October 2023

ShoreZone Polygon Mapping Summary Report

Barkley Sound

Owens Island, Broken Island Group, Barkley Sound (bc22_bk_02101)

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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 122,000 km of coastal Alaska, British Columbia, Washington State, and Oregon. ShoreZone work began in 2022 and 2023 on the East Coast of Canada around Cape Breton Island and the Bay of Fundy and there is now ~5,700km imaged (Figures 1 and 2). The most current ShoreZone protocol was updated in 2017 (Cook *et al*. 2017).

The ShoreZone imaging surveys conducted around the Barkley Sound area in August 2022 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 2022/2023, 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 Barkley Sound 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 **559 kilometers** in **3,451 along-shore segments** (units). In total, **4,423 intertidal polygons** (Section 2) covering a total of **991 ha** and **3,451 sensitive habitat polygons** (Section 3) covering **315 ha** were created.

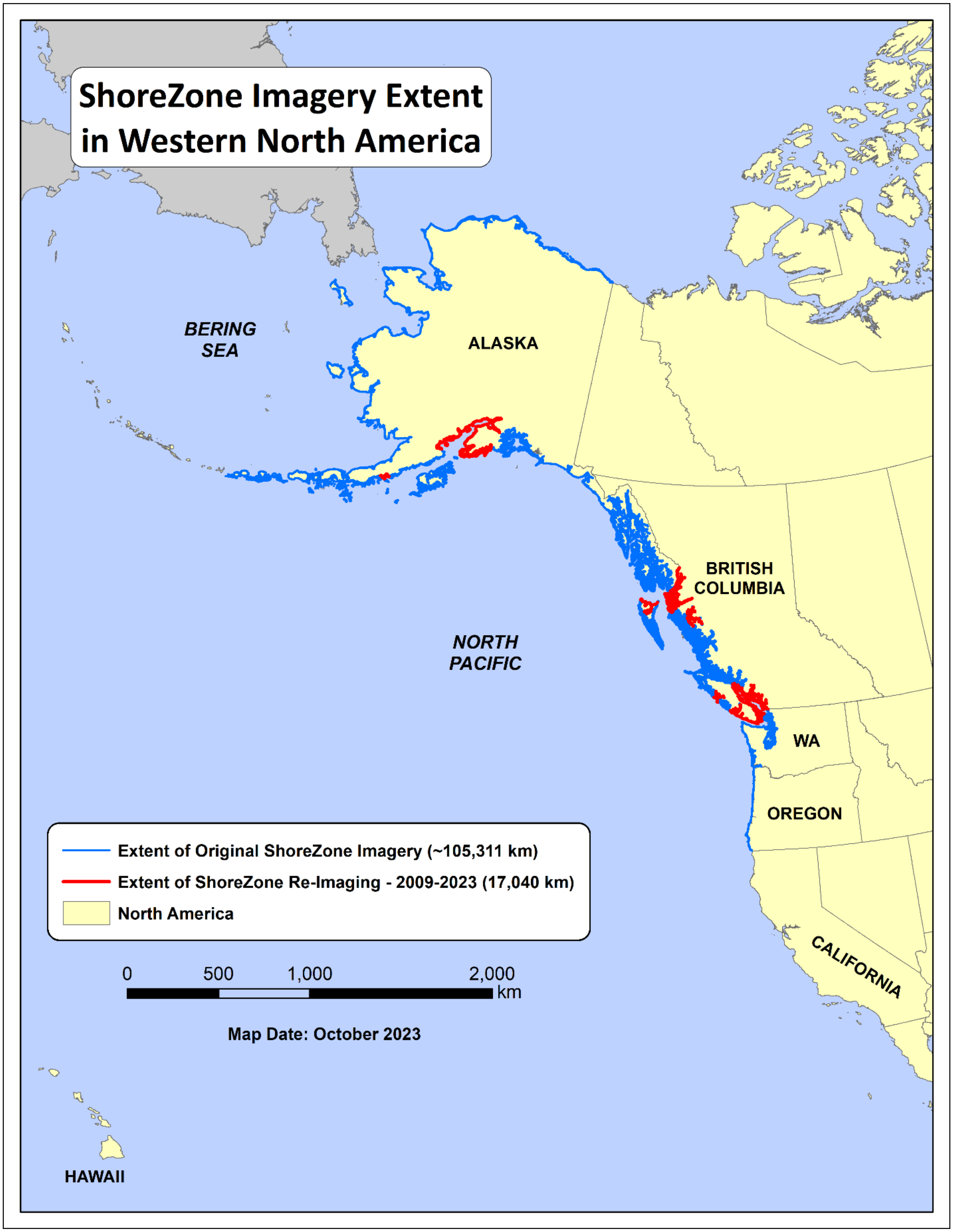

Figure 1. Extent of ShoreZone imagery in Western North America.

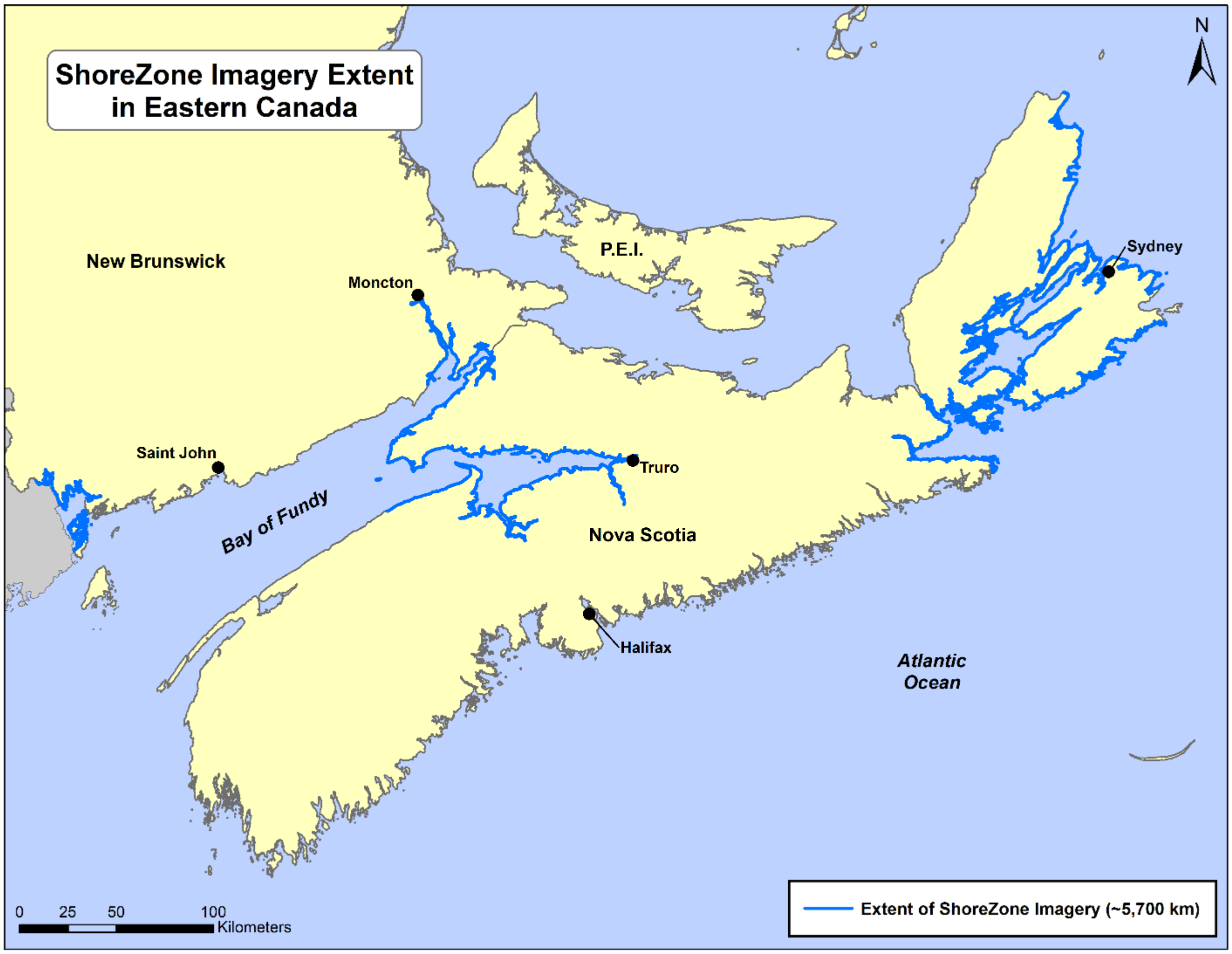

Figure 2. Extent of ShoreZone imagery on the East Coast of Canada.

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 Barkley Sound survey area was the Canadian Hydrographic Service (CHS) high water line. 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 CHS for Barkley Sound. 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. Figures 2 and 3 show examples 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 more liberally 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 Barkley Sound survey area and should be used to replace any previous geodatabase from that area.

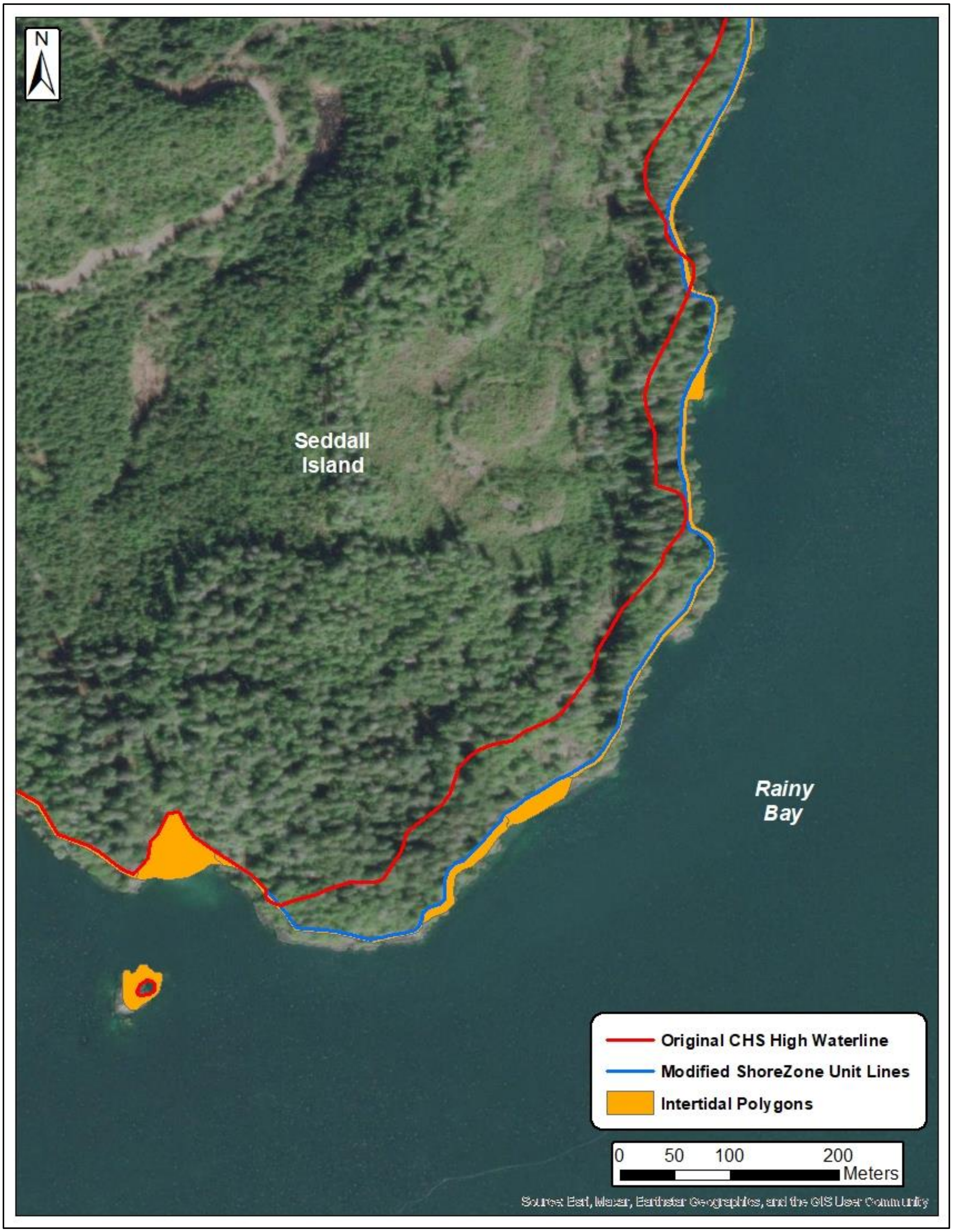

Figure 3. Example of an area around Seddall Island where the digital HWL was deemed to be significantly different from reality and needed to be shifted using the satellite and ShoreZone imagery.

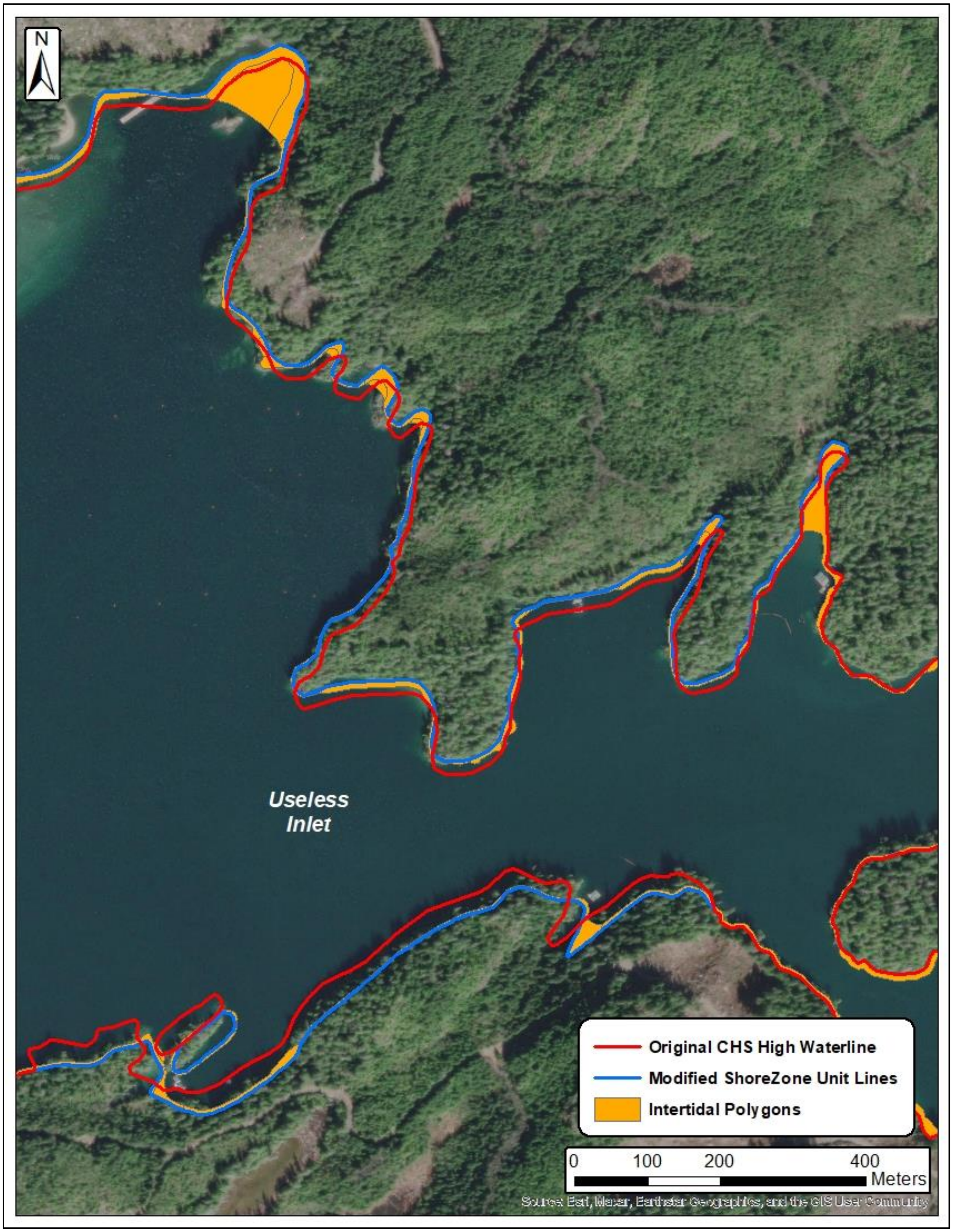

Figure 4. Example of an area in Useless Inlet where the digital HWL was deemed to be significantly different from reality and needed to be shifted using the satellite and ShoreZone imagery.

2.2 Results

In total, SeaChange created **4,423** intertidal polygons at the component level. These polygons covered **991 ha** of the intertidal zone in the Barkley Sound survey area. The final intertidal polygons add a number of attributes 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 5) and the Primary Intertidal Form (Figure 6). All ShoreZone attributes are detailed in the current protocol (Cook *et al*. 2017).

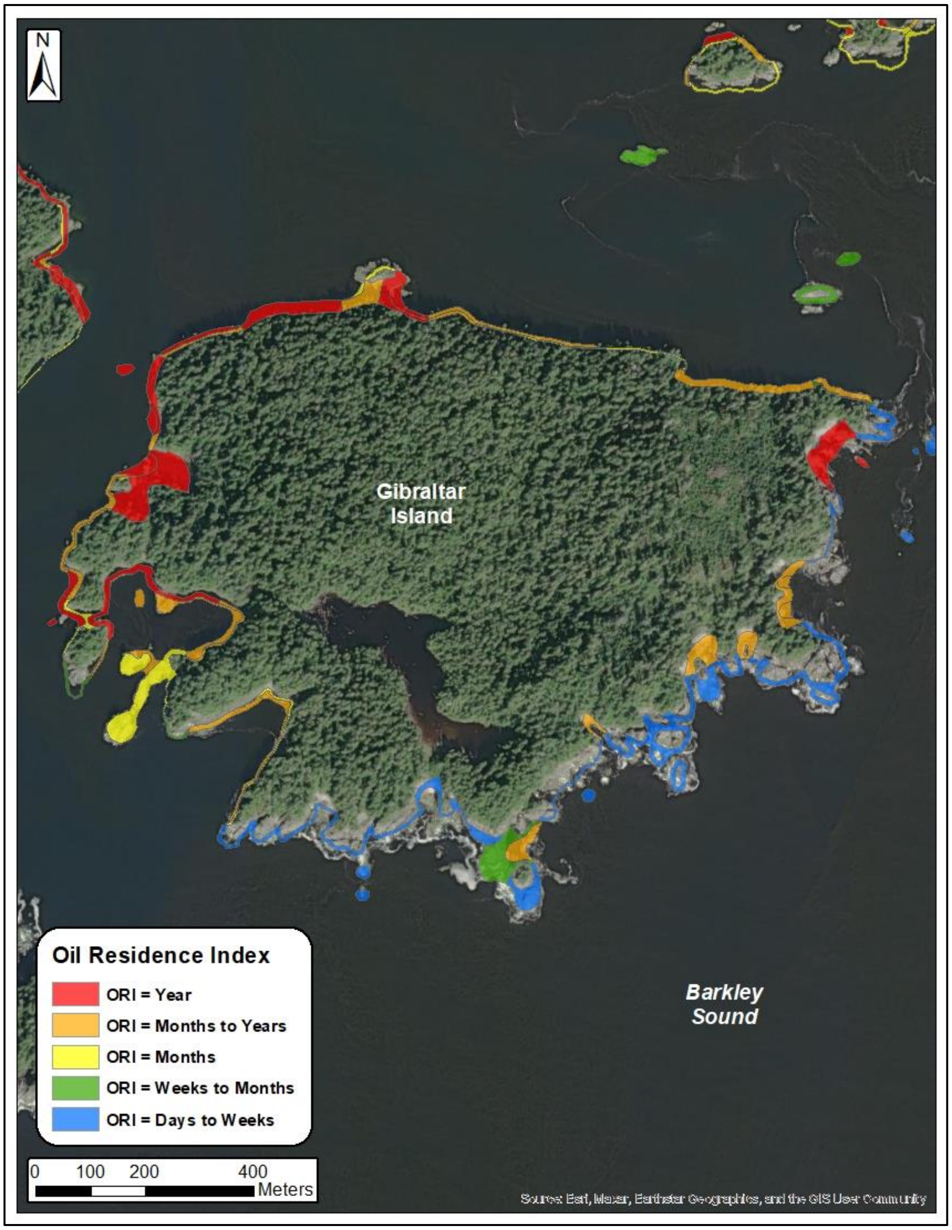

Figure 5. Example of the ShoreZone Oil Resistance Index displayed as intertidal polygons on Gibraltar Island in the Broken Island Group.

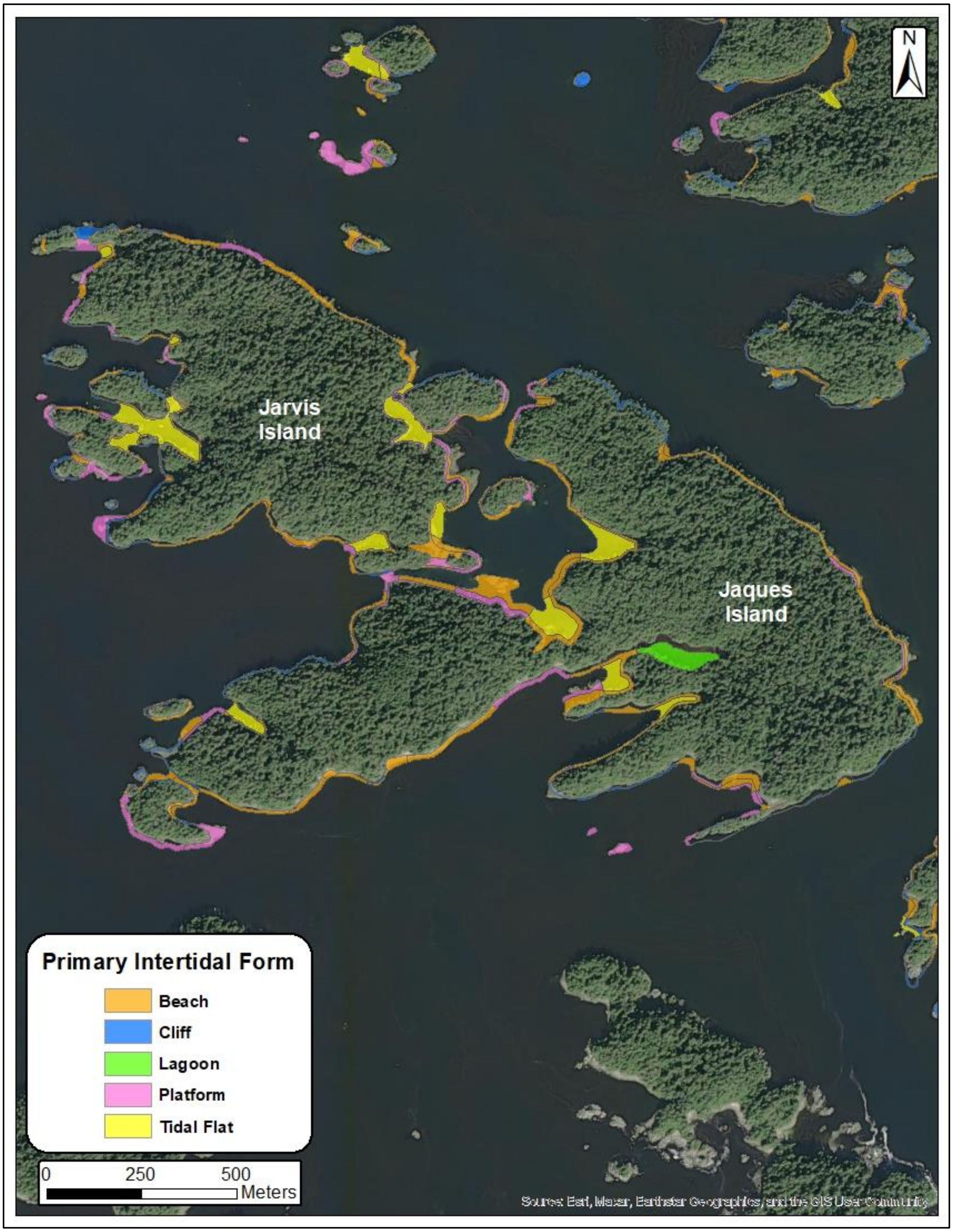

Figure 6. Example of the ShoreZone Primary Intertidal Form displayed as intertidal polygons around Jarvis and Jaques Islands in the Broken Island Group.

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 6 biobands that fit these criteria and were present in the Barkley Sound survey area were: **Dune Grass**, **Salt Marsh**, **Eelgrass**, **Bull Kelp, Giant Kelp and Urchin Barrens**. See Table 1 for the definitions of these biobands from the ShoreZone protocol and Figures 7-12 show photographic examples of these biobands. It is possible there were more Urchin Barrens in this region than documented; however Green Sea Urchins (*Strongylocentrotus droebachiensis*) are not visible from the ShoreZone imagery so barrens dominated by Green Sea Urchin would not be identified using this methodology.

Our method for creating polygons of the sensitive habitat biobands identified as part of the ShoreZone mapping of the Barkley Sound survey area (SeaChange, 2023) 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 as applicable 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) and Dense (D). 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).

Table 1 Definitions for the sensitive habitat biobands mapped as polygons in the Barkley Sound 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	Giant Kelp	MAC	**GIKE**	C	Dark brown to golden-brown	*Macrocystis pyrifera*	Canopy-forming giant kelp, long stipes with multiple floats and fronds. If associated with NER, it occurs inshore of the bull kelp. Range: Baja California, Mexico to Kodiak Islands, AK.	P to SE

Table 1. cont.

Bioband Name			Prior Code	Current Code	Zone	Typical Color	Indicator Species	Description	Biological Wave Exposure
Primary Level	**Secondary Level**	**Tertiary Level**							
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
Invertebrate	Echinoderms	Urchin Barrens	URC	**URBA**	C	Coralline pink/white	*Strongylocentrotus franciscanus*	Shows rocky substrate clear of macroalgae. Often has a pink-white color of encrusting coralline red algae. May or may not see urchins.	SP to E

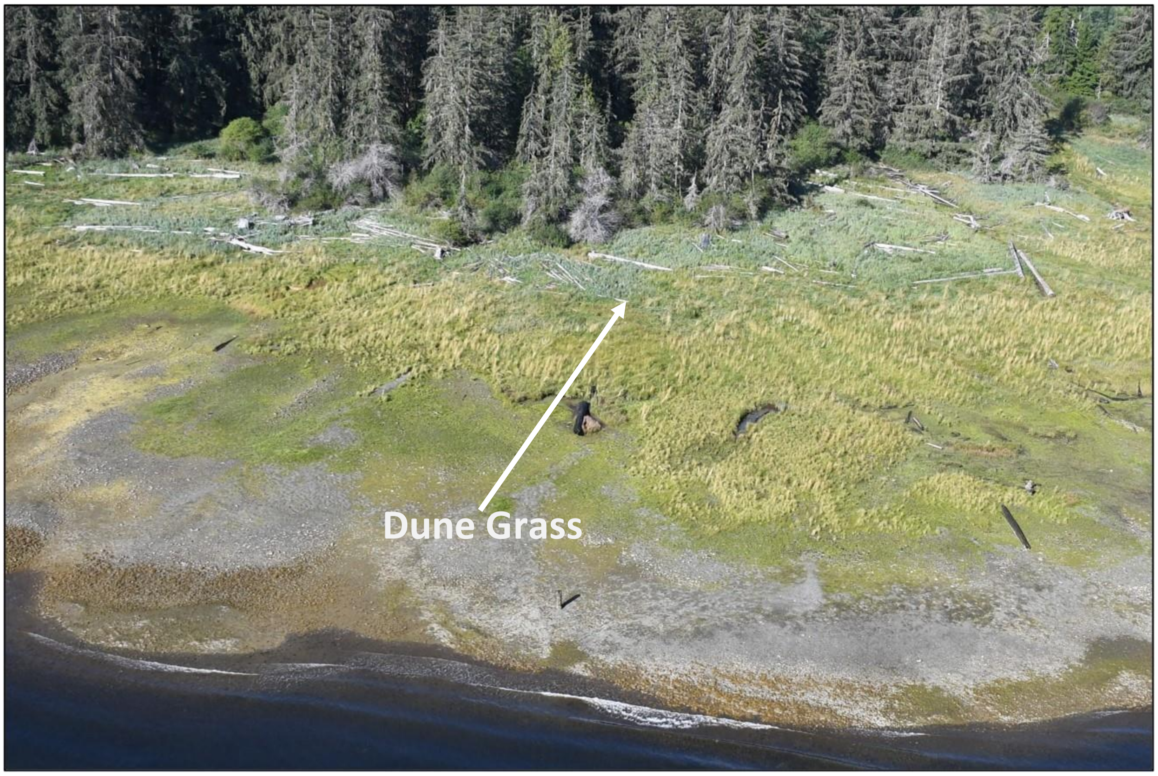

Figure 7. Good example of the blue-green Dune Grass (DUGR) bioband. Alberni Inlet, north of Macktush Bay. Photo bc22_bk_02323.

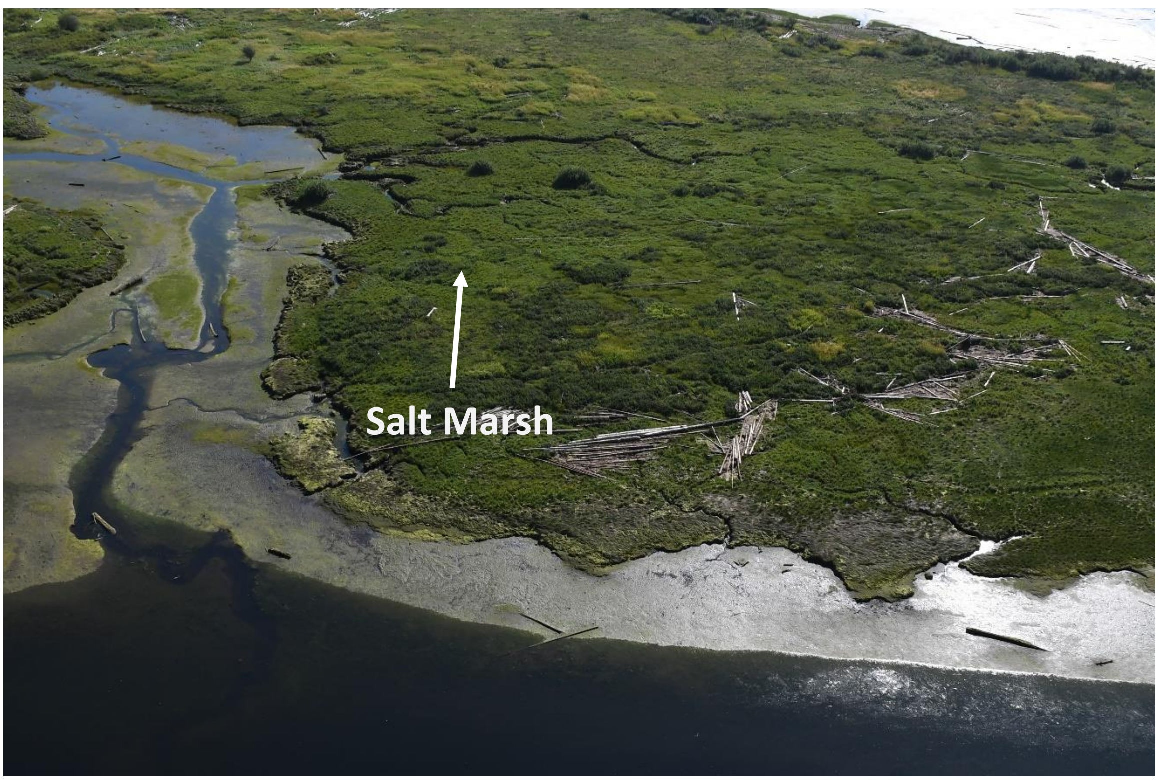

Figure 8. Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal. Johnstone Island. Photo bc22_bk_02551.

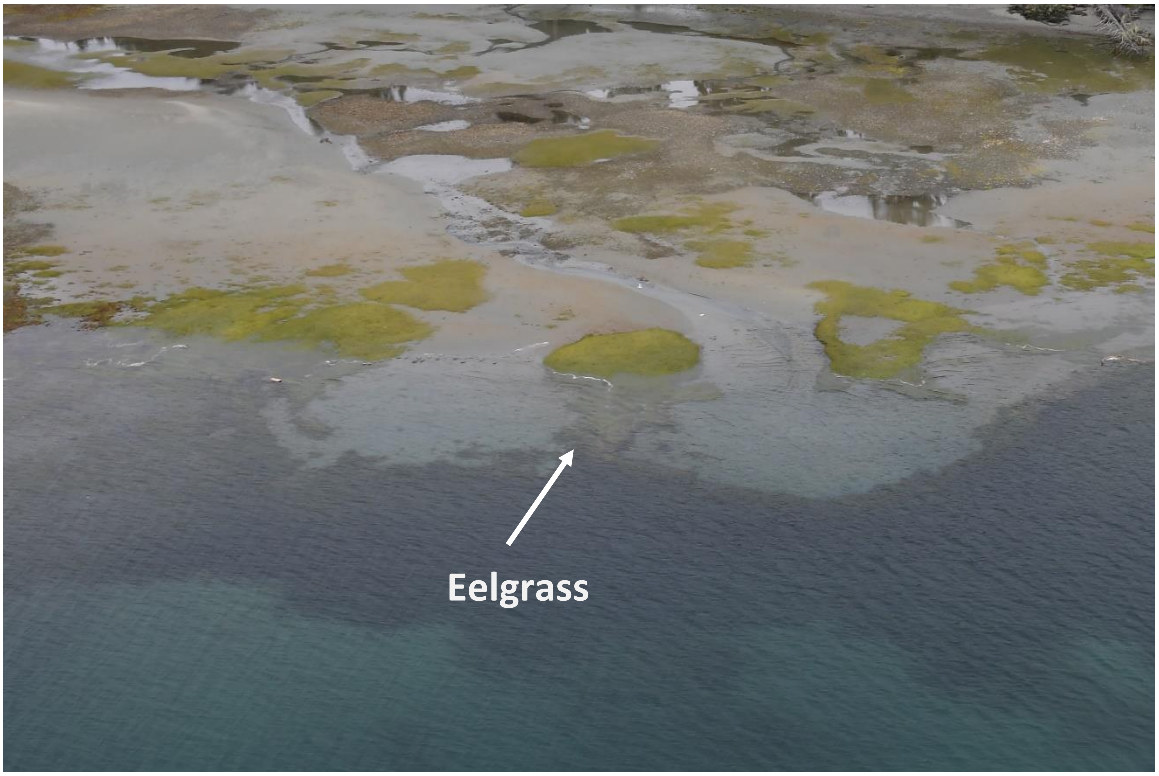

Figure 9. Example of intertidal/subtidal Eelgrass (EELG). Macoah Passage. Photo bc22_bk_05145.

Figure 10. Example of the Giant Kelp bioband in the subtidal. Lovett Island. Photo bc22_bk_1870.

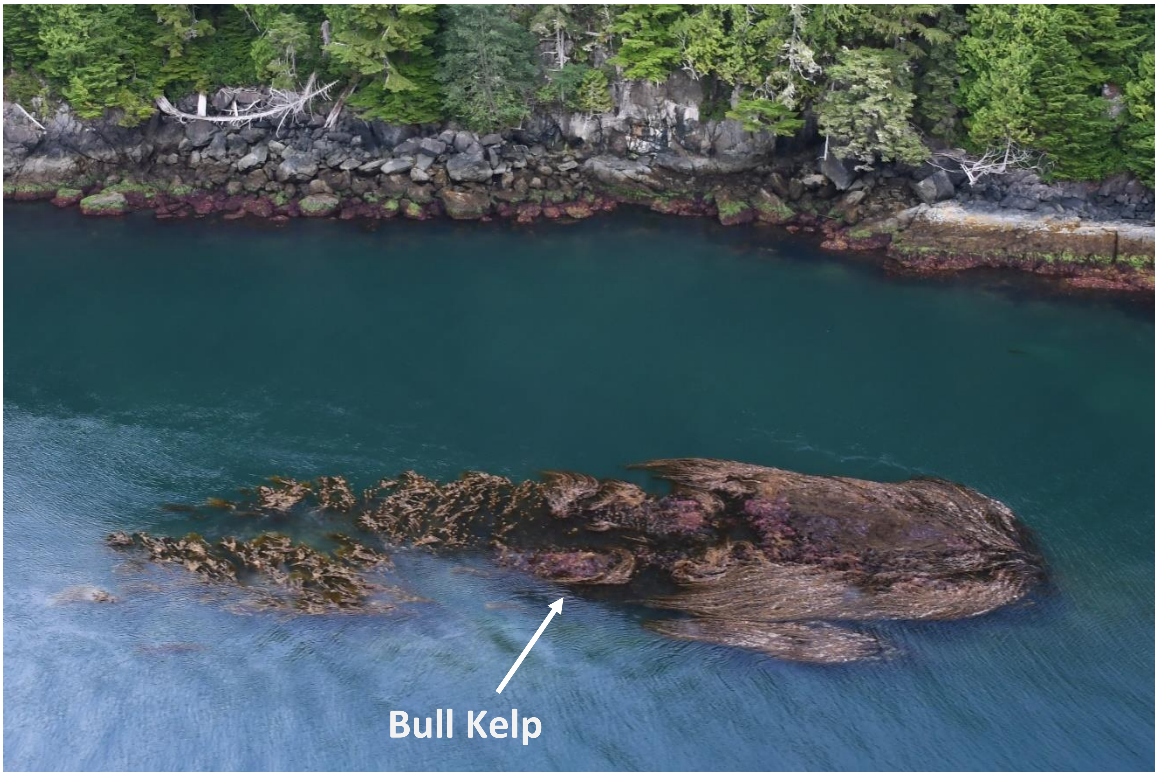

Figure 11. Good example of the Bull Kelp (BUKE) bioband in the nearshore. Useless Inlet. Photo bc22_bk_04100.

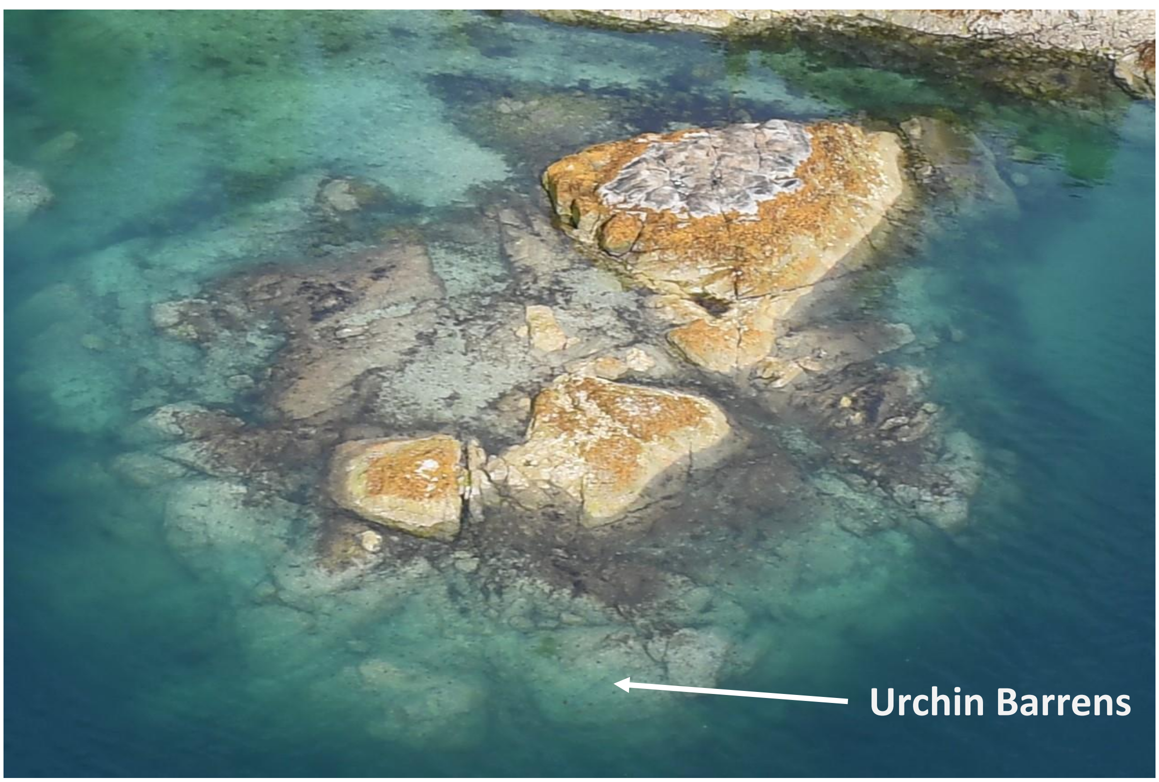

Figure 12. Good example of the Urchin Barrens (URBA) bioband in the nearshore. Toquart Bay. bc22_bk_06172.

We did encounter challenges in the creation of the sensitive habitat polygons, most of which centered around the varying resolution and quality of the ShoreZone imagery and the satellite imagery and how the two interacted. Figure 13 shows an example where the satellite image had cloud cover, which made it challenging to see landmarks that allowed for accurate location of any sensitive habitat polygons. Figure 14 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.

Another challenge we encountered were 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 most 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 Barkley Sound survey area and should be used to replace any existing geodatabase the user might have from that area.

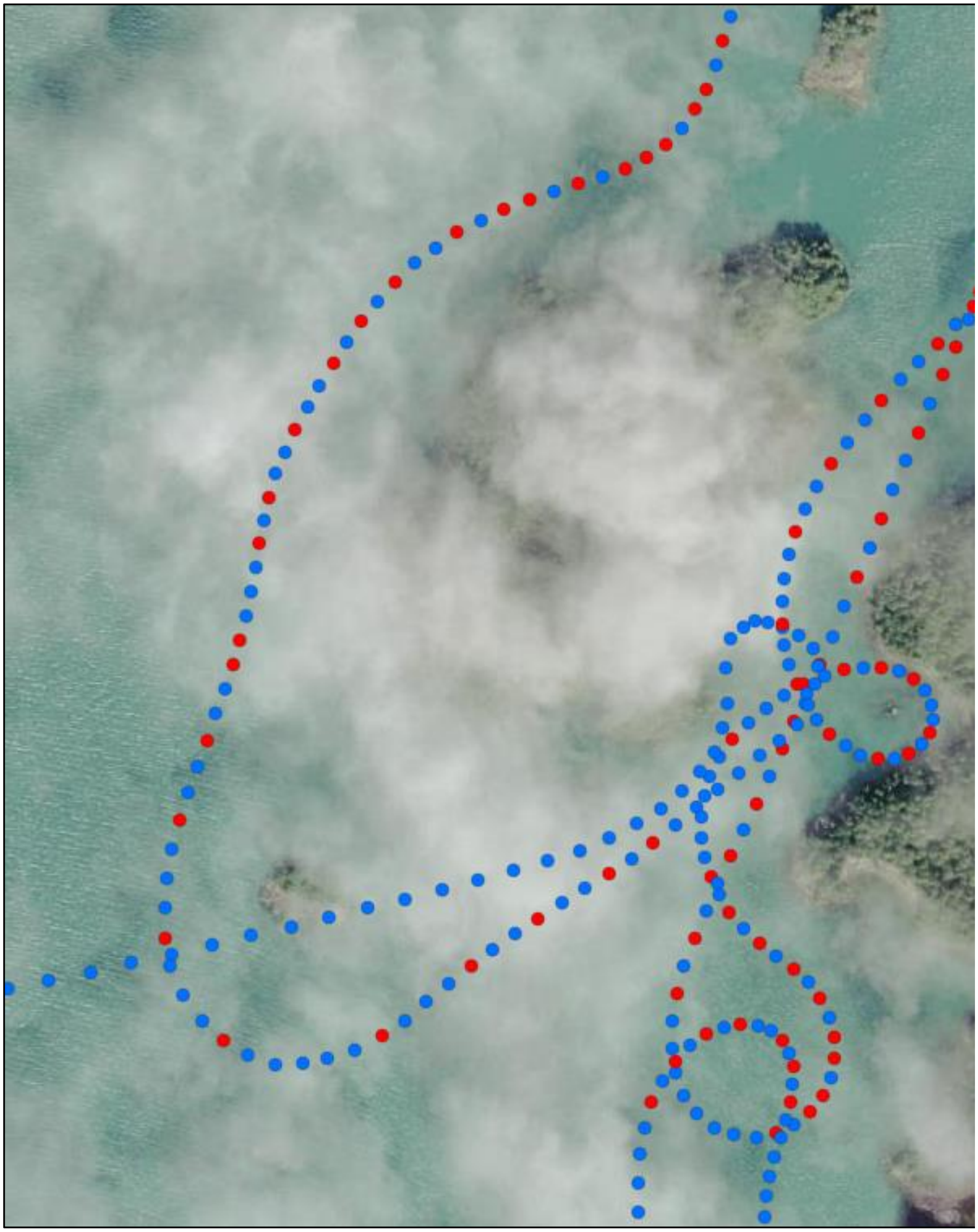

Figure 13. Example of an area where cloud cover was obscuring part of the shoreline.

Figure 14. Example of an area where the ShoreZone image (bc22_bk_00726 near Denne Island) was of poorer quality due to the shading of the shoreline and sun glare off the water.

3.2 Results

In total, SeaChange created **3,451** sensitive habitat polygons. These polygons covered **315 ha** of the supratidal, intertidal, and subtidal zones of the Barkley Sound survey area. These polygons represent the six biobands mapped as part of this project. See Figures 15 and 16 for examples of sensitive habitat polygons created for the six biobands mapped in the Barkley Sound survey area. 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.

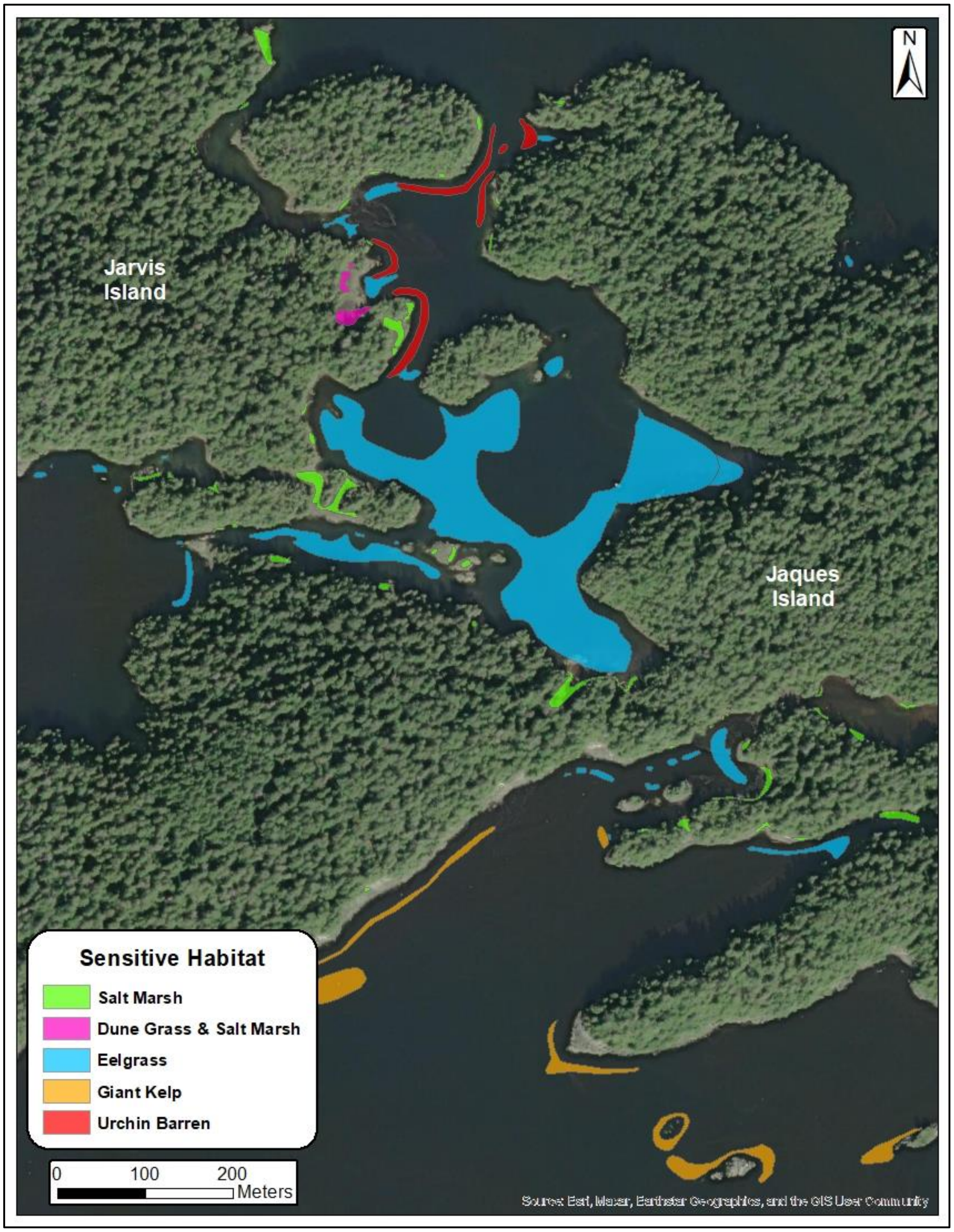

Figure 15. Example of the sensitive habitat polygons mapped around Jarvis and Jacques Islands. This was a particularly diverse area.

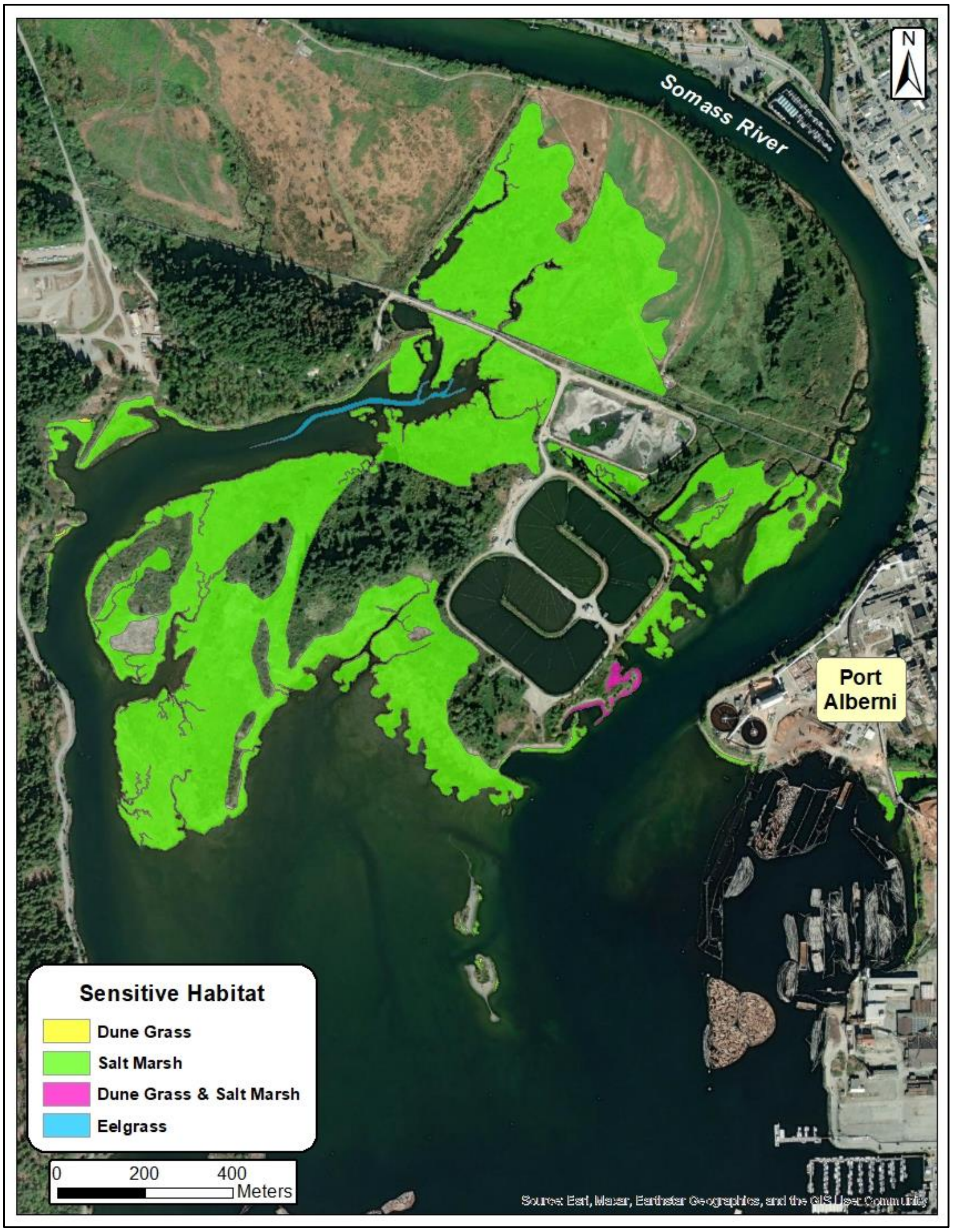

Figure 16. Example of the sensitive habitat polygons mapped around Port Alberni.

Table 2 Totals of sensitive habitat biobands mapped as polygons in the Barkley Sound 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	320	45
Salt Marsh	1626	190
Eelgrass	1013	79
Bull Kelp	106	2
Giant Kelp	343	36
Urchin Barrens	117	6

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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 shall clearly indicate their source. For questions regarding the protocols or information in this report, please contact SeaChange Marine Conservation Society at connect@seachangesociety.com.