Jordan River water use plan order review report

2019 January

BC Hydro
Power smart

Cover Photograph: Elliot Dam on the Jordan River.

The photograph depicts the fish water release valve in operation. The valve provides year-round flow to the lower Jordan River.

Date: May 12, 2017

Credit: Doug Johnson

EXECUTIVE SUMMARY

On July 20, 2004 the B.C. Comptroller of Water Rights issued an Order requiring BC Hydro to implement the Jordan River *Water Use Plan* (WUP). With the implementation phase complete, this report provides a comprehensive review of the Order implementation to date. BC Hydro initiated this review to fulfil its commitment to complete all 13 steps of the provincial water use planning process (cf. Figure 1 on page 1).

Implementation of the Jordan River Order Has Been a Success

Since Order implementation began in 2004, there has been no significant variances from the new requirements for reservoir and river flow operations ("operation constraints", Table I). In addition, BC Hydro has completed all of the ordered monitoring studies and physical works. Overall, the facility operation changes resulted in the environmental improvements intended by the WUP Consultative Committee.

Table I. WUP Order Key Operating Conditions.

Other Order conditions include monitoring, physical works, and administrative requirements.

Cond.	Order Requirement Summary
3	July-Sep: minimum operating elevation of Diversion Reservoir shall be 376.0 m Oct-Jun: minimum operating elevation of Diversion Reservoir shall be 372.0 m
5	During March for 4+ weekend days: combined maximum discharge from the generating station shall be 30 m3/s between 0600 h and 1800 h.
6	Shall release a minimum flow of 0.25 m^3/s into Jordan River at the Elliott Dam outlet

New Operations Yielded Significant Environmental Improvements; It's Hard to Tell If Surfing Improved

The ordered monitoring studies that assessed the changes to the Jordan River Project operations yielded the following conclusions:

- A fish water release valve was installed at Elliot Dam to deliver a constant minimum flow of 0.25 m^3/s to the lower Jordan River. Due to an overestimation of local inflows and an underestimation of infiltration losses to ground, the flows predicted in the WUP were greater than the flows subsequently observed in the river. However, the valve was operated fully open since the 2008 start of flows, providing an average of 0.324 m^3/s during the critical month of August during the monitoring program implementation. Under these greater flows the desired fish and fish habitat benefits were achieved as described below; it is unknown whether these benefits would also occur at 0.25 m^3/s.

- The flow release restored habitat continuity throughout the lower Jordan River and increased the abundance of rainbow trout within the lower Jordan River; fish condition (how "fat" or "healthy" the fish is) did not change.
- The flow releases did not greatly improve salmon spawning habitat; however, the flows could aid in the passage of adult salmonids.
- Flow releases did not improve incubation habitat for salmonids; however, the flows did improve rearing habitat in some areas by diluting copper contamination from past mining activities.

- Extensive drawdown at Diversion Reservoir could negatively affect rainbow trout if the reservoir habitable layer is drawn off; the higher minimum reservoir elevations (12-16 m greater than the licensed minimum) reduced the allowable drawdown at Diversion Reservoir. This operation saw a significant increase in number of rainbow trout but was not observed to lead to a change in rainbow trout condition factor. The elevation constraints help prevent the extraction of the critical rearing zone during severe drawdown.
- Constraints on generation could potentially benefit surfing quality at the Jordan River estuary. However, surfing quality appears to be highly dependent on environmental factors such as tidal action, wave size and interval, wind, and weather. Thus, there is limited ability to predict when discharge flow constraints would improve surf conditions.

Should We Keep Operating Jordan River the Same Way?

BC Hydro considers the ordered implementation of the Jordan River *Water Use Plan* a success and is committed to maintaining the operations that have proven to benefit fish and fish habitat in the Jordan River basin:

1. Given the significant positive environmental outcomes associated with the Elliot Dam fish water flow release, the Order minimum flow condition (3) should be maintained. In addition, the minimum flow provision should be modified (or clarified) to state that BC Hydro must operate the Elliot Dam fish flow release value in the fully open position.
2. The Diversion Reservoir elevation constraints reduce the potential for extraction of the critical rearing layer during severe drawdown. With the constraints rainbow trout numbers increased. Therefore, the Order elevation constraints (6) should be maintained.
3. In addition, constraints on generation could potentially benefit surfing quality at the Jordan River; therefore, the existing constraints should be maintained. However, given the significant dependence on physical environmental factors, this operation cannot be easily refined (e.g., specifically forecast when discharge flow constraints would improve surf conditions).

The Order recommendations and status updates for the Comptroller of Water Rights' consideration are presented below in Table II.

Table II. Order Conclusions and Recommendations for the Comptroller of Water Rights' Consideration.

Cond.	Order Requirement Summary	Conclusion or Recommendation
1	Submit plan for Fish Flow Release Valve	Complete
2	The licensee shall alter the works	Complete
3	**July-Sep: minimum operating elevation of Diversion Reservoir shall be 376.0 m Oct-Jun: minimum operating elevation of Diversion Reservoir shall be 372.0 m**	**Continue**
4	**The licensee shall leave the low level outlet at Bear Creek Reservoir closed**	**Continue**
5	**During March for 4+ weekend days: combined maximum discharge from the generating station shall be 30 m3/s between 0600 h and 1800 h.**	**Continue**
6	**Shall release a minimum flow of 0.25 m^3/s into Jordan River at the Elliott Dam outlet.** *Modify to state the fish water release value must be maintained and operated in a full-open position year-round.*	**Continue & Supplement**
7	**Minimum fish flows take operational precedence over reservoir minimum elevations**	**Continue**
8	The licensee shall submit a monitoring plan	Complete
9	The licensee shall implement monitoring in accordance with the plan as accepted	Complete
10	The licensee shall provide annual reports to the Comptroller including the following information: a) size and abundance of rainbow trout in lower Jordan River, b) salmonid spawner surveys in lower Jordan River, c) fish stress indicators in Diversion Reservoir	Complete
11	The licensee shall provide annual reports to the Comptroller documenting surfing conditions	Complete
12	**The works may be operated in an alternate manner in the event of an emergency; a dam safety requirement, or an extreme hydrologic event**	**Continue**
13	**All emergency operations or other deviations from this ordered shall be reported to the Comptroller**	**Continue**

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1. OVERVIEW OF WATER USE PLANNING AND ORDER REVIEWS

1.1. Introduction

The operation of hydropower facilities and the relationship between fish, wildlife, archaeology, flood protection, recreation, power generation, and other water uses began to receive considerable attention in the 1990s. Environmental and other groups called for greater protection of natural and heritage resources. Consequently, the province began requiring Operating Plans (which evolved into Water Use Plans) for hydropower facilities and other water control structures (Province of British Columbia, 2018). BC Hydro has been engaged in this effort since it began in the 1990s when the province published their *Water Use Plan Guidelines* (the Guidelines), depicted in Figure 1 (Province of B.C., 1998, p. 17).

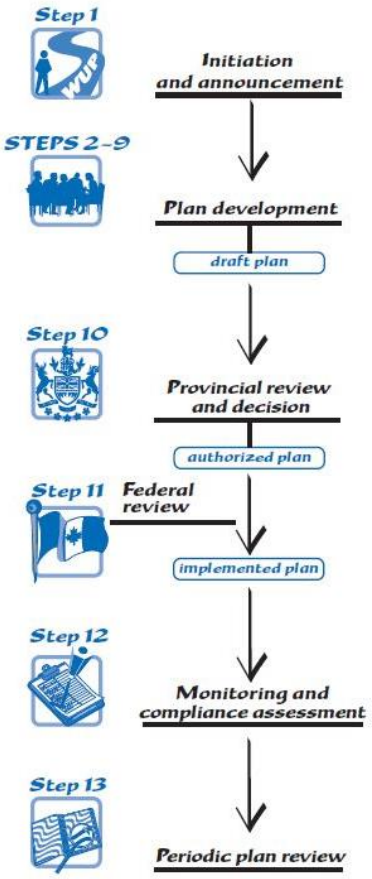

Figure 1. The Provincial Water Use Planning Process.

Water use plans deal with the day-to-day operation of BC Hydro facilities and how the operations can be optimized to achieve a balance between competing uses of water that is environmentally, socially, and economically acceptable to British Columbians. While many of BC Hydro's 23 Water Use Plans are still in implementation, others have matured and are now ready to be reviewed. Therefore, BC Hydro has established the Water Use Plan Order Review Program which includes a review of the implementation of the Jordan River WUP (Step 13 in Figure 1).

On July 20, 2004 the Comptroller of Water Rights (Comptroller) issued their Order for BC Hydro to implement the Jordan River *Water Use Plan*. The Order notes BC Hydro's recommended changes to the operations of the Jordan River hydropower system are intended to provide benefits to fish, wildlife habitat, and recreation. These operations have been in place now for over ten years and BC Hydro implemented a number of studies to assess whether these operations have achieved the power generation, environmental, and social outcomes that were recommended to achieve the optimal balance of water use in the Jordan River Basin. This document consolidates all the related information to conduct a review of the Jordan River Order implementation and provides an update and recommendation considerations to the Comptroller and other regulators, First Nations, and key stakeholders.

1.2. The Process of Water Use Planning

The process of determining Order requirements and their implementation for BC Hydro's 23 WUPs generally followed the sequence of activities, in order of execution, depicted in Figure 2. The figure represents the multi-

year process from initiation of water use planning to the Order review which occurs after implementation is complete.

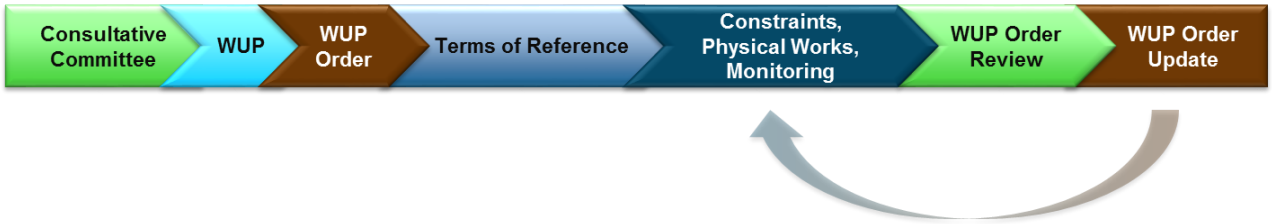

Figure 2. Water Use Planning and Implementation at BC Hydro.
Water Use Plan Orders do not expire. In addition to periodic reviews such as this one, depending on circumstance, the Comptroller of Water Rights may review an order at any time during the WUP's implementation.

1.2.1. Why Water Use Planning?

In 1998 the B.C. provincial government issued their *Water Use Plan Guidelines* with an overall goal of finding a better balance between the often competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage protection, flood control, and electrical power generation. Implementation of water use plans refines a BC Hydro facility's licensed operations by making incremental adjustments to levels on reservoirs and flows downstream. (These parameters and boundaries are termed "operation conditions" or "operation constraints".) Thus, WUP process is designed to provide benefits to British Columbians across a variety of cultural, economic, environmental, and social objectives.

> *Water use plans (WUPs) are intended to provide greater clarity with respect to the use of water resources, for the licensee… as well as for other water users, by specifying operating parameters and boundaries.*
>
> *BC Hydro et al., 1998, p. 1.*

1.2.2. How Were BC Hydro's WUPs Developed?

Water Use Planning is a 13 step process developed by the Province of British Columbia and described in their *Water Use Plan Guidelines* (Province of British Columbia, 1998). In general, BC Hydro's 23 WUPs were developed through a consultative, multi-stakeholder engagement process that identified and evaluated BC Hydro operations against multiple other uses of water resources using a structured decision making approach (BC Hydro, 2009). The water use planning process included input from First Nations, local communities, stakeholders, other interested parties, and municipal, provincial, and federal government agencies.

The outcomes of the consultative process for each facility are captured in a *Consultative Committee Report*. From the *Consultative Committee Report* recommendations, a *Water Use Plan* was drafted by BC Hydro and submitted to the Comptroller for acceptance.

1.2.3. How Are WUPs Implemented?

Once accepted by the Comptroller, the Plan is ready for implementation. The Comptroller then issues BC Hydro a *Water Act*[1] Order. Generally, the Comptroller has required BC Hydro to implement most, if not all, elements of the *Water Use Plan* and also includes a reporting component. Therefore, this report, and all other related WUP implementation reports, are submitted to the Comptroller.

The 23 WUP Orders specify various combinations of: (i) facility operation changes optimized for power generation, recreation, heritage protection, and habitat enhancement, (ii) monitoring studies, (iii) physical works, and (iv) effectiveness and compliance monitoring and reporting.

The implementation of Water Use Plans is directed by the B.C. Comptroller of Water Rights. The Comptroller's direction is in the form of a Water Act Order issued to BC Hydro.

Actual examples of operation changes to BC Hydro facilities include:

- Absolute limits on water releases discharged from facilities. E.g., a minimum flow of 142 m^3/s.
- Ramping rates: the rate at which flows may change. E.g., a maximum change of 142 m^3/s per hour or 425 m^3/s per day.
- Reservoir drawdown rates: the rate at which a reservoir may be lowered. E.g., 15 cm/h.
- Reservoir and tailrace elevation limits. E.g., a minimum elevation of 372 m.
- Downstream compliance points. E.g., provide a minimum flow of 73 m^3/s as measured below the confluence of two rivers (and downstream of a BC Hydro facility).

Physical works may be prescribed in lieu of operation constraints. For example, boat ramps may be extended to lower elevations to provide recreational access to reservoirs that otherwise would have to be held at higher elevations at the expense of power generation. Monitoring programs are implemented to confirm the effectiveness or define the effects of the operation constraints (including the physical works). For example, a monitoring program may be implemented to assess whether a minimum flow yields benefits to fish and fish habitat.

Once ordered, operation changes are amongst the first WUP recommendations to be implemented. Monitoring programs and physical works are implemented over a period of a year to a decade or longer. Once implemented, the changes to operations and physical works typically continue indefinitely; monitoring programs typically end after a specified implementation period or when the related operation uncertainties or management questions have been answered[2].

[1] Superseded by the *Water Sustainability Act*.

[2] It must be noted that typical WUP monitoring programs differ from those implemented by regulatory agencies. For example, a stock assessment monitoring program informs regulatory agencies about the health of the ecosystem in general, and more specific, the status of specific commercial and/or recreational fish stocks from one fishing season to the next, and define or recommend what are sustainable harvests. Thus, regulatory monitoring programs may go on indefinitely to facilitate ongoing sustainable resource management including harvesting.

Across the province, BC Hydro is implementing/has implemented approximately 750 ordered changes to operations and 360 ordered monitoring studies and physical works.

1.2.4. What Happens after Order Implementation?

Once all the ordered requirements have been implemented and are complete in fulfilling the requirements of the Order and the intent of the WUP, then the WUP's implementation phase is complete and a review of the ordered requirements may occur. The review is Step 13, the final step, of the provincial water use planning process and is the focus of this report. The deliverable of the Water Use Plan Order Review (WUPOR) Program is a recommendation to the Comptroller to consider changes or clarifications to the Order to reflect what has been learned to date from the Order implementation or to confirm the ordered requirements are complete. If new in-scope issues have come to light, then a new Order requirement may have to be implemented; depicted as the arrow in Figure 2.

1.3. The WUP Order Review Program

BC Hydro created the WUPOR Program to assess the activities undertaken in response to the WUP Order once all the ordered conditions of the WUP have been implemented. Ordered conditions generally relate to changes to facility operations, new physical works (usually in lieu of an operation change), and monitoring programs to assess the operation change. The *Consultative Committee Report* and *Water Use Plan* will serve as important foundational guides, as these were the primary inputs to developing the Order.

BC Hydro initiated the WUPOR Program to review the outcomes from implementing 23 Water Use Plans. These results will be communicated to agencies, First Nations, and key stakeholders. Recommendations and conclusions coming from the reviews will be submitted to the B.C. Comptroller of Water Rights.

1.3.1. Goals of the Order Review

The goals of the WUP Order Review Program are to:

- Synthesize and document the outcomes of the water management operation constraints, physical works, monitoring, and other activities with respect to the Order objectives.
- Identify any areas where it was not possible to fully comply with the Order and explain why.
- Describe what actions, if any, that are required to fulfil BC Hydro's ordered obligations.
- Identify any new facility operations-related issues that may have arisen or been discovered since the initial WUP planning process.
- Document the recommended WUP costs compared to actual implementation costs.
- Seek input from regulators, First Nations, and key stakeholders on priority aspects of Order implementation and what an updated Order could contain.
- Use all the above to develop a report containing recommendations and conclusions for the Comptroller of Water Rights to consider during their review of the Order (if undertaken), such that it

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WUP monitoring programs are typically designed to answer management questions to assess the impacts of a change in facility operations; therefore, they only run until the management questions have been answered.

reflects the current status and outcomes of the Order implementation and any new issues that may need addressing.
- The recommendations must be mindful of the work already accomplished and the need to contain costs to keep electricity rates affordable for British Columbians.

As noted in the provincial guidelines, a WUP can be reviewed by the Comptroller of Water Rights at any time for compliance or in response to new water use issues (Step 13). The Comptroller will determine the appropriate extent of the review. The guidelines also note that WUPs should provide the opportunity for a scheduled periodic review oriented to specific priority issues that may arise during the plan's implementation.

With the implementation of the Jordan River WUP complete, BC Hydro has initiated this review of the Order.

1.3.2. Process to Assess and Evaluate Order Implementation

The WUP activities that BC Hydro was ordered to implement will be reviewed by the WUPOR Program.

The reviews will be based on data and documents from the studies and projects implemented under the Order. (Much of this information is published on bchydro.com, see Appendix E). It is expected the Order could be amended or clarified to reflect the status of activities associated with the original WUP Order.

The BC Hydro WUPOR Program's six core principles are:

1. Focus on specific priority issues
2. Apply an issue evaluation approach
3. Use foundational documents and processes
4. Engage First Nations
5. Engage regulators
6. Seek input from key stakeholders

1.3.2.1. Order Review Issue Scope

The scope of the WUP Order review is framed by the activities or constraints that were ordered by the Comptroller of Water Rights. Therefore, the WUPOR Program will focus on BC Hydro's facility operations, monitoring, and physical works implemented in lieu of operation changes.

If a new operation-related issue is raised or discovered, it will be assessed during the review (the same for issues that may arise in the future). BC Hydro may consider new physical work projects, monitoring studies, or facility operations in response to new issues; new activities or conditions may be recommended if:

- the information necessary for decision making related to the Order is not available or incomplete and gathering new information is expected to inform the operation decision(s).

- a significant new issue has arisen or been discovered during the implementation period.

Therefore, issues already reviewed during the development of the WUP, such as those that did not get recommended by the Consultative Committee, or were not ordered by the Comptroller of Water Rights, are out of scope for the Program.

In addition to Order implementation, BC Hydro implements a number of other environment and heritage mitigation programs to address existing effects related to a facility's footprint and operation. These other programs range from dealing with facility environmental footprint, fish impact mitigation directly at the facility (e.g., fish passage and entrainment), projections of climate change for the region, through to reservoir archaeology. If such issues arise during the WUPOR, they will be documented and the other programs are engaged as appropriate. These programs are described in detail in Appendix C.

1.3.2.2. Spatial and Temporal Boundaries of the Review

The Order Review will be limited to the water use planning boundaries; i.e., those areas of a drainage basin impacted by BC Hydro facility operations. As the Order does not expire, the Review will encompass the entire period after the WUP Order was issued/implemented (e.g., facility water conveyance will be assessed through to the year previous to current).

1.3.3. External Engagement on the Results and Recommendations

Performance reports on environment, heritage, and operations[3] will be prepared and provided to federal and provincial government agencies, First Nations, regional and municipal governments, and key stakeholders. The reports will also be posted on bchydro.com. Input from these groups will be considered by BC Hydro and provided to the Comptroller of Water Rights. It is expected this input, along with the technical and financial information, will inform any additional action that may be needed and what operation constraints and commitments should continue to be maintained by BC Hydro. There may be a need for more extensive engagement, depending on the nature of the issues raised during the review process.

1.3.4. Final Deliverable to the Comptroller of Water Rights

The core deliverable of the WUPOR Review is reports such as this one, including recommendations and conclusions for the Comptroller of Water Rights' consideration. The recommendations and conclusions would show how the Order could reflect the current status and outcomes of the Order implementation and any new or residual issues that may need addressing.

Step 13 of the Guidelines state the: "licensee and Comptroller (will) review the plan on a periodic and ongoing basis". BC Hydro has initiated this review to fulfil BC Hydro's commitment to complete the 13 Steps of the provincial *Water Use Planning Guidelines*.

1.4. Future Order Reviews

The WUPOR Program has scheduled 23 facility/system WUP Order reviews over approximately 15 years. At this time, there is no plan to routinely repeat the reviews (e.g., on rotating 15 year cycles). However, as noted in the provincial guidelines, a WUP can be reviewed by the B.C. Comptroller of Water Rights at any time (Step 13). It is anticipated that the scope and timing of future Jordan Order reviews will depend on the context of the issue, in line with the direction in the Guidelines (e.g., new water use conflicts or water conveyance non-compliance issues).

[3] These reports are in the form of an "environmental synthesis report" and a "WUPOR report".

2. THE JORDAN RIVER PROJECT AND THE COMPTROLLER'S ORDERED OPERATION

2.1. Location of the Jordan River Project

The Jordan River is located within the Capital Regional District, along the southwest coast of Vancouver Island, approximately 72 km by road from Victoria, B.C. The 25 km long river flows southwesterly between the Sooke Hills and the Seymour Mountain range into the Juan De Fuca Strait at the community of Jordan River. The Jordan River Generating Station is located on the west bank of the Jordan River, approximately 1 km off of Highway 14. Associated facilities can be reached on logging roads that provide access to the upper basin. A map of the Jordan River facility is provided in Figure 3.

2.2. History of Jordan River Hydropower Development

The original Jordan River power development was initiated in 1909 and completed in 1912. The plant operated from 1912 to 1969. The Elliott Dam did not exist at this time. In 1969 work began to build the new powerplant on the opposite side of the river from the original structure. Elliott Dam was created to replace the forebay headpond, and a single high head 170 MW Francis turbine was installed in the new powerhouse on the east bank of the Jordan River about 200 m upstream from where it enters the Juan de Fuca Strait. The powerhouse was fed by a new pressure tunnel and penstock from Elliott Dam which bypassed the original forebay (now referred to as the Old Forebay).

A comprehensive history of the development, operations, and industrial activity in basin is contained in Appendix A of the *Consultative Committee Report* (BC Hydro, 2002).

2.3. Jordan River Facility Components

Jordan River facility components consist of physical infrastructure such as dams, a powerhouse, and flow control infrastructure. These elements are described in the following subsections. The subsections are divided into a discussion of the facility physical components (structures), their role in the hydropower system, and their role in BC Hydro generation system operations. The schematic of the basin, hydrology, and facility components is presented in Figure 4.

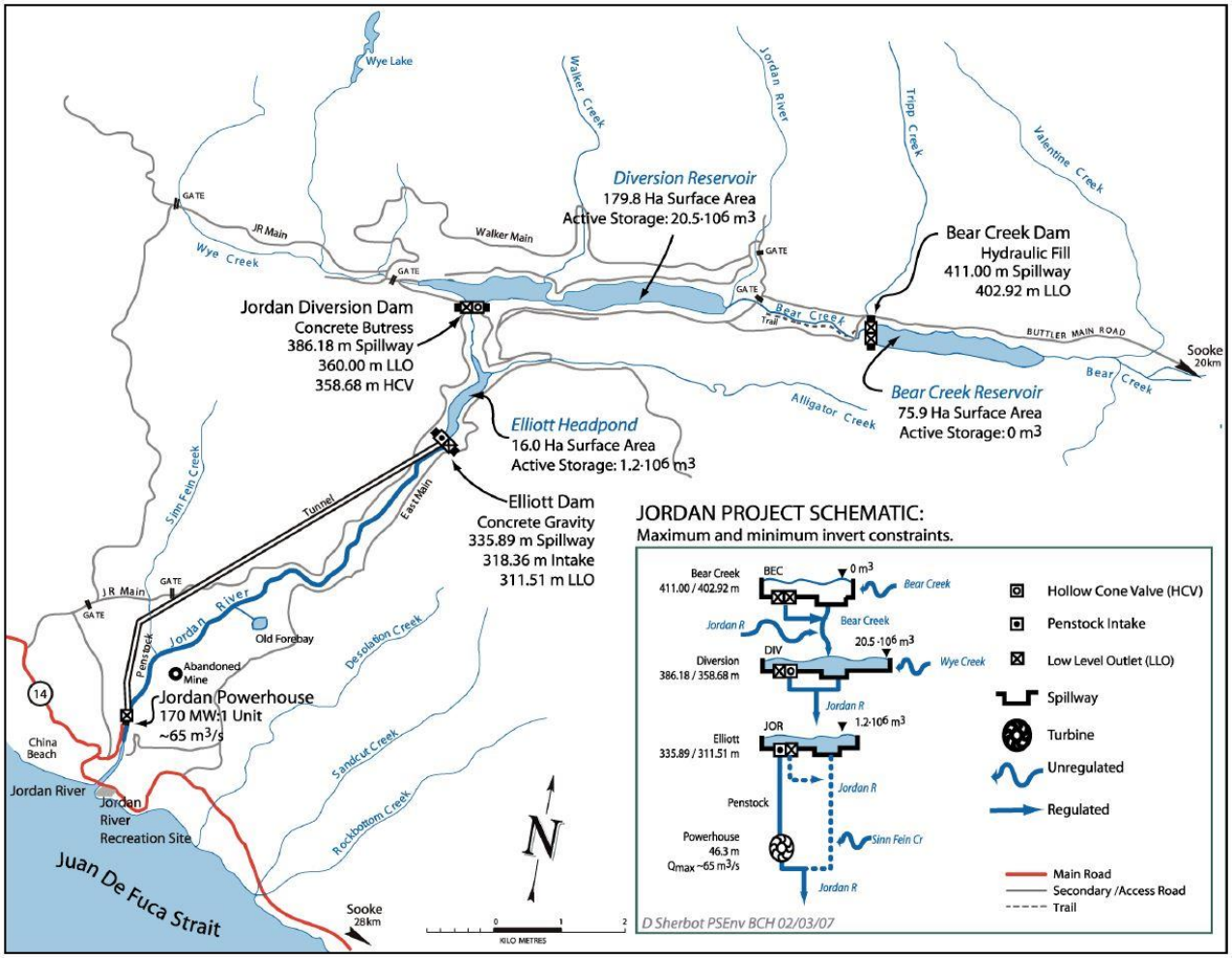


Figure 3. Jordan River Map and BC Hydro Infrastructure.
BC Hydro (2003, p. 2). Note: a fish water release valve (FWRV) has been added to Elliot Dam to provide the ordered minimum flow to the lower Jordan River.

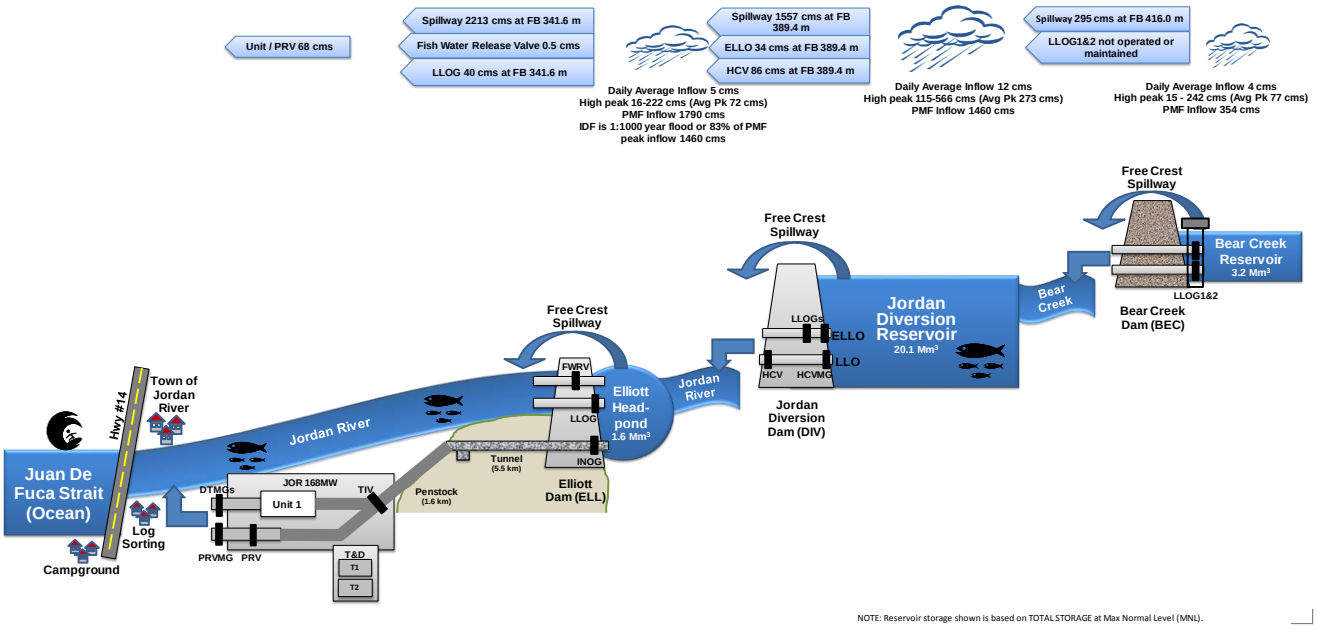


Figure 4. Jordan River Facility and Basin Schematic.

2.3.1. Dams

The current physical structures comprising the Jordan River project include the following:

Bear Creek Dam: The Bear Creek Dam is located on Bear Creek at the upstream end of the reservoir chain. The earthfill dam is 337 m long and 17.4 m high. Water release facilities consist of a freeflow overflow weir and spillway (411 m) and two low level outlet gate (LLOG) valves (402.92 m). The LLOGs are no longer operated or maintained and currently serve no operation purpose.

Jordan Diversion Dam: The Jordan Diversion Dam impounds Diversion Reservoir. It is located on the Jordan River approximately 2.8 km downstream from the Bear Creek Dam. The concrete buttress dam is 232 m long and 40 m high, has an uncontrolled freeflow overflow weir and spillway (386.18 m), a controlled low level (hollow cone valve) outlet (358.68 m), and an emergency low level outlet (360.0 m).

Photograph 1. Jordan River Diversion Dam. Discharge in the photo is through the hollow cone valve (HCV).

Elliott Dam: The Elliott Dam is located on the Jordan River approximately 1.6 km downstream of the Jordan Diversion Dam. The concrete dam is 114.6 m long and 27.4 m high, and has an uncontrolled freeflow overflow weir and spillway (335.89 m) and a low level outlet gate (311.51 m). The power intake sill is located at 318.36 m.

Photograph 2. Elliot Dam.
The fish water release valve providing the minimum flow is evident in the bottom-centre right.

2.3.2. Powerhouse

The Jordan River powerhouse is located on the west side of the lower end of Jordan River just upstream of its confluence with the Strait of Juan De Fuca and contains a single 168 MW capacity turbine generator unit. A water intake structure is located on the left upstream abutment of Elliott Dam. The intake diverts water from Elliott Headpond through a combined 7.2 km long pressure tunnel and penstock to the Jordan River Generating Station.

Photograph 3. Jordan River Powerhouse.
The penstock is visible running behind the back top corner of the Powerhouse.

2.3.3. Project Operations

Relevant current operation aspects of the Jordan River project are as follows:

Bear Creek Reservoir: Bear Creek Reservoir is not actively managed and is operated as run-of-river by passing inflows via the spillway at 411 m (the elevation of the Bear Creek Dam overflow weir). As a result, Bear Creek effectively functions as a natural lake. The reservoir is approximately 7.5 km^2.

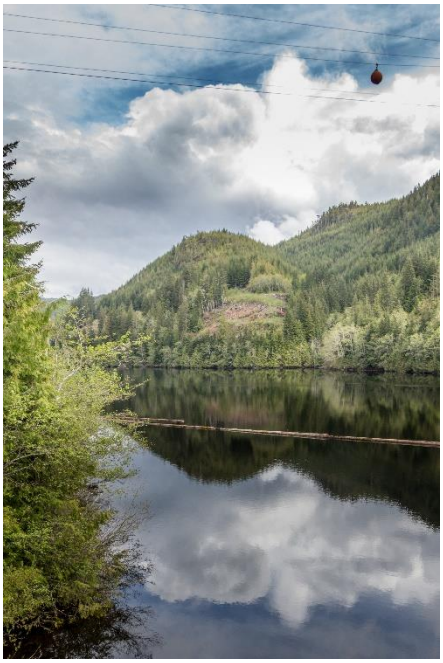
Diversion Reservoir: Diversion Reservoir (Photograph 4) has the largest storage capacity of the three reservoirs in the system. The storage capacity of the reservoir provides for approximately 3.5 days' operation. Generally, the amount of inflow received in the basin limits the generating ability of the Jordan River project. The normal operating level range is between 367.9 m and 386.2 m; the licensed minimum is 360.09 m. At elevations above 386.2 m water is released from the reservoir overflow weir at Jordan Diversion Dam. A Low Level Outlet (LLO) is the primary method of releasing water to the headpond at Elliott Dam for power generation. It consists of a 2.44 m diameter steel pipe controlled by a hollow-cone valve (HCV). The reservoir is approximately 18 km^2.

Photograph 4. Diversion Reservoir.

Elliott Headpond: The Elliott Headpond is the intake for the Jordan River powerhouse. It has the smallest storage capacity and has a normal operating level range between 325.2 m and 335.9 m. At elevations above 335.9 m water is released via the overflow weir at Elliott Dam. The surface area at full pool is approximately 1.6 km^2.

A Fish Water Release Valve (FWRV) was installed in 2008 to provide a minimum 0.25 m^3/s for fish habitat flows into the Jordan River immediately downstream of Elliott Dam. The discharge may be seen in Photograph 2.

Jordan River Powerhouse: The Jordan River Powerhouse is normally operated as a peaking plant. Operation generally follows domestic electricity demand such that the generator may be operated on and off up to twice a day. Maximum turbine discharge is approximately 65 m^3/s; the average annual plant capacity is 243 GWh.



Photograph 5. Elliot Headpond.

2.4. Project Role in BC Hydro System Operations

The Jordan River generating facilities are part of BC Hydro's integrated generation system. The Jordan River facility is the only major hydropower development on the southwest coast of Vancouver Island. The facility has a generating capacity of 170 MW and can contribute up to approximately 35% of total island generation. The plant also plays a very important role in providing voltage control for the transmission network and helps to offset the effects of transmission losses that may occur as a result of transmission failures (outages/losses) on the provincial transmission grid system. The Lower Mainland to Vancouver Island submarine cable transmission system typically supplies approximately 80% of Vancouver Island's electrical demand.

Jordan River is an "energy constrained system", with insufficient reservoir storage or inflows to sustain round-the-clock generation. As a result, Jordan River is typically run as a peaking facility and operations are driven primarily by area rainfall and by area load requirements. The system storage capability is very small; therefore, the level of the main storage reservoir (Jordan Diversion Reservoir) fluctuates significantly during the time of

the year when the area experiences rainfall. When system inflow is low the generating unit tends to be operated at lower load and less frequently and usually only to help meet demands on the power system. The system is susceptible to very large inflows from storm activity.

As a peaking plant, the Jordan River powerhouse is brought online to meet electricity demands at peak times of the day. As a result, the average daily turbine discharge from the Jordan River generating station varies seasonally and daily with the demand for electricity and the availability of water. BC Hydro uses all of the available inflow, within the storage and generation limits of the facilities. Spills occur when inflows exceed generation or storage capacity.

2.5. Jordan River Basin Hydrology

The Jordan River basin is situated in the southern portion of Vancouver Island along the southwest coast. The tributary drainage areas above Bear Creek, Jordan Diversion, and Elliott dams are 23, 97, and 24 km^2 respectively. The Jordan River is primarily a rainfall driven basin although snow can occur within the watershed. Precipitation along the coast is high; however, inflows vary considerably throughout the year. The most intense precipitation period is generally confined to October through March, with the greatest runoff in December. April to September is typically a period of low average inflow into the Jordan Reservoirs. August is the month of lowest baseflow. Compared to the volume of inflow, the combined storage capacity of the reservoirs and the headpond is small. The Jordan River reservoirs can hold enough water to run the powerplant at full load for approximately 3.5 days (assuming no inflow). A detailed summary of the Jordan River basin hydrology is provided in Appendix 1 of the WUP (BC Hydro, 2003).

2.6. Jordan River WUP Order

On July 20, 2004 the Comptroller of Water Rights issued its Order for the Jordan River *Water Use Plan*. The Order notes BC Hydro's recommended changes to the operations of Jordan River hydropower system are intended to provide benefits to fish, wildlife habitat, and recreation. All 13 requirements of the Order are presented in Appendix J on page 63; the key conditions are in Table , below[4]. Other Order conditions include monitoring, administrative tasks (such as reporting), or allowance for emergency operations.

[4] Note that in this and subsequent tables "Cond." is a cross-reference to the relevant numbered condition in the Order.

Table 1. WUP Order Key Operation Changes and Related Priority Issues.

WUP Order Requirements for JOR (Key Elements)					
Cond.	**Order Requirements**	**Operations**	**Fish**	**Monitoring**	**Recreation**
3	Between July 1 and September 30 of any year, the minimum operating elevation of Diversion Reservoir shall be 376.0 m, measured at the dam using the Geodetic Survey of Canada (GSC) datum. Between October 1 and June 30 of any year, the minimum operating elevation of Diversion Reservoir shall be 372.0m, measured at the dam using the Geodetic Survey of Canada (GSC) datum	✓	✓		
5	The licensee shall ensure that, on a minimum of 4 weekend days during the month of March, the combined maximum discharge rate under licences FLI 17999 and FLI 18000 shall be 30 cubic metres per second between the hours of 06:00 and 18:00. This maximum discharge rate may be exceeded in emergency situations and the Comptroller of Water Rights shall be notified at the earliest possible convenience in this event;	✓			✓
6	The licensee shall release a minimum flow of 0.25 cubic metres per second into Jordan River at the Elliott Dam outlet (PD31684), at all times, commencing within 2 years of the date of this order (hereinafter referred to as the "commencement date"), the works having been altered as per conditions 1 and 2 above;	✓	✓		

As part of the changes to facility operations, the Consultative Committee recommended monitoring programs designed to address key uncertainties and answer specific questions that may change future decisions regarding these WUP-ordered operations (Jordan River Water Use Plan Consultative Committee, 2002, p. 8-1)[5]. Accordingly, BC Hydro recommended in the WUP that the change in operations should be contingent on the implementation of a monitoring program that would:

- assess expected outcomes of the operation changes being recommended
- provide improved information upon which to base future operation decisions

with the main conditions of the program described in Table 5-1 of the WUP (BC Hydro, 2003. p. 7).

Therefore, the Comptroller ordered the changes to operations and complementary monitoring programs to assess whether the expected benefits from the changes are realized.

[5] The “future changes” are the outcome of this review.

2.7. Order Implementation Details

In response to the Order, BC Hydro developed Terms of Reference to define the budget, timeline, and scope of the physical works and monitoring studies to comply with the Order. Appendix D (Jordan Water Use Plan Order Implementation Summary) includes a summary of the Terms of Reference development and related approval timeline. The Terms of Reference are published on bchydro.com (Appendix E).

BC Hydro has completed the ordered monitoring programs required to assess the environmental and social benefits as a result of the implemented changes to facility operations.

Order conditions 1 and 2 (Appendix J) specify the requirements for design and construction of one physical work project. Condition 8 (Appendix J) included five monitoring programs: four related to fish and one related to recreation opportunities. To assess whether the expected benefits are provided by the change in facility operations, each study has specific objectives, hypotheses, and management questions.

These and an overview of the studies are summarized in Chapter 3 and Appendix D.

3. INPUT RECEIVED: EXTERNAL ENGAGEMENT AND REVIEW

3.1. Introduction

The water use planning process included consultation and engagement with First Nations, regulators, and key stakeholders in the development of the *Jordan River Consultative Committee Report* and *Water Use Plan*. As part of the WUP Order Review Program, BC Hydro is re-engaging with these parties to report on the outcomes of implementing the WUP Order. In general, engagement included:

- First Nations with asserted rights and title in the project area, as defined by the B.C. Consultative Area Database or who participated in the Jordan River water use planning process.
- B.C. Ministry of Environment and Climate Change Strategy
- B.C. Ministry of Forests, Lands, Natural Resource Operations & Rural Development
- Canada Department of Fisheries and Oceans
- Potentially affected key stakeholders

Two engagement rounds were completed: (i) for the *Environmental Synthesis Report* (ESR) and (ii) for this *WUPOR Report*. Responses from both rounds were considered in the context of finalizing the draft recommendations and conclusions to the Comptroller of Water Rights (Chapter 5).

The full engagement process is presented in the Appendices. Appendix F provides a list of people and groups engaged. Appendix G describes the First Nation engagement process, comments from First Nations, and BC Hydro responses; Appendix H includes regulatory agencies and Appendix I includes stakeholders. A brief summary of the feedback is presented in the following section.

3.2. Feedback Received and BC Hydro's Responses

The *Environmental Synthesis Report* and *WUPOR Report* were provided to regulators, First Nations, and key stakeholders for review and comment. The Ministry of Environment and Climate Change representative provided positive feedback on the ESR and requested no changes; no agency comments were received on the *WUPOR Report*.

The only comments received from stakeholders was from a Jordan River resident and Jordan Watershed Roundtable member on the *Environmental Synthesis Report* regarding facility discharges to the lower Jordan River. These comments, along with BC Hydro's responses, are provided in Appendix I.

Pacheedaht First Nation provided a number of comments on both the ESR and the *WUPOR Report*. BC Hydro has responded to these comments and incorporated many of them into this *WUPOR Report*. Comments from Pacheedaht First Nation can be found in Appendix G, along with BC Hydro's responses.

T'Sou-ke First Nation provided comments on the *WUPOR Report* and these comments included some comments on the ESR. BC Hydro has responded to these comments and incorporated many of them into this *WUPOR Report*. Comments from T'Sou-ke First Nation can be found in Appendix G, along with BC Hydro's responses.

The comments received from First Nations included many related to the operation of the fish water release valve and the minimum flows provided to the lower Jordan River. There were also requests for new lower Jordan River monitoring programs.

BC Hydro met with Ditidaht First Nation in 2015 but did not receive comments back from them on any of the reports.

4. WHAT HAPPENED WHEN WE IMPLEMENTED THE NEW OPERATIONS?

In this section the outcomes of the Jordan River Order implementation and performance are summarized. Priority conditions of the Order requirements are emphasized: system operation water conveyance, environment and recreation monitoring studies, and facility physical work implementation[6]. The outcomes are assessed using a critical review of the data and documents from the studies, work, and conveyance reports. In addition, the outcomes were presented to regulators, First Nations, and key stakeholders. The outcomes and feedback was then assessed and recommendations subsequently formulated using an iterative engagement and review approach.

Appendix E summarizes the extensive inputs to the water use planning process; Appendix D summarizes implementation of the Order, implementation, and review for Jordan River operations. Appendix F presents the Order review engagement participants.

4.1. Changes to Project Operations and Works

At the core of the Jordan River Order are the changes to operations and facility physical works (Table 1). These changes to facility discharges and reservoir elevations were implemented with the objective to improve the environmental and recreational values identified by BC Hydro, regulators, First Nations, and key stakeholders during the consultative WUP planning process. Therefore, a critical performance measure is to implement and sustain the changes ordered to facility operations.

BC Hydro's Water Licences and WUP Orders, issued by the Comptroller of Water Rights, identify the regulated rights and constraints under which BC Hydro may operate its hydropower facilities. It is a regulatory requirement under the *Water Sustainability Act* that BC Hydro monitor and report on its compliance with these constraints. Therefore, BC Hydro submits to the Comptroller of Water Rights an annual *Water Conveyance Report*. The annual summary for each hydropower development includes constraints and operation data associated with water licence obligations and the ordered constraints. Exceptions to the operation requirements are noted in the *Report* and below in Table 2. All charts submitted to the Comptroller since the implementation of the Jordan River Order are contained in Appendix K.

For the Jordan River operation, the following operations are summarized in the charts (Appendix K); the relevant Jordan River Order requirement (Appendix J) is in *parentheses*:

- Bear Creek Reservoir
- Diversion Reservoir
  (seasonal minimum elevations: 372 m, except 376 m July-September)
- Elliot Reservoir
- Jordan River Generating Station
  (4+ March weekend days - maximum discharge of 30 m^3/s between 0600 h and 1800 h)

Since WUP Order implementation began in 2004, Jordan River operations have had no significant or systematic exceptions to the ordered operation constraints.

[6] Other Order elements, such as administrative conditions, are presented in Appendix D (d).

- Elliot Dam minimum flow
  (0.25 m^3/s into lower Jordan River)

Since 2004 the entire record of operation observations contains only three reportable exceptions to the Licence and Order requirements:

Table 2. Order Operation Exceptions 2004-2017.

Date	Constraint	Exception
2005 Jan 16	Diversion Reservoir Minimum Elevation (372.0 m)	0.8 m (371.2 m)
2008 Sep 14	Diversion Reservoir Minimum Elevation (376.0 m)	0.5 m (375.5 m)
2012 Sep 17	Bear Creek Reservoir Minimum Elevation (411.0 m)	0.04 m (410.96 m)

- In January 2005 BC Hydro Coastal Operations were drafting reservoirs in preparation for a significant storm and forecasted inflows. With the generating station operating at near-full load the reservoir was over-drafted by 0.8 m to 371.2 m; as soon as the condition was noted the unit was shut down and the hollow cone valve closed to allow the reservoir to recover to meet the minimum elevation constraint. In this incident reporting of the exception to the Comptroller was not completed in a timely manner. This was the first year of operation under the WUP Order and reporting expectations were still being defined.
- On September 14, 2008 in preparation for the annual unit overhaul, BC Hydro inadvertently over-drafted the Jordan Diversion reservoir by 0.5 m to 375.5 m. After realizing the exception, the generating unit was shut down as soon as possible to facilitate refill.
- Due to insufficient natural inflow on September 17, 2012 the Bear Creek Reservoir dropped below the specified minimum elevation of 411.0 m. The recorded minimum was 410.96 m.

BC Hydro now adds a small buffer to the Diversion Reservoir minimum elevation to provide time to react to any unforeseen incidents and thereby maintain operations above the specified minimums.

Conclusion 1: ***Implementation of the Diversion Reservoir operation changes are complete and meet the Order intentions.***

Conclusion 2: ***Implementation of the Generating Station operation changes are complete and meet the Order intentions.***

Conclusion 3: ***Implementation of Elliot Dam minimum flow operation changes are complete and meet the Order intentions.***

4.2. Monitoring Program Results

Physical works are the one-time modification or addition of infrastructure to facilitate an equivalent operations outcome. Monitoring programs are implemented to confirm the effectiveness or define the impacts of an operation constraint (or the physical work). Once the operation's effectiveness is confirmed (or refuted), then the monitoring program has met the intent of the WUP and the Order and the ordered condition may be considered complete in the context of the water use planning process. The main outcomes are summarized in Table 3 (which is derived from the more detailed tables in Appendix D).

The ordered WUP changes to facility operations resulted in the environmental and recreational improvements intended by the Consultative Committee.

Table 3. Summary of Ordered Monitoring Program Objectives and Results.

JOR Ordered Study Objectives and Response		
Study	**Study Objective**	**Operation Implications**
JORMON-01 Lower Jordan River Inflow Monitoring	**Assess the accuracy of WUP-modelled inflows and the performance of the fish flow release valve in delivering the minimum flow. August was selected as the critical month (summer base flow).**	1) Due to overestimation of local inflow and in-stream infiltration of the flow release into ground, the Elliott Dam discharge would need to be 0.395 m3/s (not 0.25 m3/s) in order to achieve the WUP rearing area and wetted stream length target of 0.41 m3/s. 2) Due to the control valve being locked fully open, the above revised flow target were largely achieved under the current flow release of ~0.3 – 0.4 m3/s.
JORMON-02 Fish Index: Lower Jordan River	**Assess for measureable benefits of the minimum flow release to rearing salmonids and their habitat using fish abundance and fish condition as performance measures.**	The flow release was successful in providing measureable biological and habitat benefits for resident rainbow trout and provided sufficient dilution of copper in Reach 2 to allow salmonid rearing to occur (coho and steelhead can now produce smolts). Benefits were achieved under a 0.3 – 0.4 m3/s release; it is unknown whether benefits would be sustained if the release is reduced to the original intent of 0.25 m3/s.
JORMON-03 Lower Jordan River Salmon Spawning Assessment and Enumeration	**1) Assess whether the flow release improves spawning and incubation success in the anadromous reaches. 2) Quantify anadromous spawning habitat and whether availability is influenced by the flow release. 3) Assess the effects of copper on incubation and rearing, and whether the flow release mitigates effects.**	Improved juvenile salmonid response to the dilution of copper provided by the flow release was the most significant observation; there were no observed increases in adult salmon or steelhead counts over the WUP study period. Observations made in a separate non-WUP project have confirmed higher returns. Increased and sustained salmon spawning in the lower reaches could require further considerations in a future WUP Order Review.
JORMON-04 Diversion Reservoir Fish Indexing	**1) Assess the impacts of extensive drawdowns on Diversion Reservoir rainbow trout condition factor and water quality. 2) Monitor lentic trout populations for potential benefits from reduced drawdown and evaluate the effects of extensive drawdown on these fish.**	The increased abundance of lentic trout suggests a positive response to reduced drawdown. Hollow Cone Valve (HCV) releases during periods when the critical mid-water layer is at the level of the HCV intake may have negative impacts to trout. Severe drawdown during the summer period can severely limit the habitat available for Rainbow and Cutthroat trout, while increasing the possibility of mortality to anoxia and entrainment. Given the observations, it appears that elevation constraints mitigate the potential for extraction of the critical rearing zone during severe drawdown.
JORMON-05 Monitoring Surfing Quality Below the Jordan River Generating Station	**Assess the benefits of constrained generation discharge (≤ 30 m3/s) on the quality of the surfing experience off the mouth of the Jordan River.**	Maintaining constraints at times when it contributes to surf quality would be desirable, but the range of environmental conditions, and the variability in their nature and occurrence, limit the ability to predict when flow constraints would improve surf conditions. Continuation of generation curtailment over weekends during the surf season would need to consider the costs and benefits of the operation in the context of the effects of non-operational variables on surf quality.
JORWORKS-01 Water Release Mechanism	**Release a minimum flow of 0.25 cubic metres per second into Jordan River at the Elliott Dam year-round.**	Variable flow regulation through the fish water release valve was intended. The valve was left fully open until emergency back up power was available. By that time the valve regulation controls were corroded and no longer functional. As a result, the valve remains fully open and released an average of 0.35 m3/s during the 3 years of monitoring that followed valve installation.

The issues with the operation of the fish water release valve meant that it was not possible to confirm the benefits to resident fish in the lower Jordan River at the minimum flow limit of 0.25 m^3/s. The habitat benefits that were observed in the lower Jordan River were associated with higher flow releases (approximately 0.35 m^3/s) from the control valve, not the 0.25 m^3/s minimum flow release.

Except for the surfing quality experiences, the ordered WUP changes in operations resulted in the improvements envisioned by the Consultative Committee. There are no residual or unfulfilled implementation issues from the 2003 WUP and subsequent Order. No new in-scope issues have been identified (see Section 1.3.2.1).

Conclusion 4: ***Implementation of the physical works are complete and meet the Order intentions.***

Conclusion 5: ***Implementation of the monitoring programs are complete and meet the Order intentions.***

Conclusion 6: ***There were significant positive environmental outcomes associated with the Elliot Dam fish water release flow.***

Conclusion 7: ***Diversion Reservoir elevation constraints mitigate the potential for extraction of the critical rearing zone during severe drawdown.***

Conclusion 8: ***Constraints on generation could potentially benefit surfing quality at the Jordan River.***

4.3. Assessment of the Results

- **Conclusion 1: Diversion Reservoir operation changes**
  Diversion Reservoir elevation constraints mitigate the potential for extraction of the critical rearing zone during severe drawdown. With the constraints rainbow trout abundance increased. Therefore, the elevation constraints (Condition 6) should be maintained.
- **Conclusion 3 and 6: Elliot Dam minimum flow implementation**
  Given the significant positive environmental outcomes associated with the Elliot Dam fish water release flow, ordered WUP conditions (Condition 3) should be maintained. In addition, the minimum flow provision should be modified or clarified to state that BC Hydro must maintain the Elliot Dam fish flow release value in the fully open position.
- **Conclusion 4: Implementation of the physical works**
  As the monitoring and physical work programs were successfully and completely implemented these Order (Condition 2) may be removed or deemed complete.
- **Conclusion 5: Implementation of the monitoring programs**
  As the monitoring and physical work programs were successfully and completely implemented these Order (Condition 9) may be removed or deemed complete.
- **Conclusion 8: Constraints on generation to benefit surfing quality**
  Constraints on generation could potentially benefit surfing quality at the Jordan River; therefore, the existing constraints should be maintained. However, given the significant dependence on physical environmental factors, this operation cannot be easily refined (e.g., actively forecast when discharge flow constraints would improve surf conditions).

4.4. Summary

The operation constraints were implemented and the expected benefits were tested and analysed. Since initiation of the Order implementation in 2004, Jordan River operations have had no significant or systematic exceptions to the ordered operation constraints on water discharges and reservoir elevations. The overall outcome of BC Hydro's implementation of the Jordan River System Order was positive and resulted in benefits to fish populations and habitat. The monitoring studies successfully answered the fish- and recreation-related uncertainties, with the exception of benefits to fish habitat from 0.25 m^3/s minimum flows (the benefits observed were associated with higher discharges).

5. CONCLUSIONS AND RECOMMENDATIONS TO THE COMPTROLLER OF WATER RIGHTS

To comply with the Jordan River Order implementation, BC Hydro completed the required actions related to operation constraints and environmental and other monitoring over an eight-year period to address fish habitat and recreation objectives. Implementation of the Jordan River Order was conducted within the Comptroller of Water Rights'-approved budgets (Appendix D (b)). The overall outcome of Order was positive, and resulted in benefits to fish resources; therefore, the objectives of the Order have been satisfied.

The following conclusions are made based on monitoring conducted to answer management questions and assessment of water conveyance:

- There were no significant or systematic exceptions to the water conveyance requirements.
- The predicted lower Jordan River inflows were greater the inflows observed in the field.
- The flow release from Elliot Dam restored habitat continuity throughout the lower Jordan River and increased abundance of rainbow trout within the lower Jordan River.
- The flow releases did not greatly improve salmon spawning habitat; however, the flows could aid in the passage of adult salmonids.
- Flow releases did not improve effective incubation habitat for salmonids; however, the flows improve rearing habitat in some areas by diluting harmful mining-related copper contamination within the lower Jordan River.
- Extensive drawdown of Diversion Reservoir could negatively affect rainbow trout if the habitable layer of the reservoir was drafted. The reduced allowable drawdown at the Diversion Reservoir was not observed to lead to a change in rainbow trout condition; however, a significant increase in abundance of rainbow trout was found. The elevation constraints mitigate the potential for extraction of the critical rearing zone during severe drawdown.
- Constraints on generation could potentially benefit surfing quality at the Jordan River.

Based on the Order implementation conclusions and feedback received, BC Hydro recommends the Comptroller of Water Rights consider updates or clarifications to the Jordan River Order, as presented below. This update is an opportunity to have the Order reflect the outcomes and current status of the Order implementation and to confirm future operation constraints to benefit and balance power generation, environment, and recreation values.

BC Hydro considers the ordered implementation of the Jordan River Water Use Plan a success and is committed to maintaining the ordered operations that have been shown to benefit fish and fish habitat and recreation in the Jordan River basin.

Table 4 contains BC Hydro's suggestions regarding possible amendments or clarifications to the Jordan River Order. Conditions recommended for remaining unchanged, clarified, or improved are in bold. All others are recommended for removal as they are complete (or otherwise acknowledged they are complete). There is no recommendation for new conditions. (Note that the annual water conveyance and other reports will continue to be submitted to the Comptroller of Water Rights as per regulatory requirements and the specifics of what must be reported under the facility water Licence and/or the WUP Order).

Table 4. Order Conclusions and Recommendations for the Comptroller of Water Rights' Consideration.

Cond.	Order Requirement Summary	Conclusion or Recommendation
1	Submit plan for Fish Flow Release Valve	Complete
2	The licensee shall alter the works	Complete
3	**July-Sep: minimum operating elevation of Diversion Reservoir shall be 376.0 m Oct-Jun: minimum operating elevation of Diversion Reservoir shall be 372.0 m**	**Continue**
4	**The licensee shall leave the low level outlet at Bear Creek Reservoir closed**	**Continue**
5	**During March for 4+ weekend days: combined maximum discharge from the generating station shall be 30 m3/s between 0600 h and 1800 h.**	**Continue**
6	**Shall release a minimum flow of 0.25 m^3/s into Jordan River at the Elliott Dam outlet.** *Modify to state the fish water release value must be maintained and operated in a full-open position year-round.*	**Continue & Supplement**
7	**Minimum fish flows take operational precedence over reservoir minimum elevations**	**Continue**
8	The licensee shall submit a monitoring plan	Complete
9	The licensee shall implement monitoring in accordance with the plan as accepted	Complete
10	The licensee shall provide annual reports to the Comptroller including the following information: a) size and abundance of rainbow trout in lower Jordan River, b) salmonid spawner surveys in lower Jordan River, c) fish stress indicators in Diversion Reservoir	Complete

11	The licensee shall provide annual reports to the Comptroller documenting surfing conditions	Complete
12	**The works may be operated in an alternate manner in the event of an emergency; a dam safety requirement, or an extreme hydrologic event**	**Continue**
13	**All emergency operations or other deviations from this ordered shall be reported to the Comptroller**	**Continue**

BC Hydro considers the ordered implementation of the Jordan River *Water Use Plan* a success and is committed to maintaining the facility ordered operations that benefit fish and fish habitat in the Jordan River basin.

Appendix A. *GLOSSARY*

Completion Report – A report submitted to the Comptroller of Water Rights at the conclusion of each monitoring study and physical works. The report indicates the ordered requirements are complete and concludes with a request that BC Hydro be relieved of its implementation obligation under the Order.

Condition Factor – A qualitative measure is usually based on a visual assessment of the fish, including the general "shape" of the fish, its length and weight, and its appearance (which usually equates to how "fat" the fish is). Fish biologists can measure condition based on a ratio between fish weight and length.

Consultative Committee (CC) Report – Facility-specific *Consultative Committee Report* published by BC Hydro. The reports were prepared in accordance with the provincial government's *Water Use Plan Guidelines*. The reports document the interests, values, and recommendations of the Committee and is a supporting document to BC Hydro's *Water Use Plans.*

CWR, Comptroller – Comptroller of Water Rights for British Columbia. The Comptroller approves BC Hydro's WUPs, monitoring and physical works Terms of 4, and issues WUP implementation Orders.

Demersal Zone - on or near the bottom of a sea, lake, or river**.**

***Environmental Synthesis Report* –** A Report which integrates all the monitoring programs for a facility across fields of study (e.g., fish) and time (e.g., a series of annual studies). Also used as generic term that can be applied to social issue studies (e.g., archaeology) and/or environmental issue studies (e.g., vegetation or wildlife). This will be an input to, and part of, the *WUPOR Report*.

Energy Constrained System – Electrical generating stations with insufficient reservoir storage or inflows to support around-the-clock generation**.**

Facility – BC Hydro generating station or water control structure. In the context of BC Hydro *Water Use Plans* and related *Water Act* Orders, facility may refer to a systematic grouping of facilities. E.g., The Columbia *Water Use Plan* Order refers to the collective of Mica and Revelstoke Generating Stations and H.L. Keenleyside Dam.

FWRV - Fish Water Release Valve. A valve to release a minimum flow, usually to benefit fish and fish habitat.

Generation Operating Order - summarises the generation, reservoir management, and water conveyance parameters for a facility.

Guidelines – *Water Use Plan Guidelines* (Province of British Columbia, 1998).

Incremental (and Practical) Changes to Facility Operations – Principle from the Guidelines: recognizing the legislative, policy, and other limits on trade-offs, and seeking incremental operational improvements to balance competing water uses.

Jordan River System - Jordan River hydropower facility. Part of the Bridge River/Coastal Generation Area and includes the Jordan Generating Station, Elliott Dam and Headpond, Jordan Diversion Dam, Diversion Reservoir, Bear Creek Dam, and Bear Creek Reservoir.

JORMON-1 – lower Jordan River Inflow Monitoring

JORMON-2 – Fish Index, lower Jordan River

JORMON-3 – lower Jordan River Salmon Spawning Assessment and Enumeration

JORMON-4 – Diversion Reservoir Fish Indexing

JORMON-5 – Monitoring Surfing Quality below the Jordan River Generating Station

JORWORKS-1 - Water Release Mechanism at Elliott Dam (Physical Works)

Lotic Ecosystems - Refers to flowing water. Lotic waters range from springs only a few centimeters wide to major rivers kilometres in width.

Littoral Zone - the part of a sea, lake, or river that is close to the shore.

Lentic Ecosystems – Refers to involve relatively still terrestrial waters such as lakes and ponds.

Monitoring Studies (or Monitors) – Programs implemented to monitor the efficacy of BC Hydro operations for environmental, social (including recreational), or economic (including power generation) benefit. May be referred to "environmental" in the text but should be considered to include all monitoring programs related to the Order. Monitoring programs are implemented to confirm the effectiveness or define the impacts of the operation constraints (including the physical works). For example, a monitoring program may be implemented to assess whether a minimum flow yields benefits to fish and fish habitat.

MW – Megawatt (1000 watts). Unit of power. Power is energy transfer per unit of time. 1 W = 1 J/s.

Natural Inflow – Total water supply to a point or area from all natural inputs from the hydrologic cycle such as precipitation, streamflow, and groundwater. (vs. Regulated Inflow).

Order – A *Water Act* (or *Water Sustainability Act*) Order. Made by the Comptroller of Water Rights to require BC Hydro to implement the priority elements of a *Water Use Plan*.

Pelagic Zone – being neither close to the bottom nor near the shore of a sea, lake, or river

Physical Works – Construction programs undertaken generally in lieu of operation constrains. For example: instead of holding a reservoir at a high elevation, (i) a control structure may be constructed to hold water in a wetland, thereby maintaining its ecological integrity during low reservoir elevations, or (ii) a boat ramp may be constructed or extended to allow reservoir recreational access during low elevation periods.

Regulated Inflow –Water supply to a point or area from all regulated, or controlled inputs such as water discharged from a dam or generating station. (vs. Natural Inflow).

***Social Issue* –** The subset of social issues related to environmental quality. For example a flow discharge or reservoir wave action that erodes a shoreline containing a valued assets such as artifacts, architecture, biofacts or ecofacts, and cultural landscapes

Total Inflow –Water supply to a point or area from all regulated and natural sources; Total Inflow = Regulated Inflow + Natural Inflow.

***Water Act/Water Sustainability Act* –** Legislation that enables the CWR to require BC Hydro to implement priority operations, monitoring, and physical works recommended in *Water Use Plans.* The *Water Sustainability Act* superseded the *Water Act* in 2016.

Water Use Plan (WUP) – *Water Use Plan* published by BC Hydro. A WUP is a technical document that defines the detailed operation parameters to be used by facility managers in their day-to-day water conveyance decisions. Plans are intended to clarify how BC Hydro's rights to provincial water resources should be exercised and to take account of the multiple uses for those water resources. WUPs recognise existing legal and constitutional rights and responsibilities, as set out in legislation and court decisions.

WUPOR – Water Use Plan Order Review Program.

WUPOR Report – The final report of the Water Use Plan Order Review Program. A report will be submitted to the Comptroller of Water Rights for each of the WUP implementation Orders. The report will contain an environmental synthesis and an operational compliance summary. It will be complete with recommendations regarding the Order such that it could reflect the new status of activities and outcomes associated with the implementation of the Order.

Appendix B. *REFERENCES*

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Appendix C. *ABOUT BC HYDRO AND OUR ENVIRONMENTAL AND HERITAGE MITIGATION PROGRAMS*

A variety of mitigation programs are implemented at BC Hydro hydropower generation facilities to address existing effects related to the facility's footprint and operation. These programs include:

- Water Use Plan implementation
- Fish and Wildlife Compensation Programs
- Fish Passage Decision Framework
- Fish Entrainment Strategy
- Total Dissolved Gas Strategy
- Generation Wildlife Program
- Environmental Management System
- Reservoir Archaeology Program
- Climate Change Strategy

a. BC Hydro

BC Hydro is a provincial Crown Corporation, owned by the people of British Columbia. We operate an integrated system of generation, transmission, and distribution infrastructure to deliver reliable, affordable, and clean electricity to our four million customers, safely. As an organization, we have a huge impact on the lives of the people of British Columbia and we are working together to uphold this responsibility and become the most trusted, innovative utility company in North America - smart about power in all we do.

BC Hydro is one of the largest energy suppliers in Canada, generating and delivering electricity to 95 per cent of the population of British Columbia. We operate an integrated system backed by 30 hydropower plants and two thermal generating stations as well as over 79,000 kilometres of transmission and distribution lines.

Generating, transmitting, and distributing electricity in an affordable and environmentally- and socially-conscientious manner is tremendous responsibly for BC Hydro. Energy, environment, and economy directly impact all British Columbians and there are high expectations to manage all three responsibly.

BC Hydro has become a leading sustainable energy company by producing and delivering electricity in environmentally and socially responsible ways. The first and best way to meet our future electricity and environmental needs is through "demand side management" such as conservation and energy efficiency efforts. Through the Power Smart Program, BC Hydro is a global leader in conservation, providing programs and incentives to encourage customers to use less energy.

Reducing the demand for energy can eliminate or at least delay the need for new generation and thereby eliminate or delay any environmental, economic, or social impacts associated with the construction, footprint, and operation of new facilities.

When hydropower generation facilities are established and operated, sustainability and impact mitigation programs are factored into operations. These programs are described below and include:

- Water Use Plan implementation
- Fish and Wildlife Compensation Programs
- Fish Passage Decision Framework
- Fish Entrainment Strategy
- Total Dissolved Gas Strategy
- Generation Wildlife Program
- Environmental Management System
- Reservoir Archaeology Program
- Climate Change Strategy

b. Water Use Plans

Water use planning is an example of sustainable work in practice at BC Hydro. The overall goal is to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage, flood control and electrical power needs. When achieving a better balance, changes to facility operations should be incremental and practical.

Water use plans were developed for most of BC Hydro's hydropower facilities through a consultative planning process involving participants, such as government agencies, First Nations, local citizens, and other interest groups.

The provincial Comptroller of Water Rights reviewed the Water Use Plans under the provisions of B.C.'s *Water Act*, and involved Fisheries and Oceans Canada, other provincial agencies, First Nations, and holders of water licences who might be affected by the plans. Once accepted by the Comptroller, operation changes, monitoring studies and physical works outlined in the plans were implemented by BC Hydro through Orders from the Comptroller under B.C.'s *Water Sustainability Act*.

Starting in 2015, and occurring over the next 15 or more years, reviews will be undertaken of the activities that BC Hydro has performed to meet the intent of the Orders.

c. Fish and Wildlife Compensation Program

The Fish and Wildlife Compensation Program (FWCP) is a partnership between BC Hydro, the Province of BC, DFO, First Nations, and Public Stakeholders conserve and enhance fish, wildlife and their supporting habitats impacted by existing BC Hydro owned and operated generation facilities. Since 1988[7], through funding from BC Hydro, the FWCP has invested more than $160 million in fish and wildlife projects that support the FWCP's vision of thriving fish and wildlife populations in watersheds that are functioning and sustainable. The FWCP operates in three regions in BC: Peace, Columbia, and Coastal.

[7] The Peace-Williston Fish and Wildlife Compensation Program (now known as the FWCP Peace Region) was established in 1988. The Columbia Basin Fish and Wildlife Compensation Program (now known as the FWCP Columbia Region) was established in 1995. The Bridge-Coastal Restoration Program (now known as the FWCP Coastal Region) was established in 1999.

For more information about the FWCP, see www.fwcp.ca.

d. Fish Passage Decision Framework

The development of some BC Hydro dams in certain drainage basins resulted in a blockage to migratory fish. Dams can create two categories of impacts on fish passage: those resulting from dam operations and those resulting from the dam footprint. Dam operations can create conditions where river hydraulics (low or high flows) impede migration or create homing issues. Operations can also result in mortality to fish upstream of the dam through entrainment. Operations-related fish passage issues and solutions are evaluated as part of the WUP process and the Fish Entrainment Strategy. In most cases these programs do not consider fish passage solutions that would mitigate footprint impacts.

BC Hydro's Fish Passage Decision Framework (the Framework) was developed in 2008[8] to establish a process for determining how BC Hydro addresses fish passage issues at its facilities. The Framework was based on recommendations made by Bocking and Gaboury (2002)[9] in their peer-review of a preliminary evaluation of restoring historical passage at BC Hydro facilities (Bengeyfield et al. 2001). The current focus of the Framework is the restoration of passage for anadromous populations of salmon and steelhead. The Framework is a collaborative process involving regulatory agencies, First Nations, stakeholders, and other interest groups whose mandate is to determine the feasibility of restoring fish passage at each facility.

The Framework is implemented as a partnership between BC Hydro and FWCP. The focus of FWCP's involvement in the analysis and decision making around restoring fish passage is the determination of environmental and technical feasibility and likelihood of success. BC Hydro then evaluates feasibility with respect to operations and dam safety requirements as well as social and financial objectives.

The Framework is a seven step process that outlines the role of both FWCP and BC Hydro in the advancement, evaluation, implementation and funding of fish passage restoration projects. The Framework also shows the flow of work and decisions needed to advance proposals and where proposals may be terminated in the decision process (Figure 5). The Framework is divided into two parts:

1. The FWCP Role

   The process is initiated when a proponent (typically a fish passage committee) seeks funding from FWCP to evaluate the feasibility of restoring target species above a BC Hydro facility through the installation of some form of fish passage infrastructure. This part of the Framework is completed when a proposal is either found to be infeasible or is endorsed by the regional FWCP Board.

2. The BC Hydro Role

   Following regional FWCP Board endorsement ("Step 5" of the Framework), the proponent submits a supported project proposal to BC Hydro for business case and financial approvals.

[8] The Framework was updated in 2017. The most recent version can be accessed at: http://fwcp.ca/app/uploads/2017/03/Fish-Passage-Decision-Framework-Revision-1-Final-17Jan2017.pdf

[9] Recommendations included an expanded decision making process beginning with the establishment of stock and habitat profiles, followed by operational and structural profiles, and finally an assessment of cost-effectiveness.

Further information on the Framework, including the Fish Passage Decision Framework for BC Hydro Facilities process guide (BC Hydro 2016b), can be found at http://fwcp.ca/fish-passage-decision-framework/ .

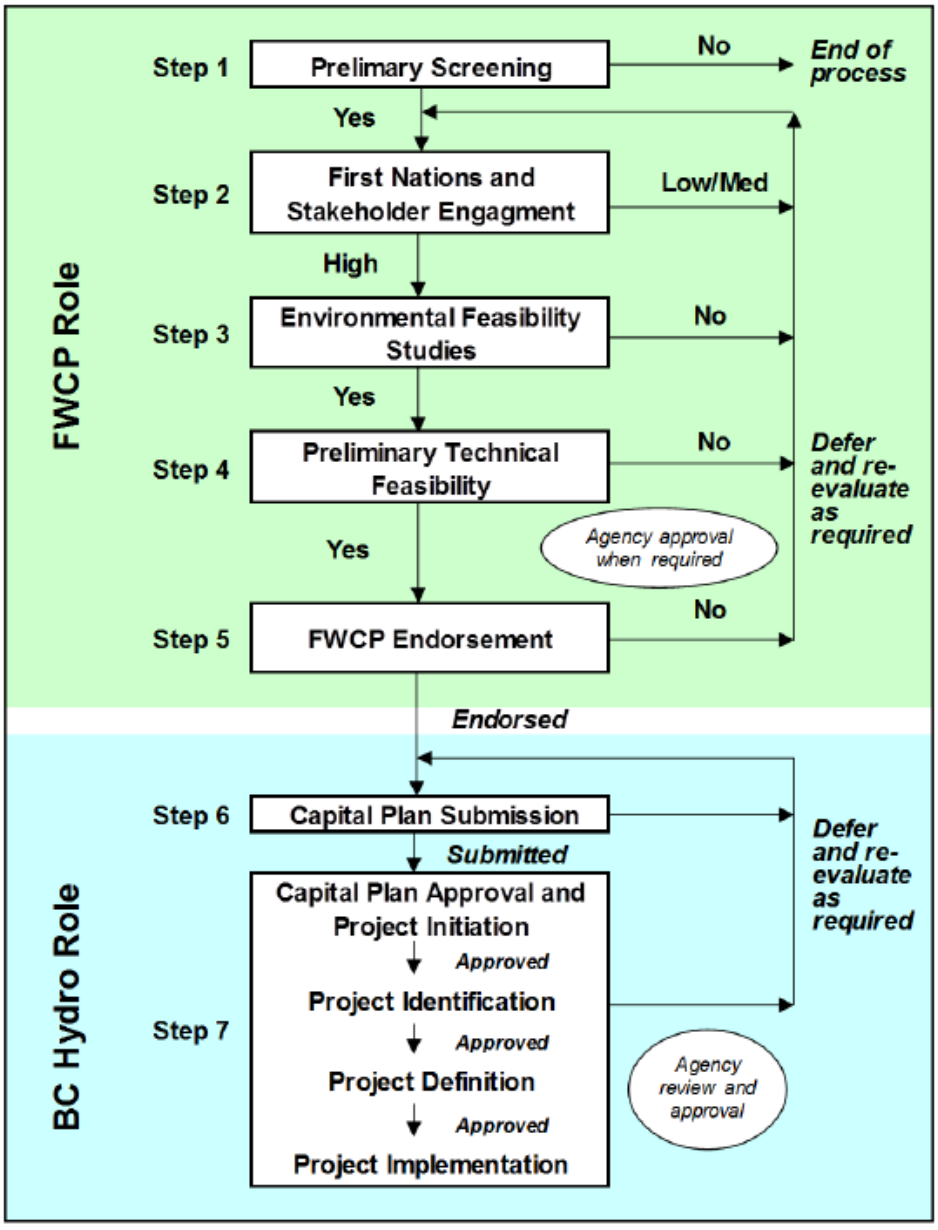


Figure 5. BC Hydro's Fish Passage Decision Framework.

e. Fish Entrainment Strategy

To achieve regulatory certainty regarding *Fisheries Act* requirements to mitigate fish mortality through entrainment at existing facilities, BC Hydro developed a Fish Entrainment Strategy. The Entrainment Strategy defines a process for assessing and resolving entrainment risks, a methodology for evaluating risks, and a schedule for application to existing facilities throughout the BC Hydro system. The Entrainment Strategy was supported by BC Hydro, DFO, and the BC Ministry of Environment (BCMOE) and had input from various regional First Nations representatives. Water use planning and capital projects have relied on the Entrainment Strategy to resolve fish entrainment issues that were beyond the capacity and scope of the respective WUP and BC Hydro facilities to fully address.

The Entrainment Strategy process is divided into four steps:

1. Prioritization: Based on fisheries and regulatory issues, operation risks and commitments, should this facility be included in the Entrainment Strategy process?
2. Risk Screening: For high priority facilities, what is the focus for assessment in the Entrainment Strategy?
3. Action Planning: What are the entrainment impacts and what options exist to mitigate impacts?
4. Mitigation-Compensation: What is the final recommendation for mitigation?

f. Total Dissolved Gas Strategy

Total dissolved gas (TDG) levels downstream of some BC Hydro facilities can exceed the Province's Approved Water Quality Guidelines, particularly where high magnitude spill flows or air injection methods are used during operations. High TDG levels can be harmful to fish, causing gas bubble disease and mortality. To address these challenges BC Hydro developed a Total Dissolved Gas Strategy (the TDG Strategy).

The TDG Strategy is being implemented at generating stations, as needed, to reduce environmental and regulatory risk. The TDG Strategy evaluates the TDG risk associated with facility operations to determine where more monitoring is needed to develop the relationship between operations and TDG production. It also determines where mitigation involving operation changes or cost-effective physical works can be undertaken. The TDG Strategy's implementation is regularly reviewed by provincial and federal regulators to determine its overall success.

g. Generation Wildlife Program

BC Hydro's Generation Wildlife Program has been developed to manage wildlife issues associated with the operation of its generation facilities, including habitat loss, migration route disruption, and mortality. Wildlife issues are addressed by a number of programs and projects, including the FWCP, the water use planning process, capital projects, and operations, maintenance and administration projects. The foundation of the Wildlife Management Program consists of the Wildlife Issues Management Guide and Facility Reports.

The BC Hydro Wildlife Issues Management Guide (BC Hydro 2011) provides the legal and policy background for the Generation Wildlife Program, along with recommendations on how to safely manage wildlife issues. Wildlife issues captured in the Guide include birds, species and ecosystems at risk, pest management, problem wildlife, hazardous wildlife, wildlife-borne diseases, wildlife mortality (reporting and disposal), vegetation management, hydrocarbon spills, and human health and safety.

h. Environmental Management System

In 2016, BC Hydro drafted a new Environmental Management System (EMS) Framework and preliminary strategy. These documents are being integrated into a comprehensive system emphasizing delivery of environmental standards, tools, and procedures. The EMS encompasses the four elements of "plan, do, check, act"; components of each are outlined briefly below.

Plan

The planning element of the EMS includes BC Hydro's Corporate Environmental Responsibility Policy and two Statements of Strategic Intent that provide elaboration on the management of fisheries and species at risk. This element also defines standards for document definitions and approval processes.

Do

The implementation of the EMS includes, hazard and risk assessment, training, Incident Management System, and resources and tools (e.g., environmental best management practices).

Check

Monitoring the application and effectiveness of the EMS includes components of reporting, auditing, and compliance reviews.

Act

Periodic management reviews of the EMS ensure objectives are being met and there is continual improvement within the system.

i. Reservoir Archaeology Program

BC Hydro established the Reservoir Archaeology Program (RAP) in 2008 to ensure that reservoir operations comply with the B.C. *Heritage Conservation Act*. Through RAP, BC Hydro works with the Archaeology Branch of FLNRO and affected First Nations to assess and manage impacts to protected archaeological sites in the active erosion zones of 26 reservoirs across the Province. The RAP is a two phase program:

- Phase 1: Inventory and the development of archaeological management plans
    - An inventory of archaeological sites in active erosion zones of reservoirs;
    - Archaeological site significance assessments
    - Identification of potential impacts to sites
    - Development of reservoir-specific Archaeological Management Plans
- Phase 2: Implementation of Archaeological Management Plans

j. Climate Action Strategy

Global climate change is upon us. The provincial government's responsibility to current and future generations as natural resource stewards requires coordinated, province-wide action on climate change (Province of British Columbia, 2018).

If significant impacts result from climate change to a basin's hydrology or ecology, the provincial water use planning guidelines allow for another Order review to assess and accommodate adaptation strategies.

BC Hydro is doing its part. Both natural cycles and human-related greenhouse gas emissions influence climate in British Columbia and the river flows that supply the majority of power that BC Hydro generates. BC Hydro's climate action strategy addresses both the mitigation of climate change through reducing our greenhouse gas emissions and adaptation to climate change by understanding the risks and magnitude of potential climatic changes to our business today and in the future. BC Hydro has published reports on bchydro.com regarding the potential impacts of climate change on BC Hydro-managed water resources, the most recent being Jost and Weber (2013).

As part of its climate change adaptation strategy, BC Hydro has undertaken internal studies and worked with some of the world's leading scientists in climatology, glaciology, and hydrology. BC Hydro collaborated with scientists from the Pacific Climate Impacts Consortium (PCIC) at the University of Victoria; the Western Canadian Cryospheric Network (WC2N), which consists of six Western Canadian and two Washington state universities; and the Climate Impacts Group (UW-CIG) at the University of Washington.

If significant impacts result from climate change to a basin's hydrology or ecology, the provincial water use planning guidelines allow for another Order review to assess and accommodate adaptation strategies.

Appendix D. *JORDAN WATER USE PLAN ORDER IMPLEMENTATION SUMMARY*

a. Chronological History

The Jordan River *Water Use Plan* (JOR WUP) was initiated in 2000 and finalized in 2003. The outputs during the WUP process included:

- **Jordan River *Consultative Committee Report* (BC Hydro 2002)** – documentation of the structured decision making process which evaluated operation alternatives against objectives represented by the Consultative Committee, and documented uncertainties that would define the study program for implementation following WUP approval;
- **JOR Water Use Plan (BC Hydro 2003)** – submitted by BC Hydro to the Comptroller of Water Rights (CWR) as the summary of operation constraints and implementation commitments (studies and physical works) to be appended to its Water Licenses;
- **Jordan River Facility Order (Comptroller of Water Rights 2004)** – the Water Act Order issued by the CWR to implement the *Water Use Plan* as a condition of the 5 licenses associated with the Jordan River projects; and
- **Study progress reports and annual watershed reports** – reports summarizing annual data collection results for ordered studies were prepared, and watershed activities were summarized each year in an annual watershed report and submitted to the CWR. All reports were published online.

As noted above, in 2004, the Comptroller of Water Rights (CWR) issued an Order in response to the JOR WUP under the Water Act that included implementation of a fish flow release of 0.25 m3/s from Elliott Dam, and the undertaking of five monitoring projects to assess for anticipated benefits to fish, fish habitat, and recreational activities. As a result, the following outputs were prepared:

- **Water Licence Requirements (WLR) Monitoring Terms of References (BC Hydro 2004)** - for the five monitoring studies ordered by the CWR, management questions and methodologies were prepared to address uncertainties defined in the WUP consultative process and submitted to the CWR for Leave to Commence; and
- **WLR Physical Works Terms of Reference (BC Hydro 2006)** - for the physical works (Elliot Dam flow release mechanism) ordered by the CWR, statement of objectives and project plans were submitted to the CWR for Leave to Commence.

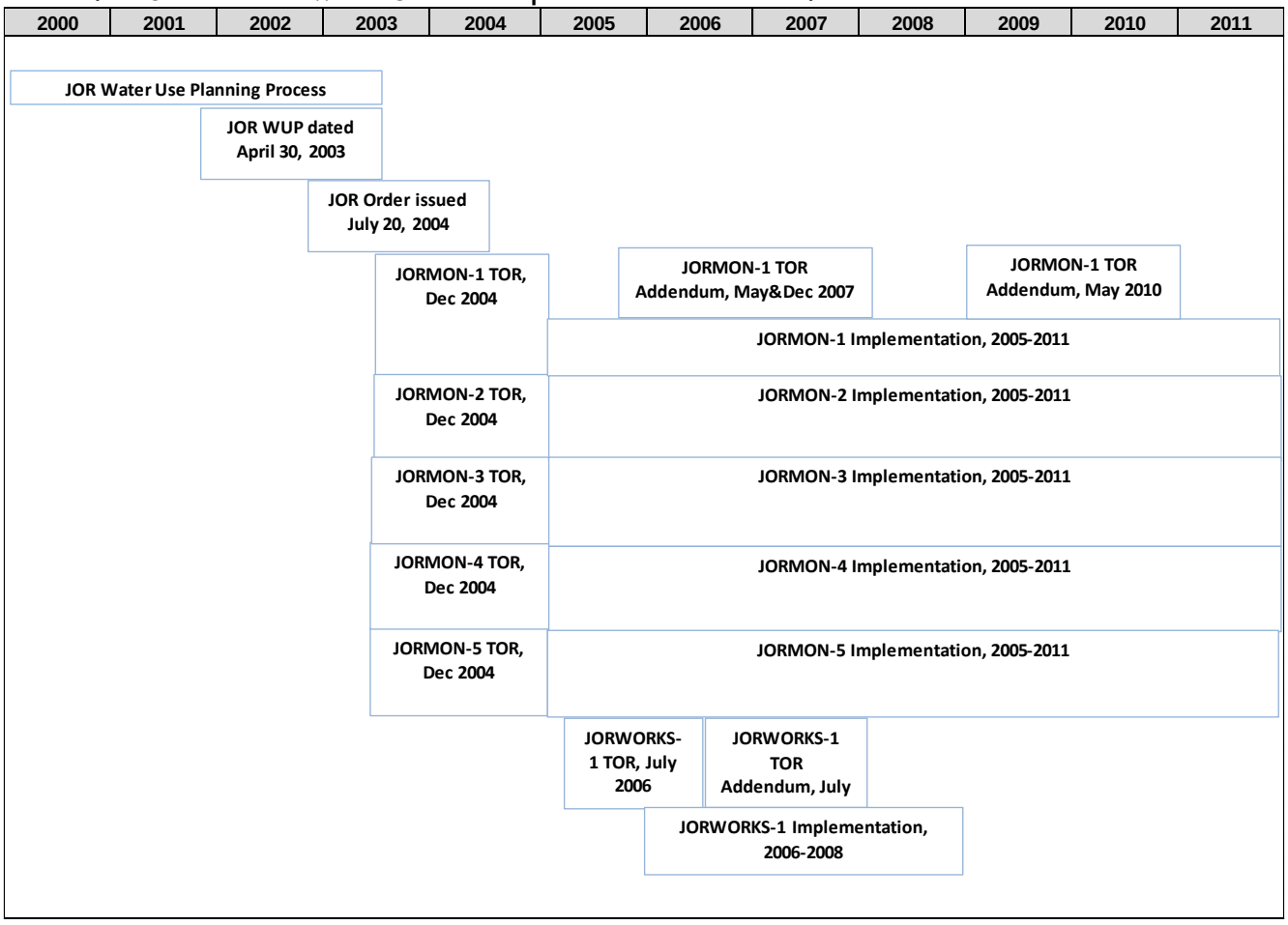
The physical works and five monitoring studies were as follows:

- **JORWORKS-1** – Water Release Mechanism at Elliott Dam (Physical Works): design and plan for the installation of a fish-water release valve in Elliott Dam to enable a minimum flow release of 0.25 m3/s into the lower Jordan River;
- **JORMON-1** – lower Jordan River Inflow Monitoring: assess the performance of modelled flows used in the minimum flow decision relative to measured flows in the Jordan River below Elliot Dam;
- **JORMON-2** – Fish Index – lower Jordan River: assess the performance of the minimum flow release using fish abundance and fish condition as performance measures;
- **JORMON-3** – lower Jordan River Salmon Spawning Assessment and Enumeration: assess spawning success of salmon in the anadromous reach of the lower Jordan River;

- **JORMON-4** – Diversion Reservoir Fish Indexing: assess the impacts of extensive drawdowns on Diversion Reservoir rainbow trout condition factor and water quality; and
- **JORMON-5** – Monitoring Surfing Quality below the Jordan River Generating Station: assess the performance of generation constraints on surf quality.

The installation of the fish release pipe, pneumatic gate valve, and gauging instrumentation (JORWORKS-1) was initiated in 2006 and completed in 2008. Fish flow releases commenced in January 2008. The five monitoring studies were 6-year programs and collected data for 3 years prior to, and 3 years after the flow release. These commenced in 2005 and were complete in 2011. The table below outlines the implementation timeline of the Jordan *Water Use Plan*.

Table 5. Jordan River Water Use Plan Implementation Timeline.



b. Financial Summary

This section describes the costs associated with implementation of the JORWORKS-1 physical works program and the JORMON-1 through JORMON-5 monitoring programs. During the WUP process, detailed cost

estimates were prepared that reflected the construction, data collection and analysis costs, which were submitted to the CWR with the Terms of References. Upon CWR approval, these costs became the budgets for the physical works and monitoring studies. The table below provides the CWR approved costs, actual costs, and the variance between CWR approved and actual costs. As shown in the table, all work was completed within budget.

Table 6. Jordan River WUP Order Implementation Budget and Cost.

Physical Works Project or Monitoring Study	CWR Approved Cost	Actual Cost	Variance Between CWR Approved and Actual Costs	
			Dollars Under Budget	Percent Under Budget
JORMON-1	$ 178,412	$ 165,234	$ 13,178	7.39%
JORMON-2	$ 175,923	$ 138,928	$ 36,995	21.03%
JORMON-3	$ 144,894	$ 121,827	$ 23,067	15.92%
JORMON-4	$ 121,543	$ 81,180	$ 40,363	33.21%
JORMON-5	$ 65,362	$ 36,134	$ 29,228	44.72%
JORWORKS-1	$ 675,982	$ 671,092	$ 4,890	0.72%
Total	**$ 1,362,116**	**$ 1,214,395**	**$ 147,721**	**10.84%**

The annual value of energy, forgone to implement the changes to Jordan River operations, was estimated as $449,000/yr (c. 2007).

c. *Environmental Synthesis Report* Summary

Burt (2011) considers the results from the five monitoring programs ordered in response to the Jordan WUP, and outlines whether benefits anticipated by the WUP Consultative Committee (CC) are being realized under the current operation constraints. The Report is summarized in this section; the full report is published on bchydro.com.

All changes to operations yielded significant positive environmental outcomes, as intended. March restrictions on generation flows to enhance ocean surfing experience was found to be significantly influenced by other natural environmental variables.

The five WUP monitoring programs were generally successful in addressing the management questions posed by the WUP CC.

The following conclusions were made based on monitoring conducted to answer management questions around the effectiveness of the ordered changes to Jordan River facility operations:

- The monitoring studies assessing the Elliot Dam fish water release valve discharge of 0.3 – 0.4 m^3/s captured habitat conditions close to the WUP target. The ordered minimum release of 0.25 m^3/s was not assessed by the studies due to the valve being operated fully open during the study period (and at all times since).

The Order's 0.25 m^3/s minimum flow was recommended by the WUP CC based on modelled inflows. The total flows predicted certain gains in rearing habitat (weighted usable area) and wetting of an additional 3 km of stream length below Elliott Dam. JORMON-1 found that, due to overestimation of modelled inflows and streamflow infiltration losses to ground, a release of 0.395 m^3/s would be required to achieve the WUP habitat targets. As it turned out, the actual discharges resulted in flow that were reasonably close to this flow and the monitoring studies captured habitat conditions close to the WUP target.

- The fish water minimum flow release restored habitat continuity throughout the lower Jordan River; the rainbow trout population experienced increased abundance; however, there were no changes to average condition factor.
- The flow releases did not greatly improve salmon spawning habitat; however, they could aid in the passage of adult salmonids.
- Flow releases did not improve effective incubation habitat for salmonids; however, they did improve rearing success by diluting harmful mining-related copper contamination within the lower reaches of Jordan River.
- Extensive drawdown at Diversion Reservoir could negatively affect rainbow trout if the habitable layer of the reservoir was drafted; therefore, consideration should be given to avoiding HCV releases during periods when critical mid-water layer is at the level of the HCV intake. The reduced drawdown ranges (ordered minimum seasonal elevations of 372 m and 376 m versus the licensed minimum of 360.09 m) at the Diversion Reservoir were not observed to lead to a change in rainbow trout condition; however, a significant increase in abundance of rainbow trout was found. Given the observations, it appears that elevation constraints mitigate the potential for extraction of the critical rearing zone during severe drawdown.
- Constraints on generation potentially could benefit surfing quality at the Jordan River. However, surfing quality appears to be highly dependent on physical environmental factors such as tidal action, wave size and interval, wind, and weather. Therefore, there is limited ability to actively forecast when discharge flow constraints would improve surf conditions.

The implementation of the WUP operation changes have benefited fish and fish habitat in the lower Jordan River and Diversion Reservoir.

Table 7 (fish) and Table 8 (recreation) summarize the *Environmental Synthesis Report* results.

Table 7. Summary of *Environmental Synthesis Report* - Fish

Study	Objectives	Management Questions	Response	Operation Implications
JORMON-1 lower Jordan River Inflow Monitoring	Assess the accuracy of the modelled inflows and the performance of the fish flow release in delivering the anticipated discharge.	1) How accurate were the inflows modelled for the WUP for the region downstream of Elliott Dam?	1a) WUP flows overestimated August inflows between Elliott Dam and the JOR tailrace by 0.105 m^3/s. 1b) There was a loss of	1) Due to overestimation of local inflows, and losses of the flow release to groundwater, in order to achieve the WUP rearing area and

	August was selected as the critical month (month of summer base flow).	2) What are the reasons for differences between monitored and modelled inflows? 3) What implications do measured inflow data have on the WUP release flow recommendation?	0.03 – 0.05 m^3/s of the flow release to groundwater conveyances. 2) The overestimation by WUP flows was due an erroneous assumption in the modelling process. 3) Implications – see next column As noted in the synthesis report text, release flows ranged from ~0.3 – 0.4 m^3/s as opposed to the intended 0.25 m^3/s.	wetted stream length targets, the flow release at Elliott Dam would need to be 0.395 m^3/s as opposed to 0.25 m^3/s. 2) Due to the control valve being locked fully open, the above revised flow requirement and associated targets were largely achieved under the existing flow release (0.3 – 0.4 m^3/s).
JORMON-2 lower Jordan River Fish Index Study	Assess for measureable benefits of the flow release to rearing salmonids and their habitat. Additional objective: assess water quality before/after the flow release (including copper).	1) How will the flow release affect standing stock of rainbow trout? 2) How will the flow release affect rainbow trout condition (weight to length ratio)? 3) Will the flow release restore habitat continuity?	1) Density of age 1+ and 2+ rainbow trout increased after the flow release. Juvenile trout and coho fry repopulated the copper impacted zone after the flow release (Reach 2). 2) No change in condition factor. 3) Habitat continuity was greatly improved; wetted channel right up to Elliott Dam; sufficient depths in riffles for fish to freely disperse between habitat units.	The flow release was successful in providing measureable biological and habitat benefits for resident rainbow trout in reaches below Elliott Dam. The flow release provided sufficient dilution of copper in Reach 2 to allow successful rearing of resident and anadromous species (i.e. coho and steelhead can now produce smolts). Benefits were achieved under a 0.3 – 0.4 m^3/s release; it is unknown whether benefits would be sustained if the release is reduced to the original intent of 0.25 m^3/s. A reduction to 0.25 m^3/s could reintroduce copper toxicity issues.
JORMON-3 Assessment of spawning and	Assess whether the flow	1) Will the flow release improve spawning	1a) Snorkel counts of adult salmon and	The dilution of copper provided by the flow

incubation success, anadromous reaches	release improves spawning and incubation success in the anadromous reaches. Quantify anadromous spawning habitat and whether availability is influenced by the flow release. Assess the effects of copper on incubation and rearing, and whether the flow release mitigates effects.	habitat for salmon and steelhead in anadromous reaches? 2) Will the flow release improve incubation success for salmon and steelhead? 3) What effects, if any, will the flow release have on chronic toxicity affecting rearing and incubating salmonids?	steelhead were low within the study years, but subsequent surveys by FWCP projects showed an increase in coho and chum salmon. 1b) The flow release was estimated to have little effect on the quantity of available spawning habitat as spawning tends to occur after the arrival of fall rains; however, the release appears to have improved adult access into Reach 2. 2) The flow release did not appear to influence incubation success (survival of coho eggs within incubators was high both before and after the flow release). 3a) Incubation success appeared to be unaffected by levels of copper in the water (high egg-to-alevin survival throughout the study). 3b) Rearing was not viable within the copper impacted zone prior to the flow release but was successful after the flow release (see JORMON-2).	release, and subsequent ability of the anadromous portion to support rearing (and potentially produce smolts) represents a significant ecological response. Increased abundance of adult coho and chum found by recent snorkel surveys suggest benefits are beginning to manifest in adult returns. The positive response in anadromous rearing and adult returns suggest that the needs of anadromous fish may require review in the WUP OR process.
JORMON-4 Diversion Reservoir Fish Index Study	Monitor lentic trout populations for potential benefits from reduced drawdown and evaluate the effects of extensive drawdown on these fish.	1) What are the benefits to rainbow trout condition (weight to length ratio) associated with a reduced allowable drawdown? 2) What are the impacts on rainbow trout	1a) No significant increase was found in trout condition factor under reduced drawdown. 1b) However, abundance increased significantly and was concluded to be a	The increased abundance of lentic trout suggests a positive response to reduced drawdown. Thus, the reduced drawdown operating protocol should be maintained.

		condition associated with a prolonged extensive drawdown?	better indicator of drawdown performance. 2) Limnological conditions can develop where trout are sandwiched between warm surface waters, and an anoxic bottom layer. Extensive drawdown at these times can result in the HCV drawing off water from the crucial mid-water layer.	Consideration should be given to avoiding HCV releases during periods when critical mid-water layer is at the level of the HCV intake.

Table 8. Summary of *Environmental Synthesis Report* - Recreation

Study	Objectives	Management Questions	Response	Operation Implications
JORMON-5 Surf Quality Survey	Assess the benefits of constrained generation discharge (≤ 30 m^3/s) on the quality of the surfing experience off the mouth of the Jordan River.	How do constraints on generation benefit surf quality at the Jordan River? Assessed by surfer response to a questionnaire.	25% of surfers reported an effect of generation on surf quality when there was no generation flows, 32% at constrained flows, and 49% at unconstrained generation flows.	Concluded that maintaining constraints at times when it contributes to surf quality would be desirable, but the range of environmental conditions, and the variability in their nature and occurrence, limit the ability to predict when flow constraints would improve surf conditions.

d. Order Completion by Aspect and Condition

(i) Changes to Operations

Current key operation conditions are depicted in Table 9. Key conditions represent those implemented at the facility that are associated with a significant change from the pre-WUP operation regime.

Table 9. Core Order Conditions - Changes to Operations.

WUP Order Requirements for JOR (Key Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
3	July-Sep: minimum operating elevation of Diversion Reservoir shall be 376.0 m Oct-Jun: minimum operating elevation of Diversion Reservoir shall be 372.0 m	✓
5	During March for 4+ weekend days: combined maximum discharge from the generating station shall be 30 m3/s between 0600 h and 1800 h.	✓
6	Shall release a minimum flow of 0.25 m3/s into Jordan River at the Elliott Dam outlet	✓

Table 10 depicts other operational or related administrative requirements in the Order.

Table 10. Static and Administrative Facility Operation Requirements.

WUP Order Requirements for JOR (Static Ops Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
4	The licensee shall leave the low level outlet at Bear Creek Reservoir closed	✓
7	Minimum fish flows take operational precedence over reservoir minimum elevations	✓
12	The works may be operated in an alternate manner in the event of an emergency; a dam safety requirement, or an extreme hydrologic event	✓

(ii) Monitoring Studies and Physical Works

Physical works are the one-time modification or addition of infrastructure to facilitate an equivalent operations outcome. Monitoring programs are implemented to confirm the effectiveness or define the impacts of an operation constraint (or the physical work). Once the operation's effectiveness is confirmed (or

refuted), then the monitoring program has met the intent of the WUP and the Order and the ordered condition may be considered complete in the context of the water use planning process.

Table 11 and Table 12 show the monitoring, physical works, and administrative sections of the Order.

Table 11. Monitoring and Physical Works Conditions.

WUP Order Requirements for JOR (Monitoring Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
2	The licensee shall alter the works	✓
9	The licensee shall implement monitoring in accordance with the plan as accepted	✓

Table 12. Order Administrative Conditions.

WUP Order Requirements for JOR (Administrative Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
1	Submit plan for Fish Flow Release Valve	✓
8	The licensee shall submit a monitoring plan	✓
10	The licensee shall provide annual reports to the Comptroller including the following information: a) size and abundance of rainbow trout in lower Jordan River, b) salmonid spawner surveys in Lower Jordan River, c) fish stress indicators in Diversion Reservoir	✓
11	The licensee shall provide annual reports to the Comptroller documenting surfing conditions	✓
13	All emergency operations or other deviations from this order shall be reported to the Comptroller	✓

Appendix E. *LIST OF WUP IMPLEMENTATION DOCUMENTATION AND RECORDS*

Appendix B References refers to discrete documents such as the *Water Use Plan* and *Consultative Committee Report* used extensively in the preparation of this report. Appendix K contains the Annual Water Conveyance Charts submitted to the Comptroller of Water Rights.

Below is a complete list of Jordan River WUP implementation documents found on bchydro.com related to the monitoring programs and physical work. The full URL is: https://www.bchydro.com/about/sustainability/conservation/water_use_planning/vancouver_island/jordan_river.html.

a. Implementation Annual Reports

- December 2012 [PDF, 67 KB]
- December 2011 [PDF, 105 KB]
- December 2010 [PDF, 77 KB]
- December 2009 [PDF, 101 KB]
- December 2008 [PDF, 124 KB]
- December 2007 [PDF, 123 KB]
- December 2006 [PDF, 510 KB]

b. Study Annual Reports and Terms of References

Table 13. Jordan River WUP Study Annual Reports and Terms of References.

PROJECTS	STUDIES	TERMS OF REFERENCE
JORMON-1 lower Jordan River Inflow Monitoring	• April 2013 [PDF, 3.4 MB] • August 2012 [PDF, 2.8 MB] • June 2010 [PDF, 2.8 MB] • May 2009 [PDF, 2.7 MB] • December 2008 [PDF, 3.0 MB] • October 2006 [PDF, 1.7 MB]	• May 2010 [PDF, 10 KB] • November 2007 [PDF, 49 KB] • May 2007 [PDF, 173 KB] • December 2004 [PDF, 288 KB]
JORMON-2 Fish Index: lower Jordan River	• January 2013 [PDF, 5.5 MB] • June 2010 [PDF, 5.6 MB] • July 2009 [PDF, 3.8 MB] • December 2008 [PDF, 7.4 MB] • December 2007	• December 2004 [PDF, 333 KB]

	[PDF, 9.7 MB] • March 2006 [PDF, 1.2 MB]	
JORMON-3 lower Jordan River Salmon Spawning Assessment and Enumeration	• April 2013 [PDF, 1.4 MB] • September 2010 [PDF, 2.0 MB] • February 2010 [PDF 2.3 MB] • March 2009 [PDF, 2.6 MB] • May 2007 [PDF, 3.9 MB] • May 2006 [PDF, 1.0 MB]	• December 2004 [PDF, 271 KB]
JORMON-4 Diversion Reservoir Fish Indexing	• December 2010 [PDF, 1.0 MB] • June 2010 [PDF, 831 KB] • March 2009 [PDF, 582 KB] • January 2008 [PDF, 463 KB] • March 2007 [PDF, 6.4 MB] • January 2006 [PDF, 669 KB]	• December 2004 [PDF, 381 KB]
JORMON-5 Monitoring Surfing Quality Below the Jordan River Generating Station	• October 2013 [PDF, 1.0 MB] • August 2010 [PDF, 1.5 MB] • December 2009 [PDF, 1.0 MB] • December 2008 [PDF, 652 KB] • December 2007 [PDF, 551 KB] • September 2006 [PDF, 398 KB]	• December 2004 [PDF, 376 KB]
JORWORKS-1 Water Release Mechanism	• December 2008 [PDF, 59 KB]	• July 2007 [PDF, 48 KB] • July 2006 [PDF, 164 KB]

Appendix F. *WUP ORDER REVIEW ENGAGEMENT PROCESS PARTICIPANTS*

The following regulatory agencies and key stakeholders were engaged for the Jordan River Water Use Plan Order Review.

- Department of Fisheries and Oceans (Dan Sneep)
- Ministry of Forests, Lands, and Natural Resources (Mike McCullough)
- Ministry of Environment and Climate Change Strategy (Ron Ptolemy)
- Ministry of Environment and Climate Change Strategy (Steve McAdam)

The following First Nations were engaged in the Jordan River Water Use Plan Order Review based on their involvement in the *Water Use Plan* and also based on the Project area (which is determined by the Order issued for the Jordan River System) and the B.C. Provincial Consultative Area Database (CAD):

- Ditidaht First Nation
- Pacheedaht First Nation
- T'Sou-ke First Nation

The following key stakeholders were engaged for the Jordan River Water Use Plan Order Review based on their participation in the Water Use Planning Consultative Committee:

- RD CRD (Mike Hicks)
- Sooke Parks & Recreation (Laura Hooper)
- Victoria Chamber of Commerce (Catherine Holt)
- West Coast Surfing Association

Appendix G. *FIRST NATIONS ENGAGEMENT*

a. Introduction

BC Hydro recognizes that our system has impacts on the lives and interests of First Nations communities. We are committed to working together and to building relationships that respect these interests. Through our Statement of Indigenous Principles, we have made commitments that include:

- We will inform First Nation communities of projects and works as early as possible for discussion;
- We will strive to provide the most clear, accessible, and transparent information possible;
- We will seek advice on First Nations perspectives on how to best reduce or avoid impacts on the environment, cultural heritage, and social needs;
- We will be accessible and open to understanding the unique interests of First Nations communities in relation to our operations;
- We will respect that our perspectives may be based on different world views.
- We will deliver on our commitments and we will be open and transparent if something is standing in the way of our mutual success.

b. First Nations

The following First Nations were engaged based on their involvement in the *Water Use Plan* and also based on the Project area (which is determined by the Order issued for the Jordan River System) and the B.C. Provincial Consultative Area Database (CAD):

- Ditidaht First Nation
- Pacheedaht First Nation
- T'Sou-ke First Nation

c. Engagement Objectives

The objectives of BC Hydro's engagement with First Nations were to:

- Inform identified First Nations of the WUPOR Process
- Ensure the First Nations were proactively informed of the reviews and received clear, concise information in a timely manner to facilitate their appropriate engagement in the WUPOR of the Jordan River System;
- Communicate WUP Order review scope (see Section 1.3 The WUP Order Review Program on page 4):
    - The scope of the WUP Order review was framed by the province's *Water Use Plan Guidelines*.
    - Only those activities or constraints that were ordered by the Comptroller of Water Rights were included.

- WUPOR focused on BC Hydro's facility operations, monitoring, and physical works implemented in lieu of operation changes.
- New issues that may have arisen directly related to facility operations.

- Solicit input from the identified First Nations and consider incorporating that input into the Jordan River *WUPOR Findings Report*, *Environmental Synthesis Report*, draft *WUPOR Report*, and associated work;
- Ensure transparency and accountability in communicating with the identified First Nations; and
- Maintain and build relationships with First Nations in the Jordan River System area.

d. Engagement Activities Summary

A summary of BC Hydro's engagement activities with First Nations is provided in Table 16 below. BC Hydro communicated with the identified First Nations and invited them to review material as it became available. BC Hydro also invited the First Nations to meet to discuss their comments on the various reports and considered incorporation of comments in the reports.

Table 14. First Nation Engagement Summary.

Activities	Activity Duration
Send Project Information and updates a to First Nations through email and mail. (First Information Sheet went out on August 22, 2014)	First Information Sheet went out on August 22, 2014
Responded to First Nations general questions and concerns - phone calls, email	Through-out project
Capacity Funding Agreements	Funding was offered in 2015. Revised funding agreements were sent out in October 2017 with draft reports
Met with First Nations to provide information on WUPOR Jordan River	Meetings held in November and September 2015 with those First Nations who responded to meeting offers
Documented consultation activities	Through-out project
Issued Draft Findings Report and Draft *Environmental Synthesis Report* for comment to First Nations	Version 3 sent April 2016 Final Draft October 2017
Met with First Nations to present the report and discuss its	No meetings were requested

Activities	Activity Duration
contents (if requested)	
Received Issues/Comments from First Nations on ESR	Received comments from Pacheedaht First Nation on ESR, February 2018
Analyzed Issues/Comments from First Nations - issues raised were evaluated individually to determine if additional engagement was needed.	February/March/April 2018 – held three conference calls with Pacheedaht First Nation to discuss comments on ESR.
Provided Draft Water Use Plan Order Review Report to First Nations for comment	Shared draft *WUPOR Report* May 18, 2018
Met with First Nations to present the WUPOR report and discuss its contents (if requested)	Met with T'Sou-ke First Nation in August, 2018
Received Comments from First Nations	Fall 2018 – received comments from Pacheedaht First Nation and T'Sou-ke First Nation on the WUPOR Report

e. First Nation Interests, Concerns, and Responses

BC Hydro met with Pacheedaht First Nation in 2015, early in the review process, to discuss the overall WUP Order Review. BC Hydro received comments from Pacheedaht First Nation on the Draft *Environmental Synthesis Report* and the Draft *Findings Report*. BC Hydro and Pacheedaht First Nation had a conference call on March 16, April 20, and April 25, 2018 to review and discuss Pacheedaht's comments and to review the WUPOR process and next steps. BC Hydro also received comments from Pacheedaht First Nation on the Final *Water Use Plan Order Review Report.* Pacheedaht First Nation's comments and BC Hydro's responses are provided below in Table 17 and 18.

BC Hydro and T'Sou-ke First Nation met on August 17, 2018 to review and discuss the WUPOR Reports and process. BC Hydro received comments from T'Sou-ke First Nation on the Draft *Final Water Use Plan Order Review Report* in the fall of 2018, which included comments on the ESR. T'Sou-ke First Nation's comments and BC Hydro's responses are provided below in Table 19.

BC Hydro did not receive comments back from Ditidaht First Nation on the various reports that were shared.

Table 15. Pacheedaht First Nation Interests & Concerns and BC Hydro Responses on Draft *Environmental Synthesis Report* and Draft *Findings Report*.

Comments Received on Draft Environmental Synthesis Report and Draft Findings Report from Pacheedaht First Nation	BC Hydro Responses
Given all the biological benefits under the current flow release, and the uncertainty and risk of going down to a 0.25 cms flow release, we feel it is important that the current flow release be written into the new Jordan WUP (Elliott Dam Fish Flow Release valve locked fully open), replacing the 0.25 cms release prescribed in the 2003 WUP.	BC Hydro has also concluded that we should continue with the current release, with the clarification that the valve must be operated fully open.[10]
During base flow periods, Elliott is refilled about every 7-14 days by release of water from Diversion Reservoir. PFN is asking that the height and pressure of Elliott head pond be maintained such that the valve delivers the maximum amount of flow to the river. If the valve at Diversion does not allow for a constant release, then cannot the valve at Diversion be opened more often so that the water elevation in Elliott does not drop so low. The ordered minimum (0.25 cms) was based erroneous inflow estimates and an assumption of zero groundwater losses. The request to maintain a higher elevation in Elliott is to provide fish release flows that more closely matches the WUP Weighted Usable Area (WUA) habitat target. The 0.25 release was supposed to provide this WUA but did not due to the above reasons. The current flow release averages 0.324 cms, whereas 0.385 cms is needed to achieve the WUA target. Agreed that ecological benefits have occurred from the current flow release regime, however, additional benefits may occur with an increased flow release. We are particularly interested in potential benefits to	We generally operate Elliot Reservoir as high as reasonably possible as higher head allows for more efficient use of water for power generation. This also helps enhance the fish water discharges to the river downstream of Elliot Dam. We recognize the importance of the of downstream fish habitat and will continue operating Jordan River to support system reliability and optimize power generation and downstream fish habitat. However, there are times when we need to draw on the working storage in the reservoir as Jordan River generation is required as a “must-run” plant to ensure enough electricity to meet demand on Vancouver Island. Additional operation considerations include minimizing spill and operating and maintenance costs on the generating unit. This “must run-working storage” requirement is reflected in the WUP which explicitly notes no operation constraints on Elliot Reservoir and none were ordered by the Comptroller. We have consistently delivered greater flows than the ordered minimum over the entire period of Order implementation; the monitoring studies have shown the expected ecological benefits from these flows and, therefore, the additional flows meet the ecological

[10] Table 15 in the draft Water Use Plan Order Review report (2018) indicated that BC Hydro would provide a recommendation to the CWR. BC Hydro has clarified these statements to reflect that BC Hydro will provide status updates to the CWR for completed items and clarifications or conclusions regarding flows and releases.

Comments Received on Draft Environmental Synthesis Report and Draft Findings Report from Pacheedaht First Nation	BC Hydro Responses
anadromous species. Generation appears to be minimal during July to September so maintaining the head pond height during the month of August and early September is the specific ask to ensure optimal downstream flows during a critical rearing and in migration period in the anadromous fish life stage is the specific request.	intent of the WUP. These additional flows come at a cost to BC Hydro that was not anticipated in the WUP. As the ecological improvements to the lower Jordan River are also valued by BC Hydro, we have also concluded that we should continue to provide these greater flows going forward.
Pacheedaht First Nation will require water access (water supply as defined as a PFN treaty right to water) for the Jordan River Lands, as negotiated within the Treaty Process. The JOR WUP needs to accommodate this requirement at some point in the future.	BC Hydro notes this comment for future reference.

Table 16. Pacheedaht First Nation Interests, Concerns, and BC Hydro Responses on the Final *Water Use Plan Order Review Report*

Comments Received on Water Use Plan Order Review Report from Pacheedaht First Nation	BC Hydro Responses
(It is) critical to convey to the comptroller the current state of biological response to the WUP flows... Hence Pacheedaht is requesting that funding for monitoring annual escapement is included in the WUP order. While BC Hydro's three-year post flow release monitoring study did not observe increases in adult salmon or steelhead escapement to the Jordan River as a result of the delayed natural response timing. Monitoring in subsequent and recent years has found an increase in salmon escapement, both in species diversity and abundances in the Jordan River. This data is housed in the NUSEDS database. In addition, rearing success improved dramatically within the copper affected zone following the flow	The Comptroller ordered a monitoring program to study key uncertainties identified during the WUP consultative process. The monitoring was implemented over the 2005-2011 period to assess the new operation at Elliot Dam (i.e., the minimum flow) and to inform future operating decisions; in specific, to monitor for successful spawning and rearing of anadromous salmonids in the lower Jordan River below the first passage barrier. The monitoring has confirmed the biological response to the new Elliot Dam minimum flow operation: 1) There were no observed increases in adult salmon or Steelhead escapement to the Jordan River. 2) The flow release did not appear to influence incubation success. 3) Rearing success improved within the copper affected zone following the flow release.

Comments Received on Water Use Plan Order Review Report from Pacheedaht First Nation	BC Hydro Responses
release. The long term rebuilding of the Jordan River salmon runs requires further restoration of the critical habitat and the stocks to rebuild viable populations, this is critical to the cultural continuity of the Pacheedaht First Nation at their origin site of Diitida. Hence Pacheedaht maintains that annual escapement work be funded and continued and even more importantly periodic habitat and population assessments be funded and implemented to track the long biological benefits of the habitat improvements to the Jordan River as a result of the WUP flow increases. Pacheedaht maintains that BC Hydro's responsibility to the restoration of the Jordan River after turning off the river flow for 30 plus years fully surpasses the limitations of the available FWCP funding availability and scope.	As BC Hydro has completed the ordered monitoring and confirmed the environmental effects of the new minimum flow release, any further monitoring, such as for habitat and population assessments, is out of scope of the WUPOR Program. The Fish &Wildlife Compensation Program's Jordan River Watershed Action Plan identifies priority actions to conserve and enhance fish and wildlife impacted by BC Hydro dams. Please contact the FWCP to discuss project ideas and funding applications to support the restoration of salmon habitat, recovery of anadromous fish populations, and alignment with FWCP's action plans. Priority actions include opportunities to increase the quantity and quality of salmon spawning and rearing habitat in Lower Jordan River.
BC Hydro should make publically available online real time fish flow release data collected by the flow gauge in the fish release pipe.	BC Hydro does not publish real-time flow release data for specific water conveyance devices. Real-time data may be subject to errors and is quality assured and quality controlled before release. BC Hydro, however, does track and record such data and can provide this QA/QCed information upon request (e.g., annually). For this specific device, its operation is set such that it will release a minimum flow or more at all times. BC Hydro remain assured, at all times, the minimum flow is being met.
Pacheedaht has noted that there has been at least one situation during the WUP where flows have ceased. Pacheedaht is concerned that either a mechanical failure or some sort of a debris plug or other occurrence could possibly result in a situation where fish flow releases cease reducing the flows to pre-WUP conditions resulting in fish mortality in reach two as a result of the increase in copper concentrations. See fig 8 below.	BC Hydro is not aware of a zero flow incident at any time since implementation of ordered operations; none have been recorded from the fish water release valve since it was commissioned on January 30, 2008 (see Appendix K). The January 2008 implementation of the minimum flow was one year later than scheduled under the Jordan River WUP Order monitoring program. The delayed implementation timing did not undermine the study effectiveness, as the comparison of biologic response

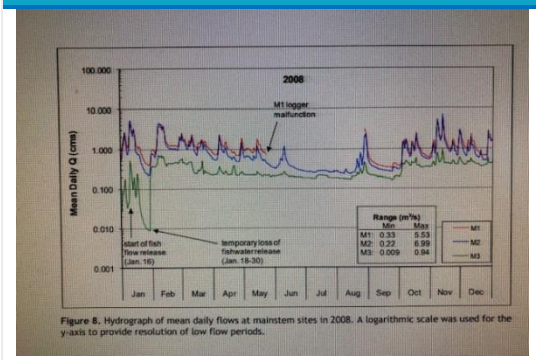
Comments Received on Water Use Plan Order Review Report from Pacheedaht First Nation	BC Hydro Responses
 Figure 8. Hydrograph of mean daily flows at mainstem sites in 2008. A logarithmic scale was used for the y-axis to provide resolution of low flow periods.	using 3 years' prior-/3 years' post-flow implementation still adequately described flow effects.
BC Hydro should have an Environmental Response plan including a communication strategy to respond to the flow cessation which includes having equipment on site to deploy response crews for fish salvage in reach two to reduce overall fish mortality.	While there have been no BC Hydro-related instances where we have not met the minimum flow requirement, BC Hydro does have a system in place to deal with such environmental incidents. BC Hydro's Planning, Scheduling, & Operations Shift Engineers (PSOSE), which monitor system operations 24/7, have an alarm which will trigger if the fish flow release drops below the 0.25 m^3/s ordered minimum. PSOSE will call the local BC Hydro Standby Manager if the alarm triggers. Options available to the Manager may include: checking and repairing the fish water release valve, increasing the release from Diversion Dam to initiate a free crest spill at Elliot Dam, issuing a public communique, and referring the matter to environmental field staff to assess whether fish salvage is effective under current conditions.

Table 17. T'Sou-ke First Nation Interests, Concerns, and BC Hydro Responses on the Final *Water Use Plan Order Review Report*

Comments Received Water Use Plan Order Review Report from T'Sou-ke First Nation	BC Hydro Responses
Remove Condition 1 and Condition 2: works are completed	Yes, works are completed and we are providing this status update to the CWR.[11]
Continue Condition 3: meet seasonal minimum operating levels at the Diversion Reservoir	Agree and we are providing this conclusion to the CWR
Continue Condition 4: leave the low-level outlet at Bear Creek Reservoir closed	Agree and we are providing this conclusion to the CWR
Continue Condition 5: limit maximum discharge from the generating station in March to support surfing conditions	Agree and we are providing this conclusion to the CWR
Continue Condition 6: require the fish flow release valve at the Elliot Dam must be in a full-open position year-round (also recommended by BC Hydro) to achieve a minimum fish flow release of 0.395 m^3/s.	Net flows to the lower Jordan River fluctuate with environmental and operating conditions. Under such variations, we have consistently delivered flows greater than the ordered minimum over the entire period of Order implementation. The monitoring studies have shown the expected ecological benefits from these flows have occurred: the additional flows, as currently delivered, meet the ecological intent of the WUP. Therefore, we are providing the conclusion to the CWR that this operation be continued as is (i.e., fish water release valve operated fully open with the current minimum flow requirement).
Continue Condition 7: minimum fish flow release in Condition 6 will take precedence over the minimum operating elevation in Condition 3 in the event that both cannot be met	Agree and are providing this conclusion to CWR

[11] Table 17 in the draft Water Use Plan Order Review report (2018) indicated that BC Hydro would provide a recommendation to the CWR. BC Hydro has clarified these statements to reflect that BC Hydro will provide status updates to the CWR for completed items and clarifications or conclusions regarding flows and releases.

Continue with Conditions 8, 9 and 10: prepare and implement a new monitoring program to monitor impacts to fish and fish habitat, including ramping.	The Comptroller ordered a monitoring program to study key uncertainties identified during the WUP consultative process. The monitoring was implemented over the 2005-2011 period to assess the new operation at Elliot Dam (i.e., the minimum flow) and to inform future operating decisions. The flow release was successful in providing measureable biological and habitat benefits for resident rainbow trout and provided sufficient dilution of copper in Reach 2 to allow salmonid rearing to occur (Coho and Steelhead can now produce smolts). As BC Hydro has completed the ordered monitoring and confirmed the environmental benefits of the minimum flow release, the WUP-related need for monitoring is complete and new monitoring is considered out of scope of the WUPOR Program.

Initiate and complete studies including environmental and economic analyses by qualified professionals to determine the needs of recovering anadromous fish populations: as stated in the Environmental Synthesis Report, Fish and Wildlife Compensation Program surveys and JORMON-2 results indicate benefits from the implementation of the flow release valve at Elliot Dam. It is further stated that: "*These findings suggest that the needs of anadromous fish may require review in the future Water Use Plan Order Review process"* We agree, in particular as required to successfully implement and support eh Fish and Wildlife Compensation Program Jordan River Restoration Plan. Therefore: A. Assess the economic and operation impacts of maintaining Elliot Head Pond levels so as to maintain fish flow release valve flows of at least 0.395 m^3/s to meet the WUP rearing area and wetted stream length target of 0.41 m^3/s; based on the findings of this work quantify the minimum fish flow release rates through the valve	Jordan River is a "must-run" facility and Elliot Reservoir functions as the headpond for the powerhouse. The Consultative Committee agreed that there should be no operating constraints for Elliott Headpond and none were ordered by the Comptroller. Therefore, it would conflict with the WUP objectives if operation of Elliot headpond were significantly restricted. That said, we generally operate Elliot Reservoir as high as practicable as higher head allows for more efficient use of water for power generation (and greater releases from the fish water release valve). In addition, if the generating units are started at low headpond elevations, there can significant impacts to the power intake (penstock) in the form of debris accumulation, thereby reducing capacity and requiring additional maintenance. However, there are times when we need to draw on the working storage in the reservoir as Jordan River generation is required to ensure enough electricity to meet demand on Vancouver Island. Additional operation considerations include minimizing spill and operating and maintenance costs on the generating unit. We have consistently delivered flows greater than the ordered minimum over the entire period of Order implementation; the monitoring studies have shown the expected ecological benefits from these flows. Therefore, the additional flows meet the ecological intent of the WUP. These additional flows have come, and will continue to come, at a cost to BC Hydro that was not anticipated in the WUP. As the ecological improvements to the lower Jordan River are also valued by BC Hydro, we will provide the conclusion to the Comptroller that we should continue to provide these higher flows going forward. BC Hydro quantifies releases from the fish water release valve. These data are quality controlled annually and are available on request.

B. Identify seasonal maximum discharges from generating station and other required operation parameters needed to support recovery of anadromous fish populations; determine appropriate ramping rates consistent with current federal and provincial government requirements for hydropower facilities	The *Consultative Committee Report* notes there was a suggestion that anadromous fish could be re-introduced back into the Jordan River: this was concluded to be a footprint issue and not an ongoing operational issue. Fish-related issues focused on lower Jordan River base (minimum) flow operations (Elliot Dam discharges). Turbine (Generating Station) impacts focused on recreation (surfing). Data from the ordered monitoring programs related to the change in operations cannot be used define habitat requirements for anadromous fish in the Jordan River. The Fish &Wildlife Compensation Program's Jordan River Watershed Action Plan identifies priority actions to conserve and enhance fish and wildlife impacted by BC Hydro dams. Please contact the FWCP to discuss project ideas and funding applications to support the recovery of anadromous fish populations and alignment with their action plans. Priority actions include opportunities for limiting factors analysis, building on the lower Jordan River Restoration Plan, and high priority species and habitat-based actions.
Adapt Conditions 8, 9 and 10 as required for continuation of JORMAN-3: Reinitiate JORMON-3 Lower Jordan River Salmon Spawning Assessment and Enumeration monitoring program to identify long-term benefits to fish populations in the anadromous reaches of Jordan River from the fish flow release valve. As stated in the Environmental Monitoring Synthesis Report the benefits of the flow release as indicated by an increase in adult fish return would not be anticipated to manifest until at least fall 2010 and post-release snorkel surveys were complete in fall 2008 and fall 2010. While additional surveys were completed as part of the Fish and Wildlife Compensation Program, a targeted monitoring program should be developed to support and quantify benefits.	The Comptroller ordered a monitoring program to study key uncertainties identified during the WUP consultative process. As BC Hydro has completed the ordered monitoring and confirmed the environmental benefits of the ordered incremental change to operations (i.e., the new minimum flow release), new monitoring for a new target species is out of scope of the WUPOR Program. The Fish &Wildlife Compensation Program's Jordan River Watershed Action Plan identifies priority actions to conserve and enhance fish and wildlife impacted by BC Hydro dams. Please contact FWCP to discuss project ideas and funding applications to support the recovery of anadromous fish populations and alignment with their action plans. Priority actions include opportunities for inventories and monitoring and evaluation of FWCP's habitat-based actions.

Remove Condition 11: remove reporting requirements documenting surfing conditions	Yes, reporting is complete and we are providing this status update to CWR
Continue Condition 12: the works may be operated in an alternate manner only in the event of an emergency, a dam safety requirement, or an extreme hydrological event	Agree and are making this recommendation to the CWR
Continue Condition 13: all emergency operations or other deviations from this ordered shall be reported to the Comptroller of Water Rights in a timely manner	Agree, and we are making this recommendation to the CWR
T'Sou-ke Nation requires ongoing access to the Jordan River watershed for traditional uses and water access	BC Hydro has noted this for future reference.
The Comptroller of Water Rights will agree to initiate future reviews and revisions of the Water Use Plan Order and Water Use Plan Order Review upon formal request from T'Sou-ke Nation	BC Hydro has noted this request in the final *Water Use Plan Order Review Report* to be submitted to the CWR.

Appendix H. *AGENCY ENGAGEMENT*

a. Introduction

(i) Objectives

Receive feedback from identified agency representatives regarding the Jordan River *Environmental Synthesis Report* (ESR), and *Findings Report*.

(ii) Agency Identification

In an October 2017 meeting of the Fish Hydro Management Committee, a subcommittee was formed with the purpose of identifying the appropriate regional and provincial agency representatives to review the Jordan *Environmental Synthesis Report* and *Findings Report*. The following agency representatives were engaged:

- Dan Sneep, Department of Fisheries and Oceans
- Ron Ptolemy, Ministry of Environment and Climate Change Strategy
- Mike McCullough, Ministry of Forests, Lands, and Natural Resources
- Steve McAdam, Ministry of Environment and Climate Change Strategy

(iii) Engagement Plan and Activities

Table 18. Agency Engagement Plan and Activities.

Activity	Lead	Timing
Contact agency representatives	Teri Neighbour	Before 2017-Nov-14
Make *Environmental Synthesis Report* (ESR) and *Findings Report* available for review and comment on BCH website	Teri Neighbour	2017-Nov-14
Follow up and respond to any comments on the reports	Teri Neighbour	2018-Jan

b. Engagement

(i) Communication and Engagement Activities and Record

The table below outlines the communication and engagement activities related to request for review and comment by agencies on the Jordan *Environmental Synthesis* and *Findings* reports.

Table 19. Regulatory Agency Communication Activities and Record

Date	Communication Type	Notes	Sent to
14-Nov-17	email	initial notification that draft ERS and findings report are posted; request for review and comment by Jan 13/18	Dan Sneep Ron Ptolemy Mike McCullough Steve McAdam
29-Nov-17	phone call	reminder that ESRs are posted and that comment period ends January 13	Dan Sneep Ron Ptolemy (voice mail) Mike McCullough (voice mail)
05-Dec-17	email from Ron Ptolemy	Indicated that he had reviewed and provided his comments to Mike McCullough. Positive comments regarding Jordan, with no changes or clarifications requested.	Teri Neighbour
09-Jan-18	email	notification that this is final week for comments	Dan Sneep

(ii) Summary of Feedback and Responses

No requests for changes or clarifications were received from agencies regarding the Jordan *Environmental Synthesis* or *Findings Report*s. The complete synthesis of outcomes can be found in Appendix D and the complete *Environmental Synthesis Report* is posted on bchydro.com

Appendix I. *STAKEHOLDER ENGAGEMENT*

a. Introduction

(i) Objectives

Receive feedback from interested stakeholders that were part of the water use planning process regarding Jordan River.

(ii) Key Stakeholder Identification

The following stakeholders were engaged based on their involvement in the *Water Use Plan*:

- Laura Hooper, Sooke Parks & Recreation
- Catherine Holt, Victoria Chamber of Commerce
- Mike Hicks, RD CRD
- West Coast Surfing Association

(iii) Project Purpose

Receive feedback from interested stakeholders regarding Jordan WUPOR.

(iv) Project Background

BC Hydro developed WUPs through a consultative committee process that involved representatives from BC Hydro, regulating agencies, special interest organizations and the First Nations. The Jordan River Consultative Committee concluded its last meeting in November 2005.

(v) Engagement Process

Table 20. Stakeholder Engagement Activity.

Activity	Lead	Timing
Contact consultative committee member organizations	Ted Olynyk	Before 2017-Nov-14
Make WUPOR report available for review and comment on BCH website	Ted Olynyk	2017-Nov-14

b. Engagement

(i) Communication and Engagement Activities and Record

Table 21. Stakeholder Engagement Record.

Activity	Lead	Timing
Contact consultative committee member organizations	Ted Olynyk	Before 2017-Nov-14

Make WUPOR report available for review and comment on BCH website	Ted Olynyk	2017-Nov-14 – 2017-January-13

(ii) Summary of Feedback and Responses

Only comment received on the Environmental Synthesis Report from regulatory agencies or stakeholders was from Jordan River resident and Jordan Watershed Roundtable member, Wayne Jackman.

Table 22. Stakeholder Comments on the *Environmental Synthesis Report*.

Comments received	BC Hydro Response
"strongly support maintaining the Elliott Fishway control valve locked in the full open position… [and maintain reservoir] levels at the top end of its operating range, especially during key salmon spawning times." "In addition, I encourage BC Hydro to recognize the destruction of critical salmon habitat by high-energy water flows discharged directly into the river from the power plant. Restoration of historical salmon spawning habitat will require some effort by BC Hydro to minimize the impact of the current outflow system."	BC Hydro notes these comments for future reference. The reservoir elevation issue is discussed in detail in Appendix G (First Nations Engagement).

Appendix J. *JORDAN RIVER WATER ACT ORDER*

Order source: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/117500-119999/117999/Jordan%20WUP%20order.pdf

Province of British Columbia
Water Act

Order
Water Act
Section 39

File No. 0281532

WHEREAS British Columbia Hydro and Power Authority (BC Hydro) is the operator of the Jordan River hydroelectric system, in respect of which it holds the following 5 licences: FL117999, FL118000, FL118001, FL118004, FL118005; and

WHEREAS the licensee has submitted the Jordan River Project Water Use Plan, which recommends changes to the operations of Jordan River hydroelectric system and which are intended to provide benefits to fisheries and wildlife habitat and recreation; and

WHEREAS I have accepted the Jordan River Project Water Use Plan dated April 30, 2003; and

WHEREAS BC Hydro has proposed a monitoring programme to determine whether operating the facility in accordance with the operating parameters and procedures in the Jordan River Water Use Plan will provide the expected benefits;

I HEREBY ORDER THAT:

1. The licensee shall submit, to the Comptroller of Water Rights, design plans, prepared by a professional engineer registered in British Columbia, for the alteration of works to enable a flow release into Jordan River through Elliott Dam.
2. The licensee shall alter the works in accordance with the approved plans after leave is given in writing by the Comptroller of Water Rights.
3. Between July 1 and September 30 of any year, the minimum operating elevation of Diversion Reservoir shall be 376.0 m, measured at the dam using the Geodetic Survey of Canada (GSC) datum. Between October 1 and June 30 of any year, the minimum operating elevation of Diversion Reservoir shall be 372.0m, measured at the dam using the Geodetic Survey of Canada (GSC) datum.

.....2

23 June 2004

4. The licensee shall leave the low level outlet at Bear Creek Reservoir closed and shall obtain approval of the Comptroller of Water Rights in advance of any draft below 411.0 metres, the full supply level.
5. The licensee shall ensure that, on a minimum of 4 weekend days during the month of March, the combined maximum discharge rate under licences FL117999 and FL118000 shall be 30 cubic metres per second between the hours of 06:00 and 18:00. This maximum discharge rate may be exceeded in emergency situations and the Comptroller of Water Rights shall be notified at the earliest possible convenience in this event;
6. The licensee shall release a minimum flow of 0.25 cubic metres per second into Jordan River at the Elliott Dam outlet (PD31684), at all times, commencing within 2 years of the date of this order (hereinafter referred to as the "commencement date"), the works having been altered as per conditions 1 and 2 above;
7. The minimum release specified in condition 6 above takes precedence over the minimum operating elevation specified in condition 3, in the event that both conditions cannot be met. The licensee shall notify the Comptroller of Water Rights when the reservoir elevation falls below that minimum elevation as a result of this precedence.
8. The licensee shall submit a monitoring plan for acceptance by the Comptroller within three months of the date of this order outlining details of the monitoring proposed, including what is to be measured, the frequency, location and how it is to be reported.
9. The licensee shall implement monitoring in accordance with the plan as accepted under condition 8 above.
10. The licensee shall provide annual reports to the Comptroller beginning one year after the commencement of the monitoring as per the plan accepted in condition 8 above, including the following information:
    a) size and abundance of rainbow trout in lower Jordan River below Elliott dam,
    b) salmonid spawner surveys in Lower Jordan River,
    c) fish stress indicators in Diversion Reservoir in comparison to the inventory measured during the preparation of the Jordan River Water Use Plan.
11. The licensee shall provide annual reports to the Comptroller beginning one year from the effective date of this Order documenting pertinent information regarding surfing conditions during the days outlined in condition 5 above.
12. The licensee may operate the works in an alternate manner in the event of an emergency, a dam safety requirement, or an extreme hydrologic event.
13. All emergency operations or other deviations from this ordered shall be reported to the Comptroller of Water Rights in a timely manner.

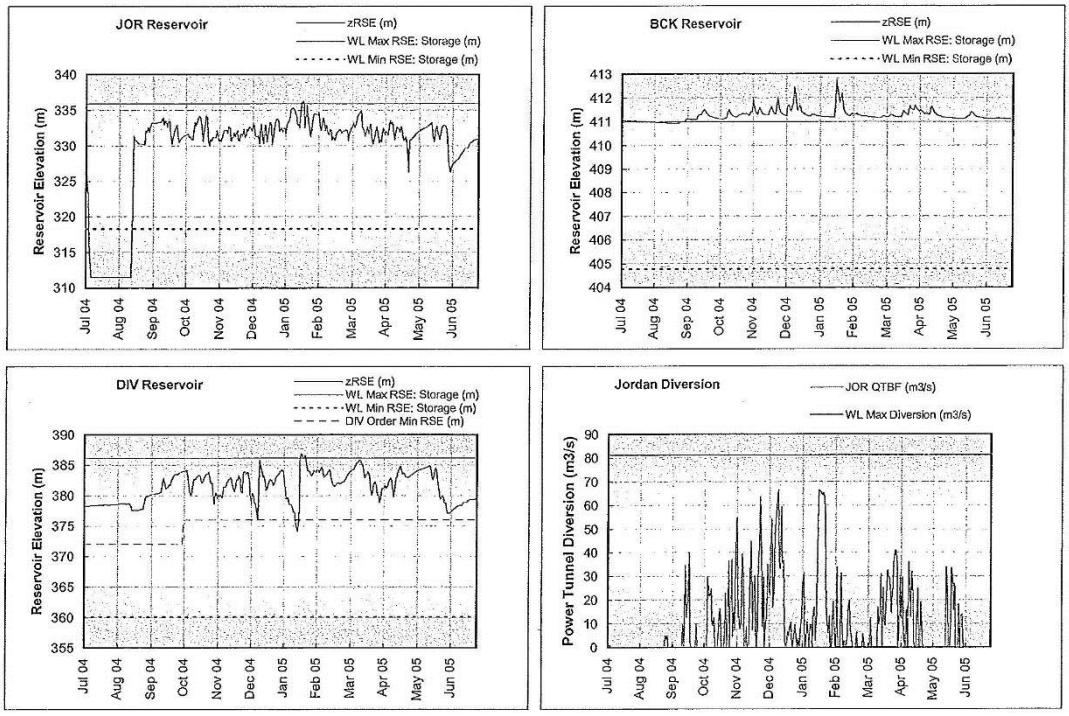
Dated at Victoria, B.C., this 20th day of July, 2004.

Glen Davidson, P. Eng
Deputy Comptroller of Water Rights

Appendix K. *ANNUAL WATER CONVEYANCE CHARTS*

06-01-26 DSherbot (73053)
J:\PS\pso\Staff Folders\Harry B\180 - Operations Planning\200 - General\12 - Water License Compliance Project JT\[CWR Conveyance Compliance Charts Jan 05 V2 (HEB Feb 13 2006).xls]JOR Plot

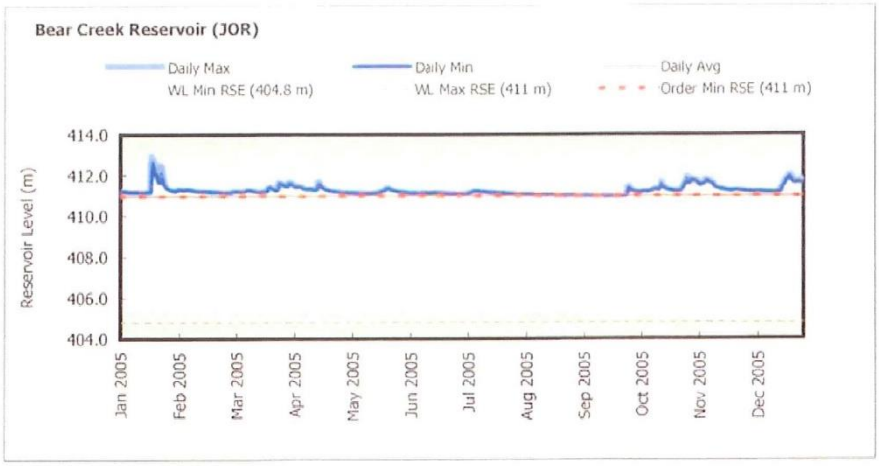
PROJECT: **JORDAN RIVER**
REPORTING PERIOD START: Jan 05
REPORTING PERIOD END: Jun 05

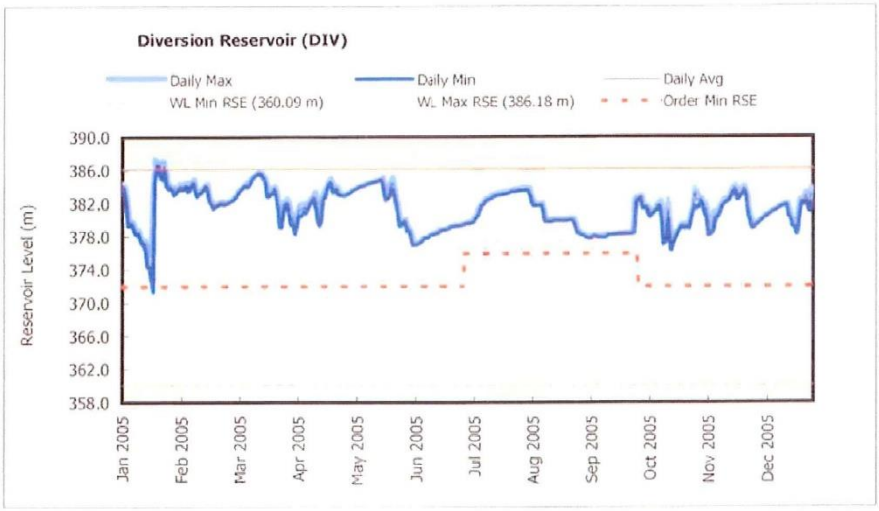


NOTES:
All values reported as daily averages.
JOR Reservoir: Maximum storage elevation controlled by freespill weir at 335.89 m.
BCK Reservoir: Maximum storage elevation controlled by freespill weir at 411.0 m.
DIV Reservoir: Maximum storage elevation controlled by freespill weir at 386.18 m.
Minimum fish flow from Elliot Dam not required until July 20, 2006.
DIV Reservoir: Minimum storage diversion Jan 16, 2005 associated with preparing for storm inflows

JOR

JORDAN RIVER PROJECT

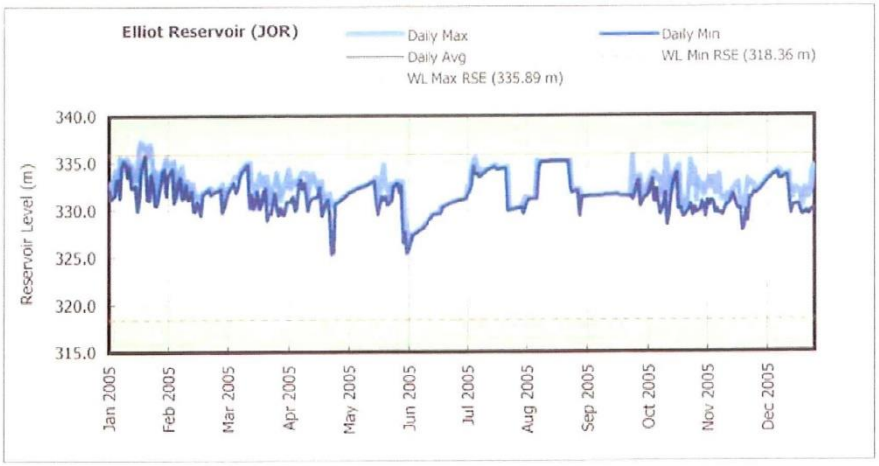


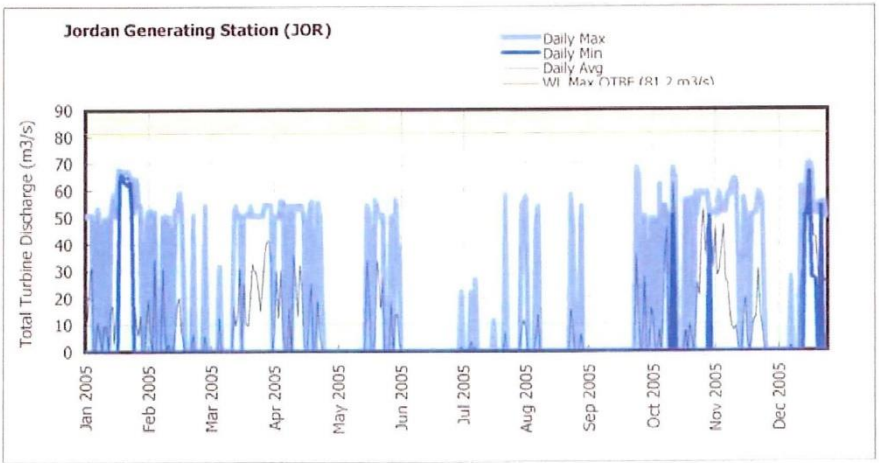


NOTES:
Values reported as daily average, daily maximum, and daily minimum.
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period July 1 to Dec 31, 2005.

Page 1 of 3

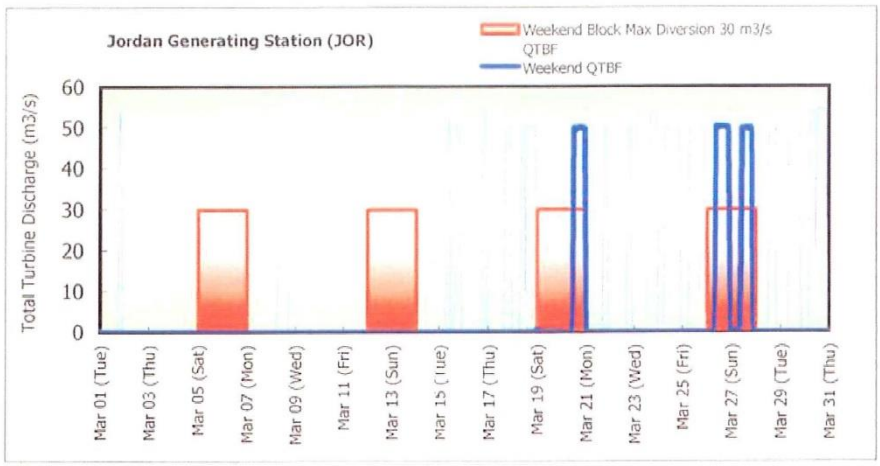
JOR





NOTES:
Values reported as daily average, daily maximum, and daily minimum.
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There are no reportable exceptions for the period July 1 to Dec 31, 2005.

JOR



NOTES:
Values reported as hourly average discharge.
Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.
Generation was curtailed for > 5 weekend days during March.
There are no reportable exceptions for the period July 1 to Dec 31, 2005.

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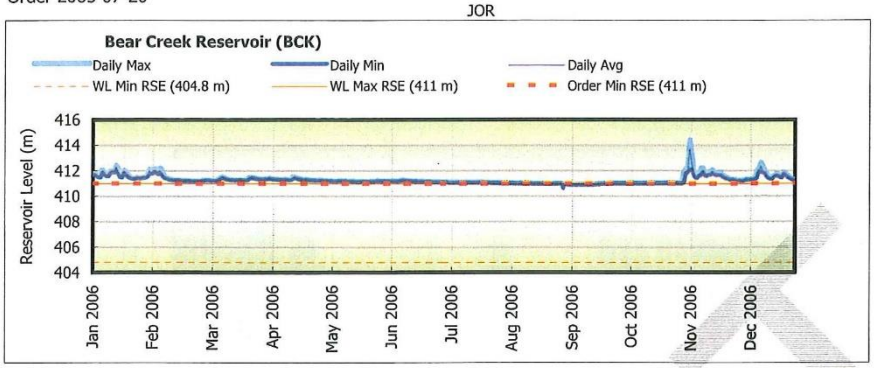
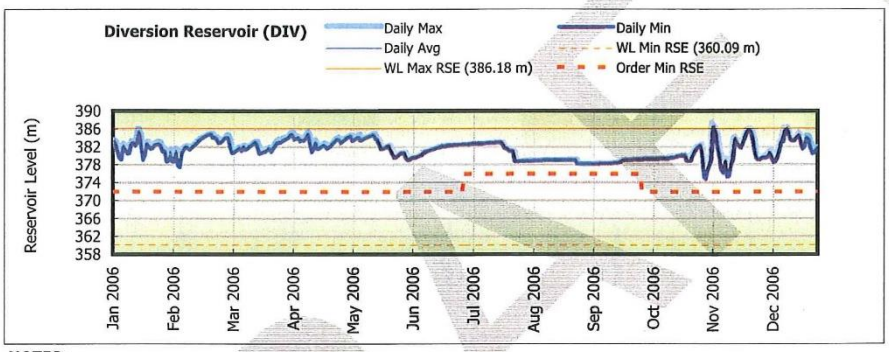
JORDAN RIVER PROJECT
Order 2005-07-20

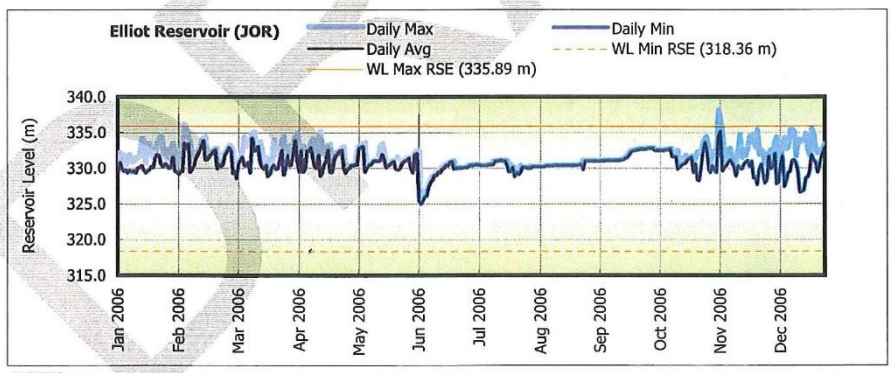
JOR



NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2006

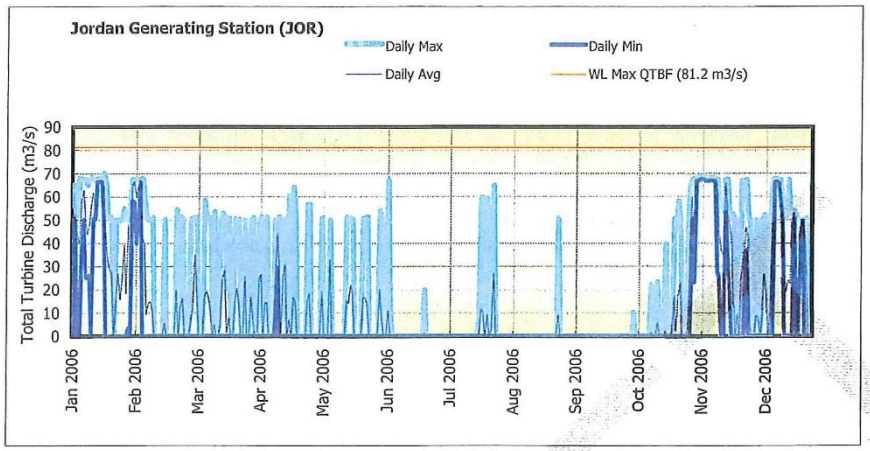


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2006



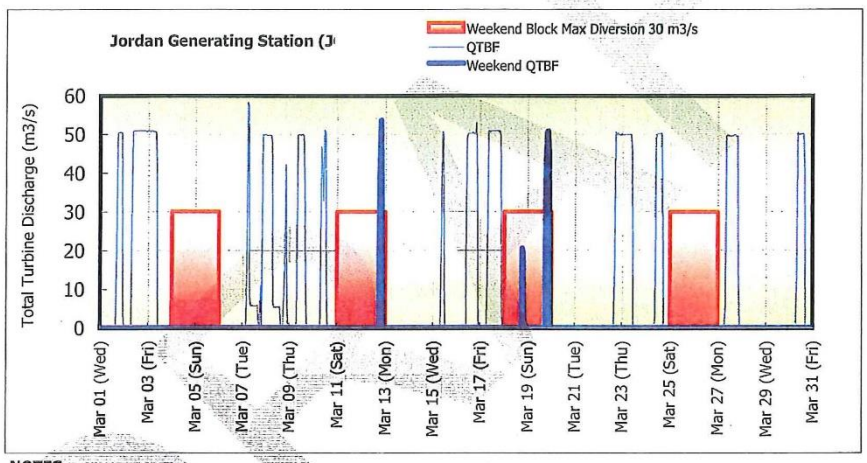
NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2006

JOR



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2006



NOTES:

Values reported as hourly average discharge.

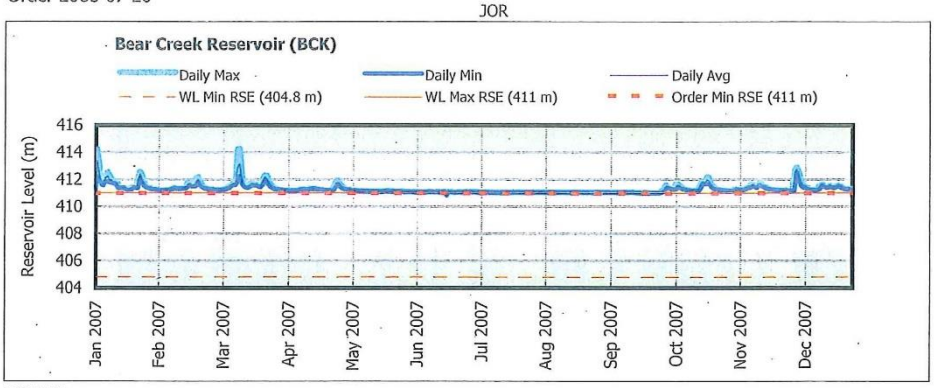
Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.

Generation was curtailed for > 6 weekend days during March.

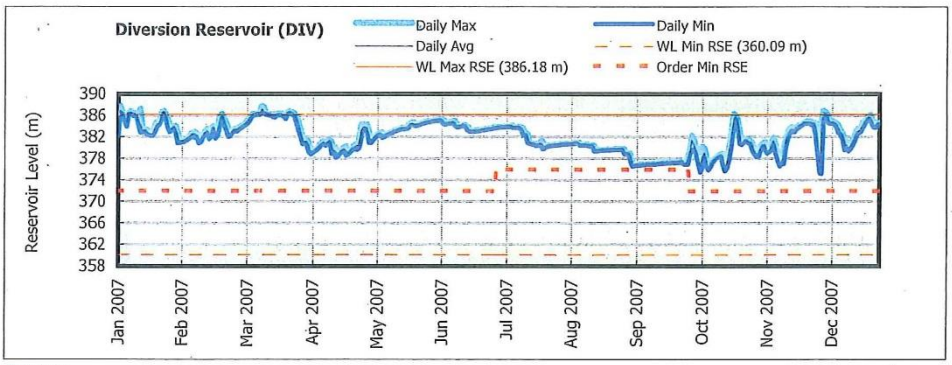
There are no reportable exceptions for the period Jan 1 to Dec 31, 2006

JORDAN RIVER PROJECT
Order 2005-07-20

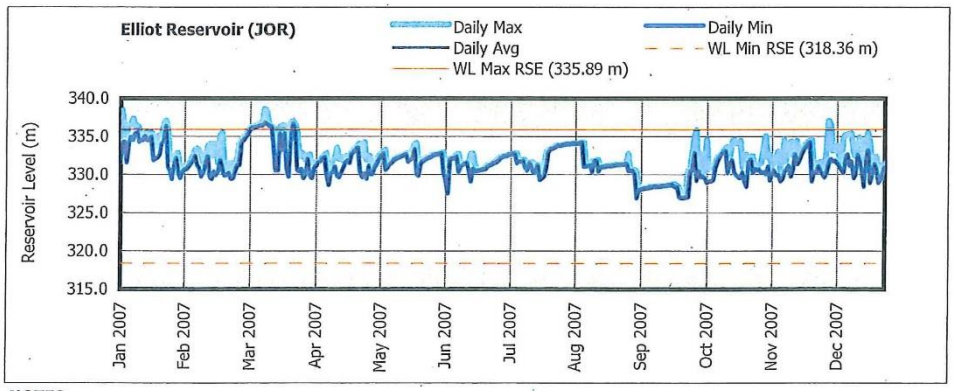
JOR



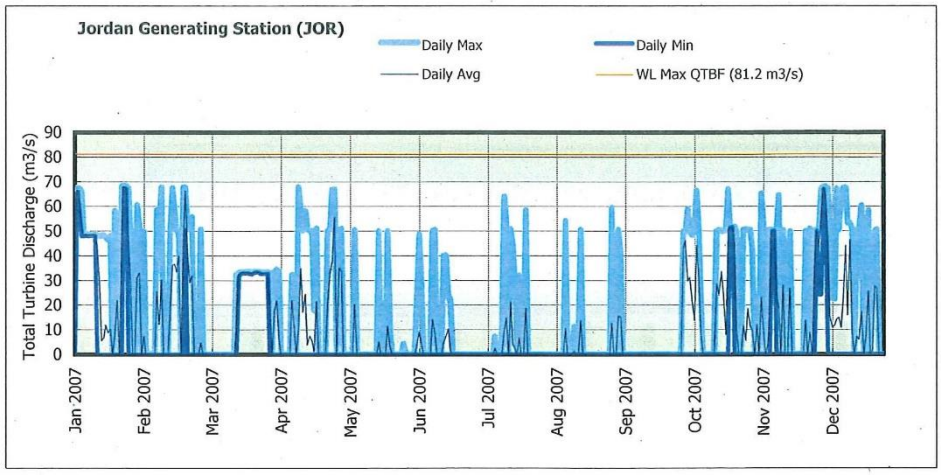
NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.



NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.

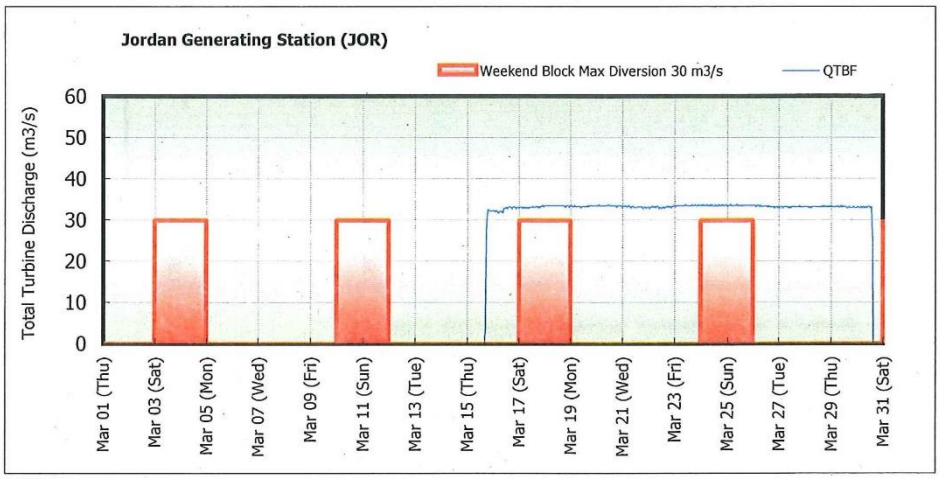


NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.



NOTES:

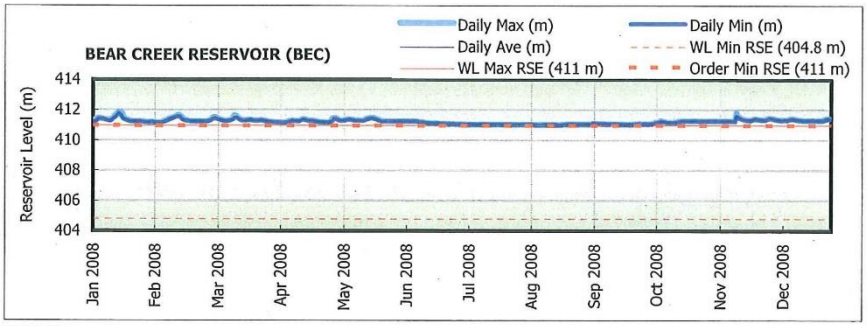
Values reported as hourly average discharge.

Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.

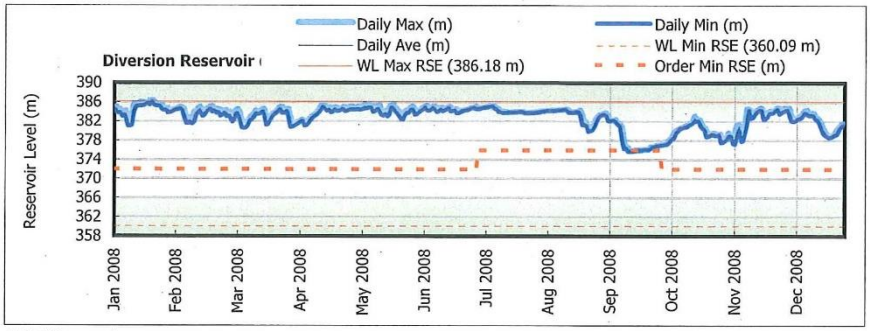
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007

JORDAN RIVER PROJECT
Order 2005-07-20

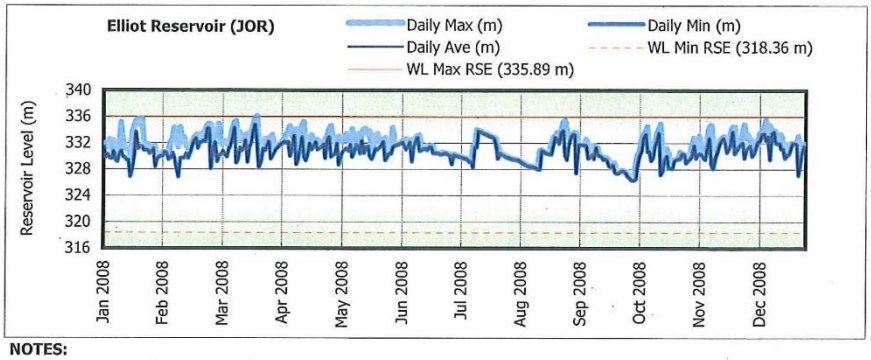
JOR DIV BEC



NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.

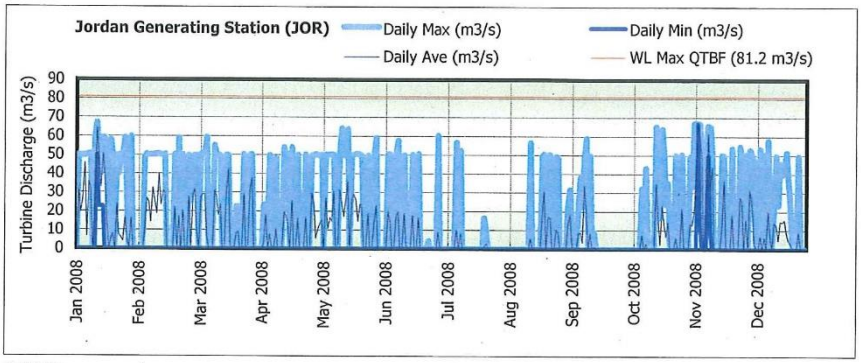


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
Reservoir drafted below minimum Order limit of 376.0 m to 375.5 m 14 Sep to 19 Sep 2008. CWR Notified 15 Sep 2008. EIR FISH2008091501.

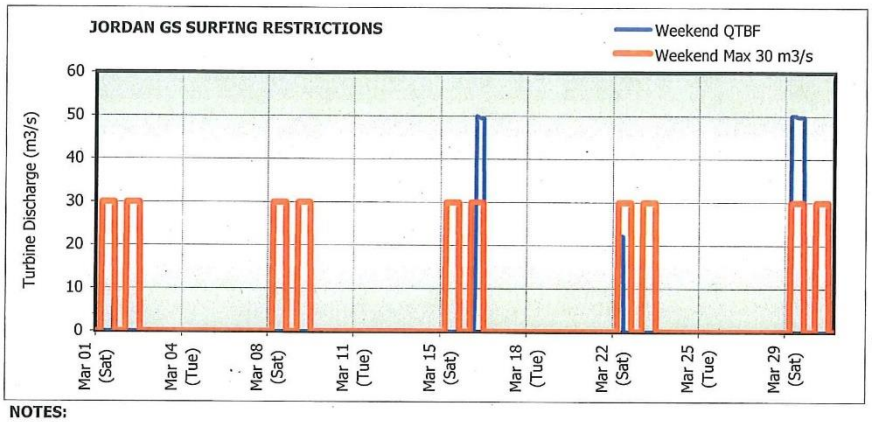


NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.

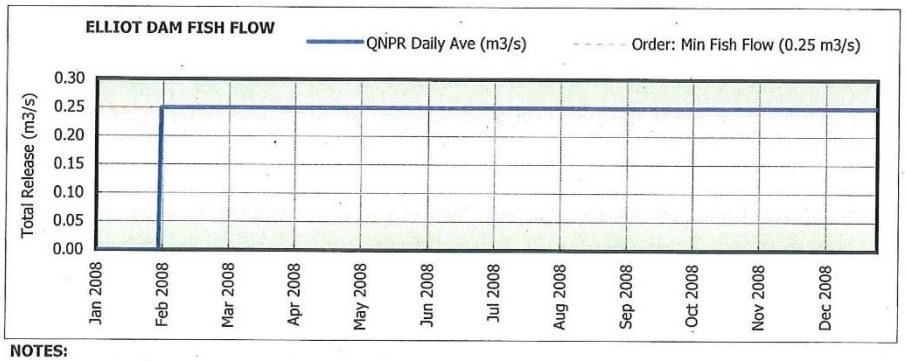
JOR DIV BEC



NOTES:
Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.



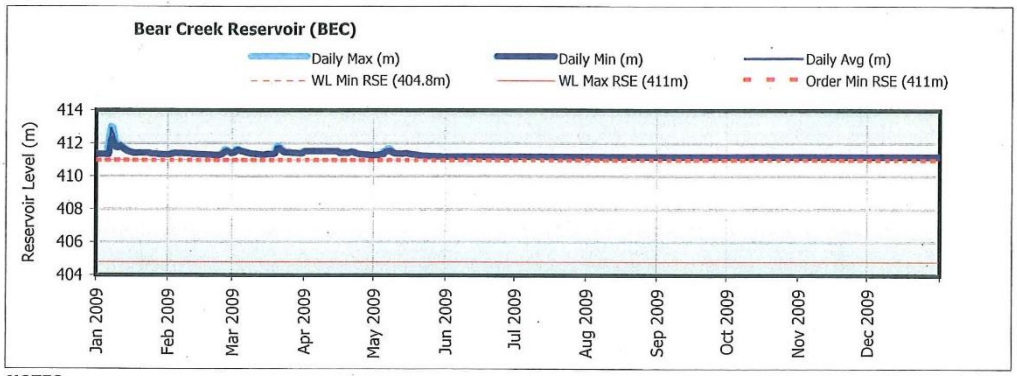
NOTES:
Values reported as hourly average discharge.
Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.
Only turbine discharge during the restricted period is plotted. Restriction met for 7 weekend days.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.



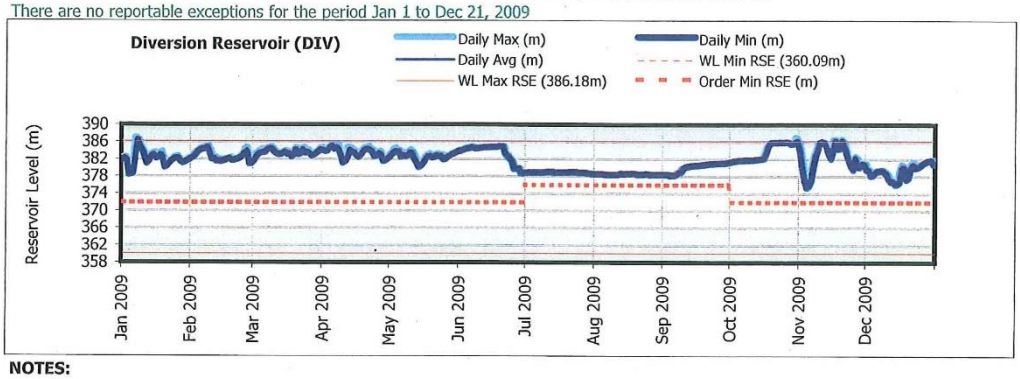
NOTES:
Discharge regulated by design: FWRV will release 0.25 m3/s or more at all times.
The fish release valve at Elliot Dam was commissioned on Jan 31 2008 which has been providing a minimum 0.25cms since then.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.

JORDAN RIVER PROJECT
Order 2005-07-20

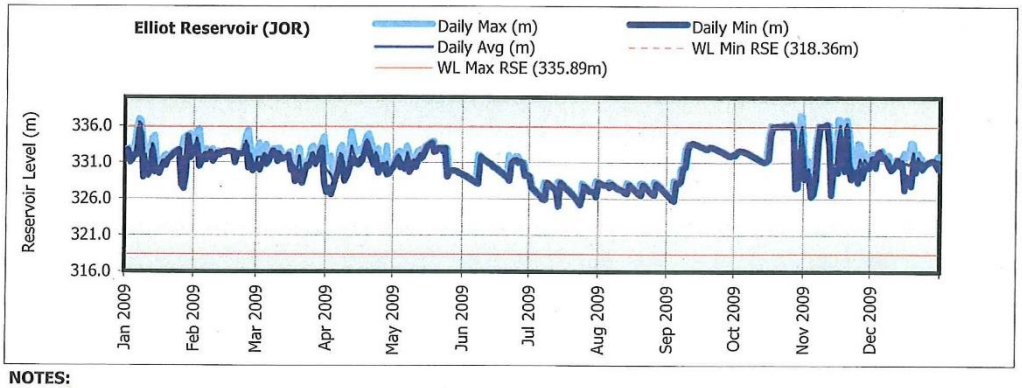
JOR DIV BEC Charts



NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 21, 2009

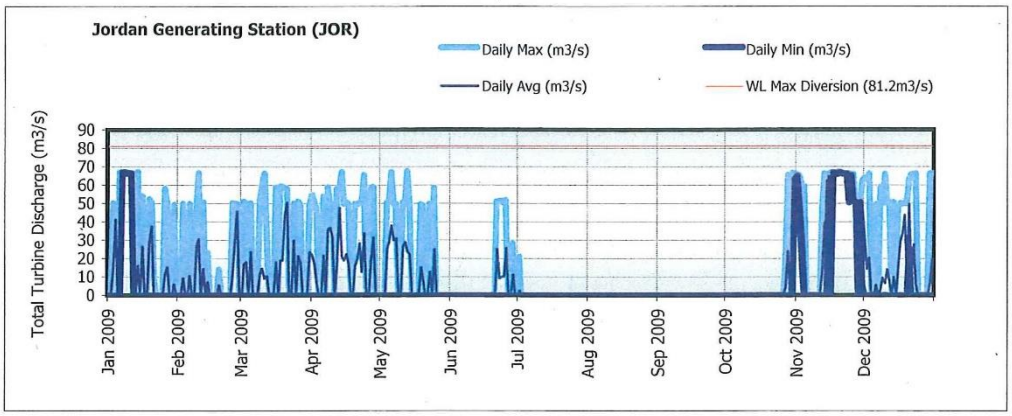


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2009



NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2009

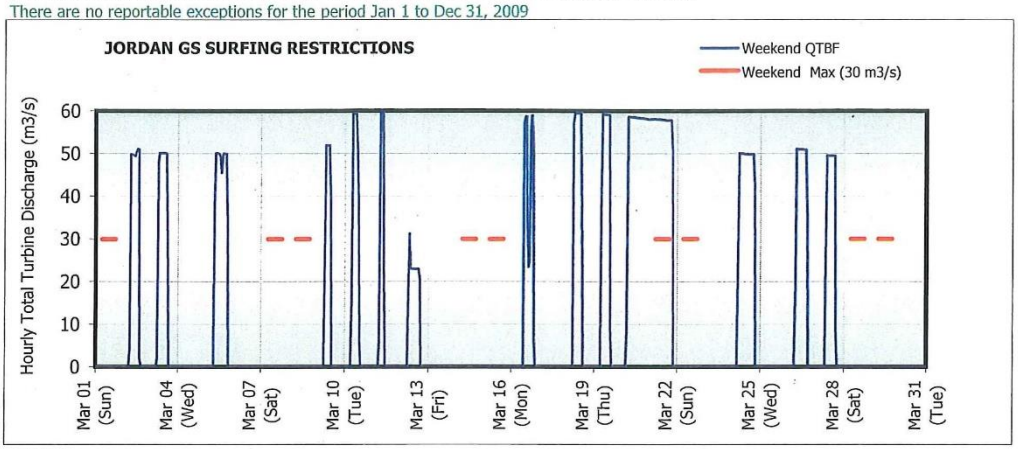
JOR DIV BEC Charts



NOTES:

Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s

There are no reportable exceptions for the period Jan 1 to Dec 31, 2009



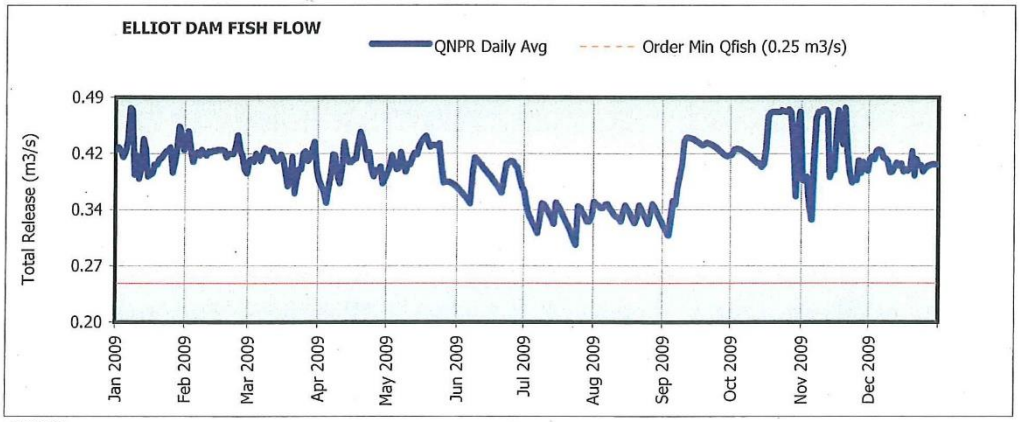
NOTES:

Values reported as hourly average discharge.

Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.

Only turbine discharge during the restricted period is plotted. Restriction met for 8 weekend days.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2009



NOTES:

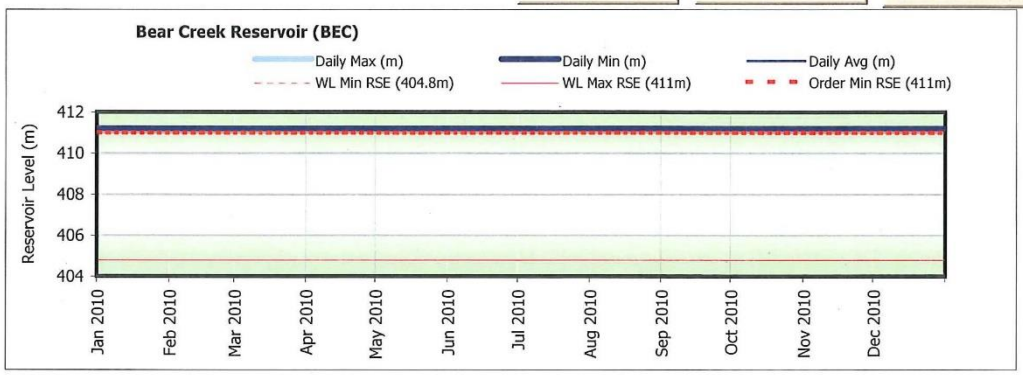
Discharge regulated by design: FWRV will release 0.25m3/s or more at all times.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2009

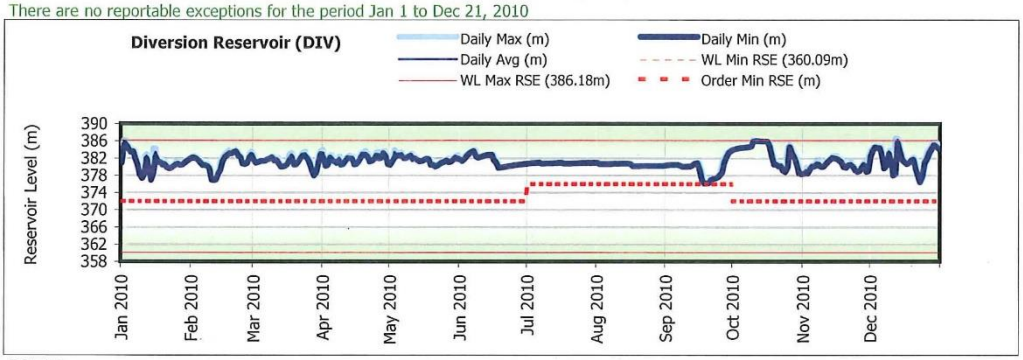
JORDAN RIVER PROJECT
Order 2005-07-20

JOR DIV BEC Charts

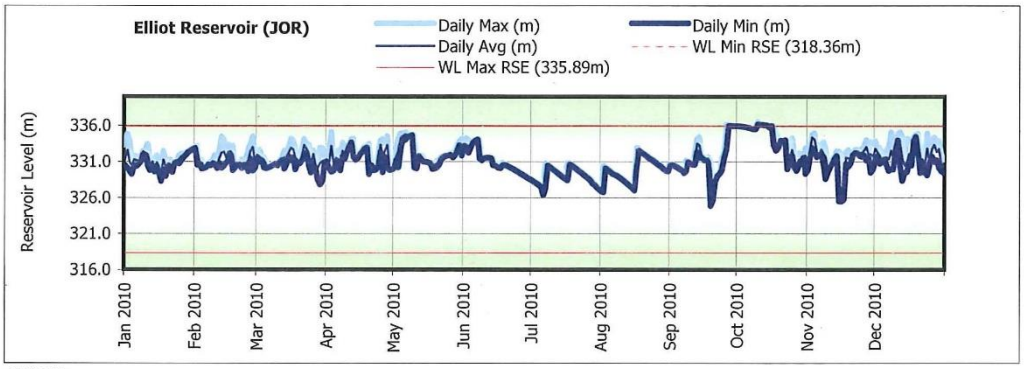
Go to JOR Data | Go to DIV Data | Go to BEC Data



NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 21, 2010

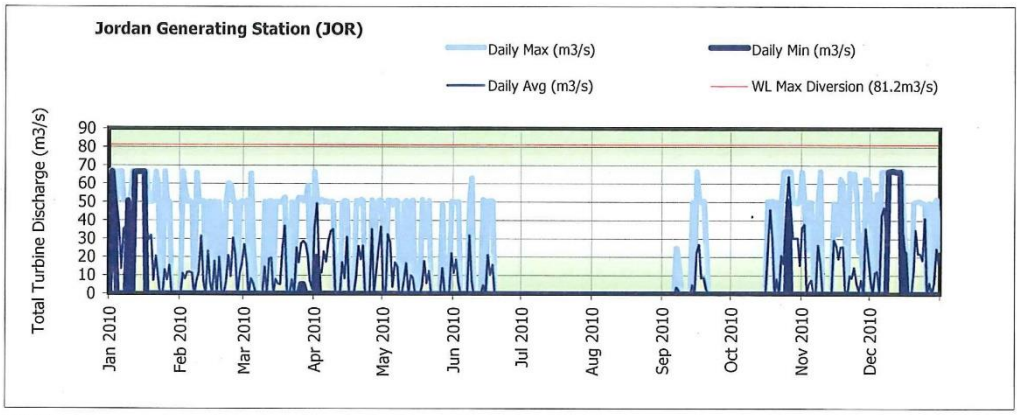


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2010



NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
Auto control system for Fishwater Rlease Valve commissioned on 3 Nov 2010. CWR notified 26 Oct 2010.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2010

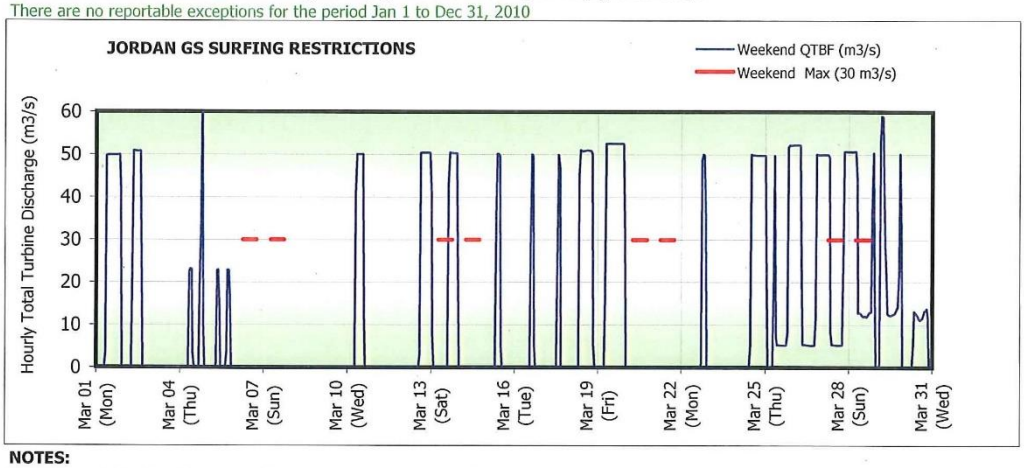
JOR DIV BEC Charts



NOTES:

Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s

There are no reportable exceptions for the period Jan 1 to Dec 31, 2010



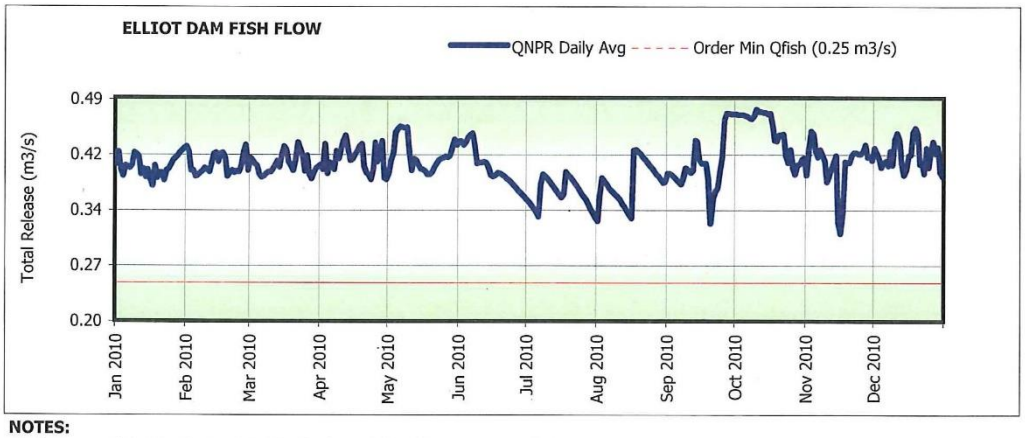
NOTES:

Values reported as hourly average discharge.

Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.

Only turbine discharge during the restricted period is plotted. Restriction met for 7 weekend days.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2010



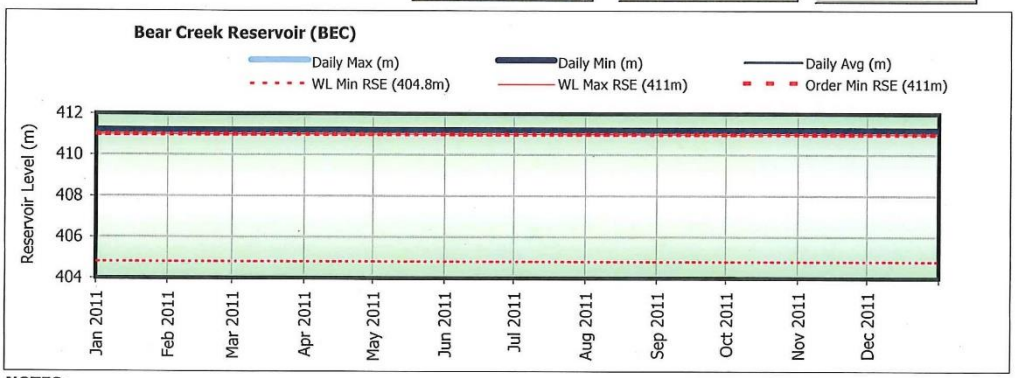
NOTES:

Discharge regulated by design: FWRV will release 0.25m3/s or more at all times.

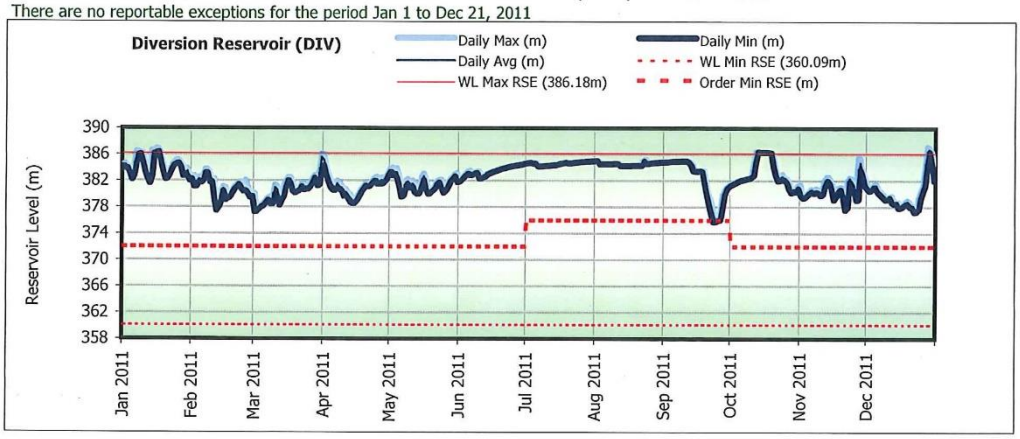
There are no reportable exceptions for the period Jan 1 to Dec 31, 2010

JORDAN RIVER PROJECT
Order 2005-07-20

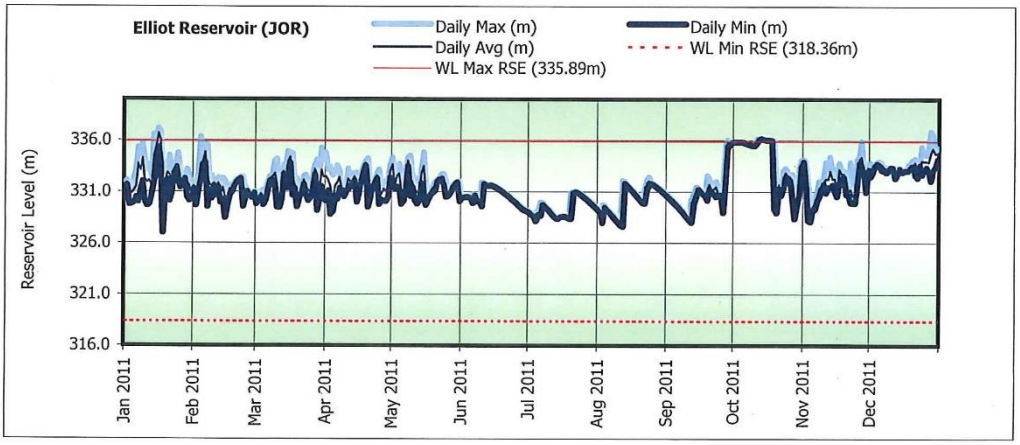
Go to BEC Data | Go to DIV Data | Go to JOR Data



NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 21, 2011

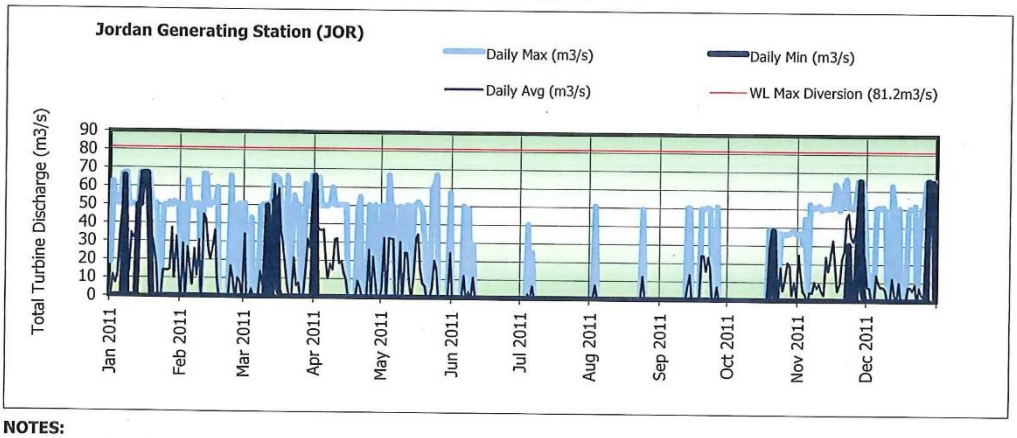


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2011

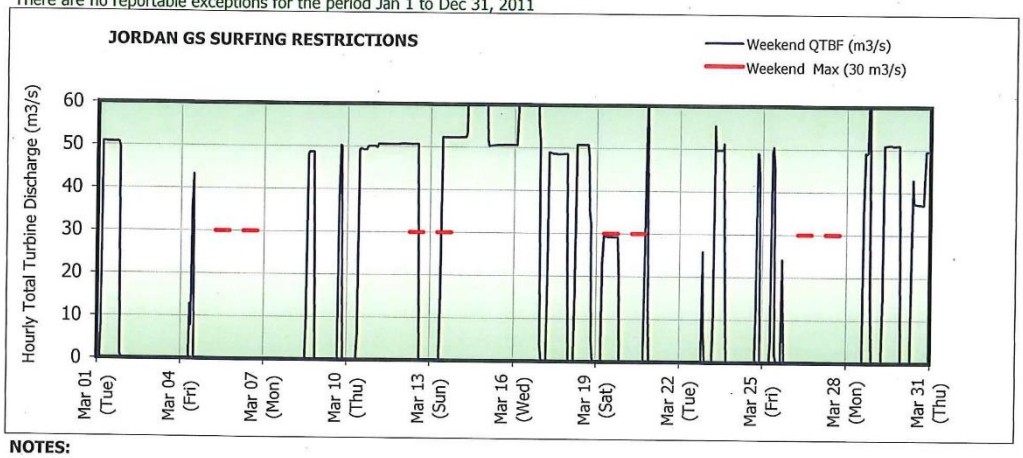


NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2011

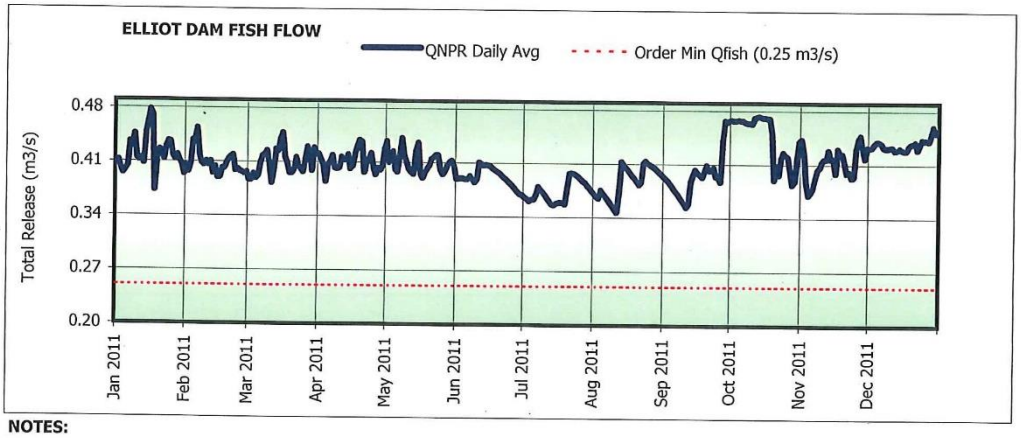
JOR DIV BEC Charts



NOTES:
Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s
There are no reportable exceptions for the period Jan 1 to Dec 31, 2011



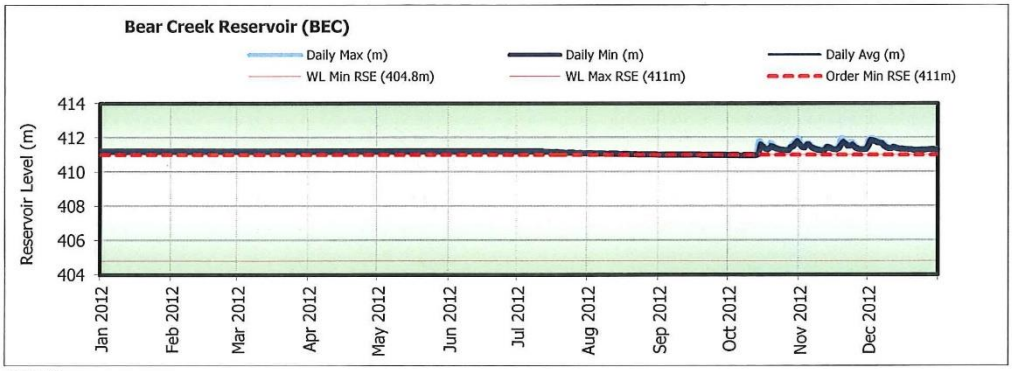
NOTES:
Values reported as hourly average discharge.
Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.
Only turbine discharge during the restricted period is plotted. Restriction met for 8 weekend days.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2011



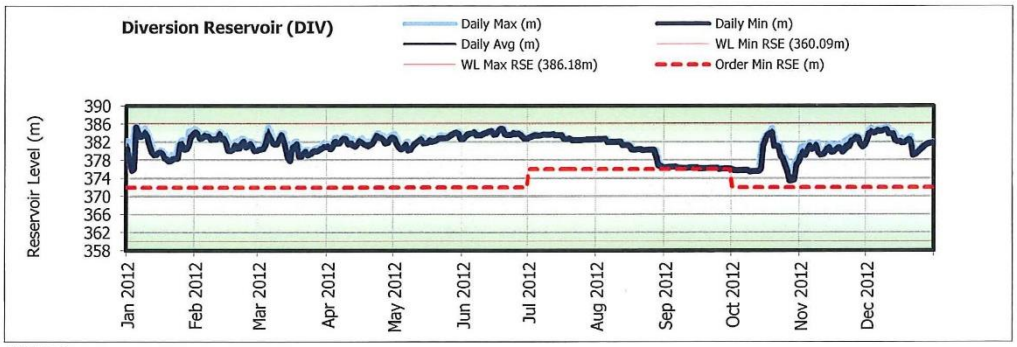
NOTES:
Discharge regulated by design: FWRV will release 0.25m3/s or more at all times.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2011

JORDAN RIVER PROJECT
Order July 20, 2005

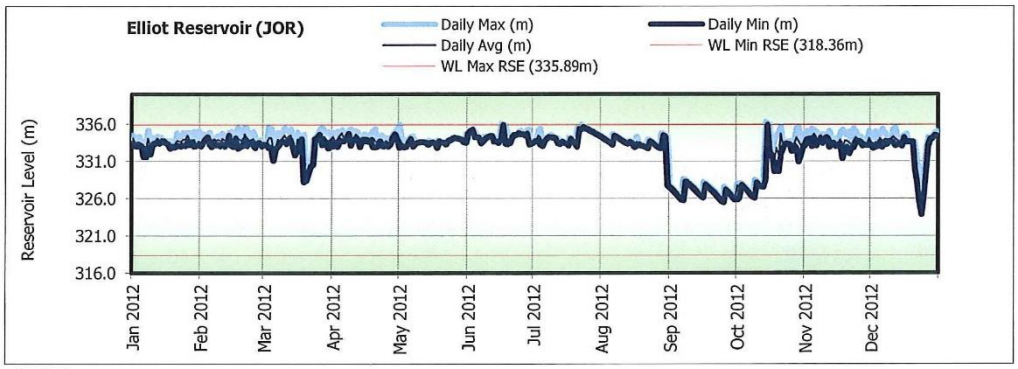
Go to BEC Data | Go to DIV Data | Go to JOR Data



NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
New reservoir level gauge installed July 13, 2012
17-Sep-12 Reservoir drafted below 411.0 m due to insufficient inflow. CWR notified Sept 26, 2012.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2012

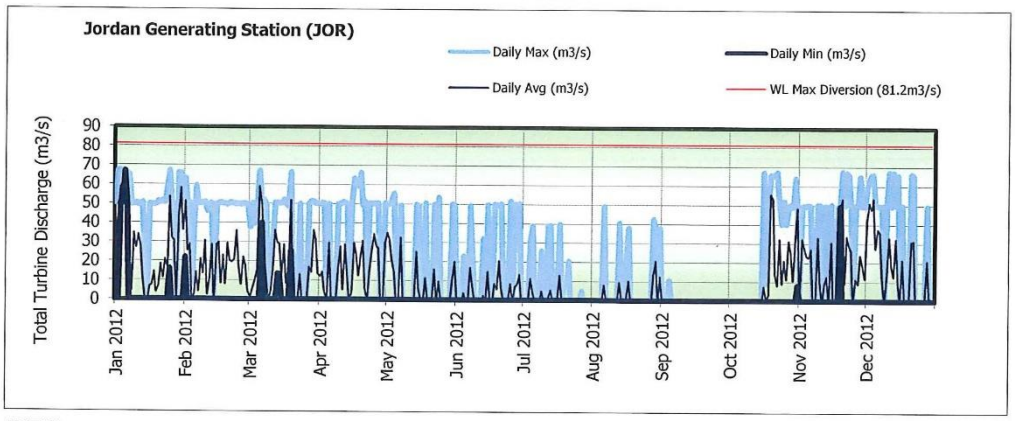


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2012

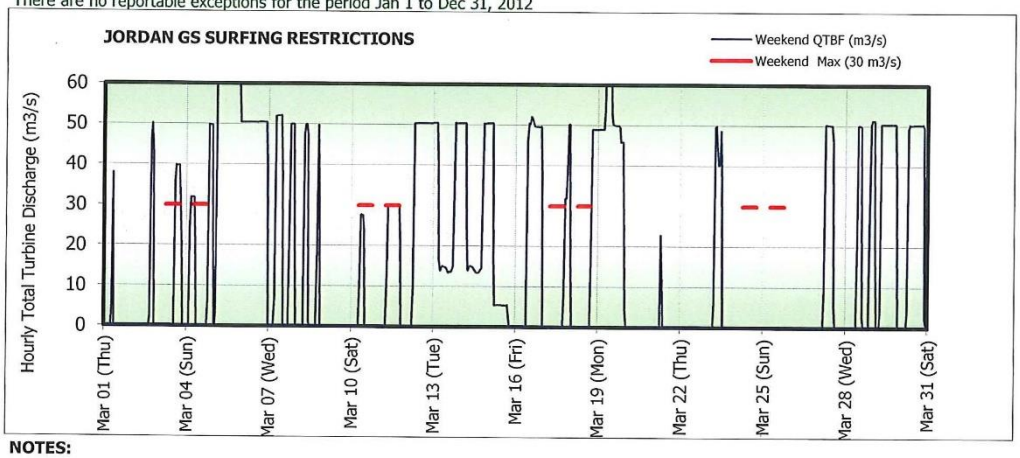


NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2012

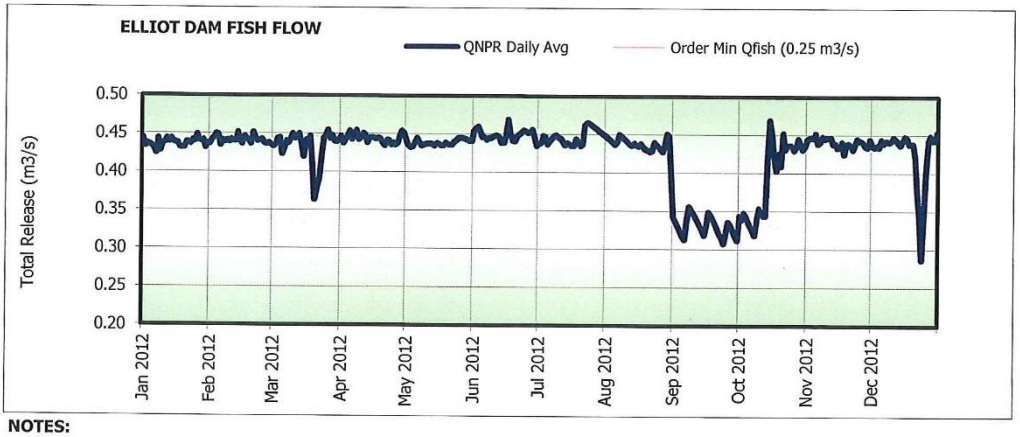
JOR DIV BEC Charts



NOTES:
Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s
There are no reportable exceptions for the period Jan 1 to Dec 31, 2012



NOTES:
Values reported as hourly average discharge.
Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.
Only turbine discharge during the restricted period is plotted. Restriction met for 8 weekend days.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2012



NOTES:
Discharge regulated by design: FWRV will release 0.25m3/s or more at all times.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2012

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JOR DIV BEC Charts

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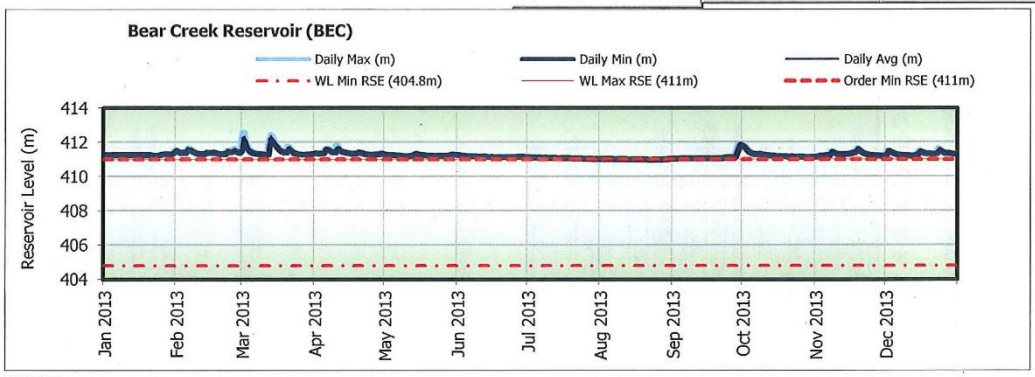
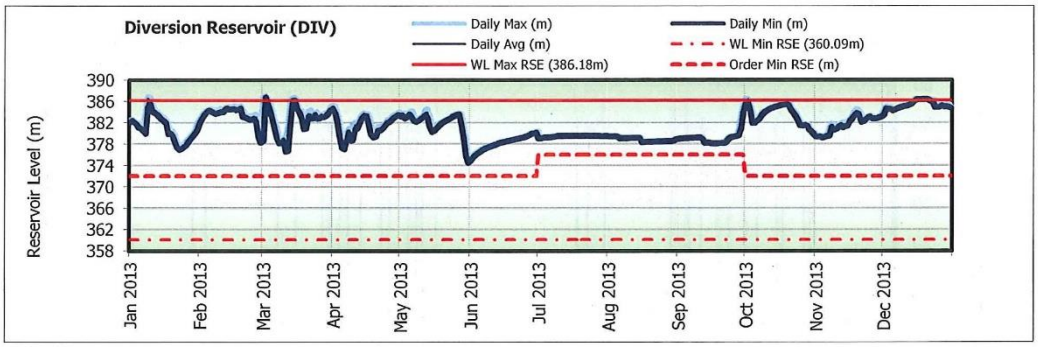
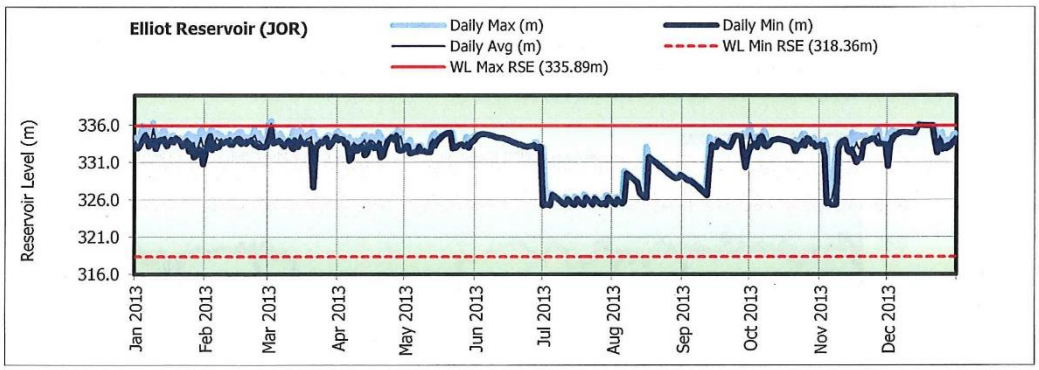


NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 21, 2013

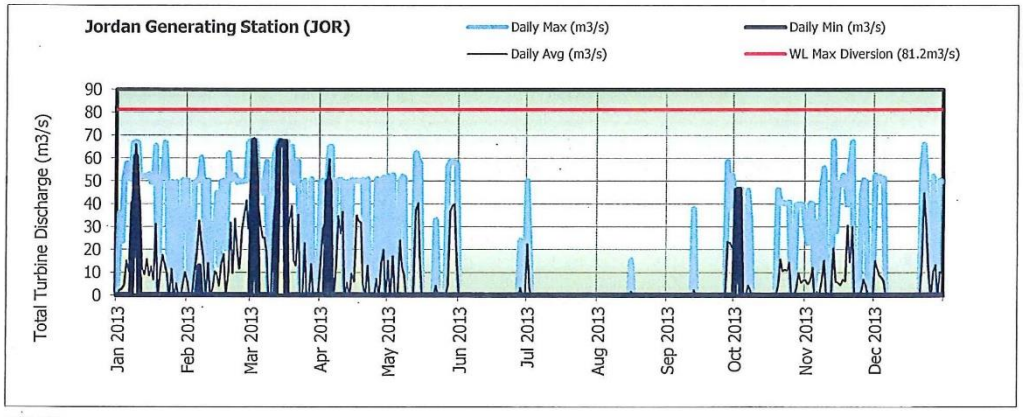


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2013

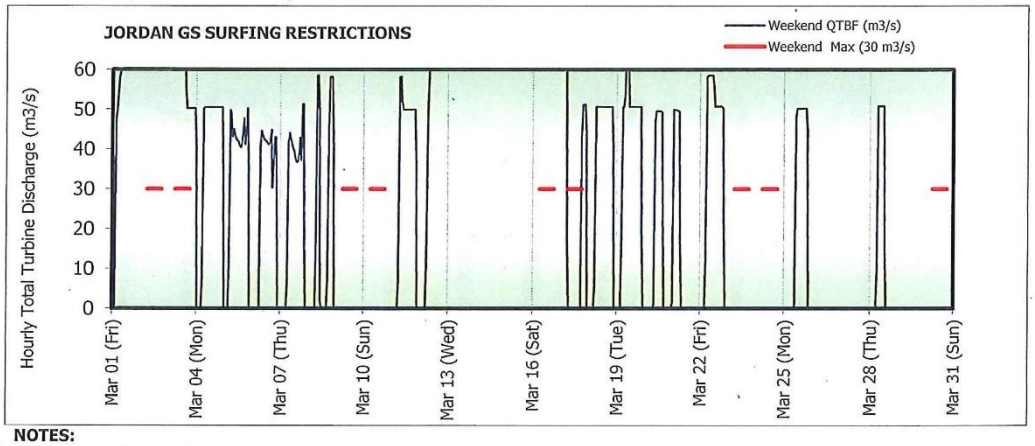


NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2013

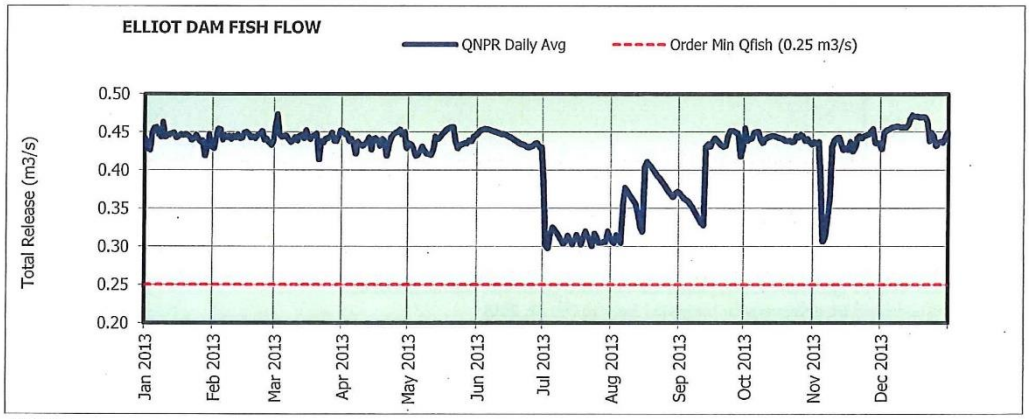
JOR DIV BEC Charts



NOTES:
Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s
There are no reportable exceptions for the period Jan 1 to Dec 31, 2013



NOTES:
Values reported as hourly average discharge.
Requirement to limit generation to less than 30 m3/s for 4 weekend days in March between 06:00 and 18:00 hrs.
Only turbine discharge during the restricted period is plotted. Restriction met for 8 weekend days.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2013



NOTES:
Discharge regulated by design: FWRV will release 0.25m3/s or more at all times.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2013

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JOR DIV BEC Charts

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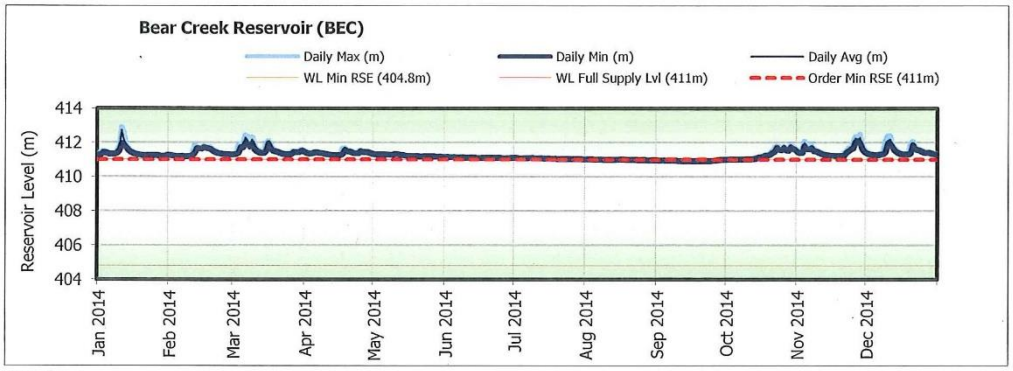
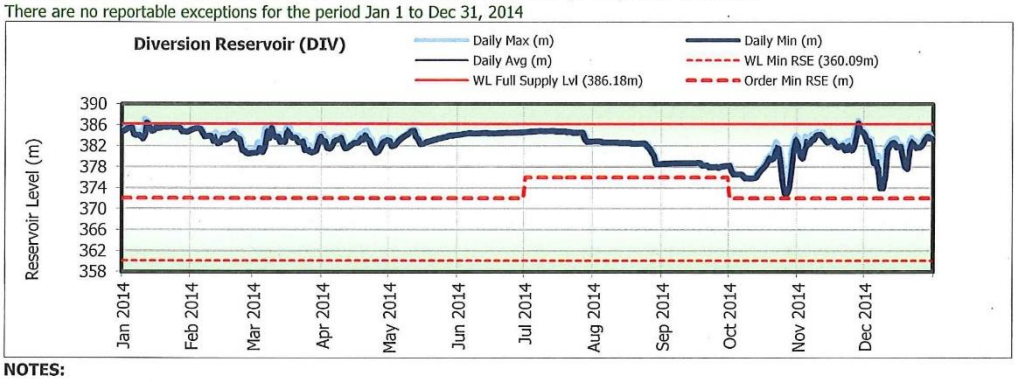
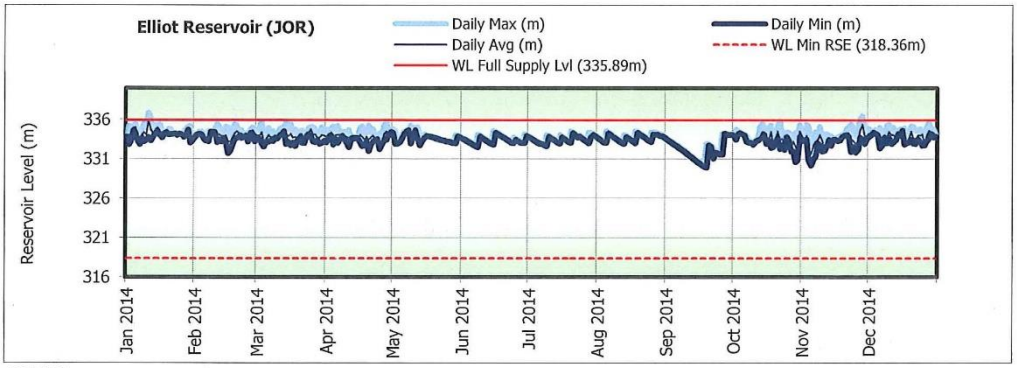


NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2014

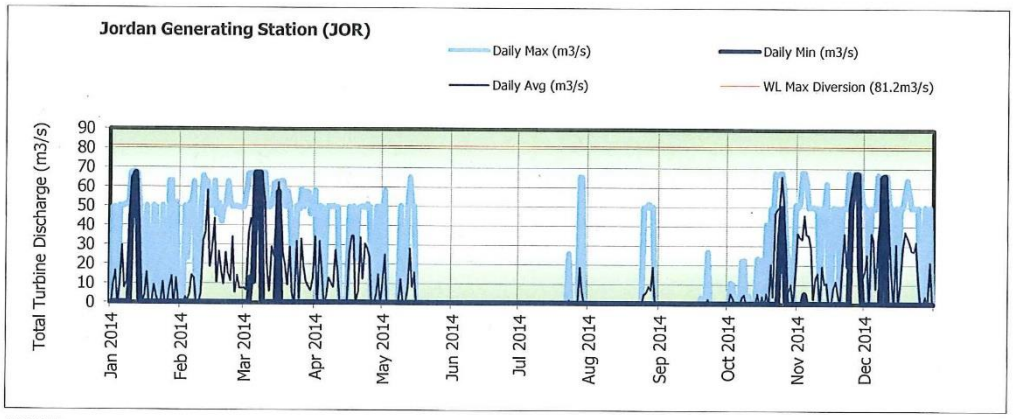


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2014



NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2014

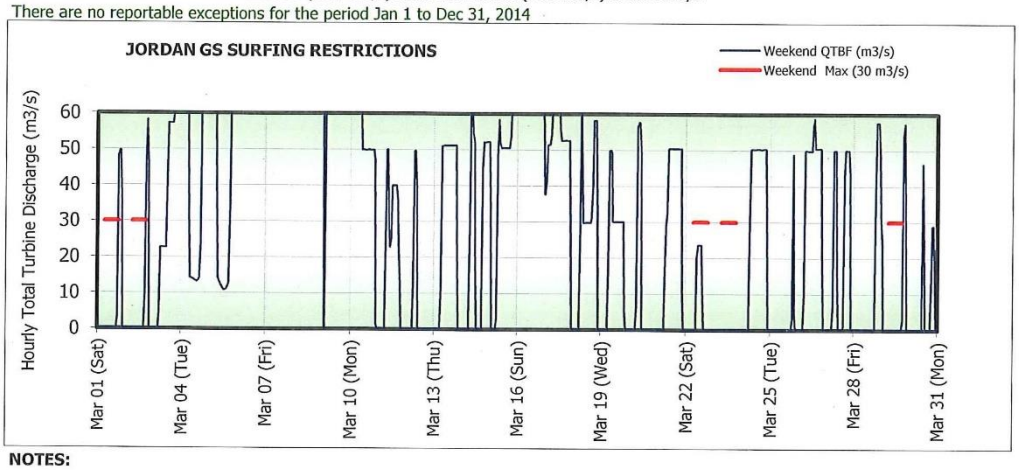
JOR DIV BEC Charts



NOTES:

Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s

There are no reportable exceptions for the period Jan 1 to Dec 31, 2014



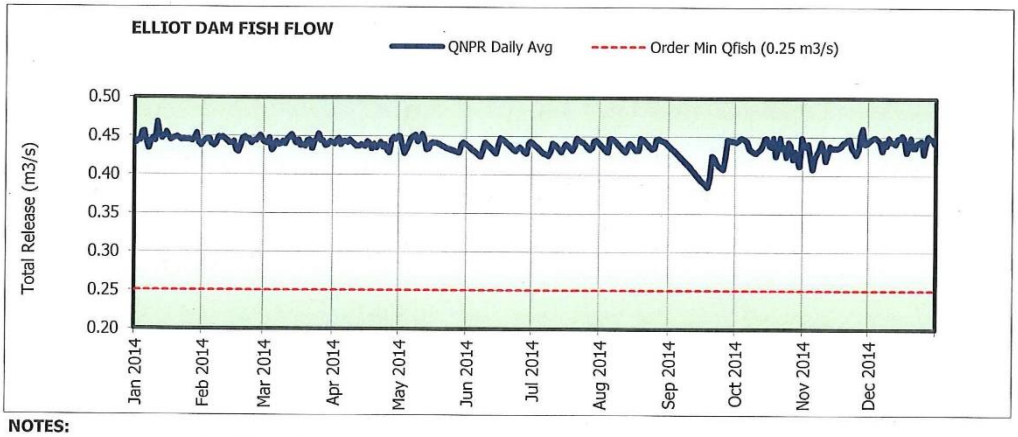
NOTES:

Values reported as hourly average discharge.

Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.

Only turbine discharge during the restricted period is plotted. Restriction met for 5 weekend days.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2014



NOTES:

Discharge regulated by design: FWRV will release 0.25m3/s or more at all times.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2014

JOR DIV BEC Charts

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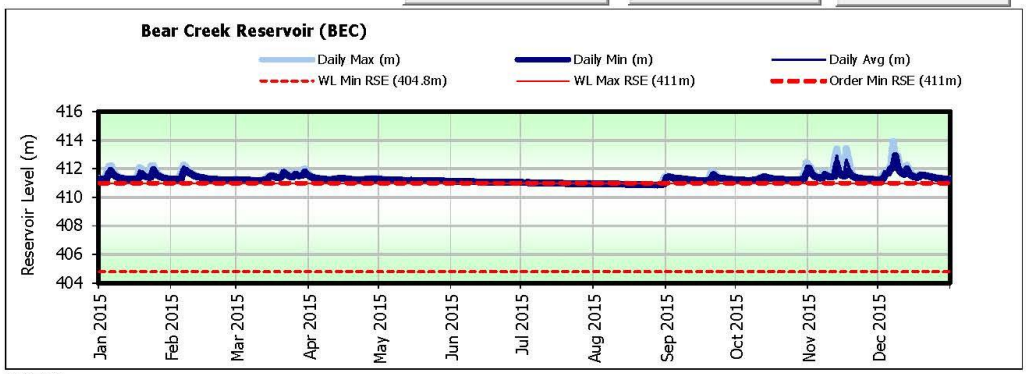
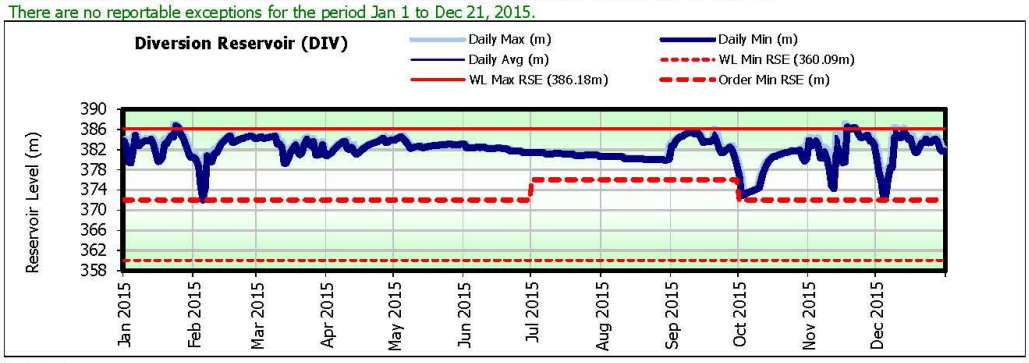
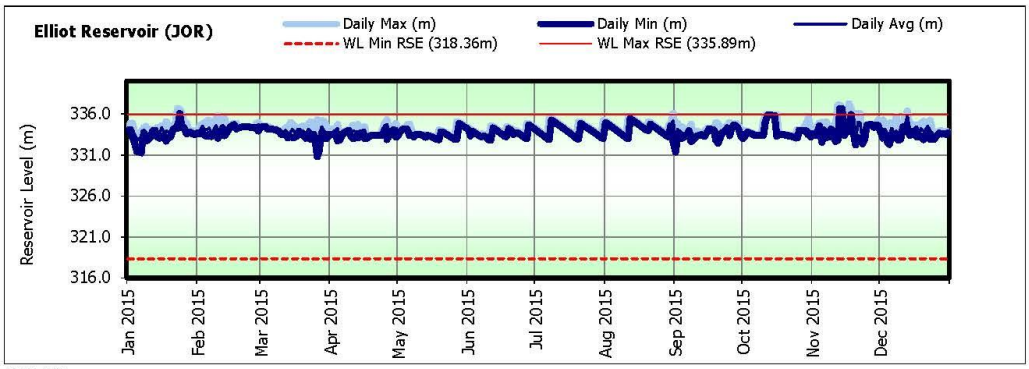


NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 21, 2015.

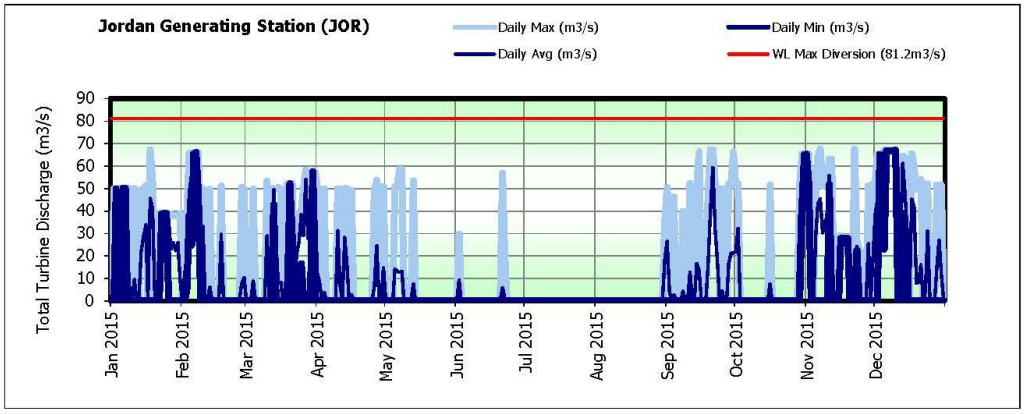


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2015.

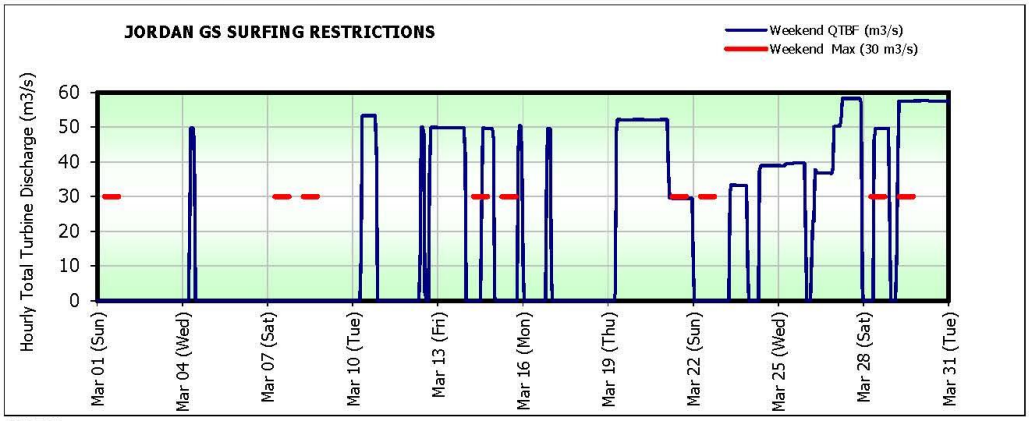


NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There is no reportable exceptions for the period Jan 1 to Dec 31, 2015

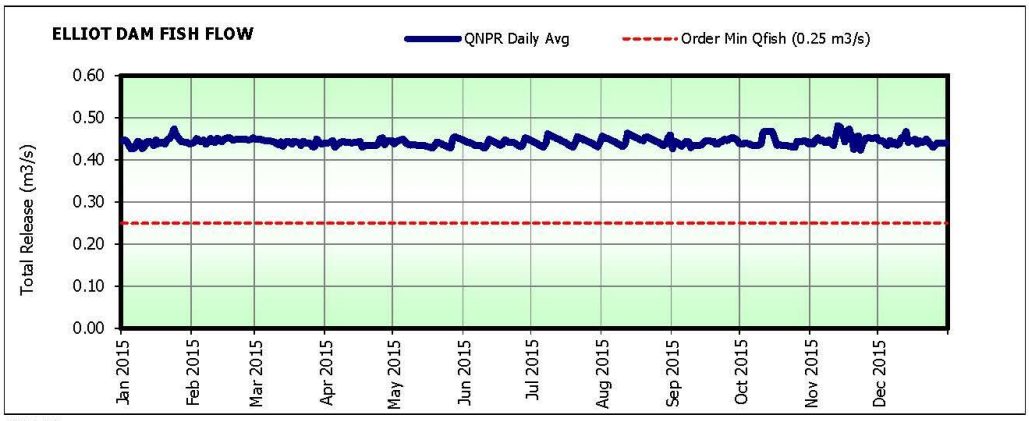
JOR DIV BEC Charts



NOTES:
Maximum turbine diversion FWL 117999 (10.4 m3/s) and FWL 118000 (70.8 m3/s) is 81.2 m3/s
There are no reportable exceptions for the period Jan 1 to Dec 31, 2015



NOTES:
Values reported as hourly average discharge.
Requirement to limit generation to less than 30 m3/s for 4 weekend days during March between 06:00 and 18:00.
Only turbine discharge during the restricted period is plotted. Restriction met for 6 weekend days.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2015



NOTES:
Discharge regulated by design: FWRV will release 0.25 m3/s or more at all times.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2015

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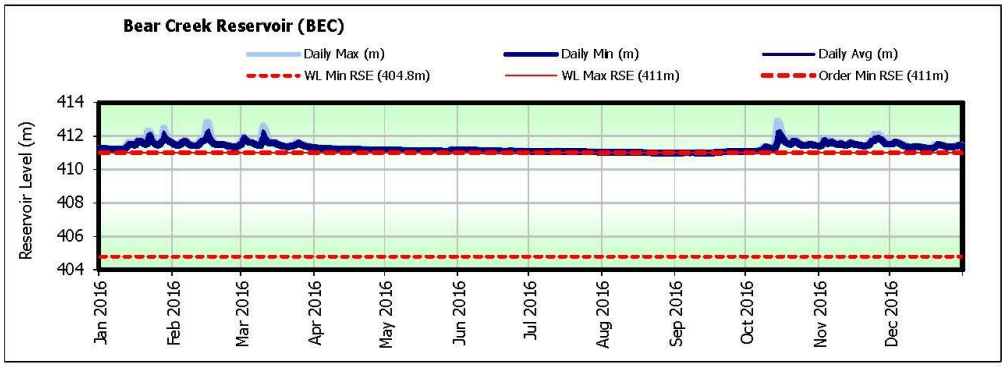
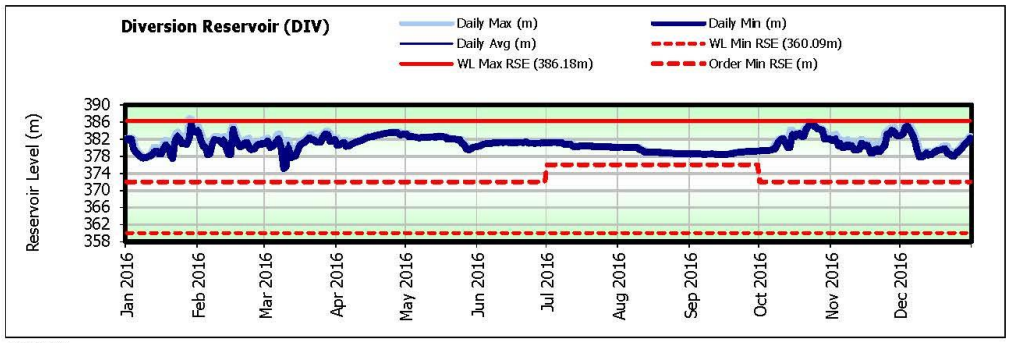
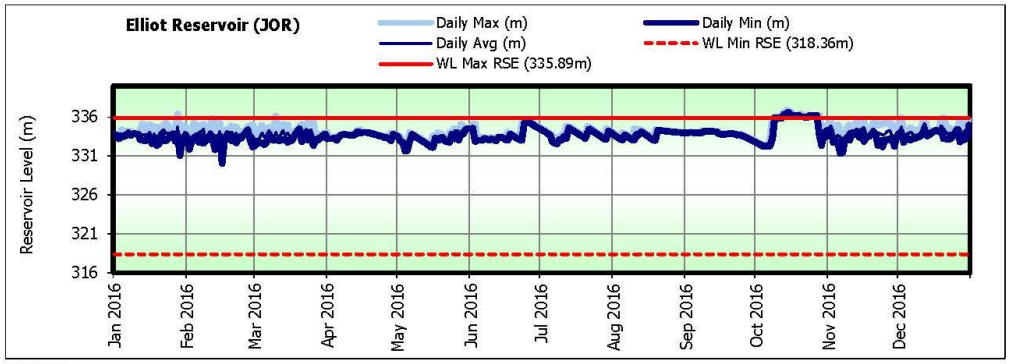


NOTES:
Maximum & minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.

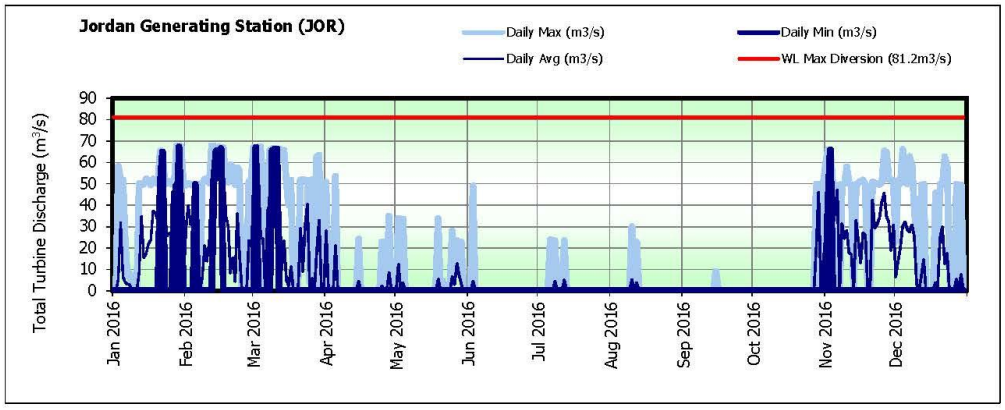


NOTES:
Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.



NOTES:
Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.

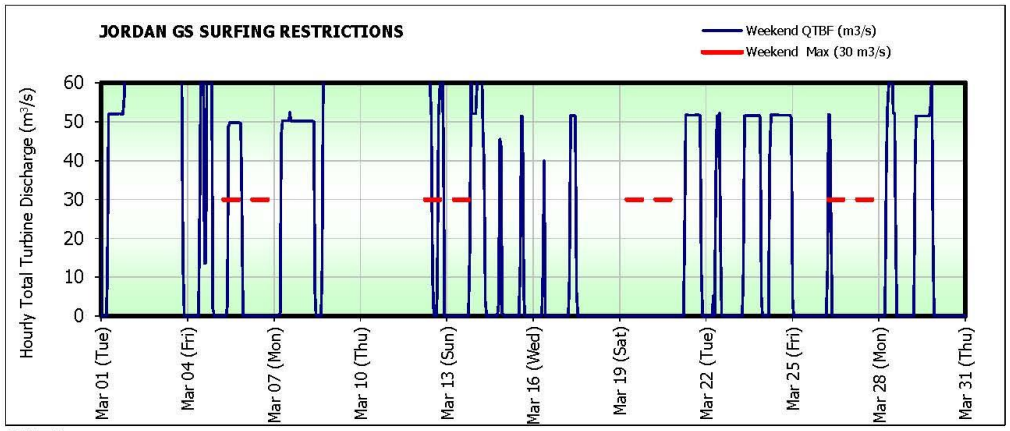
JOR DIV BEC Charts



NOTES:

Maximum turbine diversion FWL 117999 (10.4 m^3/s) and FWL 118000 (70.8 m^3/s) is 81.2 m^3/s

There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.



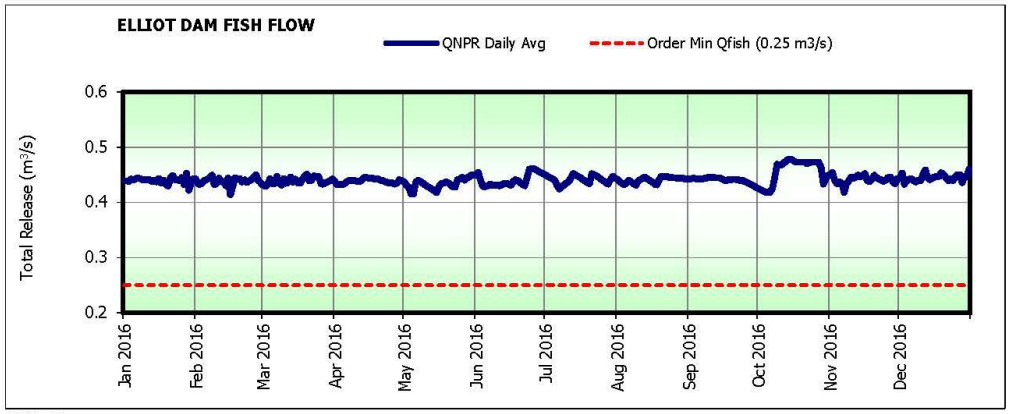
NOTES:

Values reported as hourly average discharge.

Requirement to limit generation to less than 30 m^3/s for 4 weekend days during March between 06:00 and 18:00.

Only turbine discharge during the restricted period is plotted. Restriction met for 5 weekend days.

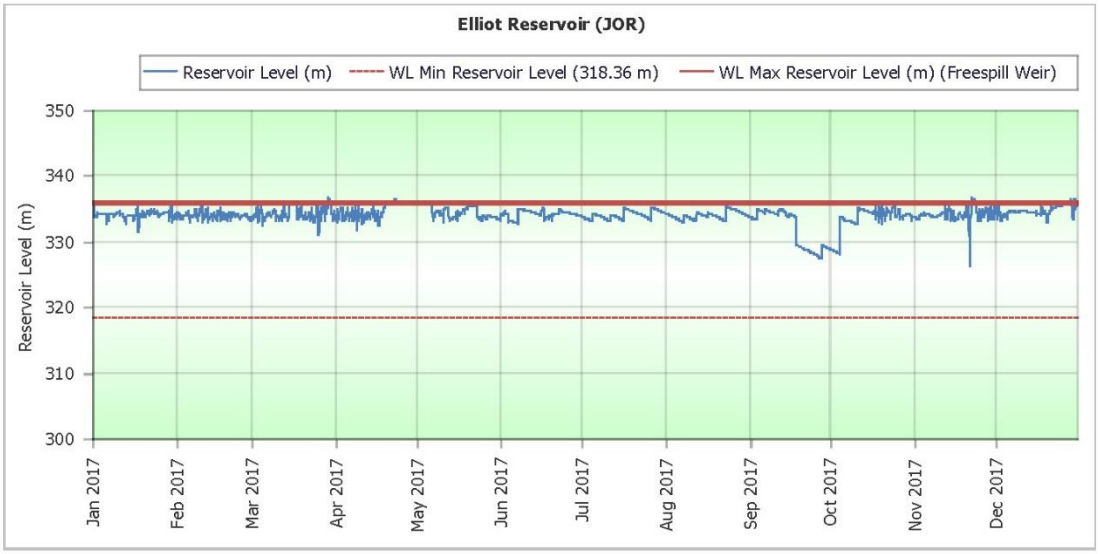
There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.



NOTES:

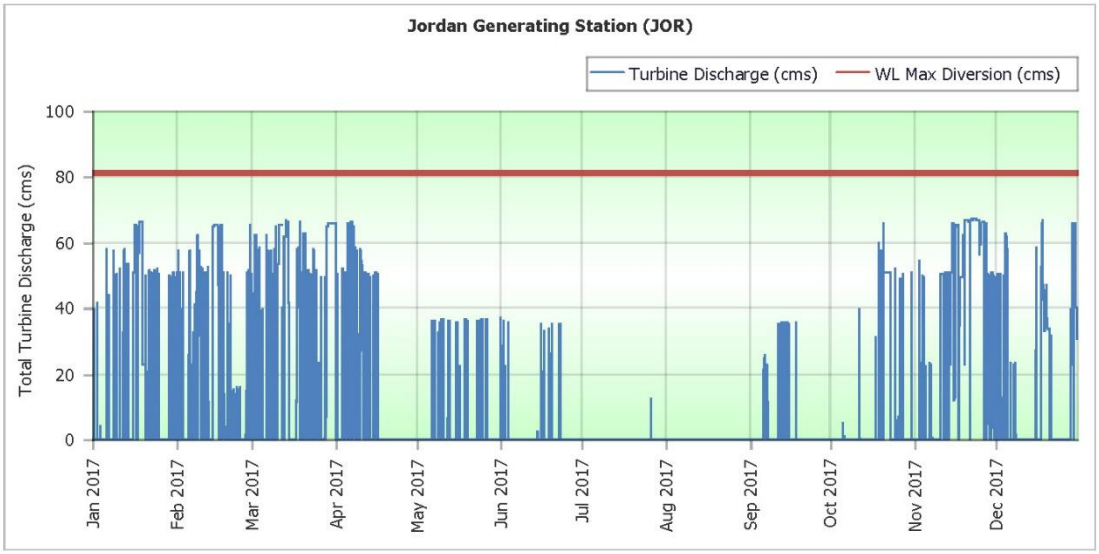
Discharge regulated by design: FWRV will release 0.25 m^3/s or more at all times.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.



Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Maximum reservoir elevations at Elliott Reservoir controlled by freespill weir at 335.89 m.

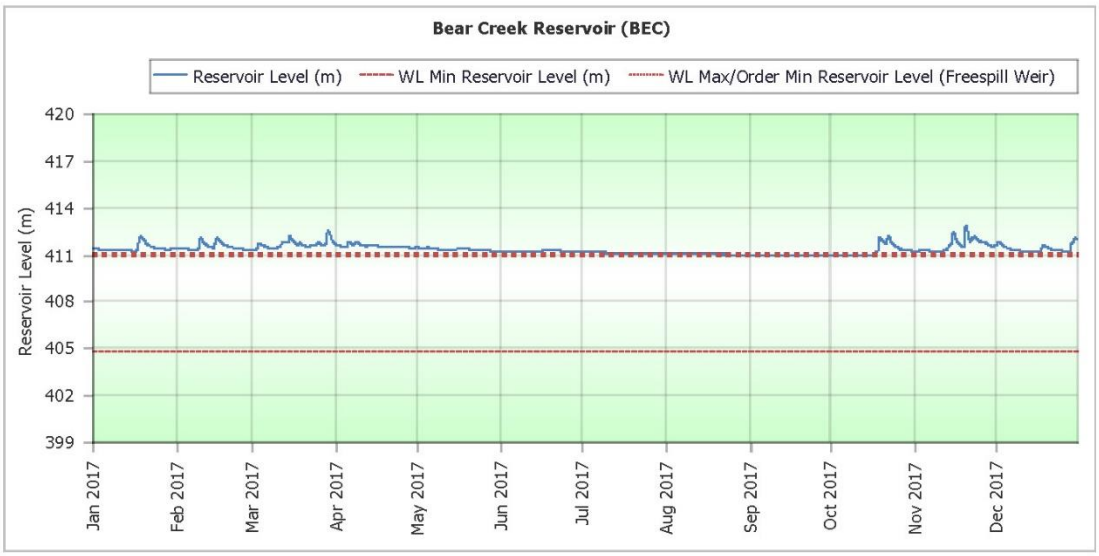
There are no reportable exceptions for the period Jan 1 to Dec 31, 2017



Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Maximum turbine diversion FWL 117999 (10.4 cms) and FWL 118000 (70.8 cms) is 81.2 cms.

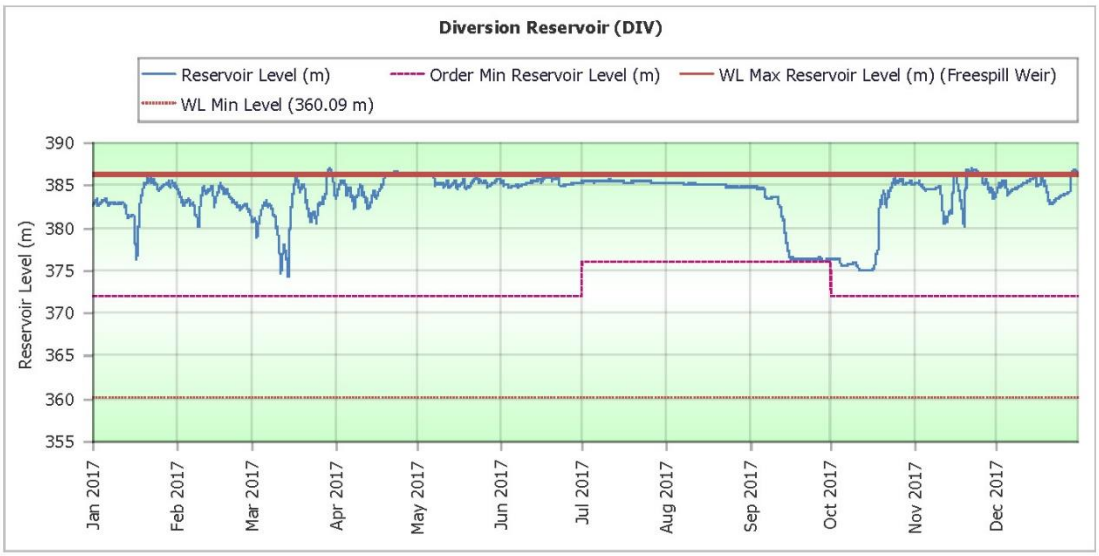
There are no reportable exceptions for the period Jan 1 to Dec 31, 2017

JOR 2017



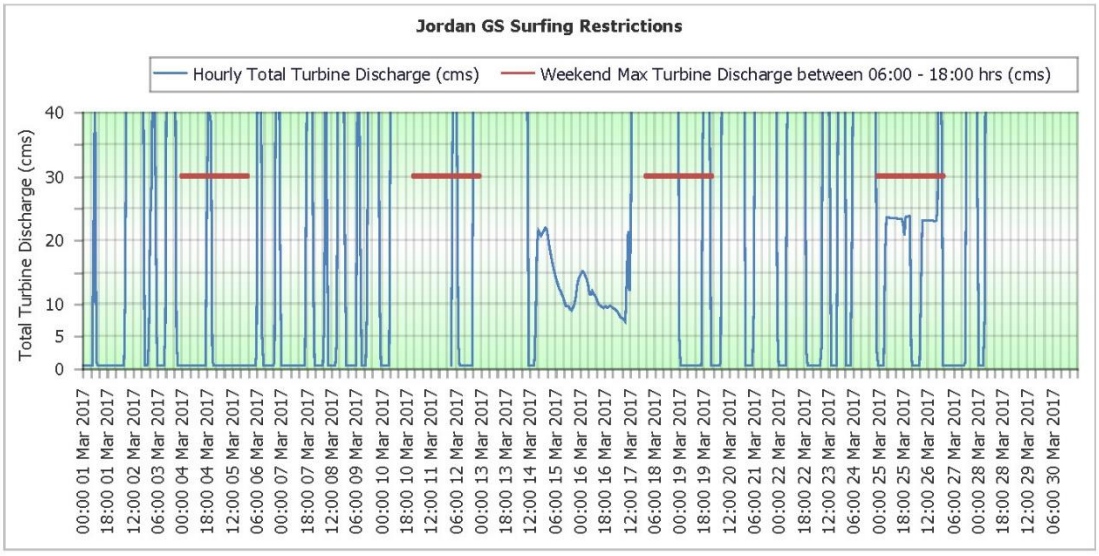
Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Maximum and minimum reservoir elevations at Bear Creek Reservoir controlled by freespill weir at 411.0 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2017



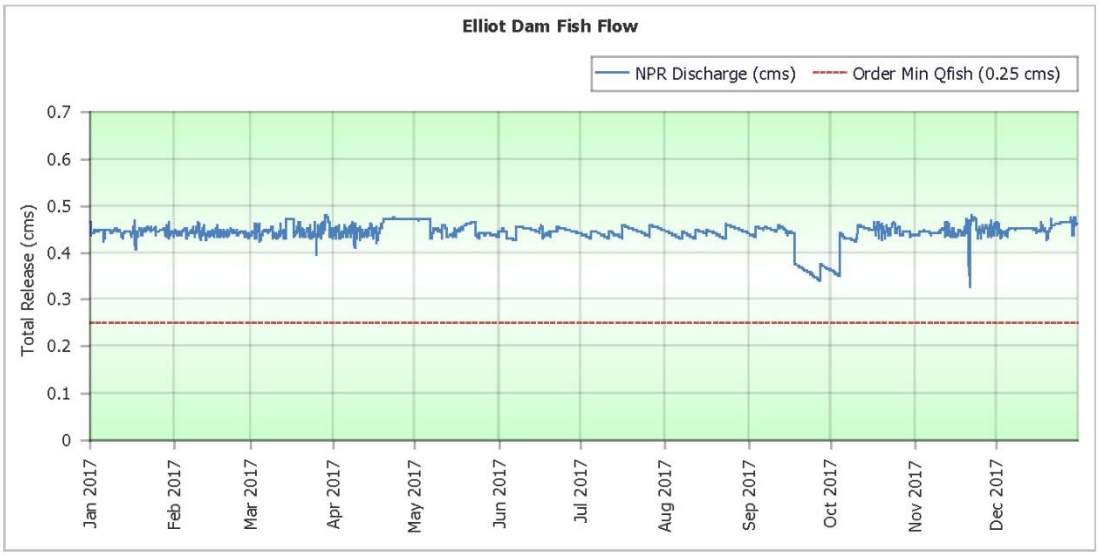
Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Maximum reservoir elevation at Diversion Reservoir controlled by freespill weir at 386.18 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2017



Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Values reported as hourly average discharge. Required to limit generation to less than 30 cms for 4 weekend days during March between 06:00 and 18:00. Only turbine discharge during the restricted period is plotted.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2017



Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Discharge regulated by design: FWRV will release 0.25 cms or more at all times.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2017