The Kananaskis Valley

It is Time for Water Management Policy Change

A report prepared by

Calgary River Users Alliance

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Summary

The Kananaskis River is in the heart of Alberta Parks' Kananaskis Country Recreation Area and within a one-hour drive of Calgary. It has long been considered a whitewater mecca on the lower reach of the river below Barrier Lake and has the potential to be a world-class Westslope Cutthroat Trout and Bull Trout fishery over a 40 Km reach of the river downstream of the Lower Kananaskis Lake in Peter Lougheed Provincial Park.

Water management policy is currently administered under TransAlta hydroelectric power agreements dating back to 1933, and Alberta Environment & Parks flood mitigation initiatives. A total of three peak hydropower plants operate at the discharge of each of the Upper Kananaskis Lake, Lower Kananaskis Lake, and Barrier Lake. The Pocaterra Power Plant at the discharge of the Lower Kananaskis Lake has been a focus of possible operational change to enhance the downstream river fishery for some time. In 2001 the Fisheries and Recreation Enhancement Working Group (FREWG) presented an in-depth assessment of water management and hydro operational change that could be implemented to enhance the Kananaskis River fishery while protecting other recreational activities. The proposal was to move away from peakhydro to more of a run-of-the-river water management policy. Unfortunately, the recommendations of the report were not implemented.

Twenty years later, the need for the Kananaskis River hydropower change is more apparent. Hydropeaking has been shown to have far more environmental consequences than previously considered. There are alternatives to peak power generation in Alberta with a move from coal to natural gas power plants. The socio-economic considerations for environmental enhancement and change are more prominent. And the Kananaskis River offers a unique opportunity to reestablish Alberta's native and endangered Westslope Cutthroat Trout and Bull Trout into a provincially protected watershed.

This report reviews the FREWG Kananaskis River Enhancement report, adds more recent data, and opinions that would support change to the existing water management policy. It is an opportunity to protect a native population of trout within a much-needed expansion to the sports fishery while also enhancing the important outdoor recreational activities in one of Alberta's most beautiful provincial parks.

Introduction

The Kananaskis River in Kananaskis Country was once the home to a thriving population of Westslope Cutthroat Trout and Bull Trout. The river runs from the Upper Kananaskis Lake into the Lower Kananaskis Lake and then flows through the valley for 40 Km until entering Barrier Lake and a further 10 Km reach to the confluence with the Bow River at Seabee. TransAlta has three hydroelectric power generation plants with a combined generating capacity of 33 megawatts, which is roughly 10 percent of the generating capacity of the TransAlta's Bow River hydro system. The Bow River system is less than 3% of TransAlta's Alberta current electrical power capacity.

All three hydro plants are operated under peakhydro power generation, whereby the plants are either "on" or "off', with no intermediate operation, and that the timing of plant operations is geared to daily peak electrical demand periods. At the time the plants were built from 1933 to 1955, hydroelectric power was considered the most cost-effective source of electricity with limited environmental impact. In later years it has been demonstrated that aquatic habitat and fish populations are severely impacted by peakhydro power plant**s**. Peak Hydro operations has left the Kananaskis River almost devoid of fish.

Kananaskis Country has become a mecca for outdoor recreational pursuits. The park's location is within a one-hour drive of Calgary and adjacent to Banff National Park. Modifications to the river and changes to hydro release schedules on the Lower Kananaskis River below Barrier Lake has created a popular whitewater destination. The 40 Km reach of the river between Lower Kananaskis Lake and Barrier Lake would be a treasure for the sportfishing community that would complement the other world class outdoor recreation adventures found in Kananaskis Country.

The focus of this report is to review research, surveys, and reports that have contributed to the opinion that it is time to reassess water management policy within the Kananaskis River Basin to enhance sport fishing opportunities while protecting established river recreational pursuits.

1.Background

1.1. Fisheries and Recreation Enhancement Working Group (FREWG)

The following statements are taken from the 2001 report, **Kananaskis River System Assessment** [(1)] summarizes the results of FREWG's assessment for improving fisheries and recreational opportunities in the Kananaskis River system. (Figure 1)

> *The two key components of the system that were assessed are Lower Kananaskis Lake and the Kananaskis River from Lower Kananaskis Lake to Barrier Lake. This assessment considered existing data and the various studies and investigations done by FREWG and its member organizations. The project started in 1992 when the* ***Fisheries and Recreation Enhancement Working Group (FREWG)*** *was formed to examine options for improving fish habitat and recreational opportunities for reservoirs and rivers affected by hydroelectric*

operations in Alberta. FREWG was a partnership among ***Trout Unlimited Canada, TransAlta Utilities, Parks Canada, Fisheries and Oceans Canada, and Alberta Environment and Parks.***

The group's mission statement was:
"To provide stewardship for improving fish habitat and enhanced recreational opportunities."

The Objectives of FREWG were:

- *to define management objectives for fish and recreational uses within waters affected by hydroelectric operations in Alberta,*
- *to identify and assess existing fish and recreational management issues and concerns,*
- *to evaluate options that address these issues and concerns,*
- *to determine strategies for the improvement of fish habitat, and recreational opportunities, and*
- *to seek approval of recommended strategies and implement, monitor, and evaluate approved strategies.*

Figure 1: Kananaskis River

As well, FREWG adopted the following principles (not in any order of priority) to guide its work:

- *Work would be conducted in a spirit of partnership and shared responsibility.*
- *There would be no compromise in dam or public safety.*
- *The concepts of sustainability and biological diversity would be emphasized with the goal of establishing healthy, naturally sustaining populations of bull, cutthroat, rainbow, and brown trout.*
- *There would be no compromise in TransAlta's s corporate performance.*

TransAlta's hydroelectric operations have long provided reliable, relatively cheap power to help meet the needs for electricity in Alberta. As well, the reservoirs and some downstream sections of rivers provide recreational opportunities that did not exist before the construction of the dams. However, there are negative impacts on the environment and recreational opportunities associated with dam construction and operation.

TransAlta operates three hydroelectric developments along the Kananaskis River.

The Interlakes Plant:
The Upper Kananaskis Lake was a natural lake but has been increased in size and depth by dam construction. Initial development took place in 1933 and was followed by an increase in dam height in 1942 and construction of the Interlakes Plant in 1955**.** Upper Kananaskis Lake has a total live storage capacity of 124,500dam^3 The Interlakes Plant has a **capacity of 5 megawatts, with typical annual power production of 8,600 megawatt-hours.**

The Pocaterra Plant:
The Lower Kananaskis Lake was also a natural lake and has similarly been increased in size and depth by dam construction. The dam and power plant were both constructed in 1955. Lower Kananaskis Lake has a total live storage capacity of 63,100dam^3. The Pocaterra Plant has a capacity of 15 megawatts, with typical annual power production of 29,500 megawatt-hours. The physical configuration of the Pocaterra development is unique and quite different from the Interlakes or Barrier plant, the Pocaterra plant is located approximately 1.3 km downstream of the dam and is connected to the reservoir by a penstock to maximize the vertical elevation difference between the reservoir and power plant.

The Barrier Plant:
The Barrier Lake was created by the Barrier hydro development. The dam and power plant were constructed in 1947. Barrier Lake has a total live storage capacity of 24,800dam^3. The Barrier Plant has a capacity of **13 megawatts, with typical annual power production of 40,400 megawatt-hours.**

Electrical Power Generating Capacity:
The combined generating capacity of the three Kananaskis River hydro plants is **33 megawatts, which is roughly 10 percent of the generating capacity of TransAlta's Bow River hydro system** All three hydro plants are operated under "peakhydro" mandates whereby the plants are either "on" or "off', with no intermediate operation, and that the timing of plant operations is geared to daily peak electrical demand periods. The Barrier Plant's peak hydro flows have been modified for the public to use the whitewater reach below the dam during "peak recreation" times.

The Interlakes Plant discharges directly into Lower Kananaskis Lake and as a result, peaking operations at this facility have limited downstream impacts. Peaking operations at the Pocaterra Plant result in fluctuating water levels along a 40 km reach of the Kananaskis River extending downstream to Barrier Lake. Numerous tributary streams join the Kananaskis River through this reach which results in some attenuation of water level fluctuations. Peaking operations at the Barrier Plant result in fluctuating water levels along a 10 km reach of the Kananaskis River to its confluence with the Bow River.

1.2. The Kananaskis Lakes Fishery

The three lakes within the basin all face similar problems due to the impact of water level fluctuations in the reservoirs. This prevents the development of a productive littoral zone along the edge of the reservoir, which is a major factor limiting the quality of the fishery. Suitable spawning and rearing success are also considered to be limiting factors.

Upper Kananaskis Lake was originally barren of sport fish. It was first stocked with adult Westslope Cutthroat Trout in 1914. Rainbow Trout were introduced in 1935 and were regularly stocked until 1988 but survival from year to year was limited. More recently both Bull Trout and Westslope Cutthroat Trout have been introduced successfully and it is a thriving and valued sport fishing destination.

The Lower Kananaskis Lakes supported a self-sustaining fishery for native Bull Trout and Westslope Cutthroat trout before development as a hydro reservoir. Cutthroat Trout virtually disappeared from the Lower Kananaskis Lakes following impoundment due to damming and water diversion to support hydro. Bull trout have maintained a self-sustaining population in the Reservoir by spawning in Smith-Dorrien Creek. Attempts have been made to establish a Rainbow Trout and, more recently, a Cutthroat Trout fishery have been unsuccessful. Over-harvest by angling had a major impact on the Bull Trout population. But with fishing regulation change in 1992 the Bull Trout have staged a remarkable recovery.

Barrier Lake did not exist before the construction of the dam and power plant in 1947. There are self-sustaining populations of Brown Trout and Mountain Whitefish that use Barrier Lake and the Kananaskis River upstream of the lake during different portions of the year. Natural reproduction is sufficient to maintain a medium quality fishery in the lake.

1.3. Kananaskis River from Lower Kananaskis Lake to Barrier Lake

The FREWG assessment for improving this fishery.

> *Before hydro development, the Kananaskis River below Lower Kananaskis Lake supported a self-sustaining fishery for native Bull Trout, Westslope Cutthroat Trout, and Mountain Whitefish. At present, bull and cutthroat trout are largely absent from this reach of river, but a self-sustaining population of native Mountain Whitefish remains. Self-sustaining populations of Brook Trout and Brown Trout are now present in this reach of the river as*

the result of earlier stocking efforts. The quality of the fishery in this reach of the Kananaskis River is generally poor. The fluctuation of water levels that result from peaking operations at the Pocaterra Plant is considered to be the major factor limiting the quality of the fishery in this reach of the river.

The reach of the Kananaskis River below Barrier Lake would have supported similar populations of fish to that in the reach upstream of Barrier Lake before hydro development. The status of the fishery is low due to impacts on habitat associated with the greater fluctuation in water levels which result from hydropeaking operations at the Barrier plant.

1.4. The impact of Kananaskis River on Bow Basin Hydro Operations

The FREWG assessment states:

The primary downstream river basin impact of hydro operations is related to reservoir operations. The reservoirs are progressively filled during the spring and summer, then progressively drawn down over the fall and winter, reaching minimum levels in approximately mid-May. The storage available during spring runoff in hydro reservoirs in the upper Bow River Basin is sufficient to reduce peak flow rates, and thereby reduce potential flooding. A much more important product of hydro reservoir operation is increased river flow during the fall and winter period. Minimum winter flows through Calgary now are more than double what would have occurred without the reservoirs in place.

The 2013 flood that devastated the entire Bow River Basin made it clear that water management policy would need to change. Following extensive analysis, a recommendation was made to release reservoir water storage within the Kananaskis drainage in the spring before mountain runoff occurs. And, the-run-of-the-river flows maintained until the risk of flooding declined in July (Figure 2)

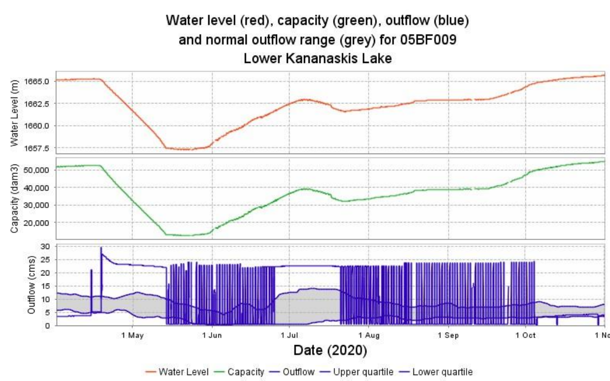

Figure 2: Lower Kananaskis Water Level and Discharge

1.5. Recreation

In 1977, the provincial government announced plans to develop Kananaskis Country as a provincially significant outdoor recreation area for Albertans. As part of this, Peter Lougheed Provincial Park was established in 1978 and Upper and Lower Kananaskis Lakes became focal points for significant campground, day-use and trail recreation developments.
Each of the three lakes have boat access, hiking trails, and campsites. Fishing is a popular recreational pursuit at all three lakes

The Kananaskis River from Lower Kananaskis Lake to Barrier Lake has several day-use sites and campgrounds presently along this river reach. As well, the Kananaskis Golf Course borders the river.

Other recreation-associated infrastructure along the river include the Kananaskis Village and Nakiska Ski Area. The daily flow variations associated with the Pocaterra hydro development restrict paddling use in this river reach. The sport fishery has also been devastated by hydro operations with limited angler usage.

The Kananaskis River from Barrier Lake to the Bow River is used by commercial, institutional, and public recreational paddlers.Whitewater rafting, kayaking, canoeing, river surfboarding, river rescue training and Olympic slalom whitewater kayak training occur in this reach. It is one of the most heavily used river recreational reaches in Alberta. One of the reasons for the high usage of this river reach is that the scheduled release rate from the Barrier Plant provides good to optimum flow conditions for a full range of paddling activities. Because the flow rate is now regulated, good paddling conditions exist from early spring until late fall, well before and well after Alberta's natural rivers flow.

In 2018 the Government of Alberta released the **Lower Kananaskis River – Barrier Lake Redevelopment Plan**[2] that recognized the need for improved recreational infrastructure in the area. The development of the Canoe Meadows Whitewater Park (Figure 3) recognizes the economic importance of river recreational pursuits in future water management policy.

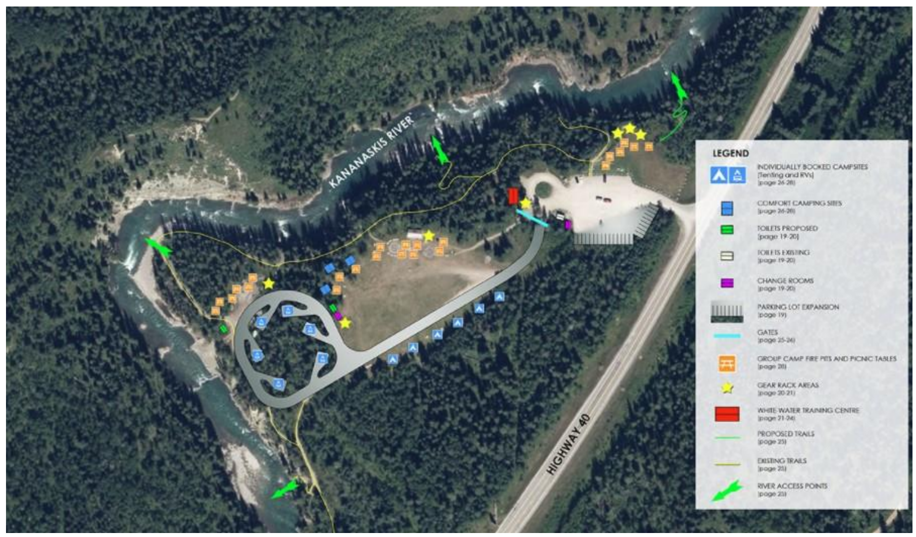

Figure 3: Barrier Lake Canoe Meadows

2.The FREWG Assessment

Considerable fishery and recreation information was available for portions of the Kananaskis River system. However, a few data gaps were identified. Commencing in 1994, a series of projects were initiated by FREWG to fill the most important data gaps that included:

- *Biological Productivity of Water Bodies*
- *Fish and Fish Habitat Inventories*
- *Water Level and Water Temperature Monitoring*
- *lnstream Flow Needs*
- *Recreational Use*
- *Lower Kananaskis Lake Fishery Monitoring*

Defining Management Scenarios

Once data for the Kananaskis River system became available, FREWG conducted numerous analyses to enable an eventual assessment of the following water management scenarios:

- *Kananaskis Hydro System Simulation Modeling*
- *Lower Kananaskis Lake Fishery Enhancement Assessment*
- *Kananaskis River Temperature Assessment*
- *Kananaskis River Fishery Enhancement Assessment*
- *Recreation Enhancement Assessment*
- *Kananaskis River Regime Assessment*
- *Downstream Water Rights Assessment*
- *Water Quality Downstream of Calgary Assessment*
- *Hydroelectric Considerations*

2.1. Upper Kananaskis Lake Scenarios Upper Kananaskis Lake has a total live storage capacity of 124,500dam^3 This Lake has the most storage capacity in the Kananaskis Valley but the lowest energy production. In the last 3 years the water level has varied by 7 meters through the season from 1693 m to 1700 m. Storage capacity during this period ranges from 55,000 dam^3 to 124,500 dam^3 . The lowest level is reached in May and continually rises through to October before dropping through the winter.

The Interlakes Plant has a **capacity of 5 megawatts, with typical annual power production of 8,600 megawatt-hours.** This is the smallest power plant in the Kananaskis Valley.

The Upper Kananaskis Lake was considered a less suitable candidate for stabilization because of the volume of storage that would be sacrificed. It also has a steep rocky shoreline that limits the amount of productive littoral zone that could be enhanced through stabilization.

2.2. Lower Kananaskis Lake Management Scenarios

Five options were considered in 1999 when selecting scenarios for the management of the reservoir. Stabilization above 1665 m would not allow for safe operation of the spillway for the dam. Stabilization at 1661 m was selected as the lowest level to evaluate because it is the operating target that provides benefits in terms of increased biological productivity and full utilization of a spawning channel.

Flood protection protocols now operate the Lower Kananaskis Lake with lower levels of 1657 m being maintained from mid-May to late July before peaking in September at 1665 and holding at this level until April. This provides 42,500 dam^3 of flood protection storage during the prime June-July high water periods.

Each of the five lake management scenarios is described in detail below.

Scenario A: Current Lake Operations. The Current Operations scenario represents the current operating objectives and constraints that are utilized to manage Lower Kananaskis Lake and the

Pocaterra Plant. Under this scenario. the reservoir is managed using guide curves that draw the reservoir down before spring-runoff and raise its level from late spring through to late fall. This enables the maximum volume of run-off to be stored for energy production. Under this scenario, the reservoir elevation varies annually between **1653.5 m to 1667 m**.

Scenario B-1: Stabilization at 1661 m. Stabilization at 1661.l m represents the lowest reservoir stabilization level modeled**.** This scenario was devised, in part, to accommodate the development of a Cutthroat Trout spawning channel at the inlet to Lower Kananaskis Lake. No modification to the existing spillway would be required.

Scenario B -2: Stabilization at 1663 m. Stabilization at 1663.0 m represents the intermediate reservoir stabilization level modeled. This scenario would reduce the length of a Cutthroat Trout spawning channel compared to stabilization at 1661 m but does not eliminate that option. No modification to the existing spillway would be required.

Scenario B-3: Stabilization at 1665 m Stabilization at 1.665.0 m represents the highest reservoir stabilization level modeled. This scenario negates the possibility of using the former Kananaskis River channel as a Cutthroat Trout spawning channel.

Scenario C: Partial Seasonal Stabilization. This scenario represents partial stabilization of the reservoir at elevation 1661 m between May I and July 27 each year and allowing the reservoir to fill to Full Supply Level (FSL) later in the season. This scenario was created to promote multiple use of the reservoir, including developing a Cutthroat Trout spawning channel in the former Kananaskis River channel, utilizing available reservoir storage, and maintaining a minimum flow of 1.0 cms (35 cfs) in the Kananaskis River. No modification to the existing spillway would be required to accommodate this scenario.

In terms of the Lower Kananaskis Lake. Each stabilization scenario was analyzed separately. However, in assessing the combined plant operating and lake management scenarios only **Scenario B – Stabilization at 1663 m** was considered to represent the best option for the Kananaskis River and Pocaterra Plant operation. Of the combinations possible between the six plant and five lake operations, a total of twelve combined scenarios were examined in detail. Natural river flow conditions were also examined for comparison purposes.

2.3 Pocaterra Plant & Kananaskis River Operating Scenarios

A preliminary assessment identified the Kananaskis River from Lower Kananaskis Lake to Barrier Lake as the best option for fishery enhancement because of the length of the reach, the better fishery that existed before hydro development, and existing self-sustaining fish populations are present and would probably re-establish a higher quality fishery if better habitat conditions were available.

The FREWG scenario options are based on information available in 2001 – a new Pocaterra Plant penstock infrastructure was installed in 2012 that could impact the options available today:

A total of six operational scenarios are presented (Table 1). Some background information on the Pocaterra Plant's operation characteristics is first provided. The Pocaterra Plant consists of a single turbine/generator unit. At its maximum operating head of 56.4 m, the maximum flow and generating capacities of the unit are 27.8 cms and 13.7 MW, respectively. The Pocaterra Plant cannot be operated for sustained periods between 11.3 and 19.8 cms and below 7.1 cms as these are "rough zones", defined as ranges of flow in which excessive machine vibration and cavitation occur. In its current peaking mode of operation, the Pocaterra Plant is operated at two gate settings: 70% in the summer and 90% in the winter.

Scenario 1: Baseline Current Operations. Current Operations involves running the Pocaterra Plant at full or near full capacity for a limited period of the day, then turning the plant off for the remainder of the day. No minimum flow is provided in this mode.

Scenario 2: Revised Peaking Option #1. Revised Peaking is like peaking since the plant operates in an on/off fashion. However, the extreme flow variability is decreased by reducing the maximum flow and increasing the minimum flow. The Revised Peaking Option #I scenario entails limiting the gate opening to 70% for the entire year and ensuring that a minimum flow of 1.0 cms is passed to the downstream river channel via a bypass.

Scenario 3: Revised Peaking Option #2. The Revised Peaking Option #2 scenario is identical to the Revised Peaking Option #I scenario, except the minimum flow is increased from 1.0 to 2.0 cms.

Scenario 4: Flat Loading Option #1. The goal of "Flat Loading" the plant is to minimize the variability in plant flow release without violating the operating constraints of the plant. This is accomplished by operating the plant in one of the acceptable flow ranges: 19.8 to 27.8 cms or 7.1 to 11.3 cms. Depending on the total volume of water being passed through the plant each week. the water release may be constant or may alternate between the acceptable operating zones. If there is insufficient flow to allow continuous operation of the plant in the acceptable zones, a minimum flow of 1.0 cms is passed to the river via a bypass.

Scenario 5: Flat Loading Option #2. The Flat Loading #2 scenario is identical to the Flat Loading #1 scenario, except the minimum flow is increased from 1.0 to 2.0 ems Flat Loading #2 was only evaluated with Current Operations of Lower Kananaskis Lake.

Scenario 6: Average Weekly. The Average Weekly mode of plant operation ignores the plant operating constraints and rough zones and operates the plant at a steady flow rate equal to the weekly flow rate provided by the reservoir model. This mode of operation is currently not possible with the existing machinery at the Pocaterra Plant in 2001.

Table 1: Pocaterra Hydro Plant Operating Scenarios

Plant scenario	Scenario	Generating flow ranges cms	Maximum flow cms	Minimum flow cms	Plant modifications required?
Current Operations	I	Winter: 25.5 to 27.8 Summer: 19.8 to 21.8	Winter= 27.8 Summer= 21.8	0.1	No
Revised Peaking # I	2	Year-round: 19.8 to2I.8	21.8	1.0	No
Revised Peaking #2	3	Year- round: 19.8 to 21.8	21.8	2.0	Yes 2.0 cms bypass required
Flat Loading # I	4	7.1 to 11.3 19.8 to 27.8	27.8	1.0	No
Flat Loading #2	5	7.1 to 11.3 19.8 to 27.8	27.8	2.0	Yes 2.0 ems bypass required ·
Average Weekly	6	0.1 to 27.8	27.8	0.1	Yes Plant modifications required

2.4. Barrier Lake Scenarios

Barrier Lake has a total live storage capacity of 27,000 dam^3 This Lake has the smallest storage capacity in the Kananaskis Valley but the most energy production. In the last 3 years the water level has varied by 8 meters through the season from 1367 m to 1375 m. Storage capacity during this period ranges from 2,500 dam^3 to 22,500 dam^3 · The lowest level is reached in mid May, is maintained at this level till August and rises through to October and maintained at a high level before dropping in April.

With its small storage capacity and high peaking power potention, the Barrier Lake is considered a less suitable candidate for stabilization because the storage is minimal and can be maintained at a moderate level through the year.

2.5 Barrier Plant & Lower Kananaskis River

The Barrier Plant has a **capacity of 13 megawatts, with typical annual power production of 40,400 megawatt-hours.** This is the largest power plant in the Kananaskis Valley accounting for 50% of the power generated in the system. The hyrdro-peaking operations of the Barrier Plant creates optimal high flows in the Lower Kananaskis River for recreational whitewater paddling. The whitewater reach attracts 100,000 users each year with a value to the Alberta economy of $15 Million per year. The Kananaskis River from Barrier Lake to the Bow River is not considered a viable option for fishery enhancement due to the short length of this reach, and its intense use for whitewater paddling recreation.

3.Results of the FREWG Assessment.

In assessing the management alternatives for the Kananaskis system, FREWG considered a variety of factors:

- ***Reservoir productivity -*** *fish and invertebrates.*
- ***Fish habitat -*** *river flow and temperature.*
- ***Wildlife and vegetation -*** *adjacent to Lower Kananaskis Lake and the Kananaskis River.*
- ***Reservoir recreation -*** *the impact of changes on use, facilities, and the environment.*
- ***River recreation:*** *Changes in flow and how it affects recreational.*
- ***Capital and lost opportunity costs-****The costs associated with changes in the production of electricity and capital investment for reclamation and modification of facilities*
- ***Flood control and safety*** *- the ability to control high flows and the level of the lake.*
- ***EUB criteria*** *– regulatory considerations*
- ***Downstream impacts*** *-the effects of changes in flow within the Bow River Basin.*
- ***River regime*** *- the effects on winter ice jams, summer flood damage, flushing flows, and changes in the river channel that help sustain a healthy ecosystem.*

A detailed analysis is available in the FREWG report that summarizes the impacts of changing water management. This analysis considered the pros and cons of the various lake and river management scenarios. The assessment showed the substantial benefits, costs, and trade-offs that are involved in changing water management in the Kananaskis system.

3.1. Lower Kananaskis Lake

- *The stabilization of the Lower Kananaskis Lake would triple the reservoir's biological productivity compared to current conditions. The potential yield of sportfish {kg/ha) would be similar to natural conditions.*
- *Partial stabilization of Lower Kananaskis Lake would only increase potential sportfish yield by 6%. It is not an efficient way to improve productivity.*
- *Fertilization of Lower Kananaskis Lake was evaluated as a way to improve productivity in the reservoir. Fertilization would not be effective without stabilization.*
- *Stabilization would also benefit recreation at Lower Kananaskis Lake. Improved access to the lakeshore, better fishing opportunities, and improved aesthetics would enhance the quality of visitors' recreational experiences on and near the reservoir.*
- *The total cost of stabilization would be in the order of $3 million* ***Net Present Value of Capital and Operation Costs -2001****(NPV) over the next thirteen years due to increased capital and lost opportunity costs.*

- *Compared to current conditions, stabilization or partial stabilization would generally decrease flow in the Bow River during the winter and spring and increase flow during the summer and fall. The greatest decrease in flow occurs in March and April. These changes would not affect existing irrigation or other withdrawals nor would they result in reduced water quality in the winter with existing wastewater discharges.*
- *Stabilization or partial stabilization would not change existing water temperature in the Kananaskis River and would create a marginally positive increase in flushing flows. As well, stabilization would not affect ice jams, summer flooding, or changes in the river channel relative to existing conditions.*

3.2. Kananaskis River

- *In terms of fish habitat in the Kananaskis River, scenarios with **Average Weekly** plant operations would provide the greatest improvements compared to current conditions and the amount of habitat would be comparable to natural conditions.*
- *The **Flat Loading** scenarios provide less of an improvement for fish habitat compared to current conditions and provide much less habitat than both the **Average Weekly** scenarios and natural conditions.*
- *The Revised Peaking scenarios do not provide much improvement over current conditions.*
- *In those scenarios where fish habitat would improve in the Kananaskis River, it is expected that angling success would also improve.*
- *The total cost of implementing **Average Weekly** operations would be in the order of $7 million (NPV) over the next thirteen years due to increased capital and lost opportunity costs.*
- *Implementing **Flat Loading** alternatives would be less expensive with a total cost of $3.6 to 3.9 million (NPV).*
- *In terms of river regime, the **Flat Loading** and **Average Weekly** options would have:*
    - *a positive effect on reducing winter ice jams, particularly in the vicinity of the Kananaskis Golf Course,*
    - *a marginally positive effect on maintaining a healthy river channel,*
    - *and a marginally negative effect on summer flooding.*
- *The **Average Weekly** option would marginally increase the risk for TransAlta in terms of flood control and safety. As well, the **Average Weekly** option requires a new turbine and g enerator unit which, in turn, could require approval from the Alberta Energy and Utilities Board.*
- *Plant operating scenarios would not affect existing irrigation or other withdrawals nor would they result in reduced water quality in the Kananaskis and Bow Rivers with existing wastewater discharges.*

3.3. Combined Plant Operating and Lake Management Scenarios

The FREWG report concluded that there is no single scenario that would provide a mutually satisfactory result for all interests, but suggests that the **Average Weekly Pocaterra Plant** discharge combined with one of the three **Lower Kananaskis Lake Stabilization** option would be the best-combined scenario to improve the fisheries and recreation Reservoir productivity and fish habitat would be comparable ore better than natural conditions:

- **Scenario 6- The Average Weekly:** whereby the Pocaterra Plant operation ignores the plant operating constraints and rough zones and operates the plant at a steady flow rate equal to the weekly flow rate provided by the reservoir model. This mode of operation was not possible in 2001 but maybe feasible once the plant infrastructure was upgraded in 2013 or the installation of a new turbine.
- **Scenario B – Lower Kananaskis Lake Stabilization at 1663 m** was considered to represent the best option for the Kananaskis River and Pocaterra Plant operation.

- The **Net Preset Value of Capital Costs and Lost Opportunity Costs (NPV)** for these scenarios was estimated at $9.8 Million in 2001.

4. FREWG Conclusions.

1. *The information that has been compiled was sufficient to decide whether changes to the management of Lower Kananaskis Lake and the Kananaskis River should be considered.*

2. *There would be substantial benefits to fisheries and recreation with changes in the management of Lower Kananaskis Lake and the Kananaskis River (Lower Kananaskis Lake to Barrier Lake).*

3. *The Weekly Average Flow option combined with Lower Kananaskis Stabilization at 1663 m would provide the greatest benefits including:*
    - *a tripling of the biological productivity of Lower Kananaskis Lake*
    - *improved access to the lakeshore, better fishing opportunities, and improved aesthetics at Lower Kananaskis Lake*
    - *a substantial increase in fish habitat in the Kananaskis River, Lower Kananaskis Lake to Barrier Lake to a level that would be comparable to natural conditions*
    - *a positive effect on reducing winter ice jams, particularly in the vicinity of the Kananaskis Golf Course.*

The 2010 Bow River Project[3] showed similar scenarios and outcome from modeling the Kananiskis River.

- The Lower Kananaskis Lake is stabilized at 1663.5 metres, with a fluctuation of ± 0.5 metre.
- The reservoir is not allowed to use its spillway unless elevation rises above 667 metres.
- Discharge flows from the Pocaterra power plant are held steadier, with the objective of ensuring that within-day instantaneous flows vary by no more than a factor of three, maximum day-to-day instantaneous flows vary by no more than a factor of two, and minimum day-to-day instantaneous flows vary by no more than a factor of 0.5.
- A loss of electrical power generation revenue of $1.1 million annually.
- There would be substantial benefits to the ecology of the river and recreation activities that would offset the cost on power palat improvements and lost lost electrilcal power revenue.

5. The Future - A Time for a Second Look

Although a clear vision for the enhancement of sport fishery and recreation was presented by the Fisheries and Recreation Enhancement Workshop Group (FREWG), the outcome appears to be clouded. It is understood that the principals within the FREWG; TransAlta, Alberta Environment & Parks, Fisheries & Oceans Canada, Parks Canada, and Trout Unlimited Canada had developed an agreement in principle to advance the Kananaskis River Enhancement Project, but support was withdrawn with a halt to further development.

Twenty years have passed since that decision to abandon the FREWG recommendation with the accumulation of a considerable dossier of scientific and survey information that would indicate peakhydro power generation has far more deleterious impacts on the environment than previously understood. The 2010 Bow River Report supported most of the FREWG finding, but added the importance of recreational activities ni the area. Also, the 2013 Bow River Basin flood has changed the dynamics of water management policy within the basin. In 2014 a modified hydro operation protocol [4] was initiated on the main stem of the Bow River at Ghost Reservoir. It was later expanded to include the Kananaskis River drainage that could impact the assumptions made with the FREWG Kananaskis River Enhancement Assessment. Deregulation of the Bow River hydro operation price point takes place in 2021 that will add another variable into the equation.

5.1. Current Considerations.

The Bow River, along with tributaries, is a world-renowned wild and native trout sports fishery. This exceptional fishery is under pressure from the ever-increasing population and its demand for water for drinking, industry, energy, agriculture, and outdoor recreational pursuits. These demands are compounded by human-caused environmental changes and degradation of the river's aquatic, riparian, and upland habitats. An ecosystem-based restoration and management approach for the Bow Basin and its fishery is required to maintain watershed values for the growing Calgary Region.

5.1.1: Fish Population Declines:

A report "The Impact of Bow River Water Management on the Fish Population" [(5)], discusses reasons for the decline in fish numbers are the result of the complex nature of the Bow River's highly managed water supply. The Bow River stems from the most regulated river basin in Western Canada. There are fifteen dams and dikes in the Bow watershed, plus numerous diversions, and withdrawals, along with kilometers of straightened, channelized, and riprapped stream banks have helped in the demise of the trout fishery. And peakhydro power generation that occurs on the Kananaskis River is known to cause loss of productivity, fish and aquatic insect mortality, and reduced recruitment. Extreme environmental and climate events, watershed-wide habitat degradation, mortality from natural predators and angling pressure, and human-caused changes to water quality, compound the complex cumulative effect of a basin-wide managed river. It is becoming increasingly evident that the impact of the hydroelectric water management protocols may well contribute significantly to the trout population declines, as well as the entire river aquatic eco-system.

5.1.2: The Impact of Paekhydro Operations on the Fishery:

The 2001 FREWG Kananaskis River Enhancement Assessment did establish protocols that would aid in the enhancement of a 40 km reach of the river fishery. However it did not incorporate the more recent dossier of evidence that supports either decommissioning or eliminating the variable water flow management practices within hydropeaking operations. TransAlta's peakhydro-electric power generation protocols have come under considerable scrutiny in recent years for the same reason.
A large study conducted by a collaboration of researchers from the U.S. Geological Survey, Oregon State University, Utah State University, and Idaho State University [(6)] raises serious questions about the current practice of hydropeaking to meet electricity demand, which has nearly wiped-out local populations of some insects that feed local river ecosystems. The researchers' comments illustrate the concerns: *"Insects have evolved to live with occasional extreme floods and droughts, and gradual or seasonal changes in river levels. These large daily rises and peaks in river flows due to hydropower dams are not normal. Prior to the construction of dams, there were almost no major daily changes in river levels. This can interrupt the egg-laying practices of some species, and the impact of this is poorly appreciated. Until now no one really looked at this, and it's a serious problem."*
This research found a clear correlation between hydropeaking and the number of insect species present and an almost complete absence of certain insects in some parts of rivers where they should have been present. The researchers go on to say, *"The loss of these aquatic insects can have a major impact on fisheries and other aspects of ecosystem health".*

Two research projects in 2013 and 2015 ([7,8]) did report that downstream of the Pocaterra Power Plant, researchers had assessed morphological change of the river because of the hydropeaking flow regime. Hydropeaking appears to drive channel change in the upper reaches during high flows but appears to change channel morphology in the more downstream reaches under low flows. The extent of daily changes in physical habitat conditions that organisms in the stream and fish would have to endure was also studied. Changes in habitat between high and low flow dam releases were extreme and happen regularly. The FREWG assessment reported a 1999 study on the movement of Brown Trout in the Kananaskis river [9] indicated that fish move to the protection of pools and slower moving water closer to the bank under high water velocities during periods of peak water discharge from the dam. This poses challenges to fish under variable flow conditions. An increase in fish movement that is evident under the Kananaskis River flow management regime suggests that it results in possible increased degradation and the survival of fish populations

5.1.3: The Impact of Water Temperature on Fish Population Recruitment:
Water temperature can be a limiting factor for a fishery. The FREWG assessment decided it was important to establish baseline conditions to be able to assess conditions that might result from modifications to current water management practices. Water temperature data was collected in Upper and Lower Kananaskis Lakes and at several points along the Kananaskis River. The data was included in modeling analysis to determine the suitability of water temperatures on all life stages of fall-spawning Brown Trout and Mountain Whitefish. *"The results of the analysis revealed that there was essentially no difference in the suitability of water temperatures with the various scenarios. As a result, the effect of reservoir operation on downstream water temperatures was eliminated as a criterion in scenario evaluation".*

If spring spawning Westslope Cutthroat Trout and possibly fall spawning Bull Trout are considered the target species for reintroduction into the Kananaskis River there is a need to recognize the importance that water temperature has on recruitment of both species. For Cutthroat Trout a water temperature range of 6–17ºC throughout the spawning and incubation season is desirable with an optimal water temperatures close to 10ºC [10]. Furthermore, where water temperatures are low, trout appeared to delay spawning until water temperatures remained above 7◦C. These temperature ranges may depend on the strain of Cutthroat Trout and their adaptability to location [11]. Bull trout spawn in the fall, and it is this difference in spawning time that underlies the difference in temperature tolerances of eggs and larvae of the two trout species. Bull Trout spawn in October, triggered by cooling temperatures, and the eggs incubate during the six cold winter months to emerge in March. Certainly current hydropeaking operations and the water management policies to enhance flood protect could impact trout recruitment in the river. Therefore further investigation is needed to assure a sutainable fishery.

5.1.4: Reintroduction of native Westslope Cutthroat and Bull Trout into the Kananaskis River:
Westslope Cutthroat Trout, (WCT) *and* Bull Trout (BT) are SARA "threatened" species located in 5% of the historic range, in Oldman and Bow River Basins. The Cause of decline includes invasive species (hybridization, disease, and competition), exacerbated by increased mortality and reduced recruitment/productivity from human development. The Kananaskis River peakhydro operations together with the lack of fishing regulation control have destroyed both species of trout in the river. Additionally, hydrograph variations of a meter or more reduce biological productivity, strands fish eggs/fry, alters stream morphology, suppresses water temperatures for incubation, and scours critical riparian habitat. Returning the Kananaskis River close to natural flows will allow for the revitalization of the fishery with trout that are under considerable threat of existence in Alberta.

5.1.5: Socio-Economic Considerations:
The Calgary River Users' Alliance (CRUA) presented "The Economic Importance of Recreational River Use to the City of Calgary [12], to the City of Calgary to support river access infrastructure enhancement for recreational river use. By using data collected in the AEP, Fisheries Management Branch's Sports Fishing in Alberta, 2010 Survey [13] it was shown that with a Calgary population of 1,200,000 there could well have 71,000 anglers who are passionate about fishing the eastern slopes of the Rocky Mountains and local lakes. The report also indicated that more than 12,000 anglers fish the Bow River on average 14.8 days a year. This accounts for more than 177,600 fishing days per year contributing more than $24,500,000 to the local economy.

It is expected that with an enhancement of the Kananaskis River fishery, many Calgary and visiting anglers will relish the opportunity to fish what could become a world-class native trout fishery in a beautiful provincial park setting. The above reports were based on an economic contribution to the Alberta economy of $138/angler/day of fishing. A 3% annual inflation rate would increase this to $180/angler/day in 2021. At 40 Km in length, the Kananaskis River can support at least 40 and possibly 160 anglers each day on the river depending on the quantity and quality of the fishery. When the Kananaskis River flow management enhancement is made, and fish stocking and habitat management practices are completed, a sustainable trout fishery could in place within three years. This would likely correspond to an increase in angling effort reaching 120 anglers per day on the river contributing $3.88 million annually to the economy (Table 2).

Table 2: Kananaskis River - Angling Effort Potential - 2021

Length of river (Km)	**40**	**40**	**40**	**40**
Contribution / Angler Day ($)	**180**	**180**	**180**	**180**
Anglers per Day	**40**	**80**	**120**	**160**
Total $ Contribution /Day	$ 7,200	$ 14,400	$ 21,600	$ 28,800
Total $ Contribution /Month	$ 216,000	$ 432,000	$ 648,000	$ 864,000
Total $ Contribution /Year	**$ 1,296,000**	**$2,592,000**	**$3,888,000**	**$5,184,000**

The societal importance of the reintroduction of native trout that were once abundant in the Kananaskis River is difficult to determine economically, as is the protection of the environment of the river itself. But it is fair to say that it far exceeds what has been suggested a quality and sustainable fishery will contribute to the Alberta economy. But at a minimum of $3.88 million annually, it substantially exceeds the operational and capital improvements costs to upgrade the Pocaterra hydro plant operations.

5.2. The Proposal.

Since the FREWG report was completed in 2001, the need for peakhydro power generation has diminished with the move to natural gas co-generation where power generation needs can be met instantaneously. This suggests that there is less of a need the peakhydro power from the Kananaskis River plants in the future. It is also important to recognize that less than 0.3% of TransAlta's power generation capacity comes from the Kananaskis River.

The total amount of water stored and released within the Kananaskis River Basin and what that might mean for water management that prioritizes the fishery and recreation use needs to be considered. Since 2016 the Government of Alberta has mandated TransAlta to keep the reservoirs at the lowest operation capacity from mid-May to early July for flood protection. This indicates that the stabilized Lower Kananaskis Lake water management scenarios be normalized year round with environmental and recreational benefits that provide the greatest flood protection.
Normalized flows in the Kananaskis River below the Pocaterra Power Plant would allow for further environmental and recreational benefits without affecting flood protection plans

5.2.1: There is a place for a hybrid water management model that should be considered:

- The Upper Kananaskis Lake would be used for storage to supply the demand downstream. It has the most storage capacity and is less suitable for enhancement by a stabilization regime.
- The Lower Kananaskis Lake would be kept relatively stable at the lowest level possible with perhaps some seasonal variations and provide summer flood protection and some late season storage. Environmental restoration of the littoral zone and slopes will enhance the fishery and aesthetics of the lake.
- Barrier Lake would be kept at moderate storage levels to feed the Lower Kananaskis River Recreation Area and to maintain an aesthetic and environment for the fishery and recreation. As the smallest reservoir in the valley, water can be drained within 30 hours from the reservoir if needed .

5.2.2: For the Water Management of the River Operations:

- The Upper Kananaskis Lake discharge would be used for peaking power – no change from current operations except to maintain Lower Lake levels
- The Kananaskis River downstream discharge out of the Pocaterra Plant would be changed to:
    - minimal constant flows for the winter in the range of 1.0 - 2.0 cms. This would have several effects in reducing ice damming, natural type of winter flows for fish, and retain water for summer recreational use.
    - higher constant flows from mid-May through September in the range of 10 cms. A spring freshet might be advisable to flush out the river. There could be some diurnal changes to have a little less flow at night and more flow in the day but not more than what is considered acceptable to enhance the fishery.
- The Lower Kananaskis River would continue to maintain peaking levels to have constant daily flows of 30 cms from April to November. Hours of operation would depend on the amount of water cycling into Barrier Reservoir.

In summary, there is justification to re-evaluate the proposals made by the FREWG report considering the current economics and social acceptance of hydroelectric power generation operation within the Kananaskis River. Significant improvements in fish habitat can be made with a limited capital investment, resulting in possibly the reintroduction of native trout populations and a substantial economic boost to recreational river use and the local economy. It would also demonstrate that both government and industry are committed to improvements to our environment while allowing industrial interests to continue in a provincial park.

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