

B.C. DAM SAFETY PROGRAM ANNUAL REPORT 2020/2021

EXECUTIVE SUMMARY

The B.C. Dam Safety Program Annual Report for 2020/21 summarizes the achievements, challenges and ongoing initiatives of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development's (FLNR) Dam Safety Program.

The purpose of the Dam Safety Program (DSP) is to confirm that owners of dams licensed under the *Water Sustainability Act (WSA)* operate their dams in a safe manner in accordance with the Dam Safety Regulation (Regulation).

The objective of the Regulation is to mitigate loss of life and damage to property and the environment from a dam breach by requiring dam owners to inspect their own dams, undertake proper maintenance on them, and ensure that these dams meet engineering standards to minimize associated public safety, economic, social, and environmental risks.

Despite the restrictions imposed by the COVID-19 pandemic the DSP, conducted by FLNR in partnership with the B.C. Oil and Gas Commission (OGC), was fully operational. The tables below list important data for the DSP's 2020/21 fiscal year.

2020/21 Summary of Key Performance Indicators (KPI) for the DSP

KPI	Completed			Benchmark (%)
	Actual	Required (Goal)	Achieved (%)	
Undertaken by DSP				
Dam Owners Trained	173	120	144	95
Dam audits completed by DSOs	128	125	102	95
Submitted by Dam Owner				
Status Reports ¹	342	357	96	95
Reported by Dam Owner				
Formal Inspections undertaken	334	342	98	100
Site surveillance undertaken	292	341	86	95
OMS ² manuals up to date	334	342	98	95
DEPs ³ up to date	297	340	87	100
DEP contact info up to date	303	338	90	100
DEP info submitted to LEA ⁴	264	341	77	100

¹ Refer to *Self Reporting by Owners on the Status of Their Dams* section of the annual report for more information on status reports

² OMS is an abbreviation for Operations, Maintenance and Surveillance (see Dam Safety Regulation for definition)

³ DEP is an abbreviation for Dam Emergency Plan (see Dam Safety Regulation for definition)

⁴ LEA is an abbreviation for Local Emergency Authority (see Dam Safety Regulation for definition)

2020/21 Program Statistics (as of March 31, 2021)

Active⁵ Dams in B.C.	1966
Regulated Dams	1824
Unregulated Dams	142
Dam Failure Consequence Classification⁶	
Extreme Consequence	44
Very High Consequence	87
High Consequence	230
Significant Consequence	609
Low Consequence	822
Undetermined	32
Dam Failure Risk Levels⁷	
1 - Alert	1
2 - Caution	85
3 - Stable	268
4 - No concerns	685
5 - Effectual	763
None/Unclassified	18
Dam Incidents⁸	
Dam breach response	4
Dam alert Response	8
Dam incident response	13
Orders issued by DSP to ensure dam owner compliance	50

⁵ An *Active* dam is a dam that has the ability to store or divert water, irrespective of whether the dam is fully operational or undergoing major repair/refurbishment.

⁶ Refer to [Schedule 1](#), Dam Safety Regulation, for Dam Failure Consequence Classification definitions.

⁷ Refer to *Dams in B.C.* section of the annual report for more information on Dam Failure Risk Levels.

⁸ Refer to *Dam Incidents* section of the annual report for more information on Dam Incidents.

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1.0 INTRODUCTION

1.1 Purpose of DSP Annual Report

On July 13, 2010, the Solicitor General issued a report on the June 10, 2010 Testalinden Dam Failure. The report contained 12 recommendations for improvements to the DSP including “the Ministry should publish an annual Program report on its public website for the information of the public”. The DSP Annual Report is a result of that recommendation and presents key information about the progress of the DSP as administered by FLNR in the tenth year since the disaster.

1.2 DSP Mandate

The purpose of the DSP is to confirm that owners of dams licensed under the *WSA* operate their dams in a safe manner in accordance with the Regulation.

The objective of the Regulation is to mitigate loss of life and damage to property and the environment from a dam breach by requiring dam owners to inspect their own dams, undertake proper maintenance on them, and ensure that these dams meet engineering standards to minimize associated public safety, economic, social, and environmental risks.

This mandate is realized through the DSP’s 4 objectives:

1. Providing formal and informal training to dam owners and dam safety professionals,
2. Ensuring dam owner compliance with the Regulation,
3. Reviewing project plans for dams to ensure consistency with Canadian Dam Association (CDA) guidelines and other industry standard practices, and
4. Supporting dam safety emergency planning and response.

2.0 DAMS IN B.C.

2.1 Why We Have Dams

While the diverse physiography of B.C. provides its people tremendous social and economic opportunities, it also presents challenges for the management of water resources during times of water deficit or surplus. One of the important solutions to manage the availability and use of water is through the impoundment or diversion of water using dams. Provincially, dams serve many purposes including:

- Power generation
- Municipal and domestic water supply
- Irrigation and livestock watering
- Fish and wildlife enhancement
- Industrial use
- Recreation
- Flood control

2.2 Status of B.C. Dams

In B.C. there are 1,966 active water supply dams registered with the DSP. Of these, 1,824 fall under the Regulation (see Table 1 and Figure 2).

Table 1: Regulatory Status of Active Dams under the Regulation, WSA (as of March 3, 2021) per Natural Resource Area and Regions

Natural Resource Areas and Regions	Regulated	Not Regulated	Total
Cariboo Region	370	5	375
Thompson – Okanagan Region	662	72	734
Kootenay - Boundary Region	109	8	117
<i>South Area - Subtotal</i>	<i>1141</i>	<i>85</i>	<i>1226</i>
West Coast Region	327	31	358
South Coast Region	105	11	116
<i>Coast Area - Subtotal</i>	<i>432</i>	<i>42</i>	<i>474</i>
Skeena Region	92	6	98
Omineca Region	77	7	84
North East Region	82	2	84
<i>North Area - Subtotal</i>	<i>251</i>	<i>15</i>	<i>266</i>
All Active Dams - Total	1824	142	1966

2.3 Failure Consequence Classification of Dams

Under the Regulation, a dam failure consequence classification is given to all active freshwater storage dams based on the potential for loss of life, the deterioration of environmental and cultural values, and the losses to infrastructure and the economy should the dam fail. The dam failure consequence classification of the 1824 active regulated dams in BC are depicted in the chart below.

Failure Consequence Classification of Active Regulated BC Dams

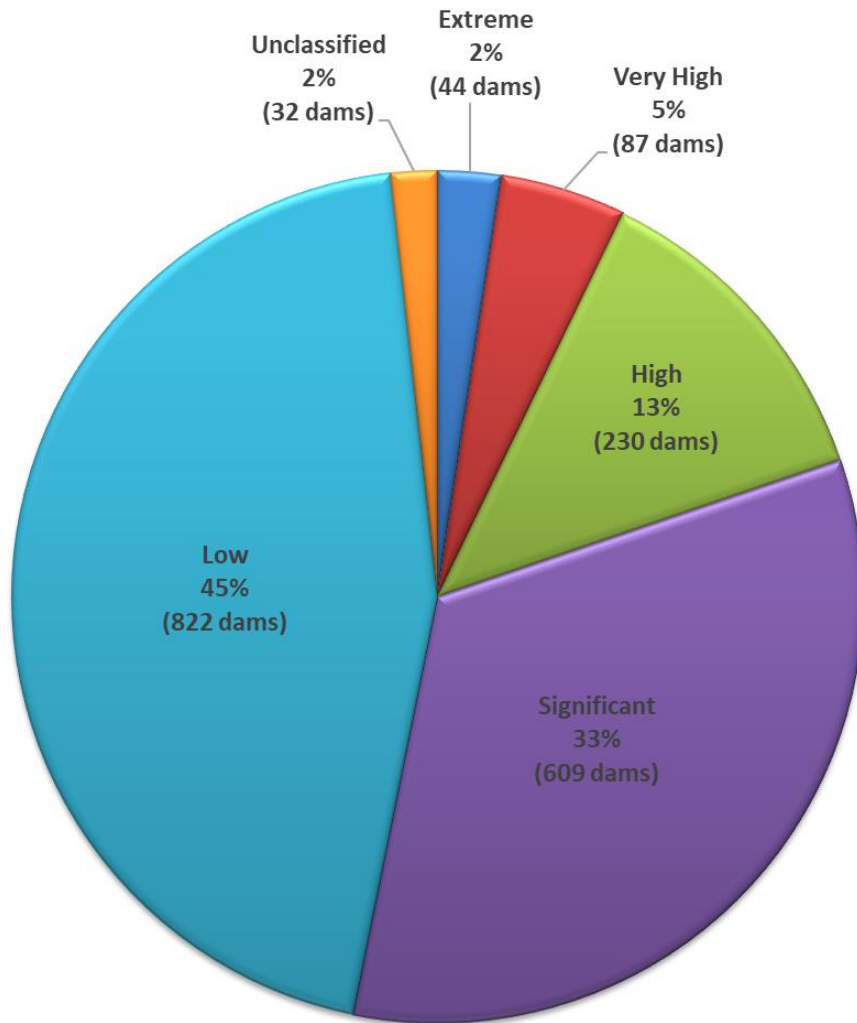


Figure 1: Distribution of Dam Failure Consequence Classification (as of March 3rd, 2021) amongst Active Regulated B.C. Dams

Of all dams in British Columbia, 62% are located in the South Natural Resource Area, 20% are located in the North Natural Resource Area, and 18% are located in the Coast Natural Resource Area (see Figure 2).

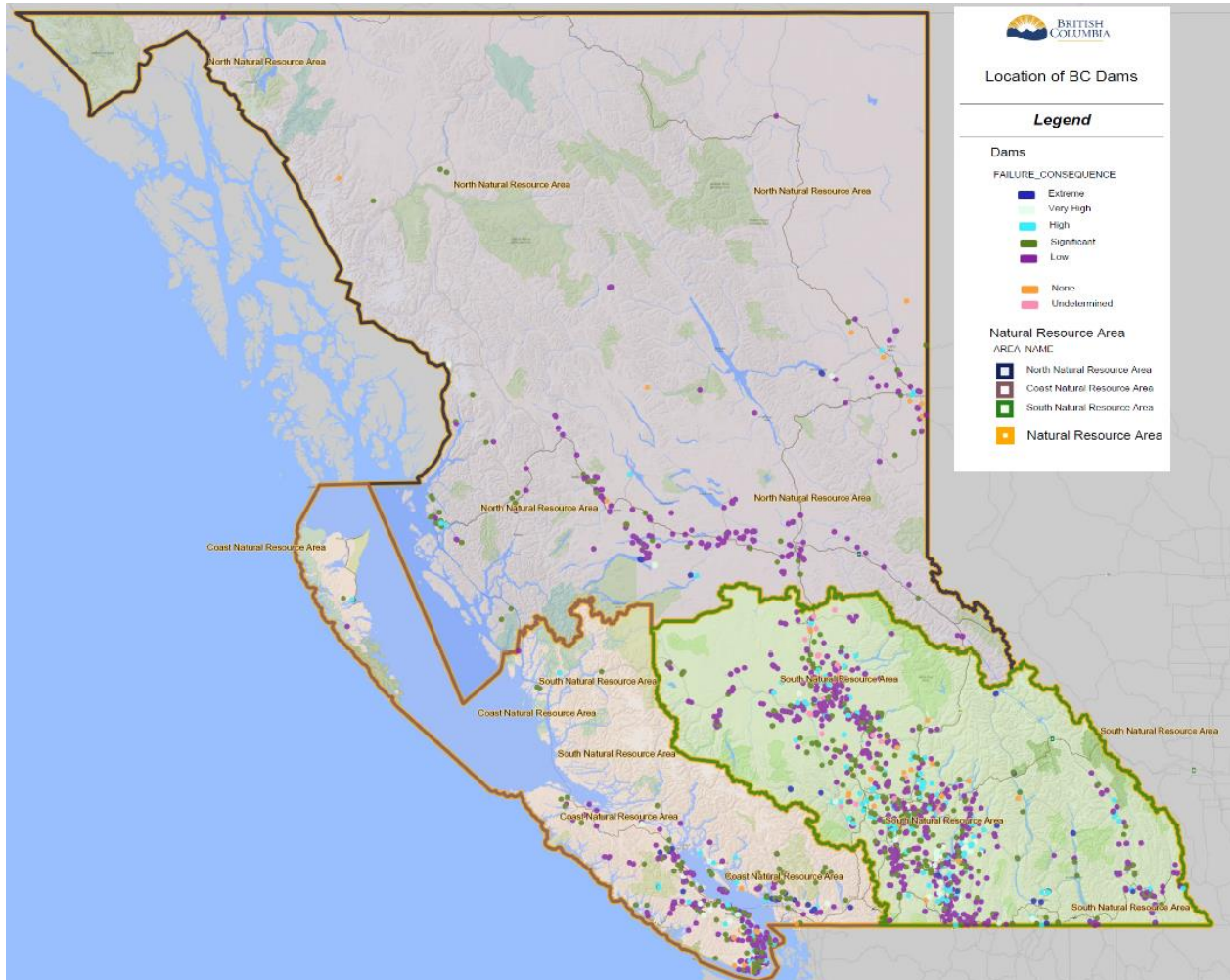


Figure 2: Spatial Distribution of B.C. dams by Dam Failure Consequence Classification

2.4 Failure Risk Level of Dams

Failure Risk Level is determined from a combination of the dam failure consequence classification and the failure probability rating of a dam. The failure probability rating is influenced by several factors such as the dam’s design, construction method, and level of operation, maintenance and surveillance undertaken by the dam owner. In British Columbia, the risk of active regulated dams is classified into the following five levels (see Figure 3):

1 - ALERT (immediate attention required):

A dam identified with this risk level requires enhanced monitoring, involvement of consultants, and repairs to be made as soon as possible. The provincial Dam Safety Officer (DSO) may restrict reservoir operation. The Dam Emergency Plan (DEP) should be reviewed. The Comptroller of Water Rights (CWR) or Water Manager (WM) is notified of the situation. An Order made under the *WSA* may be issued to the dam owner.

2 - CAUTION (considerable work to do):

For this risk level, the dam requires increased monitoring and planning for rehabilitation. The DSO may require modification of the reservoir operation, and the DEP reviewed. The DSO may request submission of Inspection Report (perhaps weekly), revision of the Operation, Maintenance and Surveillance (OMS) manual, or require that the dam owner complete an early dam safety review. The CWR or WM is made aware of the situation.

Risk Level 2 is further defined by the following subcategories:

- (a) owner is not actively working on correcting the deficiency, OR
- (b) owner is actively working on an approved project to correct the deficiency.

3 - STABLE:

This risk level requires regular owner inspections of dams plus monitoring of operation under peak loading conditions. Rehabilitation of hazardous conditions of the dam is required. The DSO may request submission of Inspection Report (perhaps weekly), revision of the OMS manual, or require that the dam owner complete an early dam safety review.

4 - NO CONCERNS:

For this risk level, the dam is included in regular audit program to identify any changes to normal operation.

5 - EFFECTUAL (significant and low consequence dams ONLY):

With this risk level, Significant failure consequence dams are included in regular dam audit program to monitor determinants of the failure consequence. The dam is under normal operation.

Note:

- Currently there are 18 dams that remain to be audited and assigned a Failure Risk Level. A cursory review by DSOs indicates that none of these 18 dams pose a Risk Level of 1 or 2.

Risk Levels of Active Regulated Dams in BC

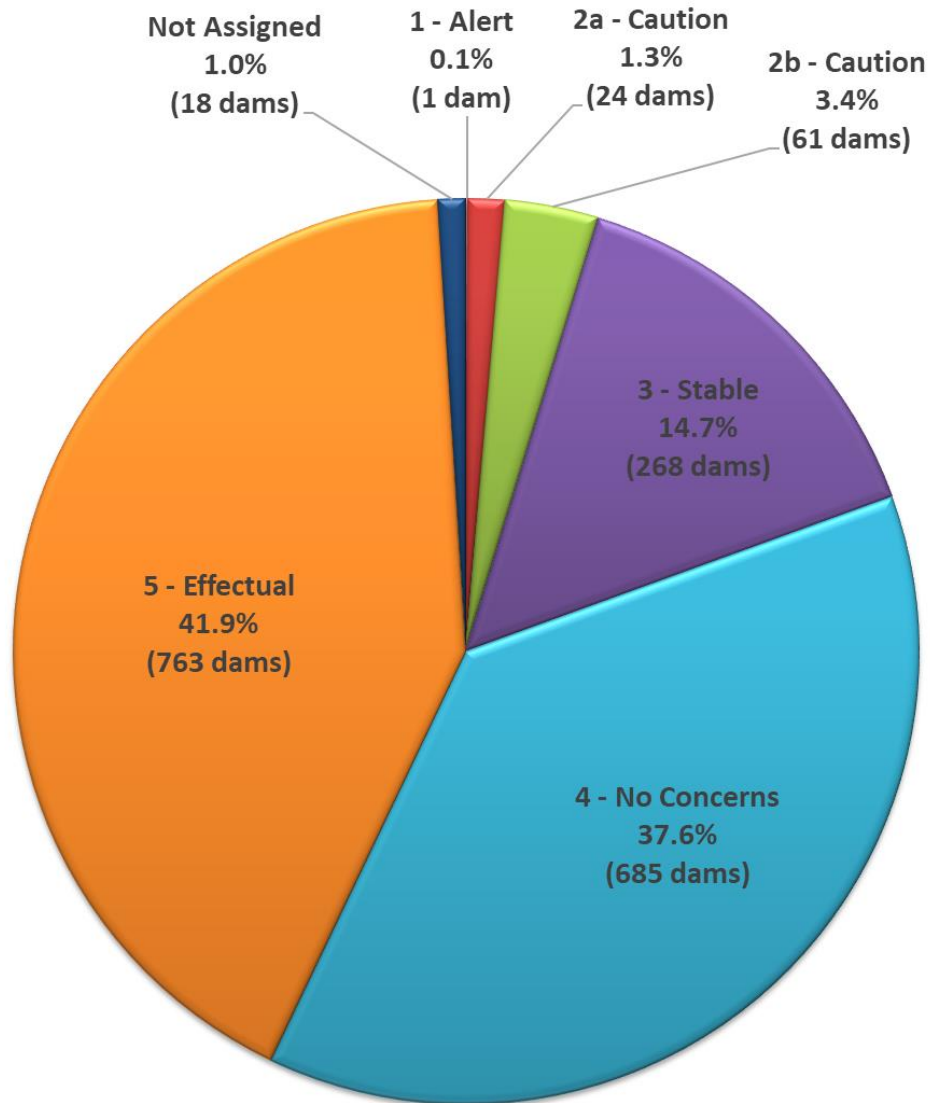


Figure 3: Failure Risk Level Classification of Active Regulated B.C. Dams (as of January 27th, 2021)

Although the DSP audits dam owners routinely, dams with higher risk levels may be audited more frequently (see Figure 4 for the locations of Risk Level 1 and 2 dams as of February 18, 2021):

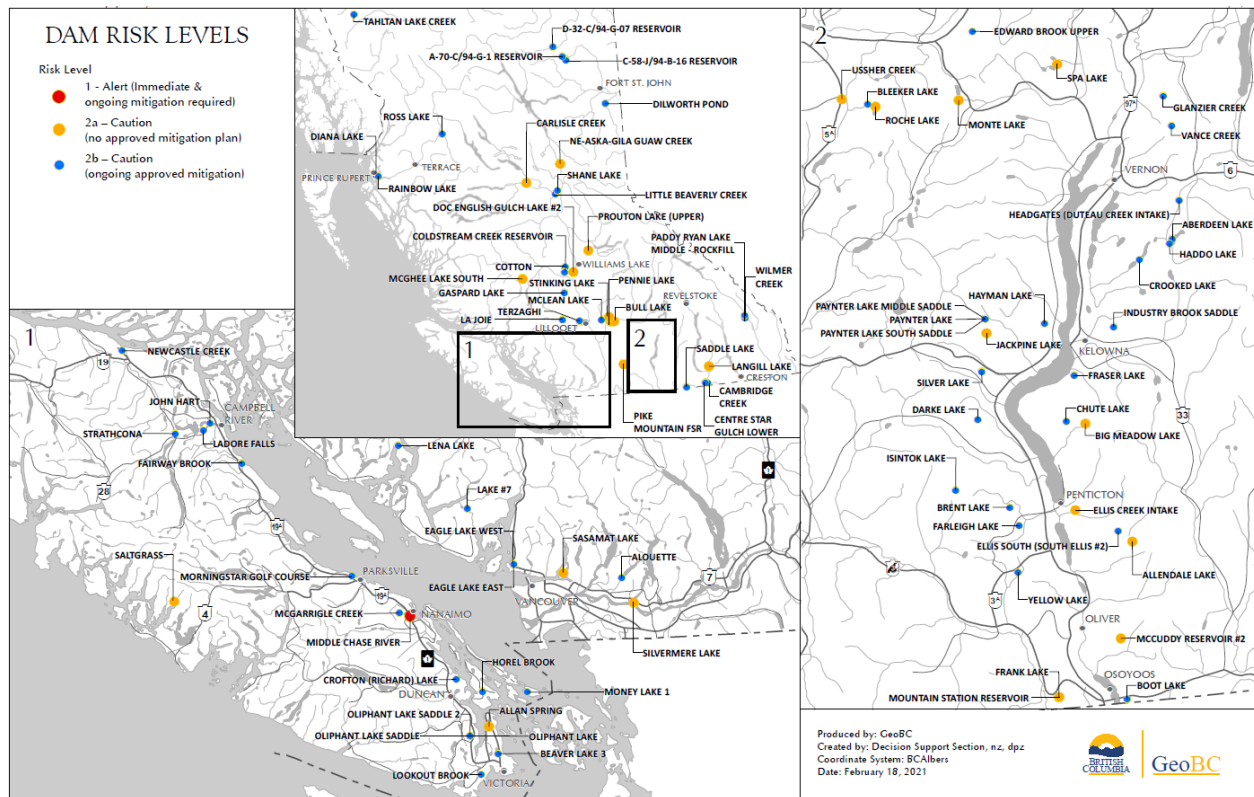


Figure 4: Locations of current Risk Level 1 and 2 dams in B.C.

3.0 2020/2021 DAM SAFETY PROGRAM SUMMARY

The COVID-19 pandemic has demanded dam safety staff across the province to creatively deliver the DSP while keeping the public and themselves safe. For example, external training of dam owners and their staff and the internal annual Community of Practice meeting for FLNR/OGC dam safety staff was conducted online. Despite the COVID-19 restrictions, the DSP and its staff had many accomplishments.

3.1 Key Performance Indicators for the DSP

To measure the effectiveness of the DSP the following Key Performance Indicators (KPI) were chosen:

3.1.1 Educating Dam Owners

In response to the Covid-19 pandemic and public health protocols limiting public interaction, the DSP partnered with the Ministry of Agriculture, Food, and Fisheries and hired a qualified dam engineering consulting firm to develop dam safety educational webinars for dam owners. These webinars were delivered in the first quarter of 2021 and covered core concepts and fundamental knowledge on dam safety. Table 2 provides further information and links to the webinar recordings.

Table 2: Dam Safety Webinar information

Webinars (linked)	Description	Attendance Numbers
Webinar 1: Surveillance and Inspection	Best practices of site surveillance, documentation, and reporting. Includes information on: <ul style="list-style-type: none"> dam classification dam case examples dam owner responsibilities regulatory requirements in BC records management 	57
Webinar 2: Operations, Maintenance and Repair	Best practices in routine operations, maintenance, and repairs. Includes information on: <ul style="list-style-type: none"> operations under seasonal conditions monitoring instrumentation data equipment testing repairs 	68
Webinar 3: Emergency Planning & Response	Best practices in incident management, hazardous conditions, and emergency planning. Includes information on: <ul style="list-style-type: none"> dam failures dam emergency plan emergency response case examples 	48
Total Number of Webinar Trainees		173

KPI – Educating Dam Owners

1. Purpose: Assess the level of engaged and proactive dam owners.

	Attendance	Goal
Dam Owner Education (In-class, webinars, etc.)	173	120

2. Purpose: Assess effectiveness of formal dam safety training initiatives. Note score is based on post course surveys using a Likert Scale (1 indicates Poor and 5 indicates Exceptional).

	Average Score (out of 5)	Goal
Average Course Feedback from Attendees	4.6	4

3.1.2 DSP Audit of Dams

All owners of dams that have a failure consequence classification of Significant, High, Very High or Extreme are audited by the DSP's Dam Safety Officers (DSOs) at regular intervals. These audits are performed to ensure that owners of dams are compliant with the Regulation. The audits are an opportunity for DSOs to meet with and educate dam owners, review their records, conduct site visits, and identify deficiencies. The dam audit targets and number of completed audits for 2020/21 by administrative unit are shown in Table 3.

Table 3: Dam audits in 2020/2021 identified by administrative unit

Administrative Unit (FLNR/OGC)	Dam Audit Target for 2020/21	Dam Audits Completed*
Dam Safety Section	25	18
West Coast	14	18
South Coast	8	11
Thompson	26	24
Cariboo	17	31
Kootenay	5	5
Okanagan	20	7
North	10	14
B.C. Oil and Gas Commission	0	0
B.C. Total	125	128

KPI - Dam Audits

Purpose: Assesses resourcing capacity of the program.

	2020/21 Audits Required	2020/21 Audits Completed	% Complete	Goal
Dam Audits	125	128	102	90

3.1.3 Self-Reporting by Owners on the Status of their Dams

Every December all owners of dams that have a failure consequence classification of High, Very High or Extreme are required to submit a report on the regulatory compliance status of their dams by March of the following year. DSOs use the information in the report to assess compliance levels, update information in the provincial dam database, and help dam owners address any emerging dam safety issues. The following information collected from these reports is used as KPIs of the DSP:

- Annual dam status reports (returns/required),
- Formal inspections (completed/required),
- Site surveillance (completed/required),

- Operations, Maintenance, and Surveillance (OMS) manual (updated/required),
- Dam Emergency Plan (DEP) (updated/required),
- DEP contact information (updated/required),
- DEP information submitted to LEA (submitted/required), and
- Verification of changes to downstream land use that might affect the failure consequence classification (completed/required).

The dam owners' status reports for 2020 are summarized by administrative units in Table 4:

Table 4: 2020/21 Summary of Dam Owner Compliance by Administrative Unit

Administrative Units	% Compliance							
	Reports Submitted	Formal Inspections	Site Surveillance	OMS	DEP	DEP Contact Info	DEP to LEA	Verification of No Land Use Changes
Dam Safety Section (Victoria)	97%	100%	100%	91%	95%	93%	88%	94%
West Coast	94%	86%	100%	97%	90%	82%	68%	89%
South Coast	100%	88%	100%	82%	94%	76%	76%	100%
Cariboo	91%	100%	100%	93%	79%	93%	48%	100%
Thompson	91%	98%	98%	83%	81%	84%	58%	100%
Okanagan	98%	100%	96%	71%	78%	94%	88%	87%
Kootenay	100%	92%	100%	62%	69%	85%	92%	100%
North	100%	100%	100%	100%	100%	80%	80%	100%
B.C. Oil and Gas Commission	100%	100%	100%	83%	83%	83%	50%	100%
B.C.	96%	98%	99%	86%	87%	90%	77%	95%

KPI - Annual Dam Status Reports for High, Very High and Extreme Failure Consequence Dams

1. Purpose: Assesses outreach and engagement with dam owners.

	Total Required for H, VH, E Dams	No. Reports Received	% Return	Goal
Dam Status Reports	357	342	96	95

2. Purpose: Assesses whether dam owners have conducted formal inspections.

	Total Required for H, VH, E Dams	Formal Inspections conducted	% Completed	Goal
Formal Inspections	342	334	98	100

3. Purpose: Assesses whether dam owners have conducted site surveillance.

	Total Required for H, VH, E Dams	Site Surveillance conducted	% Conducted	Goal
Site Surveillance	341	292	86	100

4. Purpose: Assesses whether dam owners have updated their OMS manuals.

	Total Required for H, VH, E Dams	OMS manuals updated	% Updated	Goal
Up-to-date OMS manual	342	334	98	100

5. Purpose: Assesses whether dam owners have updated their DEP.

	Total Required for H, VH, E Dams	DEP updated	% Updated	Goal
Up-to-date DEP	340	297	87	100

6. Purpose: Assesses whether dam owners have updated the contact information in their DEP.

	Total Required for H, VH, E Dams	Updated DEP contact information	% Updated	Goal
Up-to-date DEP Contact Information	338	303	90	100

7. Purpose: Assesses whether dam owners have submitted DEP information to the LEA.

	Total Required for H, VH, E Dams	LEA submissions completed	% Completed	Goal
Up-to-date information submitted to LEA	341	264	77	100

8. Purpose: Assesses whether dam owners have verified that no land use changes have occurred downstream of their dam that would change the dam failure consequence classification of their dam.

	Total Required for H, VH, E Dams	Verification completed	% Completed	Goal
Verification - No land use changes downstream of dam	340	322	95	100

3.2 Office of the Auditor General’s Audit of the DSP

In the Fall of 2020 the Office of the Auditor General (OAG) confirmed they would undertake an audit of the DSP pursuant to section 11(8) of the *Auditor General Act* giving them the authority to assess, among other things, the efficiency, effectiveness and economy of provincial government programs and services. The objective of the audit is to determine whether FLNR has effectively overseen the safety of dams in B.C.

The audit is currently in progress and is focused on FLNR’s work to promote, verify, and enforce dam owner’s compliance with the Regulation along with how FLNR monitors its own performance to ensure that the DSP is effective. The audit will primarily focus on dam safety program activities from January 1, 2020 to December 31, 2020 but will also include relevant information prior to that timeframe that impact program activities in 2020.

The OAG report on the DSP is scheduled to be published in the Fall of 2021.

3.3 B.C. Extreme Flood Project

The B.C. Extreme Flood Project consisted of three separate sub-projects. The goal of the project was to supplement available hydrology and hydrometeorological information and improve the quality and confidence in baseline data pertaining to the magnitude and uncertainty of extreme flood events to support the design of hydrotechnical structures. The reports will be available through the provincial government’s [Ecological Reports Catalogue](#).

3.3.1 Regional Flood Frequency Analysis (RFFA)

The RFFA was completed for the province of B.C. and extended into Yukon, Alberta, Alaska, Washington, Idaho, and Montana to expand the Study Region and take advantage of the streamflow data in these other jurisdictions.

3.3.2 Regional Precipitation Frequency Analysis (RPFA)

The RPFA was completed for the province of B.C. and extended into Yukon, Alberta, Alaska, Washington, Idaho, Montana, Oregon, northern California, northern Nevada, northern Utah, and western Wyoming. A total of 2,966 meteorological stations within the project domain were utilized for the frequency analysis.

3.3.4 Probable Maximum Precipitation (PMP)

B.C. specific guidelines were developed and PMP values calculated in four separate regions across the study domain using historical storm selection. The PMP study domain was consistent with the RPFA study area. Storm intervals assessed were 24-hr, 48-hr in all regions, and additionally 72-hr in the lowland interior and up to 96-hr for the coastal region.

3.4 Climate Change Actions

The DSP anticipates that dams will continue to play a large role in a changing climate throughout the province; hydropower will remain as a dominant provider of electricity and more water storage will be required in regions where increased water scarcity is projected.

Precipitation and streamflow patterns will change. Our current methodology to assess dam reservoir Inflow Design Floods (IDF) is based upon guidelines created by the CDA. Any dam with a Significant failure consequence, where loss of life is possible in the event of failure, must be designed to safely pass a hydrological event with an annual exceedance probability better than 1/100 years. Any dam with an Extreme failure consequence, where loss of life after a failure could result in more than 100 fatalities, must be designed to safely pass the Probable Maximum Flood (PMF). The PMF is a deterministic method that evaluates the greatest amount of inflow possible into the dam's watershed. These values have annual exceedance probabilities greater than 1/10,000 years.

Guidelines surrounding the Regulation of dams in a changing climate are still in development. Moreover, B.C. has diverse geography where climate change will manifest in different ways. Our current guidelines are conservative and can account for this uncertainty to keep British Columbians safe while we work with multiple stakeholders in the global dam safety community to develop defensible methods that are conservatively balanced against the risks.

3.5 WSA Orders to Ensure Dam Owner Compliance

The Comptroller of Water Rights, Water Managers and Engineers all have the authority under the WSA to issued Orders to owners of dams. These Orders vary greatly from authorizations to undertake dam rehabilitation work to compliance and enforcement directives such as dam decommissioning. In 2020/21 a total of 50 Orders were issued to owners of dams (see Table 5 for numbers of orders issued per administrative unit):

Table 5: Number of WSA Orders Issued per Administrative Unit

Administrative Unit (FLNR/OGC)	No. of Orders
Dam Safety Section	13
West Coast	6
South Coast	2
Thompson	7
Cariboo	4
Kootenay	1
Okanagan	7
North	10
B.C. Oil and Gas Commission	0
B.C. Total	50

3.6 Funding Programs

Many dam owners lack the resources to make necessary upgrades to their dams to keep the public safe. However, there are several applicable federal and provincial funding programs such as the *Investing in Canada Infrastructure Fund* that are available to assist dam owners. Many dam owners are unaware of such programs and this year the DSP updated its [website](#) to include links to these resources (refer to Funding Opportunities sidebar on the DSP website). Additionally, DSOs will now advise dam owners of the website linking to funding programs.

4.0 Dam Emergency Response

4.1 Impact of Flooding on Dams in B.C.

In B.C. the highest risk of flooding occurs in the Spring due to additional runoff from the melting snowpack. However, snowpack alone cannot predict whether flooding will occur or not. Irrespective of snowpack levels, the timing and severity of temperature and rainfall patterns are important drivers of flooding at any time of the year and owners of dams are advised to monitor weather warnings closely and are urged to take the necessary precautions during these times. The DSP notifies owners of dams when high risk of flooding is predicted in their area.

4.2 Dam Incidents

When an incident related to a dam is reported, a DSO will, as stated in the provincial Dam Emergency Response Plan, assess the situation to determine the severity and the level of response required. Although not all reported incidents are deemed an emergency or even an issue related to a dam, each report is investigated, and a Dam Incident Report created and filed. The following is a list of the dam incidents reported in 2020/21:

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

An actual breach of the dam has occurred, or severe abnormal conditions or performance of the dam is occurring that has a significant probability of leading to a breach of the dam.

There were four dam breaches reported in 2020/21.

1. Dam Name: Little Beverly Creek Dam
DFile: D530199-00
Date: April 5, 2020
Classification: High
Location: West of Prince George

On April 12, 2020, dam owners discovered seepage downstream of Little Beverly Creek Dam during freshet. During the next two weeks the owners conducted surveillance of the dam and brought in equipment to shore up the upstream face of the dam to minimize downstream seepage. Thirteen siphon lines of two to four-inch diameter were originally used to control the flows into the reservoir but eventually were used to dewater the reservoir. On April 20, 2020, erosion was discovered at the downflow culvert under the main 1000mm culvert. The main culvert was then blocked to prevent seepage downstream. The water level rose until the spillway passed the freshet flow. Two days later, the water level stabilized but on April 24, it fell due to continued siphoning. Minimal seepage was still observed. Another two days later, an active sinkhole was formed on the downstream side of the dam. On April 26 at a site visit, FLNR staff ordered the dam owner to retain a qualified engineering consultant oversee the work to dewater the site and produce a plan to either rehabilitate or decommission the dam. The consultant determined that piping around the culvert was responsible for the failure of the culvert and the dam. A temporary breach was created in the dam to keep the reservoir from filling during freshet. On November 20, the dam was removed by the dam owner.

2. Dam Name: Spokin Lake Dam
DFile: D810450-00
Date: April 23, 2020
Classification: Low
Location: Northeast of 150 Mile House

On April 23rd, 2020, FLNR staff discovered Spokin Lake Dam was overtopping at the peak of freshet, starting the erosion of the downstream slope of the dam (Photo1). The unauthorized dam has an undersized outlet inadequate to pass inflows which cause flooding. It causes the reservoir to back up and floods upstream residential areas and the Spokin Lake Road at 11km. FLNR notified and worked on a plan with the dam owner to decommission the dam. An Order was issued on November 25th, which the dam owner promptly complied with, resulting in the decommissioning of the dam on February 24th, 2021.



Photo 1: Overtopping and erosion of downstream face of Spokin Lake Dam

3. Dam Name: Valley Pond (Lower) Dam
DFile: D810559-00
Date: June 23, 2020
Classification: Low
Location: Near 150 Mile House

On June 23rd, 2020, on a works assessment regarding land transfer to the new owner from the former owner, FLNR staff discovered Valley Pond (Lower) Dam already breached (Photo 2). FLNR is coordinating efforts between the two parties ensuring that the dam is either decommissioned or rehabilitated in compliance with the Regulation and the choice of either one will depend on the needs of the new owner.



Photo 2: Valley Pond (Upper) Dam breach

4. Dam Name: Unauthorized dams on tributary to Kiskatinaw River
DFile: None
Date: July 2, 2020
Classification: Probably Significant
Location: Southwest of Pine Valley, northeastern B.C.

On July 2nd, 2020, FLNR staff reported the failure of two unauthorized earthen dams associated with adjacent ponds on a tributary to the Kiskatinaw River (Photo 3). The lower pond was dammed and there was no spillway nor outlet supporting it. The lower pond dam was breached and at the time of the initial report the owner mobilized an excavator to control the erosion of the breach. The upper pond flowed into the lower pond through an outlet channel which was also slowly eroding. Current satellite imagery shows the dams have been removed but the bed of the lower pond has been raised yet still allowing drainage from the upper pond area. There are issues associated with unlicensed use of water and unauthorized construction of works especially dams that FLNR is currently resolving legally with the dam owner.



Photo 3: Unauthorized dams associated with storage ponds southwest of Pine Valley

4.2.2 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, breach may occur.

There were eight dam alerts reported in 2020/21.

1. Dam Name: Goldie Lake Dam
DFile: D110229-00
Date: May 15, 2020
Classification: Low
Location: East of Clinton

On May 15, 2020, FLNR staff discovered Goldie Lake Dam was overtopping because of the 900mm culvert spillway under the road accessing recreational land on the other side of the lake was blocked with debris (Photo 4). The dam owner, upon being notified by FLNR to activate the dam emergency plan, removed the debris with equipment to allow flood water pass through the spillway to reduce the water level. The owner was also required to monitor the condition of the dam. FLNR staff have since been to the site to confirm the work has been completed, water level receding, and the spillway performing as it should.



Photo 4: Overtopping of Goldie Lake Dam (looking south south-west from right bank)

2. Dam Name: Ussher Creek Dam
DFile: D120298-00
Date: June 15, 2020
Classification: Significant
Location: Southeast of Kamloops

On June 15, 2020, Ministry of Transportation and Infrastructure (MOTI) staff notified FLNR that Chilliheetza Pond had exceeded its capacity overtopping Ussher Creek Dam (Photo 5). The resulting excessive flows downstream impacted the ditches and undersized culverts of Hwy 5A below, near Shumway Lake. On a visit to the dam, FLNR staff discovered the cause of the overtopping: the dam did not have a lower level outlet, showed excessive seepage below the dam, and had debris blocking the spillway. The dam owner was contacted to clear the spillway of the debris, monitor the condition of the dam, retain a qualified engineer to assess the dam, and keep FLNR informed of any development. It was evident that the dam owner had not maintained the flows into the reservoir nor the dam. Because of the lack of full channel flow in recent years and continued property development downstream of the dam, no action was taken during the time for dam remediation. The owner only monitored the condition of the dam and continued surveillance of Hwy 5A to ensure the travelling public was not put at risk. FLNR followed up with an order for the owner to drain the reservoir and assemble a plan to either repair or replace the dam. The current water licence held by

the owner does not permit the total diversion of water from Ussher Creek to the reservoir. FLNR had also ordered the installation of a proper and adjustable diversion structure.



Photo 5: Debris in the spillway and high-water level at the Ussher Creek Dam (looking southeast)

- Dam Name: Kloiya Dam
DFile: D630007-00
Date: August 15, 2020
Classification: Significant
Location: East of Port Edward

On August 15, 2020, rainfall from a large localized storm increased the reservoir level of Kloiya Dam causing large flows through the spillway of the dam breaking the log boom holding a lot of debris (Photo 6). The dam owner advised FLNR that the debris would be removed from the spillway, the spillway inspected, and the log boom repaired; these were all completed when the reservoir level fell after the storm to its normal level. The gates were also inspected.



Photo 6: Log Debris from broken boom at Kloiya Dam

- 4. Dam Name: Diana Lake Dam
- DFile: D630002-01
- Date: August 15, 2020
- Classification: High
- Location: East of Port Edward

On August 15, 2020, the same storm impacting Kloiya Dam also impacted Diana Lake Dam raising the reservoir level resulting in large flows bringing log debris onto the spillway (Photo 7). Similarly, the dam owner hired a contractor to remove the debris from the spillway and reset the log boom when it was safe. After the storm, the owner drew down the reservoir to inspect the spillway and the dam including the gates.



Photo 7: Log debris on the spillway of the Diana Lake Dam

- 5. Dam Name: Ross Lake Dam
- DFile: D620240-00
- Date: November 13, 2020
- Classification: High
- Location: Southwest of New Hazelton

On November 13, 2020, FLNR was made aware of an unauthorized 65m long dam on the northern end of the Ross Lake Park. On November 16 and 18, the dam owner and FLNR staff discovered Ross Lake Dam had overtopped and a stable breach had formed spilling water into a channel outlet (Photo 8) which flowed in the direction of the Bulkley River. At the time, no sign of active erosion of fill material was visible and the dam allowed 1.5m depth of live storage of water. Concerned that an uncontrolled breach could destroy railway infrastructure below, FLNR ordered the dam owner on November 20 to breach the dam to prevent any water storage and then retain a qualified professional to assess the structure. FLNR is working with the dam owner to either rehabilitate or decommission the dam depending on the interests of the dam owner and Canadian National Railway.



Photo 8: Upstream view of breached dam looking south to Ross Lake

6. Dam Name: Pike Mountain FDR Dam
DFile: D230153-00
Date: Unknown
Classification: Significant
Location: South of Aspen Grove
7. Dam Name: Frank Lake Dam
DFile: D230122-00
Date: Unknown
Classification: Significant
Location: West of Osoyoos
8. Dam Name: Saltgrass Pond Dam
DFile: D220171-00
Date: Unknown

Classification: Significant
Location: South of Willowbrook

4.2.3 Dam Incident (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 breach of the dam.

There were thirteen dam incidents reported in 2020/21.

1. Dam Name: Unauthorized dam on lake west of Okanagan Lake
DFile: None
Date: April 6, 2020
Classification: Significant
Location: Vicinity of Turtle Road in Okanagan Falls

On April 6, 2020, FLNR staff discovered a dam was constructed on an unnamed lake near Okanagan Falls (Photo 9). On April 23rd, a DSO further found the dam to have 0.8m of material added, raising the dam crest to 6m in height to accommodate a corrugated metal pipe 40cm in diameter as a spillway. Freeboard on the lake was 0.5m and seepage at the downstream toe of the dam was at 1 to 2 litres per minute. The DSO determined that the dam was regulated under the Dam Safety Regulation. After contacting the owner the next day about the dam, FLNR learned that the owner thought he was authorized to construct the dam from the water licences he was issued. None of the licences authorized the construction of the dam at this location. Uncontrolled release of water from this lake would create a debris flow that would destroy private and public roads downstream of the dam causing significant damage. The dam owner was directed to remove the dam, or if the dam was to be kept, to have it rehabilitated to meet the requirements of the Regulation.



Photo 9: Unauthorized regulated dam with recently added culvert spillway of unnamed lake northwest of Okanagan Falls.

2. Dam Name: Anahim Creek Diversion Dam
DFile: D810584-00
Date: April 30, 2020

Classification: Significant

Location: Northeast of Alexis Creek

On April 30, 2020 during an aerial rapid dam assessment, FLNR staff noted Anahim Creek Diversion Dam was performing as designed but discovered other problems with the dam that needed to be rectified. Specifically, debris plugged the gate (Photo 10), scouring the left and right abutments, concrete catwalk supports excessively damaged, the stair foundation settled, gate slides misaligned, and the lock block reinforcement wall had fallen into the creek. FLNR has directed the dam owner to retain a qualified engineer to review the dam and other structures and plan the repair of the facilities.



Photo 10: Debris plugging the opening preventing closure of the slide gate of the Anahim Creek Diversion Dam

3. Dam Name: Cold Spring Creek Dam
DFile: D330122-00
Date: May 31, 2020
Classification: Significant
Location: Vicinity of Fairmont Hotsprings

On May 31st, 2020, 33mm of rainfall in the area around Fairmont Hotsprings followed by two days of extremely hot weather resulted in substantial snow melt in the upper elevations. This triggered several debris flows that flooded areas of the town including Cold Spring channel and Cold Spring Creek Dam. In addition to the debris filling the headpond behind the dam, it overtopped the dam, eroding the abutments on the downstream face (Photo 11). The Regional District of the East Kootenay (RDEK) have dredged the reservoir of the dam to remove debris as part of an extensive effort to repair the damage caused by the debris flood. FLNR was informed by the RDEK that the repairs to the dam, however, was not completed by the dam owner. FLNR staff had confirmed with the owner on June 17th that the dam had been rehabilitated. They also informed the dam owner on the need to contact FLNR when a hazardous incident occurs at the dam. RDEK had commissioned

several studies which recommended that the dam and reservoir be upgraded to also contain debris and improve routing of water flow, should a similar event recur on the Cold Spring Creek.



Photo 11: Downstream face of the Cold Spring Creek dam showing path of water to right side of spillway and resulting scour (Credit: Northwest Hydraulics Consultants)

4. Dam Name: Rover Creek Dam
DFile: D350152-00
Date: June 2, 2020
Classification: Significant
Location: West of South Slocan

On June 2nd, 2020 during freshet, FLNR staff was notified by dam owner staff that sediment was filling the reservoir of Rover Creek Dam to the height of the spillway sill (Photo 12) because of increased inflows. In monitoring the condition of the dam, they were advised to contact FLNR if there were changes that require attention. They had indicated that the new sediment load would be dredged after the freshet.



Photo 12: The sediment load has reached the spillway sill of the Rover Creek Dam

5. Dam Name: Headwaters #1 Dam
DFile: D220003-00
Date: June 3, 2020
Classification: Very High
Location: West of Peachland

On June 3rd, 2020 after regular surveillance, dam owner staff contacted FLNR about a seepage boil discovered at the toe of Headwaters #1 Dam. Such boils emerge typically due to preferential water flow and movement of soil particles through earthen dams towards the downstream toe and, if not remediated, can eventually lead to internal piping failure. FLNR staff advised the dam owner to provide updates on the progress of the work to mitigate piping. The dam owner had retained an engineering consultant to investigate and recommend appropriate measures to repair the problem and to keep FLNR informed of the work. In addition to receiving an engineering report documenting the work that was completed, FLNR staff have visited the site on July 24th to review and confirm the placement of a sand/gravel filter over the boil and continued surveillance (Photo 13).



Photo 13: Repaired boil at Headwaters #1 Dam. Photo taken on July 24, 2020.

6. Dam Name: Bleeker Lake Dam
DFile: D120113-00
Date: June 8, 2020
Classification: Significant
Location: South of Kamloops

On June 8, 2020, FLNR staff visited Bleeker Lake Dam and discovered the following: 30cm freeboard of the reservoir level, numerous areas of subsidence on the crest, debris and vegetation in the spillway, and indications of seepage on the downstream face of the dam. In several notifications made to the dam owner in 2019 and following this visit, FLNR staff communicated to the dam owner that the gate controlling the lower level outlet was still inoperable and needed to be repaired. On October 30, 2020, FLNR issued an order for the dam owner to drain the reservoir, retain a professional engineer to plan the rehabilitation of the dam, and undertake work to complete the repairs of the dam in a timely manner.

7. Dam Name: Cleveland Dam
DFile: D420003-00
Date: October 1, 2020
Classification: Extreme
Location: Head of Capilano River, North Vancouver

On October 1, 2020, the radial drum gate of Cleveland Dam unexpectedly open spilling water during maintenance work on sensors that control the drum gate (Photo 14). This sudden uncontrolled release of water into the Capilano River resulted in the deaths of two people and injury to several other people who were recreating near the river. FLNR staff have met Metro Vancouver dam safety staff and completed a site visit to review and work with Metro Vancouver to determine the cause of the dam incident. An investigation by Metro Vancouver revealed that faulty instrumentation programming controlling the movement of the gate by dam maintenance staff created conditions

leading to an unscheduled release of water. Staff responsible for the incident had their employment subsequently terminated. Other investigations conducted by the RCMP, BC Coroner's Service, and WorkSafe BC are currently underway. The BC Dam Safety Program will be closely reviewing any recommendations regarding public safety around dams resulting from these assessments to help improve public safety.



Photo 14: Uncontrolled release of water from the Cleveland Dam, October 1, 2020
(Credit: Twitter/Christine Tam)

8. Dam Name: Unknown dam near Usk
DFile: None
Date: Unknown
Classification: Unknown
Location: Northeast of Terrace

After consultation with the FLNR staff, the unauthorized dam discovered in 2019 was completely removed from the creek during the dry summer months when no water was present.

9. Dam Name: Swede Creek Dam
DFile: D620202-00
Date: Unknown
Classification: Low
Location: Pineview area, southeast of Prince George

The unauthorized dam discovered in 2020 was originally authorized as an off-channel dugout to store water. Beavers have dammed up the outlet, and possibly the inlet. FLNR staff are currently working with the owner to bring the dam into compliance.

10. Dam Name: Natta Creek Dam
DFile: D530170-00
Date: Unknown
Classification: Low
Location: Southwest of Prince George

11. Dam Name: Neilson Lake Dam
DFile: D530192-00
Date: Unknown
Classification: Low
Location: Adjacent to Summit Lake, north of Prince George

The dam was inundated due to culvert issues under the road downstream. Culverts are being replaced, and the condition of the dam will be checked in 2021.

12. Dam Name: Willan Lake Dam
DFile: D810140-00
Date: Unknown
Classification: Low
Location: South of Alexis Creek

13. Dam Name: Unauthorized dam on Hawks Creek
DFile: None
Date: Unknown
Classification: Unknown
Location: North of Williams Lake?

4.2.4 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 seven reports classified as “no dam incidents” in 2020/21.

1. Dam Name: Twin Lake (Lower and Upper) Dams
DFile: D120296-00 and D120197-00
Date: April 27, 2020
Classification: Both Significant
Location: West of Kamloops

On April 27, 2020, staff associated with the ranch below Twin Lake (Lower and Upper) Dams reported the headgates of both dams missing to FLNR. FLNR contacted the dam owner about the vandalism who then replaced the headgates.

2. Dam Name: Peter Hope Lake Dam
DFile: D130167-00
Date: April 28, 2020
Classification: High
Location: Northeast of Merritt

On April 28, 2020, a member of the public was concerned about the excessive flows associated with Peter Hope Lake Dam. FLNR explained that the water licence for conservation allowed maintenance of high-water level in the reservoir.

3. Dam Name: Palmer Meadows Dam
DFile: D130164-00
Date: May 1, 2020
Classification: Significant
Location: Northeast of Merritt

On May 1, 2020, local government staff reported a potential breach to FLNR at Palmer Meadows Dam because of high water flows from the lower level outlet and the spillway. FLNR advised local government that there was no breach by email on May 4, 2020 after confirming with the dam owner that no breach occurred. A week earlier, the dam owner had opened the lower level outlet to alleviate rising water level due to potential freshet flows. This action had assisted with moving the high inflows.

4. Dam Name: Hutchison Lake Dam
DFile: D110210-00
Date: May 11, 2020
Classification: Significant
Location: East of 70 Mile House

On May 11, 2020, a concerned member of the public had reported to FLNR that Hutchison Lake Dam was experiencing freshet outflows. The lower level outlet could not be opened because the outflow channel was piled with earth. A sinkhole also had formed on the downstream toe of the dam. FLNR staff had previously noted similar occurrences with past freshets. Typically, the spillway would flow freely; while the water level may rise due to the earth in the channel, it would recede as designed to the full supply level.

5. Dam Name: Saddle Lake Dam
DFile: D210135-00
Date: May 30, 2020
Classification: Very High
Location: North of Almond Gardens

On May 30th, 2020, Regional District of Kootenay Boundary staff alerted FLNR about the rehabilitated Saddle Lake Dam whose new spillway was to be tested against inflows arising from forecasted extreme precipitation. It required additional surveillance. No incident arose from these abnormal flows that required FLNR attention.

6. Dam Name: Sooke Lake Dam
DFile: D730006-01
Date: December 10, 2020
Classification: Extreme
Location: West of Langford

On December 10, 2020, Sooke Lake Dam owner staff, conducting maintenance work stripping the ground to bedrock at the toe of the dam, discovered seepage collecting in the created depression (Photo 15) over time. A consultant engineer determined that the source of the seepage was not from the dam but from the rockfill also located at the toe of the dam but higher up relative to the depression location.



Photo 15: Filled depression at toe of Sooke Lake Dam where seepage collected

- 7. Dam Name: Lake #7 Dam
- DFile: D420005-00
- Date: Unknown
- Classification: Very High
- Location: North of Port Mellon

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