.10	6.00	93.90	66.00	19 08 98
16.50	450.00	0.60	8.50	6.00	93.70	62.00	
15.50	400.00	0.65	8.80	5.00	93.60	70.00	
16.00	490.00	0.50	8.50	8.00	93.80	64.00	
16.50	490.00	0.50	8.50	6.00	93.90	64.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 19/98							

16.20	569.30	0.45	9.70	5.40	93.90	67.80	19 08 98
15.60	620.00	0.23	8.40	3.00	93.70	65.00	20 08 98
15.50	450.00	0.60	8.50	7.00	93.60	68.00	
15.00	450.00	0.55	7.50	10.00	93.80	64.00	
15.50	450.00	0.55	8.00	8.00	93.70	64.00	
15.50	530.00	0.50	7.50	6.00	93.80	60.00	
ATEMP(C)	RAD(LY)	CC(TTHS)	DPT(C)	SPD(KH)	SPR(KPA)	RH(%)	DD MM YY
WORLD WEATHERWATCH FORECAST ISSUED AUG 20/98							

Appendix E

Summer Water Temperature and Flow Management Project Reservoir Release Volume Calculations for July 6 to August 20, 1998

APPENDIX E
 Summer Water Temperature and Flow Management Project Reservoir
 Release Volume Calculations for July 6 to August 20, 1998

Skins Lake Spillway base release for the period July 6 (187) to August 20 (232) = 49.0 m³/s (1,730 cfs)
 Summer Water Temperature and Flow Management Project Base Release Volume = (232 - 186) * 49.0 = 2,254.0 m³/s*days

Time period (Julian Day)	Time (hrs)	Flow Rate (m ³ /s)	Volume (m ³ /s*hrs)
July 6 (187) @ 0000 hrs to July 6 (187) @ 1600 hrs	16.0	49.0	784
July 6 (187) @ 1600 hrs to July 9 (190) @ 1630 hrs	72.5	227.0	16457.5
July 9 (190) @ 1630 hrs to July 12 (193) @ 1600 hrs	71.5	453.0	32389.5
July 12 (193) @ 1600 hrs to July 13 (194) @ 1600 hrs	24.0	14.2	340.8
July 13 (194) @ 1600 hrs to July 14 (195) @ 1600 hrs	24.0	170.0	4080
July 14 (195) @ 1600 hrs to July 15 (196) @ 1600 hrs	24.0	453.0	10872
July 15 (196) @ 1600 hrs to July 18 (199) @ 1630 hrs	72.5	14.2	1029.5
July 18 (199) @ 1630 hrs to July 21 (202) @ 1200 hrs	67.5	453.0	30577.5
July 21 (202) @ 1200 hrs to July 21 (202) @ 1600 hrs	4.0	283.0	1132
July 21 (202) @ 1600 hrs to July 22 (203) @ 1600 hrs	24.0	14.2	340.8
July 22 (203) @ 1600 hrs to August 6 (218) @ 1600 hrs	360.0	283.0	101880
August 6 (218) @ 1600 hrs to August 10 (222) @ 0800 hrs	88.0	14.2	1249.6
August 10 (222) @ 0800 hrs to August 13 (225) @ 1600 hrs	80.0	170.0	13600
August 13 (225) @ 1600 hrs to August 14 (226) @ 1600 hrs	24.0	453.0	10872
August 14 (226) @ 1600 hrs to August 15 (227) @ 1600 hrs	24.0	14.2	340.8
August 15 (227) @ 1600 hrs to August 17 (229) @ 1600 hrs	48.0	170.0	8160
August 17 (229) @ 1600 hrs to August 20 (232) @ 2400 hrs	80.0	14.2	1136
Total	1104 (46 days)		235,242
Total Release Volume	= 235,242 m ³ /s*hrs = 9,801.7 m ³ /s*days		
Therefore, Volume Released for Cooling Purposes	= Total Volume - Base Volume = 9,801.7 - 2,254.0 = 7,547.7 m ³ /s*days		
Average Release over Summer Management Period (July 6 to August 20, 1998)	= 9,801.7 m ³ /s*days / 46 days = 213.1 m ³ /s = 7,525.0 cfs		