

SOME OBSERVATIONS ON THE DECISION TO REMOVE COLLIERY PARK DAMS

The first inkling that most of us got about Council's decision to remove the Middle and Lower Colliery Park Dams was from the Nanaimo news papers of Wednesday, 31st October and Thursday 1st November 2012. It had been announced to the public two days previously, following a closed meeting of Council a week before that. The newspaper rolled out a similar story to that offered in glossy hand-outs and displays at two Open Houses the following week: the dams are old and unstable; they wouldn't stand a major seismic or extreme weather event; a breach could flood part of Harewood downstream and the City would be responsible for potential losses; it was unfortunate for the fishermen and other users, but the Chase River could be naturalized; it would cost \$7-million to take the dams down, not including park improvements.

Like many residents, I was shocked by this news. The lakes are beautiful tranquil places. Why were they so suddenly a threat? I collected newspaper articles, I visited the archives, I attended the Open Houses, I searched the internet, I walked the Harewood flood plain, I talked to friends – everybody was angered by this news. Ron Bolin (thanks Ron) had obtained two studies from the City that are available on his Nanaimo City Hall Blog (go to nanaimocityhall.com, then scroll down Most Recent Columns and click on "That Dam Decision") and initially, seemingly nowhere else. They are – SEISMIC HAZARD ASSESSMENT MIDDLE & LOWER CHASE DAMS (#1) &– CHASE RIVER DAM BREACH FLOOD INUNDATION STUDY (#2).

On-line there was a story from the Daily News from Saturday, 15th May, 2010 informing us of the first study. It stated that a study on the consequences if the Middle and Lower Chase River Dams failed would likely begin in the fall and take up to two years to complete (this would be the second study referred to above). It would study what kind of damage the failed dams in Colliery Dam Park would cause to the high school, daycare and other downstream structures along the chase river. There was a brief summary from the first study: The three options were - Removal, reinforcement, or replacement; the two dams (which hold about 266,000 cubic metres of water in total) would not withstand a major earthquake. Bill Sims, manager of water resources for the city was quoted " It's a decision that won't be made lightly. These are hundred-year old dams, and they won't last forever. It was a 'no-brainer' to save the Westwood Lake dam, but the answer may not be so clear for Colliery Dam Park. Changing the park would obviously have opponents. Then there is the social impact. That's a pretty well-liked park." Richard Harding, director of parks, recreation and culture was quoted, " The removal of the dams could bring the area back to its natural state. So there could be some naturalization opportunities, but it could definitely take away the fishing and the swimming."

According to the minutes of the Regular Committee of the Whole meeting of 22nd October 2011 was held "in-camera" because of the Community Charter, Section 90 (1) (e) – "the acquisition, disposition or expropriation of land and improvements, if the Council considers that disclosure could reasonably be expected to harm the interests of the municipality;" (g) – "litigation or potential litigation affecting the municipality;" (j) "information that is prohibited, or information that if it were presented in a document would be prohibited, from disclosure under section 21 of the Freedom of Information and Protection of Privacy Act (=Disclosure harmful to business interests of a third party);" and,

Section 90 (2) (b) – “the consideration of information received and held in confidence relating to negotiations between the municipality and a provincial government or the federal government or both, or between a provincial government or the federal government or both and a third party.” These seem awfully vague and broad reasons to limit democratic discussion. The first three reasons are optional for the City and the last one is mandatory under provincial legislation. Presumably, the potential litigation could follow a flooding of Harewood. The client may be the city but they are meant to serve on our behalf. Shouldn't we know the legal risks too? Are the business interests related to the engineering firms or another kind of contractor or consultant? What negotiations there were between the provincial and/or the federal government and the City and/or a third party, we have no clue; surely a letter from the Dam Safety Branch doesn't s secret. Why? – Since the relative reports have now been released. What are they not telling us? Is there some vested interest here?

One recent newspaper stated, “Nanaimo Mayor John Ruttan defended the decision to go in camera to discuss the issue, saying staff and council needed to not only advise the public of the potential danger but also to announce safety procedures that needed to be established.” Quote, “It's new information and we couldn't just announce the risk to the public. We also needed to come up with an emergency evacuation plan to go with that. I feel we approached this in the right manner and made the right decisions.” One has to wonder why the City was surprised by the inundation study (#2). It would have been delivered to staff at least a month before the council meeting. More importantly is the fact that seismic studies have been conducted on the dams for decades. As early as 2002 (Chase River Dams Incremental Damage Assessment by Water Management Consultants study that modeled breaches of every Chase River dam) or 2003 there was concern for dam safety. The Dam Safety Review that year recommended a seismic hazard assessment on the two dams. In December 2008, the City of Nanaimo put out a request for proposals and in February 2009 EBA was authorized to begin work. Why did it take the City six years to start the process? Virtually everywhere in Nanaimo slopes down to the sea: did nobody on staff realize that the Chase River flowed down to Harewood below? It was certainly pointed out in the EBA study two years ago and that triggered the inundation study. EBA recommended some immediate action on the dams and review of the Emergency Preparedness Planning/Emergency Response Plan (EPP/ERP). Why was that new information to the Mayor? Were the 2010 recommendations brought to Council's attention by staff? For at least two years and maybe ten (or more), the affected residents of Harewood should have been advised of the risk. Why weren't they? There seems to have been no emergency or evacuation procedures in place. Who is responsible? If you missed the day the 2010 news story came out, you'd have to wait almost two and a half years to hear anything more about the flooding issue. For sure, staff didn't share the 2010 report with the populace until very recently and then only on request. I'll address that study first (#1).

(#1) SEISMIC HAZARD ASSESSMENT MIDDLE & LOWER CHASE DAMS by EBA Engineering Consultants Limited, dated April 14th 2010 (52.3 MB – about 190 pages) and

It isn't my intention to challenge this study: I'm not an engineer. It is mostly easy to read by a layman but there are some formulae and modeling that I glossed over. As something of an historian I sympathize with the engineers for the lack of historical information available on the dams. I note that some assumptions have been made with regard to the construction of the dams

and speculation as to their current condition. For the most part, in the interests of safety, these are quite understandable conclusions. In fairness, of course, the client (the City) wants something fairly definitive. Rather than repeat the studies or even try to condense them, I mostly just want to selectively extract some points. I am not entirely convinced that there was no reinforcing steel or that the elusive Middle Dam low-level conduit has been located, but I have that prerogative. Do I think that a dam that carried loaded coal trains across it for twelve years (admittedly some decades ago) is at risk of imminent collapse? Well, no, and I don't think the engineers do either. But there are obviously extreme scenarios were any structure might fail with enough impetus. I strongly encourage others to review the studies and make their own conclusions. Where possible, to help, I have included markers thus [], to indicate sections of the first report (#1).

Middle Dam: 50m long, 13m high, 5m wide at crest. Central concrete core wall 0.6m wide. Estimated to hold about 92,600 cubic metres of water. Upstream face of the concrete is generally vertical [4.2.2]

Lower Dam: 77m long, 24m high, 10m wide at crest, Central concrete core wall 1.2m wide. Estimated to hold about 173,000 cubic metres of water. Concrete wall appears to be in good and straight condition. [4.2.2]

Both dams buttressed by earth & rock fill upstream and downstream plus additional fill [3.3]. Cross- section diagrams indicates a maximum depth up to about 10 metres [figures 4 & 7]

Although not strictly part of its mandate, EBA stressed the need for public involvement prior to making a decision and warned of the potential public reaction.

“The City’s post seismic performance expectations, the budget for such works and the social and environmental value of Colliery Dam will to a large part determine what measures are appropriate for addressing the seismic hazards posed by the existing dams.” [11.1]

“ Dam removal is an option for addressing the seismic hazard posed by the dams. From a long-term risk management perspective, removing the risk is the most appealing option. However, given that the dams are part of a popular public park and constitute fish habitat as well as support a sport fishery, any decision to remove the dams will need to consider the financial, social and environmental aspects of dam removal. The triple bottom line, a popular sustainability model, can be used to illustrate the difference between a financial bottom line and a balanced approach that seeks to find more appropriate solutions by including environmental and social aspects. Although this work is not part of EBA’s scope of work for the seismic hazard assessment, conducting this assessment should be part of any detailed future assessments of the feasibility and cost of dam removal.” [11.3]

“Public consultation associated with reservoir drawdown and/or dam removal. It is expected that dam removal, or even prolonged drawdown of the reservoir associated with upstream works associated with seismic rehabilitation could be a contentious issue.” [11.8]

Although the City had indicated that it was not prepared to rebuild the dams, EBA nevertheless included this possibility in its recommended options, which were – (a) Remove the dams, (b) Seismic upgrades or (c) New dams or extensive improvements of the fill in existing dams with jet grouting or other in-situ treatment. They offered rough costs for these options too – (a) Removal (not including dewatering, environmental or public interaction costs) Middle Dam – 4,700 cubic metres of material including concrete = \$0.5 million. Lower Dam – 18,800 cubic metres of material including concrete = \$1.5 million.

(b) Rehabilitation (not including dewatering, environmental or public interaction costs)

Middle Dam – Excavation of the upstream rock fill berm and replacing it with a compacted rock fill buttress. From the upstream side, decommission the low-level conduit where it passes through the concrete wall and cast a concrete bulwark over the existing wall.

Upstream Berm 2,800 cubic metres = \$ 0.5 million.

Lower Dam – Constructing a rock fill buttress upstream of the concrete wall and a downstream berm. Drilling boreholes through the concrete wall and grouting reinforcing steel into the holes appear not be required. Installing steel reinforcement in boreholes = 1.0 million (requires dewatering)

Upstream Berm 1,100 cubic metres = \$ 0.5 million.

Downstream Berm 25,000 cubic metres = 1.5 million.

(c) New concrete gravity dams to replace the Middle and Lower Chase Dams with integrated overflow spillways will cost in the order of \$10 million or more [11.8].

Note that the removal costs start at \$2.0 million, a long way from the City's \$7.0 million, and rehabilitation upgrades start at \$2.5 or \$3.5 million. For new dams, \$10 million, as opposed to the City quotes \$ 20 – 30 million (specifically, \$23 million has been the figure overheard used by some staff).

The Lower Chase downstream berm is noted to be in keeping with the Westwood Lake dam rehabilitation in 2008. [11.8]. The 2003 Dam Safety Review identified Westwood Dam as the highest risk of all the city dams and that flood inundation studies be completed. The 2005 Seismic Stability Review determined that the dam was in need of upgrading to meet current standards.

No magnitude has been offered for the destruction of the two Chase River dams. The seismic upgrade to the existing Westwood Dam was to prevent a sudden discharge of water during or shortly after a 7.0 magnitude earthquake. The City budgeted \$530,000 for a proposed new rock fill buttress downstream of the dam to add mass to it.

Fournier Excavating got the contract for this work at Westwood with a low bid of \$447,352 (the highest was \$608,975), so \$0.5 million seems like a baseline. The valley shape was more compact and we do not know how much material was involved. The Lower Chase Dam is possibly lower on the downstream side and probably a little longer with a more open valley, so three times that amount of fill (and money) may be needed.

Westwood Lake Dam (earth fill – clay core) dates from 1907. A park proposal from the 1950's in Nanaimo Community Archives (NCA) for Westwood Lake estimates the volume of water from 59 million gallons (268,220 cubic metres) to 200 million gallons (909,220 cubic metres). Considering that the surface area is given as 130 acres (nine times the individual Colliery dams), the volume estimates seem remarkably low. The depth at the dam outlet was 33 feet (10 metres). By comparison, the Lower and Middle Chase Dams are each about 8 acres in surface area. Clearly, Westwood Dam holds back a much greater volume of water, and prior to the 2008 rehabilitation work was considered the dam most at risk in Nanaimo.

How much difference is there from four or two years ago in gas prices and construction steel or the cost of moving rocks around and dumping them? It would appear that all those costs are down today. \$7.0 million seems like an awful lot of money by comparison with the above figures.

Some recommendations from the seismic hazard study:

Any rehabilitative solution selected by the City should, have minimal reliance on the structural integrity of the concrete walls due to their anticipated poor condition, and consider the inherent variability of the original rock fill placed within the dams.

The 1980 fill used in the downstream shell of the Middle Chase Dam and the filter zone in the Lower Chase Dam does not need retrofitting.

The seismic retrofit conducted on Reservoir #1 Dam and the seismic stability of Harewood Dam should be reviewed to ensure that it provides adequate stability during the design seismic event appropriate to the structure.

The low level conduit passing through Middle Chase Dam should be decommissioned as soon as possible.

The City should review the EPP/ERP for the Chase River in light of this assessment, should report and, if necessary, prepare a subsection of the EPP/ERP that deals with the failure mechanism described herein for the dams in their current condition.....

Install electronic monitoring equipment for possible movement in the dam (they could be linked to a system of sirens or other public warning devices downstream).

Downstream Dam Failure Consequence Classification for Middle & Lower Chase Dams:

The 2003 Dam Safety Review (Golder 2004) was “High” (less than 10 people may die), based on 1999 CDA Dam Safety Guidelines of a 4-tier (Very Low, Low, High, Very High) failure consequence classification system and equivalent to the 2000BC Dam Safety Regulation “High-Low”. In 2007, the CDA Guidelines were rewritten. BCMoE revised the classification to “High-High” (more than 10 people might die), the equivalent of 2007 CDA of “Very High” (between 10 and 100 people may die). The 2008 Dam Safety Review (EBA) concluded “High Low” (1-10 people could die) but BCMoE never ratified this. In June 2010 the 80-year old Testalinden Lake Dam burst and mud destroyed five homes. Subsequently ministry staff began checking all dams in the province. New legislation was enacted in November 2011 – BC Dam Safety Regulation was amended to include a 5-tier dam failure consequence classification (Low, Significant, High, Very High, Extreme). The bar has been raised. Applicable design seismic event for the two structures is the 3000-year event, unless they are modified significantly, in which case, the more recent and stringent 5000-year design event is applicable. It seems that following the flood inundation study, the dams are now classified at the highest level “Extreme” (more than 100 people may die) the equivalent of the older “Very High”.

CDA = Canadian Dam Association. BCMoE = British Columbia Ministry of Environment

There are seven dams that directly or indirectly feed the Chase River. Jump Lake Dam (built 1930) and South Fork Dam (built 1974) hold back up to 18.6 million cubic metres (over 4.1 billion gallons) and 2 million cubic metres (over 400 million gallons) respectively. If they breached, they would flood the Nanaimo River, but through twined 1200 mm (48 inch) and 762 mm (30 inch) diameter steel pipelines deliver up to 54 million gallons (245,490 cubic metres) to the City of Nanaimo daily. They pass, buried under the Nanaimo Lakes Road between Upper

Chase River Dam and Number One Reservoir. Part of this water (the smaller pipe) currently flows into Reservoir #1, the rest goes to other reservoirs in the city. Their potential breach is briefly addressed in EBA's study in 2010 – The dam is stable but the danger is from instability of buried large diameter waterline beneath the road at the crest of the dam. However, neither the Upper Chase Dam or Reservoir #1 were part of the study.

The Upper Chase Dam (previously known as #2 Reservoir) is small earth fill dam with a concrete retaining wall built in 1911. It has a capacity of about 30,000 cubic metres. Associated Engineering (AE) suggested in 2011 that the dam could be removed or spillway capacity provided for PMF and a 1000-year flood event, otherwise it could flood Nanaimo Lakes Road and the water mains.

In October 1921, #2 Dam broke in two places, water overflowed its banks and the bridge was in danger of being washed away. The heavy pipeline to the city from South Forks dam was in danger of collapsing too. More than the average rainfall for the month fell in 24 hours. Bridges at Chemainus, Nanaimo Rivers and South Forks were down, cutting off Duncan. Cameron Lake bridge was destroyed. Fifty people were killed at Britannia Beach and Vancouver was isolated owing to bridges being washed away by floods.

Harewood Dam was another dam built in 1911. Harewood Creek flows out north to Colliery Park and joins Chase Creek just below the Lower Dam spillway. EBA recommended a seismic assessment in 2010 for Harewood Dam and Reservoir #1. It does not appear to have happened.

1 Reservoir has a capacity 60,000 cubic metres. It too was built in 1911. In 1970 it was reshaped and lined with concrete. In 1996 the dam was repaired and brought up to current seismic standards. In 2011, Associated Engineering recommended verification of the ability of #1 Dam to resist overtopping floods. Was such a study completed?

Why was the new 14,000 cubic metre enclosed water reservoir placed in Colliery Park when the Water Resources (City of Nanaimo) own several hundred acres of land south of land including #1 Reservoir? What is to become of this land when the existing open reservoir is decommissioned as a storage facility. There are quite possibly forest fire situations where a couple of extra lakes might come in very handy for fire fighting. In 1951, a huge fire on the south side of Mount Benson almost reached Nanaimo Military Camp.

It might be noted that the combined Upper Chase Dam, #1 Reservoir and the new Reservoir if damaged could deliver a total of 104,000 cubic metres of water into the Chase River, notwithstanding the flow from the mains supply of 245,000 cubic metres in a day. An interesting comparison with the alleged Middle and Lower Chase River Dam breaks risk, before any unusual flooding event is added to the mix.

All the dams survived the 7.3 magnitude earthquake centered at Forbidden Plateau in 1946, the largest on-shore earthquake ever to occur in Canada. There have been tens of thousands of other local earthquakes within the past hundred years.

(#2) CHASE RIVER DAMS BREACH FLOOD INUNDATION STUDY by Associated Engineering dated 12th September 2012 (23.6 MB – about 100 pages).

The second study (#2) seems quite repetitious and involves complicated formulae and modeling. Associated Engineering had a choice of models and admits to their respective limitations. Did they pick the best one? One wonders about the accuracy of volume estimates too. EBA says that the Middle Dam is about a quarter of the volume of the Lower Dam. Yet it gives the combined volume as 266,000 cubic metres, made up as 93,600 cubic metres and 173,000 cubic metres respectively. Associated Engineering in their study amended these figures to 110,000 cubic metres and 112,000 cubic metres respectively. Who is right? Or are they both wrong. Anyone familiar with the dams has shaken their heads when confronted with the inundation study, with a huge lake in South Harewood, roughly centered at Bruce and Seventh at a depth of 6 metres. There just doesn't seem like enough water in the lakes to flood such a large area, especially when much of the water behind the dams is only a metre or so deep. It should be noted that the banks of the Chase River are quite wide in most places and could easily absorb 2 or 3 metres of water without any detrimental effect.

In the study scenario, the potential casualty list is as follows: Approximately 130 buildings will be flooded to a significant depth within 30 minutes, with the risk of \$40 million in damage. Of the daytime population of 1810 people, 35 to 40 could die in the flood plane out of an overall total of 80. Of the nighttime population of 1883 people, 45 to 60 could die in the flood plain out of an overall total of 150 (the difference is those further downstream nearer the ocean).

Has the City approved any construction within the flood plain since becoming aware of the potentially serious inundation issue? Well, yes, at least one – there are a number newly completed townhouses/duplexes for sale at the intersection of Bruce and Eighth. These homes would be impacted by the following scenarios: (4) 100% Probable Maximum Flood (PMF) with Lower & Middle Dam breaks (maximum flood depth and extent); (flood warning) and (property damage).

Heritage Value:

The Harewood Colliery (Lower Chase) Dam is listed on the National Heritage register. It is a rare tangible link with Nanaimo's industrial past. Built to supply the coal company docks with water for coal washing the water system was soon adapted to domestic use in South Harewood. All of the remaining components of the original dam including the concrete-faced, earthen dam and the concrete spillway are present. Christine Meutzner, NCA manager was quoted in 2010, "Colliery Dam is one of the few features in the landscape that actually says something about that early history." Nanaimo was the first municipality to put its heritage assets on the national site. It also has the distinction of being the first to remove them – the Hunt Estate Cottage was destroyed by fire and Raines Cabin was removed and returned to the family it came from, but Nanaimo Public School, Nanaimo Foundry, (and the Civic Arena) were all allowed to be pulled down. The last Five Acres Farm on Third Street is in the process of being developed and now the Colliery Dam has been condemned. Not a very honourable record. Harewood (Five Acres) was probably the first planned agricultural community in BC and likely the only one on Vancouver Island. Dickinson barn near Barsby High School belonged to the largest dairy farm in Nanaimo.

In the 1920's and 1930's, automatic machines milked their herd, of about 45 cows. Last year, it was denied heritage status and parks staff want to demolish it soon.

Are there plans to dispose of the City storage site and/or the adjoining parkland? Could John Barsby Community School become surplus to requirements in the near future? Could that future include development if the dams pose no risk?

Social Aspects: Our right to quiet enjoyment is of little importance to the City – only numbers of park users count. Parks development seems to mean money spent on buildings and roads and infrastructure

Environmental Issues:

These no longer seem to be an issue from a Federal perspective, but surely the provincial government still has some responsibility. There is a quite inclusive study of fauna and flora of Colliery Park at NCA (Harewood Recreation Advisory Council – An Environmental Survey of Harewood and Colliery Dam Parks – Summer 1980).

A Potential Solution:

Downstream of the Lower Chase Dam, the land drops away sharply into a bowl surrounded by land of similar height. Only a relatively small gap allows the Chase River to flow onwards. This gap is only 6 metres at the base (EBA – 2010). The best location might be just downstream of where the Harewood Creek joins the Chase River, before the second dog-leg. I suggest that culverts could be placed in the river to allow regular flow and masses of earth and rock fill could be tipped on top of the culverts to form a dam barrier (of whatever necessary height) to trap any water released by a breach of either or both of the Middle and Lower Chase Dams. Perhaps berms might be placed (in the shape of “T” lying on its right side) at the bottom (downstream) of the Lower Dam to resist debris and offset the surge. Eventually the water would likely release through the new dam, but not in a dangerous amount. \$7.0 million could buy an awful lot of rock fill. Access might be possible from off the old rail right of way on the south side of the park, or possibly through private property on either the east or south sides. I would appreciate a technical appraisal of this suggestion (and for any other alternative and creative possibilities).

Also, what about digging out channels from the Lower Lake (and maybe the Middle Lake too), a short distance to the underutilized, relatively deep Harewood Creek valley and installing an open (or closed) concrete spillway. The water level would drop a bit and it should satisfy flooding safety concerns.

Another consideration is perhaps to save only one dam, probably the Lower one, but that doesn't sit well with me either.

The inconsistency of staff and their recommendations to council should be noted when comparing the decision of spending \$17 million for a new earthquake proof annex for themselves instead of \$4 million to fix the old one, and the seemingly cheapest option in the case of Colliery Park dams, in a matter that is of great concern to the well being of the citizens.

At Monday (26th October) night's Committee of the Whole, City staff recommended to Council that Associated Engineering should get a nearly \$1 million contract for #1 Reservoir as well as a \$4 million contract for the new water treatment plant.

Some Afterthoughts:

All of us who have attended the public meetings in support of retaining the dams have heard about Elsie Lake near Port Alberni and how its much larger (longer and higher) BC Hydro dam (holding back magnitudes more water), has recently been seismically upgraded with new concrete, a self-sealing membrane and 50,000 cubic metres of rock fill (twice the amount recommended for the downstream of Lower Chase Dam), all for \$4.5 million.

We have also read that rocks may be placed in the lakes to displace water and lower the risk.

The following quotes are taken from the Nanaimo Free Press:

In July 1887, Nanaimo Water Works (until 1901, a private company) commenced work on #1 Dam (16 feet high) on the Chase River and water service was turned on in December 1887.

In August #2 Dam together with a waste weir and bridge was completed.

In November 1910, both the Water Works and Western Fuel Company (WFC) were building dams on the Chase River.

The original #1 Reservoir dam was of logs and cement, and when demolition work was begun for a new concrete dam, the timbers were found to be sound and it could have been repaired. Rock was blasted to prepare the new foundation, which was intended to be some feet back from the old dam. However, the new dam was actually placed almost on the site of the old dam, and was higher than before. The work also involved removing vegetation right up to #2 Dam.

“The WFC are putting in a dam about a mile below that of the city. The location is close to that of the southwest corner of the Five Acre Lots, and there the company has obtained a fine natural basin, which will store all the water necessary for their purposes.the company have found an excellent location for their dam. Running out of a large and wide basin, with gently sloping sides and a level bottom, the creek passes through a deep and narrow cleft and here is a reservoir ready made which will hold an immense quantity of water. All the same the stopping up of this cleft which must have appeared an easy enough matter, has not proved such an easy thing actually to accomplish, and much more expensive than was anticipated. The rock itself was not as it might have been and made the work of getting an inset for the dam something of a difficulty. The bed of the creek, or in other words the into the rock made by the creek was deeper than was anticipated, and as a consequence there was more excavating than was expected to get to solid rock. The company, as might be expected are proceeding with all their usual thoroughness. In the first place a spur line was laid from the Harewood track to the location of the mine. This provides cheap transport for all their material. The actual work of excavation is being carried out with steam power. A special portable engine was purchased for the purpose, and while the burlies are driven with compressed air generated by the engine the material blasted out of the cut is hoisted by means of a steam winch. Altogether it is a much bigger job than the city has on hand, and the water has yet to be piped from the dam to the mine.”

From the above one may see that it was the two city reservoirs that had originally been wood structures, not the mining companies dams. It should also put to rest the suggestion that these latter dams were not founded on solid rock foundations. The 1909 map of Five Acres at NCA shows #1 and #2 Reservoirs, as well as Howard Reservoir in the space that the Lower Chase Lake occupies. This may be a projection of future work. There is no indication of Middle Chase

Lake, leading one to suppose that it was started after. There are two identifiable conduits from the Lower Chase Dam. There is little reason to assume one from Middle Chase Dam, which may simply have been built to provide more water for the lower dam.

One Council member voiced concern as to whether the risk of a seismic event was 40% or 1.6%. I think that I can answer that question. Consider apples and oranges.

First I quote from EBA:

“The data available from the Pacific Geosciences Centre in Sidney indicates that a 1:475 year seismic event (10% chance in 50 years) will have a peak ground acceleration (PGA) of 0.27g and a 1:100 year event (40% chance in 50 years) will have a PGA of 0.13g. Given the variability associated with the Middle Chase Dam concrete wall, it is not reasonable to predict the exact return period of the seismic event that will result in toppling. However, seismic events GPA of 0.1g and 0.2g will occur with a 15% and just over 40% chance in 50 years.” [10.4]

I was unfamiliar with Peak Ground Acceleration, so I turned to Wikipedia. “PGA is a measure of earthquake acceleration on the ground and an important parameter for earthquake engineering Unlike the Richter scale, it is not a measure of the total energy (magnitude, or size) of an earthquake, but rather of how hard the earth shakes in a given geographical area. These values vary in different earthquakes, and in differing sites within one earthquake event, depending on a number of factors. Due to the complex conditions affecting PGA, earthquakes of similar magnitude can offer disparate results, with many moderate magnitude earthquakes generating significantly larger PGA values than larger magnitude quakes.”

There are 10 levels of Instrument Intensity (‘I’ through ‘X’).

Acceleration of 0.13 falls within ‘VI’; Perceived Shaking is Strong; Potential Damage is Light.

Acceleration of 0.27 falls within ‘VII’; Perceived Shaking is Very Strong; Potential Damage is moderate.

As already stated, there can be little collation between PGA values and magnitude.

As I interpret this information, the predictions from the centre in Sidney are general for somewhere within the Lower Mainland and Vancouver Island including the ocean, but not necessarily anywhere near Nanaimo.

As Low As Reasonably Practical (ALARP) as regards tolerable risk. Again I quote from EBA:

“The analysis and modeling conducted by EBA indicates that a 1:3000 year (1.66% chance in 50 years) seismic event will likely cause uncontrolled discharge from both reservoirs during or shortly after the seismic event.” [10.5]

This is merely saying that there is a 1.6% chance of failure at these specific Colliery dams when considering a 1 in 3000 year seismic event.

So both figures are correct, but apply to macro and micro situations.

On October 17th 2012, BC Dam Safety Branch apparently requested an indication of the City’s decision on a course of action for the Middle and Lower Chase River Dams by November 30th. So why did Bill Sims, Manager of Water Resources feel the need to respond on 29th October, a week after the In-Camera Committee of the Whole meeting, and before the public were informed that same night at the next Council meeting? To outsiders, this looks like a very tidy arrangement, keeping the citizens in the dark until too late. No body has adequately explained why all these decisions were made in secret. Such behavior is becoming all too normal here.