District Lot 86 Baseline Report

Prepared by Keefer Ecological Services Ltd.

2021-10-07

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1. Summary

1.1. Objectives

Keefer Ecological Services Ltd. (KES) was contracted to undertake an ecological inventory of District Lot 86 to describe the current condition of the property's terrestrial ecosystems, which may be relied upon as necessary in future land management.

1.2. Contributors

Table 1. Project contributors.

Name	Title	Organization
Mike Keefer, MSc, PAg	Senior ecologist	Keefer Ecological Services Ltd.
Andrew Simon, MSc	Biodiversity Specialist & GIS Analyst	Keefer Ecological Services Ltd.
Emma Cooke, BSc	Junior GIS Analyst	Keefer Ecological Services Ltd.

2. Parcel Location and Identification

District Lot 86 (PID: 008-015-961) is located on the northeast coast of Galiano Island, BC, off Bodega Beach Drive, at approximately 48.999650°, -123.561863° (Fig. 1).

3. Indigenous Land Acknowledgment

District Lot 86 lies in the traditional territories of Penelakut, Hw'litsum, and Tsawwassen First Nations, and other Hul'qumi'num-speaking peoples.

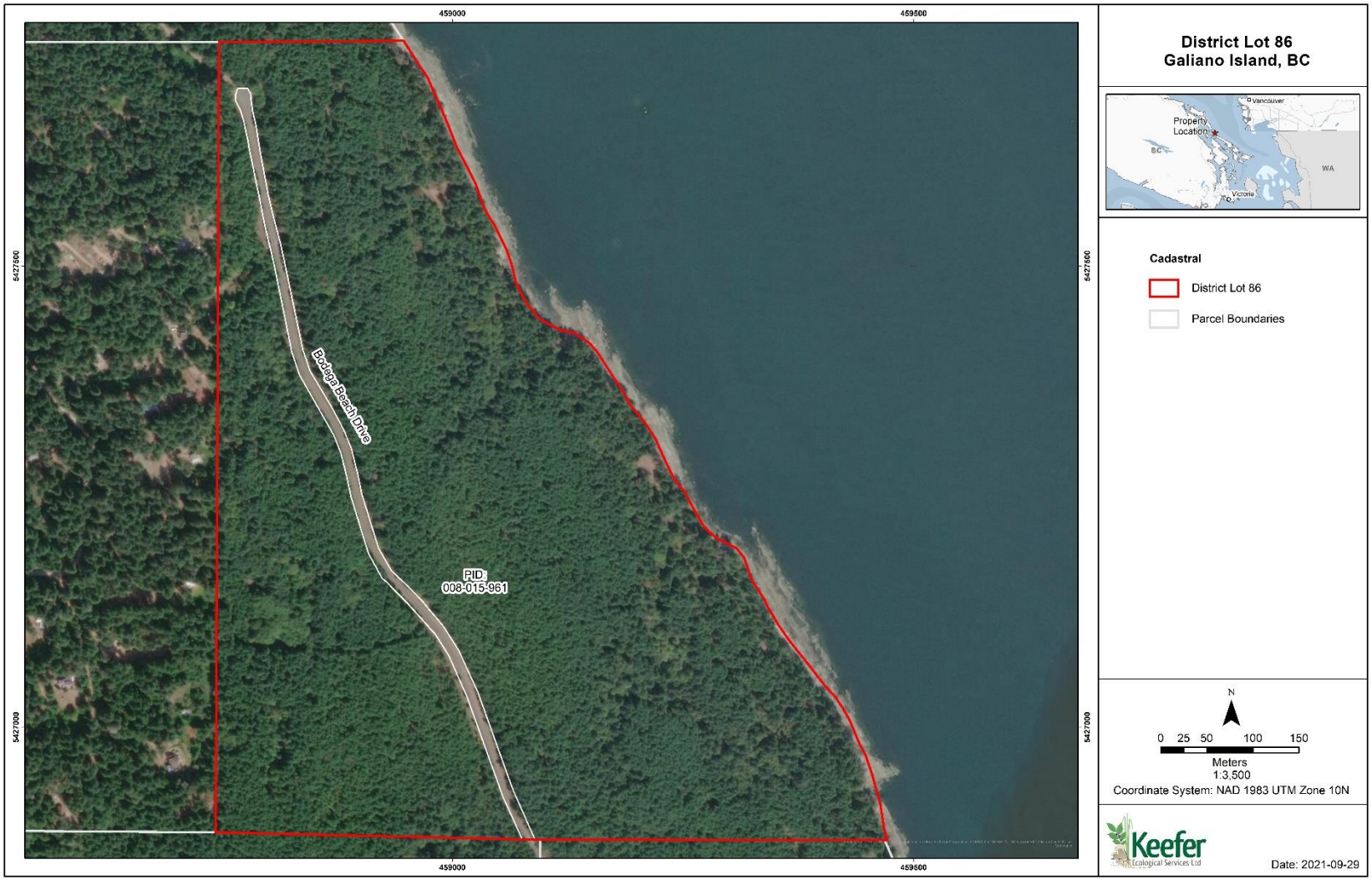

Figure 1. Distict Lot 86.

4. Acknowledgment

The owner hereby acknowledges and agrees that the following is an accurate description of the property, as of the reference date of this agreement.

5. General Description

District Lot 86 is located on the northeast coast of Galiano Island, British Columbia, Canada. Dionisio Point Provincial Park lies adjacent to the northern property boundary, which traces the 49th Parallel. The property comprises 40.5 ha of mostly forested land, including 1 km of shoreline along the Georgia Strait. District Lot 86 was recently subject to extensive clear-cut logging by MacMillon Bloedel in the early 1980s, and portions of the land subsequently restocked with Douglas-fir as a third-growth forest plantation. This historical impact is clearly visible in early Landsat satellite imagery (Fig. 2). Because of these logging practices, the forested ecosystems of DL86 are now in a mature seral stage, with Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) establishing a canopy, and species such as grand fir (*Abies grandis*), western redcedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) regenerating in the understory.

Other notable anthropogenic impacts on DL86 include a gravel pit (~0.4 ha in size), Bodega Beach Drive, and a network of skidder trails, all of which have significantly impacted the soils and underlying water table. A small, one-storey cabin is the only building constructed on the land, which was built in 1994 according to available cadastral data.

District Lot 86 lies within the Coastal Douglas-fir moist maritime (CDFmm) Biogeoclimatic Zone, an ecoregion with a semi-Mediterranean climate that supports the highest density of species at risk in the province of British Columbia (BC CDC, 2021a). In this densely populated region, habitat loss and fragmentation continue to pose the greatest threats to ecological communities. Cumulative anthropogenic impacts associated with these threats include human-induced changes to predator-prey dynamics, which have resulted in increasing browsing pressures by deer and, in turn, diminished native plant abundances, as well as other higher level trophic effects (*e.g.*, Martin et al., 2011). Other impacts include long-term declines in wildlife populations resulting from fragmentation of surrounding matrix habitat (Shackelford et al., 2018); the dispersal of exotic plant and animal species (Marx et al., 2016; Shackelford et al., 2018); and numerous stressors associated with climate change (Austin et al., 2008; Klassen et al., 2015; Salathé et al., 2008; Spies et al., 2010).

Figure 2. Landsat imagery dating to December 1984 shows a recent clear-cut spanning DL86 (outlined in red) as well as DL85 and DL87 to the south. This logging event dates to ca. 1981/'82. Source: Google Earth.

6. Property Access

District Lot 86 can be accessed from the end of Bodega Beach Drive, approximately 25 km from the ferry terminal at Sturdies Bay, Galiano Island, BC.

7. Significance of the Land and the Amenities

Although heavily impacted by a history of clear-cut logging, the forested ecosystems of District Lot 86 are relatively intact ecologically, with most of the property comprising maturing seral stages of ecological communities that are of critical conservation concern within British Columbia (BC CDC 2021a). Over the course of the last century, Coastal Douglas-fir forests have been dramatically diminished, fragmented by logging and land conversion for agriculture and urbanization. Approximately 90% of the CDF has been logged as of the 1990s, leaving <1% of its forested ecosystems in a mature or old growth state (Austin et al., 2008). The ecological value of DL86 thus largely lies in the potential of young forests to become restored as healthy mature forests, representing rare ecosystems that are otherwise dwindling in British Columbia. A small proportion of DL86's forests have been retained in a mature state (dating to earlier logging events, ca. 1892), setting a benchmark for how the property's young forests might mature if conserved. The natural values of these forests will continue to increase with age as stand structure become more complex, giving rise to an increasing number of microhabitats for species.

The property also holds value as matrix habitat providing connectivity with adjacent forested communities, including large tracts of mature forests in Dionisio Point Provincial Park to the north.

Lands known to be culturally significant to Indigenous peoples are located nearby at Dionisio Point, known as *Quelus* in Hul'qumi'num, as well as to the northwest, within in the 29.1 ha Penelakut First Nation reserve. The cultural importance of lands at DL86 is currently unattested and lies beyond the scope of this baseline report.

8. Methods

8.1. Terrestrial Ecosystem Mapping

Terrestrial ecosystem mapping (TEM) stratifies a landscape into map polygons based on ecological variables such as climate, vegetation, physiography, surficial material, bedrock geology, and soil (Resource Inventory Committee, 1998). Based on the Biogeoclimatic Ecosystem Classification (BEC) system, which was first developed to classify and manage forested ecosystems of British Columbia, the TEM methodology is currently applied to map a range of forested and non-forested communities, supporting ecosystem-based land management of a diverse range of landscapes throughout BC.

Ecological inventory and mapping of DL86 first entailed the interpretation of satellite imagery, LiDAR, and existing geospatial data to divide the landscape into recognizably distinct areas, which were circumscribed as polygons in a geographic information system (GIS). Field work was then conducted by trained ecologists with expertise in terrestrial ecosystem mapping and the ecology and biodiversity of the CDF Zone, to validate and classify the ecological communities represented on the landscape. We also collected detailed data on forest canopy composition, tree heights, and tree diameters (plots = 13), which may be used to develop a forest cover map for sustainable forestry applications. Preliminary terrestrial ecosystem mapping was then refined based on field data using spatial analysis tools in QGIS and ArcGIS, to improve the delineation of polygons and ascribe attributes to each community.

Terrestrial ecosystem mapping of DL86 was developed according to RISC standards (Resource Inventory Committee, 1998), meeting the requirements of survey intensity level 1—a level appropriate for an area of the scale of the property. Ecosystem attribution includes sites series, structural stage, and site modifiers. Polygons were classified with up to three ecosystem components or deciles, representing each community present as a fraction of total percent land cover. Components with less than 5% cover were not noted. Site series and map code descriptions used for the attribution of ecosystems are described in Section 9.1 of this report.

Field work was conducted on September 12th and 22nd 2021. Due to the timing/seasonality of this survey, and a limited budget, comprehensive species inventory was beyond the scope of this contract. The resulting TEM mapping for DL86 provides a summary of the condition and extent of ecological communities present on the land, which may serve as the basis for ecosystem-based land management, and to inform sampling designs for future inventories.

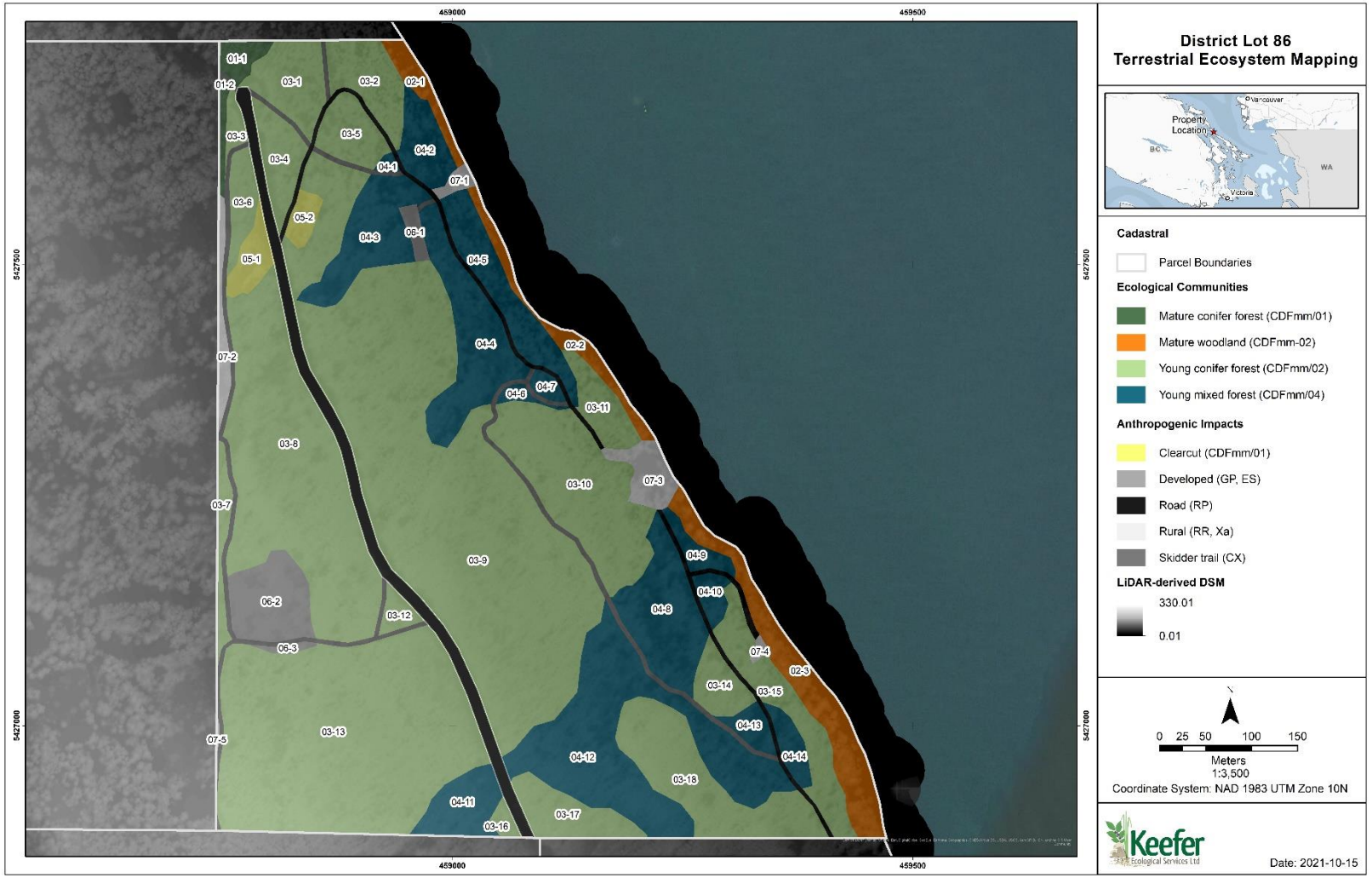

Figure 3. Terrestrial Ecosystem Map of DL86. Base map: LiDAR-derived Digital Surface Model.

9. Description and Mapping of Natural State

9.1. Ecological Classifications

The terrestrial ecosystem mapping developed for DL86 circumscribes six major groups of recognizable ecosystems and land cover types, including forested and non-forested communities (Fig. 3). Forested ecosystems fall within several biogeoclimatic units (CDFmm/01, CDFmm/02, CDFmm/04), which are described in the following section. Unforested ecosystems (CDFmm/00) have been classified using a set of more generic map codes, including wetlands (Ws) and anthropogenic impacts such as roads, skidder trails, gravel pits, areas of exposed soil, rural areas and disclimax communities (RP, CX, GP, ES, RR, Xa). These forested and non-forested communities are tabulated (Table 2), and described below, in descending rank order of area covered.

Table 2. Ecological communities and land cover types mapped at District Lot 86

Ecological community	Biogeoclimatic Unit	Map Codes	Polygons	Area (ha)	% Total Area
Young conifer forests	Douglas-fir / dull Oregon grape (CDFmm/01)			27.3	67
Young mixed forests	grand fir / dull Oregon-grape CDFmm/04			6.8	17
Anthropogenic	CDFmm/00	CX, ES, GP, RP, Xa		4	10
Mature woodlands	Douglas-fir - arbutus (CDFmm/02)			1.8	4
Mature conifer forests	Douglas-fir / dull Oregon grape CDFmm/01			0.3	1
Wetland	CDFmm/00	Ws		0.2	1

Figure 4. Young conifer forests are the most extensive ecological community represented on DL86.

Young conifer forest – Douglas-fir / dull Oregon grape

CDFmm / 01 – *Pseudotsuga menziesii / Mahonia nervosa*

Young conifer forests (Polygons 03-1–19), comprising 27.3 ha, represent about 67% of DL86 by area. These forests date to forestry activities ca. 1981/'82 when the property was clear-cut logged by MacMillan Bloedel. The leading age class of trees is thus ~40 years old as of the date of this baseline report. Conifer forests in the CDFmm/01 site series form the dominant forest matrix of the Coastal Douglas-fir (CDF) biogeoclimatic zone, occurring at middle- to upper-slope positions, on all aspects, and are characterized by a moderately dry (submesic to mesic) soil moisture regime and a poor to medium soil nutrient regime (BC CDC, 2021c). As represented on DL86, these forests are densely stocked, at an early stage of self-thinning, and would benefit from mechanical thinning as a treatment measure. Over the course of ecological succession, these young forests will age to become mature conifer forests such as those represented in Polygons 01-1 and 01-2, described below.

Douglas-fir forms the canopy of these young conifer forests (Fig. 4), with a scattered occurrence of arbutus (*Arbutus menziesii*), bigleaf maple (*Acer macrophyllum*), bitter cherry (*Prunus emarginata*), red alder (*Alnus rubra*), and western redcedar (*Thuja plicata*). The understory is poor, with sparse patches of salal (*Gaultheria shallon*), oceanspray (*Holodiscus discolor*), evergreen huckleberry (*Vaccinium ovatum*), red huckleberry (*Vaccinium parviflorum*), and sword fern (*Polystichum munitum*). On all sites, the

moderately well-developed moss layer is dominated by Oregon beaked-moss (*Eurhynchium oreganum*), electrified cats-tail moss (*Rhytidiadelphus triquetrus*), and step moss (*Hylocomium splendens*), with trace occurrences of juniper haircap moss (*Polytrichum juniperinum*) and broom moss (*Dicranum howellii*). On average, trees among the leading age class of Douglas-fir measured 23 m tall and 27" in diameter, relatively shorter and of smaller diameter than those in the moister riparian forest community (CDFmm/04) documented in this report. These size differences are indicative of the soil moisture and nutrient regimes supporting these forested communities.

At the drier end of the spectrum, toward the shoreline, these forested ecosystems transition to more open woodland environments classified in the CDFmm/02 site series, with arbutus (*Arbutus menziesii*) and shore pine (*Pinus contorta* ssp. *contorta*) becoming more prevalent. Downslope, in lowland areas of the landscape, they transition to mixed forests classified in the CDFmm/04 site series, with an increasing occurrence of bigleaf maple, bitter cherry, red alder, and western redcedar.

Considerable dieback among western redcedar was noted in this community. Due to processes of self-thinning, a large amount of treefall and coarse woody debris is also accumulating in some areas (*e.g.*,Polygon 03-8), which may present a fire hazard if not managed appropriately.

Figure 5. Young mixed forests are the dominant ecological community mapped in Polygon 04-8.

Young mixed forest – Grand fir / dull Oregon grape

CDFmm/04 – Abies grandis / Mahonia nervosa

Young mixed forests classified as CDFmm/04 encompass about 6.8 ha (17%) of DL86. These forests have regenerated from the same clear-cut logging event in 1981/'82, dating the leading trees to ~40 years old. This ecological community is generally found in mid-slope positions, on morainal and inactive colluvial materials, whereas moister mixed forest communities (*e.g.*, CDFmm/06) tend to lie at lower slope positions. Soils are well-drained, with a medium texture, and are moderately dry, with a rich to very rich nutrient regime (BC CDC 2021d). On DL86, this seasonally wet ecological community is found in swathes along two gently-sloping, descending valleys, which drain northeast toward the coast. While these communities have naturally emerged from soils enriched by water flowing from the greater watershed, their hydrological regime has been altered to some extent due to the road and skidder trails that cross the property. This community type is perhaps most well expressed in Polygon 04-8 (Fig. 5), portions of which may be characterized as floodplain forest emergent from an ephemeral watercourse.

These mixed forests are largely dominated by Douglas-fir, with patches of bitter cherry, red alder, western redcedar, and the occasional occurrence of arbutus and bigleaf maple. The understory is less sparse as compared with the young zonal forests described above, exhibiting a greater percent cover of salal, oceanspray, and sword fern, with patches of vanilla leaf (*Achlys triphylla*), Pacific soft rush (*Juncus effusus* ssp. *pacificus*), and fragrant bedstraw (*Galium triflorum*), indicative of the relatively rich soil moisture and nutrient regime. Mosses such as badge moss (*Plagiomnium insigne*) and palm tree moss (*Leucolepis acanthoneuron*) are common and are also good indicators of this riparian forest community. Leading Douglas-firs on average measured 29 m tall and 38" in diameter, considerably larger than those sampled in the young conifer forests described above.

Natural features mapped in this ecological community include a small pond (Polygon 04-11) and large-diameter, veteran Douglas-fir which was retained by MacMillan Bloedel as a wildlife tree (Polygon 04-14).

Figure 6. A small cabin in Polygon 07-5 is the only building established on the property.

Anthropogenic

CDFmm / 00 – CX, ES, GP, RP, RR, Xa

Anthropogenic communities cover approximately 4 ha (10%) of the DL86 landscape. These non-forested areas include skidder trails (CX), rural areas (RR), and permanent road surface (RP). More heavily impacted areas include a gravel pit (GP) in Polygon 06-2 and a clearing with heavily disturbed, exposed soils and bedrock (ES) in Polygon 06-1. Two recent clear cuts (ca. 2019?) are also mapped on DL86 (Polygons 05-1, 05-2), which appear to have been cleared to open a view for residents on the adjacent District Lot 91 to the west.

While some areas mapped as anthropogenic are heavily impacted and ecologically compromised (*e.g.*, the road), other areas remain relatively intact ecologically, albeit transformed from their natural condition. Such "disclimax" communities (Xa) are relatively stable ecological communities that have been altered due to human modification, interrupting the natural process of ecological succession. On DL86, one disclimax community is mapped in Polygon 07-1: a heavily disturbed clearing nearby the shoreline that includes a firepit and woodfire hot tub. Other rural areas include an open, modified area toward the shoreline (Polygon 07-3), and a clearing surrounding a small, one-storey cabin (Polygon 07-4, Fig. 6), as well as areas disturbed by adjacent rural developments to the west of the property (Polygons 07-2, 07-5). Bodega Beach Drive has been mapped as a permanent road, as well as the more established skidder trail that serves as a laneway to the rural areas on the property. The other skidder trails are less

frequently used; about 15 feet wide, these old skidder trails frequently become congested by regenerating trees, vanishing into the forest. The most severe anthropogenic impacts on DL86 include the 0.4 ha gravel pit (Polygon 06-2, 06-3) and a 0.1 ha area with exposed soils that was cleared and partially excavated (Polygon 06-1).

Areas mapped as anthropogenic are largely dominated by exotic species. Without ongoing management, these species may present a threat to surrounding natural ecosystems as a source of exotic seed dispersal. Scotch broom (*Cytisus scoparius*) is an invasive species of particular concern, especially where it is established in rural and disclimax communities proximate to the shoreline (*e.g.*, Polygon 07-1). Other exotic species of note on DL86 include tansy ragwort (*Jacobaea vulgaris*), Himalayan blackberry (*Rubus bifrons*), and bull thistle (*Cirsium vulgare*), which were found throughout the rural areas and alongside roads and skidder trails yet were especially prevalent in Polygons 06-1 and 07-1. A lone ponderosa pine (*Pinus ponderosa*) and large patch of old man's beard (*Clematis vitalba*) were also documented in the heavily disturbed clearing represented by Polygon 06-1.

Figure 7. A narrow band of mature woodland retained from past logging events skirts the shoreline of DL86.

Woodlands - Douglas-fir / arbutus

CDFmm / 02 – *Pseudotsuga menziesii / Arbutus menziesii*

About 1.8 ha (4%) of DL86 comprise coastal woodlands classified in the CDFmm/02 site series (Fig. 7). This community occurs in a narrow 10–20 m wide band along the coastline (Polygons 02-1–3),

supported by shallow soils which form a thin veneer over the sandstone bedrock. Owing to its slope position and gradient, the soil moisture regime of this community is very dry (xeric) to dry (subxeric), and the soil nutrient regime medium to very poor (BC CDC 2021b).

Douglas-fir and arbutus feature prominently in this community, as well as an abundance of shore pine (*Pinus contorta* var *contorta*) which rivals the occurrence of Douglas-fir. The understory includes salal, dull Oregon-grape, evergreen huckleberry, and red huckleberry, all occurring with greater frequency in these woodlands as compared with the young conifer forests present on the land due to the open canopy which allows more light to reach the forest floor. Other species present in this woodland community include western yew (*Taxus brevifolia*), saskatoon (*Amelanchier alnifolia*), western starflower (*Lysimachia latifolia*), and orange honeysuckle (*Lonicera ciliosa*), with *Rhytidiadelphus triquetrus* common among the mosses. Coastal woodlands on DL86 possibly date to 1892, when the earliest logging event is recorded in land classification data, though they may be older. That said, there is evidence of recent selective logging (ca. 1981) having occurred in Polygon 02-3. On average, leading Douglas-firs in this community measured 30 m tall and 55” in diameter.

Because this survey was conducted in the late season it was not possible to undertake a comprehensive inventory of the herbaceous layer, which is generally highly diverse in this community. Species expected to occur include chocolate lily (*Fritillaria affinis*), sea blush (*Plectritis congesta*), western fescue (*Festuca occidentalis*), Pacific fescue (*Vulpia microstachys* var. *pauciflora*), and white fawn lily (*Erythronium oregonum*). In contemporary times, these woodland communities have been dramatically diminished by intensified deer browsing pressure, owing in part to declines in hunting and low-intensity controlled burns practiced by Indigenous peoples, but primarily due to the decline or exclusion of dominant apex predators such as a cougars (Martin et al., 2011). The invasion of Scotch broom (*Cytisus scoparius*) and other exotic species also represents a major threat. The systematic removal of Scotch broom from this community, which holds significant ecological value on DL86, is strongly recommended.

A considerable amount of dieback was noted among the western redcedar established in this community. These snags hold little merchantable value and might be retained as wildlife trees.

Figure 8. A small patch of mature conifer forest.

Mature conifer forest – Douglas-fir / dull Oregon grape

CDFmm / 01 – *Pseudotsuga menziesii* / *Mahonia nervosa*

About 0.3 ha (~1%) of DL86 are classified as mature conifer forests in the CDFmm/01 site series (previously described), featuring a structurally complex canopy and dense understory, with leading trees dating to ca. 1892 based on pre-existing site classification data. This healthy, mature conifer forest occurs on terrain gently sloping northeast toward the coast, and is coextensive with a 3.4 ha stand of mature conifer forest that extends beyond DL86 into Dionisio Point Provincial Park. The canopy is primarily composed of Douglas-fir with some arbutus interspersed. The robust understory includes salal and evergreen huckleberry, with maturing young western redcedar occurring sporadically in the subcanopy (Fig. 8). Leading trees on average measured 31 m tall and 52” in diameter. Along with the mature woodland communities described above, these mature conifer forests represent the most ecologically significant communities on the land and set a benchmark for how the seral conifer forests may mature if conserved.

Figure 9. Modified swamp featuring red alder, scouring rush, and slough sedge.

Modified swamp wetland

CDFmm / 00 – Ws

A small pocket of forested swamp was mapped at DL86, representing about 0.2 ha (~1%) of the landscape. This community lies adjacent to the gravel pit mapped in Polygon 06-2, but because it represents a lesser component of this polygon by area is not represented on the TEM map (Fig. 3). The swamp includes a dense stand of red alder, with scouring rush (*Equisetum hyemale* ssp. *affine*), slough sedge (*Juncus effusus*), and lady fern (*Athyrium filix-femina*) occurring below in a seasonally inundated depression (Fig. 9), as well as Douglas-fir, western hemlock, and grand fir regenerating in the understory. Given the intense modification of the surrounding terrain, the wetland is likely anthropogenic, resulting from machine excavation and its impacts on the water table. Nevertheless, it represents an important natural feature on the landscape, providing habitat for vulnerable species such as the red-legged frog (*Rana aurora*), which was observed on site during this survey.

9.2. Anthropogenic features

Notable anthropogenic features mapped on DL86 include the small cabin (Polygon 07-4), the woodfire hot tub (Polygon 07-1), and other minor impacts such as gates, posts, and detritus left over from previous landowners. There are three wells on the property, mapped in Polygons 03-2, 07-3, and 03-15. Figure 10 documents the anthropogenic features encountered during this survey.

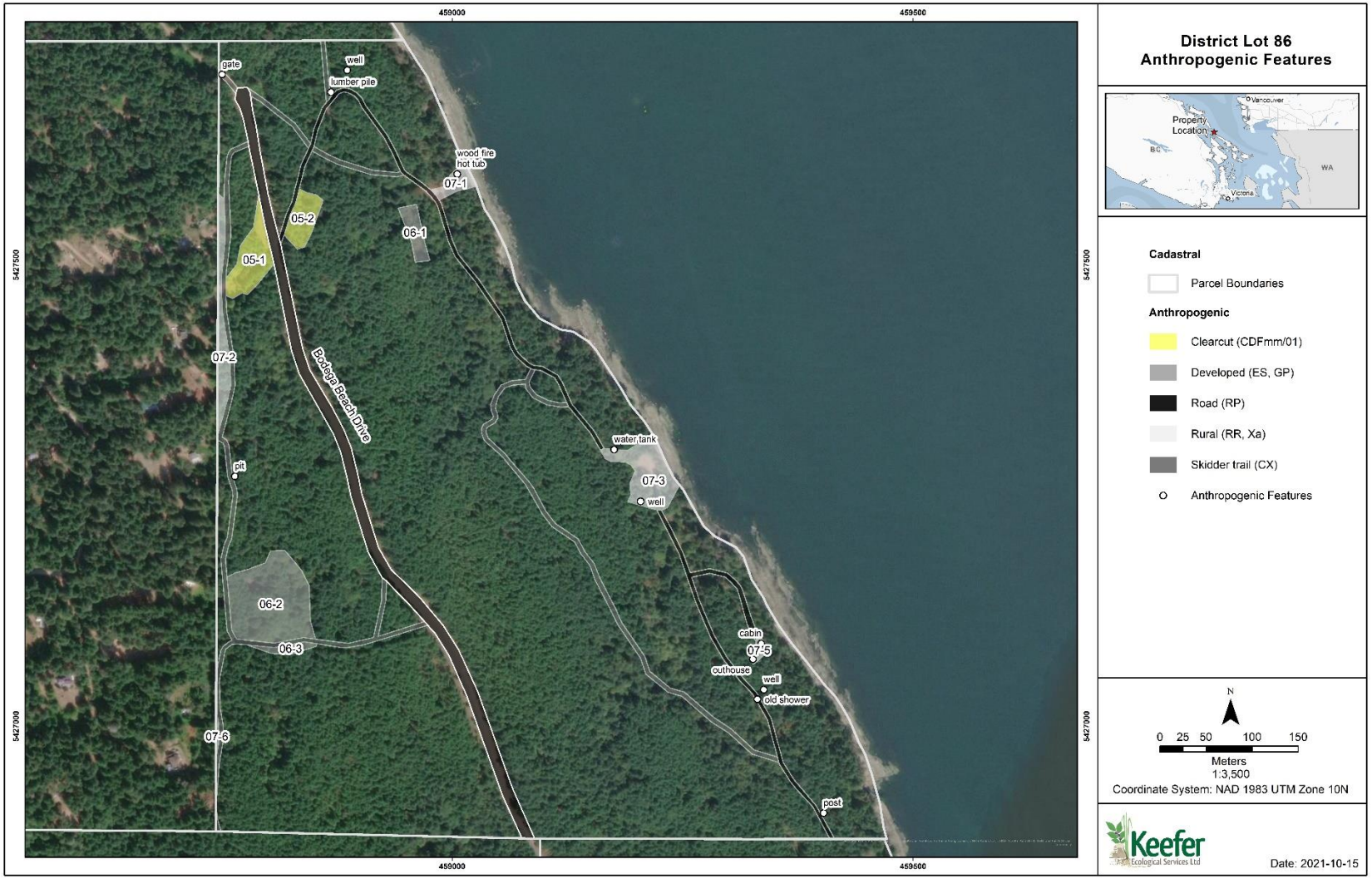

Figure 10. Anthropogenic features mapped on DL86.

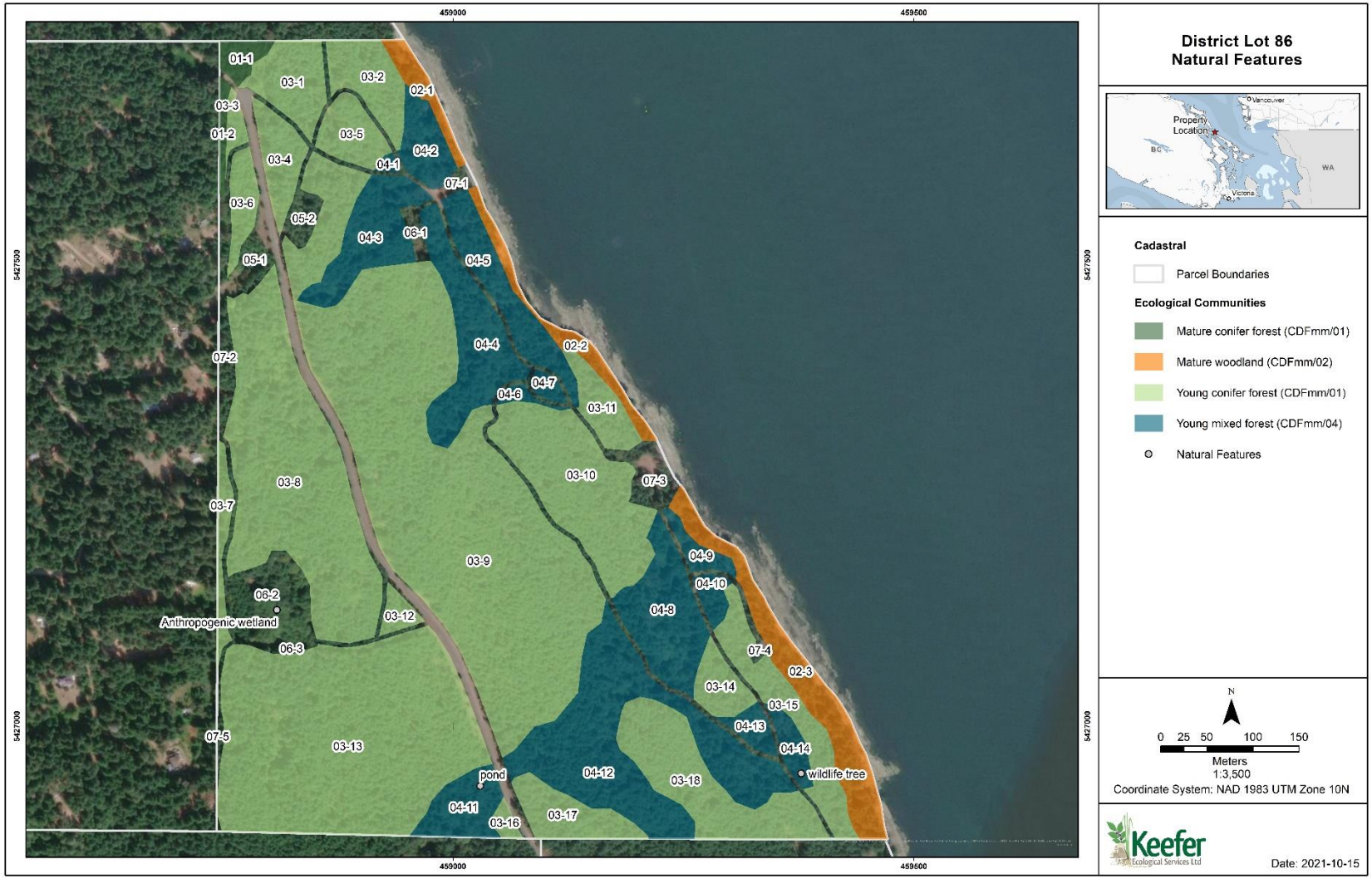

Figure 11. Natural features mapped on DL86.

9.3.Significant Natural Features

Several natural features were mapped on DL86, including the pond in Polygon 04-11, the anthropogenic wetland in Polygon 06-2, and the wildlife tree in Polygon 04-14 (Fig. 11). Other natural features intrinsic to the ecological communities represented on the land are detailed in the above community descriptions.

9.4. Ranked Ecological Communities

Three of the ecological communities mapped on DL86 are listed by the BC Conservation Data Centre as at-risk ecosystems (BC CDC, 2021), all of which are red-listed communities considered threatened in British Columbia (Table 3). While these communities are ranked as at-risk in BC regardless of their successional stage, those retained in a mature state are of greater ecological importance and should be prioritized for conservation. A description of these ecological communities, and a summary of their proportional representation across the landscape of DL86, is presented in Section 9.1. Figure 12 identifies the polygons within which each of these communities are represented. Note, however, that these communities are mapped as deciles or components of each polygon, following the TEM methodology described in Section 8.1. Thus, there are numerous instances where one ranked community may coincide with other ranked and/or unranked communities within a given polygon. These dimensions of the TEM methodology should be borne in mind when interpreting the map symbology in Figure 12.

Table 3. CDC Ranked Ecological Communities

Ranking	Biogeoclimatic Unit	Ecological community
S1 (2018)	CDFmm / 01	Douglas-fir / dull Oregon grape
S2 (2004)	CDFmm / 02	Douglas-fir / shore pine - arbutus
S1 (2009)	CDFmm / 04	western redcedar / Douglas-fir - Oregon beaked-moss

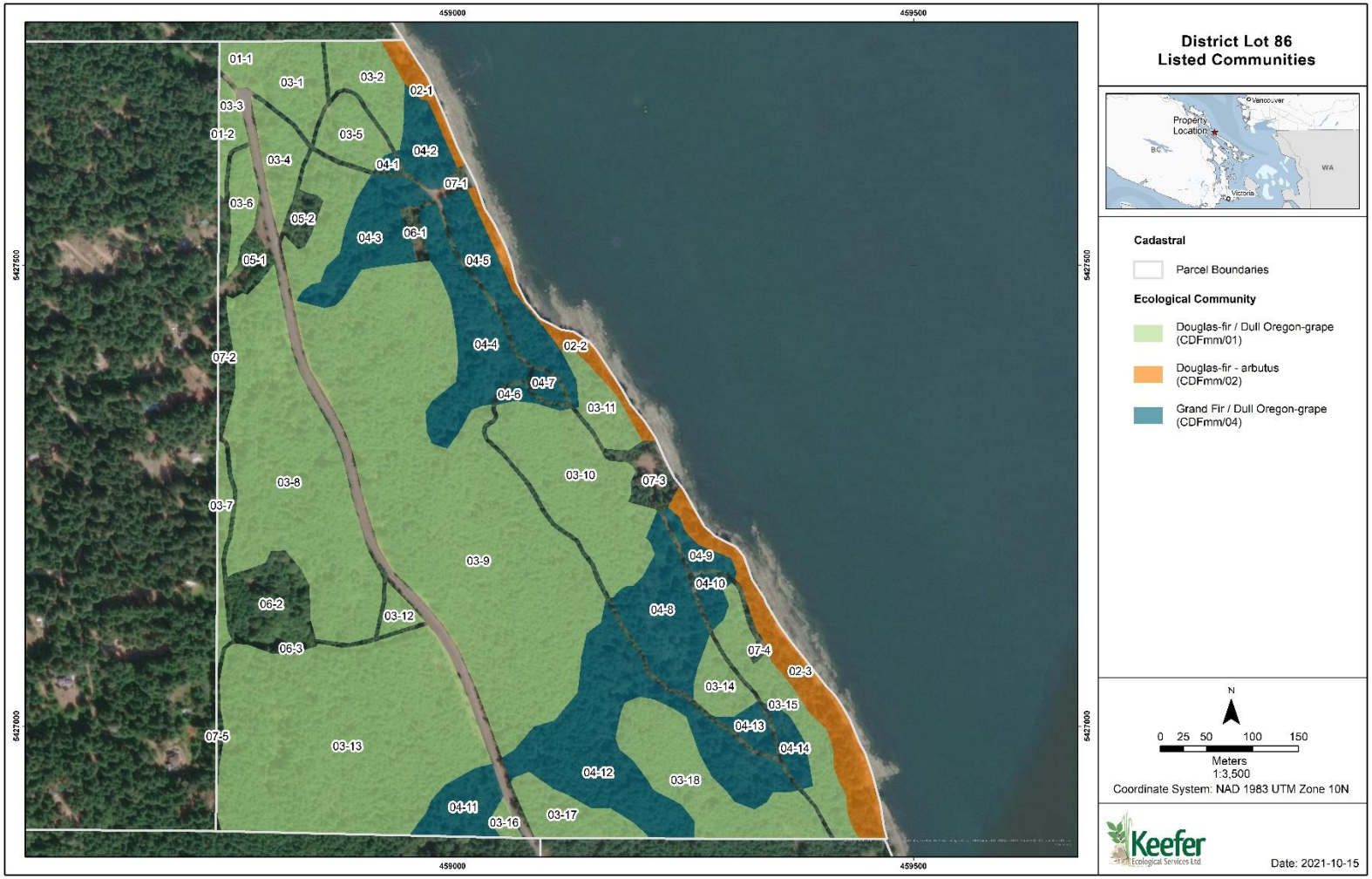

Figure 12. Distribution of ecological communities of conservation concern at DL86.

10. Threats to condition and natural state

District Lot 86 is surrounded by a matrix of protected and rural land that has historically been subject to intensive forestry practices and continues to be affected by several anthropogenic factors. The activities associated with roads, utility corridors, and nearby subdivision development contribute to numerous stressors having cumulative impacts on the surrounding ecology. These cumulative environmental impacts may result in diminishing wildlife habitat, intensified grazing by ungulates such as black-tailed deer, and increasing invasion by alien species (Martin et al., 2011; Shackelford et al., 2019; Shackelford et al., 2018).

Climate change is also altering the ecology of the Coastal Douglas-fir BEC Zone, causing increasing forest fire risk and drought stress (Klassen et al., 2015), the signs of which are particularly evident in the decline of western redcedar in the region (Seebacher, 2007). These signs of stress were evident throughout the forest communities of DL86, with numerous dead stands of western redcedar noted on the property. These forested ecosystems will be increasingly subject to climatic stressors including the more severe seasonal drought and more extreme winter precipitation forecasted under future climate scenarios (Klassen et al., 2015; Salathé et al., 2008; Spies et al., 2010).

On DL86, several invasive species, including Scotch broom, tansy ragwort, bull thistle, and Himalayan blackberry, were noted during this baseline inventory. Each species requires a particular management regime to ensure they are effectively controlled. Any further modification of the lands, including construction, maintenance, and the everyday use of trails and other infrastructure, may increase the abundance of invasive species on DL86. Management plans should account for potential increases in these activities in the future, to ensure the integrity of the property's ecosystems.

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