

### Mission Statement

In carrying out its mandate, Bowen Island Municipality will work towards conducting operations in a way that:

- Improves the economic, environmental and social well-being for present and future generations;
- Encourages and fosters community involvement;
- Enhances the small, friendly, caring character of the community;
- Maintains an open, accountable and effective operation; and
- Preserves and enhances the unique mix of natural ecosystems and green spaces that Bowen Island possesses.

**NOTICE: That a Committee of the Whole meeting of Bowen Island Municipal Council will be held via Zoom on Monday, February 28, 2022 at 4:00 PM for the transaction of business listed below.**

## AGENDA

### Committee of the Whole Meeting

### Monday, February 28, 2022

|   |  |
|---|--|
| <p style="text-align: center;"><b>How to join/watch the Council meeting</b></p> <ol style="list-style-type: none"> <li>1. <a href="#">Join Zoom Meeting</a><br/>Meeting ID: 869 2250 9060<br/>Passcode: 375709</li> <li>2. Watch the Council meeting live on our <a href="#">YouTube Channel</a>.</li> <li>3. At Municipal Hall. You will be watching the livestream on a television in Council Chambers. Please note, you must wear a mask while inside Municipal Hall.</li> </ol> | <p style="text-align: center;"><b>How to comment on an agenda item</b></p> <ol style="list-style-type: none"> <li>1. Write to Mayor and Council at <a href="mailto:mayorandcouncil@bimbc.ca">mayorandcouncil@bimbc.ca</a> For details on submission deadlines, visit our <a href="#">website</a>.</li> <li>2. Sign up to speak during Public Comment (instructions included in Section 2 of the Agenda)</li> </ol> |
|---|--|

**Page                      Timing**

#### OPENING OF COMMITTEE OF THE WHOLE MEETING

#### 1. APPROVAL OF AGENDA

##### 1.1 Introduction of Late Items

***Recommendation:***

*That Council approve the agenda and Late Items agenda (if applicable) for the February 28, 2022 Committee of the Whole meeting.*

## 2. PUBLIC COMMENTS

### How to sign up for Public Comments:

Email the Corporate Officer BEFORE 4:00 PM at [hdallas@bimbc.ca](mailto:hdallas@bimbc.ca). In your email, please include the following:

1. Subject line "Public Comment"
2. Name (first and last), telephone number and topic or agenda item.
3. Join the meeting via the Zoom link provided in the Council agenda and wait for your name to be called during the public comment section.

We ask that you respect the time limit allotted by the Mayor and once finished to please leave the Zoom meeting and watch via the [BIM YouTube Channel](#).

## 3. HAZARDOUS AREAS DPA & SITE ALERTATION

- a. Proposed Hazardous Areas Development Permit Area - Daniel Martin, Manager of Planning and Development, dated February 16, 2022 **3 - 23**

***Recommendation:***

*That the Committee of the Whole recommend Council direct staff to not proceed with the proposed Hazardous Areas Development Permit Area.*

- i. Results of Public Consultation on the Hazardous Areas Development Permit Area **24 - 102**
- b. Proposed Site Alteration Bylaw - Daniel Martin, Manager of Planning and Development, dated February 16, 2022 **103 - 129**

***Recommendation:***

*That the Committee of the Whole recommend Council direct staff draft a Site Alteration Bylaw to present at a Regular Council Meeting, and recommend Council direct staff to prepare engagement materials associated with the Site Alteration Bylaw for a public engagement session.*

## 4. ADJOURNMENT



To: Committee of the Whole

From: Daniel Martin, Manager of Planning and Development

Date: February 16, 2022 Meeting Date: February 28, 2022

Subject: **Proposed Hazardous Areas Development Permit**

---

**RECOMMENDATION**

That the Committee of the Whole recommend Council direct staff to not proceed with the proposed Hazardous Areas Development Permit Area.

---

**PURPOSE**

To present the latest update on the Hazardous Areas Development Permit work plan.

**BACKGROUND**

At the July 26, 2021, Council Meeting staff presented [draft findings of Hazardous Areas Development Permit Areas](#). Council adopted the following motion:

*RES#21-303*

***It was Moved and Seconded***

*That Council receive for information the staff report dated July 12, 2021, presenting draft findings of Hazardous Areas Development Permit Areas; and*

*That Council refer this report to a future Committee of the Whole Meeting, the Advisory Planning Commission, the Emergency Program Executive Committee, the Environment and Climate Action Advisory Committee, the Parks, Trails and Greenways Advisory Committee, and to a public open house.*

*CARRIED UNANIMOUSLY*

Previously, staff had outlined a work plan for a [site alteration bylaw and Hazardous Areas DP](#) in the September 28, 2020 Council Meeting, and previously had presented to a Committee of the Whole a [report](#) outlining the potential scope of a Site Alteration Bylaw or Development Permit Area.

**PUBLIC CONSULTATION**

Staff have prepared an overview report outlining the public consultation steps taken and responses received, including responses from committees, is included in an additional report found on this agenda.

**STAFF DISCUSSION**

As seen in the Public Consultation Report, while there is some support for the proposed Hazardous Areas Development Permit Area, a vocal majority of respondents are opposed to the project as

presented. Even members of the public who express support for the project have provided valuable feedback for staff to consider and address. This points to the need for additional actions, including refinements to the proposed mapping and process, more public engagement, as well as a review of how a new Development Permit Area would impact Staff time and processes.

Staff are currently developing a proposal for a new Site Alteration Bylaw. In the coming years, the Municipality will likely be conducting an Official Community Plan review. This would allow for a public opportunity to identify planning priorities, such as additional development permit areas. The Steep Slope Development Permit Area was identified in the Official Community Plan along with another unenacted Development Permit Area – the Environmentally Sensitive Areas Development Permit Area, while guidelines for a further Development Permit Area – the Cape Roger Curtis Development Permit Area – remains in the Land Use Bylaw. A focus of any OCP review and consultation would be determining community intentions for development permits to regulate development permit activities.

#### **NEXT STEPS**

Should Council adopt the staff recommendation to not proceed further with the proposed Development Permit Area, staff note the following items would remain able to be regulated:

##### **1. Stream Flooding and Erosion**

The majority of this proposed Hazardous Area falls within the existing Watershed, Aquifer, and Streamside Protection (WASP) DPA. Guidelines for this DPA include a condition that any development not:

*Cause any potential erosion of soil or contribute to any land slip, rock fall, mud flow or debris torrents which may adversely affect the quality or quantity of water resources or supplies.*

Where appropriate, in reviewing Development Permit applications for the WASP DPA, staff may be seeking further information to certify that the proposed development meets this guideline.

##### **2. Coastal Erosion and Flooding**

This Hazardous Area proposed using a Flood Control Reference Plan of 5 metres above mean sea level, and then extending back 15 metres from that point. This approach follows practices recommended by the Provincial Government in their [Guidelines for Management of Coastal Flood Hazard Land Use](#) which outlines steps for establishing a Flood Control Level (FCL) which incorporates elements of high tides, storm surge, sea level rise, and freeboard. This report recommends a preliminary Flood Construction Reference Plan of 5.0m in Vancouver Harbour and the Squamish River Delta and a Flood Construction Level (including freeboard) of 5.6 metres.

Figure 1 - Definitions for Flood Control Level and Setbacks (Source BC Ministry of Environment)

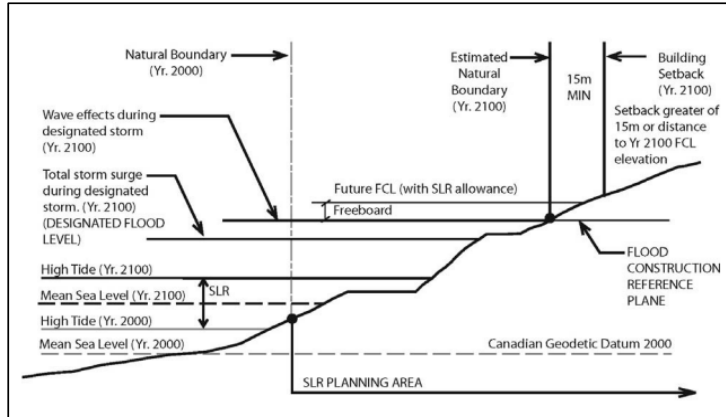


Figure 2 - Preliminary Flood Construction Reference Plan and FCL for 2100 for Specific Areas in Coastal British Columbia (Source BC Ministry of Environment)

|   | Fraser River Delta | Vancouver Harbour | Squamish River Delta | East Vancouver Island | West Vancouver Island | Central and North Coast |
|---|--------------------|-------------------|----------------------|-----------------------|-----------------------|-------------------------|
| Global SLR Allowance  | 1.0 m              |                   |                      |                       |                       |                         |
| Regional Adjustment <sup>1</sup>  | +0.21 m            | 0 m               | 0 m                  | -0.17 m               | -0.27 m               | -0.22 m                 |
| High Tide <sup>2</sup> (HHWLT m CGD)  | 2.0 m              | 1.9 m             | 2.05 m               | 1.6 m                 | 2.0 m                 | 3.8 m                   |
| Surge Allowance <sup>3</sup>  | 1.7 m              | 1.4 m             | 1.3 m                | 1.3 m                 | 1.3 m                 | 1.7 m                   |
| Wave Effect Allowance <sup>4</sup>  | 0.65 m             | 0.65 m            | 0.65 m               | 0.65 m                | 0.65 m                | 0.65 m                  |
| Flood Construction Reference Plane (FCRP)   | 5.6 m              | 5.0 m             | 5.0 m                | 4.4 m                 | 4.7 m                 | 6.9 m                   |
| Freeboard <sup>5</sup>  | 0.6 m              | 0.6 m             | 0.6 m                | 0.6 m                 | 0.6 m                 | 0.6 m                   |
| Flood Construction Level (FCL)  | 6.2 m              | 5.6 m             | 5.6 m                | 5.0 m                 | 5.3 m                 | 7.5 m                   |
| <sup>1</sup> Based on current values for areas (Vancouver and Squamish taken to be neutral due to regional variations or present lack of site specific data)<br><sup>2</sup> Varies by site and location in BC, as defined by CHS Tide Tables for areas, – Cowichan Bay used for East Vancouver Island – Tofino used for West Vancouver Island - Queen Charlotte City used for Central and North Coast.<br><sup>3</sup> Recommended value for AEP based on "Policy Discussion Paper 2010" – includes allowances for local wind setup.<br><sup>4</sup> Based on wave runup on natural gravel – pebble beach shoreline.<br><sup>5</sup> Assumes no Flood Proofing, specific Building Foundation type, or Tsunami. |                    |                   |                      |                       |                       |                         |

Some communities have taken this approach further and done detailed mapping of appropriate FCLs for their communities based on details assessments of the various shorelines. See for

example work done by the [Regional District of Nanaimo](#) identifying FCLs of between 4.5-6.8 metres, or work done by [West Vancouver](#) identifying FCLs between 4.75 and 8.79 metres.

In the absence of a Coastal Erosion hazardous areas, building within 30 meters of the highwater mark will continue to be, in most zones on Bowen, be regulated by the Land Use Bylaw. Based on the report provided, in any variance application received to reduce the required setback to the sea BIM staff will be asking the application to incorporate a consideration of the FCL of 5.0 metres into their application for Council's consideration.

### **3. Steep Slopes and Landslide Risk**

The Building Inspector has the authority to request a geotechnical report for building activities that take place on areas deemed hazardous. In the absence of a DPA, BIM staff will continue to require such a report where warranted.

Additionally, as part of a subdivision application, if the approving officer considers that the land is, or could reasonably be expected to be, subject to flooding, erosion, land slip, or avalanche, they may require that the applicant provide a geotechnical report certifying that the land may be used safely for the use intended.

### **4. Site Alteration Bylaw**

Later on this agenda staff have prepared a report outlining recommendations around a Site Alteration Bylaw. Such a bylaw would be able to regulate significant land alteration, and has the ability to require technical assessment of the work proposed.

In the absence of the proposed hazardous areas DPA, the main areas remaining at risk would be land clearing and site alteration in hazardous area below the scale identified in and Site Alteration Bylaw. Further, should such a bylaw not be adopted then land clearing and altering work not associated with a Building permit of subdivision application would remain unregulated and possible to cause a hazardous condition.

## **ALTERNATIVES**

Based on feedback provided through the online survey, Staff have identified the following potential actions:

- 1) That no further immediate action be taken on the Hazardous Areas DPA.
- 2) That the proposed DPA be revised to incorporate feedback by limiting the scope (for example by removing the proposed Coastal Erosion, Lake/Wetland Flooding, and Streams (Flooding/Erosion) hazardous areas, or other options identified by Council)
- 3) That the proposed DPA proceed

## **FINANCIAL CONSIDERATIONS**

Staff time required to complete the Hazardous Areas Development Permit Area is included in the 2022 work plan of the Planning Department, and would include incidental costs associated with any public engagement.

Should a bylaw be adopted, managing permit applications, reviewing applications, and issuing permits will entail staff time and consideration on how to fit into existing workloads. Additionally, staff would anticipate an increase in requests for bylaw services to enforce any new regulations, which would entail increase Bylaw Staff time to manage.

### **COMMUNICATION TO THE PUBLIC**

Should Council proceed with the proposed Hazardous Areas Development Permit Area, staff will prepare amendment bylaws for Council's consideration. Following presenting the draft bylaws for Council's consideration, staff will seek direction to refer the bylaws to advisory committees, the Islands Trust, and a public open house.

### **ECOLOGICAL CONSIDERATIONS**

Bylaw Services estimates that up to 20 % of Land Use Bylaw complaints are related to land alteration concerns i.e., tree removal, excavation, and blasting and how these alterations may affect, for example, water flow, erosion, sediment movement, water resource quality and quantity, and slope stability. Often these types of complaints are not covered by existing bylaw provisions.

A Hazardous Areas DPA may enhance safety to the public and at the same time help protect some ecologically rich areas such as bluffs, foreshore habitat, and water resource areas. However a Site Alteration Bylaw could also result in ecological protections providing staff with bylaw provisions to address environmental concerns brought forward by Bowen Island residents.

### **CONCLUSION**

Based on the feedback received through the consultation process, staff recommend not proceeding with the Hazardous Areas DPA, or revising the DPA to limit its scope. Further on this agenda staff have prepared a report outlining a process for a Site Alteration Bylaw which Council may wish to consider.

### **ALTERNATIVES**

As discussed above, staff have identified the following options for Council to consider:

1. That the Committee of the Whole recommend Council direct staff to not proceed with the proposed Hazardous Areas Development Permit Area
2. That the Committee of the Whole recommend Council direct staff to amend the proposed Hazardous Areas Development Permit Area to remove the proposed Coastal Erosion and Flooding and Stream Erosion and Flooding hazardous areas, direct staff to prepare amendment to bylaws to enact the Hazardous Areas Development Permit Area, and direct staff to prepare engagement materials to accompany the amendment bylaws.
3. That the Committee of the Whole recommend Council direct staff to prepare amendment to bylaws to enact the Hazardous Areas Development Permit Area, and direct staff to prepare engagement materials to accompany the amendment bylaws.

### **ATTACHMENTS AND REFERENCES:**

1. [Staff Report – July 26, 2021 Meeting](#)
2. [Staff Report – September 28, 2020 Meeting](#)
3. [Staff Report – February 3, 2020 Meeting](#)

**Submitted by:** Daniel Martin, Manager of Planning and Development

**REVIEWED BY:**

- CAO
- Bylaw Services
- Communications
- Finance
- Fire & Emergency
- Environment & Parks
- Planning
- Public Library
- Public Works
- Recreation & Community Services



# Committee of the Whole

## Hazardous Areas DP Report

February 28, 2022

**BOWEN ISLAND**  
**🌲 Municipality 🌲**

# Background

July 26, 2021

RES#21-303

That Council receive for information the staff report dated July 12, 2021, presenting draft findings of Hazardous Areas Development Permit Areas; and

That Council refer this report to a future Committee of the Whole Meeting, the Advisory Planning Commission, the Emergency Program Executive Committee, the Environment and Climate Action Advisory Committee, the Parks, Trails and Greenways Advisory Committee, and to a public open house.

**CARRIED UNANIMOUSLY**

# PUBLIC CONSULTATION

## **ADVISORY PLANNING COMMISSION – NOVEMBER 16, 2021**

It was Moved and Seconded

That the Advisory Planning Commission provide the following comments regarding the Hazardous Areas Development Permit Area Draft Report Findings as presented at its November 16, 2021 meeting:

- That requirements for the safety of people and infrastructure be considered;
- That the impact on expense and timing of development be considered; and,
- That existing bylaws and policies that address these hazards be taken into account.

**CARRIED UNANIMOUSLY**

# PUBLIC CONSULTATION

## **EMERGENCY PROGRAM EXECUTIVE COMMITTEE – SEPTEMBER 27, 2021**

It was Moved and Seconded

That the Emergency Program Executive Committee support measures that increase public safety and continue to improve emergency response including the Hazardous Areas Development Permit proposed at its September 27, 2021 meeting.

**CARRIED UNANIMOUSLY**

# PUBLIC CONSULTATION

## **ENVIRONMENT AND CLIMATE ACTION ADVISORY COMMITTEE – OCTOBER 6, 2021**

It was Moved and Seconded

That the Environment and Climate Action Advisory Committee support the proposed Hazardous Areas Development Permit Areas as presented at its October 6, 2021 meeting with the comments provided to Staff.

**CARRIED UNANIMOUSLY**

# PUBLIC CONSULTATION

## **PARKS, TRAILS AND GREENWAYS ADVISORY COMMITTEE – OCTOBER 19, 2021**

It was Moved and Seconded

That the Parks, Trails and Greenways Advisory Committee support additional protection and regulating of development of hazardous areas to protect parks, trails, greenways and beaches, particularly given extreme weather events and their likely more frequent event in future due to climate change.

**CARRIED UNANIMOUSLY**

# PUBLIC CONSULTATION

## Open House –

- In person week of December 6<sup>th</sup>
- Zoom December 8<sup>th</sup> and 9<sup>th</sup>
  
- Online Survey December & January
  
- 72 survey responses
- 8 letters received as well

# PUBLIC CONSULTATION

Online Survey Results:  
72 responses

1. Which of the following hazards are you concerned about anywhere on island?

Respondents could select all that apply.

- 38 respondents (52%) indicated they were concerned about landslides
- 34 respondents (47%) indicated they were concerned about stream erosion, flooding, debris flow
- 28 respondents (39%) indicated they were concerned about coastal erosion and flooding
- 29 respondents (40%) indicated they were concerned about none of the listed hazards



# PUBLIC CONSULTATION

Online Survey Results:  
72 responses

6. Please provide any feedback you have regarding the proposed development permit “TRIGGERS.”

Responses were provided as written comments. A total of 45 written comments were provided. 22 comments (49%) were negative. 10 comments (22%) were critical (seemed broadly supportive of initiative, but suggested refinements to the proposed project), 5 comments (11%) were supportive without additional comment. 8 comments (18%) were either unclear or neutral.

# PUBLIC CONSULTATION

Online Survey Results:  
72 responses

7. Please provide any feedback you have regarding the proposed development permit area MAPPING.

This answer received a total of 34 comments. 26 (76%) were negative, 7 (21%) were positive, and 1 (3%) comment was neutral. Supportive comments provided support for the initiative, or trust that the map was accurate. Most critical comments voiced dissatisfaction with the whole project rather than provide specific feedback

# PUBLIC CONSULTATION

Online Survey Results:  
72 responses

8. Please provide any feedback you have regarding the proposed PROCESS.  
35 respondents provided written responses. Of those, 25 (71%) expressed a lack of support for the project as presented. 10 respondents (29%) expressed support for this project.

# STAFF DISCUSSION

As seen in the Public Consultation Report, while there is some support for the proposed Hazardous Areas Development Permit Area, a vocal majority of respondents are opposed to the project as presented. Even members of the public who express support for the project have provided valuable feedback for staff to consider and address. This points to the need for additional actions, including refinements to the proposed mapping and process, more public engagement, as well as a review of how a new Development Permit Area would impact Staff time and processes.

# STAFF DISCUSSION

Should Council adopt the staff recommendation to not proceed further with the proposed Development Permit Area, staff note the following items would remain able to be regulated:

## **1. Stream Flooding and Erosion**

The majority of this proposed Hazardous Area falls within the existing Watershed, Aquifer, and Streamside Protection (WASP) DPA.

## **2. Coastal Erosion and Flooding**

In the absence of a Coastal Erosion hazardous areas, building within 30 meters of the highwater mark will continue to be, in most zones on Bowen, regulated by the Land Use Bylaw setbacks. Based on the report provided, in any variance application received to reduce the required setback to the sea BIM staff will be asking the application to incorporate a consideration of the FCL of 5.0 metres into their application for Council's consideration

# STAFF DISCUSSION

Should Council adopt the staff recommendation to not proceed further with the proposed Development Permit Area, staff note the following items would remain able to be regulated:

### **3. Steep Slopes and Landslide Risk**

Can be regulated at time of BP submission, or submission application. Other activities would remain unregulated at present.

### **4. Site Alteration Bylaw**

Later on this agenda staff have prepared a report outlining recommendations around a Site Alteration Bylaw. Such a bylaw would be able to regulate significant land alteration, and has the ability to require technical assessment of the work proposed.

# RECOMMENDATION

That the Committee of the Whole recommend Council direct staff to not proceed with the proposed Hazardous Areas Development Permit Area.



To: Committee of the Whole  
From: Daniel Martin, Manager of Planning and Development  
Date: February 16, 2022 Meeting Date: February 28, 2022  
Subject: **Results of Public Consultation on the Hazardous Areas Development Permit Area**

---

## **PURPOSE**

To present the results of Public Consultation on the Hazardous Areas Development Permit Area conducted in late 2021 and early 2022. This report is to provide background information to Council. No action is required from this report.

## **HAZARDOUS AREAS DEVELOPMENT PERMIT AREA**

# **Public Consultation Report**

February 2022

## **INTRODUCTION**

Bowen Island Municipality's 2010 Official Community Plan mapped a Development Permit Area for the Protection of Steep Slopes. In 2011, a draft Steep Slopes Bylaw (Bylaw No. 296) was proposed, but not passed. In 2017, the need for a steep slopes Development Permit Area was reiterated in the Island Community Plan. The Plan also proposed the establishment of an environmentally sensitive areas bylaw.

Following Council direction, the Municipality engaged a PhD Candidate through the University of British Columbia Sustainability Scholars program to produce a report that mapped a potential Hazardous Areas Development Permit Area and proposed processes (Appendix A). The report also provided a summary of best practices for similar development permit areas and site alteration bylaws.

In a Regular Council Meeting on July 26, 2021, Res #21-303 was moved and seconded:

*That Council receive for information the staff report dated July 12, 2021, presenting draft findings of Hazardous Areas Development Permit Areas; and*

*That Council refer this report to a future Committee of the Whole Meeting, the Advisory Planning Commission, the Emergency Program Executive Committee, the Environment and Climate Action Advisory Committee, the Parks, Trails and Greenways Advisory Committee, and to a public open house.*

This report will present an overview of the public consultation approach and summarize input from the committees and the public



## **PUBLIC CONSULTATION APPROACH**

The goal of this public consultation was to inform the public of the draft report and to obtain input for the development of future bylaws. Due to the ongoing COVID-19 pandemic, staff adopted both a hybrid (in-person and digital consultation) approach to the public open house.

Communications materials that were available online and in analog formats included:

- The Geotechnical Analysis to Identify Potentially Hazardous Areas for Development draft report (Appendix A)
- Hazardous Areas DP Area Draft Report Findings [Council Report] dated July 12, 2021 (Appendix B)
- Community Engagement Boards (Appendix C)
- Survey (Appendix D)
- Open House Presentation (Appendix E)

The in-person component of the Open House occurred at Municipal Hall between 8:30am and 4:30pm Monday, December 6<sup>th</sup> through Friday, December 9<sup>th</sup>, 2021. Individuals were asked to abide by public health guidelines, and planners were available to discuss the materials. The analog information materials and paper survey continued to be available at Municipal Hall up until Friday, January 28<sup>th</sup>, 2022. While at least eight individuals visited Municipal Hall during this period, no members of the public provided the Municipality with a completed paper survey.

Two virtual open houses were held at the following dates and times:

- December 8<sup>th</sup>, 2021 2pm – 4pm
- December 9<sup>th</sup>, 2021 2pm – 4pm (5 attendees)

A 'Hazardous Areas Development Permit Area' page was added to the Bowen Island Municipality website (Appendix F).

Notification of the open houses and survey was provided in the Island Page in the Bowen Island Undercurrent and online communication.

Input from the public was provided verbally during the open houses and through email. Some feedback was forwarded to Council, which was then forwarded to the Planning & Development department. All email input is included in Appendix G.

The online survey was the primary public consultation tool.

Committee meetings are currently held through video conference (Zoom). The Manager of Planning and Development provided committees with a Presentation previously presented to Council (Appendix H). Committee feedback is provided in the subsequent section.

## **CONSULTATION RESULTS**

### **Online Survey Results**

The online survey received 72 responses between Dec 9<sup>th</sup>, 2021 and January 31<sup>st</sup>, 2022. Appendix I includes the raw data collected from the survey.

**1. Which of the following hazards are you concerned about anywhere on island?**

**Respondents could select all that apply.**

- 38 respondents (52%) indicated they were concerned about landslides
- 34 respondents (47%) indicated they were concerned about stream erosion, flooding, debris flow
- 28 respondents (39%) indicated they were concerned about coastal erosion and flooding
- 29 respondents (40%) indicated they were concerned about none of the listed hazards

**2. Which of the following hazards are you concerned about anywhere on island?**

**Respondents could select all that apply.**

- 17 respondents (24%) indicated they were concerned about landslides
- 12 respondents (17%) indicated they were concerned about stream erosion, flooding, debris flow
- 6 respondents (8%) indicated they were concerned about coastal erosion and flooding
- 46 respondents (64%) indicated they were concerned about none of the listed hazards

While 38 (52%) respondents have concerns about environmental hazards on Bowen Island, 46 respondents (64%) indicated that they were not concerned about these hazards on the land they live or reside on. In other words, while respondents did report to be concerned about environmental hazards in general, they were not specifically concerned about the impact on their own land and property.

Of the listed hazards, landslides are the hazard respondents were most concerned about, followed by stream erosion, flooding, and debris flow.

**3. Is your property within the proposed Hazardous Areas Development Permit Area?**

- 32 respondents (45%) indicated "Yes"
- 16 respondents (23%) indicated "No, but it is close"
- 9 respondents (13%) indicated "No"
- 14 respondents (19%) indicated "Unsure"

More respondents indicated they reside in or near the proposed development permit area than those who selected "unsure" or "no." This suggests that residents who would be directly impacted were more likely to complete the survey than residents who were not impacted. The municipality did receive requests to help identify whether specific properties were part of the proposed development area, and some members of the public indicated the mapping was either unclear or inaccurate.

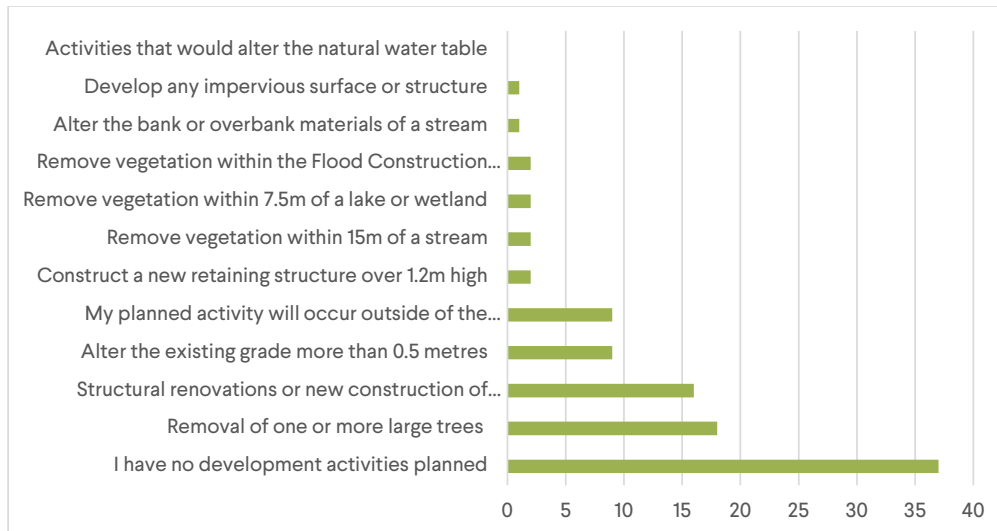
**4. Have you ever applied for a development permit with Bowen Island Municipality?**

- 17 respondents (24%) indicated "Yes"
- 52 respondents (72%) indicated "No"
- 3 respondents (4%) indicated "Unsure"

This question served two purposes (a) to assess possible redundancy with existing development permit areas and (b) to assess whether first-hand experience with development permit

application process impacted responses. The majority of respondents indicated that they have not applied for a development permit with BIM. Feedback provided to staff about this project, as well as general inquiries regarding development permitting, suggests a need for staff to provide further education about development permit areas and procedures.

**5. Are you likely to conduct, contract or assist with any of the following activities within the proposed hazardous areas development permit area?**



- Activities that would alter the natural water table (e.g. ditching, intensive drawdown from groundwater wells, impoundment structures) – 0
- Develop any impervious (paved or hardened) surface or structure – 1 respondent (1%)
- Alter the bank or overbank materials of a stream – 1 respondent (1%)
- Remove vegetation within 7.5 metres of a lake or wetland – 2 respondents (3%)
- Remove vegetation within 15 metres of a stream – 2 respondents (3%)
- Remove vegetation within the Flood Construction Reference Plane – 2 respondents (3%)
- Construct a new retaining structure over 1.2 metres high – 5 respondents (7%)
- Alter the existing grade more than 0.5 metres (by constructing a deck, stairs, retaining wall...) – 9 respondents (13%)
- My planned activity will occur outside of the proposed development permit area – 9 respondents (13%)
- Structural renovations or new construction of structures and decks larger than 25 square metres – 16 respondents (22%)
- Removal of one or more large trees – 18 respondents (25%)
- I have no development activities planned – 37 respondents (51%)

**6. Please provide any feedback you have regarding the proposed development permit “TRIGGERS.”**

Responses were provided as written comments. A total of 45 written comments were provided. 22 comments (49%) were negative. 10 comments (22%) were critical (seemed broadly supportive of initiative, but suggested refinements to the proposed project), 5 comments (11%) were supportive without additional comment. 8 comments (18%) were either unclear or neutral.

Respondents who provided negative comments regarding the proposed triggers expressed the following concerns:

- That the project would pose a barrier to development
- Perceived infringement of property owner rights
- The triggers were overly broad
- High applicant costs
- Opposition to Island-wide “blanket policies”
- Need for a revised report by consultant or Staff with local knowledge

*“What’s being considered would surely increase BIM staff work, adding to the already oppressive property tax bills. The hazard is that we’d strangle in red tape.”*

*“I think this is a great opportunity for public education. Most of us want to protect the natural environment but sometimes we don’t realize that our activities are destabilizing and harmful. ie.: removing tree roots on steep slopes, hard barriers at the oceanfront to try to reduce seaside erosion etc”*

Specific feedback about the development permit triggers included:

- Refining the tree removal trigger (suggested scaling number of trees to lot size, considering species of tree, lack of clarity in current wording)
- Requests for more information about possible exemptions to this development permit area, such as repairs to existing structures
- Further consideration regarding the type of soil on a steep slope
- The suggestion of increasing the size threshold for trigger pertaining to deck construction

**7. Please provide any feedback you have regarding the proposed development permit area MAPPING.**

This answer received a total of 34 comments. 26 (76%) were negative, 7 (21%) were positive, and 1 (3%) comment was neutral.

Supportive comments provided support for the initiative, or trust that the map was accurate.

While most critical comments voiced dissatisfaction with the whole project rather than provide specific feedback, the following feedback was provided:

- The accuracy of the map was questioned relative to on-site conditions and existing geotechnical assessments
- Some comments proposed assessing risk on a case-by-case basis
- Respondents indicated that the identified hazards have not yet impacted properties
- Respondents and members of the public expressed that they had difficulty accessing the online (reduced quality) map
- Further justification for the 5 metre Flood Construction Reference Plane (FCRP) required

**8. Please provide any feedback you have regarding the proposed PROCESS.**

35 respondents provided written responses. Of those, 25 (71%) expressed a lack of support for the project as presented. 10 respondents (29%) expressed support for this project.

The following feedback about the proposed process was provided:

- Proposed process (with geotechnical assessments) will help conserve staff time
- Application process should only be necessary if construction of structure larger than 100 ft<sup>2</sup> proposed.
- Suggestion that this development permit area apply solely to large-scale development, while allowing “every day work” to continue
- Concern about applicant resources (time, money)
- Suggestion that an additional, professional report be provided
- That the proposed process does not sufficiently protect the environment
- Respondents expressed appreciation for the opportunity to provide input
- Request for more transparency and public involvement
- Request that affected property owners and residents be contacted via direct mail and impacts of project clearly conveyed

*“I support it fully.”*

*“If the municipality and those that need to enforce these bylaws are looking for a fight, proceed with caution as any interference with my use and enjoyment of my land will be responded to as I feel necessary.”*

**9. Please provide additional feedback or comments here.**

37 respondents provided additional feedback. 21 (57%) voiced opposition or a lack of support for the project. 11 (30%) expressed support, while 5 (13%) provided neutral feedback. Most respondents reiterated general support or opposition to the project, and repeated feedback provided earlier in the survey. The following, additional feedback was provided.:

- Suggestion that the project should be tailored to different areas
- That Staff and Council focus on other, pressing priorities

*“Council should come back to earth and deal with the more mundane jobs of fixing roads and water systems and not try to create more layers of red tape.”*

*“More than anything we cannot allow any developments or alterations in hazard areas done by individuals or businesses to be a burden on the public purse when the terrain sustains damage because of the development or alteration, the development(s) sustain(s) damage and would result in pain, suffering and death, because of level of risk involved in developing in such an area, or the development or alterations in a hazard area.”*

*“We need to make sure we have strong regulations for tree removal and blasting.”*

#### **DIRECT CORRESPONDENCE RECEIVED**

Appendix G contains the direct correspondence received on the proposed Hazardous Areas DPA. A total of 8 letters were received from 7 individuals. Of those, 4, from three individuals (including two writing as chairs of stratas on Bowen Island, provided comments on the proposal and 3 expressed strong opposition to components of the proposed DPA, most particularly the proposed Coastal Erosion hazard area.

#### **COMMITTEE INPUT**

Following Council direction, Staff presented the draft report to a number of committees, the recommendations from which are contained below,

#### **ADVISORY PLANNING COMMISSION – NOVEMBER 16, 2021**

##### **It was Moved and Seconded**

That the Advisory Planning Commission provide the following comments regarding the Hazardous Areas Development Permit Area Draft Report Findings as presented at its November 16, 2021 meeting:

- That requirements for the safety of people and infrastructure be considered;
- That the impact on expense and timing of development be considered;
- and,
- That existing bylaws and policies that address these hazards be taken into account.

CARRIED UNANIMOUSLY

#### **EMERGENCY PROGRAM EXECUTIVE COMMITTEE – SEPTEMBER 27, 2021**

##### **It was Moved and Seconded**

That the Emergency Program Executive Committee support measures that increase public safety and continue to improve emergency response including the Hazardous Areas Development Permit proposed at its September 27, 2021 meeting.

CARRIED UNANIMOUSLY

#### **ENVIRONMENT AND CLIMATE ACTION ADVISORY COMMITTEE – OCTOBER 6, 2021**

Discussion included:

- Geotechs needs to dig a soil pit prior to conducting analysis; this may trigger the need for an environmental DP before this could take place;
- Spatial resolution of the mapping does not include anything that relates to the spatial area over which the steep slope might apply; discussion regarding ground truthing and potential measurement (five square metres was suggested);

- Including a mechanism by which property owners could apply for a site risk specific assessment in search of an exemption if they believe the site is not hazardous;
- Hazardous tree assessments in ravines or close to riparian areas removal would require additional geotechnical expertise requirements;
- Creation of hazardous areas: Risks to water sources and creation of steep slopes and erosion associated with blasting, and the lack of mechanisms to request information regarding blasting, were discussed. Staff advised that a site alteration bylaw could address these concerns; Committee members recommending including these potential sites in the mapping.

Recommendation

**It was Moved and Seconded**

That the Environment and Climate Action Advisory Committee support the proposed Hazardous Areas Development Permit Areas as presented at its October 6, 2021 meeting with the comments provided to Staff.

CARRIED UNANIMOUSLY

**PARKS, TRAILS AND GREENWAYS ADVISORY COMMITTEE – OCTOBER 19, 2021**

Discussion included:

- Ensuring that arborist who designates a tree a hazard is both certified and unbiased. Third party, peer review of reports is an option outlined in the Land Use Bylaw – a petition to the municipality for a peer review is an option for concerned citizens.
- Differentiating between exemptions that the municipality enjoys (day to day operation) and works that require a development permit. Concerns regarding oversight that is built into that.
- Map versions: Concerns were expressed regarding, for example, an earlier map of the recent Rivendell development which indicated a steep slope, while current map does not. Despite Geotech report, neighbours have concerns regarding earthquakes. Staff and Council advised that not only is Geotech more advanced, but ground truthing would have occurred to alter map depictions.
- It was suggested that more specificity regarding coastal flooding and erosion be included. Members suggested writing a set of guidelines that accompany into the permit application to add clarity. This could include using a defined Flood Construction Reference Plane (FCRP), a DPZ map, description of how to apply for an exemption, and other elements.



- Concerns regarding hazardous areas in trails were expressed. Possible safety mitigation included installation of signage and issuing of alerts.

Recommendation vote was deferred. It was agreed that the Manager of Planning and Development would return to PTGAC at its November meeting, subsequent to the public Open House.

**PARKS, TRAILS AND GREENWAYS ADVISORY COMMITTEE – NOVEMBER 23, 2021**

Discussion ensued and it was agreed that in light of current climate devastation happening to BC infrastructure, regulation of development in hazardous areas is of great importance. The Committee decided to provide an overarching recommendation to support the hazardous areas development areas permit to be supplemented by the notes capture from discussion at the [October 19, 2021 PTGAC meeting](#).

Recommendation

**It was Moved and Seconded**

That the Parks, Trails and Greenways Advisory Committee support additional protection and regulating of development of hazardous areas to protect parks, trails, greenways and beaches, particularly given extreme weather events and their likely more frequent event in future due to climate change. CARRIED  
UNANIMOUSLY


**CONCLUSION**

In this report Staff have presented an overview of public consultation conducted on the Hazardous Areas Development Permit Area. Staff Discussion regarding how to proceed is contained in another report on this agenda.

**Appendices:**

- A. Geotechnical Analysis to Identify Potentially Hazardous Areas for Development
- B. Hazardous Areas DP Area Draft Report Findings dated July 12, 2021
- C. Hazardous Areas Development Permit Boards
- D. Survey
- E. Open House Presentations
- F. Hazardous Areas Development Permit Web Page
- G. Letters Received
- H. Council Presentation – July 2021

**Submitted by:** Daniel Martin, Manager of Planning and Development



# GEOTECHNICAL ANALYSIS TO IDENTIFY POTENTIALLY HAZARDOUS AREAS FOR DEVELOPMENT

Draft Report

Daniel Martin, Manager of Planning & Development  
Bowen Island Municipality  
June 2021

Mike Turley  
mbturley@student.ubc.ca

Page 131 of 453

## Contents

|  |    |
|--|----|
| Purpose .....  | 2  |
| 1 Conditions on Bowen Island.....  | 2  |
| Potential Hazards.....   | 2  |
| Landslides: Shallow Landslides, Debris Flows, Rockfall .....                     | 2  |
| Stream Erosion and Flooding .....  | 3  |
| Coastal Erosion and Flooding.....  | 3  |
| 2 Hazardous Areas Development Permit Area .....                                  | 3  |
| Executive Summary.....   | 3  |
| Best Practices .....   | 4  |
| Definitions .....  | 4  |
| BC Guidelines and Regulations .....  | 4  |
| Bowen Island Analyses.....   | 11 |
| Limitations of the Report .....  | 11 |
| Explanation of the Analyses Conducted .....                                      | 12 |
| Proposed Map of the Development Permit Area .....                                | 14 |
| Suggested Development Permit Triggers .....                                      | 16 |
| References .....   | 18 |
| 3 Site Alteration Bylaws .....   | 19 |
| 4 Recommendations for the Municipality on future data-gathering or policies..... | 20 |

## **Purpose**

This report was prepared for the Bowen Island Municipality (BIM) and is meant to support the creation of two new bylaws, (i) a Hazardous Areas Development Permit Area, and (ii) a Site Alteration Bylaw. There are four main components to this report. First, the conditions on Bowen Island relevant to hazard analyses are noted. Second, hazardous areas DPA best practices are summarized. Analysis methods are then selected and applied based on the best practices research that are most relevant to the local conditions identified on Bowen Island. A Hazardous Areas DPA map is presented for review by the BIM Council. Third, best practices for site alteration bylaws are summarized. Fourth, recommendations for the municipality on future data gathering or policies is presented.

## **1 Conditions on Bowen Island**

Bowen Island is a 50 km<sup>2</sup> forested, mountainous island located within Howe Sound, British Columbia. The island is home to nearly 4000 residents, old growth forests, and fragile ecosystems. Bowen Island is composed of sedimentary rocks (i.e., argillite, greywacke, conglomerate turbidites) of the Bowen Island Group, and igneous rocks such as quartz diorite. In most locations, the bedrock is overlain by a discontinuous thin veneer of soil, with exposed bedrock at higher elevations and on steeper slopes. Within the lower lying valleys, well data suggests the soil may reach up to 300 metres thick. The island rises from sea level to a maximum elevation of ~725 metres (Mount Gardner). The mean slope gradient of the island is ~20°, with local values encompassing the full range of possible values (0-90°).

Bowen Island is within the Coastal Western Hemlock biogeoclimatic zone and receives approximately 1840 mm of precipitation each year. November through January are the wettest months, while July through September are the driest months. Precipitation data collected at the Bowen Bay weather station on Bowen Island over the years 1967-1978 and 1992-2014 record a maximum daily precipitation of \*80 mm (\*12 years of the 35-year record is incomplete). Precipitation and groundwater maintain numerous wetlands, lakes, and ponds found within local depressions. Small mountain streams redistribute water on the island and ultimately flow into the ocean. Many streams are intermittent, only occupied by flowing water during the wet season. However, none of the streams are gauged, and so little information is available regarding streamflow. The channel gradients range from 0.5° to just over 30°.

### **Potential Hazards**

Bowen Island's geographic location, geology, topography, and climate create conditions that may lead to natural hazards such as shallow landslides, debris flows, stream erosion and flooding, and coastal erosion and flooding.

#### **Landslides: Shallow Landslides, Debris Flows, Rockfall**

Steep soil mantled slopes are the most susceptible to shallow landslides, while rocky cliffs are prone to rockfall. An air photo analysis for the period 1947-present and high-resolution LiDAR revealed no historical landslides (shallow landslides, rockfall, or debris flows) on the island. However, it is not always possible to identify past landslides from these data, and they may still occur in the future. Shallow landslide occurrence is likely limited by soil thickness, or more specifically a lack of soils, on the steeper and higher elevation slopes.

Shallow landslides that enter steep creeks may mobilize into debris flows (another type of landslide) and travel great distances. Channels with a slope of 15° or greater are the most prone to initiating debris flows/floods which may travel on slopes as low as 5°. Approximately 1/3<sup>rd</sup> of the mapped streams meet these criteria.

### **Stream Erosion and Flooding**

If they were to occur, debris flows/floods, have the potential to be more hazardous than even the largest clear water floods. However, clear water floods and bank erosion can still damage nearby infrastructure. Creeks such as Terminal, Guild, Grafton, and others have steep banks making them more susceptible to bank collapse.

### **Coastal Erosion and Flooding**

Bowen Island's coastline is primarily bedrock that rises steeply out of the ocean, making it less susceptible to bluff erosion and sea level rise. However, after accounting for 1-metre of sea level rise by the year 2100, storms and wave runup could result in flooding of low-lying areas, such as parts of Snug Cove.

## **2 Hazardous Areas Development Permit Area**

### **Executive Summary**

The following section provides an overview of the best practices in creating a Hazardous Areas Development Permit Area, a summary of the analyses conducted, and the proposed map. Bowen Island's densely forested, mountainous terrain and wet, coastal climate create conditions that may lead to natural hazards such as shallow landsliding, rockfall, debris flows, stream erosion and flooding, and coastal erosion and flooding. EGBC professional reports provide the most up-to-date guidelines for hazard mapping in British Columbia. Given the current conditions on Bowen Island, it is suggested that four different hazard types be mapped separately given their different controlling mechanisms.

- (i) **Lakes and Wetlands** may be prone to flooding hazards, and a minimum setback distance of 7.5 metres is suggested.
- (ii) **Small Streams** may be prone to bank erosion, flooding, and debris flows (where sufficiently steep). A minimum setback of 15 metres is suggested.
- (iii) **Steep Slopes** may be prone to landsliding, and a high and moderate category is proposed based on a coupled slope stability and runout model. Slopes that may become unstable with 80 mm or less of rainfall are categorized as high hazard. Slopes requiring between 80 and 150 mm of rainfall to become unstable are categorized as moderate hazard. The categories are based on the maximum daily recorded rainfall on Bowen Island. However, model results should be interpreted as relative first-order estimates, rather than absolute values.
- (iv) **Coastal** erosion and flooding may occur particularly as a result of sea level rise, and it is suggested that a flood construction reference plane 5.0 metres above the modern-day sea level plus a setback of 15 metres be adopted.

This report is meant to inform and support the creation of a Hazardous Areas Development Permit Area for the Bowen Island Municipality.

## Best Practices

### Definitions

Acceptable Risk: "Acceptable risk is a risk for which, for the purposes of life or work, stakeholders are prepared to accept 'as is', and for which no risk control is needed."

Consequence: "The effect on human well-being, property, the environment, or other things of value; or a combination of these. Conceptually, consequence is the change, loss or damage to the elements caused by the landslide."

Flood Construction Levels (FCLs): An elevation above the natural boundary. The FCL is generally the observed or calculated water surface elevation for a flood having a 200-year recurrence interval, unless already established otherwise.

Setback: "A measured distance from the natural boundary within which development and site alteration should not occur".

Hazard: "A source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to property, the environment, and other things of value; or some combination of these."

Landslide: "A movement of a mass of rock, debris, or earth down a slope."

Qualified Professional: "A professional engineer, professional geoscientist, or licensee with the appropriate level of education, training, and experience to conduct hazard assessments, and licensed by Engineers and Geoscientists BC".

Risk: "The chance of injury or loss as defined as a measure of the probability and the consequence of an adverse effect to health, property, the environment, or other things of value."

### BC Guidelines and Regulations

Within British Columbia, guidelines for terrain stability assessments (TSA; e.g., Landslide) and floodplain mapping have been published as a collaboration between government and private organizations to address some of the most significant hazards within the province. These guidelines can be incorporated into certain stages of the planning process such as, official community plans (OCPs), bylaws and development permits, and the subdivision approval process (Ministry of Water, Land and Air Protection [MWLAP], 2004). The same report states that regulating land development to keep people out of harm's way is the most practical and cost-effective strategy for avoiding and/or mitigating risk to humans and infrastructure (MWLAP, 2004).

Engineers and Geoscientists British Columbia (EGBC) is the business name for the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) and is the regulating and governing authority of these professions under the Professional Governance Act. EGBC provides the state-of-practice guidance for hazard assessments in British Columbia.

The BC Local Government Act requires local governments to consider provincial management and planning guidelines including those relating to natural hazards. The provincial guidelines are meant as minimum requirements in the absence of site-specific information and studies and may be increased by the decision maker (MWLAP, 2004). To date, there is no provincial legislation that pertains to landslides

or other hazards when designating a Development Permit Area or preparing a bylaw (APEGBC, 2010a). However, although not required, the guidelines for legislated landslide and flooding assessments (APEGBC, 2010a; EGBC, 2018), and other provincial guidelines (e.g., APEGBC, 2008; APEGBC, 2010b) are still relevant.

Hazard assessments and mapping must be compared to a defined acceptable level of risk (ideally adopted by the approving jurisdiction) to be complete (APEGBC, 2010a). However, there is not an agreed upon standard definition for what constitutes an acceptable level of risk at the federal or provincial level (Ministry of Forests, Lands and Natural Resource Operations [MFLNRO], 2013), and few jurisdictions have addressed this issue.

The provincial best practices guidelines and corresponding guidelines for qualified professionals relevant to Bowen Island are summarized in the following sections.

#### Flood Hazard Area mapping

The goal of flood hazard area mapping is to “reduce or prevent injury, human trauma and loss of life, and to minimize property damage during flooding events.” (MWLAP, 2004). Many different types of flooding may occur (e.g., meteorological, seasonal, etc.), and may affect streams, lakes or ponds, wetlands, or coastlines.

#### *Small Streams*

In BC, standard flood assessments for rivers are typically based on the 200-year flood determined by a flood frequency analysis (EGBC, 2018). APEGBC (2017) provides an example classification used for flood hazard mapping where the hazard rating (HR) is the product of the depth of flooding (d; in metres) and the velocity of the floodwaters (v; in m/s) with an optional debris factor (DF; ranging from 0-1) as seen below.

$$HR = d * (v + 0.5) + DF$$

The general hazard rating can then be subjectively related to the hazard it poses to people based on Table 1 below.

**Table 1: Example hazard to people classification taken from APEGBC (2017; table 1).**

| Hazard Rating (HR) | Hazard to People Classification                                  |
|--------------------|--|
| < 0.75             | Very Low Hazard (Caution)  |
| 0.75 – 1.25        | Danger for Some (includes children, the elderly, and the infirm) |
| 1.25 – 2.00        | Danger for Most (includes the general public)                    |
| > 2.00             | Danger for All (includes emergency services)                     |

This hazard rating method was implemented by Kerr Wood Leidal (KWL) in 2017 to create an integrated flood hazard management plan for the District of Squamish, BC.

However, smaller streams, such as those on Bowen Island, are rarely gauged making detailed assessments impossible. As a result, the most common method used for regulatory purposes (i.e., Development Permit Areas) is where inundation mapping is incremented by a freeboard allowance (generally ranging between 0.3 and 1.0 m) to establish FCLs (APEGBC, 2017). In the absence of inundation mapping, an assessed height above the natural boundary of the waterway or above the natural ground elevation may be used (MWLAP, 2004). Table 2 below summarizes BC mapping guidelines for floods and related hazards that are relevant to Bowen Island.

**Table 2: Selected BC flood mapping guidelines from MWLAP (2004, 2018) relevant to Bowen Island.**

| Feature                                  | Setback   | Flood Control Level (FCL)   |
|--|---|---|
| Small Lakes, Ponds, Swamps & Marsh Areas | 7.5m from boundary  | 1.5m above boundary   |
| Bluffs                                   | 3 x bluff height  | NA  |
| Small Streams                            | 15m from boundary   | 1.5m above boundary   |
| Coastlines                               | 15m from FCRP - flood construction reference plane, (2100 natural boundary)<br>FCRP = FCL - Freeboard | Combination of: <ul style="list-style-type: none"> <li>• Global Sea Level Rise (SLR) Allowance (1.0 m for the year 2100)</li> <li>• Regional Adjustment</li> <li>• High Tide</li> <li>• Surge Allowance</li> <li>• Wave Effect Allowance</li> <li>• Freeboard (0.6 m)</li> </ul> Local Examples: <ul style="list-style-type: none"> <li>• East Vancouver Island – 5.0 m</li> <li>• Squamish River Delta – 5.6 m</li> <li>• Vancouver Harbour – 5.6 m</li> </ul> |

*Coastal Flooding and Erosion*

In a report for the city of Vancouver in 2011, Ausenco Sandwell estimated future sea level rise (SLR), and appropriate FCLs and setbacks for locations in Coastal Southwest British Columbia. Examples of FCLs for specific locations around Bowen Island are noted in Table 2. Coastline development should be restricted to the greater of the setback distance from the flood construction reference plane (FCRP) or the FCL for the year 2100. While the construction of FCRPs and FCLs is a site-specific process, neighboring examples may provide a first order estimate while illustrating best practices in the region.



### *Debris Flows*

Debris flows are, by definition, a landslide process but occur in stream channels and so are often discussed within flood hazard mapping reports. According to APEGBC (2018), “debris flows are most often triggered by shallow (<1m thickness) debris avalanches on hillslopes that run into channels (> 15° average channel slope) and lead to fluidization of the channel debris”. A common criterion for initial identification of drainage basins in British Columbia that may be subject to debris flows is,

$$\frac{R_d}{\sqrt{A_d}}$$

where  $R_d$  is the drainage basin relief and  $A_d$  is the drainage basin area (Wilford et al., 2004). When applying this metric, commonly referred to as the Melton Ratio, basins with values: < 0.3 are said to be flood prone, 0.3 – 0.6 are debris flood prone, and > 0.6 are debris flow prone. While this metric has proven to be a useful first approach, it should not replace detailed site-specific studies whenever possible. Bovis and Jakob (1999) found that sediment supply conditions are also fundamental in predicting debris flow activity. Without sufficient sediment available for mobilization, debris flows likely will not occur.

For additional flood mapping resources, NRCan (2018) provides an overview of the federal flood mapping guidelines series and a comprehensive list of the materials referenced while compiling the series.

### *Landslide and Terrain Stability Mapping*

Landslides happen every year in BC. They may be caused by heavy rain, human activity, or earthquakes; and move at speeds that range from being imperceptible to the human eye to greater than 100 km/h. As development and site alteration activities expand onto steep slopes, landslides become a greater hazard for both people and infrastructure.

### *Terrain Attributes*

Landslides are complex phenomena that are controlled by many factors. In 1996 the Resources Inventory Committee of the Government of British Columbia (RIC BC) identified 59 terrain attributes as influencing landslide occurrence. Ideally, landslide hazard maps should consider all influencing variables. However, this would result in overly complex maps and methods, and so relatively few variables that address site-specific conditions may be chosen. Table 3 presents a list of commonly measured terrain attributes relevant to terrain stability mapping. Data for many of these attributes either does not exist for Bowen Island, or is too low quality/resolution to be used in detailed terrain assessments.

**Table 2: Selected terrain attributes, relevant to terrain stability mapping, taken from RIC BC (1996) table 5.3.**

| Terrain Attribute                   | Examples (not exhaustive)                        |
|-------------------------------------|--|
| <b>Slope Morphology</b>             |  |
| Gradient                            | Typical, average or range                        |
| Curvature                           | Convex, concave, planar                          |
| Elevation                           | Typical, range                                   |
| Aspect                              | Quadrant with respect to north                   |
| Length                              | Slope length with similar features               |
| <b>Surficial Material</b>           |  |
| Origin                              | Glaciofluvial, fluvial, colluvial, etc.          |
| Texture                             | Gravel, sand, silt, clay, till, etc.             |
| Drainage                            | Rapid, well, moderate, poor                      |
| Thickness                           | Typical, average or range                        |
| Geomorphic Expression               | Fan, apron, cone, landslide                      |
| Geomorphic Process                  | Gullying, erosion, failing, etc.                 |
| Engineering Properties of Soil      | Strength, consistency, etc.                      |
| <b>Bedrock</b>                      |  |
| Geological Classification           | Granodiorite, mudstone, etc.                     |
| Weathering                          | Fresh, slightly weathered, etc.                  |
| Structural Features                 | Bedding, faults, folds, other discontinuities    |
| Structural Attitudes                | Strike, dip, dip direction                       |
| Engineering Properties of Rock Mass | Strength, fracture roughness, RQD                |
| <b>Water</b>                        |  |
| Stream Order and Status             | First, second, third... ; permanent vs ephemeral |
| Channel Gradient                    | Typical, average or range                        |
| Channel Processes                   | Flood, debris flood, debris flow, etc.           |
| Channel Width                       | Typical, average or range                        |
| Channel Bed Material                | Inorganic vs wood debris; typical sizes          |
| Precipitation                       | Annual, monthly, extreme daily                   |
| <b>Vegetation</b>                   |  |
| Forest Type                         | Hemlock, cedar, alder, etc.                      |
| Stand Age                           | <10 years, 10-30 years, 30-100 years, >100 years |
| Harvest/Fire History                | Logged, unlogged, forest fire plus years since   |
| Other Vegetation                    | Skunk cabbage, willows, etc.                     |
| <b>Human Activity</b>               |  |
| Type                                | Fill at top of slope, road cut, etc.             |
| Quantity                            | Road Length, logged area, etc.                   |

RIC BC (1996) further reviewed 12 different terrain mapping projects and found slope gradient to be the only terrain attribute considered in all studies. Table 4 provides a summary of common slope classes in terrain assessments.

**Table 3: Common Slope Classes used in terrain stability assessments. Taken from RIC BC (1996) Table 5.2.**

| Slope Class | Range of Percent | Range of Degrees |
|-------------|------------------|------------------|
| 1           | 0-5              | 0-3              |
| 2           | 6-27             | 4-15             |
| 3           | 28-49            | 16-26            |
| 4           | 50-70            | 27-35            |
| 5           | >70              | >35              |

*Available Methods*

The BC forestry sector has done a lot of work to define and standardize TSAs in the context of forestry. APEGBC (2008) outlines terrain stability management models that determine when a TSA should be carried out, establish risk criteria, define forest development strategies that are consistent with the risks, and establish a consistent and logical decision-making process. Additionally, APEGBC (2010b) provides guidelines for qualified professionals to, (i) establish a standard of care for carrying out terrain stability assessments, (ii) assist a terrain specialist and their client in defining the scope of work, and (iii) describe the skill sets needed to accomplish the work.

Unlike in the BC forestry sector (MFLNRO, 1999) there is not a set method for terrain stability mapping for land use/Land planning purposes. The method must be chosen based on site specific conditions, available data and resources, and the desired results. RIC BC (1996) identified 13 different methods for mapping terrain stability. Many of these methods require a detailed landslide database and given that no such record exists for Bowen Island, these methods are not applicable.

*Selecting a Method*

Based on data availability and resources, the “subjective rating analysis” and/or “slope stability method” are likely the most relevant for terrain mapping on Bowen Island (RIC BC, 1996). A subjective rating analysis assigns classes based on an algorithm that subjectively weights different relevant terrain attributes. The criteria for classifying the terrain should be uniform throughout the map area but can change between map areas due to regional differences such as terrain and climate. In most cases, terrain attributes such as slope gradient, surficial materials, and geomorphic process are used. Additionally, soil drainage, soil depth, and vegetation cover may be used. In a review of terrain hazard assessments in 2006, BGC suggested that simple algorithms (e.g., subjective rating analysis or slope stability) combined with an awareness of the limitations of the input data provide the most cost-effective landslide mapping and can be most effectively communicated with the public.

The slope stability method identifies potentially unstable locations by applying the infinite slope equation. This equation is a simple representation of the resisting forces, and the driving forces present

on a given slope. The equation incorporates attributes such as slope geometry, material strength properties, and groundwater conditions when available. In the case of Bowen Island, many of these variables have not been measured directly or at a proper spatial resolution, and so assumptions would need to be made for many of these variables and the results would depend on the assumptions.

A particularly simple, but useful, application of the slope stability method was outlined by Montgomery and Dietrich (1994). Their model couples a hydrologic model with a slope stability component to estimate the daily rainfall required to cause a slope failure. This model identifies the initially unstable locations, and then must also be coupled with an estimate of landslide runoff.

*Air Photo Analysis*

All of the terrain stability assessment and landslide mapping guidelines reviewed in this report suggest analyzing historical air photos as part of the mapping process. It is often possible to identify and delineate historical landslides, surface erosion, and/or other geomorphic processes from a proper air photo analysis. Table 5 below lists indicators of past and potential slope instability that may be identified from air photos (RIC BC, 1996; Table 5.6).

**Table 5: Indicators of past or potential slope instability that may be identified from air photos.**

| Indicators of Slope Instability  |
|--|
| • Recent landslide scars   |
| • Revegetated landslide scars or partially revegetated strips                          |
| • Linear strips or even-aged vegetation or trees                                       |
| • Fresh rock or soil surfaces on steep faces   |
| • Fresh rock or soil on lower slopes or at the base of a steep slope                   |
| • Talus/scattered boulders at base of slope  |
| • Bulging in the lower portion of a slope  |
| • Hummocky ground, sag ponds   |
| • Steeply dipping bedrock discontinuities and/or intersections that parallel the slope |
| • Tension cracks   |
| • Crescent shaped or curved scarps or depressions                                      |
| • Shallow, linear depressions  |
| • Step-like benches or small scarps  |
| • Displaced or disrupted stream channels   |
| • Recently scoured gullies   |
| • Debris fans or piles at the mouths of gullies or streams                             |
| • Trim lines, levees along gully   |
| • No vegetation or younger vegetation in gully bottoms compared to adjacent forest     |
| • Disrupted roads, fences, or other linear features                                    |

A review of historical records related to natural hazards should compliment the air photo analysis whenever possible.

#### *Field Mapping*

Field mapping and validation should be completed whenever possible to compliment and extend the mapping beyond the level of detail possible through remote methods. Many terrain attributes necessary for a detailed flood assessment or terrain stability map must be measured in the field and cannot be accurately estimated from remotely sensed data or historical records. For example, bedrock weathering, engineering properties of rock and soil, channel bed material, water table depth, etc. must be measured in the field (RICBC, 1996). Publicly available data of this nature is rare and typically exists at coarser resolutions than is necessary for detailed mapping. Remotely sensed data should also be validated to ensure data quality standards. MFLNRO (1999) suggests five terrain survey intensity levels, each representing the extent of field-checking completed, and subsequently the reliability of the mapping. The levels range from no field checking for confidence at coarser scales (i.e., > 1:20,000), to 75-100% of the polygons checked in the field for confidence at finer scales (i.e., 1:5000).

#### *Additional Considerations*

EGBC (2018) suggests that hazard mapping should be based on historical records where possible, but also incorporate the modeled effects of future climate change scenarios. Specifically, the report suggests considering the following changes relevant to flooding and related hazards by the year 2100.

- Average annual precipitation increase of 6-17%.
- More pronounced changes in seasonal flow (i.e., increase in winter, decrease in summer).
- Net sea level rise of 1m.
- Increase in precipitation will likely result in increased shallow landsliding.

Hazard maps designed for the public should include a disclaimer to acknowledge that hazards may occur outside of mapped areas. An example disclaimer might be, “hazardous conditions may still occur outside the defined Hazardous Areas Development Permit Area, and the local government does not assume any liability by reason of the failure to delineate areas on this map” (APEGBC, 2017).

## **Bowen Island Analyses**

### **Limitations of the Report**

“M. Turley prepared this report for the Bowen Island Municipality. M. Turley is a Ph.D. student in the Earth Sciences but not a licensed and practicing member of the Association of Professional Engineers and Geoscientists of British Columbia. The material in this report reflects the judgement of M. Turley in light of the information available at the time of report preparation. Any use a Third Party makes of this report is the responsibility of such Third Parties. M. Turley accepts no responsibility for damages, if any suffered by any Third Party as a result of decisions made, or actions, based on this report.”

## Explanation of the Analyses Conducted

### Air Photo Analysis

Air photos have been regularly collected of Bowen Island beginning in the 1940's. The entire archive of historical air photos was requested from the UBC Geography Geographic Information Centre (GIC). Photos were available for the years 1947, 1952, 1957, 1966, 1968, 1979, 1982, 1984, 1990, 1991, 1996, 1999, and 2004. The bulk of the analysis was performed using photos from the years 1957 and 2004 given the quality of the images and complete coverage of the island. However, photos from the other years were analyzed when needed.

The air photos were analyzed for indicators of past or potential slope instability (Table 5). The analysis revealed no conclusive historical landslide occurrences but was complicated by the amount of development and site alteration that has occurred over the last 70 years. Although no landslides were identified, the air photo analysis confirmed that conditions exist on Bowen Island that may lead to slope failures in the future.

### Steep Slopes (Landslide Susceptibility)

Bowen Island's wet, coastal climate and mountainous terrain make it potentially susceptible to slope failures. In British Columbia, most landslides are triggered after an extended period of heavy rain when the soil reaches saturation. Shallow landslide susceptibility was estimated based on the model proposed by Montgomery and Dietrich (1994). The model is based on empirical data and is a simple representation of the affect that topography and hydrology have on slope stability. The model solves for the critical daily rainfall required to cause a slope failure (Equations 1-3).

$$Q_c = \left[ \frac{T \times \sin \theta \times \left( \frac{\rho_s}{\rho_w} \right)}{\left( \frac{a}{b} \right)} \right] \times \left[ 1 - \frac{\tan \theta}{\tan \phi} \right] \quad [1]$$

$$\tan \theta \leq \tan \phi \times \left( 1 - \frac{\rho_w}{\rho_s} \right) \quad [2]$$

$$\tan \theta > \tan \phi \quad [3]$$

**Table 6: Variables, their descriptions and assumed values used in equations 1-3.**

| Symbol   | Description   | Assumed Value |
|----------|---|---------------|
| $a$      | Upslope Contributing Area (m <sup>2</sup> )             | Raster Value  |
| $b$      | Length across flow (m)                                  | Raster Value  |
| $Q_c$    | Critical Rainfall (mm day <sup>-1</sup> )               | Calculated    |
| $T$      | Soil Transmissivity (m <sup>2</sup> day <sup>-1</sup> ) | 65            |
| $\phi$   | Friction Angle of Soil (°)                              | 45            |
| $\theta$ | Local Slope (radians)                                   | Raster value  |
| $\rho_w$ | Water Bulk Density (kg m <sup>-3</sup> )                | 1000          |
| $\rho_s$ | Soil Wet Bulk Density (kg m <sup>-3</sup> )             | 1800          |

The values assumed for soil transmissivity, friction angle of soil, and soil bulk density are based on Montgomery and Dietrich (1994) and other commonly used published values. Due to a lack of available spatially variable data, these variables were assumed to be constant across Bowen Island. This is a major

limitation of this model. The remaining variables relate to topography and hydrology and were calculated directly from the elevation data and therefore vary in space. The 1-metre resolution LiDAR data was rescaled to a 5-metre raster to remove the obscuring effect of micro-topography, which has little influence on landslide susceptibility. The critical daily rainfall required to cause slope instability can be related to relative hazard classes when compared to historical rainfall data.

The historical daily precipitation at Bowen Bay was compiled and analyzed to compare to the shallow landslide model results. Data was available for the periods 1967-1978 and 1992-2014, with 23 years of the 35-year record being complete. The maximum daily precipitation recorded was 80 mm with 3 years recording daily precipitation of more than 70mm. Daily rainfall totals up to 80 mm are therefore considered likely (high hazard; Table 7). However, nearby locations have recorded up to 120 mm in a single day. This value was conservatively increased to 150 mm to account for any increases in precipitation due to climate change. As a result, daily rainfall values between 80 and 150 mm are considered unlikely but are physically possible (moderate hazard; Table 7).

**Table 7: Relative landslide susceptibility classes based on the Montgomery and Dietrich (1994) model and observed maximum daily precipitation values for Bowen Island.**

| Relative Hazard | Required Precipitation Range (mm) |
|-----------------|-----------------------------------|
| High            | < 80                              |
| Moderate        | 80 - 150                          |

Landslide runout was then estimated based on flow routing and a minimum slope. The multiple flow direction algorithm was selected because it is more realistic on convex hillslopes. Landslides travel downslope until they reach a slope at which the driving forces are less than the yield strength of the flowing material and deposition occurs. For debris flows, this typically occurs on slopes between 3° and 6° (Montgomery and Dietrich, 1994). Here, a slope of 5° was selected.

The Melton ratio, which is a metric that relates to debris flow hazard, was calculated for the 81 sub-watersheds on Bowen Island. A total of 25 of the 81 sub-watersheds were identified as being debris flow prone, most of which are along the base of Mount Gardner. An additional 36 sub-watersheds were identified as debris flood prone. These sub-watersheds and the corresponding streams closely match with areas identified as being relatively more susceptible to shallow landslide hazards.

#### Small Streams, Lakes, Wetlands

Based on the best practices research, a simple setback distance of 7.5 metres was mapped at all lake/wetland boundaries. The most prominent streams on Bowen Island were also mapped as well as the stream banks, with a 15-metre setback.

#### Coastal Flooding and Erosion

The coastal flooding and erosion hazard was mapped based on local examples. A Flood Construction Reference Plane 5.0 metres above the modern sea level was selected, equivalent to the Squamish and Vancouver deltas. Although the FCRP should be based on site specific data, given the proximity, this

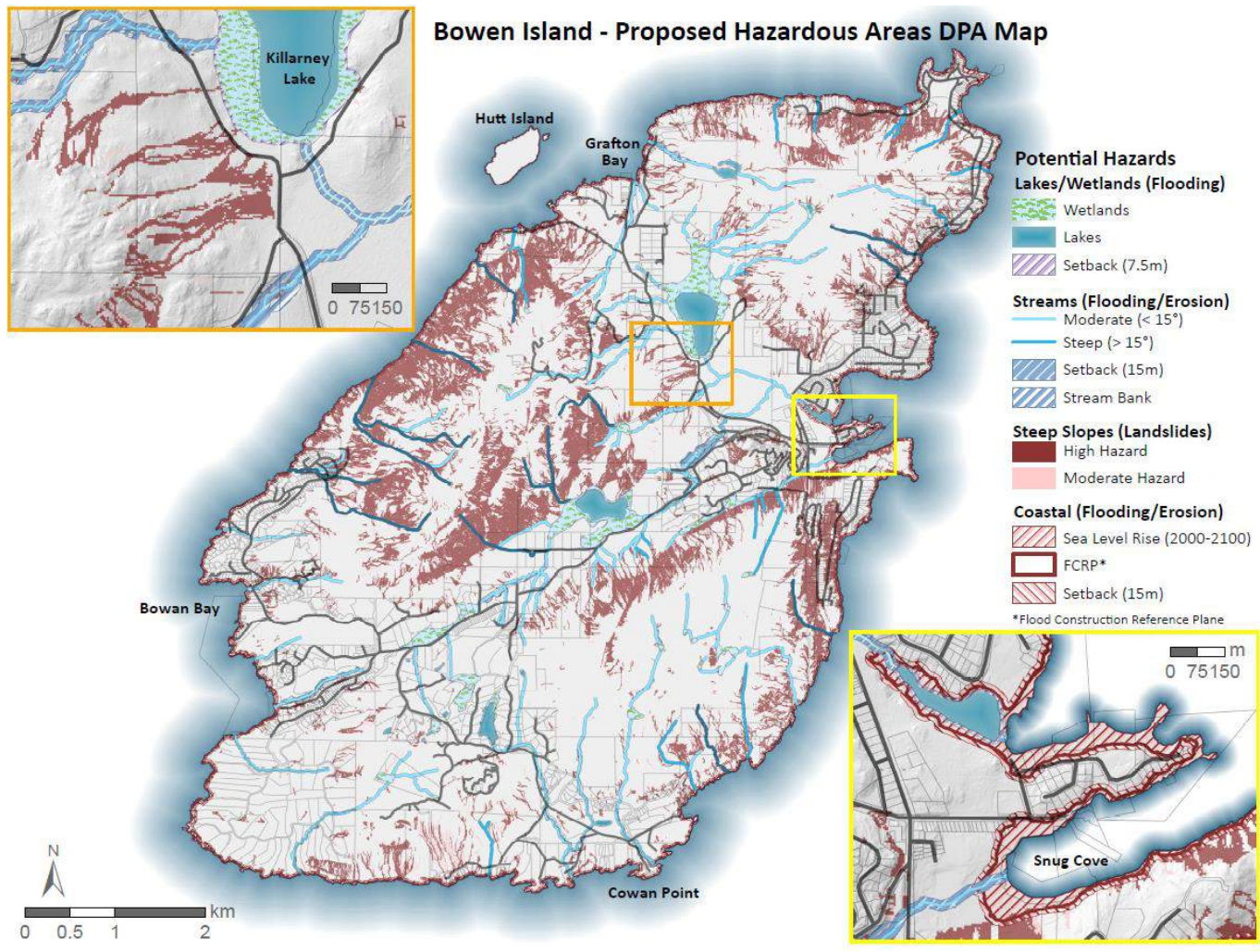
value is assumed to be a reasonable estimate. An additional setback of 15 metres was added inland of the FCRP.

**Proposed Map of the Development Permit Area**

The proposed Hazardous Areas Development Permit Area map can be seen in Figure 1. Two insets, Killarney Lake and Snug Cove, illustrate the different hazards mapped. The percent area of the island designated as potentially hazardous for each of the categories is as follows: lakes/wetlands – 2.9%, streams – 4.9%, steep slopes – 18.7%, and coastal – 2.7%. Some locations were identified as hazardous based on two or more of these categories, and so a great deal of overlap exists.



Figure 1: Proposed Hazardous Areas Development Permit Area Map



### Suggested Development Permit Triggers

This section outlines potential conditions or activities that would trigger the development permit process. Development permit triggers are based on activities that may increase on- or off-site hazards including but not limited to, increasing or altering surface water runoff, increasing the surface gradient, decreasing the soil infiltration capacity, decreasing soil cohesion and/or friction angle, increasing overburden, altering the water table, increasing wave runup, etc. General triggers include conditions or activities relevant to all hazard categories. Suggested triggers specific to each hazard category are also listed below.

#### General (All hazard categories)

1. Structural renovations or new construction of structures/decks >25 m<sup>2</sup>.
2. Alteration of existing grade over 0.5m at any point.
3. Removal of more than 4 trees <30 cm dbh (retaining roots), or 1 tree >30cm dbh within 5 consecutive years.

#### Lakes and Wetlands Flooding Areas

1. Activities that would alter the natural water table such as but not limited to, ditching, intensive drawdown from groundwater wells, or impoundment structures.
2. Vegetation removal within the designated setback from the natural boundary.
3. Any construction of structures.

#### Stream Erosion and Flooding Areas

1. Vegetation removal within the designated setback from the natural boundary.
2. Alteration of bank or overbank materials within the designated setback from the natural boundary.
3. Any construction of structures.

#### Coastal Erosion and Flooding Areas

1. Vegetation removal within the designated FCRP.

#### Steep Slope Hazard Areas

##### *Moderate Hazard Slope*

1. New retaining structures over 1.2 m high.

##### *High Hazard Slope*

1. All activities for moderate hazard slope, plus
2. Development of any impervious surfaces or structures.
3. Removal of 1 tree > 20 cm dbh.

#### Exemptions

1. Public works and services and maintenance activities carried out by, or on behalf of, Bowen Island Municipality.
2. Removal of hazard trees.

#### Requirements

If any of the above conditions are met, a preliminary assessment, as outlined in the Geotechnical Assessment Terms of Reference document, including a partial risk assessment or qualitative hazard

assessment should be completed by a Qualified Professional as an initial step to determine whether risks are broadly acceptable. If the preliminary assessment suggest that risks are broadly acceptable, then further risk assessment may not be required. Where a preliminary assessment report demonstrates that risk is not broadly acceptable, a detailed assessment should be required.

## References

- Association of Professional Engineers and Geoscientists of British Columbia. (2008). *Guidelines for Management of Terrain Stability in the Forest Sector*. Retrieved from the Engineers and Geoscientists of British Columbia website: <https://www.egbc.ca/app/Practice-Resources/Individual-Practice/Guidelines-Advisories/Document/01525AMW6P45TR26OGVVCK64IPXCQ5CCSD/Management%20of%20Terrain%20Stability%20in%20the%20Forest%20Sector>
- Association of Professional Engineers and Geoscientists of British Columbia. (2010a). *Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC*. Retrieved from the Engineers and Geoscientists of British Columbia website: <https://www.egbc.ca/getmedia/5d8f3362-7ba7-4cf4-a5b6-e8252b2ed76c/APEGBC-Guidelines-for-Legislated-Landslide-Assessments.pdf.aspx>
- Association of Professional Engineers and Geoscientists of British Columbia. (2010b). *Guidelines for Professional Services in the Forest Sector – Terrain Stability Assessments*. Retrieved from the Engineers and Geoscientists of British Columbia website: <https://www.egbc.ca/getmedia/684901d7-779e-41dc-8225-05b024beae4f/APEGBC-Guidelines-for-Terrain-Stability-Assessments.pdf.aspx>
- Association of Professional Engineers and Geoscientists of British Columbia. (2017). *Professional Practice Guidelines – Flood Mapping in BC*. Retrieved from the Engineers and Geoscientists of British Columbia website: <https://www.egbc.ca/app/Practice-Resources/Individual-Practice/Guidelines-Advisories/Document/01525AMW6CMLNYZOFJFZ5AY4MD3UNNDZQWW/Flood%20Mapping%20in%20BC>.
- Ausenco Sandwell. (2011). *Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use, Guidelines for Management of Coastal Flood Hazard Land Use*. Prepared for the BC Ministry of Environment. Retrieved from: [https://www.env.gov.bc.ca/wsd/public\\_safety/flood/pdfs\\_word/guidelines\\_for\\_mgr\\_coastal\\_flood\\_land\\_use-2012.pdf](https://www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/guidelines_for_mgr_coastal_flood_land_use-2012.pdf)
- BGC Engineering Inc. (2006). *Stage 1 Review of Terrain Hazard Assessments and Mapping in Northeast British Columbia*. Retrieved from the official website of the Government of British Columbia: [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-gas-oil/petroleum-geoscience/terrain-hazards/stage\\_1\\_terrain\\_hazard\\_assess.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-gas-oil/petroleum-geoscience/terrain-hazards/stage_1_terrain_hazard_assess.pdf)
- Bovis, M. J., & Jakob, M. (1999). The role of debris supply conditions in predicting debris flow activity. *Earth Surface Processes and Landforms*, 24(11), 1039–1054. [https://doi.org/10.1002/\(SICI\)1096-9837\(199910\)24:11<1039::AID-ESP29>3.0.CO;2-U](https://doi.org/10.1002/(SICI)1096-9837(199910)24:11<1039::AID-ESP29>3.0.CO;2-U)
- Engineers and Geoscientists British Columbia. (2018). *Legislated Flood Assessments in a Changing Climate in BC*. Retrieved from the Engineers and Geoscientists of British Columbia website: <https://www.egbc.ca/app/Practice-Resources/Individual-Practice/Guidelines-Advisories/Document/01525AMW332SPI4ZAIGJB3DXYJEIYYEDUJ/Legislated%20Flood%20Assessments%20in%20a%20Changing%20Climate%20in%20BC>

- Kerr Wood Leidal. (2017). *Integrated Flood Hazard Management Plan*. Prepared for the District of Squamish, BC. Retrieved from the official website of the District of Squamish: [https://squamish.ca/assets/IFHMP/1117/5dbb51bad9/20171031-FINAL\\_IFHMP\\_FinalReport-compressed.pdf](https://squamish.ca/assets/IFHMP/1117/5dbb51bad9/20171031-FINAL_IFHMP_FinalReport-compressed.pdf)
- Ministry of Forests, Lands and Natural Resource Operations. (1999). *Forest Practices Code of British Columbia: Mapping and Assessing Terrain Stability Guidebook*. Retrieved from the official website of the Government of British Columbia: <https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/terrain/zipped/terrain.pdf>
- Ministry of Forests, Lands and Natural Resource Operations. (2013). *Review of Landslide Management in British Columbia*. Retrieved from the official website of the Government of British Columbia: [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/integrated-flood-hazard-mgmt/review\\_of\\_landslide\\_management\\_in\\_bc-2013.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/integrated-flood-hazard-mgmt/review_of_landslide_management_in_bc-2013.pdf)
- Ministry of Water, Land and Air Protection. (2004, sections 3.5 & 3.6 amended in 2018). *Flood Hazard Area Land Use Management Guidelines*. Retrieved from the official website of the Government of British Columbia: [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/integrated-flood-hazard-mgmt/flood\\_hazard\\_area\\_land\\_use\\_guidelines\\_2017.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/integrated-flood-hazard-mgmt/flood_hazard_area_land_use_guidelines_2017.pdf)
- Montgomery, D. R., & Dietrich, W. E. (1994). A physically based model for the topographic control on shallow landsliding. *Water Resources Research*, 30(4), 1153–1171. <https://doi.org/10.1029/93WR02979>
- Natural Resources Canada. (2018). *Bibliography of Best Practices and References for Flood Mitigation V2.0*. Retrieved from the Natural Resources Canada website: [https://ftp.maps.canada.ca/pub/nrcan\\_rncan/publications/STPublications\\_PublicationsST/308/308380/gip\\_115\\_v2\\_0\\_en.pdf](https://ftp.maps.canada.ca/pub/nrcan_rncan/publications/STPublications_PublicationsST/308/308380/gip_115_v2_0_en.pdf)
- Resources Inventory Committee, Government of British Columbia. (1996). *Terrain Stability Mapping in British Columbia: A Review and Suggested Methods for Landslide Hazard and Risk Mapping*. Retrieved from the official website of the Government of British Columbia: [https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/terrain\\_stability\\_mapping\\_in\\_bc\\_a\\_review\\_and\\_suggested\\_methods\\_for\\_landslide\\_hazard\\_and\\_risk\\_mapping\\_-\\_final\\_draft.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/terrain_stability_mapping_in_bc_a_review_and_suggested_methods_for_landslide_hazard_and_risk_mapping_-_final_draft.pdf)
- Wilford, D. J., Sakals, M. E., Innes, J. L., Sidle, R. C., & Bergerud, W. A. (2004). Recognition of debris flow, debris flood and flood hazard through watershed morphometrics. *Landslides*, 1(1), 61–66. <https://doi.org/10.1007/s10346-003-0002-0>

### 3 Site Alteration Bylaws

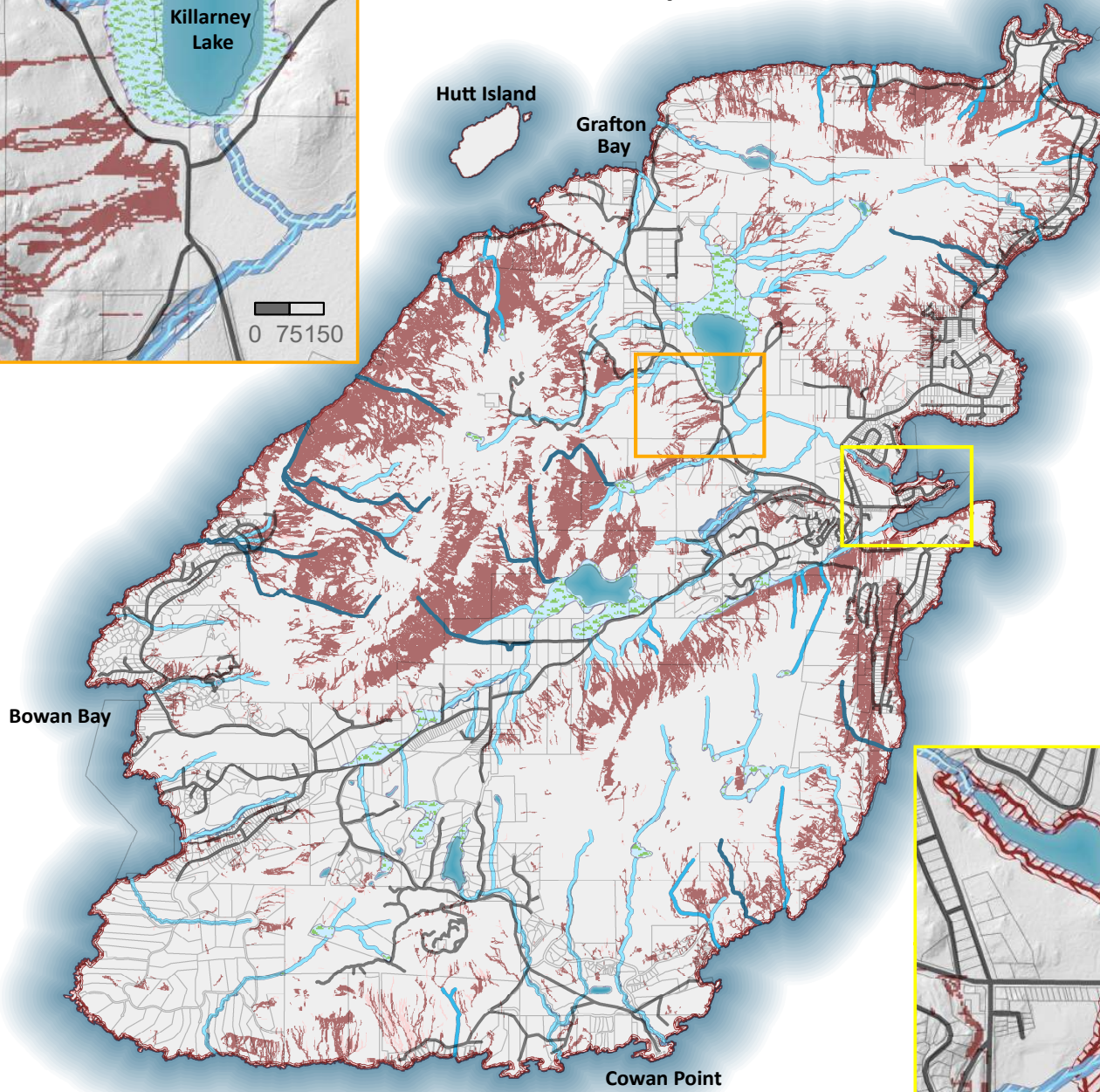
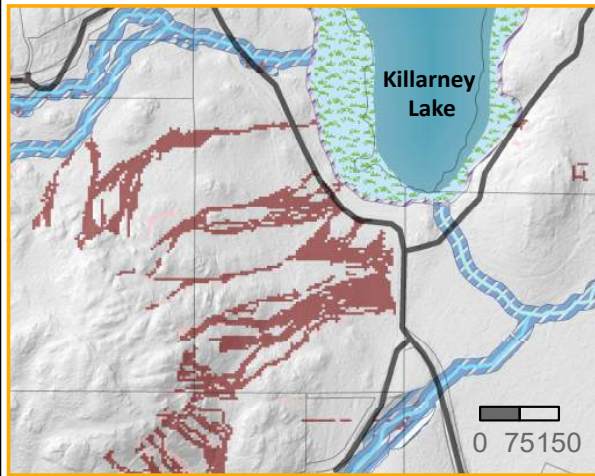
Site alteration bylaw best practice research is currently underway and will be presented here in the coming weeks.

#### **4 Recommendations for the Municipality on future data-gathering or policies**

A key component to any hazard assessment is an archive of past events in the area. It is recommended that Bowen Island Municipality collect citizen reports on local hazards (e.g., rockfall, excessive soil erosion, etc.) in an anonymized, location specific way.

In following a report by APEGBC (2017) it is recommended that any hazard related DPA maps and bylaws should be reassessed every 10 years if there are significant changes to the conditions on the island, data availability, or infrastructure.

# Bowen Island - Proposed Hazardous Areas DPA Map



## Potential Hazards Lakes/Wetlands (Flooding)

- Wetlands
- Lakes
- Setback (7.5m)

## Streams (Flooding/Erosion)

- Moderate (<math>< 15^\circ</math>)
- Steep (>math>> 15^\circ</math>)
- Setback (15m)
- Stream Bank

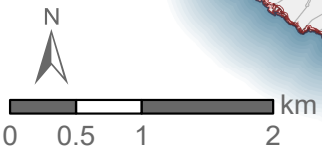
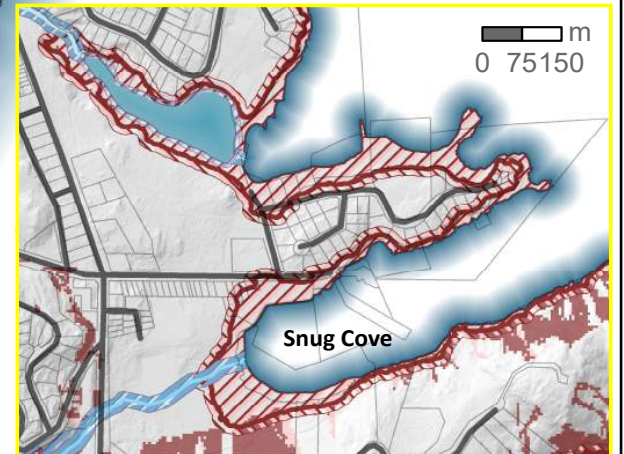
## Steep Slopes (Landslides)

- High Hazard
- Moderate Hazard

## Coastal (Flooding/Erosion)

- Sea Level Rise (2000-2100)
- FCRP\*
- Setback (15m)

\*Flood Construction Reference Plane





To: Mayor Ander and Council

From: Daniel Martin, Manager of Planning and Development

Date: July 12, 2021 Meeting Date: July 26, 2021

Subject: **Hazardous Areas DP Area Draft Report Findings**

---

**RECOMMENDATIONS**

That Council receive for information the staff report dated July 12, 2021, presenting draft findings of Hazardous Areas Development Permit Areas; and  
That Council refer this report to the Advisory Planning Commission, the Parks, Trails and Greenways Advisory Committee, and to a public open house.

---

**PURPOSE**

To present to Council preliminary findings on identifying Hazardous Areas on Bowen Island.

**BACKGROUND**

Priority B1 of the Island Plan 2019 is named "Strengthen our infrastructure and ecosystems through municipal actions." It further directs as step 3:

- 3. For the Site Alteration Bylaw:
  - a) review topographical mapping
  - b) review similar bylaws in other communities
  - c) present completed research and recommendations to Council
  - d) draft bylaw

At the [September 28, 2020 Meeting](#) Council made the following motion:

*RES#20-389*

**It was Moved and Seconded**

That Council approve the Site Alteration Bylaw and Hazardous Areas DP Area Work Plan as per the Base Scenario as presented at the September 28, 2020 Council Meeting.

At the [March 22, 2021 Meeting](#) Council authorized spending of up to \$8,800 for development of this Development Permit Area, to be funded from the Council Strategic Initiatives Reserve balance.

**Preliminary Report**

Mike Turley, a Ph. D student in the Earth Sciences, prepared a report, provided as Attachment 3, on behalf of the Bowen Island Municipality. The report analyzed historic air photos of Bowen to



identify past slope failures, as well as using Lidar and rainfall data to identify slopes at risk of landslide runout.

### **Hazard Types on Bowen Island**

The report identified four different hazard types on Bowen, with recommended setbacks, as follows:

- I. **Lakes and Wetlands** may be prone to flooding hazards, and a minimum setback distance of 7.5 metres is suggested.
- II. **Small Streams** may be prone to bank erosion, flooding, and debris flows (where sufficiently steep). A minimum setback of 15 metres is suggested.
- III. **Steep Slopes** may be prone to landsliding, and a high and moderate category is proposed based on a coupled slope stability and runout model. Slopes that may become unstable with 80 mm or less of rainfall are categorized as high hazard. Slopes requiring between 80 and 150 mm of rainfall to become unstable are categorized as moderate hazard. The categories are based on the maximum daily recorded rainfall on Bowen Island. However, model results should be interpreted as relative first-order estimates, rather than absolute values.
- IV. **Coastal** erosion and flooding may occur particularly as a result of sea level rise, and it is suggested that a flood construction reference plane 5.0 metres above the modern-day sea level plus a setback of 15 metres be adopted.

A map is provided as Attachment 4, showing the location of these potential hazards. The percent area of the island designated as potentially hazardous for each of the categories is as follows: lakes/wetlands – 2.9%, streams – 4.9%, steep slopes – 18.7%, and coastal – 2.7%. Some locations were identified as hazardous based on two or more of these categories, and so a great deal of overlap exists.

### **Suggested Development Permit Triggers**

The report outlines potential conditions or activities that would trigger the development permit process. To the extent possible, these are specific to the hazard type identified. Recommended triggers are as follows:

#### General (All hazard categories)

1. Structural renovations or new construction of structures/decks >25 m<sup>2</sup>.
2. Alteration of existing grade over 0.5m at any point.
3. Removal of more than 4 trees <30 cm dbh (retaining roots), or 1 tree >30cm dbh within 5 consecutive years.

#### Lakes and Wetlands Flooding Areas

1. Activities that would alter the natural water table such as but not limited to, ditching, intensive drawdown from groundwater wells, or impoundment structures.
2. Vegetation removal within the designated setback from the natural boundary.
3. Any construction of structures.

#### Stream Erosion and Flooding Areas

1. Vegetation removal within the designated setback from the natural boundary.

2. Alteration of bank or overbank materials within the designated setback from the natural boundary.
3. Any construction of structures.

**Coastal Erosion and Flooding Areas**

1. Vegetation removal within the designated FCRP.

**Steep Slope Hazard Areas**

*Moderate Hazard Slope*

1. New retaining structures over 1.2 m high.

*High Hazard Slope*

1. All activities for moderate hazard slope, plus
2. Development of any impervious surfaces or structures.
3. Removal of 1 tree > 20 cm dbh.

**Exemptions**

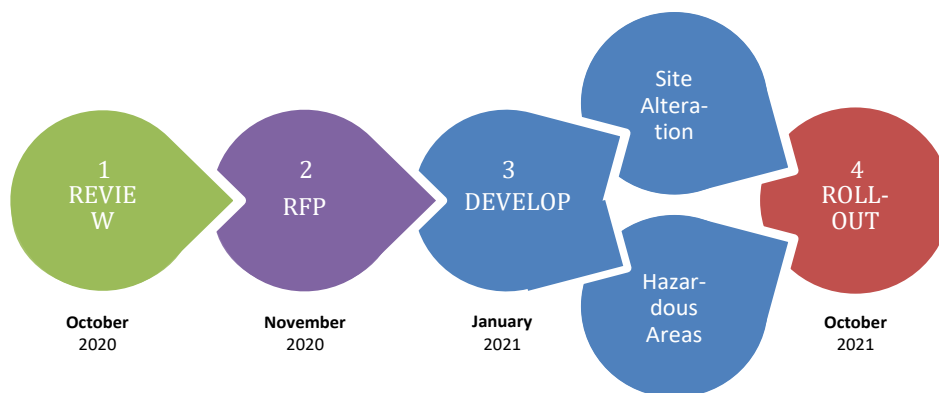
1. Public works and services and maintenance activities carried out by, or on behalf of, Bowen Island Municipality.
2. Removal of hazard trees

**Development Permit Requirements**

The report proposes that if any of the above conditions are met, a preliminary assessment, as outlined in the Geotechnical Assessment Terms of Reference document, including a partial risk assessment or qualitative hazard assessment should be completed by a Qualified Professional as an initial step to determine whether risks are broadly acceptable. If the preliminary assessment suggest that risks are broadly acceptable, then further risk assessment may not be required. Where a preliminary assessment report demonstrates that risk is not broadly acceptable, a detailed assessment should be required.

**WORK PLAN PROGRESS**

The adopted Work Plan for the Hazardous Areas DPA and Site Alteration Bylaw identified a 4 step process, as follows:



Staff are roughly following the work plan, with some delays in implementing the project. Staff intend to focus time in August on Developing the Site Alteration Bylaw, as well as communication

material for outreach on this report. The Development of the Hazardous Areas DPA identified the following steps:

#### **HAZARDOUS AREAS DPA WORK PLAN STEPS**

- A) Gather spatial data
- B) Establish areas of high vulnerability to hazards
- C) Define the trigger for application of the dp that captures large scale development while not impeding everyday work by locals
- D) Determine the permit application process
  - (1) Generate the necessary permit forms and checklists
  - (2) Define the review process
  - (3) Define enforcement procedures and mitigation requirements
- E) Draft the bylaw document
- F) Draft the geotechnical assessment report terms of reference (tor)
- G) Conduct public engagement online, summarize the results of such engagement, and adjust bylaw accordingly
- H) Provide a map of the dp area
- I) Amend the ocp to include the dp area
- J) Adopt new bylaw

With the presentation of this report, staff have completed steps A and B, and have drafted criteria to meet step C. Before proceeding to bylaw drafting and preparing permit forms and checklists, staff recommend taking time in the Fall to do outreach on this report. Depending on COVID restrictions, this could mean in-person open houses in the Fall, and/or virtual open houses, and associated notice of events. Staff also recommend referral to relevant Bowen Island committees for further review.

#### **FINANCIAL IMPLICATIONS**

The proposed work plan base scenario anticipates expenditures of \$8,800 in addition to 152 hours of staff time over 12 months. Alternatives 1 and 2 have additional consultant fees and (see alternatives below) have proposed a budget of \$11,300-\$51,300. The Proposed Work Plan would result in additional costs that would have to be approved through the 2022 budget process.

#### **COMMUNICATION STRATEGY**

Staff are presenting draft findings to Council now for an initial review. Should Council wish to proceed, staff would present this report to the public in the Fall, and bring any feedback back to Council before proceeding to develop any necessary bylaws. Should the workplan proceed as outlined above, public engagement will be carried out once a bylaw is drafted.

#### **ENVIRONMENTAL IMPLICATIONS**

The proposed work plan would create new bylaws intended to reduce harmful environmental impacts.

#### **OTHER IMPLICATIONS**

In order for the new Hazardous Areas Development Permit Area to be integrated into the existing bylaws, the OCP will require an amendment.

**CONCLUSION**

Staff are presenting a report identifying Hazardous Areas on Bowen Island, broken into 4 categories. Staff recommend Council receive this report, and direct staff to seek public input on the draft report prior to drafting any necessary amendment bylaws.

**ALTERNATIVES**

1. That receive this report and direct staff to being engagement;
2. That Council request additional information from staff;
3. Other alternative identified by Council.

**ATTACHMENTS AND REFERENCES:**

Attachment 1 – [September 22, 2020 Staff Report](#)

Attachment 2 – [March 22, 2021 Staff Report](#)

Attachment 3 – Geotechnical Analysis to Identify Potentially Hazardous Areas for Development, Mike Turley Draft Report

Attachment 3 – UBC Sustainability Scholars Program Proposal

**Submitted by:** Jennifer Rae Pierce, Planner 1

**REVIEWED BY:**

- |                                 |                                     |
|---------------------------------|-------------------------------------|
| CAO/CO                          | <input checked="" type="checkbox"/> |
| Bylaw Services                  | <input type="checkbox"/>            |
| Finance                         | <input type="checkbox"/>            |
| Fire & Emergency                | <input type="checkbox"/>            |
| Planning                        | <input checked="" type="checkbox"/> |
| Public Library                  | <input type="checkbox"/>            |
| Public Works                    | <input type="checkbox"/>            |
| Recreation & Community Services | <input type="checkbox"/>            |

# Hazardous Areas Development Permit Area

## History & Context

- 2010** Bowen Island Municipality's Official Community Plan is adopted
- Identifies Priority B1, Step 3, Site Alteration Bylaw
  - Identifies Development Permit Area for Protection of Steep Slopes
- 
- 2011** A draft Steep Slopes Bylaw (Bylaw No. 296) was proposed, but not passed
- 
- 2017** Strategic Priority A2, "Develop environmental protection measures," would be achieved by developing hazardous slopes and environmentally sensitive areas bylaws
- 
- 2020** Council approves work plan for Site Alteration Bylaw, Hazardous Areas Development Permit Area
- 
- 2021** Report with recommendations prepared by PhD Student through the University of British Columbia

Help shape the Hazardous Areas Development Permit Area bylaw! Bowen Island Municipality is seeking input on report recommendations prior to preparing the draft bylaw for Council consideration. Feedback can be submitted by survey (submitted either online or by paper), by email to [planning@bimbc.ca](mailto:planning@bimbc.ca), or letter to the Planning Department, 981 Artisan Lane, Bowen Island, BC V0N 1G2.

## What is a Development Permit Area?

**Development Permits (DPs)** help to ensure development in certain areas reflect the community's values. **Development Permit Areas** are enacted through Bylaw.

**The Local Government Act** empowers the municipality to establish Development Permit Areas to:

- Protect the natural environment
- Establish form and character of intensive development
- Revitalize a commercial area

The following Development Permit Areas or types are already in effect on Bowen Island:

- Watershed, Aquifer & Stream Protection (WASP)
- Village Revitalization
- Village Periphery
- Light Industrial
- Detached Secondary Suites

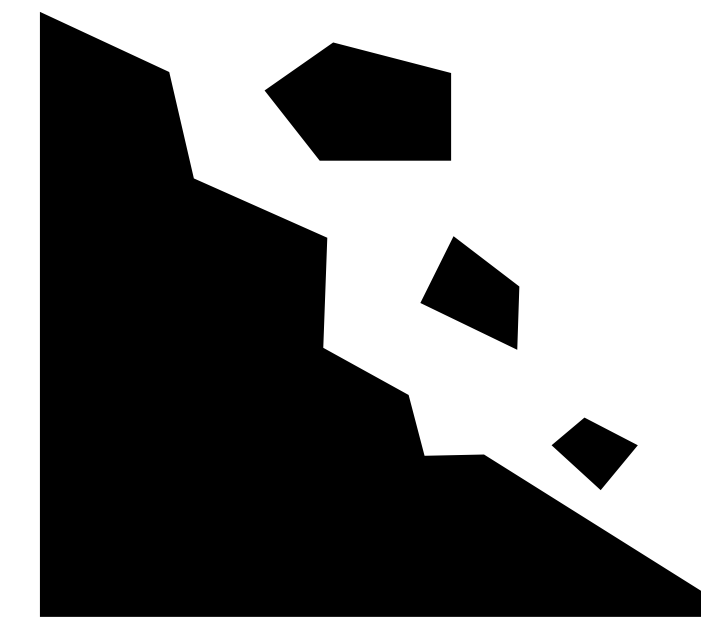
**Development may be any activity that disturbs the soil or vegetation.**

## Report Findings

The report author analyzed historic air photos of Bowen to identify past slope failures, as well as Light Detection and Ranging (Lidar) and rainfall data to identify slopes at risk of landslide runout.

Lidar is a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth.

**The report identified three categories of potential hazards.**



### Landslides

Steep soil mantled slopes are the most susceptible to shallow landslides, while rocky cliffs are prone to rockfall. An air photo analysis for the period 1947 - present and high-resolution Lidar revealed no historical landslides on the island. Shallow landslide occurrence is likely limited by soil thickness, or more specifically a lack of soils, on the steeper and higher elevation slopes.

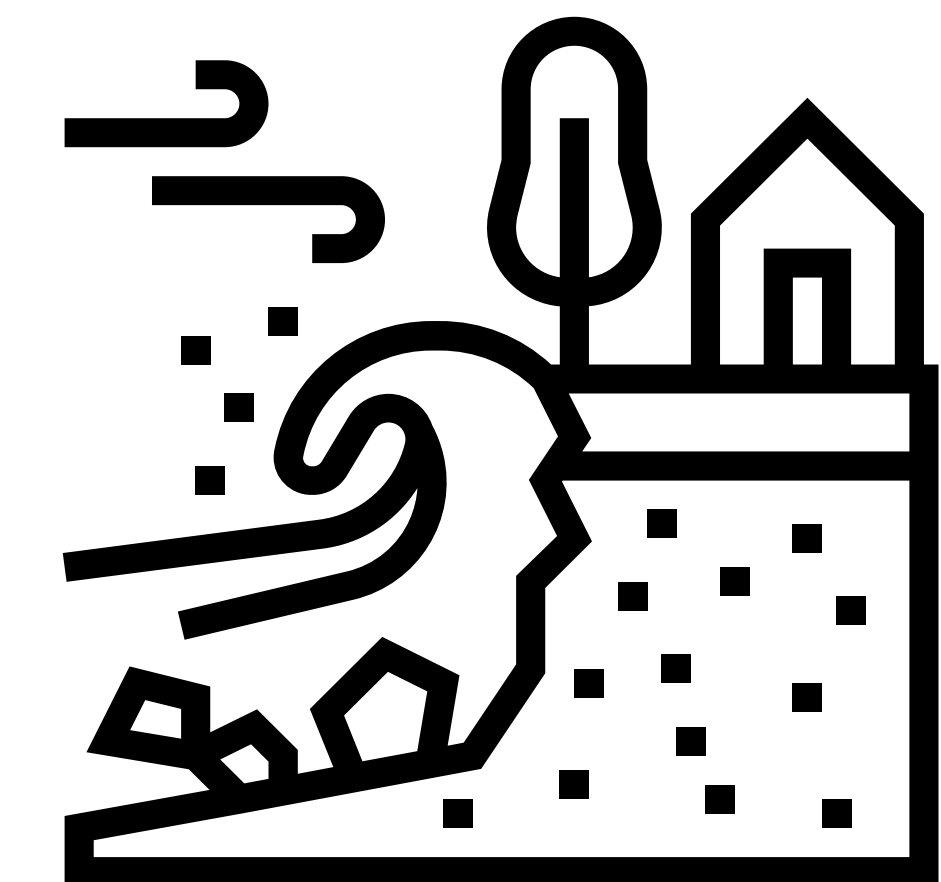
Shallow landslides that enter steep creeks may mobilize into debris flows (another type of landslide) and travel great distances. Channels with a slope of 15 degrees or greater are the most prone to initiating debris flows/floods which may travel on slopes as low as 5 degrees. Approximately one out of three of the mapped streams meet these criteria.

### Stream Erosion and Flooding

If they were to occur, debris flows/floods have the potential to be more hazardous than even the largest clear water floods. However, clear water floods and bank erosion can still damage nearby infrastructure. Creeks such as Terminal, Guild, and Grafton have steep banks, making them more susceptible to bank collapse.

### Coastal Erosion and Flooding

Bowen Island's coastline is primarily bedrock that rises steeply out of the ocean, making it less susceptible to bluff erosion and sea level rise. However, after accounting for 1 metre of sea level rise by the year 2100, storms and wave runup could result in flooding of low-lying areas, such as parts of Snug Cove.



# Hazardous Areas Development Permit Area

Four proposed hazard types, with different development permit 'triggers' and setback requirements

## TRIGGERS - ALL HAZARD TYPES

- Structural renovations or new construction of structures/decks larger than 25 square metres
- Alteration of existing grade over 0.5 metres at any point
- Removal of more than 4 trees larger than 30 cm dbh (retaining roots), or 1 tree larger than 30 cm dbh within 5 consecutive years

## LAKES & WETLANDS | PRONE TO FLOODING

RECOMMENDED SETBACK DISTANCE: 7.5 METRES

- + Activities that would alter the natural water table (e.g. ditching, intensive drawdown from groundwater wells, impoundment structures)
- + Vegetation removal within the designated setback from the natural boundary
- + Construction of any structures

## COASTAL EROSION AND FLOODING AREAS

### VULNERABLE TO SEA LEVEL RISE

RECOMMENDED SETBACK DISTANCE: 5 METRES ABOVE SEA LEVEL + 15 METRES

- + Vegetation removal within the designated Flood Construction Reference Plane (FCRP)

## STEEP SLOPE HAZARD AREAS

### PRONE TO LANDSLIDING

#### Moderate Hazard Slope

Estimated to require between 80mm and 150mm of rain to become unstable

- + New retaining structures over 1.2 metres high

#### High Hazard Slope

Estimated to require 80mm of rain or less to become unstable

- + New retaining structures over 1.2 metres high
- + Development of any impervious surfaces or structure
- + Removal of 1 tree larger than 20 cm dbh

## STREAM EROSION AND FLOODING AREAS

### PRONE TO BANK EROSION, FLOODING, DEBRIS FLOW

RECOMMENDED SETBACK DISTANCE: 15 METRES

- + Vegetation removal within the designated setback from the natural boundary
- + Alteration of bank or overbank materials within the designated setback from the natural boundary
- + Construction of any structures

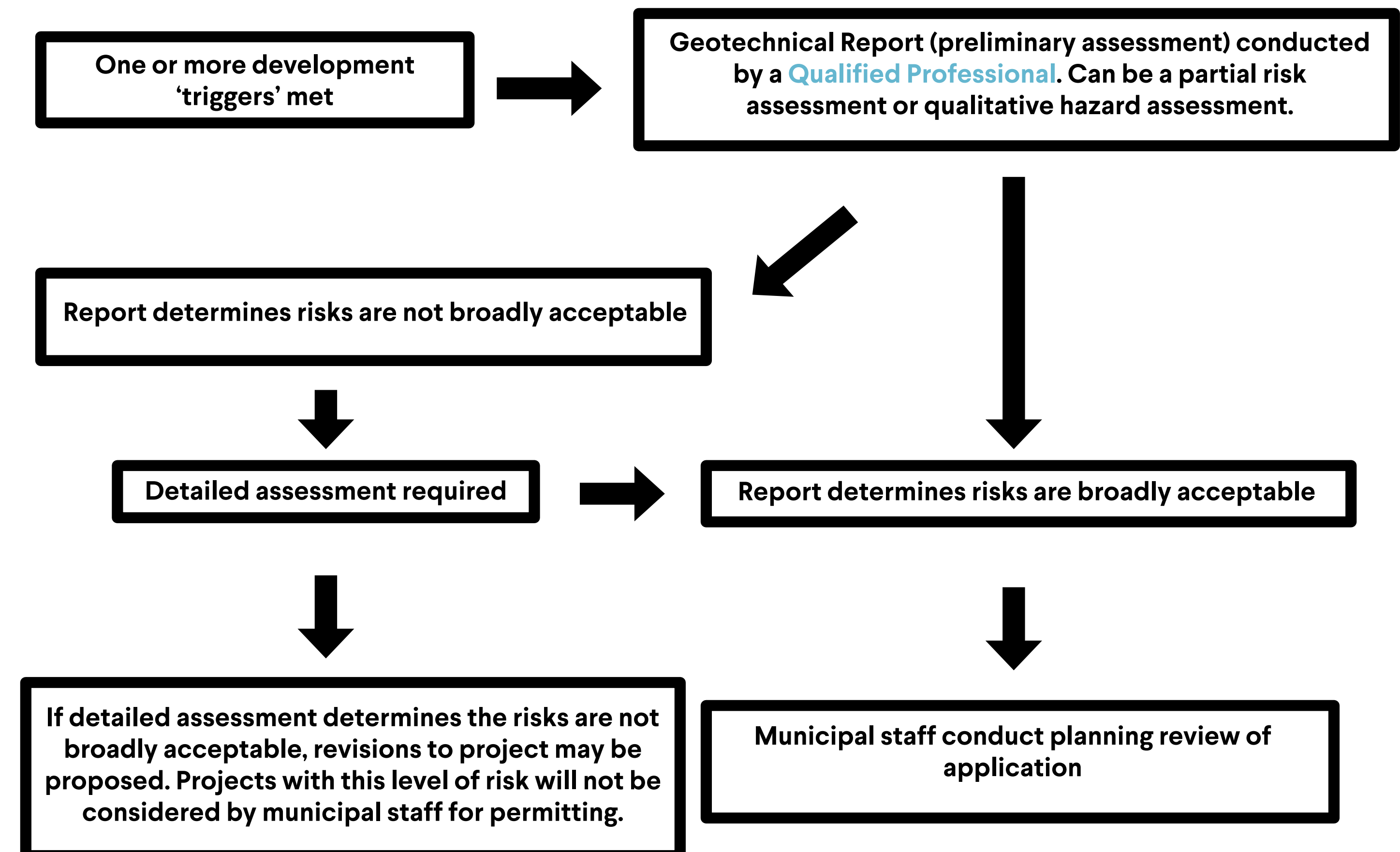
A **setback** is the required minimum horizontal distance between a characteristic (steep slope, high water mark, or lot line) and a building or structure or use.

## EXCEPTIONS

The following activities would not require a development permit application:

- Public works, services and maintenance activities carried out by, or on behalf of Bowen Island Municipality
- Removal of hazardous trees

## PROCESS



A **Qualified Professional** is a professional engineer, professional geoscientist, or licensee with the appropriate level of education, training, and experience to conduct hazard assessments, and licensed by Engineers and Geoscientists BC.

# Hazardous Areas Development Permit Area

## Legend

### Lakes

- Lakes
- Wetlands
- Setback (7.5m)

### Streams

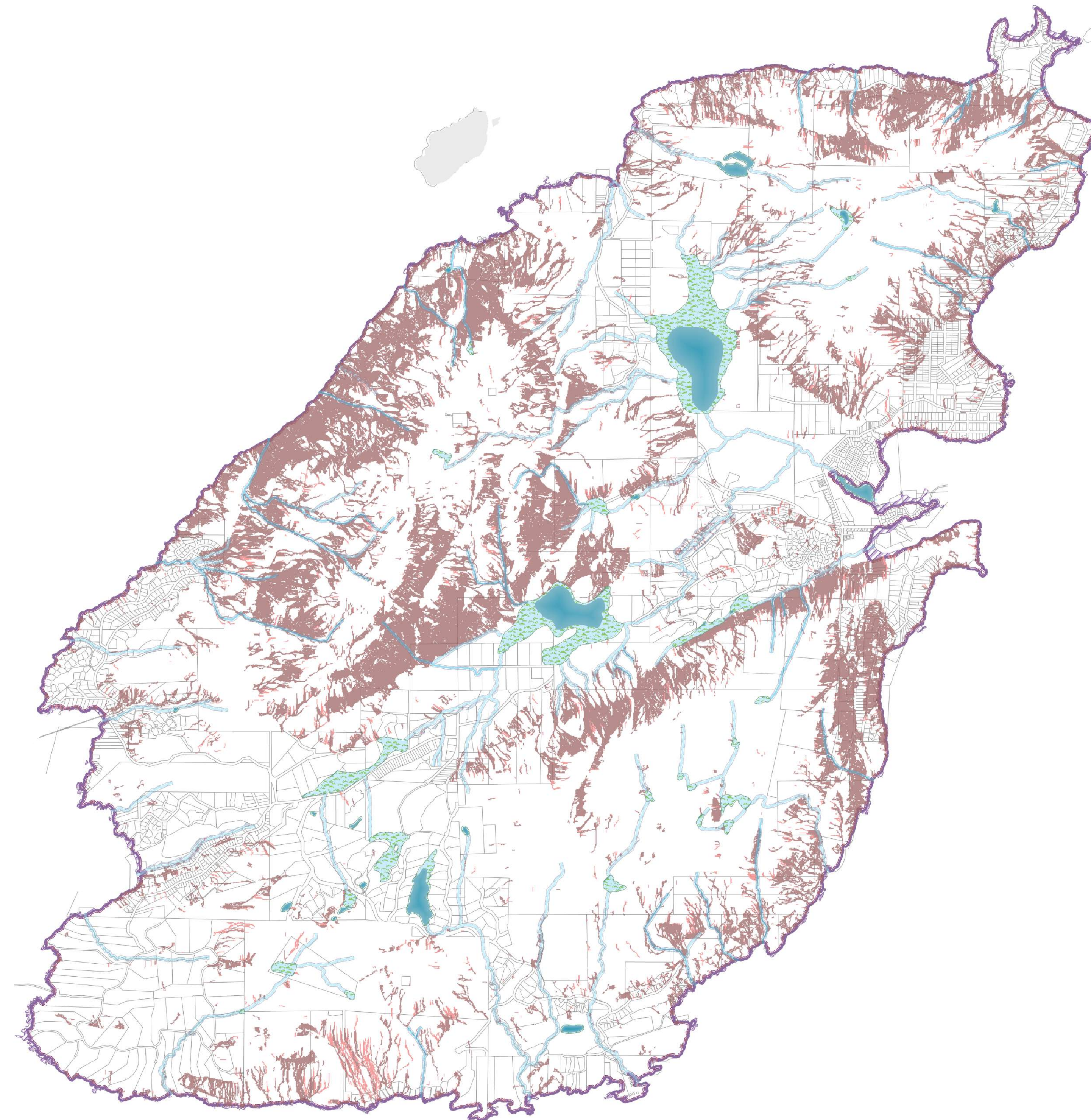
- Moderate (<15 degrees)
- Steep (>15 degrees)
- Stream Setback (15m)
- Stream Bank

### Coastal

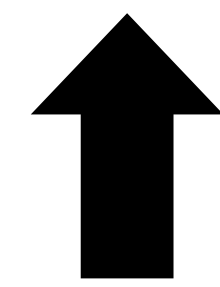
- Sea Level Rise (2000-2100)
- FCRP
- Coastal Setback (15m)

### Steep Slopes

- High Hazard
- Moderate Hazard



North



Hazardous conditions may still occur outside the defined Hazardous Areas Development Permit Area, and the local government does not assume any liability by reason of the failure to delineate areas on this map.

## Hazardous Areas Development Permit Area Survey

December 2021

**1. Which of the following hazards are you concerned about anywhere on island?**

You may circle more than one response.

- a. Landslides
- b. Stream erosion, flooding, debris flow
- c. Coastal erosion and flooding
- d. None of the above

**2. Which of the following hazards are you concerned about on the property you own or live on?**

You may circle more than one response.

- a. Landslides
- b. Stream erosion and flooding
- c. Coastal erosion and flooding
- d. None of the above

**3. Is your property within the proposed Hazardous Areas Development Permit Area?**

Please only circle one response.

- a. Yes
- b. No, but it is close
- c. No
- d. I don't know

**4. Have you ever applied for a development permit with Bowen Island Municipality?**

Please only circle one response.

- a. Yes
- b. No
- c. I don't know

**5. Are you likely to conduct, contract, or assist with any of the following activities within the proposed hazardous area development permit area?**

You may circle more than one response.

- a. Structural renovations or new construction of structures and decks larger than 25 square metres
- b. Alter the existing grade more than 0.5 metres (by constructing a deck, stairs, retaining wall)
- c. Removal of one or more large trees
- d. Activities that would alter the natural water table (e.g. ditching, intensive drawdown from groundwater wells, impoundment structures)
- e. Remove vegetation within 7.5 metres of a lake or wetland
- f. Remove vegetation within 15 metres of a stream



## Hazardous Areas Development Permit Area Survey

December 2021

- g. Remove vegetation within the Flood Construction Reference Plane (FCRP) (shown on map)
- h. Construct a new retaining structure over 1.2 metres high
- i. Develop any impervious (paved or hardened) surface or structure
- j. Alter the bank or overbank materials of a stream
- k. Construct any buildings or structures within 15 metres of a stream
- l. I have no development activities planned
- m. My property is outside of the proposed development permit area

**6. Please provide any feedback you have regarding the proposed development permit “triggers.”** The triggers consist of the activities listed in question 5 or on Board Two.

**7. Please provide any feedback you have regarding the proposed development permit area mapping.**

**8. Please provide any feedback you have regarding the proposed process.**

**9. Please provide additional feedback or comments here.**

# Planning & Development

Hazardous Areas Development Permit Area

Open House

December 2021

**BOWEN ISLAND**  
Municipality



# History & Context

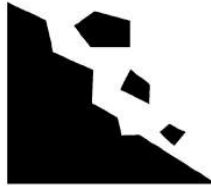
- 2010** Bowen Island Municipality's Official Community Plan is adopted
- Identifies Priority B1, Step 3, Site Alteration Bylaw
  - Identifies Development Permit Area for Protection of Steep Slopes
- 
- 2011** A draft Steep Slopes Bylaw (Bylaw No. 296) was proposed, but not passed
- 
- 2017** Strategic Priority A2, "Develop environmental protection measures," would be achieved by developing hazardous slopes and environmentally sensitive areas bylaws
- 
- 2020** Council approves work plan for Site Alteration Bylaw, Hazardous Areas Development Permit Area
- 
- 2021** Report with recommendations prepared by PhD Student through the University of British Columbia

# Potential Hazards

The report author analyzed historic air photos of Bowen to identify past slope failures, as well as Light Detection and Ranging (Lidar) and rainfall data to identify slopes at risk of landslide runoff.

Lidar is a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth.

**The report identified three categories of potential hazards.**



## Landslides

Steep soil mantled slopes are the most susceptible to shallow landslides, while rocky cliffs are prone to rockfall. An air photo analysis for the period 1947 - present and high-resolution Lidar revealed no historical landslides on the island. Shallow landslide occurrence is likely limited by soil thickness, or more specifically a lack of soils, on the steeper and higher elevation slopes.

Shallow landslides that enter steep creeks may mobilize into debris flows (another type of landslide) and travel great distances. Channels with a slope of 15 degrees or greater are the most prone to initiating debris flows/floods which may travel on slopes as low as 5 degrees. Approximately one out of three of the mapped streams meet these criteria.

## Stream Erosion and Flooding

If they were to occur, debris flows/floods have the potential to be more hazardous than even the largest clear water floods. However, clear water floods and bank erosion can still damage nearby infrastructure. Creeks such as Terminal, Guild, and Grafton have steep banks, making them more susceptible to bank collapse.

## Coastal Erosion and Flooding

Bowen Island's coastline is primarily bedrock that rises steeply out of the ocean, making it less susceptible to bluff erosion and sea level rise. However, after accounting for 1 metre of sea level rise by the year 2100, storms and wave runup could result in flooding of low-lying areas, such as parts of Snug Cove.



# Proposed Development Permit “Triggers”

## **TRIGGERS - ALL HAZARD TYPES**

- Structural renovations or new construction of structures/decks larger than 25 square metres
- Alteration of existing grade over 0.5 metres at any point
- Removal of more than 4 trees larger than 30 cm dbh (retaining roots), or 1 tree larger than 30 cm dbh within 5 consecutive years

## **LAKES & WETLANDS | PRONE TO FLOODING**

**RECOMMENDED SETBACK DISTANCE: 7.5 METRES**

- + Activities that would alter the natural water table (e.g. ditching, intensive drawdown from groundwater wells, impoundment structures)
- + Vegetation removal within the designated setback from the natural boundary
- + Construction of any structures

## **COASTAL EROSION AND FLOODING AREAS**

### **VULNERABLE TO SEA LEVEL RISE**

**RECOMMENDED SETBACK DISTANCE: 5 METRES ABOVE SEA LEVEL + 15 METRES**

- + Vegetation removal within the designated Flood Construction Reference Plane (FCRP)

## **STEEP SLOPE HAZARD AREAS**

### **PRONE TO LANDSLIDING**

#### **Moderate Hazard Slope**

**Estimated to require between 80mm and 150mm of rain to become unstable**

- + New retaining structures over 1.2 metres high

#### **High Hazard Slope**

**Estimated to require 80mm of rain or less to become unstable**

- + New retaining structures over 1.2 metres high
- + Development of any impervious surfaces or structure
- + Removal of 1 tree larger than 20 cm dbh

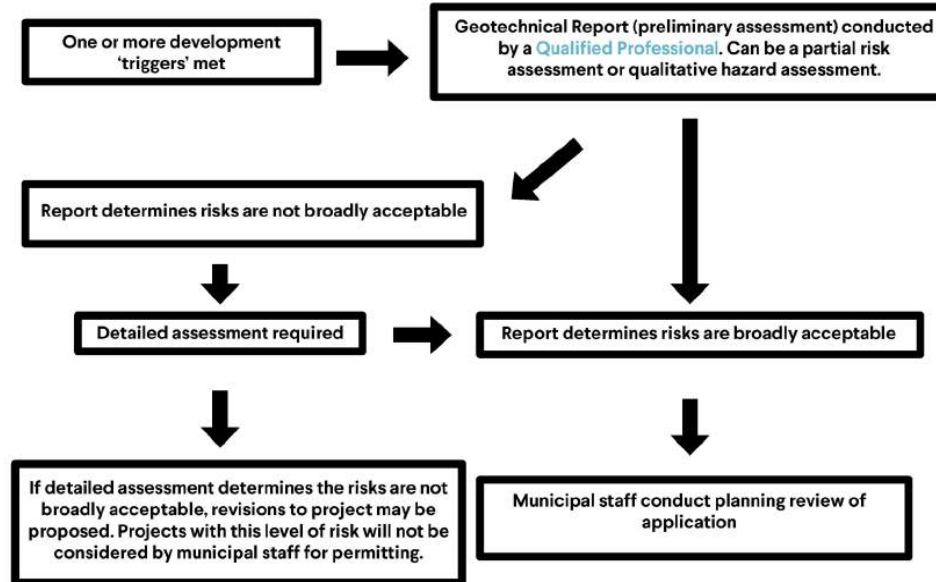
## **STREAM EROSION AND FLOODING AREAS**

### **PRONE TO BANK EROSION, FLOODING, DEBRIS FLOW**

**RECOMMENDED SETBACK DISTANCE: 15 METRES**

- + Vegetation removal within the designated setback from the natural boundary
- + Alteration of bank or overbank materials within the designated setback from the natural boundary
- + Construction of any structures


# Proposed Process







A **Qualified Professional** is a professional engineer, professional geoscientist, or licensee with the appropriate level of education, training, and experience to conduct hazard assessments, and licensed by Engineers and Geoscientists BC.

**Legend**




**Lakes**

-  Lakes
-  Wetlands
-  Setback (7.5m)

**Streams**

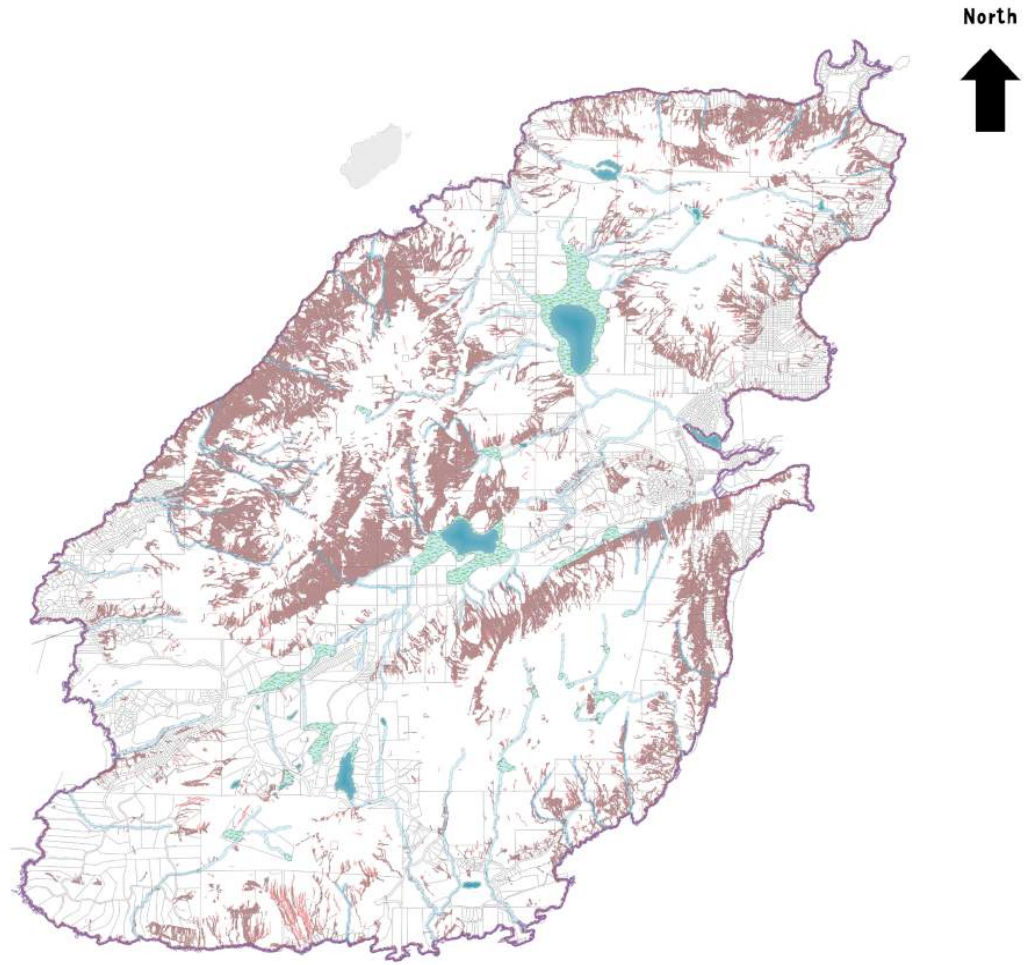
-  Moderate (<15 degrees)
-  Steep (>15 degrees)
-  Stream Setback (15m)
-  Stream Bank

**Coastal**

-  Sea Level Rise (2000-2100)
-  FCRP
-  Coastal Setback (15m)

**Steep Slopes**

-  High Hazard
-  Moderate Hazard



Hazardous conditions may still occur outside the defined Hazardous Areas Development Permit Area, and the local government does not assume any liability by reason of the failure to delineate areas on this map.

# Ways to Have Your Say

- Online Survey available on this proposal at:  
<https://bowenisland.citizenlab.co/en/projects/hazardous-areas>

Or provide comment and this open house, or by email to me at [dmartin@bimbc.ca](mailto:dmartin@bimbc.ca)

- Staff to collect all feedback and present to Council in the New Year
- Following Council direction, staff to draft bylaws and conduct further engagement on the content of the bylaws
- [www.bowenislandmunicipality.ca/hazardous-areas-development-permit-area](http://www.bowenislandmunicipality.ca/hazardous-areas-development-permit-area)





Alerts BowMap Contact Us Meetings News My Account

Home Services

Our Government

Our Community

Property & Development

Parks Recreation & Culture

Home Services

Our Government

Our Community

Property & Development

Parks Recreation & Culture



Alerts BowMap Contact Us Meetings News My Account

You Are Here: [Hazardous Areas Development Permit Area](#)

## Questions?

Please contact Daniel Martin, Manager of Planning & Development  
604-947-4255 extension 230  
[dmartin@bimbc.ca](mailto:dmartin@bimbc.ca)

## Questions?

Please contact Daniel Martin, Manager of Planning & Development  
604-947-4255 extension 230  
[dmartin@bimbc.ca](mailto:dmartin@bimbc.ca)

# Hazardous Areas Development Permit Area

Share 0 Print Tweet Email

## Development in hazardous areas: what do you think?

Bowen Island Municipality is considering regulating development in hazardous areas on Bowen Island and is considering a future Hazardous Development Permit Area. The establishment of a new Development Permit Area would require an amendment to Bowen Island Municipality Land Use Bylaw No. 57, 2002.



## Background

Bowen Island Municipality's 2010 Official Community Plan mapped a Development Permit Area for the Protection of Steep Slopes. In 2011, a draft Steep Slopes Bylaw (Bylaw No. 296) was proposed, but not passed. In 2017, the need for a steep slopes Development Permit Area was re-iterated in the

Island Community Plan. The Plan also proposed the establishment of an environmentally sensitive areas bylaw.

The Municipality recently received a report from a University of British Columbia Sustainability Scholar, identifying a Hazardous Areas Development Permit Area that includes lakes and wetlands, coastal erosion and flooding areas, steep slopes hazard areas, and stream erosion and flooding areas. It also recommends permit “triggers,” process, and requirements. This report was presented to Council at the July 26, 2021 Council Meeting.

An amendment to *Bowen Island Municipality Land Use Bylaw No. 57, 2002*, would be required prior to establishing a new development permit area. Staff are actively seeking input from the public now, before the preparation of a draft amendment.

### **Thanks for your feedback**

Virtual Open House meetings were held by Zoom on December 8 and 9, 2021. In addition, staff displayed posters at Municipal Hall and were available to present and answer questions December 6-10, 2021 for those who prefer in-person engagement.

The online survey was available until 11:59pm on Monday, January 31, 2022. Paper surveys and informational materials were also available at Municipal Hall. A report summarizing community feedback will be available by February 28<sup>th</sup>, 2022.

### **Open house displays**

Click to view the images below, or download a [PDF \(25 mb\)](#)

# Hazardous Areas Development Permit Area

## History & Context

- 2010** Bowen Island Municipality's Official Community Plan is adopted
  - Identifies Priority B1, Step 3, Site Alteration Bylaw
  - Identifies Development Permit Area for Protection of Steep Slopes

---

- 2011** A draft Steep Slopes Bylaw (Bylaw No. 296) was proposed, but not passed

---

- 2017** Strategic Priority A2, "Develop environmental protection measures," would be achieved by developing hazardous slopes and environmentally sensitive areas bylaws

---

- 2020** Council approves work plan for Site Alteration Bylaw, Hazardous Areas Development Permit Area

---

- 2021** Report with recommendations prepared by PhD Student through the University of British Columbia

**Help shape the Hazardous Areas Development Permit Area bylaw!** Bowen Island Municipality is seeking input on report recommendations prior to preparing the draft bylaw for Council consideration. Feedback can be submitted by survey (submitted either online or by paper), by email to [planning@bimbc.ca](mailto:planning@bimbc.ca), or letter to the Planning Department, 961 Artisan Lane, Bowen Island, BC V0N 1G2.

### What is a Development Permit Area?

Development Permits (DPs) help to ensure development in certain areas reflect the community's values. Development Permit Areas are enacted through Bylaw.

The Local Government Act empowers the municipality to establish Development Permit Areas to:

- Protect the natural environment
- Establish form and character of intensive development
- Revitalize a commercial area

The following Development Permit Areas or types are already in effect on Bowen Island:

- Watershed, Aquifer & Stream Protection (WASP)
- Village Revitalization
- Village Periphery
- Light Industrial
- Detached Secondary Suites

Development may be any activity that disturbs the soil or vegetation.

## Report Findings

The report author analyzed historic air photos of Bowen to identify past slope failures, as well as Light Detection and Ranging (Lidar) and rainfall data to identify slopes at risk of landslide runoff.

Lidar is a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth.

The report identified three categories of potential hazards.



### Landslides

Steep soil mantled slopes are the most susceptible to shallow landslides, while rocky cliffs are prone to rockfall. An air photo analysis for the period 1947 - present and high-resolution Lidar revealed no historical landslides on the island. Shallow landslide occurrence is likely limited by soil thickness, or more specifically a lack of soils, on the steeper and higher elevation slopes.

Shallow landslides that enter steep creeks may mobilize into debris flows (another type of landslide) and travel great distances. Channels with a slope of 15 degrees or greater are the most prone to initiating debris flows/floods which may travel on slopes as low as 5 degrees. Approximately one out of three of the mapped streams meet these criteria.

### Stream Erosion and Flooding

If they were to occur, debris flows/floods have the potential to be more hazardous than even the largest clear water floods. However, clear water floods and bank erosion can still damage nearby infrastructure. Creeks such as Terminal, Guild, and Grafton have steep banks, making them more susceptible to bank collapse.

### Coastal Erosion and Flooding

Bowen Island's coastline is primarily bedrock that rises steeply out of the ocean, making it less susceptible to bluff erosion and sea level rise. However, after accounting for 1 metre of sea level rise by the year 2100, storms and wave runup could result in flooding of low-lying areas, such as parts of Snug Cove.



# Hazardous Areas Development Permit Area

## Four proposed hazard types, with different development permit 'triggers' and setback requirements

### TRIGGERS - ALL HAZARD TYPES

- Structural renovations or new construction of structures/decks larger than 25 square metres
- Alteration of existing grade over 0.5 metres at any point
- Removal of more than 4 trees larger than 30 cm dbh (retaining roots), or 1 tree larger than 30 cm dbh within 5 consecutive years

### LAKES & WETLANDS | PRONE TO FLOODING

RECOMMENDED SETBACK DISTANCE: 7.5 METRES

- Activities that would alter the natural water table (e.g. ditching, intensive drawdown from groundwater wells, impoundment structures)
- Vegetation removal within the designated setback from the natural boundary
- Construction of any structures

### COASTAL EROSION AND FLOODING AREAS VULNERABLE TO SEA LEVEL RISE

RECOMMENDED SETBACK DISTANCE: 5 METRES ABOVE SEA LEVEL + 15 METRES

- Vegetation removal within the designated Flood Construction Reference Plane (FCRP)

### STEEP SLOPE HAZARD AREAS PRONE TO LANDSLIDING

**Moderate Hazard Slope**  
Estimated to require between 80mm and 150mm of rain to become unstable  
• New retaining structures over 1.2 metres high

**High Hazard Slope**  
Estimated to require 80mm of rain or less to become unstable  
• New retaining structures over 1.2 metres high  
• Development of any impervious surfaces or structure  
• Removal of 1 tree larger than 20 cm dbh

### STREAM EROSION AND FLOODING AREAS PRONE TO BANK EROSION, FLOODING, DEBRIS FLOW

RECOMMENDED SETBACK DISTANCE: 15 METRES

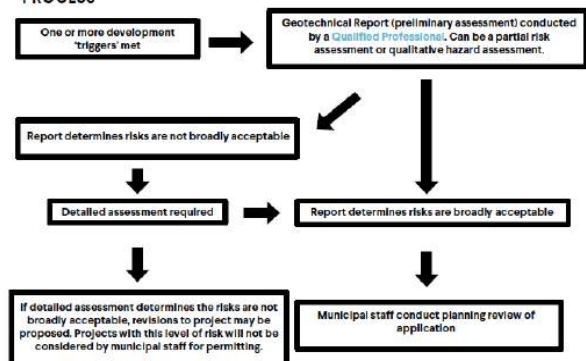
- Vegetation removal within the designated setback from the natural boundary
- Alteration of bank or overbank materials within the designated setback from the natural boundary
- Construction of any structures

A **setback** is the required minimum horizontal distance between a characteristic (steep slope, high water mark, or lot line) and a building or structure or use.

### EXCEPTIONS

- The following activities would not require a development permit application:
  - Public works, services and maintenance activities carried out by, or on behalf of Bowen Island Municipality
  - Removal of hazardous trees

### PROCESS



A **Qualified Professional** is a professional engineer, professional geoscientist, or licensee with the appropriate level of education, training, and experience to conduct hazard assessments, and licensed by Engineers and Geoscientists BC.

## Hazardous Areas Development Permit Area

### Legend

#### Lakes

- Lakes
- Wetlands
- Setback (7.5m)

#### Streams

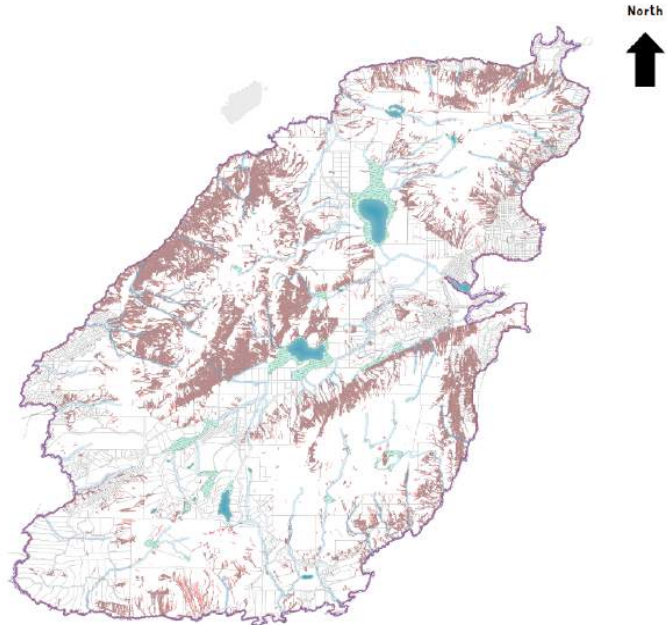
- Moderate (<15 degrees)
- Steep (>15 degrees)
- Stream Setback (15m)
- Stream Bank

#### Coastal

- Sea Level Rise (2000-2100)
- FCRP
- Coastal Setback (15m)

#### Steep Slopes

- High Hazard
- Moderate Hazard



Hazardous conditions may still occur outside the defined Hazardous Areas Development Permit Area, and the local government does not assume any liability by reason of the failure to delineate areas on this map.

## Map

[Hazardous Areas Bowen Island Map](#)

## Reports

[Hazardous Areas DP Area Draft Report Findings](#)

[Hazardous Areas DP Council Presentation](#)

## Questions?

Please contact Daniel Martin, Manager of Planning & Development at 604-947-4255 ext. 230 or [dmartin@bimbc.ca](mailto:dmartin@bimbc.ca)

Last Updated on 2022-02-01 at 11:12 AM

**Bowen Island Municipal Hall**  
981 Artisan Lane  
Bowen Island, BC V0N 1G2  
Phone: 604-947-4255  
[bim@bimbc.ca](mailto:bim@bimbc.ca)

**Hours of Operation**  
Monday - Friday  
8:30 AM - 4:30 PM  
Closed on statutory holidays



## Appendix G - Letters Received

## Daniel Martin

---

**From:** Sophie Taylor <>  
**Sent:** Wednesday, December 8, 2021 8:40 AM  
**To:** Daniel Martin  
**Subject:** Hazardous Area DP - Public Comment  
**Attachments:** site alteration by law\_taylor.pdf; View Corridors.JPG; Parkview-Slopes-Green-Belt-Covenant-Areas (2).jpg

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

This message's attachments contains at least one web link. This is often used for phishing attempts. Please only interact with this attachment if you know its source and that the content is safe. If in doubt, confirm the legitimacy with the sender by phone.

Please find a letter attached (and some images) that were submitted last year but now seem appropriate to send again considering the current call for public comment. I would have liked to attend the open house on Monday and /or the zoom presentations today and tomorrow but my work schedule sadly won't allow it. I did wonder if there was a higher resolution of the map below though? The clarity is not there when I zoom in for more detail.

Many thanks Daniel and forgive the brevity of this email and any spelling errors. A broken wrist prevents too much typing (which may be a good thing!)

Warmly,

Sophie



Sophie Taylor



In the 2018 Island Plan – Priority A2 outlined the drafting of a Site Alteration Bylaw. This included the development of permit guidelines requiring a project impact report to be prepared by a qualified professional *before* any alteration of steep or hazardous slopes (perhaps a similar bylaw as the one initiated in 2011 <https://bowenisland.civicweb.net/document/23573?>

While I'm not sure why the proposed 2011 bylaw didn't pass, and despite the years between these proposals and readings, I was heartened to hear that the concept of this bylaw is still being pursued as a Strategic Priority B1 within the 2019 Island Plan. I listened to the Committee of the Whole Meeting held on Monday, February 3, 2020 and am writing as a home-owner living below the new sub-division that sits atop a steep slope (Bowen Island Properties "Rivendell Heights".) In the development process the site prep comprised over a year of blasting, crushing (tamping) and denuding a once densely forested slope designated a covenanted green belt.

Having approached the municipality a couple of times with concerns and questions I gather 'covenanted' doesn't necessarily mean 'no build' and that development *is* allowed with specific criterion - although the covenant documentation does read that 'the existing tree cover will be retained to the fullest extent possible'.

It also states that view corridors are permitted but given the narrowness of these specific lots and the expansiveness of the views - it is entirely reasonable (indeed likely) to assume that every tree in the green belt will eventually obstruct the view corridor of at least one or more of the lots. The only imaginable way that the green belt could be protected from the encroachment of the view corridors would be if it were planted with trees that didn't exceed perhaps 25 - 30 ft in height but to my knowledge there are no common native species so limited. In this respect, it appears there's an apparent conflict between the view corridors and the designated green belt.

I'm sure (hope) the slope will green up eventually, and perhaps even be encouraged not only for a natural esthetic and habitat for wildlife, but also because root systems of trees and other vegetation increases the strength of unstable overburden. It is perplexing to read however that view corridors are protected in perpetuity (as opposed to covenanted green belts?) so I'm not sure how this works. Perhaps a review of the site plans in context of the covenant could remedy / mitigate some of the damage already done and /or prevent more going forward. Gary Ander asked in the meeting if the new Site Alteration Bylaw would have prevented this kind of environmental mismanagement from happening, but the designation 'covenanted' implies that *some* kind of protection mechanism was already in place. I have to wonder why wasn't this enough?

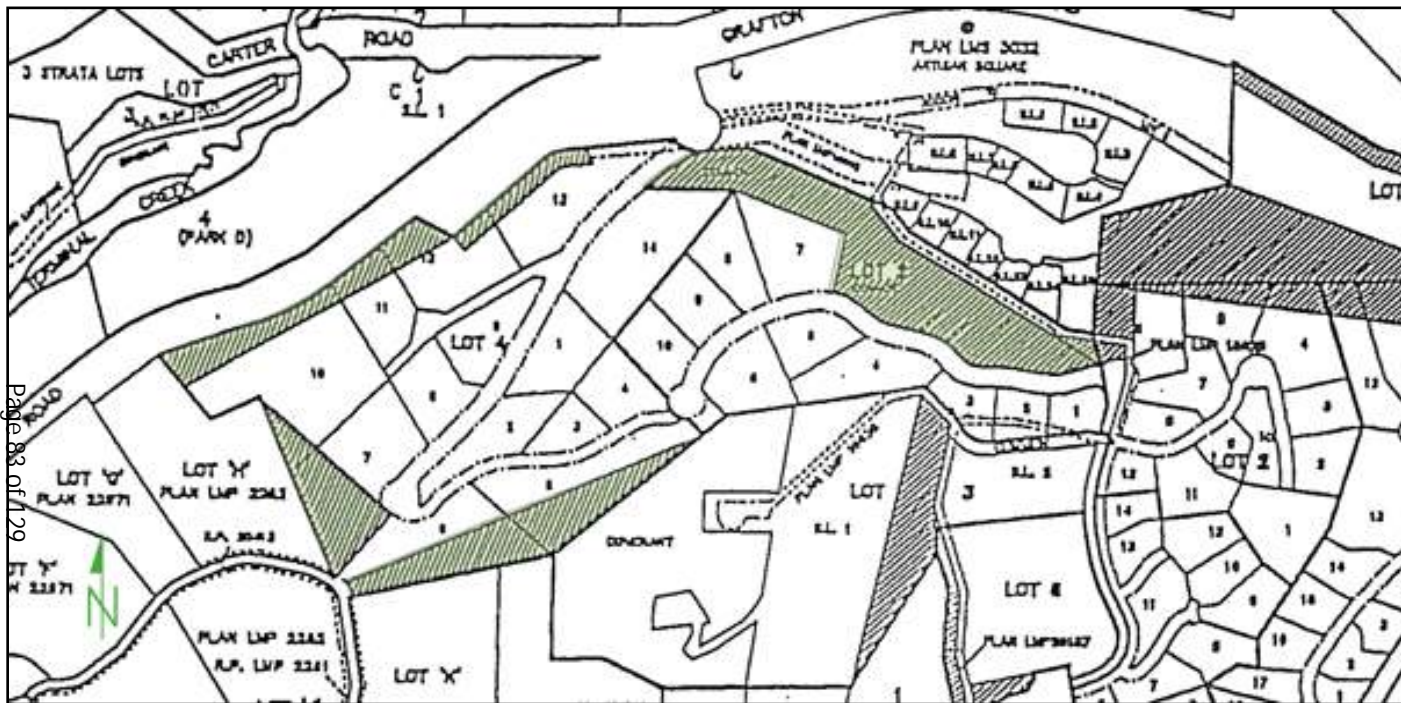
So, for this particular project, as advanced as it is (and developed under the current development permitting framework - albeit with some ambiguous interpretation and some frightening rock walls), I assume there is little recourse, but it would be encouraging to know that this is not the typical path going forward and that a stricter - not prohibitive - set of enforceable bylaws would ensure a more sensitive approach to retaining the natural terrain and topography of any given site or new development. As initially outlined in the 2018 Island Plan;" to minimize disturbance to natural

vegetation and to protect as much of the local plants and tree species as possible” and, I assume when it comes to steep slopes – “to minimize any risk posed to people and property.”

I thank you for taking the time to read this letter. I’m quite certain as a lay person I don’t fully understand the process / legal definitions within fairly wordy documentation (the Cates Hill Vegetation Covenant) – but am sending this letter again (slightly modified from the original sent in Feb 2020 and again in July 2020) as this discussion has been opened up for public comment. Please pass a bylaw that assesses, monitors and sometimes prevents site alteration BEFORE it happens.

Warm regards,

Sophie Taylor  
555 Roocoft Lane



**DEFINITIONS:**

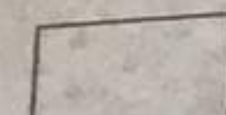
**GREEN BELT:** GREEN BELTS SHALL MEAN THOSE PRE-DEFINED AREAS OF LAND WHEREIN THE EXISTING TREE COVER AND OTHER ASSOCIATED VEGETATION IS TO BE RETAINED WITHOUT FURTHER DISTURBANCE, EXCEPT WHERE SAFETY ISSUES OR THE PROVISION OF VIEW CORRIDORS REQUIRE SELECTIVE TREE REMOVAL.

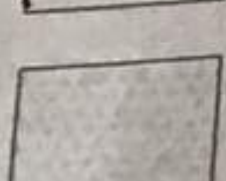
**SETBACK/LANDSCAPE BUFFER:** AREAS OF LIMITED DISTURBANCE BETWEEN INDIVIDUAL LOTS (3m FROM EACH SIDE LOT LINE AND 4.5m FROM FRONT AND REAR LOT LINES.)


**LANDSCAPE AREA:** AREA WHICH WILL REMAIN UNDER SOME FORM OF VEGETATION COVER, BUT NOT NECESSARILY SPECIES THAT WILL DEVELOP INTO LARGE TREES IN THE LONG TERM. REFER TO LANDSCAPE DESIGN MANUAL FOR SPECIFIC LANDSCAPE RECOMMENDATIONS


**RIGHT OF WAY (ROW):** AREA DEDICATED TO PRESENT OR FUTURE UTILITIES AND SERVICES (ABOVE OR BELOW GROUND)

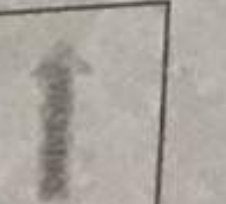
**LEGEND:**

 GREEN BELT AREA

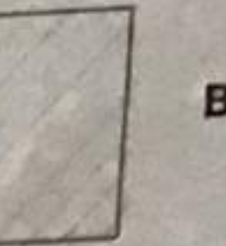
 SETBACKS/LANDSCAPE BUFFER (3m FROM EACH SIDE LOT & 4.5m FRONT & REAR LOT LINES)

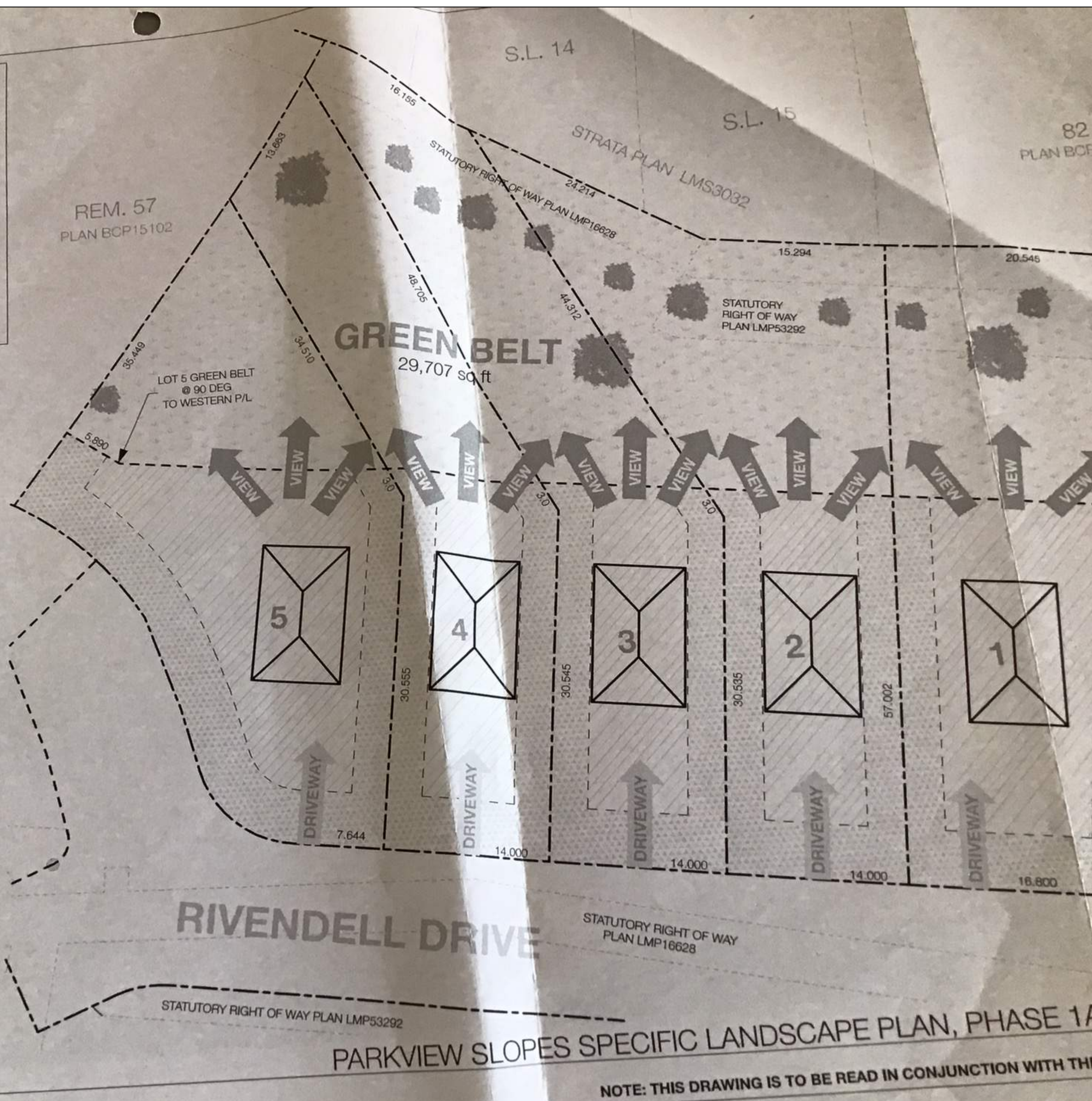
 VIEW CORRIDORS

 EXISTING TREES (APPROXIMATE LOCATION)

 PROPOSED DRIVEWAY ACCESS

 SHARED DRIVEWAY ACCESS BY EASEMENT (SEE HATCHED AREA ON SUBDIVISION PLAN BCP32677)

 BUILDING ENVELOPES



PARKVIEW SLOPES SPECIFIC LANDSCAPE PLAN, PHASE 1A

NOTE: THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE

## Daniel Martin

---

**From:** Peter Frinton  
**Sent:** Thursday, December 9, 2021 11:30 AM  
**To:** Daniel Martin  
**Subject:** DPA survey

Oops- I pressed a return button and the survey completed...

SO in addition to my support for the understructure of the DPA ie use of triggers, and agreement that risks are generally low, I pointed out historic land slumpages, and noted that there should be different DBH parameters by tree species eg Arbutus should be smaller than Doug. Fir. Any assessment for tree removals should include an arborist report if questionable.

Setbacks from streams should always be from 'top of bank' not stream edge. This is well grounded in historical DPA bylaw development, and in the original 'Streamside Protection Act' brought in provincially ca ~ 2000

The west side of Mt. Gardner has evidence of considerable historic large rockfall. Some water access properties between Bluewater and S. end of Mt. Gardner Rd. are at risk particularly, I would think, in the event of earthquake. There was one application requiring a geotech. some years ago that was successful for construction of a house.

A scalable LIDAR map would be useful. I would like to see more detail. Is the map at Muni. Hall much bigger?

I think the biggest concern is alteration of waterways, and any ditching on a slope concentrates water flow. The development at Belterra seriously impacted Carter Rd, such that it now washes out as the drainage pattern was badly altered. Emphasis on surface drainage in all development, especially at the subdivision approval stage, should be ensured.

Peter Frinton

Retired Local/Regional politician  
V.P.- Society for Atmosphere Solutions

Tel:

## Daniel Martin

---

**From:** Peter Frinton  
**Sent:** Monday, December 13, 2021 10:53 AM  
**To:** Daniel Martin  
**Subject:** Hazard DPA

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Thinking a little bit more...

Intensity of disturbance through vegetation removal is a good metric.

For larger trees (30cm+ DBH for softwoods, alder and Bigleaf Maple), perhaps a stricture of 1 tree/2 years (or annually or every 5 years or whatever the science would uphold as reasonable) PER lot up to .5 Ha, then an allowance of 1 additional tree per .5 Ha of land. So an owner with a 4 Ha parcel might be able to remove 8 trees, with a cutting plan identifying locations such that they are not too closely spaced.

Another approach would be to regulate cutting on the basis of the Hazard Area itself, and obviously a lower threshold would apply (eg 1 tree per .25Ha of hazard area)

For smaller trees and shrubs, the stricture could be on %age of vegetation removed- eg 5% Not directly related is a need to formally protect some tree species- eg Dogwood and Arbutus due to their precipitous decline due to disease and other factors. Saanich and Victoria have done this, plus included restrictions for Garry Oak (not applicable here)

I would hate to see the DPA stall due to arguments about the details and numbers, so researching other jurisdictions and relying on the science advisors is critical to defending the policies.

Peter Frinton

Retired Local/Regional politician  
V.P.- Society for Atmosphere Solutions

## **Daniel Martin**

---

**From:** Bruce Weston <>  
**Sent:** Friday, December 17, 2021 11:39 AM  
**To:** Daniel Martin  
**Subject:** Hazordous Area Development(s)

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

### **David:**

- By way of background we have owned our place on Senator Road( 1140) since 1965 thus we are familiar with the evolution of the Island. In addition I personally have been in the real estate finance, development and management area for almost 50 years and have been involved in steep slope developments in the Province and in the USA and thus familiar with benefits and burdens;
- Our company runs a Fund for one of the major pension plans( BC based) and some 5+ years ago we were very involved in the development of a multi-family project in West Kelowna on what would have been deemed as steep slope. While all of the appropriate steps were taken to deal with that the sponsor of the project chose the short cut some of the fill requirements ( and the installation thereof) which left us with a \$3million repair bill for having undertaken the works improperly. One of the consultants we used to remedy the situation is a soils consultant named Jeff Glasser who is based in Vernon. During the course of fixing the project we came to know and respect him but learned in that process that many municipalities in Okanagan were, by then, banning future steep slope projects. I know that Jeff did some work for BIM a number of years ago and I would suggest and recommend that you consult with him again not only as a resource but on specific sites.....well worth getting to know him.....see link below;
- Best for the season and hope this is of some help/thought

**Daniel Martin**

---

**From:** Jon Sigurdson <>  
**Sent:** Wednesday, January 19, 2022 11:09 AM  
**To:** Daniel Martin  
**Cc:** jon sigurdson; paul roscorla  
**Subject:** Submission to Mayor and Council of Bowen Island Municipality re Hazardous Areas Development Permit Areas  
**Attachments:** 2020051-20211222-SurveyPlan.pdf  
**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Dear Mr. Martin,

Thank you for your email this morning. I attach an email submission for circulation to the Mayor and Council.

January 19, 2022,

Dear Mayor and Members of Council,

Re Proposed Hazardous Areas Development Permit Areas

I am writing as Chair of the Fairweather Point Strata, a bare-land strata of 18 lots on the rocky south coast of Bowen Island.

I understand the Council is entertaining submissions in connection with the report on the proposed regulation of hazardous areas on Bowen Island.



While we commend the Council for addressing issues of climate change, rising water levels and potentially unstable land areas, we are concerned with and raise an objection to what is proposed in the report.

We are concerned with the implications of this recommendation at page 3 of the Draft Report from Mike Turley that the following be included in the Hazardous Areas Development Permit Area (the "Suggested Flood Hazardous Area):

(iv) **Coastal** erosion and flooding may occur particularly as a result of sea level rise, and it is suggested that a flood construction reference plane 5.0 metres above the modern-day sea level plus a setback of 15 metres be adopted

The Draft Report notes at page 6 that it is expected that the Global Sea Level Rise (SLR) Allowance will be 1 metre for 2100, not 5 metres. The Draft Report also notes at page 6 that "the construction of FCRPs [Flood Control Reference Plane] and FCLs [Flood Construction Levels] is a site- specific process...".

We were therefore surprised that the Draft Report suggested an FCRP of 5 metres with a set-back for construction of 15 metres for all of Bowen Island. Although the report references Vancouver in Table 2 as a basis for the Suggested Flood Hazardous Area, we observe that Vancouver has not adopted this suggestion for construction throughout the city and note that if it did, parts of Kitsilano and Point Grey, as well as Southlands, would all be within such a Hazardous Area.

The notional line creating the Suggested Hazardous Area simply applies around the whole of Bowen Island without any even general assessment of any possible hazard due to the condition of the slope in the area or sea-level change.

We strongly urge you not to follow this one-size fits all approach. Presently there are onerous set-back requirements for any construction on all waterfront

properties including Fairweather properties i.e. 30 meters from the highwater mark. Moreover, and also importantly, there is nothing in the topography or the history of the Fairweather properties that suggests that the rocky slopes in our neighbourhood are unstable or hazardous.

We attach a site plan showing the impact of the Suggested Coastal Hazardous Area at Fairweather. As you can see, if the suggestion was adopted by municipal council, a number of houses or other construction would be within the Suggested Coastal Hazardous Area. We expect that if a similar assessment was done around the island, there would be numerous houses on Bowen Island that would find themselves within the Suggested Coastal Hazardous Area.

Other municipalities have taken a more nuanced approach and site-specific approach in assessing creation of Hazardous Areas. That seems to be the preferred approach according to the Draft Report. We at Fairweather are concerned that once this Suggested Hazardous Area is introduced on a sweeping basis, there is a substantive risk that lenders and insurers will be reluctant to finance or insure proposed construction or rebuilding/repair of structures that are within the Suggested Hazardous Area. In such a case, this would have a profound negative impact on property valuations and BIM's tax base. Surely this is not intended.

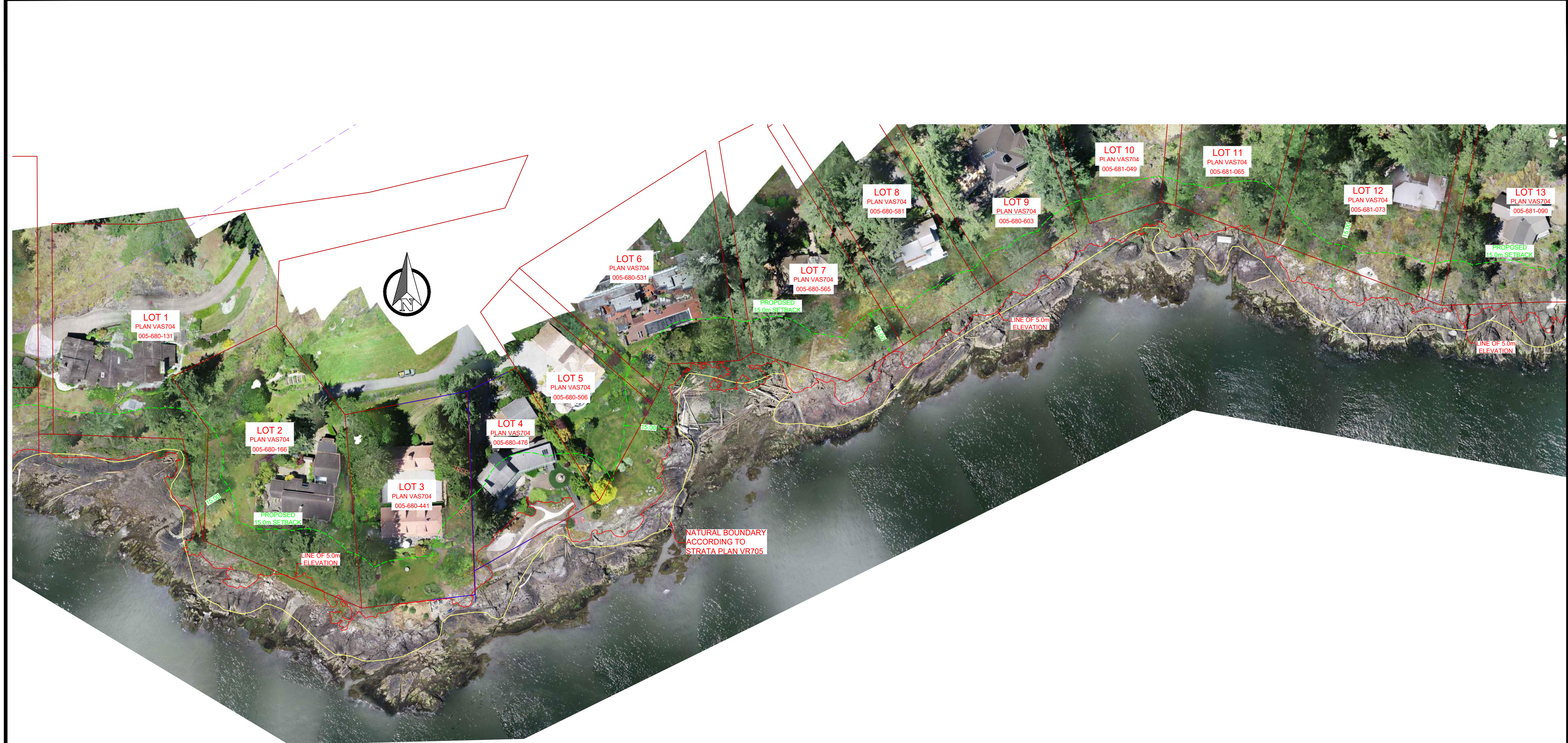
In addition, the proposed bylaw does not take into account the strict regulations that many strata councils have, including Fairweather, for development of strata common property and the bare land strata areas. The Suggested Hazardous Area covers property which is subject to regulation by the Strata Corp including removal of trees and building of structures (where no building permit is required). We think this would be an important additional site-specific consideration as contemplated by the Draft Report.

We appreciate your consideration of these comments and ask you not to adopt the report for the reasons we have mentioned.

Yours truly,

Jon Sigurdson

Enc.



**SURVEY PLAN OF STRATA PLAN VR704  
GROUP 1 NEW WESTMINSTER DISTRICT**

1 : 750

ALL DISTANCES ARE IN METRES  
THE INTENDED PLOT SIZE OF THIS PLAN IS 560mm IN WIDTH BY 432mm IN HEIGHT (D SIZE) WHEN PLOTTED AT A SCALE OF 1:750.

**DISCLAIMER:**  
THIS PLAN IS NOT INTENDED FOR CONSTRUCTION PURPOSES.  
TREE SPECIES AND DIMENSIONS SHOULD BE VERIFIED BY A QUALIFIED ARBORIST PRIOR TO DESIGN AND PERMIT APPLICATION.  
THIS PLAN SHOWS HORIZONTAL GROUND-LEVEL DISTANCES UNLESS OTHERWISE SPECIFIED. OFFSETS TO PROPERTY LINES ARE RADIAL OR PERPENDICULAR TO BOUNDARIES UNLESS SHOWN OTHERWISE.  
THIS DOCUMENT SHOWS THE RELATIVE LOCATION OF THE SURVEYED STRUCTURES AND FEATURES WITH RESPECT TO THE BOUNDARIES OF THE PARCEL DESCRIBED ABOVE. THIS DOCUMENT SHALL NOT BE USED TO DEFINE PROPERTY LINES OR PROPERTY CORNERS.



#20 - 1880 TRIUMPH STREET VANCOUVER, BC V5L 1K3 604-816-4292 INFO@360SURVEYS.CA  
1332 EAGLE CLIFF RD BOWEN ISLAND, BC V0N 1G1 JOB: 2020051

|                  |            |
|------------------|------------|
| <b>DATE:</b>     | <b>BY:</b> |
| JULY 06, 2020    | EP         |
| <b>REVISION:</b> | 0          |

THIS PLAN WAS PREPARED FOR BUILDING PERMIT APPLICATION AND ARCHITECTURAL DESIGN PURPOSES AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES. THIS DRAWING IS FOR THE EXCLUSIVE USE OF OUR CLIENT.  
360 LAND SURVEYING LTD. AND EVGENY PETUSHKOV, BCLS, ACCEPT NO RESPONSIBILITY AND HEREBY DISCLAIM ALL OBLIGATIONS AND LIABILITIES FOR DAMAGES INCLUDING, BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL, AND CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH ANY DIRECT OR INDIRECT USE OR RELIANCE UPON THIS PLAN BEYOND ITS INTENDED USE.  
THIS DOCUMENT IS NOT VALID UNLESS ORIGINALLY SIGNED AND SEALED  
© 360 LAND SURVEYING LTD. 2021. ALL RIGHTS RESERVED. NO PERSON MAY COPY, REPRODUCE, REPUBLISH, TRANSMIT, OR ALTER THIS DOCUMENT, IN WHOLE OR IN PART, WITHOUT THE EXPRESS CONSENT OF 360 LAND SURVEYING LTD.

**CERTIFIED CORRECT**  
ACCORDING TO LAND TITLE & SURVEY AUTHORITY RECORDS AND FIELD SURVEY. UNREGISTERED INTERESTS HAVE NOT BEEN INCLUDED OR CONSIDERED.

EVGENY PETUSHKOV, BCLS  
JULY 5th, 2020  
FB: 024 FIELD CREW: EP, LD, JP DRAFTER: EP

# R.B. RUSSELL

, Bowen Island, BC V0N 1G1

January 20, 2022

Bowen Island Municipality  
981 Artisan Lane  
Bowen Island, BC V0N 1G2

Attention: Mr. D. Martin, Planning Director

[dmartin@bimbc.ca](mailto:dmartin@bimbc.ca)

Dear Daniel:

**Re: Hazardous Areas Development Permit Area Survey (December 2021)**

Daniel, further to my brief December 16, 2021 email of OPPOSITION to the contemplated Hazardous Areas regulation, THAT 2-line email said it all: "*not all of the entire Bowen Island waterfront area is/should be considered hazardous or endangered*".

The proposal to implement BLANKET REGULATIONS is as WRONG and UNACCEPTABLE now, as it was when a similar proposal was rejected by a referendum in 2011! BIM's proposal flies in the face of reason and a fundamental convention of society; NOT EVERYONE IS GUILTY UNTIL THEY PROVE THEIR INNOCENCE. You have the cart before the horse.

By all means, those specific, on a site-by-site/property-by-property basis that may be considered hazardous/dangerous should be subject to a special review as dictated by the unique characteristics of THAT site, *not* the entire waterfront. A "rifle" not a "shotgun" approach should be taken. What is proposed is "overkill" when a "targeted" approach is more reasonable, fair and makes more practical sense. Subject those "suspect" properties to rigorous engineering testing that not all waterfront properties need to undertake. Unique waterfront sites warrant a unique review, but not all sites ("guilty until the owner proves their innocence"!!) A single lot site likely should be considered differently than that of large multi-acre site.

I attended the open house on December 8, 2021, no one was in attendance. I have enclosed my questionnaire. What I saw served only to convince me BIM's proposal is not reasonable or necessary. That said, some questions come to mind, namely:

1. WHO BROUGHT this initiative forward and why?
2. IS IT REASONABLE to rely on the qualifications of a university "scholar" for such far-reaching legislation/regulations?
3. WHAT FIELD EXPERIENCE does this "scholar" have to qualify him to be BIM's authority. Has any field experience in developments enabled him to have established a reputation embraced by the industry, including planners, other consultants, municipalities and "clients/property owners"?
4. WHY LUMP "HAZARDOUS" and "ENVIRONMENTAL" concerns in one catch-all category?

5. HOW MANY, major, serious rock slides has Bowen Island experienced in the past 10, 20 to 100 years? Since my time on the island, 1942, I don't recall any, nor since my family roots dating back to the early 1920's (100 years). AGREED, that is not to say there might not be one, but let's be reasonable.

IN CONCLUSION, I am supportive for the need for special consideration of a waterfront site in an inappropriate hazardous area, but AGAINST this blanket island-wide approach. What is proposed does not require yet more city hall staff to administer the "you are guilty until proven innocent" approach. I thank you for your time and considering my concerns and those of similar-minded property owners, be they waterfront or not.

Yours truly,



R.B. (Bruce) Russell

RBR/as

Encl.

cc. Mayor and Council  
L. Edwards

## Daniel Martin

---

**From:** Sam Gudewill <>  
**Sent:** Saturday, January 22, 2022 10:10 AM  
**To:** Daniel Martin  
**Subject:** Hazardous Areas Development Permit Area Survey.

Dear Mr. Martin (Daniel),

Daniel, this Sam Gudewill writing to you today about said subject matter; you may recall our conversation on the matter in December during your Open House commentary-period. We chatted at some length after the formal part of the meeting had ended and as 92 year seasonal-residents on the south side of Bowen at Fairweather Bay (neighbours of Fairweather Point, from whom you already have their objections to this proposal, as I gather from my sources there), you may recall my vociferous objection to this idea.

In short, Daniel, my main objection is around the 'blanket' nature of the Proposal covering all foreshore areas of Bowen Island. While I am not any kind of expert to say whether or not there are isolated issues around Bowen (though I sincerely doubt it), the untargeted nature of what BIM is suggesting is foolishness in the extreme, in my view-yet another boondoggle from the Municipality. As I recall from our call, you had little to refute the claim that the 'blanket' nature of what is being suggested might in fact, be 'overkill' (my interpretation). The fact that you confirmed to me where we live, and our 1400' of waterfront, are not of the description to be 'under review', this does not change my view on behalf of countless others who, in some cases may yet be unwittingly affected.

Finally, I want to ensure that you received my Reply to your Questionnaire in Objection to this Proposal that I filed on the website in December; I am AGAINST this Proposal in any way shape, or form as proposed. Please send it back to 'Committee' for a re-write or terminate it altogether (my preferred option). I have assumed that this letter will be filed as being received before the January 23<sup>rd</sup> Deadline, as I understand the case to be for Letters of Objection.

Yours Sincerely,  
Sam Gudewill,  
XX Lindy's Road, Fairweather Bay.

Mayor Ander and Council,

As President of the Hood Point West Strata, I am writing on behalf of a number of the members of our strata who have raised the following concerns in response to your request for input regarding a proposed regulatory regime to govern activity in so-called "hazardous development areas".

It would appear from our maps that most of the 15 lots in our neighbourhood would lie at least in part in areas which have been defined as "hazardous". We take exception to that designation, which has apparently resulted from the assumption that all waterfront lots on Bowen are "hazardous".

A similar regulatory initiative was launched a decade ago and abandoned. We are not aware of any problems which have arisen during the past ten years which could have been prevented had this program been in place.

Bowen currently has some serious housing issues. Mayor Ander has just announced a moratorium on building permits in Snug Cove. A number of communities on the island are struggling with issues related to basic infrastructure; water; sewer; and road maintenance. Layering broad regulatory regime on to the existing challenges facing the maintenance and development of existing and new housing stock on Bowen at this time is inappropriate, counter-productive, and fails to meet the most basic cost-benefit test for new regulation. This initiative can be expected to both increase property taxes on existing homes while reducing their value. It is also likely to delay construction of new homes and render them more expensive to build and to own.

The costs of the design, implementation, and administration of this program cannot possibly result in sufficient benefit to justify them, but they are bound to divert attention and resources from the real issues facing Bowen and our Council, and result in unnecessary conflict.

All owners of HPW have had the opportunity to review the submission on this subject from the Chair of Fairweather Point Strata and we would support and adopt the positions set out in that submission in their entirety.

We appreciate the opportunity to provide our perspective on this initiative.

Bob Miller

President, Hood Point West Strata.



# Mayor & Council

Planning Department

**Hazardous Areas DP**

**Draft Report Findings**

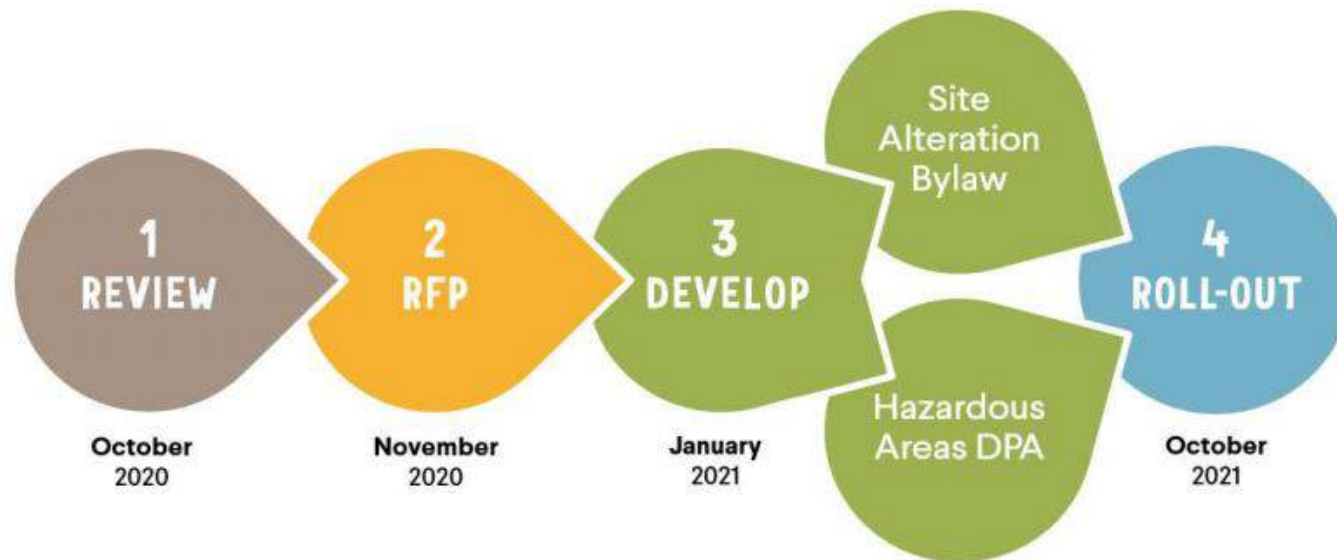
July 26, 2021

**BOWEN ISLAND**  
**🌲 Municipality 🌲**

# Background

September 28, 2020 RES#20-389

It was Moved and Seconded That Council approve the Site Alteration Bylaw and Hazardous Areas DP Area Work Plan as per the Base Scenario as presented at the September 28, 2020 Council Meeting.



# Background

## HAZARDOUS AREAS DPA WORK PLAN STEPS

- A) Gather spatial data
- B) Establish areas of high vulnerability to hazards
- C) Define the trigger for application of the dp that captures large scale development while not impeding everyday work by locals
- D) Determine the permit application process
  - (1) Generate the necessary permit forms and checklists
  - (2) Define the review process
  - (3) Define enforcement procedures and mitigation requirements
- E) Draft the bylaw document
- F) Draft the geotechnical assessment report terms of reference (tor)
- G) Conduct public engagement online, summarize the results of such engagement, and adjust bylaw accordingly
- H) Provide a map of the dp area
- I) Amend the ocp to include the dp area
- J) Adopt new bylaw



# Background

*RES#21-106 – March 22, 2021*

## **It was Moved and Seconded**

That Council approve the expenditure of \$8,800 for the hazardous areas work plan to be funded from the Council Strategic Initiatives Reserve balance.

- CARRIED UNANIMOUSLY

Staff successfully applied for funding under the UBC Sustainability Scholars program, and hired Mike Turley, Ph.D. Candidate in Earth Sciences, who has provided the draft report

# Background

*RES#21-106 – March 22, 2021*

## **It was Moved and Seconded**

That Council approve the expenditure of \$8,800 for the hazardous areas work plan to be funded from the Council Strategic Initiatives Reserve balance.

- CARRIED UNANIMOUSLY

Staff successfully applied for funding under the UBC Sustainability Scholars program, and hired Mike Turley, Ph.D. Candidate in Earth Sciences, who has provided the draft report

# Recommendation

- That Council receive for information the staff report dated July 12, 2021, presenting draft findings of Hazardous Areas Development Permit Areas; and
- That Council refer this report to a future Committee of the Whole Meeting, the Advisory Planning Commission, the Emergency Program Executive Committee, the Environment and Climate Action Advisory Committee, the Parks, Trails and Greenways Advisory Committee, and to a public open house.



To: Committee of the Whole

From: Daniel Martin, Manager of Planning and Development

Date: February 16, 2022 Meeting Date: February 28, 2022

Subject: **Proposed Site Alteration Bylaw**

---

**RECOMMENDATION**

That the Committee of the Whole recommend Council direct staff draft a Site Alteration Bylaw to present at a Regular Council Meeting, and recommend Council direct staff to prepare engagement materials associated with the Site Alteration Bylaw for a public engagement session.

---

**PURPOSE**

To outline to Council recommendations for a Site Alteration Bylaw to regulate land alteration on Bowen Island.

**BACKGROUND**

In February 2020 staff presented to a Committee of the Whole a [report](#) outlining the potential scope of a Site Alteration Bylaw or Development Permit Area. Staff then further outlined a work plan for a [site alteration bylaw and Hazardous Areas DP](#) in the September 28, 2020 Council Meeting, and previously had presented the initial findings from work on Hazardous Areas DP conducted by Mike Turley on behalf of the Bowen Island Municipality to the [July 26, 2021 Council Meeting](#). This report brings the initial recommendations for a Site Alteration Bylaw received as an addition to that earlier Turley Report. This report further contains staff discussion about the scope and contents of a potential Site Alteration Report.

**GEOTECHNICAL ANALYSIS REPORT**

BIM staff received an update report from Scholar Mike Turley who identifies best practices associated with Site Alteration Bylaws. His report outlines that Site Alteration Bylaws may be used to regulate practices that may otherwise present safety concerns (e.g., increase potential for hazards), reduce ecosystem health, or be a nuisance to the community. The report further notes that the scope of Site Alteration Bylaws range widely. The report considers the regulation of four site alteration practices as follows: (1) Grade Alteration and soil removal; (2) Soil Compaction; (3) Vegetation Removal; and (4) rock blasting. The report then outlines best practices for regulating these four activities as follows.

**Best Practices**

**1. Grade Alteration and Soil Removal**

The report states that the exact volume of fill that may be safely removed or added and the acceptable degree of grade alteration is site specific. For this reason it is recommended to consult with a Qualified

Professional before undertaking such work. However, it is generally accepted that small-scale, low-risk modifications can be made without consultation. The

## **2. Soil Compaction**

The report notes the affect that soil compaction can have on drainage patterns, in particular the creation of impervious surfaces. The report recommends establishing a threshold of 10% of a property being impervious surfaces.

## **3. Vegetation / Tree Removal**

Vegetation affects the properties of soil related to shallow landslides. Vegetation increase soil infiltration capacity and roots further stabilize the slope and reduce erosion. The report notes that many bylaws regulate either the removal of individual trees or the extent of site clearing permitted.

## **4. Rock Blasting**

The report recommends incorporating a provided draft blasting bylaw into any Site Alteration Bylaw.

### **Regulated Activities**

The report recommends that a Site Alteration Bylaw require that any of the following activities would trigger the need for a Site Alteration Permit.

1. Alteration of existing grade over 1 m at any point.
2. Removal, relocation, or deposition of more than 10 m<sup>3</sup> of soil or fill material within a 2-year period.
3. Creation of impervious surfaces or compaction of soil other than that of a primary driveway no more than 4 metres in width.
4. Removal of more than 4 trees (not including Significant Trees), or 10 m<sup>2</sup> of vegetation within a period of 5 years.
5. Damage or removal of any vegetation located within a Riparian Zone, an Environmentally Sensitive Area, or Hazardous Areas Development Permit Area.
6. Triggers relating to rock blasting as presented in Appendix 1.

The bylaw would then require that any activity on this list would require consultation with a Qualified Professional. Finally, the report recommends that conditions and procedures be included in any Site Alteration Bylaw.

### **STAFF DISCUSSION**

#### **Community Comparison**

The staff report from the [February 2020 Committee of the Whole](#) included a table comparing some site alteration bylaws looking at the intent behind the bylaw, what triggers the need for a permit, what is exempt from requiring a permit, and what is required in obtaining a permit. The table is duplicated below, with updated information for the Squamish regulatory bylaw.



**Table 1: Comparison of example Site Alteration Bylaws**

| <i>intent</i>  | <i>Trigger</i>  | <i>Exemptions</i>   | <i>Requirements</i>  |
|--|---|---|--|
| <b><u>Whistler Soil Removal and Deposit Bylaw No. 1332, 1998</u></b>   |   |   |  |
| regulate and collect fees for removal and deposit of soil  | <b>Class 1 Permit Required if:</b><br>1. <200 m3 soil removed/deposited incidental to an approved subdivision<br>2. <25,000 m3 soil removed for a project limited to 2 years<br><b>Class 2 Permit if:</b><br>1. >25,000 m3 removed, or<br>2. Project duration is >2 yrs                   | 1. soil removal/deposit for farming or horticultural business purposes or for forest management<br>2. government or public infrastructure work  | 1. EIA<br>2. explanation of work and impacts with mitigation and control measures<br>3. mitigation statement by a qualified professional<br>4. Registered Professional requirement may be waived for Class 1   |
| <b><u>Squamish Soils Management Bylaw No. 2641, 2018, amended</u></b>  |   |   |  |
| regulate the deposit and removal of soil and other material  | Deposit or removal of soil or other material  | 1. <30m3 of soil over a 12 month period, unless land is sloped or in an environmentally sensitive area<br>2. Government Works, habitat restoration, or under a servicing agreement.<br>3. Done as a landscaper stockpiling soil or done by a horticulturist | 1. Site Plan<br>2. Grading Plan<br>3. Erosion and Sediment control plan<br>4. If required, report by a QEP   |
| <b><u>Port Moody Site Alteration Bylaw 3012</u></b>  |   |   |  |
| regulate site alteration, deposit and site clearing  | 1. >10 m3 of soil to be deposited on a residential lot within 2yrs, or<br>2. >20m3 of soil to be deposited on a non-residential parcel over 2 yrs, or<br>3. >30m3 of soil to be removed from a lot within 2 yrs, or<br>4. Site clearing results in exposure of soil on over 30% of parcel | 1. Government works<br>2. Processing of soil or its components as a business<br>3. Permitted sewage disposal or septic field<br>4. Site clearing or deposit of mulch for landscaping less than 150mm deep   | the municipal Engineer dictates the degree of detail to be included in the application   |
| <b><u>Pemberton Bylaw No. 822, 2017</u></b>  |   |   |  |
| regulate site alteration so as to minimize nuisance, safety concerns and the spread of invasive species within the community | deposit/removal of over 10 m3 in a calendar year site alteration includes placing or removal of soil, trees, or other materials, soil compaction, creation of impervious surfaces, and grade alteration.  | government or road maintenance works, landscaping, or flood protection works, emergency works, hazardous tree removal   | 1. a tree management plan, prepared by a registered professional arborist<br>2. if over 100 m3 of material, then also provide plans by a registered professional indicating erosion plan, drainage control, noise and dust control, site access, and a site reclamation plan that includes an Invasive Species Management Plan |

**Range of Bylaw**

As can be seen in the table above and in reviewing the bylaws themselves, there is a range of activities and scope of work that Municipalities choose to regulate through a Site Alteration Bylaw.

**1. Development Triggers & Exemptions:**

Staff would aim to tailor a bylaw such that a permit would be required for large-scale projects such as subdivisions, large driveway construction, or significant grade alteration. Staff do not intend to capture small-scale work such as landscaping and garden creation. The Turley report notes that small-scale, low-risk modifications can be made without consulting a QEP, and what communities determine is “small-scale and low-risk” varies by community. The report recommends an amount of soil removal of 10 m<sup>3</sup> as triggering the need for a Site Alteration Permit. Staff would support this, or a higher general threshold such as the 30 m<sup>3</sup> in the Squamish bylaw with a 10 m<sup>3</sup> in areas that are highly sloped.

**2. Tree Removal**

Many Site Alteration Bylaws state that they are regulating the removal of vegetation, as a component of soil removal. Some bylaws in addition regulate the removal of trees themselves, without any underlying soil alteration. Others regulate vegetation removal only as it results in a large amount of exposed soil.

Staff would seek direction from Council on this point, but as currently envisioned staff would tailor a bylaw to regulate vegetation removal only as it relates to grade alteration or the creation of exposed soils.

**3. Permit Application Requirements**

Some requirements, such as the need for property information and a site plan of intended works appear to be universal in Site Alteration Bylaws. Others are more varied. In particular as some requirements which would cost more for applicants to provide, such as the need for a registered professional to provide a covering report, or a geotechnical report be provided to support the application. Staff favour approaches that provide some flexibility in determining which applications require such supporting documentation, such as the requirements in Squamish’s bylaw which require such report “if required by the General Manager”

**4. Permit Fees**

Currently a Development Permit, which includes registration of the permit on the title of the property, costs \$350, and an Excavation Permit obtained as part of a Building Permit application costs \$250. Based on these charges, staff would recommend a fee of \$300 as an appropriate amount.

**4. Overlap with Existing Bylaws**

As an internal matter, in developing a bylaw Staff would include a consideration of how a potential Site Alteration Bylaw would overlap with either a Development Permit for the WASP DPA or an Excavation Permit issued as part of a Building Permit.

**NEXT STEPS**

Staff seek Council direction to draft a Site Alteration Bylaw to present at a Regular Council Meeting. At that meeting staff would then seek direction to refer the draft bylaw to committees and to the broader public.

**FINANCIAL CONSIDERATIONS**

Staff time would be required to draft a Site Alteration Bylaw and conduct the consultation. Incidental costs associated with any public engagement would be covered in the Planning Departments 2022 budget.

Should a bylaw be adopted, managing permit applications, reviewing applications, and issuing permits will entail staff time and consideration on how to fit into existing workloads. Additionally, staff would anticipate an increase in requests for bylaw services to enforce any new regulations, which would entail increase Bylaw Staff time to manage.

#### **COMMUNICATION TO THE PUBLIC**

Should Council proceed with the proposed Site Alteration Bylaw, staff will prepare a bylaw for Council's consideration. Following presenting the draft bylaw for Council's consideration, staff will seek direction to refer the bylaws to advisory committees and broader public engagement.

#### **ECOLOGICAL CONSIDERATIONS**

Bylaw Services estimates that up to 20 % of Land Use Bylaw complaints are related to land alteration concerns i.e., tree removal, soil (fill) deposition, excavation, and blasting and how these alterations may affect, for example, water flow, erosion, sediment movement, water resource quality and quantity, and slope stability. Often these types of complaints are not covered by existing bylaw provisions.

The Environment and Parks Planning Department is aware of potential ecological degradation stemming from soil movement and clear-cutting land and has seen alterations in water drainage patterns after excavations and blasting activities have taken place. Undesirable invasive species rapidly become established in clear-cut areas and are brought into sites through soil deposition. Invasive plants threaten biodiversity and can impact water resources and normal carbon cycling.

This bylaw could help alleviate resident's concerns and ecological degradation.

#### **CONCLUSION**

Staff have presented an overview of Site Alteration Bylaws, including recommendations from the Scholar employed by BIM. Staff recommend Council direct staff to draft such a bylaw to bring to a Regular Council Meeting.

#### **ALTERNATIVES**

As discussed above, staff have identified the following options for Council to consider:

1. That the Committee of the Whole recommend Council direct staff to draft a Site Alteration Bylaw.
2. That the Committee of the Whole recommend Council direct staff to bring further information on Site Alteration Bylaws to a subsequent Committee of the Whole Meeting.
3. That the Committee of the Whole recommend Council direct staff to take no further action on developing a Site Alteration Bylaw.

**ATTACHMENTS AND REFERENCES:**

1. [Staff Report – July 26, 2021 Meeting](#)
2. [Staff Report – September 28, 2020 Meeting](#)
3. [Staff Report – February 3, 2020 Meeting](#)
4. Turley Site Alteration Bylaw Report

**Submitted by:** Daniel Martin, Manager of Planning and Development

**REVIEWED BY:**

- |                                 |                                     |
|---------------------------------|-------------------------------------|
| CAO                             | <input checked="" type="checkbox"/> |
| Bylaw Services                  | <input type="checkbox"/>            |
| Communications                  | <input checked="" type="checkbox"/> |
| Finance                         | <input type="checkbox"/>            |
| Fire & Emergency                | <input type="checkbox"/>            |
| Environment & Parks             | <input checked="" type="checkbox"/> |
| Planning                        | <input type="checkbox"/>            |
| Public Library                  | <input type="checkbox"/>            |
| Public Works                    | <input type="checkbox"/>            |
| Recreation & Community Services | <input type="checkbox"/>            |

## 3 Site Alteration Bylaws

### 3.1 Executive Summary

Site Alteration Bylaws may be used to regulate practices that may otherwise present safety concerns (e.g., increase potential for hazards), reduce ecosystem health, or be a nuisance to the community. The regulatory scope of Site Alteration bylaws ranges widely. In this report, four different site alteration practices are considered, (i) grade alteration or rerouting of surface drainage through the removal, relocation, or deposition of soil or fill; (ii) soil compaction or creation of impervious surfaces; (iii) vegetation/tree removal; and (iv) rock blasting. Some specifics of each practice are discussed below.

(i) Grade alteration or rerouting of surface drainage has the potential to increase slope stability and erosion hazards and should generally require the consultation of a Qualified Professional. The removal, relocation, or deposition of soil or fill may also result in the spread of invasive species. The Ontario Ministry of Environment, Conservation and Parks provide best management practices for managing excess soils to limit these hazards.

(ii) Soil compaction and the creation of impervious surfaces has been linked directly to stream system health. Total impervious coverage should be maintained below 10% of the total land area to avoid potentially irreversible damage to stream health. Stormwater management BMP's are most effective as preventative measures rather than mitigation tools and should be applied immediately.

(iii) Vegetation stabilizes hillslopes through the alteration of the hydrological and mechanical properties of the soil and helps to maintain ecosystem health. Commonly, vegetation removal is restricted within riparian zones, environmentally sensitive areas, and areas identified as hazardous or steep. Exemptions may include the removal of hazard trees, work completed by the city, or forestry practices.

(iv) There are several potentially adverse effects of urban blasting, including vibration, overpressure, dust, fumes, and potentially flyrock. A detailed synthesis of best practices related to rock blasting was completed by Loeb in 2012. In this report, a draft blasting bylaw was presented for BC Municipalities (Appendix 1). It is recommended that the Bowen Island Municipality incorporate a version of this text in the proposed Site Alteration Bylaw.

The fees for site alteration permits are generally hundreds of dollars, while fines for failing to comply with the bylaws are generally thousands of dollars.

### 3.2 Best Practices

#### 3.2.1 Grade Alteration or Rerouting of Surface Drainage through the Removal, Relocation, or Deposition of Soil or Fill

The removal, relocation, or deposition of soil or other fill material alters the surface drainage patterns, infiltration capacity, and shear strength of the landscape. Grade alteration or the rerouting of surface drainage has implications for slope instability (e.g., landslides) and erosion, both on- and off-site. The exact volume of fill that may be safely removed or added and the acceptable degree of grade alteration and surface drainage rerouting is site specific. As such, it is recommended to consult a Qualified Professional before undertaking such work. However, it is generally accepted (see local community bylaws) that small-scale, low-risk modifications can be made without consultation.

The Ontario Ministry of Environment, Conservation and Parks (MECP; 2018) provide best management practices (BMP's) for managing excess soils. In this guide, which is meant for large-scale or high-risk work, MECP underscores the importance of considering the soil quality, potential contamination, and invasive species. The guide then outlines transportation procedures and both a soil management plan (source site) and a fill management plan (receiving site) as well as dust and noise control measures.

Invasive plants have the capacity to establish quickly and easily, especially on disturbed sites. They can “cause widespread negative economic, social, and environmental impacts” (MFLNRO, 2013). It is recommended that equipment is cleaned before and after site alteration work to prevent the spread of invasive species.

### 3.2.2 Soil Compaction or Creation of Impervious Surfaces

Impervious surfaces are those that resist the absorption of water into the ground. Schueler (1994) identified several effects of changes to imperviousness. Those include subsequent changes to, runoff including increased flooding, lowered groundwater level, stream morphology, reduced water quality (pollutants), stream warming, and a reduction in stream biodiversity and fish health. In most cases, the impervious surfaces don't generate pollutants and contaminants themselves. However, they (i) alter the hydrology causing degradation, (ii) are a component of land uses that do generate pollution, (iii) prevent natural pollutant processing by preventing percolation, and (iv) efficiently transport pollutants into waterways (Arnold and Gibbons, 1996). In fact, imperviousness has been correlated directly with measures of stream health.

Because impervious coverage is easily measured, Arnold and Gibbons (1996) suggest that impervious coverage may be the most feasible and cost-effective vehicle for addressing water pollution in community planning. Researchers have suggested simple thresholds that capture changes in stream system health (Prisloe et al., 2000; Table 8), although it should be remembered that stream health forms more of a continuum. Guthrie and Deniseger (2001) provide a good example of an impervious surfaces study within the French Creek Watershed, Vancouver Island. There is ample research to motivate the reduction of impervious cover, and ideally it should be maintained below 10% total coverage.

**Table 8: Suggested threshold relations between impervious coverage and stream system health.**

| Impervious Coverage | Stream Health |
|---------------------|---------------|
| < 10%               | Protected     |
| 10 – 30%            | Impacted      |
| > 30%               | Degraded      |

In a report prepared for the City of Vancouver in 2016, Golder Associates Ltd. set out a BMP's toolkit for improving rainwater management which generally aligns with practices to reduce impervious coverage. The toolkit highlights practices such as, pervious paving, green roofs, daylighting streams, and constructing wetlands. However, BMP's are more effective as a preventative measure rather than a mitigative tool and so should be implemented before reaching the threshold for impacted watersheds (Guthrie and Deniseger, 2001). Although the total percent impervious coverage on Bowen Island is expected to be well below 10%, localized effects including increased surface runoff and subsequent

slope destabilization are possible. As such, it is recommended to restrict the creation of impervious surfaces through a site alteration bylaw.

### **3.2.3 Vegetation / Tree Removal**

Vegetation strongly affects the mechanical and hydrological properties of soil related to shallow landsliding. Vegetation increases soil infiltration capacity and reduces soil water content through interception, transpiration, and evaporation (Mulyono et al., 2018). Roots further stabilize the slope and reduce erosion through the mechanical reinforcement of soils. The stabilizing effect of vegetation is quantifiable and significant (Schwarz et al., 2010). In the absence of slope stability and erosion concerns, vegetation provides habitat for many species, and can help maintain ecosystem health.

The beneficial nature of vegetation warrants its preservation whenever possible. Site alteration bylaws in communities neighboring Bowen Island vary between the protection of individual trees (District of Squamish, 2018) to site clearing of up to 30 percent of a parcel depending on other restrictions (City of Port Moody, 2015). It is common to restrict vegetation removal within riparian zones, environmentally sensitive areas, and areas identified as hazardous or steep. Common exemptions include the removal of hazard trees, work completed by the City, or logging with valid permits in active forestry areas.

### **3.2.4 Rock Blasting**

There are several potentially adverse effects of urban blasting, including vibration, overpressure, dust, fumes, and potentially flyrock. A detailed synthesis of rock blasting best practices and current municipal bylaws (in British Columbia and throughout Canada) was completed by Loeb in 2012. Here only a brief summary of the results is presented.

After conducting best practices research and interviewing regulators, blasting contractors, and blasting consultants, Loeb (2012) created a draft blasting bylaw (attached as Appendix 1) to be used by municipalities within BC. Within this draft bylaw, mitigation practices such as the hours of blasting, maximum particle velocity, maximum overpressure, etc. are presented. Loeb (2012) also found that most blasting complaints are the result of a lack of communication or miscommunication with nearby residents and suggest a pre-blast survey is conducted. As part of this survey, an information pamphlet (attached as Appendix 2) that is designed to educate and inform homeowners that may be affected by blasting, is to be distributed. The attached draft bylaw may be modified by Bowen Island Municipality to form part of the proposed (more comprehensive) Site Alteration Bylaw.

### **3.2.5 Fees and Fines**

The fees collected for Site Alteration Permits vary, but are generally a few hundred dollars (e.g., District of Squamish - \$250). Fines for a person who fails to comply with any provision of the Site Alteration Bylaw generally reach \$10,000 or more (e.g., District of Squamish, 2018).

### 3.3 Draft Site Alteration Bylaw

#### 3.3.1 Definitions

**“Significant Trees”** means a tree identified by Council as significant because of its importance to the community, or as wildlife habit; or a mature tree.

#### 3.3.2 Triggers

This section outlines potential activities that would trigger the Site Alteration permit process. Site Alteration permit triggers are based on activities that may present on- or off-site safety concerns (e.g., increase potential for hazards), reduce ecosystem health, or be a nuisance to the community. Some suggested triggers are presented below.

1. Alteration of existing grade over 1 m at any point.
2. Removal, relocation, or deposition of more than 10 m<sup>3</sup> of soil or fill material within a 2-year period.
3. Creation of impervious surfaces or compaction of soil other than that of a primary driveway no more than 4 metres in width.
4. Removal of more than 4 trees (not including Significant Trees), or 10 m<sup>2</sup> of vegetation within a period of 5 years.
5. Damage or removal of any vegetation located within a Riparian Zone, an Environmentally Sensitive Area, or Hazardous Areas Development Permit Area.
6. Triggers relating to rock blasting as presented in Appendix 1.

#### 3.3.3 Exemptions

1. Removal of hazard trees.
2. Site alteration completed by or for the Bowen Island Municipality.

#### 3.3.4 Requirements

If any of the above conditions are met, consultation with a Qualified Professional should be required. A document should be created that outlines the conditions and procedures to apply for a Site Alteration permit.



### 3.4 References

- Arnold, C.L. & Gibbons, C. J. (1996). Impervious surface coverage: the emergence of a key environmental indicator. *Journal of the American Planning Association* 62(2), pp. 243-258.
- City of Port Moody, Bylaw No. 3012, Site Alteration Bylaw (2015).
- District of Squamish, Bylaw No. 2640, Tree Management Bylaw (2018).
- Guthrie, R., Deniseger, J. (2001). Impervious Surfaces in French Creek. Ministry of Water, Land and Air Protection, Vancouver Island, British Columbia. <https://www.env.gov.bc.ca/vancouver-island/es/pdf/Impervious%20Surfaces%20technical%20document.pdf>
- Loeb, J. T. (2012). Regulatory mitigation of the adverse environmental effects of urban blasting. Unpublished Thesis. University of British Columbia. Retrieved from <https://open.library.ubc.ca/collections/ubctheses/24/items/1.0050876>
- Ministry of the Environment, Conservation and Parks. (2018). Management of excess soil - a guide for best management practices. Ontario.ca. <https://www.ontario.ca/page/management-excess-soil-guide-best-management-practices>.
- Ministry of Forests, Lands and Natural Resource Operations. (2013). Best Practices for Preventing the Spread of Invasive Plants During Forest Management Activities. Retrieved from the official website of the Government of British Columbia: <https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/publications/forestry-bp-09-11-2013-web.pdf>
- Mulyono, A., Subardja, A., Ekasari, I., Lailati, M., Sudirja, R., Ningrum W. (2018). The Hydromechanics of Vegetation for Slope Stabilization. *IOP Conference Series: Earth and Environmental Science*. 118, pp. 012038
- Prisloe, S.M., Giannotti, L., Sleavin, W. (2000). Determining Impervious Surfaces for Watershed Modeling Applications. *Nonpoint Education for Municipal Officials*, University of Connecticut, College of Agriculture and Natural Resources, 17pp.
- Schueler, T. (1994). The Importance of Imperviousness. *Watershed Protection Techniques* 1(3): 100-111.
- Schwarz, M., Preti, F., Giadrossich, F., Lehmann, P., Or, D. (2010). Quantifying the role of vegetation in slope stability: A case study in Tuscany (Italy). *Ecological Engineering*. 36, pp. 285-291

#### **4 Recommendations for the Municipality on future data-gathering or policies**

A key component to any hazard assessment is an archive of past events in the area. It is recommended that Bowen Island Municipality collect citizen reports on local hazards (e.g., rockfall, excessive soil erosion, etc.) in an anonymized, location specific way.

In following a report by APEGBC (2017) it is recommended that any hazard related DPA maps and bylaws should be reassessed every 10 years if there are significant changes to the conditions on the island, data availability, or infrastructure.

## Appendices

### Appendix 1 – Suggested Draft of a Blasting Bylaw (Loeb, 2012)

# [Interested] Regional Municipality By-Law Number [00000] Respecting Blasting General

#### Number and Short Title

1. This By-law shall be known as By-law Number [00000] and shall be cited as the “Blasting By-law.”

#### Jurisdiction

2. The Blasting By-law contains laws that must be complied with, in addition to those blasting laws that are regulated by the provincial and federal governments.

#### Appendices

3. Appendix “A” and Appendix “B” form part of the By-law.

#### Definitions

4. In this By-law:
  - a) **“Affected Community”** means all properties within a distance of 150 m from the Blasting Area, unless adjusted by the Consultant;
  - b) **“Air Overpressure”** means the airborne disturbance which results from Blasting, which may or may not be audible, measured in linear decibels (dBL);
  - c) **“Applicant”** means a person who has applied for a Blasting Permit under this By-law;
  - d) **“Blaster”** means a person named on a valid Urban Blasting Certificate issued by the Province of British Columbia;
  - e) **“Blasting”** means the handling, preparation and use of explosives, but does not include delivery or storage by a properly qualified person in accordance with Federal and Provincial Law;
  - f) **“Blasting Area”** means the zone extending 15 m of all directions from the place in which holes will be loaded with explosives to be detonated;
  - g) **“Consultant”** means a Professional Engineer, or a person with other relevant qualifications or reputation acceptable to the Inspector, that has expertise in blasting in urban areas with at least 5 years blast consulting experience, and is independent of the Blaster and the explosives manufacturer or distributor.
  - h) **“Inspector”** means the person appointed by the Chief Administrative Officer of the Municipality to be the Inspector of Blasting or their designate;
  - i) 121
  - j) **“Municipality”** means the [Interested] Regional Municipality;
  - k) **“Particle Velocity”** means the measure of the intensity of ground vibration, measured in millimeters per second;
  - l) **“Qualified Monitor”** means a person who is;
    - i. the Consultant, or a person working under the supervision of a Consultant;

- ii. trained on the proper use of the monitoring instruments by a representative of the manufacturer or distributor of the monitoring instruments or other competent individual, and;
- iii. shall not be the Blaster or the Applicant, or an employee of the Blaster or the Applicant;

**Blasting Permit**

- 5. (1) No person shall carry out or cause to be carried out Blasting in the Municipality without a Blasting Permit first having been obtained from the Inspector.
- (2) A Blasting Permit shall not be issued to an Applicant unless the Applicant is a Blaster, the Applicant has a Blaster in his/her employ, or the Applicant has a contract with a Blaster in respect of the work for which the Blasting Permit is intended.
- (3) Notwithstanding subsection (1), the inspector may give permission for Blasting without a Blasting Permit in an emergency situation.

**Hours of Blasting**

- 6. No person shall carry out or cause to be carried out Blasting on a Saturday, a Sunday, Remembrance Day, or a holiday as defined in the Interpretation Act, R.S.N.S. 1989, c.35, as amended from time to time.
- (2) No person shall carry out or cause to be carried out Blasting outside of daylight hours.
- (3) Notwithstanding to subsections (1) and (2), the council of the Municipality may allow the Inspector to issue a Blasting Permit to carry out Blasting on weekends or holidays if such operation is in the interest of public convenience. In such cases, the hours of Blasting shall be as per 6 (2).

**Limits**

**Particle Velocity**

- 7. No person shall carry out or cause to be carried out Blasting which results in a Particle Velocity measured at the closest structure to the blast which exceeds the limits set out in Figure 1, unless otherwise specified by the Consultant.

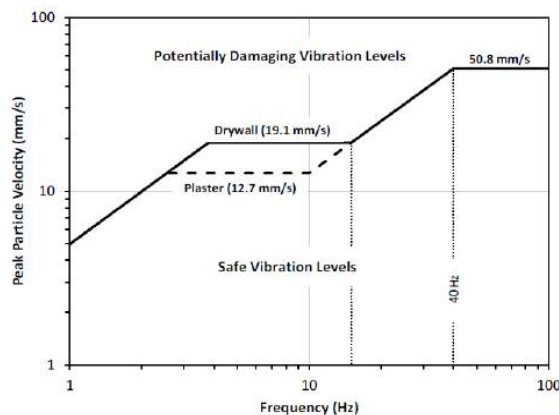


Figure 1: Safe levels of blasting vibration for residential houses (RI 8507, U.S. Bureau of Mines)

**Maximum Air Overpressure**

8. No person shall carry out or cause to be carried out Blasting which results in an Air Overpressure measured at the closest inhabited building to the blast which exceeds 128 dB(L), measured on the linear scale, unless otherwise specified by the Consultant and accepted by the Inspector.

### **Activities During Blasting**

#### **Pre-Blast Survey**

9. (1) No person shall carry out or cause to be carried out Blasting unless a pre-blast survey is completed on every structure within 65 m of the Blast Area unless adjusted by the Consultant, and which meets the following requirements.
  - a) Notification, containing project description / location, the blasting contractor's name, the name of the firm conducting the survey, and an approximate start and completion date for the project, is distributed to all property owners in the area to be surveyed;
  - b) appointments are made and the survey is carried out in a timely manner and in advance of the commencement of Blasting on the project;
  - c) each property owner is contacted in person and if the homeowner cannot be contacted, notification is left in the mailbox advising the owner who to contact to schedule an appointment;
  - d) the survey consists of high quality video photography, unless still photographs are preferred by the property owner, of the structure, in reproducible format, and which provides an overview of the entire structure, interior and exterior, provided consent is given by the property owner or his/her respective representative;
  - e) the survey shows fences, sidewalks, trees, and other similar features adjoining the property;
  - f) the video record may be reviewed by the property owner upon request;
- (2) Notwithstanding subsection (1) a pre-blast survey shall not be required before a Blasting Permit is issued in the event the property owner cannot be contacted after a minimum of four visits to the property, with a maximum of one visit per day, or refuses entry to the property.

#### **Notification**

10. (1) No person shall carry out or cause to be carried out Blasting unless the pamphlet (provided in Appendix A) is delivered by hand after the Blasting Permit is issued and at least two days (48 hours) prior to the commencement of Blasting, to every property owner or business within the Affected Community which shall contain:
  - a) the name of the person or company responsible for Blasting, including a contact person and telephone number;
  - b) the intended date and time when Blasting shall commence and its expected duration, and;
  - c) the location of Blasting.
- (2) No person shall carry out or cause to be carried out Blasting within 300 m of a school, hospital, or other health care facility unless:
  - a) such notice as required by subsection (1) has been given to the senior administrator of the school, hospital, or other health care facility, and;
  - b) the senior administrator is also informed at least 2 hours prior to each blast.

#### **Blaster Required**

11. No person shall carry out or cause to be carried out Blasting unless the Blasting is under the care and control of a Blaster.

**Drilling Dust Control**

12. No person shall carry out or cause to be carried out Blasting without the use of an acceptable dust collection system as part of the drill machine.

**Blast Monitoring**

13. (1) No person shall carry out or cause to be carried out Blasting unless:
- a) a Qualified Monitor monitors every blast;
  - b) blast monitoring equipment and procedures meet the standards of Appendix B that refers to Appendices D and E of the ISEE Blasters Manual, 18 ed.

**Hole Size**

14. No person shall carry out or cause to be carried out Blasting where blast holes exceed a diameter of 70 mm, unless adjusted by the Consultant and approved in writing by the Inspector.

**Submit Records**

15. (1) During the course of blasting, the Consultant shall review the blast records and confirm to the Blaster and/or Inspector, if requested, that blasting is being carried out in accordance with the specifications of this by-law, and shall immediately report any problems, unusual circumstances or inconsistencies to the Blaster and/or Inspector.
- (2) The Consultant will report, within 24 hours to the Blaster and/or Inspector, any instance when, and under what circumstances, vibrations and/or Air Overpressure exceeded the specified maximum limits. This report will include a written explanation for the excessive Air Overpressure and Particle Velocity level(s) as well as a description of corrective actions.

**Administration**

**Blasting Permit Application**

16. The Applicant for a Blasting permit shall make written application on a form provided by the Inspector.
17. The application shall contain the following information:
- h) the Applicant's name, address, telephone number, and type of business;
  - i) a contact person's name, title, and telephone number;
  - j) a description of the scope of work, including purpose for which Blasting is required;
  - k) the date upon which work is proposed to commence and the probable duration;
  - l) a copy of a valid urban blasting certificate issued by the Worker's Compensation Board or the BC Ministry of Mines to the blaster who will undertake the work;
  - m) a certificate of insurance on a form acceptable to the Inspector which provides a policy of commercial general liability for bodily injury and property damage in the amount of \$5,000,000 per occurrence which includes the [Interested] Regional Municipality as an additional insured, a cross liability clause and a Blasting endorsement for the full limits of the policy; and

n) such other information as the Inspector may require.

**Other Rights and Remedies**

Terms and Conditions, penalties, duration, fees etc. as required by [Interested] Municipalities

Done and passed in Council this [#] day of [Month], [Year]

\_\_\_\_\_  
MAYOR

\_\_\_\_\_  
ACTING MUNICIPAL CLERK

**Appendix A of Bylaw**

Notification – Informative Pamphlet (Appendix 2 below)

**Appendix B of Bylaw**

Standards and Requirements for Monitoring as per ISEE Handbook 18<sup>th</sup> ed. (ISEE, 2011)

## Appendix 2 – Blasting Bylaw: Education Plan / Informative Pamphlet (Loeb, 2012)

### NOISE

Blasting noise creates two common concerns: 1) the nuisance of the sound (measured in dB), and 2) the pressure that is exerted on a home from the air blast (which causes the noise). The noise limit for your home is 128 dB. This noise level is 6 dB lower than the recommended limit by the US Bureau of Mines, and has a pressure equivalence of an average windy day.

The following table compares this safe limit to other occupational health and safety limits.

| Noise Level (dB) | Sound Limits   | Wind Speed Equivalence (km/hr) |
|------------------|--|--------------------------------|
| 90               | Max. for 8 hours of continuous exposure                    | 3.5                            |
| 115              | Complaints likely for 15 minutes of continuous exposure    | 15                             |
| 120              | Pain threshold for continuous exposure                     | 20                             |
| 128              | Recommended limit for impulsive sound produced by blasting | 32                             |
| 134              | Recommended Safe limit for impulsive sound by the USBM     | 46                             |
| 140              | Maximum for impulsive sound (blasting) – threshold of pain | 65                             |
| 150              | Some windows break   | 115                            |
| 170              | Most windows break   | 362                            |
| 180              | Structural damage  | 644                            |

### FLYROCK

Flyrock is rock discharged onto your property from the blast site. It is a result of poor blasting practice, or unforeseen geological conditions. The blaster must take every precaution to ensure that flyrock is minimized. If flyrock were to land on your property, the blaster would be in violation of Section 21.66 (1) of the provincial Occupational Health and Safety Act. Violation of this section results in the suspension of the blaster's certificate and, in some cases, a fine. Call WorkSafeBC claims centre at 1-888-967-5377 to report flyrock that has landed on your property.

### WHAT IS THIS THING ON MY LAWN?

Although a technician will check with you before placing a seismograph on your property, the following is a brief description of what a seismograph does and where it *should* be placed. A seismograph is used to monitor ground vibrations (mm/s) and noise (dB). The device is set up before blasting commences. It is automatically activated, or triggered, by a vibration "event" and data are stored digitally and is then downloaded to a computer. A typical seismograph is shown in below:



Typical Seismograph ([www.instantel.com/products](http://www.instantel.com/products))

Blasters are sometimes accused of improper installation in order to produce results in their favour. Guidelines on where and how the seismograph should be set up are:

1. The seismograph should be placed at the closest point of the closest structure to the blast. Vibration levels are dependent on distance. Therefore the closest house to the blast usually experiences the highest vibrations, and it is not necessary to measure vibrations at every home.
2. The geophone, which measures vibration, should be buried underground. In cases where this is not possible, it should be placed on a level surface with a sandbag (or other weight) placed over top of it.
3. The geophone arrow (shown above), and the microphone should both be directed towards the location of the blast.

## Urban Blasting in British Columbia

A Guide for People Living  
Near Blasts





# Committee of the Whole

## Site Alteration Bylaw Report

February 28, 2022

**BOWEN ISLAND**  
**🌲 Municipality 🌲**

# Site Alteration Bylaws

## *Community Charter*

8. (3)A council may, by bylaw, regulate, prohibit and impose requirements in relation to the following:

(m)the removal of soil and the deposit of soil or other material.

# Site Alteration Bylaws

| intent   | Trigger  | Exemptions   | Requirements   |
|--|--|--|--|
| <b>Whistler Soil Removal and Deposit Bylaw No. 1332, 1998</b>  |  |  |  |
| regulate and collect fees for removal and deposit of soil  | <p>Class 1 Permit Required if:</p> <ol style="list-style-type: none"> <li>1. &lt;200 m3 soil removed/deposited incidental to an approved subdivision</li> <li>2. &lt;25,000 m3 soil removed for a project limited to 2 years</li> </ol> <p>Class 2 Permit if:</p> <ol style="list-style-type: none"> <li>1. &gt;25,000 m3 removed, or</li> <li>2. Project duration is &gt;2 yrs</li> </ol> | <ol style="list-style-type: none"> <li>1. soil removal/deposit for farming or horticultural business purposes or for forest management</li> <li>2. government or public infrastructure work</li> </ol>   | <ol style="list-style-type: none"> <li>1. EIA</li> <li>2. explanation of work and impacts with mitigation and control measures</li> <li>3. mitigation statement by a qualified professional</li> <li>4. Registered Professional requirement may be waived for Class 1</li> </ol>   |
| <b>Squamish Soils Management Bylaw No. 2641, 2018, amended</b>   |  |  |  |
| regulate the deposit and removal of soil and other material  | Deposit or removal of soil or other material   | <ol style="list-style-type: none"> <li>1. &lt;30m3 of soil over a 12 month period, unless land is sloped or in an environmentally sensitive area</li> <li>2. Government Works, habitat restoration, or under a servicing agreement.</li> <li>3. Done as a landscaper stockpiling soil or done by a horticulturist</li> </ol> | <ol style="list-style-type: none"> <li>1. Site Plan</li> <li>2. Grading Plan</li> <li>3. Erosion and Sediment control plan</li> <li>4. If required, report by a QEP</li> </ol>   |
| <b>Port Moody Site Alteration Bylaw 3012</b>   |  |  |  |
| regulate site alteration, deposit and site clearing  | <ol style="list-style-type: none"> <li>1. &gt;10 m3 of soil to be deposited on a residential lot within 2yrs, or</li> <li>2. &gt;20m3 of soil to be deposited on a non-residential parcel over 2 yrs, or</li> <li>3. &gt;30m3 of soil to be removed from a lot within 2 yrs, or</li> <li>4. Site clearing results in exposure of soil on over 30% of parcel</li> </ol>                     | <ol style="list-style-type: none"> <li>1. Government works</li> <li>2. Processing of soil or its components as a business</li> <li>3. Permitted sewage disposal or septic field</li> <li>4. Site clearing or deposit of mulch for landscaping less than 150mm deep</li> </ol>  | the municipal Engineer dictates the degree of detail to be included in the application   |
| <b>Pemberton Bylaw No. 822, 2017</b>   |  |  |  |
| regulate site alteration so as to minimize nuisance, safety concerns and the spread of invasive species within the community | deposit/removal of over 10 m3 in a calendar year site alteration includes placing or removal of soil, trees, or other materials, soil compaction, creation of impervious surfaces, and grade alteration.   | government or road maintenance works, landscaping, or flood protection works, emergency works, hazardous tree removal  | <ol style="list-style-type: none"> <li>1. a tree management plan, prepared by a registered professional arborist</li> <li>2. if over 100 m3 of material, then also provide plans by a registered professional indicating erosion plan, drainage control, noise and dust control, site access, and a site reclamation plan that includes an Invasive Species</li> </ol> |

# GEOTECHNICAL ANALYSIS REPORT

BIM staff received an update report from Scholar Mike Turley who identifies best practices associated with Site Alteration Bylaws.

His report outlines that Site Alteration Bylaws may be used to regulate practices that may otherwise present safety concerns (e.g., increase potential for hazards), reduce ecosystem health, or be a nuisance to the community. The report further notes that the scope of Site Alteration Bylaws range widely.

The report considers the regulation of four site alteration practices as follows:

- (1) Grade Alteration and soil removal;**
- (2) Soil Compaction;**
- (3) Vegetation Removal; and**
- (4) Rock blasting.**

# Staff Discussion

## 1. Development Triggers & Exemptions:

Staff would aim to tailor a bylaw such that a permit would be required for large-scale projects such as subdivisions, large driveway construction, or significant grade alteration. Staff do not intend to capture small-scale work such as landscaping and garden creation.

The Turley report notes that small-scale, low-risk modifications can be made without consulting a QEP, and what communities determine is “small-scale and low-risk” varies by community.

The report recommends an amount of soil removal of 10 m<sup>3</sup> as triggering the need for a Site Alteration Permit. Staff would support this, or a higher general threshold such as the 30 m<sup>3</sup> in the Squamish bylaw with a 10 m<sup>3</sup> in areas that are highly sloped.

# Staff Discussion

## 2. Tree Removal

Many Site Alteration Bylaws state that they are regulating the removal of vegetation, as a component of soil removal. Some bylaws in addition regulate the removal of trees themselves, without any underlying soil alteration. Others regulate vegetation removal only as it results in a large amount of exposed soil.

Staff would seek direction from Council on this point, but as currently envisioned staff would tailor a bylaw to regulate vegetation removal only as it relates to grade alteration or the creation of an area of exposed soils.

# Staff Discussion

## 3. Permit Application Requirements

Some requirements, such as the need for property information and a site plan of intended works appear to be universal in Site Alteration Bylaws. Others are more varied.

In particular some requirements which would cost more for applicants to provide, such as the need for a registered professional to provide a covering report, or a geotechnical report be provided to support the application.

Staff favour approaches that provide some flexibility in determining which applications require such supporting documentation, such as the requirements in Squamish's bylaw which require such report "if required by the General Manager"

# Staff Discussion

## 4. Permit Fees

Currently a Development Permit, which includes registration of the permit on the title of the property, costs \$350, and an Excavation Permit obtained as part of a Building Permit application costs \$250. Based on these charges, staff would recommend a fee of \$300 as an appropriate amount.

## 5. Overlap with Existing Bylaws

As an internal matter, in developing a bylaw Staff would include a consideration of how a potential Site Alteration Bylaw would overlap with either a Development Permit for the WASP DPA or an Excavation Permit issued as part of a Building Permit.



# RECOMMENDATION

That the Committee of the Whole recommend Council direct staff draft a Site Alteration Bylaw to present at a Regular Council Meeting, and recommend Council direct staff to prepare engagement materials associated with the Site Alteration Bylaw for a public engagement session