Resilient Estuaries of the Salish Sea

Taking Action: Restoration, Conservation, and Education

Year 1 Summary Report

2023-2024

SEACHANGE
MARINE CONSERVATION SOCIETY

The citations for this report should be:

Anthony, S., Cook, S. and Nelson, K. 2024. Resilient Estuaries of the Salish Sea, Taking Action: Restoration, Conservation and Education, Year 1 Summary Report, 2023-2024. Prepared by SeaChange Marine Conservation Society. 53 pp.

Funding for this portion of the Resilient Estuaries of the Salish Sea project is provided through grant 23-AERF-PAC-060 from the Aquatic Ecosystem Restoration Fund which is funded by the Department of Fisheries and Oceans.

Contents

Executive Summary

Estuaries are essential aquatic habitats whose ongoing resilience is necessary to maintain with the increased impacts of human activities, especially climate change. The Resilient Estuaries of the Salish Sea (RESS) project is focused on studying the small and medium sized estuaries of the Salish Sea to understand features that lead to resilience and implement ways in which humans can help maintain that resilience. This project has two parts: (1) baseline data collection and assessment, and (2) conservation, restoration, and education initiatives to act on the data collected in the first phase. The results of the baseline assessments are presented in a separate report, titled Resilient Estuaries of the Salish Sea: Baseline Assessments and Ground-truthing, Preliminary Year 1 Summary Report, 2023-2024.

As part of the baseline assessment phase of RESS, we developed action plans for each of the six estuaries that were assessed in Area 1 of the RESS project. Those estuaries were: Oak Bay, Cadboro Bay, Saanichton Bay, Portage Inlet, Tod Inlet (SṈIDȻEŁ), and Roberts Bay. These actions plans outlined suggested restoration, conservation, and educational actions that could be taken in each of those estuaries to maintain or enhance their resilience to the effects of climate change. Not all the actions were realistically able to be accomplished during the timeline of this project, and only those met with the approval of the local First Nations and community organizations were undertaken. The RESS project is designed to be collaborative, the intention is to ensure any work fits within existing priorities rather than imposing outside values.

The estuaries in this area were more urban in nature and therefore had unique challenges in terms of conservation and restoration actions. Marine debris cleanups, including ghost gear removal, were completed in Oak Bay, Cadboro Bay, and Saanichton Bay, as the surveys there identified large amounts of debris on the seafloor. In total, 4.65 tonnes of debris were removed from the seafloor in those three bays, with the majority coming out of Oak Bay. Derelict vessels were also identified as concerns, especially in Oak Bay and Cadboro Bay, and while we were not able to tackle that issue under this project, we were able to work with Transport Canada to identify a derelict vessel sunken in an eelgrass bed in Oak Bay, which TC then removed. We then cleaned up the seafloor debris from the vessel removal and transplanted eelgrass into the damaged part of that eelgrass bed to aid recovery. Other actions included the installation of a voluntary no-anchor zone around the healing eelgrass bed in Oak Bay to encourage boaters to anchor outside the bed and prevent further damage. Informational signage was also designed and installed in Tod Inlet to help educate boaters about actions they can take to prevent environmental damage, and further signage to educate and inform about restoration work already completed in the area. Another restoration action to take place is shoreline restoration in Portage Inlet (View Royal) to be conducted when it will not cause damage to the fish populations. Monitoring plans have been designed to measure the success and impact of these actions and will be implemented in future years of the RESS project.

The Resilient Estuaries Team

Sarah Cook, Executive Director of SeaChange Marine Conservation Society
Susan Anthony, Project Manager and Researcher
Justin Lisaingo, Operations Manager
Kendra Nelson, Outreach Coordinator
Jamie Smith, Logistical Director, Boat Operator, and Diver
Justin Bland, Boat Operator and Diver
Viki Kolatkova, Diver and Boat Crew
Joshua Prahl and (Scott) Landon Maybaum, Divers
Alison Prentice, Budgeting and Bookkeeping
Seanie Malcolm, Thomas Armitage, Diego Vega, Cole Rader, and Laurie McCormick, SeaChange staff
Nikki Wright, Mentor and former SeaChange Executive Director

Acknowledgements

SeaChange and the RESS Team would like to acknowledge the partners, collaborators, and contributors who put so much time, effort, and heart into the work outlined in this report:

Kyle Armstrong (Peninsula Streams Society)
Isobel Pearsall, Ben Skinner, Kyla Sheehan (Pacific Salmon Foundation)
Carmen Pavlov, Lexi Kosmides, Noah Kaefer (Songhees Marine)
Laís Chaves, Neil Fowler, Shae Harding, Chrissy Chen (STÁUTW (Tsawout) Fisheries)
Judith Lyn Arney, Sarah Jim, Kyle Clarke (PEPAKEN HÁUTW)
Gerald Herris, Jacques Sirois (Friends of Bowker Creek)
Brook Castelsky, Kyra Crouzat, and Kendall Farrell (Oak Bay Marine Group)
Louise McLean and Gerry Thompson (Royal Victoria Yacht Club)
Tim Clermont (Guardians of Our Salish Estuaries)
Eric Dahli (Cadboro Bay Dead Boats Society)
Pauline Finn and Tina Kelly (Shaw Centre for the Salish Sea)
Chris Hyde-Lay (Parks, Recreation, and Culture, District of Oak Bay)
Lehna Malmkvist and Sarah Stallard (Swell Environmental Consulting)
Katy Fulton (BC Parks)
Streamside Native Plants
Lucas Glenn
Alena Ebeling-Schuld

1. Introduction

Estuaries are essential aquatic habitats for numerous fish and invertebrate species, including commercially important species such as Pacific salmon. Each Pacific salmon species relies on estuaries for one or more activities, such as shelter, food, and reproduction. Not only do salmon depend on the estuary at the mouth of their natal stream, but they also depend on a series of estuaries (Moore *et al.* 2016) along which they stop to feed and avoid predators. The estuaries that provide these stopover points along the 'salmon highway' are essential but difficult to identify as they may not have large or even small salmon bearing streams associated with them. Estuaries, where fresh and seawater meet, are also areas of high human activity and sites of increased invasive species establishment. The impacts of pollution in terrestrial watersheds, streams, and oceans mix to create a region that is being damaged from many directions. Adding to this is the current and future impacts of climate change, such as sea level rise, sea surface temperature increases, and changes in freshwater impact sources and timing.

The importance of the small to medium sized estuaries of the Salish Sea have not been well-studied, which is a significant gap in knowledge in terms of conservation of essential fish habitat for Pacific salmon and many other species. Preserving the connectivity between the natal river mouth of the Pacific salmon runs and the open ocean through estuary restoration and conservation is therefore crucial to protect salmon and the overall health and diversity of our oceans. Given the importance of, and the damage occurring to, these fragile ecosystems, SeaChange has developed the Resilient Estuaries of the Salish Sea (RESS) project.

The first Phase of the RESS project is funded through the British Columbia Salmon Restoration and Innovation Fund (BCSRIF). The goal of that phase is to identify the small and medium sized estuaries of the Salish Sea, collect baseline data about historic and current conditions, and rank them according to their resilience to the effects of climate change. We will also create actions plans outlining potential conservation, restoration and educational initiatives for those estuaries based on the results of the data gathered. For the first year of the project (2023-2024) we focused on the Saanich Peninsula (Figure 1).

For the second phase of the RESS project, SeaChange will implement the action plans by conducting conservation and restoration activities as well as provide education on the importance of estuaries and the work being undertaken. These actions are geared toward maintaining and improving resilience for these critical areas. The focus will be vegetative habitats, both sub-tidally and marine riparian, and forage fish spawning areas in estuaries with high salmon habitat connectivity and relatively low backshore development. The actions potentially undertaken will fall under broad categories:

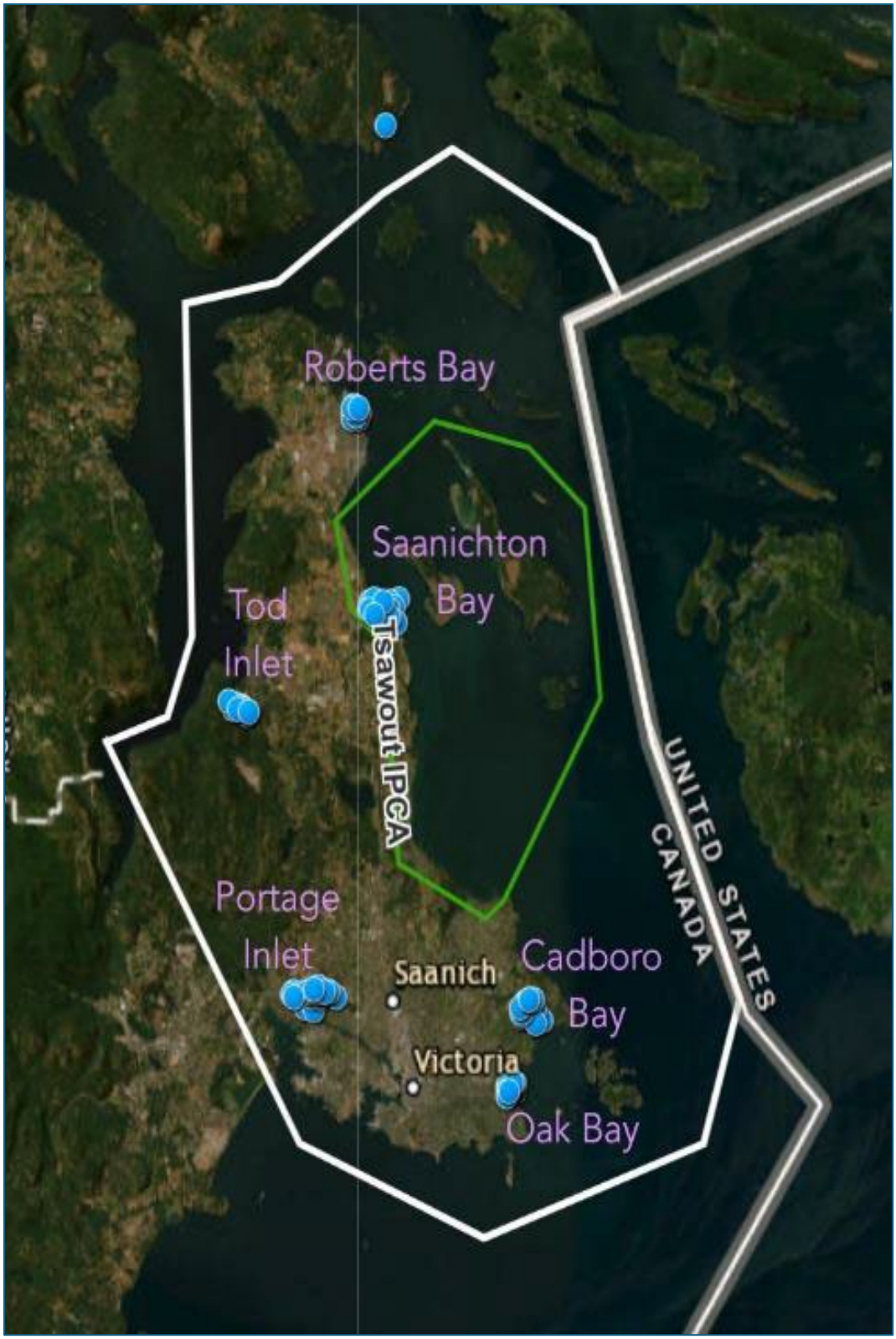


Figure 1: Resilient Estuaries of the Salish Sea Area 1. The six studied estuaries are in blue, the Area 1 boundary is in white, and the Tsawout Indigenous Protected and Conservation Area (IPCA) is outlined in green.

1. Habitat Restoration
   The goal of restoration activities is to help impacted areas regenerate and/or return to a previous state of being. Potential activities could include:

   a. Removal of marine debris: Debris, such as household garbage, construction materials, and sunken vessels can smother and shade eelgrass and understory kelps, damage suitable substrate habitats, and leach contaminants into the surrounding area. Further, ghost gear can impact the ecosystem by directly causing the entrapment and death of fish, crabs, and other marine life. Debris and larger items will be collected with a barge and crane by a commercial diving team.

   b. Eelgrass planting: Eelgrass (*Zostera marina*) is an ecosystem engineer; it slows water flow, allowing deposition of nutrient-rich sediment, and provides food and shelter to estuarine animals. The SeaChange dive team can harvest shoots from donor beds and transplant them to suitable areas. The donor stock of this eelgrass will be determined by the recipient seabed's features and health of the nearby bed, with the possibility that the donor plants will come from multiple sites to increase genetic diversity. Seeding could eventually be added to further enhance diversity.

   c. Riparian planting: The riparian zone is the strip of terrestrial vegetation connecting the estuary to the backshore. It provides food and shelter to the estuarine animals and can help filter excess nutrients and contaminants in runoff and stormwater. Where riparian areas are depauperate, appropriate native vegetation will be planted to encourage native terrestrial ecosystem function.

   d. Invasive species removal: In some estuaries, the introduction of non-native species has altered the habitat negatively for indigenous species. Japanese Wireweed (*Sargassum muticum*) can shade eelgrass, and the European Green Crab (*Carcinus maenas*) feeds on eelgrass directly and competes with and kills native species, such as the Dungeness Crab. Non-native species will be removed by hand and/or using species-specific traps.

2. Conservation
   The goal of conservation actions is to maintain areas that already exhibit resilience and prevent impacts from occurring in the future. Potential activities will include:

   a. Permanent mid-line mooring buoys: Estuaries are common mooring sites for watercraft, given the soft sediments and generally sheltered nature of the bays.

Anchors and traditional fixed moorings can cause damage to the seabed in a width area around the anchor or mooring point. Mid-line float mooring buoys can be installed for visiting boaters, decreasing the impact of recurring anchoring damage. The moorings have a float attached part-way up that keep the chain off the seabed even at low tides.

b. Voluntary No Anchor Zones: In delicate sediment and eelgrass sites, "Voluntary No Anchoring" or "Voluntary Eelgrass Protection Zone" buoys can be installed that delineate the subtidal edge of the eelgrass bed, which is often not visible from the surface. Previous experience shows that when made aware, people are willing to anchor outside those zones to avoid causing damage.

c. Signs: Informing the public, like the "Voluntary No Anchoring" buoys of the sensitive ecosystem and the potential effects of their activities in the region. This goes beyond education, as it highlights the direct effect that people are having in the area.

3. Monitoring
   Monitoring will be conducted in some of the estuaries where restoration actions are undertaken to measure the impact of those activities. The specific monitoring plan for each estuary will depend on the actions taken but could include mapping the extent or abundance of species of concern, such as salmonids or eelgrass, and monitoring for the presence of aquatic invasive species. The methods for these monitoring events will follow the protocols designed in the baseline assessment phase of the project, which include sampling designed to detect any changes as a result of our activities. The results of the monitoring will provide insight into the long-term recovery and stability of the estuaries in which intervention has occurred.

4. Education
   Citizens, businesses, and students all have the capacity to take action in their lives, workplaces, and schools to reduce their impact on our environment and create positive change. Most people and organizations have the desire to do what is best, but they need to understand what those actions are and why it is important to take them. Part of the RESS project is to conduct outreach and provide educational opportunities about the importance of estuaries to our communities and presenting actions people can take to make change. This can involve talks to community/school groups, attendance at tabling events, and providing educational materials in both physical and digital form. It could also involve training citizen and community scientists to build local capacity for surveying their environment and conducting conservation and restoration activities as the need arises.

All work undertaken as part of the RESS project will be in cooperation with local First Nations and communities and will help to move the existing priorities of those communities forward. A collaborative, community-driven approach is fundamental to ensure the long-term success of any conservation and restoration action.

2. Summary of Actions By Location

Oak Bay

Oak Bay is an excellent example of an urban estuarine system. Bowker Creek, which empties into the Bay, flows from its headwaters at the University of Victoria and a tributary in Cedar Hill Park golf course. Bowker Creek meanders through the municipalities of Saanich, Victoria, and Oak Bay. The creek flows roughly parallel to Shelbourne street, around Hillside Mall towards the Royal Jubilee Hospital, past Oak Bay High School and empties into Oak Bay near the Glenlyon-Norfolk school (Figure 2). About half of Bowker Creek is in underground culverts. The shoreline of Oak Bay has extensive development, including old (potentially heritage) buildings, schools, and seawall. The estuary has an active marina with room for several hundred vessels and there are typically 10-30 anchored boats in the bay. When Oak Bay was surveyed, we identified eight derelict vessels on the seafloor, including one sunken in the eelgrass bed on the west side of the bay (Figure 3). That vessel was removed by Transport Canada during the course of the assessment work. There is a small soft sediment beach below the road, seawall, and buildings (paved surfaces). The prospective long-term impacts of sea level rise on the eelgrass beds are likely to be exacerbated due to shoreline armouring and the Bowker Creek watershed urbanisation will harm the estuary without conservation actions inland. The Friends of Bowker Creek have been working hard toward that goal and toward having Bowker Creek be a salmon bearing stream again and the Songhees First Nation Marine department is actively concerned with the human impact on Oak Bay and the heavy trap fishing in the area.

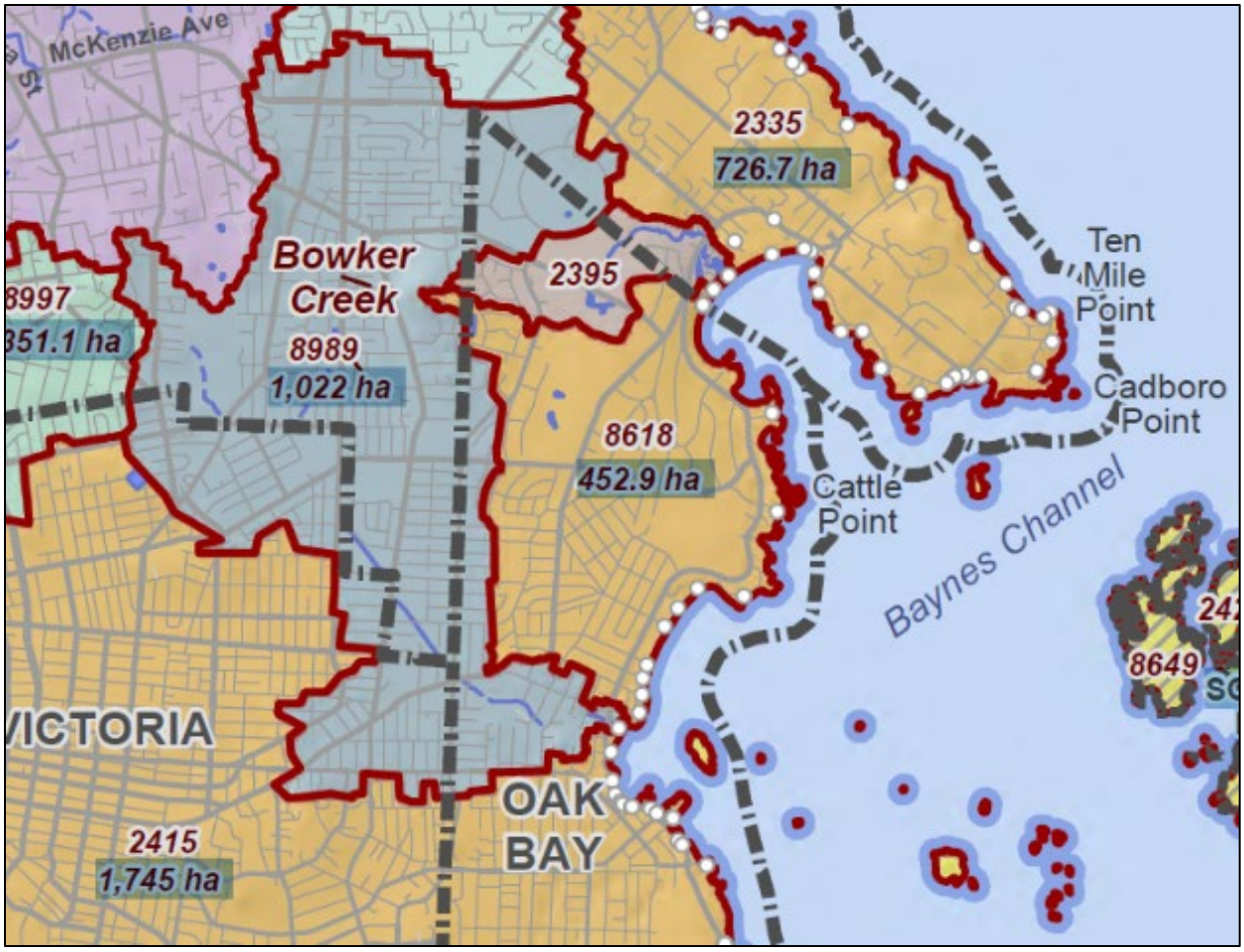


Figure 2. Map of the Bowker Creek watershed (in grey). The white dots are stormwater drains. Source: CRD (https://www.crd.bc.ca/about/document-library/documents/maps/watersheds).

Figure 3. Oak Bay shoreline and transient anchored boats as well as derelict vessels. Photos by S. Anthony.

A great deal of marine debris on the seafloor was identified by the sidescan sonar sweep of Oak Bay conducted in November 2023 as part of the baseline assessments (Figure 4, left image). Fortunately, there is a fair amount of water exchange in the bay, and there is an eelgrass bed near the entrance (green area in Figure 4, right image), both of which indicate this area is a good candidate for restoration and conservation actions. For details about the baseline assessment work done in Oak Bay for the first phase of the RESS project, please see Anthony et al. (2024).

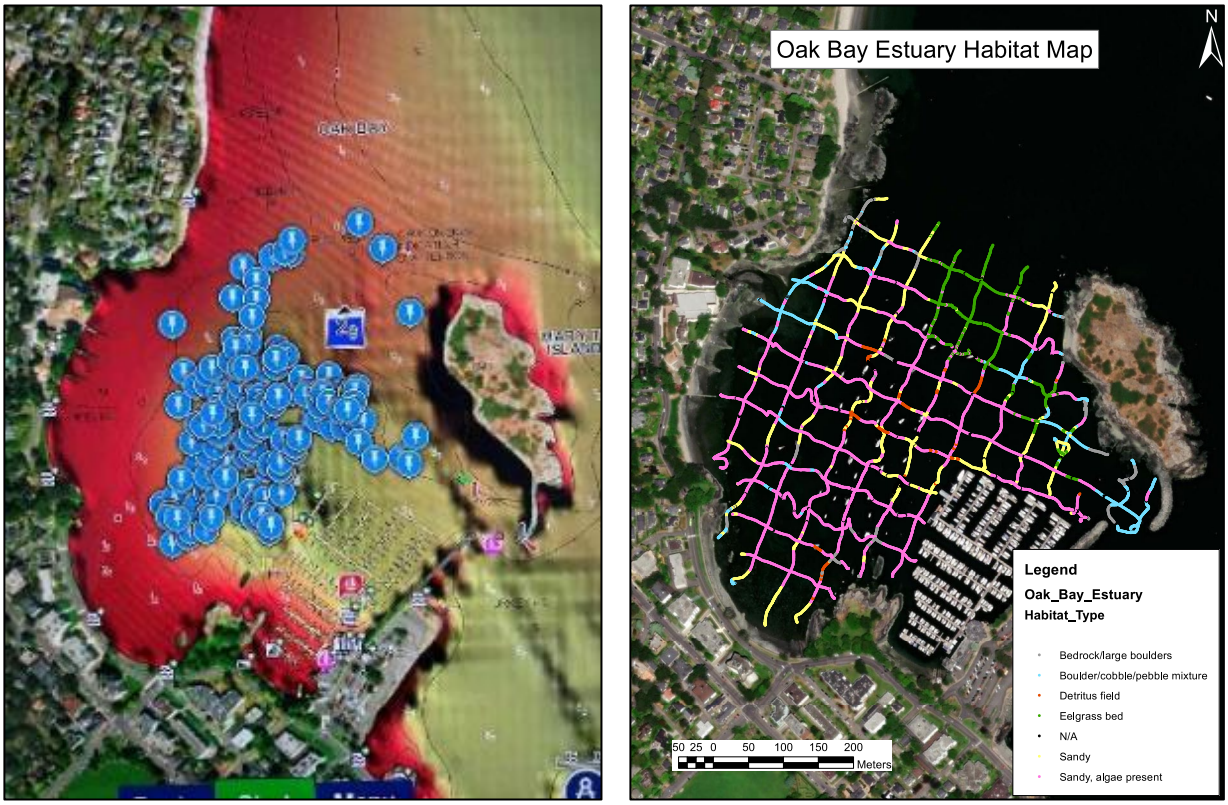


Figure 4. Sidecan sonar map of identified debris on the seafloor of Oak Bay (left), and the habitat map of Oak Bay showing the location of the eelgrass bed (green) (right).

The action plan created as part of that report suggested the following potential restoration, conservation and educational activities for Oak Bay:

- **Debris removal** of the items identified on the seafloor by the sidescan survey.
- **Education and outreach** aimed to prevent anchor and mooring damage, trash, and limiting the impact of abandoned and derelict boats.
- **Eelgrass transplant** in the area left bare after vessel removal by Transport Canada.
- **Voluntary No Anchoring Zone installed** which alerts anchoring vessels to the presence of the eelgrass bed to prevent future damage.
- **Removal of shoreline modifications** and armouring would allow for **riparian planting** and shoreline expansion inland; however, that work would need to be

undertaken as part of a much larger project involving the municipality and residents.

- Future **removal of other abandoned and derelict vessels**: 2 other sailboats, 5 other boats: one 12ft Runnabout, one buried boat, one Guru wreck, one wood boat, and one fiberglass boat.
- Continued **support of inland conservation actions** carried out by the Friends of Bowker Creek, Peninsula Streams Society, and the Municipality of Oak Bay.

Actions Undertaken in Oak Bay

Underwater Debris Removal and Disposal

Date: 29 January – 7 February 2024

Location: Oak Bay, Northwest Bowker Creek Estuary, near the mouth of the creek, within the transient mooring area

Divers collected items in baskets tied to buoys (or buoys directly tied to the debris item, if large). The *Collective Effort* crane barge lifted the items from the seafloor, and an excavator moved the debris from to a dumpster that was placed at Cattle Point. A bin removal company took the debris to the Hartland Landfill for proper recycling or disposal, as appropriate (Figure 5-10). **2.4 tonnes of debris was removed** during this cleanup. The debris included sails, masts, rope, ghost gear (crab traps), clothing, and appliances. Due to the volume of material, we only covered about 30% of the area we wanted, and therefore planned to return to collect more at another time.

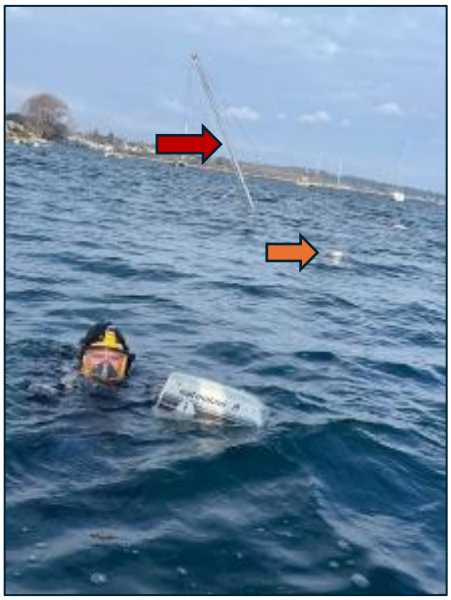


Figure 5. Oak Bay Debris Removal Event (Jan/Feb). Diver Joshua Prahl with a motorboat engine cover in foreground, a marker buoy attached to debris or a basket filled with debris (orange arrow), and mast of a sunken vessel (red arrow). We were not able to remove this sunken vessel. Photo from J. Lisaingo.

Figure 6. Oak Bay Debris Removal Event (Jan/Feb): Debris removal process, taken from the deck of the *Klanawa*. Left: Justin Bland (diver) brings a basket attached to a float down to the seafloor to fill with debris; Jamie Smith (on the boat) is in communication with the diver, and if more baskets or floats are required, he sends them down. Right: the marker buoys (orange arrows) are left behind when the divers come out of the water; later the crew returns on the *Collective Effort* and lifts the items and baskets on deck, sorts them into super sacks, and brings it to the trash bin of shore. Photos from S. Anthony.

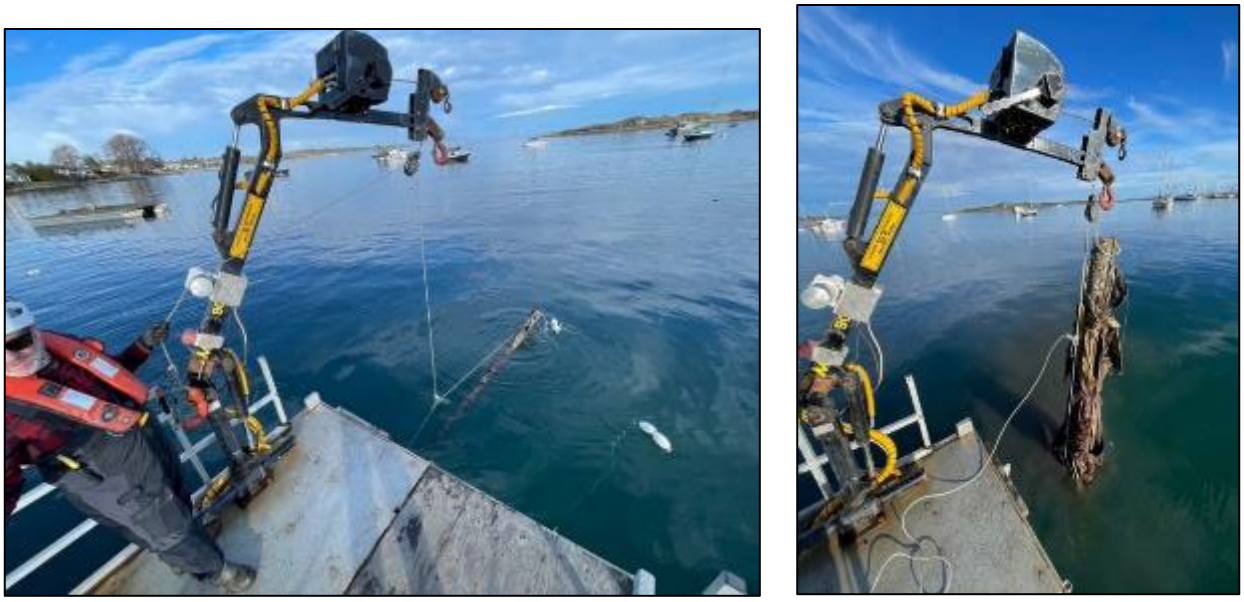


Figure 7. Oak Bay Debris Removal Event (Jan/Feb). Two examples of the many sailboat masts collected from the seafloor. Photos by J. Lisaingo.

Figure 8. Oak Bay Debris Removal Event (Jan/Feb): Left: the *Collective Effort* coming to shore at the Cattle Point boat ramp, Right: the trash bin with informational signage at Cattle Point. Photos by S. Anthony.

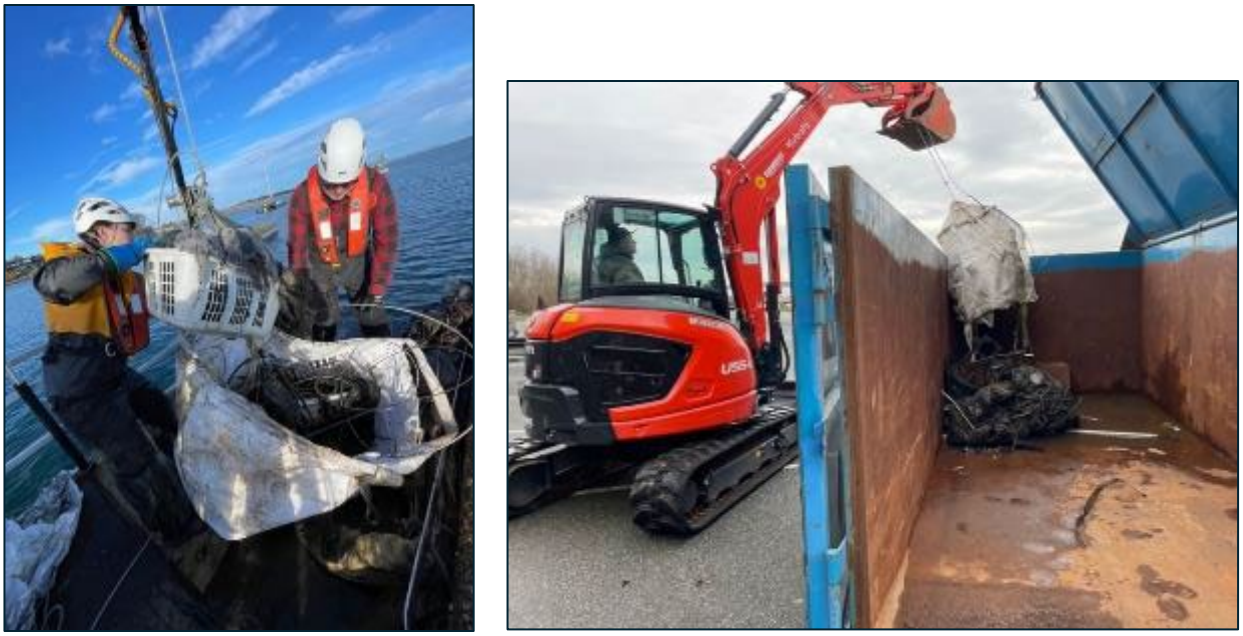


Figure 9. Oak Bay Debris Removal Event (Jan/Feb). Left: Aboard the vessel *Collective Effort*, Viki Kolatkova (left) and Jamie Smith (right) moving hoisted debris into the super sacks. Right: dumping the debris from the sacks into a trash bin on land, transferred from the *Collective Effort* with an excavator. Photos from J. Lisaingo.

Figure 10. Oak Bay Debris Removal Event (Jan/Feb). The *Collective Effort* bringing the trash bags on shore at Cattle Point boat ramp, where the trash bin and excavator were parked. Viki Kolatkova and Jamie Smith spoke to visiting families, sharing their knowledge and experience of debris removal, educating them about the problem with ocean trash. Photo by J. Lisaingo.

Underwater Debris Removal and Disposal

Date: 18 – 22 March 2024

Location: Oak Bay, Bowker Creek Estuary (South and East); cleaning up more of the transient mooring area and removing debris left behind from the sailboat raised from the eelgrass bed (Figure 11).

Divers collected items in baskets tied to buoys (or buoys directly tied to the debris item, if large). The *Collective Effort* crane lifted the items from the seafloor, and excavator moved the debris from the *CE* to a dumpster, and a bin removal company took the debris to Hartland Landfill (Figures 12 and 13). **1.51 tonnes of debris** were removed during this event. The debris was made up of materials left behind by the raised boat, crab traps, plastic toys, and cans and bottles. The area left bare by the raised derelict sailboat and the debris cleanup and is an ideal candidate for an eelgrass transplant. Follow-up will include community education on the issue of debris in the estuary, which will be part of some "dock talks" at the Oak Bay Marina that are in the planning stage for summer 2024.

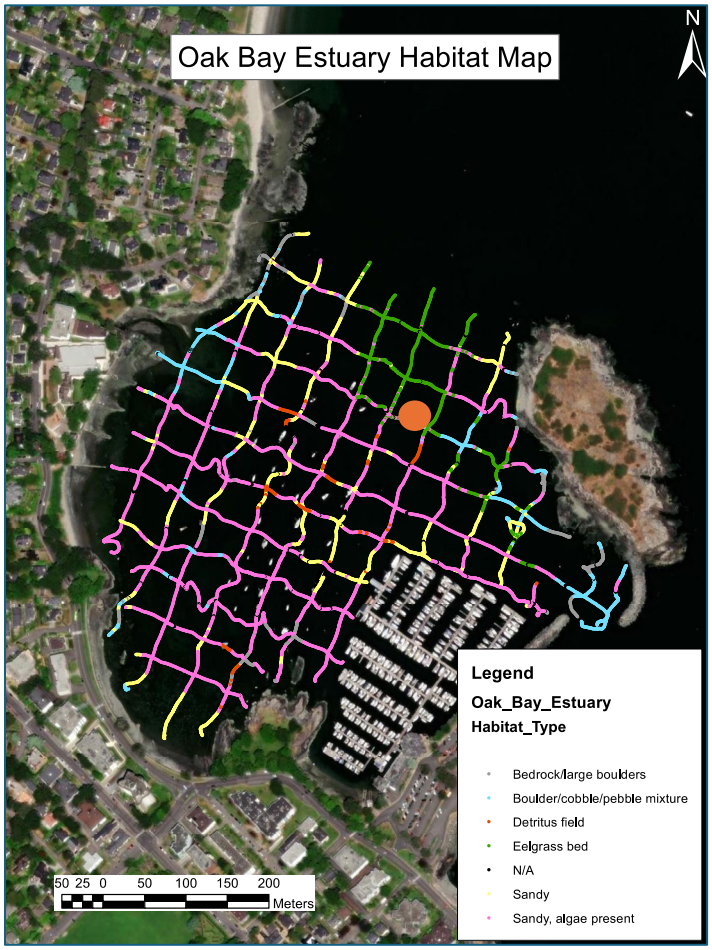


Figure 11. Oak Bay Habitat Map with an orange dot in the location of the sunken vessel in the eelgrass bed.

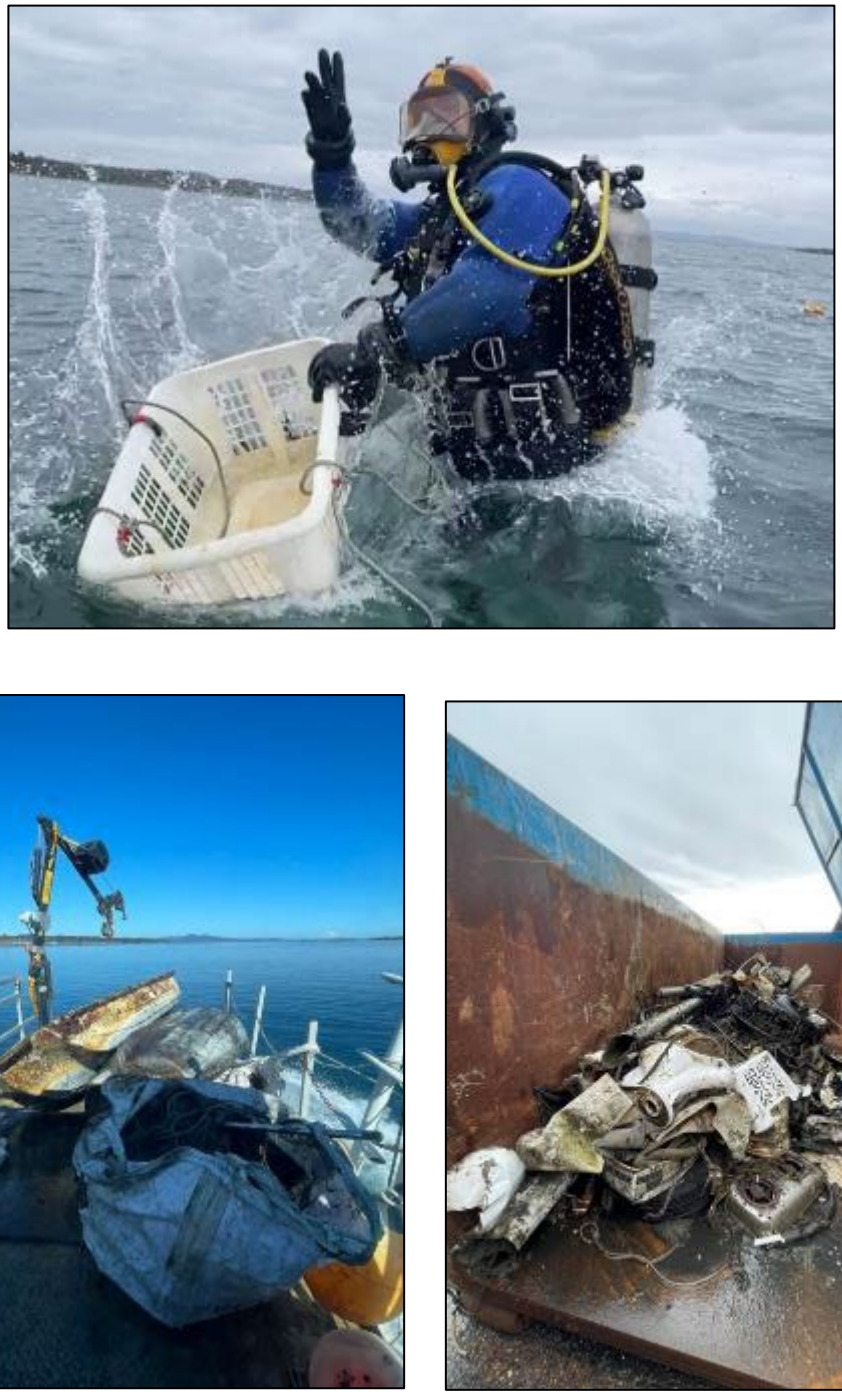


Figure 12. Oak Bay Debris Removal Event (Mar). Top: Diver Landon Maybaum dropping into the water with basket. Bottom-left: debris from the seafloor in Oak Bay on the deck of the *Collective Effort*. Bottom-right: debris in the trash bin at Cattle Point. Photos by J. Smith.

Figure 13. Oak Bay Debris Removal Event (Mar): assorted underwater photos of debris. Photos from divers V. Kolatkova and L. Maybaum.

Eelgrass transplant

Date: 7 – 9 April 2024

Location: Oak Bay, Bowker Creek Estuary (Figure 14).

Divers collected 1,000 shoots from the donor site and kept them submerged in seawater until they were attached to washers and bound together by 15 volunteers and then stored in seawater until the dive team could plant them in their new site (Figures 15-17). The divers took video of the site before the transplant (https://youtu.be/h84PImg7Ioc) and after the transplant (https://youtu.be/xtfsJ-1eyyI). The transplant covered 66 m^2 and the density of the plantings was ~15 shoots/m^2. The monitoring plan for this area is outlined in Section 3.

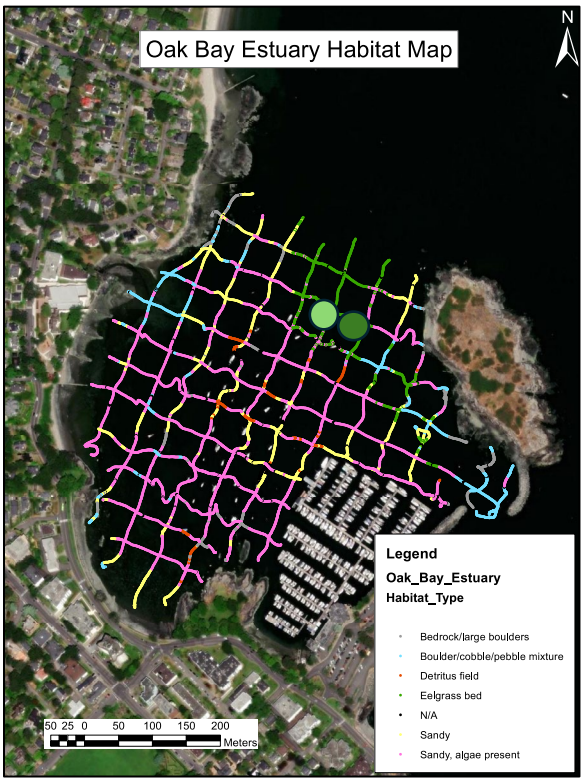
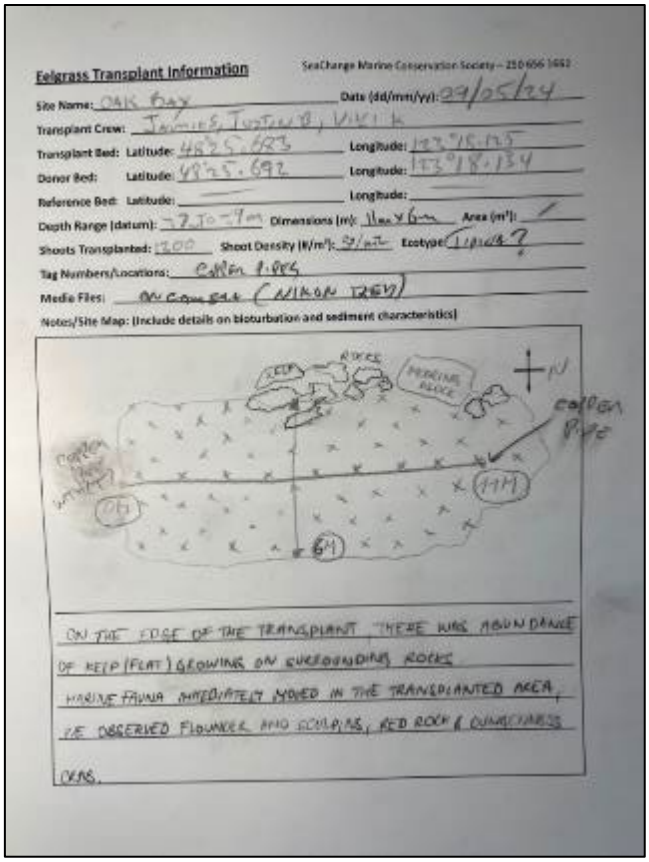


Figure 14. Oak Bay Habitat Map with pale green showing the location of the eelgrass donor site and the dark green showing the location of the transplant site.

Figure 15. Oak Bay Eelgrass Transplant Event Staging Area at Willows Beach. Top: table with information on SeaChange and RESS; Middle-left: Divers (l-r) Viki Kolatkova, Justin Bland, and Jamie Smith bringing bags of eelgrass from the donor site to the beach for volunteers to bind for transplant; Middle-right: Jamie Smith (l) leading the volunteer orientation and giving eelgrass shoot binding instructions to the volunteers; Bottom: volunteers binding eelgrass shoots to washers and twine for transplant.

Figure 16. Oak Bay Eelgrass Transplant. Left and middle: Justin Bland instructing volunteers on proper eelgrass shoot binding technique; Right: volunteers binding eelgrass shoots.



Eelgrass Transplant Information

SeaChange Marine Conservation Society – 2506561662

Site Name: OAK BAY Date (dd/mm/yy): 29/05/24

Transplant Crew: JUSTIN, JUSTIN B, VIVI K

Transplant Bed: Latitude: 48°25.623 Longitude: 123°16.175

Donor Bed: Latitude: 48°25.692 Longitude: 123°18.134

Reference Bed: Latitude: Longitude:

Depth Range (datum): -7.3 to -7m Dimensions (m): 11m x 6m Area (m²):

Shoots Transplanted: 1200 Shoot Density (#/m²): 32/m² Ecotype: Upright?

Tag Numbers/Locations: CAMP 1.085

Media Files: ON CAMERA (VIMON REV)

Notes/Site Map: (Include details on bioturbation and sediment characteristics)

ON THE EDGE OF THE TRANSPLANT THERE WAS ABUNDANCE OF KELP (FLAT) GROWING ON SURROUNDING ROCKS

MARINE FAUNA IMMEDIATELY MOVED IN THE TRANSPLANTED AREA, WE OBSERVED FLOUNDER AND SCULPINS, RED ROCK & CUMACEANS

OCAS.

Figure 17. Oak Bay Eelgrass Transplant Filled Datasheet. Divers completed the form during the eelgrass transplant event. The data here will be compared to the follow-up monitoring activity.

Installation of Voluntary "No Anchor" Zone

Date: 21 May 2024

Location: Three buoys were installed are in the sheltered side of Mary Tod Island, at the southwestern edge of the eelgrass bed; two were installed on the northeastern edge of the eelgrass bad in the less-sheltered area (Figure 18).

The eelgrass in Oak Bay is doing well in the areas where anchoring is not allowed, potentially because it is a "throughfare" or it is not sheltered enough for anchoring. The decision to not place buoys on the Southeastern edge of the eelgrass bed (between the marina and Mary Tod Island), is that there is already a law in place to prevent anchoring in that area (Canadian Navigable Waters Act 15 (1)-(2)), so any buoys in that region would be redundant. The 3 buoys to the Southwest were placed to discourage anchoring by boaters in the sheltered part of the bay and the 2 buoys in the Northeast were placed to discourage summer boating visitors to the Willows area from impacting the eelgrass from the North (Figures 18 and 19). SeaChange will be collaborating with the Friends of Bowker Creek to remove the buoys for winter to minimize potential winter storm damage to the buoys. The monitoring plan for the eelgrass bed is outlined in Section 3.

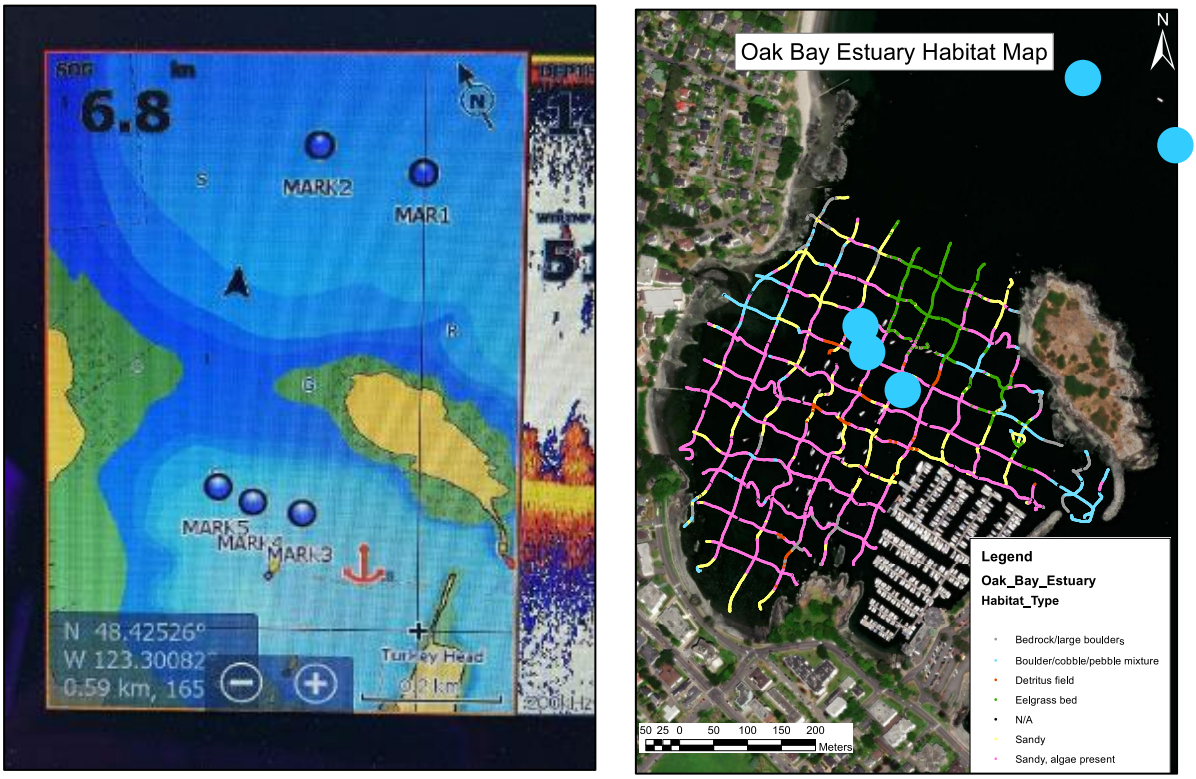


Figure 18. Location of marker buoys in Navionics Chart Plotter (left) and habitat map of Oak Bay from RESS Phase 1 (BCSRIF-funded, right). The locations were chosen to provide a wide buffer around the eelgrass bed.

Figure 19. Deployment of the "Voluntary No Anchor Zone" buoys. A crane on board the *Collective Effort* drops the anchor block into the sea. The buoy is attached to the mooring block with a mid-line buoy system, which keeps the line from scouring the seafloor. Photos by J. Smith.

Educational Videography Project

A short film showing the effect of debris on the seafloor and eelgrass beds is being put together using the footage obtained in Oak Bay and Cadboro Bay from March to June of 2024. The video will include interviews, and underwater and drone footage. Raw videos and photographs will be available for other events. A short teaser trailer has been put together for this project which is called 'Deep Troubles': https://youtu.be/cyV7pOmuTIo. The work is being done by Jamie Smith of Coastal Photography Studio. The filming is complete, while the interviews and editing are underway.

Cadboro Bay

Cadboro Bay is a large bay in the southeastern corner of Victoria, right beside Ten Mile Point. It has a large shallow, soft sediment seafloor with no eelgrass at present but a good deal of ghost gear (crab traps). There are no creeks emptying into the Bay directly at this point in history, but Mystic Creek (or Hobbs Creek) ends in a pond just behind the beach which then empties into Cadboro Bay (Figure 20). There is also a large storm drain that empties into the Bay further to the east. While this Bay may not be considered a traditional estuary at this point, there is nonetheless a significant fresh-water input into the Bay that is now highly channelized and modified. The bay is used extensively by visiting boaters, liveaboards, recreational kayakers, and stand up paddleboarders. The Royal Victoria Yacht Club, which is a large marina facility, is located on the west side of the bay. The antiquated sewage treatment in the surrounding neighbourhood and the density of liveaboards have resulted in almost constant warnings against "water activities" (including kayaking and sailing) in the bay due to health risks from bacterial contamination (https://inspections.myhealthdepartment.com/island-health/program-water-sample) (Figure 21). The shoreline has a community park, low-lying residential properties, and rocky shoreline with houses lining the waterfront. There are some low-lying properties with indigenous planting, but mostly there are seawalls along the low part of the bay (Figure 22). Cadboro Bay also has a large issue with derelict and abandoned vessels (Figure 23).

Figure 20. Map of the watersheds around Cadboro Bay. Area 2395 is the Mystic Creek (Hobbs Creek) watershed. The white dots are stormwater drains. Source: CRD (https://www.crd.bc.ca/about/document-library/documents/maps/watersheds).

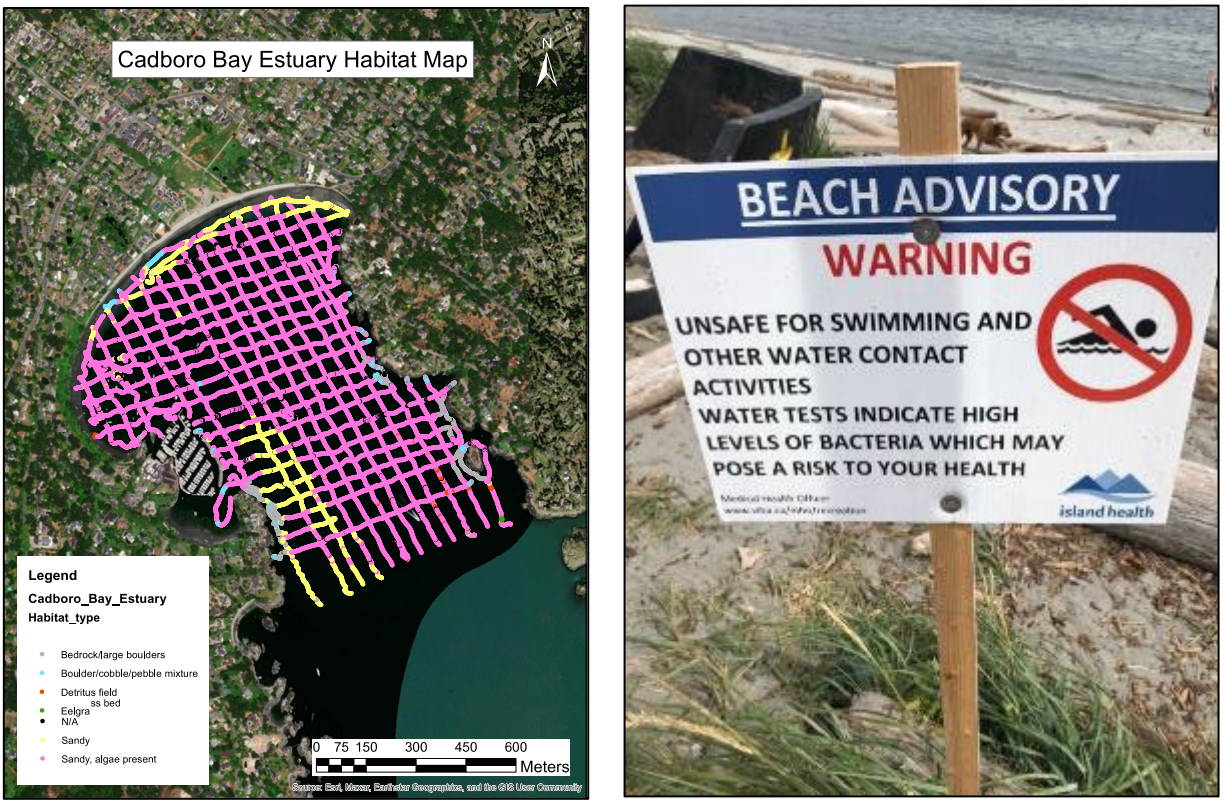


Figure 21. Top-left: The habitats of Cadboro Bay as determined from towed camera footage. Top-right: Beach advisory posted at the beach in Cadboro Bay. Photo by S. Anthony.

Figure 22. Cadboro Bay shoreline. Top-right: Northeastern point, rocky shoreline. Top-left: Northeast shoreline, rocky with large houses and trees. Middle: North and northwestern shore with sandy substrate and low houses and vegetation. Bottom: Western shoreline of Cadboro Bay, with low-lying vegetation, houses lining the shoreline and the Royal Victoria Yacht Club. Photos by S. Anthony.

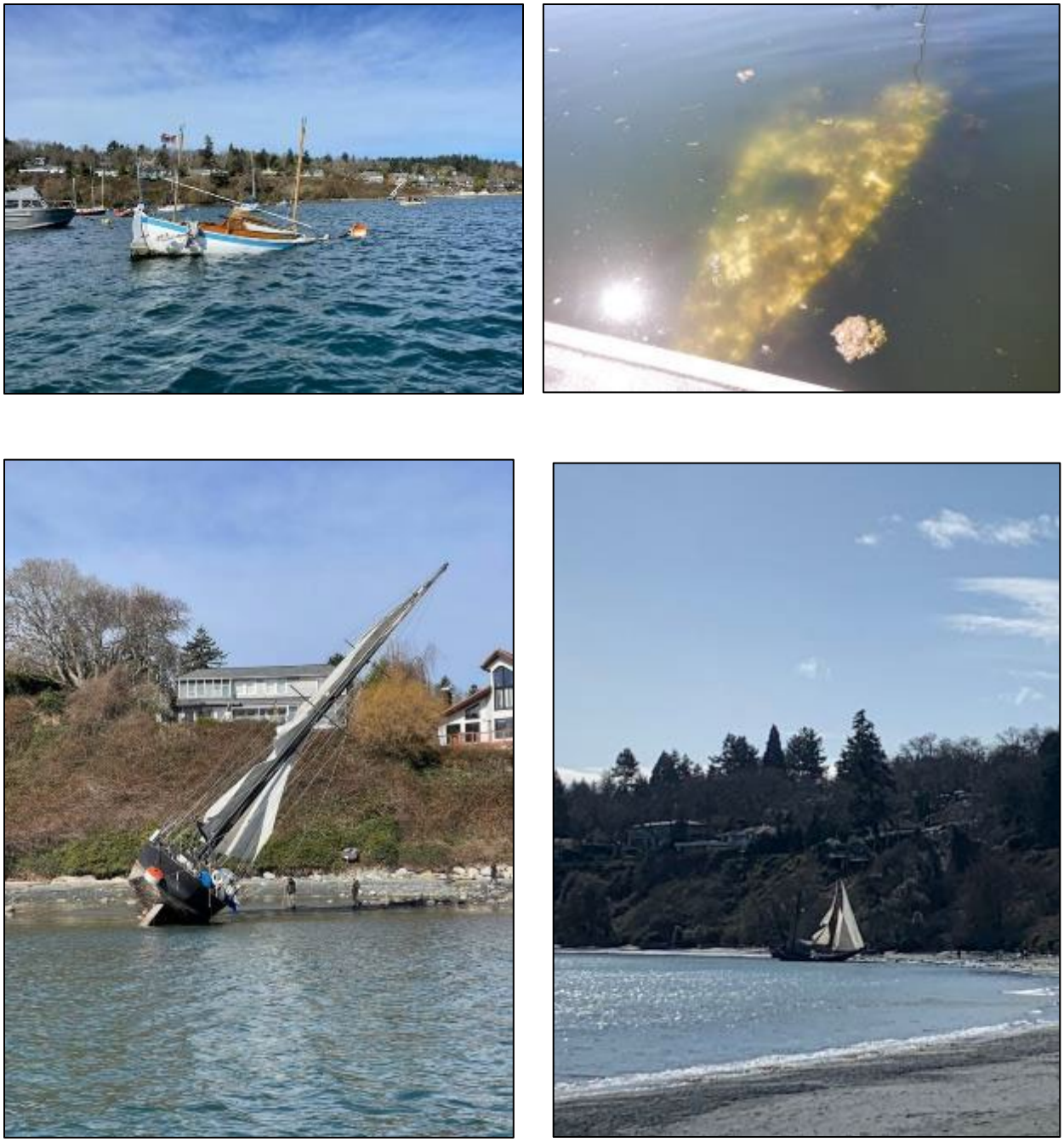


Figure 23. Examples of Cadboro Bay abandoned and derelict vessels. Top-left: A half-submerged sailboat still attached to a mooring. Top-right: Submerged and alga-covered abandoned vessel which we almost hit with the vessel *Klanawa*. Bottom-left and right: sailboat washed up on shore, later removed by the owner with the assistance of the Cadboro Bay Dead Boats Society. Photos: S. Anthony (top) and Eric Dahli (bottom).

For details about the baseline assessment work done in Cadboro Bay for the first phase of the RESS project, please see Anthony et al. (2024). The action plan created as part of that report suggested the following potential restoration, conservation and educational activities for Cadboro Bay:

- **Signage** for sewage dumping, debris, and anchor damage.
- Not likely a candidate for an eelgrass transplant site until the reason for eelgrass loss is remedied.
- **Potential riparian planting** (as seen in some residents' yards).
- **Marine debris removal**, especially in the region of the liveaboards. The area away from the liveaboards **has ghost gear** that is endangering wildlife (Figure 24).

Actions Undertaken in Cadboro Bay

Ghost Gear Removal and Disposal

Dates: 13-15 May 2024

Divers collected items in baskets tied to buoys (or buoys directly tied to the debris item, if large). The *Collective Effort* crane lifted the items from the seafloor, and excavator moved the debris from the *CE* to a dumpster, and a bin removal company took the debris to Hartland Landfill (short video: https://youtube.com/shorts/DirsF2Ykmp8). The total mass of ghost gear removed was 0.240 tonnes. This included 20 crab traps some of which had trapped live crabs which were released by the team, although many contained the remains of crabs unable to escape, one crab trap alone had 18 dead crab shells inside (Figure 25 and 26). No follow-up is planned at present, other than to return for more ghost gear removal or debris removal when we are more confident that the source of the debris has been addressed.

Educational Videography Project

Conducted along with the Oak Bay videography, please see section above for more details and a link to the teaser trailer (page 20).

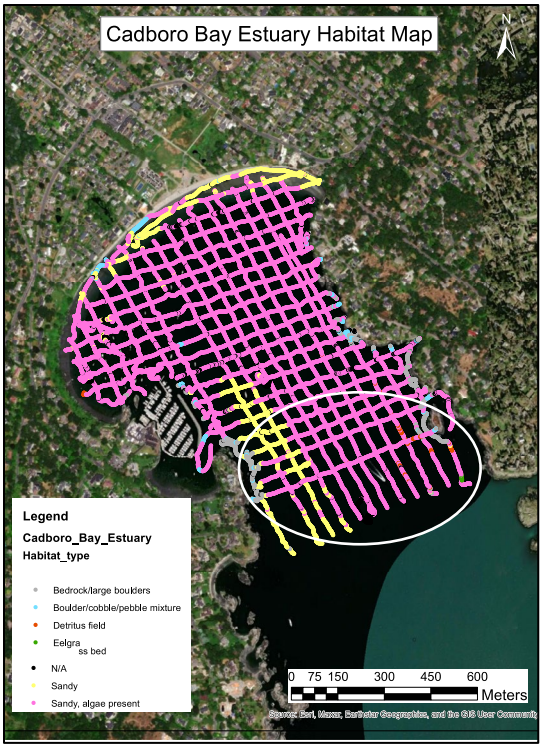


Figure 24. Cadboro Bay map showing locations of the anthropogenic materials identified from tow camera footage (circled in white).

Figure 25. Cadboro Bay ghost gear removal. Left: Abandoned crab trap with live crabs trapped inside. Right: Justin Bland and Joshua Prahl removing live crabs trapped in an abandoned crab trap.

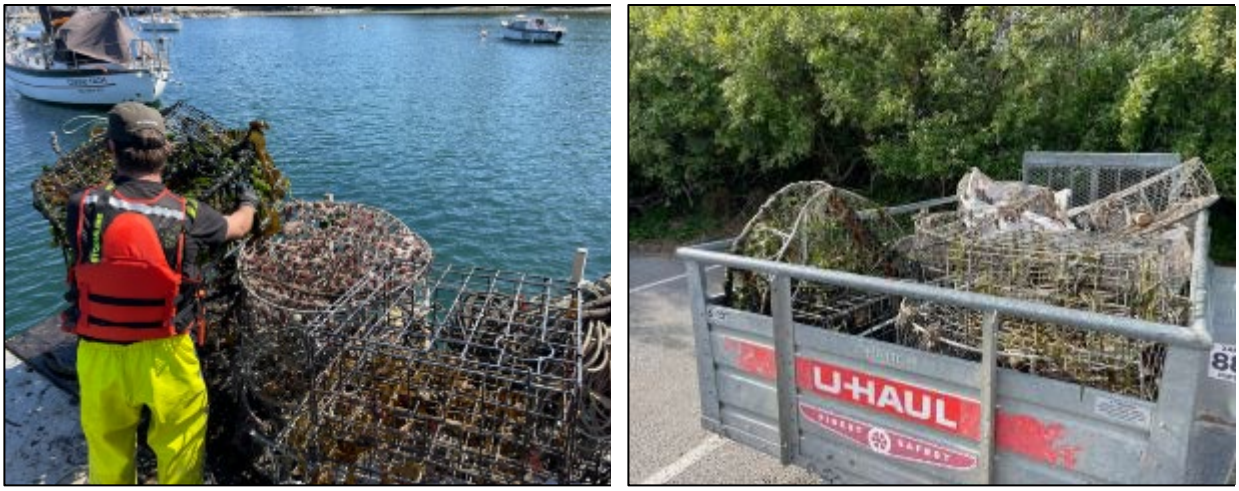


Figure 26. Cadboro Bay ghost gear removal. Top: Joshua Prahl stacking the collected abandoned crab traps aboard the *Collective Effort*. Bottom: the traps loaded to be taken to Hartland Landfill.

Saanichton Bay

Saanichton Bay is located on the eastern side of the Saanich Peninsula, on the Tsawout First Nation Reserve (Figure 27). Tetayut Creek empties into the bay and while the Tetayut watershed is not highly urbanized, it does have a large amount of agricultural land along its extent (Figure 28). The bay has lots of water movement and the lack of shelter in winter from the storms and winds means there are very few moored recreational boats (Figure 29). There are, however, large mooring buoys for barges and log booms (including a log boom that was nearshore at one of the visits to the location) (Figures 30 and 31; short video: https://youtube.com/shorts/onxbl7-V-kw). Water quality is an issue because of sewage leaks in the Tetayut watershed and the water treatment plant (near ɈIXEN). The goal of the Tsawout (SȾÁUTW) Fisheries Department is to restore crab, shellfish, forage fish, and salmon habitat for harvesting by the community. The SȾÁUTW Reserve covers a portion of the shoreline and the spit (ɈIXEN), therefore harvesting is not heavy in this region. The Northern end of the bay has heavy harvesting of crabs by traps off the James Island Wharf, and therefore a concentration of abandoned crab traps (ghost gear). Further, there is potential for salt marsh restoration, which is of interest to the Fisheries department but at odds with the requests from local farmers, businesses, and the Municipality of Central Saanich.

Figure 27. Saanichton Bay aerial image showing the James Island Wharf, the mouth of the Tetayut Creek, mooring barges, TIXEN (Cordova Spit), the lagoon, a flap gate, the tidal marsh, and the sewage treatment plant.

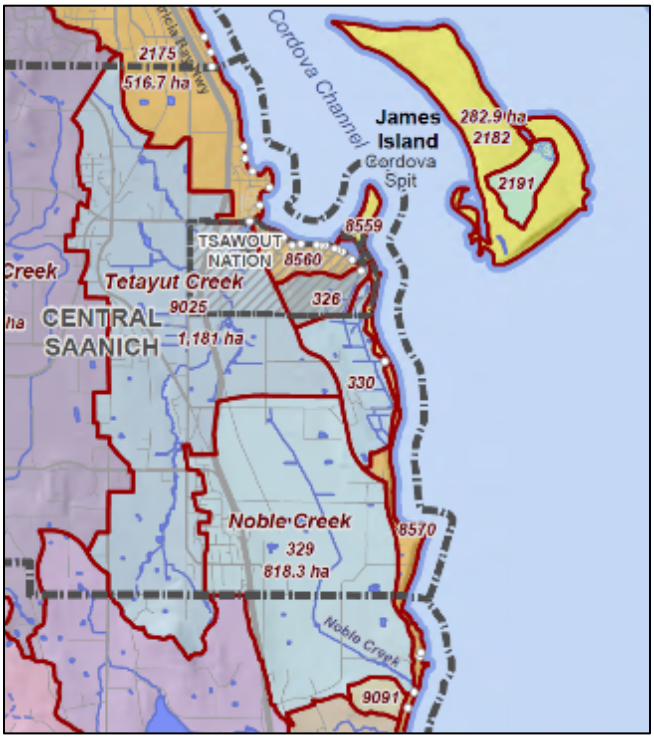


Figure 28. Map of the Tetayut Creek watershed. The white dots are stormwater drains. Source: CRD (https://www.crd.bc.ca/about/document-library/documents/maps/watersheds).

Figure 29. Saanichton Bay shoreline. Top-left: Northwest tip of the bay with rocky shoreline and James Island Wharf, with residents near the cliffside. Top-right, bottom-left: shoreline with soft sediment and vegetation on the SȾÁUTW̱ (Tsawout) First Nation Reserve lands. Bottom-right: close up of SȾÁUTW̱ First Nations canoe the *Cecilia Rose* on the shoreline. Photos from S. Anthony.

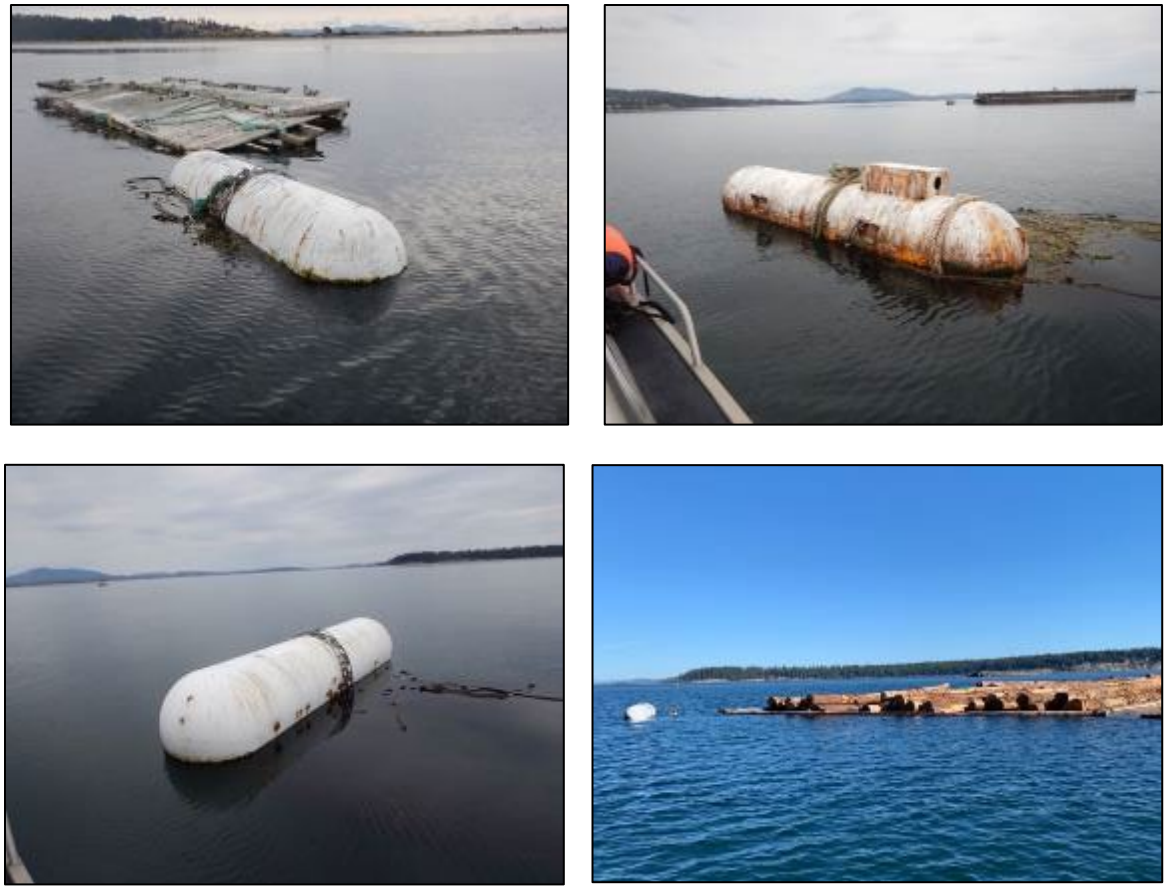


Figure 30. Large mooring buoys in Saanichton Bay. Top-left: small, dilapidated barge (with dead baby seal on it) attached to a water or gas-tank mooring "buoy". Top-right: Mooring "buoy" in the foreground, large, moored barge in background. Bottom-left: another mooring "buoy". Bottom-right: a log boom that was temporarily moored in the bay near the centre of the bay, towards the southeastern side. Photos from S. Anthony.

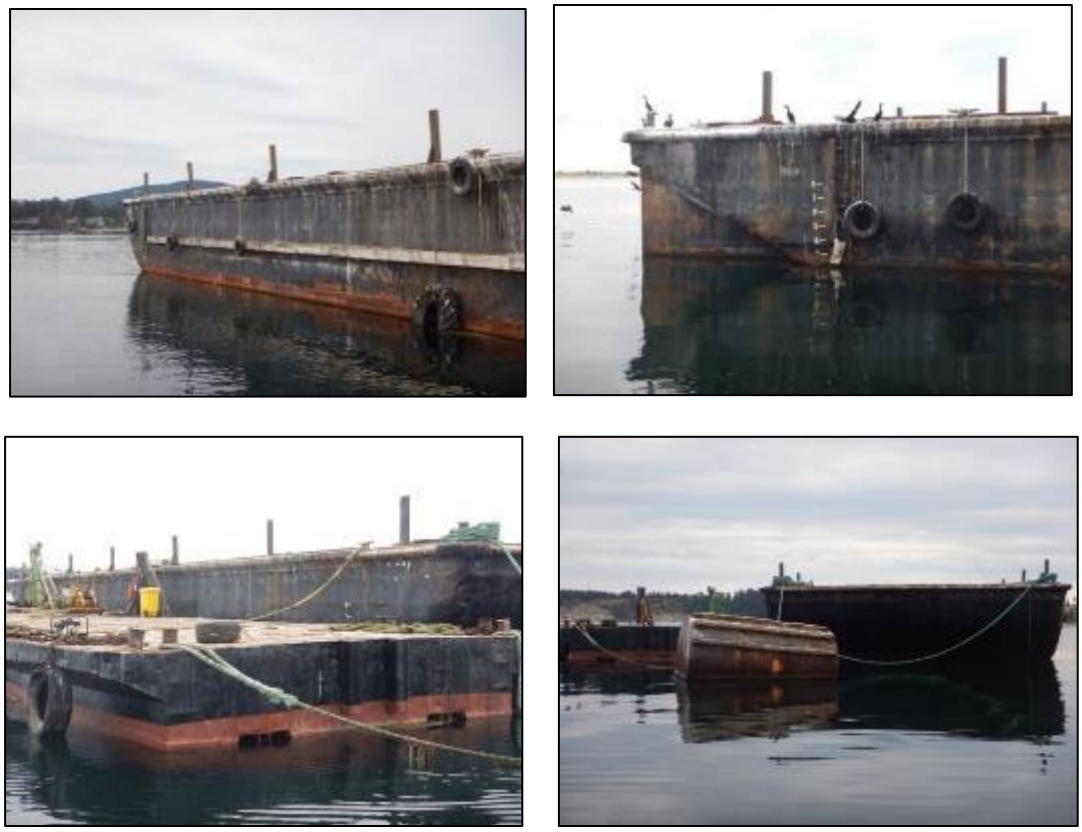


Figure 31. Close-up of the barge that is consistently moored in Saanichton Bay. The barge is so often moored that it is on the Google Map satellite images. Photos by S. Anthony.

For details about the baseline assessment work done in Saanichton Bay for the first phase of the RESS project, please see Anthony et al. (2024). The action plan created as part of that report suggested the following potential restoration, conservation and educational activities for Saanichton Bay:

- **Debris removal** where the sidescan suggests and around James Island Wharf.
- Develop a **marsh restoration plan.**
- **Educational events and signs** about estuary ecosystems at the public James Island Wharf.
- A **Q and A** along with the SȾÁUTW Fisheries for the community to update those interested on the ecosystem function, the impacts to it, and what we are doing about it.

Actions Undertaken in Saanichton Bay

Underwater Debris Removal and Disposal

Dates: 19-22 Dec 2023

Location: The eelgrass bed had little debris, so most of the time was spent around James Island Wharf.

Divers collected items in baskets tied to buoys (or buoys directly tied to the debris item, if large). The *Collective Effort* crane lifted the items from the seafloor, and a crane truck removed the super bags of debris and brought them to Hartland Landfill (Figures 12 and 13). Approximately 0.5 tonnes of debris was collected and disposed of. The debris included a dinghy, truck tire, and lots of crab traps; a large boat had to be left behind because it was too large and heavy for our team to remove (Figures 32 and 33; short videos: https://youtube.com/shorts/Uip9okuiftE; https://youtube.com/shorts/cHIxZuGjSLM). There are no immediate plans for further actions in the Bay or follow-up monitoring while we wait for direction from the SȾÁUTW_Fisheries department.

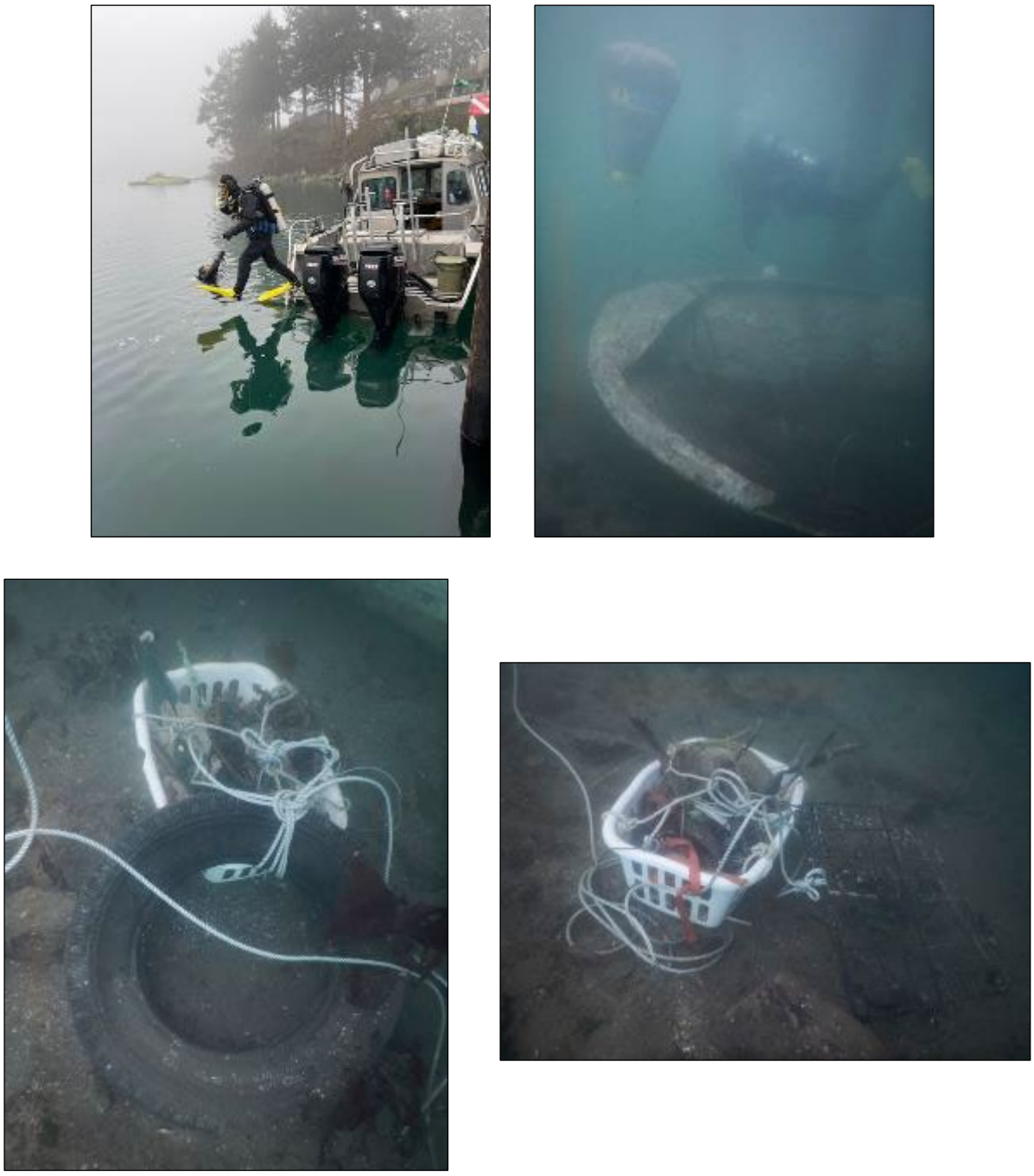


Figure 32. Saanichton Bay debris removal. Top-left: Joshua Prahl and Viki Kolatkova in the water, diving from the *Klanawa*, moored at James Island Wharf. Top-right: lift bags used to move a dinghy from the seafloor. Bottom-left and bottom-right: baskets filled with debris and lines attached directly to debris (a tire and abandoned crab trap). Photos: S. Malcolm (top-left) and V. Kolatkova (underwater).

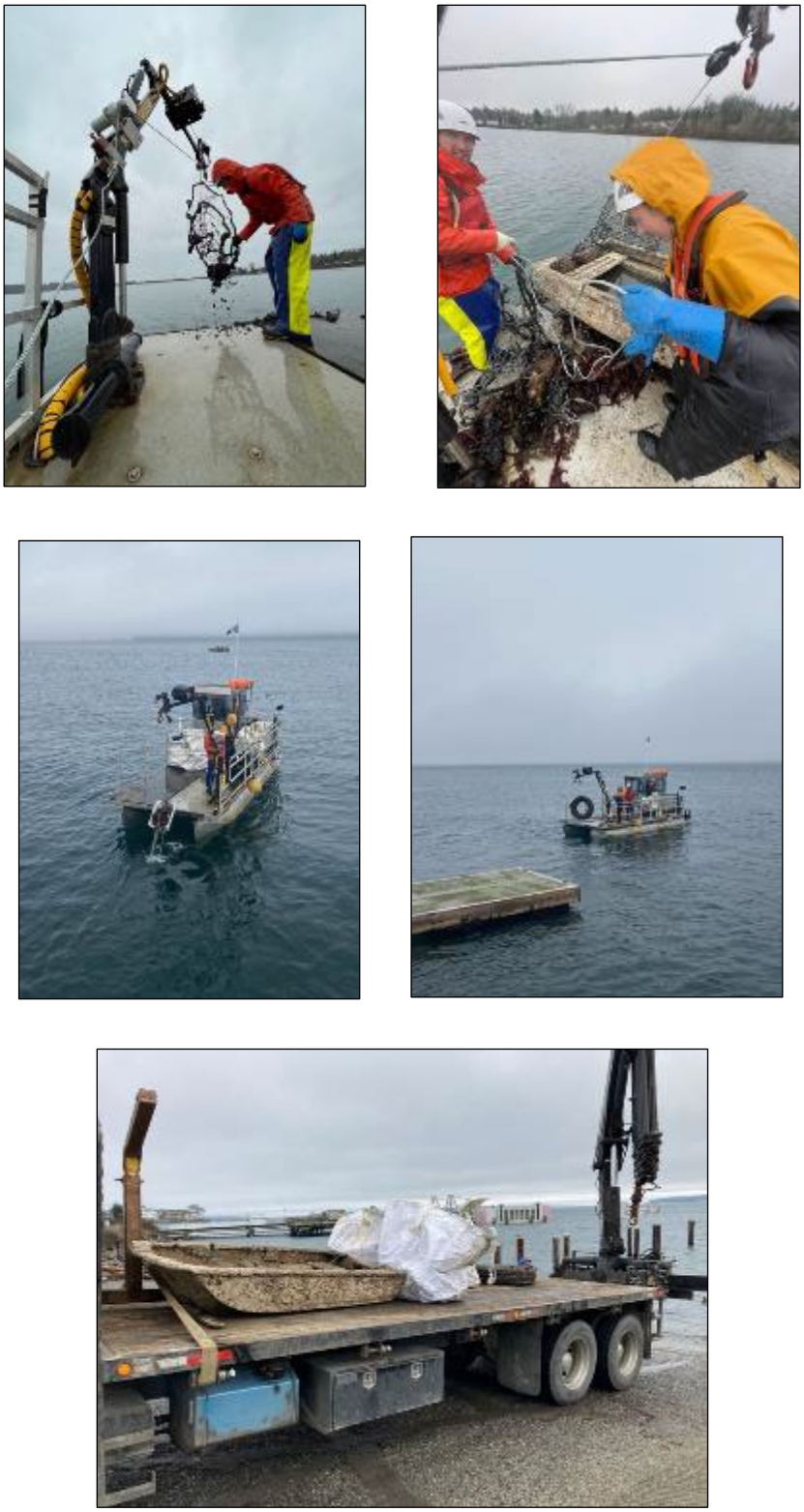


Figure 33. Saanichton Bay debris removal. Top: Joshua Prahl and Viki Kolatkova pulling items onto the *Collective Effort*. Middle: Pulling debris from baskets and a tire onto the *Collective Effort* (crew: Jamie Smith, Viki Kolatkova, Joshua Prahl). Photos: J. Smith, J. Lisaingo, S. Anthony, S. Malcolm.

Portage Inlet

Portage Inlet is at the very head of the Gorge Waterway that runs up from Victoria Harbour. It is a very sheltered inlet that is behind a tidal waterfall at the Tillicum Rd bridge, making access challenging for surveys but also restricting water exchange (Figure 34). Three waterbodies empty into Portage Inlet: Craigflower Creek, Hospital Creek and Colquitz River (Figure 34). These are significant waterbodies that drain a large area, some of which is highly urbanized in the lower reaches, but the upper reach is more natural, with some agricultural land use (Figure 35). There is very little mixing and flushing in the inlet and the influence of freshwater is high, making the estuary's water quality poor. Shoreline modification, urban run-off, sewage, and Canada Goose excrement and herbivory leading to erosion all contribute to the low biodiversity, poor sediment quality, and high nutrient and bacterial concentrations in the inlet (Figure 36). There have already been successful restoration activities (by Peninsula Streams Society and Guardians of Our Salish Estuaries): riparian planting and goose exclusion fencing ("waddle fences") at the mouth of Hospital Creek have stabilised shorelines and deterred herbivory, likely improving water quality through filtration (Figure 37).

Figure 34. Portage Inlet aerial maps. Top: Portage Inlet as the head of the Gorge Waterway near Victoria, BC (colours in the inlet are green for eelgrass and yellow for sandy substrate). Bottom: a closer view of Portage Inlet with the three freshwater inputs labelled.

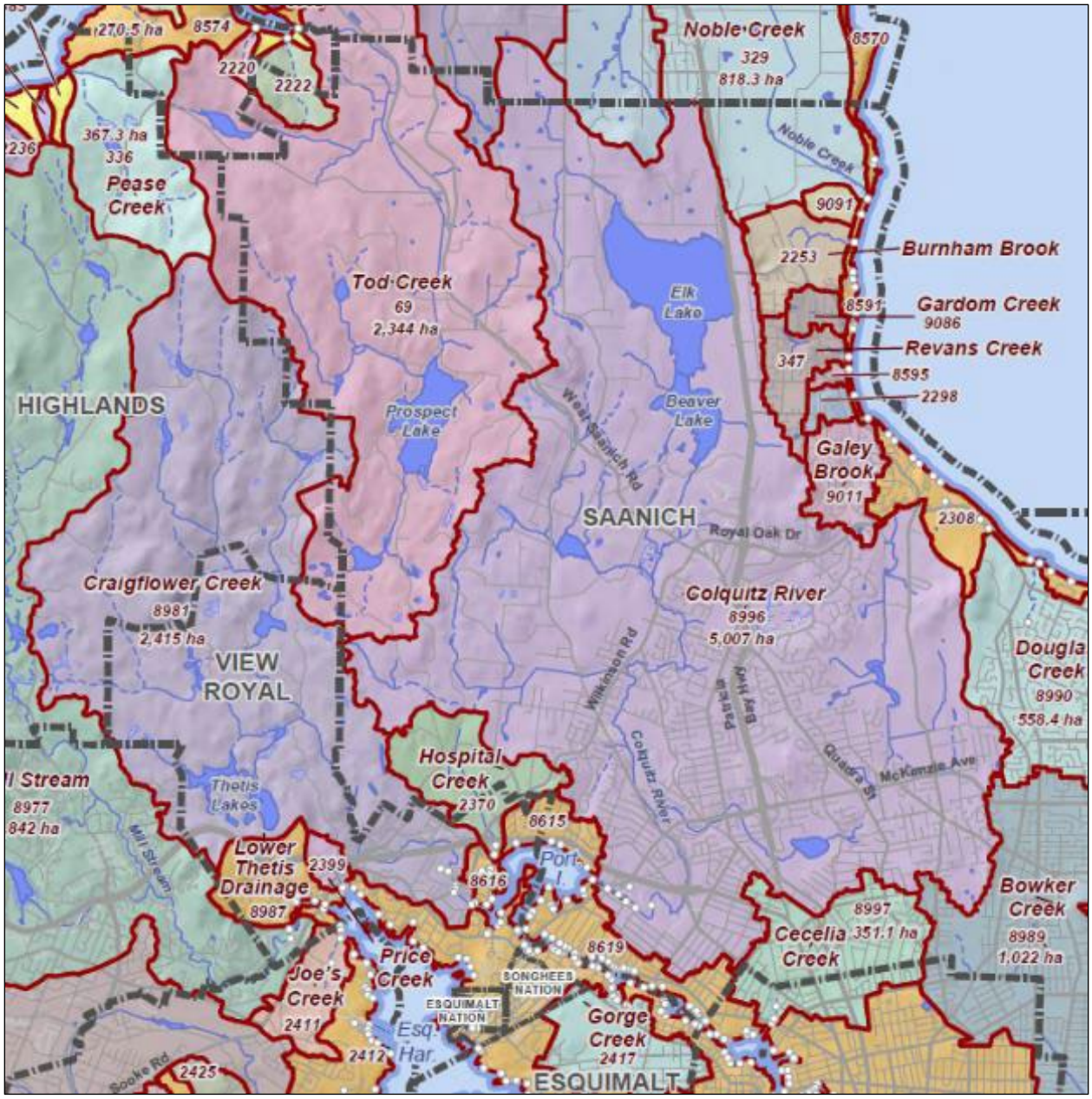


Figure 35. Map of the Craigflower Creek, Hospital Creek, and Colquitz River watersheds, as well as the other watersheds that drain into Portage Inlet. The white dots are stormwater drains. Source: CRD (https://www.crd.bc.ca/about/document-library/documents/maps/watersheds).

Figure 36. View Royal Park tidal marsh. Left: muddy sediment eroded to marsh plant line. Right: muddy substrate with the highly abundant non-indigenous mud snails, *Batillaria attramentaria*. Photos by S. Anthony.

Figure 37. Portage Inlet Site Photos. Top-left and right: Canada geese at the mouth of Hospital Creek. Bottom: waddling fence with bare substrate (with beach wrack) and marsh plants in the goose exclusion area in Hospital Creek. Photos: S. Anthony.

For details about the baseline assessment work done in Portage Inlet for the first phase of the RESS project, please see Anthony et al. (2024). The action plan created as part of that report suggested the following potential restoration, conservation and educational activities for Portage Inlet:

- Extend the streamside/tidal marsh **restoration with dredging, sediment deposition, riparian planting, and waddle fencing** along Craigflower Creek (View Royal Park).
- Look into further actions that will deter goose herbivory such as community **education.**

Actions Undertaken in Portage Inlet

Tidal Marsh Restoration

Dates: Beginning 2 July 2024

Location: View Royal Park, westside of Craigflower Creek, about 100m north of the parking lot. The planned restoration involves planting of indigenous species and soil deposition/dredging at View Royal Park (Figure 38). The work was partially completed by the end of March 2024, where we built waddle fences (Figure 39) and established some test plots with different sediment mixtures at a high tidal height (Figure 40), that gave us the mixture of sand and sediment that is most effective at allowing the marsh plants to establish at this particular site (see the before and after images (Figure 41). Kyle Armstrong (Peninsula Streams and Shorelines, Executive Director) is leading the project and their funding comes from the World Wildlife Fund. The consulting firm Swell has been hired as consulting biologists on the project and the plants have been seeded and are established with Streamside Native Plants, Nat's Nursery, and Satinflower Nursery. The plan is to dredge a drainage channel, build up the shoreline, and maintain the present waddle fence. The plants will be in the newly established shore and bushes towards the storm-drain entrance. SeaChange is funding the seeding and planting of 1,550 native plants and will provide in-kind labour support for the work.

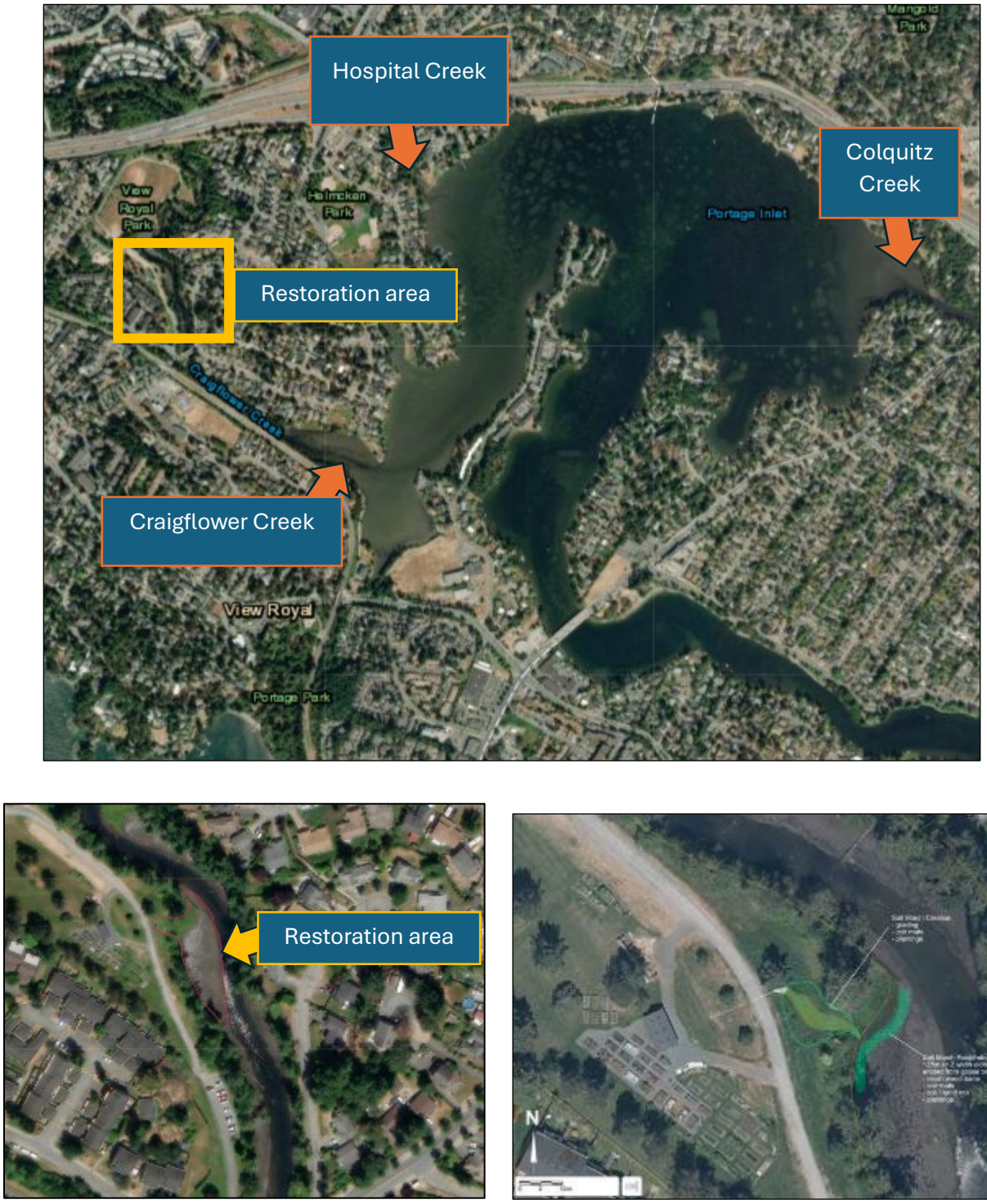


Figure 38. Portage Inlet aerial maps. Top: Portage Inlet with the three freshwater inputs and restoration area labelled. Bottom-left: close-up of restoration area. Bottom-right: restoration plans from Swell Consulting.

Figure 39. More view of View Royal Marsh restoration location, May 2024. Top-left: View of the marsh from the pathway, with creek channels visible as channels in the vegetation. Top-right: View of the creek channels. Bottom-left: north end of waddling fence in the marsh. Bottom-right: the remaining waddling fencing to the southern side and a fence bisecting the marsh area. Photos by S. Anthony.

Figure 40. View Royal Park sediment testing plots, May 2024. The three plots were along the northern shoreline of the tidal marsh "muck" area (top-left) and the low (top-right), medium (bottom-left), and high (bottom-right) -concentration of sand in the sediment with *Carex lyngbyei* (Lyngby's sedge) planted within. The number of surviving plants (after winter and spring) were higher in the higher sand-to-soil concentration sediment bed (plants circled in orange, lower right photo). Photos by S. Anthony.

Figure 41. View Royal Marsh in July 2023 (left) and after test plots and waddling fencing have been there for six months May 2024 (right). Photos by S. Anthony.

Tod Inlet (SȽIDǾEŁ)

Tod Inlet, or SȽIDǾEŁ (pronounced sneed-kwith, or "Place of the Blue Grouse"), is a popular site for walks and water sports, but more importantly, it is a culturally significant place. The WȽSÁNEĆ people lived at SȽIDĆEŁ for centuries until the 1600s, when a Haida raiding party came and burned the village there. Afterwards the survivors of this raid left to found the two villages currently known as WȽJOŁEŁP (Tsartlip) and SȾÁUTWȽ (Tsawout). This area does have a complex history from the settler perspective as well. From 1904-1913, the Vancouver Portland Cement Company operated a limestone quarry in SȽIDǾEŁ, which eventually led to the environmental degradation of the adjacent lands and seafloor of the inlet (Figure 42). The area around the cement quarry became home to the Chinese and Sikh men who worked there, and evidence of their lives is also present throughout the forests of SȽIDǾEŁ. Tod Creek, which flows from Prospect Lake, drains into the Inlet (Figure 43). The watershed for Tod Creek also includes the Hartland Landfill and runoff from that facility historically affected that creek and consequently the inlet. The area around the Inlet has The Butchart Gardens on the east side and is also surrounded by the Gowland Tod Provincial Park, so much of the immediate backshore is protected from further development.

Previous restoration activities by SeaChange, Peninsula Streams and Shorelines, and other conservation organizations, and the continuous reclamation of SȽIDǾEŁ by PEPAKEȽ HÁUTW (PH) has made this a very attractive area, and it attracts numerous visitors daily. Unfortunately, the members of PH have noticed the lack of respect from visitors with long-term anchoring (and likely sewage dumping), off-leash dogs, and trampling in restoration sites. Island Health monitors Tod Inlet for bacterial content between May and September, with variable frequency (https://inspections.myhealthdepartment.com/island-health/water-sample-history/?permitID=E8C0A3DA-8DAD-4132-92F1-1DD76DED90FF): Enterococci levels are rarely over an unacceptable amount; however they are present, and we have also found the same results in our sampling (in October 2023 and April 2024, see Anthony et al., 2024). The timing and frequency of the tests may miss seasonal bacterial inputs from many recreational boats that anchor in the inlet over the summer months. The signs at the welcoming stand need updating with appropriate cultural context, and they need to be designed to keep people from going off trails or having dogs off-leash. Currently there are no signs directed at the boaters.

A previously completed restoration of the shoreline, which included beach nourishment with sediments and shell hash, was successful (Figure 44). The shell-hash deposit not only increased the larval settlement of pacific oysters, but also the Olympia oyster (*Ostrea lurida*), a "Species of Special Concern" https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/olympia-oyster-2011.html#_cas).

Figure 42. Historic photos from SṈIDȻEŁ. Left: a cement factory (c. 1904) on the Tod Inlet shoreline. Right: the same shoreline in 2015 (pre-restoration). Photos from BC Photo Archives and Gwen Curry.

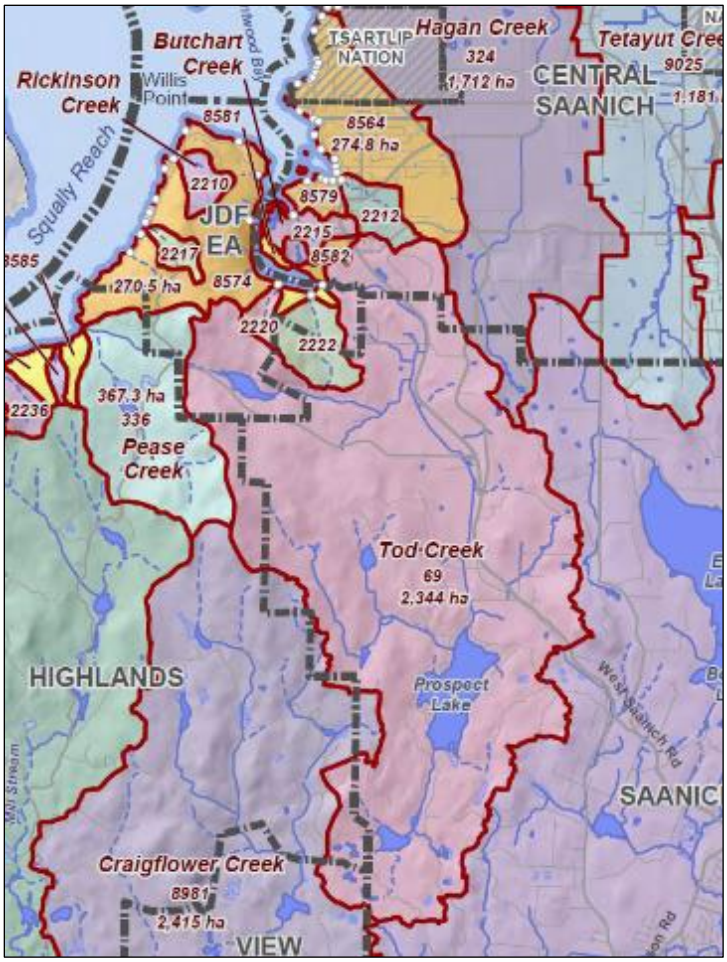


Figure 43. Map of the Tod Creek watershed, as well as the other watersheds that drain into Tod Inlet (SṈIDȻEŁ). The white dots are stormwater drains. Source: CRD (https://www.crd.bc.ca/about/document-library/documents/maps/watersheds).

Figure 44. Aerial photo of Tod Inlet, northern shoreline. Left: after shoreline/beach enhancement in 2019. Right: before the enhancement (2015). Photos from CRD Mapping Atlas.

For details about the baseline assessment work done in Tod Inlet for the first phase of the RESS project, please see Anthony et al. (2024). The action plan created as part of that report suggested the following potential restoration, conservation and educational activities for Tod Inlet:

- Updated **signage** about the restoration activities and the ecosystem to keep visitors from going off-trail
- Boater-specific **signage** informing boating visitors about local pump stations and nearest toilets; and that they are in a sacred place with ongoing cultural restoration
- Expand the shoreline **restoration eastward** along the shore by sediment and shell-hash deposition.

Actions Undertaken in Tod Inlet (SṈIDǨEŁ)

Informational Signage

Date: In Progress

This action is in the design phase. Collaboratively with PH, we commissioned an artist (Alena Ebeling-Schuld) and graphic designer (Lucas Glenn) who have provided first drafts and images that are being incorporated into the signs (Figures 45 and 46). The plan is to install 3 signs in collaboration with PH, BC Parks, and the WJOŁEŁP First Nation. The RESS AERF through SeaChange will fund the design and installation of two signs at the welcoming board and one on the dock facing the boaters (to replace the temporary sign) (Figure 47). We estimate this work will be complete in September 2024 pending approval from WJOŁEŁP First Nation, BC Parks, and DFO.

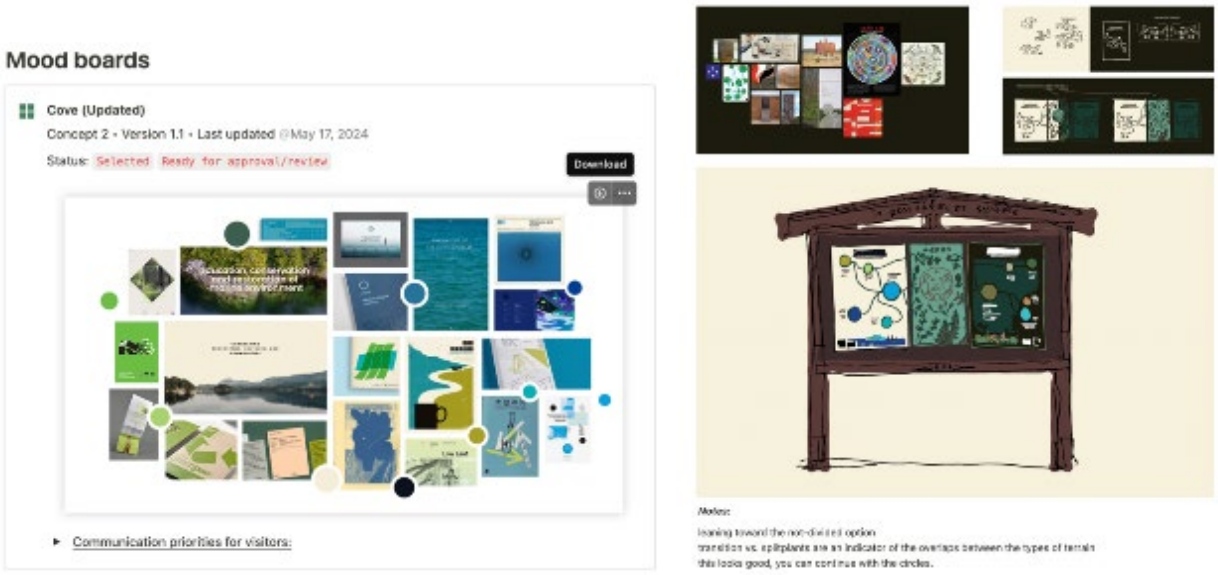
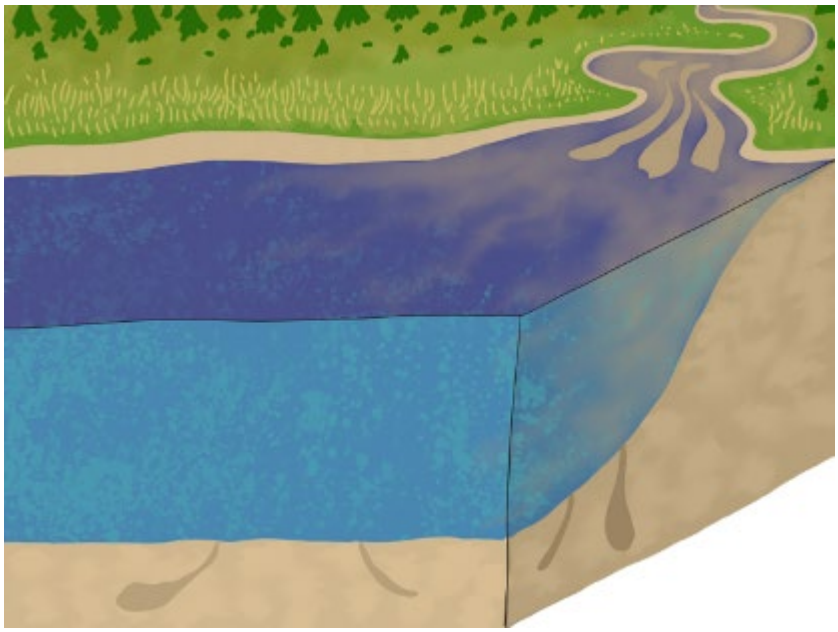


Figure 45. Initial design of educational signage for SṈIDǨEŁ. Left: Approved "mood board". Right: the design concepts for the front Welcome Signs, including inspiration and the PEPAKEṈ HÁUTW sign ideas. All images from Lucas Glenn.



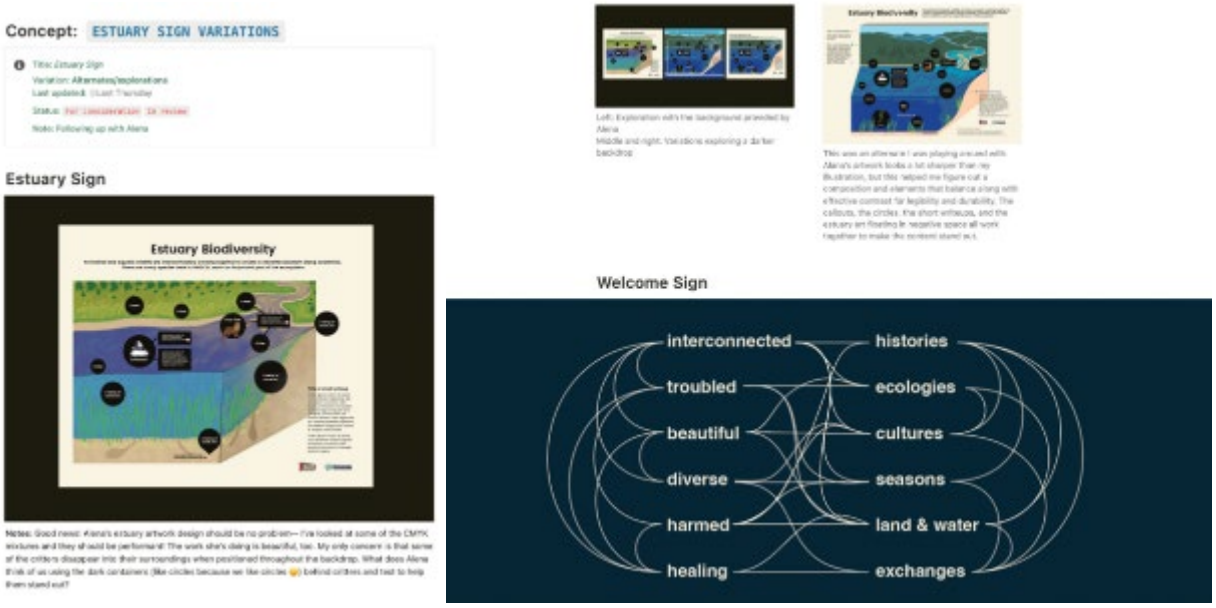


Figure 46. Design of the signage for SḴIDƛEŁ. Top: Estuary rough mock-up from Alena Ebeling-Schuld. Bottom: design ideas for the estuary signs from Lucas Glenn.

Figure 47. Aerial Map of Tod Inlet. Top: aerial image of the inlet filled with anchored boats (about 25-30) and restoration site (outlined in orange) Bottom: close-up aerial image with locations of the Welcome Signs and Boater's Sign.

Roberts Bay

Roberts Bay is on the northern end of the Saanich Peninsula, in the municipality of Sidney. Mermaid Creek runs into the southern portion of the bay and a relict creek, which is now a storm drain, runs into the northern portion of the bay (Figure 48). Mermaid Creek is largely below ground and in culverts at this point, and drains a large area covered in residential lots. When it rains, large amounts of water can flush through Mermaid Creek, causing scouring and exacerbating erosion of the marsh which is also eroding due to wave action. A small Pickleweed/Salt Grass marsh (a Provincially Red Listed habitat) grows at the mouth of Mermaid Creek, although it has been eroding rapidly over the past 20 years and has been experiencing coastal squeeze. SeaChange, Peninsula Streams and Shorelines, and the World Wildlife Fund have worked to assess and restore the blue carbon stocks of Roberts Bay over the past 3 years and had been planning a restoration of the salt marsh at Mermaid Creek.

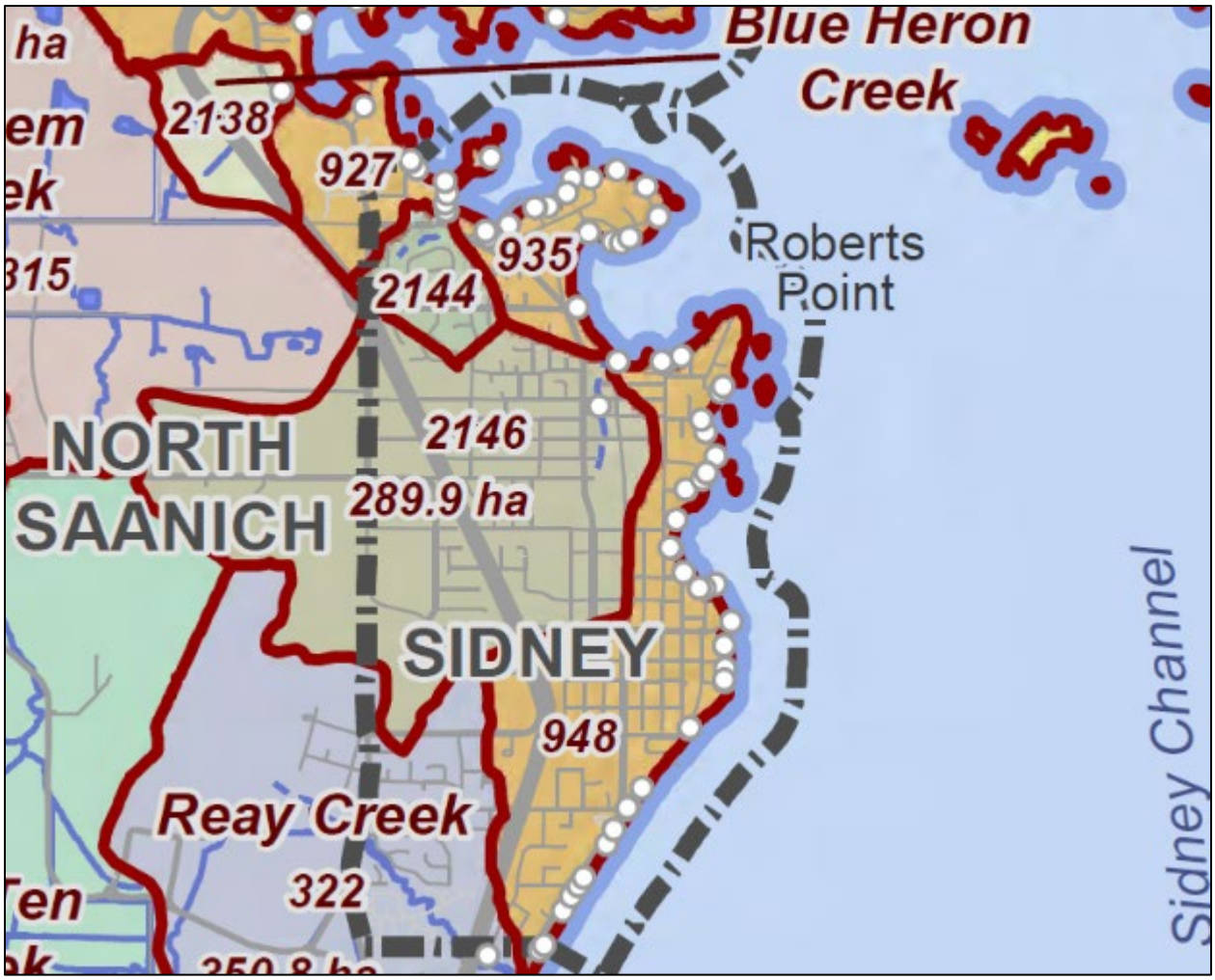


Figure 48. Map of the Mermaid Creek watershed (numbered 2146), as well as the other watersheds that drain into Roberts Bay. The white dots are stormwater drains. Source: CRD (https://www.crd.bc.ca/about/document-library/documents/maps/watersheds).

For details about the baseline assessment work done in Roberts Bay for the first phase of the RESS project, please see Anthony et al. (2024). The action plan created as part of that report suggested the following potential restoration, conservation and educational activities for Roberts Bay:

- **Restoration of the salt marsh** at the mouth of Mermaid Creek or conservation actions if restoration is not possible.
- Conservation of the eelgrass bed offshore with the installation of a **voluntary no-anchor zone** to guide boaters on less impactful anchoring sites.
- Look into methods of ***Ulva* control** or monitoring of the *Ulva* blooms in the bay to determine if they are causing issues for the eelgrass or community of the tidal flat.

Actions Undertaken in Roberts Bay

SeaChange had intended to support the salt marsh restoration at Mermaid Creek as part of the RESS project. Unfortunately, the project was cancelled in February of 2024, as the Land Tenure permit application to the Province was unable to move forward due to a local resident claiming the project infringed their Riparian Rights. West Coast Environmental Law are currently making a case study to help inform future salt marsh restoration projects, especially those in more urban areas. We were unable to undertake any other RESS action projects in Roberts Bay during this year of the project; however, discussion with the municipality regarding the installation of a voluntary no-anchor zone has occurred and may move ahead in the following year as part of a separate initiative.

3. Monitoring Plans

Bacterial and Nutrient Concentrations

Bacteria and nutrient concentrations will indicate the level of contamination, and by selecting collection sites with intention, the source of the contamination can be deduced. Bacteria we would test for are *Enterococcus* spp. and faecal coliform. These test for human and other animal faeces, from old or leaky septic tanks and sewage infrastructure, human sewage from boats, wastewater treatment plants, farming, and direct animal faeces from waterfowls and marine mammals in the estuary. We intend to conduct ongoing monitoring in Tod Inlet and Portage Inlet due to the potential impacts from seasonal boaters in Tod Inlet that may not have been captured by our initial sampling, and the delayed sampling in Portage Inlet into the rainy season, and therefore not capturing the extent of sewage concentration.

The bacteria tests will be run through a subcontracted lab (such as Bureau Veritas in Esquimalt/Burnaby) and the nutrient concentration will either be conducted through the

same lab or by a SeaChange staff member. The results of the bacterial tests will be in colony forming units (CFU) per 100mL of water sample, where 35 CFUs/100mL is the maximum allowable concentration of *Enterococcus* spp. before water activities are not recommended (https://www.islandhealth.ca/learn-about-health/environment/recreational-water-beach-reports). The nutrient concentrations are high when there are excessive fertiliser or other agricultural run-offs into the estuary, or even direct human or other animal waste input. High nutrient concentrations lead to eutrophic water conditions, leading to high primary productivity and potential anoxia (Howarth et al., 2011).

Collection sites will depend upon location and question. In Tod Inlet, the collection sites will be near the river mouths, within the area of anchored boats, and off the beach. This will separate out the source of nutrients and bacteria between inland sources (watershed) and boat effluent. In Portage Inlet, the sites include the river mouths and closest to the rest of the Gorge Waterway (where tidal exchange come from). We intend to recruit local volunteers to conduct this sampling and to feed the results into an updated action plan for these areas.

Eelgrass Transplant Monitoring

We intend to monitor the eelgrass transplant conducted in Oak Bay to gauge its success and determine if future action is needed. Eelgrass density, leaf area index, and bed extent are used as metrics to assess the eelgrass's health. Divers collect this information to determine the success of transplants, by comparing the transplanted site's health to that of the donor bed. These monitoring activities have been established many years ago by SeaChange and Cynthia Durance, a long-time eelgrass researcher. The timing of this monitoring event is to be determined. The data will be added to SeaChange's long-term eelgrass transplant monitoring dataset. We will modify the action plan for Oak Bay depending on the results of the monitoring.

Riparian Vegetation Monitoring

Once the Portage Inlet/Craigflower Creek marsh restoration is completed, SeaChange will conduct monitoring in partnership with Peninsula Streams to measure the long-term success of the transplant. The results of that monitoring will determine future actions that need to be taken. The restoration will involve digging channels, building sediment, planting native species (marsh species and riparian bushes and trees), and maintaining the ecocultural waddling fences. The main measure of success of the restoration will be the survival of the plants. We will call out for volunteers to conduct the monitoring from natural history societies, botany enthusiast groups, terrestrial and streamside conservation groups, and students of environmental studies and ecology.

4. References

Bates, A.E., Cooke, R.S.C., Duncan, M.I., Edgar, G.J., Bruno, J.F., Benedetti-Cecchi, L., Côté, I.M., Lefcheck, J.S., Costello, M.J., Barrett, N., Bird, T.J., Fenberg, P.B., and Stuart-Smith, R.D. 2019. *Climate resilience in marine protected areas and the 'Protection Paradox'*. Biological Conservation 236: 305-314.

Chalifour, L., Scott, D.C., MacDuffee, M., Iacarella, J.C., Martin, T.G., and Baum, J.K. 2019. *Habitat use by juvenile salmon, other migratory fish, and resident fish species underscores the importance of estuarine habitat mosaics*. Marine Ecology Progress Series 625: 145-162.

Elliott, M. and McLusky, D.S. 2002. *The need for definitions in understanding estuaries*. Estuarine, Coastal, and Shelf Science 55(6): 815-827.

Howarth, R., Chan, F., Conley, D. J., Garnier, J., Doney, S. C., Marino, R., & Billen, G. (2011). Coupled biogeochemical cycles: eutrophication and hypoxia in temperate estuaries and coastal marine ecosystems. *Frontiers in Ecology and the Environment*, *9*(1), 18-26.

Moore, J.W., Gordon, J., Carr-Harris, C., Gottesfeld, A.S., Wilson, S.M., Russell, J.H. 2016. *Assessing estuaries as stopover habitats for juvenile Pacific salmon*. Marine Ecology Progress Series 559: 201-215.

Oliver, T.H., Heard, M.S., Isaac, N., Roy, D.B., Procter, D., Eigenbrod, F., Freckleton, R., Hector, A. Orme, C.D.L., Petchey, O.L., Proença, V., Raffaelli, D., Suttle, K.B., Mace, G.M., Martín-López, B., Woodcock, B.A., and Bullock, J.M. 2015. *Biodiversity and Resilience of Ecosystem Functions*. Trends in Ecology and Evolution 30(11): 673-684.

Schindler, D.E., Armstrong, J.B. and Reed, T.E. .2015. *The portfolio concept in ecology and evolution*. Frontiers in Ecology and the Environment 13: 257-263.