APPENDIX A: HYDRODYNAMIC MODEL RESULTS
1 MODEL DEVELOPMENT

The model grid covers the northern Strait of Georgia (Figure A-1) and extends from Campbell River at the north boundary to Ballenas Islands at the south boundary. The model consists of three 2-way coupled curvilinear domains with progressively fining resolution, with the finest grid resolution in the vicinity of the Balmoral Beach, where it is 100 m. In the vertical direction, the model grid consists of 20 fixed z-layers that are thinner near the surface (top 2 m) and thicker at depth. The difference in horizontal and vertical geometry is required because of the large aspect ratio characterizing the marine environment, and because much of the variability (density stratification, vertical shear in horizontal flow) is concentrated near the surface, which requires a finer vertical resolution. The bathymetry for the model is derived using datasets from CHS hydrographic charts.

![Coarse model grid of the northern Strait of Georgia and fine grid near the Balmoral Beach.](image)

It is expected that the pipe rupture event would occur during the winter months. Freshwater runoff from the Fraser River (the most significant freshwater source in the model domain) is mostly confined to a region well south of Texada and Lasqueti Islands during winter. The overall range of salinity is consistently small in winter within northern Strait of Georgia and near uniform salinity conditions always prevail (Thomson 1981); therefore the initial salinity value of 31 psu was applied for all grid cells.

1.1 Boundary Conditions

Tides are simulated with amplitudes and phases of locally dominant tidal constituents along the open ocean boundaries (Ballenas Island and Campbell River). Two months of predicted hourly tidal elevations at Comox Harbour are shown in Figure A-2, illustrating the daily and biweekly tidal variability.
In addition to tidal forcing, wind forcing can be a dominant factor affecting current circulation within the surface layer of the water. As a rough rule of thumb, maximum speed of surface water under a steady wind along the strait is about 3% of the wind speed (Thomson 1981). Model simulations were made initially assuming no winds. Later on, a southeast wind was applied over the ocean, with the speed varying between 10 and 15 m/s.

River runoff can be a major factor affecting current circulation at the mouths of major rivers. Most of the freshwater inflow in the study area comes from the Courtenay River, which is located approximately 6 km west of Balmoral Beach. The mean discharge for the Courtenay River is approximately 52.6 m³/s (MELP 1996). This flow was used to set the upstream discharge boundary in the estuary.

### 1.2 Wastewater Properties

Water quality parameters from the Balmoral Wastewater Treatment plant are summarized in Table A-1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp (°C)</td>
<td>17.3</td>
<td>10.7</td>
<td>23.5</td>
</tr>
<tr>
<td>pH</td>
<td>7.6</td>
<td>7.1</td>
<td>8.0</td>
</tr>
<tr>
<td>BOD (mg/l)</td>
<td>228.9</td>
<td>145</td>
<td>454</td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>213</td>
<td>42</td>
<td>726</td>
</tr>
<tr>
<td>TKN (mg/l)</td>
<td>47.6</td>
<td>37.1</td>
<td>164</td>
</tr>
<tr>
<td>Alkalinity (mg/l)</td>
<td>298</td>
<td>111</td>
<td>505</td>
</tr>
<tr>
<td>Fecal Coliform</td>
<td>53,400,300</td>
<td>2400</td>
<td>&gt;160,000,000</td>
</tr>
<tr>
<td>E-Coli</td>
<td>27,311,500</td>
<td>230,000</td>
<td>&gt;160,000,000</td>
</tr>
</tbody>
</table>
MODEL VALIDATION

The Balmoral Beach model was first validated against water level at Comox Harbour. Predicted water levels based on tidal constituents and modelled hourly water levels from December 2015 at Comox Harbour are compared in Figure A- 3. Results indicate good agreement between predicted and modelled water levels. The tidal range variability from spring to neap tidal cycles and the daily high and low water level elevations are well reproduced. The maximum root-mean-squared error (RMS) values between observed and predicted water levels is 0.17 m and compared to mean tidal range of 3.4 m at Comox Harbour, these errors are within 5%.

Figure A- 3: Comparison between predicted (black line) and modelled (red line) water levels.

In addition to the water level comparison, the Balmoral Beach model result was validated against tidal current maps published in Juan de Fuca Strait to Strait of Georgia Current Atlas (JDEF/SOG Current Atlas).

Figure A- 4 and Figure A- 5 show the surface current distribution during flood tide two hours before turning to ebb from JDEF/SOG Current Atlas and from the Balmoral Beach Model respectively. The model reproduced the weak northerly flood current in most of the northern Strait of Georgia and the southerly flood current from the Discovery Passage. In the vicinity of the study area, the model shows that during the flood tide surface current flows westerly across Comox Bar, and with a portion of the flow heads northward into Comox Harbour and the rest heads southward into Baynes Sound. This pattern matches the flood tide circulation (left panel on Figure A- 8) information from the Oceanographic Characteristic of Comox Harbour and Approaches in Relation to Sea Disposal of Sewage - Fisheries Research Board of Canada, 1962.

Figure A- 6 and Figure A- 7 show the surface current distribution during ebb tide two hours before turning to flood from JDEF/SOG Current Atlas and from the Balmoral Beach Model respectively. The model reproduced the weak southerly ebb current in most of the northern Strait of Georgia and the northerly ebb current near the Discovery Passage. In the vicinity of the study area, the model shows that during the ebb tide surface current flows eastward across Comox Bar, and southward into Baynes Sound. This is also similar to the circulation pattern (right panel on Figure A- 8) presented in Oceanographic Characteristic of Comox Harbour and Approaches in Relation to Sea Disposal of Sewage - Fisheries Research Board of Canada, 1962.
The results show that the model is capable of reproducing water levels and reproducing similar velocity magnitude and pattern against JDEF/SOG Current Atlas.

Figure A-4: Two hours before turn to ebb – reproduced from JDEF/SOG Current Atlas Page 6.
Figure A- 5: Two hours before turn to ebb – Balmoral Beach Model.
Figure A-6: Two hours before turn to flood – reproduced from JDEF/SOG Current Atlas Page 27.
Figure A-7: Two hours before turn to flood – Balmoral Beach Model.
3 MODEL RESULTS

3.1 Model Runs

Five scenarios (Table A-2) were conducted to assess the dispersion and dilution of the effluent and the extent of the impact zone in the event of a pipe rupture under a range of environmental conditions.

Table A-2: Modelled Scenarios

<table>
<thead>
<tr>
<th>Run</th>
<th>Tide</th>
<th>Wind</th>
<th>Courtenay R. (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spring</td>
<td>Calm</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Neap</td>
<td>Calm</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Neap</td>
<td>Calm</td>
<td>52</td>
</tr>
<tr>
<td>4</td>
<td>Neap</td>
<td>Southeasterly, varying between 10 and 15 m/s</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Neap</td>
<td>Southeasterly, varying between 10 and 15 m/s</td>
<td>52</td>
</tr>
</tbody>
</table>

The initial concentration of the wastewater discharged from the pipe is prescribed to be 1.0, with a background concentration of 0.0 in the ocean. The actual concentration of any contaminant can be
computed from the model results by multiplying the model prediction by the actual concentration discharged from the plant (Table A-1).

### 3.2 Run 1: Spring Tide and Calm Winds

This run represents the case of a large tidal range, with no significant wind effects or freshwater river inflows. Time series of the water level and effluent discharge history modelled are shown in Figure A-9. Effluent dilution maps at -2 m GD 12 hours, 24 hours, 2 days and 4 days after the initial discharge are shown in Figure A-10.

Nearshore tidal currents during the discharge are relatively small, with maximum speeds reaching 0.25 m/s. Tidal currents further offshore by Comox Bar are stronger with maximum speeds reaching 0.5 m/s. During the flood tide surface current flows westerly across Comox Bar, and with a portion of the flow heads northward into Comox Harbour and the rest heads southward into Baynes Sound. During the ebb tide, this pattern reverses and the surface current generally flows eastward across Comox Bar, and southward into Baynes Sound. As a result, the plume of effluent remains relatively close to the shoreline between Cape Lazo and Comox harbour. After 24 hours from the start of the discharge the effluent is diluted by a factor of 100 to 500 within a zone extending approximately 2 km from the shoreline. The effluent plume is deflected into the estuary of the Courtenay River 48 hours after the discharge.

![Figure A-9: Run 1 – Water level and discharge history time series.](image-url)
Figure A-10: Run 1 – Dilution maps for effluent discharged into Strait of Georgia.

3.3 Run 2: Neap Tide and Calm Winds

This simulation represents the case of a discharge during a relatively small tidal range with no effect from winds or significant freshwater inflows from the Courtenay River. Time series of the water level and effluent discharge history modelled for Run 2 are shown in Figure A-11. Effluent dilution maps at -2 m GD 12 hours, 24 hours, 2 days and 4 days after the initial discharge are shown in Figure A-12. After 24 hours, the discharge from the forcemain will be diluted by a factor of between 100 and 500 along most of Balmoral Beach. Dilution rates inside the Courtenay estuary-Comox harbour were in the range of 4000 to 5000 after 48 hours. At this time, the plume extends over a 2 km wide, 8 km long band that covers the tip of Cape Lazo to the northern end of Baynes Sound. Figure A-13 shows the extent of the plume after 96 hours at an expanded spatial scale and using a larger dilution scale. This plot shows that the effluent would be diluted by a factor of approximately 100,000 at the north end of Baynes Sound. Based on the data from Table A-1, coliform counts would still be in the range of 300 to 1600.
Figure A-11: Run 2 – Water level and discharge history time series.

Figure A-12: Run 2 – Dilution maps for effluent discharged into Strait of Georgia.
3.4 **Run 3: Neap Tide with Courtenay River Inflow and Calm Winds**

This run represents the same tidal conditions as Run 2 but with a constant inflow of fresh water from the Courtenay River. The effect of winds was not accounted for. Effluent dilution maps at -2 m GD 12 hours, 24 hours, 2 days and 4 days after the initial discharge are shown in Figure A- 14.

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**Figure A- 13:** Run 2 – Dilution map 96 hours after discharge, expanded scale.
Figure A-14: Run 3 – Dilution maps for effluent discharged into Strait of Georgia.

The flow from the Courtenay River tends to keep the plume from entering the estuary and deflects it towards the north, increasing effluent concentrations near Cape Lazo in comparison to Run 2.

3.5 Run 4: Neap Tide with Southeasterly Wind

This simulation is the same as in Run 2 but includes superimposing a southeasterly wind field over the model domain. The freshwater inflow from the Courtenay River during the event was assumed to be negligible. Time series of the water level, discharge history and wind climate modelled for Run 4 are shown in Figure A-15.
Effluent dilution maps at -2 m GD 12 hours, 24 hours, 2 days and 4 days after the initial discharge are shown in Figure A- 16. The southeasterly winds have a significant influence on the dispersal path of the plume, forcing it towards Goose Spit and into Comox Harbour and the estuary. After 24 hours, the dilution rate offshore from Balmoral Beach remained between 100 and 500. After 48 hours, dilution rates remained between 2000 and 3000 at the northern end of the beach and near Cape Lazo and were between 5000 and 10,000 inside Comox Harbour. Unlike Run 2, the plume did not extend significantly into Baynes Sound.
Figure A-16: Run 4 – dilution maps for effluent discharged into Strait of Georgia.

3.6 Discussion of Model Results

The model simulations show that the dispersal pattern of the plume from a relatively short-term discharge (24 hour duration) will be governed by the magnitude of the tidal currents, winds and freshwater inflows during the event. Dilution is reduced when the daily tidal range is small (neap tide conditions). This is because the smaller tidal range results in lower tidal currents and lower dispersion rates of the effluent plume. Consequently, a rupture of the forcemain during a neap tide is expected to have greater dispersion, a greater effect in Comox harbour and greater effect in the north end of Baynes Sound than spring tide conditions.
Freshwater outflows from the Courtenay River will push the plume northwards, maintaining its extent off Balmoral Beach and Cape Lazo, but reducing its excursion into Comox Harbour and Baynes Sound. Southeasterly winds will push the plume around Goose Spit into Comox Harbour.
APPENDIX B: COMPARISON OF NHC WORK PLAN TO ISO 31000 RISK MANAGEMENT STANDARD
22 August 2016

Comox Valley Regional District
600 Comox Road
Courtenay, BC
V9N 3P6

Attention: Marc Rutten, P.Eng.
General Manager of Engineering Services Branch

Copy to: Via email: mrutten@comoxvalleyrd.ca

Re: Coastal Engineering Services - Risk Assessment of CVRD Forcemain on Balmoral Beach
Comparison of NHC Work Plan to ISO 31000 Risk Management Standard
Summary Letter

Dear Mr. Rutten

Northwest Hydraulic Consultants Ltd. (NHC) is pleased to provide this summary of NHC’s comparison of
the proposed work plan for coastal engineering services to assess the risk of scour and erosion causing a
failure to the Comox Valley Regional District (CVRD) existing sewer forcemain on Balmoral Beach to the
ISO 31000 Risk Management Standard1. This document outlines where the work plan conforms to the
standard, and where it deviates. The project background and the scope of work were provided in NHC’s
proposal submitted by Dave McLean (NHC) to you on April 28, 20162.

1 ISO 31000 RISK MANAGEMENT STANDARD

The ISO 31000 Risk Management Standard1, referred to herein as ‘the Standard,’ outlines key principles
and guidelines that can be applied to a variety of activities for effective risk management. The Standard
provides a systematic approach to managing any type of risk and is not specific to a particular industry,
association or type of project. The Standard defines risk as: “effect of uncertainty on objectives”, which
is typically described in terms of consequences of an event and likelihood of occurrence.

2 Northwest Hydraulic Consultants Ltd., 2016. “Risk Assessment, CVRD Sewer Forcemain along Balmoral Beach
The approach is structured according to principles, framework and process. The principles outlined in the Standard declare that risk management should: create value, be part of organizational processes and decision making, clearly address uncertainty, be systematic, structured and timely, be based on the best available information, be adapted to the specific context, account for human and cultural factors, be transparent and inclusive, have appropriate and timely involvement of stakeholders and decision makers, be responsive to change, and facilitate continual improvement.

The risk management framework aligns the risk management activities with the principles and is comprised of the design of the framework for managing risk, implementation of the risk management process, monitoring and review of the framework, and the continual improvement of the framework. The framework is intended to establish the risk management policy, accountability, communication and reporting mechanisms, and how risk management integrates into the project activities. Planning and commitment to risk management is a vital component of the framework.

The key activities included within the risk management process as outlined in the Standard are:

- Communication and consultation during all stages of the risk management process.
- Establishing the objectives and scope, and defining the parameters and risk criteria.
- Risk assessment, which is the process of risk identification, risk analysis and risk evaluation.
- Risk treatment, which is the selection and implementation of alternative(s) for modifying risks.
- Monitoring and review.

Documentation is also an important component of the risk management process.

The ISO 31000 Risk Management Standard has been adapted and applied to coastal zone management in Australia (Rollason et al, 2010). Many of the same general principles can be applied to assessing risks of a forcemain failure on Balmoral Beach. Rollason et al (2010) found that application of the Standard helped to prioritize the risk treatment and gain acceptance when a risk treatment may not be required.

2 COMPARISON OF WORK PLAN TO ISO 31000 RISK MANAGEMENT PROCESS

2.1 Communication and Consultation

NHC’s management principles include establishing and upholding effective communications amongst all staff members, our sub-consultants and our clients, maintaining close liaison with the client during execution of the project and after submission of deliverables, and maintaining an appropriate level of documentation and records pursuant to the engineering profession.

The NHC / Current Environmental team will draw on the combined experience of the two firms and collaborate closely with CVRD to provide a thorough and practical approach to completing the study. We feel working closely with CVRD through all phases of the risk management process will be critical to

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the overall success of the project. It is vital that stakeholders and those accountable for implementing the risk management process have a clear understanding of the reasons for required actions.

The work plan includes various communication and reporting activities such as:

- A kick-off meeting with CVRD staff as part of the site inspection to clarify the scope of work and study objectives, and review the schedule and available information that can be provided to support the study. In terms of the recommended guidelines in the Standard, this is an initial step toward ensuring that the interests of stakeholders are understood and considered.
- The letter herein, which summarizes the comparison of the work plan to the Standard, to review and communicate the framework of the risk assessment and identify improvements to the framework.
- A presentation of the interim study results to provide the CVRD with a preliminary summary of potential risks, causes, consequences, and preventative measures, and provides CVRD the opportunity to comment and provide input to the study.
- A draft report to summarize the technical information and recommendations to the CVRD for review and comments.
- A final report that addresses the CVRD’s review comments.
- A final presentation to the CVRD that summarizes NHC’s analysis and the key findings.

NHC’s policies and procedures for communication and consultation is in compliance with the recommendations for recording the risk management process that is provided in Section 5.2 of ISO 31000:2009(E).

### 2.2 Establishing the Context

Establishing the context involves outlining the objectives and scope, and defining the parameters and risk criteria. The overall objective is to assess the likelihood and consequence of failure of the sewer forcemain at Balmoral beach due to erosion and/or impact caused by natural coastal processes. The specific objectives of the study include:

- Estimate the rate of erosion over the forcemain due to long-term degradation or beach lowering.
- Provide an indication of the likelihood that the forcemain will rupture due to scour during storm events.
- Provide an indication of the likelihood that impacts from debris during storm events could damage exposed sections of the forcemain.
- Predict the extent of effluent dispersion in the event the forcemain ruptures and the associated clean-up costs.
- Develop recommendations for maintenance and inspection practices.
- Provide technical input to assist in defining the emergency response plans in the event of failure.
The scope has been outlined in the work plan and will be reviewed and refined based on a preliminary assessment of available information, the site visit, the kick-off meeting with CVRD staff, and this comparison to the ISO 31000 Standard. The extent of the study area will be established and the key coastal processes, which are both specific to the area and generate risk, will be identified. In addition, the economic (eg. coastline development, commercial shellfish industry), social (eg. recreational demand), ecological (eg. fish and wildlife), and other values associated with the study area will be identified. The predicted consequences of failure of the forcemain will be identified using numerical modelling to estimate the extent of effluent dispersion in the event that the forcemain ruptures, and estimation of the associated clean-up costs. The consequence analysis will consider whether the impacts are likely reversible or irreversible, long-term or short-term.

A key preliminary task that will be required for the risk assessment to conform to the Standard will be to define the risk criteria or metrics that will be used to evaluate the significance of risk. The risk criteria should reflect the objectives of the risk assessment, the available information and resources, and the economic, social, ecological, and other values relevant to the study. This allows for both technical and non-technical criteria to be included in the analysis and will facilitate setting priorities for risk treatment. The risk criteria scale will relate to how significant each risk is in terms of likelihood (hazard probability from very low to high), and consequence (from very low to severe) as shown in Figure 2.1. The risk will be rated according to timeframes of 1 year, 5 years, and 10 years. The consequences will be based on actions such as: no action, repairs, emergency response within 24 hours, and emergency response within 72 hours. The risk metrics may be amended based on stakeholder input and the study findings.

![Figure 1: Risk matrix](image)

NHC’s work plan is generally consistent with the recommendations for establishing the context that is provided in Section 5.3 of ISO 31000:2009(E), but would be improved through active participation by CVRD in establishing and accepting the metrics that will be used to evaluate the significance of risk, near the beginning of the analysis. This will provide an opportunity for all parties to contribute to the analysis and ensure that the outcome of the analysis is accepted by the project stakeholders.
2.3 Risk Assessment

Risk assessment involves the process of risk identification, risk analysis and risk evaluation. The objective of risk identification is to develop a comprehensive list of the processes or events that have the potential of causing, preventing, accelerating, delaying or enhancing failure of the forcemain. During this phase of the study, key sources of risk, causes, potential consequences and possible interdependence or cumulative effects will be noted.

The NHC / Current Environmental team will then conduct the risk analysis by exploring the likelihood that the sewer forcemain will rupture from those potential causes such as natural coastal processes like erosion and/or impact. The consequence of a forcemain failure will also be evaluated. The analysis will include investigating the potential rate of erosion, and estimating what lands and waters are likely to be impacted in the event of an effluent leak. As part of the consequence evaluation, the range of clean-up costs associated with a rupture will be appraised. An overview environmental assessment will be conducted to assess the potential effects of a rupture on salmonids, forage fish and shellfish, including both recreational and commercial resources. This study will also include providing a high level assessment of the short-term clean up and mitigation costs associated with a breach. The findings of the analysis may be quantitative and/or qualitative in nature. The goal of the analysis is to provide the input for decisions regarding priorities and appropriate risk treatment. The team will identify factors that give rise to uncertainty such as where information used in the analysis may be lacking, when assumptions need to be made, when there is divergence of expert opinions, and note the limitations of the tools being used for the analysis.

The purpose of risk evaluation is to facilitate decisions that are based on the results of the risk analysis. The risk evaluation is conducted by comparing results of the analysis to the established risk criteria, thereby prioritizing the need for a risk treatment. The evaluation may also result in a recommendation to conduct additional analysis or an informed decision not to seek a risk treatment. NHC’s proposed work plan for the risk assessment is in compliance with the recommendations provided in Section 5.4 of ISO 31000:2009(E).

2.4 Risk Treatment

Selection of a risk treatment to mitigate risk or a decision to not take action should involve balancing priorities and benefits with costs and effort. The Standard emphasizes that stakeholders should be involved in the decision. This will provide an opportunity for all parties to contribute to the analysis and ensure that the outcome of the analysis is technically sound, achievable, and accepted by the project stakeholders. All decisions should comply with legal and regulatory requirements and take into account social responsibility and environmental protection. The treatment option should be analyzed in terms of effectiveness, potential residual effects, and how the likelihood or consequences of risk may be altered by the treatment. A risk treatment plan should be prepared, and should include direction for how the treatment plan should be implemented, the responsibilities of those involved in approvals and implementation, required timing, the anticipated outcomes, monitoring requirements, and performance metrics. The reasons for selecting the plan should be clear within the documentation of the plan. NHC’s proposed work plan is in compliance with the recommendations provided in Section 5.5 (risk treatment) of ISO 31000:2009(E).
2.5 Monitoring and Review

Monitoring and review should be planned with responsibilities clearly defined. Monitoring can provide new information that improves the risk assessment. The work plan includes development of recommendations for inspection practices that the CVRD should employ until the forcemain has been relocated. The recommendations for the types and frequency of checks and reviews will be based on the assessed risk.

The monitoring and review process is strengthened by establishing performance indicators or triggers for management responses. Action plans should be developed to respond to these triggers. For example, the work plan includes provision of technical input by NHC to assist in defining emergency response plans that would be triggered by a rupture of the forcemain. Action plans should be documented and communicated appropriately.

In addition, analysis of the monitoring results is required to detect changes over time and identify trends or emerging risks. Evaluations should be conducted to update the assessment based on the new information, and to determine whether performance indicators are being met and whether modifications to the action plans are required.

NHC’s proposed work plan for monitoring and review is generally in compliance with the recommendations provided in Section 5.6 of ISO 31000:2009(E). However, the scope of the work plan does not currently include implementation of the monitoring nor evaluation of the surveys.

2.6 Documentation of Risk Management Process

The policies and procedures for project documents and records control that are being implemented within NHC’s BC-based offices are summarized for our staff in NHC’s Organizational Quality Manual. This manual was prepared to meet the requirements for professional practice quality management set out in the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) Organizational Quality Management (OQM) Program. The procedures outlined in the manual are in compliance with all regulatory and statutory requirements, including APEGBC’s Professional Practice Guidelines.

NHC’s policies and procedures for project documents and records control is also in compliance with the recommendations for recording the risk management process that is provided in Section 5.7 of ISO 31000:2009(E). Improvements to the documentation process for better consistency with the guidelines in the Standard would be to more clearly outline how the need for continuous learning is taken into account, and the benefits of re-using information for the management process. This is, however, more effectively implemented when the Standard is applied to a company’s organizational processes as a whole rather than to specific project tasks.
3 CONCLUSIONS

The Standard provides general guidelines that can be applied to a particular industry, association, and/or type of project to manage any form of risk in a systematic and transparent manner. In the context of the risk assessment of the CVRD forcemain on Balmoral Beach, application of the Standard is being compared to the approach to a specific project work plan. NHC’s work plan is generally in compliance with the recommendations provided in ISO 31000:2009(E). However, better consistency with the guidelines in the Standard would be attained through:

- Active participation by CVRD in establishing and accepting the metrics that will be used to evaluate the significance of risk near the beginning of the analysis, and participation in the selection of the risk treatment.
- Inclusion of the implementation of monitoring, and reviews of the monitoring within the scope of the project.
- Application of the Standard to CVRD’s organizational processes as a whole in addition to its application to these specific project tasks, which would help to better implement the guidelines and the principle of continual improvement.

4 CLOSURE

We appreciate the opportunity to help with the study. Please do not hesitate to contact me (khurtig@nhcweb.com) directly by phone (604-980-6011) or email if you have any questions or require additional information.

Sincerely,

Northwest Hydraulic Consultants Ltd.

Prepared by:

Kara Hurtig, M.Sc., P.Eng., Associate

DISCLAIMER

This document has been prepared by Northwest Hydraulic Consultants Ltd. for the benefit of Comox Valley Regional District for specific application to the Risk Assessment of CVRD Forcemain on Balmoral Beach near Comox, BC. The information and data contained herein represent Northwest Hydraulic Consultants Ltd.’s best professional judgment in light of the knowledge and information available to Northwest Hydraulic Consultants Ltd. at the time of preparation, and was prepared in accordance with generally accepted engineering practices.

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