Bow River Trout Foundation

The State of the Bow River Fishery

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The Impact of Bow River Water Management on the Fish Population

Introduction:

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. The Bow River's wild and native trout populations can serve as indicators of overall Bow River watershed health.

Background:

Fishery managers have monitored the Bow River for more than 30 years, and in this time, it has been demonstrated that up until 2003 the fishery was sustainable with proper regulatory constraints. More recently though, dramatic declines in the Bow River fishery have been documented. This 15-year fish decline corresponds with spring floods and low summer flows, high water temperatures, anthropogenic changes in nutrient inputs, increased fishing pressure, Whirling Disease [(1),] and changes to the hydrological regulatory regime, including timing and rapidity of river-bed dewatering.

A recent University of Calgary study [(2)] indicated that Bow River trout populations are in serious trouble. Data analysis showed that the Rainbow Trout population has declined by as much as 50% over ten years from 2003 to 2013. Alberta Environment & Parks conducted a fish population survey in 2018 to add to the data pool. The survey data was generated from the long-term sample sites downstream of Policeman's Flats [(1)] and at additional sites along the Bow River from Bears Paw to Carseland Dams. The preliminary results [(3)] indicate that rainbow trout, brown trout, and whitefish populations have all continued to decline. It also suggests that this decline may well have started as far back as 2003, regardless of flood events, disease, and increasing fishing pressure. The data also indicates that the decline is across all species and age classes of fish (a synopsis of the results is expected in the first quarter of 2019).

The U of C researchers have suggested that flood events, whirling disease, and angling pressure are primary causes of the trout and whitefish decline. And, because disease and floods are largely uncontrollable from a management perspective, the researchers suggest that stringent tactics such as angler restrictions may be the only tool to stop the decline and enhance the fishery. However, flood events are known to replenish the gravel bed river ecosystem, Whirling Disease is known to be transient, catch and release angler mortality is negligible if properly implemented, and the declines have been in all species since 2003; including species rarely impacted by angler pressure (white fish).

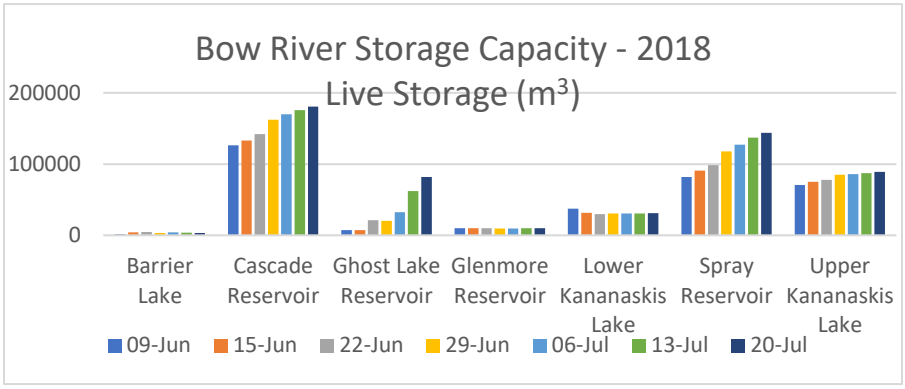
The Foundation believes the reasons for the decline in fish numbers are inadequately studied and documented, and are likely the result of the complex nature of the Bow River's highly managed water supply. The Bow River stems from the most regulated river basin in Western Canada. There are fifteen dams and dikes in the Bow watershed, plus numerous diversions and withdrawals, along with kilometers of straightened, channelized, and rip-rapped stream banks. Over 1,000 stream road culverts, along with the numerous dams and dikes, can limit the movement of fish for reproduction and feeding. "Peakhydro", the rapid dewatering of the river channel, 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 Bow River hydro and irrigation water management protocols may well contribute significantly to the trout population declines, as well as the entire river aquatic ecosystem. But unfortunately, very little data is available to support or deny this opinion. Alberta Environment and Parks have suggested that a Cumulative Effect Modelling initiative for the Bow River Basin is desirable to define the major components contributing to the cold-water ecosystem decline. A system-wide hydrological and biological inventory and regular monitoring are required to assess and adapt to changing conditions and restore biological productivity.

Bow River Water Management:

The following is a review of current water management operational procedures and the available scientific evidence of the impact on the ecology of the river and its fisheries. It is hoped that further investigation will take place within government departments to define ways to protect the Bow River ecosystem and its fishery.

The Bow River fishery needs a constant supply of cold clean water to sustain its future as a world-recognized trout river. The management of water flows is controlled by the Province of Alberta within long-standing agreements with TransAlta who control the hydro-electric dam infrastructure above Calgary, the city itself, and the irrigation districts downstream. Every week, each of these stakeholders meets to establish the water release rates through the upstream storage capacity to meet demands for water and minimum flow legislation. Water will be released or held back within the Bow River Basin storage capacity to meet projected demand. There is a total of 9 reservoirs within the Bow River Basin of which 7 have regulated capacity to store water for year-round operation of TransAlta's power generation plants (Table 1). The largest storage capacity is maintained at Cascade and Spray Reservoirs which account for 60% of the total basin storage. Both Upper Kananaskis and Ghost Reservoirs each account for approximately 15% of the total. Storage levels in each of the reservoirs are at their lowest in the spring and reach their upper limits of capacity by the end of July.

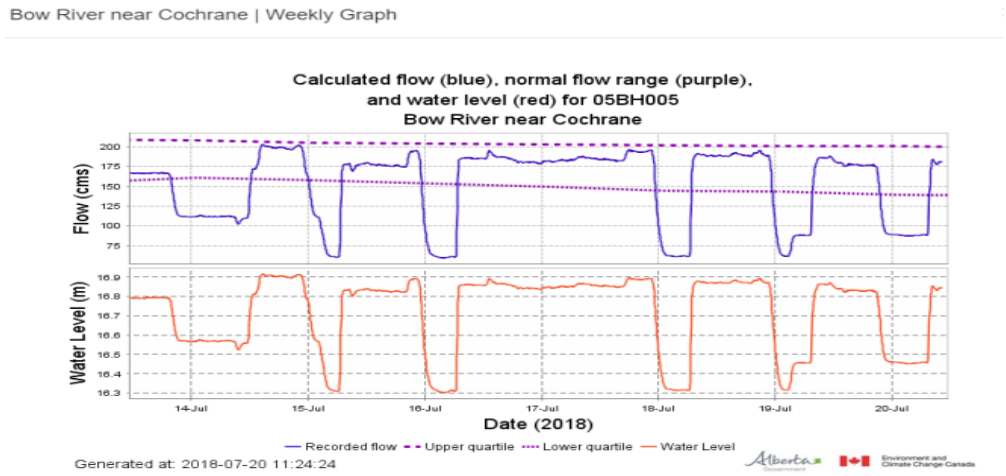
Table 1: Bow River Basin Storage Capacity Upstream of Calgary



Water is subsequently released from each reservoir to meet hydroelectric demand throughout the year. Electrical power generation is the highest at Spray (103 MW) followed by Ghost on the Bow River (54 MW) and Rundle on the Kananaskis River (50 MW). A total of 329 MW of electrical power capacity can be generated within the Bow River Basin, representing 5% of TransAlta's total Alberta generating capacity.

Ghost Reservoir power generation is referred to as "Hydropeaking" which allows TransAlta to turn the generators on when electrical power demand is high and turned off when not needed. This gives rise to extreme changes in flows below the dam (Figure 1).

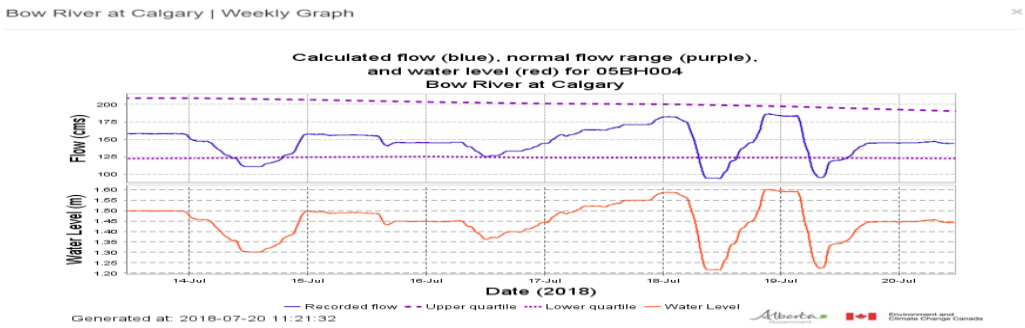
Figure 1: Bow River Flows at Cochrane – Below Ghost Hydroelectric Plant



The rapid changes in river flows below Ghost hydro-electric power plant are contained by Bearspaw Reservoir and which insulates the City of Calgary from the large water flow fluctuations experienced by the Bow River between Ghost and Bearspaw reservoirs.

Historically, consistent Bow River flows gave rise to a very productive trout fishery, but in recent years, floods, droughts and modification to the Bow River hydro operation protocol [4] have given rise to extreme changes in flow rates. In recent years the Bow River downstream of Bearspaw has experienced as much as a 50% drop or increase in flows within a very short time period (Figure 2). These dramatic fluctuations have a very detrimental effect on the Bow River fishery.

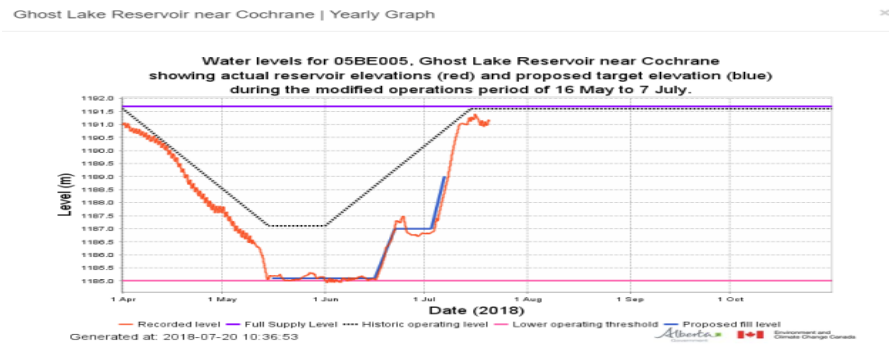
Figure 2: Bow River Flows at Calgary from July 14 to July 20, 2018



Why have we seen these dramatic changes in river flow in recent years?

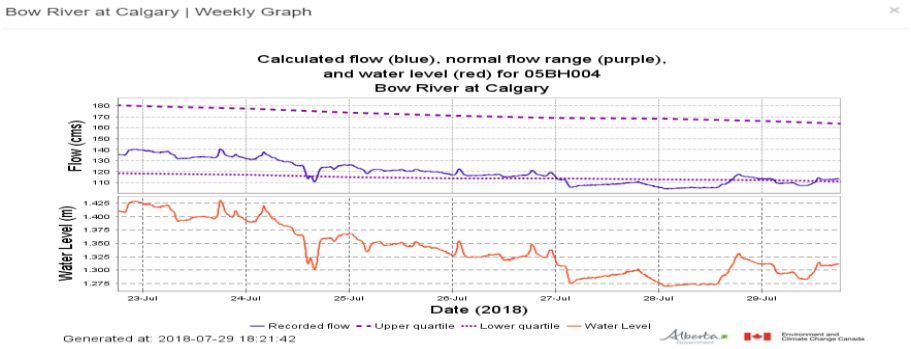
Due to a modified Bow River water management protocol that empties Ghost Reservoir in May to aid in potential flood relief for the City of Calgary in the event of high flow advisories (Figure 3). Once the city's exposure to this threat is reduced, the reservoir is returned to normal operation capacity by the middle of July. During this time, flood risk protocols are put in place across the upper Bow River watershed to contain water in the basins' reservoirs during times of high rainfall and enhanced snowmelt. Once natural flows recede, the accumulated storage will be released to accommodate further containment of rainfall. Any excess water will flow through the upper Bow River and finally through Calgary. Although river flows will increase significantly after high rainfall in the mountains and foothills, the magnitude of the increase is reduced considerably through and downstream of Calgary.

Figure 3: Ghost Reservoir Water Levels for April – July 2018



Bow River Trout Foundation has documented the modified water management protocol for some time and has expressed our concerns to TransAlta and Alberta Environment & Parks regarding the sudden spikes and drops in water flow through the City of Calgary as illustrated in Figure 2. Unfortunately, there appeared to be a breakdown of the water management operations for the week of July 15, 2018, where the extreme changes in flow had a severe impact on the recreational fishing downstream of Calgary and may have long-term impacts on the survival of the fishery itself. An immediate correction in the water management protocol was put in place that continued to stabilize flows through the summer months (Figure 4)

Figure 4: Stabilized Bow River Flows at Calgary from July 23 to July 29, 2018



The Impact of Water Management on the Bow River Basin Ecosystem.

TransAlta's hydroelectric power generation protocol which is referred to as hydropeaking has come under considerable scrutiny in recent years. 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 [5] 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 flow 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 looked at this, and it's a serious problem.*" Hydroelectric power generation has an impact on insects that lay their eggs near the shore of streams, such as a mayfly, stonefly, or caddis fly. Under normal water conditions, the eggs are laid slightly below the water surface and soon hatch. But if the water level drops suddenly, they can be stranded, dry out, and die before hatching. 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".*

The same scenario applies within the Bow River Basin. Downstream of the Pocaterra dam on the Kananaskis River, University of British Columbia researchers [6,7]. assessed morphological change of the river as a result of the hydropeaking flow regime. Pre and post-dam channel conditions were assessed. 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. An earlier study on the movement of brown trout in the Kananaskis River [8] 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 increased 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.

Alberta Environment and Parks Review of Benthic Invertebrates and Epilithic Algae at Long-term Monitoring Sites on the Bow River in 2009 [9] reported ongoing changes in water quality across the Bow River Basin, but it also shed light on the impact of hydropeaking on invertebrate concentrations below Ghost dam. The abundance of invertebrates was low at the Cochrane sampling site downstream from the Ghost Dam as compared to downstream of Calgary. It was also very noticeable within varieties of mayflies and stoneflies that were much lower than what would have been expected at a relatively clean natural flow water site.

Although the Bow River has relatively clean water when it enters Calgary, there has been concern that the rapid growth of the city can cause increased wastewater inputs that could be harmful to the Bow River fishery. A University of Calgary report [10] sheds light on the fate of wastewater effluent from Bonnybrook Wastewater Treatment Plant. The investigators assessed water quality, sediments, macrophytes, and invertebrate loads. Although there was a significant increase in biomass immediately downstream as opposed to upstream of the wastewater treatment plant all measurements of water quality fell within acceptable standards. Although there was an increase in invertebrate abundance downstream, they were more pollution-tolerant species which indicates a negative impact on water quality, but a positive impact on fish food. The social science component of the survey investigated stakeholder opinions of the Bow River fishery. There was general acceptance that the fishery was in good shape, but government agencies need to take steps to ensure better management of the fishery in the future. What was not done in the project was to compare both the changes in water quality and the impact on the fishery before and after upgrades to water treatment.

The AEP report from 2009 [9] compared invertebrate abundance from 1993 to 2006 across the lower Bow River basin from Cochrane to the confluence of the Oldman River. Although there were signs of nutrient enrichment immediately downstream of Calgary and at Carseland there was little change between the 13 years of the two investigations. The investigators concluded that variable flow conditions between years and immediately before sampling may well have impacted results. They went on to say more regular sampling is needed to ascertain the state of the Bow River.

High river flows and extreme flooding scour the river bottom, redistributing gravel and other forms of sediment. Fauna is displaced and regrowth takes time. Following the Bow River flood of 2005, University of Calgary researchers [11] investigated the regrowth of aquatic vegetation from June to September 2006. The results indicated that macrophyte growth was lower and periphyton growth was higher than pre-flood conditions. Although this study was designed to modify the City of Calgary's water quality modeling techniques, it indicates the variability of vegetation growth during naturally occurring and possibly man-made high-flow events.

Each of these three investigations [9, 10, 11] indicates that high and variable flow regimes such as have been seen on the Bow River in recent years have an impact on invertebrate life and aquatic vegetation growth. These

observations also fall in line with the published data on the negative impact of hydropeaking electrical power generation from the U.S Geological Survey [5] reported earlier.

Historically the impact of the Ghost Dam hydropeaking operations had little impact on the daily variables of flows in and downstream of Calgary, but with the introduction of the modified Bow River Water Management Protocol in 2014 the Bow River has seen extreme daily variability of flows during the modified operations timeline of April to July that would be similar to the impact of hydropeaking at both TransAlta's Pocaterra and Ghost hydroelectric operations. This is at a time of year when both mayflies and stoneflies will be most vulnerable to highly variable flows. There is therefore a justification on the part of regulators, fishery managers, and TransAlta, the hydroelectric operator, to cushion the impact of current water management protocols for the protection of the Bow River ecosystem, the fishery, and the fish population itself.

There is a need for a multi-disciplined research investigation to define what is influencing the decline in the Bow River fish population. Hydrology, habitat enhancement, invertebrate tolerance, and environmental variables need to be considered in the management of the Bow River ecosystem and a very important fishery. Without such a study it will be difficult to define a future fishery management policy for the river.

A Need to Look for a Solution

Although the focus of this document has been to address the impact of the Bow River water management on the lower Bow River's declining trout population, there is a need to recognize that the impact of TransAlta's hydropeaking electric generations has an enormous influence on more than 50 Km of the Kananaskis River and an equal amount of the Bow River between Ghost and Bearspaw reservoirs. There is also the impact of flow diversion from the Ghost River into Lake Minnewanka which also supports hydroelectric power generation. All these water bodies have historically supported native species of Westslope Cutthroat Trout and Bull Trout. The Kananaskis River in particular was historically an exceptional Westslope Cutthroat trout fishery. Hydropeaking has made the river devoid of this species of critically endangered fish and eliminated the river's sports fishery.

With less than 5% of TransAlta's total Alberta power generation capacity derived from the Bow River hydro plants, an alternate peak demand power generation source should be considered. Decommissioning the Bow River Basin's hydropeaking facilities or modifying their operation protocols would not only enhance the river's ecosystem, and add to the sustainability of threatened and endangered species of fish, but also contribute to the recreational fishery and Alberta's economy.

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Update March 28, 2024

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