WASKESIU LAKE

RIFFLE WEIR

DESIGN SUMMARY

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November, 2004

DESIGN SUMMARY

The existing dam at the outlet of Waskesiu Lake does not meet current standards for fish passage. A February, 2004 report demonstrated that a more natural riffle weir could overcome the fish passage deficiency. Based on consultation between Parks Canada, DFO and lake users it was decided to construct a riffle weir outlet control that would provide normal lake levels similar to those experienced during the past 60 years while reestablishing the natural fish migration potential of the Waskesiu River. An operating range around 532.24 m has been identified as desirable.

In addition to being a physical barrier to fish movement, the old stoplog dam reduced the lake level variation so that the lake storage was not contributing to the flow attenuation that naturally occurs downstream of lakes. The planned riffle weir will reestablish a more natural lake level and downstream flow regime. The operating levels of the lake will be higher than the natural level but the design will ensure that future flood levels are not extreme in order to protect against shoreline damages, particularly damage to the beaches and riparian vegetation that have become established in the past 60 years of operation with the old dam. The range of levels in drought and flood periods will be wider than would be the case with the old dam in order that the lake can store high inflows and attenuate outflows in drought periods.

The old dam will be decommissioned by removing the stop logs. Its foundation and structure will continue to function as a pedestrian bridge for the trail that currently uses it. The new riffle weir will be a short distance downstream of the old dam.

Construction is planned for fall of 2005 to avoid the main fish migration season and to take advantage of the usually lower fall flows. The lake and old dam will be used to control flows during construction and if natural flows indicate the need, a live stream downstream will be maintained by a temporary diversion past the construction site.

The riffle weir will incorporate a concrete wall, buried in the upstream riffle that will function as a fixed limit on low outflows from the lake.

In order to minimize the length of river disturbed by construction, the riffle weir will be constructed as a series of rapids and small pools which concentrate the drop in water level in short reaches that the fish can traverse using their ability to swim quickly for short distances.

The main construction materials will be gravel, cobbles and rock rip rap with a small amount of concrete for the fixed overflow crest. The resulting project will take on the appearance of a natural set of three small rapids with two pools between the rapids.

Several alternative geometries were considered.

The possibility of fixing the lowest overflow point at 532.24 m and allowing the lake to fluctuate above this level was considered but, in order to avoid high flood levels, this option could not provide for lake storage to attenuate flows to restore the natural downstream flow regime. This option would also result in average lake levels higher than those experienced in recent decades and damage to the established shoreline. In order to avoid high lake levels, provision for fish passage through a central channel in the control weir would be too shallow, 0.15 m, for large fish.

An option with the upstream riffle having a minimum level of 531.9 m, a 0.3 m deep fish passage channel and a 40 m wide flood overflow section was found to closely reproduce the flow attenuation of the natural channel and maximize the depth of the fish passage channel at low flows. This option results in an approximate 0.6 m water level difference from the lake to the downstream channel during low flows periods. The possibilities of achieving this drop in two, 0.3 m riffles or three, 0.2 m riffles were investigated. The two riffle option was found to be close to the limit for fish movement. The three riffle option would be substantially better for fish and only marginally more expensive. Therefore the three riffle option was selected.

Figures 1, 2 and 3 show the main dimensions of the proposed riffle weir. The vertical scale has been exaggerated to emphasize the shape. In order to help visualize the relatively flat nature of the project, Figure 4 shows a profile without the vertical exaggeration.

Figure 5 shows the lake level versus outflow relationship for Alternative A (minimum overflow 532.24 m); Alternative B (minimum overflow 531.9 m), the natural channel (minimum overflow level 531.36 m); and the old dam (stoplogs set at 532.25 m).

Figure 6 shows the simulated lake levels for the period from 1954 to 2002 that would result under natural conditions; if the stoplog dam was operated at a fixed level of 531.25 m; Alternative A; and Alternative B. Figure 7 shows the probability of lake levels occurring. Figure 8 shows the simulated outflows and Figure 9 shows the probability of outflows. Because the low outflows are critical to fish passage, Figure 10 shows the low flow probabilities in more detail.

Figure 10 demonstrates that, in addition to being a physical barrier to fish, the old dam increased the frequency of low and zero outflows in the Waskesiu River. For the simulated study period, the natural monthly flow would have been zero, 10 percent of the time. If the old dam was operated with a fixed overflow it would have resulted in an increase in the zero flow probability to over 30 percent of the time. This substantially changes the river habitat. The high level riffle weir, Alternative A would partially overcome this impact by reducing the frequency of zero flow to 15 percent of the time. Alternative B would reduce the zero flow probability to about 5 percent. For flows below 0.2 m^3/s, which is likely about the lower limit for useful fish migration, the probability of insufficient flows would be 24 percent, 38 percent, 32 percent and 27 percent for the natural outlet, the old dam, Alternative A and Alternative B respectively. Alternative B comes close to restoring the natural low flow regime in the Waskesiu River.

Figures 6 and 7 compare the lake levels for the four scenarios. The old dam raised the normal lake level about 0.7 m from its natural condition and reduced the variability of the levels. Alternative A would raise the normal level an additional 0.16 m and would result in a very similar range of levels compared to the old dam. If achieving similar lake levels was the only criteria, a riffle weir similar to Alternative A but 0.16 m lower would achieve the result required. However, the downstream flow distribution from Alternative A was not satisfactory. Therefore Alternative B was designed to get the flood performance close to the old dam performance and also incorporate a deeper, 0.3 m, “V” notch fish passage channel to achieve better attenuation of low flows. During periods of normal and flood flow, Alternative B will result in lake levels similar to the old dam but in low flow periods, it will allow the lake to draw down farther to extend the probability of low river flows.

It should be noted that, if the old dam was not replaced, fishery requirements would result in operational changes to maintain more natural river flows in low flow periods. The actual lake levels would not be as stable as the simulation of the stoplog dam scenario indicates. Levels and flows would be more like the Alternative B scenario. Mitigating the physical barrier to fish migration would require substantial structural changes.

Alternative B was selected for implementation because it results in lake levels similar to those experienced for the past 60 years, eliminates the physical barrier to fish movement and reestablishes a more natural downstream flow regime.