

This is the 1st affidavit of
Robert McLean in this case and
was made on 15/JUN/2015]

Appeal File No.: 2015-WAT-004

Environmental Appeal Board for British Columbia

In the matter of an appeal under section 92 of the *Water Act*, R.S.B.C. 1996, c. 483

Between

City of Nanaimo

Appellant

and

Comptroller of Water Rights, Water Management Branch
Dam Safety Section, Ministry of Forests, Lands and Natural Resource Operations

Respondent

AFFIDAVIT

I, Robert McLean, Civil Servant, of 3rd floor – 395 Waterfront Crescent, Victoria, BC, SWEAR THAT:

1. I am employed as a Senior Dam Safety Engineer with the Dam Safety Section of the Water Management Branch in the Ministry of Forests, Lands and Natural Resource Operations (the “Ministry”) and, as such, have personal knowledge of the facts and matters hereinafter deposed to save and except where stated to be made upon information and belief and, where so stated, I verily believe the same to be true.
2. I am a professional registered engineer in the Province of British Columbia and have held the position of Senior Dam Safety Engineer with the Ministry since January 2015. Prior to that, I was employed as an engineer in the private sector for approximately 18 years in various fields including hydrology, hydraulics and hydrogeology. I am also a registered professional engineer in the state of Colorado in the specialized area of Water Resources

Engineer. Attached hereto and marked as **Exhibit “A”** is a true copy of my Curriculum Vitae.

3. I am swearing this affidavit in support of the Respondent’s response to the Appellant City of Nanaimo’s (the “City”) application for a stay of the order of the Respondent Director and Comptroller of Water Rights, Glen Davidson (the “Comptroller”) issued on April 29, 2015 (the “April 29 Order”).
4. In my current position, I am responsible for reviewing Dam Safety Reviews and related reports, completing dam audits, developing dam safety related guidelines, and, as part of government regulatory oversight, review dam safety compliance by dam owners in relation a portfolio of dams. I am also the hydrotechnical specialist for the Dam Safety Section (DSS) and frequently review hydrotechnical issues for other dam safety officers. I report directly to Scott Morgan, Head of the DSS.
5. On behalf of DSS, I have reviewed a number of the engineering reports on the Chase River Middle and Lower Dams (“Middle Dam” and “Lower Dam”, respectively) that were completed for the City by their consultant engineers including all of the following reports (the “Reports”):
 - (a) Golder Associates, 2015a, *Colliery Dams, Nanaimo, BC – Auxiliary Spillway – Conceptual Design* (16 January 2015), a true copy of which is attached hereto and marked as **Exhibit “B”**;
 - (b) Golder Associates, 2015b, *Colliery Dams, Nanaimo, BC – Summary of Lower Dam Hydraulic Modelling Methods* (9 March 2015), a true copy of which is attached hereto and marked as **Exhibit “C”**;
 - (c) Golder Associates, 2014a, *Collier Dams, Nanaimo, BC Hydrology, Hydraulics, and Middle Dam Breach Analysis* (25 July 2014), a true copy of which is attached hereto and marked as **Exhibit “D”**;
 - (d) Golder Associates, 2014b, *Colliery Dams, Nanaimo, BC Dam Stability* (25 July 2014), a true copy of which is attached hereto and marked as **Exhibit “E”**;
 - (e) Golder Associates, 2014c, *Colliery Dams, Nanaimo, BC Risk Assessment* (25 July 2014), a true copy of which is attached hereto and marked as **Exhibit “F”**;
 - (f) Golder Associates, 2014d, *Colliery Dams, Nanaimo, BC Report on Dam Remediation Options* (29 August 2014), a true copy of which is attached hereto and marked as **Exhibit “G”**;
 - (g) Golder Associates, 2014e, *Colliery Dams, Nanaimo BC Consequence Classification* (21 November 2014), a true copy of which is attached hereto and marked as **Exhibit “H”**; and

- (h) Water Management Consultants, 2002b, *Middle and Lower Chase River Dams Spillway Hydrology Study* (April 2002), a true copy of which is attached hereto and marked as **Exhibit "I"**.

Technical Memorandum and Spillway Capacities

6. Based on my review of the Reports, I drafted a technical memorandum dated April 7, 2015 (the "Memorandum"). The Memorandum is addressed to Scott Morgan, Head of the Dam Safety Section. It is marked "draft" but served as the final version. Attached hereto and marked as **Exhibit "J"** is a true copy of the Memorandum. I am advised by Scott Morgan that he briefed the Comptroller regarding the content of the Memorandum.
7. In part, the Reports I reviewed draw conclusions about the adequacy of the spillways of Middle and Lower Dams, and about the probability of the dams overtopping. The purposes of the Memorandum were primarily to assess the hydrological and hydraulics methodologies used by the consultant engineers and to determine if the Reports conclude that overtopping of the dams may potentially lead to failure or whether the dams were assessed to be somewhat resistant to erosion and potential failure if overtopping occurred.
8. The Middle and Lower Dams are earthen dams. It is a common dam industry standard to design spillways to prevent overtopping of earthen dams as practically as possible unless the dams are specially designed to manage flow over top of the dam crest. Overtopping of earthen dams is a common failure mode and dams are specifically designed to prevent overtopping.
9. I did not do an in depth analysis of whether each of the conclusions in the Reports are correct and nor have I conducted my own analysis of the risks posed by Middle and Lower Dams. Rather, I assessed the methodologies in the Reports to determine whether they appear reasonable using my own knowledge and expertise and to determine if they conform to common good engineering practice. In particular, I wanted to determine whether the consultant engineers were underestimating the capacity of the spillways or overestimating the design floods.
10. I found no reason to conclude that the consultant engineers were being too cautious in estimating the capacity of the spillways or the design floods. That is, I am of the view they were not overstating the degree to which the spillways for both Middle and Lower Dams are inadequate.
11. While there is some difference in methodology and calculation, both engineering firms that authored the batch of reports I reviewed conclude that the spillways for Middle and Lower Dams are not even close to being adequate in terms of their capacity to handle extreme weather events. As a result, remediation is necessary.
12. Further to this conclusion, I also outlined the following conclusions on page 7 of my Memorandum based on the information presented in the Reports:
 - (a) There is a high probability both dams will overtop on [sic] any given year.

- (b) There is a medium probability that overtopping will lead to a breach and dam failure (it depends on the height and time of overtopping).
- (c) There is a low probability that either dam will fail suddenly and catastrophically resulting in full release of the reservoir.
- (d) Breaching of the Lower Dam could potentially have significant consequences with respect to loss of life and property damage.

High Probability of Middle and Lower Dams Overtopping

- 13. The high probability that both Middle and Lower Dams will overtop in any given year as outlined in paragraph 12(a) in this Affidavit is related to the probability of the dams overtopping should a weather event of a certain magnitude occur in a given timeframe.
- 14. In the Golder Associates report entitled *Hydrology, Hydraulics, and Middle Dam Breach Analysis* (Exhibit “D” to this Affidavit) (“Golder Report”), Golder determines that Middle Dam would overtop in a 1 in 50 years flood event and that Lower Dam would overtop in a 1 in 25 years flood event (see Appendix H, Golder Report).
- 15. When considering the probability the dams will overtop over specific time periods (several years) the probability of overtopping increases compared with considering the probability on a year by year basis. The probability of a flood event of a Specified Flood Risk (R) will occur over a service life (L) of a dam can be calculated using the equation in the Canadian National Research Council publication titled *Hydrology of Floods in Canada: A Guide to Planning and Design* (1989, Watt et al.). This equation will allow one to determine the return periods required for specified risk over a specified service life. Attached hereto and marked as **Exhibit “K”** is a true copy of an excerpt from this publication showing the equation.
- 16. In order to determine the specified risk of Middle and Lower Dams overtopping during a specified service life, the equation can be rearranged to solve for R (Specified Flood Risk) given T (flood event return period) and L (service life) as follows (the “Rearranged Equation”):

$$R = 1 - \left(1 - \frac{1}{T}\right)^L$$

- 17. The 2013 Canadian Dam Association publication *Dam Safety Guidelines 2007* (2013 edition) provides design guidelines for sizing a spillway in Table 6-1B. In addition to calculating the actual specified risks associated with Middle and Lower Dams, one can also calculate how the actual specified risk compares to the CDA design guidelines and standards of the Canadian Dam Association (CDA) using the following information:
 - (a) Given the Golder Report indicated in Appendix D that a return period (T) equal to a 50,000 year storm event is approximately equal to a probable maximum precipitation (PMP) event;

- (b) The CDA design guideline for a high consequence dam (Middle Dam) that is 1/3 of the way between a T=1000 year event and a PMP (T=50,000 year event) results in a design return period of T=16,333 years. Similarly, the design guideline for a very high consequence dam (Lower Dam) that is 2/3 of the way between a T=1000 year event and a PMP results in a design return period of T=32,666 years;
- (c) Table 6-1B recommends that the spillway for a high consequence dam (Middle Dam) be designed to manage a storm event 1/3 of the way between a T=1000 year and PMP event; and
- (d) Table 6-1B recommends that the spillway for a very high consequence dam (Lower Dam) be designed to manage a storm event 2/3 of the way between a T=1000 year and PMP event.

Attached hereto and marked as **Exhibit "L"** is a true copy of Table 6-1B from the CDA publication with associated text.

- 18. In preparation for the stay application and using the Rearranged Equation along with the CDA design guidelines, I have produced the following table:

Table 1: Specified Risk (R) of Middle and Lower Dams Overtopping or Exceeding the CDA Guideline During Specified Service Life

Service Life (L)	Middle Dam		Lower Dam	
	Overtop (T=50)	CDA Design (T=16,333)	Overtop (T=25)	CDA Design (T=32,666)
1	2.0%	0.006%	4.0%	0.003%
2	4.0%	0.012%	7.8%	0.006%
3	5.9%	0.018%	11.5%	0.009%
4	7.8%	0.024%	15.1%	0.012%
5	9.6%	0.031%	18.5%	0.015%
10	18.3%	0.061%	33.5%	0.031%
15	26.1%	0.092%	45.8%	0.046%
20	33.2%	0.122%	55.8%	0.061%
25	39.7%	0.153%	64.0%	0.077%
50	63.6%	0.306%	87.0%	0.153%
75	78.0%	0.458%	95.3%	0.229%
100	86.7%	0.610%	98.3%	0.306%

Note: T – flood event return period

19. Table 1 can be interpreted as follows:

(a) Looking backward:

- (i) for example, given the Middle and Lower Dams are over 100 years old, the specified risk that Middle Dam could have overtopped in the last century is 86.7% for Middle Dam (in a 1 in 50 year flood event), whereas the CDA standards indicate that for a dam of the same consequence with an adequately designed spillway, the specified risk at which the design will be exceeded is just 0.610% (i.e. there is a huge discrepancy between the actual specified risk associated with the current spillway of Middle Dam versus the CDA standard); and
- (ii) for Lower Dam, the specified risk that it could have overtopped in the last century is 98.3% (in a 1 in 25 year flood event), whereas the CDA standards indicate that for a dam of the same consequence with an adequately designed spillway, the specified risk at which the design will be exceeded is just 0.306% (i.e. there is a huge discrepancy between the actual specified risk associated with the current spillway of Middle Dam versus the CDA standard).

(b) Looking forward:

- (i) for example, if Middle Dam is not remediated for another year, the specified risk that it could overtop in that timeframe is 2.0% (in a 1 in 50 year flood event), whereas the CDA standards indicate that for a dam of the same consequence with an adequately designed spillway, the specified risk at which the design will be exceeded is just 0.006% (i.e. there is a significant discrepancy between the actual specified risk associated with the current spillway of Middle Dam versus the CDA standard); and
- (ii) if Lower Dam is not remediated for another year, the specified risk that it could overtop in that timeframe is 4.0% (in a 1 in 25 year flood event), whereas the CDA standards indicate that for a dam of the same consequence with an adequately designed spillway, the specified risk at which the design will be exceeded is just 0.003% (i.e. there is a significant discrepancy between the actual specified risk associated with the current spillway of Middle Dam versus the CDA standard).

20. While Table 1 was made in preparation for the stay application, I am advised by Scott Morgan that he discussed these risks with the Comptroller prior to the April 29 Order using a similar table.

21. A particular geographic area could go a very long time without an extreme flood event even if it is probable one will occur, or the area could suffer several extreme events year after year.

22. Despite the unpredictability, it is safe to say the risk of an extreme flood event occurring increases the longer the timeframe considered. Thus, the longer the Middle and Lower Dams go without being remediated, the probability they will overtop due to an extreme flood event increases.

Medium Probability of Dam Failure

23. The Golder Report describes the hybrid construction of Middle and Lower Dams which consist of concrete core walls that are buttressed by various zones of non-cohesive fills. The report concludes that this construction makes it difficult to predict exact breach probabilities but that the hybrid construction is likely fairly resilient to breaching from overtopping flows (see page 6).
24. Beyond the construction of the dams, whether the dams will breach in the event they overtop and lead to dam failure depends on the amount and timing of water that enters the reservoir as a result of the particular flood event. It is important to consider that the flood events which would lead to overtopping are extreme.

Low Probability of Sudden Failure

25. The Golder Report indicates that Middle and Lower Dam will likely fail in a “stepped progression” as described on page 6 as opposed to an instantaneous or sudden burst. However, this does not mean the breach would not occur quickly. The breach parameters used in the Golder report were the most likely, median value breach development times of 120 minutes for Lower Dam and 60 minutes for Middle Dam (page 5).

Consequences of Dam Failure

26. Respecting the potential consequences of a dam breach, an analysis of the various factors considered in dam failure consequence classification pursuant to the criteria in Schedule 2 of the *British Columbia Dam Safety Regulation*, B.C. Reg. 44/2000, as amended by B.C. Reg. 163/2011, was conducted by Golder Associates in their report *Colliery Dams, Nanaimo BC Consequence Classification* (letter report prepared for the City of Nanaimo, November 21, 2014) (Exhibit “H” of this Affidavit). Included in their analysis is the following:
 - (a) As there is a population downstream including permanent residents and those temporarily populating the area depending on the time of day (e.g. at the John Barsby Community School and daycare, which is presumably the Little Ferns Early Learning Centre daycare that is located at the school), there are an expected number of fatalities at a rate that place the dams predominantly in the “high” category to just slightly exceeding the boundary with the “very high” category (see page 5);
 - (b) There is an expected release of contaminated soils into the downstream portion of Chase River and onto the inundated low-lying areas adjacent to the Chase River (see page 6);

- (c) Destruction of aquatic and terrestrial resources is likely to occur and it is probable that the resulting flooding downstream would permanently alter or destroy habitat (page 6);
- (d) There would be expected impacts to infrastructure including public transportation, services and commercial facilities – principally related to some damage to the John Barsby Community School and to some bridges serving local streets in the residential area (page 7);
- (e) Between 13 and 27 residences would sustain severe damage for the scenarios considered (page 7); and
- (f) The amount of approximate damage is between \$5.3m and \$8.3m for the two dam breach rates considered (page 7).

SWORN BEFORE)
 ME at Victoria, British Columbia)
 on June 15, 2015.)
 _____)
 A commissioner for taking)
 affidavits for British Columbia)
 [*print name or affix stamp of commissioner*]



 ROBERT MCLEAN

Pamela Manhas
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This is the 1st affidavit of
Scott Morgan in this case and
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Appeal File No.: 2015-WAT-004

Environmental Appeal Board for British Columbia

Between

City of Nanaimo

Appellant

and

Comptroller of Water Rights, Water Management Branch
Dam Safety Section, Ministry of Forests, Lands and Natural Resource Operations

Respondent

**Affidavit of Scott Morgan
Volume #1**

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City of Nanaimo

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Comptroller of Water Rights, Water Management Branch
Dam Safety Section, Ministry of Forests, Lands and Natural Resource Operations

Respondent

AFFIDAVIT

I, Scott Morgan, Civil Servant, of 3rd floor – 395 Waterfront Crescent, Victoria BC, AFFIRM
THAT:

1. I am employed as the Head of the Dam Safety Section (“DSS”) of the Water Management Branch in the Ministry of Forests, Lands and Natural Resource Operations (the “Ministry”) and, as such, have personal knowledge of the facts and matters hereinafter deposed to save and except where stated to be made upon information and belief and, where so stated, I verily believe the same to be true.
2. I have held the position of Head of DSS since May 8, 2012. Prior to that, I was a Senior Dam Safety Officer for approximately 20 years.
3. In my current position, I am a provincial expert on dam safety and, as such, provide advice and professional oversight as part of the dam safety program on all aspect of dam safety in the province in order to ensure that provincial dams and projects are designed, constructed, operated and maintained in a manner that safeguards the province’s population, economy and environment. I manage the provincial dam safety program including overseeing the review of reports and manuals submitted to the provincial dam

safety program for acceptance, such as Dam Safety Reviews, emergency preparedness plans for emergency response by dam owners, and operation, maintenance and surveillance manuals for dams, which are regulated under the *BC Dam Safety Regulation*, B.C. Reg., 44/2000, as amended by B.C. Reg. 163/2011 (the "Regulation"). I am also responsible for providing direction on the dam owner compliance program.

4. I report directly to Wenda Mason, Manager of DSS, and work directly with the Respondent Director and Comptroller of Water Rights, Glen Davidson's (the "Comptroller") on matters relating to Orders, and have worked closely with him on matters involving the Middle and Lower Dams.
5. I am swearing this affidavit in support of the Respondent's response to the Appellant City of Nanaimo's (the "City") application for a stay of the Comptroller's order issued on April 29, 2015 (the "April 29 Order").

Timeline Leading up to the Order and Associated Documents

6. I have scanned the materials the City has submitted in support of its stay application and see that they have included materials explaining, in part, events that have occurred over the previous 3 years, mostly by way of resolutions and reports that have been considered by the City's Council. The materials described in the preceding paragraphs and exhibited in this Affidavit supplement the City's materials and provide a more fulsome picture of what has transpired in the years leading up to the April 29 Order. The body of this Affidavit does not present a complete timeline but rather should be read in conjunction with materials contained in the Affidavit #1 of Chris Jackson made on May 21, 2015, in support of the City's stay application.
7. The City is the holder of water licences on Chase River, including Conditional Water Licences (CWL) C61423 and 61424 both of which authorize dams to store water for land improvement purposes related to its Colliery Dams Park. Attached hereto and marked as **Exhibit "A"** are true copies of both Conditional Water Licenses.
8. In 2002, Water Management Consultants ("WMC") undertook a study for the City of Nanaimo entitled *Middle and Lower Chase River Dams Spillway Hydrology Study* (report dated April 30, 2002) which, among other things, concluded the current spillway capacities for Middle and Lower Dams are significantly inadequate. I understand this report is Exhibit "I" to the Affidavit #1 of Robert McLean made in support of the City's stay application.
9. In 2003, Golder Associates ("Golder") conducted a Dam Safety Review for the City on Middle Dam and Lower Dam. I have reviewed the report and, among other things, it recommends that the City confirm the conclusions of the WMC 2002 spillway hydrology study indicating the inadequacy of these spillways. Attached hereto and marked as **Exhibit "B"** is a true copy of the Golder report. SM
DM
10. In 2010, EBA engineering consultants wrote a report for the City entitled *Seismic Hazard Assessment Middle and Lower Chase Dams* (report dated April 14, 2010), which I have

reviewed. Among other things, the report recommends that a dam breach flood inundation study be completed. Attached hereto and marked as **Exhibit "C"** is a true copy of the report.

11. In 2012, Associated Engineering undertook a study for the City and issued a report entitled *Chase River Dam Breach Flood Inundation Study* (report dated September 12, 2012) (the "2012 Inundation Study"), which I have reviewed. Among other things, the report concludes and recommends the following:

- (a) the Middle and Lower Dams present a significant risk to downstream areas in the event of a dam failure;
- (b) the estimated number of casualties as a result of a flood related dam failure is in the range of 30 to 60 people;
- (c) the estimated direct losses from a flood driven failure range from \$40 million to \$46 million;
- (d) the consequence classification of both dams should be raised to "extreme"; and
- (e) Middle and Lower Dams should be rehabilitated, replaced or removed.

Attached hereto and marked **Exhibit "D"** is a true copy of the report.

12. On October 17, 2012, DSS wrote to the City asking for a decision by October 30, 2012, on their course of action regarding the findings of the 2012 Inundation Study. Attached hereto and marked **Exhibit "E"** is a true copy of the letter.
13. On October 29, 2012, the City responded by letter advising the City Council passed a resolution to proceed with the removal of the dams. Attached hereto and marked **Exhibit "F"** is a true copy of the letter.
14. On December 12, 2012, the former Head of DSS and I met with City staff, City consultants, and the Save the Dams group to discuss options as the Save the Dams group was concerned about the planned removal of the dams. DSS presented the requirements of the Regulation. The City agreed to recommend to their Council to undertake further studies on options to rebuild and/or replace the dams.
15. On January 21, 2013, the Comptroller wrote a letter in response to the City's letter dated October 29, 2012, stating that the decision to remove the dams is an acceptable option. Attached hereto and marked **Exhibit "G"** is a true copy of the letter.
16. On January 28, 2013, the Comptroller and I met with the Save the Dams group (now called the Colliery Dam Preservation Society (CDPS)) at their request along with the City and the City's engineering consultants. This meeting was held primarily to discuss the Canadian Dam Association (CDA) guideline recommendations related to dam safety based on dam consequence classification.

17. On May 31, 2013, the engineering firm Klohn Crippen Berger (“KCB”) provided written notice on behalf of the City to the DSS to initiate the application process for replacement of the two dams through a two-phased approach beginning with dam removal in the late summer through early fall 2013 and reconstruction in the subsequent year. Attached hereto and marked **Exhibit “H”** is a true copy of the written notice.
18. On July 25, 2013, the City wrote to DSS requesting their application to replace Middle and Lower Dams be placed on hold until the conclusion of a period of community consultation. Attached hereto marked as **Exhibit “I”** is a true copy of the letter.

19. On July 30, 2013, the Comptroller wrote to the City and advised their request was accepted but also expressing concern with delays in the plans to mitigate the ongoing risk. DSS urged the City to quickly implement a plan to correct the deficiencies with Middle and Lower Dams as quickly as possible. Attached hereto marked as **Exhibit “J”** is a true copy of the letter.
20. On August 19, 2013, I emailed Bill Sims, the City’s Manager of Water Resources to advise the Comptroller’s position with regard to Middle and Lower Dams had not changed and that the City must mitigate the flood safety risks associated with the dams by some method acceptable to the Comptroller. Attached hereto marked **Exhibit “K”** is a true copy of the email.
21. On August 28, 2013, School District 68 (SD68) wrote a letter to the Minister requesting the City take immediate action to address the risks posed by the Middle and Lower Dams. Attached hereto marked **Exhibit “L”** is a true copy of the letter.
22. On September 17, 2013, I met with Wenda Mason, Manager of DSS, Bruce O’Neill, Senior Dam Safety Engineer and the Comptroller to discuss the situation respecting the Middle and Lower Dams, including options for an Order under the *Water Act*, R.S.B.C. 1996, c. 483.

23. On September 24, 2013, Wenda Mason sent an update via email to the Comptroller advising of the current status of the situation respecting Middle and Lower Dams and that the Comptroller should consider an Order. The email further confirms a meeting is being organized with City staff the following week to discuss progress and the possibility of an Order by the Comptroller. Attached hereto and marked **Exhibit “M”** is a true copy of the email.
24. On September 30, 2013, the Minister responded via correspondence to School District 68. The School District’s facilities were identified as being located in the area at risk of flooding in the event of dam failure. Attached hereto and marked **Exhibit “N”** is a true copy of the letter.
25. On October 01, 2013, I attended a meeting in Nanaimo with Wenda Mason and the Comptroller along with various City staff. The City was advised of the possibility of an Order by the Comptroller due to concerns with the delay in the City coming up with a plan to address, on a long term basis, the risks posed by the Middle and Lower Dams. Attached hereto and marked as **“Exhibit O”** is a true copy of the agenda of this meeting.

26. On October 10, 2013, School District 68 wrote to the City's Mayor expressing dam safety concerns related to its facilities. Attached hereto and marked **Exhibit "P"** is a true copy of the letter.
27. On December 13, 2013, the Comptroller and a DSS Senior Dam Safety Engineer, Bruce O'Neill, attended a meeting with the City's Technical Committee which included a risk assessment presentation by Golder of the Middle and Lower Dams. I was not present at the meeting but reviewed the minutes of the meeting in the New Year. Attached hereto and marked as **Exhibit "Q"** is a true copy of the minutes.

28. On January 21, 2014, the Comptroller, Bruce O'Neill and I attended a meeting of the City's Technical Committee at which Golder presented its risk assessment findings regarding these dams and Golder informed the Technical Committee that it would be useful to get more geotechnical information by coring into dam. Attached hereto and marked as **Exhibit "R"** is a true copy of the minutes.
29. On February 11, 2014, the Comptroller issued an order to the City to allow Golder authorization to proceed with the preliminary geotechnical investigation program of the Lower Dam. This authorization was required due to the nature of the investigation, as contemplated by s. 10(4) of the Regulation. Attached hereto and marked **Exhibit "S"** is a true copy of the Order.
30. On March 4, 2014, Monty Miedreich, DSS Senior Dam Safety Officer, and I attended a meeting with the City's Technical Committee, Fisheries and Oceans Canada, and Colliery Dams Park Preservation Society (CDPPS) at which Golder discussed its geotechnical investigation. Golder presented options for remediation of the Lower Dam: enlarge the spillway, auxiliary spillway (swale), labyrinth spillway, and overtopping approach. Golder held up a draft document of a US Federal Emergency Management Agency (FEMA) manual on overtopping approaches and advised that it would be published soon but did not share the draft document with us. DSS advised that the overtopping approach has never been undertaken in BC and therefore an expert opinion would most likely be required prior to authorization. The Technical Committee agreed to consider a preferred as well as a secondary option. The City voiced some uncertainties respecting the options but agreed that the labyrinth spillway was the preferred option and the overtopping approach is the secondary option. Attached hereto and marked **Exhibit "T"** is a true copy of the minutes from this meeting and presentation materials.
31. On March 5, 2014, the Technical Committee met and agreed to recommend to the Executive Committee that their term be extended to allow it to receive the additional information from Golder and to make a final report to the Executive Committee by the end of April 2014. Attached hereto and marked **Exhibit "U"** is a true copy of the minutes of this meeting.
32. On April 4, 2014, the Comptroller and DSS staff including Wenda Mason, Bruce O'Neill and I attended a Risk Assessment Workshop at Golder's office in Burnaby. Attached hereto and marked as **Exhibit "V"** is a true copy of a draft agenda.

33. On April 24, 2014, Bruce O'Neill, the Comptroller and I met with the City's Technical Committee and Golder in Victoria to discuss Golder's consequence classification for the Middle and Lower Dams. The Comptroller agreed in principle to a "very high" consequence classification for Lower Dam and a "high" consequence classification for Middle Dam, pending receipt of Golder's final report on the technical rationale for revision of the previous consequence classification of "extreme" for these dams.
34. July 25, 2014, marks the date of three reports completed by Golder for the City of Nanaimo and I understand that all of these reports are Exhibits "D", "E" and "F" in the Affidavit #1 of Robert McLean:
- (a) Golder Associates, 2014a, *Collier Dams, Nanaimo, BC Hydrology Hydraulics, and Middle Dam Breach Analysis*;
 - (b) Golder Associates, 2014b, *Colliery Dams, Nanaimo, BC Dam Stability*; and
 - (c) Golder Associates, 2014c, *Colliery Dams, Nanaimo, BC Risk Assessment*.

I received these reports on October 28, 2014, along with a fourth report on top of which a date stamp indicating receipt was affixed by our office. Attached hereto and marked **Exhibit "W"** is a true copy of the DSS date stamp indicating receipt of all four reports.

35. On August 11, 2014, Peter Bullock of Geo Stabilization International (GSI) presented an overtopping approach to remediation to the City's Council. This is reflected in the meeting minutes contained in the City's stay application materials as Exhibit "Y" to the Affidavit #1 of Chris Jackson made on May 21, 2015.
36. August 29, 2014, marks the date of Golder's report *Dam Remediation Options* completed for the City and sent to me via email on September 3, 2014 (a hard copy was also sent on October 28, 2014, the date stamp for which is Exhibit "V" to this Affidavit). I understand the report is Exhibit "G" in the Affidavit #1 of Robert McLean. Attached hereto and marked **Exhibit "X"** is a true copy of the email.
37. November 21, 2014, marks the date of Golder's report to the City (in letter form) entitled *Consequence Classification*. I have reviewed the report and in it Golder recommends that DSS adopt consequence classifications of "very high" for Lower Dam and "high" for Middle Dam. The City forwarded this report to me via email on December 23, 2014. I understand the report is Exhibit "H" in the Affidavit #1 of Robert McLean. Attached hereto and marked **Exhibit "Y"** is a true copy of the email.
38. January 16, 2015, marks the date of Golder's report (in letter form) completed for the City entitled *Auxiliary Spillway – Conceptual Design*, with respect to which I was advised by the City via email on January 15, 2015. I obtained the report from the City's website. I understand the report is Exhibit "B" in the Affidavit #1 of Robert McLean. Attached hereto and marked **Exhibit "Z"** is a true copy of the email.
39. On January 23, 2015, DSS wrote to the City accepting Golder's consequence classification recommendations and requesting the City prepare a revised plan that

identifies and prioritizes the actions required to correct potential and existing safety hazards at the Middle and Lower Dams, and gives a timeline for completion, as contemplated by s. 7.1 of the Regulation. The deadline for submissions of the revised plan was February 27, 2015. This correspondence of January 23, 2015, is included in the City's stay application materials as Exhibit "NN" of the Affidavit #1 of Chris Jackson made on May 21, 2015.

40. On January 27, 2015, the City wrote to the Comptroller requesting reconsideration of the deadline of February 27, 2015, due to illness of a member of the City's Council. Attached hereto and marked "**Exhibit "AA"**" is a true copy of this letter.
41. On February 2, 2015, the City submitted a report to the City's Council, which I have reviewed and which appends the Golder report *Auxiliary Spillway – Conceptual Design*. The report states on page 7 that:

The Golder report confirms that the existing spillway is substantially undersized and will not meet engineering or DSS regulations in a severe storm event. The Golder report also identified that the alternate swale/drainage course to Harewood Creek is viable... . This staff report outlines the various remediation options presented to Council over the past eight months. Staff recommends pursuing the alternate drainage course/swale as it is the option that appears to be most viable (pending final design review), is estimated to be approximately two thirds of the cost of the labyrinth spillway or overtopping option, and may allow for additional cost savings that could be achieved through the design and construction process.

This February 2, 2015, report is included in the City's stay application materials as Exhibit "FF" of the Affidavit #1 of Chris Jackson made on May 21, 2015.
42. On February 6, 2015, the City wrote to the Comptroller to advise of a number of motions passed at a City Council meeting on February 2, 2015, which included a motion not to proceed with any design work or expenditure for the auxiliary spillway remediation approach to Lower Dam (referred to as the "alternate drainage course/swale" in the motion), motions respecting consultation with stakeholders, and a motion to amend the Schedule for Remediation to "permit more time to investigate and prepare a revised plan for any required remediation when determined". On this basis, the City advised DSS they would not be in position to meet the DSS deadlines outline in the January 23, 2015, correspondence. Attached hereto and marked **Exhibit "BB"** is a true copy of the February 6, 2015, letter.
43. On February 25, 2015, the Comptroller wrote to the City to advise that the City must select a remediation option for Lower Dam, submit a plan respecting the remediation of Lower Dam and a plan respecting any action required respecting Middle Dam, and implement both plans within a reasonably expeditious timeframe in accordance with the Regulation. The Comptroller advises in the letter that he is granting the City's request for a one month extension of the deadline for submission of the plans to 4pm on March 27, 2015. This correspondence is included in the City's stay application materials as Exhibit "OO" of the Affidavit #1 of Chris Jackson made on May 21, 2015.

44. March 9, 2015, marks the date of Golder's report (in letter form) completed for the City entitled *Summary of Lower Dam Hydraulic Modelling Methods*, which summarized Lower Dam hydraulic modelling methods. I or someone else at DSS obtained the report from the City's website. I understand the report is Exhibit "C" in the Affidavit #1 of Robert McLean.
45. The City penned a report to the City's Council dated March 16, 2015, that states "during the past 18 months, extensive engineering, committee, staff and public input has been provided to Council regarding options to remediate the Colliery Dams". The report recommends the Council direct staff to:
- (a) Install an auxiliary spillway for the Lower Dam and provide a plan for Middle Dam that complies with the Regulation, plus ensure deadlines and requirements outlined in the Comptroller's letter of February 25, 2015, are met; or
 - (b) Pursue the labyrinth spillway or overtopping options instead of the auxiliary spillway.

Attached hereto and marked as **Exhibit "CC"** is a true copy of the report.

46. The City Council minutes of the March 16, 2015, meeting (included in the City's stay application materials as Exhibit "HH" of the Affidavit #1 of Chris Jackson made on May 21, 2015), which I have reviewed, indicate the Council received a "Colliery Dams Update" following which a motion to direct staff to install an auxiliary spillway and take the action identified in paragraph 45(a) in this Affidavit was defeated. Instead, the minutes indicate the Council passed a motion for staff to work with the Technical Committee to develop and implement plans for the dams that do not involve any remediation at all, and submit those plans to "confirm" with the Comptroller that the plans are an acceptable approach to the issues identified in the Comptroller's correspondence of February 25, 2015.
47. On March 17, 2015, the City wrote to the Comptroller advising of the motions described above with no further clarification. Attached hereto and marked **Exhibit "DD"** is a true copy of this correspondence.
48. On March 27, 2015, the City wrote to the Comptroller confirming that the Council's motion remains Council's direction and providing a copy of the plans described in the motion that do not involve any remediation of the dams. Attached hereto and marked as **Exhibit "EE"** is a true copy of this correspondence.
49. On April 9, 2015, the Comptroller wrote the City advising the City is not in compliance with the Regulation as none of the information specified in the Comptroller's correspondence of February 25, 2015, had been received. The April 9 letter enclosed an Order (the "April 9 Order") issued by the Comptroller requiring the City to correct the potential safety hazard of Middle and Lower Dams by "immediately undertaking the necessary steps to increase the flood routing capacity of Lower Dam to 144.0 cms., as calculated by Golder, in order to meet an annual exceedance probability design flood event level that is 2/3 of the way between a 1 in 1000 year flood and the Probable

Maximum Flood”, which requirement reflected current practice for dam safety under the Canadian Dam Association Dam Safety Guidelines (2013). At paragraph 1, the Order requires the City to select either the Labyrinth Spillway Design option as described in the Golder *Dam Remediation Options* report of August 29, 2014, or the Auxiliary Spillway Design as described in Golder’s *Auxiliary Spillway – Conceptual Design* report of January 16, 2015. The April 9 Order and the enclosing correspondence are included in the City’s stay application materials as Exhibit “PP” of the Affidavit #1 of Chris Jackson made on May 21, 2015.

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50. On April 16, 2015, the City wrote to the Comptroller advising of a motion passed by the City’s Council on April 13, 2015, to file an appeal of the April 9 Order with the Environmental Appeal Board and suggesting the City make a presentation to DSS outlining an overtopping remediation approach of GeoStabilization International (GSI) presented by Councillor Kipp at the April 13, 2015, Council meeting. The City requested that the Comptroller amend the April 9 Order to allow for consideration of GSI’s overtopping approach proposal and that further time be granted to develop the proposal. Attached hereto and marked as **Exhibit “FF”** is a true copy of this correspondence.
 51. On August 20, 2014, I had received an email notification from BC Hydro that the published FEMA Manual was available for download. This the final version of the draft document Golder had help up during the March 4, 2014, meeting with the City. It is entitled *Overtopping Protection for Dams* (“FEMA Manual”). Attached hereto and marked as **Exhibit “HH”** is a true copy of the email.
 52. The FEMA Manual includes a section that stipulates the maximum recommended height for dams when using the overtopping protection approach. The maximum height according to the FEMA Manual is 40 feet. The height of Lower Dam is 77 feet (or 23.3 metres). This raises serious concerns about the advisability of the overtopping protection approach for Lower Dam. Attached hereto and marked as **Exhibit “GG”** is a true copy of an excerpt from the FEMA Manual.
 53. Several people including the Comptroller, Wenda Mason and I were present for a presentation given by Herb Hawson, principal engineer at Golder, on overtopping protection at the Dam Safety Community of Practice annual meeting held in Richmond, BC, on March 23, 2015. Mr. Hawson went over the maximum height table in the FEMA Manual. Attached hereto and marked as **Exhibit “II”** is a true copy of the agenda.
 54. On April 22, 2015, the Comptroller, Wenda Mason and I met with a delegation from the City (Mayor McKay, Councillor Bestwick, Councilor Kipp, Toby Seward, and Ted Swabey) and GSI (Peter Bullock) to hear the presentation respecting GSI’s overtopping approach to remediation. The presentation was given by Councillor Kipp with some comments provided by Peter Bullock. The Comptroller agreed to amend the April 9 Order to include GSI’s approach as an option but told the City that an expert opinion on the advisability in terms of proper practice of the approach would be required. The Comptroller also requested that the City provide examples of where GSI technology has been used on other dams and advise which of the overtopping protection types described in the FEMA Manual is comparable to GSI’s proposal. During the meeting, GSI made it

clear that they would only be responsible for the portion of the project that involved the slope of the dam and that another engineering firm (such as Golder) would be required for all other aspects of the project. Attached hereto and marked as **Exhibit “JJ”** is a true copy of the draft agenda for the meeting.

55. On April 28, 2015, the City wrote to the Comptroller requesting an amendment to the April 9 Order to include a third remediation option for Lower Dam, to wit “the Overtopping option (as presented at the City’s meeting with you April 22, 2015, which includes hardening of the Lowers Colliery Dam embankment and improvements to the Lower Colliery Dam spillway...”. Attached hereto and marked as **Exhibit “KK”** is a true copy of this letter.
56. On April 29, 2015, the Comptroller issued the Order of April 29 (the “April 29 Order”) under cover of a letter with the same date which adds an overtopping protection approach as a remediation option alongside the other two remediation options for Lower Dam but requiring an independent expert report on the overtopping protection approach. The April 29 Order and the enclosing correspondence are included in the City’s stay application materials as Exhibit “QQ” of the Affidavit #1 of Chris Jackson made on May 21, 2015.
57. On May 12, 2015, I emailed the City accepting one of two independent experts proposed by the City to assess the technical feasibility of the overtopping approach proposed by GSI. Paul G. Schweiger, the person I advised the City was acceptable, was one of the peer reviewers of the FEMA Manual. Attached hereto and marked **Exhibit “LL”** is a true copy of this email
58. On May 12, 2015, GSI indicated in correspondence to the City that there appeared to be no need for GSI’s participation in either the design or project delivery phase as a more traditional approach proposed by Golder “seems to provide the City a much higher level of comfort”. The correspondence further states “[i]f for some reason, we are misreading the City’s level of comfort and willingness to contemplate a higher level of managed-risk”, GSI would be prepared to deliver on their proposal. This correspondence is contained in the City’s stay materials as Exhibit “LL” of the Affidavit #1 of Chris Jackson.
59. On May 18, 2015, GSI wrote a second letter to the City referring to their realization that their proposal could not be meshed with that of Golder. This correspondence is contained in the City’s stay materials as Exhibit “MM” of the Affidavit #1 of Chris Jackson.
60. As GSI had already made it clear they would only be able to deal with the portion of the project involving the slope of the dam and would need another engineering firm on board for the rest of the project, this meant that GSI’s proposal would not be feasible.

61. The two remediation approaches for Lower Dam that are acceptable to the Comptroller as specified in the April 29 Order – that is, the auxiliary spillway design or the labyrinth spillway design – remain acceptable approaches open to the City to implement to address the potential safety hazards of Lower Dam within the timeframe contemplated by that Order, that is substantially completed by November 15, 2015.

~~AFFIRMED BEFORE~~)

ME at Victoria, British Columbia)

on June 15, 2015.)



A commissioner for taking)

affidavits for British Columbia)

[print name or affix stamp of commissioner]

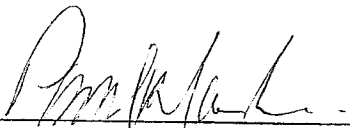

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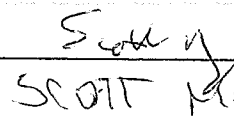
Reaffirmed before me)

at Victoria, British Columbia)

on June 17, 2015)



A commissioner for taking
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