Dam Safety Review Check Sheet

Dam: **D#:** **Date of DSR:**

Dam Owner: **QP Engineer:**

Engineering Firm: **Review Engineer:**

DSR Guidelines	*Completed?*		*Comments*
Phase 1 - Review of Available Information and Data			
Records should include reports from previous DSRs, design calculations, as-built drawings, updated drawings, data from hydrological, structural and operational monitoring, all safety inspection reports, etc.			
Data & records compiled?	Yes ☐	No ☐	
Documentation list provided?	Yes ☐	No ☐	
Informational gaps identified?	Yes ☐	No ☐	
Phase 2 - Field Review			
The extent of a field review should be identified beforehand, but as a minimum include: upstream areas including reservoir slopes; abutment areas; upstream slopes or faces of the dam, where visible; dam crest; downstream slopes or faces, and toe areas; spillway and stilling basin (includes flow control equipment and power sources); drainage systems and discharge points; and areas downstream of the dam site that may be impacted in a breach.			
Site inspection performed?	Yes ☐	No ☐	
Confirmed proper functioning of equip.?	Yes ☐	No ☐	
Debris Management system assessed?	Yes ☐	No ☐	
Monitoring system analysis completed?	Yes ☐	No ☐	
Communications system assessed?	Yes ☐	No ☐	
Operating personnel Interviewed?	Yes ☐	No ☐	
OMS reviewed?	Yes ☐	No ☐	
EPP reviewed?	Yes ☐	No ☐	
Maintenance records reviewed?	Yes ☐	No ☐	
Phase 3 – Consequence Classification Review			
Dam breach calculation done?	Yes ☐	No ☐	
Flood routing & inundation mapping done?	Yes ☐	No ☐	
Inundation area reviewed for changes?	Yes ☐	No ☐	
Change in consequence recommended?	Yes ☐	No ☐	
Phase 4 – Dam Safety Analysis			
Internal & External hazards[1] identified?	Yes ☐	No ☐	
Failure modes[2] & effects identified?	Yes ☐	No ☐	
Hazards & Failure Modes matrix provided?	Yes ☐	No ☐	
Hydrotechnical assessment			
1:1,000, PMF and IDF calculated?	Yes ☐	No ☐	
Spillway capacity meets/exceeds IDF?	Yes ☐	No ☐	
Wind setup & wave runup calculated?	Yes ☐	No ☐	
Freeboard adequate[3]?	Yes ☐	No ☐	
***Geotechnical assessment*[4]?**			

EDGM has been established?	Yes ☐	No ☐	
Static stability assessed?	Yes ☐	No ☐	
Rapid drawdown assessed?	Yes ☐	No ☐	
Seismic (pseudo static) stability assessed?	Yes ☐	No ☐	
Liquefaction (settlement)?	Yes ☐	No ☐	
Internal Erosion (seepage & piping potential)?	Yes ☐	No ☐	
Deficiencies documented?[5]	Yes ☐	No ☐	
Dam safety management system			
Review should consider policy development, planning, training, implementation of procedures, checking, corrective action, and reporting.			
OMS compliant?	Yes ☐	No ☐	
EPP compliant?	Yes ☐	No ☐	
Site and operating equipment secured from vandalism?	Yes ☐	No ☐	
Surveillance and inspection adequate to document dam performance? (eg. Seepage, instrumentation, documentation, etc.)	Yes ☐	No ☐	
Surveillance adequate to discover and promptly address vandalism?	Yes ☐	No ☐	
Has staff/owner had formal training?	Yes ☐	No ☐	
Roles, responsibilities, and authorities are clearly assigned?	Yes ☐	No ☐	
Key activities are clearly assigned?	Yes ☐	No ☐	
Personnel understand their roles & responsibilities?	Yes ☐	No ☐	
OMS activities are carried out and documented?	Yes ☐	No ☐	
Incidents are reported and addressed?	Yes ☐	No ☐	
Safety measures recommended in previous DSR reports have been carried out?	Yes ☐	No ☐	
Phase 4 – *Dam Safety Review* report			
Executive summary?	Yes ☐	No ☐	
Introduction – purpose & scope?	Yes ☐	No ☐	
General description of dam, reservoir and areas downstream that may be impacted?	Yes ☐	No ☐	
Summary of findings of previous DSRs?	Yes ☐	No ☐	
Summary of owner's compliance record?	Yes ☐	No ☐	
Details of all design assumptions?	Yes ☐	No ☐	
Summary of design calculations performed to support the technical analyses?	Yes ☐	No ☐	
Details of the assessment of each component of the dam?	Yes ☐	No ☐	
Details of the assessment of the OMS?	Yes ☐	No ☐	

Details of the review of the EPP/ERP?	Yes ☐	No ☐	
Summary of staff interview Q&A?	Yes ☐	No ☐	
Conclusions supported with clear rationale?	Yes ☐	No ☐	
Recommendations provided?	Yes ☐	No ☐	
Prioritization of recommendations?	Yes ☐	No ☐	
Dam Safety Review Assurance Statement completed?	Yes ☐	No ☐	
Report accepted?	Yes ☐	No ☐	

Note: The Qualified Professional Engineer is referred to APEGBC's *Professional Practice Guidelines –Legislated Dam Safety Reviews in BC V2.0* and the CDA's *Dam Safety Guidelines (2013)* and accompanying Technical Bulletins for additional information.

General Comments:

Reviewed by:

Review date:

Endnotes

[1] External hazard type

- ***Meteorological events***.
  - Floods, intense rain events (causing local erosion, landslides etc.), temperature extremes and the effects of ice, lightning strikes and wind storms.
- ***Seismic events***.
  - Natural and those caused by economic activity such as mining or even reservoir induced seismicity. The fact that areas without active seismicity can be disturbed by distant earthquakes should not be ignored.
- ***Reservoir environment***.
  - Includes all reservoir rim features including upstream dams, slopes around the reservoir, overhead off spillways etc. that pose a threat.
  - Reservoir environment also includes any deleterious substances, or burrowing or other animals, that can affect the physical performance of the dam.
- ***Terrorist attacks and vandalism***.
  - Including vandalism and sabotage by various groups ranging from local disaffected individuals, through domestic terrorism and international terrorism.

Internal hazard type

- Errors and omissions in the design of the dam and water conveyance structures including inadequate consideration of the performance of the reservoir rim and upstream dams.
- Construction errors or design compromises to accommodate natural or imposed deviations from the design assumptions.
- Maintenance procedure errors where maintenance requirements are not fully defined at the design stage.
- Errors and omissions in the development and maintenance of operating rules or means of verifying adequate operation (e.g. infrastructure problems with water level recorders).

The internal hazard types are further subdivided into "sources":

- *Water barrier*
- *Hydraulic structures*
- *Mechanical and Electrical sub-systems*
- *Infrastructure and Plans*

[2] Failure Modes

- ***Overtopping failure mode***
  - Inadequate freeboard leading to the flow of water over the crest of the dam in a manner not intended or provided for in the design, construction, maintenance and operation of the dam.
- ***Collapse failure mode***
  - Inadequate internal resistance to the hydraulic forces applied to the dam, foundations and abutments while being hydraulically operated in accordance with the design intent.
- ***Conveyance failure mode***
  - Loss of control of the flows through and around the dam.
- ***Combinations of Hazards and Failure Modes***

Endnotes

[3] **Freeboard** (taken from *Plan Submission Requirements for the Construction and Rehabilitation of Dams)*

a) **Normal Freeboard** (or Gross Freeboard) is the difference of elevation between the lowest elevation of the top of the dam (or top of impervious core) and the maximum reservoir operating level (full supply level, often the spillway sill elevation).
b) **Minimum Freeboard** (or Net Freeboard) is the difference of the elevation between the lowest elevation of the top of the dam (or top of impervious core) and the maximum water level of the reservoir should the Inflow Design Flood (IDF) occur.

To prevent overtopping and provide redundancies in the dam design, the following freeboard standards shall be applied:

- The normal freeboard shall be at least 1.0m in combination with a spillway width of at least 4 metres.
- If the design engineer wants to present a case for a spillway width of less than 4 metres wide, the *minimum* freeboard shall be at least 1.0m. A spillway width of less than 4 metres wide is not recommended for high to extreme consequence dams.

[4] **Slope Stability of Embankment Dams**

- Seepage analysis
- Seepage Control
- Granular Filter Design
- Surface Erosion
- Seismic Stability Analysis
- Liquefaction Potential

[5] **Deficiencies**

Deficiencies are to be characterized as Actual, Potential or Non-Conformance (see "Dam Safety Expectations & Definitions of Deficiencies and Non-Conformances" in the DSR Section of the MFLNR Dam Safety Program website).

Definitions of Deficiencies and Non-Conformances

1) Deficiencies:
   a) Actual – An unacceptable dam performance condition has been confirmed, based on the CDA Guidelines, BC Dam Safety Regulations or other specified safety standard. Identification of an actual deficiency generally leads to an appropriate corrective action or directly to a capital improvement project
      i) (**An**) Normal Load – Load which is expected to occur during the life of a dam.
      ii) (**Au**) Unlikely Load – Load which could occur under unusual load (large earthquake or flood)
   b) Potential – There is a reason to expect that an unacceptable condition might exist, but has not been confirmed. Identification of a potential deficiency generally leads to a Deficiency Investigation
      i) (**Pn**) Normal Load – Load which is expected to occur during the life of a dam.
      ii) (**Pu**) Unlikely Load – Load which could occur under unusual load (large earthquake or flood)
      iii) (**Pq**) Quick – Potential deficiency that cannot be confirmed but can be readily eliminated by a specific action.
      iv) (**Pd**) Difficult - Potential deficiency that is difficult or impossible to prove or disprove.
2) Non-Conformances: Established procedures, systems and instructions are not being followed, or, they are inadequate or inappropriate and should be revised.
   a) Operational (**NCo)**, Maintenance (**NCm**), Surveillance (**NCs**)
   b) Information (**NCi**) – information is insufficient to confirm adequacy of dam or physical infrastructure for dam safety.
   c) Other Procedures (**NCp**) – other procedures, to be specified