Jordan River Project Water Use Plan

Monitoring Program Terms of Reference

- **Addendum 1 to JORMON-01 Lower Jordan River Inflow Monitoring**

May 2007

Lower Jordan River Inflow Monitoring

1 Monitoring Program Rationale

1.1 Background

The Jordan River CC's recommendation (BC Hydro 2002) to release a base flow was based, in part, on estimates of weighted usable rearing area (WUA). For a given section of the river (x), WUA was based both on assumed local inflow, $Q_{Local(x)}$, and the flow release ($Q_{BaseFlow}$):

$$WUA_{(x)} = f(Q_{Local(x)} + Q_{BaseFlow})$$

The combination of local inflow and the base flow selected by the CC was predicted to yield approximately 3 km of additional wetted habitat in the upper reaches.

The Jordan River CC has recommended that more accurate river discharge and local inflow contributions be assessed. This information is required to confirm benefits to resident fish habitat in the Lower Jordan River that were calculated using an assumed local inflow and a $0.25 m^3 s^{-1}$ flow release. The information will also be used to determine the actual flows in the river and if there are any sub-surface flow losses.

1.2 Management Questions

The primary management questions discussed regarding the natural inflows below Elliott Dam are:

1. How accurate were the assumptions of local inflows used for WUP recommendations accurate?
2. What implications, if any, are there on the WUP recommendations based on revised inflow data?
3. What are the reasons for the differences, if any, between the monitored and assumed inflows?

No real time series data for local inflow below Elliott Dam was available for the purposes of calculating the WUA during the Jordan River WUP. Total local inflow below Elliott Dam was calculated based on the proportional contribution of daily surface and tributary inflows for the next upstream catchment area, the drainage area for Elliott Headpond (BC Hydro *in Draft*). Similarly, contribution of flow along the linear length of the river below Elliott Dam was determined as a proportion of discrete drainage area to total drainage area. It should also be noted that the daily inflow to the Elliott Dam catchment, the reference watershed, was also not directly measured. Daily inflow to the Elliott Dam catchment was back calculated from changes in reservoir levels, spill, and turbine discharge for the entire system. The culmination of these factors, required the FTC to acknowledge the high degree of uncertainty associated with the local inflow data set.

In addition, base flow releases were modeled in the WUA estimate assuming all base flows contribute to the downstream watercourse. It is possible, however, that subsurface conveyance losses in the dry section of the channel immediately below Elliott Dam may negate any benefits associated with the base flow release from Elliott Dam in providing additional wetted habitat. Following the collection of these data, if estimates of local inflow contribution are not underestimated and a base flow release is implemented, the stations will subsequently monitor the efficacy of the base flow release at both downstream sites.

1.3 Summary of Competing Hypotheses

The following competing hypotheses have been proposed to address the management questions outlined above:

H_1: Estimated instream flow overestimates monitored instream flow.

> H_{1a}: Proportional watershed area calculations for runoff are not representative of actual instream flows.

H_2: Groundwater losses undermine ability for base flow releases to meet habitat expectations.

> H_{2a}: Estimated instream flows underestimated losses due to groundwater flow.

1.4 Key Water Use Decision Affected

The key water use decision affected by the results is amount of water released. This monitoring program will determine the extent to which actual minimum flows below Elliott Dam were modeled in the Jordan WUP. The recommendation of $0.25 m^3 s^{-1}$ release from the dam has an associated habitat connectivity benefit that will be tested before and after the base flow implementation. At the end of the 6year review period, the base flow release will be $0.25 m^3 s^{-1}$ or less depending on the amount of water release required to meet the habitat expectation.

2 Monitoring Program Proposal

2.1 Objective and Scope

The objective of this monitoring program is to assess the performance of the key WUP decision to increase flows in the lower Jordan River from leakage/local inflows to ≥ $0.25 m^3 s^{-1}$ using instream flow measurements as the performance measure.

The monitoring program will be assessed at two points of the lower Jordan River below Elliott Dam (reach 4 and reach 8 of Figure 1). The program will be in effect for six years – two years prior to the implementation of the minimum flow and four years after.

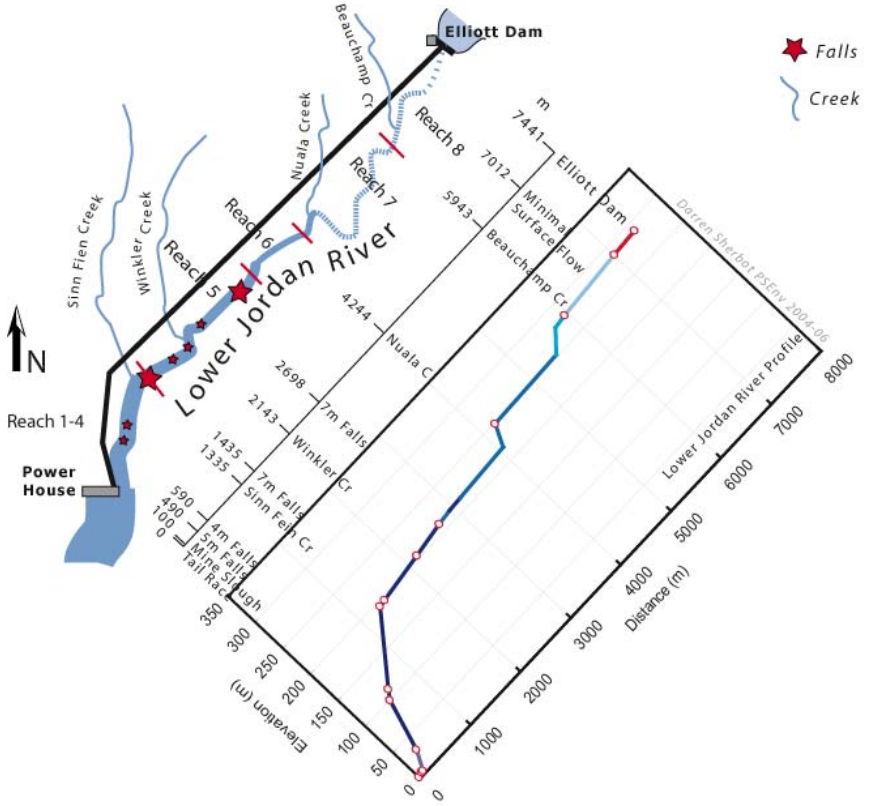

Figure 1: Lower Jordan River. River profile and approximate distances of significant reach breaks relative to the tailrace. Flow continuity stylised as line thickness.

2.2 Approach

This monitoring program will monitor instream flow at three locations in Lower Jordan River through the combination of water level monitoring and rating curve (flow-water surface elevation relationship) development. Opportunistic evaluations of "no-flow" regions will be provided during the monitoring during known low inflow periods, but this aspect of monitoring is to be collected in other monitoring programs for this facility.

2.3 Methods

2.3.1 Site Selection

A hydrologist will choose three sites for the locations of the data collection platforms in consideration of the data requirements associated with the management questions for this monitoring program. The hydrologist should consider those sites:

- that are minimally affected by groundwater losses;
- that provide channel control for stability and water level monitoring;
- adjacent or proximal to suitable water measurement locations;
- with reasonable access;
- adequately protected from vandalism or damage from debris/inflows; and

- that reasonably articulate the variation in inflows through the lower Jordan River.

There are currently two sites that have been established for the purposes of WUP data collection that may be used for the purposes of WUP monitoring (one located approximately 200m upstream of the Jordan GS tailrace, and the other just upstream of Sinn Fein Creek confluence). A third site should be located proximal to the Elliot Dam outlet to monitor leakage and fish release flows.

2.3.2 Installation of Data Collection Platforms (DCP)

Installation of pressure transducer, data logger and staff gauge at each site will be done according to standard practices. The data logger will be kept dry and must be accessible at high water. The installation must be stable through a range of events, and the staff gauge must be visible from a preferred vantage-point. The transducer cable will be protected, and all points of installation will be anchored to large boulders where possible. The staff gauge and transducer installation will be surveyed to a local bench-mark, and a site drawing (by hand) will be completed to illustrate the location and survey information. Photos will be taken to document the installation. The Elliot Dam installation site should be done such that impacts of large spill events will be mitigated, and access considers safety aspects associated with being located downstream of the dam.

It is expected that one of the loggers will be replaced over the six-year period due to environmental conditions[1]. The loggers will be set to collect water levels at 15-minute intervals.

2.3.3 Rating Curve Development

Flow-stage relationships (rating curves) for each DCP will be gathered over a range of low flow conditions (0-5cms) at a site proximal to the DCP location. Alternatively, this data will be collected during fish release valve testing over a smaller time period. A minimum of five flow conditions will be measured to articulate the rating curve. Each measurement will be completed three (3) times to establish standard deviation. Measurements will be completed according to standard practice, and related to a staff gauge measurement. Consult the Resource Inventory Standards Committee's hydrometric standards (1998) for detailed methodologies. Photos will be taken from an established photopoint to document the range of flow conditions observed.

If the error is large compared to the flow of interest ($0.25 m^3 s^{-1}$) – i.e. SD > 0.1cms – other means of measurement must be sought. Site modifications and measurement devices should be geared towards the collection of low flow information.

Three rating curve periods are planned over the 6 year program[2].

2.3.4 Data Download

Data are to be downloaded from the sites once every four months, preferably prior to inflow events, if possible. Where opportunities exist due to activities related to this program, data should be downloaded at a higher frequency. Each download will be an opportunity to ensure the data logger and staff gauge are synchronized per the

[1] In November 2006, all three data logger installations were lost due to an extremely high inflow event. These terms of reference were revised to consider the additional costs of replacement.
[2] Due to the replacement of the DCPs, an additional set of rating curve development trials will be performed for this monitoring program. These terms of reference were revised accordingly.

installation. Data collection by the logger will be observed in the field. If the data are not synchronized, the site will be re-surveyed once the set-up is properly stabilized.

2.3.5 Reporting

An annual report will be provided at the end of each fall season summarizing the instream flows at each site for November 1st to October 31st period. Graphical presentation of results (annual hydrograph, absolute maximum and minimum flows, etc.) and rating curve changes with a short description of methods and equipment used will satisfy the reporting requirements.

2.4 Interpretation of Monitoring Program Results

The decision to release 0.25m^3s^{-1} from Elliott Dam was predicated on the contribution of local inflow and an effective base flow release to provide an additional 3 km of habitat immediately downstream of Elliott Dam. The decision will also preserve flows ≥ 0.25m^3s^{-1} for the length the Lower Jordan River. If after monitoring inflows over the 6year review period it is evident that the assumption of the habitat benefits associated with local inflows based on drainage area calculations were underestimated, the necessity to provide a 0.25m^3s^{-1} base flow may be reduced. Habitat benefits will be assessed in terms of WUA and habitat connectivity.

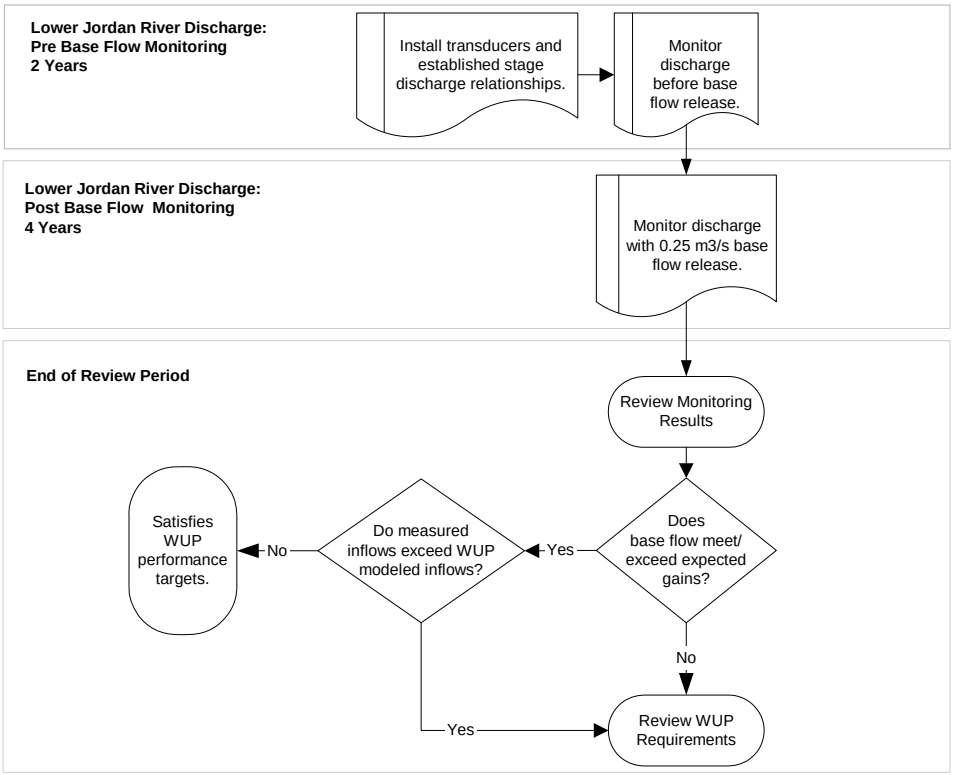

Figure 2: Operational and Environmental Implications of Accurate Local Inflow Data

2.5 Schedule

Pre base flow release data will be collected in the first two field seasons following the approval of the Water Use Plan. Four years of post base flow release data will be

subsequently collected pending engineering completion of the release mechanism and establishing a stable operating regime.

2.6 Estimated Budget

The following budget assumes that consultants will provide the technical resources to complete this monitoring program over the 6 year period. As of January 2007, the budget originally approved in June 2005 has been revised in consideration of:

- equipment losses which occurred November 2006: the purchase, installation and additional rating curve development requirements will add approximately $15K to the total budget cost;
- day-rate updates: in consideration of rates for consultants available to conduct inflow monitoring, the commensurate rate increases have resulted in $15K in increased costs over the 6-year monitoring period (a portion of these costs were off-set in year 1 due to in-kind equipment contributions); and
- resource allocations: a review of site logistics and field conditions have resulted in the increase of field resource requirements – approximately 40 additional days of work over the 6-year program – resulting in over $20K of additional cost to the project.

As a result of these changes, the total budget for the 6-year program is $103.7K, compared to the original submission of $49.9K. The average annual cost is expected to be $17.2K. Costs include 15% contingency and administration for study costs.

3 References

BC Hydro, 2002. Jordan River Water Use Plan Consultative Report. Prepared for the BC Hydro Jordan River Water Use Plan project, Burnaby, BC ISBN0-7726-4722-4

BC Hydro, *in draft.* Jordan River Fisheries Information Overview. Prepared for the BC Hydro Jordan River Water Use Plan project, Burnaby, BC.

Ministry of Environment, Lands and Parks, 1998. Manual of Standard Operating Procedures for Hydrometric Surveys in British Columbia. Prepared for the Resources Inventory (Standards) Committee, Victoria, BC ISBN0-7726-3484-X