DAM SAFETY QUARTERLY REPORT

EXECUTIVE SUMMARY

The purpose of this report is to update the Capital Projects Committee of the Board of Directors on key dam risk management activities during the period from October 1, 2014 to December 31, 2014, and to provide reasonable assurance that the safety of dams operated by BC Hydro continues to be managed to the established guidelines and criteria of the Dam Safety program.

The Dam Safety Program has been carried out consistent with its stated objectives throughout the reporting period. The overall Dam Safety risk profile is shown in Figure 1. There is overall decrease in the risk profile this Quarter, due to the completion of work at Kootenay Canal to reduce leakage through the canal liner.

QUARTERLY FEATURED DAMSITES – JORDAN RIVER SYSTEM DAMS

The Jordan River System has three dams: Bear Creek Dam, furthest upstream which originally provided some storage; Jordan River Diversion Dam (also known as "Diversion Dam") which provides the main regulation of flows and Elliott Dam, furthest downstream which contains the power intake. The river system is approximately 50 kilometres west of Victoria on Vancouver Island.

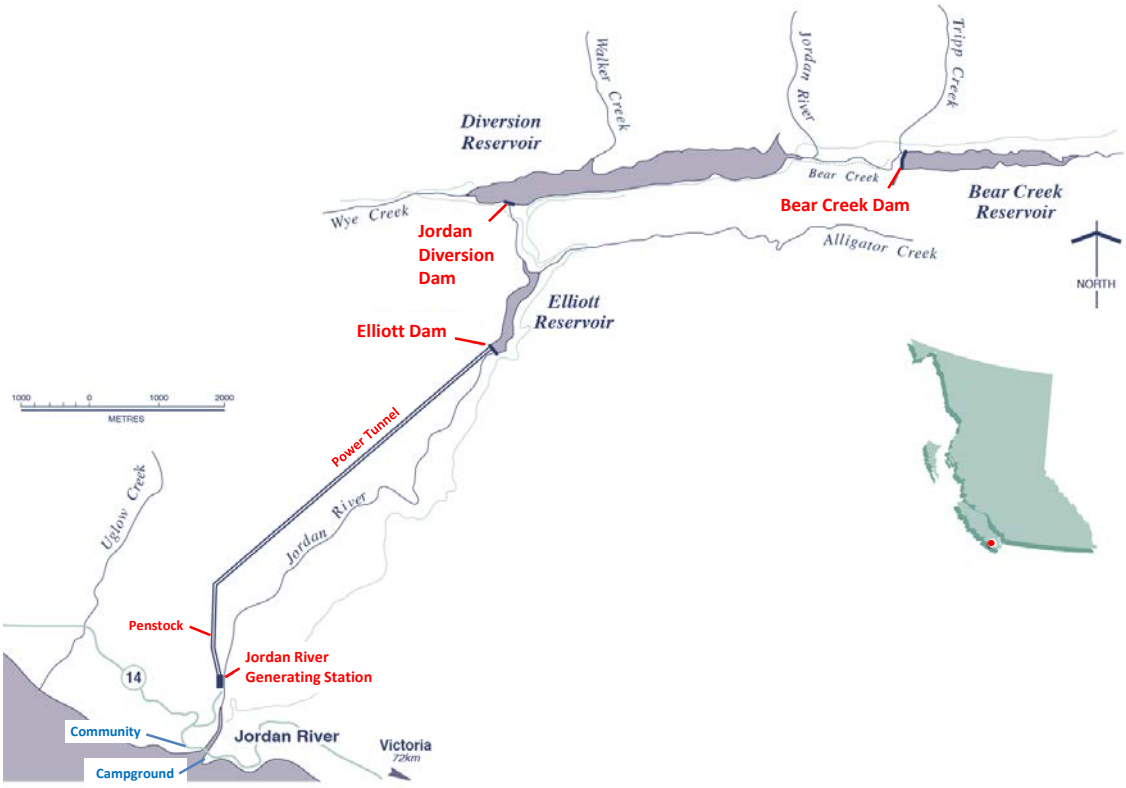


Figure 1: Schematic of Jordan River System

Bear Creek Dam

The Bear Creek Dam is a hydraulic fill structure built in 1911-12 and is currently classified as “Low” consequence. The dam was originally 17.5 metres high and 337 metres long.

The dam is founded on coarse cemented gravel (hardpan) underlain by sand and fine gravel. To form a positive cut-off, a 2.5 metre to 9.5 metre deep trench was excavated along the dam through the hardpan. Where bedrock was not reached, a row of interlocking sheetpiles was driven from the bottom of the trench to bedrock. The dam core consists of fine sands and silts which were sluiced into place over the foundation from the right abutment. The upstream and downstream shell materials vary from fine gravel, sand and clay near the core, to small boulders and coarse gravel near the outer slopes. The dam was raised in 1971 by 1.5 metres to provide additional freeboard for flood passage.

There are two 0.76 metre diameter low-level outlet pipes near the left abutment located through the base of the dam. The low-level outlets have not been operated since 2000.

The spillway consists of an approximately 110 metre long free overflow spillway channel excavated in rock at the right abutment. In 1971, the spillway capacity was increased by removing original spillway piers and stoplogs.

The seismic withstand of the dam has been estimated to be 0.065g which has a theoretical annual exceedance frequency of 1/37. As such, the spillway channel was lowered by 2.5 metres in 1993 to permanently reduce the reservoir volume to that which would be contained by the downstream reservoirs. This in turn reduced the consequence category of the dam, and no upgrades are in the capital plan. The site now essentially provides no active water storage, and a decision will need to be made in the future to either rehabilitate or fully decommission the structures.

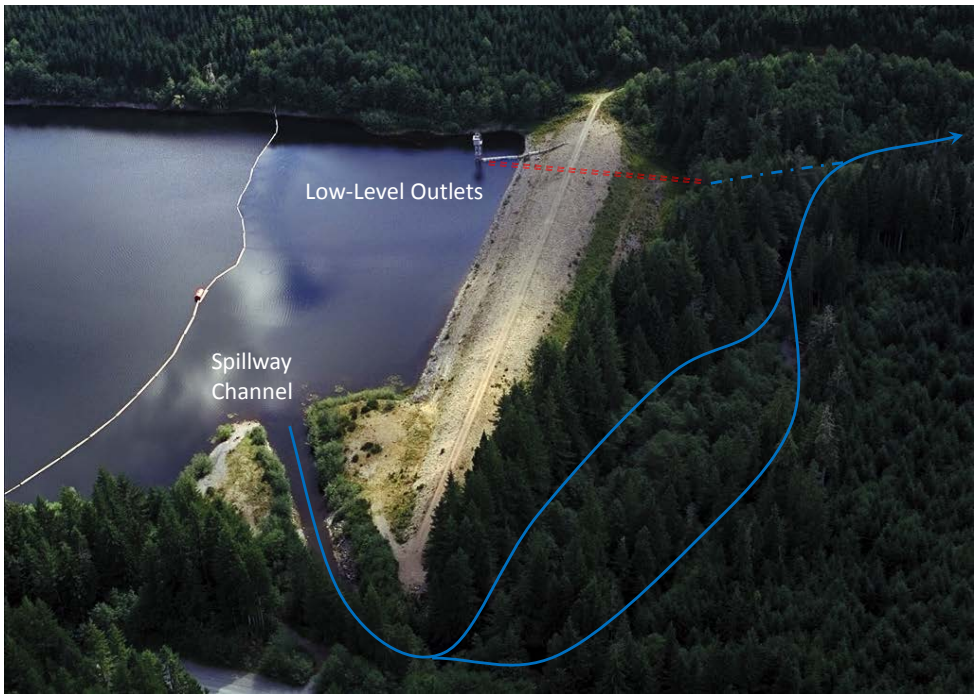


Figure 2: Bear Creek Dam

Jordan Diversion Dam

Jordan Diversion Dam, completed in 1913, is an Ambursen type concrete buttress dam, 40 metres high by 232 metres long, founded on bedrock. The dam is currently classified as "Very High" consequence. On the left abutment of the buttress dam is an embankment dam containing a central concrete cut-off wall. The spillway consists of a seven-bay free overflow section at the left end of the buttress dam.

The low-level outlet is the primary method of releasing water to the headpond at Elliott Dam. It consists of a 2.44 metre diameter steel pipe, controlled by a hollow-cone valve and a guard gate. A second emergency low-level outlet consists of a 1.1 metre wide by 1.7 metre high sluice, controlled by a hydraulic slide gate and a guard gate but this gate is not tested as there are concerns it may not close due to debris becoming jammed in the opening.

In 1971, the Jordan River hydroelectric facility was upgraded and reconfigured. Jordan Diversion Dam was rehabilitated to increase its outflow capability, thereby reducing the probability of overtopping. The project also included construction of the Elliott Dam, a new tunnel, penstock and powerhouse. These works replaced a flume that supplied flows to the Forebay Dam, the Forebay Dam, the old penstocks and old powerhouse. The Forebay Dam was subsequently decommissioned in 2005 and the property on which it sat was sold to a forestry company.

In 1990, the buttress dam and spillway section of Jordan Diversion Dam were rehabilitated to improve its seismic withstand for a 1/10000 AEF design load of 0.45g. However with the increase in seismic loading (the 1/10,000 AEF is now 1.475g), the dam no longer meets current guidelines. Refer to the New Issues section for a discussion regarding the ongoing public awareness work at Jordan River in regard to seismic withstand.

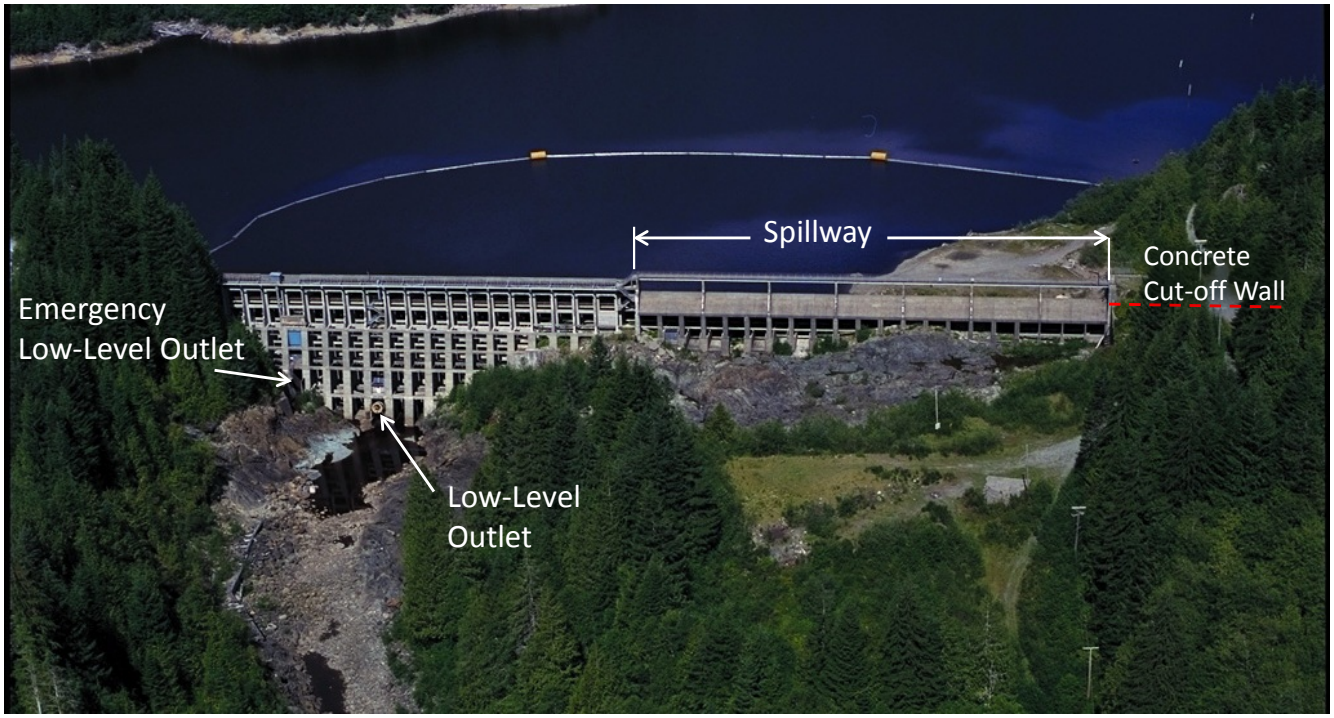


Figure 3: Jordan Diversion Dam

Elliott Dam

Elliott Dam is located 7 kilometres upstream of where the Jordan River enters the Strait of Juan de Fuca and is currently classified as “Very High” consequence. The Elliott Dam, put into operation in 1971, impounds a small headpond and serves as an intake for the 7.2 kilometre long pressure tunnel and penstock that leads to the 170 MW Jordan River Generating Station.

Elliott Dam is a 27 metre high, 115 metre long concrete gravity dam founded on bedrock. It consists of a non-overflow section on the right side where the power intake is located, a 73 metre long free overflow spillway and a non-overflow section on the left side. A low-level outlet is located at the base of the free overflow spillway.

No significant changes or major repairs have been made to the dam since construction other than the addition of a fish by-pass through the dam in 2005. The consequence classification of the dam increased from “Low” to “Very High” as a result of updated inundation mapping.

The seismic withstand has been estimated to be less than 0.4g, and as a “Very High” consequence dam, the dam does not meet current guidelines.

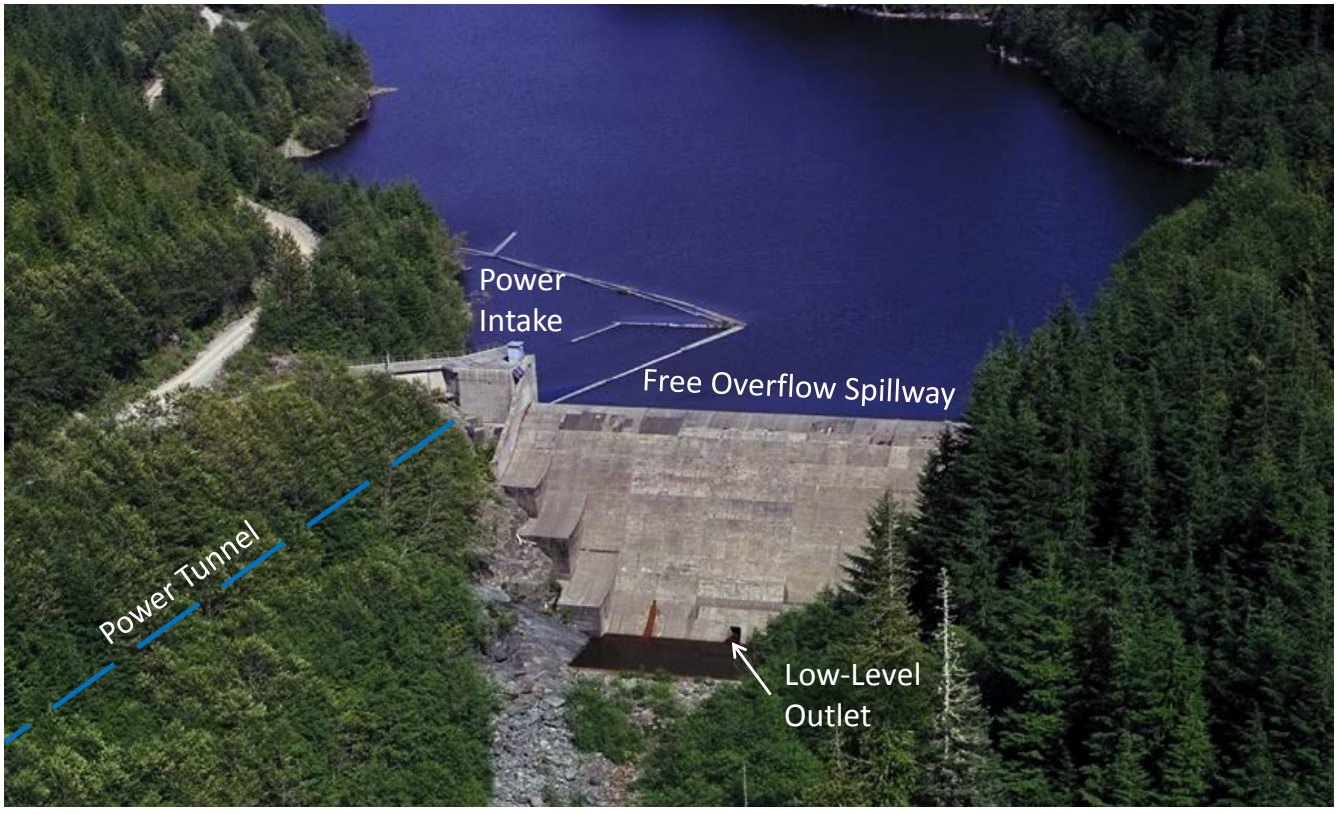


Figure 4: Elliott Dam

UPDATE ON OTHER MAJOR DAMS

Mica Dam

Decisions will be made in F2015 regarding the selection of the temperature, flow and turbidity monitoring equipment for the instrumentation upgrade work. In Q3, the thermistors were installed in

the selected holes, and the inflow pumping test was successfully completed in November. Project documentation continued in Q3, with targeted completion in Q4.

La Joie Dam

A recommendation had been previously made to reduce the maximum operating level of the reservoir as an alternative to requiring an additional major capital project in the 10-year Capital Plan. Consultations with First Nations were completed in late Q2. A decision was made by in Q3 to implement the reservoir restriction option following a public awareness campaign. Changes to the reservoir operation orders are planned to be in place before the 2015 spring freshet.

Progress continues to be made to improve the functionality of the water passages. The hollow cone valve heaters were installed in October to ensure winter availability. Project documentation is underway.

Terzaghi Dam

Work is in progress to determine the performance of the dam for the updated seismic hazard. Additional analyses were carried out in Q3. A draft summary report was prepared by the consultant in Q3. An external Dam Safety Review of Terzaghi Dam is also in progress.

Revelstoke Dam

A decision was made in F2014 to include the installation of additional piezometers in the Marble Shear Block project scope. This work was completed in late June, with five new piezometers now being connected to the automatic data acquisition system. Further analyses to better estimate the current stability of the block were also undertaken. Project documentation continued into Q3.

The investigation into the stability of the Left Bank slopes near the downstream face of the dam, to determine the rockfall/rockslide hazard and risk mitigation options, has been completed. A capital project to install instrumentation is underway. Instrumentation design is in progress, with field installation planned for spring/early summer of 2015. Some local trenching and geological mapping was completed in Q3.

WAC Bennett Dam

There are five ongoing dam safety projects:

Condition of the spillway (deterioration of the spillway chute concrete surface)

All in-chute work was completed in Q3, with the contractor de-mobilized from site. Not all the planned 2014 work was completed, but will be included with the planned 2015 work. Discussions are underway with the Contractor for scheduling of the remaining work for the next construction season.

Spillway gate reliability

A current project will upgrade selected electrical and mechanical components of the three spillway gates as the first of a multiple stage program to improve the reliability of gate operations. The project is currently in Definition Phase.

Long-term performance of the dam core

The F2015 work continued in Q3 with the development of the 3-D model and the performance assessment of the dam, including the failure modes identification work. A status update on the recommendations from the Expert Engineering Panel is given in the Supporting Documents section.

Casing Upgrades

A number of open casings (including Observation Wells, drill holes and a cross-arm device) were installed in the dam core for monitoring performance both during construction and during the 1996/97 sinkhole investigations/remediation. A number of these casings leak, and water levels in some of the casings have been observed to fluctuate and suddenly drop, necessitating the permanent sealing of these casings. However, some of these casings have become important for monitoring the long term condition of the damaged areas of the core, and long-term access to the casings is, and will continue to be, a valuable means of monitoring core performance.

This project was initiated to address the open casings in the core, while retaining their usefulness where applicable. Work is planned for spring/summer 2015, and includes instrumentation installation and grouting at six Observation Wells and five drill holes, all located in the dam core. In Q3, the funding request to carry out the work was approved.

Further work is required to address the remaining drill holes in the dam core and the cross arm device. This assessment will continue for the next year, and any construction/remediation work is planned for 2016.

Condition of the riprap layer protecting the upstream face of the dam

Additional field investigations to obtain information on the quality of the rip rap fills were completed in May 2014, during the low reservoir period. In Q3, work continued in developing details of the preliminary design, and a draft report was completed. Further work to assess the rip rap performance versus cost was completed. Additional meetings to discuss key constructability and risk issues were held. Permit applications to obtain use of the rip rap borrow areas were submitted.

Ruskin Dam

As noted previously, the right abutment seismic upgrades of Ruskin Dam are now mostly completed. Project documentation of the right abutment continued with a draft construction report completed in Q3.

Work is progressing with the demolition of the first three existing piers and the construction of new piers. The need for further anchoring in the Spillway was identified, and the design plan was approved in Q3. The plan includes the development of a detailed dam/foundation seismic model and some large diameter concrete testing of the samples obtained from the pier demolition.

Kootenay Canal

The project has successfully installed a CARPI geomembrane over the problematic cracked and jointed sections of the canal's concrete lining. This leakage was considered a significant risk to the Kootenay Canal earth fill embankment.

Campbell River System

An integrated communications plan for downstream communities and First Nations, that provides an understanding of the risks and assists in developing appropriate emergency action plans, following a major earthquake, has now been implemented. The Project has completed targeted general and specific communications across the province including Ministries, response agencies (e.g. Emergency Management BC), local municipalities, the general public, First Nations and residents of the City of Campbell River. A series of four public meetings were held, with about 40 public attendees at each meeting. Flood inundation mapping is now available via published brochures and the recently launched BC Hydro Dam Safety website. BC Hydro will continue to work with the response agencies and local municipalities to improve emergency response plans. Regular reporting on this work at Campbell River will now be discontinued.

Other recent and ongoing work at the three sites is as follows:

Strathcona Dam

No work this Quarter.

Ladore Dam

Investigations to assess the seismic withstand of the dam continue. Additional analyses were completed in Q3 and preparation of a summary report was started. Preliminary results show that some remedial work will be required.

John Hart Dam

The field investigations work was successfully completed in Q3. Further work in the development of options continue.

NEW ISSUES

Clowhom Dam

During a routine inspection at Clowhom Dam in September, it was discovered that Interfor or their contractor has again located a barge for accommodating workers in the inlet across from the Clowhom spillway. This resulted in a temporary increase in consequence from Significant to Very High. A letter was sent to Interfor regarding the risk associated with locating the barge in the inundation zone. The barge has since been removed for the season.

Jordan Dam

Public disclosure of the seismic withstand issues (refer to Quarterly Featured Damsites section) occurred via individual meetings with the land owners within the Inundation Zone, and a general public meeting held in Sooke. Liaison with the property owners is ongoing. Dam Safety will be working together in the coming Quarter with the Comptroller of Water Rights on this issue of acceptable societal risks. See also Tolerability of Risk section in Supporting Documents.

GATE MAINTENANCE AND TESTING

During the period of September 2014 to November 2014, 58 scheduled gate tests at 23 sites were carried out. One gate system failed to operate on demand during testing or normal operations. In nine other cases, gates operated on demand however certain equipment malfunctioned or was found to be in near-fail condition. Ten new deficiencies were identified.

As per 30 November 2014, operational restrictions were in place on 6 out of 111 flood discharge gates due to known deficiencies (decreased from 9 in the previous quarter). In addition, 6 out of 111 flood discharge gates were locked out for construction and operational reasons (no change from August 2014). Dam Safety continues to monitor the interim risks.

There were 56 corrective maintenance issues outstanding at the end of November 2014, compared to 53 as of one year ago. A total of 20 corrective maintenance issues were identified through ongoing testing and maintenance between September and November 2014. A total of 26 new and previous issues were addressed in the same period, for a reduction of 6 issues overall in this reporting period.

CIVIL MAINTENANCE

Thirty-two projects have been completed to date. Another three projects are scheduled to be completed by end of F2015. In addition, the bridge inspection tender for the Peace River, Bridge River and Lower Mainland regions has been awarded. All on-site bridge inspections have been completed and analysis of the inspection work is due by end of F2015.

The F2015 civil maintenance program is currently estimated to spend $2.87M by the end of F2015. This has been reduced from the original $3.7M with more than 80% of the underspend being related to 3 projects: the Elko penstock inspection is now deferred indefinitely as the plant is currently out of service, dredging in front of Wilsey dam is deferred to F16 due to contractor delays, and the scope of spillway repairs at Bennett Dam were reduced to better integrate the work with the ongoing capital project.

Planning for the F2016 program is now complete, on the basis of a $4M budget that will cover all currently identified items with a Corporate Risk Score of 9.5 and higher.

EMERGENCY PREPAREDNESS AND PUBLIC SAFETY

Emergency Preparedness[1]

Emergency Planning Guides for all areas will be distributed in Q4 except for Vancouver Island as these were distributed earlier this year. An Emergency Action Plan for Lower Mainland Generation will also be distributed in Q4.

Generation Emergency Coordination Centre emergency response training is scheduled for January 6, 2015, and this will be followed by response exercises on January 12th and 14th, 2015. The exercise scenario will be the initial response to a major earthquake event off the south coast of Vancouver

[1] Emergency Preparedness is managed by the Strategic Emergency Management team in Transmission and Distribution. Dam Safety audits the updating of emergency plans for compliance with the BC Dam Safety Regulation.

Island. Jordan River crews, Vancouver Island Generation, Dam Safety and Generation staff assigned to the Emergency Coordination Centre are participating in the exercise.

An external agency tabletop exercise for the Campbell River System is scheduled for February 2015.

Public Safety[2]

From Q1 F2015 and onwards, all Public Safety Management Plans will be reviewed on a recurring three year basis. High risk items identified for remediation will be forwarded to Generation Asset Management for consideration and scheduling. The 3 year schedule will be adjusted to accommodate any unplanned exceptions requiring immediate attention. A study has been initiated to document and review the use of warning sirens and strobes downstream from spillways.

COMPLIANCE WITH PROCESSES AND REGULATION

Interim Dam Safety Risk Management Plans were provided for response testing of instruments at Duncan Dam, investigative work at John Hart Dam and for flood routing procedures at Ruskin Dam.

A flow disruption in the Columbia River occurred at Hugh Keenleyside Dam, caused by the accidental release of log bundles in the reservoir. BC Hydro decided to close the Low Level Outlets to reduce the stress on the heavily loaded BC Hydro debris boom (which is scheduled for replacement next year). Loss of this boom could result in the plugging of the Outlets with debris, and a subsequent Dam Safety Incident. Following this decision, there was a failure of the Columbia Power Corporation's Arrow Lake Hydro debris boom, which necessitated shutdown of that plant, and the temporary loss of downstream river flow. There was no concern regarding the safety of the Hugh Keenleyside Dam, however an Environmental incident was logged.

The two Operation, Maintenance and Surveillance Manuals (OMS) to be submitted in Q3 will now be forwarded to the Comptroller early in Q4, The annual meeting between the Comptroller of Water Rights and the Director of Dam Safety is scheduled for early Q4.

Inspections

Overall regulatory expectations were met in Q3 for weekly and monthly dam safety inspections. Two of 392 scheduled inspections for Q3 were not completed. To the end of Q3, the number of missed inspections is four of 1,237, due to manpower constraints at Aberfeldie (Q1), Elko (Q2), Seven Mile (Q3) and Terzaghi (Q3).

Dam Safety Reviews

Dam Safety Reviews are a regulatory requirement carried out at minimum intervals of every five to 10 years at high, very high and extreme consequence dams. The final reports the F2014 Dam Safety Reviews at Sugar Lake and Wilsey Dams were received in Q3.

Four external Dam Safety Reviews are underway in F2015 for La Joie, Terzaghi, Seton and Elliott Dams. The draft report for Elliott Dam was received in Q3. Draft reports for La Joie, Terzaghi and Seton are expected in Q4.

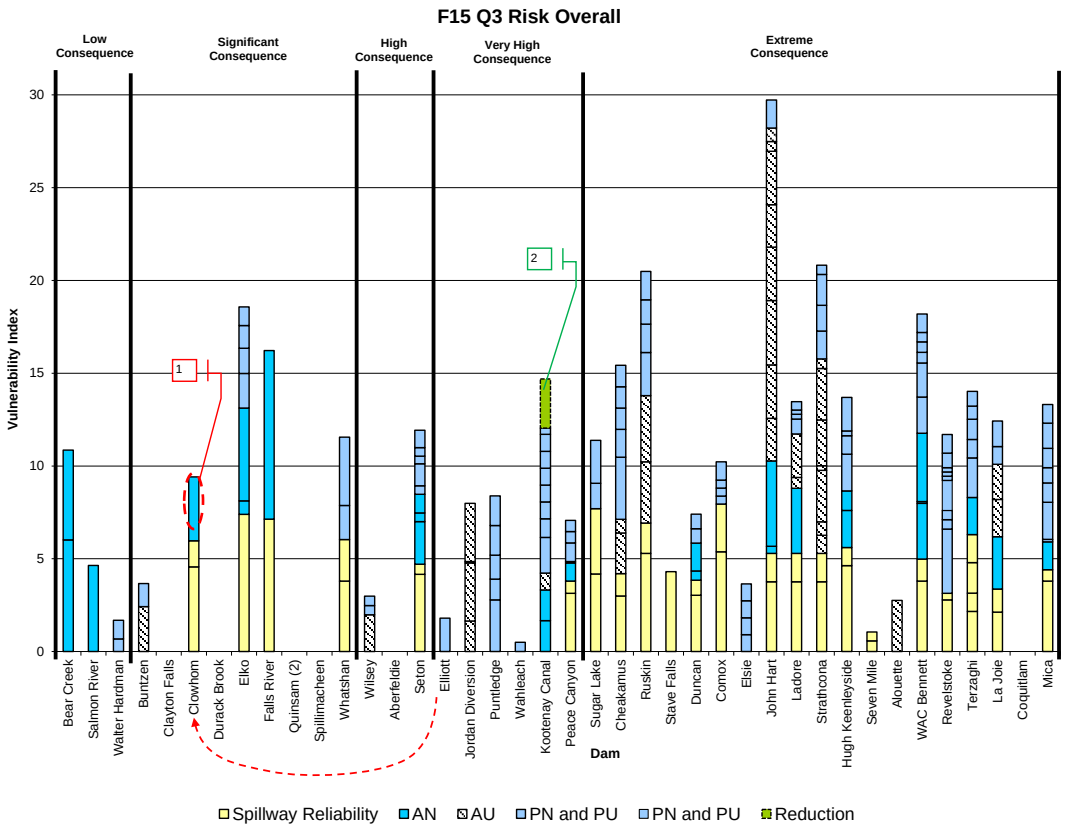
[2] Public Safety is managed by the Public Safety team in Generation Safety. Dam Safety audits Public Safety activities related to dams.

VULNERABILITY INDEX: UPDATE

Changes in Vulnerability Index for actual and potential deficiencies, as outlined in Figure 1, are tracked on a quarterly basis and shown on Figures 2 and 3. This is an indication of the changes in the understanding of the dam safety risk profile.

In Figure 3, the total index is shown (sum of actual and potential deficiencies), as well as separate plots for decreases and increases in the total index. Decreases are due to remediation projects as per the Capital Plan and resolution of issues via Performance Investigations. Increases in the index are due to the recognition of new issues. Existing issues are re-examined on a regular basis, and re-rated as required.

FIGURE 1 - DAM SAFETY: OVERALL RISK PROFILE



Legend and Summary of Changes:

Increase in Risk

1. Clowhom Dam – *Rating increased for seismic deficiency as reported last quarter. Consequence has since decreased, and this will be reflected next quarter.*

Reduction Risk

3. Kootenay Canal Dam *– the vulnerability associated with leakage through the canal liner has been decreased based on the installation of a Carpi membrane.*

A – Actual deficiencies have been shown to exist.
P – Potential deficiencies require further investigation.
N – Normal Load conditions; associated with daily or short-term operations.
U – Unusual Load conditions: associated with flood and earthquakes

Consequence classifications reflect current BC Dam Safety Regulations
Dam order reflects generally increasing downstream consequences

NOTES:

- Vulnerability Index (Rating) is a qualitative assessment of future dam performance from all causes – the higher the rating the higher the likelihood of poor performance.
- 34 dam sites as identified have reportable risk at present
- Additional details are provided in the Dam Safety Report Appendix provided to the Board
- This Risk Profile represents only currently known and rated issues. Changes do not necessarily indicate a physical change to BC Hydro assets that increase or decrease risk; rather they often represent a change in knowledge and understanding of the risk. Additionally, many known deficiencies (those without a direct impact on potential dam failure) have yet to be rated.

FIGURE 2 – CHANGE IN VULNERABILITY INDEX

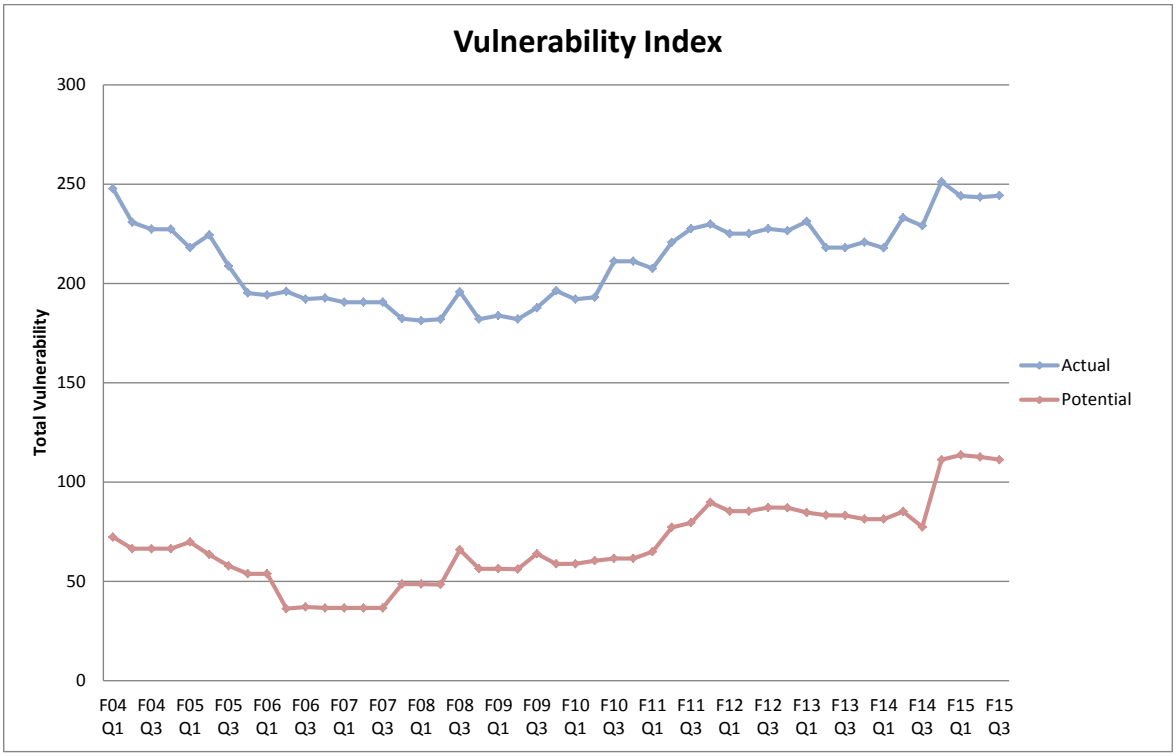


FIGURE 3 – CHANGE IN VULNERABILITY INDEX COMPONENTS