

Forwarded by Email

August 22, 2023

Doug Bentley (doug@bercumbuilders.com)

Dear Doug:

**Subject: Preliminary Geotechnical Assessment for Flood Exemption - Final
9651 Kilkenny Place, Vernon**



Our File: RGC-3655

EXECUTIVE SUMMARY

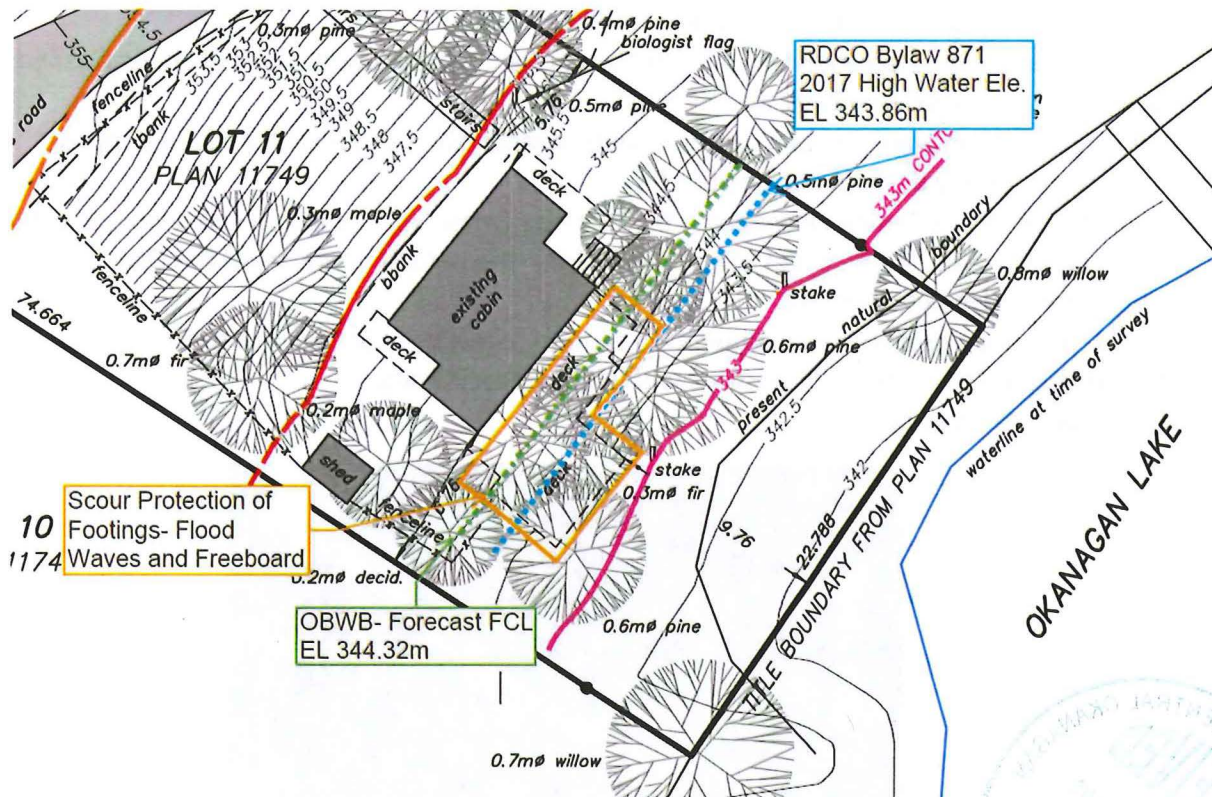
- Renovation to a seasonal cabin residence is proposed at 9651 Kilkenny Place, Vernon with title description of Lot 11, PLAN KAP11749, District Lot 3330, ODOY.
- Renovation activities will include changes to interior and exterior walls, improvements to existing concrete footings. Any excavation or construction is planned to have a light footprint with no machinery on ground at cabin or shoreline is anticipated
- This property is situated on the west shoreline of Okanagan Lake and is part of an established development, considered Zone RU5 by RDCO.
- Proximity to Okanagan Lake and any covenants, riparian zone and floodplain issues impose constraints for any development on this lot.
- Regional District of Central Okanagan (RDCO) Zoning Bylaw No. 871 Floodplain Regulations has FCL elevation of EL 343.86m and 15m setbacks from the natural boundary of the Okanagan Lake requirements for development.
- Flood Exemption assessment is required to confirm regulatory 15m setback from Okanagan Lake for existing building and decks, located within the setback limits.

Figure 1 – Property survey plan



- Conclusion of geotechnical assessment confirms that property is generally stable with slope related hazards observed
- Septic disposal field is located the 30m setback from shoreline at an elevation of 356m.
- Recommendation is that existing building and decks can remain with improvements to shallow concrete foundations
 - Concrete footings – building and decks require an engineering assessment of concrete condition, bearing capacity and minimum depth for frost protection. Indicative mitigation measures may require minor excavation, placement of structural concrete and backfilling.
 - Scour Protection – concrete footings and foundation area located below EL 344.5m should be protected against flood induced erosion and wave scour. Mitigation measures should be designed to account for longer term forecast flood conditions and should extend up to 600mm outside footprint of the deck. Scour and erosion protection measures should be engineered, and may include options such as placement of course rock/ riprap underlain by geotextile filter material, or suggest proprietary geosynthetic products from Layfield including Geoweb or Shoreline Transition Mat.

Figure 2 – Site Plan showing Flood Construction Levels (RDCO and OBWB) and Footing Scour Protection



1. Introduction and Background

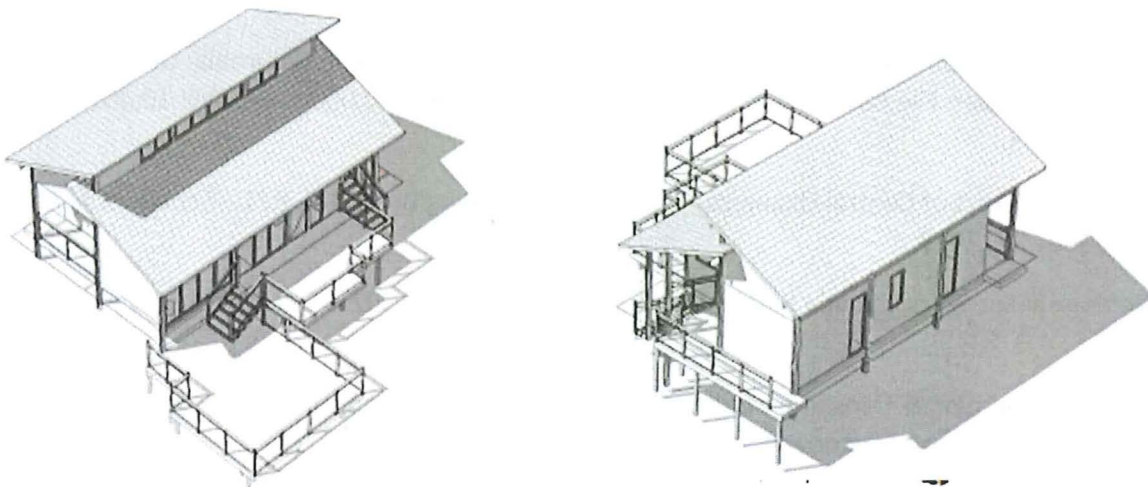
Rock Glen Consulting Ltd. (RGC) was retained by Bercum Builders to provide geotechnical engineering services to assess an exemption to RDCO's Bylaw (871), for a proposed renovation of an existing single season cabin at 9651 Kilkenny Place, Vernon.

The property owner plans to renovate an existing wood framed cabin structure, including the changes to interior and exterior walls. Tiered wooden decks are located on the lakeside of the cabin; lower deck is about 1m below cabin floor elevation. Assessment and improvements to shallow concrete footings are anticipated but will be completed without machinery on the ground at cabin level. Total footprint of the cabin and decks will not change as part of the planned work.

BC Assessment describes the lot area of 0.449 acres and cabin floor area including loft is 80.4 m² (865 sqft), with footprint of 51m² (550 sqft). A light wooden shed is set against the south property boundary towards the back of the cabin. The shed is approximate 1.2m by 2m, providing cover over septic tank, pump and controls.

In addition, the existing building is supplied by an existing pump and water line into Okanagan Lake- for domestic water source. Septic services is provided by a tank buried south of the cabin and pumps system up to septic disposal field near EL 356m, located beyond the parking area or +30m from shoreline.

Figure 3 –Indicative cabin arrangement- Isometric view from southeast and northwest



As discussed below, the property is adjacent to Okanagan Lake and the existing building encroaches on the into the floodplain and 15m setback. issues impose constraints to development on this lakefront lot.

Property Description

The subject property is located 45km north of West Kelowna, on the western shoreline of the Okanagan Lake. Access is via Westside Road, turning east on Kilkenny Place, then following right of way to parking area on the property near El 356m. The cabin is located near toe of the slope (accessed via a long run of wooden stairs. Elevation of the Main Floor of the cabin is EL 346, with an estimated 450mm (18in) depth of framing below.

Property is Zoned RU5- Rural Residential

Property location and development are depicted in Figures in Appendix A

- Figure A1- Location Plan
- Figure A2 - , Site Plan
- Figure A3 – Indicative Building Section.

RDCO Bylaw 871 specific flood construction levels and minimum setbacks from Okanagan Lake and any development within this setback must be assessed for exemption to RDCO Flood Mitigation Strategy

A setback of 15m from the Okanagan Lake and a Flood Construction Level (FCL) of 343.86m G.S.C. datum for a habitable structure or storage areas for goods damageable by floodwaters. FCL includes provisions of freeboard and waves. above flood elevation.

2. Documents Reviewed

The following documents provide general references to documents reviewed and consider in the recommendations below.

- BC Assessment. [BC Assessment - Independent, uniform and efficient property assessment](https://www.bcassessment.ca//Property/Info/QTAWMDBBQTdLTA==)
<https://www.bcassessment.ca//Property/Info/QTAWMDBBQTdLTA==>
- Northwest Hydraulic Consultants Ltd. (OBWB, 2000). Okanagan Basin Water Board, Kelowna, BC, 2020, Okanagan Mainstem Floodplain Mapping.
- Okulitch, A.V. (comp.), 2013. Geology, Okanagan Watershed, British Columbia; Geological Survey of Canada, Open File 6839, scale 1:1000,000. Insert Map 3, 1:50,000 scale. DOI:10.4095/292220. Sheet 2 of 3.
- Regional District of Central Okanagan (RDCO, 2023). Zoning Bylaw No. 871 – Schedule A. Revision Date June 27, 2023.
- Geological Survey of Canada Surficial Geology Vernon, MAP 1392A. Geological Survey of Canada, 1974.
- Sage Environmental Consulting Ltd. Environmental Inventory and Impact Assessment for 9651 Kilkenny Place. Dated October 5, 2022.
- West Coast Design. Project: 9651 Kilkenny Place, Vernon. Permit Drawing Package- A1.01, A2.01 & A3.01. Dated June 24, 2023.

3. Property Description

The property is accessed by turning south off Westside Road, following Hodges Road then turning northeast onto Kilkenny Place. Access to the property is available through right of way, allowing access to neighboring properties beyond. Paved parking space at an approximate elevation of 354m is located mid-property with wooden stairs leading down to the cabin.

The property is Zoned RU5, with neighboring residential zones to the northeast and southwest, and Okanagan Lake to the southeast. Elevation of the property varies from 370m at Kilkenny Place road to

342m at lake shore. The property has two distinct slope areas. The top of the property, to the west, slopes down towards the east at an average grade 75% (1.25H:1V). Change in slope grade occurs near west or back side of the building, to an approximate 15% grade, providing the foundation grade for the building and continues to the lake shore.

4. Site Reconnaissance

Generally, the existing building is a light timber structure. The building is connected to basic utilities- including buried water service from the lake, septic system with disposal field north of the parking area, and electricity from an overhead powerline. Broadly, the property is well vegetated and layered with native grasses and shrubs, and a variety of trees including maple, fir, pine, and willow trees (20 to 70cm dia.) down from the access road to the shoreline. Upper area of the property is covered by a mix of mature conifers, grasses and shrubs.

Geological setting is based on regional geological mapping- this property is underlain by:

Bedrock Geology - Mesozoic granodioritic intrusive rocks from the Jurassic to Paleogene age.

Outcrops are evident in excavated upper slope of the access road slope, mid-length on property. Groundwater seeps to surface near the outcrops and drains via rock ditching. This may indicate shallow overburden over bedrock and that stability of the forested slope is bedrock controlled. Projections from bedrock exposure indicate that bedrock is likely deeper than 5m below foundation depth of the cabin. This means that footings are likely founded on coarse grain soils. Depth to footing elevation and subgrade materials should be assessed and confirmed by a geotechnical engineer, as part of engineering and construction renovation.

Buildable area above flood construction level consists of soils over bedrock. Bedrock will not influence foundations and is well suited for construction of house and utilities.

Surficial Soil - mapping indicates that this property is located on the border of Kettle Terrace and Undivided deposits. These deposits consist of gravel, sand from the Cenozoic era, as well as undifferentiated morainal deposits. Site inspection by Travis Brown noted that observable soils on surface primarily consisted of gravels and lakeshore sediments.

Surface and Groundwater – Locally there are minor creeks south and north of the property- Norris creek to the South and Fisbee Creek respectively. These creeks drain forested areas up slope of Westside Road but do not influence the subject property. There were no observations of seasonal or ephemeral surface water drainage on the property.

Groundwater levels near the cabin are likely comparable to lake water elevation and should be a consideration during assessment of foundation depth and characterisation of subgrade soils.

Groundwater seeps near bedrock rock outcrops have caused instabilities but no slope instabilities were observed within the property.

Strategy for roof water should include disposal to ground in accordance with BC Building Code; drain pipe to extend 5m from building foundation and disposed to a non-erodible surface or buried dry well. In-ground stormwater disposal works will also need to be accommodated on the building area without encroaching on the 15m setback.

Building foundations – shallow footings generally consist of concrete footing with 80mm by 80mm wooden piers supporting cabin and deck framing, Building is primarily supported on square (16in x 16in) concrete footings. Subgrade soils appear to be compact sand and gravel material, however most footings have less than 600mm cover for frost protection. Deck area is supported by Sono-tube type footings.

All footings require an engineering assessment as part of structural design. Improvements to concrete footings will likely require changes to bearing pad and depth below ground surface for frost protection. Use of tracked or wheeled machinery is not planned.

Slope stability – the lot slopes up from water line with an increasing grade, the road (Kilkenny Place) marks the high point of the property at elevation.

Cut slopes along the road are generally vegetated and appear stable at a slope of 0.75H:1V to 1H:1V.

Cut slopes along the paved access indicate bedrock is near surface, with thin overburden supporting mature conifers. Site measurement confirmed that slopes are steeper than 30%; measured at 1.25H:1V. There were no observation of instability during site reconnaissance and slopes of concern in recent aerial imagery.

Below the access road, slope moderates to 1.25H:1V, transitioning to a 6H:1V slope below the cabin, then tapering to shoreline.

Shallow depth to bedrock and course grained foundation soils are assessed to have a factor of safety greater than 1.5.

Access down from the parking area is limited. It is expected that construction will require delivery of materials by crane. Use of a crane should include a lift plan including position of outriggers, weight and reach limits, and geotechnical assessment.

Select Site Photos – are presented in Appendix B including

- Photo No. 1, 2 & 3 are indicative of existing conditions near front of the cabin and shoreline adjacent to the Okanagan Lake. The shoreline is generally sandy gravel with cobbles, with shrubs set on shore slope. Area appears stable with no shoreline erosion.
- Photos No. 4, 5, 6 & 7 provides a record of building foundations and other structures and utilities on the property.
- Photo No. 8 & 9 – access road, bedrock outcrops, slopes are forested.

5. Floodplain Regulation and Mapping

RDCO Zoning Bylaw No. 871 Section 3.28 Part 2 specifies that:

- Flood Construction Level is 343.86 metres (CGVD28) 343.48 (CGVD2013) for land adjacent to Okanagan Lake
- Floodplain setback of 15.0 metres (49.2 ft.) from the natural boundary of Okanagan Lake must be maintained and
- An exception (Part 3) can be made if the property can be demonstrated to be safe for the intended use by a qualified professional.

The estimated elevation of main floor of the cabin is EL 346m less 450mm (18in) depth of wood framing. Floor elevation is about 2m above FCL, accounting for framing thickness.

Purpose of the floodplain setback is to prevent the flood hazard and erosion caused by the proximity of the watercourse from impacting the proposed development. These structural may remain in place and will not be affected by prescribed flood water levels, except for foundation of the deck area.

Okanagan Basin Water Board Okanagan Mainstem Floodplain Mapping project was initiated following the record-setting high flows in the Okanagan Valley in 2017. OBWB study also assessed impacts of climate change and forecasts flood levels for mid-century (2040-2070) and end-of-century (2070-2100)- to guide long-term planning. OBWB's recent floodplain mapping is based on the latest hydrological models and analysis, but there are limitations to the analysis as the project is regionally based.

According to CVGD2013 calculated flood construction level is 343.48 m which includes 0.6 m of freeboard above the calculated water surface elevation during the design event. In addition to the water surface elevation, the lake shoreline flood construction level zone, which is defined as the area where wave setup and run up must be considered.

The OBWB 2020 flood mapping design event on Okanagan Lake considers the flood of record (2017) adjusted to mid-century for climate change. The CVGD2013 calculated flood construction level is 344.3 m (OBWB, 2020) which includes 0.6 m of freeboard above the calculated water surface elevation during the design event. In addition to the water surface elevation, the lake shoreline flood construction level zone, which is defined as the area where wave setup and run up must be considered.

Considering the property foreshore is intact with limited infrastructure and no changes to foreshore are planned, flood mapping and models are considered appropriate for the subject property and site-specific assessment is not necessary. Visual observation was used to confirm that the results of the Okanagan Lake shoreline wave effects floodplain extents were appropriate. The site topography rises from the high-water mark at about 15%, the balance of the property above is steeper at 75% (1H.25:1V).

The estimated elevation of main floor of the cabin is EL 346m less 450mm (18in) depth of wood framing. Considering FCL recommended by RCO and OBWB, and accounting for framing thickness cabin floor elevation is about 1.25m above RDCO FCL (short term) and 0.75m above OBWB longer term forecasted FCL value. Lower Deck will have 0.25m above RDCO FCL (short term).

The existing building encroaches on the recommended shoreline flood construction zone identified in the 2020 OBWB Floodplain Mapping Study. Figure A3 (attached) provides a schematic section of the lower portion of the property including reference elevations.

Wave Run-Up is a risk to the deck area. RGC briefly assessed configuration of a raised mitigation structure such as an embankment or vertical wall. However analysis confirmed that these structures would raise elevation of wave run-up.

Preference is to maintain existing low grade slopes below the deck and shoreline to minimise wave height. Footings and deck area should be protected from scour and erosion related to waves and flood water levels.

Okanagan Lake is large with limited occurrence of floating debris, such that no provision for protection of deck structure against floating debris is required.

6. Conclusion and Recommendations

Broadly the property is stable with no slope or terrain hazards identified. Engineering assessment of all footings is required but construction planning does not anticipate use of machinery (ie wheeled or tracked) or an increase in the building footprint. For this reason, no recommendations for water management, building area preparation, and seismic site class are not described below.

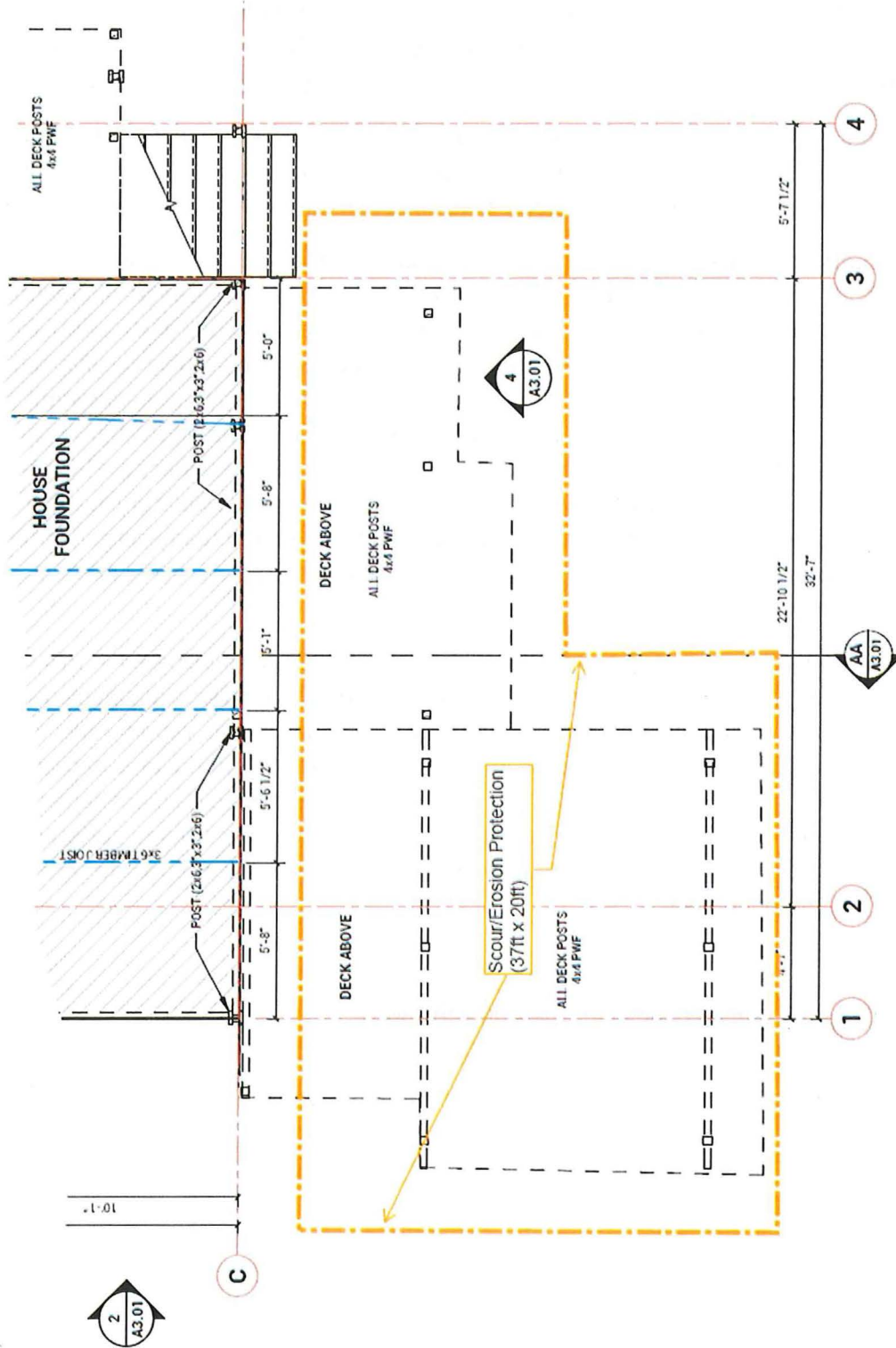
Recommendations below are for the flood hazard relative to Okanagan Lake only. The technical and site review completed in this study show that although flood risk is present, the proposed renovation can be safely completed for its intended use provided the following recommendations are implemented.

1. Surveyed elevations should be checked against CGVD2013 vertical datum for establishing of benchmarks and elevation control for Flood Construction Levels. See discussion [in OBWB Report \(NHC, 2021\)](#).
2. Existing deck area can remain within the 15 m setback, ie building to remain within the shoreline floodplain zone as established in the 2020 OBWB Floodplain Mapping Study.
3. Flood Construction Level (FCL), which is defined as the design flood level plus an allowance for freeboard, determines the minimum habitable floor level of a structure or infrastructure that could be damaged by flood waters and is 343.46 m (CGVD2013) for this site according to the 2020 OBWB study. It applies to the underside of a wooden flooring system. Floor level of the existing cabin is EL 346 m less 450mm (18in) depth of wood framing and is not proposed to change according to West Coast Design drawings.
4. The existing building footprint is within the shoreline flood construction zone, with floor level above the required elevation of EL 343.48 m (CGVD2013) and future forecasted level of 344.3m. The floodplain setback can be reduced from 15 m to an estimate 7m for the cabin building and 1m for deck. Further, renovation planning should include provisions to assess deck and house footings, and measures to protect against scour and erosion due to flood water level and waves (see Figure A3).
5. Scour and erosion protection measures – concrete footings and foundation area located below EL 344.5m should be protected against flood induced erosion and wave scour. Area is estimated at 37ft by 20ft. Mitigation measures should be designed to account for longer term forecast flood conditions and should extend up to 600mm outside footprint of the deck.

Scour and erosion protection measures should be engineered. Traditional approach is to place course rock or riprap underlain by geotextile filter material (see BC MOE Design

Guidelines). Proprietary products may offer a lower effort approach - suggest proprietary geosynthetic products from Layfield Group (<https://www.layfieldgroup.com/>) including Geoweb or Shoreline Transition Mat.

Figure 4 – Excerpt of Foundation Site Plan showing extent of Footing Scour Protection



7. Closure & Limitations

This report is prepared for the exclusive use of Bercum Builders Ltd. and the owners of 9651 Kilkenny Place, Vernon BC and, may not be used by other parties without the written permission of Rock Glen Consulting Ltd. The Regional District of Central Okanagan may also rely on the findings of this report.

Where building plans change from the permitting drawing set, or if during construction soil or drainage conditions are noted to be different from the description in this report, RGC should be notified immediately in order that the report conclusions can be confirmed or modified, if required.

It should be noted that the conclusions provided in this geotechnical assessment are based on a limited site reconnaissance and that subsurface conditions can vary. This report should not be included in any tender or contractual specifications without suitable qualifications approved by the geotechnical engineer.

The reader’s attention is drawn specifically to those conditions, as it is considered essential that they be followed for proper use and interpretation of this report. The geotechnical aspects of any future design drawings and specifications should be reviewed by RGC prior to tendering and construction, to determine that the intent of this report has been satisfied. During construction, sufficient subgrade inspections should be carried out to review the exposed soil conditions and determine if they are consistent with those encountered in the site review, as well as to monitor conformance to the geotechnical specifications. Adequate field review, observation, and testing during construction are necessary for RGC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, RGC’s responsibility is limited to interpreting accurately the information encountered on site, at the time of their determination or measurement during the preparation of the Report.

Where conditions encountered at the site differ significantly from those anticipated in this report, it is a condition of this report that RGC be notified of any changes and be provided with an opportunity to review and revise the recommendations within this report. The material in this report reflects RGC's best judgment and professional opinion in light of the information available to it at the time of preparation. Any use which a third party makes of this report or any reliance on or decision to be made based on it are the responsibility of such third parties. RGC accepts no responsibility for damages, if any, suffered by any third party as a result of decision made or action based, or lack thereof, on this report. No other warranty is made, either expressed or implied.

Please contact us if you have any questions regarding this work.

Yours truly,

This document is a printed copy from Digitally Authenticated original



A handwritten signature in black ink, appearing to read "R.B.", located to the right of the seal.

Travis Brown, P.Eng.
Rock Glen Consulting Ltd.
EGBC Permit No. 1002767

Rowan Brown- Engineering Intern

Appendix A – FIGURES

Figure1 – Location Plan

Figure 2 - Site Plan

Figure 3 - Indicative Building Section



Figure 1: Location Plan
9651 Kilkenny Place, Vernon, BC

RGC-3655
August 14, 2023

Design	TB	2023 08 14	Drawn	RB	2023 08 14
Checks					
Date	Name	Description			
2023 08 22	TB	FOR PERMITTING			
EGBC Permit No. 1002767					

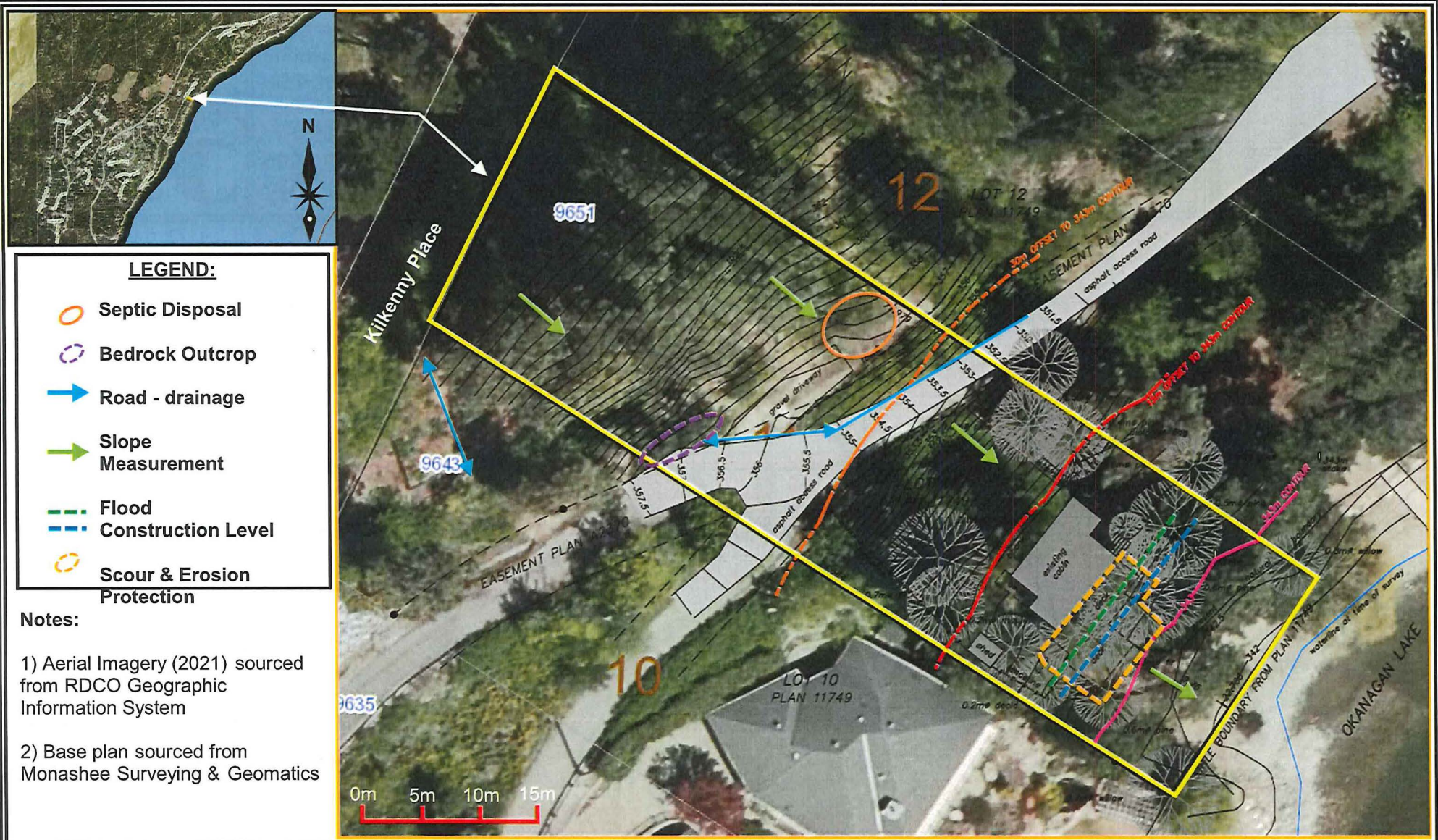


Figure 2: Site Plan
 9651 Kilkenny Place, Vernon, BC

RGC-3655
 August 14, 2023

Design	TB	2023 08 14	Drawn	RB	2023 08 14
Checks					
Date	Name	Description			
2023 08 22	TB	FOR PERMITTING			
EGBC Permit No. 1002767					

Notes:

- 1) Section sourced from Bercum Builders Inc.
- 2) Site topography based on survey by Monashee Surveying & Geomatics.

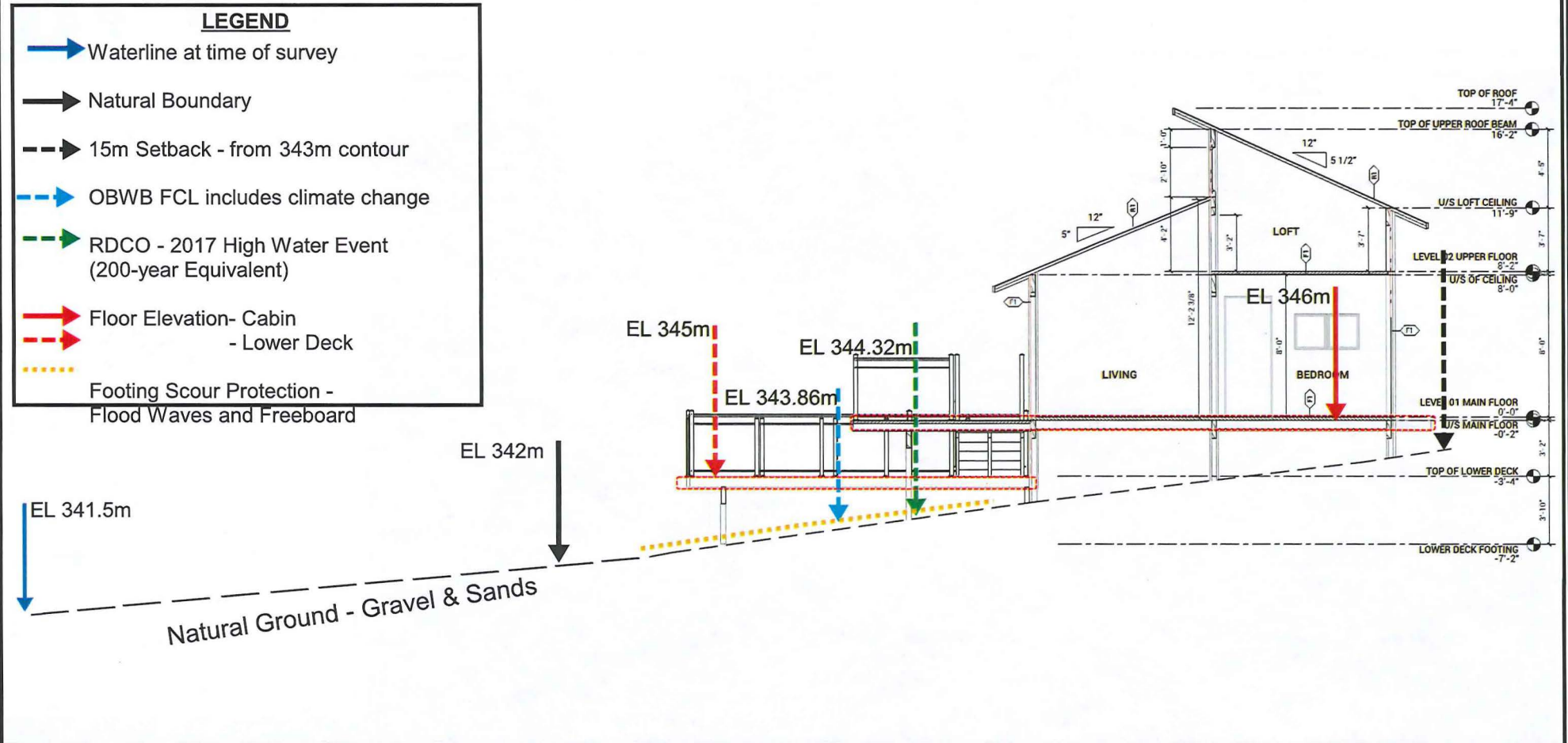


Figure 3: Typical Section
 9651 Kilkenny Place, Vernon, BC

RGC-3655
 August 15, 2023

Design	TB	2023 08 15	Drawn	RB	2023 08 15
Checks					
Date	Name	Description			
2023 08 22	TB	FOR PERMITTING			
EGBC Permit No. 1002767					

Appendix B – Select Site Photos

Photo 1 – Looking at front of cabin (northwest) and water intake from shoreline.

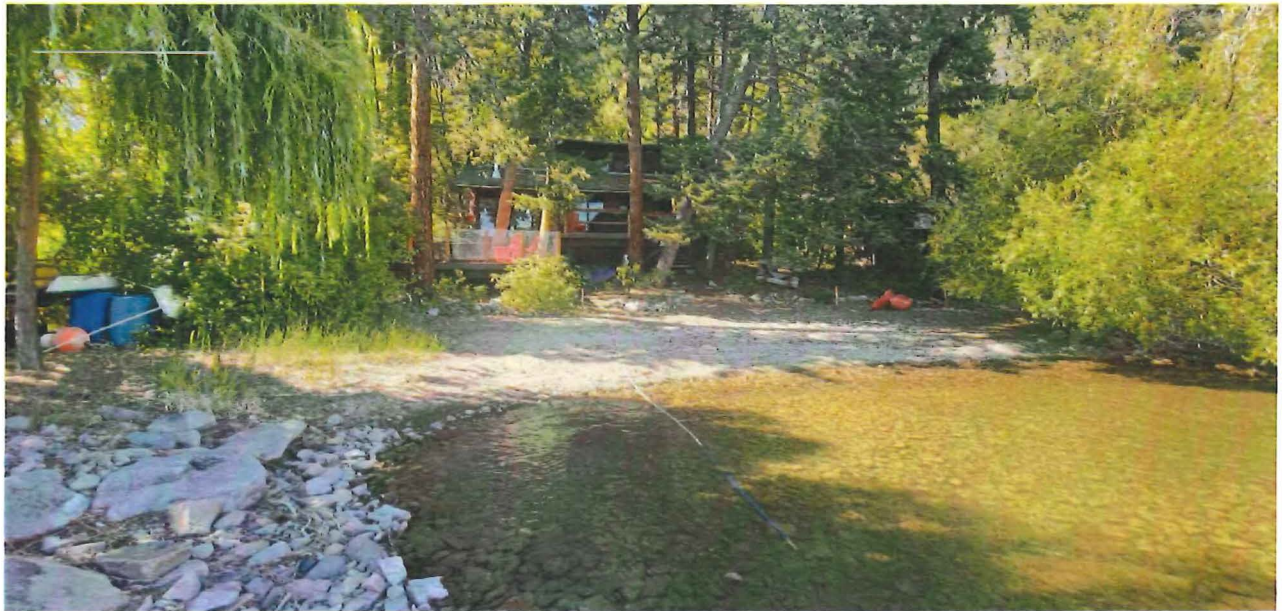


Photo 2 - Looking down shoreline (to south) at lower deck area.



Photo 3 – Looking at cabin and pumphouse (northwest) – within 15m Setback

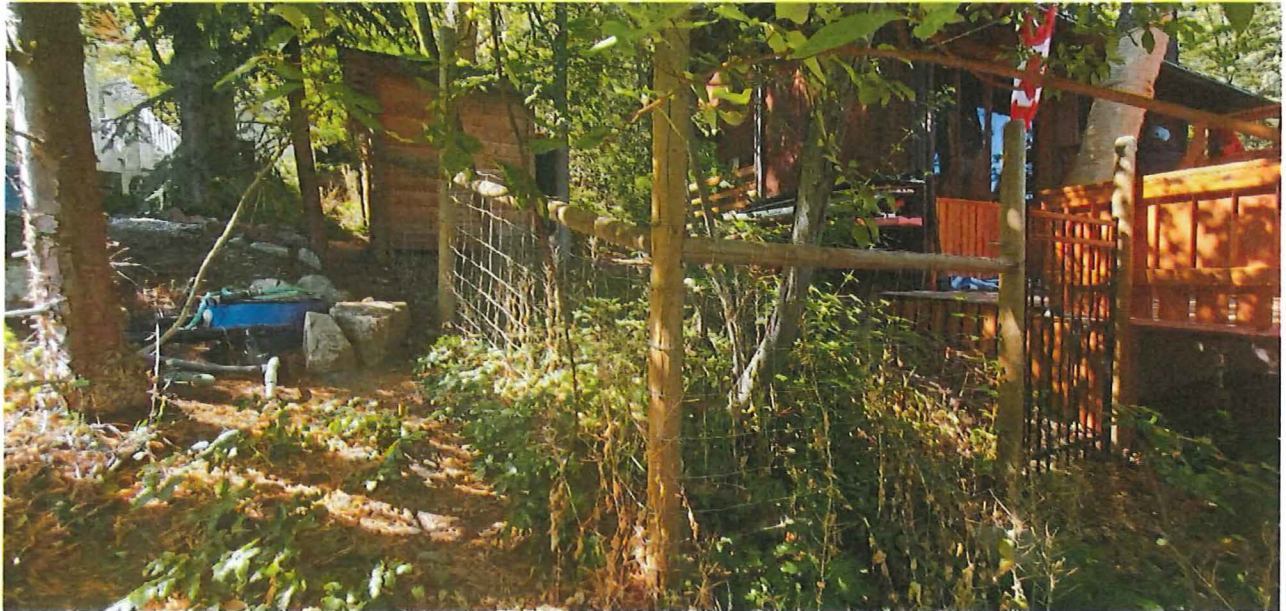


Photo 4 – Looking at – entrance to upper deck area, and south roof and downspout



Photo 5 – Under cabin, buried water intake suction pump and control valve



Photo 6 – Shallow concrete footings on Sands and Gravels



Photo 7 – Storage shed over septic tank and pump



Photo 8 – Vegetated slope behind the cabin, below access road

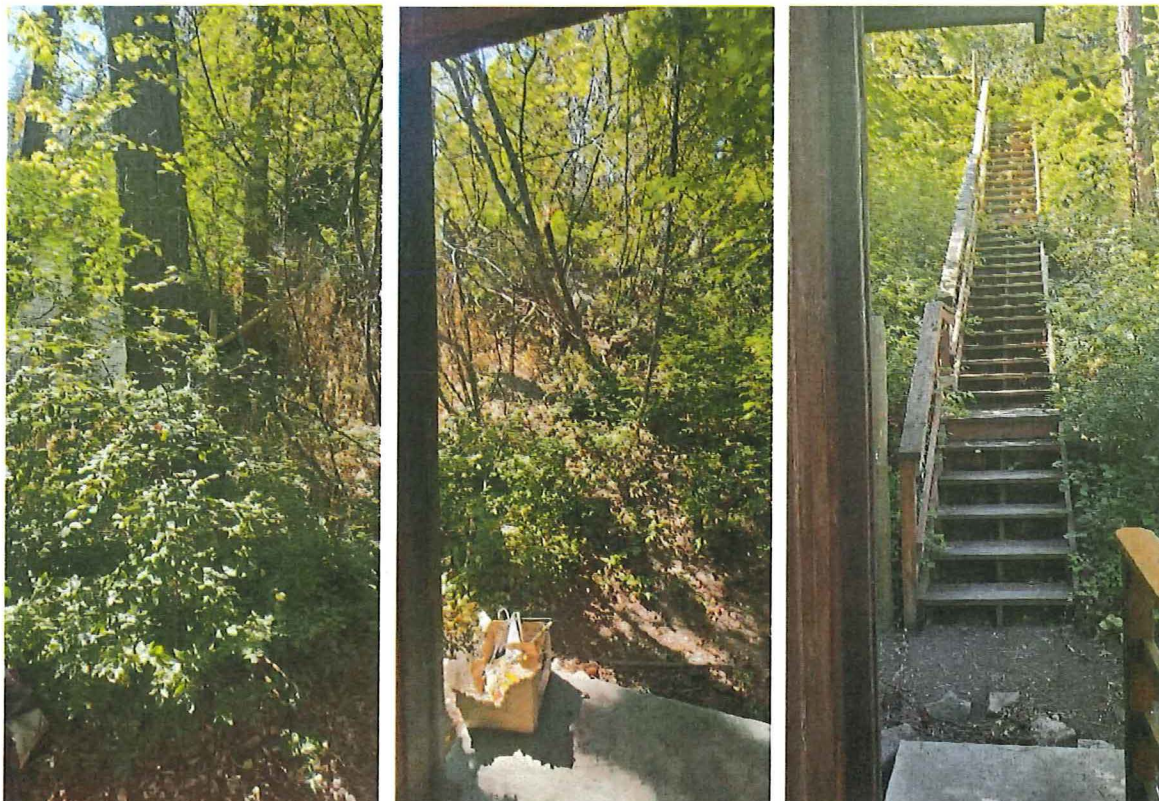


Photo 9 – Forested slope above access road, groundwater seep and bedrock outcrops

