DISTRICT OF UCLUELET

REGULAR MEETING OF COUNCIL
George Fraser Community Room, Ucluelet Community Centre,
500 Matterson Drive, Ucluelet, and
Electronically via Zoom (Ucluelet.ca/CouncilMeetings)
Tuesday, November 26, 2024 @ 4:00 PM

LATE ITEM(S)

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1. LATE ITEMS

November 19th, 2024

Incorporation No: BC 1319635
2200, 885 Georgia St West, Vancouver, British Columbia, CA V6C 3E8

To:

Mayor and Councillors

communityinput@ucluelet.ca

Copied to:

Duane Lawrence, CAO
Bruce Greig, Director of Community Planning
John Towgood, Municipal Planner
District of Ucluelet

RE: 221 MINATO ROAD – OCP & SUBDIVISION APPLICATION – FLOOD ASSURANCE STATEMENT

Dear Councillors,

ERIF Economic Restoration Infrastructure Fund Inc (ERIF) is pleased to provide the following supplementary documents for the OCP Amendment and Subdivision proposed for the Development Permit for 221 Minato lodged on September 20, 2024, and Revision A lodged November 3.

The DOU requested a further flood report and Flood Assurance Statement to support subdivision and development of the site. This report has been prepared by BC's most highly regarded Costal Engineers, Kerr Wood Leidal (KWL) and the draft flood documents have been submitted.

The Flood Hazard Assessment supports the proposed development of Lots 1, 2, 4, and 5 and a Flood Assurance Statement can be issued for these lots.

A Flood Risk Assessment is provided for the final Lot, Lot 3, which is proposed to develop with eleven single family homes. This risk assessment supports the proposed development of Lot 3 and can be finalised with written support from Council.

The Flood Report is marked as 'draft' because in section 8, the flood engineers request that Council review the Risk Assessment for Lot 3 (excerpted below) and confirm that the 'low' risk level identified is acceptable. Once this is received the flood Report will be finalised and Flood Assurance Statement issued. This confirmation of acceptable risk is required because the DOU Tsunami Interim Policy does not provide a general acceptable risk level, but requires a site-specific assessment.

The Risk Assessment provides detailed modelling of the potential economic and physical loss to the eleven homes on Lot 3 in the event of major tsunami. It confirms the assessed risk level as 'low' with a ratio of 1:142,000 annual chance of fatality. It sets out international best practices standard of risk assessment and provides support for this risk level being acceptable by those standards.

In response to this risk assessment, ERIF has prepared a detailed Risk Management Plan with evacuation plan, carefully reviewed with Ucluelet's Fire Chief responsible for emergency response. ERIF has proposed structural mitigation measures to raise the homes above the reported flood level. KWL have tested this modelling and confirmed their assessed risk levels support the proposed development as safe and suitable for a Flood Assurance Statement.

To finalise the report and provide the requested Flood Assurance Statement, KWL's flood engineer has requested correspondence from the Council to confirm the risk level is acceptable noting:

The Council has reviewed the Risk Assessment prepared by Kerr Wood Leidel for 221 Minato Rd, Ucluelet and confirms that the risk set out in the report is acceptable including:

- *That this development may proceed in the absence of a standard dike.*
- *That the development of Lot 3 with 11 houses represents a nominal increase to the housing density on the DoU tsunami floodplain.*
- *That the risk of mortality associated with the development of Lot 3 is acceptable (1:142,000 annually).*

We ask that the Council provide this correspondence so that the Flood Engineers can finalise their report and provide the requested Flood Assurance Statement.

With the flood documentation as the final document requested now complete for this submission, we ask that the Council consider the proposed OCP and By Law Amendment for subdivision and development at their upcoming meeting on December 10 2024. This will enable us to provide appropriate public notice periods before the end of the year.

We trust this report provides what is required to move forward with the letter requested. Please reach out if there are any further questions we can assist with.

We look forward to the application being presented to Council so we can move toward construction of this much needed housing to provide for Ucluelet's flourishing future.

In partnership,

Joshua Hunt

CEO – ERIF Sustainable Solutions

APPENDIX A – Lot 3, 221 Minato Rd Ucluelet – Risk Assessment KWL Nov 19 2024

Report link: https://drive.google.com/drive/folders/1ytjEWqk6VT2PAzUVmQ1-Vc9qkq9C5JVJ?usp=sharing

6. Tsunami Risk Assessment – Lot 3

Flood risk is determined based on assessment of the flood hazard and the consequences of the flooding. It is most often quantified in terms of mortality and economic losses and these metrics may be annualized to normalize the assessment process. Depending on the degree of detail of the risk assessment, multiple flooding events may be considered.

6.1 Risk Assessment Methods

This section outlines the methods used to assess the tsunami flood hazard at the project site. The selected approach for risk assessment is outlined in [5]:

A Flood Risk Assessment (FRA) involves estimating the likelihood that a flood will occur and cause some magnitude and type of damage or loss. Following are the principal steps in the Risk Assessment:

1. Identify Flood Hazard Scenarios. These are defined as distinct outcomes from a given hazard that result in some direct Consequence (e.g., fatalities, damage to a building, environmental damage, intangibles such as human suffering) and are based on the results of the hazard assessment described in Section D: Flood Hazard Assessments. They can include different return periods for the same hazard, variable flood extent or Flood Intensity, multi-hazard chains of events, or different consequence chains.
2. Estimate the probability of a Hazard Scenario resulting in some undesirable outcome. This is based on the estimated likelihood that the hazard will occur, reach the Element at Risk when it is present within the hazard zone, and cause the undesirable outcome. These may include a range of outcomes in categories such as economic loss, environmental damage, safety, and corporate or political reputation.
3. Estimate the Consequences of the unwanted outcome including economic losses; human health and loss of life; environmental losses; cultural/historic losses; and intangibles such as psychological distress. Details are described in Section E2.2.
4. Define Tolerable Risk criteria.
5. Prioritize Risk reduction strategies

Flood Risk can be expressed as:

$R = P_H * P_{S:H} * P_{T:S} * V * E$

where:

- R = total Flood Risk;
- P_H = annual exceedance probability of a flood occurring;
- $P_{S:H}$ = spatial probability that the flood will reach the Element at Risk;
- $P_{T:S}$ = temporal probability that the Element at Risk will be present when the flood occurs (for fixed infrastructures and homes this is equal to 1);
- V = the Vulnerability, or probability of loss of life or the proportion of an asset loss to total loss; and
- E = the number of people at Risk or the homes and infrastructures at Risk.

Hazard Scenario

As in Section 5.3, risk has been evaluated based on a single largest-credible hazard scenario with implementation of the proposed mitigation measures (land raising). The use of a single hazard scenario for risk assessment is appropriate given the non-random nature of rupture along a given fault zone. Put another way, it is highly unlikely that more than one tsunami-generating rupture of the CSZ occurs within the design life of the proposed development.

Probability of Consequences

The time-dependent probability of a full rupture of the CSZ is estimated in [11] and [12]. For the year 2100, the annual occurrence probability is estimated to be about 0.2%; equivalent to a 1:500-year return period. Here the occurrence probability is taken as equivalent to the exceedance probability (P_H).

For the purposes of this assessment all people living on Lot 3, and all assets located below the flood level, are assumed to be at risk. i.e., $P_{S:H}$=100%.

For fixed infrastructure the temporal probability that the Element at Risk will always be present, so $P_{T:S}$=100%. People, on the other hand, spend about 70% of their time indoors at home on average, and about 6% of their time outdoors (including at their home) [13]. Given that the habitable space of homes is to be raised above the flood construction level, and the homes are to be designed to withstand the earthquake and tsunami, it might be considered reasonable to assign risk only for the time they are outdoors. However, any residents which failed to evacuate could be stuck in their homes without functioning utilities and without a means of egress, which could have negative impacts on mortality, especially for vulnerable populations. For the purpose of this assessment, it has been assumed that the residents have a 70% chance of being at home and exposed to tsunami hazard. i.e., $P_{T:S}$=70%.

Elements at Risk

In this risk assessment, the evaluated elements at risk are limited to people and built infrastructure. It should be noted, however, that all infrastructure at risk will be the responsibility of either the homeowner or the strata corporation of Lot 3. The DoU will not own or maintain this infrastructure.

Eleven detached houses, each with a secondary suite, are planned for Lot 3, for a total of 22 residences. According to 2021 census data, the average occupancy in the Ucluelet area is 2.3 per residence [14]. This yields an expected total of 51 people living on Lot 3.

ERIF have provided an estimate of the total value of the infrastructure damage during the design tsunami event. Note that habitable spaces of homes are to be elevated above the Flood Construction Level, so are not included in these totals.

Repairs to homes: $2.75M. Includes replacement of break-away wall panels on uninhabitable lower floors, stair replacement, and landscaping.

Common area servicing and infrastructure: $1.6M. Includes landscaping, damage to roads, sewage and water pipe and pump systems.

Estimation of Risk

Loss of Life

The probability of mortality as a function of tsunami height is estimated in [15] for the 2011 Japanese tsunami. For a tsunami height of approximately 10 m, the estimated mortality rate ranges from 3 to 5% with a best estimate of 4%. Another study estimated the mortality rate as a function of flood depth in New Orleans during Hurricane Katrina [16]. For a flood depth 3 m, the estimated mortality rate ranges from about 0.5% to 4% with a best estimate of 2%. It should be stressed that these estimates are specific to the social and geographic conditions of the studied event and region. Important is the variation in available warning, and the age and robustness of the building stock. While there is variance between and within these studies, they do provide similar estimates of the mortality rate during a large flooding event.

The proposed flood mitigation measures influence the selection of an appropriate mortality rate in this application. With suitable emergency management plan, most residents should be able to evacuate to high ground, only about 300 m away, before the tsunami arrives. Further, the proposed homes will be designed to withstand the design tsunami with habitable space above the flood level. So even if a resident fails to evacuate, the risk to that person sheltering in these homes is still substantially lower than in a conventional home constructed at grade. Given these factors, a mortality rate on the low range of the observed data of has been selected for use in this analysis. i.e., V_{life}=0.5%

Economic Losses

Given the limited scope of this assessment, it was possible to directly estimate the potential economic losses due to damage to infrastructure located below the FCL directly as $4.35M. i.e., V * E = $4.35M.

Risk Tolerance

Risk tolerance is a community value, and so should be defined by representatives of the community. It is understood that ERIF have been engaging with emergency management personnel as well as District Council to discuss the issue of risk tolerance. ERIF have reported that DoU has no pre-established risk criteria or tolerance for risk.

In the United Kingdom maximum tolerable risk of death to an individual is 1:100,000 annually for a new development. The Netherlands uses a more stringent maximum risk tolerance of 1:1,000,000 annually. A plot indicating ranges of risk acceptability levels is provided in Figure 6-1 (reproduced from [5]). This plot suggests that an annual risk of death to a single person is “broadly acceptable” below a likelihood of 1:100,000, and unacceptable above 1:1000. Between these to thresholds is the *as low as reasonably possible* (ALARP) zone, where mitigation measures should be used to reduce the risk to as low as reasonably possible.

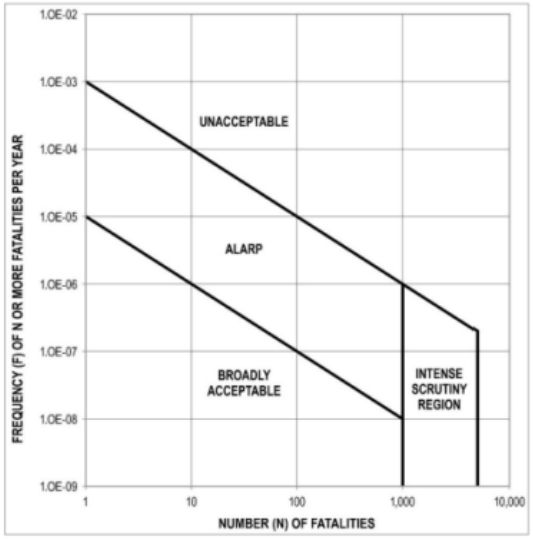

Figure 6-1: F-N curves to evaluate the risk to life loss of groups (source Kendall et al. 1977). Reproduced from [5]

6.2 Risk Results and Discussion

Using the methods of Section 6.1, the total economic losses on Lot 3 due to the design tsunami event are estimated to be $4.35M. The annualized economic losses can be calculated as:

$$R_{econ} = P_H * P_{S:H} * P_{T:S} * V * E = 0.002 * 1 * 1 * \$4,350,000 = \$8,700$$

The expected mortality during the design tsunami event can be calculated as:

$$R_{life} = P_{S:H} * P_{T:S} * V_{life} * E = 1 * 0.70 * 0.005 * 51 = 0.18 \text{ people}$$

This suggests only about a 18% chance that someone on Lot 3 dies during the design tsunami event. This can be restated as about a 1:142,000 chance of death annually due to tsunami to any of the residents of Lot 3. Based on the guidance in the [5], this level of risk falls in a category of risk which is "broadly acceptable".

However, the representatives of the District of Ucluelet should review this analysis and the estimated risk level and determine for themselves if this level of risk is acceptable to the community. This community feedback must be integrated into this report and used as a basis for determining the acceptable level of risk for the proposed development. **The report cannot be completed until this feedback is obtained.** The potential loss of life during the design event is 0.18 people (i.e. <1), and the annualized infrastructure losses are $8,700. Based on the risk matrix provided in Table 6-1, this puts the overall risk at of the proposed development at "low". Given this overall risk level and the guidance in Table E-2 of [5], the current analysis is deemed a suitable assessment of the risk and no further refinement of this assessment is necessary.

Table 6-1: Matrix to Determine the Level of Risk Assessment Needed Based on the Exposure of a Development and Vulnerable Populations to Flood Hazards (reproduced from [5])

Potential Loss of Life for Applied Return Period	Annualized Potential Building Loss ($)				
	<1,000	1,000 to 10,000	10,000 to 100,000	100,000 to 1,000,000	>1,000,000
>100	VH	VH	VH	VH	VH
10 to 100	H	H	VH	VH	VH
2 to 10	H	H	H	H	VH
1 to 2	M	M	M	H	H
0	VL	L	M	M	H

Notes:
VH = Very High; H = High; M = Moderate; L = Low; VL = Very Low

8. Input Required from the DoU

Feeback from the DoU District Council is needed to facilitate the completion of this report. The DoU District Council must provide written feedback indicating if they accept or not the following:

- That this development may proceed in the absence of a standard dike.
- That the development of Lot 3 with 11 houses represents a *nominal* increase to the housing density on the DoU tsunami floodplain.
- That the risk of mortality associated with the development of Lot 3 is acceptable (1:142,000 annually).