SeaChange Project: 23-13 **July 2024**

ShoreZone Polygon Mapping Summary Report

Campbell River Survey Area

Quadra Island, western side (bc23_cr_00674)

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1 Introduction

ShoreZone is an imaging and habitat classification system for the coastal nearshore margin including the shallow subtidal, intertidal shoreline and supratidal fringe. One objective of ShoreZone is to produce a georeferenced, searchable inventory of the physical and biological attributes of coastal habitats. ShoreZone imagery and habitat mapping attributes can provide a useful baseline from which to study change over time, while the attributes mapped (such as shoreline sediments, predicted oil residence and biotic communities) provide an important resource for scientists, managers and responders. The ShoreZone mapping system provides a decision support tool with many potential uses including community planning, facilities citing, conservation planning, research and fisheries management, emergency planning and response, search and rescue, education and habitat modeling.

The ShoreZone system was developed in the 1980s and 1990s to map coastal habitats in British Columbia and Washington State (Howes 2001; Berry *et al.* 2004). In 2001 ShoreZone was implemented in Alaska, beginning with Cook Inlet, Outer Kenai, Katmai, and portions of the Kodiak Archipelago (Harper and Morris 2004; Harper and Morris 2014). ShoreZone has since expanded to a spatially continuous database of over 123,500 km of coastal Alaska, British Columbia, New Brunswick, Nova Scotia, Washington State and Oregon (Figure 1). Figure 2 shows the extent of the shoreline mapped around the Campbell River survey area and is the section of shoreline covered by this summary report. The most current ShoreZone protocol was updated in 2017 (Cook *et al*. 2017).

The ShoreZone imaging survey conducted around the Campbell River survey area in August 2023 acquired aerial video and digital still images of the coast during minus tides (zero-meter tide levels and lower). The imagery and associated audio commentary were used to map the physical and biological attributes of the shoreline. The entire shoreline was mapped according to the most recent ShoreZone coastal habitat mapping protocol (Cook *et al*. 2017). In 2023/2024, the existing ShoreZone imagery and mapping, in conjunction with publicly available satellite imagery (ArcGIS Earth, ArcMap, Google Earth), was used to create intertidal and sensitive habitat polygons for the Campbell River survey area.

The purpose of this report is to detail the polygon mapping work with summaries of the data and descriptions of the challenges involved. The length of shoreline mapped is **394 kilometers** in **957 along-shore segments** (units). In total, **1,566 intertidal polygons** (Section 2) covering a total of **4,924 ha** and **2,087 sensitive habitat polygons** (Section 3) covering **1,820 ha** were created.

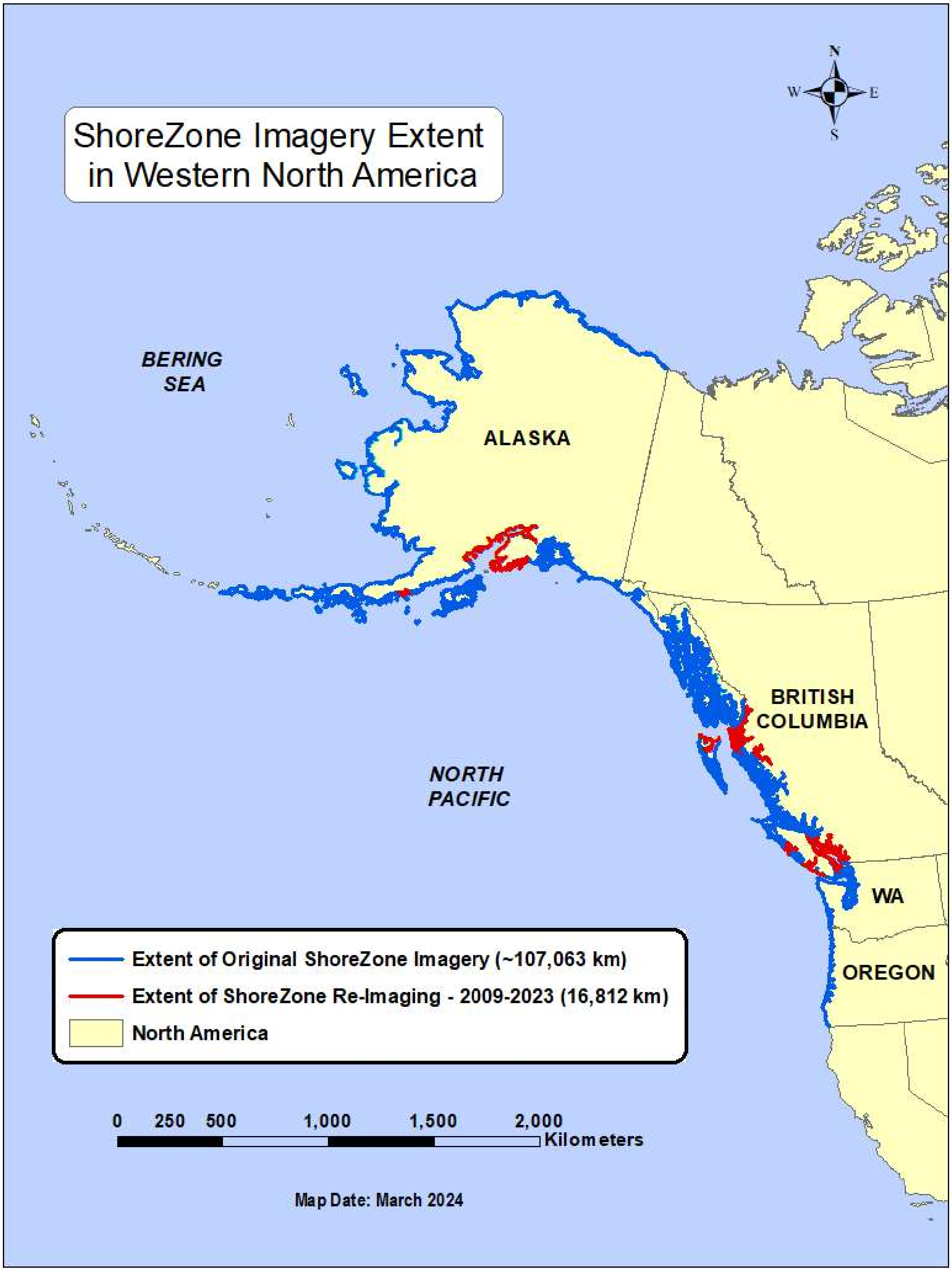

Figure 1. Extent of ShoreZone imagery and mapping in Western North America as of March, 2024.

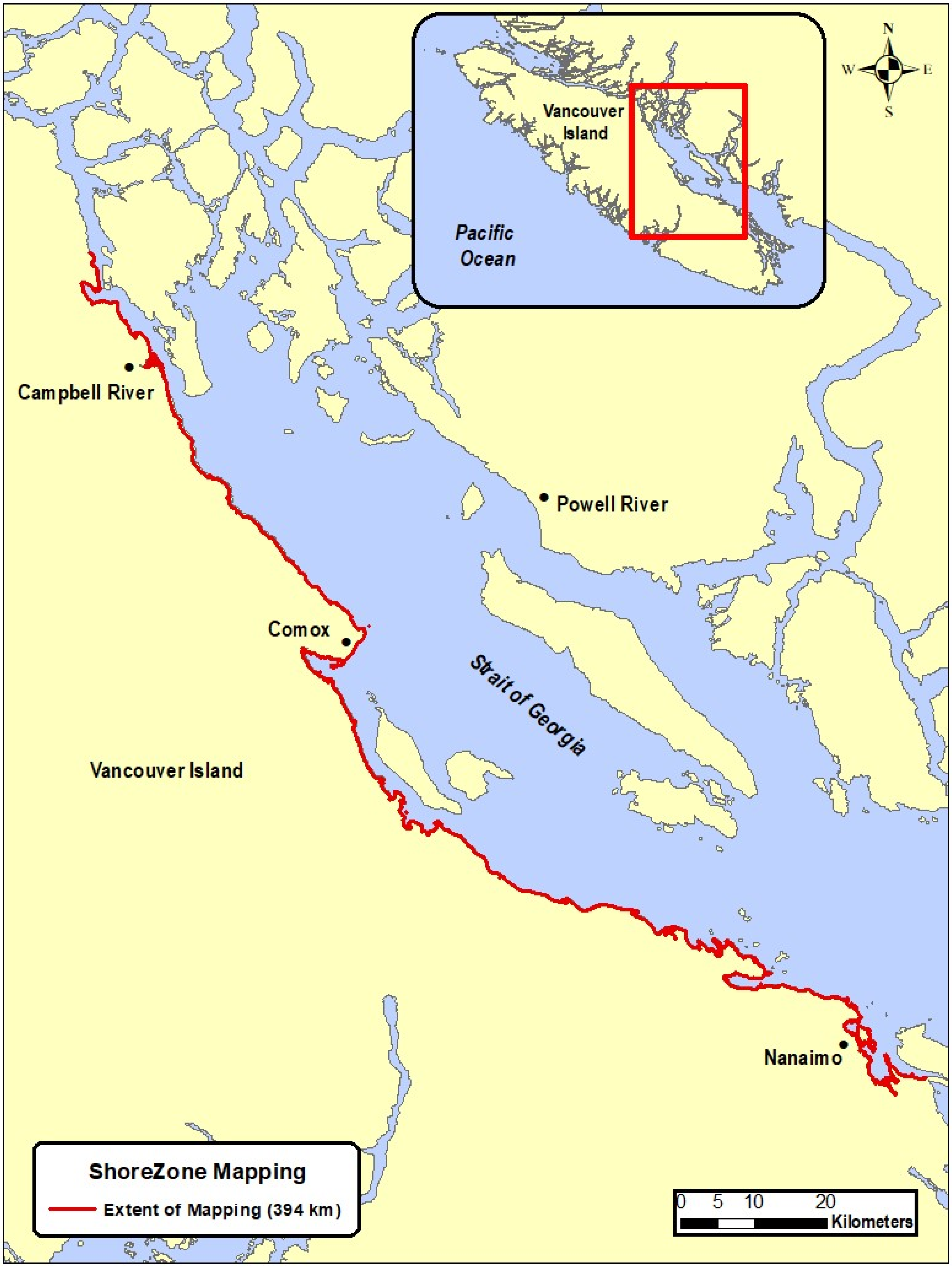

Figure 2. Extent of ShoreZone mapping for the Campbell River survey area covered in this report.

2 Intertidal Polygon Data Summary

2.1 Methodology

ShoreZone habitat mapping uses low-altitude (100 m elevation), high resolution aerial imagery taken from helicopters to define relatively homogenous segments of shoreline, called 'units', based on the physical characteristics of the intertidal and supratidal zones. These units are delineated on the best available digital high water line (HWL) which, in the case of the Campbell River survey area, was the CHS_Highwaterline_BCalbers.shp. Each alongshore unit can also be divided into across-shore components where there is variation in the substrate and geomorphological forms from the top of the beach to the waterline. However, representing ShoreZone data as a one-dimensional line does not accurately display the complexity of the data that is collected. Representing the intertidal as a two-dimensional polygon is possible where there is both a digital HWL as well as a digital low water line (LWL).

Our method for creating polygons of the intertidal portion of each ShoreZone unit was to take the existing digital HWL with the existing unit segments and add the best available digital LWL, which is also from the Canadian Hydrographic Service for the Campbell River survey area. We then used the ShoreZone imagery, in conjunction with the best available public satellite imagery, to define the shape of each intertidal polygon. The satellite imagery (which is orthorectified) was used as a guide to provide positional data for all boundaries but the ShoreZone imagery (which is not orthorectified) was used as the final guide as it was taken at low tide while the satellite imagery was often at mid-tide or higher.

We did encounter some challenges in the creation of the intertidal polygons, most of which centered around the accuracy of the high and low water lines. We made the decision to not edit the HWL unless we encountered what we considered to be an error which would significantly affect the overall size and shape of the final polygon. Figure 3 shows an example of areas where the original CHS high water used for the linear mapping needed to be modified in order to accurately create intertidal polygons. The LWL did vary significantly from both the satellite imagery and the ShoreZone imagery along much of the coastline, so it was edited to better reflect reality.

These challenges mean that the quality of the intertidal polygons is variable from unit to unit; however, we feel confident that the general shape and size of the polygons are consistent with reality in the majority of units.

Small corrections were made to the original ShoreZone mapping attributes during the polygon creation process. These changes were noted in a small portion (<1%) of units and were made only where the polygon mapper noted a significant difference between the imagery and the existing ShoreZone mapping. The geodatabase that accompanies this report is now considered the most accurate ShoreZone data for the Campbell River survey area and should be used to replace any previous geodatabase from that area.

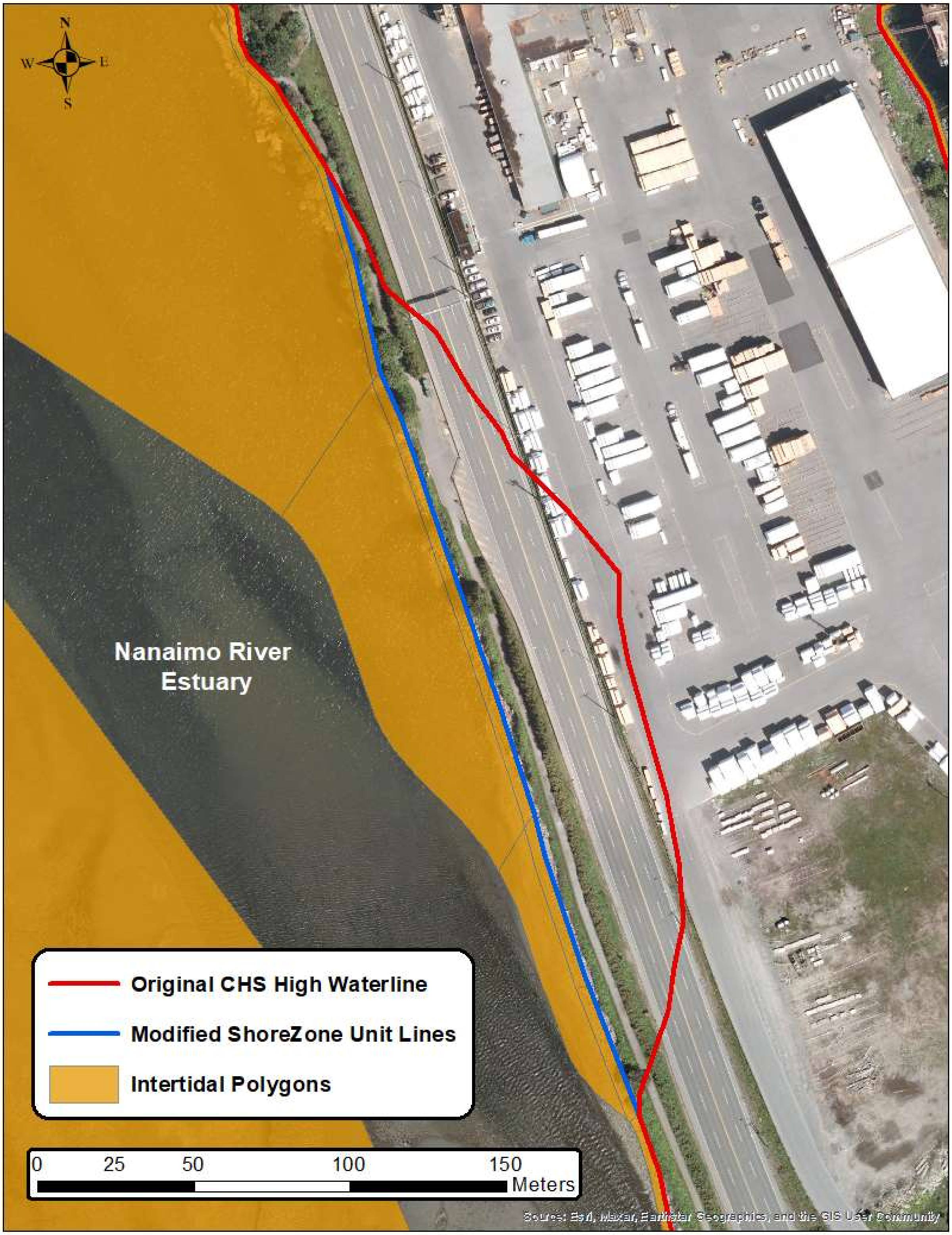

Figure 3. Example of an area around the Nanaimo River Estuary where the digital HWL was deemed to be significantly different from reality and needed to be re-digitized using the satellite and ShoreZone imagery.

2.2 Results

In total, SeaChange created **1,566** intertidal polygons at the component level. These polygons covered **4,924 ha** of the intertidal zone in the Campbell River survey area. The final intertidal polygons add significant detail to the ShoreZone dataset and are part of the final geodatabase product for this area. These polygons represent the across-shore components and can therefore represent both unit level and component level attributes such as the Oil Residence Index (Figure 4) and the Primary Intertidal Form (Figure 5). All ShoreZone attributes are detailed in the current protocol (Cook *et al*. 2017).

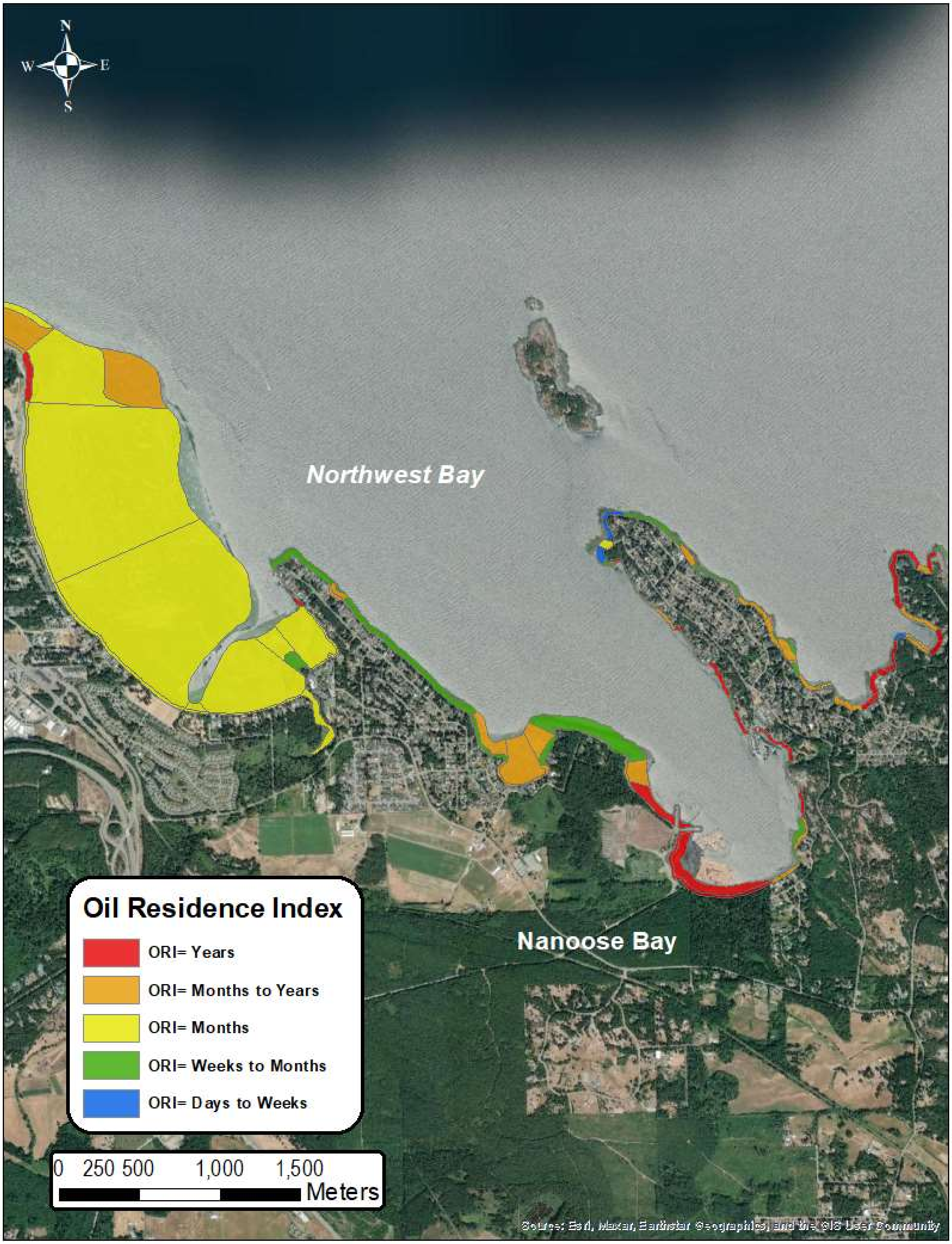

Figure 4. Example of the ShoreZone Oil Resistance Index displayed as intertidal polygons in Northwest Bay.

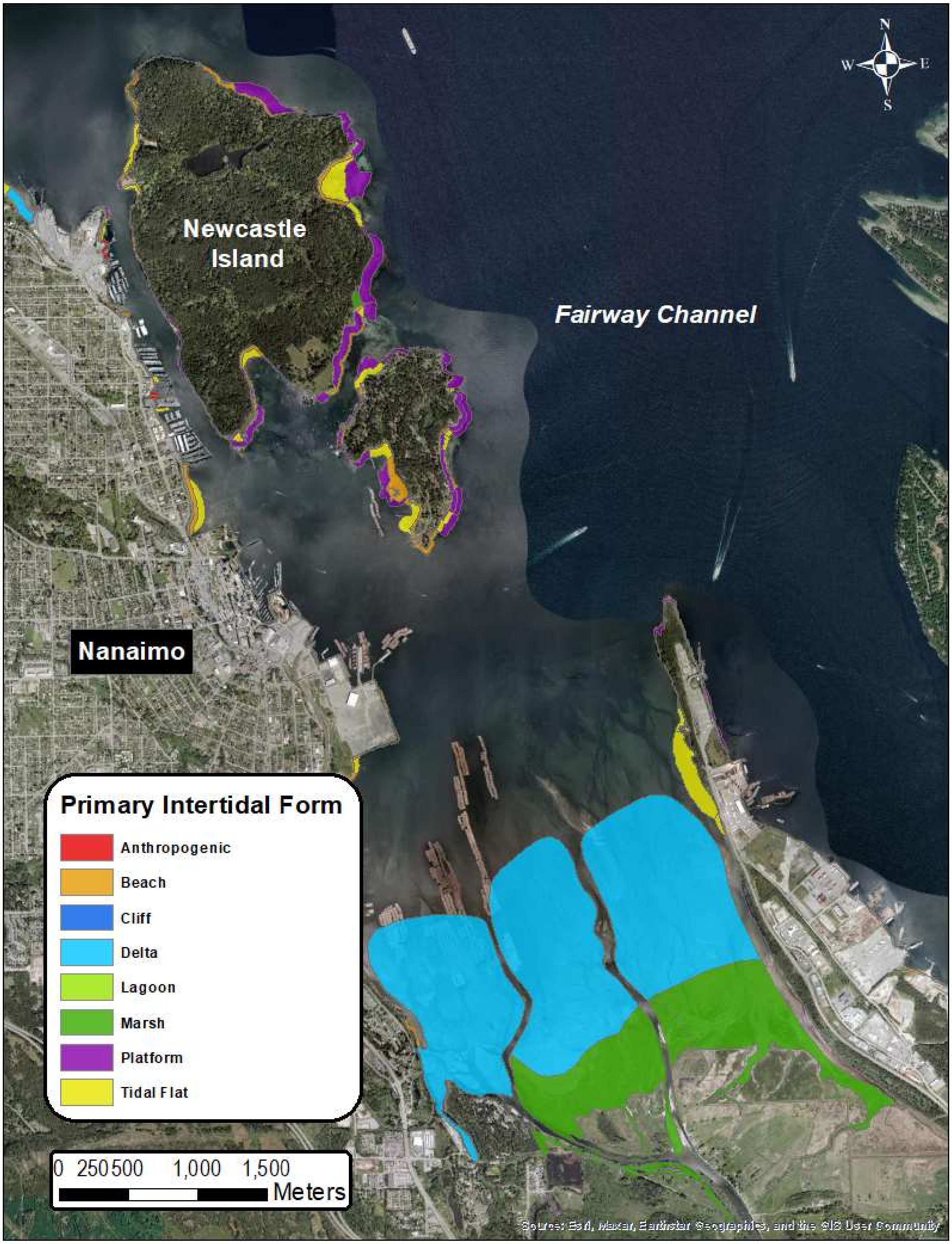

Figure 5. Example of the ShoreZone Primary Intertidal Form displayed as intertidal polygons around Nanaimo and Newcastle Island.

3 Sensitive Habitat Polygon Data Summary

3.1 Methodology

ShoreZone habitat mapping uses low-altitude (100 m elevation), high resolution aerial imagery taken from helicopters to classify the biological attributes in each ShoreZone unit. These attributes are called **biobands** and are defined by a typical tide height, colour and texture. For the purposes of this project, we proposed to map the biobands that we defined as 'sensitive habitats', meaning those that are productive ecosystems upon which many other species rely for food or shelter, and which may be adversely affected by pressures arising from human activities (including climate change, fisheries and development). The 4 biobands that fit these criteria and were present in the Campbell River survey area were: **Dune Grass**, **Salt Marsh**, **Eelgrass**, and **Bull Kelp**. See Table 1 for the definitions of these biobands from the ShoreZone protocol and Figures 6 and 7 show photographic examples of these biobands. In other areas the Giant Kelp and Urchin Barren biobands are also mapped as sensitive habitat polygons; however, they were not present in this survey area.

Our method for creating polygons of the sensitive habitat biobands identified as part of the ShoreZone mapping of the Campbell River survey area (CORI, 2022) was to take the existing high resolution ShoreZone imagery in conjunction with the best available public satellite imagery, to define the shape and position of each polygon. The satellite imagery (which is orthorectified) was used as a guide to provide positional data for all boundaries but the ShoreZone imagery (which is not orthorectified) was used as the final guide for shape and extent of the polygon. We attached the unique unit identifier(s) (PHY_IDENT) to each polygon and provided an estimate of the Density of the Indicator Species defined for each bioband within each polygon. Our Density categories were Sparse (S), Moderate (M), Dense (D), and Unknown (U) (used when the sensitive habitat was observed in the unit, but density could not be qualified). These are qualitative assessments based on classifier observations rather than quantitative assessments; however, these categories should still be useful for any calculation of biomass etc. We also added a qualitative measure of Confidence to each polygon to give the users of the data an idea of the overall accuracy of each polygon. Our Confidence categories were Low (L), Medium (M) and High (H).

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Table 1. Definitions for the sensitive habitat biobands mapped as polygons in the Campbell River survey area.

Bioband Name			Prior Code	Current Code	Zone	Typical Color	Indicator Species	Description	Biological Wave Exposure
Primary Level	**Secondary Level**	**Tertiary Level**							
Terrestrial Vegetation	Grasses	Dune Grass	GRA	**DUGR**	A	Pale blue-green	*Leymus mollis*	Found in the upper intertidal zone, tall grasses observed as clumps continuous on dunes, in logline or on beach berms. This band may be the only band present on high-energy beaches.	VP to E
Intertidal/ Subtidal Vegetation	Wetland Vegetation	Salt Marsh (BC & Washington State)	SAL	**SAMB**	A & upper B	Light, bright, or dusty green	*Sarcocornia pacifica*	Salt-tolerant herbs and grasses associated with freshwater. This band is often associated with estuaries, marshes, and lagoons although it is not uncommon as a fringing meadow in the supratidal. Used to describe a 'low marsh' in Washington State and generally lacking associated grass species in that classification. Specific to BC and Washington State.	SE to VP
Intertidal/ Subtidal Vegetation	Rooted Vegetation	Eelgrass	ZOS	**EELG**	B & C	Bright to dark green	*Zostera marina*	Commonly visible in estuaries, lagoons or channels, generally in areas with fine sediments. Eelgrass can occur in sparse patches or thick dense meadows.	VP to SP
Intertidal/ Subtidal Vegetation	Brown Canopy-Forming Algae	Bull Kelp	NER	**BUKE**	C	Dark brown	*Nereocystis luetkeana*	Distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Eularia fistulosa* and *Macrocystis pyrifera*. Often indicates higher current areas if observed at lower wave exposures. Range: Point Conception, CA to Unimak Island, AK.	SP to VE

Photo bc23_cr_05369: Good example of the blue-green Dune Grass (DUGR) bioband. Deep Bay, Vancouver Island.

Photo bc23_cr_05462: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone. Mud Bay, Vancouver Island.

Figure 6. Examples of the Dune Grass (top) and Salt Marsh (bottom) sensitive habitat biobands mapped as polygons in the Campbell River survey area.

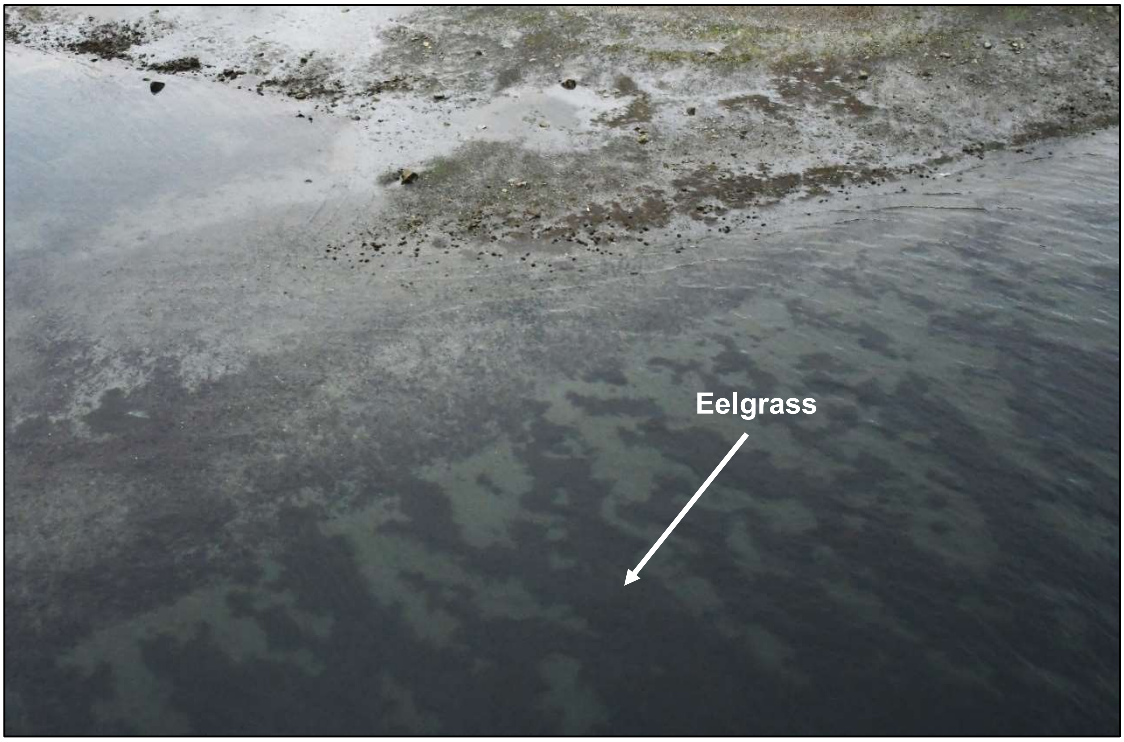

Photo bc23_cr_04662: Example of the Eelgrass (EELG) bioband in the subtidal. Lantzville, Vancouver Island.

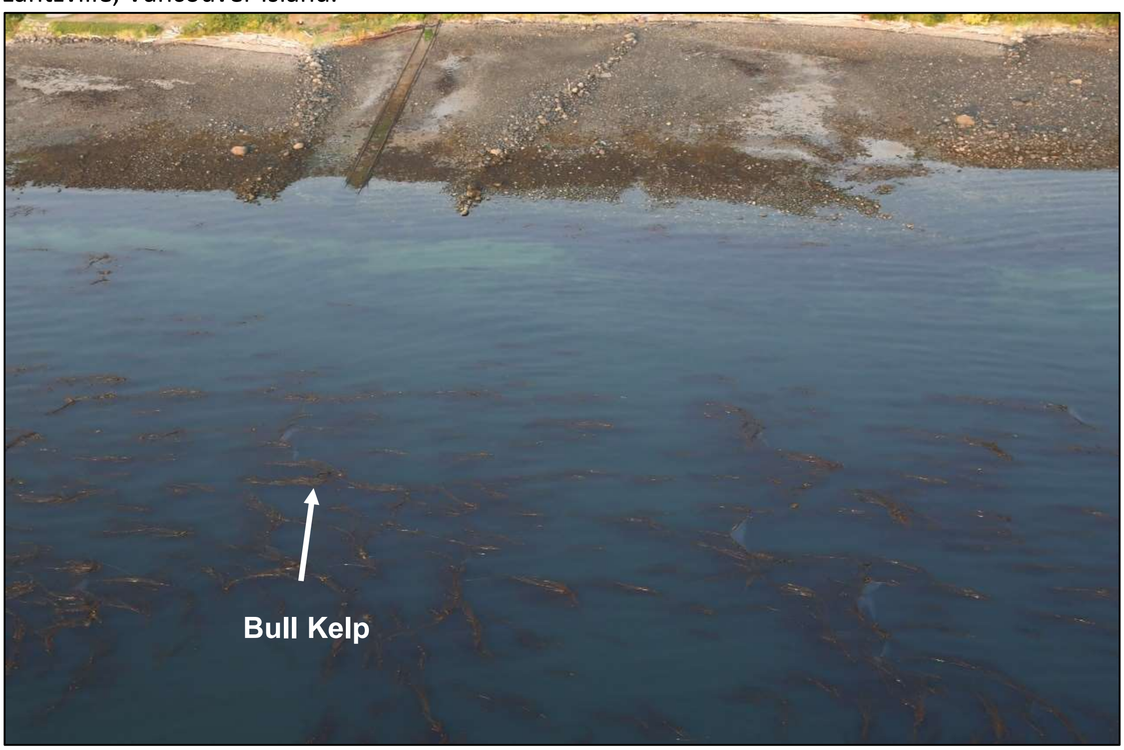

Photo bc23_cr_002865: Example of the Bull Kelp (BUKE) bioband in the nearshore. Orange Point, North of Campbell River.

Figure 7. Examples of the Eelgrass (top) and Bull Kelp (bottom) sensitive habitat biobands mapped as polygons in the Campbell River survey area.

We did encounter a few challenges in the creation of the sensitive habitat polygons, some that centered around the varying resolution and quality of the ShoreZone imagery and the satellite imagery and how the two interacted. Overall, however, the satellite imagery in the Campbell River survey area is high quality. Cloud cover and poor-quality satellite imagery can often be a challenge to see landmarks to allow for accurate location of any sensitive polygons but that was found to not be an issue in this survey area.

Figure 8 shows an example of a ShoreZone image of poorer quality due to the shading of the shoreline and the glare of the sun off the water. Weather conditions and the timing of the tide windows can cause challenging imaging conditions during any ShoreZone survey.

The sheer size of some of the tidal flats in this survey area made it a challenge at times to gather imagery that included both the supratidal and high intertidal zones in the same image as the subtidal zone. Figure 9 shows an example of one of these larger tidal flats to highlight the challenge faced.

Lastly, we encountered areas where biobands were overlapping each other. If it was possible, we created overlapping polygons that indicated where the separate biobands interacted; however, where it was not possible (areas where the imagery made it too time consuming or potentially inaccurate to separate the biobands) we created mixed polygons. These mixed polygons will need to be treated differently in any analyses of the data.

The challenges encountered in this project means that the quality of the sensitive habitat polygons is variable; however, we feel confident that the general shape and size of the polygons are consistent with reality in the majority of cases. The more complex the coastline and the more complex the biology of the area, the more variable the polygons might be. The Confidence measure will be useful in allowing users to understand the accuracy of each polygon for analysis and management decisions.

Some corrections were made to the original ShoreZone mapping during the polygon creation process which changed the presence and/or abundance of biobands in some units. These changes were only made to a small portion (<1%) of units and were made only where the polygon mapper noticed a significant difference between the imagery and the existing ShoreZone mapping. This means the geodatabase that accompanies this report is now considered the most accurate ShoreZone data for the Campbell River survey area and should be used to replace any existing geodatabase the user might have from that area.

Figure 8. Example of an area where the ShoreZone image (bc23_cr_00155, North Campbell River) was of poorer quality due to the shading of the shoreline and sun glare off the water.

Figure 9. Example of an area where the ShoreZone image (bc23_cr_05055, Brant Point near Parksville) where the tidal flat was so large that imagery could not capture the supratidal/high tide zone in the same image as the subtidal zone.

3.2 Results

In total, SeaChange created **2,087 s**ensitive habitat polygons. These polygons covered **1,820 ha** of the supratidal, intertidal and subtidal zones of the Campbell River survey area. These polygons represent the four biobands mapped as part of this project (Figures 10 and 11). Table 2 shows a breakdown of the number and area of polygons of each type. The final sensitive habitat polygons are part of the final geodatabase product for this area.

Figure 10. Example of the sensitive habitat polygons mapped around Goose Spit, Comox Valley.

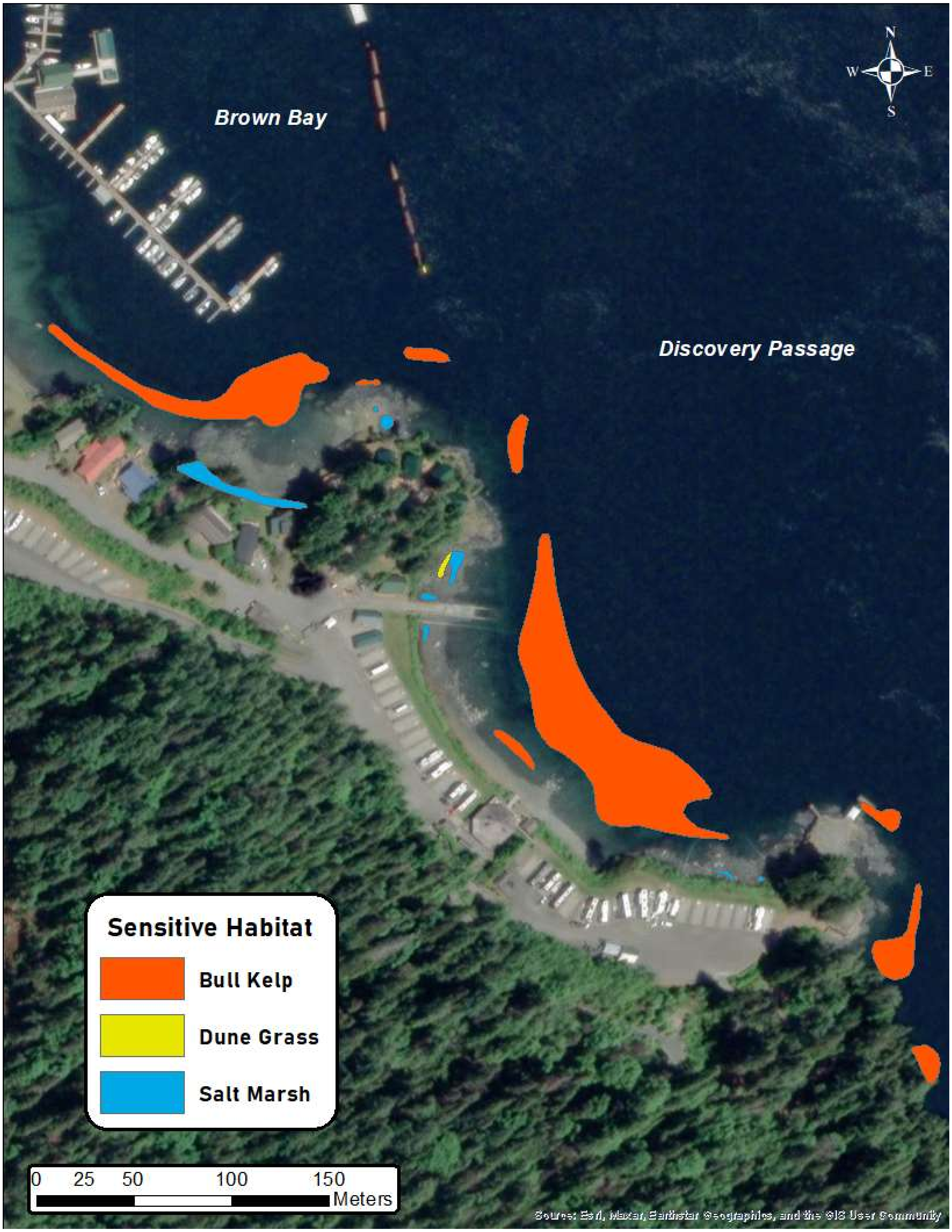

Figure 11. Example of the sensitive habitat polygons mapped around Brown Bay, north of Campbell River.

Table 2. Totals of sensitive habitat biobands mapped as polygons in the Campbell River survey area.

Please note that the totals in this table will equal more than the overall total number or overall total area as there are mixed polygons that include multiple biobands.

Sensitive Habitat Bioband	Number of Polygons Created (including mixed polygons with multiple biobands)	Area of Polygons (ha) (including mixed polygons with multiple biobands)
Dune Grass	919	32
Salt Marsh	951	477
Eelgrass	154	1284
Bull Kelp	108	44

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5 Acknowledgments

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Protocols for data access and distribution are established by the program partner agencies. Please see www.ShoreZone.org for a list of partner agencies and related web sites. Imagery, reports, geodatabases and shapefiles for the ShoreZone dataset can be downloaded online at www.ShoreZone.org or through the links on that site.

Any hardcopies or published data sets utilizing ShoreZone products should clearly indicate their source. For questions regarding the protocols or information in this report, please contact SeaChange Marine Conservation Society at connect@seachangesociety.com.