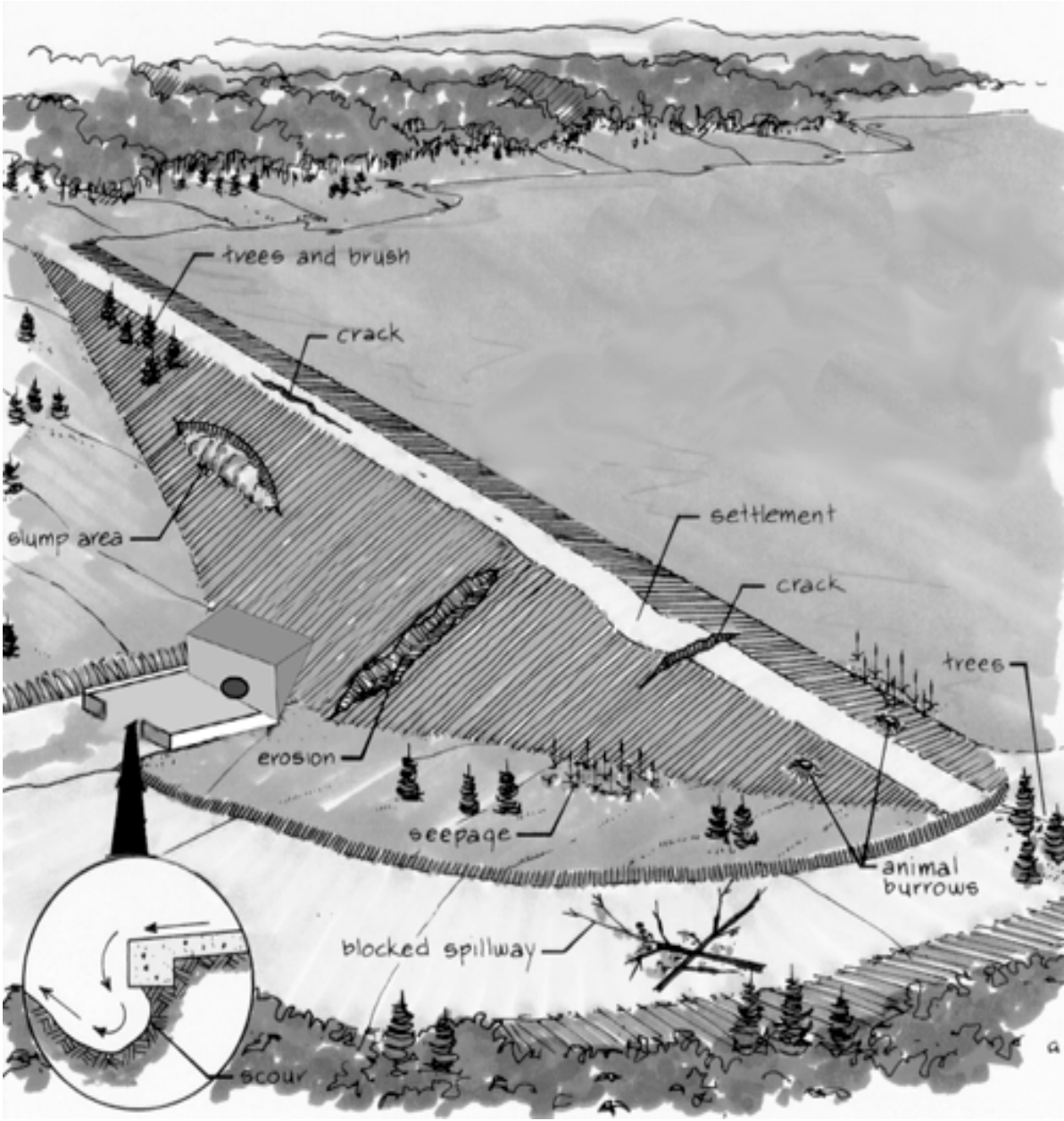


Emergency Dam Assessment

Dam Safety Deficiencies

The following diagram illustrates a number of dam safety deficiencies. During times of high reservoir levels and large spillway flows, these deficiencies pose a greater threat to the safety of the dam and should be investigated thoroughly. If the deficiency is considered a threat to the integrity of the dam, it should be reported immediately and appropriate action taken to alleviate the problem. If the problem is escalating and there is a chance that the dam could breach, evacuation procedures should be initiated immediately. Note: The area downstream of the dam should be considered when determining the potential risk the dam poses (i.e. what is the risk to life, property and/or the environment?).





DAM SAFETY EMERGENCIES & IMMEDIATE RESPONSE ACTIONS

Important Note: If the problem is escalating and there is a chance that the dam could breach, evacuation procedures should be initiated immediately.

A. OVERTOPPING BY FLOODWATER

- Open outlet to its maximum safe capacity.
- Place sandbags along the crest to increase freeboard and force more water through the spillway and outlet.
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas.
- Divert floodwater around the reservoir basin if possible.
- Create additional spillway capacity by making a controlled breach in a low embankment or dyke section where the foundation materials are erosion resistant.

B. OVERTOPPING DUE TO BLOCKED SPILLWAY CHANNEL

- Open outlet to its maximum safe capacity.
- If the reservoir does not drop with outlet open then slowly remove debris blocking the spillway channel to allow more water through the spillway. (Note, rapid removal of the spillway blockage may result in extensive flooding downstream. Only if there is an immediate threat to the integrity of the dam should the blockage be removed rapidly.)
- If debris cannot be removed then follow the response action noted above under 'Overtopping by Floodwater'. (Note: During times of large storm events, high inflow and high reservoir levels, debris resting along the reservoir shoreline can be washed into the reservoir and drawn up to the spillway entrance. This debris should be monitored and removed if it threatens to block the spillway or break the log boom.)

C. LOSS OF FREEBOARD OR DAM CROSS SECTION DUE TO STORM WAVE EROSION

- Place additional riprap or sandbags in damaged areas to prevent further embankment erosion.
- Lower the water level to an elevation below the damaged area.
- Restore freeboard with sandbags or earth and rock fill.
- Continue close inspection of the damaged area until the storm is over.

D. FAILURE OF APPURTENANT STRUCTURES SUCH AS OUTLETS OR SPILLWAYS

- Implement temporary measures to protect the damaged structure, such as closing an outlet or providing temporary protection for a damaged spillway.
- Lower the water level to a safe elevation. If the outlet is inoperable, pumping, siphoning or a controlled breach may be required.
- Uncontrolled seepage alongside the structure may cause damage or failure.

E. SPILLWAY CHANNEL EROSION THREATENING RESERVOIR EVACUATION

- Reduce the flow over the spillway by fully opening the main outlet.
- Provide temporary protection at the point of erosion by placing sandbags, riprap materials or plastic sheets weighted with sandbags.
- When inflow subsides, lower the water to a safe level.
- Continue operating at a low water level in order to minimize spillway flow.

F. SLIDES ON THE UPSTREAM OR DOWNSTREAM SLOPE OF THE EMBANKMENT

- Lower the water level at a rate and to an elevation considered safe given the slide condition. If the outlet is damaged or blocked, pumping, siphoning or a controlled breach may be required.
- Restore lost freeboard if required by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock or gravel.

G. EROSIONAL FLOWS (PIPING) THROUGH THE EMBANKMENT, FOUNDATION OR ABUTMENTS

- Plug the flow with whatever material is available (hay bales, bentonite or plastic sheeting if the entrance to the leak is in the reservoir basin).
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place protective sand and gravel filter over the exit area to hold materials in place.
- Continue lowering the water level until a safe elevation is reached.
- Continue operating at a reduced level until repairs can be made.
- Note: this flow may originate alongside an outlet of spillway structure (see section D).

H. EXCESSIVE (NON-EROSIONAL) SEEPAGE AND HIGH LEVEL SATURATION OF THE EMBANKMENT

- Lower the water to a safe level.
- Continue frequent monitoring for signs of slides, cracking or concentrated seepage.
- Continue operation at a reduced level until repairs can be made.

I. EXCESSIVE SETTLEMENT OF THE EMBANKMENT

- Lower the water level by releasing it through the outlet or by pumping, siphoning or a controlled breach.
- If necessary, restore freeboard, preferably by placing sandbags.
- Lower water to a safe level.
- Continue operating at a reduced level until repairs can be made.

J. LOSS OF ABUTMENT SUPPORT OR EXTENSIVE CRACKING IN CONCRETE DAMS

- Lower the water to a safe level by releasing it through the outlet.
- Implement notification procedures.
- Attempt to block water movement through the dam by placing plastic sheets on the upstream face.



DAM DEFICIENCIES

The following table lists some *Potential Problems* (worst case scenario) associated with *Problem Indicators* that may be seen during an Assessment of a Dam along with some likely *Causes*:

PROBLEM INDICATORS	CAUSE	POTENTIAL PROBLEM
Reduced Freeboard	Flood Water	Overtopping/Embankment Failure
Reduced Freeboard	Blocked Spillway Channel	Overtopping/Embankment Failure
Reduced Freeboard or Dam Cross Section	Storm Wave Erosion	Overtopping/Embankment Failure
Cloudy Seepage through the Embankment, Foundation or Abutments	Poor Internal Drainage, Seepage Removing Embankment Material (Piping)	Piping/Embankment Failure
Excessive Clear Seepage and High Level Saturation of the Embankment	Poor Internal Drainage	May Lead to Piping Failure
Damage to Appurtenant Works	Poor Maintenance, Flood Water and/or Debris Damage etc.	Safe Operation of the Dam Impaired
Spillway Channel Erosion	High Spillway Flows, Poor Spillway Construction etc.	Uncontrolled Reservoir Release
Embankment Slides/Sloughs	Structural Deficiency, Saturated Embankment etc.	Embankment Failure
Excessive Settlement of the Embankment	Structural Deficiency, Foundation Deficiency etc.	Overtopping/Embankment Failure
Extensive Cracking in Concrete Dams	Structural Deficiency	Uncontrolled Reservoir Release
Broken Log Boom	Poor Construction or Maintenance, Excessive Force on Boom due to Excessive Debris etc.	Spillway Channel Blocked, Safe Operation and Maintenance of Dam Impaired.