# THE 2000 SUMMER WATER TEMPERATURE AND FLOW MANAGEMENT PROJECT

*NECHAKO FISHERIES CONSERVATION PROGRAM*
*Technical Report No. RM00-1*

Prepared by:
Triton Environmental Consultants Ltd.

January 2003

# Contents

# List of Figures

# List of Tables

# List of Appendices

## ABSTRACT

The 2000 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) from July 20 to August 20. Water temperatures were managed by regulating Skins Lake Spillway releases to control flows in the Nechako River below Cheslatta Falls and at Vanderhoof. In 2000, mean daily water temperatures in the Nechako River above the Stuart River confluence exceeded 20.0°C (68.0°F) on three days (August 5 to 7) during July 20 to August 20, with a maximum mean daily temperature of 20.7°C (69.2°F) recorded on August 6. During the period of August 5 to 7, flow in the Nechako River below Cheslatta Falls was approaching the maximum allowable level of 283 $m^3/s$ (10,000 cfs), and thus no further action could be taken.

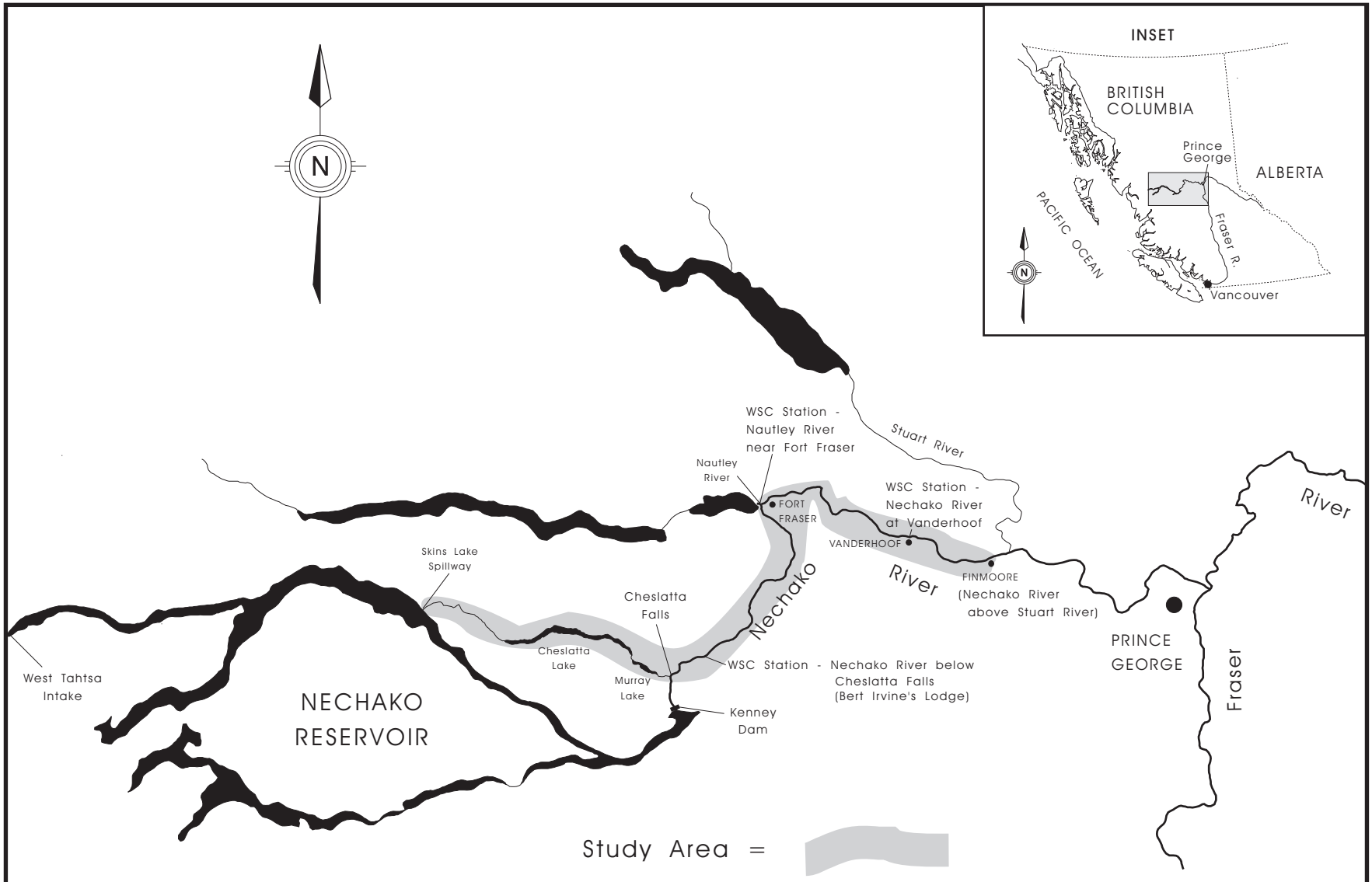
Over the duration of the 2000 Summer Water Temperature and Flow Management Project (July 10 to August 20), the total volume of water released was 7,273.2 $m^3/s$-d, (256,853 cfs-d), and the average release during the Project was 173.2 $m^3/s$ (6,116 cfs).


## INTRODUCTION

Control of the Nechako River water temperature for protection of fish resources is a concern of both government agencies and Alcan Primary Metal Group (Alcan). 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 $m^3/s$ (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, analogous water temperature and flow management projects (Triton 1995a through 1995h, Triton 1996, Triton 1997, Triton 1998, Triton 1999) 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 temperatures 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 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). 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. 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.

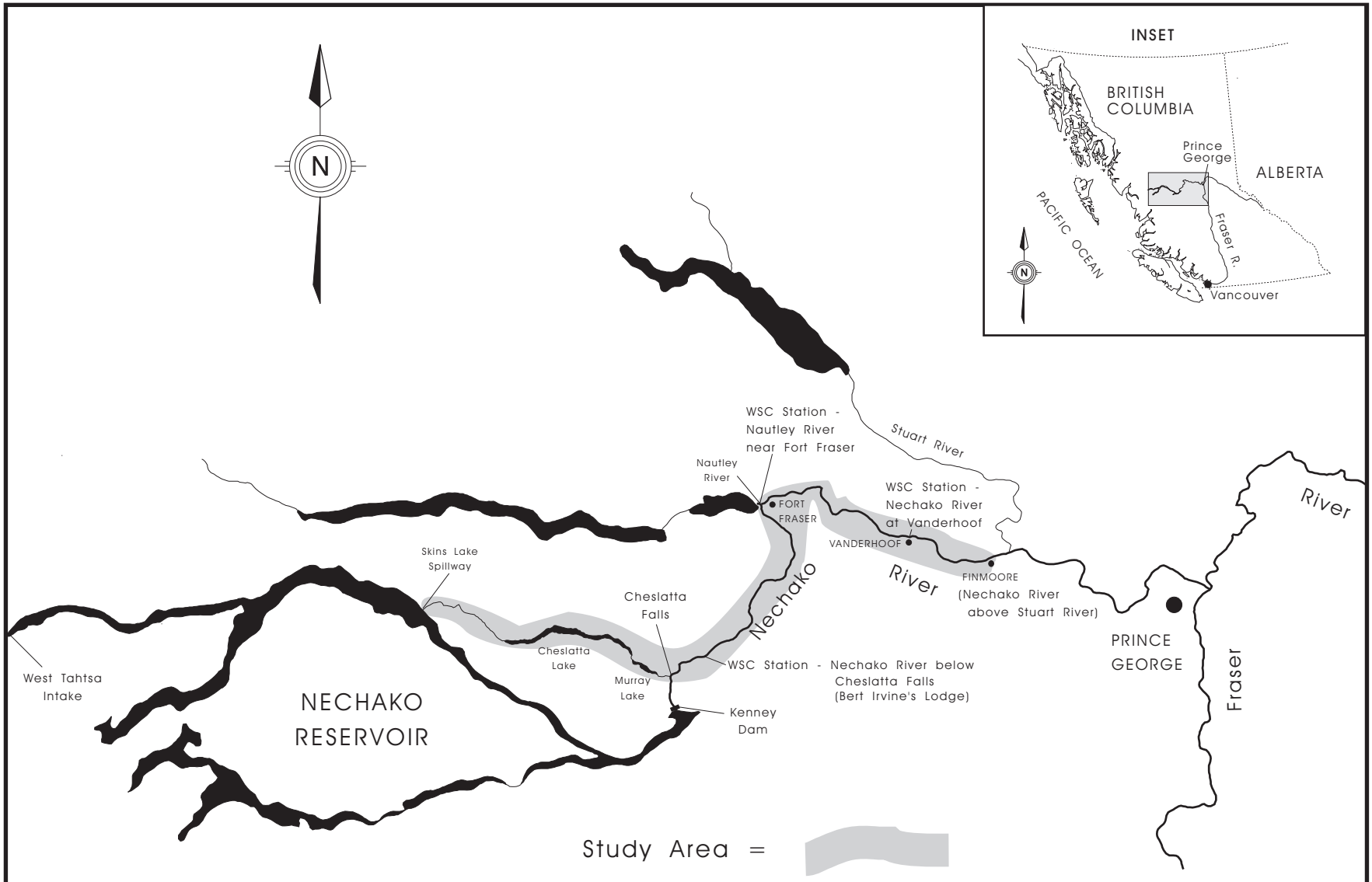
This report reviews the 2000 Summer Water Temperature and Flow Management Project and includes an outline of Triton's method of determining Skins Lake Spillway releases, a summary of Triton's 2000 Skins Lake Spillway release recommendations for the period July 10 to September 6 inclusive, and a summary of observed flows (July 10 to September 6) and water temperatures (July 10 to August 20) at various locations along the Nechako River. Also discussed is the volume of cooling water used in the 2000 Summer Water Temperature and Flow Management Project.




| | |
|---|---|
| Nechako Fisheries Conservation Program | Map # RM00-1 |

FIGURE 1. NECHAKO RIVER STUDY AREA

0 50 km
(approx.)




| | |
|---|---|
| Nechako Fisheries Conservation Program | Map # RM00-1 |

FIGURE 1. NECHAKO RIVER STUDY AREA

0 50 km
(approx.)

## 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 project objectives. The Summer Water Temperature and Flow Management 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 nature of 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 sub consultant 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 it is the preliminary data that was 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, July 10 to July 19, 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 20, and to increase flows in the Nechako River from spring flows to the minimum cooling flow of 170 $m^3/s$ (6,000 cfs) required below Cheslatta Falls. The 2000 Skins Lake Spillway spring base release, as determined by NFCP, was 49.0 $m^3/s$ (1,730 cfs). Upon commencement of the operational period on July 10, the observed flow in the Nechako River below Cheslatta Falls was 50.9 $m^3/s$ (1,798 cfs). On July 11, 2000, the Skins Lake Spillway release was increased from the spring base release to 227 $m^3/s$ (8,000 cfs) to ensure flows in the Nechako River below Cheslatta Falls reached the minimum cooling flow of 170 $m^3/s$ (6,000 cfs) by July 20 (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 four 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 calcu-

Table 1
Daily Operations to Manage Water Temperatures in the Nechako River above the Stuart River Confluence

| 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 | | | | |

observed trend
predicted trend
forecast trend

* The current day (e.g., the day of operation) for this example is July16

lated 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 on a day-by-day basis:

1. Observed trend; developed from observed 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 2 days is extrapolated over the next 5 days to determine the observed water temperature trend.
2. Predicted trend; developed from the predicted water temperatures for the previous day and the following 5 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 5 day and previous 5 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 5 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 the Stuart River confluence 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. 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 the Stuart River confluence, and these trends show that potentially the water temperature could 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 flow in the Nechako River below Cheslatta Falls ranges between 170 $m^3/s$ (6,000 cfs) and 283 $m^3/s$ (10,000 cfs) as required, and flow in the Nechako River above the Stuart River confluence does not exceed 340 $m^3/s$ (12,000 cfs). It is understood that the flow in the Nechako River below Cheslatta Falls is to be not less than 170 $m^3/s$ (6,000 cfs) by the beginning of the control period, and is to be reduced to approximately 31.2 $m^3/s$ (1,100 cfs) by September 6.

3. At any time of release, increase Skins Lake Spillway from the current level to 453 $m^3/s$ (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 potentially the water temperature could 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 $m^3/s$ (500 cfs).

## RESULTS

Predicted and observed mean daily water temperatures for the Nechako River above the Stuart River confluence, 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 the Stuart River confluence 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 20.7°C (69.3°F) on August 6 and 15.9°C (60.6°F) on August 20. 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 flows in the Nechako River below Cheslatta Falls were to range between 170 $m^3/s$ (6,000 cfs) and 283 $m^3/s$ (10,000 cfs) and flows at Vanderhoof were not to exceed 340 $m^3/s$ (12,000 cfs).

Skins Lake Spillway releases and their corresponding flows in the Nechako River below Cheslatta Falls and at Vanderhoof are plotted in Figure 3. Daily Skins Lake Spillway releases, Nautley River flows and flows

Table 2
Predicted and Observed Mean Daily Water Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2000

| | JULY | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 5th Day's Predicted Water Temperature at Date + 4 Days | | | | | 19.8 | 19.5 | 19.9 | 19.3 | 19.3 | 19.5 | 19.4 | 19.1 | 18.9 | 18.6 | 18.9 | 18.3 | 18.3 | 18.7 | 18.8 | 18.5 | 18.7 | 18.9 |
| 4th Day's Predicted Water Temperature at Date + 3 Days | | | | 20.0 | 19.4 | 19.7 | 18.9 | 18.8 | 18.8 | 18.9 | 19.0 | 19.0 | 19.0 | 19.1 | 18.9 | 18.4 | 18.6 | 18.8 | 18.5 | 18.4 | 18.8 | 19.4 |
| 3rd Day's Predicted Water Temperature at Date + 2 Days | | | 20.3 | 19.4 | 19.8 | 18.4 | 18.0 | 17.8 | 18.2 | 19.0 | 19.1 | 19.4 | 19.3 | 19.4 | 18.9 | 18.7 | 19.1 | 18.6 | 18.3 | 18.4 | 19.0 | 18.4 |
| 2nd Day's Predicted Water Temperature at Date + 1 Day | | 20.5 | 19.6 | 20.0 | 18.4 | 17.3 | 16.9 | 17.8 | 19.0 | 19.4 | 19.7 | 19.6 | 19.8 | 19.8 | 19.0 | 19.6 | 19.0 | 18.5 | 18.2 | 18.5 | 18.4 | 19.1 |
| Current Day's Predicted Water Temperature at Date | 20.7 | 19.6 | 20.0 | 18.9 | 17.7 | 16.6 | 17.6 | 18.4 | 19.3 | 19.9 | 19.8 | 19.9 | 20.4 | 19.5 | 19.7 | 19.5 | 18.8 | 18.6 | 18.3 | 18.3 | 18.9 | 19.4 |
| Previous Day's Calculated Water Temperature at Date - 1 Day | 20.5 | 19.7 | 19.7 | 18.7 | 17.4 | 17.3 | 17.9 | 18.5 | 19.6 | 19.9 | 19.9 | 20.2 | 20.2 | 19.8 | 19.6 | 19.4 | 18.9 | 18.5 | 18.3 | 18.4 | 18.9 | 19.2 |
| Previous Day's Observed Water Temperature at Date - 1 Day | 19.3 | 19.6 | 18.9 | 18.2 | 17.4 | 16.9 | 17.2 | 17.8 | 18.8 | 19.5 | 19.4 | 19.7 | 19.9 | 19.2 | 19.1 | 19.1 | 18.8 | 18.6 | 17.9 | 17.8 | 18.2 | 18.9 |
| Current Day's Skins Lake Spillway Release at Date ($m^3/s$) | 49.0 | 49.0 to 227 @ 1600 hrs | 227 | 227 | 227 | 227 | 227 | 227 | 227 | 227 to 170 @ 1600 hrs | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 to 453 @ 1600 hrs | 453 to 14.2 @ 1330 hrs | 14.2 to 170 @ 2000 hrs | 170 |

Table 2 (continued)
Predicted and Observed Mean Daily Water Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2000

| | AUGUST | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 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 | 19.6 | 18.7 | 18.4 | 18.6 | 18.9 | 19.2 | 18.8 | 19.5 | 19.9 | 20.0 | 19.1 | 18.5 | 18.2 | 18.2 | 18.0 | 18.2 | 19.1 | 18.3 | 18.0 | 17.3 |
| 4th Day's Predicted Water Temperature at Date + 3 Days | 18.7 | 18.6 | 18.5 | 18.4 | 19.0 | 18.9 | 19.6 | 19.9 | 20.2 | 19.4 | 18.8 | 18.3 | 18.1 | 17.8 | 17.7 | 18.7 | 18.3 | 18.5 | 17.8 | 17.5 |
| 3rd Day's Predicted Water Temperature at Date + 2 Days | 18.9 | 18.7 | 17.9 | 18.2 | 19.0 | 20.1 | 20.1 | 20.6 | 19.8 | 19.1 | 18.5 | 18.1 | 17.9 | 17.5 | 18.2 | 18.2 | 18.7 | 18.3 | 18.2 | 16.9 |
| 2nd Day's Predicted Water Temperature at Date + 1 Day | 19.2 | 17.9 | 17.4 | 19.1 | 20.5 | 20.5 | 21.0 | 20.6 | 19.6 | 18.9 | 18.3 | 18.1 | 17.6 | 18.0 | 18.2 | 18.7 | 18.8 | 18.6 | 17.2 | 16.0 |
| Current Day's Predicted Water Temperature at Date | 18.5 | 17.0 | 18.6 | 20.0 | 20.7 | 21.1 | 21.3 | 20.4 | 19.5 | 18.7 | 18.4 | 18.0 | 17.8 | 18.2 | 18.3 | 18.8 | 18.6 | 17.7 | 16.6 | 16.6 |
| Previous Day's Calculated Water Temperature at Date - 1 Day | 18.0 | 17.5 | 18.9 | 20.1 | 20.9 | 21.2 | 21.3 | 20.3 | 19.5 | 18.8 | 18.3 | 17.9 | 18.0 | 18.1 | 18.3 | 18.6 | 18.3 | 17.4 | 16.8 | |
| Previous Day's Observed Water Temperature at Date - 1 Day | 17.9 | 17.4 | 18.2 | 18.8 | 20.2 | 20.7 | 20.5 | 20.0 | 19.4 | 18.3 | 18.2 | 17.7 | 17.7 | 17.3 | 17.7 | 17.8 | 17.7 | 17.3 | 16.6 | 15.9 |
| Current Day's Skins Lake Spillway Release at Date ($m^3/s$) | 170 | 170 | 170 | 170 to 453 @ 1600 hrs | 453 | 453 | 453 to 14.2 @ 1600 hrs | 14.2 | 14.2 | 14.2 to 170 @ 1600 hrs | 170 | 170 | 170 | 170 | 170 | 170 | 170 to 14.2 @ 1600 hrs | 14.2 | 14.2 | 14.2 |

Table 3
Observed Mean Daily Water Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2000

| Date | Water Temperature (°C) | Date | Water Temperature (°C) |
|---|---|---|---|
| 10-Jul | 19.3 | 01-Aug | 17.9 |
| 11-Jul | 19.6 | 02-Aug | 17.4 |
| 12-Jul | 18.9 | 03-Aug | 18.2 |
| 13-Jul | 18.2 | 04-Aug | 18.8 |
| 14-Jul | 17.4 | 05-Aug | 20.2 |
| 15-Jul | 16.9 | 06-Aug | 20.7 |
| 16-Jul | 17.2 | 07-Aug | 20.5 |
| 17-Jul | 17.8 | 08-Aug | 20.0 |
| 18-Jul | 18.8 | 09-Aug | 19.4 |
| 19-Jul | 19.5 | 10-Aug | 18.3 |
| 20-Jul | 19.4 | 11-Aug | 18.2 |
| 21-Jul | 19.7 | 12-Aug | 17.7 |
| 22-Jul | 19.9 | 13-Aug | 17.7 |
| 23-Jul | 19.2 | 14-Aug | 17.3 |
| 24-Jul | 19.1 | 15-Aug | 17.7 |
| 25-Jul | 19.1 | 16-Aug | 17.8 |
| 26-Jul | 18.8 | 17-Aug | 17.7 |
| 27-Jul | 18.6 | 18-Aug | 17.3 |
| 28-Jul | 17.9 | 19-Aug | 16.6 |
| 29-Jul | 17.8 | 20-Aug | 15.9 |
| 30-Jul | 18.2 | | |
| 31-Jul | 18.9 | | |

Figure 2
Observed Mean Daily Temperatures in the Nechako River above the Stuart River Confluence, July 10 to August 20, 2000

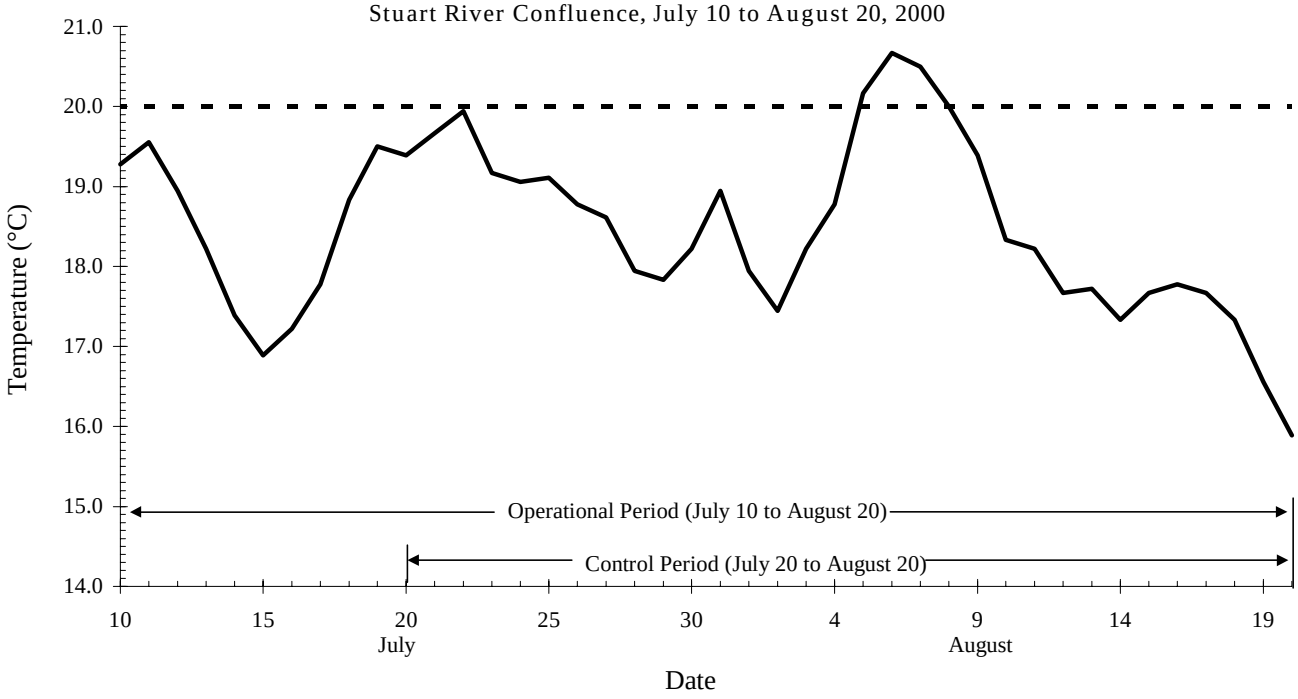
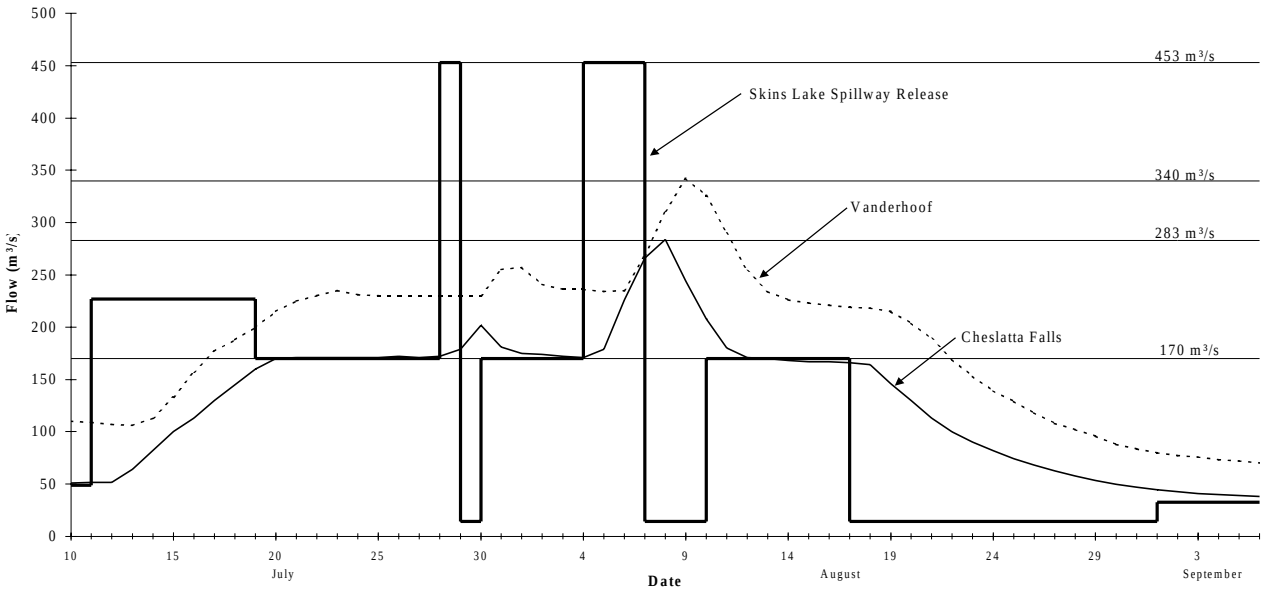


Figure 3
Skins Lake Spillway Releases and Flows in the Nechako River below Cheslatta Falls and at Vanderhoof, July 10 to September 6, 2000




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 the reasoning behind them 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 284 $m^3/s$ (10,029 cfs) on August 8 and a minimum of 130 $m^3/s$ (4,591 cfs) on August 20. Flows measured in the Nechako River at Vanderhoof ranged between a maximum of 342 $m^3/s$ (12,078 cfs) on August 9 and a minimum of 204 $m^3/s$ (7,204 cfs) on August 20. Following the control period, the mean daily flow in the Nechako River below Cheslatta Falls was reduced to approximately 38.2 $m^3/s$ (1,300 cfs) by September 6.

# DISCUSSION

Decision criteria used to determine Skins Lake Spillway releases during the 2000 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 2000 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 2000 Summer Water Temperature and Flow Management Project. The fourth section discusses instances when judgment was exercised during the application of the release 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 initialise 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

Table 4
Rationale for Skins Lake Spillway Release Changes, July 10 to September 6, 2000

| Date 2000 | Old Setting ($m^3/s$) | New Setting ($m^3/s$) | Time of Change (hrs) | Reason for Changing SLS Release Setting |
|---|---|---|---|---|
| 11-Jul | 49.0 | 227 | 1600 | To ensure base flow of 170 $m^3/s$ in the Nechako River below Cheslatta Falls by July 20 |
| 19-Jul | 227 | 170 | 1600 | To maintain base flow of 170 $m^3/s$ |
| 28-Jul | 170 | 453 | 1600 | In response to a predicted warming trend |
| 29-Jul | 453 | 14.2 | 1330 | In response to a predicted cooling trend |
| 30-Jul | 14.2 | 170 | 2000 | To maintain base flow of 170 $m^3/s$ |
| 04-Aug | 170 | 453 | 1600 | In response to a predicted warming trend |
| 07-Aug | 453 | 283 | 1030 | To avoid exceedence of 283 $m^3/s$ in the Nechako River below Cheslatta Falls |
| 07-Aug | 283 | 14.2 | 1600 | In response to a predicted cooling trend |
| 10-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 |
| 01-Sep | 14.2 | 32.5 | 1600 | To achieve spawning flow in the Nechako River below Cheslatta Falls by September 6 |

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 2000, 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 well below average for the time of year. The ability to obtain hourly stage data from the gauging station located on the Nechako River below Cheslatta Falls proved very useful in verifying the daily predictions of the flow model and accounting 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 forecast meteorological data were obtained daily from World Weatherwatch, a sub consultant to Triton. These forecast weather data obtained from World Weatherwatch 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 forecast 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 following four days. A listing of the observed and forecast meteorological data is provided in Appendix D.

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

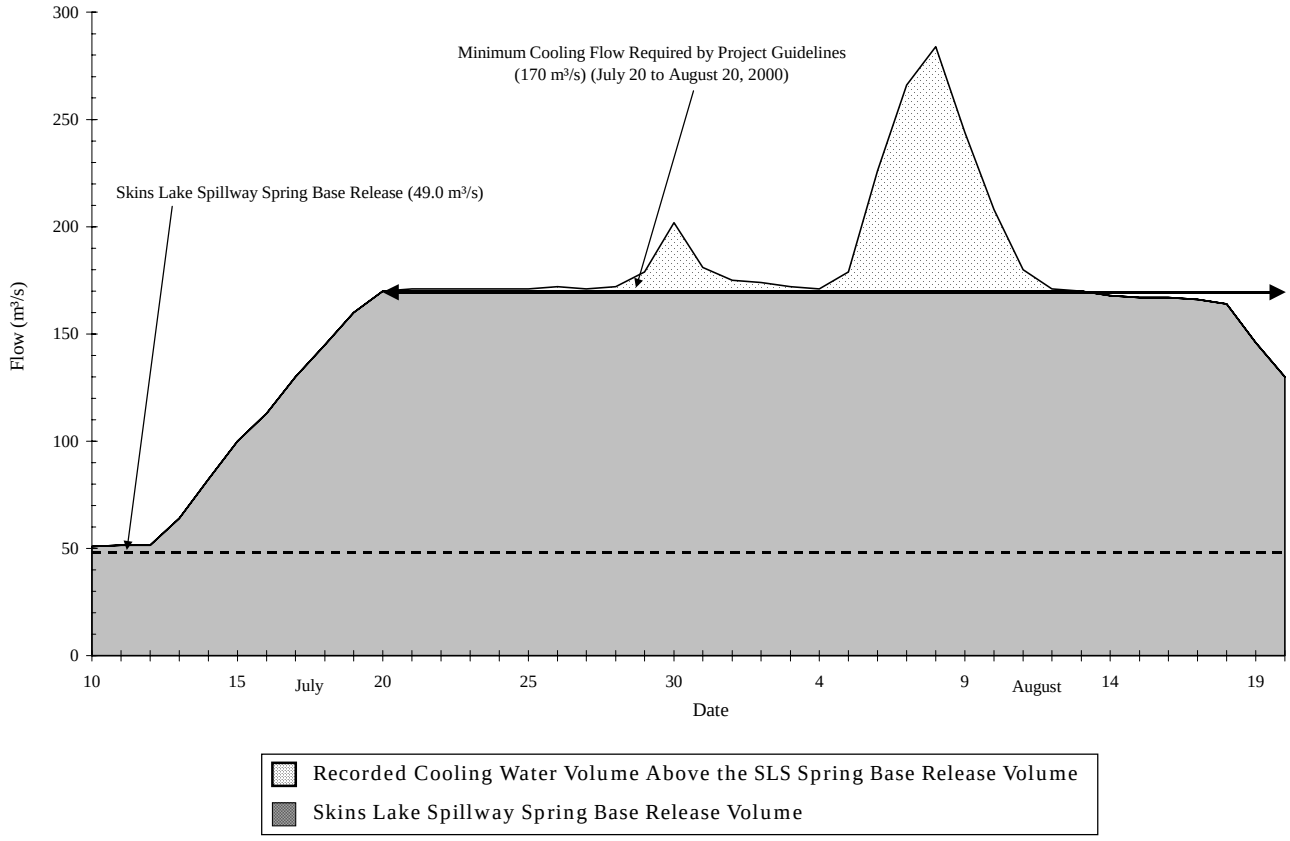
Mean daily water temperatures in the Nechako River above the Stuart River confluence exceeded 20.0°C (68.0°F) on three days (August 5 to 7) during the control period, with a maximum mean daily temperature of 20.7°C (69.3 °F) recorded on August 6. During this period, flow in the Nechako River below Cheslatta Falls was approaching the maximum allowable level of 283 $m^3/s$ (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 the Stuart River confluence did not exceed 20.0°C (68.0°F).

## Volume of Water Used

Figure 4 presents the observed flows in the Nechako River below Cheslatta Falls for the 2000 Summer Water Temperature and Flow Management Project. Also indicated is the minimum cooling flow of 170 $m^3/s$ (6,000 cfs) in the Nechako River below Cheslatta Falls, and the Skins Lake Spillway release of 49.0 $m^3/s$ (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 $m^3/s$ (1,730 cfs) are considered releases used for cooling purposes.

The total volume of water released during the 2000 Summer Water Temperature and Flow Management Project operational period was 7,273.2 $m^3/s$-d, (256,853 cfs-d). The volume released for cooling purposes was 5,215.2 $m^3/s$-d (184,175 cfs-d), and is based on an assumed Skins Lake Spillway release of 49.0 $m^3/s$ (1,730 cfs) for the period July 10 to August

Figure 4
Flows in the Nechako River below Cheslatta Falls Resulting from
Skins Lake Spillway Releases, July 10 to August 20, 2000



20, inclusive. The average release during the operational period was 173.2 $m^3/s$ (6,116 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 reversal of the temperature change prematurely. In these instances, it may be required to exercise judgment when applying the Summer Water Temperature and Flow Management Project 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 judgment required to make exceptions to the release criteria during such events, which has proven to be beneficial in the management of downstream water temperatures. No exceptions were made to the application of the release criteria during the entire operational period.

## REFERENCES


*Anon. 1987. Settlement Agreement 1987.*

*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 Primary Metal Group*

*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.*

*Triton Environmental Consultants Ltd. 1998. The 1998 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM98-1.*

*Triton Environmental Consultants Ltd. 1999. The 1999 Summer Water Temperature and Flow Management Project. Nechako Fisheries Conservation Program Technical Report No. RM99-1.*

# 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 down by 0.5°C from 17.4°C (J14) to 16.9°C (J15). Take the previous day's observed temperature 16.9°C (J15) and extrapolate the trend for 5 days at -0.5°C. The observed trend shows that the water temperature could potentially reach 16.9°C + 5(-0.5°C) = 14.4°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 up from 17.3°C to 19.4°C with the potential to reach 19.4°C.

3. Forecast Trend

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

   | | | | |
   |---|---|---|---|
   | July 16 | 16.9 to 17.6 | = | up 0.7°C |
   | July 17 | 17.8 to 17.8 | = | even 0.0°C |
   | July 18 | 18.8 to 18.2 | = | down 0.6°C |

   Mean of 3 differences = up 0.03°C

   This mean of +0.0°C is added to the fifth day predicted water temperature to give 19.4°C + (0.0°C) = 19.4°C.

   The forecast trend is up 0.0°C with the potential to reach 19.4°C.

## Appendix A
## Numerical Example of Water Temperature Trend Calculation

Table A1: Predicted and Observed Mean Daily Water Temperatures in the Nechako River Above Stuart River, 2000

| | JULY | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 5th Day's Predicted Water Temperature at Date + 4 Days | | | | | 19.8 | 19.5 | 19.9 | 19.3 | 19.3 | 19.5 | 19.4 |
| 4th Day's Predicted Water Temperature at Date + 3 Days | | | | 20.0 | 19.4 | 19.7 | 18.9 | 18.8 | 18.8 | 18.9 | |
| 3rd Day's Predicted Water Temperature at Date + 2 Days | | | 20.3 | 19.4 | 19.8 | 18.4 | 18.0 | 17.8 | 18.2 | | |
| 2nd Day's Predicted Water Temperature at Date + 1 Day | | 20.5 | 19.6 | 20.0 | 18.4 | 17.3 | 16.9 | 17.8 | | | |
| Current Day's Predicted Water Temperature at Date | 20.7 | 19.6 | 20.0 | 18.9 | 17.7 | 16.6 | 17.6 | | | | |
| Previous Day's Calculated Water Temperature at Date - 1 Day | 20.5 | 19.7 | 19.7 | 18.7 | 17.4 | 17.3 | | | | | |
| Previous Day's Observed Water Temperature at Date - 1 Day | 19.3 | 19.6 | 18.9 | 18.2 | 17.4 | 16.9 | | | | | |
| Current Day's Skins Lake Spillway Release at Date ($m^3/s$) | 49.0 | 49.0 to 227 @ 1600 hrs | 227 | 227 | 227 | 227 | 227 | | | | |

# APPENDIX B

## Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 2000

Appendix B
Mean Daily Water Temperatures in the Nechako and Nautley Rivers, 2000

| Date | Nechako River | | | Nautley | Date | Nechako River | | | Nautley |
|---|---|---|---|---|---|---|---|---|---|
| | Cheslatta Falls (°C) | Fort Fraser (°C) | above the Stuart River (°C) | Fort Fraser (°C) | | Cheslatta Falls (°C) | Fort Fraser (°C) | above Stuart River (°C) | Fort Fraser (°C) |
| 10-Jul | 15.7 | 17.3 | 19.3 | 17.2 | 01-Aug | 16.6 | 16.9 | 17.9 | 17.1 |
| 11-Jul | 16.3 | 17.7 | 19.6 | 18.1 | 02-Aug | 16.6 | 17.3 | 17.4 | 17.9 |
| 12-Jul | 16.1 | 16.9 | 18.9 | 17.8 | 03-Aug | 16.8 | 18.3 | 18.2 | 18.5 |
| 13-Jul | 15.8 | 16.5 | 18.2 | 16.8 | 04-Aug | 17.2 | 19.0 | 18.8 | 19.8 |
| 14-Jul | 15.3 | 15.6 | 17.4 | 15.6 | 05-Aug | 17.7 | 19.6 | 20.2 | 20.5 |
| 15-Jul | 15.5 | 16.2 | 16.9 | 15.9 | 06-Aug | 17.9 | 19.8 | 20.7 | 20.3 |
| 16-Jul | 15.7 | 17.2 | 17.2 | 16.8 | 07-Aug | 17.8 | 19.2 | 20.5 | 19.8 |
| 17-Jul | 15.7 | 17.3 | 17.8 | 17.6 | 08-Aug | 17.8 | 19.2 | 20.0 | 19.5 |
| 18-Jul | 16.0 | 17.9 | 18.8 | 17.8 | 09-Aug | 17.7 | 18.1 | 19.4 | 19.1 |
| 19-Jul | 16.3 | 17.6 | 19.5 | 17.8 | 10-Aug | 17.6 | 17.9 | 18.3 | 19.3 |
| 20-Jul | 16.3 | 17.8 | 19.4 | 18.3 | 11-Aug | 17.6 | 17.9 | 18.2 | 19.3 |
| 21-Jul | 16.4 | 18.2 | 19.7 | 18.7 | 12-Aug | 17.5 | 17.9 | 17.7 | 18.6 |
| 22-Jul | 16.7 | 18.7 | 19.9 | 19.2 | 13-Aug | 17.5 | 17.6 | 17.7 | 18.2 |
| 23-Jul | 16.8 | 18.3 | 19.2 | 18.5 | 14-Aug | 17.5 | 17.8 | 17.3 | 18.4 |
| 24-Jul | 16.9 | 18.1 | 19.1 | 18.5 | 15-Aug | 17.4 | 18.2 | 17.7 | 18.2 |
| 25-Jul | 16.7 | 17.9 | 19.1 | 18.8 | 16-Aug | 17.3 | 18.3 | 17.8 | 18.1 |
| 26-Jul | 16.8 | 17.7 | 18.8 | 18.8 | 17-Aug | 17.2 | 17.8 | 17.7 | 18.3 |
| 27-Jul | 16.6 | 17.6 | 18.6 | 17.8 | 18-Aug | 16.9 | 17.3 | 17.3 | 17.8 |
| 28-Jul | 16.6 | 17.1 | 17.9 | 18.3 | 19-Aug | 16.8 | 16.8 | 16.6 | 17.8 |
| 29-Jul | 16.7 | 17.4 | 17.8 | 18.3 | 20-Aug | 16.5 | 16.3 | 15.9 | 16.6 |
| 30-Jul | 16.6 | 18.2 | 18.2 | 18.3 | | | | | |
| 31-Jul | 16.7 | 18.2 | 18.9 | 18.5 | | | | | |

n/a denotes that datum is unavailable

# APPENDIX C

## Mean Daily Skins Lake Spillway Releases and Flows in the Nechako and Nautley Rivers, 2000

Appendix C
Mean Daily Skins Lake Spillway Releases and Flows in the Nechako and Nautley Rivers, 2000

| Date | Skins Lake Spillway Release ($m^3/s$) | Nechako River | | Nautley |
|---|---|---|---|---|
| | | Cheslatta Falls ($m^3/s$) | At Vanderhoof ($m^3/s$) | Fort Fraser ($m^3/s$) |
| 10-Jul | 49.0 | 50.9 | 110 | 35.9 |
| 11-Jul | 49.0 to 227 @ 1600 hrs | 51.6 | 109 | 35.9 |
| 12-Jul | 227 | 51.6 | 107 | 35.0 |
| 13-Jul | 227 | 64.0 | 106 | 34.1 |
| 14-Jul | 227 | 82.2 | 113 | 34.1 |
| 15-Jul | 227 | 100.0 | 133 | 34.1 |
| 16-Jul | 227 | 113 | 157 | 33.2 |
| 17-Jul | 227 | 130 | 177 | 32.4 |
| 18-Jul | 227 | 145 | 188 | 31.5 |
| 19-Jul | 227 to 170 @ 1600 hrs | 160 | 200 | 31.5 |
| 20-Jul | 170 | 170 | 215 | 30.7 |
| 21-Jul | 170 | 171 | 225 | 29.8 |
| 22-Jul | 170 | 171 | 230 | 29.8 |
| 23-Jul | 170 | 171 | 235 | 31.5 |
| 24-Jul | 170 | 171 | 231 | 28.2 |
| 25-Jul | 170 | 171 | 230 | 28.2 |
| 26-Jul | 170 | 172 | 230 | 27.5 |
| 27-Jul | 170 | 171 | 230 | 27.5 |
| 28-Jul | 170 to 453 @ 1600 hrs | 172 | 230 | 27.5 |
| 29-Jul | 453 to 14.2 @ 1330 hrs | 179 | 230 | 26.7 |
| 30-Jul | 14.2 to 170 @ 2000 hrs | 202 | 230 | 26.7 |
| 31-Jul | 170 | 181 | 255 | 26.0 |
| 01-Aug | 170 | 175 | 257 | 28.2 |
| 02-Aug | 170 | 174 | 241 | 26.7 |
| 03-Aug | 170 | 172 | 236 | 26.0 |
| 04-Aug | 170 to 453 @ 1600 hrs | 171 | 236 | 26.0 |
| 05-Aug | 453 | 179 | 234 | 25.3 |
| 06-Aug | 453 | 226 | 235 | 26.0 |
| 07-Aug | 453 to 283 @ 1030 hrs<br>283 to 14.2 @ 1600 hrs | 266 | 268 | 24.6 |
| 08-Aug | 14.2 | 284 | 311 | 23.9 |
| 09-Aug | 14.2 | 244 | 342 | 23.3 |
| 10-Aug | 14.2 to 170 @ 1600 hrs | 208 | 326 | 22.6 |
| 11-Aug | 170 | 180 | 290 | 22.0 |
| 12-Aug | 170 | 171 | 254 | 22.0 |
| 13-Aug | 170 | 170 | 234 | 21.3 |
| 14-Aug | 170 | 168 | 226 | 20.7 |

Appendix C (continued)
Mean Daily Skins Lake Spillway Releases and Flows in the Nechako and Nautley Rivers, 2000

| Date | Skins Lake Spillway Release ($m^3/s$) | Nechako River | | Nautley |
|---|---|---|---|---|
| | | Cheslatta Falls ($m^3/s$) | At Vanderhoof ($m^3/s$) | Fort Fraser ($m^3/s$) |
| 15-Aug | 170 | 167 | 223 | 20.7 |
| 16-Aug | 170 | 167 | 221 | 20.0 |
| 17-Aug | 170 to 14.2 @ 1600 hrs | 166 | 219 | 18.7 |
| 18-Aug | 14.2 | 164 | 218 | 19.4 |
| 19-Aug | 14.2 | 146 | 215 | 18.1 |
| 20-Aug | 14.2 | 130 | 204 | 18.1 |
| 21-Aug | 14.2 | 115 | 186 | 17.5 |
| 22-Aug | 14.2 | | | |
| 23-Aug | 14.2 | | | |
| 24-Aug | 14.2 | | | |
| 25-Aug | 14.2 | | | |
| 26-Aug | 14.2 | | | |
| 27-Aug | 14.2 | | | |
| 28-Aug | 14.2 | | | |
| 29-Aug | 14.2 | | | |
| 30-Aug | 14.2 | | | |
| 31-Aug | 14.2 | | | |
| 01-Sep | 14.2 to 32.5 @ 1600 hrs | | | |
| 02-Sep | 32.5 | | | |
| 03-Sep | 32.5 | | | |
| 04-Sep | 32.5 | | | |
| 05-Sep | 32.5 | | | |
| 06-Sep | 32.5 | | | |

n/a - data not available

# APPENDIX D
# Observed and Forecast Meterological Data

Appendix D
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.20 | 496.80 | 0.82 | 10.50 | 2.80 | 93.50 | 75.90 | 9 07 00 |
| 15.60 | 495.00 | 0.78 | 13.75 | 8.50 | 93.40 | 87.00 | 10 07 00 |
| 14.90 | 520.00 | 0.75 | 10.90 | 8.60 | 93.40 | 77.00 | |
| 15.20 | 400.00 | 0.88 | 11.50 | 5.20 | 93.30 | 79.00 | |
| 14.90 | 505.00 | 0.62 | 12.60 | 5.60 | 92.80 | 86.00 | |
| 15.70 | 460.00 | 0.81 | 11.40 | 5.90 | 93.00 | 75.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 10/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.50 | 501.20 | 0.86 | 12.50 | 8.40 | 93.30 | 79.00 | 10 07 00 |
| 15.40 | 510.00 | 0.65 | 8.00 | 10.00 | 93.51 | 61.00 | 11 07 00 |
| 15.80 | 440.00 | 0.75 | 10.00 | 6.00 | 93.37 | 68.00 | |
| 15.80 | 450.00 | 0.75 | 10.00 | 6.50 | 92.93 | 68.00 | |
| 15.60 | 470.00 | 0.72 | 9.80 | 6.50 | 93.08 | 68.00 | |
| 16.80 | 515.00 | 0.68 | 12.00 | 5.50 | 93.73 | 73.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 11/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.40 | 602.30 | 0.56 | 6.90 | 10.10 | 93.50 | 59.40 | 11 07 00 |
| 15.50 | 570.00 | 0.50 | 8.50 | 6.00 | 93.44 | 65.00 | 12 07 00 |
| 15.40 | 400.00 | 0.85 | 11.40 | 7.00 | 93.00 | 77.00 | |
| 15.00 | 460.00 | 0.80 | 9.00 | 7.50 | 93.06 | 67.00 | |
| 16.60 | 525.00 | 0.68 | 10.00 | 6.00 | 93.66 | 65.00 | |
| 16.60 | 600.00 | 0.50 | 6.00 | 3.00 | 93.99 | 50.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 12/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.10 | 520.30 | 0.43 | 8.50 | 4.50 | 93.50 | 72.00 | 12 07 00 |
| 13.20 | 280.00 | 0.90 | 11.40 | 7.00 | 93.30 | 84.00 | 13 07 00 |
| 13.40 | 425.00 | 0.87 | 9.00 | 7.50 | 93.10 | 67.00 | |
| 16.60 | 520.00 | 0.62 | 10.00 | 6.00 | 93.70 | 65.00 | |
| 16.60 | 580.00 | 0.45 | 6.00 | 3.00 | 93.90 | 50.00 | |
| 17.10 | 565.00 | 0.37 | 6.50 | 4.20 | 93.40 | 47.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 13/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13.20 | 280.00 | 0.85 | 11.40 | 3.70 | 93.30 | 89.00 | 13 07 00 |
| 13.10 | 380.00 | 0.81 | 9.20 | 20.50 | 93.60 | 78.00 | 14 07 00 |
| 16.40 | 520.00 | 0.62 | 8.70 | 4.60 | 94.10 | 68.00 | |
| 16.80 | 575.00 | 0.52 | 7.40 | 3.90 | 94.00 | 54.00 | |
| 16.30 | 590.00 | 0.46 | 6.90 | 4.40 | 93.80 | 48.00 | |
| 16.90 | 560.00 | 0.53 | 7.90 | 4.70 | 93.90 | 45.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 14/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12.00 | 245.90 | 0.89 | 8.50 | 16.50 | 93.80 | 80.30 | 14 07 00 |
| 13.80 | 480.00 | 0.60 | 8.00 | 7.00 | 94.30 | 68.00 | 15 07 00 |
| 16.00 | 575.00 | 0.35 | 7.10 | 5.00 | 94.10 | 56.00 | |
| 16.30 | 600.00 | 0.40 | 6.70 | 4.50 | 94.00 | 53.00 | |
| 17.00 | 610.00 | 0.45 | 7.00 | 4.40 | 93.90 | 52.00 | |
| 17.50 | 590.00 | 0.52 | 7.50 | 4.50 | 93.70 | 52.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 15/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.10 | 617.20 | 0.84 | 9.30 | 11.50 | 94.10 | 74.00 | 15 07 00 |
| 14.60 | 400.00 | 0.70 | 8.10 | 7.30 | 94.00 | 71.00 | 16 07 00 |
| 16.00 | 530.00 | 0.43 | 7.30 | 6.00 | 93.80 | 56.00 | |
| 16.70 | 610.00 | 0.40 | 7.00 | 5.50 | 94.10 | 53.00 | |
| 17.30 | 590.00 | 0.45 | 7.50 | 5.50 | 94.00 | 53.00 | |
| 17.50 | 570.00 | 0.45 | 7.70 | 5.00 | 94.20 | 53.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 16/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.30 | 527.60 | 0.65 | 8.60 | 5.40 | 93.90 | 66.10 | 16 07 00 |
| 15.00 | 650.00 | 0.25 | 7.60 | 3.00 | 93.70 | 61.00 | 17 07 00 |
| 16.00 | 550.00 | 0.40 | 8.00 | 4.00 | 93.70 | 59.00 | |
| 16.50 | 500.00 | 0.55 | 8.50 | 4.00 | 93.90 | 59.00 | |
| 17.00 | 600.00 | 0.30 | 8.20 | 6.00 | 94.00 | 56.00 | |
| 17.50 | 550.00 | 0.40 | 8.50 | 8.00 | 93.90 | 57.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 17/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.80 | 633.30 | 0.35 | 8.10 | 2.30 | 93.70 | 67.20 | 17 07 00 |
| 18.00 | 475.00 | 0.70 | 10.50 | 3.00 | 93.70 | 62.00 | 18 07 00 |
| 17.50 | 400.00 | 0.80 | 11.00 | 6.00 | 93.90 | 66.00 | |
| 17.50 | 550.00 | 0.60 | 10.50 | 10.00 | 94.00 | 63.00 | |
| 17.00 | 500.00 | 0.70 | 11.00 | 10.00 | 93.80 | 68.00 | |
| 16.50 | 400.00 | 0.80 | 11.50 | 10.00 | 93.60 | 72.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 18/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18.70 | 534.20 | 0.78 | 11.40 | 4.70 | 93.70 | 64.70 | 18 07 00 |
| 20.50 | 400.00 | 0.70 | 11.50 | 7.00 | 93.70 | 55.00 | 19 07 00 |
| 19.00 | 500.00 | 0.60 | 12.50 | 8.00 | 93.80 | 68.00 | |
| 18.00 | 450.00 | 0.60 | 11.00 | 10.00 | 93.60 | 60.00 | |
| 17.00 | 400.00 | 0.75 | 12.00 | 12.00 | 93.60 | 72.00 | |
| 18.00 | 430.00 | 0.60 | 11.00 | 9.00 | 93.80 | 60.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 19/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19.50 | 378.80 | 0.80 | 12.20 | 7.80 | 93.90 | 64.00 | 19 07 00 |
| 18.70 | 400.00 | 0.80 | 13.00 | 9.00 | 93.70 | 70.00 | 20 07 00 |
| 19.00 | 475.00 | 0.70 | 12.00 | 9.00 | 93.50 | 64.00 | |
| 18.00 | 370.00 | 0.85 | 12.50 | 10.00 | 93.50 | 70.00 | |
| 17.00 | 450.00 | 0.65 | 10.00 | 9.00 | 94.00 | 63.00 | |
| 16.00 | 420.00 | 0.80 | 11.00 | 10.00 | 94.10 | 73.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 20/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18.50 | 508.60 | 0.50 | 12.50 | 7.40 | 93.80 | 71.00 | 20 07 00 |
| 19.00 | 540.00 | 0.50 | 11.00 | 9.00 | 93.58 | 60.00 | 21 07 00 |
| 19.00 | 450.00 | 0.75 | 12.30 | 9.00 | 93.25 | 65.00 | |
| 17.70 | 450.00 | 0.70 | 10.00 | 11.00 | 93.78 | 61.00 | |
| 15.80 | 360.00 | 0.85 | 10.80 | 9.00 | 93.80 | 72.00 | |
| 15.70 | 450.00 | 0.60 | 9.00 | 7.50 | 93.13 | 64.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 21/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18.80 | 678.00 | 0.33 | 10.50 | 4.50 | 93.60 | 60.90 | 21 07 00 |
| 18.70 | 500.00 | 0.65 | 12.30 | 11.00 | 93.30 | 66.00 | 22 07 00 |
| 17.00 | 400.00 | 0.73 | 11.00 | 13.00 | 93.50 | 68.00 | |
| 16.30 | 360.00 | 0.80 | 10.80 | 9.00 | 93.70 | 70.00 | |
| 16.00 | 440.00 | 0.65 | 9.00 | 6.50 | 93.00 | 63.00 | |
| 16.00 | 490.00 | 0.55 | 9.00 | 6.00 | 92.88 | 63.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 22/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18.80 | 453.30 | 0.56 | 12.70 | 9.60 | 92.30 | 70.00 | 22 07 00 |
| 16.50 | 430.00 | 0.76 | 11.40 | 8.10 | 93.50 | 74.00 | 23 07 00 |
| 16.80 | 390.00 | 0.72 | 10.60 | 8.60 | 93.80 | 72.00 | |
| 16.20 | 430.00 | 0.78 | 9.40 | 6.20 | 93.00 | 72.00 | |
| 16.20 | 420.00 | 0.71 | 10.00 | 7.00 | 92.90 | 70.00 | |
| 16.60 | 475.00 | 0.69 | 11.10 | 7.20 | 93.70 | 72.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 23/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.90 | 661.40 | 0.51 | 10.50 | 10.60 | 93.60 | 65.00 | 23 07 00 |
| 18.20 | 520.00 | 0.45 | 10.80 | 9.40 | 93.90 | 64.00 | 24 07 00 |
| 16.40 | 400.00 | 0.81 | 10.20 | 6.80 | 93.30 | 76.00 | |
| 16.30 | 420.00 | 0.77 | 10.40 | 7.10 | 92.90 | 72.00 | |
| 16.60 | 440.00 | 0.72 | 10.80 | 7.20 | 93.30 | 75.00 | |
| 16.50 | 415.00 | 0.74 | 10.50 | 7.40 | 92.90 | 77.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 24/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.70 | 539.50 | 0.39 | 10.10 | 7.00 | 93.80 | 63.00 | 24 07 00 |
| 15.80 | 390.00 | 0.85 | 11.00 | 7.00 | 93.20 | 73.00 | 25 07 00 |
| 15.40 | 380.00 | 0.85 | 12.00 | 7.20 | 92.90 | 80.00 | |
| 15.70 | 360.00 | 0.89 | 11.50 | 7.20 | 93.00 | 76.00 | |
| 16.00 | 400.00 | 0.70 | 11.50 | 7.40 | 93.40 | 75.00 | |
| 17.20 | 460.00 | 0.40 | 10.00 | 10.00 | 94.00 | 63.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 25/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.50 | 389.40 | 0.57 | 10.90 | 2.50 | 93.20 | 71.00 | 25 07 00 |
| 16.60 | 400.00 | 0.77 | 11.50 | 8.50 | 93.10 | 72.00 | 26 07 00 |
| 15.70 | 340.00 | 0.89 | 11.70 | 7.80 | 93.20 | 71.00 | |
| 16.40 | 410.00 | 0.65 | 11.00 | 8.30 | 93.70 | 70.00 | |
| 17.40 | 480.00 | 0.38 | 10.00 | 8.00 | 94.00 | 62.00 | |
| 18.00 | 480.00 | 0.40 | 10.70 | 5.00 | 93.80 | 62.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 26/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.70 | 427.80 | 0.74 | 10.90 | 8.30 | 92.90 | 71.30 | 26 07 00 |
| 16.30 | 300.00 | 0.90 | 11.80 | 12.80 | 92.90 | 75.00 | 27 07 00 |
| 16.00 | 390.00 | 0.78 | 11.50 | 8.00 | 93.30 | 75.00 | |
| 17.00 | 520.00 | 0.40 | 10.00 | 8.00 | 94.00 | 62.00 | |
| 17.50 | 440.00 | 0.50 | 10.70 | 5.00 | 93.80 | 65.00 | |
| 17.50 | 480.00 | 0.40 | 10.00 | 6.00 | 93.70 | 61.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 27/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.00 | 225.70 | 0.90 | 11.10 | 15.20 | 92.90 | 69.10 | 27 07 00 |
| 17.60 | 550.00 | 0.46 | 8.10 | 8.00 | 93.50 | 54.00 | 28 07 00 |
| 17.50 | 550.00 | 0.40 | 8.40 | 6.00 | 93.90 | 55.00 | |
| 18.00 | 450.00 | 0.60 | 9.50 | 5.00 | 93.80 | 60.00 | |
| 18.50 | 550.00 | 0.40 | 9.50 | 3.00 | 94.10 | 56.00 | |
| 18.50 | 500.00 | 0.50 | 9.50 | 6.00 | 93.80 | 56.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 28/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.90 | 500.90 | 0.55 | 8.40 | 9.50 | 93.40 | 59.00 | 28 07 00 |
| 15.20 | 500.00 | 0.60 | 6.70 | 8.50 | 93.90 | 58.00 | 29 07 00 |
| 17.00 | 450.00 | 0.55 | 9.00 | 6.00 | 93.70 | 57.00 | |
| 17.00 | 500.00 | 0.50 | 9.50 | 6.00 | 94.00 | 61.00 | |
| 17.50 | 500.00 | 0.50 | 8.50 | 6.50 | 93.90 | 56.00 | |
| 16.00 | 450.00 | 0.60 | 6.50 | 6.00 | 93.80 | 53.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 29/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.60 | 590.80 | 0.56 | 6.50 | 9.50 | 93.80 | 56.60 | 29 07 00 |
| 15.70 | 550.00 | 0.42 | 8.70 | 3.50 | 93.90 | 63.00 | 30 07 00 |
| 17.00 | 480.00 | 0.50 | 9.90 | 7.00 | 93.70 | 63.00 | |
| 16.00 | 450.00 | 0.60 | 9.00 | 7.50 | 93.90 | 60.00 | |
| 15.00 | 470.00 | 0.60 | 6.50 | 6.00 | 93.80 | 55.00 | |
| 16.00 | 500.00 | 0.45 | 7.50 | 7.00 | 93.50 | 57.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 30/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.30 | 543.70 | 0.38 | 9.10 | 1.90 | 93.80 | 66.60 | 30 07 00 |
| 18.00 | 480.00 | 0.46 | 11.50 | 12.00 | 93.50 | 66.00 | 31 07 00 |
| 17.00 | 450.00 | 0.62 | 10.00 | 9.00 | 93.97 | 63.00 | |
| 15.20 | 440.00 | 0.70 | 8.00 | 6.00 | 94.00 | 62.00 | |
| 16.60 | 500.00 | 0.47 | 8.00 | 7.00 | 93.60 | 57.00 | |
| 17.50 | 530.00 | 0.40 | 7.80 | 5.00 | 93.65 | 53.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED JUL 31/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18.30 | 388.70 | 0.49 | 12.60 | 12.80 | 93.50 | 72.00 | 31 07 00 |
| 15.20 | 400.00 | 0.67 | 8.80 | 14.40 | 93.80 | 73.00 | 01 08 00 |
| 15.30 | 420.00 | 0.70 | 8.10 | 7.50 | 93.50 | 74.00 | |
| 16.90 | 480.00 | 0.57 | 9.60 | 7.20 | 93.40 | 66.00 | |
| 17.60 | 530.00 | 0.41 | 8.00 | 5.10 | 93.70 | 58.00 | |
| 17.90 | 520.00 | 0.42 | 8.20 | 6.10 | 93.60 | 50.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 01/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11.40 | 248.00 | 0.98 | 10.00 | 17.20 | 93.90 | 91.00 | 01 08 00 |
| 13.80 | 420.00 | 0.68 | 9.80 | 4.00 | 94.00 | 84.00 | 02 08 00 |
| 16.60 | 475.00 | 0.55 | 10.00 | 8.20 | 93.40 | 76.00 | |
| 17.80 | 530.00 | 0.39 | 9.10 | 5.20 | 93.70 | 56.00 | |
| 17.50 | 540.00 | 0.20 | 8.00 | 5.50 | 93.80 | 48.00 | |
| 16.70 | 400.00 | 0.71 | 9.00 | 9.00 | 93.50 | 73.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 02/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.20 | 551.90 | 0.64 | 9.70 | 3.20 | 94.00 | 77.00 | 02 08 00 |
| 16.90 | 420.00 | 0.69 | 12.80 | 5.90 | 93.80 | 76.00 | 03 08 00 |
| 17.90 | 440.00 | 0.62 | 10.40 | 7.30 | 93.80 | 65.00 | |
| 17.30 | 540.00 | 0.33 | 8.80 | 6.50 | 93.70 | 58.00 | |
| 16.80 | 465.00 | 0.57 | 9.20 | 8.00 | 93.60 | 63.00 | |
| 17.00 | 535.00 | 0.36 | 9.40 | 7.50 | 93.80 | 56.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 03/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18.00 | 588.70 | 0.43 | 12.30 | 3.70 | 93.70 | 72.00 | 03 08 00 |
| 18.50 | 600.00 | 0.10 | 13.00 | 4.00 | 93.50 | 70.00 | 04 08 00 |
| 18.00 | 560.00 | 0.20 | 11.00 | 8.00 | 93.40 | 64.00 | |
| 17.10 | 510.00 | 0.35 | 10.20 | 7.00 | 93.50 | 64.00 | |
| 17.60 | 575.00 | 0.30 | 11.20 | 6.00 | 93.20 | 66.00 | |
| 17.30 | 540.00 | 0.40 | 12.00 | 7.50 | 93.10 | 70.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 04/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19.40 | 629.40 | 0.09 | 11.40 | 3.30 | 93.40 | 65.00 | 04 08 00 |
| 19.80 | 575.00 | 0.25 | 12.00 | 15.00 | 93.40 | 60.00 | 05 08 00 |
| 17.30 | 520.00 | 0.38 | 10.70 | 8.00 | 93.50 | 65.00 | |
| 18.10 | 575.00 | 0.28 | 11.50 | 6.00 | 93.40 | 65.00 | |
| 18.00 | 530.00 | 0.42 | 12.50 | 6.50 | 93.60 | 71.00 | |
| 18.50 | 530.00 | 0.48 | 12.80 | 5.50 | 93.10 | 70.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 05/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21.70 | 614.20 | 0.18 | 11.80 | 10.00 | 93.30 | 57.60 | 05 08 00 |
| 20.50 | 550.00 | 0.30 | 10.50 | 9.00 | 93.30 | 55.00 | 06 08 00 |
| 18.50 | 575.00 | 0.30 | 10.50 | 5.00 | 93.40 | 60.00 | |
| 18.00 | 530.00 | 0.40 | 12.00 | 4.00 | 93.30 | 65.00 | |
| 19.00 | 500.00 | 0.55 | 12.50 | 8.00 | 93.10 | 70.00 | |
| 17.50 | 450.00 | 0.65 | 11.00 | 6.00 | 93.20 | 75.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 06/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 20.80 | 602.50 | 0.40 | 11.00 | 7.10 | 93.20 | 54.30 | 06 08 00 |
| 20.00 | 500.00 | 0.60 | 9.50 | 8.00 | 93.10 | 52.00 | 07 08 00 |
| 18.00 | 480.00 | 0.65 | 9.00 | 4.00 | 93.20 | 50.00 | |
| 17.00 | 450.00 | 0.70 | 10.00 | 8.00 | 93.00 | 60.00 | |
| 16.50 | 470.00 | 0.60 | 9.50 | 8.00 | 93.20 | 70.00 | |
| 15.50 | 380.00 | 0.80 | 10.00 | 6.00 | 93.40 | 75.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 07/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19.40 | 586.30 | 0.52 | 9.10 | 7.20 | 93.00 | 54.30 | 07 08 00 |
| 17.00 | 460.00 | 0.60 | 10.00 | 7.00 | 93.16 | 63.00 | 08 08 00 |
| 16.70 | 430.00 | 0.75 | 11.50 | 8.50 | 93.07 | 71.00 | |
| 15.80 | 430.00 | 0.70 | 9.50 | 8.00 | 93.26 | 66.00 | |
| 14.80 | 330.00 | 0.90 | 9.00 | 5.50 | 93.48 | 68.00 | |
| 15.30 | 400.00 | 0.68 | 7.50 | 5.00 | 93.82 | 60.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 08/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.00 | 424.40 | 0.56 | 8.90 | 7.40 | 93.20 | 61.70 | 08 08 00 |
| 16.50 | 450.00 | 0.63 | 9.50 | 8.50 | 93.15 | 68.00 | 09 08 00 |
| 15.30 | 420.00 | 0.70 | 8.80 | 7.50 | 93.38 | 65.00 | |
| 14.90 | 350.00 | 0.85 | 8.70 | 6.00 | 93.57 | 66.00 | |
| 14.60 | 360.00 | 0.80 | 8.50 | 5.50 | 93.75 | 67.00 | |
| 15.00 | 420.00 | 0.65 | 8.00 | 7.00 | 93.52 | 63.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 09/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.80 | 525.70 | 0.33 | 6.80 | 7.80 | 93.20 | 58.00 | 09 08 00 |
| 13.00 | 550.00 | 0.30 | 5.80 | 4.00 | 93.40 | 65.00 | 10 08 00 |
| 14.00 | 360.00 | 0.80 | 7.50 | 7.00 | 93.60 | 70.00 | |
| 14.50 | 380.00 | 0.70 | 9.00 | 6.00 | 93.80 | 65.00 | |
| 15.00 | 400.00 | 0.70 | 8.00 | 8.00 | 93.60 | 70.00 | |
| 15.50 | 450.00 | 0.60 | 9.00 | 12.00 | 93.40 | 60.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 10/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12.90 | 623.70 | 0.28 | 5.20 | 5.20 | 93.40 | 62.80 | 10 08 00 |
| 13.30 | 410.00 | 0.70 | 7.00 | 6.00 | 93.50 | 70.00 | 11 08 00 |
| 13.50 | 430.00 | 0.60 | 8.50 | 5.00 | 93.70 | 65.00 | |
| 13.50 | 380.00 | 0.70 | 8.00 | 10.00 | 93.50 | 70.00 | |
| 13.00 | 450.00 | 0.60 | 9.00 | 10.00 | 93.40 | 60.00 | |
| 14.50 | 470.00 | 0.60 | 9.50 | 5.00 | 93.50 | 55.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 11/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12.50 | 400.80 | 0.68 | 8.20 | 6.00 | 93.60 | 76.20 | 11 08 00 |
| 11.80 | 450.00 | 0.55 | 7.50 | 6.50 | 93.90 | 72.00 | 12 08 00 |
| 12.50 | 390.00 | 0.60 | 8.00 | 9.00 | 93.60 | 70.00 | |
| 13.50 | 430.00 | 0.55 | 9.00 | 10.00 | 93.70 | 65.00 | |
| 14.50 | 410.00 | 0.60 | 9.00 | 6.00 | 94.00 | 60.00 | |
| 15.50 | 570.00 | 0.30 | 8.50 | 3.00 | 94.30 | 55.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 12/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12.30 | 395.90 | 0.47 | 7.00 | 7.30 | 93.70 | 73.00 | 12 08 00 |
| 13.20 | 440.00 | 0.68 | 8.90 | 7.10 | 93.60 | 72.00 | 13 08 00 |
| 13.80 | 490.00 | 0.45 | 8.50 | 9.40 | 93.80 | 60.00 | |
| 15.00 | 480.00 | 0.52 | 9.00 | 6.80 | 94.00 | 50.00 | |
| 15.80 | 530.00 | 0.35 | 8.80 | 3.50 | 94.30 | 55.00 | |
| 16.00 | 500.00 | 0.40 | 9.00 | 5.50 | 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 13/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12.80 | 512.70 | 0.70 | 7.10 | 4.90 | 93.60 | 71.50 | 13 08 00 |
| 13.10 | 550.00 | 0.27 | 6.40 | 10.40 | 93.70 | 64.00 | 14 08 00 |
| 14.00 | 500.00 | 0.40 | 7.20 | 8.00 | 93.90 | 64.00 | |
| 14.50 | 480.00 | 0.50 | 7.60 | 6.00 | 94.10 | 63.00 | |
| 15.00 | 460.00 | 0.60 | 8.00 | 6.00 | 93.90 | 63.00 | |
| 14.50 | 420.00 | 0.65 | 8.00 | 8.00 | 93.70 | 66.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 14/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.00 | 486.70 | 0.28 | 6.60 | 11.30 | 93.60 | 64.00 | 14 08 00 |
| 15.50 | 480.00 | 0.59 | 7.90 | 3.00 | 93.90 | 61.00 | 15 08 00 |
| 16.00 | 460.00 | 0.62 | 8.20 | 6.00 | 94.20 | 60.00 | |
| 15.50 | 420.00 | 0.65 | 8.00 | 8.00 | 94.00 | 61.00 | |
| 14.00 | 400.00 | 0.65 | 7.50 | 10.00 | 93.60 | 65.00 | |
| 13.00 | 350.00 | 0.70 | 8.00 | 10.00 | 93.50 | 72.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 15/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.60 | 457.60 | 0.60 | 8.10 | 2.40 | 93.80 | 63.00 | 15 08 00 |
| 15.00 | 470.00 | 0.60 | 8.30 | 3.00 | 94.00 | 64.00 | 16 08 00 |
| 15.00 | 450.00 | 0.65 | 8.50 | 10.00 | 93.70 | 65.00 | |
| 14.50 | 400.00 | 0.65 | 8.00 | 10.00 | 93.40 | 65.00 | |
| 14.00 | 350.00 | 0.70 | 8.00 | 8.00 | 93.40 | 67.00 | |
| 13.00 | 330.00 | 0.75 | 8.00 | 8.00 | 93.50 | 72.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 16/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.00 | 378.60 | 0.70 | 9.60 | 2.20 | 94.00 | 68.00 | 16 08 00 |
| 15.80 | 420.00 | 0.84 | 10.60 | 6.00 | 93.40 | 71.00 | 17 08 00 |
| 15.00 | 400.00 | 0.80 | 9.50 | 8.00 | 92.90 | 70.00 | |
| 14.00 | 350.00 | 0.80 | 7.50 | 12.00 | 92.90 | 65.00 | |
| 13.00 | 330.00 | 0.85 | 8.00 | 10.00 | 93.20 | 72.00 | |
| 12.50 | 400.00 | 0.65 | 6.50 | 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 AUG 17/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.80 | 325.00 | 0.88 | 9.10 | 5.50 | 93.40 | 70.50 | 17 08 00 |
| 13.50 | 350.00 | 0.70 | 8.50 | 7.00 | 92.94 | 72.00 | 18 08 00 |
| 13.00 | 300.00 | 0.90 | 8.00 | 10.00 | 93.12 | 72.00 | |
| 12.70 | 350.00 | 0.75 | 7.50 | 9.00 | 93.55 | 71.00 | |
| 12.30 | 390.00 | 0.70 | 7.00 | 6.80 | 93.51 | 70.00 | |
| 14.00 | 370.00 | 0.80 | 8.30 | 7.00 | 93.01 | 69.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 18/00

Appendix D (continued)
Observed and Forecast Meterological Data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 10.80 | 246.20 | 0.74 | 8.20 | 6.00 | 93.00 | 84.80 | 18 08 00 |
| 11.00 | 290.00 | 0.85 | 8.50 | 10.00 | 93.20 | 88.00 | 19 08 00 |
| 11.80 | 380.00 | 0.70 | 7.50 | 12.00 | 93.40 | 78.00 | |
| 12.50 | 360.00 | 0.75 | 8.50 | 9.00 | 93.50 | 75.00 | |
| 13.80 | 330.00 | 0.85 | 9.00 | 9.00 | 93.20 | 80.00 | |
| 12.80 | 400.00 | 0.65 | 7.50 | 6.50 | 93.20 | 70.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 19/00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11.30 | 410.70 | 0.81 | 8.10 | 13.30 | 93.10 | 82.20 | 19 08 00 |
| 11.80 | 370.00 | 0.75 | 7.50 | 13.50 | 93.70 | 72.00 | 20 08 00 |
| 12.50 | 380.00 | 0.75 | 8.20 | 7.00 | 93.60 | 75.00 | |
| 13.80 | 400.00 | 0.60 | 8.00 | 5.00 | 93.50 | 72.00 | |
| 13.50 | 450.00 | 0.50 | 7.50 | 5.00 | 93.40 | 65.00 | |
| 14.20 | 570.00 | 0.20 | 6.50 | 6.00 | 93.70 | 55.00 | |
| ATEMP(C) | RAD(LY) | CC(TTHS) | DPT(C) | SPD(KH) | SPR(KPA) | RH(%) | DD MM YY |

WORLD WEATHERWATCH FORECAST ISSUED AUG 20/00

# APPENDIX E

## Summer Water Temperature and Flow Management Project Reservoir Release Volume Calculations for July 10 to August 20, 2000

Appendix E
Summer Water Temperature and Flow Management Project Reservoir Release
Volume Calculations for July 10 to August 20, 2000

Skins Lake Spillway base release for the period July 10 (192) to August 20 (233) = 49.0 $m^3/s$ (1,730 cfs)
Summer Water Temperature and Flow Management Project Base Release Volume = (233 - 191) * 49.0 = 2,058.0 $m^3/s*days$

| Time period (Julian Day) | Time (hrs) | Flow Rate ($m^3/s$) | Volume ($m^3/s*hrs$) |
|---|---|---|---|
| July 10 (192) @ 0000 hrs to July 11 (193) @ 1600 hrs | 40.0 | 49.0 | 1,960 |
| July 11 (193) @ 1600 hrs to July 19 (201) @ 1600 hrs | 192.0 | 227 | 43,584 |
| July 19 (201) @ 1600 hrs to July 28 (210) @ 1600 hrs | 216.0 | 170 | 36,720 |
| July 28 (210) @ 1600 hrs to July 29 (211) @ 1330 hrs | 21.5 | 453 | 9,740 |
| July 29 (211) @ 13300 hrs to July 30 (212) @ 2000 hrs | 30.5 | 14.2 | 433 |
| July 30 (212) @ 2000 hrs to August 4 (217) @ 1600 hrs | 116.0 | 170 | 19,720 |
| August 4 (217) @ 1600 hrs to August 7 (220) @ 1030 hrs | 66.5 | 453 | 30,125 |
| August 7 (220) @ 1030 hrs to August 7 (220) @ 1600 hrs | 5.5 | 283.0 | 1,556 |
| August 7 (220) @ 1600 hrs to August 10 (223) @ 1600 hrs | 72.0 | 14.2 | 1,022 |
| August 10 (223) @ 1600 hrs to August 17 (230) @ 1600 hrs | 168.0 | 170 | 28,560 |
| August 17 (230) @ 1600 hrs to August 20 (233) @ 2400 hrs | 80.0 | 14.2 | 1,136 |
| Total | 1,008 (42 days) | | 174,556 |

Total Release Volume = 174,556 $m^3/s*hrs$
= 7,273.2 $m^3/s*days$

Therefore, Volume Released for Cooling Purposes = Total Volume - Base Volume
= 7,273.2 - 2,058.0
= 5,215.2 $m^3/s*days$

Average Release over Summer Management Period (July 10 to August 20, 2000) = 7,273.2 $m^3/s*days$ / 42 days
= 173.2 $m^3/s$
= 6,115.5 cfs