TALTSON RIVER
Hydroelectric Expansion Project

Trudel Creek Minimum Flow Interim Report

– DRAFT –

September 2007

CAMBRIA GORDON LTD.
STRATEGIC EXPERTISE IN THE NORTHWEST

Dezé Energy Corporation

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SEPTEMBER 2007

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ACKNOWLEDGEMENTS

Cambria Gordon Ltd. acknowledges the following for their contribution and input to this report.

Arc Environmental Ltd., of Kamloops, B.C., developed the approach and data for the assessment of fish habitat structure and cover change, and assisted with the development of the biophysical and biological parameters.

Rescan Environmental Services Ltd., of Vancouver, B.C., developed and managed the HEC-ResSim model, validation, and scenario runs for Trudel Creek.

Fisheries and Oceans Canada reviewed and provided input to the Habitat Suitability Curves, and commented that they expect the lake whitefish in Trudel Creek to be adfluvial lake whitefish, as opposed to riverine lake whitefish.

1.0 INTRODUCTION

The Taltson Hydroelectric Expansion Project (the Project) is a hydroelectric development project that proposes to add a new 36 MW power plant to the existing 18 MW Taltson Twin Gorges plant. The existing 18 MW Twin Gorges plant was established in 1965 to provide power to the Pine Point Mine. Closure of the Pine Point Mine in 1986 allowed the expansion of power supply to the communities of Hay River and Fort Fitzgerald, NWT; however, as the power requirement for the communities is substantially lower than what was generated for Pine Point, excess water in the Taltson River that was previously used for power generated is spilled over the South Valley Spillway (SVS) into Trudel Creek.

The SVS is located approximately 7 km northeast of the Taltson Twin Gorges dam. Water over the SVS spills into Trudel Creek, which then flows approximately 33 km and rejoins the Taltson River immediately downstream of Elsie Falls and the existing Twin Gorges facility. Three lake systems are located within the Trudel system (Gertrude Lake, Trudel Lake and Un-named Lake) which are connected by a series of rapids.

A hydrological analysis of Trudel Creek indicates that prior to construction of Twin Gorges, Trudel Creek was sourced from local overland flow within the relatively small catchbasin. It is likely that during periodic high flows, the Taltson River naturally flowed into Trudel Creek over a bedrock sill at the location of the SVS.

Flows through the SVS into Trudel Creek, since construction of the Twin Gorges facility, have varied as a result of the operational history. Low flows have been managed from zero or near-zero flows from Twin Gorges commencement in 1965 until the closure of Pine Point Mine in 1986. From 1986 to present, low flows are periodically between 25 to 45 m^3/s, and flow over the SVS peaks at approximately 400 m^3/s in an average year. The existing Twin Gorges water licence has no minimum release requirements.

The Project proposes to maximize the use of the currently spilled water for power production. This would have the effect of reducing the flow in Trudel Creek to a flow that would be similar to the managed low flow of the first 20 years of Twin Gorges operations, and potentially similar to the natural flow, pre-Twin Gorges.

Dezé Energy Corporation has run economic feasibility models for the Expansion Project using various minimum flow release scenarios. Based on these models, Dezé Energy Corporation proposes a minimum release over the SVS at a specific flow rate within the range of 0 m^3/s to 4 m^3/s.

This minimum release flow is lower than what Trudel Creek has experienced over the past 20 years and would change the water depths and velocities from current conditions. This would, in turn, have potential to change the biophysical and biological components that create productive fish habitat, which may have developed over the past 20 years.

Recognizing that a minimum flow release of 4 m^3/s or less would result in changes to current habitat conditions, Dezé Energy Corporation developed an approach to assess the current habitat conditions and habitat productivity in Trudel Creek, and to assess the changes to the habitat conditions and productivity under the minimum release scenario. This report discusses the approach.

2.0 OVERVIEW OF APPROACH

In order to assess the habitat conditions and productivity in Trudel Creek, key biophysical and biological components of productive habitat were identified and are listed below. These components were taken, in part, from the Department of Fisheries and Oceans Canada (DFO) Pathway-of-Effect for "Change in Timing, Duration and Frequency of Flow", and have been expanded to include other known components typically associated with hydropower projects.

- Fish habitat structure and cover;
- Water quality;
- Erosion;
- Benthic invertebrates;
- Temperature;
- Frazil ice;
- Fish migration;
- Ramping;
- Entrainment; and
- Total gas pressure.

To estimate the scale, timing, and magnitude of potential flow alteration changes on fish habitat in Trudel Creek, the British Columbia In-stream Flow Methodology (BCIFM), as described in Lewis et al. (2004), is used for the assessment of existing habitat conditions, and to estimate effects of reduced flows. The BCIFM method was designed to provide a standardized approach to the collection of in-stream flow information in relation to fish and fish habitat, and in BC provides a basis for the evaluation of water diversion applications.

A study program has been developed to characterize each of the biophysical and biological effects components identified above, for Trudel Creek. Their significance as a pathway-of-effect and the assessment approach is summarized below.

3.0 HEC-RES MODELING

To assist with the assessment and development of flow scenarios, a hydrological model was developed for Trudel Creek from the SVS through to the proposed tailrace in the

Taltson River. The model uses HEC-ResSim software developed by the US Army Corps of Engineers (USACE). This model is part of the popular HEC suite of hydrological and hydraulic models. HEC-ResSim is a 'Reservoir System Simulation' model, developed to allow modeling and management of reservoir operations, including simulation of hydropower operations and impacts on downstream flows.

The model was developed from field measurements taken at two different flows (spring low flow and summer flow) over a series of 19 river transects. Measurements at each transect included flow, elevation, river profile, water depths and velocity. The model outputs include water elevations, depths, and average velocities for various operating scenarios at each of the 19 river transects.

Although HEC-ResSim is not used for lakes, based on transects immediately up and downstream of the lakes, the model outputs are used to predict changes in lake elevations. Lake bathymetry measured during the field programs is then used to calculate the change in wetted areas within the lakes between different operating scenarios.

Prior to finalizing the economic feasibility model, flow scenarios were generated for Trudel Creek using the HEC-ResSim model. A series of minimum release flows from 0.5 m^3/s (nearest to zero that the model could manage) up to 40 m^3/s, were input to the model. Example of model outputs for typical river transects are shown in Figure 1 and 2 below. Now that the economic feasibility model has been completed, minimum flow scenario runs can be generated for flow intervals between 0 m^3/s and 4 m^3/s.

The model indicates that at a flow of 0.5 m^3/s over the SVS, a considerable area of Trudel Creek remains wetted, as seen in the output examples below. This is a result of the very flat gradient along reaches of the creek, with steeper gradients at the short sets of rapids that connect the reaches.

Figure 1. Example 1 of Trudel Creek HEC-ResSim model output under various flow scenarios

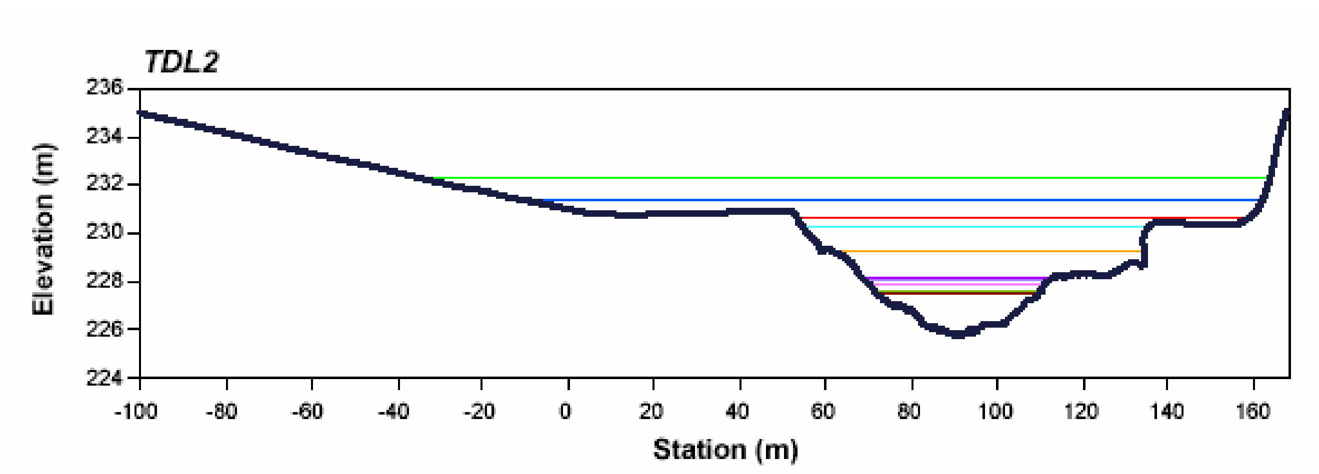
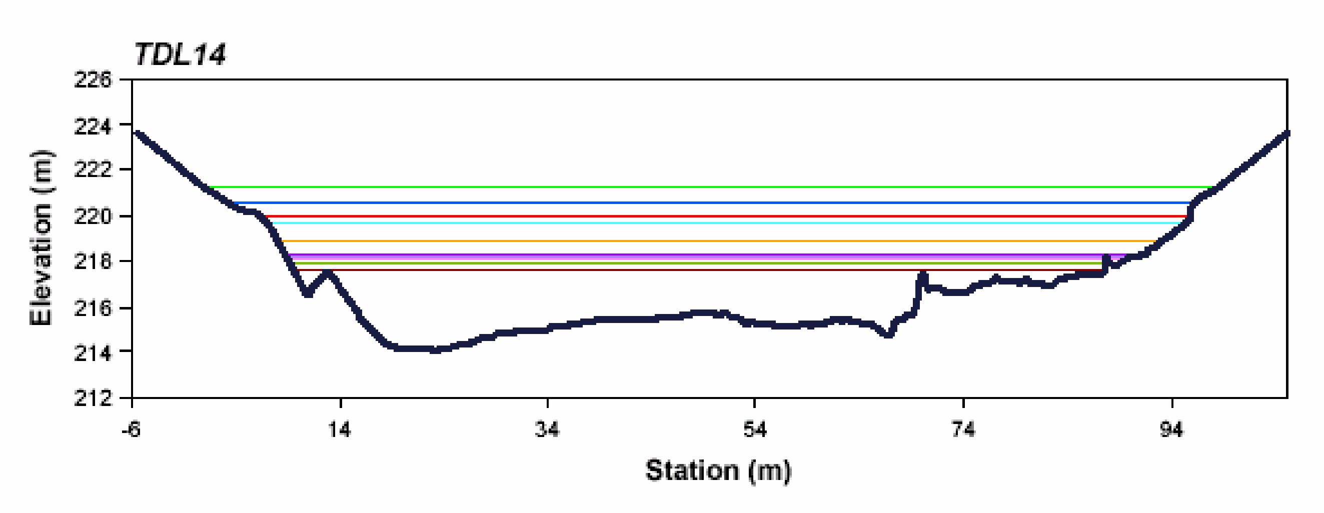


Figure 2. Example 2 of Trudel Creek HEC-ResSim model output under various flow scenarios



4.0 INDICATOR SPECIES

A field program conducted by Rescan Environmental Services Ltd. (Rescan) in September 2006 identified baseline conditions of fish habitat and fish communities within the Trudel system. As a result of the September 2006 field program, northern pike and lake whitefish were identified as the two indicator species for the assessment. Northern pike are considered an indicator species as it has specific habitat requirements that overlap with other species in the system. In addition, the northern pike is a high level predator and typically requires an ecologically productive habitat for foraging. Lake whitefish was chosen as an indicator species due to its abundance in Trudel Creek and its general importance to local user groups. Walleye was considered as a potential indicator species for its preferred riffle spawning habitat; however, after further field assessments that identified limited walleye spawning habitat and very low catch numbers (only three adult walleye captured in the lower reaches of Trudel Creek), the program focused on northern pike and lake whitefish.

Life history characteristics for both northern pike and lake whitefish, as summarized below, was obtained from), Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Lake Habitat Requirements, Richardson et al. (2001), and Evans et al, Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Riverine Habitat Requirements, (Evans et al, 2002).

Lake whitefish are most commonly found in lake systems; however, they have been documented in larger rivers and brackish waters. Adfluvial lake whitefish typically spawn in late summer or fall, from September to October. Unlike lacustrine lake whitefish, adfluvial lake whitefish spawn in rivers. River spawning lake whitefish usually utilize shallow running waters or rapids with cobble and gravel sized substrate materials. Lake spawning lake whitefish are less selective about substrate and utilize a variety of types from large boulders to gravel, and occasionally sand. Mud substrates are generally avoided by both river and lake spawners.

Young of the year lake whitefish are commonly found in shallow water areas (<1 m) adjacent to their spawning grounds; however, they tend to drift downstream until they reach the receiving lake. Once juvenile lake whitefish reach the lake, they usually remain there until sexual maturity. As surface water temperature increases during summer, juvenile lake whitefish move to deeper waters (3-15 m), where they gradually adopt the bottom feeding habits typical of adults.

Northern pike inhabit densely vegetate or weedy areas of slow meandering rivers and weedy bays of lakes and marshes. Typically, northern pike begin to spawn after ice break-up in April to May, in the shallows of lakes or the backwaters of rivers. Lake spawners utilize habitats with very shallow water (<1 metre) that are wind-sheltered with a variety of vegetation types. Short emergent vegetation such as grasses, sedges and bulrushes are the best substrates for egg deposition. Bottom substrate at spawning grounds consists primarily of soft fine sediments of silt and mud, although spawning may occur in areas with gravel, cobble or boulder.

Eggs are laid and adhere to the vegetation above the substrate and incubate for 10-21 days. After hatching, young northern pike remain attached to the vegetation for 6-10 days before they become free swimming, remaining in spawning areas for several weeks. Young of the year northern pike are typically found in areas <1 m deep but will frequently move to deeper water in the summer or when water temperatures rise.

Adult northern pike remain in areas <5 m deep for most of the year and move into deeper water to overwinter. As adult northern pike are ambush predators, they require moderate densities of vegetation in addition to logs or stumps for cover. An excess of cover tends to inhibit foraging capabilities. Adult northern pike prefer soft substrates, although they may be found in areas with boulders, cobbles and gravel substrates.

5.0 BIOPHYSICAL AND BIOLOGICAL COMPONENTS

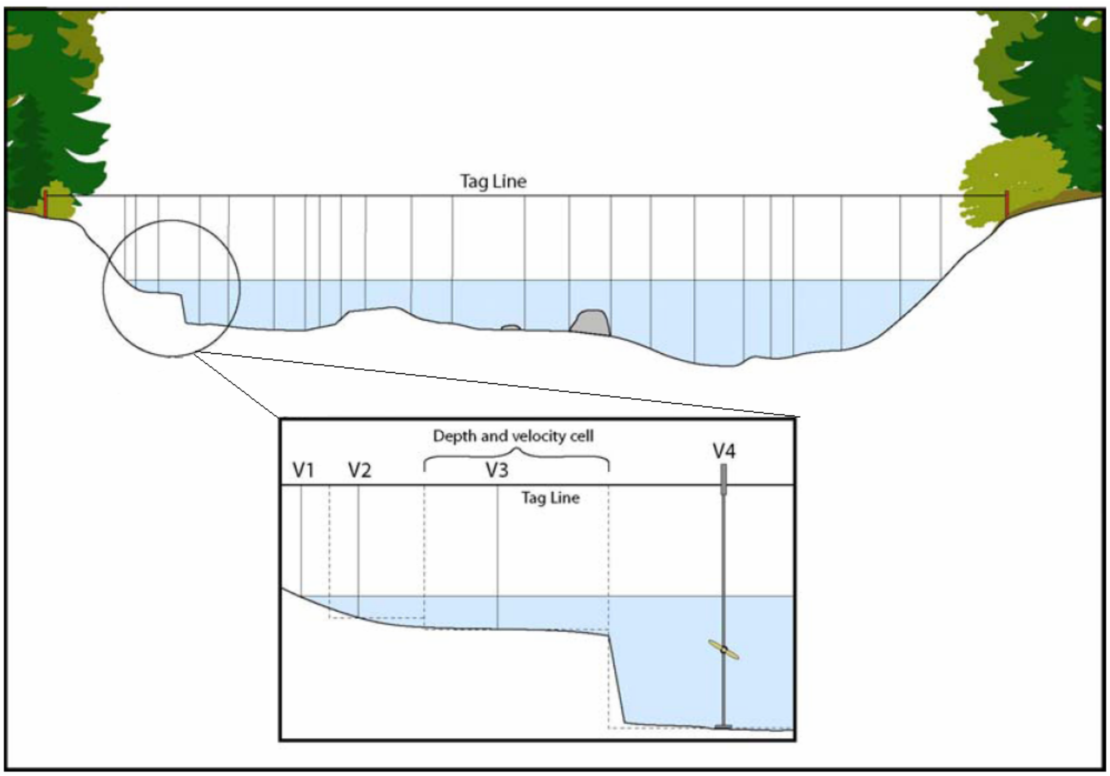
5.1 Fish Habitat Structure and Cover Changes

The principal effect of the Project will be flow alteration affecting the depth and the velocity of the water in Trudel Creek, which in turn will affect the amount of in-stream fish habitat.

BCIFM provides an index of habitat usability of the wetted stream channel, as expressed in weighted usable width (WUW) for various life stages of fish. WUW is the segment of the total channel width where all channel conditions (i.e. depth, velocity, substrate, and cover) are suitable for the requirements of the particular life stage being considered. For the BCIFM, measurements of habitat characteristics (depth, velocity, substrate, and cover) are collected at predetermined cross-section locations of the watercourse.

In smaller streams, transects are positioned to accommodate 20 or more verticals along each transect line (Figure 1). The positioning of verticals depends on streambed topography, taking into account changes in water surface elevation over the projected range of metered flows. The locations of verticals are usually chosen to capture water edges along large embedded objects, e.g. boulders and protruding bedrock outcrops.

Figure 3. Example of Vertical Positioning to Capture Streambed Topography



For the study on Trudel Creek, data for the BCIFM analysis was obtained from bathymetric surveys at cross-section profiles done by Rescan Environmental Services Ltd. (Rescan) in the fall of 2006 and spring of 2007. Since Trudel Creek, under its current operational flow regime is a large wide river, water depths and velocity for these surveys were measured using an Acoustic Doppler Current Profiler (ADCP), mounted from the side of an inflatable Zodiac boat. For the spring 2007 surveys, measurements/estimates of substrate and cover were collected, as well as depth and velocity at each transect cross-section.

Generally, the BCIFM method requires the collection of transect data at three or more flow levels, ideally at flows ranging from 5% to 40% Mean Annual Discharge (MAD), in order to provide the empirical data around which a habitat-flow relationship can be predicted; however, at Trudel Creek it is only practical to collect transect data at two flow levels, mainly because low flow situations occur only during winter months when access is limited and is unsafe due to icing conditions.

The dominant substrate is generally identified / estimated at each measurement point along a transect as closely as possible, based on the size classes listed below, which exist in an approximately 1 m^2 patch centered on the vertical:

Fines	< 2 mm
Gravels	2-64 mm
Small Cobble	64-128 mm
Large Cobble	128-256 mm
Boulders	256-4000 mm
Bedrock	>4000 mm

Cover elements are identified by visual observation, and classified as boulders, wood (large and small woody debris), in-stream vegetation, overhanging vegetation, and undercut banks.

5.1.1 Calculating Weighted Usable Width (WUW)

Weighted usable width (WUW) is calculated for each segment (a cell) of stream between measurement points along the transect. Habitat suitability index values are applied to the mean depth, the mean velocity, and the dominant substrate and cover (for juveniles) in each segment. The calculation is expressed as:

$$WUW_{dvs} = \Sigma_i^n (W_i * D_i * V_i * S_i);$$

where Wi is the width of cell *i* on the transect, Di is the suitability of depth at cell *i*, Vi is the suitability of velocity at cell *i*, Si is the suitability of substrate and cover at cell *i*. The model assumes that habitat is determined by the habitat variables in the multiplicative fashion.

5.1.1.1 Habitat Suitability Index

Habitat suitability index (HSI) curves have been created for northern pike and lake whitefish, both indicator species identified for the Project. The proposed low flow into Trudel Creek is anticipated to primarily affect the littoral habitat areas along associated shorelines. Thus, HSI curves were developed for fish species and their associated life stages that will potentially be affected the most by a reduced flow. For example, adult northern pike are known to use densely vegetated areas for spawning. In addition, juvenile northern pike initially use these same habitats for rearing and foraging. Therefore spawning and juvenile northern pike utilizing the vegetated shorelines will experience the greatest change under a reduced flow regime and HSI curves are required to assess the affects of that change. In contrast, adult northern pike are typically associated with the deeper waters of lakes or river systems where changes from a reduced flow will be limited. Consequently, HSI curves were not created for adult northern pike.

Separate HSI curves are presented for various life stages which are important in the life cycle of northern pike and lake whitefish. These HSI curves have been redefined based on peer review of, and DFO input on, a preliminary set in August 2007.

Northern Pike HSI curves

Figure 4

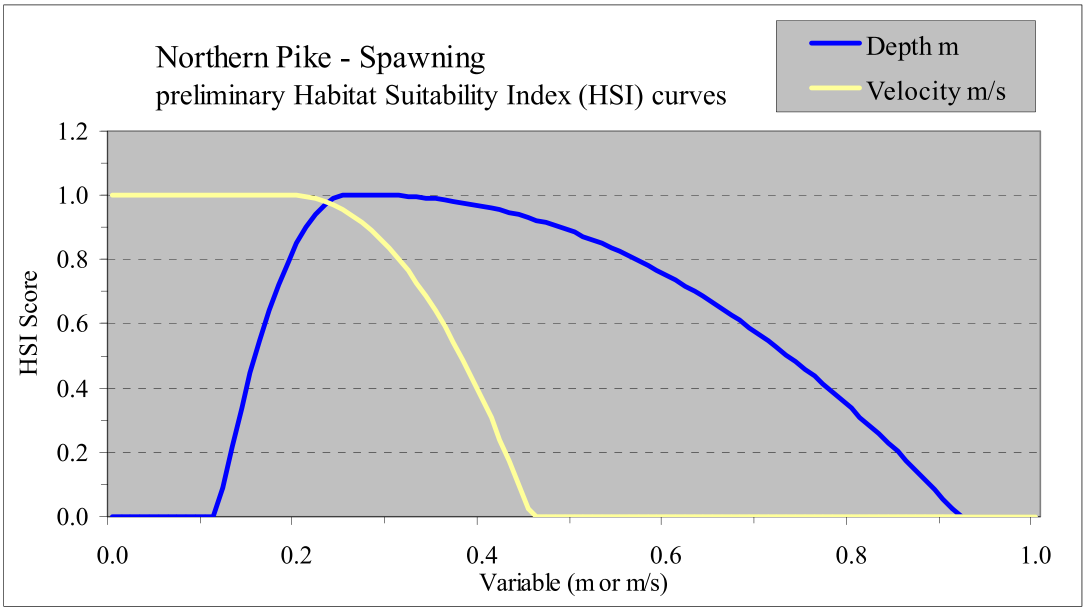


Figure **5**

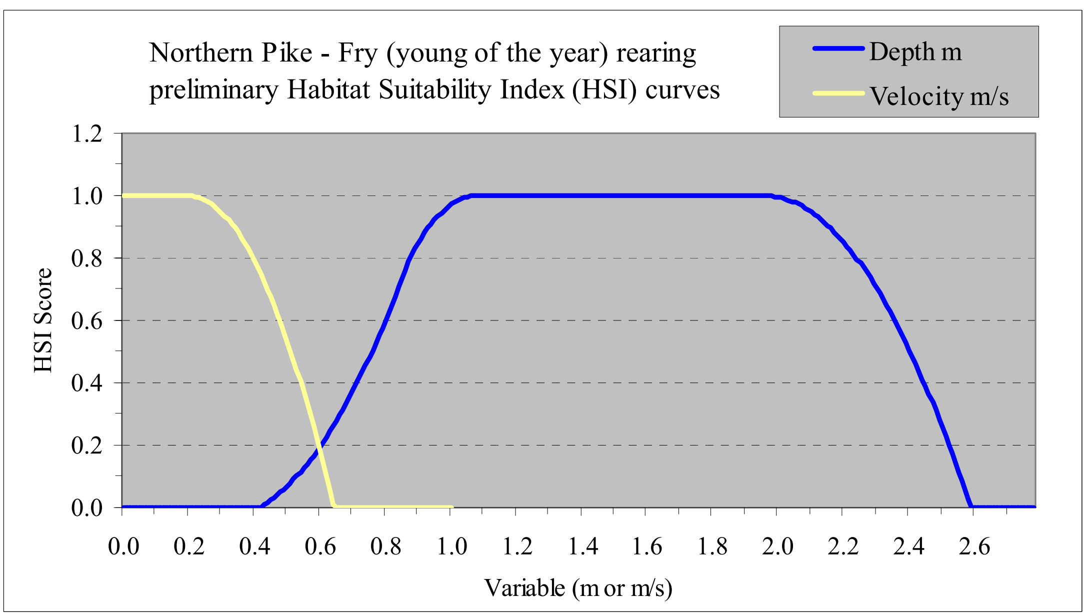
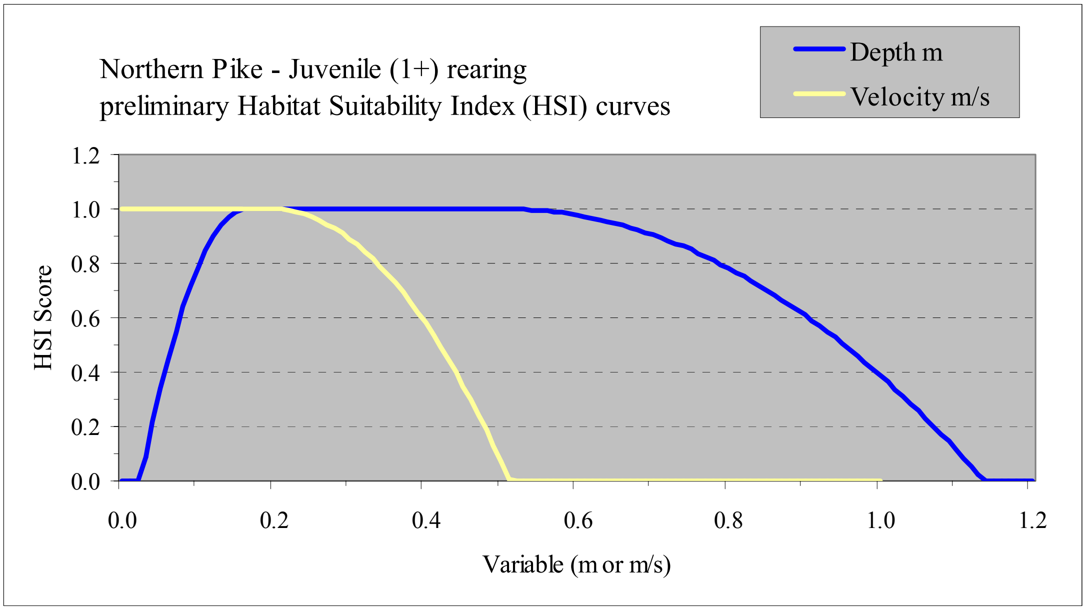


Figure 6



Adfluvial Lake Whitefish HSI curves

Figure 7

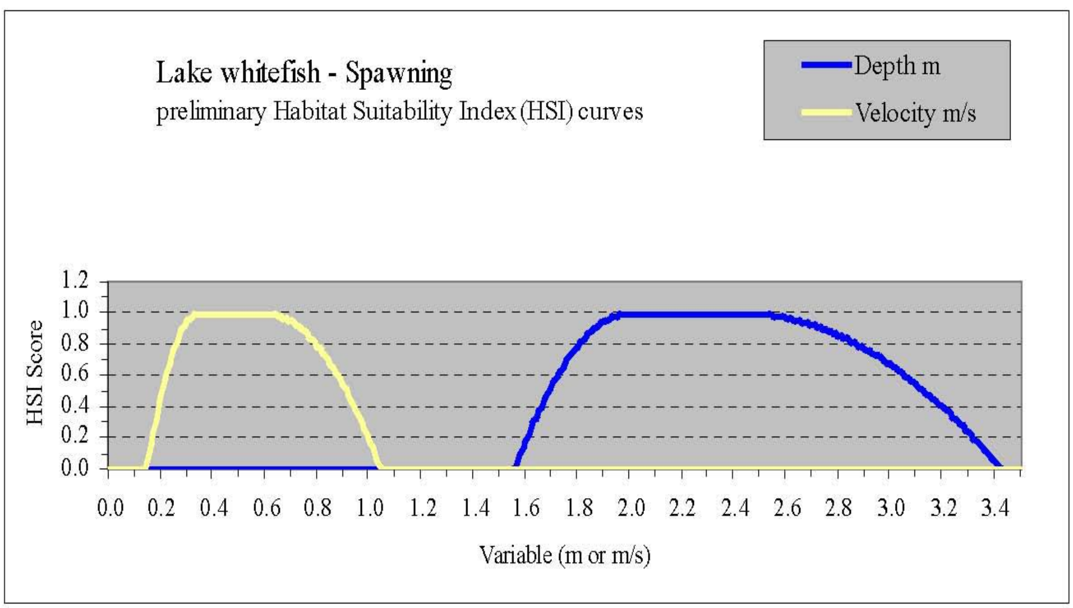


Figure 8

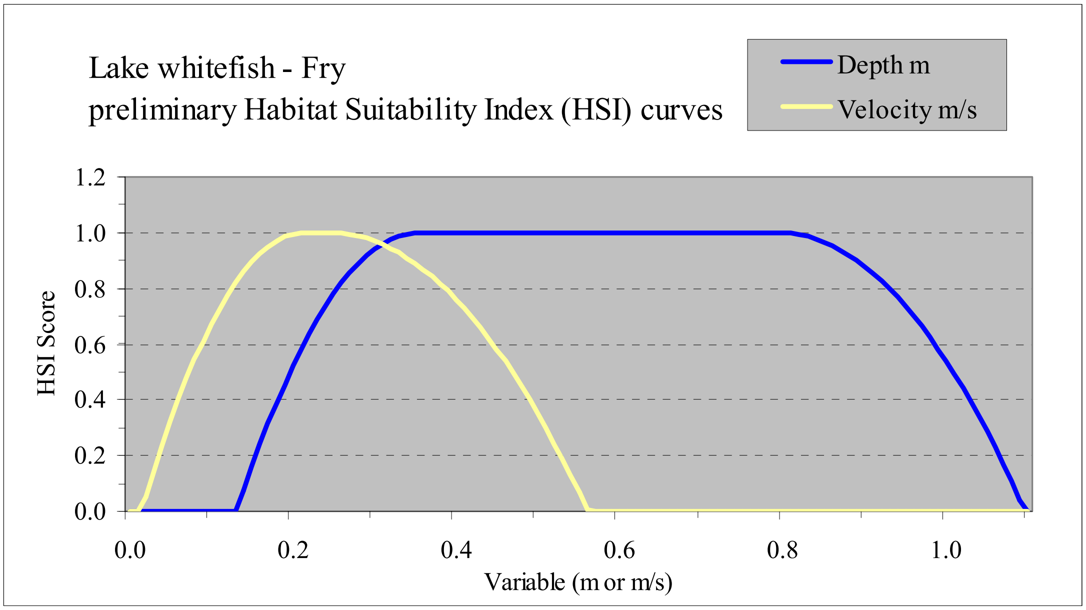


Figure 9

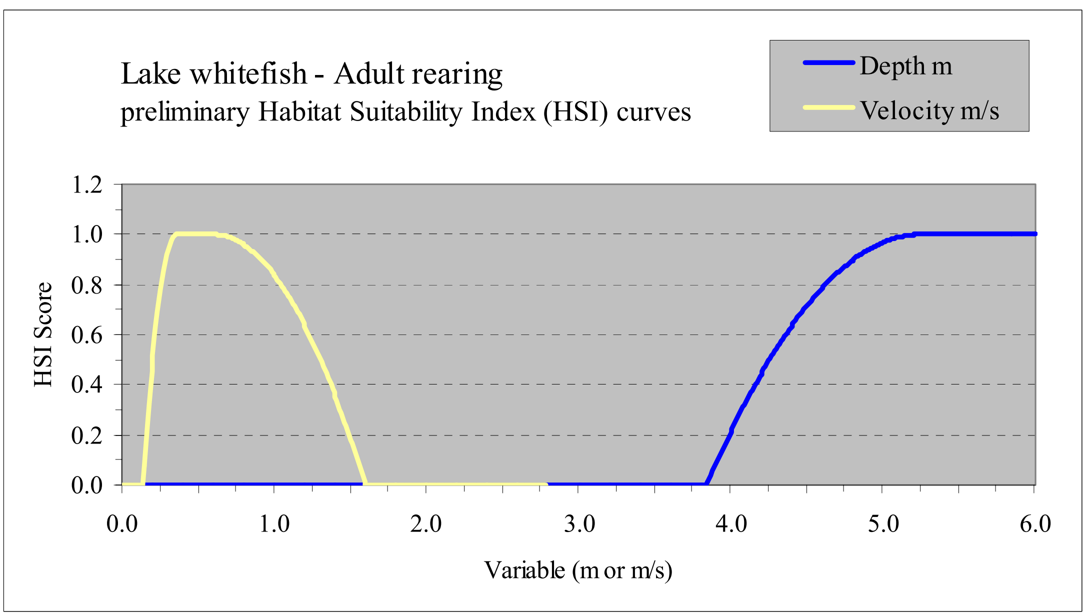
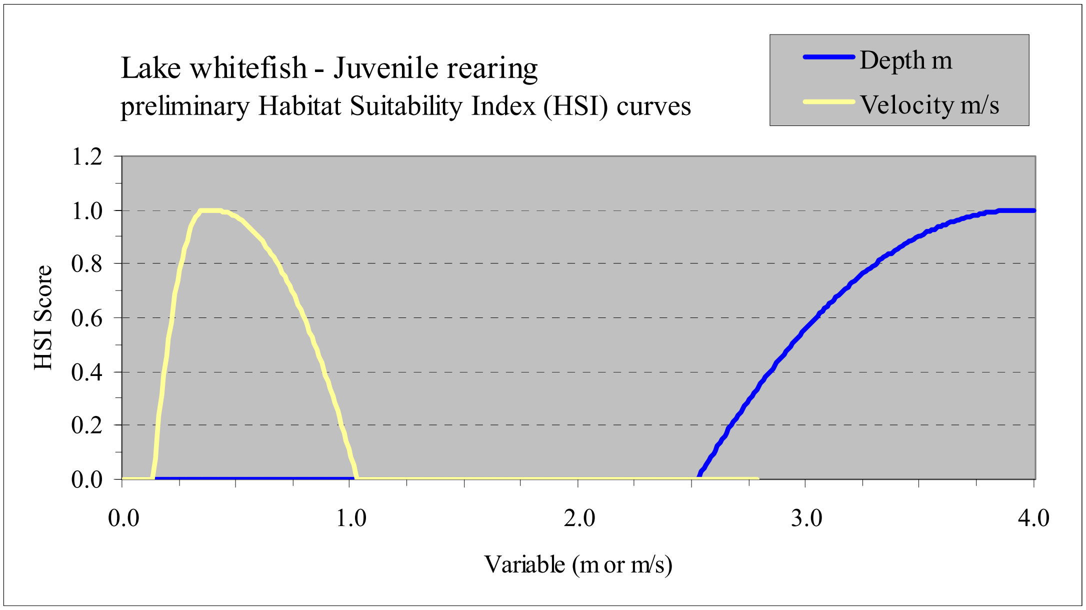


Figure 10



Substrate and cover HSI values will also be included in determining weighted usable width per cell for the various life stages of the indicator species. Table 1 below, summarizes the HSI values to be attributed to each of the various life cycles for northern pike and lake whitefish.

Table 1 – Cover and Substrate HSI Values for Various Life Stages of Northern Pike and Lake Whitefish

Substrate and cover values (Initial judgement)						updated:	070911	
		NP Juv	NP Adult	NP Spawn		LW Juv	LW Adult	LW Spawn
Substrate								
Rock		0.10	0.10	0.00		0.50	0.50	0.00
Boulder		0.20	0.20	0.00		1.00	1.00	0.50
Large Cobble		0.20	0.20	0.00		1.00	1.00	1.00
Small Cobble		0.20	0.20	0.00		1.00	1.00	1.00
Large Gravel		0.20	0.20	0.00		1.00	1.00	1.00
Sand/Small Gravel		0.50	0.50	0.50		1.00	1.00	0.60
Silt		1.00	1.00	0.80		1.00	1.00	0.20
Detritus		1.00	1.00	1.00		0.00	0.00	0.10
Cover								
Undercut		0.00	0.10	0.00		0.00	0.00	0.00
Instream Submerg Veg		1.00	1.00	1.00		0.50	0.50	0.00
Instream Emerg Veg		1.00	1.00	1.00		1.00	1.00	0.00
Wood		0.20	0.50	0.20		1.00	1.00	0.00
Boulder		0.00	0.00	0.00		0.00	0.00	0.00
Overhang Veg		0.00	0.00	0.00		0.00	0.00	0.00

HSI values for cover are more relevant in mountain streams where marginal channel conditions can be improved by the presence of cover, such as large wood or overhanging vegetation. In Trudel Creek, for the most part, these extra-channel features do not typically exist, and other elements of the analysis (depth, velocity and substrate) will indicate where in-stream cover, such as vegetation, is likely to be. For example, in shallow areas with fine substrates and where velocity is low, in-stream vegetation will likely exist.

These HSI curves were constructed from professional information obtained from available literature and life history characteristics of the indicator species. Predominately information was sourced from the following two documents prepared by Fisheries and Oceans Canada:

1. Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Riverine Habitat Requirements (Evans et al, 2002); and
2. Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Lake Habitat Requirements (Richardson et at, 2001).

The BCIFM is not directly applicable to the analysis of lacustrine fish species. Therefore, lake bathymetry and an interpretation of model results for lake depth and surface area changes will be used to assist with lacustrine interpretation.

5.1.1.2 Modeling Habitat Capability

For Trudel Creek, transect data has been collected by Rescan at two different flows. Subsequently, Rescan has used HEC-RAS modeling software developed by the US Army Corps of Engineers, to provide estimates of depth at each transect measurement point, and average velocity at each transect, for a range of possibly pre- and post-project discharge rates.

Using the HEC-RAS estimates of depth and average flow, the relationship between the two parameters is determined, to estimate the velocity at each transect measurement point. The HEC-RAS model generates values for depth and the estimated values for velocity (as well as available substrate/cover information) which is assigned to the corresponding HSI values at each vertical point along a transect. The weighted usable width will then be determined for each cell, and also for the entire transect length. The predicted WUW values are compared to measured WUW values obtained at known discharge rates, in order to establish a relationship between habitat quality and discharge rates outside the measured range.

Fish habitat suitability is then modeled for a series of hypothetical discharge rates representing potential post-project flow scenarios. The results are then graphed to show relationship between flow and habitat quality over the range of discharge rates.

Comparisons are made between habitat conditions at baseline condition, and under various post-project discharge scenarios.

5.2 Water Quality / Nutrients

Water quality sampling is currently ongoing to determine baseline conditions in the system and to allow for post-project monitoring of these parameters, as required.

The change in flow in Trudel Creek should not affect water quality parameters, such as pH, conductivity, and alkalinity. Flow reductions are not anticipated to influence stratification and nutrient availability in the Trudel lakes systems, as these lakes are too shallow under current flow conditions to exhibit stratification at any time of the year (Chris Perrin, Limnotech, pers. com. June 14, 2007). A series of surveys have been undertaken to determine temperature and dissolved oxygen profiles in the lakes at various times of the year. To date, no stratification has been noted anywhere in the system.

The proposed minimum flow release is not expected to significantly affect the size of the three large lakes in the Trudel Creek system, or the reservoir upstream of the Twin Gorges Dam (i.e. the Twin Gorges Forebay); however, with proposed flow reductions, the retention time in the Trudel lake systems may increase. In lakes where nutrient levels are low, increased retention time does not lead to increased photosynthesis and significant changes to water quality (Chris Perrin, Limnotech, pers. com. June 14, 2007). Water quality sampling will determine baseline nutrient levels and the likelihood for significant water quality changes that may occur with changes in retention time in the lakes.

Water quality samples have been collected in August 2007, to establish baseline conditions in Trudel Creek. The following parameters were assessed for 3 replicate samples:

- Total phosphorus;
- Total and dissolved metals including mercury;
- SRP (orthophosphate);
- Ammonia;
- Nitrite, nitrate;
- Total suspended solids (TSS); and
- Alkalinity.

In addition to the above parameters, field measurements were taken for dissolved oxygen (DO), Ph, conductivity, temperature and turbidity (NTU).

5.3 Erosion & Turbidity

From observations within the Trudel system, erosion of banks and remobilization of deposited fines is predicted to occur under current flow regime when flows increase (rising water levels) and during very high flow events. Aerial photographs and total suspended solid (TSS) water quality samples taken during relatively static spring and summer flows do not show an increase in turbidity loads.

Current erosion rates are anticipated to vary considerably by season and year. As the erosion rate is related to the seasonal flows and annual peak flow events, and as the seasonal flows and annual peaks vary from one year to the next, establishing a baseline erosion rate would very difficult.

The reduced flow over the SVS, with lower summer average flows as a result of the Taltson Basin flow management, and reduced peak flows, is expected to reduce the erosion rates.

Due to the difficulties in establishing baseline erosion rates, a monitoring program is proposed to document erosion. Potential cost-effective monitoring methods include photo-logs of observable water characteristics under various flow conditions, photo-logs of specific erosion sites over time, or TSS and turbidity measurements at established sites that could be accessed from camp.

5.4 Benthic Invertebrate Production

The channel of Trudel Creek is dominated by fines, a substrate type which is not highly productive in terms of benthic production. Riffle areas in the stream where boulders or cobbles predominate, areas which are important benthic producers, are very limited in the system. Even with the proposed flow reductions, the few riffle sections in Trudel Creek will likely still exhibit suitable depths and velocities for benthic production. Therefore, flow reduction is not considered to be a critical issue in regards to benthic invertebrate production and their overall biological production.

Flow reduction is expected to lead to a decrease in the average water depth and turbidity loads in Trudel Creek. These factors may potentially lead to greater light penetration and stimulus for primary (and thus secondary) production in the limited areas that support benthic production. In addition, scour of benthic organism habitat may be reduced. Due to these considerations, it is not believed that the sensitivity of the benthic production is sufficient to require a sampling program.

5.5 Temperature

Current water temperatures are being monitored in Trudel Creek and Trudel lakes Tidbit temperature loggers, which were deployed in August 2007. Proposed flow reductions are not expected to influence temperature stratification in the Trudel lakes, as these lakes are likely too shallow to exhibit stratification.

5.6 Frazil ice

Frazil ice is sometimes an impact consideration in some cold climate rivers. Frazil ice is generated in open water areas often associated with riffles or turbulent flow. It then settles out and adheres to coarse river bottom substrates and organic debris. Due to the morphology and hydrology of Trudel Creek, frazil ice production is not expected to increase, as the conditions that lead to frazil ice risks are largely absent from the Trudel Creek system. For example, frazil ice does not form when the water body has cover on it, and Trudel Creek appears to exhibit competent ice cover over most of the system throughout winter. Substrate in Trudel is generally fines throughout the system; and stream sections capable of generating frazil ice (i.e. riffles) are short. With the proposed minimum flow, stream section that may generate frazil ice will likely be reduced; therefore, no increase are expected in the production risks of frazil ice.

5.7 Fish Migration

Three velocity barriers to fish have been identified in the Trudel system. These barriers likely prevent upstream fish migration at all flows, for every species and every life stage currently found in the Trudel Creek system. As such, these barriers essentially divide the Trudel system into three sub-systems, where upstream fish movement from one sub-system to another is not possible. Fish recruitment is only in a downstream direction through Trudel Creek. Therefore, it is not anticipated that the Project will have any impacts on the existing fish migration pattern.

The three barriers are located:

1. At the downstream end of Gertrude Lake - a series of cascades, rapids, chutes between RKM[1] 3.0 to 5.5; no upstream fish access through this sub-reach is possible from lower Trudel Creek into Gertrude Lake.
2. At the upstream end of Trudel Lake – two high and narrow chutes, both velocity barriers, from RKM 12.5 to 13.5, no fish access is possible from Trudel Lake upstream into Unnamed Lake.
3. At the South Valley Spillway (SVS) and numerous rapids downstream of the SVS – from RKM 31.5 to 32.5; no fish access is possible from Trudel Creek upstream into Twin Gorges Forebay.

5.8 Ramping and Flood Flows

Ramping is the rate of flow change within a channel that results from changes in flows through the hydro plant. Ramping occurs as a result of controlled and uncontrolled plant shutdowns, and as a result of plant start-up.

Plant operations that result in larger than natural rates of change in stream flow can result in impacts to fish and aquatic organisms, such as the displacement of fish during large flow increases, or rapid dewatering of fish habitat during large flow decreases resulting in the isolation and stranding of fish.

[1] RKM = River Kilometer i.e. distance from the mouth of the stream

5.8.1 Plant Shut-down

During a plant shut-down, water that had been flowing through the power plant would be spilled over the SVS to Trudel Creek. As the spillway is located 7 km upstream from the plant intake, and as the Forebay is a considerable size, flows would be partially attenuated in the Forebay and spills rates over the SVS would increase gradually.

Controlled plant shut-downs occur for maintenance reasons. During controlled shut-downs, only one plant (i.e. existing plant vs. new plant) would be shut-down at any time, to reduce impacts to power generation and to reduce spillage to Trudel Creek. The new (larger plant) uses a flow of 107 m^3/s.

During controlled shut-down, the flow rate to the plant can be gradually decreased, resulting in a more gradual rise in river of water levels in the Forebay and even slower rate of increase over the SVS.

During emergency shut-down, both plants may be shut-down simultaneously. In such an event, the flow rate to the plants may decrease suddenly. Due to the storage potential, and thus buffering effect, of the Forebay and the location of the SVS in relation to the plant intakes, the corresponding rate of increase in flow to Trudel Creek would likely remain gradual. The combined flow through both plants is of 182 m^3/s.

5.8.2 Plant Start-up

During plant start-up, regardless of the selected ramping rate, water level in Trudel Creek would decline only gradually, again due to the buffering effect of the reservoir. However, a high ramping downstream of the plant rate could lead to large flow increases, which could displace fish from preferred rearing habitat.

To minimize the potential of fish displacement during plant start-up, a maximum ramping rate could be established. The existence of two plants provides for additional control and management of start-up flows.

5.8.3 Flood Flows

Although the Taltson system will be managed to maintain power flows to the plant, seasonal high flows will still exist in the system, which will be spilled over the SVS. These flood flow peaks, however, will be considerably lower than current flow peaks.

The HEC-ResSims model of Trudel Creek will be used to determine the change in water elevations as a result of increased flows over the SVS, both associated with flood flows and with plant shut-downs.

5.9 Entrainment

Fish, particularly fry and small fish, have the potential to be entrained in the intake structure, and drawn into the turbines. This is a particular issue with high-head power facilities that utilize small-propeller, high-velocity turbines.

The Taltson Expansion Project is designed using Kaplan turbines. Kaplan turbines are large-propeller, low-velocity turbines. The characteristics of these turbines have been documented to increase fish survivability to approximately 90%, by allowing fish to migrate through the propellers.

The likelihood of fish movement towards the turbines will be minimum, due to the characteristics of the intake canal, being a smooth blasted bedrock canal, of approximately 1000 m in length. The long, smooth walls and canal floor do not provide suitable substrate or cover for fish. The characteristics of the intake canal will deter fish from moving down the canal towards the turbines, considerably reducing the probability of fish entering the turbines.

5.10 Total Gas Pressure

Gas supersaturation (primarily nitrogen and oxygen) can occur in water from deep wells, below waterfalls, and in some tailrace waters below hydroelectric installations. This occurs at hydroelectric plants where tailrace water plunges from a significant height into standing water, causing entrapped air to go into solution. Gas supersaturation can be hazardous or lethal to fish.

Gas supersaturation would not be an issue with the proposed facility. The tailrace design exits into the Taltson River within the range of the natural water elevation, and does not spill into deep water. This design prohibits potentially entrapped air from going into solution.