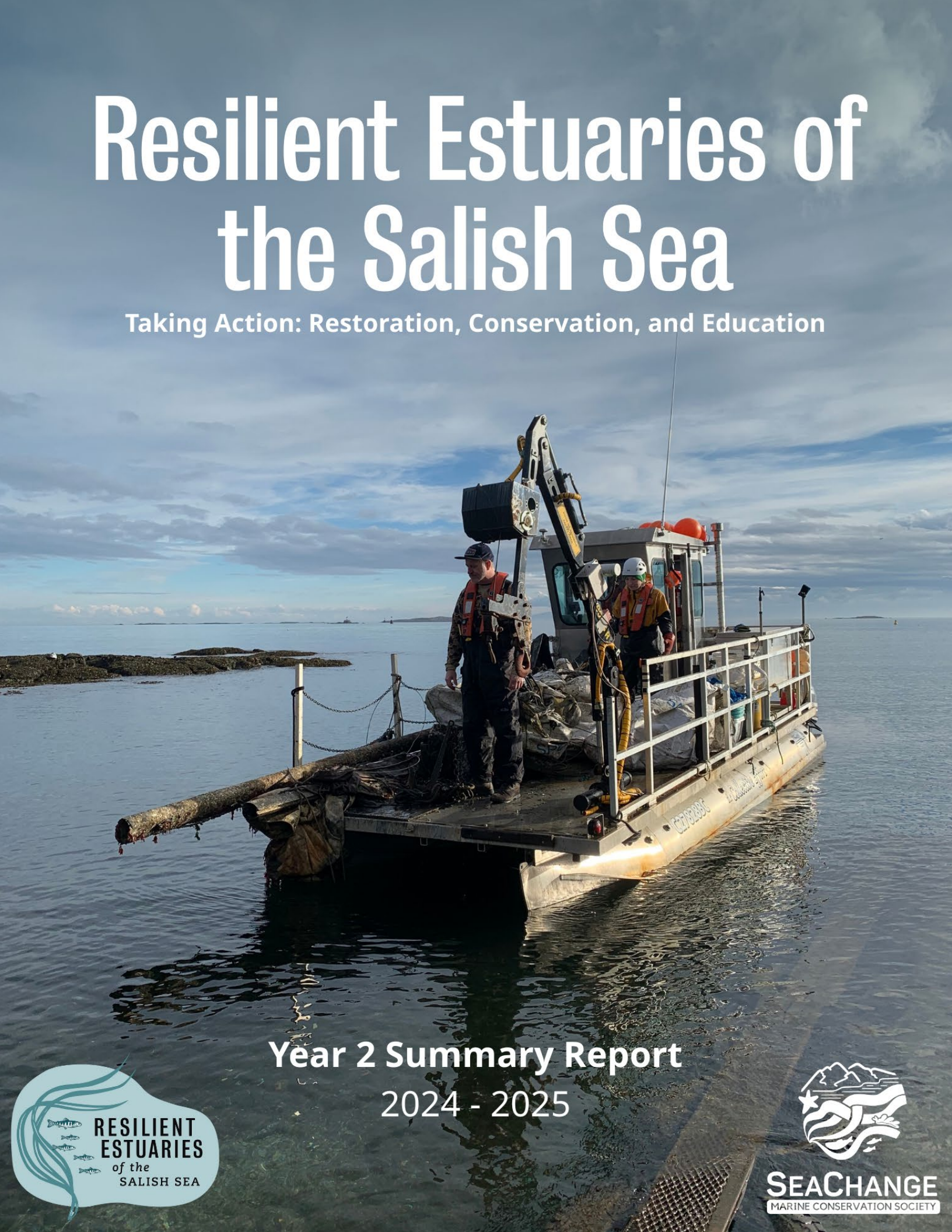
Resilient Estuaries of the Salish Sea

Taking Action: Restoration, Conservation, and Education



Year 2 Summary Report

2024 - 2025

RESILIENT ESTUARIES of the SALISH SEA

SEACHANGE
MARINE CONSERVATION SOCIETY

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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 for 2024-2025 are presented in a separate report, titled Resilient Estuaries of the Salish Sea: Baseline Assessments and Ground-truthing, Preliminary Year 2 Summary Report, 2024-2025.

As part of the baseline assessment phase of RESS, we developed action plans for 5 new estuaries in Area 2 of the RESS project. Those estuaries were: Chemainus River Estuary, Village Bay, Horton Bay, Retreat Bay, and Montague Harbour. 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 that 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. Other conservation and restoration work was also undertaken in five of the six estuaries from Area 1: Oak Bay, Cadboro Bay, Saanichton Bay, Tod Inlet, and Portage Inlet. The monitoring plans that were designed for these areas in Year 1 were also implemented in Year 2 and included water quality monitoring, nutrient level monitoring, and bacterial concentration monitoring, as well as sediment sampling in Portage Inlet.

Marine debris cleanups were completed in Cadboro Bay and Horton Bay, with a total, 2.28 tonnes of debris were removed from the seafloor in those bays, with the majority coming out of Cadboro Bay. Other actions included the extension of the voluntary no-anchor zone around the healing eelgrass bed in Oak Bay as well as monitoring of the eelgrass transplant from last year. Informational signage was installed in Tod Inlet to help educate boaters and other visitors about actions they can take to prevent environmental damage, and further signage to educate and inform about restoration work already completed in the area. An information video called ‘Deep Trouble’ was also produced to help inform the public about the issue of marine debris in the nearshore environment. Work continued on the Craigflower Creek salt marsh restoration with Peninsula Streams and Shorelines in Portage Inlet and plans for a large-scale marsh restoration in the Tetayut Creek salt marsh was implemented. Numerous outreach and educational events were attended to help the public understand the important of estuaries to the health and resilience of the coastlines we love.

The Resilient Estuaries Team at SeaChange

Susan Anthony, Project Manager and Researcher
Justin Lisaingo, Operations Manager
Kendra Nelson, Outreach Coordinator
Phil Climie, Regional Coordinator North Salish Sea
Isabelle Maurice-Hammond, Regional Coordinator South Salish Sea
Jamie Smith, Logistical Director, Boat Operator, and Diver
Justin Bland, Boat Operator and Diver
Viki Kolatkova, Diver and Boat Crew
Sarah Cook, Executive Director
Alison Prentice and Vanessa Hendel-Farias, Budgeting and Bookkeeping
Seanie Malcolm, Thomas Armitage, and Elle Schroeder, Mappers
Nikki Wright, Mentor and former Executive Director

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Isabella Fiddes, Cosmo Roemer, Haley Moskal (Halalt First Nation)
Joachim (Yogi) Carolsfeld (World Fisheries Trust)
Pauline Finn (Shaw Centre for the Salish Sea)
Chris Hyde-Lay (Parks, Recreation, and Culture, District of Oak Bay)
Dr. Caren Helbing (University of Victoria)
Ethan Edson (Ocean Diagnostics Inc.)
Dr. Hugh MacIntosh (Royal BC Museum)
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Rob Underhill (Mayne Island Conservation Society)
Chessi Miltner, Adam Huggins, Sofia Silverman (Galiano Conservancy Association)

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Leanna Boyer, Rachel Bevington, Sulsamee George, Tony George (Stqueeye' Learning Society)
Alena Ebeling-Schuld (Owl and Bear Studio)
Lucas Glenn
Satinflower Nursery

Table of Contents

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 freshwater 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 experiencing impacts 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 sources and timing.

The importance of the small to medium sized estuaries of the Salish Sea has 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 action 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. For the second year, we expanded up the East Coast of Vancouver Island and into the Southern Gulf Islands (Figure 1), as well as following up on and expanding actions within the Year 1 estuaries.

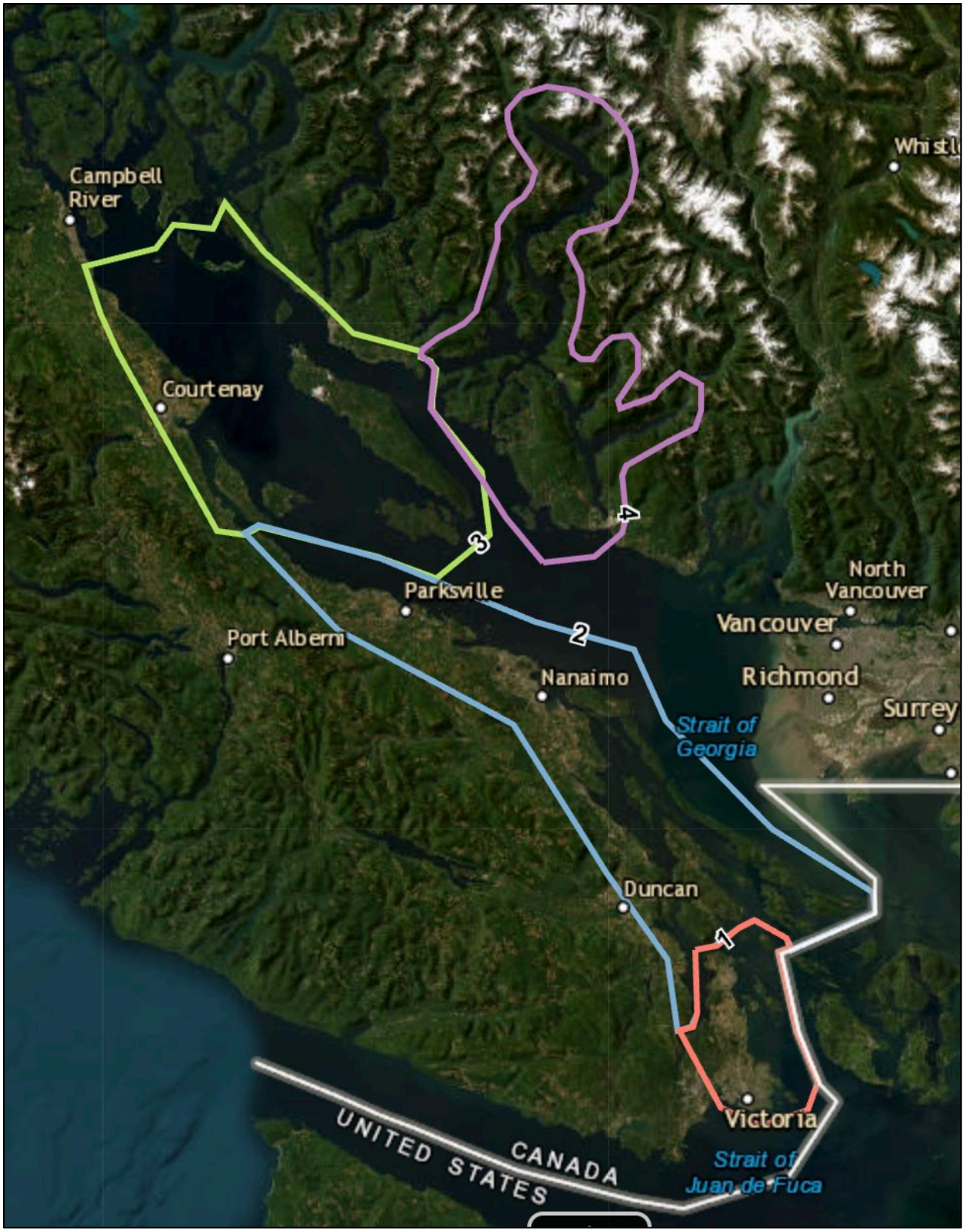

Figure 1: Resilient Estuaries of the Salish Sea Areas 1 through 4.

In the second phase of the RESS project, funded by the Aquatic Ecosystem Restoration Fund (DFO), SeaChange will implement the action plans created in Phase 1 by conducting conservation and restoration activities as well as providing 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-tidal and 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:

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 will 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 bed restoration: 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. Salt Marsh restoration: Many estuaries have associated salt marshes, which can be a strip or a large meadow at the mouth of the stream/river consisting of salt-tolerant plant species that are inundated by salt water with the daily tide cycle. This area connects the estuary to the backshore. It provides food and shelter for the estuarine animals and can help filter excess nutrients and contaminants in runoff and stormwater. Where salt marsh areas are depauperate, appropriate native vegetation will be planted to encourage native terrestrial ecosystem function. Other actions to restore marshes could include control of the introduced Canada Goose (*Branta canadensis*) population which can degrade marsh habitats in the Salish Sea.

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. Preventative Actions
   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. Signage: 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 those estuaries where restoration actions are undertaken in order 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 changes. 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 present actions people can take to make change. This will 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 citizens 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 is done 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 preventative or restoration action.

2. Summary of Actions by Estuary

Chemainus River Estuary

The Chemainus River Estuary is located on the east coast of the mid-southern region of Vancouver Island (see Figure 2). The estuary stretches for about 5 km along the coast and is an important habitat for many species, such as eelgrass, Pacific oysters, and salmon. This estuary is in the traditional and unceded territory of the Halalt First Nation, the Cowichan Tribes, and the Chemainus First Nation. The Halalt First nation has two reserves in the area, one on the Chemainus River and one on Willy Island (across from the estuary), though only the former is inhabited today.

Figure 2: Aerial image of the Chemainus estuary

The Halalt people have faced many challenges to re-establish traditional harvesting practices in the estuary. One challenge is historic contamination from a pulp and paper mill at the south end of the estuary. At the start of 2025, it was announced that the paper-

production side of the mill would be closing indefinitely, while the pulp mill would be staying open. The mill provides economic benefits to the local community but has had a negative impact on the local environmental and quality of life for the Halalt.

Another challenge is multiple log booms situated at the north end of the estuary since the mid-1900s. That log boom lease is now held by Timberwest Forest Corporation (Mosaic Forest Management) until 2045. Logs from all over Vancouver Island have been stored in this estuary as they wait for the Western Forest Products mill. A six-year study in the Cowichan Estuary found that the Chinook salmon population was severely impacted by the presence of log booms (Atkinson *et al*. 2024). This study found the booms in the Cowichan Estuary caused habitat loss from anoxia as debris settled to the bottom, allowed for increased predation by pinnipeds during the fall salmon run, caused hypoxia, reduced zooplankton, and allowed for toxic chemical leaching. These same issues can be seen across BC log boom storage sites, including those in Chemainus.

In 2002, the Ministry of Sustainable Resource Management prepared a log storage report for the Nanaimo estuary in hopes to change how and where logs were stored (Log Storage Working Group, 2002). This report stated that storage is being phased out in Chemainus due to it being a "prime eelgrass site", however 20 years later logs are still being stored in the estuary yearly. There is a need for research and restoration action in the Chemainus estuary to help the eelgrass habitat that should be thriving there.

Working with the Halalt First Nation and using the data collected under Phase 1 (Anthony *et al*., 2025), a plan was developed for restoration work to be conducted in Year 3 of the RESS project. One aspect of that plan would be to set up a joint training session for underwater biological surveys and restoration methods (debris clean-up, eelgrass transplanting) in order to build capacity within the Nation to conduct future restoration work. This would be desgined by Halalt and SeaChange and would be open to members of all the local Nations and possibly other NGOs. The purpose is to share the best practises in a hands-on way, and for Nations to have in-house trained divers. Another part of the future restoration plan, will be to carry out a sampling study, with the goal of finding faster, easier, and less expensive ways to assess the level of contamination within harvested food, which is the biggest concern for the Nation.

Mayne Island

Mayne Island, one of the southern Gulf Islands, is 21 km^2 and has a peak of 255 m above sea level. It is nestled between Galiano Island to the north and Saturna Island to the south. As with the other Gulf Islands, Mayne Island experiences a Mediterranean style climate with warm summers and mild winters. Mayne Island was first called SḴŦAḴ by the WSÁNEĆ people. The islands' many sheltered bays have midden piles which are evidence of shellfish harvesting, some of which date back to 3000 BCE. Today, there is a WJOŁEŁP (Tsartlip) First Nation reserve on the Island, although there are few year-round inhabitants.

In the last ten years, the W̱SÁNEĆ Leadership Council, Mayne Island residents and other groups began an Interpretation/Relationship Building Project which resulted in an exhibit about the W̱SÁNEĆ history, language, and culture. SeaChange is in contact with W̱JOŁEŁP Council members and the W̱SÁNEĆ Leadership Council about our work on SḴŦAḴ.

Eelgrass beds, kelp forests, and other crucial nearshore ecosystems surround Mayne Island, providing habitat for many important coastal species, such as migrating salmon. These ecosystems provide a sanctuary for salmonids travelling to and from the Fraser River, which is the largest spawning area for wild salmon in Canada. The Mayne Island Conservation Society (MICS) has diligently mapped eelgrass beds around the island and other islands nearby, including Galiano and Saturna. They have documented a loss in eelgrass extent toward the nearshore over recent years. Reason could include *Ulva* growth, which can shade out or smother eelgrass, as well as goose herbivory by the introduced resident Canada Goose population in the Salish Sea. Also of concern are boat anchoring, especially during the busy summer months, which can cause impacts to the seafloor and eelgrass beds due to anchor scouring and accumulation of marine debris.

Working with MICS, we identified two estuaries of potential interest for the RESS project, located in Village Bay and Horton Bay (Figure 3). Four other eelgrass beds of concern were also identified, although they are outside the scope of the RESS project as they are not directly connected to an estuary. Mayne Island has many residents who are passionate about conservation, and the island is experiencing a boom in development, so it is an ideal time to ensure that the coastal environments are protected.

The waters off Mayne Island are influenced by the large output of the Fraser River. The river empties 112 km^3 of sediment and nutrient dense water into the Strait of Georgia every year. This freshwater is less saline than the sea water in the Strait and spreads over the top layer of water, rushing toward the Gulf Islands. This results in highly productive, cold, low saline water intersecting Mayne Island, which is in the river's direct path (Figure 4). This also means that changes in the Fraser River, like droughts, flooding, or changes in nutrient input directly impacts the nearshore ecosystems of the Gulf Islands.

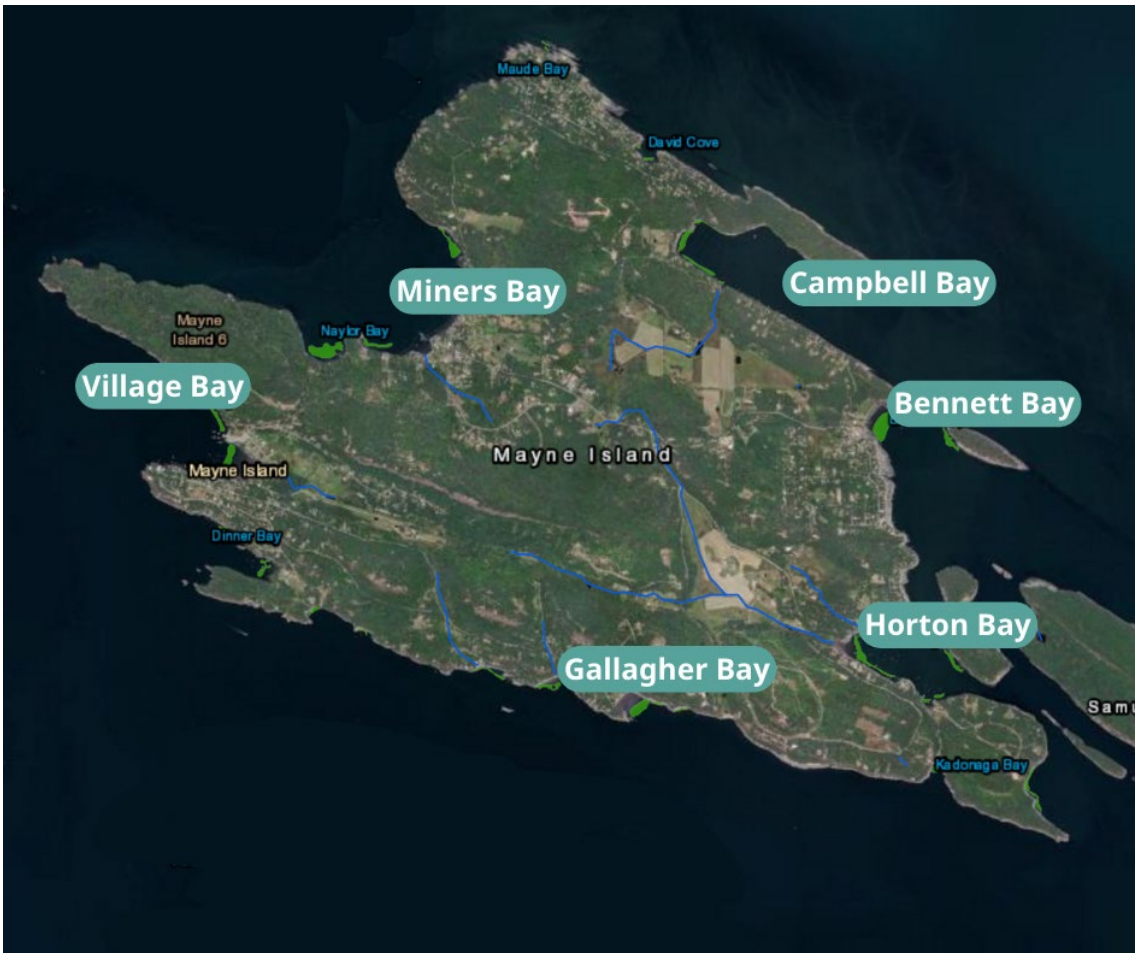

Figure 3: Map of Mayne Island showing the location of the estuaries in Village Bay and Horton Bay and other eelgrass beds of concern in Miner's Bay, Bennett Bay, Campbell Bay, and Gallagher Bay, as identified by the Mayne Island Conservancy.

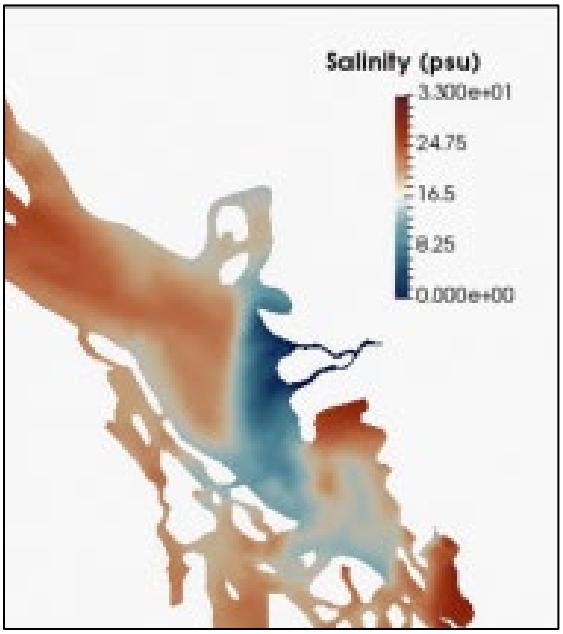

Figure 4: Salinity map around the Fraser River plume (Salish Sea Institute)

Debris Removal

SeaChange mapped the debris on the seafloor of Horton Bay after it was identified as a potential concern for the estuary. A cleanup was identified as a potential restoration action for the Bay based on that survey. In January 2025, the SeaChange dive team collected over 700 kg of debris from the seafloor of Horton Bay. A sunken vessel was identified that was too large for our crane barge, the *Collective Effort*, to deal with. The divers ensured there were no items of immediate concern on the vessel, such as batteries, fuel etc., but had to leave it *in situ*. They did remove a dinghy, ladder, various ropes and cables, and plenty of plastic and metal debris (Figure 5).

Figure 5: Images of the debris removal event in Horton Bay on Mayne Island in January 2025.

Outreach Events

Members of the RESS team wrote two articles for the Oystercatcher, which is the Mayne Island Conservation Society's newsletter. One was focussed on our debris removal (LINK), and the other was to advertise a community talk our team members were giving focused on the work being done, how to help, and how to get involved (LINK). The latter was also written about in the MayneLiner, the printed Mayne Island Newsletter, and was advertised on community bulletin boards and through social media (LINK). Although we believe we advertised our event widely, we had limited turnout; however, we carried out our talk and beach walk with those that did attend. We have since heard that many were confused about how long the event was which is a lesson we will carry into future events.

Although the RESS project is focusing on Horton and Village Bays for sampling and restoration work, we plan to cast a wider net for education and outreach, as many of the

concerns in these bays translate to other bays, such as anchoring, mooring, eutrophication, and eelgrass loss.

Monitoring

Another future plan for both Horton Bay and Village Bay is repeated nitrate and phosphate sampling, to get a handle on seasonal and annual variation. We also intend to work with MICS to organize volunteers to count the number of geese that they see when visiting the bays, the number of boats in the bays, and whether the boats are at anchor or moored. This will allow us to narrow down some of the issues impacting each bay and measure the severity. We will also re-survey eelgrass beds in the bays to create a more detailed map from our team that could be used to quantify any future declines. We also intend to do repeated eDNA sampling to identify how long salmon use these bays for during the year.

Galiano Island

Galiano Island is a southern Gulf Island, about 30 km long and 1.6 km wide at its narrowest point. The highest elevation on the island is Mount Galiano at 314 m. Under the Köppen climate classification system the area classes as warm-summer Mediterranean (Csb). Galiano is directly impacted by the Fraser River plume. As the Fraser empties into the Strait of Georgia, it carries huge amounts of silt and nutrients, supporting phytoplankton growth throughout the strait. As the plume heads toward Galiano Island, the shores are provided with warm, turbid, nutrient-filled freshwater which mixes with the clearer, cooler ocean currents. This helps to facilitate diverse, highly productive, nearshore ecosystems in its estuaries and bays, like eelgrass meadows and bull-kelp forests. This creates habitat for vital forage fish and juvenile salmonoids, along with many other important coastal species, like Southern Resident Killer Whales, which are often spotted off the coast of the island.

Galiano Island rests in the traditional territories of the Hul'qumi'num-speaking peoples, including the Spune'luxutth, Tsawwassen, and Hwlitsum Nations. Galiano has areas of traditional subsistence harvesting, with middens in Montague Harbour over 3000 years old (Mitchell, 1971), showing evidence of shellfish harvesting and fish traps. The island has historically been, and still is, inhabited by Indigenous peoples year-round. There is currently one reserve, Galiano Island 9, at the northern tip of the island.

The Galiano Conservancy Association (GCA) has been working for over 30 years to steward and protect Galiano Island. They have spearheaded the official protection of multiple natural sites on the island, amounting to nearly 250 ha of protected land. The Conservancy also educates people both on and off the island and empowers participatory action to protect the ecosystems on Galiano Island. They are also committed to honoring the traditional lands of and working with the First Nations on the island. GCA identified three bays on the island as fitting within the criteria of an estuary according to RESS that they were interested in looking at restoration actions: Retreat Cove (RC), Montague Harbour (MH), and Whaler Bay (WB) (Figure 6).

Figure 6: Map of Galiano Island showing the location of the estuaries in Retreat Cove, Montague Harbour, and Whaler Bay.

Retreat Cove was suggested to us because of its freshwater input, salmon-bearing stream, and land use by the GCA; however, is also small and close to a channel with high currents, which means there may be less soft-sediment habitat. Montague Harbour has been on SeaChange's radar since 2015, where we asked for residents' input on areas of concern. Montague Harbour is part of the Montague Harbour Provincial Park (MHPP) and is a busy area for boaters and tourists, especially in the summer months. Whaler Bay was selected because of the concern of potential contamination and its historical use as a site of log booming. It is also an area of importance for some of the local First Nations.

Potential Actions

GCA/MICS and SeaChange have done mapping of the eelgrass beds on Galiano Island and have identified potential declines in some areas, including Retreat Cove. We believe that installing an "anchor out" sign on the public dock and potentially installing a voluntary "no anchor zone" with seafloor friendly buoys would be of benefit. Surveys did not find

evidence of significant amounts of seafloor debris; however, some sunken dock pilings were noted that may have creosote. We intend to confirm whether that is the case in Year 3 of the RESS project and look at potential removal if that is deemed the best course of action.

Montague Harbour is a good candidate for public outreach and education which could include signage to educate about the damage of anchoring and mooring to eelgrass and address boaters that beach vessels along the shoreline. The possibilities for installation of seafloor-friendly mooring systems to reduce anchoring as well as a potential voluntary no-anchor zone are being discussed with the GCA as well as MHSS staff and may be undertaken in Year 3 of the RESS project. Local residents indicated concern over a recently sunken vessel in the Harbour, but it was not observed during our surveys, and neither were there any significant accumulations of marine debris.

Oak Bay

Oak Bay, which is the Bowker Creek estuary (Figure 7), was identified in the first year of the RESS project and the actions taken during that year are detailed in the Year 1 report (Anthony *et al*., 2024).

One of the actions taken was an eelgrass transplant into an area of the existing eelgrass bed that had been damaged by a sunken derelict vessel that was removed by Transport Canada. Our divers revisited the transplant site and the donor site in October 2024 (5 months after the transplant) to assess biodiversity and check on the status of the transplanted area. Shrimp, gunnel, and various types of crab, including Dungeness, helmet, and red rock, were found at both sites. Anemones and a Red Irish Lord were seen only at the original site and Decorator and Kelp Crabs were only seen at the transplant site. Overall, both sites had a healthy level of species abundance and diversity. The transplant site was well established with few bare patches and large bladed brown algae (*Saccharina* spp.) covering parts of the bottom.

Another action taken in Oak Bay in Year 1 was the installation of five seafloor friendly buoys (Figure 8) marking the edge of the eelgrass bed asking boaters to voluntarily anchor outside the eelgrass bed to avoid damaging it. The action taken in Year 2 was to monitor the buoys after the winter storm season. On May 21, 2025 the dive team surveyed the mooring attachments and found them secure and in good condition. The divers also determined that another two buoys should be installed to properly mark the edge of the eelgrass bed so they chose the sites for the buoys and measured the depths. Those buoys have been purchased, and they will be installed in Year 3.

Figure 7: Map of Oak Bay showing the location of eelgrass in the bay (green) as well as the location of the voluntary no-anchor buoys.

Figure 8: Images of the deployment of the voluntary no-anchor buoys in Oak Bay.

Outreach

This year, we began to set up dock talks at the Oak Bay Marina during the summer (Figure 9). The goal was to connect directly with boaters to share about the various work done through RESS in the area, learn more about concerns boaters have, and encourage stewardship. Across these two days, we were able to talk to 25 community members and boaters about RESS work in Oak Bay and concerns that the community is most focused on.

Figure 9: RESS team members at the Oak Bay Marina.

We also were able to present to the Oak Bay branch of the Royal Canadian Marine Search and Rescue team a talk titled, "Estuaries, Eelgrass, and How to Protect Them." About 20 members attended to learn about the various actions RESS has implemented in Oak Bay and we had a Q&A session with them as well.

RESS team members also attended Bowker Creek Biodiversity Day, an event hosted by the Friends of Bowker Creek to share more about the creek, estuary, and the work being done in both habitats. The RESS Team set up a table with specific information on marine debris removal work in Oak Bay, eelgrass transplants, and images from biodiversity surveys and tow camera surveys (Figure 10).

Figure 10: RESS team members talking to community members at Bowker Creek Biodiversity Day. Photos by Whispering Oaks Photography.

In late 2024, Oak Bay Park Services Manager Chris Hyde-Lay reached out to the RESS Team to inquire about the potential for installing educational signage about eelgrass at various beach sites and the Oak Bay Marina. We are waiting to hear back from Oak Bay Parks regarding the budget for this work, so this action is ongoing.

Monitoring

Summer 2024 and Winter 2025 sampling gave us more understanding of the seasonal changes to Oak Bay. Summer 2024 was colder than summer 2023, but similar to Fall 2023, showing the effect of unusually hot and dry summers and falls. Winter 2025 had very low temperatures and salinities compared to any other sampling times so far: Oak Bay can have water temperatures to 8 °C in the winter, where they were c. 12 °C in the summer of 2023, and salinity was c. 1.5 ppt lower in winter. Dissolved oxygen was similar in winter 2025 to the summer of 2023 and slightly higher than summer 2024; the lowest was in fall 2023.

Like the first year of sampling, Summer 2024 and Winter 2025 had low or indetectable amounts of bacteria. The orthophosphate concentrations in the Summer 2024 and winter 2025 are lower than the in-house phosphate concentrations from Spring 2024 because orthophosphate is only the bioavailable phosphate, and therefore only makes up a percentage of total phosphate in the water. Nitrate concentrations were higher in winter 2025 than in Spring 2024 or Summer 2024, likely caused by the increase in land runoff in the wet season.

Working with the Friends of Bowker Creek (FOBC), we are organising a hub for monitoring data from local residents and boaters. This monitoring will focus on boat use to collect information on the number of boats, their locations, if they are mooring or anchoring, if the mooring new, and if there are any abandoned boats. FOBC is also seeding and monitoring

salmon use in the estuary. We will complement this with eDNA samples from the area in spring and fall, looking for salmonids, forage fish, and their known food sources. There is already a bird count in the area through the eBird app which will inform us as to any increase or decrease in bird use of the habitat. The area has experienced a huge increase in bird use after the leash laws were enforced on the beaches. We have also discussed signage for the area with FOBC.

Cadboro Bay

Cadboro Bay is located at the southernmost point of Vancouver Island, close to downtown Victoria and is the estuary for Hobbs Creek (Figure 11). The estuary in the bay is fed freshwater by Mystic Creek and twelve stormwater drainage points (Figure 12). 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 native plants, but mostly there are seawalls along the low part of the bay. The seafloor is shallow, with soft sediment but little eelgrass coverage.

Figure 11: Aerial photo of Cadboro Bay.

Figure 12: Map of Cadboro Bay with storm water drains labeled by green squares. Map from SaanichMap.

Cadboro Bay is a center for sailing and mooring due to its sheltered position and being home to the Royal Victoria Yacht Club. This has resulted in a high volume of derelict and abandoned vessels and ghost gear, mainly crab traps, at the bottom of the bay (Figure 13).

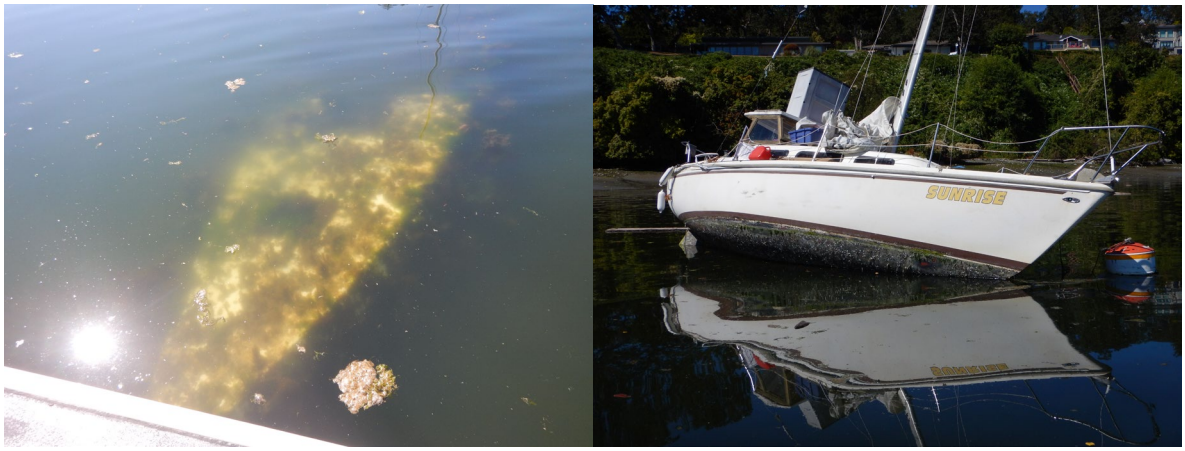

Figure 13: Derelict vessels in Cadboro Bay.

Debris Removal

In the spring of 2024 and 2025, our dive team collected ghost gear in the open area of Cadboro Bay in May 2024. The total ghost gear removed includes 20 crab traps weighing at 260 kilograms (Figure 15). Many traps contained the remains of crabs unable to escape, one crab trap alone had 18 dead crabs inside. In March 2025, our divers went into the sheltered portion of Cadboro Bay near the marina where a number of liveaboard boats were previously anchoring and removed 1.48 tonnes of debris over a two-week period (Figure 14).

Figure 14: Marine debris pulled from the sea floor of Cadboro Bay. Image 2 is a small dingy that was removed and needed to be towed to shore.

Figure 15: Derelict crab traps pulled from Cadboro Bay. The team pulled 20 crab traps from the water, with one trap containing 18 crab shells. All living crabs were returned to the back to the water safely.

Outreach

The RESS team has worked hard to connect with the community and boaters around Cadboro Bay through different avenues. One of these is the short film, Deep Trouble, that was filmed mostly in Cadboro Bay by Jamie Smith, Dive Team Lead at SeaChange. The film documents the impacts of marine debris on eelgrass and the benthic habitat, as well as highlighting the importance of marine debris removal.

In an evening event hosted by the Cadboro Bay Dead Boats Society, we were invited to present about the issues impacting Cadboro Bay's waters to members of the Cadboro Bay Residents Association. We presented alongside representatives from Surfrider Foundation and Peninsula Streams and Shorelines Society. Also in the audience was Oak Bay Mayor Kevin Murdoch and MLA Hon. Diana Gibson. We had great conversations with the residents and this presentation led to two more presentation opportunities with the Oak Bay Search and Rescue and the Bluewater Cruising Association.

We were also able to host an informational booth at the Cadboro Bay Festival (Figure 16). For this event, we showcased a video of the marine debris removals and underwater transect work to show attendees a look at the underwater world within the bay. We also had flashcards with specific wildlife species RESS recorded in the bay during biodiversity surveys, along with a game to help educate children about the importance of estuaries.

Figure 16: RESS team member at Cadboro Bay Festival.

Monitoring

We went back to Cadboro Bay three times in Year 2 to monitor the physical attributes. In the Spring 2024, we saw a bacterial spike in faecal coliforms, although we detected nearly zero bacterial colonies in Summer 2024 and Winter 2025. We are hopeful that this trend continues with the completion of the sewer upgrades in the local area. Nutrient concentrations were lower in Summer 2024 than Spring 2024, but nitrate levels increased to some of the highest levels in Winter 2025. While not exceeding the dangerous limits of phosphate, orthophosphate concentrations were very high and are considered medium to high risk of over-enrichment (Bicker et al. 1999). The antiquated sewage system in the neighborhoods around Cadboro Bay leads to constant warnings against "water activities" (including kayaking and sailing) in the bay due to health risks from bacterial contamination. In this past year, the municipality has begun its sewage upgrade, which will hopefully alleviate the issue.

The members of the Cadboro Bay Dead Boats Society have petitioned for a License of Occupancy to be required to moor in Cadboro Bay, on the Oak Bay side. This idea has led to an Oak Bay Derelict Vessel Task Force and a chance for Eric Dahli to speak to the House of Commons. This was the reason we were able to move forward with the larger marine debris cleanup in Cadboro Bay. We intend to do more cleanup in Cadboro Bay in Year 3 of the RESS project as well as look at the potential for installation of a no-anchor zone and some eelgrass restoration as a few plants of eelgrass were noted in the area during the marine debris removal. We are also looking at working with residents living along Cadboro Bay to so some riparian planting to increase the resilience of the backshore.

Saanichton Bay

Saanichton Bay is located on the eastern side of the Saanich Peninsula, on the Tsawout First Nation Reserve (Figure 17). 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. 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.

Water quality is an issue because of sewage leaks in the Tetayut watershed and the water treatment plant (near ɁIXEN). 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 (ɁIXEN), therefore harvesting is not heavy in this region. At the Northern end of the bay, there is extensive harvesting of crabs by traps off the James Island Wharf. This has created a concentration of abandoned crab traps in the area. There is also potential for salt marsh restoration in Saanichton Bay,

which is of interest to the Department of Fisheries and Oceans, but at odds with the requests from local farmers, businesses, and the Municipality of Central Saanich.

Figure 17: Map of Saanichton Bay

Salt Marsh Restoration

Over the past year, Tsawout Fisheries Management have been working with World Wildlife Fund Canada and Peninsula Streams and Shoreline Society on a restoration strategy for the salt marsh. SeaChange has contributed to the first phase of the project which is to collect data on current conditions and compile all historical data. The steps taken by Kerr Wood Leidal (KWL) has collaborated with SȾÁUTW̱, SeaChange, and DFO – discussed goals for the work, available data, and path forward. They have also developed a project road map, timeline, and clarified what information DFO is collecting.

As of Spring 2025, RESS South Salish Sea Coordinator, Isabelle Maurice-Hammond, and members of the Tsawout Fisheries Management team are collaborating on a gathering to

gain input from the community in order to shape the project and invite involvement. KWL is collecting historical data, and along with DFO and SeaChange, designing a monitoring program.

Monitoring
SeaChange went back to Saanichton Bay three times in Year 2 to monitor physical attributes. In September 2024, we recorded that salinity was much lower than either Summer 2023 or Fall 2023. This is likely because Summer and Fall 2023 were very dry and had low freshwater input. However, the temperature values were greater than Fall 2023 and less than Summer 2023. Unusually, the turbidity *increased* between Fall 2023 and late Summer 2024; in 2024, Victoria experienced the wettest summer in the last 27 years according to Environment Canada and freshwater input can bring sediment, causing turbidity to increase.

The nitrate and phosphate levels were lower in late Summer 2024 compared to spring 2024, and the orthophosphate exceeded limits in five of six sites. The bacterial tests show that there was a spike in faecal coliform concentrations at one site in late Summer 2024; previous tests in Spring 2024 showed no detectable bacteria throughout the bay.

Portage Inlet

Portage Inlet is at the very head of the Gorge Waterway, which runs up from Victoria Harbour. It is a very sheltered inlet that is behind a tidal waterfall at the Tillicum Rd bridge, which restricts water exchange and makes access challenging for surveys. Three watersheds empty into Portage Inlet: Craigflower Creek, Hospital Creek and Colquitz River (Figure 18). These are significant watersheds that drain a large area, some that are highly urbanized in the lower reaches, but the upper reach is more natural, with some agricultural land use. 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. There have been successful restoration activities by Peninsula Streams Society (PSS) and Guardians of Our Salish Estuaries. These actions have included riparian planting and the implementation of goose exclusion fencing ("waddle fences") at the mouth of Hospital Creek. This work is to help stabilise the shoreline and deter herbivory, which is likely improving water quality through filtration.

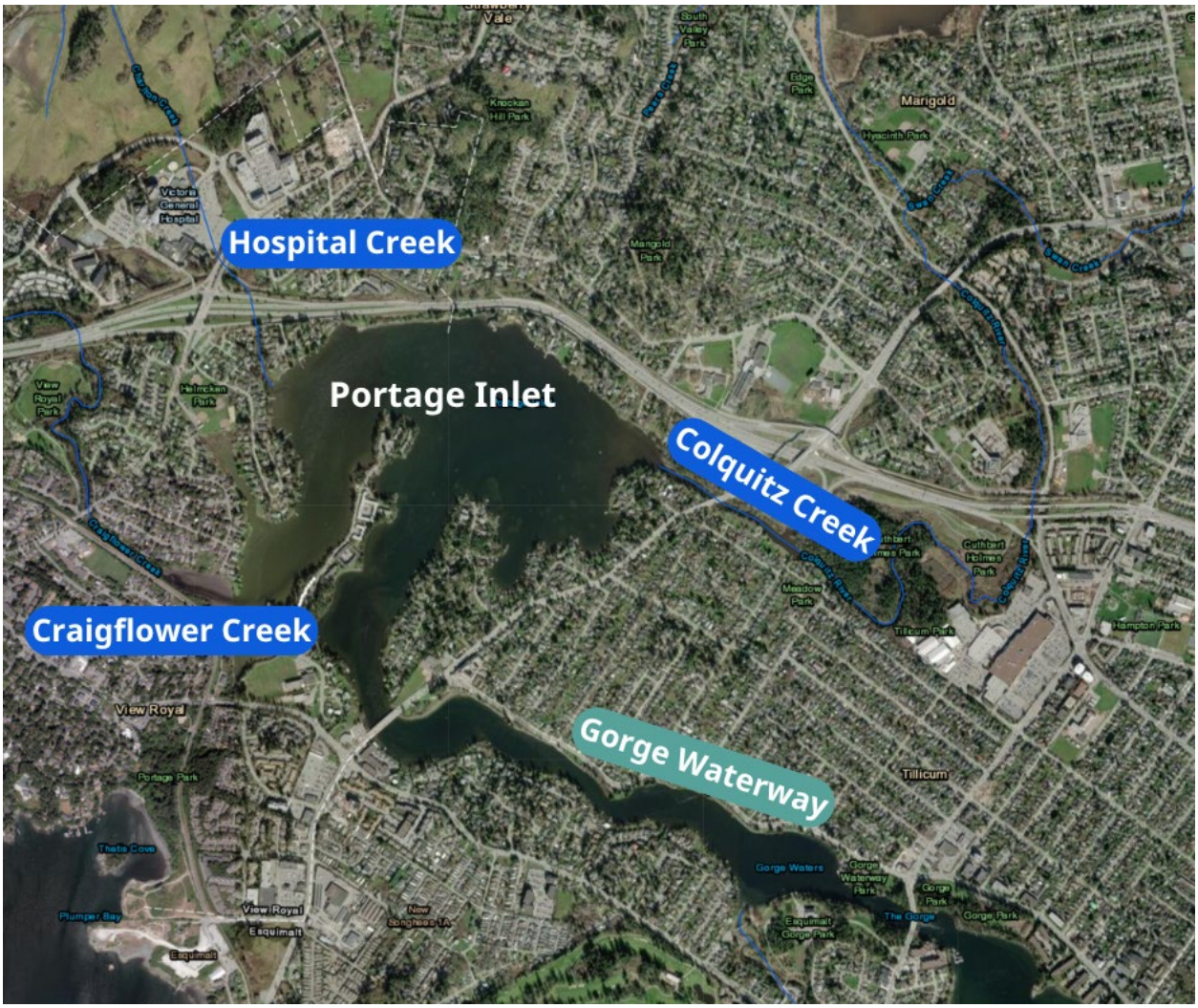

Figure 18: Map of Portage Inlet, labeling the different waterways connected to the estuary.

Monitoring

The RESS team initiated monitoring in Portage Inlet to continue the work started in Year 1 of the project. We monitored water quality attributes twice in Year 2, in Summer 2024 and Winter 2025. In February 2025, the inlet froze over, so we collected surface salinity and temperature to capture this event (Figure 19). There are only two sampling times for salinity, temperature, and dissolved oxygen, and the Winter 2025 values were extremely different from Fall 2023: the salinity decreased c. 20 ppt, the temperature decreased c. 5 °C, and the dissolved oxygen increased by 10-15 mg/L. Faecal coliforms increased from Fall 2023 to Summer 2024 and then decreased to nearly nothing in Winter 2025. *Enterococcus* spp. concentrations had more variability within season than between seasons and exceeded VIHA limits at most sites in winter 2025. Fall 2023 and Summer 2024 had lower nitrate concentrations than in Winter 2025. We conducted in-house and lab nitrate measurements in Winter 2025 for comparison between methods: the results were very similar, and very

high at the Beach sites and not at the Creek sites. Phosphate and orthophosphate were also higher at the Beach locations compared with the Creek sites in Winter 2025. Most phosphate/orthophosphate concentrations exceeded the limits for phosphate concentration.

Figure 19: Water sampling from February 2025 when the inlet was forzen over.

We followed up the restoration work completed in Year 1 by sampling sediment in the restored area and in sites along Craigflower Creek. The sediment pH, grain size composition, and heavy metal concentrations did not change between seasons, but differed between sites. We will report on further analysis of this sampling in the Year 3 report due to the timing of when we received the results from the lab.

With PSS, we have designed a long-term monitoring plan for the marsh that includes:

- Dataloggers in the saltmarsh measuring salinity
- Frequent sediment measurements for anoxia, pH, and salinity; as well as photo monitoring of plant health through the growing season
- Monthly biodiversity survey of the restored area in the growing season
- 2-3 times per year eDNA sampling, biodiversity surveys, and sediment measurements in the dormant season (Spring and Fall)

This plan will be implemented in Year 3 of this project.

Tidal Marsh Restoration

At View Royal Park, on the west side of Craigflower Creek, the RESS team continued to support the ongoing restoration efforts lead by PSS in Year 2 (Figure 20) which included sediment deposition, channel building, installation of waddle fencing to prevent goose herbivory (Figure 21) and planting (Figures 22 and 23) have occurred on site. The RESS team participated in several of the planting events throughout the summer and fall as well as working on the monitoring efforts detailed previously.

Figure 20: Photo from View Royal Park restoration efforts.

Figure 22: 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 23: 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 24: 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.

Some future plans for Portage Inlet include continuation of the monitoring and more restoration of the marsh along Craigflower Creek, as well as looking into further actions that will deter goose herbivory in the area.

Tod Inlet (SṈIDȻEŁ)

Tod Inlet, or SṈIDȻEŁ (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 and is the estuary for Tod Creek (Figure 25). The WSÁNEĆ people lived at SṈIDĆEŁ 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 WJOŁEŁP (Tsartlip) and SȾÁUTW (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 SṈIDȻEŁ, which eventually led to the environmental degradation of the adjacent lands and seafloor of the inlet.

Figure 25: Image of Tod Inlet

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 SṈIDȻEŁ. 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 SṈIDȻEŁ by PEPAKEṈ HÁUTW (PH) has made this a very attractive area. 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. Enterococci levels are rarely over an unacceptable amount; however, they are present. We also found similar results in our Year 1 sampling (Anthony et al., 2024). The timing and frequency of the tests may miss seasonal bacterial inputs from many recreational boats that anchor over the summer months.

Informational Signage

In conjunction with PH, we commissioned an artist (Alena Ebeling-Schuld) and graphic designer (Lucas Glenn) who have provided artwork for signage designed to educate visitors and boaters about how to interact respectfully with SN̲IDȻEŁ. Three signs have been installed in collaboration with PH, BC Parks, and the WJOŁEŁP First Nation. Two of these signs are on the welcoming board (Figure 26) and one on the dock facing the boaters, which includes information on where the closest sani-dumps are.

Monitoring

The RESS team conducted monitoring of physical attributes in SN̲IDȻEŁ continuing the work completed in Year 1. Summer 2024 and late Winter 2025 salinities were lower than Fall 2023, due to the unusually low precipitation in 2023 and unusually high precipitation in 2024. However, the temperature in Summer 2024 was largely higher than in Fall 2023 and both were higher than late Winter 2025. Dissolved oxygen was not greatly different among seasons, and caried mostly between 6.5 and 10.5 mg/L.

Future work in SN̲IDȻEŁ will include more shoreline restoration as well as additional signage and monitoring to continue understanding of the conditions in this estuary.

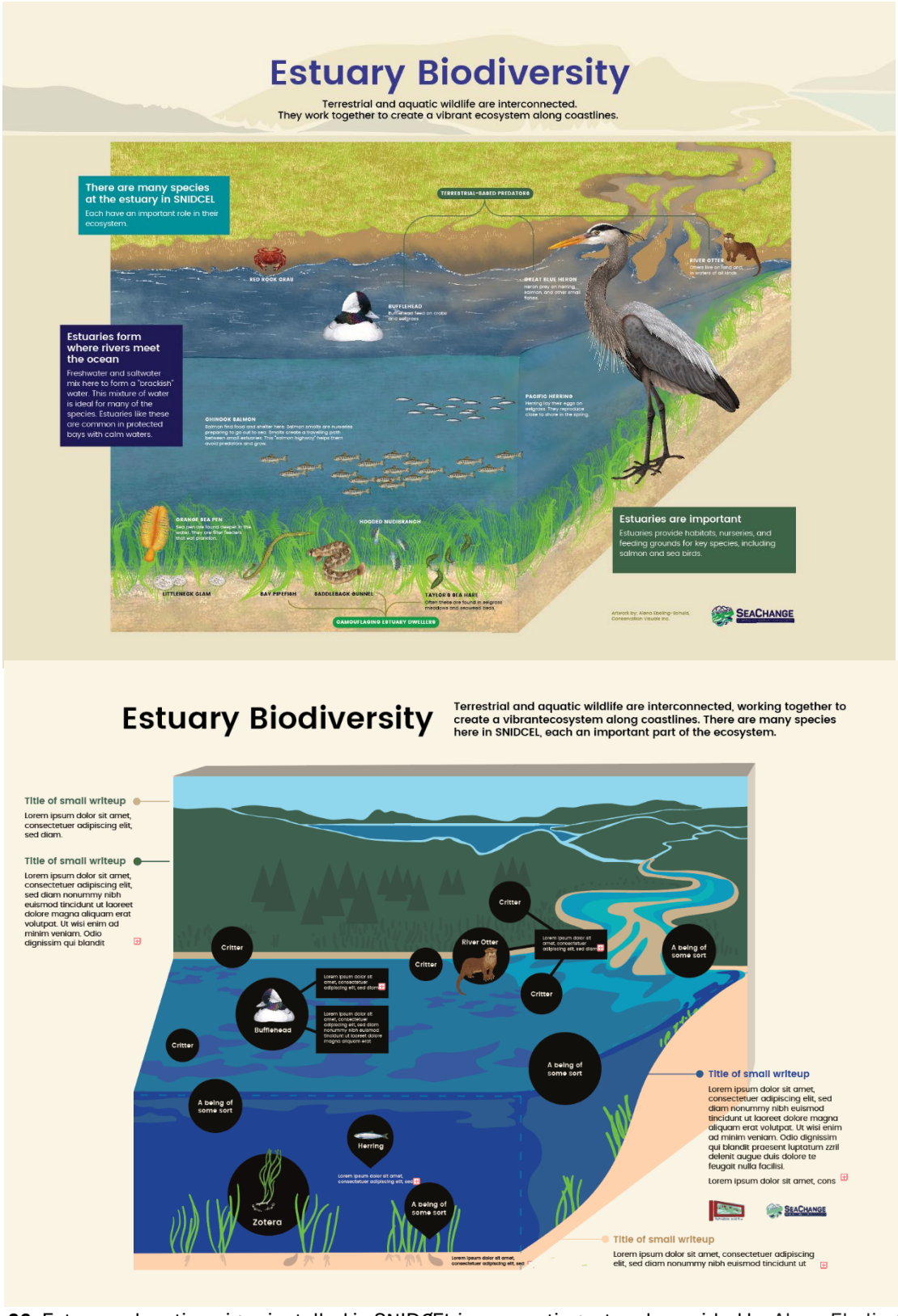

Figure 26: Estuary education signs installed in SṈIDƛEŁ incorporating artwork provided by Alena Ebeling-Schuld and Lucas Glenn.

Outreach and Education

There were a number of conferences, workshops, symposiums, events, and activities that members of the RESS team participated in that were not directly connected to the work in any specific estuary. Details of those events are in this section.

Northwest Aquatic and Marine Educators (NAME) Conference – August 2024
Our outreach coordinator attended the NAME conference to present on the education and outreach efforts from the RESS project titled, "How the Resilient Estuaries of the Salish Sea Initiative is building connections for long-term ecosystem resilience." The goal of the presentation was to share the various avenues RESS has undertaken to respond to community needs through education and outreach, and more creative ways the project is working to educate the public. Roughly 25 people attended this presentation.

Pacific Workshop on Nature-Based Coastal Solutions – October 2024
Our Operations Manager and Executive Director attended the Pacific Workshop on Nature-based Coastal Solutions in October 2024. The focus of the workshop was sharing experiences working on the coast of BC and ideas on how to leverage natural ecosystem functions to improve/remediate/conserve/modify coastlines and cities to be more climate resilient. The team was able to make good connections and talk to other practitioners about the work being done under the RESS project.

Eelgrass Symposium - October 2024
Team members attended the eelgrass symposium organized by SeaChange, the Pacific Salmon Foundation, Department of Fisheries and Oceans, and Hakai Research Institute. Nearly 70 experts from First Nations, government, academia, NGOs, and community groups came together for this symposium. This was a great opportunity to connect with and learn more about eelgrass work and knowledge. Attendees shared about the advances in eelgrass research, understanding the threats eelgrass face, and work to aid eelgrass restoration. SeaChange team members gave some presentations on the work done mapping and restoring eelgrass beds.

Salt Marsh Symposium – November 2024
The Pacific Salmon Foundation organized a symposium on Salt Marsh work being conducted in BC in November of 2024. RESS team members attended to connect with other restoration practitioners and learn about other work being done that was relevant to the RESS project.

BC Salmon Recovery and Resilience Conference – December 2024
RESS team members attended the BC Salmon Recovery and Resilience Conference, put on by the Pacific Salmon Foundation in Vancouver, BC. The conference was an opportunity to learn about other work in the province to help salmon, share more about RESS, and connect with organizations and researchers. We were able to make connections with First Nations Fisheries Council, CRS, and Oyster River Enhancement Society.

HELIT TŦE SŁON̲,ET (Let the Herring Live) – March 2025
This herring symposium was put on by W̲SÁNEĆ Hereditary Chiefs and the Herring Conservation and Restoration Society. The focus was on the importance of herring to local Indigenous Peoples and the issues associated with the ongoing and unsustainable commercial fishery of herring in the Salish Sea. Slightly more than half of attendees were First Nations and there was also strong representation of NGOs working in conservation and restoration.

Eelgrass Display and Presentation in Qualicum
In March of 2025, the RESS team worked with the Mount Arrowsmith Biosphere Region (MABR) to create an educational eelgrass display for their Education Centre in Qualicum. They wanted an exhibit that showcased eelgrass, where eelgrass beds were located near Qualicum Beach, the connection with eelgrass and estuaries, and how people could help protect eelgrass meadows (Figure 27). We worked with local artist, Alena Ebeling-Schuld to create an illustration of the eelgrass lifecycle (Figure 28), as well as one of Japanese eelgrass for the display.

Figure 27: Photos of the display at the MABR Education Centre. The display included a tri-fold with information, felted eelgrass, a ceramic tile art piece of the eelgrass lifecycle, an estuary game, and a wood board with photos from RESS work on doors that lift and have information about the photo underneath.

Figure 28: Artwork of the eelgrass lifecycle by Alena Ebeling-Schuld.

To launch the event, RESS team members gave a presentation about eelgrass (Figure 29), the connection with estuaries, and the work RESS does to protect these habitats. Roughly 20 people attended.

Figure 29: Susan Anthony presenting to attendees at the MABR Education Centre.

Community Tabling Events

During the summer of 2024 and spring of 2025, RESS team members attended a number of community events with our education and information booth. We were present at four different events, three of these were part of Ocean Week Victoria, and the fourth was for the Brandt Wildlife Children's Festival. Our educational booth shows the work done by RESS and has games around salmon and estuary wildlife. We were able to connect with at least 270 people during these events (Figure 30).

Figure 30: The SeaChange educational booth at events during Ocean Week Victoria 2024. Third photo from Shawn Thomson Photography.

Lecture for Marine Conservation in British Columbia Course (UBC)
RESS team members gave a virtual lecture to University of British Columbia (UBC) students. The lecture was titled, "Measuring Resilience in Salish Sea Estuaries." The focus was on how to determine metrics of resilience when there are multiple definitions of resilience.

Talk for the Sunshine Coast Conservation Association NEMO Talks
An RESS Team member gave a one hour virtual talk titled, "Taking Out the Trash." The focus was on the trouble with marine debris, how difficult it is to remove it, and the legal issues with derelict vessels

Training programs
The RESS team has come up with two training programs to fill in some gaps identified by the groups we have been working with in terms of capacity for conservation work: Monitoring and Diving. The Monitoring training will be tailored to the needs of the group we are working with. The Diving training will be more rigid and will be split between underwater biodiversity and scientific-style diving, and eelgrass transplanting and debris removal. All attendants will have commercial diving certification. We have had interest in this program from Halalt Fisheries and are working on a time in the coming Year to deliver these programs.

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