

City of Nanaimo
REPORT TO COUNCIL

DATE OF MEETING: 2013-MAY-06

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RE: COLLIERY DAMS – COST OF ALTERNATIVES TO REMOVAL

STAFF RECOMMENDATION

That Council consider any further decisions regarding the Colliery Dams at the Monday, May 13 Council meeting.

PURPOSE:

To update Council on the requested costs regarding alternative options to removal that reduce the risks posed by the presence of the Middle and Lower Colliery dams to an acceptable standard.

EXECUTIVE SUMMARY

The Lower and Middle Colliery Dams are 100 year old structures that are no longer used for the purpose for which they were built, but have a recreational and aesthetic value important to the community. Engineering studies have concluded that the Colliery Dams no longer meet the standards imposed by the Dam Safety Regulation and pose an unacceptable life safety risk to the downstream community. The structures are deficient in their ability to withstand a significant seismic event or extreme weather event. Climate change is increasing the severity and frequency of such events. The City has a legal duty to protect its citizens from death or injury due to the failure of these dams.

The BC Dam Safety Branch has directed that the City of Nanaimo take action to reduce that risk. In October 2012, balancing the risks to human lives, costs, ongoing liabilities and the potential for environmental enhancement, Council directed that the dams be removed. This direction ensures compliance with the regulation and removal of the risk. In response to a community group's desire to ensure that alternatives to removal be more thoroughly considered, Council directed staff to undertake conceptual-level cost estimates. This report presents those costs and other considerations.

Rehabilitation of the dams involves high life cycle costs ranging from \$23.7 to 43.0 Million, uncertain quality of the end product, an extended time to take corrective action and residual risk to public life safety.

Replacement of one or both of the dams is less costly and has a lower risk than rehabilitation, yet still carries increased life cycle costs of \$14.3 to 20.8 Million, an extended time for this alternative to be fully implemented, residual life safety risk and liability, monitoring, maintenance

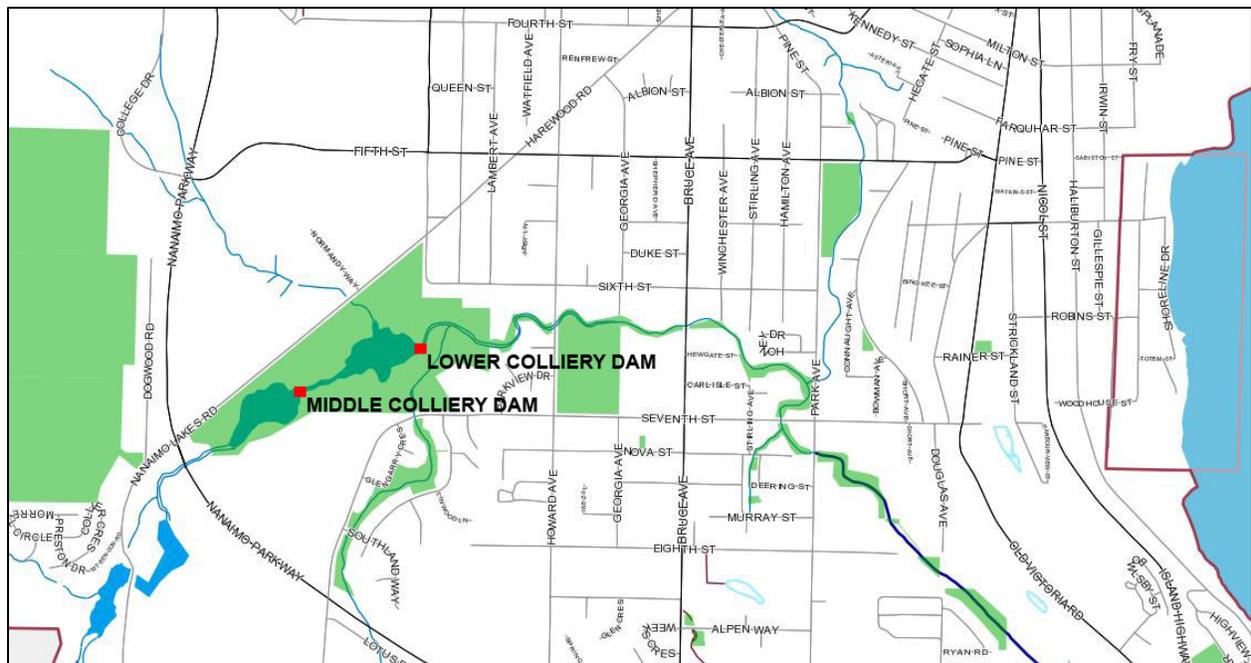
and future upgrades. Since the existing dams need to be removed prior to building new ones, it is still possible to reduce the imminent risk this year and meet the City’s obligations.

Removal of the dams and re-naturalization of the Chase River offers the lowest cost alternative, having a life cycle cost of \$7.5 Million, the elimination of life safety and property damage risk, offers an opportunity to explore First Nations traditional uses of the area, and recreate the pre-industrial landscape and ecological systems in the Park. Dam removal and restoration of ecosystems is becoming a common practice across North America.

The City will meet its obligation to take corrective action to reduce the risk by removing both dams. Council can then balance the ongoing liability and costs of having the lakes in place and determine whether to re-naturalize the Chase River valley, or to rebuild one or both of the dams.

BACKGROUND:

The Lower and Middle Colliery Dams are structures that were built in 1911 by a private coal mining company for washing coal on the waterfront. The City of Nanaimo assumed ownership and responsibility for the dams in 1975 when the Harewood Improvement District was amalgamated into the City. Since assuming ownership, the dams have been operated and maintained as recreational amenities by the City. The lakes are now used by the community for fishing, swimming and to provide a pleasing aesthetic backdrop to a natural park.



Colliery Dams Location

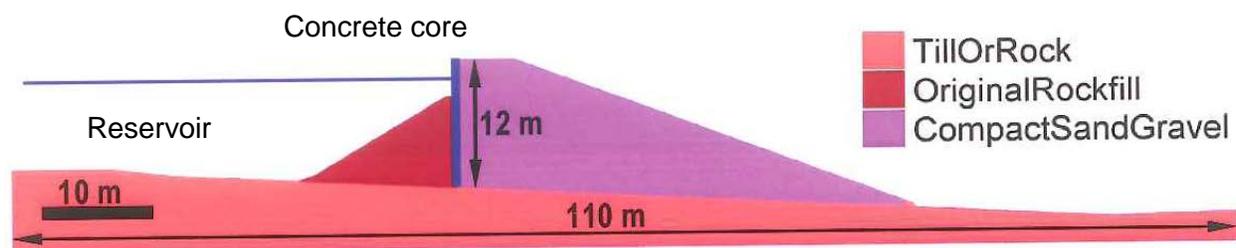
Dam safety is regulated by the Province through the Dam Safety Regulation, as dams are considered to be ‘inherently dangerous’ structures. The regulations require regular engineering reviews as well as ongoing maintenance and repair. As a result of recommendations in the 2003 Dam Safety Review, the City undertook a major assessment of these two dams. In October of 2010, staff informed Council and it was reported in the media that studies were underway that would define the risk of the presence of the dams to the community. They were undertaken by

professional engineering firms, with extensive experience in dam safety engineering. The final report in the series of studies was received in September of 2012. These studies:

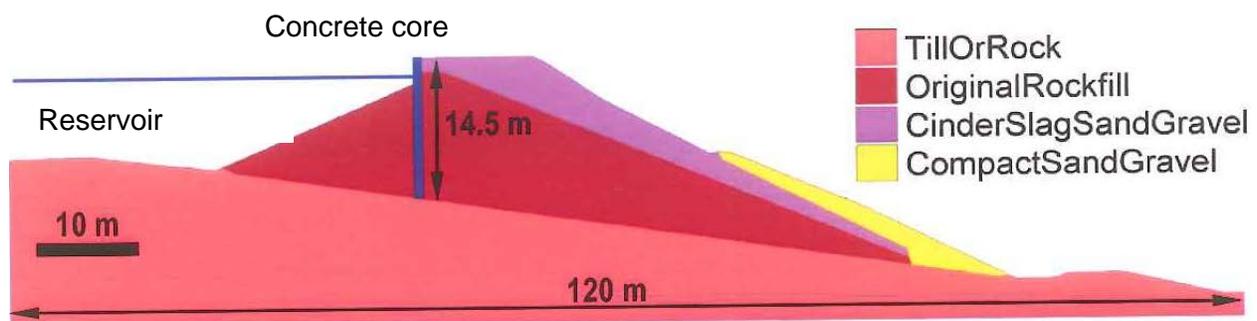
- assessed the current condition of the dams;
- predicted the probable modes of failure;
- outlined the probabilities of the events that could lead to a failure;
- modelled the consequences of the dam failures, and
- made recommendations for actions to reduce the risk posed by the dams.

Study Results

Both dams have a concrete core with downstream and upstream fill slopes. The purpose of the core is to impound the water and the purposes of the fill slopes are to protect the core. The concrete is unreinforced and shows signs of loss of the cement matrix at the cold pour joints. The original rock fill that makes up the slopes is un-compacted and of unknown quality. In 1978 the downstream fill slope of the Middle Colliery Dam was replaced with compact sand and gravel and a filter blanket was added to the toe of the Lower Dam.



Middle Colliery Dam Section



Lower Colliery Dam Section

Modes of Failure

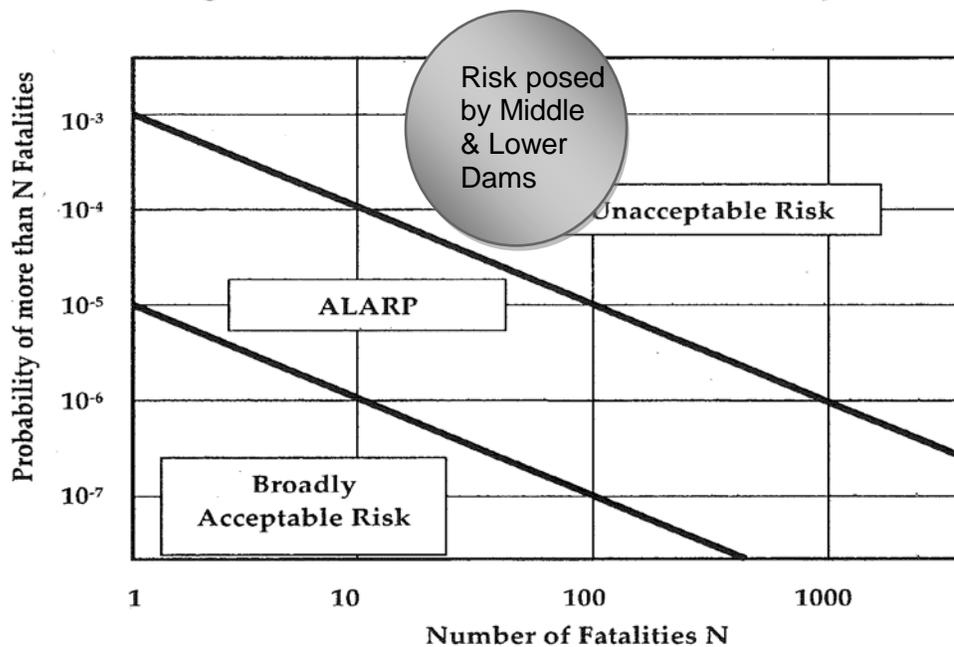
During a seismic event, the concrete wall of the Middle Dam is predicted to topple upstream, causing the dam to breach and the water to drain uncontrolled over the downstream face. The Lower Colliery Dam concrete wall would crack, causing leaks and instability while the water from the already failed Middle Dam will cause the lower dam to fail.

A second mode of failure can occur due to the significant under sizing of the spillways. They are not large enough to accommodate a flood caused by an extreme rainfall event. The excess runoff would breach the dams, cause catastrophic failure and uncontrolled draining of the lakes.

Risk

Risk is defined by two factors; probability and consequences of failure. Societal acceptance of the risk of fatalities from dam failure is represented here graphically. If a high number of fatalities are possible from a failure, and the likelihood of failure is also high, then society will deem that risk unacceptable. Risk due to the presence of dams is required to fall within the band in the middle of the graph, where the risk is considered As Low As is Reasonably Practicable (ALARP).

Figure 1: Societal Risk Criteria for Dam Safety



Based on the recently conducted studies, both dams pose an unacceptable risk. The dams cannot withstand the seismic event nor pass the floods required by the Dam Safety Regulations. These dams are now characterized as having an *Extreme Consequence*: Expected loss of life of up to 130, major loss of critical fisheries or wildlife habitat where restoration is impossible, extreme economic losses affecting critical infrastructure including highways, the railway, John Barsby Secondary School, Little Ferns Daycare and up to 340 residences and 1900 people impacted; with a *Large* probability of failure.

The Dam Safety Branch has now assigned these dams their highest risk level (Alert) and has stated that: Immediate corrective action is required; Emergency Management BC and downstream residents must be informed; emergency management is a high priority; and an Order may be required. Of the 1649 regulated dams in the province, 38 are rated Extreme consequence. Two of those 38 dams are the Middle and Lower Colliery Dams and these two are the only dams in the province that are at the highest risk level.

Emergency Planning

With the Middle and Lower Colliery Dams being rated at the highest risk level, from an emergency management perspective these are the highest hazard and risk within the City. As

such, extensive work has been performed in the development of a 'Colliery Dams Emergency Action Plan' with review by first responders and pre-assigned Emergency Coordination Centre staff. A number of emergency exercises have also been conducted to focus on emergency response and recovery.

The Emergency Action Plan addresses trigger points for the activation of the Emergency Coordination Center among other critical issues. The required documentation for the declaration of 'Local State of Emergency', 'Evacuation Alerts' and 'Evacuation Notices' as required by the BC Emergency Program Act have been completed to expedite response action plans if required. An evacuation plan has also been developed that shows evacuation routes, high ground areas, communication, notification and predefined Reception Centres.

It is important to note that the City is under a legal obligation as per s.25(1) of the Freedom of Information and Protection of Privacy Act to disclose the public information about a "risk of significant harm to the environment or to the health or safety of the public or a group of people" or the disclosure of which is "clearly in the public interest". As such, the City has informed the public residing in the inundation zone of the hazard that exists, the importance of personal preparedness and actions required to safely evacuate in accordance with the Emergency Action Plan.

Council Direction

Having received expert advice from several sources, each indicating the presence of and defining the extent of risks to public life safety, the City was compelled by legislation and common law to act. In considering available options for risk mitigation, on October 22, 2012 Council directed staff to:

- “(1) proceed with removal of the Middle and Lower Chase Dams, as soon as is reasonably practicable by:
 - engaging an engineering consultant by direct award to provide design, cost estimates, and oversee a contractor for the dam decommissioning and land restoration process;
 - obtaining the necessary approvals and permits to perform the work; and,
 - exploring options and costs for restoring this section of the Chase River Valley to a naturalized state in keeping with the existing Colliery Dam Park uses.
- (2) proceed with short-term borrowing of up to \$7 million in 2013 and prepare an appropriate resolution for Council approval at a future meeting, and
- (3) implement a communications campaign that informs the general public of the issues and intended actions, and that communicates to the impacted properties the emergency response plan to follow in the event of an evacuation emergency.”

Community Input

When reviewing the options for action in October of 2012, three general approaches were considered: replacing or rehabilitating both dams to current standards or removing the dams. Furthermore, the costing information was very preliminary in nature. Subsequent community input from several sources including the Colliery Dams Preservation Society (CDPS), the Nanaimo Historical Society and the Archaeological Society of British Columbia resulted in a

decision by Council to concurrently request more accurate costing for alternative options that could safely retain the lakes impounded by the dams.

On December 17, 2012 Council directed staff to:

“Engage professional engineers to undertake conceptual level cost estimates for building new dams and rehabilitating the dams and that it is to be done concurrently with the engineering and environmental studies already underway in relation to the deconstruction of the Colliery Dams and re-naturalization of the Chase River.”

Klohn Crippen Berger (KCB) was retained to provide conceptual level cost estimates for the remediation and replacement of the dams and to provide the basis for comparison of the options on a consistent cost, feasibility and safety basis. A peer review engineer Hatch Ltd. was retained to: hear input from the CDPS, consider the viability of suggested options, recommend options for costing, and finally to review the costs submitted by KCB. Both the KCB and Hatch reports are attached.

DISCUSSION

After CDPS presented a variety of ideas to Hatch, Hatch and KCB agreed on the seven most viable alternatives for costing. Staff added the removal option in the analysis for comparative purposes. This report presents those costs as well as a framework for consideration of each of the alternatives.

Costing the Alternatives to Removal

Four alternatives were examined that allow the lakes to retain their current location and size; one has both lakes lowered and two more involve removal of the middle lake. The alternatives that consider lowering the water level in the lakes were requested by the CDPS in order to find cost effective rehabilitation solutions. These alternatives assume that it would be possible reduce the consequence rating for a rehabilitated dam from *Extreme* to *Very High*. This assumption would be subject to further study and verification of acceptance by the Regulator.

The labels used in the following table are included here in order to cross reference the material in the attached KCB report. EXT refers to an *Extreme Consequence* option and VH refers to a *Very High* consequence option.

Capital and Life Cycle Costs

| | Lower water, Rehab both Dams | Remove Middle, Rehab Lower | Remove Middle, Replace Lower | Rehab Both Dams | Replace Middle, Rehab Lower | Rehab Middle, Replace Lower | Replace both Dams | Remove & re-naturalize |
|----------------------------------|------------------------------|----------------------------|------------------------------|-----------------|-----------------------------|-----------------------------|-------------------|------------------------|
| | VH 1 | VH2 | VH4 | EXT1 | EXT2 | EXT3 | EXT4 | REM |
| Capital Cost from KCB Report \$ | 17.8 M | 14.6 M | 7.9 M | 23.6 M | 16.2 M | 16.1 M | 8.6 M | 5.5 M |
| Capital Cost with contingency \$ | 23.1 M | 17.5 M | 9.5 M | 30.7 M | 21.0 M | 21.0 M | 11.2 M | 6.3 M |
| Life Cycle Cost | 35.5 M | 23.7 M | 14.3 M | 43.0 M | 32.0 M | 31.9 M | 20.8 M | 7.5 M |

This table presents three costs for each option:

- The capital costs are from the KCB report Table 1.
- A suggested contingency for each is from KCB report Table 2. These range from 15% for dam removal to 30% for rehabilitation and are based on the level of confidence in the capital costs.
- The lifecycle costs include capital costs and contingency plus ongoing operating and maintenance, as well as periodic upgrades to meet changes in physical condition or in regulations over the 80-year life of the structures. Replacement of the dams after the 80 year life is not reflected in the life cycle cost.

Comments on the Costs

The capital costs for rehabilitated dams are the highest of all of the alternatives, ranging from \$17.5 M to \$30.7 M. Furthermore the level of confidence in these estimates is the lowest due to the expected uncertainty in the condition of the existing structures. Lifecycle costs range from \$23.7 to \$43.0 M.

The capital costs for replacement of the dams ranges from \$9.5 M for one dam to \$11.2 M for both. The lifecycle costs are estimated to be approximately \$14.3 M to \$20.8 M.

The capital and life cycle costs for removal and re-naturalization are estimated to be \$6.3 M and \$7.5 M respectively. This estimate has a higher degree of certainty than the estimates for dam building. On-going costs include additional parkland, trail maintenance, bridge replacement and maintenance.

A more complete discussion of how the costs were arrived at is presented in the KCB report. In their peer review of the costs, Hatch has indicated that they are in agreement with the options for rehabilitation and replacement and are in agreement with the technical evaluations and costs developed.

Hydro Generation Potential

The potential of using rehabilitated or new dams for hydro generation has been considered at a screening level by Hatch Ltd. It is feasible to generate power for about seven months of the year and the lower dam provides the best option of the two dams. At the screening level, net annual revenues have been estimated at about \$85,000 per year against a borrowed capital investment of \$2.1 million. The payback period for this hydro generation project is about 30 years.

Given its marginal potential for a positive income stream, this capital cost is not included in any of the cost estimates for dam rehabilitation or replacement. Because the concept has such a long payback period, it will not finance the rebuilding or rehabilitation of new dams. However, if Council wishes to pursue new dam construction a low level outlet will be included in the design which provides the option for hydro generation to be re-examined in the future. Also, the generation of hydro may impact recreational uses.

Financial Implications

The two basic options for funding this project are long term borrowing and short term borrowing. Long term borrowing is five years or longer, with the usual term being 20 years. Rates are normally set for 10 years. Long term borrowing will require the assent of the electors either through a referendum or an alternative approval process.

The following table shows the borrowing cost for each of the options. The 2013-2017 Financial Plan already includes a 1.04% property tax increase for the project, based on what was estimated at the time of budget preparation.

| | Lower water, Rehab both Dams | Remove Middle, Rehab Lower | Remove Middle, Replace Lower | Rehab Both Dams | Replace Middle, Rehab Lower | Rehab Middle, Replace Lower | Replace both Dams | Remove & re-naturalize |
|-------------------------------|------------------------------|----------------------------|------------------------------|-----------------|-----------------------------|-----------------------------|-------------------|------------------------|
| | VH1 | VH2 | VH4 | EXT1 | EXT2 | EXT3 | EXT4 | REM |
| Budget including contingency | 23,140,000 | 17,520,000 | 9,480,000 | 30,680,000 | 21,060,000 | 20,930,000 | 11,180,000 | 6,325,000 |
| Amount to borrow | 20,640,000 | 15,020,000 | 6,980,000 | 28,180,000 | 18,560,000 | 18,430,000 | 8,680,000 | 3,825,000 |
| Short Term borrowing (5 year) | | | | | | | | |
| 2014 property tax increase | 4.76% | 3.47% | 1.61% | 6.50% | 4.28% | 4.25% | 2.00% | 0.88% |
| Total interest cost | 1,548,000 | 1,126,500 | 523,500 | 2,113,500 | 1,392,000 | 1,382,250 | 651,000 | 286,875 |
| Long Term borrowing (20 year) | | | | | | | | |
| Annual repayment | 1,415,527 | 1,030,098 | 478,700 | 966,317 | 1,272,877 | 1,263,962 | 595,290 | 262,325 |
| 2014 property tax increase | 1.62% | 1.18% | 0.55% | 1.11% | 1.46% | 1.45% | 0.68% | 0.30% |

Short term borrowing (five years or less) is also done through the Municipal Finance Authority, but there are different considerations:

- No elector or minister approval is required. This is permitted under Section 175 of the *Community Charter*.
- The interest rate is variable, not fixed; therefore there is a risk that the rate will increase over the five year period. Interest is simple interest, not compounded.
- The debt cannot be converted to long term debt or extended beyond the five years.
- The principal payments can be made at any time; staff have assumed that there will be five equal payment made annually.
- The loan will be secured with a promissory note.
- The MFA will require a Council resolution that must include a repayment schedule (i.e. a commitment to repay the principal). If Council proceeds with short term borrowing, then staff will bring back a report with an appropriate resolution at a future meeting.

Assessing the Alternatives

In addition to the financial impacts, the following non financial factors are presented for Council's consideration to be used to assess each of the alternatives.

- **Life Safety and Liability:** Immediate and residual risk to life safety in the inundation zone, future City liability under the legislation and common law;
- **Park Use:** Recreational and aesthetic benefits;
- **Cultural:** Considerations of archeological elements, Snuneymuxw traditional uses and historical interest in mining infrastructure;
- **Environmental:** Long term fisheries, wildlife and other biophysical impacts;

Rehabilitation

Rehabilitation generally involves jet-grouting on either side of the core wall to solidify the existing fill, and building massive buttresses upstream and downstream of the dams, diminishing the size of the lakes. In addition, the spillway capacity would need to be addressed, either by deepening be several feet or by widening significantly, resulting in permanent loss of forest.

- **Safety and Liability.** The dams would still have either the *Extreme* or *Very High* rating along with the residual risk to the public posed by dams, and the associated ongoing liability for the City. The City will likely be required to upgrade the dams as standards change over the years.
- **Park Use.** The current recreational and aesthetic uses in the Park would remain in place for the options where the lake levels are retained and would have some adaptations if the lakes were lowered. However, it should be noted that rehabilitation of the dams would alter the landscape and aesthetics of the existing pools.
- **Cultural.** The tangible evidence of historical mining activity in Nanaimo would be altered due to the required changes to the spillways and dam structures.
- **Environmental.** The ecology of this landscape would remain unchanged, but the construction would be considered a "harmful alteration" to fish habitat, and would require compensation.

Replacement

New dam construction is briefly described in KCB's report, and consist of roller compacted concrete dams with a concrete facing. The steep-fronted dam serves as the main spillway with bridges across the spillways.

- **Safety and Liability.** The dams would have the same *Extreme Consequence* rating along with the residual risk to the public posed by dams (but within the ALARP range), and the associated ongoing liability for the City. The project would proceed with dam removal this year to eliminate the City's liability risk due to the condition of the existing dams.
- **Park Use.** The current recreational uses in the Park remain. Building two large dams would mean heavy civil construction, severely impacting the Park use in that period. The look and feel of the existing pools would be changed due to the new structures and the public safety elements (booms, fences) that would need to be incorporated into the dams. Approval to construct new dams could be a multiple year process.
- **Cultural.** Removal and replacement of the dam structures will be a loss of evidence of historical mining activity. However, the lower spillway structure can be retained as an historic artifact.
- **Environmental.** The ecology of this landscape would remain unchanged, but alterations would be considered a harmful alteration to fish habitat, and would require compensation.

Removal and Re-naturalize the Chase River

Removal of the dams would see the Chase River restored to its original stream channel, and the lake beds would be replanted with appropriate natural plantings. Over time, these areas would regenerate into a diversified habitat.

- **Safety and Liability.** The risk to public life safety is permanently eliminated. The City's liability due to dam failure is removed.
- **Park Use.** The greatest use of the park is for hiking, biking, and dog-walking, which would continue. Bridges spanning the ravine at or near each dam's location will maintain the trail system. The river environment will change the way that park users enjoy the area, and it will take several years to re naturalize.
- **Cultural.** Removal of the dam structures will be a loss of evidence of historical mining activity; however the lower spillway structure can be retained. This provides opportunity to explore First Nation traditional uses.
- **Environmental.** Removal of the dams restores the Chase River to its natural state. There is potential for short-term environmental impacts from sedimentation during the removal process, but these will be actively mitigated. There is an opportunity for a wider variety of habitat types to return to the Park.

Status of Removal Project

As directed by Council on October 22, 2012, staff proceeded with the necessary steps to move forward with the dam removal project. Biophysical assessments, archeological assessments, detailed designs for the removal process, bridge construction and re-naturalization concepts are nearing completion. Regulatory applications have been submitted and Snuneymuxw engagement is underway. A contract for dewatering and dam removal will need to be tendered by mid May in order to meet the construction window required for dam removal in 2013. Bridge construction and re naturalization contracts may need to occur next year.

Legal issues

The City's solicitors have advised as follows:

"First, as the owner of the dams, the City has a legal obligation to remedy any identifiable and unreasonable risk to its residents and their property caused by a dam failure if it can reasonably control or eliminate that risk. In these circumstances, the City has advice from professional engineers and the Dam Safety Branch that places these two dams into an extreme consequence rating. There is little debate that as the owner of the dams, the City must make a decision to eliminate, or seriously reduce, the identifiable risks caused by its dams if they fail.

Second, the City has advice that will allow it to remove the ongoing risk by physically removing the two dams at issue. The financial cost of the removal option, on the basis of further expert advice, is the least expensive of all the options and would remedy the liability and public safety concerns entirely. Again, from an ongoing liability analysis, the complete removal of the dams would be the legally preferable option from a liability analysis as no physical structure would remain into the future.

Last, we strongly encourage the City to implement its plan to remedy the risk as soon as possible, and in particular, before the expiry of the upcoming construction season. To allow the risk to remain any longer than necessary in the face of the professional advice received to date would be courting an ongoing liability risk that we do not recommend".

Respectfully submitted,



Bill Sims, Manager,
Water Resources



Susan Clift, P. Eng., Director,
Eng. & Public Works

Concurrence by:



Tom Hickey, General Manager,
Community Services

CITY MANAGER COMMENT:

I concur with the Staff recommendation.

2013-MAY-06

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