

CONFIDENTIAL MINUTES
COLLIERY DAMS TECHNICAL COMMITTEE
TUESDAY, 2014-MAR-04 AT 9:00 A.M.
BOARD ROOM, SERVICE & RESOURCE CENTRE, 411 DUNSMUIR STREET

PRESENT:

Snuneymuxw First Nation:

Chris Good, Lands & Resource Coordinator (9:25 a.m.)

Colliery Dam Park Preservation Society:

Jeff Solomon

Geraldine Collins

Golder Associates:

Herb Hawson, Director of Special Projects

Leon Cake

Bruce Downing, Principal

Lorne Gale

Dr. Bill Roberds, Principal, Decision & Risk Analysis (10:30 a.m.)

(Provincial) Dam Safety Section:

Scott Morgan, Head, Dam Safety Section (9:50 a.m.)

Monty Miedreich, Sr Dam Safety Officer , Dam Safety Section (9:50 a.m.)

City of Nanaimo:

Toby Seward, Director, Social & Protective Services

Dale Lindsay, Director, Community Development

Holly Pirozzini, Recording Secretary

(Federal) Fisheries and Oceans Canada:

Brian Naito, Sr. Fisheries Protection Biologist, Ecosystem Management Branch

Katherine Gordon, Facilitator

John McCormick, Alternate Facilitator

1. Call to Order

The meeting was called to order at 9:05 a.m.

2. Review/Approve Agenda

Agenda was approved.

3. Review/approve draft Minutes:

- 2014-Jan-21;
- 2014-Jan-22; and
- 2014-Jan-27.

The Minutes provided at the meeting were approved.

4. Golder Associates Presentation and Q & A from Committee

The Committee agreed to begin today's meeting with the Mitigation Conceptual Design Options proposed by Golder Associates (GA). GA provided a ppt presentation. **A copy of the presentation will be distributed to the Committee [done].**

GA focused its site investigation and Options Assessment phase (Phase 2) on comparing remediation alternatives for the Lower Dam only.

Chris Good arrived at the meeting.

GA advised that Associated Eng. (AE) carried out work (hydraulic modeling) and Herold Engineering (assessed structure of dam) to assess downstream consequences based on inundation model runs. The risk model was run based on inputs and dam safety was assessed based on Canadian Dam Association (CDA) Dam Safety Guidelines.

Four mitigation conceptual designs and relative costs were developed:

- Option 1: Enlarge Existing Spillway
- Option 2: Swale (auxiliary spillway)
- Option 3: Labyrinth Spillway
- Option 4: Overtop Dam (soil stabilization)

GA reviewed the above options and stated that a combination of the options could also be considered.

Option 1 Q&A: Enlarge Existing Spillway – approximate cost \$2,589,000

- Is the total spillway 48 m across? GA answered yes.
- Will the enlarged spillway include a seismic event? GA answered yes, this is an option for a flood or seismic event.
- What if the Lower Dam fails due to the Middle Dam? GA responded that the Lower Dam is not failing as the Middle Dam is. The biggest concern is that failure of the Middle Dam would cascade over the Lower Dam; overtopping of the dam. We have provided options to remove failure mode #2 (cascading failure), but still need to remove the cracking and release of water through the core for the Lower Dam.

Option 2 Q&A: Swale (auxiliary spillway) – approximate cost \$1,345,000

- What happens in the riparian area of the lake? GA answered that the high zone is being removed to divert the water to an auxiliary spillway. This option requires the removal of some trees, but the function will be to control the water flow. Contouring will remain and can the area can be replanted to be aesthetically pleasing. Water will flow into an existing spillway, then into an auxiliary spillway, into a side channel and eventually into the creek.

Scott Morgan and Monty Miedreich arrived at the meeting.

Option 2 Q&A continued:

- Is the beach area lower? GA answered yes.
- Would the existing bridge remain? GA answered yes.
- Will the public be able to walk across the existing bridge and then on top of the swale? GA answered yes, the auxiliary spillway is about 1m higher than the existing spillway.

- Will the bridge need to be closed and the public warned not to cross it in heavy rain conditions? GA answered yes and we will provide an optimum depth and flow from a safety perspective.
- Will the revegetation in the swale be washed away in a flood, which will cause problems downstream? GA suggested that at minimal cost, the swale can be reinforced with materials (e.g. a geogrid) to make it more resistant.
- If the water flow is more than 175 m³/sec, what happens to the water when it connects back to the creek because the volume of water has to flow through, even though the dam has been saved? GA responded that it will depend on how fast the Middle Dam breaches. The risk assessment will review the consequences.
- Is the creek Harewood Creek? GA answered yes.

Option 3 Q & A: Labyrinth Spillway – approximate cost \$2,592,000

- Would the entire length of the new spillway have to be 3m lower than the existing spillway? GA answered yes. The new spillway would be 20 m wide for the entire length. The major cost will be in replacing the existing spillway with a new spillway to a depth of approximately 3m. There will be a drop off from the existing crest to a 5m depth, which will require a new bridge with railings for public safety. The wall acts as an overflow weir and needs to be 3m in depth to be effective.
- Is the labyrinth actually a reinforced dam? GA answered yes.
- Is Option 3 the same design as Options 1 and 2, but with a lesser footprint? GA answered yes.
- What happens at the falls? GA responded that nothing changes; water shoots over, the same as it has been doing.
- In a low flow situation, would a mechanism be in place for fish habitat? GA answered yes; it could be designed to include a valve for this once the wall is constructed.

Option 4 Q&A: Overtop Dam (soil stabilization) – approximate cost \$1,487,000

- Will the mixed contaminants stay in the ground? GA answered yes, the contaminants will be hardened by deep soil mixing the cinder and ash layer from the surface down to approximately 5m. The extent of the contaminants are unknown. Two suggestions are: either deep soil mix the contaminants and the soil stays in the ground or excavate the soil. The soil can be put in a pug mill, mixed up and put back into the ground. Uncertain whether there are regulations to prevent contaminated soil from being returned to the ground. Contaminants appear to be above the water table and not be leachable. The trail containment berm wall will need to be built up to 75m to control the flow of water to the specific area that has been stabilized.

Dr. Bill Roberds arrived at the meeting.

GA stated that the railway may have been built for the army to bring equipment to the camp. The concrete core wall is a well-engineered structure and the base was prepared very well to pour the concrete for the wall. The spillway excavation discovered bedrock present.

- Is it necessary to mix the soil behind the dam to 5m depth because the coal slag fill may contain arsenic materials? GA responded that the amount of arsenic is higher than is currently allowed in a park area, but it has been there for 100 years and is not mobile, so it doesn't trigger any regulations.

GA stated that water seepage could occur if the wall cracks. Suggested a drain (auger back filled up with crushed stone) be installed to prevent the water from rising. Success of this depends on the depth of the cinder slag, which is unknown at this time.

- To decrease the cost for this option; could rock or concrete mats be used? GA responded that those options are not feasible.
- Can a low level outlet be installed at the dam? GA answered no.
- Is a new bridge required? GA answered no, but will need to consider public safety.

GA stated that all four options are economical, doable and keep the status quo more or less.

BREAK at 10:45 a.m. for 15 minutes.

Ian Howat arrived at the meeting at 11:00 a.m.

Question: Having to deal with contaminants is a real uncertainty and there may be significant additional costs. For each of the four options, what is the level of exclusions that potentially could increase costs? GA responded that most of the costs are reasonable, but a decision needs to be made about removing the contaminants. From a risk perspective, there should not be contaminants involved in enlarging an existing spillway (Option 1). The swale (Option 2) is the cheapest, but would need to investigate to find out what is in the soil before additional work is done. The labyrinth (Option 3) is deepening the existing bedrock and is a small footprint and the potential of having contaminated soil there is low. Overtop Dam (Option 4) the water will be taken over the wall and the contaminated soil needs to be handled. There is a low risk of contaminated soil in all of these options.

Question: What was the dollar figure to remove the contaminants in the original solution which was for a huge excavation? GA responded that identification of contaminants is new; there was no previous identification by Klohn Crippen Berger (KCB) or data provided.

Question: What would be the costs to address the cracking issue of the shell? GA responded that there are no costs built in for this because at this point we don't think it is needed. We have reviewed the findings from EBA (2010) and discussed them with Herold Engineering and believe that if the dam suffers damage during an earthquake, GA does not believe it will lead to a breach or failure. If the cascading effect can be eliminated, the amount of cracking that would occur is insufficient to cause destabilization of the dam. An additional assessment for dynamic analysis will need to be done in future to verify that this conclusion is reasonable.

Design Options and Construction Schedules were discussed and GA stated that Options 1 and 3 can begin in June and Options 2 and 4 would begin in July, with all options being able to be completed this year.

Question: Does a June start mean underway with designs and tenders or shovels in the ground? GA responded yes to shovels in the ground. The later start for Options 2 and 4 will allow more time for design and hiring of a specialist contractor (Option 4 only).

It was noted that DFO, MoE, and Heritage components will need to be considered in the construction schedule. GA stated that regardless of which option is chosen, once the work begins, you will want to complete it to avoid leaving it unfinished over the winter.

Question: Will the Lower Dam be shut off to the public once construction is started? GA answered yes, you will lose the use of the park for a summer.

Question: In terms of the risk assessment approach and the options proposed to address the Lower Dam, does the Dam Safety Section (DSS) have any comments about what has been presented so far? DSS responded that there is still concern with the consequences to the Middle Dam. Can't see the rating dropping lower than a *high* consequence because of the fisheries value and the fact that the dams are in a public park.

GA stated that from previous meetings and discussions, DSS indicated that they are willing to work with this new risk assessment approach.

DSS stated that there needs to be consideration of protecting the environment, as well as public safety. This is the first step and the options heard today for the Lower Dam are good.

GA stated that the risk assessment based on Canadian Dam Association (CDA) Dam Safety Guidelines says that not remediating the Middle Dam is acceptable.

GA stated that the intention is to design the dam to take a severe flood event, something more than a PMF (probable maximum flood) and also so that it will not breach under a severe earthquake.

Question: Approximately how long is the timeframe for permitting from the Department of Fisheries and Oceans Canada (DFO)? DFO responded that at this point it is uncertain whether an authorization will be required. A review would take 2 - 3 wks and then longer to process if a *Fisheries Act* authorization is required, but if not; it will be dependent on a letter of advice.

GA stated that the Fisheries window does not apply to Options 2 (swale) and 4 (overtop dam). Options 1 (enlarged spillway) and 3 (labyrinth) will require DFO involvement because construction will take place in the water. Suggested that only the Middle Dam be stocked with fish this year.

DFO clarified that the federal government manages salmon; fish in the lakes is managed by the province. The Fisheries window applies to in-stream work only.

GA stated that work will need to be done outside of the Fisheries window. All construction issues will be in place to avoid contaminated silt flowing downstream and impacting fish and ecology.

Question: Why are Option 3 (labyrinth) costs so high? GA responded that it's because of the construction of a 3 m high concrete wall and careful removal of 3 m of rock, as well as costs for controlled blasting and vibration monitoring.

GA was requested to emphasize more defined costs for all of the options to assist in determining the most cost-effective option. GA stated that there will be design issues for all of the options.

GA stated that the focus was on if the Middle Dam fails, how do we prevent the Lower Dam from failing too.

Question: The topography of the Middle Dam is a defined channel of mainly bedrock; what is the environmental damage if the Middle Dam failed? GA responded that the risk assessment presentation will address this, but the question is how fast will it fail? Most of the time it takes hours for it to fail; usually not instantaneous. The risk assessment came to the conclusion that it is acceptable for the Middle Dam to fail and the Lower Dam not to fail with respect to the risk to the community, property costs, damages, and public safety. The risk assessment focused on damage costs and safety and didn't look at environmental damage. If the Middle Dam is allowed to fail, there will be environmental consequences for both the Middle and Lower Dams because the water and debris will flow downstream. All of our downstream risk assessment focused on what happens downstream of the Lower Dam because that is where the people are.

Question: Did the risk assessment model consider if improvements were made to the Middle Dam how much lower the consequences will be? GA answered no, we've looked at flood hydrographs of the Middle Dam breaching and not breaching and can see what the consequences are. As the probability of breaching goes down, those consequences will decrease. We saw big improvements by remediating the Lower Dam, but small incremental improvements by remediating the Middle Dam.

Question: Of the four options, is any one better than the other or are they all within the same design criteria? It's important to choose the right option in case further work needs to be considered for the Middle dam next year, from a cost perspective. GA responded that they are all designed with the same criteria. If you know you are going to improve the Middle Dam next year, then it would make a difference in the design depths for the spillway and the size of the swale for the Lower Dam. If further work is done next year than you will have oversized the remediation work for the Lower Dam.

Question: What fill is used behind the Middle Dam wall? GA responded that the fill was replaced in the late 1970s or early 1980s so the soil behind the Middle Dam is not the same as in the Lower Dam because there were quality spill specifications. It's not a contamination issue.

Question: Have you looked into the statement in the KCB report that the Middle Dam will fail rapidly? GA responded that the KCB report stated that of all the possible ways the dams could fail, the Middle Dam is the one that is most likely to happen.

GA stated that dams don't fail instantaneously. The risk analysis has assessed fast to slow fail (10 mins to 2.5 hours). Those are the two endpoints with 60 mins probably being the expected time. A slow dam failure is more typical.

Ian Howat left the meeting at noon.

LUNCH BREAK at 12:00 p.m. for 25 minutes.

Golder continued with review of its ppt presentation.

GA summarized its investigation of the dams and advised that drilling was carried out Feb. 11 – 14, 2014. Two different drill rigs operated concurrently on the concrete core wall and into the downstream dam fills. Two coreholes determined that the core was observed to be in good condition with no signs of deterioration, voids or honeycombing and 5/8 inch twisted rebar was found and in excellent shape. Bedrock was encountered.

Risk Management Plan (RMP) was reviewed. Summarized downstream sonic drilling.

Two questions arose in environmental assessment of cinder slag fill:

- What about leachate under less aggressive conditions (i.e. from precipitation)?
- Where do provincial and/or federal standards/guidelines apply with respect to the site? (soil, groundwater, surface water, soil vapour, sediment)

May require additional investigations.

Spillway hydrology and hydraulics studies were undertaken to update hydrographs from Water Management Consultants (2002) and discovered differences in the baseflow to Lower Dam, PMF peak flow to Lower Dam and an increase in the 1,000-year peak flow to Lower Dam.

Structural considerations and seismic response of the Lower Dam found the concrete core to be in significantly better condition than previously expected, reinforcement was present and there was no sign of carbonation/deterioration. The foundation was found to be good quality conglomerate bedrock. Failure modes were shown for 1:3000 year earthquake (EQ) and preliminary conclusions are that toppling and post seismic internal erosion are considered to be unlikely and that there is also a low likelihood of cascading, provided the Lower Dam can be remediated to accommodate cascading failure. Provided eight inundation scenarios (seismic, PMF and 1000 yr flood) from no breach to slow breach (150 mins) to fast breach (10 mins).

Ian Howat returned to the meeting at 1:05 p.m.

Key Conclusions - with Lower Dam remediation:

- Seismic (Sunny Day) no failure scenario – peak flow approx 75 m³/sec
- PMF no failure scenario – peak flood flow approximately 300 m³/sec
- 1000 year flood no failure – peak flood flow approximately 250 m³/sec

The current key Dam Safety concern (which drives the Dam Classification) is the Sunny Day Failure, which the AE model predicted approximately 1000 m³/sec peak flood flow (cascading failure). Lower Dam remediation (e.g. increased spillway) would be sufficient to pass a conservative Middle Dam breach and not trigger a cascading failure.

Dr. Bill Roberds (Golder Associates) provided a ppt presentation respecting the Colliery Dam Risk Assessment. **A copy of the presentation will be distributed to the Committee [done].**

GA provided Phase 1 scenarios covering a range of possibilities with no Lower Dam failures. Examined failure scenarios (storm, seismic, other) and reviewed each in terms of consequences and the probability of that scenario, then combined all of these to determine the uncertainty of the consequences.

Combined Middle Dam seismic failure probability with site storm frequency-magnitude and watershed runoff /reservoir capacity/release for both Middle and Lower Dams, plus reservoir storage curves to evaluate storm scenarios. Middle Dam overtopping failure in terms of depth and duration and probability of a breach. Middle Dam release to the Lower Dam (with and without a breach). Then assume the Lower Dam doesn't breach and water releases downstream. Discussed the probability of overtopping leading to a breach.

Question: Does 1 m of water for 100 minutes equal a 90% probability of failure? GA responded yes, this is subjective and based on hydrologists studies, and there are guidelines on this relationship between all the likelihoods and non-likelihoods.

Breach duration is a function of the dam condition (release of impoundment) more than the flow coming through. Overtopping and seismic are similar for breach duration because once it starts, the impoundment is the driver. 90% chance it would be 2 hours or less and 10% chance it would be 10 minutes or less. These are upstream characteristics.

Downstream inundation/consequence scenarios were run for Middle Dam failures only. Considered 6 scenarios in Stage 1.

Question: Does the slope need to be included? GA responded that it is essentially zero with no impact downstream.

GA used the AE analysis (2012) that identified the inundation area based on a worst case breach to focus on properties and population within the area (subdivided the area into 174 potentially affected spatial zones).

Question: Were the updated population numbers used? GA responded yes, the population numbers are based on 2.2 people per unit in daytime and 3.3 people per unit in nighttime.

GA used 6 scenarios to subjectively evaluate the warning/evacuation procedure that the City has in effect and the impacts on public safety and property values during day and night populations. Property Damage and mortality curves were graphed and re-evaluated.

Question: Can you explain the individual safety breach percentage? GA responded that in a large population it is a society risk, but in a smaller population it is a maximum exposed individual risk, based on an acceptable 10 to -4 annual probability of fatality in traffic. The goal is to protect the most exposed/vulnerable person.

GA provided the results for the annual probability of each scenario, for fast (10 minutes), slow (150 minutes) and mean (60 minutes) breach durations.

Question: Was a risk analysis done on the status quo? GA responded that the status quo was not evaluated because a new hydraulics study would be required for results for the Lower Dam failure for overtopping and seismic.

Question: Can you analyze the options? GA responded that they are assuming there is no Lower Dam failure. Need to evaluate selected options and their impact, review relationships of scenarios and refine the results, which could be done on the chosen/favourite options. There are no zero risk options. GA requested comments and concurrence from the Technical Committee on the work done so far.

Question: Do we need to choose an option and then run the risk assessment?
GA responded yes.

Question: If we choose any one of the options provided to remediate the Lower Dam, will it be extremely unlikely that it would fail? GA responded that to trigger a failure would require a PMF, plus a fast breach. There is no zero risk, even if you rehabilitate both dams.

Question: The dams have an extreme classification now, so will one of the options lead to a lower rating or should we accept that the rating stays at *extreme*, which is the same as many dams are in BC? GA stated that based on the risk analysis, the risk is quite low, even though under the deterministic analysis, the risk is *extreme*. The number of people that are located in the inundation area dictate the level of risk.

Question: Does twice the volume of water equal twice the likelihood of failure? GA responded no, the Lower Dam is more robust, so there is less chance of it failing in a seismic event. For the same amount of overtopping, there is less chance of it breaching and it may take longer for the breach to happen. The Lower Dam won't fail at the same time or in the same manner as the Middle Dam; it is more resistant to seismic failure, but it is located downstream. Due to time constraints, we focused remediation options only on the Lower Dam.

Question: Do we need to remediate the Lower Dam? GA responded yes, the risk analysis shows the minimum acceptable level. We have got to do something with the Lower Dam because we are above the absolutely acceptable level for safety. We have taken an approach that if the Middle Dam is not remediated and the Lower Dam is allowed to pass the flood, it is acceptable in a probabilistic analysis. The risk analysis proves that if we do one of the four options, we will satisfy the CDA Dam Safety Guidelines.

Question: Do you know the size of the breach used in the 1980s model? GA responded that the breach was essentially the valley; the same as what we used.

Question: Would more information impact the findings about the Middle Dam (some assumptions have been made)? GA responded that more information may change our understanding of the probability of failure, but substantially more is known about the Middle Dam now.

Question: Are you comfortable with the findings on record about the Middle Dam? GA responded yes, we have shown that the amount of flow that will come down in a failure is much less than originally proposed, provided the Lower Dam does not fail.

Question: Is there a way to change the dam classification because the time of failure has been increased from 3 minutes to at the very minimum 10 minutes and more likely 60 minutes? No response.

It was suggested that a simpler version of the risk assessment document be provided for the general public to understand.

Question: Is the Lower Dam in as much jeopardy as the Middle Dam? GA responded no, but there is no zero risk.

Question: Is it exhaustive to run a status quo model? GA responded that more assessments would have to be done, such as the probability of failure under various seismic loads and under various overtoppings.

Question: What would be the result of remediating both the Middle and Lower Dams? Could we run both models: a status quo and remediation of both dams? What's the cost of running these two scenarios? GA responded that the question is whether it's acceptable to not do anything.

Ian Howat left the meeting at 2:25 p.m.

City stated that DSS has to be supportive of the risk assessment approach and the preference is to have the remediation work done in 2014.

GA suggested that the risk analysis workshop be scheduled in the near future and include DSS to more fully understand the risk assessment approach.

Facilitator – At this point, it's important to hear from DSS because it is key to hear their reaction to the information presented today.

DSS requested a copy of the Risk Assessment presentation to review **[done]**. A risk workshop would be beneficial. This approach is quite a shift from previous specification-based dam assessments. As a regulator, we have to be careful to consider other applications throughout the province; unfortunately, this is the guinea pig model. The status quo option should be off the table. The environmental impact on the river is important. It is unusual to retain dams when other communities are removing them. Suggested that the consultants begin working on one of the options and do a seismic analysis. Are you aware of PGA and grandfather issues? GA responded yes and they will be using them.

DSS stated that it is a big assumption that the Lower Dam is not going to fail. To start work in the beginning of June is only 12 weeks away and it may take time for permits from other sections (e.g. provincial Ministry of Environment, *Fisheries Act* review, etc.).

Question: What is DSS' timeframe for this? DSS responded that the option(s) presented will be reviewed by a group and will require an expert opinion for a cleared geopath. Option 4 (overtop dam) may take the longest to approve because it is the one we know the least about.

Question: Has the dam overtopping method been done in other places? GA responded no, there are not a lot of overtopping designs done anywhere, so it is unknown whether there are regulations regarding excavation and replacement of the stabilized contaminated soils. Option 2 (swale) is the easiest, but will involve removing a large area of the park, which may not be acceptable to the community.

Ted Swabey arrived at the meeting at 2:40 p.m.

Question: The 2014-Feb-24 Council report estimated that consulting costs for completion of Phases 1 and 2 would be \$470,000. Is there more money to continue with the remediation options? City responded that all of the \$470,000 has been spent now.

Question: What are the environmental concerns if the dams fail? DSS responded that a dam failure will take out the river and the fish will be impacted. It is unknown if soils in the stream are contaminated or not and they will be carried downstream which could affect spawning, etc. Dam failures are never good for a stream.

Facilitator – The Committee’s mandate it to provide options by 2015 at the latest, so it’s important to hear from DSS and get a sense of how much time will be required to review the risk assessment. DSS responded that a peer group review will be required and those that have attended Technical Committee meetings and been engaged in the process will be able to do a review more quickly than others. More time will be necessary because we are not familiar with this approach and may need to ask for a second opinion, as well as confirm that the engineering reports are acceptable.

Question: What is DSS’ role? City responded that DSS is the regulator. They set a standard and the City has to work to it. Our goal is to deal with the safety issue. We need support from DSS. There is an order in place on these dams.

Question: Will DSS be able to take this new approach into consideration or does it conflict with your mandate? DSS responded that the new approach needs to be discussed in the office with a group of staff.

GA stated that because of the nature of this Committee there is no report and a design to give DSS to review, so these may be required first.

CDPPS expressed confidence that DSS will look at the option(s) presented by the Technical Committee and that this will be done fairly and as quickly as possible.

Question: Would it be beneficial to have a risk analysis workshop? DSS expressed an interest in being involved.

DSS left the meeting at 3:00 p.m.

Recommendations for next steps

Facilitator – General discussion of options that have been presented and questions / concerns regarding them.

Agreed: That the Technical Committee consider a preferred option, as well as a secondary option.

CDPPS (Lorne Gale) reiterated request to know the value and costs of exploring the status quo and remediation of both dams. **Preferred option is dam overtopping (Option 4).**

City stated that there are still some uncertainties for some solutions that may increase the costs. Options 1 and 2 - extremely disruptive to the park (spillway options). Option 2 (swale) - completely changes the park and may be difficult to accept that from a community perspective. Option 3 (labyrinth spillway) - advantage in that a weir can be installed to increase water flows during the summer, but there will be increased costs for blasting the rock for the new concrete wall. Option 4 (overtop dam) – uncertainties about mixing the contaminants in the soil, how long this process would take, and whether

environmental approval is required. **Option 3 (labyrinth spillway) is preferred and Option 4 (overtop dam) is the secondary option.**

DSS repeated that it may take longer for a review of Option 4 (overtop dam).

Question: What is the width of the Lower Dam? GA estimated it may be 80 m across.

Question: In terms of the environmental impact, would numerous studies have to be done to determine the impact of overtopping? GA responded that it is not believed so.

Question: Is the best case scenario that there wouldn't be any release of contaminated soils downstream? GA responded that there is a penalty for releasing contaminated soils downstream into the river and there will be contractual obligation to avoid this.

Question: Do you have a contractor who could do the overtopping work? GA responded no. We would not hire a conventional contractor for this work. A base design should be created to discuss with possible contractors. Then select no more than two contractors (who are pre-qualified based on their equipment and method) to work with the Committee to finalize the design for the project. Options 1, 2 and 3 can be designed fairly quickly; Option 4 will take longer and may not be possible to begin this year. Working with the Contractor and going through the approval process concurrently, will save time.

SFN expressed appreciation for the four proposed options, but cautioned everyone on making a decision today on an option when there may be variations on the options to investigate. **Option 3 (labyrinth spillway) is preferred because it has less impact on the footprint of any existing structure.**

Question: Has the water quality downstream been monitored? GA responded that water samples will be taken as part of the environmental work.

Question: Is the rebar in the concrete sufficient to today's standards? GA responded that it is not sufficient compared with today's standards, but it is sufficient to withstand a 100 year failure. It appears that the dams were designed well.

It was suggested that the revegetation in Option 4 (overtop dam) is proposed for aesthetics only and it could be left in an asphalt state.

Question: In Option 4, can you explain the area on the plan that is to be lowered? GA answered that the water will be channelled over the area that is lowered and the existing spillway will be altered by raising it to not allow the water to jump over.

Question: Based upon findings of the Lower Dam concrete and the confidence in the construction, can you make a conjecture about the Middle Dam now? GA responded that the Middle dam is more of a concern. It has been rebuilt, so greater displacement will occur in an earthquake and even if the core is determined to be of good quality, it will not be able to resist overtopping.

Question: Can the overtopping be dealt with by dumping rock in front of the Middle Dam? GA responded that this hasn't been looked at, but that would resist dam displacement. If the Middle Dam fails during an earthquake, water flow can be accommodated through routing. Updating it for an earthquake won't make much of a difference in terms of reducing the risk because it never contributed much to the risk profile anyway.

Question: How much work would it take to model strengthening the Middle Dam? GA responded that it wouldn't be a lot of work, but the probability effect would need to be changed. Our understanding was that we wouldn't be required to remediate the Middle Dam unless this is a further requirement by DSS. Remediation work could be done in the Lower Dam this year, which is not detrimental to remediation work that may be done in the Middle Dam next year.

City expressed concern with overdesigning of the Lower Dam this year, if remediation is being considered for the Middle Dam next year. GA responded that the excavation could be reduced for the work in the labyrinth spillway on the Lower Dam, if it is known that remediation work will be done in the Middle Dam next year.

CDPPS stated that remediation of both dams would be too expensive.

Ted Swabey left the meeting at 3:45 p.m.

CDPPS expressed concern with blasting in bedrock (labyrinth spillway). GA responded that they blast bedrock all the time.

Question: Option 3 (labyrinth spillway) - Will the cost be decreased if the wall size is reduced? GA responded that if the wall was reduced to a 2.5 m height there would be savings in concrete, bore work, and excavation.

Question: Option 3 (labyrinth spillway) - Would trees need to be removed? GA responded yes.

Question: Who provided the costs for each option? GA responded that staff in GA's construction division reviewed each option similar to the way you would bid on a contract.

Question: If Option 4 (overtop dam) is chosen and if we were to review the Middle Dam at a later date, is there a substantial loss if we don't use the soil stabilization? GA responded no, there is no benefit to doing the soil mixing on the Lower Dam and then do the Middle Dam. You get benefit if you do the spillway structure.

Option 4 (overtop dam) It was noted that the volume of contaminated soil is unknown.

Question: Explain incremental? GA responded that a dam failure will cause a surge which causes an additional amount (incremental) of damage in the inundation downstream, which is what the CDA Dam Safety Guidelines are based on. A PMF causes inundation downstream. The incremental consequences take the values associated with the Lower Dam breach on top of the Middle Dam breach. This consequence won't be as bad as indicated in the previous study.

Question: Are the assessment numbers accurate for the height of the water over cresting as opposed to the time it takes for the dam to fail (1m of water to 10 mins)? GA responded that the deeper the water over the crest and the longer time, the higher the possibility of a breach. AE collected the damages, but they never did an FN curve. Our assessment of the PMF is about 1 in 50,000 yr and their assessment was 1 in 10,000 yr. AE didn't take into account a mortality curve.

Chris Good left the meeting at 3:55 p.m.

Ted Swabey left the meeting at 4:00 p.m.

Question: Option 4 (overtop dam) - Does the Lower Dam concrete wall have to be lowered? GA answered no, the volumes will go over the dam.

Question: Option 4 (overtop dam) – Does the thatched area on the map need to be widened and excavated to be equivalent with the rest of the area (remove trees and blast out the area)? GA answered yes because that area is rock. Will also need to raise the berm wall about 1m.

It was noted that the current retaining wall in this area is collapsing. Will need to analyze the contaminated soil to find out if it is detrimental because there will be a large amount to dispose of.

Facilitator – The archaeological impact is another consideration. There are other costs associated with Options 1, 2 and 4 for public safety.

GA stated that Option 3 (labyrinth spillway) is the only one that doesn't have a tremendous impact; it has the smallest footprint. It is deeper, but isn't extensive beyond the existing footprint. Guard rails will be necessary for public safety.

Vacated the Board Room at 4:10 p.m. and reconvened in the HR Training Room, City Hall, at 4:20 p.m.

Question: What further work needs to be done on the Lower Dam from a seismic perspective? GA responded that the assessment being done by Herold Engineering is subjective. The dynamic analysis done by EBA in 2010 will need to be updated for a higher consequence and magnitude earthquake, with the known dam conditions. Failure modes will need to be analyzed and will need to assess the level of cracking in the dam after the earthquake.

Question: Will knowing the seismic information impact the options? GA responded that from our studies, we think the dam will perform fine in a seismic event, but we still need to analyze the data.

Question: Will the seismic information make one of the options better than another one? For example, is Option 4 (overtop dam) soil mixing better because it reinforces the dam? GA responded that the Middle Dam was rehabilitated in 1980 and fill was added which makes the situation worse because now the fill pushes on the dam in one direction during an earthquake, which aggravates the deflection vs. loose rock. All of the options are based on the Lower Dam performing adequately under storm and earthquake conditions.

Question: How much does stiffening the soil play a role in stiffening the dam for a seismic event? GA responded that the soft soil will be stiffened to be almost like concrete on the downstream side. It is unknown if this will have an adverse effect. The stiffer soil may put more force onto the wall.

Question: Will this be part of the investigation? GA responded that it will be part of the design to analyze the dam performance both with and without the hardened downstream shell.

Facilitator - Will DSS be concerned with this? GA answered yes.

Question: Does the seismic analysis have an impact on Option 3? GA answered yes, on all of the options.

Question: Is there an ability to design to a 1 in 10,000 seismic event as part of the risk analysis? What would the design look like for the Lower Dam for seismic? GA responded that the analysis for the Lower Dam would be 1 in 10,000 because it is the standard. Storm events, PMF and consequences have been reviewed.

CDPPS stated that Option 1 (enlarge spillway) is too invasive and expensive, so not a consideration. Option 2 (swale) is acceptable because it could be turned into a recreational area, but still very invasive as two acres will be cleared. Option 3 (labyrinth spillway) is expensive, invasive and a large amount of the peninsula will be lost. Option 4 (overtop dam) is cost effective and the most non-invasive option. The contaminated soil is in question, but presume it can be mixed and left there for the next 100 years.

City stated that Option 2 improvements as a recreational area will need to be budgeted for.

Facilitator – Reminded the Committee that SFN expressed concern about Option 2.

CDPPS stated that it's important not to come to a decision about an option today. Need to discuss with others in our groups and return with feedback to this Committee on Monday. The community needs to have more involvement. Would not feel comfortable making a decision without consultation.

Facilitator – In the terms of reference for this Committee, the public is not involved in the Committee's decisions.

CDPPS repeated that the public have to be involved.

City stated that this information certainly needs to go to Council if it is going to be made public. There are four members here representing the CDPPS and they will have to make a decision on behalf of their group.

Facilitator – All four of the options stand equally, although all have advantages and disadvantages. All four options require further work to refine them before design stage

Question: Are there some merits to refining the two recommended options? GA responded that they can carry two options to a certain stage, but will need to have an objective of what is required to be done this year. DSS may want a report and that will take time to prepare to the standard that they will want for a review. Some options will require less time for DSS to review.

Question: Option 4 (overtop dam) - What are the disadvantages? City responded that DSS will need to take their time reviewing it and may be concerned with loss of 3000 m² of habitat and the contaminated soil erosion. The contaminated soils and erosion issues will require involvement of an environmental consultant to ensure compliance. GA responded that 95% of the soil can be stabilized, but the construction of the downstream shell is unknown. It is presumed that DSS will hire another consultant to assist in their review and

may also require a comprehensive report. This may delay the process and mean we lose the construction window this year.

Question: Do we have a construction window for Option 4 (overtop dam)? GA responded that they would prefer not to do this work in the rain because of the required equipment and cement and the sloped ground.

City added that DSS will not want to delay the review of Option 4, but it may be unavoidable because the method is brand new.

CDPPS stated that it may be beneficial to have the risk workshop soon, which includes DSS so that they will have a better understanding.

GA advised that DSS will probably require a second opinion and hire a risk management consultant for their review, regardless of the risk analysis workshop.

Facilitator – This is the end of Phase 2. The Committee needs to decide if it wants to stick with the existing schedule with Council making a final decision in July or do you want to try to have an option implemented this year which means shovels in the ground by June?

CDPPs stated that DSS are the ones setting the time frame and they are who we need to satisfy. There has not been continuity with DSS attending Technical Committee meetings; different representatives have attended each time.

Herb Hawson and Bill Roberds left the meeting at 4:55 p.m. and agreed to be available by phone tomorrow at 2:00 p.m. to receive any further questions from the Committee.

Question: What has not been included in the costs? GA responded that detailed design, construction management, environmental and archaeological assessments, and contingency are not included.

CDPPS suggested that a public update be released advising that there are four options being considered.

Facilitator – If this group can reach a consensus on what you'd like to see in terms of recommendations, we can reconvene tomorrow afternoon to ensure that everyone is comfortable with the decisions made today.

City stated that there are two key pieces of information that the Committee needs to make a decision on the two options that are on the table (Option 3 and 4). Firstly, understanding if the DSS will be supportive of the concept of remediating just the Lower Dam. DSS stated today the importance of being involved in a risk analysis workshop, so this workshop needs to be arranged by GA. Secondly, there is unknown information for a final analysis of the Lower Dam from a seismic perspective and the impacts of the soil mixing.

Question: Are there other gaps in information missing? GA responded that downstream shell information is required to understand the depth of the contaminated fills.

CDPPS - Option 4 (overtop dam) - Suggested that GA review the 3000m² loss of habitat area because it may actually be less.

City stated that Option 4 has the most unknowns, compared with the other three options.

Agreed: The Committee is generally focusing on Options 3 (labyrinth spillway) and Option 4 (overtop dam).

CDPPS expressed concern with the costs of the bedrock excavation and the new bridge design, as well as loss of vegetation for Option 3. Option 4 we know what the end product will look like.

CDPPS stated that the Committee needs to respect all the work GA has done in a short timeframe.

City is in favour of Option 3 because it has the ability to install a weir and none of the other options have that. The concern with Option 4 is the length of time it may take to begin construction because there are still many uncertainties. A risk analysis workshop will determine if the uncertainties are as strong for Option 4. DSS needs to attend the workshop because the City has to answer to DSS. There are real concerns with soil mixing of contaminated soil and preservation of the lakes and dams for fishing and swimming. The seismic effect of water against hardened soil and how that might behave may be a detriment to choosing Option 4 too.

Question: How quickly can a risk analysis workshop be arranged? GA answered that it could probably happen quickly.

Question: Is it possible for any portion of the heritage bridge to be salvaged and utilized in the new construction to maintain that look and feel? GA responded that the bridge is too short a span. It was suggested that GA try to replicate the appearance of the current bridge in a new bridge.

CDPPS stated that the Committee needs to provide DSS with a positive approach. DSS needs to respect the information provided by the hired engineers.

CDPPS agreed that the advantage to Option 3 is the ability to install a weir.

Question: How important is the ability to control the water flow to the fishery? City responded that this is a big concern for the SFN, especially during the summer months when there's no flow.

Facilitator – Suggested the Committee may be in a position to report to the Executive Committee the following: that it's possible to remediate; there are a couple of viable options being considered for the Lower Dam; DSS is open to those options; there may be a third viable option to mitigate the Middle Dam as part of Option 3 or 4; that further work is required; that the risk workshop is being arranged and will include DSS; that DFO is committed to undertaking the application review promptly; there will be further consideration of the pros and cons of the options to the end of April; and at that point could assess whether one specific option can be recommended for work to be commenced in June.

Ian Howat arrived at the meeting at 5:15 p.m.

City stated that a report to Council should not eliminate any of the options that have been presented, so that Council and the community are informed of all of the options being considered.

CDPPS stated that we should explore everything because it may be determined that nothing needs to be done to the Lower or the Middle Dams, based on the risk assessment methodology. GA responded that the purpose of the risk assessment is that we have determined that the greatest bang for the buck is to just remediate the Lower Dam.

CDPPS stated that GA has provided historic information (coring and sonic) on the dams that wasn't known before. The risk assessment approach includes the CDA Dam Safety Guidelines. GA stated that the risk assessment approach is an accepted practice and DSS has indicated that they are willing to work with this new approach. DSS will need to learn about it and to go through it step-by-step. The risk analysis workshop is an important part in the process and it enables everyone to participate and have a better understanding of this methodology.

Question: Who will author the report to the Executive Committee? The facilitator responded that the report will come from the Technical Committee and it will be decided at tomorrow's meeting who will author it. City staff will draft an Information Report to Council this week and will distribute it to the Technical Committee for review before it is finalized.

Question: To meet the CDA Dam Safety Guidelines is it reasonable to do nothing to the dams? GA answered no.

GA suggested that before a decision is made, DSS should be asked about their overall requirements and if they will be insisting that something be done to the Middle Dam. And if they will be engaging someone else to review the option(s) chosen.

City requested that GA contact DSS to coordinate the date for the risk analysis workshop in Vancouver (as soon as possible). GA responded that all the experts should attend.

CDPPS stated that it is premature to discuss the pros and cons of the options until all of the information has been provided. City responded that we'll never have all the information until we have a detailed design and we can't get to a detailed design until we chose the options.

5. Next Meeting:

Wednesday, March 5 at 2:00 p.m. in Room 233, Service & Resource Centre, with Golder Associates accessible by telephone. Agenda items:

- (1) Contents of the report to the Executive Committee from the Technical Committee and who will draft it.
- (2) What are the next steps and who's doing what.
- (3) Public information

6. Conclusion:

The meeting concluded at 5:40 p.m.