

## *SUMMARY*

# **Maintaining and Enhancing Agricultural Dams in the Cariboo Region** *Discussion Document*



November 2015

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### ***Project background and objectives***

In the Cariboo region, agricultural dams play a significant role in retaining water for agriculture during the production season. With the effects of climate change on hydrology and temperatures, ensuring sustainable water supply for agriculture will become increasingly critical in the future. However, in recent years challenges have emerged related to maintaining accessible, reliable water sources and meeting dam safety requirements under the *B.C. Dam Safety Regulation*.

The underlying goal of this project is to help to ensure the availability of sustainable and adequate water supply for future agricultural production in the Cariboo region. In the interests of supporting this goal, the project objectives are to:

- 1) Improve the knowledge of the existing agricultural dams, with regards to their status, condition and associated issues;
- 2) Identify potential cost and risk-sharing models for inspections, upgrades, and maintenance of agricultural dams;
- 3) Outline collaboration and partnership opportunities to address the requirements for dam safety and sustainable agricultural water supply; and
- 4) Identify, describe, and document the co-benefits associated with maintaining and enhancing agricultural dams.

While the issues with agricultural dams and their safety are pressing, it was not the purpose of this report to provide direction or to be definitive in terms of the issues, options and next steps. The report is intended to support a constructive dialogue amongst dam owners, relevant agencies and potential partners about how best to address the issues and challenges related to agricultural dams. It is hoped that the report will support the necessary near-term actions, starting with a workshop to bring together Cariboo dam owners, related agencies and partners on November 25, 2015.

### ***Project scope***

The scope of work for this project included an inventory of agricultural dams within the region and consultation with local stakeholders (i.e. local producers, provincial government agencies, and Ducks Unlimited Canada) to assess the magnitude and nature of issues and challenges. Also included is an analysis of how climate change will impact agricultural dams and a summary of the various costs associated with the regulatory requirements for dam owners. In addition, potential solutions for the identified challenges are explored, along with options for sharing risks and costs associated with agricultural dams.

The project scope did not include detailed assessment or inspection of individual agricultural dams. Project scope also didn't involve evaluation of the physical infrastructure or technical issues with individual dams. Therefore, the study does not provide solutions that are specific to individual dam owners and instead focuses on shared issues and concerns. The scope did not include evaluation of the provincial *B.C. Dam Safety Regulation* or the B.C. Dam Safety Program.

### ***Climate change & agricultural dams***

Some of the anticipated impacts of climate change to the Cariboo region's agricultural dams are summarized below. More details may be found in the full report.

- Higher temperatures and longer dry periods during summer are likely to decrease water supply and increase the need for water storage and yield capacity of agricultural dams.

- Higher temperatures and less frequent precipitation are anticipated to increase the risk of wildfire events. Wildfires can have long-term impacts on soil, vegetation and runoff hydrology in watersheds and fire-fighting could compete for water supplies.
- The timing and volume of peak runoff flows may have negative impacts on agricultural water storage, as the early season flows may not coincide with the growing season.
- Earlier and greater freshet flow is expected to result in increased flooding, erosion, debris supply, and channel changes.
- Greater freshet flows could lead to increased flow requirements for spillway capacity and dike crest elevation.
- Increased variability and changes in timing of streamflow may make operation of dams more difficult. This is most likely to occur where dam operation is integrating multiple objectives such as flood control, habitat (water fowl, fish, amphibians), recreation, irrigation and/or livestock water.

### ***Requirements of dam ownership in B.C.***

The full report includes a high level summary of dam safety regulations in B.C. including the definition of a dam, the requirements of a Dam Safety Management System and the frequency of associated activities. A series of tables outline the range of potential costs associated with the following aspects of dam ownership:

- Cost estimates for the operation and maintenance typical earthfill dams with different consequence ratings
- Costs of additional studies and investigations potentially required during detailed Dam Safety Review for High and Very High consequence classified dams
- Costs for upgrades based on generic deficiencies potentially identified through a DSR, dam audit, or routine surveillance and maintenance

### ***Inventory Summary***

The inventory includes 403 dams. Of these, the majority, or 60%, have a low consequence classification. Another 20% have a significant classification, and 8% have high classification, while two dams (.5%) have a very high classification. The remainder are either undetermined (6%) – indicating that it’s likely that the dam does not meet the definition covered of a dam under the current regulation – or unknown (5%), meaning that consequence information is not available.

### ***Priority issues & potential solutions***

Agricultural dams in the Cariboo region are diverse with respect to location, age, condition, consequence classification and available water yield. Although each dam is unique, through the inventory, consultation and background research, a series of common issues emerged; primarily pertaining to meeting the requirements of the B.C. Dam Safety Program or to water yield. The priority issues and potential solutions have been divided into the following four categories:

- Dam Safety Management System
- Dam Operation, Maintenance & Surveillance
- Dam Safety Reviews; and
- Water storage

The tables that follow summarize the more detailed descriptions of priority issues and solutions provided in the full report.

**Table 1: Summary of Issues and Potential Solutions**

<b>Priority #1: Dam Safety Management System</b>	
<b>Issues</b>	<b>Solutions</b>
<b>Knowledge and Information Transfer:</b>	
<ul style="list-style-type: none"> <li>➤ Some owners not aware of their responsibilities as dam owners</li> <li>➤ Some owners do not have an overarching dam safety management systems in place</li> </ul>	<ul style="list-style-type: none"> <li>• Provide training workshops regarding DSMS and regulations.</li> <li>• Provide owners with the information needed to develop their own system or contacts for individuals or companies who can provide this service.</li> </ul>
<ul style="list-style-type: none"> <li>➤ Some owners have limited knowledge of the Canadian Dam Association guidelines and BC Regulations</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a user-friendly version of the regulations for dam owners; provide necessary documentation in a form that doesn't require internet access.</li> </ul>
<b>MFLNRO Role:</b>	
<ul style="list-style-type: none"> <li>➤ MFLNRO is taking on more of an enforcement role</li> </ul>	<ul style="list-style-type: none"> <li>• Implement mechanisms to improve communication with dam owners.</li> </ul>
<ul style="list-style-type: none"> <li>➤ Inconsistencies in database and consequence classifications</li> </ul>	<ul style="list-style-type: none"> <li>• Review consequence classifications to ensure that the specified classification is reflective of the site.</li> <li>• Seek continual improvement in the data quality in the public database for better management of sites.</li> </ul>
<b>Costs associated with dam assessment, maintenance &amp; upgrades:</b>	
<ul style="list-style-type: none"> <li>➤ Dam owners may be struggling to cover costs of maintenance/upgrades and this could result in dams being decommissioned</li> </ul>	<ul style="list-style-type: none"> <li>• Explore options for collaboration between dam owners.</li> <li>• Seek opportunities to partner with other dam owners and/or co-beneficiaries of dams including wildlife/recreational users.</li> </ul>
<b>Priority #2: Operation, Maintenance &amp; Surveillance</b>	
<b>Issues</b>	<b>Solutions</b>
<b>OMS Manual Preparation and Implementation:</b>	
<ul style="list-style-type: none"> <li>➤ Dam owners not familiar with requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Deliver OMS training workshops.</li> </ul>
<ul style="list-style-type: none"> <li>➤ OMS manual difficult to comply with or follow; requirements of OMS may not always be feasible or achievable for all sites.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure OMS manuals are developed with realistic expectations for individual sites.</li> </ul>
<ul style="list-style-type: none"> <li>➤ Requirements for OMS dependent on consequence classification.</li> </ul>	<ul style="list-style-type: none"> <li>• Improve communication between Dam Safety Officer and dam owners to help understand dam classification.</li> </ul>

**Table 1: Summary of Issues and Potential Solutions**

<b>Priority #2: Operation, Maintenance &amp; Surveillance ...continued</b>	
<b>Issues</b>	<b>Solutions</b>
<b>Remote Sites:</b>	
➤ Difficult access, especially during winter months (weekly or monthly surveillance required for some dams)	<ul style="list-style-type: none"> <li>• Incorporate (into OMS manuals) consideration of site access including options for few inspections when water levels are low.</li> </ul>
➤ Slow response times to emergencies making it difficult to meet requirements of EPP.	<ul style="list-style-type: none"> <li>• Upgrade access routes to enable swift response to emergencies or allow for a helicopter use.</li> </ul>
➤ Remoteness results in challenges in controlling dam site security and public safety.	<ul style="list-style-type: none"> <li>• Install public safety warning signs and upgrades to the outlet works to prevent vandalism.</li> </ul>
<b>➤ Condition of Structures and Appurtenances:</b>	
<ul style="list-style-type: none"> <li>➤ Older/aging dam structure</li> <li>➤ Deteriorating outlet structure</li> <li>➤ Insufficient spillway capacity</li> </ul>	<ul style="list-style-type: none"> <li>• For high consequence dams, complete recommendations from DSR. For low and significant dams continue to maintain and repair structure, as required.</li> <li>• For high consequence dams, complete recommendations from DSR. For low and significant dams, keep spillway clear of debris and install log boom.</li> </ul>
➤ Costs of upgrades/repairs	<ul style="list-style-type: none"> <li>• Explore and implement collaborative/partnership opportunities.</li> </ul>
<b>Priority #3: Dam Safety Review</b>	
<b>Issues</b>	<b>Solutions</b>
<b>Finding a Qualified Professional (QPEs):</b>	
➤ MFLNRO is no longer providing feedback or guidance on DSRs - therefore QPEs must have the experience to complete a DSR independently.	<ul style="list-style-type: none"> <li>• More assistance is required from Dam Safety Officers (working with consultants and owners) to ensure acceptable DSRs and to move processes forward.</li> </ul>
➤ Liability and limited financial payback are disincentives to QPEs to being involved in conducting DSRs.	<ul style="list-style-type: none"> <li>• Limit liability either time (duration of liability with respect to study) and/or dollar value (relation to fees).</li> <li>• Seek mechanisms to top-up fees for qualified professionals.</li> </ul>
<b>DSR Costs</b>	
<ul style="list-style-type: none"> <li>➤ Current requirements for engineers to state a dam is safe require extensive background information.</li> <li>➤ There is insufficient resourcing available to complete the studies and upgrades needed to classify a dam as safe.</li> </ul>	<ul style="list-style-type: none"> <li>• Undertake DSRs with phased approach to collecting additional studies and implementing improvements over time.</li> <li>• Seek/create alternative funding opportunities to pay for DSRs.</li> </ul>

**Table 1: Summary of Issues and Potential Solutions**

<b>DSR Costs ...continued</b>	
➤ The requirements outlined in the APEGBC Guidelines and the Regulations require a comprehensive review of all design, construction, performance and safety management arrangements.	<ul style="list-style-type: none"> <li>• MFLNRO should make more information available about how DSRs are reviewed to aid consultants and owners in efficiently completing DSRs.</li> </ul>
➤ Not all agricultural dam owners have the necessary records to complete DSRs, leading to more detailed, costly reviews.	<ul style="list-style-type: none"> <li>• Local training and support for dam OMS and documentation</li> </ul>
<b>Completing necessary upgrades:</b>	
<ul style="list-style-type: none"> <li>➤ Older dams may require upgrades to meet hydrological and seismic requirements, low level outlets or head gate structures may also require repair.</li> <li>➤ High risk dams in the Cariboo may not meet the requirements of the Regulations due to age.</li> </ul>	<ul style="list-style-type: none"> <li>• Seek out cost sharing models to help fund necessary upgrades.</li> </ul>
<b>Priority #4: Water Storage</b>	
<b>Issues</b>	<b>Solutions</b>
<b>Water yield &amp; level limitations:</b>	
➤ Water yields are currently a concern for some agricultural dams	<ul style="list-style-type: none"> <li>• Maintain water licences and look for opportunities to supplement existing reservoirs with additional water availability; i.e. upstream water licences, multiple smaller storage dams/ponds within one system.</li> <li>• Identify options to create additional water storage</li> </ul>
➤ Water level constraints associated with other use requirements (e.g. wildlife and recreation)	<ul style="list-style-type: none"> <li>• Identify common or complementary objectives with other user groups with regards to water levels (e.g. establishing minimum draw down levels, optimizing water use while reservoir is high).</li> </ul>
<b>Changing water demand:</b>	
<ul style="list-style-type: none"> <li>➤ Increasing agricultural demand due to hotter/drier conditions</li> <li>➤ Inefficient water management practices</li> </ul>	<ul style="list-style-type: none"> <li>• Explore options for managing agricultural demand</li> <li>• Upgrade irrigation systems to minimize water loss and improve irrigation efficiency</li> </ul>
➤ Increasing and/or unpredictable water demand for firefighting - fire risk is anticipated to increase with climate change	<ul style="list-style-type: none"> <li>• Establish emergency water use plans.</li> </ul>
<b>Changing watersheds:</b>	
➤ Changes to upstream watersheds from logging, beetle kill and agricultural activities.	<ul style="list-style-type: none"> <li>• Implement local watershed planning with all applicable stakeholders (industry, residential, agriculture). Find ways of minimizing the transfer of sub-surface water to surface water.</li> </ul>
➤ Early season freshets can result in peak flows outside of agriculture production windows	<ul style="list-style-type: none"> <li>• Provide more natural storage within the upper reaches of the watershed (e.g. beaver dam development in suitable areas).</li> </ul>

**Table 2: Priority Solutions and Near-term Actions**

<b><i>Solution Category: Knowledge transfer and informational resources</i></b>
<b><i>Near-term Actions</i></b>
Review previous workshop and training materials and update/refine as needed to support dam owners with addressing current regulatory requirements.
Offer in-person (workshop) training with distinct training/knowledge transfer materials for low and significant consequence, focused on owner responsibilities and maintenance and operational approaches for small earthfill dams.
Offer in-person (workshop) training with distinct training/knowledge transfer materials for high consequence dam owners (including DSR):
Provide a summary (written) of the regulatory requirements (and steps involved in OMS, DSRs etc.). Ensure these documents can be reviewed off line.
Provide periodic refresher or supplemental educational/knowledge transfer opportunities (annually/ near term)
<b><i>Solution Category: Improved communication with regulator</i></b>
<b><i>Near-term Actions</i></b>
Develop a collaborative approach to delivery of knowledge transfer resources (e.g. workshops/written materials) regarding the dam regulations, OM&S and DSRs
Increase the effective information flow between MFLNRO and dam owners, specifically including:
- Inclusion of dam owners in government audits of dams
- Provision of clear documentation for dam owners and QEPs that details how DSRs are reviewed (to aid in efficiently completing DSRs)
- Provision of clear feedback to dam owners and QEPs about issues with DSRs
<b><i>Solution Category: Finding qualified professionals</i></b>
<b><i>Near-term Actions</i></b>
Review the list of QEPs produced by the Professional Engineers and Geoscientists of BC and ensure it is comprehensive (e.g. all engineers qualified to do DSRs on earthen dams are included).
Increase awareness and distribution/availability of QEPs list
Develop an option for dam owners to receive a top-up/cost-share on dam assessments (through a cooperative approach or assistance through an external cost-share) to assist in incentivizing engineers who may be deterred by relatively high liability/low compensation currently involved in undertaking DSRs.
Support dam owners to group together by geography and/or shared consequence rating to enable QEPs to undertake a number of DSRs at the same time (i.e. optimize time of professionals from outside the region, seek “economies of scale” by undertaking reviews as a group)



**Table 2: Priority Solutions and Near-term Actions**

<b><i>Solution Category: Approaches for sharing risks &amp; costs</i></b>
<b><i>a) Collaboration between multiple dam owners</i></b>
<b><i>Near-term Actions</i></b>
<b><i>Multi-user models: Wildlife, habitat and fisheries values and partners</i></b>
Conduct an assessment of the types of habitats & species supported by agricultural dams including endangered species, species at risk and recreational fish habitat
Undertake evaluations of individual dams to determine their specific habitat and/or wildlife values (for owners interested in fostering wildlife/habitat values)
Facilitate dialogue between interested dam owners and agencies and opportunities for supportive of wildlife and habitat benefits
<b><i>Recreation, tourism and/or residential values and models (e.g. downstream development tax)</i></b>
Investigate appropriate tax tools available to local government & similar application in other BC communities including consideration of implications for implementation
Undertake detailed case study analyses to test assumptions, levels of interest and requirements for implementation
<b><i>b) Granting &amp; cost-sharing programs</i></b>
<b><i>Solution Category: Redeveloping decommissioned dams</i></b>
<b><i>Near-term Actions</i></b>
Undertake a more detailed study of the decommissioned and breached dams to identify those that are of highest priority for future development – include water storage potential, local area water demand, benefits to other resources and high level estimates of upgrade costs in analysis
<b><i>Solution Category: Managing agricultural water demand</i></b>
<b><i>Near-term Actions</i></b>
Conduct outreach regarding availability of irrigation management planning and cost-shares on irrigation infrastructure improvement through EFP Program
Continue to initiate and support local research and knowledge transfer for improved resilience to drier conditions (e.g. MIG research, forage variety trials etc.)
<b><i>Solution Category: Watershed planning &amp; natural water storage enhancement</i></b>
<b><i>Near-term Actions</i></b>
Identify areas in need of near-term watershed planning support
Identify key partners with shared interest in undertaking a planning process
Seek funding support/partnerships to initiate watershed planning