REVIEW OF DOWNSTREAM SPATIAL BOUNDARIES FOR FISH AND FISH HABITAT ASSESSMENT AREAS, SITE C HYDROELECTRIC PROJECT

Context

BC Hydro is proposing to construct a hydroelectric dam at Site C on the Peace River near Fort St. John, BC The dam will be the third and furthest downstream plant on the river and will largely be operated as a run-of-river facility. In its draft '*Environmental Impact Statement Guidelines*' BC Hydro has proposed that the downstream boundary of the local assessment area for fish and habitat effects (LAA) be at Many Islands AB, about 125 km downstream of Site C, and the regional assessment area (RAA) be at Vermillion Chutes, about 740 km from Site C. For reference, the LAA is defined by CEAA as the area that potential adverse effects will be assessed within, and the RAA is the area within which cumulative effects (with other projects) will be assessed.

DFO Science Branch (Pacific Region, with assistance from Central and Arctic Region) has been asked to comment on the proposed downstream spatial boundaries for evaluating the potential effects of Site C on fish and fish habitat.

This Science Response report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Regional Science Special Response Process (SSRP) of May 7-14, 2012 on the determination of downstream boundaries for fish and fish habitat assessments for the Site C project.

The downstream boundaries for the review of the impacts of the Site C project were determined to be reasonable, although some revision to the LAA may be needed if further analysis indicates impacts to fish and fish habitat could occur downstream of the proposed boundary. Based on the information provided the incremental impacts of the Site C project on the Peace River are predicted to be largely attenuated within a few hundred kilometers downstream of the damsite and no meaningful impacts are expected at the proposed location of the RAA boundary.

Background

Setting

The Peace River has its origins in the northern Rocky Mountains of BC and it drains eastward through plateau lands of northeastern BC and northern Alberta. The Peace River turns northwards, drops through the Vermillion Chutes before draining into the Peace-Athabasca delta (PAD) at the western end of Lake Athabasca. Historically the Peace River had relatively low flows from late summer to early April, and a spring freshet driven by snowmelt that extended from April to July. The mean annual discharge is about 2200 m^3s^{-1}, and historical peak single day flows exceeded 10 000 m^3s^{-1} at the PAD (Peters and Prowse 2001).The Peace River has a relatively speciose fish community as a result of post-glacial colonization from both the west from the Pacific Refugium and the east from the Mississippi Basin (Lindsey and McPhail 1986). Upstream colonization was ultimately blocked by the appearance of the Peace Canyon after the draining of Glacial Lake Peace. Both the presence of the Canyon and habitat conditions has resulted in a downstream cline in fish communities in the Peace River. In the headwaters and extending towards the BC/Alberta border the fish community is dominated by so-called “coldwater” fishes, including Arctic Grayling, Mountain Whitefish and Rainbow Trout. Beginning at about the Pine River confluence, a “coolwater” community begins to predominate, including Goldeye, Burbot and Walleye, as well as a number of other Great Plains species (AMEC 2008). This community extends the length of the Peace River from near the Provincial border to the PAD. Coolwater species are considered to be more tolerant of higher suspended sediment levels and warmer summer temperatures (Mainstem 2006).

Flow in the Peace River was regulated in 1968 by the construction of the Bennett Dam that created a large impoundment to capture freshet flows. Typical of large storage projects, the regulated flow regime in the Peace River is characterized by higher than natural winter flows as stored water is used for power generation (Peters and Prowse 2001). River flows are lowest during the summer as the reservoir is recharged at this time and energy demand is lower. In 1980, the Peace Canyon Dam was constructed 20 km downstream from the Bennett Dam. This facility is operated essentially as a run-of-river plant as there is only a small range in storage in its reservoir.

At Peace Canyon the maximum generation flow is 1982 m^3s^{-1} and the minimum is 283 m^3s^{-1}. The facility is used for load-following or hydropeaking and flows are generally lower at night and higher during the day. No restrictions are placed on the rates of change of flows. At Site C (≈100 km downstream of Peace Canyon) daily fluctuations in river stage of 0.2-1.0 m occur. The amplitude is attenuated downstream and reduced to 0.1-0.2 m at the Town of Peace River situated 380 km from the Peace Canyon dam. Further downstream the effects of hydropeaking are undetectable (BC Hydro 2012a). The timing or phase of the high flow shifts as water flows down the river, it takes 10-12 h for flow to reach Site C from the Peace Canyon dam, which causes high flows to shift from day to night at this location.

Downstream of the Peace Canyon dam, tributary inflows tend to offset some of the impacts of flow regulation. In particular, freshet flows from tributaries create a more normalized freshet in the Peace River. That contribution is relatively minor in BC, but becomes more significant further downstream. Single day peak flows at the PAD currently range from 4 000 to 8 000 m^3s^{-1} but are approximately 3000 m^3s^{-1} less than would be expected without the hydrosystem (Peters and Prowse 2001).

Regulation of the Peace River has had typical and predicable effects on fish habitat characteristics (Prowse et al. 2002), particularly in the reach from the Peace Canyon dam to the Provincial border. The absence of spring flows has created an armoured bed and allowed for the deposition of material at tributary confluences. Woody vegetation has encroached the banks and colonized islands and gravel bars. In some cases, gravel bed side channels have become infilled and abandoned. These changes tend to reduce the diversity of fish habitats in the river. High freshet flows are likely also important for spring spawning species as flooded channel margins can provide habitat to larval and juvenile stages. Large daily fluctuations in flows likely reduce the productivity of low velocity habitats along the river margins, although in the absence of baseline data these impacts are difficult to quantify. Changes to the PAD resulting from the regulation of the Peace River are described by Prowse and Conley (2002) and Peters and Buttle (2010).

Analysis and Response

Predicted Downstream Changes to the Peace River post-Site C

Seasonal flows. The Site C facility has limited range of storage and will be operated primarily as a run-of-river plant. Modelling by BCH suggests the seasonal pattern of flows downstream of Site C will be very similar to the current conditions, with only very slight differences observed at the Town of Peace River gauge site (BC Hydro 2012a).

Daily flows. Site C moves the point of regulation downstream about 80 km, and the reaches that experience large amplitude daily fluctuations will move downstream a corresponding distance. Modelling suggests the amplitude of daily flow changes will increase by 50-100% at Taylor, ≈20 km downstream of Site C. A change in the phase (with respect to time of day) will also occur although it has not been quantified in the available documentation. A much smaller increase in amplitude (visually estimated at 20-50%, corresponding to about 5-20 cm in amplitude from BC Hydro 2012a, Appendix B) is predicted at the Town of Peace River (BC Hydro 2012a). Importantly, this location is nearly 200 km downstream from the proposed location of the LAA. Daily fluctuations due to dam operations are completely attenuated at Fort Vermillion, 700 km downstream of Site C.

River ice. Ice cover formation in the Pease River usually begins near Vermillion Chutes and progresses upstream. The Site C dam is expected to reduce the volume of ice transported downstream and increase fall and early winter water temperatures. These changes are predicted to move the maximum extent of the ice front downstream approximately 40 km. The average location of the ice front after construction of the Site C dam is near Many Islands, about 125 km from the dam site. It is unclear whether the reduction in ice volumes will meaningfully affect flooding of the PAD during spring breakup, although the analysis provided in BC Hydro (2012a) suggests ice thickness and the timing of ice breakup in the lower river will not be affected by Site C.

Suspended sediments. Reservoirs are sinks for sediment inputs and generation releases can have very low total suspended sediment (TSS) levels. Spot samples taken from 2006-2008 show that TSS immediately downstream from the Peace Canyon Dam was nearly always < 5 mg/L (Golder Assoc. 2009). At Site C, tributary inflows increased TSS to values ranging from 5-189 mg/L. Near the Provincial border values further increased from a winter low of 4.5 mg/L to a peak of 1640 mg/L. After the Site C dam is built, the reach immediately below the dam is expected to have low TSS values, but inflows from the Pine, Beatton and Kiskatinaw Rivers will restore relatively turbid conditions at the Provincial Border. Further downstream inflows from tributaries, in particular from the Smoky River, will dominate any changes associated with the Site C dam (BC Hydro 2012a).

Geomorphology. No incremental changes to the ongoing evolution of the Peace River channel to its initial regulation are expected, with the exception of the area immediately below the dam where some scour will occur.

Impacts to fish and fish habitat

The largest impacts of the Site C project will be borne by the coldwater fish community that is in greatest abundance between Peace Canyon and the BC/AB border. For these species, the conversion of 80 km of river to reservoir, the isolation of tributaries, potential passage issues and the increased variation in flows below the dam will need to be considered in the assessment. Lower turbidity levels anticipated below the Site C dam are expected to push the transition from coldwater to coolwater species further downstream towards the Provincial border. The local assessment area, bounded at a point 125 km downstream of Site C (BC Hydro 2012b) appears sufficient to capture the significant direct effects of the project on fish and fish habitat. The increase in amplitude of daily flows caused by Site C will not be fully attenuated at the LAA boundary, however, and there may be slight residual effects on fish and habitat further downstream that could warrant a revision to the LAA. A revision to the LAA may also be needed if it is determined that the range of fish impacted by the dam extends downstream past the LAA. An example might be Bull Trout that have been found in small numbers below the LAA. Some of these fish may utilize habitats upstream of Site C, and their abundance in downstream habitats could potentially be impacted if their movements were affected by Site C.

The downstream boundary for the regional assessment area is Vermilion Chutes, almost 800 km downstream of Site C. The Peace River drops about 5 m over a series of ledges at the chutes, and they are likely a barrier to upstream movement for many fish species. However, tagging studies indicate that some Goldeye may migrate past the chutes as part of their migration from Lake Athabasca to upstream spawning and rearing areas (Mainstream 2006). Information provided by BC Hydro suggest that the proposed operational regime for Site C will not cause any meaningful incremental change to fish or fish habitat at or downstream of the RAA boundary. This conclusion is based on predictions that changes in ice thickness will be small and Site C will have no impact on the timing of ice breakup (BCH 2012b); thus it is assumed there will be no changes to ice and flow conditions in the PAD.

In terms of cumulative effects on fish and fish habitat, a foreseeable project that could interact with Site C is the potential implantation of the Dunvegan dam, that would be located about 200 km downstream of Site C. The Dunvegan project is a true run-of-river facility and the Joint Review Panel for Dunvegan determined residual impacts on fish or fish habitat at Fort Vermillion were unlikely (JRP 2008). The prediction of an absence of a residual effect of Site C on fish and fish habitat at Vermillion Chutes, the determination of no residual effect of the Dunvegan Project at the same location, and the likely significance of the Chutes as an ecological boundary support the use of this location as an RAA boundary.

Conclusions

The local and regional assessment boundaries are considered to be appropriate for the assessment of direct and cumulative effects of the project. More detailed analysis of the impacts of Site C on fish populations may suggest that the LAA boundary may need to be revised as new data and analysis becomes available from the proponent. The choice of RAA appears justified as, Site C is unlikely to have any impact on fish or fish habitat in the Lower Peace River.

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