

B.C. DAM SAFETY PROGRAM ANNUAL REPORT 2017/18

EXECUTIVE SUMMARY

This annual report summarizes the achievements, challenges and ongoing improvements to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) dam safety program. In 2017/18, the program regulated approximately 1,853¹ dams in British Columbia that divert and/or store surface water or groundwater. These structures include dams associated with hydro-electric power generation, agricultural irrigation, industrial use, municipal water supply, domestic use, and structures that regulate lake or river levels for flood control. They also include dams associated with dugouts², which are often constructed to store water for the purpose of livestock watering or for irrigation. The Dam Safety Regulation requirements may apply if a dugout includes an artificial barrier or embankment that was constructed to retain water. Since the *Water Sustainability Act* and updated Dam Safety Regulation came into effect early in 2016, much effort has been expended in providing education and raising awareness to support compliance with the new legislation and regulation. Highlights of the 2017/2018 BC Dam Safety Program operational accomplishments include:

Operations

2017/18 Program Indicators	Number/Percentage completed
Dams audited	148
Percentage of annual dam status reports received from owners of 349 high, very high and extreme failure consequence dams	95%
Percentage of dams inspected, as reported by dam owners in the annual dam status reports	90%
Dam alert responses	4
Dam incident responses	2
Dam non-incident responses	6
Dam failure responses	6

¹ It is anticipated that the number of regulated dams will increase as more groundwater-filled structures and existing water supply dams and dugouts, associated with oil and gas activities in the Northeast region of B.C., are assessed and regulated under the *Water Sustainability Act* and Dam Safety Regulation.

² A dugout is a reservoir or impoundment constructed by excavating into the ground or by building an embankment to the land in order to collect and store water.

Program Accomplishments

- Funded by the Water Information Systems Project (WISP) to enhance the database management system supporting the Water Sustainability Act, Dam safety staff improved the dam database to capture more critical information about dams required under the new Dam Safety Regulation.
- WISP funding was also secured by the dam safety program to create efficient communications between the dam safety officer and the dam owner. This involved completely redesigning and testing the online process of dam safety officer notifying and, if required, receiving responses directly from dam owners.
- After the retirement of the dam safety program specialist who delivered dam safety training to dam owners, the dam safety program collaborated with other agency partners to continue dam safety education, particularly with agricultural dam owners.
- Dam safety staff participated in professional development provided internally by FLNRORD and externally by other jurisdictions and professional associations.
- FLNRORD and the Oil and Gas Commission (OGC) continue to collaborate on establishing a dam safety program within the OGC, as part of the OGC's water authorization and dam safety regulatory role under the *Water Sustainability Act*.

The dam safety program has been successful in several areas this year and continues to work toward addressing challenges, including:

Dam Owner Education: The availability of dam safety officers to deliver formal training to dam owners is limited as other aspects of the dam safety program such as auditing dam owner compliance, authorizing construction, rehabilitation and removal of dams, incident response and follow-up, take up a significant amount of time. Various avenues are being considered to have dam owner training delivered.

Information management system: The current version of the internal dam database (e-Licensing) is not optimized and information tracked about many dams can be made more robust. The program has obtained funding for an e-Licensing enhancement to better support work carried out by Dam Safety Officers (DSO) and improve the quality of dam safety records. With the assistance of the Water Business Section of the Water Management Branch, the e-Licensing system is currently being updated and improved

Unauthorized dams: The proliferation of dams and dugouts as a result of oil and gas activities in the Northeast region of B.C. is being carefully handled by FLNRORD and OGC to ensure that unauthorized and unregulated water structures are brought into compliance with the *Water Sustainability Act* and the Dam Safety Regulation.

Contents

EXECUTIVE SUMMARY.....	1
INTRODUCTION	4
B.C.'s Dam Safety Program.....	4
History and Regulatory Framework	4
Program Delivery and Operations.....	5
Regulated Dams in B.C.	6
2017/18 PROGRAM ACTIVITIES.....	9
DAM OWNER COMPLIANCE	9
Education and Awareness	9
Communications and Engagement	10
Annual Dam Status Report – Self-Reporting by Owners.....	11
Dam Safety Database	12
Audits of Owner Dam Safety Programs	12
REVIEW OF PLANS AND MONITORING OF WORK.....	13
Reviewing Plans and Monitoring Work in Progress	13
Operational Reviews	13
PROGRAM MANAGEMENT.....	14
Outreach and Professional Development.....	14
DAM INCIDENTS & FAILURES	14
Dam Breach (Breach of dam imminent, in the process of breaching, or has breached).....	15
Dam Alerts (Abnormal conditions requiring immediate action to avert breach).....	21
Dam Incidents (Conditions NOT requiring immediate intervention to avert breach).....	24
No Dam Incidents (Conditions NOT impacting safety of the dam (verify as appropriate)).....	25
PROGRAM CHALLENGES AND OPPORTUNITIES	30

INTRODUCTION

This annual report summarizes the achievements, challenges, and ongoing improvements to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development's (FLNRORD) Dam Safety Program for the period of April 1, 2017 to March 31, 2018. The publication of an annual *Dam Safety Program Report* meets a key public accountability commitment made by the B.C. Government following the 2010 Testalinden Dam failure.

B.C.'s Dam Safety Program

The aim of the Dam Safety Program is to promote the safety of water storage dams in B.C. by:

- Providing formal and informal training to dam owners and dam safety professionals, based on best practices in both dam safety and education.
- Monitoring dam owner compliance with the Dam Safety Regulation.
- Reviewing project plans for dams to ensure consistency with Canadian Dam Association Guidelines and other standard industry practices.
- Supporting emergency planning and response for dam safety incidents.

History and Regulatory Framework

B.C.'s dam safety program began in 1967 in response to the rapid development of large hydroelectric dams in B.C. At that time, dams greater than 15 metres in height were inspected by government engineers under the authority of the *Water Act*. Over time, the program expanded to include smaller dams. Inspections focused on ensuring the dams were designed, constructed, operated, and maintained to acceptable standards for public safety.

The first B.C. Dam Safety Regulation under the *Water Act* came into effect in 2000 based on recommendations from an independent program review of the 1995 Cannon Creek Dam failure. The regulation placed legal responsibility for the safety of dams on dam owners; thus, requiring owners to operate, maintain, and inspect dams to minimize risk to the public, the environment, and the economy. In addition to the new regulation, the program reviews recommended enhancements to the dam safety program to improve rigour, consistency, accountability, and to ensure adequate resources were present to deliver the program across the province. The review also recommended that the program follow the standards and guidelines of the Canadian Dam Association (CDA).

Further improvements were made to the regulation and the program in response to the Deputy Solicitor General's recommendations following the 2010 Testalinden Dam failure. These included developing a comprehensive database of dams in the province, requiring signage at dams, updating failure consequence classifications, and making education and awareness a key pillar of the program.

On February 29, 2016, the *Water Sustainability Act* (WSA) and Dam Safety Regulation (Regulation) came into effect replacing the former *Water Act* and B.C. Dam Safety Regulation. The WSA maintains the system of water rights in B.C. for streams and brings groundwater into the water rights scheme. The Regulation therefore now applies to dams in B.C. that impound stream water and/or groundwater under the WSA.

Program Delivery and Operations

The Dam Safety Program is delivered by the Dam Safety Section in Victoria and designated dam safety officers (DSOs) from FLNRORD regional offices and from the BC Oil and Gas Commission. The Dam Safety Section in Victoria is responsible for overall administration of the program, in close collaboration with regional and OGC DSOs. This includes leading development of legislation, policies and procedures, coordinating delivery of education/training sessions, reporting progress on program objectives, meeting the program's information systems needs, and leading the dam safety community of practice. DSOs in the Dam Safety Section in Victoria are also responsible for regulating most water supply dams greater than nine metres in height (also known as major dams). Dam safety officers based in FLNRORD regional offices are generally responsible for dams that are less than nine metres high within their regions. Dam safety officers in the OGC are responsible for all dams that are owned by oil and gas permit holders. The program also receives support from FLNRORD's compliance and enforcement branch and partner agencies such as Emergency Management BC.

Dam safety officers undertake the following activities while administering the dam safety program:

- Conduct periodic audits of dam owners' dam safety management systems to ensure that dam owners are compliant with the regulation and dam safety management systems are consistent with both government and CDA guidelines.
- Review annual dam status reports submitted by dam owners summarizing their dam safety activities, as required by the regulation.
- Assess formal dam safety reviews completed by an engineer on behalf of the dam owner, every 7 to 10 years for high, very high, and extreme consequence dams.
- Monitor dam owners' progress on addressing any potentially hazardous conditions at their dams, as identified through dam safety reviews, audits, regular inspections or any other means.
- Review plans for dam construction, rehabilitation, replacement, and decommissioning to ensure consistency with CDA guidelines.
- Review new and modified Dam Emergency Plans as well as Operation, Maintenance, and Surveillance Manuals for consistency with government and CDA guidelines.
- Review failure consequence classifications for new dams or changes to failure consequence classification for existing dams. Failure consequence classification determines the regulatory requirements that apply to a dam. Higher classification dams are subject to higher levels of regulation and oversight.
- Educate dam owners about regulatory requirements, government and industry guidelines, and best practices in dam safety.
- Respond to dam safety emergencies. This can involve a range of activities from overseeing a dam owner's response to hazardous conditions at a dam or, if a dam owner does not respond, undertaking the work necessary to help respond to and mitigate the hazard.

Regulated Dams in B.C.

A wide range of dams are authorized under the WSA and subject to the Regulation. These include some of the largest dams in Canada associated with hydro-electric power generation (e.g. the Mica Dam), as well as dams used for agricultural irrigation, industrial use, municipal water supply, domestic use and flood control. As of April 9, 2018 there were a total of 1,949 active dams in B.C. of which 1,853 are regulated by the Dam Safety Program. (Table 1).

Table 1: Number of regulated and unregulated active dams in British Columbia under the *Water Sustainability Act* and the Dam Safety Regulation (as of April 9, 2018).

Failure Consequence Class	Regulated Dams	Unregulated Dams	Total
Extreme	41	0	41
Very High	75	0	75
High	224	0	224
Significant	564	4	568
Low	781	60	841
None	0	5	5
Unclassified ³	168	27	195
Dam Totals	1,853	96	1,949

³ Unclassified Consequence refers to active dams whose consequence have not yet been determined. The number is due to the fact that these dams are very small and do not fall within the threshold of where the entire regulation applies (in terms of storage and height) and were considered non-regulated prior to the 2016 Regulation amendment. These dams are therefore a low priority for the Dam Safety Program. As well many dams have been built recently in the Northeast for oil & gas purposes and consequence classifications are pending following field assessments.

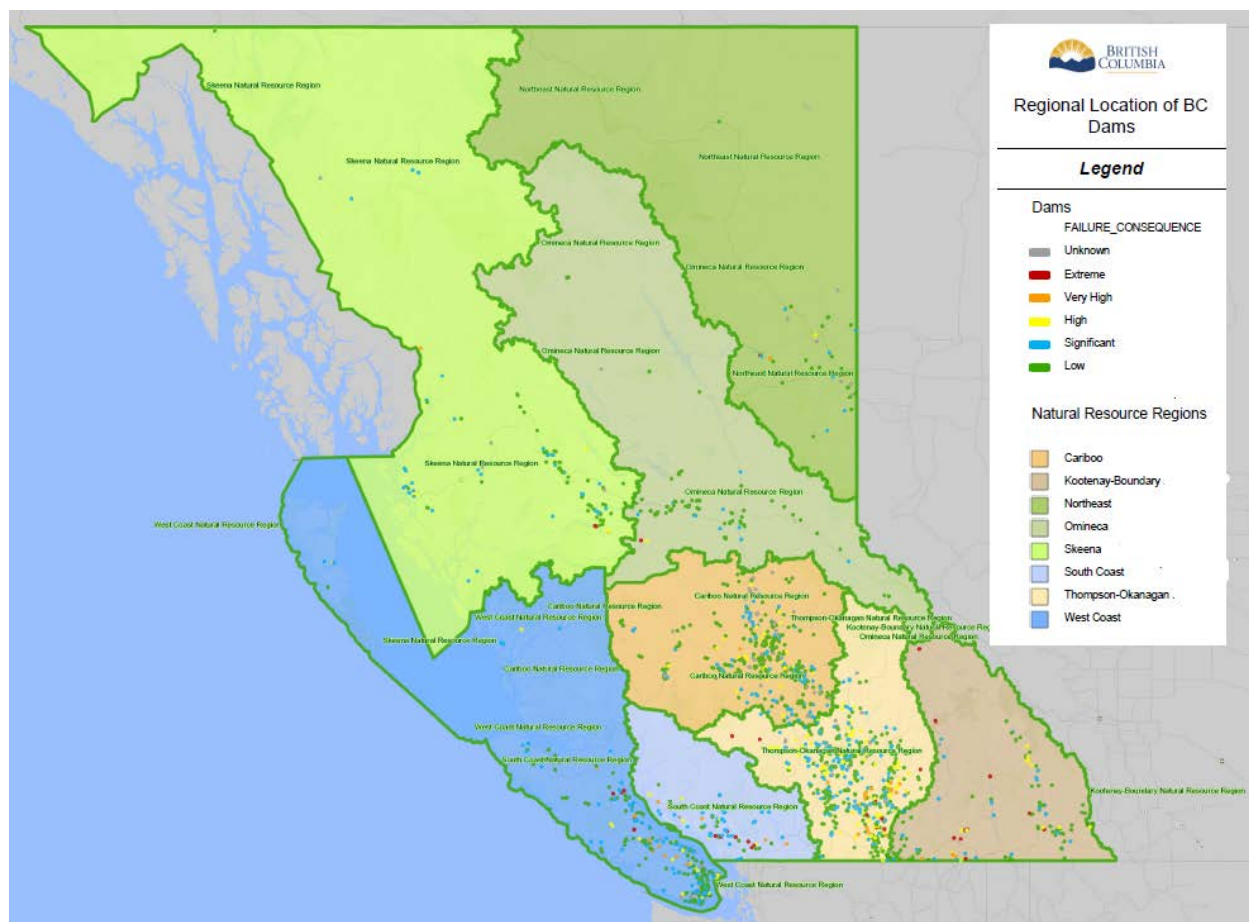


Figure 1: Regional locations of all dams of all failure consequence classes in B.C.

While Significant, High, Very High, and Extreme failure consequence dams are of special concern, they represent about 50% of the total active regulated dams in B.C. Approximately 2% of the total have been classified as Extreme consequence and these include some of the largest dams in B.C. Provincially, 63% of the total active regulated dams are found in the southern interior regions of the Cariboo, Thompson, Okanagan, and Kootenay, followed by 24% in the coastal regions, where most of the population is located, and 14% in the northern regions of the Skeena, Omineca and Northeast (Figures 1 and 2).

The total percent of the active dams that have not been classified or do not have a classification is 10% (and comprising Unclassified and None in Figure 2). Most of these dams have not been authorized under a water licence.

Distribution of BC Active Regulated Dams by Failure Consequence Class and by Regions

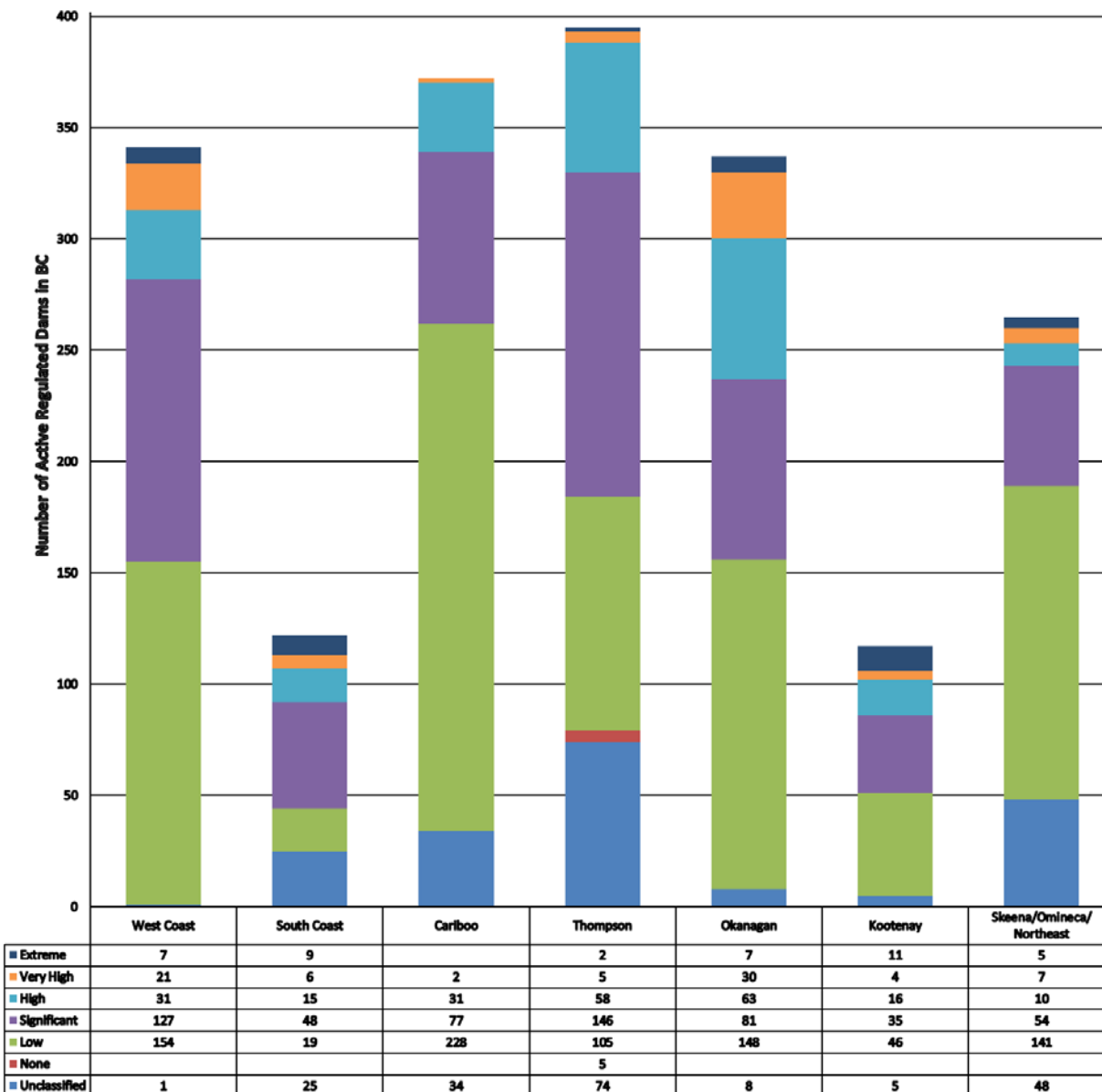


Figure 2: Regional distribution of all active regulated dams of all failure consequence classes in B.C.

Unregulated dams, including those that are less than 7.5 m in height and impounding less than 10,000 m³ of water, comprise about 5% of the total active dams in B.C. (Figure 3). These unregulated dams, also referred to as “minor dams,” can be made subject to the Regulation by order of the Comptroller of Water Rights, or a water manager if that person determines the dam is or may become hazardous to public safety, the environment, land or other property. Other unregulated dams include those that are

not active such as those still in the application stage, decommissioned, or removed. Unregulated dams however, may remain in oversight by a DSO and subject to orders under the WSA or water licence terms and conditions. The dam safety program also responds to issues at unregulated dams when necessary to ensure public safety and to protect the environment and property.



Figure 3: Regulated status of active dams in B. C. of all failure consequence classes (as of April 9, 2018)

2017/18 PROGRAM ACTIVITIES

The activities of the dam safety program in 2017/18 are grouped into the following areas:

- Dam owner compliance
- Dam safety plans review, construction and approval
- Program management
- Dam emergency planning and response

DAM OWNER COMPLIANCE

Education and Awareness

The advent of the B.C. Dam Safety Regulation in 2000 placed the burden of responsible dam management solely with the dam owner. To assist the dam owner, the Dam Safety Program promotes and provides dam safety education and awareness initiatives. Every audit that a DSO conducts with a dam owner includes a site visit to the dam, which is a valuable time to discuss dam safety aspects. It is

imperative that dam owners fully understand their dam safety responsibilities as per the Dam Safety Regulation and the importance of maintaining a safe dam. The Dam Safety Program had employed a part time Dam Safety Program Specialist, who was a former Dam Safety Section head with years of experience, to lead the education and awareness pillar of dam safety program and deliver dam safety workshops at various locations throughout the province. These workshops are available to all dam owners and are sponsored, in part, by the Water Supply Association of BC (WSABC) and the BC Waste Water Association (BCWWA).

Dam safety staff have also delivered dam safety education and awareness training internally. FLNRORD staff have been trained to assist DSOs with rapid dam assessments while they are patrolling an area. Additionally, staff who are responsible for provincially-owned dams, such as dams licenced to BC Parks, Fish & Wildlife, Crown Land Restoration Branch, etc. have also been trained to undertake their dam owner responsibilities as per the Dam Safety Regulation.

FLNRORD staff supported the development of the Agriculture Knowledge Transfer Resource, a dam safety education program targeted specifically at owners of agricultural dams. The project was made possible with support from the BC Agriculture & Food Climate Action Initiative, Ministry of Agriculture, Agriculture Canada, and the Cariboo Cattlemen's Association.

The following table summarizes some of the workshops which have been offered in various locations across B.C. along with the attendance records. The workshop delivered Inspection and Maintenance of Dams (I&M) training to dam owners.

Table 2: Dam Safety Program Workshops

Year	Location	Number of Attendees	Sponsor	Type
2017	Nanaimo	18	BCWWA	I&M
2017	Salmon Arm	11	WSABC	I&M
2017	Trail	10	BCWWA	I&M
2017	Salmon Arm	10	BCWWA	I&M
2017	CRD Water Parks	18	BCWWA	I&M

Dam safety education continues to be an important part of the BC Dam Safety Program and is key to ensuring dam owner compliance. Refer to the [BC Dam Safety website](#) for future offerings in dam safety training.

To support professional development and provide up to date knowledge on dam safety to dam owners, consultants, and regulators, many dam safety staff have participated in several conferences including the Canadian Dam Association (CDA), the Association of State Dam Safety Officials (ASDSO), and the International Commission on Large Dams (ICOLD).

Communications and Engagement

In addition to formal and informal education, the dam safety program communicates regularly with dam owners and communities of interest. Dam safety staff participated in the following communications and engagement activities in 2017/18:

- Met with BC Hydro and Rio Tinto representatives for annual and semi-annual dam safety meetings, respectively.
- Notified owners of high, very high and extreme failure consequence dams in early April ensuring their dams are maintained and operating properly to allow the safe discharge of possible flood flows during spring freshet.

Annual Dam Status Report – Self-Reporting by Owners

By order of the Comptroller of Water Rights under the WSA, owners of high, very high, and extreme consequence classification dams are required to report annually on dam safety activities, including their compliance with regulatory requirements. The annual report form is mailed to dam owners by November 30th of each year. Owners are required to complete the form and respond to questions regarding the following requirements by March 1st of the next year:

- Formal inspection(s) and regular site surveillance
- Dam safety review completed by a qualified professional engineer
- Operations, maintenance, and surveillance manual
- Dam emergency plan and emergency contact information
- Submission of dam emergency plan information to local emergency authority
- Changes to downstream land-use that might affect the failure consequence classification of the dam
- New dam safety concerns that have not previously been reported

The annual reports submitted by dam owners are used by DSOs as an important source of information to assess compliance and to prioritize dams where additional audits may be beneficial. Since 2006, annual reporting by dam owners has improved substantially. If a dam owner does not submit a report for three consecutive years, an enforcement action may be initiated. Of the 349 report notifications mailed out in 2017/18, 331 annual dam status reports were submitted. Whenever dam owners are not meeting their reporting and inspection obligations, DSOs follow up throughout the year to make sure that dam owners and their staff understand the regulatory requirements and the importance of public safety. Failure to comply with the Regulation can result in an enforcement action.

Under the new Dam Safety Regulation, owners of significant, high, very high, and extreme failure consequence classification dams are required to provide local emergency authorities with dam emergency plan information. Owners of existing dams were given until March 31, 2018 to meet this requirement. For the 2017/18 reporting period, owners of 65% of the High, Very High and Extreme failure consequence dams reported that they had complied with this new requirement (Figure 4). DSOs will continue to work with dam owners and local authorities to ensure that all parties are aware of the new requirement.

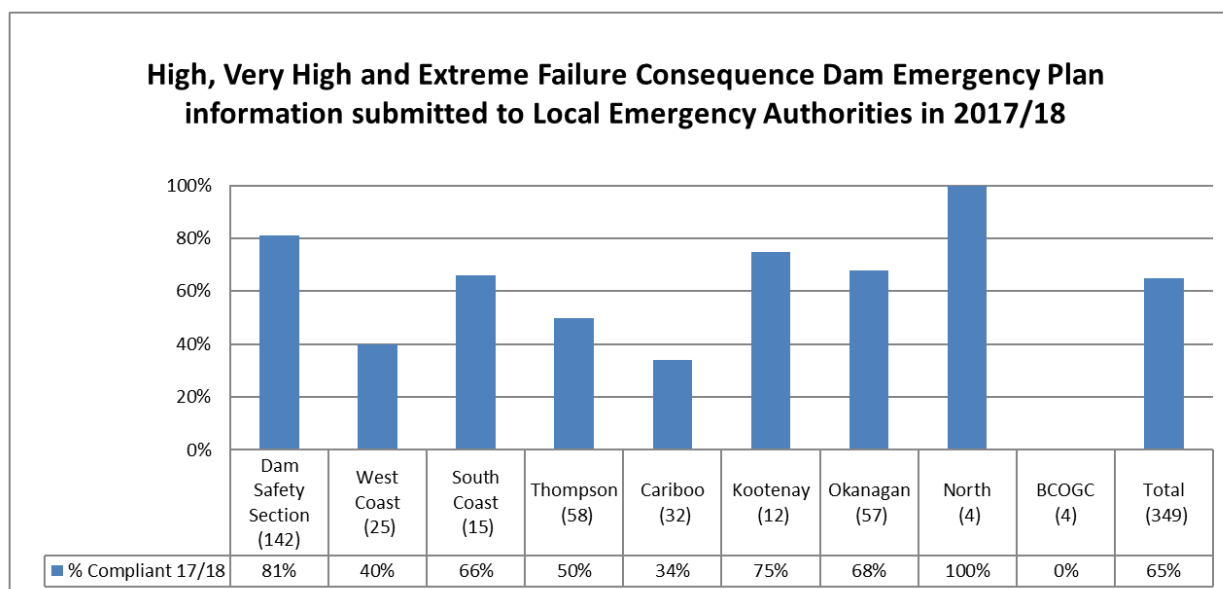


Figure 4: Percentage of dam owners self-reporting submission of dam emergency plans information to local emergency authorities in 2017/18. Bracketed numbers are the dams in each administrative unit.

Dam Safety Database

Accurate information about B.C. dams is important for DSOs to manage their portfolio of dams, report on the state of dams, and for quick access to information during emergencies. The dam safety database is comprised of two separate but linked digital information systems:

- e-Licensing - houses text-based data records for each dam, and
- BC Dams geographic dataset - provides geospatial data.

E-Licensing is the interface used by DSOs and is available to authorized internal users. Key information from e-Licensing for each dam is available to the public in a geospatial layer that can be viewed on [DataBC's iMap service](#).

Funded by the Water Information Systems Project beginning in 2017, the dam safety database was upgraded in e-Licensing to capture more information about dams and associated infrastructure, aligning with the requirements set out by the new legislation and regulation. A team of FLNRORD staff, including dam safety staff, was created to re-design the e-Licensing component of the dam safety database to be more supportive of DSO work.

Audits of Owner Dam Safety Programs

Dam safety officers meet with dam owners and conduct audits of their dam safety programs at least once every five years for all high, very high and extreme failure consequence classification dams, and at least once every 10 years for significant failure consequence classification dams. Each DSO has an annual target of audits to ensure that all dam audits are completed within the required time frame. The audits are an opportunity for DSOs to meet with dam owners to review records and conduct site visits. These

audits help confirm whether the dam owner is aware of and is carrying out the requirements of the Regulation. If deficiencies are found, DSOs provide information to help dam owners understand requirements and resolve issues. When necessary, DSOs follow up with owners to ensure that any identified deficiencies are corrected.

In 2017/18, DSOs completed a total of 148 audits. The Dam Safety Section, South Coast, Thompson, Kootenay and Okanagan administrative units met or exceeded their targets. Other administrative units such as the West Coast, Cariboo and the North did not meet their targets (Table 3). This was the result of temporary staffing issues. In years when targets are not met, the shortfall is usually addressed in a subsequent year.

Table 3: Number of audits conducted by dam safety officers in 2017/18 by region

FLNRORD Administrative Unit	Dam Audit Target for 2016/17	Dam Audits Completed
Dam Safety Section	27	51
West Coast	17	14
South Coast	6	8
Thompson	27	27
Cariboo	21	17
Kootenay	5	5
Okanagan	19	19
Skeena/Omineca/Northeast	8	7
Total	130	148

REVIEW OF PLANS AND MONITORING OF WORK

Reviewing Plans and Monitoring Work in Progress

The Regulation requires dam owners to submit plans for construction, alteration, or decommissioning of a regulated dam. The DSO must evaluate the plans before the dam owner can commence work. DSOs review these plans for consistency with the Regulation and CDA guidelines and may conduct periodic site visits to monitor construction while the work is underway. DSOs also provide professional advice to other statutory decision makers to coordinate requirements under WSA authorizations (e.g. issuing a leave to commence construction under a water licence) for work related to a dam.

Operational Reviews

The Regulation requires owners of dams, other than those with a low failure consequence classification, to periodically review and revise, if necessary, their Operations, Maintenance, and Surveillance (OMS) manuals as well as their Dam Emergency Plans (DEP). Any revisions and/or updates are submitted to the DSO. This is required at least every 10 years for significant and high failure consequence dams and every 7 years for very high and extreme failure consequence dams. The annual dam status report includes questions on the status of the OMS and DEP, while serving as a reminder to dam owners of their obligation to maintain these documents.

The Regulation also requires owners of dams to review downstream conditions and notify a DSO of any changes that may impact a dam's failure consequence classification. These reviews help ensure that dams are subject to appropriate regulatory requirements and oversight.

PROGRAM MANAGEMENT

Outreach and Professional Development

In 2017/18, dam safety staff continued to collaborate with their counterparts in other jurisdictions, agencies, industry, and professional associations on developing and improving dam safety best practices. Staff represented B.C. at the 2017 CDA Annual General Meeting and Conference in Kelowna and participated on the CDA Committee on the Regulation of Dams and CDA working groups focused on design and construction guidance and emergency management.

DSOs also participated in various technical webinars provided by the Association of State Dam Safety Officials, Engineers and Geoscientists B.C., and Natural Resources Canada.

Dam safety officers from the Dam Safety Section, Regions, and the OGC participated in the 34th annual Dam Safety Program Community of Practice (COP) held jointly with the BC Flood Safety program in Nanaimo in March of 2018. The annual COP meetings bring all DSOs across the province for an in-person conference. This allows DSOs and other dam safety staff to discuss key issues relating to the program such as regulatory compliance, technical questions, administrative inconsistencies, and legal issues. Attending this meeting, along with the biennial Technical Training, is required by all DSOs to maintain their designation under the Water Sustainability Act. The 2018 COP meeting focused on issues in common with the BC Flood Safety program such as flood and emergency response planning. It also reviewed and finalized policies and guidelines related to the dam safety program, database enhancements, and the Dam Safety Regulation. Field trips to several local locations in the vicinity focused on developing a better understanding about risk assessments.

In 2017, dam safety officer training was offered to one new staff in the North region, as well as two staff from the BC Oil and Gas Commission. All new dam safety program staff are required to receive a basic program orientation overview and undertake audits under the supervision of an experienced DSO, before receiving a DSO designation. This, along with monthly conference calls, the annual community of practice meeting and biennial technical training, helps ensure that staff have the skills necessary to fulfill their role as DSOs. It also promotes consistency in the application of the program and Regulation across the province.

DAM INCIDENTS & FAILURES

When an incident relating to a dam is reported to the province, a DSO or other FLNRORD staff person will immediately respond, occasionally with support from regional compliance and enforcement staff. The dam owner is contacted and depending on the situation, Emergency Management BC and other agencies may be involved. These investigations are recorded in incident reports. Not all reported incidents are an emergency or even an issue related to a dam, but regardless each one is followed up on and a Dam Incident Report is created and filed. The following is a summary of the dam incidents reported in 2017/18.

Dam Breach (Breach of dam imminent, in the process of breaching, or has breached)

There were five dam failures reported in 2017/18.

1. Dam Name: Lower Mamquam Dam
DFile : D420200-00
Date: December 5, 2017
Consequence Classification: Significant
Location: West of Squamish

On December 5, 2017 Lower Mamquam Dam's (*Photo 1*) inflatable rubber spillway gate failed by rapid deflation releasing a sudden flow of water into the Mamquam River. FLNRORD staff at the scene of the incident notified the dam owner representative directly. The owner has since notified FLNRORD of the intention to replace the inflatable rubber spillway gate and worked with FLNRORD staff to accomplish this replacement.



Photo 1: Lower Mamquam Dam (stock photo)

2. Dam Name: Short Creek (Pond) Dam
DFile : D810447-01
Date: April 28, 2017
Consequence Classification: Low
Location: Near 150 Mile House

On April 28, 2017, during a site visit to the Short Creek 2 Reservoir Dam (D810447-02), the DSO observed that the Short Creek (Pond) Dam had breached (*Photo 2*). The water level at Short Creek 2 Reservoir Dam was high and water was flowing over the field. FLNRORD contacted the owner regarding the plan for the Short Creek (Pond) Dam and learnt that both dams were to be repaired. The owner prepared and submitted rehabilitation plans to the DSO and FLNRORD staff.



Photo 2: Short Creek (Pond) Dam breach

3. Dam Name: Goldini Creek Dam
DFile : D620141-00
Date: May 13, 2017
Consequence Classification: Low
Location: Near Telkwa

On May 13, 2017, the regional DSO was notified by the Northeast Provincial Regional Emergency Operations Centre of a dam breach (*Photo 3*). The DSO contacted the owner of the dam who reported Goldini Creek Dam near Telkwa had failed. It was determined that heavy rainfall resulting in high inflows to the 1,200m³ reservoir caused the overtopping of the embankment dam. The only downstream issues from the overtopping were ravine channel scouring and sediment deposition in

the Bulkley River. During the incident and investigation the dam owner cooperated with the DSO and other FLNRORD staff.



Photo 3: Breach of the Goldini Creek Dam

4. Dam Name: Swartz Creek Dam
DFile : D220144-00
Date: April 26, 2017
Consequence Classification: Unknown
Location: South of Oliver

On April 26, 2017, BC Parks (dam owner) staff reported an unauthorized dam in the South Okanagan Grasslands Protected Area south of Oliver was in the process of breaching. A full breach would release water from the 550m³ reservoir onto a forest service road downstream. The dam owner was directed to stabilize the partial breach with the assistance of the DSO, who provided technical

support (*Photo 4*). The dam was decommissioned by the owner after the freshet and a dam file number assigned to the site.



Photo 4: Breach stabilization of the Swartz Creek dam

5. Dam Name: Valley of the Sun (unauthorized) dam
DFile : none
Date: April 24, 2017
Consequence Classification: Unknown
Location: Northwest of Fintry

On April 24, 2017, staff with the Regional District of the Central Okanagan reported to FLNRORD that a small earthen unauthorized dam northwest of Fintry was in the process of breaching. Sandbags were placed in the breach which stopped further erosion (*Photo 5*). The DSO engaged with both the dam owner and the Regional District in repairing the dam breach, ensuring compliance and authorizing the dam.



Photo 5: Sandbagged breach of unauthorized Valley of the Sun dam

Dam Alerts (Abnormal conditions requiring immediate action to avert breach)

A dam alert occurs when an abnormal condition is observed at a dam or a dam performs abnormally, and without swift and effective intervention, failure may occur. There were four dam alerts reported in 2017/18.

1. Dam Name: Headgates (Duteau Creek Intake) Dam
DFile : D240239-00
Date: May 5, 2017
Consequence Classification: Significant
Location: East of Vernon

On May 5, 2017, heavy rain caused high water flow in Duteau Creek, which heightened inflow into the reservoir, Harvey Lake. High water levels created risks of overtopping along the wing wall of the spillway, potentially resulting in the erosion of the earthen dam located east of Vernon. FLNRORD recommended the evacuation of affected residents downstream should inundation occur. However, the dam owner (Regional District of North Okanagan (RDNO)) only alerted residents who would be impacted by the dam breach. On the recommendation of consultant engineers, the dam owner installed flood protection measures near the spillway wing wall and the dam (*Photo 6*). 24 hour surveillance was implemented RDNO until the water level dropped substantially at which point surveillance was undertaken twice a day. RDNO had planned significant upgrades to the spillway wing wall and to the dam by raising the elevation of the structures to prevent future erosion.



Photo 6: Riprap on berm on Headgates earthen dam during high water level in reservoir

2. Dam Name: Kearns Creek Reservoir Dam
DFile : D220154-00
Date: March 26, 2018
Consequence Classification: Significant
Location: Near Willowbrook

On March 26, 2018, a member of the public contacted FLNRORD about water seeping at the base of the dam located near Willowbrook. FLNRORD staff visiting the dam discovered that the reservoir had begun to overtop a day earlier. There was significant seepage at the left toe of the dam (*Photo 7*) in addition to seepage on the middle and upper slopes of the dam, showing evidence of internal erosion. The dam owner complied with the directions to engage the services of a qualified engineer and immediately draw down the reservoir to avoid a dam breach. Additionally, the owner complied with alerting the Regional District of Okanagan-Similkameen Emergency Operations Centre of the increased flows that will result from pumping or siphoning of the reservoir, impacting the flooded Willowbrook area. The owner would be following up with FLNRORD regarding the decommissioning of the dam after the freshet of 2018.



Photo 7: Broad seepage at left toe of Kearns Creek dam

3. Dam Name: Mamit Lake Dam
DFile : D130146-00
Date: May 6, 2017
Consequence Classification: High
Location: South of Logan Lake

During freshet on May 6, 2017, FLNRORD staff received reports through the Provincial Emergency Operations Centre and the dam owner that the high failure consequence dam located south of Logan Lake was compromised. The local emergency authority for the Thompson Nicola Regional District

needed to resolve whether downstream precautions were required for public safety. A site visit by FLNRORD revealed that high inflows from several days of heavy rain altered the spillway floor and shifted the foundation of the steel walkway on the spillway. With the lake level receding during the day with no forecasted precipitation, low overnight temperatures, and the dam owner continuing all day surveillance, FLNRORD recommended evacuation alerts for some downstream residents due to the spillway condition. FLNRORD and the owner committed to re-assess site conditions on a regular basis including opening control gates of the lower level outlets to reduce flows through the spillway.

4. Dam Name: Scotty Creek Intake (BMID) Dam
DFile : D240204-00
Date: May 6, 2017
Consequence Classification: Significant
Location: South of Logan Lake

On May 12, 2018 during high flows, heavy machinery cleaned out a culvert located downstream of the dam and installed flood protection measures to prevent the dam from overtopping (*Photo 8*). The dam owner and the local fire department maintained communications with the Emergency Operations Centre during the flood alert. When water levels subsided, the dam owner removed sediment deposited in the intake pond, attempting to restore irrigation for the farmers in late May and reduce the possibility of flooding downstream in the future.



Photo 8: Gravel and debris moving over Scotty Creek Weir (Credit: D. A. Dobson)

Dam Incidents (Conditions NOT requiring immediate intervention to avert breach)

A dam incident occurs when an abnormal condition is observed at a dam or the dam performs abnormally but the condition is not expected to lead to a failure of the dam. There were two dam incidents reported in 2017/18.

1. Dam Name: Saddle Lake Dam
DFile : D210135-00
Date: April 18, 2017
Consequence Classification: Very High
Location: West of Grand Forks

On April 18, 2017, the dam owner reported to the DSO that their Very High consequence dam had reduced freeboard, a malfunctioning lower level outlet, and no emergency spillway. With rising water levels since March 21st, the reservoir had been lowered to 0.25m freeboard with the use of siphons and a pump supporting an embedded 0.2m overflow pipe (*Photo 9*). During a site visit to the dam, FLNRORD staff advised dam owner staff of the need to follow their dam emergency plan including achieving the appropriate minimum freeboard of 0.6m, stipulated in the Operations, Maintenance and Surveillance manual for the dam. The owner undertook appropriate monitoring of the reservoir level and notified downstream residents of potential flooding. The owner has since engaged a consultant engineer to design a new spillway structure and the new spillway is currently being constructed.



Photo 9: View of Saddle Lake Dam from left abutment: siphon hoses and 0.2m overflow pipe in foreground

2. Dam Name: Skaha (Dog) Lake Dam
DFile : D220189-00
Date: December 11, 2017
Consequence Classification: High
Location: OK Falls

On December 11, 2017, FLNRORD staff performing routine adjustments on one of the control gates of the dam south of Penticton caused a failure of the electrical/hydraulic system. FLNRORD, who is the dam owner, had ordered a new transformer for an electrician familiar with the dam to install. After installation, the vulnerability of the electrical system was to be assessed. The owner was required to provide a report of the assessment and any learnings was to be incorporated into the Operations, Maintenance and Surveillance manual for the dam.

No Dam Incidents (Conditions NOT impacting safety of the dam (verify as appropriate))

This term is used for reports that are initially received as dam incidents but do not impact the safety of a dam. It could refer to an erroneous report, or a report about an abnormal condition that could be interpreted as a threat to a dam. There were six reports classified as “no dam incidents” in 2017/18.

1. Dam Name: Elliott Creek (unregulated) Dam

DFile : none

Date: May 6, 2017

Consequence Classification: Low

Location: East of Lake Country

FLNRORD staff discovered a dugout (*Photo 10*) during in-flight flood inspections on May 6, 2017 north east of Lake Country. A DSO met with the owner of the dugout on July 5 and determined that the dugout should be classified as a dam. The owner was informed that the dam is regulated under the **Dam Safety Regulation**. The DSO is following up with the owner on the next steps with the water licence and dam authorization application process.



Photo 10: North end of Elliott Creek dugout and dam

2. Dam Name: Kalamalka Lake Dam
DFile : D240161-00
Date: May 11, 2017
Consequence Classification: Significant
Location: Vernon

On May 11, 2017, a concerned resident monitoring the dam south of Vernon reported overtopping of the concrete dam. Heavy sustained rainfall and melting snow had created high inflows into the lake. On May 23, the District of Coldstream raised concern about a potential dam failure due to the rising lake level and had installed more sandbags at the dam, in addition to sandbags placed by the resident (*Photo 11*). FLNRORD had assessed the dam was not at risk.



Photo 11: Sandbagging by the District of Coldstream

3. Dam Name: Savanna Pond (unauthorized) Dam
 DFile : D220133-00
 Date: May 7, 2017
 Consequence Classification: unknown
 Location: Northwest of Summerland

On May 7, 2017, FLNRORD staff discovered an unauthorized dam (*Photo 12*) during an in-flight flood inspection northwest of Summerland. The bermed dam forming part of a 43,000m³ dugout was visited by a DSO on July 19, 2017. Upon review of a groundwater licence application pertinent to the structure, it was determined that the dam was constructed without receiving authorization under

the **Dam Safety Regulation** in 2016. The dam owner is co-operating with FLNRORD in ensuring the structure is compliant with the regulation. A dam file was created for this dam.



Photo 12: Savana Pond dugout and dam

4. Dam Name: Horse Lake Dam
DFile : D810226-00
Date: May 11, 2017
Consequence Classification: Significant
Location: Near 100 Mile House

On May 11, 2017, a concerned resident reported to FLNRORD of a high-water level in the reservoir affecting the nearby septic fields. The dam owner (District of 100 Mile House) confirmed that the sheet pile weir dam was operating properly and did not have wooden stop logs in place, which would cause high water levels. The resident was directed to follow up with the dam owner for more information.

5. Dam Name: McQueen Lake Dam
DFile : D120318-00
Date: April 18, 2017
Consequence Classification: Low
Location: North of Kamloops

On April 18, 2018, a concerned land owner downstream of the McQueen Lake Dam (*Photo 13*), located north of Kamloops, informed FLNRORD of new seepage from the dam. FLNRORD staff referred the land owner to the dam owner to resolve the issue. Dam owner staff assessed the site and determined that it was the Long Lake diversion channel downstream of the dam that was

behaving normally, typical of the increased flows resulting from higher elevation ice melting during freshet.



Photo 13: McQueen Lake dam operating normally

6. Dam Name: Okanagan Lake Dam
DFile : D220176-00
Date: January 18, 2018
Consequence Classification: High
Location: Penticton

On January 18, 2018, FLNRORD staff was contacted by a concerned resident regarding a large concrete crack near the spillway bay of a government-owned high failure consequence dam near Penticton. FLNRORD staff responsible for the operation of the dam were promptly contacted and met with the resident at the site. It was determined that the issue was known and of no concern. FLNRORD had hired a qualified professional engineering consultant to conduct a comprehensive dam safety review.

PROGRAM CHALLENGES AND OPPORTUNITIES

The Provincial Dam Safety Program continues to make progress in addressing the recommendations of the 2010 Deputy Solicitor General's report on the Testalinden Dam failure. Program staff is working to address a number of challenges:

Dam Owner Education: The availability of dam safety officers to deliver formal training to dam owners is limited as other aspects of the dam safety programs such as dam audits and responding to dam construction, dam rehabilitation and removal applications, and incidents occupy significant amount of time. Various avenues are being considered to have dam owner training delivered.

Information management system: The current version of the internal dam database (e-Licensing) is not optimized and information tracked about many dams can be made more robust. The program has obtained funding for an e-Licensing enhancement to better support DSO activities and improve the quality of dam safety records. With the assistance of the Water Business Section of the Water Management Branch, the e-Licensing system is currently being updated and improved

Unauthorized dams: The proliferation of dams and dugouts as a result of the oil and gas activities in the Northeast region of B.C. is being carefully handled by FLNRORD and OGC to ensure that unauthorized and unregulated water structures are brought into compliance with the *Water Sustainability Act* and the Dam Safety Regulation.

B.C. Dam Safety Program
Ministry of Forests, Lands and Natural Resource Operations and Rural Development
September 2019