



BC DAM SAFETY ANNUAL REPORT 2011/2012

SUMMARY

The BC Dam Safety Annual Report summarizes activities undertaken by the Provincial Dam Safety Program and reports dam owner compliance for the period April 2011 – March 2012. In the past year, the Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) continued to make significant progress towards fulfilling the recommendations of the Deputy Solicitor General following the 2010 Testalinden Dam failure and improving British Columbia's Dam Safety Program. This includes amendment of the *British Columbia Dam Safety Regulation* (the *Regulation*) with changes to the downstream consequence classification of dams and new signage requirements for dams on Crown land. Approximately 1068 dam owners have been notified of the *Regulation* amendment through mail outs; the remaining dam owners will be informed this year. The quality of dam information located in the Dam Registry, Google Earth and iMap has been further improved. Signs were made for all government-owned dams and all but two are posted; the remainder will be completed this summer. The amended *Regulation* and updated summary documents are available on the [Dam Safety Program](#) website.

Across the province, 32 project reviews for new, rehabilitated or removed dams were conducted by Dam Safety Officers; 16 reviews associated with the construction phases of such dams were also reviewed. The annual dam inspection compliance survey of 313 High, Very High and Extreme consequence dams was again completed, resulting in 96% return rate. Of those returned, 95% reported completing formal inspections and 56% reported that dam safety reviews had been completed. The number of dam audits conducted by all Dam Safety Officers increased to 130, up from 99 in 2010/11 and surpassing the target of 114 audits set for 2011/12. There were seven dam incidents, one dam alert and no dam failures. These incidents have all been resolved to the satisfaction of the Ministry.

Overall the number of staff in the Dam Safety Program and supporting the Program increased, meeting government's commitment to increase the number of staff dedicated to dam safety. Last year, there were Dam Safety Officers in all regions except the Cariboo. Compliance and Enforcement staff received training in Dam Safety and now assist the Dam Safety Officers.

INTRODUCTION

The BC Dam Safety Program Annual Report is a commitment under Recommendation #12 of the Ministry of Environment's [Response to Recommendations Contained in the Report: "Review of the Testalinden Dam Failure"](#) (October 2010) report, now the responsibility of Ministry of Forests, Lands and Natural Resource Operations (MFLNRO). The report summarizes the activities undertaken by the Dam Safety Program and reports dam owner compliance for the period April 1, 2011 to March 31, 2012. The report also provides updates on the progress made towards meeting the other commitments to the Deputy Solicitor General's recommendations.

As of February 2012, there were 1,640 dams regulated under the *British Columbia Dam Safety Regulation* and 398 non-regulated dams in British Columbia. Of the regulated dams, 1,490 are operational dams ranging 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. There are an additional 150 regulated dams that are either proposed, breached or abandoned. Unregulated dams are those that do not meet height, storage capacity or dam failure consequence classification criteria specified in the *Regulation*. The Dam Safety Section in Victoria has responsibility for the administration of the provincial dam safety program and regulation of most dams greater than 9 metres in height (also known as major dams) in British Columbia. Dams less than 9 metres high comprise the regional component of the dam safety program and are managed by regional Dam Safety Officers. Each Dam Safety Officer is responsible for a portfolio of dams. Staff support to the program is also provided by the Compliance and Enforcement Branch and other MFLNRO program staff in addition to other partner agencies such as Emergency Management BC.

All dam owners in British Columbia are responsible for inspection and maintenance of their dams. To ensure that dam owners are aware of and in compliance with the *Regulation*, the Dam Safety Officers conduct audits of dams, provide education and awareness to dam owners and maintain information on each of their dams in the Provincial Dam Registry. Dam Safety Officers also review and approve project plans for new dams, the rehabilitation of existing dams or the removal of dams and respond to emergencies and situation call-outs. Each year, owners of dams classified High, Very High or Extreme are requested to complete and return Dam Inspection Compliance forms which determine if these dams are being inspected and maintained as required. In 2011/12, the 313 dam owners were also asked to provide information on the completion of Dam Safety Reviews and status of their Operation, Maintenance and Surveillance Plan and Emergency Preparedness Plan. Note that with the amendment of the *Regulation* in 2011, the consequence classification of dams previously classified as High and Very High were re-classified as High, Very High or Extreme in line with the Canadian Dam Association classification system; this did not change the number of dams in these categories.

STATUS OF MFLNRO'S RESPONSE TO TESTALINDEN RECOMMENDATIONS

Since 2010/11, progress continues to be made by MFLNRO in responding to recommendations in the July 2010 Deputy Solicitor's report regarding the Testalinden dam failure and British Columbia's Dam Safety Program.

The following commitments have been completed by MFLNRO:

1. *Review of historical warnings about the Testalinden dam (Recommendation #2)*: MFLNRO has completed the review of the historical records for Testalinden Dam which are maintained at the Penticton office. Lessons learned have been incorporated into the Dam Safety Program. The dam owner has stabilized the breach created when the dam failed and the work has been reviewed and accepted by the Ministry.
2. *Signage installation at dams on Crown land (Recommendation #3)*: The *Regulation* was amended to include the requirement for signage at all dams on Crown land. Signs have been installed at all government-owned dams on Crown land except two in the Okanagan that will be

completed later this year. All other owners of dams on Crown land have been notified of this new requirement (Figure 1).



Figure 1: Sign conforms to the *BC Dam Safety Regulation* requirement for signage on dams located on Crown land. Minton Creek Dam in the Cariboo Region.

3. *Dam Safety Regulation (Recommendation #7)*: The *Regulation* was amended in 2011 with full enactment on November 30, 2011. The approximately 1,068 primary dam owners all received copies of the amended *Regulation* by registered mail. The amended *Regulation* is being provided to the remaining dam owners early in 2012/13 by regular mail. This activity also provided the opportunity to update the dam owner information in the Dam Registry.
4. *Improving Ministry of Transportation and Infrastructure (MOTI) subdivision approvals (Recommendation #10)*: Applications for subdivision construction downstream of dams are approved by MOTI without referrals being made to MFLNRO Dam Safety Officers. Discussions have taken place between MOTI and MFLNRO to ensure that the current practices are appropriate. MOTI policy is that referrals are made only if there is evidence of natural or unmanaged hazard risks and as dams are created, owned and managed to an acceptable level of risk, referrals to Dam Safety Officers are not made.

The following longer term commitments continue:

5. *Rapid Dam Assessment (Recommendation #8)*: During the Rapid Dam Assessment in 2010/11, 1,174 dams were assessed and four required immediate attention and were addressed immediately. Less urgent follow-up was required for 473 dams and work continues on these, with over 165 of these dams being reviewed by staff in 2011/12.
6. *Consistent oversight and regulation of all water related structures (Recommendation #11)*: The Ministry of Environment (now MFLNRO, Water Management Branch and MoE, Waste Management Branch) and Ministry of Energy, Mines and Petroleum Resources, (now MFLNRO, Resource Authorizations) regulate water storage structures differently. A Memorandum of Understanding was established in 2009 between the two former agencies to enable cooperation in the management and administration of shared structures on mine property.

The following commitments have been incorporated into regular Dam Safety Program activities and are ongoing:

7. *Reviewing record keeping practices (Recommendation #1):* The Dam Registry within e-Licensing was assessed again in 2011/12 to determine whether Dam Safety Officers are updating the registry. This continues MFLNRO’s commitment to improve the quality of dam information records. Substantial improvements (i.e. greater than 34% increase) have been made this year to data associated with dam height, spillway width and gross freeboard (Figure 2). Much of this progress was made possible with auxiliaries hired to assist the Dam Safety Officer in addition to support from other regional Water Stewardship/Authorization staff. Work remains to ensure that the Dam Safety Officers provide the date that the next dam audit is required and that the ‘principal contact’ for each dam remains current.

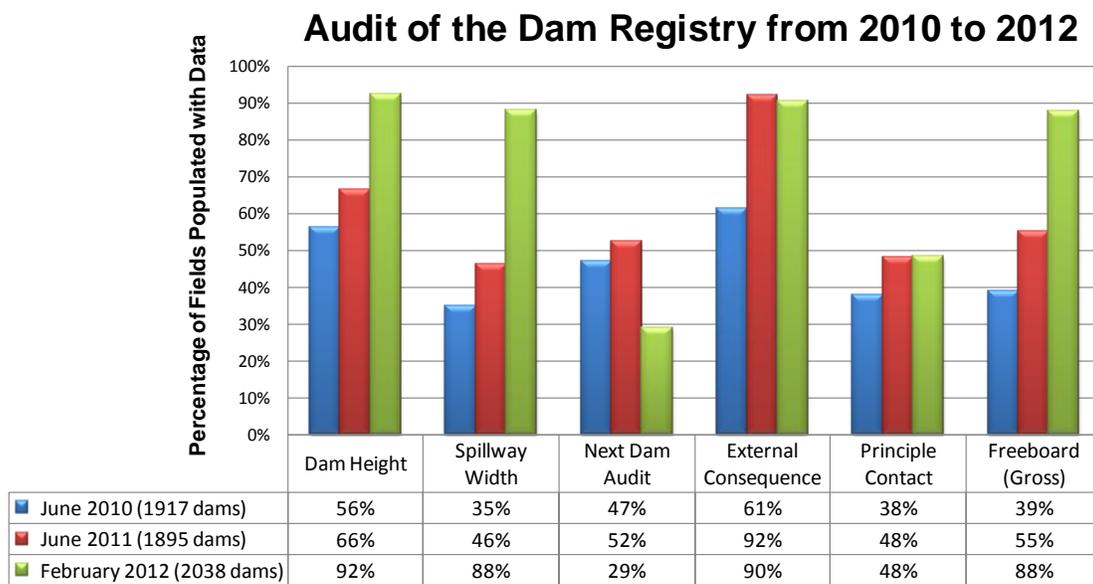


Figure 2: Audit of 6 key Dam Safety parameters in the Dam Registry as a measure of use of the database by the Dam Safety Officers.

8. *Ensuring Compliance and Enforcement staff are familiar with emergency call-out procedures (Recommendation #5):* Additional resources were made available in 2011/12 to increase Compliance and Enforcement staff presence in the field to respond to dam incidents and to conduct site surveillance. Training for Compliance and Enforcement Officers continues in various regions and these staff are now key responders in local Dam Emergency Response Plans.
9. *Continue building a robust Dam Registry (Recommendation #9):* As a result of the Rapid Dam Assessment, the mail-out of the amended *Regulation* and other initiatives, the Dam Registry has undergone substantial updating. Geospatial information for dams in Google Earth and iMap has also been updated. Work remains to improve the structure and some functions in the Dam Registry and this will be undertaken as resources permit.
10. *Continuing to expand education and awareness of dam safety practices (Recommendation #12):* Education and awareness is a central component of the Dam Safety Program and an update is provided in the section on the Education and Awareness program below.

PROGRAM ACTIVITIES AND INITIATIVES

In 2011/12, the Dam Safety Program accomplished many activities and initiatives, including:

Education and Awareness

Critical to ensuring that dam owners and government staff have sufficient knowledge to effectively undertake their dam safety responsibilities, staff in the Dam Safety Program provide education and awareness both informally when working with dam owners and more formally in workshops and meeting presentations. In 2011/12 over 70 dam owners received training at six different workshops offered around the province. Dam Safety Officers gave presentations at a number of organizations including the BC Cattlemen's Association, Okanagan Shuswap District, and Indian and Northern Affairs Canada. Provincial government dam owners were trained to conduct inspection and maintenance of their dams. Dam owners on Crown land have been informed to update their Emergency Preparedness Plans to include maintaining contact with local and provincial government emergency response officials. Over 40 Compliance and Enforcement staff and 10 other MFLNRO staff undertook basic training in compliance and emergency response for dams and in the Coast and South Areas, Dam Assessment training was provided to Compliance and Enforcement staff.

Outreach and Professional Development

To be proficient and current with the latest knowledge on dam safety staff from the Dam Safety Program engage with their counterparts in government, industry and professional associations to collaborate on the development of dam safety practices. This year staff participated at the Canadian Dam Association National Conference, and as members of the Canadian Dam Association Regulator's Committee and Dam Safety Review Committee. MFLNRO staff also collaborated with the Association of Professional Engineers and Geoscientists of BC initiating new Dam Safety Review Guidelines that will be completed in 2012/13. The 26th Annual Dam Safety Officer Community of Practice was held jointly with the Flood Hazard Management meeting with opportunities for shared learning from each other as well as from invited experts.

Dam Inspection Compliance Survey

Owners of dams with downstream consequence classifications of High, Very High or Extreme are required to annually report whether they have completed annual dam inspections and conducted regular site surveillance as required under the *Regulation*. In 2002/2003, the Dam Safety Section began formally tracking dam owner inspection compliance. Since 2005, annual reporting has improved from a total return rate of 67% to over 90% after 2008. In the last three years, there has been a 6% increase in compliance reporting; increasing from 87% to 96% (Figure 3).

These increases are a result of efforts made by the Dam Safety Program staff in directly contacting individual dam owners to ensure they return their compliance forms. For those dam owners that have not returned their forms, follow up is being done by Dam Safety Officers and Compliance and Enforcement staff to ensure that the reports are completed.

Of the dam owners returning their compliance form, over 90% report having completed the required dam inspections (Figure 4). There is a decreasing trend in reporting in the Kootenay, Cariboo and Thompson regions. Where dam owners are not meeting their obligations, staff follow-up to ensure dam owners understand the requirements under the *BC Dam Safety Regulation*.

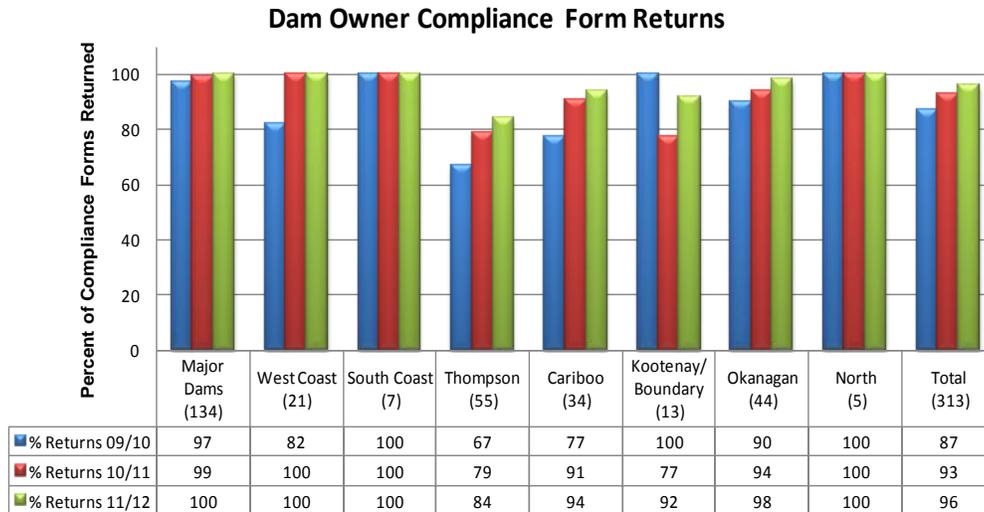


Figure 3: Percent of Dam Owners returning the completed Dam Inspection Compliance Survey Forms (numbers in brackets are the total number of High, Very High, and Extreme Consequence Dams in each region).

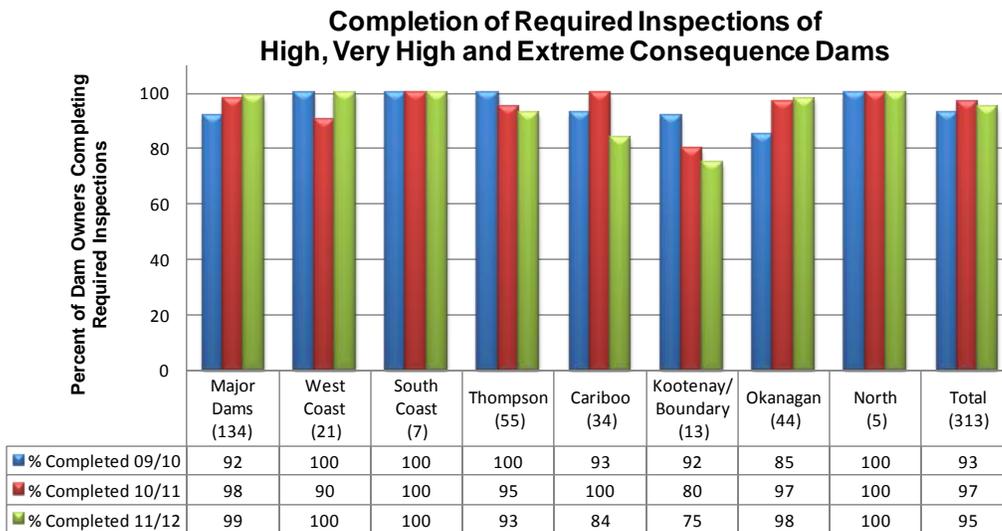


Figure 4: Percent of Dam Owners that returned their Compliance Form and indicated that they had completed the required annual dam inspections.

Dam Safety Reviews are comprehensive formal evaluations of dams conducted by a qualified engineer every 7 years for extreme consequence classification dams and every 10 years for high and very high consequence dams to determine whether an existing dam meets current engineering standards. For 2011/12, the compliance survey was revised to include a specific question about the completion of dam safety reviews. About 56% of the total returns indicated that the dam safety reviews were completed (Figure 5) with considerable variation among regions.

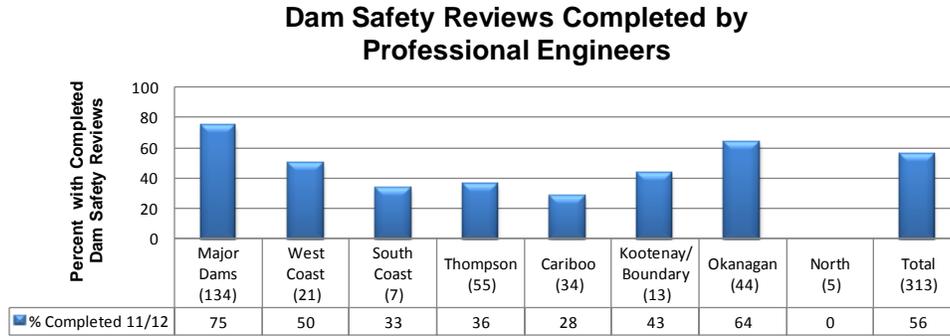


Figure 5: Percent of Dams Owners having Dam Safety Reviews for their dams.

Although the question on the Compliance Survey in the two years prior to 2011/12 were not clear on whether the dam safety reviews were to be completed by a qualified professional, the basic question about completion was surveyed and data gathered. If the data on dam safety review completion were compared, there is a distinct trend across the three years, increasing from 41% to 56% of dam owners indicating that Dam Safety Review have been completed.

The information gathered from the compliance survey shows that almost all owners of High, Very High and Extreme consequence dams are compliant with the *Dam Safety Regulation* regarding submission of compliance forms and completion of formal inspections. The survey suggest an increasing trend in the number of dam owners undertaking Dam Safety Reviews. The initiative to develop Dam Safety Review Guidelines will further support dam owners in undertaking this requirement.

Dam Audits

Under the Dam Audit Program, Dam Safety Officers are required to meet with dam owners once every 5 years for High, Very High and Extreme consequence dams and once every 10 years for Significant consequence dams. The audits are an opportunity for Dam Safety Officers to meet with dam owners, review the records being kept and visit the dams with the dam owner. These visits help determine if the dam owner is aware of and carrying out requirements under the *Regulation*. If deficiencies are found, the Dam Safety Officer can usually assist the dam owner in resolving the problem. Where necessary, follow up is done by the Dam Safety Officer or their alternate to ensure that deficiencies are corrected. Each Dam Safety Officer has a target number of audits to complete annually to ensure that all dam audits will be completed within the required time frame as per the *Regulation*.

The Dam Safety Section in Victoria and all regions were able to meet or exceed their targets except for the Cariboo and South Coast (Figure 6). The Dam Safety Officer position in the Cariboo is vacant. The South Coast region has very few dams requiring audits and will complete their audits within the required audit cycle. In 2011/12, the total number of audits exceeded the provincial target for this year by 15%. Overall the Dam Safety Officers made excellent progress with the audits, with many catching up on the backlog created during the previous year due to the Rapid Dam Assessment.

Dam Audits (2009 - 2012)

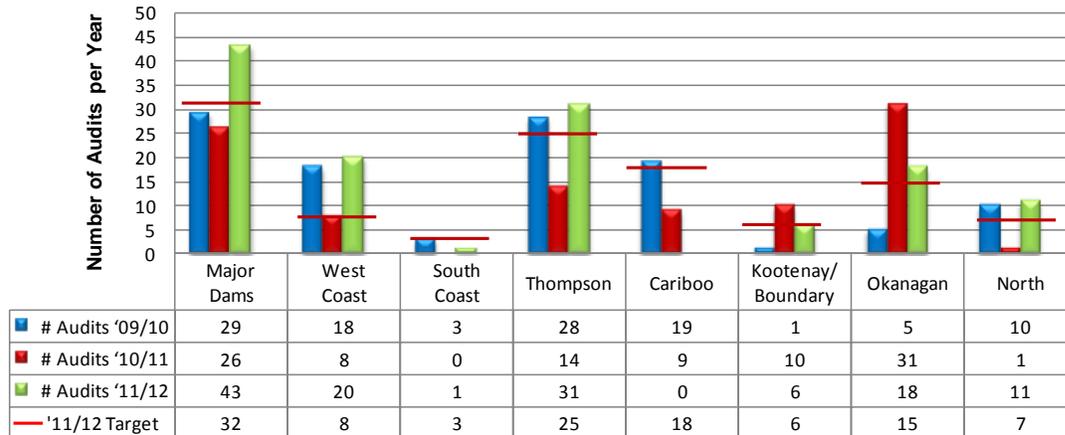


Figure 6: Number of audits completed by Dam Safety Officers in Region and Victoria compared to the target number of audits.

Dam Project Reviews

Dam Safety Officers are involved in the review and approval of project plans for new dams and dams undergoing rehabilitation or removal. They review the work during the design and construction phases of the projects. The following table summarizes the number of dams reviewed in 2011/12 (Table 1):

Table 1: Summary of Project Review and Construction for Dams in BC 2011/12 (April 2012).

Areas	New Dams ¹		Rehabilitation		Removal	
	Project Review	Construction	Project Review	Construction	Project Review	Construction
Major Dams(>9m high)	4	2	9	2	0	0
West Coast	2	2	1	1	2	1
South Coast	1	1	2	0	1	0
Thompson	0	1	0	0	0	2
Okanagan	1	0	2	0	0	1
Kootenay/Boundary	1	0	0	0	1	0
Skeena/Omineca/Peace	2	0	0	0	0	1
Cariboo	0	0	3	0	0	1
Total	11	6	17	3	4	6

Dam Registry

The inventory of dam information is contained in two separate but linked digital information systems. One is a database management system referred to as e-Licensing that contains the Dam Registry housing data records of dams. The other provides geospatial data to map viewers such as Google Earth and iMap to depict dam information spatially.

The Rapid Dam Assessment in 2010 had uncovered missing data for many dams. This resulted in the need to update the Dam Registry and to improve geospatial information. In 2011/12, several regions

¹ Includes raising a dam to create new storage.

including the Okanagan, Cariboo, West Coast, Skeena and Omineca-Peace were provided additional funds to hire auxiliaries to complete much of this work. As a result, 82% of dams in British Columbia can now be viewed on [Google Earth](#) and [iMap](#). These updates will continue into 2012/13.

The Dam Registry in e-Licensing is a relatively new tool for Dam Safety Officers. The project undertaken to provide all dam owners with information about the *Regulation* amendment provided a unique opportunity to identify issues and gaps with the data registry. It was discovered that some data fields in the Dam Registry are interpreted differently by users and dam owner information is often out-of-date due to land sales resulting in inconsistent or inaccurate information. Accuracy of dam information is important not only for managing clients but also for reporting on the state of dams in the province and for rapid access to information during emergencies. Consistency and accuracy of data entry into the Dam Registry and ensuring that information is current remains an ongoing activity for the Dam Safety Program.

Additional database changes to improve the Dam Registry within e-Licensing have been identified and prioritized with other e-Licensing initiatives. For example, with the amended *Dam Safety Regulation* enacted, data in the Registry must conform to the standards established in the regulation including the new consequence classification system.

Provincial Program Management

In addition to activities described in the sections above, there are a number of other accomplishments of the Dam Safety Program:

1. *Program Staffing:* All Regional Dam Safety Officer positions are filled with the exception of Williams Lake where several attempts have been made to hire. The Section Head, Dam Safety and one Senior Dam Safety Officer position in Victoria were vacant to the end of March with incumbents moving into those positions early in 2012/13. A new half time position, Dam Safety Specialist, was added to the Victoria section to take on training and policy development activities along with another full time position supporting the program. Additional salary budget was also made available to regions to increase the existing Dam Safety Officer time as well as for temporary staff to deal with backlog work, e.g. e-Licensing updates, new dams, emergency preparedness plan preparation, and resolving locations of dams.
2. *Communication:* In addition to providing dam owners with the amended *Regulation*, the manual *Dam Safety Guidelines: Inspection and Maintenance of Dams* was updated and mailed to 504 primary owners of High, Very High and Extreme consequence dams, and Low and Significant consequence dams on Crown land. For 2012/13, this task will continue until all dam owners are informed of the changes.

Responding to Dam Incidents and Failures

Whenever an incident about a dam is reported to the Ministry, a Dam Safety Officer will respond, sometimes with support from regional compliance staff investigating the incident. 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 logged in incident reports. The following is a summary of dam incidents reported by the Dam Safety Officers for 2011/12:

Dam Failures

No dam failures were reported in 2011/12. The Testalinden Dam which failed in 2010 has been stabilized and is no longer of concern. The breach stabilization works have been formally accepted by MFLRNO in a recent letter to the dam owner. It concluded that the dam has been decommissioned.

Dam Alerts

There was one dam alert in 2011/12. A dam alert occurs when an abnormal condition is observed at a dam or a dam performs abnormally and, without swift and effective intervention, a breach may occur.

1. *Harvey Creek Reservoir Dam*: On May 27, 2011 during freshet (i.e. spring run-off) monitoring, it was noted that a beaver dam was blocking the spillway (Figure 7), causing water to overtop the dam and erode the downstream slope of the dam. In the absence of the dam owner on the day of discovery, the Dam Safety Officer and Conservation Officer responded by bringing a backhoe to clear a portion of the spillway, allowing the water level in the reservoir to fall by 50 cm. The Dam Safety Officer followed up with the dam owner to ensure that the spillway was fully cleared, reducing the water level a further 30 to 50 cm.



Figure 7: Beaver dam blocking spillway of Harvey Creek Reservoir Dam.

Dam Incidents

There were seven 'Dam Incidents' reported. A dam incident occurs when an abnormal condition is observed at a dam or the dam performs abnormally but the condition is not expected, at the time it is observed, to lead to a breach of the dam.

1. *Baldy Creek Reservoir #1 Dam*: Large seepage was noted in 2010 and the reservoir drained to make an engineering assessment. The owner was told they must notify the regional office prior to re-filling the reservoir. May 19, 2011 it was discovered the reservoir had filled without regional authorization. The dam owner denied he allowed filling of the reservoir, pointing to vandalism as the cause. The dam owner indicated that they would continue to monitor the reservoir and keep it at a lower level.

MFLNRO staff periodically check with the owner to ensure the owner continues to monitor the reservoir level and maintains it at or below acceptable levels.

2. *Crescent Lake Dam*: On May 20, 2011 during freshet monitoring, a 25 cm sinkhole was discovered on the crest of the dam. The owner's staff notified the Dam Safety Officer and adequately placed compacted fill into the sinkhole. Enhanced monitoring of the area by the owner is now part of their weekly inspection.
3. *Idlewild Dam*: On June 8, 2011, the dam was operating outside of normal operating conditions due to freshet combined with a recent rainfall event. The Dam Safety Officer requested the owner undertake immediate action to prevent overtopping. Reservoir levels began falling the next day.
4. *McCuddy Reservoir #2 Dam*: High freshet flows caused the reservoir to fill at a rate greater than what the spillway could handle. The diversion that feeds water into the reservoir was adjusted which slowed the rate of reservoir filling to an acceptable volume. A contingency plan was developed and equipment kept on site until the freshet passed without further incident.
5. *Agur Lake Dam*: On June 2, 2011, it was reported that a 900 mm culvert used as a spillway for the earth filled dam was undersized and could result in the inflows exceeding the discharge capacity. Agur Lake Dam is an unregulated Low consequence dam and no further action was required.
6. *Kloiya Dam Waterline*: Over the dates of September 7 and 8, 2011 a large rainfall of 234 mm in two days triggered a small landslide which destroyed 10 m of the waterline running from the dam to the point of use downstream (Figure 8). This break caused the water in the fully charged and flowing 1.98 m waterline to divert directly into the adjacent Kloiya Creek. The diverted flow continued until the owners were able to close the intake gate. No damage was caused by the flow, however, the waterline is no longer operational.



Figure 8: Damage to Kloiya Dam's 1.98 m waterline from small landslide.

7. *Kitsuckus Creek Dam*: In November 2011 the embankment dam was overtopped during a large rainfall event and erosion by water resulted in a 1 m deep and 8 m wide breach in the dam (Figure 9). The overtopping was caused by stop logs in the spillway that were not removed during the heavy rain. The concrete cut-off wall in the dam helped reduce further erosion. The owner lowered the water level in the reservoir and worked on stabilizing the dam and allowing the passage of high flows in the short term. Over the longer term, plans for the dam include a spillway design that does not require removal of stop logs or opening of gates to pass high flows. If the dam is not repaired, it will be removed.



Figure 9: Cut-off wall in Kitsuckus Creek dam prevented further erosion of the breached area

“No Dam Incidents”

This term is for reports that are received regarding a situation that does not impact the safety of a dam. This could be an erroneous report or a report about an abnormal condition that could be interpreted as a threat to a dam. There were nine reports classified as ‘No Dam Incidents’ in 2011/12, all very similar in nature to the following report on Darke Lake Dam.

1. *Darke Lake Dam*: On May 14, 2011, it was reported that minor flooding in the Faulkner and Meadow Valley could significantly worsen if the water level in Darke Lake were to over top the dam. A visit to the site by the Dam Safety Officer and the dam owner revealed that the dam was not spilling yet and there was no concern of a potential breach or incident. In any case, the dam owner would monitor the dam during freshet.

Conclusion

In the second year after the Testalinden failure, MFLNRO continued to meet government’s commitments to dam safety as recommended by the Deputy Solicitor General including the commitment of an additional four staff working in dam safety. Commitments met include gathering any further information from the Testalinden dam records to improve the Dam Safety program, completing the installation of almost all signs on government-owned dams, informing all primary dam owners of the changes in the *Dam Safety Regulation*, clarifying the status of more than 165 dams identified in the 2010/11 Rapid Dam Assessments as requiring non-urgent follow-up, increasing the presence of Compliance and Enforcement staff in the field to assist Dam Safety Officers with the investigation of dams, and continuing the updates of dam information in the Dam Registry, Google Earth and iMap. More training was provided to both private and government dam owners. Compliance and Enforcement staff were also trained to support the Dam Safety Program.

Most dam owners have been provided the amended *Regulation* and updated Dam Inspection Guidelines; this task will be completed in 2012. Results of the 2011/12 Dam Inspection Compliance form returns

indicate that enforcement of compliance reporting is needed for a small percentage of dam owners who have not submitted their reports. In addition, Dam Safety Officers will need to follow up with dam owners who have not completed the required Dam Safety Reviews. Subject to available funding, additional work is planned to complete the Dam Safety Review Guidelines in 2012/13 which will support dam owners who have not yet undertaken Dam Safety Reviews. Continued updates to the Dam Registry and the dam component of the Land and Resource Data Warehouse by regions are required to continue filling data gaps. At the same time, data entry needs to be consistent across regions to improve the quality of information in the Dam Registry.

BC Dam Safety Program
May 31, 2012