

## COLLIERY DAMS PUBLIC INFORMATION UPDATE

July 9, 2014

Work undertaken by Golder Associates on behalf of the Technical Committee is coming to a close. Release of Golder's technical reports, information generated by the Technical Committee, and a report to Council are being scheduled for the next two weeks. Also, a public information meeting is being scheduled, which will include Golder representatives in attendance to answer questions.

### Background:

- An update on the status of the Technical Committee's work was last provided on 2014-MAY-26. This report provides information on Golder's analysis of the dams, proposed remediation options, estimated costs of remediation options, signage, schedule for an upcoming information meeting and Council meeting, and next steps.
- The City of Nanaimo established the Technical Committee, whose focus included development of an environmentally, minimally invasive, cost- and time-effective solution that addresses:
  - ❖ The safety of downstream residents and workers;
  - ❖ Dam Safety Section requirements;
  - ❖ The respective objectives of the City, Snuneymuxw First Nation, the Colliery Dam Park Preservation Society, and the community;
  - ❖ Environmental concerns, including fisheries habitat and ecology;
  - ❖ Cost-effectiveness; and
  - ❖ Having a timely, permanent solution in place in 2014, if possible, but no later than 2015, with shorter-term mitigation in place, if required, in 2014.

### Dam Analysis:

- As noted in previous updates, extensive site investigation indicates that risks related to the dams are significantly lower than previously believed.

Though the risks are significantly lower, analysis and recommendations from Golder Associates need to be considered in planning for dam remediation and future planning in the event of an earthquake or severe storm.

- Earthquake: Analysis has confirmed that there is an extremely low probability of a dramatic rupture of the dams during an earthquake that would put public safety at risk.

If the dams were to be damaged in an earthquake, cracks would develop in the dam walls, resulting initially in water slowly leaking through the cracks. Leaking could continue over time, leading to destabilization of the dams/embankment. If destabilization occurred, the reservoir likely would have to be dewatered to allow for repairing, rebuilding, or removing the dams.

- Severe Storm: Analysis indicates risks of serious damage resulting from a severe storm are lower than previously thought. However, spillway capacity must be addressed to reduce the risk further to a level required by dam safety standards.

Golder's analysis has confirmed that the existing Lower Dam spillway is approximately 25% of the required size to handle a severe storm. During a severe storm, the spillway would reach capacity, resulting in the reservoir water level increasing to a point where the water would flow over the top of the dam. In a severe storm, either a prolonged overtopping of the dam or a substantial volume of water overtopping the dam, or both situations, would lead to erosion of the fill material behind the dam. This fill material (embankment) provides structural support for the concrete dam, and if the embankment is substantially eroded away, the concrete dam likely will fail by toppling over. Therefore, increasing the spillway size or designing an overtopping solution (described later in this report) to prevent erosion of the embankment is required.

- Design for Storm Event: Infrastructure design for storm events is an essential design consideration for engineers. Storm events (resulting in heavy rainfall) is analyzed based on the highest one-time rainfall event in a multiple-year period. As an example, the size of piping for storm sewer infrastructure is generally designed for the 1-in-200-year storm event (the worst-case rainfall event over 200 years). Recent heavy rainfall events in Calgary (July 2013), Parksville (September 2013) and Saskatchewan (June 2014), resulted in severe flooding as the infrastructure in place could not handle the volume of rainfall.

For the Colliery Dams, the existing spillway (concrete channel that allows release of water during high rainfall events) will reach its capacity in the 1-in-50-year storm event, leading to the reservoir reaching a height where water overtops the dam (it is believed this last occurred in the 1950s). In each successively higher rainfall event, 1-in-100-, 1-in-200-, and 1-in-1000-year events, water overtopping the dam will increase in both volume and duration.

Engineers designing a new spillway or an overtopping solution base their design on the worst-case rainfall event (the peak maximum flood), taking into consideration actual rainfall, plus other factors such as snow melt, ground saturation, global warming, etc.

### **Remediation Options:**

- Increase Spillway Size: The current spillway is approximately 86 metres long, 1 – 2 metres deep and 12 metres wide. Golder is recommending that the spillway be increased in depth from 1 – 2 metres to 5 metres deep, while keeping the width at 12 metres, as one option or increasing the width to 18 metres.

Increasing the spillway size would involve temporarily lowering the Lower Dam reservoir by approximately 3 metres, building a temporary dam at the mouth of the existing spillway, installing a temporary siphon to maintain lower water levels, removing the existing spillway, and constructing a new reinforced concrete spillway with the dimensions noted above. After the spillway is built, a labyrinth structure (W-shaped dam) would be built at the mouth of the dam (including a low-level water outlet and a section of the labyrinth that could be removed if needed). Thereafter, the temporary dam would be removed and the reservoir would return to its original level once water flows from the watershed above the dams increases in the fall. Construction would take place in the late summer / early fall when waterflows and rainfall are generally at their lowest point.

Cost of construction of this option is estimated at \$5.4 million. With other costs included (design, permits, construction management, contingency, etc.), the project budget is estimated at \$8.1 million.

- **Overtopping Option:** As an alternative to increasing the size of the spillway, an overtopping option is proposed. This option would involve installing a 1 – 3 metre layer of concrete over the embankment below the Lower Dam. This would result in a hardened concrete surface, which would prevent erosion of the embankment if water flowed over the dam.

In this option, the top 1 – 3 metres of embankment soil would be mixed with concrete to create a hard shell. Prior to placing the concrete, the embankment would be reshaped to direct water to a common channel at the base of the embankment.

Cost of construction of this option is estimated at \$3.2 million. With other costs included (design, permits, construction management, contingency, etc.), the project budget is estimated at \$7.2 million.

- **Alternative Overtopping Option:** During the past month, a design build contractor brought forward an alternative overtopping option. This option would involve laying concrete mats on a partially re-contoured embankment and drilling long anchors into the soil to secure the concrete mats to the slope. If this option is to be considered, design criteria would be developed and request for proposals (RFP) would be sought from the design build contractors.

The proponent of this alternative option did not provide an estimate of costs for this option; however, preliminary calculations reflect construction costs in the same range as the increasing the spillway size or the overtopping option that involves mixing soil and concrete.

- **Status Quo Option:** Is it possible to leave the spillway as is and not undertake any work? Golder Associates have advised that after undertaking detailed analysis and review of current dam regulations, doing nothing to the spillway capacity problem is not an option. Golder recommends that either the spillway be increased in size or an overtopping solution has to be designed.
- **Actual Costs:** All construction and project budget costs generated by Golder are estimates and cannot be accurately determined until design specifications and contract documents are developed and the project is put out to tender. Golder has identified a number of possible cost savings for both options; however, these possible savings cannot be quantified until later in the process.

### **Signage Installed Below Colliery Dams:**

- In 2013-SEP-09, Council directed staff to install electronic notification/siren system and signage as part of a risk-mitigation action plan as a short-term strategy for the Colliery Dams. Further, in the event of the dams failing through an extreme weather condition or seismic event, establish a warning system for people in the area below the Colliery Dams.

Since the signage has been installed, Golder Associates has undertaken a detailed analysis of the Colliery Dams. Golder has advised that extensive site investigation indicates the risks related to the dams are significantly lower than previously believed.

There's an extreme low probability of a dramatic rupture in an earthquake that would put the public at risk. Though the dams could fail through cracking in an earthquake event, dam

failure likely would be a slow process and there is an extremely low probability of a large-scale flood hazard impacting the neighbourhood below the dams as a result of the seismic event.

The risk of serious damage from a severe storm is lower than previously thought. However, there is still a risk that the dams could fail in a severe storm event, which could result in a flood hazard in the area below the dams. This flood hazard is only likely to occur during the fall/winter season (November-March). Once the spillway size has increased or an overtopping solution is put in place (in the summer of 2015), the flood hazard risk would be extremely low and all signage could be removed. Golder has indicated that their analysis confirmed that the flood hazard perimeter is considered lesser than previously calculated in September 2013. Golder is currently working with Associated Engineering to identify the smaller-hazard areas and will be providing that information to the City in the coming weeks. Once this information is received, it is anticipated some of the existing signage identifying flood hazard zones will be removed. As soon as this information is received from Golder, the signage in place will be adjusted to reflect the smaller flood hazard zone.

#### **Status of Middle Dam:**

- In Golder's detailed analysis of the Lower and Middle Dam, it has been determined that priority for remediation is for the Lower Dam, as once the spillway capacity has been reduced, it will likely be able to withstand failure of the Middle Dam during a severe storm event. Similar to the Lower Dam, the Middle Dam will likely crack in a seismic event, leading to leaking of water, but there is an extremely low probability of a dramatic rupture of the Middle Dam in an earthquake.

Given this information, the first priority is to address the Lower Dam through increasing the spillway or determining overtopping solutions. Work on the Middle Dam is not proposed at this time. The spillway capacity of the Middle Dam is still undersized to handle a severe storm event; however, it is not considered as significant a hazard as the Lower Dam. City staff are recommending proceeding with addressing the Lower Dam spillway capacity and putting a monitoring system in place for the Middle Dam to evaluate if the spillway capacity needs to be increased in the coming years. It is proposed to allocate budget money in future years in case there is a necessity to upgrade the Middle Dam spillway capacity in the future.

#### **Next Steps:**

- At Council's Meeting 2014-JUL-14, Council will receive staff reports, which will include a summary report from the Colliery Dams Technical Committee facilitator, with a recommendation to release the Colliery Dam Technical Committee minutes to the public. The report will include information on the release of Golder's technical reports, the next steps to determine the remediation process for the Colliery Dams, and budget to date for the consultant's review of the Colliery Dams. This report also recommends holding a public information meeting that is tentatively scheduled for 2014-JUL-22 at the Vancouver Island Conference Centre (VICC). After these meetings are completed, additional reports to Council will be prepared for review in August/September, with the goal of undertaking construction work in the summer of 2015.