

The Nautley River Hydrologic Control Review

November 2, 2017

Conducted by:

Kesgwut
RESOURCE MANAGEMENT



The Nautley River Hydrologic Control

Background

Kesgwut Resource Management (Kesgwut) retained T&T Surveys Ltd. (T&T) and Swiftwater Consulting Ltd. (Swiftwater) to complete a review of the Nautley River Hydrologic control, located at the outlet of Fraser Lake, on the Nautley River, near the township of Fort Fraser in central interior of British Columbia. The review was initiated in response to a public inquiry regarding water levels on Fraser Lake. An updated survey of the hydrologic control was completed by T&T, and the assessment was completed by Cameron McCarthy (M.A.Sc., P.Eng., P.Geo.), President of Swiftwater.

The Nautley Hydrologic control

Fraser Lake is an east-west tending lake with a surface area of approximately 53 km² and a circumference of 62 km. The Nautley River is the outlet of Fraser Lake on its eastern end, and is a very small reach connecting Fraser Lake to the Nechako River. The river is entirely contained within the Nadleh Whut'en First Nation reserve. The Nautley hydrologic control, shown on Figure 1 and Plate 1, was installed during construction of Kenney Dam and is maintains the water level in Fraser Lake, such that elevation in the Nautley River upstream of the Nautley Hydrologic control corresponds to the elevation of Fraser Lake (pers. Comm. Tom Silver, 2017a). The hydrologic control is approximately 500 m upstream of the confluence with the Nechako River, and about 150 m downstream of the Highway 17 bridge crossing, as shown on Figure 1, and consists of an artificial rip-rap control structure that spans the entire river.

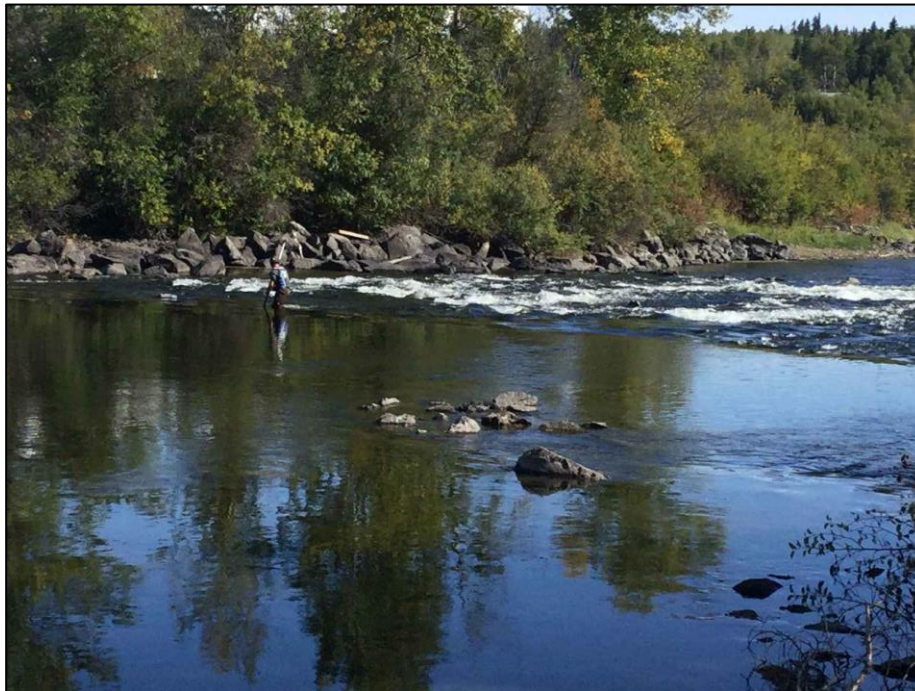


Plate 1. Nautley Hydrologic control, October 2017

1993 and 2017 Cross-Section Surveys

Tom Silver (Tom), then with W.D. McIntosh Surveys Ltd. (McIntosh) completed a survey of the Nautley hydrologic control in November 1993. Details of this survey are included in Annex A. Now with T&T, Tom completed a second survey of the Nautley Hydrologic control in October 2017. He provided a summary report which compares the results of the two surveys and this is included in Annex B. Details of this survey are included in Annex C.

The surveys were used to characterize hydrologic control stability and to determine whether the hydrologic control continues to provide a stable hydrologic control on the outlet of Fraser Lake. Tom confirmed that he was able to locate and re-survey many of the same points that were surveyed in 1993, and thus found little change in the overall cross-section geometry. He has concluded that the control structure has not noticeably changed since 1993. Surveys were completed with the same makes and models of instrumentation (just different generations), and thus not only was a comparison of surveys possible, but exact survey locations were able to be located at many of the 1993 survey points.

Additional Considerations

It is the authors understanding that the current review was requested following concerns over potential changes in lake levels within Fraser Lake and whether such changes were the result of alteration to the physical structure of the Nautley hydrologic control. The surveys described above indicate that hydrologic control alterations may not be responsible for water level fluctuations in Fraser Lake.

The Water Survey of Canada (WSC) operate a monitoring station at the out of Fraser Lake, and the approximately location of this station is shown on Figure 1. Nautley River near Fort Fraser (08JB003) is located below the Nautley Road bridge crossing, and the hydrologic control for this monitoring station is the Nautley Hydrologic control. This station has 60 years of complete and archived streamflow records dating from 1952 to 2013. WSC were contacted directly to discuss the condition of the rating curve over time. Gordon Holmes, the WSC Hydrometric Supervisor described in an email to Cameron that the rating curve appears to be slowly migrating to the right since at least 1972 (indicating that the control is very slowly going down). However, he added that the measurements over this time show a tight grouping [around the curve] indicating that the control does not suffer from volatile change. Next SL posts from year to year. Gordon's comments on this extensive period of record, and its absolute reliance on the stability of the Nautley Hydrologic control, confirms that the hydrologic control provides a stable control structure.

Perhaps related to comments regarding lake levels, it is important to consider that mean annual discharge from Fraser Lake, though variable throughout the record, is tending to decline, as shown on Figure 2, suggesting that lake levels will be generally lower, on an annual basis. The monthly distribution of runoff is also variable, as shown on Figure 3. On average, all months except April and May show a general decline in discharge since the start of data collection. Freshet tends to commence in April, with the highest flows occurring in both May and June. The net result of these trends is that, when compared with the original installation streamflow characteristics, Fraser Lake tends to have higher levels in the early Freshet months and lower levels in all other months. These changes are unrelated to stability of

the Nautley Hydrologic control, as it is assumed that the WSC rating curve would consider any alterations. Hence, it is possible that changes to lake levels may be the result of a natural decline in discharge from Fraser Lake.

Closing

Available evidence supports the conclusion that the Nautley Hydrologic control has remained stable and is not structurally different from its original 1993 survey. It is my professional opinion that changes in Fraser Lake levels may be driven by variability in natural flows out of Fraser Lake, observed in the WSC record, and that there is a general decline in mean annual discharge, and differences in the distribution of mean monthly discharge. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

SWIFTWATER CONSULTING LTD.



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References

Silver, Tom, 2017. *Phone conversation to discuss survey techniques, instrumentation, uncertainty, and physical characteristics of the Nautley Hydrologic control.*

Holmes, Gordon. 2017. *Email communications regarding historical effectiveness of Nautley Hydrologic control as the hydrological control.*

Attachments

Annex A: 1993 Survey Coordinate Listing
Annex B: T&T Surveys Ltd. Report
Annex C: T&T Surveys Ltd. 2017 Nautley Hydrologic control Survey



Figure 1. Nautley Hydrologic control

Notes:

1. Blue Icon is the Highway 17 Bridge Crossing
2. Green Icon is the Nautley Hydrologic control
3. Yellow Icon is Nechako River Confluence

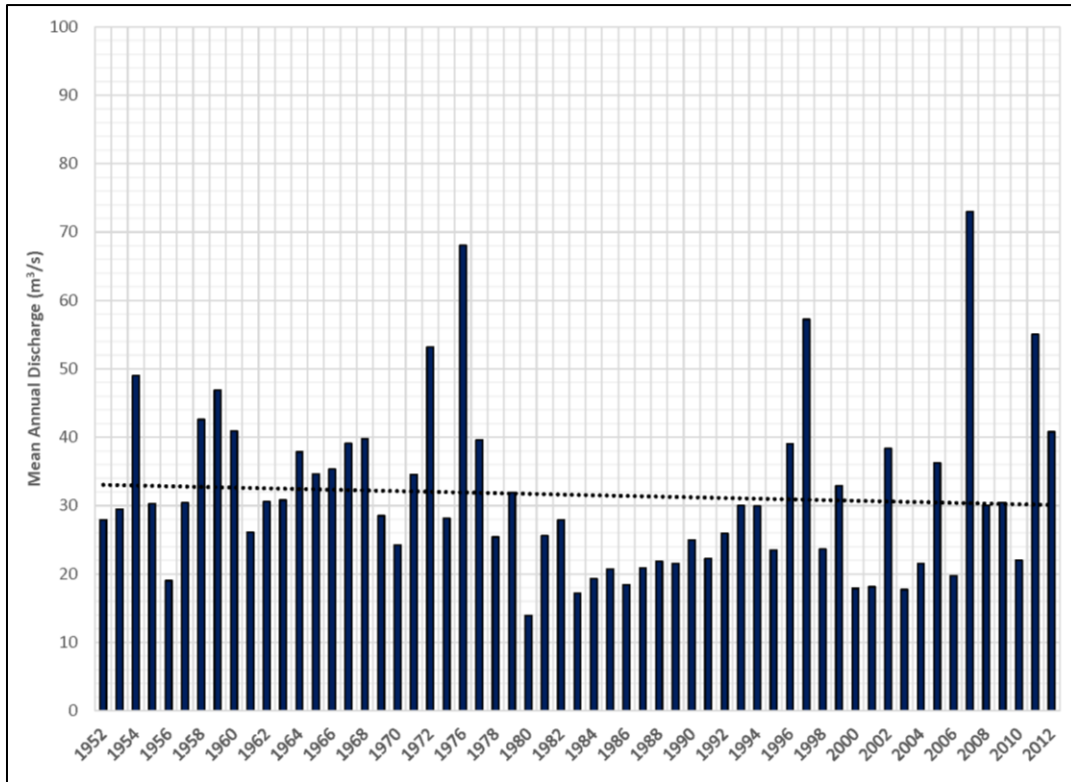


Figure 2. Mean Annual Discharge from Nautley River Near Fort Fraser. The dashed line forms the trend of annual discharge

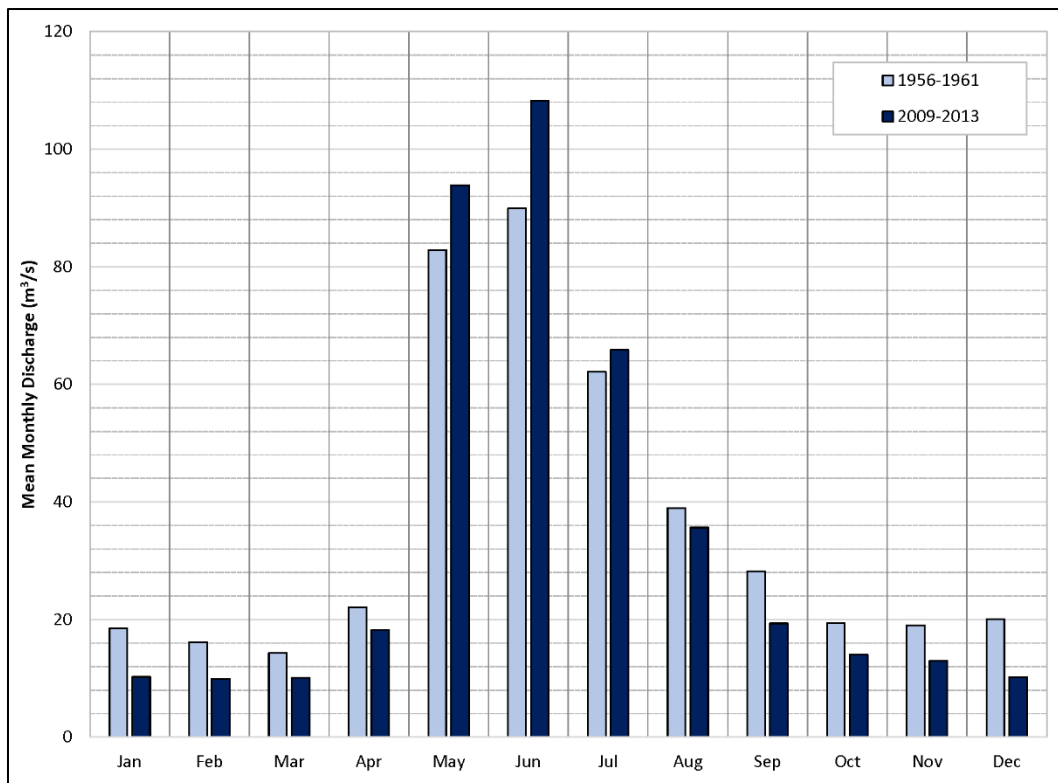


Figure 3. Variation in Mean Monthly Discharge for Two Periods at the Start and End of the Available Record

ANNEX A: 1993 Survey Coordinate Listing

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ANNEX B: T&T Surveys Ltd. Report

T & T Surveys Ltd. Report



NADLEH WEIR SURVEY 2017

19 October 2017

I, Tom Silver was present and did perform the original Nadleh weir survey with W.D. McIntosh Surveys Ltd back in November of 1993. For the WDMC 1993 survey local coordinates of N=1000.00 and E=1000.00 were adopted for Water Resources Branch Canada (WRBC) control capped pipe 2 and a compass bearing and distance established the coordinates for WRBC control point 1 (brass cap cemented into rock). The coordinates for WRBC control point 1 were determined to be N=979.416m and E=1063.352m. Elevations for the 1993 survey were referenced by spirit levels to Bench Mark 86c110 (Brass tablet in top of Northwest CNR overpass abutment on Hwy 16-BM now destroyed with overpass replacement). Elevations for the original survey were determined to be Ctrl 1 = 670.507m and Ctrl2=670.226m.

Upon arriving at the site for the 2017 survey we found WRBC control 2 to have been slightly disturbed so we adopted WRBC control 1 as the reference point and used the original compass bearing to control point 2 as the reference azimuth. A new local coordinate was then established (Ctrl 6) for the disturbed ctrl point 2. The new coordinate for Control 6 is N=1000.020m E=999.938m Elevation=670.230m.

A stakeout file was computed from the original 1993 survey plan coordinate listing provided by Bill McIntosh, and uploaded into the data collector. Individual points from the 1993 survey were staked out and recorded are shown on the present site plan. For the most part the elevations agree with the 1993 survey to +/- 0.03m. At the beginning of our 2017 survey, navigating the slippery rocks was difficult until we got the system down and we missed the exact locations of original points 14-17 showing slight differences in elevation.

It is my opinion that the weir has not moved since the W.D. McIntosh survey of 1993.

Sincerely

Tom Silver

Owner T & T Surveys Ltd

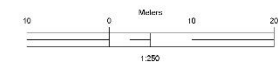


ANNEX C: T&T Surveys Ltd. 2017 Nautley Hydrologic control Survey

SECTION PLAN

Showing weir levels across the Nautley River

B008 030K/007



The horizontal size of this plan is 350mm in width to represent a length of 87.5m (width of a scale of 1:250)

TABLE:

Field survey completed on 29 September 2017

The 'X' coordinates/points and assumed horizontal positions are only indicative and do not represent an official survey. The final survey plan will be prepared by the client's surveyors.

Measurements were taken to the 100m datum. The 100m datum is used for all measurements. The 100m datum is used for all measurements.

This table contains information on the table and points and details which are not shown on the plan. The 100m datum is used for all measurements. The 100m datum is used for all measurements.

- Denotes point surveyed by W&P Hydrographic Inc.
- Denotes random point surveyed along weir high and low points
- Denotes point surveyed in 2017 corresponding to W&P Hydrographic 1993 survey point

File No. 1/29/154 7 October 2017



Point No	UTM Northing	UTM Easting	Local Northing	Local Easting	Elevation	Description
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