NFCP Methods

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Nechako Fisheries Conservation Program Technical Committee

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Introduction

The NFCP has been managing water flows and monitoring the Nechako River Chinook population since 1988. The methodology is described in several documents including the 2005 Technical Data Review and the NFCP 5-year plans for 2007 - 2012 and 2012 - 2017. Methodological procedures have been extracted from existing NFCP documents and are summarized in this report. Additional descriptions of NFCP methods are available at www.nfcp.org

Summer Temperature Management Program

1.0 OBJECTIVE

The objective of the Summer Temperature Management Project is to moderate elevated water temperatures during sockeye migration by manipulating the timing and volume of reservoir water, through Skins Lake releases, into the Nechako River.

Gate changes at the Skins Lake Spillway are used to manage flows throughout the year, and water temperatures in the Nechako River from 20 July to 20 August. The goal is to keep water temperatures in the Nechako River at Finmore (upstream of the Stuart River confluence) at or below 20 °C.

2.0 RATIONALE

Cooler water temperatures optimize sockeye salmon survival during the migration period (mid July to mid August). The 1987 Settlement Agreement defines specific water temperature targets and protocol using computer modelling and weather forecasts to effectively reduce temperature related risks during the migration period.

Nechako River water temperatures are managed by scheduling large releases from the Skins Lake Spillway with the goal to maintain mean daily water temperatures at or below 20°C in the Nechako River upstream of the Stuart River. Decisions on flow releases from the Skins Lake Spillway are facilitated using a computer-based program and decision protocol as specified in the Settlement Agreement.

3.0 METHODS

3.1 Field Data Collection

Daily field operations involve collection of water temperature, air temperature, river stage, and meteorological data in the Nechako River basin, at a number of sites. Minimum and maximum water temperatures will be collected daily from recorders maintained in the Nechako River at Bert Irvine's (Water Survey of Canada (WSC) data collection platform), the Nechako River at Fort Fraser (upstream of Nautley River), the Nechako River at Finmore (upstream of Stuart River) and in the Nautley River. River stages will be collected daily for the Nautley and the Nechako River below Cheslatta Falls and at Vanderhoof, (from the WSC data collection platforms from the real time internet web site) and used to determine daily river flows at all three locations.

3.2 Weather Forecasts

World Weather Watch, based on data available from the Prince George Atmospheric Environmental Survey weather station, will provide meteorological forecasts. These data, in conjunction with satellite data, will be used each day to develop 5-day meteorological forecasts. These forecasts will be forwarded to Triton each day and entered into a computer database for use in the water temperature forecast model. Each file contains the previous day's observed data and the 5-day meteorological forecasts for the study area.

3.3 Temperature Predictions

The flow and temperature models are run each day with the new data to predict Nechako River water temperatures based on 5-day meteorological forecasts. The data used include observed water temperatures, observed flows and the current 5-day meteorological forecast. The models are then run to predict the expected water temperatures in the Nechako River at the Stuart confluence over the next 5 days. Changes to the releases at Skins Lake Spillway are made based on the results of daily modelling runs.

3.4 Flow Release Decisions

In order to achieve the required responsiveness of the system to moderate water temperatures at Finmore, it is necessary to 'surcharge' the Murray and Cheslatta Lake system in advance to establish a higher 'base' flow through the lake system. Flows at Cheslatta Falls are typically increased from approximately 56.6 $m^3 \cdot s^{-1}$ to 170 $m^3 \cdot s^{-1}$ by July 15 by increasing Skins Lake Spillway releases from early July levels to 227 $m^3 \cdot s^{-1}$ on July 11 and controlling the Spillway so that flows at Cheslatta Falls reach a minimum of 170 $m^3 \cdot s^{-1}$ on July 15. A 5-day lead in release time is required for temperature controls at Finmore because it takes about 5 days for a change in releases at SLS to have an effect at Finmore. Flows are then regulated at Skins Lake Spillway to maintain flows at Cheslatta Falls between 170 $m^3 \cdot s^{-1}$ and 283 $m^3 \cdot s^{-1}$ as typically required during the period July 20 to August 20. Decisions to increase or decrease flows between these limits are made based on the decision protocol discussed below or as influenced by the timing of sockeye runs for any particular year.

The predicted water temperature data produced by the models is used to arrive at decisions on the necessity for flow releases from the Skins Lake Spillway in excess of the summer 'base' flow. These decisions are made by following a decision "Protocol", defined in the Settlement Agreement on Page 4, Sub-Clause 5, and described in Chapter 2 "Methods", of Envirocon Technical Memorandum 1941/C, (summarized below).

The "Protocol" structures the procedure to be followed in arriving at a decision to release additional flows from the Skins Lake Spillway. Essentially, release decisions are reached by analyzing 3 trends developed using both predicted and observed temperature data. The trends analysis is necessary because of the generally decreasing accuracy of the meteorological forecasts from 1 to 5 days in the future. The 3 trends can best be explained by reference to Table 1 and the following summary:

i. the observed trend; developed from observed mean daily water temperatures measured in the Nechako River above the Stuart River each day (b_0,c_0,). The difference in observed water temperatures for the last two days is extrapolated over the next 5 days to determine the observed water temperature trend.

ii. the predicted trend; developed from the predicted water temperatures for the previous day and the following five days (c_s,c_1,c_2,c_3,c_4,c_5). These data represent the predicted trend.

iii. the forecast trend; developed from the difference between the current five-day and previous five-day predictions for the same calendar days (c_3 and b_4, c_2 and b_3, c_1 and b_2). The differences between forecasted data on coincident dates for the next 3 days only are averaged and added to the 5th day predicted temperature to determine the trend in forecasted temperatures.

Each day, predicted water temperatures for the 5-day forecast period will be checked and the 3 trends calculated. If 2 of the 3 trends indicated that the water temperature in the Nechako River at Finmore may exceed 19.4°C (67.0°F) then Rio Tinto Alcan is directed to increase the release. When this occurs the current day's release will be revised and the flow and temperature simulations re-run using the modified flow regime. Results of each day's final computer run will be subsequently used to initialize water temperatures for the following day's computer simulations.

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

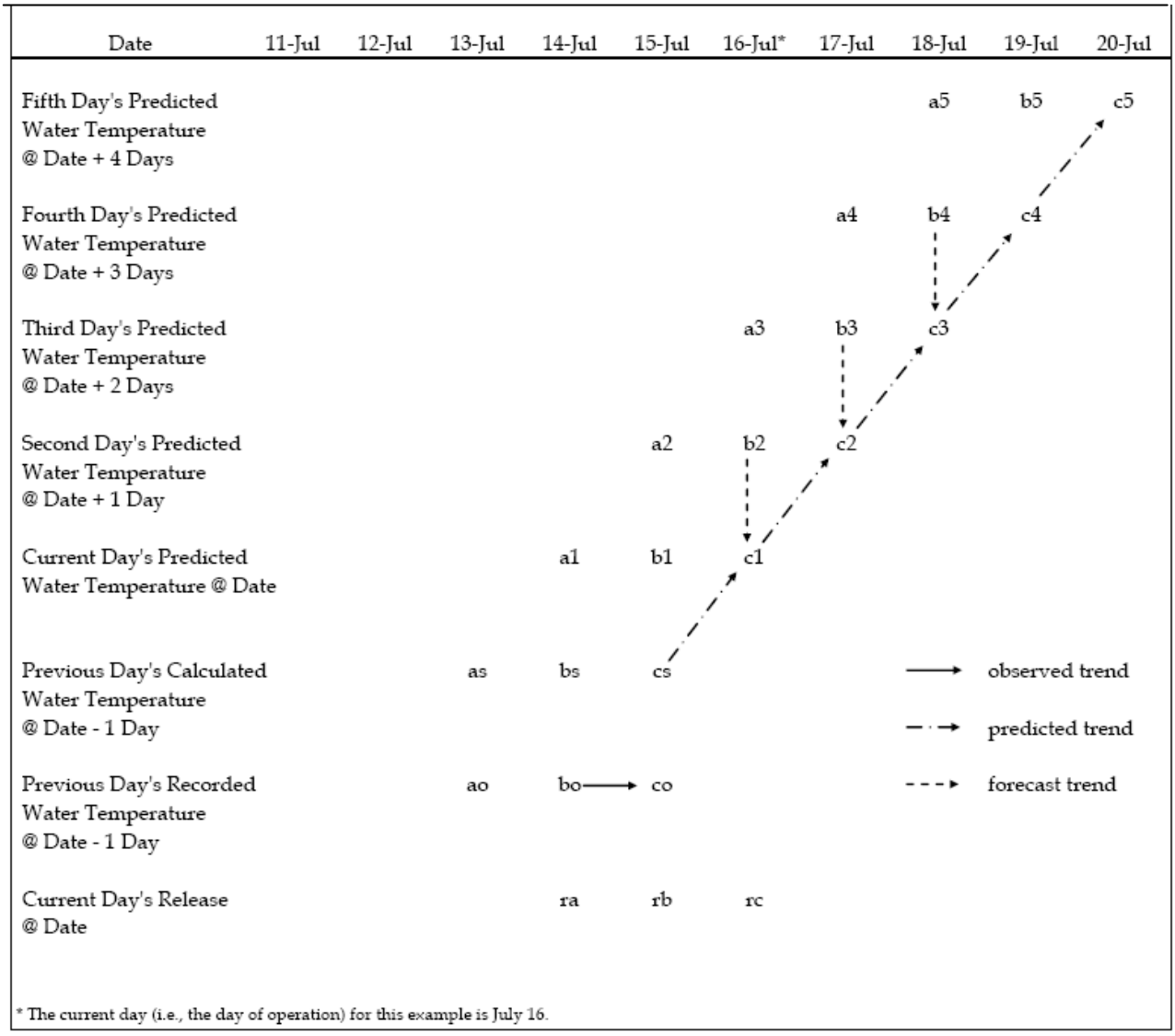
1. When 2 of the 3 trends show an increase in water temperature in the Nechako River above the Stuart River, and these trends show that potentially the water temperature could exceed 19.4°C (67.0°F), increase the Skins Lake Spillway release according to criteria 2 and 3 below.

2. Operate Skins Lake Spillway such that flow in the Nechako River below Cheslatta Falls ranges between 170 $m^3 \cdot s^{-1}$ (6,000 cfs) and 283 $m^3 \cdot s^{-1}$ (10,000 cfs) as required and flow in the Nechako River above the Stuart River does not exceed 340 $m^3 \cdot s^{-1}$ (12,000 cfs).

3. At any time of release, increase Skins Lake Spillway from the current level to 453 $m^3 \cdot s^{-1}$ (16,000 cfs) directly to achieve the flow changes in the Nechako River as fast as possible.

4. During cooling periods when 2 of 3 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 $m^3 \cdot s^{-1}$ (500 cfs).

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



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

Skins Lake Spillway releases are typically decreased to 14.2 $m^3 \cdot s^{-1}$ (500 cfs) within 3 days prior to the end of the water temperature control period (August 20) unless observed water temperatures in the Nechako River above Stuart River are in excess of 20°C (68°F) and are predicted to increase based on meteorological forecasts. The release is to be maintained at 14.2 $m^3 \cdot s^{-1}$ to ramp down the flows in the Nechako River below Cheslatta Falls to at or above 31.1 $m^3 \cdot s^{-1}$ by early September (usually on or before September 6). This approach has been implemented since the full effects of Skins Lake Spillway release changes cannot be achieved at the Stuart River confluence within the 5 day forecast period as a result of the flow routing time through the Cheslatta-Murray Lakes system and the Nechako River. Reducing the Skins Lake Spillway release prior to August 20 optimizes water use for both the NFCP annual water allocation and for Alcan's power production.

Flow Control

1.0 OBJECTIVE

The primary objectives are to determine the necessary adjustments to the Skins Lake Spillway release to meet the objectives for flow control in the Nechako River by monitoring Skins Lake Spillway releases and river flows and ensuring that the annual water allocation from the Nechako Reservoir is fully utilized.

2.0 RATIONALE

The Technical Committee is responsible for managing the release of the annual water allocation to the Nechako River during each annual water year (April 1 to March 31). The activities described below provide the necessary technical support to the Technical Committee to permit them to arrive at decisions regarding flow releases from the Skins Lake Spillway in order to fulfil this mandate.

During the spring and early summer of 1988, considerable effort was expended estimating the effect of different flow releases from the Skins Lake Spillway, in concert with different estimated inflow hydrographs from the Cheslatta-Murray Basin, on flows in the Nechako River below Cheslatta Falls. One of the primary results of this work was that due to the variable nature of the contributions of flow from the Cheslatta-Murray basin, little benefit could be realized in terms of maintaining a stable regime downstream from Cheslatta Falls by attempting month-to-month regulation of flows from the Skins Lake Spillway. However, work is required to: (a) choose the exact timing of increased flow releases following the start of the water budget year (April 1); (b) choose the monthly flow regime to be followed throughout the spring and summer; and (c) following the cessation of the cooling flow period in August, calculate the remainder of the water budget and set the flow for the rest of the year.

3.0 METHODS

Prior to April 1, the Nechako River is assessed for ice conditions and the progression of break-up. The timing of the increase in release above the winter release from Skins Lake Spillway is

dependent on these river ice conditions. Flows are increased after April 1 (typically mid to late April) to a constant level (approximately 49 $m^3 s^{-1}$) that is maintained until the cooling flow period in July. The exact timing of the April release is determined following road-based inspections at different locations along the Cheslatta Murray system to determine ice conditions. Following the cessation of the cooling flow period in August, the remainder of the water budget is calculated and the flows for the rest of the year are set.

Activities under this project are required on a periodic basis during the spring freshet period, from late March to late June. Typically, work is required over a period of 2 to 3 days immediately prior to the beginning of each calendar month. During this period, flows are estimated, recommendations are made to the Technical Committee, and the Technical Committee's decisions are communicated to Rio Tinto Alcan. For the remainder of the year, recorded releases from Skins Lake Spillway and flows in the Nechako River below Cheslatta Falls are obtained on a monthly and bi-weekly basis (daily during the summer water temperature management project), respectively. A summary of these flows are forwarded to the Technical Committee on a monthly basis.

Mean daily releases from Skins Lake Spillway and mean daily flows recorded at the WSC gauging station (#08JA017) in the Nechako River below Cheslatta Falls are tabulated on a monthly basis. These data are included in a report to be presented to the Technical Committee for review.

Should a discrepancy be observed in the fall (October) between measurements at the Skins Lake Spillway and at the WSC gauging station, it is proposed that the Water Survey of Canada under the direction of the Technical Committee, investigate the source of the discrepancy. This is done by measuring the discharge at the site established in Reach 1 of the Nechako River between Cheslatta Falls and Bert Irvine’s.

NFCP Flow Discrepancy

1.0 OBJECTIVE

The objective of this activity is to determine the cause of any discrepancy between gauge readings from the Skins Lake Spillway and the Nechako River below Cheslatta Falls monitoring stations.

2.0 RATIONALE

Should a flow discrepancy become apparent, field investigations are undertaken to investigate the discrepancy between gauge readings from the two monitoring stations.

Adult Chinook Spawner Enumeration

1.0 OBJECTIVE

The purpose of this activity is to provide an accurate estimate of the size, timing and distribution of the Nechako River Chinook spawning escapement. Helicopter counts of chinook spawners are conducted using methods consistent with previous years so as to allow year-to-year population comparison. The schedule for the flights is described within the 2007-2012 NFCP 5-year plan, specifically, 5 weekly helicopter flights are conducted throughout September and the first week of October.

2.0 RATIONALE

Knowledge of the population size is required to assess achievement of the Conservation Goal, as defined in the 1987 Settlement Agreement. The adult spawner enumeration project provides an annual estimate of the spawning escapement of Nechako River chinook salmon.

3.0 IMPLEMENTATION

3.1 Nechako River Aerial Estimate

Five helicopter counts are conducted on the Nechako River from Cheslatta Falls to Vanderhoof on a weekly basis, beginning the first week of September. Counts are conducted in a downstream direction since this has been found to maximize visibility. The target day for the weekly flights is Wednesday, and the tentative schedule of flights for 2015 is September 2, 9, 16, 23, and 30. However, the flights may be conducted on Tuesday or Thursday if it appears that weather conditions will be better for conducting the observations.

On each flight, two observers independently record spawner counts for each section. The highest count obtained by the two observers for each section is used for the escapement estimate. This procedure is based on the assumption that an experienced observer is more likely to miss counting a fish than to count an object that is not a fish. To maintain consistency each section is counted once. Chinook are counted and categorized as on redds, migrating/holding and carcasses. Following the area under the curve (AUC) method, the estimate is calculated using fish on redds only. Total live fish estimates provide information on run timing.

The AUC method is utilized, as it is considered the most accurate, reliable and cost-effective method of enumerating spawning salmon from aerial counts. The total number of spawners is equal to the area under a spawner-date curve divided by the 'survey life' or the average time that a fish resides in the area that was surveyed.

3.2 Residence Time

As outlined in the NFCP 5-year plan (2007-2012), there is low sensitivity of spawner estimates to the observed variations in residency time. Residence time was measured in 2009 to optimize the accuracy of the spawner estimate in anticipation of 2010 juvenile surveys. The estimate was

9.8 days, slightly below the long-term average of 10.6 days. Methods for undertaking this project are described in the 2005 Technical Data Review.

Chinook Carcass Recovery

1.0 OBJECTIVE

The purpose of the program is to collect biological data on size, sex, age, life history and egg retention of Nechako River Chinook salmon.

2.0 RATIONALE

Fish length and age data are obtained from scales to estimate the relative production of different Chinook year classes. The information is required for interpretation of enumeration results, as it indicates which brood years have contributed to the spawning population. Egg retention data serves as an indirect indicator of population or migration stresses and the quality of the spawning habitat.

3.0 IMPLEMENTATION

Carcass recovery is performed in two sample runs in order to collect carcasses from the early and late portions of the run-timing. Timing of these sample runs is determined based on timing of die-off, as observed during the helicopter flights conducted for the Adult Enumeration project.

The Nechako River carcass recovery is performed from Cheslatta Falls downstream to Vanderhoof. Sampling effort is divided between the upper, middle and lower sections of the river in proportion to the distribution of spawners, which is to be determined from the helicopter observations conducted for the Adult Enumeration project. A thorough search for dead chinook salmon is made including the examination of side channels. In deep-water areas, carcasses are recovered using long handled gaffs. To facilitate carcass recovery and biological sampling a two person crew is used. One person operates the boat and the other person observes and recovers carcasses.

There is a target of 200 scale samples. These are evenly split between male and female spawners. Upon recovery, carcasses are measured for postorbital-hypural length. Egg retention in both spawned and unspawned females is recorded. Ten scales are removed from each fish to permit determination of total age. In addition, the anterior dorsal fin ray is collected to provide a more accurate estimate of ocean residence.