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Drinking Water Supply Dams in NL: What Do You Mean I'm a Dam Owner?

Drinking Water Safety Workshop, Gander
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What is a dam?

- A barrier constructed for the retention of water
- Canadian Dam Association specifies volume of water retained and height
  - 30,000 m^3
  - 2.5 m (~ 1 m in NL)
- Includes all appurtenances and systems associated with the barrier (eg. intakes, gates, stoplogs, valves, fishways, etc.)
- Consequences of dam operation or failure are likely to be unacceptable to the public

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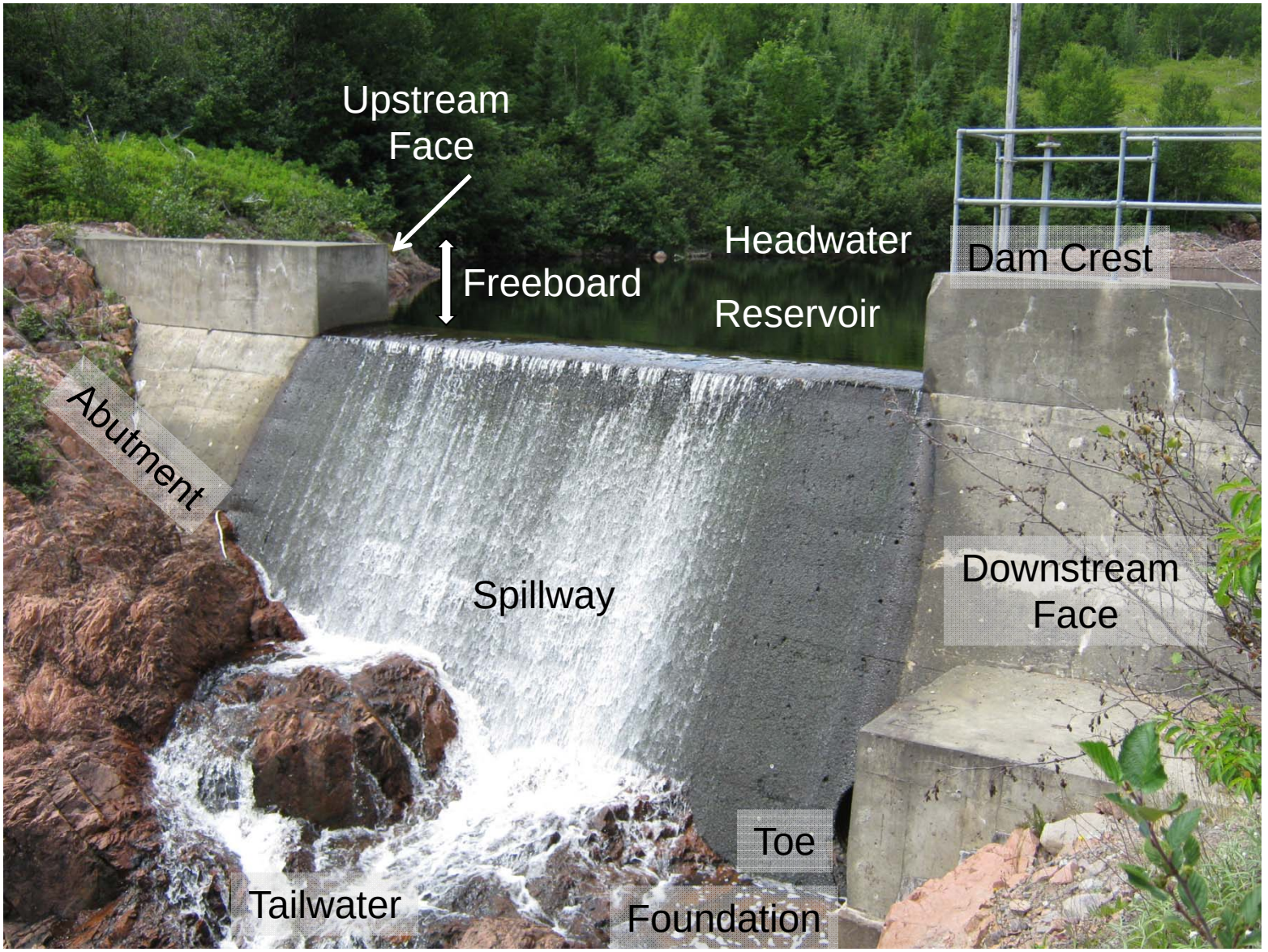
Components of a Dam



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Characteristics of NL Water Supply Dams

- Dam Height
  - Average: ~3 m
  - Range: 0.5-6 m
- Storage Volume
  - Average: 115,000 m^3
  - Range: 30-1.3 million m^3
- Dam Design Storm Return Period
  - Majority: 100-150 years
  - Range: 5-200
- Inflow Design Flood (IDF)
  - Average: 9.4 m^3/s
  - Range: 0.5-70 m^3/s

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Who is a Dam Owner?

- The person or legal entity that is responsible for the safety of the dam
  - Municipality
  - LSD
  - local water committee
- Generally, the Owner was issued a permit by ENVC for construction of the dam

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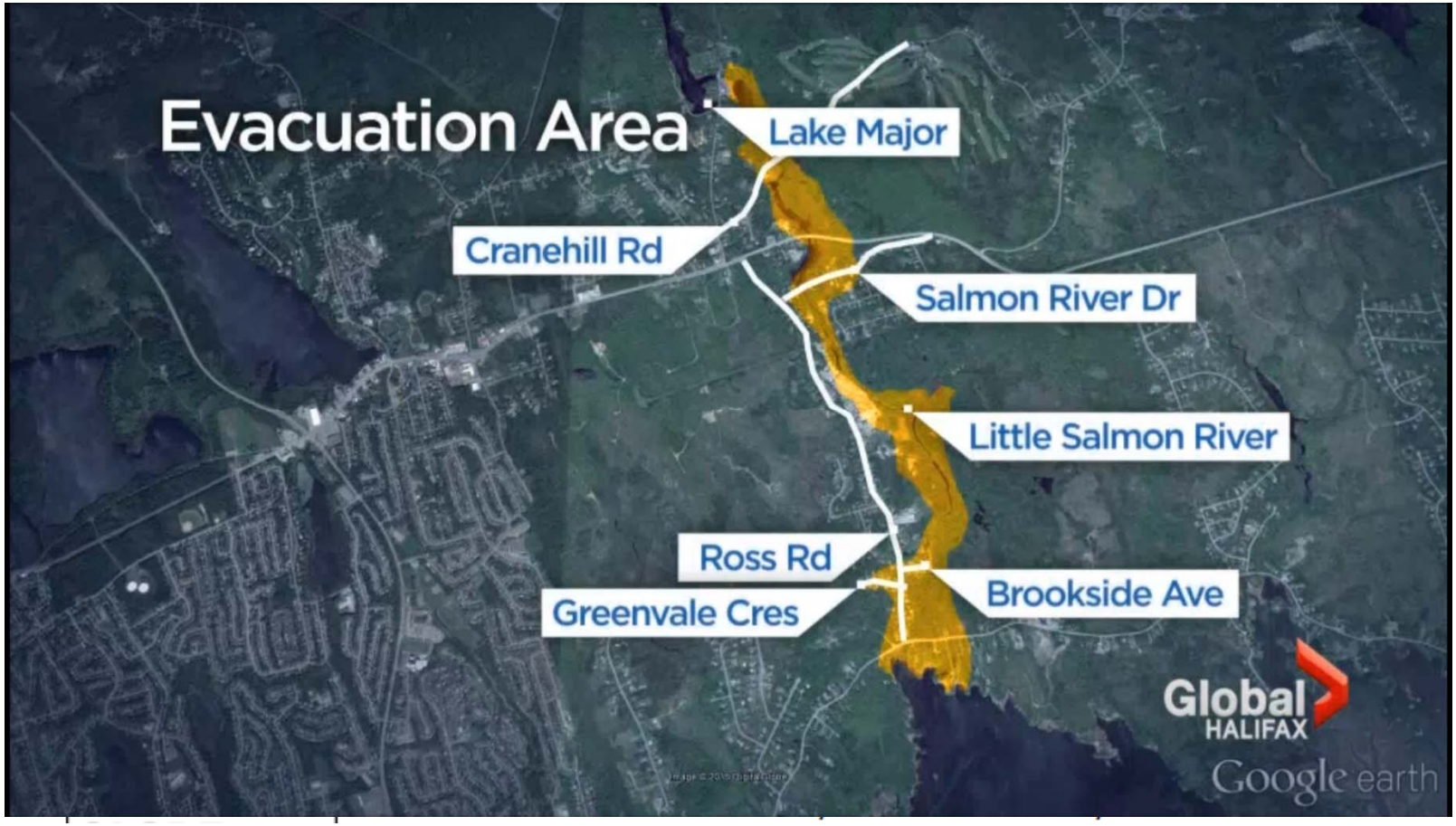
What Consequences?

- Operation and maintenance issues



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What Consequences?

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Water supply to be cut off for Grand Bank following drought

CBC News Posted: Sep 28, 2014 11:01 AM NT | Last Updated: Sep 28, 2014 11:01 AM NT

Water supply levels in the Grand Bank-Fortune area have been receding, due to a shortage of rainfall in the area. (CBC)

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What Consequences?

- Too much water
  - Risk of dam failure

Consequences of a Dam Failure

- Impacts downstream or upstream of dam
  - Population at risk
  - Potential loss of life
  - Environmental losses
  - Cultural losses
  - Infrastructure losses
  - Economic losses

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Smurf Dam or NL Water Supply Dam?

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Sunnyside Dam Failure

- Hurricane Igor- Sept 2010
- Dam breach washed away all earthen embankments, undermined the spillway and pump house

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Hermitage-Sandyville Dam Failure

- Earth dam washed out due to significant rainfall amounts in April 1998
- Town without drinking water
- Access to community cut
- Dispute over dam ownership may have resulted in failure
  - Improper operation and management practices
- Estimated costs failure approximately $3-million

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King's Point Dam Failure

- Caused by localized heavy rain on June 8, 1995 from tail end of a hurricane
- Flooding compounded by snow cover in headwater area contributing to runoff with warm temperatures
- 10 m section of earthfilled dam on the north side of the concreted spillway failed and left community without drinking water
- Reservoir went dry in a matter of minutes

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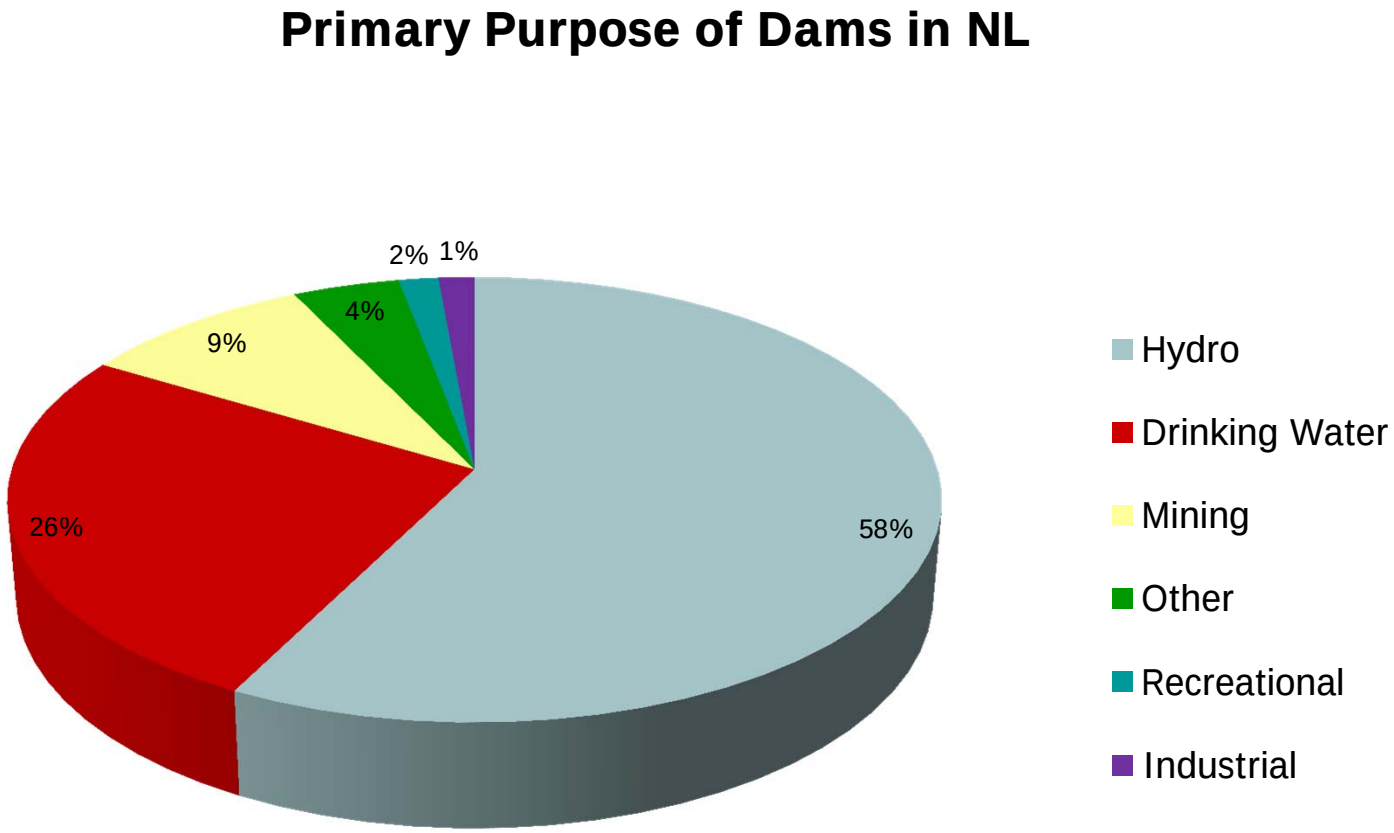
Primary Purposes of Dams in NL



166 water supply dams in the province

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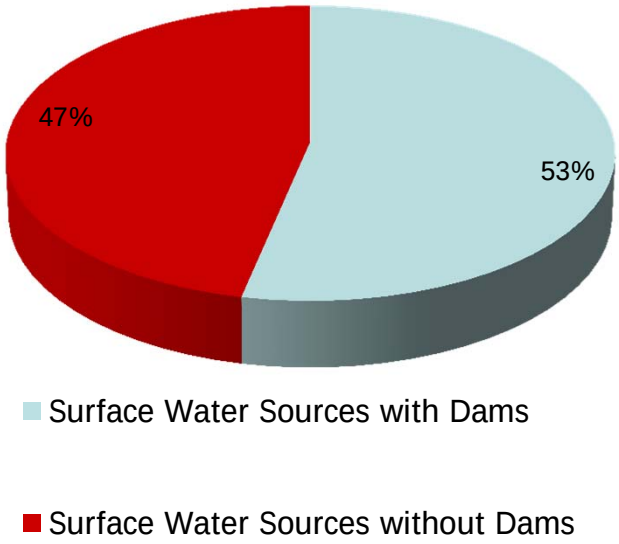
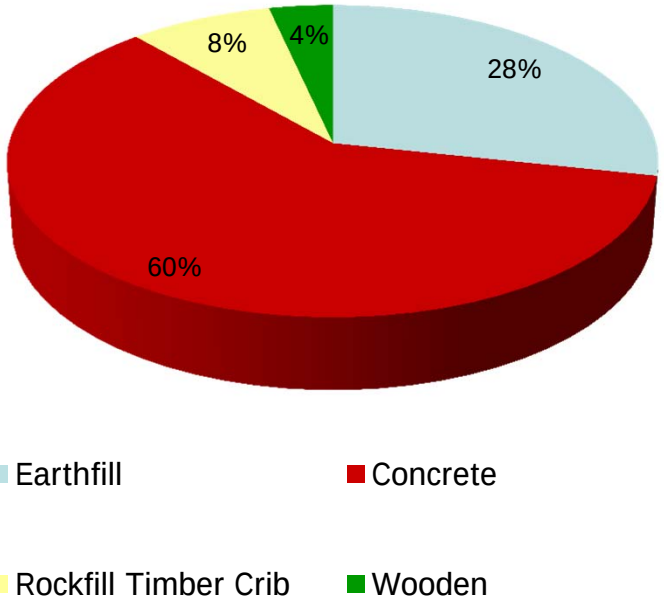
Public Drinking Water Supplies With Dams

- Majority of surface water sources have dams



- Majority of water supply dams are concrete or earthfill dams



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Cost of Public Water Supply Dams

- Cost of recent work on water supply dams (since 2011)
  - Lark Harbour- new concrete dam and transmission main- $1.7 million
  - Brighton- earthen dam improvements (liner replacement)- $350,000
  - Makkovik- new concrete/earthen dam- $560,000

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Dam Classification

Dam Class	Population at Risk	Loss of Life	Infrastructure & Economic Losses
Low	None	0	-Low
Significant	Temporary	Unspecified	-Moderate (eg. recreational facilities)
High	Permanent	10 or fewer	-High (eg. commercial facilities)
Very High	Permanent	100 or fewer	-Very high (eg. highway)
Extreme	Permanent	More than 100	-Extreme (eg. hospital)

- Environmental and cultural value losses not included
- Recommend dam breach and inundation analysis for dams of high or greater consequence

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Dam Requirements- CDA Dam Safety Guidelines

Dam Class	Design Standards- Design Flow	Frequency of Dam Safety Reviews
Low	1/100	-
Significant	Between 1/100 and 1/1000	Every 10 years
High	1/3 between 1/1000 and PMF	Every 7 years
Very High	2/3 between 1/1000 and PMF	Every 5 years
Extreme	PMF	Every 5 years

- Also requirements for:
  - Dam & Safety Inspections
  - Operation, Maintenance & Surveillance Manual
  - Emergency Preparedness Plans (external)
  - Emergency Response Plans (internal)

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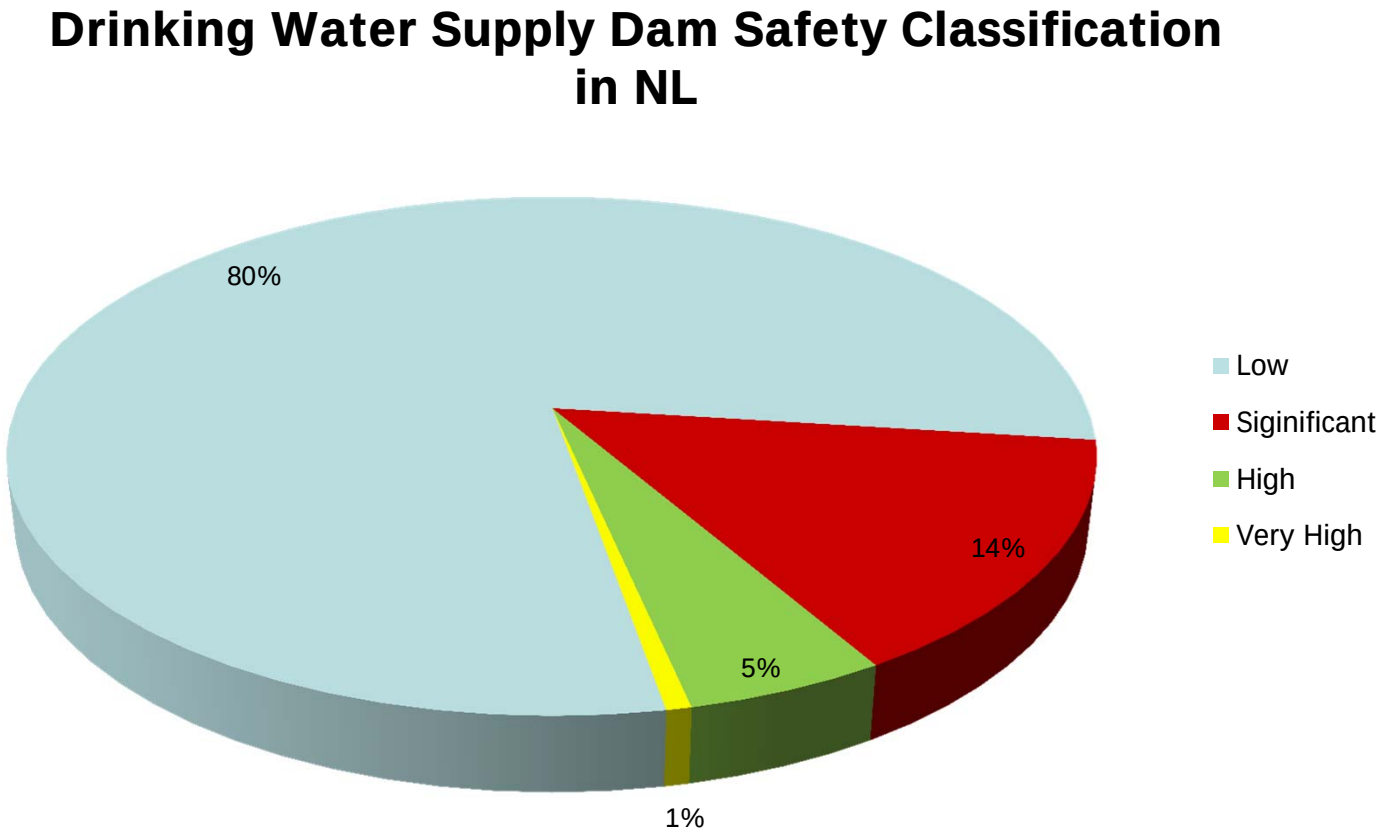
CDA Dam Classification of Drinking Water Supply Dams



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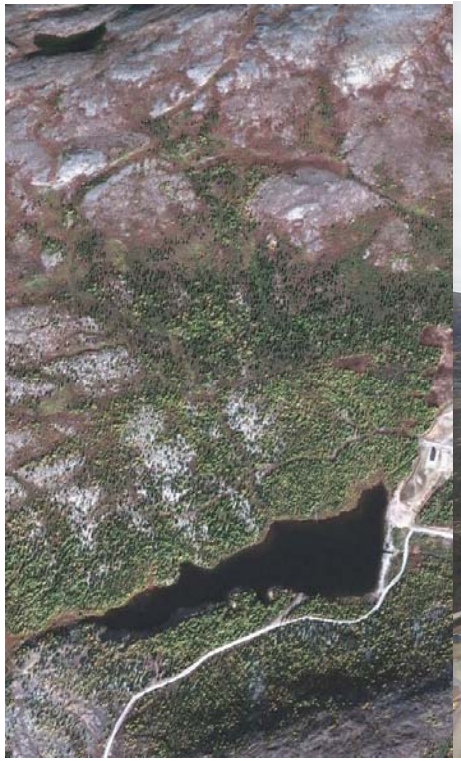
Examples of Dam Risk

- Very High
  - Nain (Anainik's Pond Dam)
  - Hazard creep



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Operation & Maintenance, Inspections

- Documentation of procedures and practices needed to ensure safe operation under various conditions
- Maintenance activities prioritized, carried out and documented
- Surveillance includes visual inspections and instrument monitoring
  - Routine inspections
  - Engineering inspections
  - Special inspections

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Standard Operating Procedures (SOP)

- For use by public drinking water system operators
- http://www.env.gov.nl.ca/env/waterres/training/operator_onsite_training/index.html

Operation & Maintenance of a Water Supply Dam

Inspections - General

- ❑ Check for any leakage from the dam structure
- ❑ Check for any seepage at the base of dam including quantity and quality (turbid or clear) of seepage
- ❑ Check for debris blocking the spillway
- ❑ Check for any signs of burrowing animals or beavers
- ❑ Check for floating debris, algae, or sediment accumulation in reservoir
- ❑ Check for signs of erosion
- ❑ Check for new occurrences or noted changes in dam condition from previous inspections

Inspections – Concrete Structures

- ❑ Check for cracks or other signs of concrete deterioration
- ❑ Check for signs of erosion around concrete structures
- ❑ Check for shifts in alignment of concrete structures

Inspections – Earthen, Rockfill or Wooden Structures

- ❑ Check condition of embankments, timber cribs, gabions, liners, etc.
- ❑ Check for settling or cracks in the dam crest, slumping along the dam face
- ❑ Check condition of rip-rap along the upstream face of the dam
- ❑ Check for and remove any vegetation (shrubs, trees) from around the dam

Water Supply Dam Operation

- ❑ Develop operating procedures for normal, flood, drought and emergency operations
- ❑ Determine frequency for routine inspections and maintenance
- ❑ Periodically inspect dam structure and equipment, test dam equipment (gates)
- ❑ Monitor water level in reservoir including max and min water levels
- ❑ Inspect dam before and after major precipitation and/or runoff events
- ❑ Address any issues identified in dam inspections (eg. seal cracks, replace rip-rap, repair settled crest, clear debris)

BC MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS

☑ Keep a record of dam and reservoir operational conditions, inspection findings, pictures of the dam, and a log of repairs

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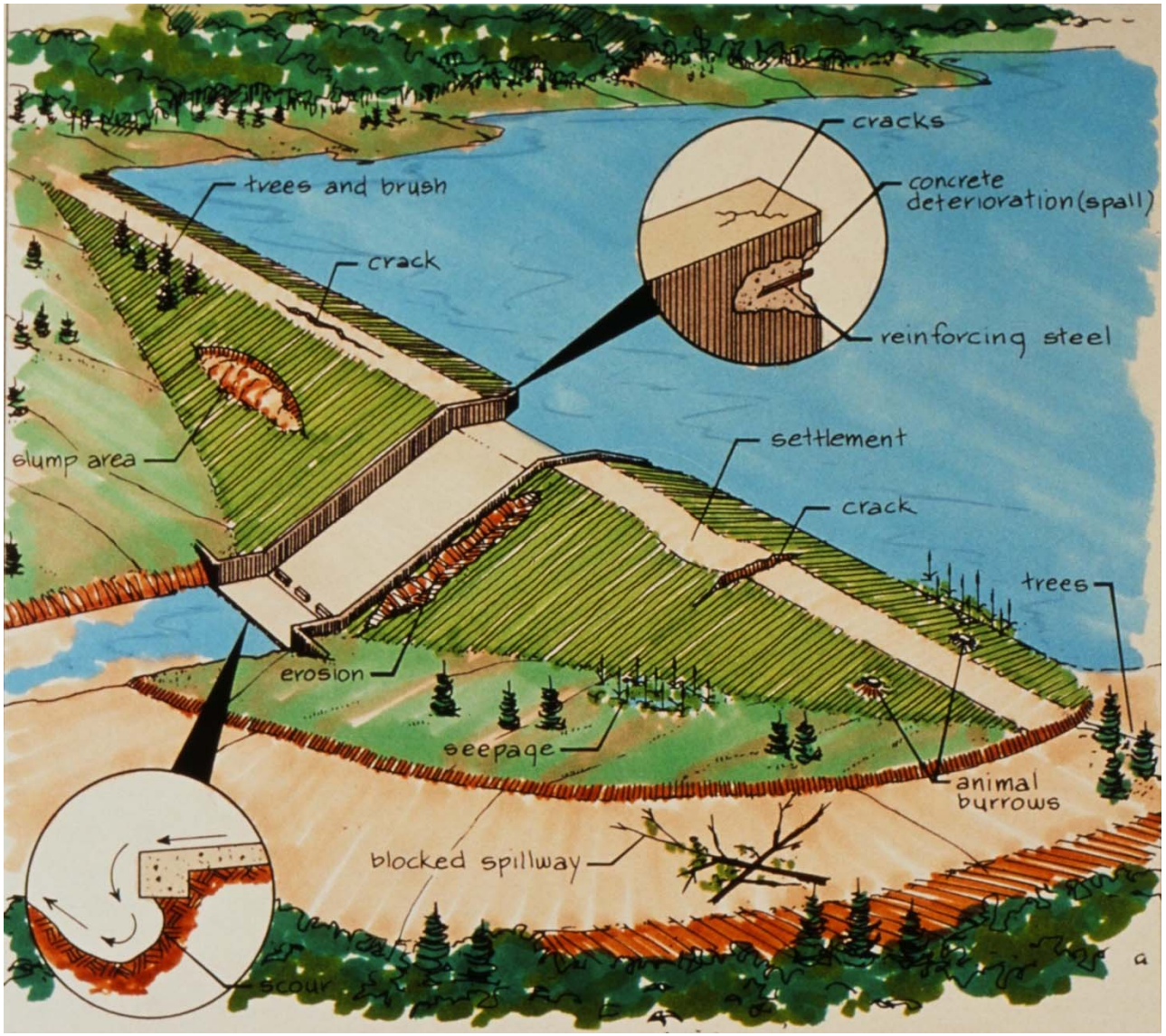
Inspections



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Maintenance of Dams

From Association of State Dam Safety Officials (ASDSO)
https://www.youtube.com/watch?v=vy6mhgUZeIY

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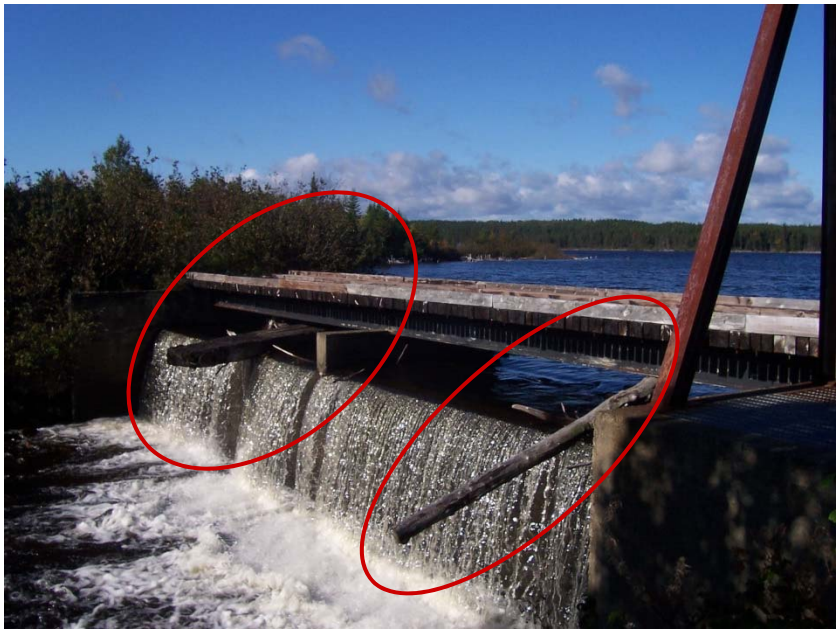
Can You Spot the Problem?

Concrete structures out of alignment



Debris blocking spillway

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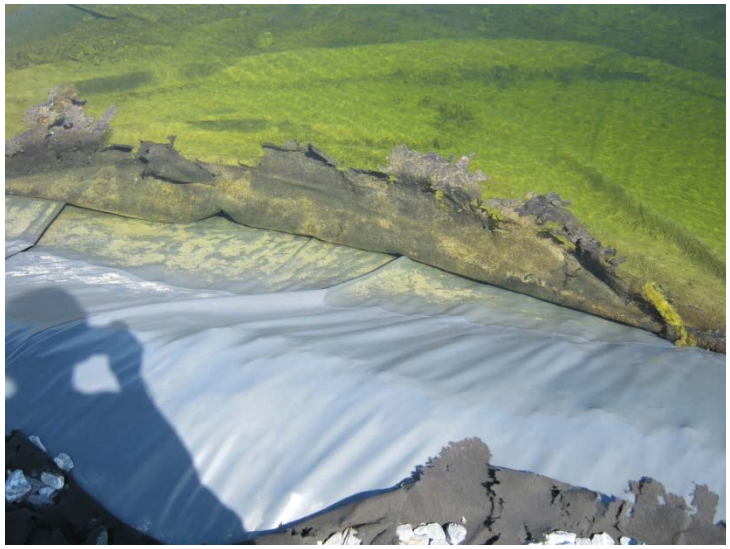
Can You Spot the Problem?

Scour and erosion at base of spillway



Tearing of the geosynthetic liner

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Can You Spot the Problem?

Deteriorating timber cribbing and gabions

Erosion

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Can You Spot the Problem?

Vegetation needs to be removed

Cracks in concrete structure

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Changes in Dam Condition

Inspect dams after heavy rainfall, melt events

Check for new occurrences or changes in dam condition

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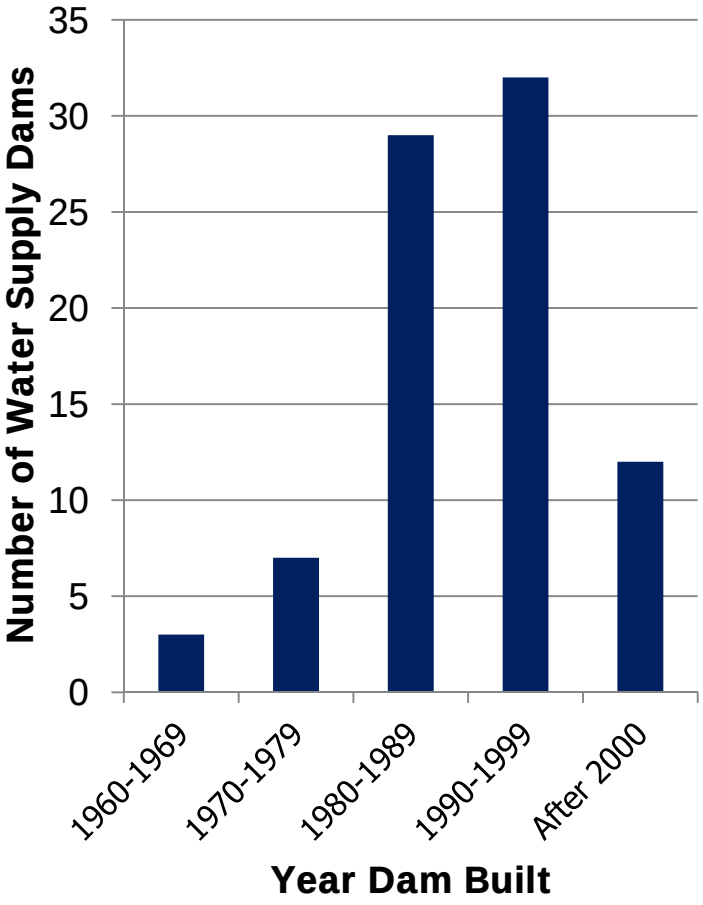
Age of Drinking Water Supply Dams in NL



- Majority of dams 35-15 years old
- Expected useful life of reservoirs and dams:

Dam Type	Years
Reservoirs and Dams	15-100
Concrete	50-100
Steel	30-80
Wood	15-30
Earthen	20-50

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Summary

- If your community's drinking water supply has a dam, the city, town or LSD is a dam owner
- Dam owners need to know their dam classification
  - Requirements based on dam classification
- Don't ignore the operation and maintenance of your dam

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Questions?