

## BC DAM SAFETY PROGRAM ANNUAL REPORT 2014/2015

### SUMMARY

This annual report summarizes the challenges, achievements and ongoing improvements to the Ministry of Forests, Lands and Natural Resource Operations Dam Safety Program. In 2014/2015 the Dam Safety Program regulated approximately 1,560 water supply dams in British Columbia. Major dams (>9m high) are regulated by the Dam Safety Section in Victoria, while the majority of the remaining dams are regulated by seven regional dam safety officers. Regulated dams, which divert and/or store surface water, require a water licence issued under the *Water Act* and are subject to the B.C. Dam Safety Regulation. These structures include dams associated with hydro-electric power generation, agricultural irrigation, industrial use, municipal water supply and domestic use—as well as structures that regulate lake or river levels.

Highlights of the 2014/2015 Dam Safety Program include:

#### *Operations*

- Similar to last year, staff reviewed 49 sets of plans covering new dams, rehabilitation or upgrading of existing dams and dam removals. Staff were also involved in monitoring 32 dams in the construction, rehabilitation, upgrading or decommissioning phases. This is an increase of 68% from the previous year.
- 76 Operation, Maintenance and Surveillance manuals (OMS) and 81 Emergency Preparedness Plans (EPPs) were reviewed. This is part of an effort to update and upgrade the quality and thoroughness of OMS manuals and EPPs.
- Staff considered 11 requests for change in failure consequence classification. The requirements of the Dam Safety Regulation are based on the failure consequence classification of a particular dam, so it is important that the consequence classification is correct and upgraded appropriately in response to any downstream development.
- 113 dam owners, or their representatives, and qualified professionals were informed about, or trained in, dam safety by program staff—including 11 government staff. This is just short of double the previous year.
- 36 ministry staff received dam assessment training. This is an increase from 26 the previous year.
- 132 dam safety audits were conducted. This number is down 29 from last year and below the annual target of 137, in part due to staff turnover. Despite the shortfall this year, the number of audits conducted keeps the program on pace to meet its commitment to audit all high, very high and extreme failure consequence dams every five years, and each significant consequence dam every 10 years.
- Annual dam status reporting forms were received from owners of 95% of the 354 high, very high and extreme failure consequence classification dams in the province. Of these, dam owners

reported that 90% of the dams were inspected annually. This is a decrease in both return of the reports and number of inspections reported as completed compared to last year.

- Of the high, very high and extreme failure consequence classification dams, 73% were reported as having completed the required dam safety reviews, an 8% increase over last year. Of the 117 dams identified by dam safety officers as currently having outstanding dam safety reviews, 87% of those reviews are in progress.
- 87% of water supply dams can be viewed on Google Earth and through Data BC. This is up 6% from last year.
- Dam safety officers responded to two dam failures, three dam alerts, three dam incidents and six reports of incidents for dams where no action was required. This was up slightly from last year (2, 2, 1 and 2 respectively).
- The two reports of dam failures were both at unregistered dams that were unknown to the Dam Safety Program before they failed. Fortunately there was no loss of life although damage to property occurred and in one instance traffic management was required during the event. This highlights the importance of dam owners complying with the *Water Act* and BC Dam Safety Regulation and implementing dam safety programs.
- There were three reports of dam alerts last year. The emergency response system worked well in all cases and timely action was taken to prevent the alerts from progressing to a more serious situation.

### ***Program Improvements***

- The dam registry has been modified significantly over the past year to further improve dam information management, searching and reporting functions, and to allow better tracking of dam owner compliance by ministry staff.
- Dam safety staff participated in a number of opportunities for professional development including external training provided by other jurisdictions and professional associations.
- Dam safety staff developed policy and guidance documents for both dam owners and ministry staff and implemented improvements to the dam safety program.
- Drafting began on an amendment to the B.C. Dam Safety Regulation that will be implemented, along with the *Water Sustainability Act*, early in 2016.

Overall, with a program that was fully staffed for most of the year, significant improvements were made in a number of areas and staff continue to work on improving where deficiencies are identified. In addition, the framework for delivering the dam safety program in the coming years was strengthened.

## Table of Contents

SUMMARY .....	1
INTRODUCTION .....	5
BACKGROUND .....	7
PROGRAM ACCOMPLISHMENTS .....	7
• Education and Awareness .....	7
• Outreach and Professional Development .....	8
• Annual Dam Status Report - Self Reporting by Owners .....	8
• Dam Safety Reviews .....	10
• Audits of Owner Dam Safety Programs.....	12
• Reviewing Plans and Monitoring Work in Progress .....	13
• Operational Reviews .....	13
• Dam Registry .....	14
• 2010 Rapid Dam Assessments Followup.....	16
• Other Dam Safety Program Highlights .....	16
DAM INCIDENTS .....	17
CONCLUSION .....	22

### LIST OF FIGURES

Figure 1: Regulated dams in British Columbia

Figure 2: Dam owners returning completed Dam Status Report forms

Figure 3: Dam owners self reporting completion of required annual dam inspection

Figure 4: Audits completed by dam safety officers

Figure 5: Audit of the dam registry

### LIST OF TABLES

Table 1: Status of outstanding dam safety reviews as reported by dam safety officers.

Table 2: Construction/rehabilitation/decommissioning – reviews and monitoring.

Table 3: OMS Manuals, EPPs and Changes in Failure Consequence Classification

### LIST OF PHOTOS

Photo 1: Embankment dam failure near Salmon Arm

Photo 2: Embankment dam failure near Bear Lake, Regional District of Fraser Fort George

Photo 3: Myren Creek – collapsed flume and eroded face

Photo 4: Myren Creek – slump on downstream face of dam

Photo 5: Myren Creek – tension crack on the dam crest

Photo 6: Vernon – seepage below beaver dam at decommissioned (breached) dam site

Photo 7: Mit Lake – blocked spillway culvert

Photo 8: Butchard Lake Dam #5 – sinkhole on downstream face

## INTRODUCTION

This annual report summarizes the challenges, achievements and ongoing improvements to the Ministry of Forests, Lands and Natural Resource Operations Dam Safety Program. 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. This report summarizes the activities undertaken by the dam safety program and reports on Dam Safety Regulation compliance for the period April 1, 2014 to March 31, 2015 for dams regulated under the *Water Act*.

In 2014/2015 the Dam Safety Program regulated approximately 1,560 water supply dams in British Columbia. Most major dams (>9m high) are regulated by the Dam Safety Section in Victoria, while the majority of the remaining dams are regulated by the seven regional dam safety officers (Figure 1). Regulated dams require a water licence issued under the *Water Act* and are subject to the B.C. Dam Safety Regulation. These structures include dams associated with hydro-electric power generation, agricultural irrigation, industrial use, municipal water supply and domestic use—as well as structures that regulate lake or river levels.

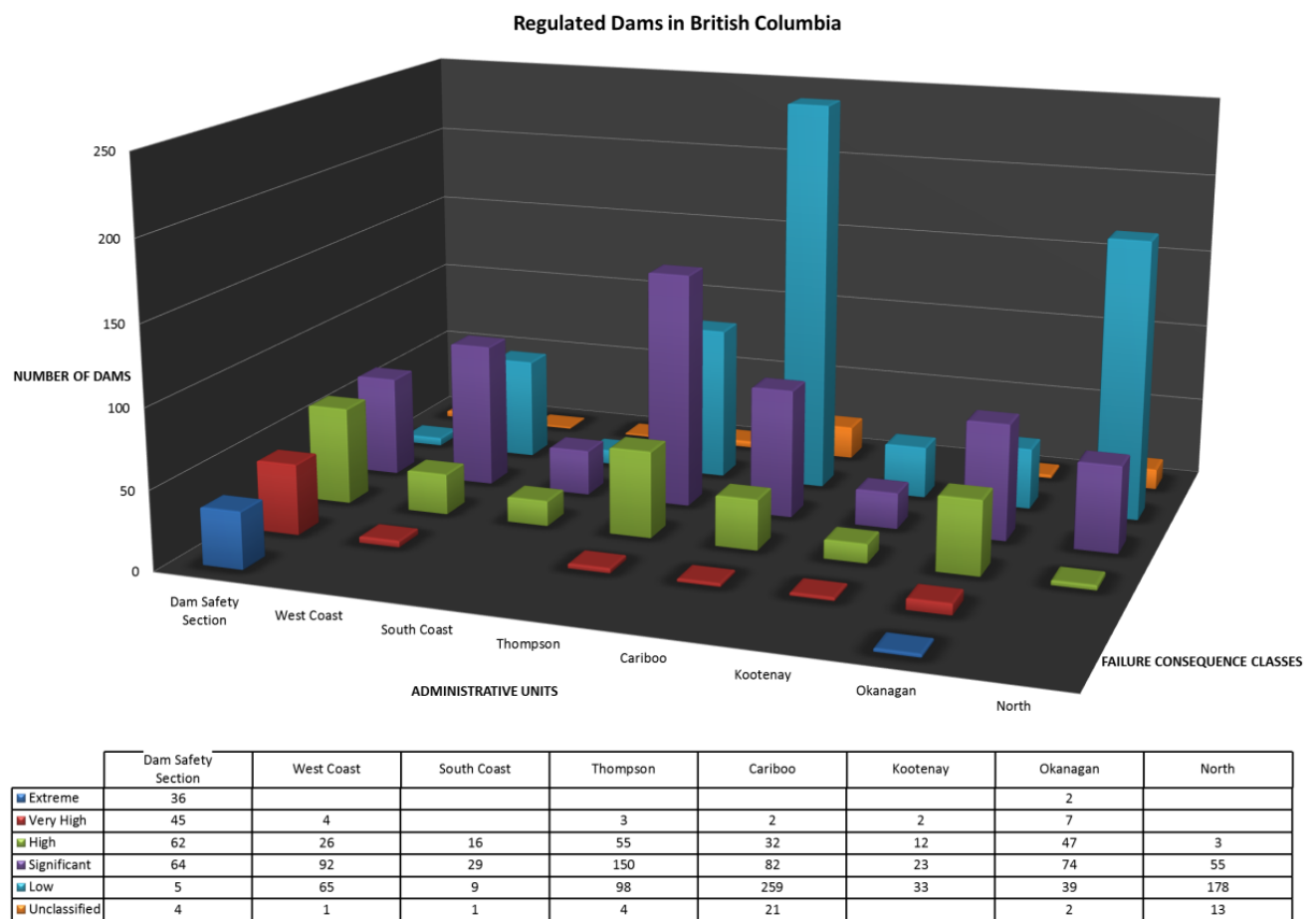


Figure 1: Regulated Dams in British Columbia

Similar looking impoundment structures on mine sites such as tailings storage facilities, sediment control or sludge ponds, and diversion channels are regulated under the *Mines Act* and the Health, Safety and Reclamation Code for Mines in B.C. As these structures are not regulated under the *Water Act* they are not discussed in this report. An MoU between the Ministry of Forests, Lands and Natural Resource Operations and Ministry of Energy and Mines clearly delineates who is responsible for which structures to ensure that every structure is regulated.

Similarly, dugouts and other water storage or diversion structures that do not divert or store surface water (they may store unconsolidated surface runoff, direct precipitation or groundwater) are not licenced under the *Water Act* and therefore are not included in this report. Dikes are also dam-like structures, but are regulated under the *Dike Maintenance Act* so are not included in this report. Of the approximately 1,560 regulated dams in B.C., 1,501 are in active operation. The others are in the application stage, under construction and/or rehabilitation, temporarily drained, filled with sediment, partially breached, breached or abandoned. The active dams range in size from some of the largest structures in Canada, such as the Mica Dam which generates hydroelectric power, to small earth-filled dams that create water storage for domestic use. For the purposes of this report, unregulated dams are those that do not meet the definition and combination of criteria (that is, dam height, volume of water stored or failure consequence classification) specified in the Regulation and are not authorized under the *Water Act*. Breached dams include those intentionally breached as part of decommissioning, or those breached by previous dam failure. Dam safety program staff also deal with unregulated water supply dams when necessary to ensure public safety, protect the environment, cultural values, infrastructure and the economy, and to ensure compliance with the B.C. Dam Safety Regulation. These include dams that meet the specifications in the Regulation but were not previously known to the dam safety program staff either because they are historic dams that have been long forgotten or they have been constructed more recently without the required authorization.

The Dam Safety Section in Victoria has responsibility for the administration of the provincial dam safety program and regulation of most dams greater than nine metres in height (also known as major dams). Dams less than nine metres high comprise the regional component of the dam safety program and are primarily administered by regional dam safety officers. Staff support to the program is also provided by the ministry's compliance and enforcement branch and other ministry staff, in addition to partner agencies such as Emergency Management BC.

All dam owners in British Columbia are legally responsible for the operation, inspection and maintenance of their dams to minimize risk to the public, the environment and the economy. To ensure that dam owners are aware of, and in compliance with, the regulation and their obligations, dam safety officers conduct audits of dam owners' safety programs and provide education and awareness to dam owners. Each year the owners of dams with a failure consequence of high, very high and extreme are required to complete and return a form, self-reporting on the status of their dam and its dam safety program. The responses help staff determine whether the dams are being inspected and maintained by the dam owner, as per the regulation, between audits conducted by dam safety officers. The self-reporting form is also a good tool for encouraging dam owners to review the status of their dam safety program on a yearly basis.

Dam safety officers maintain information on each of the dams in the provincial dam registry. Dam safety officers also review and approve project plans for new dams, the alteration of existing dams or the removal of dams, as well as respond to emergencies and situation call-outs.

## **BACKGROUND**

Prior to 1967, the safety of dams across B.C. was regulated by Regional Engineers on an ad-hoc basis. In response to the dam building boom in the 1960s, a provincial dam safety program was established by the Comptroller of Water Rights in 1967 to ensure the public safety of large dams. The program was initially for those dams above 15 metres in height but was expanded later to include dams higher than nine metres. Smaller dams continued to be inspected by Water Rights staff under the supervision of Regional Engineers. In 1976, a pilot inventory of Vancouver Island dams of less than nine metres in height provided the impetus to have dam safety staff undertake dam inspections of many of the smaller dams as well.

In 1995, the Cannon Creek dam failure started the evolution of the B.C. Dam Safety Program into its current form. An independent, comprehensive program review was commissioned in 1996 by the Province which resulted in recommendations to: place the responsibility for the safety of the dam on the dam owner; inject more rigour, consistency and accountability into the Dam Safety Program; and provide the needed resources and staff to deliver the program. The review also confirmed the importance of the dam safety guidance provided by the Canadian Dam Association (CDA) and recommended it to be the standard to follow.

From 1996 to 2007, the B.C. Dam Safety Program renewed its efforts with the introduction of an enabling regulation in 2000, that gave it the means to: implement dam safety practices with owners and their dams; replace the inspection role of government staff with that of dam audits; develop a dam owner compliance strategy; and adapt elements of the CDA guidelines into policy and practice suitable for B.C.

The 2010 Testalinden dam failure and the subsequent Deputy Solicitor General's recommendations have resulted in further improvements to the B.C. Dam Safety Program in a model of ongoing continuous improvement.

## **PROGRAM ACCOMPLISHMENTS**

In 2014/15, the Dam Safety Program had many accomplishments across different components of the program, including:

### **Education and Awareness**

The Dam Safety Program has a robust education and awareness program for dam owners ranging from provision of informal training to dam owners and their staff (for example, when dam safety officers audit dams) to formal training in workshops conducted by Dam Safety Program staff.

Victoria dam safety staff continue to work jointly with regional dam safety officers when formal training is delivered to dam owners and government staff in their region. In the past year, 11 provincial government employees from the Ministry of Transportation and Infrastructure and Ministry of Forests,

Lands and Natural Resource Operations were trained as “dam owners” at a customized, one-day course on inspection and maintenance of dams. A dam safety officer delivered a presentation at the regional FLNRO Thompson/Okanagan Water Allocation staff workshop. Internally, dam assessment courses were also delivered to 26 ministry staff in Fort St. John and 10 ministry staff in Dawson Creek.

Twenty-seven participants attended a dam owner workshop facilitated by Dam Safety Program staff and sponsored by the B.C. Water and Waste Association. A similar workshop was also provided at the Water Supply Association of BC conference. A dam safety staff member participated as a panelist at the Coast Water Resources Association Dam Safety webinar in Kelowna that had 20 participants, and a staff member assisted in delivering a Dam Safety Review webinar in Vancouver sponsored by the Association of Professional Engineers and Geologists of B.C. (APEGBC) which had 55 participants.

Annual meetings were held with large dam owners, including BC Hydro and Rio Tinto, to discuss ongoing dam safety programs and current dam safety issues.

### **Outreach and Professional Development**

In 2014/15, dam safety staff continued to collaborate with their counterparts in other jurisdictions, industry and professional associations on developing dam safety practices. Staff were involved with the APEGBC in the development of Professional Practice Guidelines for the site characterization of dams in B.C. Participation also continues with the CDA Regulators Committee and now also with the Emergency Management Working Group in the critical area of emergency preparedness planning and response.

Dam safety officers have made use of opportunities to participate in various technical webinars provided by the Association of State Dam Safety Officials (ASDSO). In the last year, several dam safety staff have advanced their knowledge through participation at the ASDSO regional conference and the CDA Annual General Meeting and Conference and represented B.C.’s interest at these meetings.

This year marked the 30<sup>th</sup> anniversary of the annual Dam Safety Program Community of Practice meeting. This meeting was held jointly with Flood Safety staff over three and a half days and provided an excellent opportunity for collaboration on similar technical and safety related issues. Subject matter experts were invited from BC Hydro, APEGBC, Golder Associates, Ducks Unlimited, Gastaldo Concrete, Emergency Management BC, Thurber Engineering Ltd. and Natural Resources Canada. The meeting elicited many interesting discussions and decisions for policy development or modification.

### **Annual Dam Status Report - Self Reporting by Owners**

Under the B.C. Dam Safety Regulation, owners of dams with high, very high and extreme downstream failure consequence classifications are required to, annually, self report on activities they are required to do under the Regulation. In particular they report on whether they have:

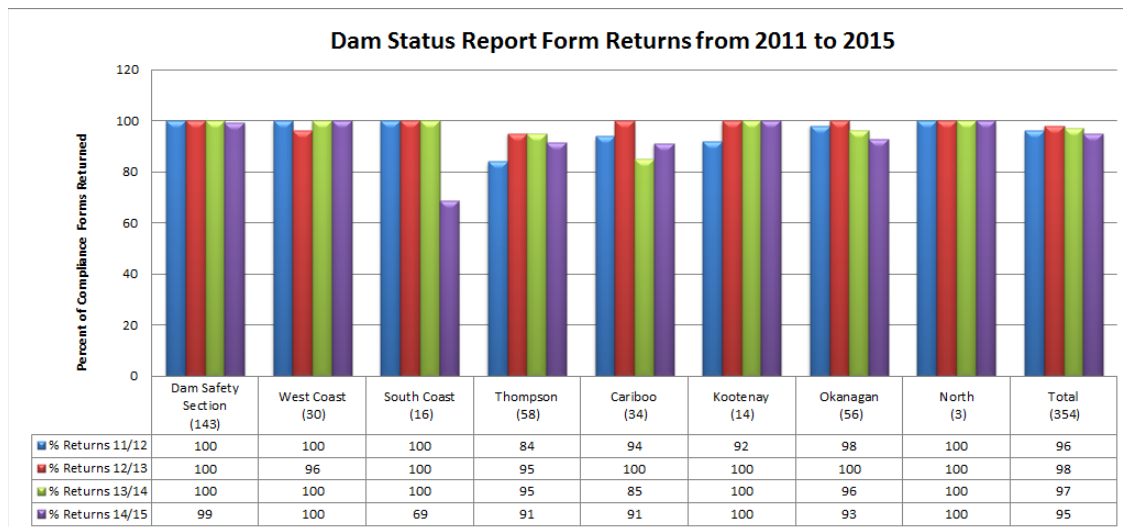
1. Completed the required formal inspections and conducted regular site surveillance;
2. A current dam safety review completed by a qualified professional engineer;
3. A current operations, maintenance and surveillance manual;
4. An updated emergency preparedness plan;
5. Observed and determined whether there has been any downstream land use development that might affect the failure consequence classification of the dam; and



6. Identified any new dam safety concerns that have not previously been reported.

The annual reports, submitted by dam owners, provide valuable insight for dam safety officers into whether a dam owner is in compliance with the Regulation. Annual reports are especially useful in years when a dam is not scheduled for audit by dam safety staff. The reports are also used to prioritize dams where additional audits or a site visit might be beneficial. Since 2006, annual reporting by dam owners has improved substantially.

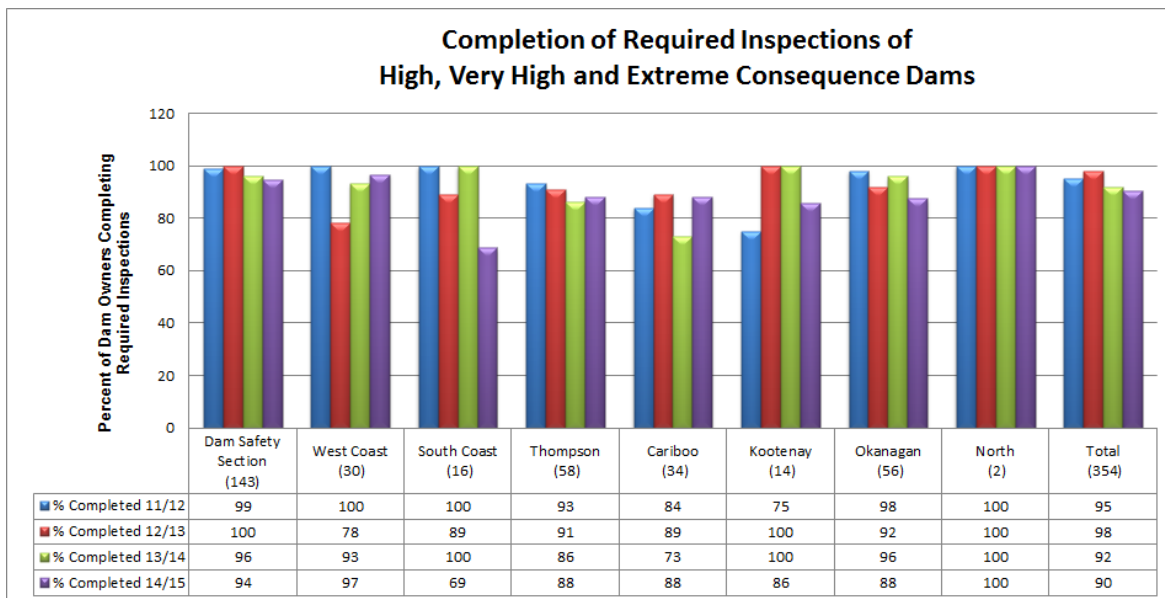
Figure 2 provides a summary of the number of annual reports submitted by dam owners each year over the last four years. This year, reports were returned for all but 18 of 354 dams. Total returns in each of the previous three years were slightly higher. For the two years prior to 2014, the returns were higher because Dam Safety Program staff called and spoke with individual dam owners requesting them to return the completed reports. In 2013/14, a new strategy was introduced to reduce the amount of staff time spent contacting dam owners to encourage submission of the reports. With the support of the compliance and enforcement branch, dam owners were advised that enforcement measures under the *Water Act* could be taken if their completed forms were not returned. This new approach has resulted in a slightly lower return rate of the dam status reports by dam owners, down to 95% from 97%. The trend is being monitored and if it continues, the strategy will be adjusted.



**Figure 2: Percent of dam owners returning completed Dam Status Report forms.** (Numbers in brackets are the number of dams in each administrative unit that are required to submit dam status report forms each year.)

Over the last four years, the returned reports indicate that the percentage of dam owners who completed the required formal inspections has decreased from a peak in 2012/13 of 98% to 90% in 2014/15 (Figure 3). Decreases occurred within the South Coast, Kootenay, and Okanagan regions, with a small increase in the West Coast and Thompson regions. If the decreasing trend continues, the compliance and enforcement strategy will be adjusted to bring dam owners into compliance. Periodic audits by dam safety officers also indicate that not everyone who self reports as having conducted a formal annual inspection actually carried out the required work. Where dam owners are not meeting their reporting and inspection obligations, staff follow-up throughout the year to ensure the dam owners

understand the regulatory requirements and the link to public safety. Failure to comply with the Regulation may result in enforcement action.



**Figure 3: Percent of dam owners self reporting they completed the required annual formal inspections.**  
(Numbers in brackets are the number of dams in each administrative unit that are required to conduct formal annual inspections in 2014/15.)

### Dam Safety Reviews

Under the Regulation, owners of high, very high and extreme failure consequence classification dams are legally required to retain qualified engineers to conduct dam safety reviews. The engineers evaluate the safety of the dams and the dam owners' safety programs and prepare a report which is provided to the dam owner and the dam safety officer. The dam owner is then responsible for following up on deficiencies identified in the review. This requirement was introduced in the Regulation in 2000 and dam owners were given 10 years to have the first review completed. Reviews are required to be submitted every seven years for extreme failure consequence classification dams and every 10 years for high and very high failure consequence classification dams. Since 2000, some dam owners have completed one or more dam safety reviews, others have dam safety reviews in progress and a few have yet to begin the dam safety review.

Dam safety officers reported the status of dam safety reviews as of March 31, 2015 (Table 1). There were 21 dam safety reviews accepted during 2014/15 and 117 outstanding. Of the 117 outstanding dam safety reviews, 15 have not yet been started while 62 are underway by dam owners. An additional 24 have been submitted and are being reviewed by the dam safety officer and 16 dam safety reviews were submitted but have been returned to the owner because additional work is required. It is expected that the number of outstanding dam safety reviews will decrease by 30–40% in 2015/16.

**Table 1: Status of outstanding dam safety reviews as reported by dam safety officers.**

	FLNRO Administrative Areas								
	Dam Safety Section	West Coast	South Coast	Thompson	Cariboo	Kootenay	Okanagan	North	Total
<b>Dams with outstanding Dam Safety Reviews:</b>									
Not started	2	4	0	2	1	4	2	0	15
Started, with work in progress	13	7	0	27	12	0	0	3	62
Submitted to and being reviewed by dam safety officer	13	5	0	0	1	0	4	1	24
Reviewed but not accepted by dam safety officer. Returned to owner because more work is needed.	2	3	0	0	3	3	4	1	16
<b>Total: Outstanding Dam Safety Reviews as of March 31, 2015</b>	<b>30</b>	<b>19</b>	<b>0</b>	<b>29</b>	<b>17</b>	<b>7</b>	<b>10</b>	<b>5</b>	<b>117</b>
<b>Dam Safety Reviews accepted in 2014/2015</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>4</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>0</b>	<b>21</b>
<b>Total: (Accepted + Outstanding)</b>	<b>31</b>	<b>21</b>	<b>0</b>	<b>33</b>	<b>23</b>	<b>11</b>	<b>14</b>	<b>5</b>	<b>138</b>

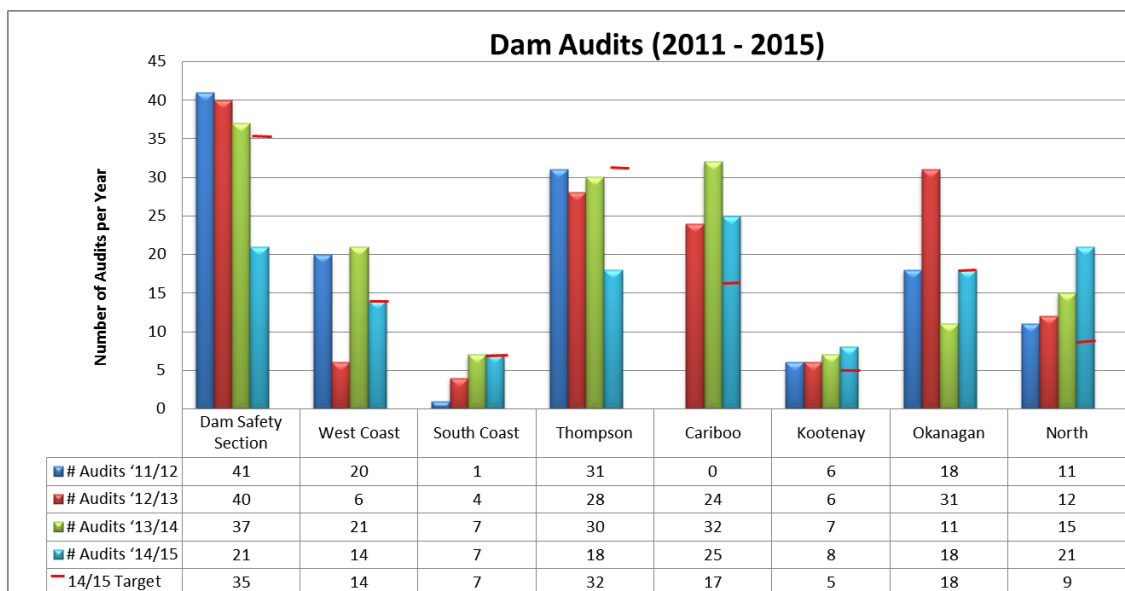
The Dam Safety Program, in collaboration with the ministry's compliance and enforcement branch, implemented a strategy in 2012 to have non-compliant dam owners complete overdue dam safety reviews for their dams. All non-compliant owners of each dam (some dams have multiple owners) were notified of their obligations under the *Water Act* and given adequate time to contact the appropriate dam safety officer about the status of their dam safety reviews. In November 2012, non-compliant dam owners were again reminded of the need for a dam safety review when they received their annual B.C. Dam Safety Regulation compliance reporting form. Non-compliant owners of 133 dams were notified of the requirement by letter. Due to the relatively small number of dams requiring dam safety reviews in their areas, the West Coast Region and North areas opted to contact non-compliant dam owners by phone or in person to encourage owners to have dam safety reviews completed.

The number of dams with outstanding dam safety reviews has declined from 55% to 27% since the compliance and enforcement program has been in effect. There are a number of contributing factors but the compliance and enforcement program has had a significant role in encouraging dam owners to complete the required reviews. The dam safety review compliance and enforcement project will continue until all the dams requiring a dam safety review are in compliance. After which, the program will continue ensuring that additional dam safety reviews are conducted when the appropriate submission anniversaries roll around—every seven to 10 years depending on the failure consequence classification of the dam.

## 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 each of the significant failure consequence classification dams. Each dam safety officer has an annual target of audits to complete to ensure that all dam audits are completed within the required timeframe. The audits are an opportunity for dam safety officers to meet with dam owners, review the records being kept and do a site visit at the dams with the owners. These audits help confirm whether the dam owner is aware of and is carrying out the requirements of the Regulation. If deficiencies are found, staff can provide information to help dam owners address the problems. When necessary, follow-up is done by dam safety officers to ensure that any identified issues are corrected.

In 2014/15, dam safety officers and other trained staff completed a total of 132 audits. This is about 4% less than the average annual target of 137 dam audits (Figure 4). The Dam Safety Section has about 143 dams on a five-year audit schedule and 60 dams on a 10-year audit schedule. The audit target for the Dam Safety Section is 35 per year and in some years more are done (e.g. 2011 through 2014) and some years less (e.g. 2014/15). The lower number of audits done by the Dam Safety Section was due in part to having exceeded the target in the previous three years as well as a vacancy for a portion of the year, as well as a focus on other higher priority dam safety issues and decommissioning of a number of dams. The Thompson area also had a vacancy for some months following retirement of the dam safety officer so also did not meet their average annual target. Several dam safety officers met or exceeded their target, in some cases making up for previous years when targets were not met. An increase in annual dam audits can be attributed to several factors. For example, efficiencies gained when a large number of dams belonging to one dam owner are grouped together for audits or a number of dams within the same geographic area are audited at the same time. In years when targets are not met the shortfall is usually addressed in a subsequent year to ensure all dams are audited on schedule.



**Figure 4: Number of audits completed by dam safety officers.**

## Reviewing Plans and Monitoring Work in Progress

Dam safety officers are involved in the review and approval of project plans for new dams, dams undergoing alteration, rehabilitation or decommissioning. They also monitor ongoing work during the construction or decommissioning phases of projects. Table 2 summarizes the number of project reviews completed by dam safety officers in 2014/15 and the number of dams that are under construction, rehabilitation or decommissioning.

**Table 2: Dam construction/rehabilitation/decommissioning – reviews and monitoring by dam safety officer.**

Areas	New Dams <sup>1</sup>		Rehabilitation		Decommissioning	
	Project Review	Under Construction	Project Review	Under Construction	Project Review	Decommissioning in progress or finished this year
Dam Safety Section	1	1	9	1	1	3
West Coast	0	0	8	8	1	1
South Coast	1	2	5	1	3	0
Thompson	0	0	2	1	0	1
Okanagan	1	2	4	1	3	2
Kootenay	0	0	0	0	1	1
North	1	1	1	1	0	0
Cariboo	2	0	5	3	0	2
<b>Total</b>	<b>6</b>	<b>6</b>	<b>34</b>	<b>16</b>	<b>9</b>	<b>10</b>

<sup>1</sup> Includes increasing the height of a dam to create additional storage

## Operational Reviews

The B.C. Dam Safety Regulation requires owners of dams, other than those with a low failure consequence classification, to review and revise if necessary, their Operations, Maintenance and Surveillance (OMS) manual and their Emergency Preparedness Plan (EPP). This is required at least every 10 years for significant, high and very high failure consequence classification dams and every seven years for extreme failure consequence dams. The annual dam status report includes questions on the status of the OMS and EPP, serving as a reminder to dam owners of their obligation to maintain these documents. In 2014/15, dam safety officers reviewed 76 new or revised OMS manuals and 81 new or revised EPPs (Table 3).

The Regulation also requires owners of dams to review downstream conditions and notify a dam safety officer if there are any changes that may impact the failure consequence classification. These reviews are an important part of dam safety staff responsibilities to help ensure that dams are being managed responsibly and in the interest of public safety. In 2014/15, the first time this metric was recorded, dam safety officers reviewed 11 requests for changes in failure consequence classification (Table 3).

**Table 3: Operation, Maintenance and Surveillance Manuals, Emergency Preparedness Plans and Changes in Failure Consequence Classification**

Areas	OMS	EPP	Change in Consequence Classification
Dam Safety Section	20	24	3
West Coast	6	6	2
South Coast	3	3	0
Cariboo	10	10	0
Thompson	13	13	Unknown
Okanagan	15	15	4
Kootenay	8	9	1
North	1	1	1
<b>Total</b>	<b>76</b>	<b>81</b>	<b>11</b>

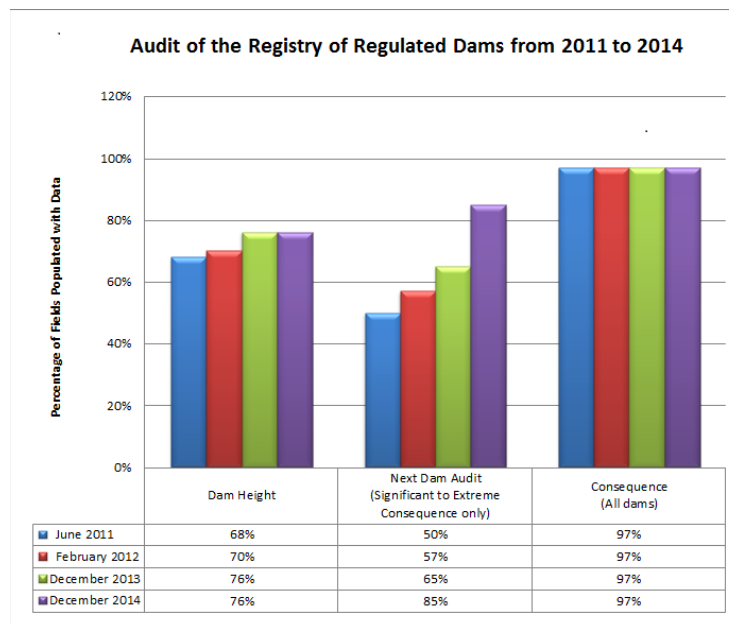
## Dam Registry

The dam registry is comprised of two separate but linked digital information systems. One is a database management system, known as e-licensing, that houses textual data records about each dam. The other provides geospatial data allowing programs such as Google Earth and iMap to depict dam information spatially. E-licensing is only available to authorized internal users but key information from e-licensing for each dam is shown alongside the geospatial data when viewed as [BC Dams](#) on Google Earth or [DataBC](#).

Accurate dam information is important for dam safety officers in managing their portfolio of dams, for reporting on the state of dams in the province and for rapid access to information during emergencies. To determine if dam safety officers update the dam registry on a regular basis, audits of the registry are carried out annually. In previous years, audits focussed on six parameters: dam height, failure consequence, next dam audit date, principle contact, spillway width, and gross freeboard. A review of representative data captured in the registry since the audits began in 2011 showed that only three of the six parameters were relevant to the dam safety officers in managing their portfolio of dams and from a dam safety perspective: dam height to determine whether it is regulated or not, failure consequence to prioritise dam audits and next audit date for significant to extreme failure consequence classification dams. Ready access to spillway width and freeboard are not important to emergency response or to the dam safety officers for dam audit purposes explaining why these are seldom populated in the dam registry. During the assessment of the parameters, it was discovered that dam safety officers do not consistently use the same field for the principle contact, instead one of three different fields was being used thus making this an unsuitable parameter as a measure of record keeping. Also during the assessment, an error was discovered in all of the reported 2011/12 data where the percentage of fields populated in the database was incorrectly calculated. The 2011/12 data has now been reassessed to allow for correct comparison of the 2011/12 percentages with those of subsequent years.

A re-examination of the data over the last four years of the remaining three parameters shows steady progress in updating the dam height information and large improvements in the next dam audit date

(Figure 5). The consequence data has remained the same at 97% for these dams over this period. Consistency and accuracy of data entry into the dam registry and ensuring that information is current remains an ongoing goal for the Dam Safety Program.



**Figure 5: Audit of the dam registry**

In 2014/15, further enhancements were made to the dam registry to improve data entry, search and reporting capabilities. Contact information was revised to ensure that the correct information about dam owners, principal contacts and their alternates was represented in such a way that dam safety officers could easily and correctly enter the information. Searching and reporting of data has been greatly improved to support dam safety officers in their audit work. Compliance and enforcement data can now be collected to track compliance of dam owners with their responsibilities under the regulation.

Recording the location parameters of a dam is required for spatial representation of the dam on maps and on Google Earth. Of the total number of dams in the dam registry, 87% have associated spatial information, an improvement of 6% from 2013/14. However, there still exist 293 dams without the required geo-referenced data and therefore cannot be viewed on Google Earth or DataBC. Of these, 45% are identified as operational dams. Spatial data for the remaining dams is updated as opportunities arise. A new initiative for the dam safety program is the inclusion of photographic imagery of dams in addition to their spatial data for posting on Google Earth. This will help anyone, especially emergency responders, to visually identify the specific dam.

Work with e-licensing and the data warehouse is ongoing as time and resources allow to further improve the management of dam information and make the databases more useful for dam safety program staff. These ongoing improvements help create a more robust registry that provides useful, accurate and timely information.

## 2010 Rapid Dam Assessments Followup

During the 2010 Rapid Dam Assessment following the Testalinden Dam failure, 473 dams were identified as requiring non-urgent follow-up such as vegetation management or rehabilitation. Each year contacting the owners of these dams to follow-up on the identified issues is prioritized by the region and dam safety officer and is undertaken when time permits or as a dam comes up for audit. In 2014/15, six of these dams were reviewed. Mit Lake Dam and Anahim Lake Dam in the Cariboo, for example, are undergoing rehabilitation and the spillway of the Chillo Creek Dam has been re-armored. In other regions, the dams are considered low priority for follow-up and no further work is anticipated except as and when an audit is scheduled or when an issue arises that is brought to the attention of the dam safety officer.

## Other Dam Safety Program Highlights

In addition to activities described in the sections above, there were a number of other notable accomplishments in the past year:

1. *Program Staffing:* The dam safety program is comprised of the Dam Safety Section, Water Management Branch in Victoria (4.5 FTEs) and regional senior dam safety officers who report through the ministry regional structure (5.5 FTEs). All regions were staffed, with either a full-time or part-time dam safety officer, for most of the year. This year saw a retirement of a long-time dam safety officer in Kamloops and a vacancy created from staff moving to another position. In addition, other Ministry staff, temporary employees and new hires all contributed to the Dam Safety Program.
2. *Improved Website:* The [Dam Safety Program website](#) was significantly upgraded to ensure that information on the Regulation, policies and other guidance and resource documents on dam safety are current and readily accessible by any user. The dam safety compliance and enforcement strategy, policy and procedures have also been uploaded to the website. The Dam Status Reporting information for 2014/15 was updated on the website to assist dam owners with their meeting their obligations. A dam safety review checklist template was added to other dam safety review resources on the website to assist dam owners and qualified professionals undertaking dam safety reviews.
3. *Communication:* In addition to being asked to complete and submit the annual dam status report by the end of January, in April, prior to the spring freshet, owners of high, very high and extreme failure consequence classification dams were notified of the need to ensure their dams were operating properly and maintained to allow the safe discharge of possible flood flows.
4. *Development of Guidelines:* Guidelines were developed to assist dam safety officers in assessing factors associated with determining the appropriate failure consequence classification. The development of improved dam decommissioning guidelines was started.
5. *Development of the New Dam Safety Regulation:* In preparation for implementing the *Water Sustainability Act* in 2016, dam safety staff, together with other ministry staff and staff from the , ministries of Environment and Justice and Attorney General, have been involved in the development of the new Dam Safety Regulation and necessary groundwork. to support the delivery of the anticipated.



## DAM INCIDENTS

When an incident relating to a dam is reported to the ministry, a dam safety officer or other staff person will immediately respond, sometimes with support from regional compliance and enforcement staff. The dam owner is contacted and, depending on the seriousness of the situation, other agencies, including Emergency Management BC, may be contacted. These investigations are recorded in incident reports. Not all reported incidents are an emergency or even a dam issue, but regardless each one is followed up on and recorded. The following is a summary of the dam incidents reported in 2014/15.

### Dam Failures

Two dam failures were reported in 2014/15, one near Salmon Arm and the other in the Regional District of Fraser Fort George.

1. Regulated unauthorized dam – On March 15, 2015, the ministry was contacted by an Emergency Management BC contractor about the failure of an unauthorized dam on private land (a dam that did not have a water licence, and was not known to dam safety program staff). The failure had occurred a day earlier near Salmon Arm (Photo 1). The dam was estimated to be eight metres high and 30 metres long with a reservoir containing no more than 3,500 m<sup>3</sup> of water. Based on height alone, the dam was subject to the B.C. Dam Safety Regulation and the owner should have obtained a water license before construction. During its 10-year existence, the dam is reported to have undergone differential settlement with the south end about 30 centimetres lower than the north end at the time of failure. When failure occurred, the water level was reported to be at crest height and heavy water seepage was observed on the downstream face of the dam. Very little water remained in the reservoir following the breach.



**Photo 1: Embankment dam failure near Salmon Arm**

There was extensive damage to property as a result of the dam breach but no fatalities occurred. A barn was destroyed; the ditches and culverts of the road leading to the property were infilled.

Another pond with an unlicensed dam exists close to the breached dam. Although the dam owner has no intention of rebuilding the failed dam, he wants to retain the other. The dam owner is co-

operating with dam safety staff to ensure that the upper dam is licensed and made safe and the failed dam is properly decommissioned or removed.

2. Regulated dam – On March 27, 2015, an authorized dam at a Canadian Forest Products sawmill near Bear Lake, 70 km north of Prince George, was partially breached causing higher than normal water flows downstream and scouring along the wetland area (Photo 2). The three-metre high dam is about 100 metres long and contains no more than 135,000 m<sup>3</sup> of stored water. The combination of height and storage volume is sufficient that this dam is regulated under the B.C. Dam Safety Regulation. The breach occurred on the left bank of the dam and initially involved Emergency Management BC, Ministry of Transportation and Infrastructure and its contractors, Ministry of Environment, CN Rail and the Regional District of Fraser Fort George. There were sufficient concerns about the possible inundation downstream, around Highway 97 and the railway crossing, that traffic had to be controlled until the water level subsided the next day. The dam failure was brought to ministry attention by knowledgeable staff who were travelling in the vicinity of the dam. The dam failed as a result of inadequate spillway size compounded by beaver debris, internal erosion, instabilities to the berm caused by beavers, overgrown vegetation and possible overtopping. Immediately following the failure the dam owner began repairs, however the dam safety officer advised that a qualified professional should oversee reconstruction because the repair work being undertaken at the time was not consistent with conventional embankment dam construction methods.



**Photo 2: Embankment dam failure near Bear Lake, Regional District of Fraser Fort George**

## **Dam Alerts**

There were three dam alerts reported in 2014/15. 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.

1. Regulated unauthorized dam – On May 10, 2014, a member of the public reported problems with an unauthorized dam on a rural property upstream of a Myren Creek tributary, north of Princeton, and accessible from the Pike Mountain Forest Service Road. Built as land improvement for a log cabin, the 13 m high steep earth embankment dam backs up a reservoir holding approximately 40,000 m<sup>3</sup> of water. The B.C. Dam Safety Regulation applies based on the height of the dam alone. Significant erosion marked the downstream face of the dam around a partially collapsed flume which served as a spillway (Photo 3). A sizeable slump was found on the downstream face of the dam (Photo 4) and a 23 m long tension fracture was identified on the downstream edge of the dam crest (Photo 5). Seepage was observed around the downstream end of the low level outlet. The gate of the low level

outlet pipe could not be opened. The dam safety officer hired a commercial diver to open the outlet so that the reservoir level could be reduced. The owners have since hired a Professional Engineer to assess the issues at the dam and a copy of the report will be provided to the dam safety officer.



**Photo 3: Myren Creek – collapsed flume and eroded dam face.**



**Photo 4: Myren Creek – slump on downstream face of dam**



**Photo 5: Myren Creek – tension crack on dam crest**

2. Dixon Dam (D240121-00) – On June 10, 2014, the Regional District of North Okanagan reported beaver damming a previously decommissioned (breached) dam east of Vernon, creating 2.1 m of storage within an old reservoir. Significant seepage was noted under the beaver dam (Photo 6). A dam safety officer assisted the Regional District with the removal of the beaver dam.



**Photo 6: Vernon – seepage below beaver dam**

3. Mit Lake Dam (D820111-00) – On July 31, 2014, FLNRO staff reported a washout of an irrigation dam near Quesnel due to overtopping. A dam audit revealed that the spillway culvert was blocked (Photo 7) causing rising water to overtop at the lowest point of the dam. Dam safety program staff ordered the dam owner to lower the water level and clear the spillway immediately, in addition to repairing the dam.



**Photo 7: Mit Lake – blocked spillway culvert**

## **Dam Incidents**

There were three dam incidents reported in 2014/15. 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.

1. Mackin Creek Diversion Dam (D810469-00) – On May 22, 2014, neighbours of the dam owner reported a washout of the channel and culvert downstream of the dam south of Quesnel. No evidence of overtopping of the dam was observed during the subsequent site visit by dam safety program staff, nor was the spillway plugged. The inspection showed a transverse crack on the dam crest straddling both upstream and downstream slopes. The dam owner was informed of the issues by letter.
2. Spokin Lake Dam (D810450-00) – On April 29, 2014, neighbours of the dam owner reported a problem with the spillway, which they believed had raised the water level of the reservoir behind the dam, located northeast of Williams Lake. A site visit showed that a spillway blockage did not exist. However during the visit, vegetative growth upstream of the dam was identified as an unrelated issue (Photo 8). The dam owner agreed to clear the vegetation.



3. Butchart Lake North West Dam #5 (D730012-05) – On September 5, 2014, the dam owner, Capital Regional District, reported a sinkhole on the downstream face of an earthfill dam near Victoria (Photo 8). The dam safety officer is working with the owner, who is rectifying the situation.



**Photo 8: Butchart Lake Dam #5 – sinkhole on downstream face**

### **No Dam Incidents**

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 2014/15.

1. Rose Lake Dam (D810445-00) – On April 23, 2014, the Ministry of Transportation and Infrastructure reported that Doyle Road, a culvert and a riparian area downstream of the dam near Williams Lake were washed out as a result of an irrigation dam. The dam owner was advised to work with the impacted riparian land owner during irrigation operations to prevent any future washouts. The owner was also advised to obtain the services of a professional engineer to update the Operations, Maintenance and Surveillance manual on the management of the water level behind the dam to minimize the potential for flooding downstream during freshet. The incident also provided an opportunity to inform the owner of the need to complete the Dam Safety Review.
2. Lac La Hache Lake Dam (D810528-00) – On May 23, 2014, a neighbour of the dam owner reported debris blocking the spillway of the dam near Lac La Hache, causing higher than normal water levels in the lake. A site visit did not reveal any problem with the spillway.
3. Horse Lake Dam (D810226-00) – On May 29, 2014, a resident in the vicinity of the dam on Bridge Creek near 100 Mile House reported high water well upstream of the dam which presented a water release concern. Although the open channel spillway of the dam was clear, a log located two kilometres upstream was blocking the stream channel and raising the water level. The dam owner, District of 100 Mile House, was contacted to resolve the problem.
4. Unknown Okanagan Lake dam – On November 2, 2014, a member of the public reported to FrontCounterBC that they heard an abnormal mechanical sound at a dam. No other information, including the location of the dam, was provided so the report could not be pursued.
5. Arrow Lakes Generating Dam (D350003-02) – On December 4, 2014, a local newspaper article alerted dam safety staff of a potential dam incident resulting from a log boom failure upstream of this dam, located near Castlegar on the Columbia River. Earlier on November 29th, high winds broke log bundles free of their mooring, allowing them to drift downstream to the dam damaging the protective log boom at the channel entrance and subsequently floating within a short distance of the

powerhouse. The dam safety officer requested an update from the dam owner regarding the repair to the log boom.

6. Lund Lake Dam (D310119-00) – On February 17, 2015, staff were contacted by a member of the public about a potential dam breach located near Wardner. A site visit revealed the dam was intact and the spillway and low level outlet were operating normally. A discussion with the dam surveillance contact showed nothing unusual about the dam, other than the flow of water was quite high.

## CONCLUSION

The Ministry continues to make dam safety a priority maintaining and, when necessary, augmenting resources and improving the program through education and tools, enhanced policies and guidelines, a more robust database and a continuing focus on ensuring dam owners are aware of and meet obligations under the BC Dam Safety Regulation.

Educating dam owners and their representatives is always an important part of the Dam Safety Program. Again this year, workshops and webinars were presented by dam safety staff to dam owners and operators at locations around the province. As well, dam safety and support staff were afforded opportunities to receive training on current dam safety best practices and to contribute to policy and guideline development at provincial and national levels.

The return rate of annual dam status reports by dam owners remains high; however, there was a small decrease in the number of dam owners who submitted the required reports. There is also a slight downward trend in the number of dams receiving annual inspections. Should these owners not submit their forms in 2015/16, Ministry staff will contact the dam owners directly for follow-up action. Failure by dam owners to submit the requested annual dam status reports may result in enforcement action.

In 2014/15, staff devoted more time than in previous years to developing technical guidance documents and policies to ensure consistent application of the Regulation across the province. The number of dams with outstanding dam safety reviews has been reduced from last year with 87% of the outstanding dam safety reviews started. Dam safety audits were conducted at the rate required to meet the audit schedule and dam safety officers responded to more reported issues than in 2013/14—including dam failures, dam alerts, dam incidents and situations that proved not to be issues (non-incidents).

The dam registry was further improved and more information was added to the database by dam safety officers. The database enhancements will assist dam safety officers in tracking information regarding the state of dams and the regulatory compliance of the dam owner, allowing dam safety officers to focus their efforts where they are needed most.

The new *Water Sustainability Act*, and a proposed amendment to the Dam Safety Regulation are expected to be implemented in early 2016. The purpose of the regulation amendment is to ensure consistency with the new Act, clarify existing requirements and further strengthen requirements to improve public safety.

BC Dam Safety Program  
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