

## DPA 4 – Rocky Beach Front/Escarpment, Rockfall and Upland Slope Hazards

### Location

DPA 4 includes the shoreline areas and upland areas along Georgia Strait and Sechelt Inlet and other upland slopes as mapped generally on Schedules E1-E3. The DPA includes the beach area from the high tide level, up to a minimum of 15m horizontal setback behind the top of slopes, or as mapped for upland areas.

This DPA also includes rockfall hazard areas within the neighbourhoods of Tuwanek, Sandy Hook, and West Porpoise Bay.

### Category

Protection of development from hazardous conditions.

### Justification

#### *Rocky Beach Front and Upland Slopes*

DPA 4 applies to:

- 1) The shoreline along Georgia Strait between the western municipal boundary at Sergeants Bay and the Fiddler Road right-of-way, within West Sechelt (Schedule D1);
- 2) The beach front area to the south of Hwy.101 and to the west of Camden Road right-of-way, within West Sechelt (Schedule D1);
- 3) The upland areas located between Hwy.101 and the northern municipal boundary, within West Sechelt and West Porpoise Bay (Schedule D1);

- 4) The shoreline area along Sechelt Inlet extending from the municipal boundary at Snake Bay, southwards to the municipal boundary adjacent to IR 3 (Swaycalse), including an area between Gale Ave. South and Lookout Ave. in Sunshine Heights/West Porpoise Bay (Schedule D1);
- 5) The shoreline areas along Sechelt Inlet to the west of Sechelt Inlet Road, the upland areas to the east of Sechelt Inlet Road, within Tuwanek (Schedule D2);
- 6) The shoreline areas along Sechelt Inlet and upland areas, between Naylor Road in Tillicum Bay and the western boundary of IR 28 (Shannon Creek), within Sandy Hook (Schedule D2);
- 7) A shoreline area along East Porpoise Bay to the west of the wharfs, and an upland area partially bounded on the east by Salmon Drive, within the Village (Schedule D1);
- 8) A shoreline area along Georgia Strait south of Browning Road between McCullough Road and the Paul Road right-of-way, within Wilson Creek (Schedule D3).

The terrain within this DPA is predominantly steep rocky beach front and upland slopes with a discontinuous surficial blanket or veneer of fine grained or granular morainal soils or rubbly colluvium over bedrock. In the Snake Bay area, soil

deposits are generally thicker and include a sand and gravel veneer of probable marine origins.

The soils are subject to potential shallow instability, small debris landslides and to minor storm wave erosion where they are exposed along the beachfront. Creep and shallow instability in the surficial soils have been observed.

On rock slopes, there is a potential for local instability including the possibility of rockfalls from exposed bedrock faces. Three areas of severe rockfall hazards are identified in the Tuwanek and Sandy Hook neighbourhoods and one in Sunshine Heights. Modifications to existing rock slopes, either as cuts or fills may increase the extent or risk of instability. Surficial runoff and seepage from perched groundwater tables have contributed to the formation of gullies within the thicker surficial soil deposits in these areas.

It is estimated that a moderate to low probability is estimated for the occurrence of shallow soil instability including debris landslides, rock slope instability and isolated rockfalls from these existing natural slopes. It is estimated that a high probability exists for soil instability including small soil slides on the slopes of the small creek gully located at the north end of Porpoise Drive in Sandy Hook.

### *Trail Bay and Davis Bay Beach Front Escarpments*

DPA 4 applies to:

- 1) The area to the south of Hwy.101 from approximately Mason Road to just east of Norwest Bay Road, along Trail Bay in West Sechelt (Schedule D1);
- 2) The area west of Highway 101 from just north of Bay Road northward to the boundary with IR2 (Sechelt), along Davis Bay (Schedule D3).

Steep beachfront escarpment slopes up to 50 m high comprising predominately gravelly to sandy veneer of probably marine origin and colluvium over compact to dense sand till. Bedrock is exposed near beach level at several locations in the Trail Bay area. There are areas of active land sliding and slumping on the escarpments, and soil creep is widespread.

Seepage from the escarpment is common, particularly along the top of the dense till. Local perched groundwater tables can be expected. Gullies have formed on the escarpments and there are many areas of saturated surficial materials. Uncontrolled drainage exists in some areas and is currently directed towards and onto these slopes. Discharge from septic fields may contribute to slope instability. The excavation of roads, driveways, footpaths and stairways for beach access is contributing to slope instability.

The potential for debris landslides, slumping, creep movements and gullying

on the face of the escarpments is high and there is some potential for storm wave erosion. It is estimated that a very high probability exists for the occurrence of landslides and related soil instability on the escarpment slopes. It is estimated that a high to moderate probability is exists for the occurrence of landslides and related soil instability within the 15 m setback zone behind the slope crest.

### *Rockfall Hazard*

Rockfall hazards are identified:

- 1) Within Tuwanek and in Sandy Hook both north and south of Four Mile Point (Schedule D2); and
- 2) Within the Sunshine Heights area of West Porpoise Bay (Schedule D1).

Rockfall is the rapid, free fall of newly detached segment of bedrock from a cliff or steep rock slope. Rockfall areas can often be identified by the presence of talus deposits and recently rockfall activity can be roughly assessed by the presence and distribution of fresh rock fragments. Rockfall hazards associated with steep bedrock bluffs have been identified at several locations in the District, and pose a threat to a number of properties. The most serious rockfall hazard has been identified in the area to the south of Sandy Hook.

These areas comprise steep fractured bedrock slopes or bluffs having a known or perceived high potential for slope

instability and rockfalls. Active rockfall areas are characterized by the presence of blocky colluvial deposits. These areas



\* *Unstable soils on upland slope.*



\* *Recent slope failure in Davis Bay/Selma Park after heavy rains.*

may present a serious hazard to development, including or in particular those properties down slope of the rockfall area. It is estimated that a very high probability exists for the occurrence of rockfalls in these areas.

### Exemptions

General exemptions for natural hazard/environmental protection DPA's 1-5 apply.

### Guidelines

1. No buildings, structures or other uses of land, including clearing, removal of soil, rock, trees or vegetation, or other alteration of the land, is permitted in DPA 4 except in accordance with a development permit issued by the District of Sechelt.
2. Buildings, pools/hot tubs, patios or other impervious surfaces, driveways, utilities, drainage facilities, septic fields, trails and stairways should not be located in unstable or erosion-prone escarpment areas. A minimum setback of 15 metres from the top of slope shall be maintained free of development.
3. Vegetation should be maintained and/or reinstated on the slopes and within the 15m setback zone from the top of the slope, to minimize erosion and instability. Lawns are discouraged near the edge of slopes, and dense, native shrubs and trees are preferred.

4. No fill should be placed or materials (i.e. lawn cuttings) should be disposed of at the top of slopes.
5. Relaxation of setbacks from Georgia Strait is discouraged in order to minimize potential impacts of erosion or runoff.
6. Alteration of the beachfront and foreshore with protective structures such as riprap, concrete block or shot rock is discouraged.

### Assessment Report

7. Prior to any development or alteration of the land, the potential for both rock and soil slope instability, landslide activity and soil movements must be addressed by a site specific investigation and report, prepared by a Qualified Professional with specific experience in geotechnical engineering and/or engineering geology.
8. The engineering report and any associated plans or designs for the proposed development shall:
  - (a) Provide accurate field definition of slope crest, location of geological features and document the extent of slope instability or rockfall areas. Site plans and slope profiles shall be included;
  - (b) Assess the erosion potential of ocean waves on beachfront slopes, including potential increase in wave action/height due to climate change;

- (c) Evaluate groundwater conditions and the potential for slope instability caused by groundwater seepage;
- (d) Identify possible changes in slope conditions that might indicate an imminent landslide or rockfall hazard, for the attention of landowners;
- (e) Identify the anticipated effects of septic and site drainage systems on slope stability. These systems should be designed to avoid surface and groundwater erosion of beach front slopes. The extent of bedrock or low permeability soils at shallow depth throughout this area will limit the viability of in-ground septic disposal systems;
- (f) Provide geotechnical assessment of cut and fill slope stability and provide appropriate recommendations and restrictions on excavation, blasting and filling;
- (g) Building envelopes and setbacks and other restrictions to development should be established with reference to natural or cut slope crests and possible rockfall zones should be determined.
- (h) Provide detailed land use and construction recommendations to address local bank erosion and protection measures, including appropriate building setbacks from hazards slopes or rockfall hazards;

- (i) In areas of bedrock, the engineer should assess the necessity and provide detailed recommendations for selective scaling, rock bolting, and tree removal/replanting to improve stability conditions, on a site-specific basis;
- (j) Reports must meet the report guidelines for *Legislated Landslide Assessments for Proposed Residential Development in British Columbia* published by the Association of Professional Engineers and Geoscientists of British Columbia, March 2006<sup>13</sup>, including submission of Schedule D (Landslide Assessment Assurance Statement) to specify that the land may be safely used for the use intended.

**Permit Conditions**

- 9.** A Development permit issued for lands in DPA 4 may:
- (a) Specify areas of land that must remain free of development, except in accordance with any conditions contained in the permit;
  - (b) Specify natural features or areas to be preserved, protected, restored or enhanced;
  - (c) Require construction of works or other protection measures,

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<sup>13</sup><http://www.apeg.bc.ca/ppractice/documents/ppguidelines/guidelineslegislatedlandslide1.pdf>

- including planting or retaining vegetation or trees, in order to control drainage, control erosion or protect banks or other hazards;
- (d) Require in any area that contains unstable soils that no septic system, drainage or water system be constructed.
- (e) Establish conditions and requirements that vary the permitted use and density of land that may be subject to hazard, but only as they relate to health, safety or protection of property from damage;
- (f) Impose conditions on the sequence and timing of construction;
- (g) Require monitoring and reporting during and post-construction.
- (h) Require security for completion of permit conditions.

- 10.** Lands in DPA 4 may also be in DPA 3 (Marine Shoreline) and DPA 5 (Steep Slopes) and guidelines for all DPA's apply.