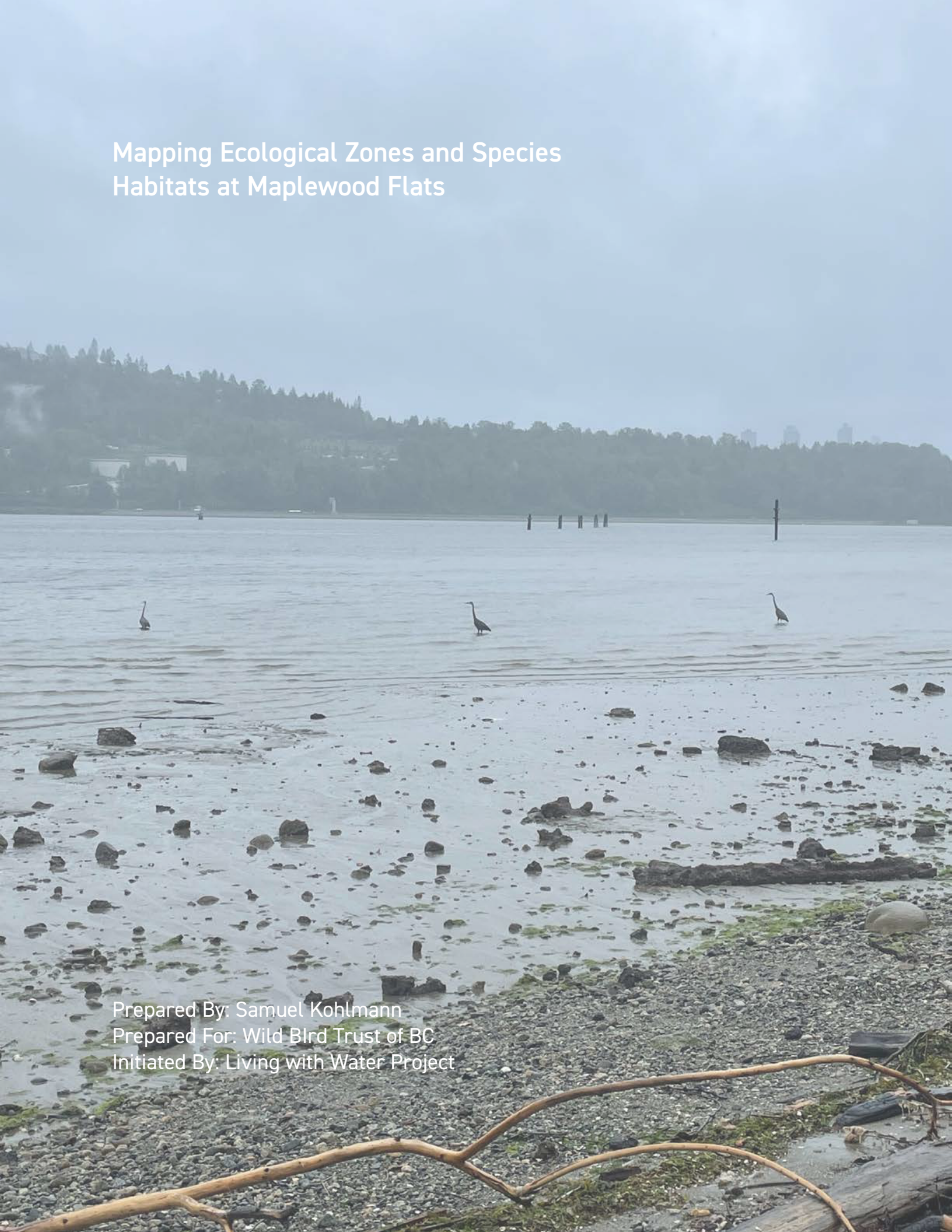
Mapping Ecological Zones and Species Habitats at Maplewood Flats



Prepared By: Samuel Kohlmann
Prepared For: Wild Bird Trust of BC
Initiated By: Living with Water Project

Disclaimers

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organizations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region. This project was conducted under the mentorship of Living with Water staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of the Living with Water or the University of British Columbia.

Acknowledgments

The author acknowledges that the work for this project took place on the unceded ancestral lands of the səlilwətaɬ (Tsleil-Waututh Nation).

This project is one step in supporting the larger project goals and ambitions set by the Tsleil-Waututh Nation and the Wild Bird Trust of BC. This greater work is ongoing.

The author would like to thank the following individuals for their contribution, feedback, and support throughout this project:

Wild Bird Trust of BC
Living with Water
Irwin Oostindie
Kees Lokman
Benji Eisenberg
Diego Lozano

Date Published: August 15, 2024

Table of Contents

Abstract

The Maplewood Flats Conservation Area is home to sixteen ecosystems in 256 acres. Located within the extensively developed Burrard Inlet, Maplewood Flats provides much needed refuge to many species through its diverse array ecosystems such as salt marshes. Much of the site's ecosystems are at risk of being lost due to sea level rise and its many impacts. This project mapped the ecosystems at Maplewood Flats and modeled sea level rise on site to better understand the impacts of rising sea levels and extreme flooding. Topography maps were created using open LiDAR from the government of British Columbia, then increases of water levels were modeled to simulate different flooding scenarios. Ecosystem data was gathered from Metro Vancouver's ecosystem mapping then verified and expanded with seven 100-125 metre transects of plants. Finally, information was synthesized into seven sections that graphically depict the plants, topography, ecosystem zones, and sea level rise along each transect. Our analysis outlined which ecosystems and important species were at risk with each increase in sea level. Then we suggest areas for coastal adaptation strategies and pilot projects. These findings, data, and graphics are intended to inform the Tsleil-Waututh Nation and the Wild Bird Trust of BC as they work together to create a long-term stewardship plan for the site.

Project Context

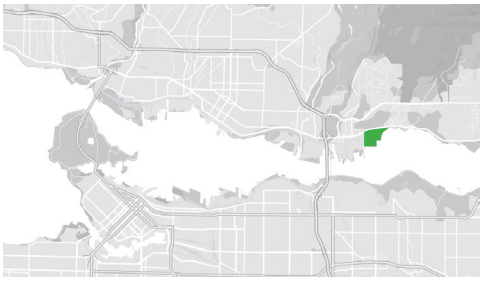


Figure A: Context maps of Maplewood Flats

Maplewood Flats is the only wild bird sanctuary on the north shore of Burrard Inlet. It is on the unceded lands and waters of the səlilwətaɬ Tsleil-Waututh Nation (TWN) and Coast Salish Peoples adjacent to the TWN community and village site. The current steward of Maplewood Flats is the Wild Bird Trust of BC (WBT). This organization is in the process of passing ownership and leadership of the organization to the TWN as part of their reconciliation efforts.[1] Concurrently, WBT in conjunction with TWN is preparing a long-term stewardship plan in response to ongoing climate change. As low-lying mudflats, marsh, and forest, Maplewood Flats is experiencing more frequent flooding events because of sea level rise. Currently there is a knowledge gap regarding ecological zones on the site and how flooding with brackish water will affect these areas. Filling in these gaps will inform near-term adaptation options and the long-term stewardship plan for the site.

Project Intention

This project builds off existing works completed and ongoing by TWN and WBT to steward these lands and water. The intention of this project is to assist the WBT and TWN in creating a long-term stewardship plan for Maplewood Flats. So far this has been accomplished in four steps during this project. The first step consisted of mapping the ecological zones on the site based on field surveys. The second, conducting a inundation analysis using a custom digital LiDAR map. Third, an analysis was conducted on the findings and graphically communicating how brackish floodwater could change the site's soil, vegetation, and wildlife. Finally, a landscape intervention is suggested for further research. These four steps are intended to provide TWN and WBT with enough information to begin work on an ecological stewardship strategy that can then be drafted based on the predicted conditions.

Site Context

Maplewood Flats is located between Dollarton Highway and the Burrard Inlet, west of the current TWN reserve. It is the only piece of connected mudflats and upland forest on the northern coast of the Burrard Inlet from West Vancouver to North Vancouver. "The Seymour River and Lynn Creek once shared a significant estuary and delta which extended out into Burrard Inlet at what is now Second Narrows. Maplewood Flats, including the McCartney Creek estuary, is a remnant of the east end of this large delta." [2] As a "green area" with multiple

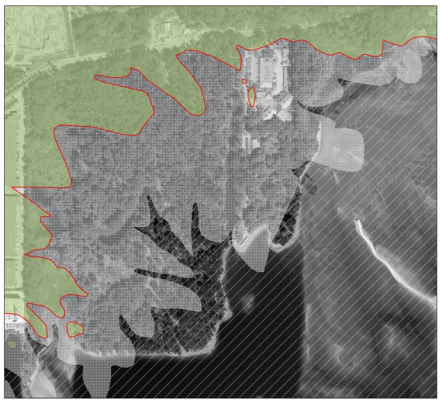


Figure B: Historic context map
(Full resolution map in Appendix)

1 "About WBT - Wild Bird Trust of British Columbia."
2 Tsleil-Waututh Nation, "Burrard Inlet Action Plan: A Tsleil-Waututh Perspective.", 7

ecosystems, MWF provides habitat for birds and other animals.[3] It also serves as an important resting point on the Pacific Flyway for migrating birds.[4]

The site itself can be categorized into different ecosystem zones as seen in Figure B. These zones are influenced by their geography, historical usage, and current stewardship. Geographically, the site begins in the water as mudflats and rises up a few metres to meet Dollarton Highway. This change in elevation determines where water pools and which areas are touched by saltwater. These directly impact the plants that can grow in each condition.

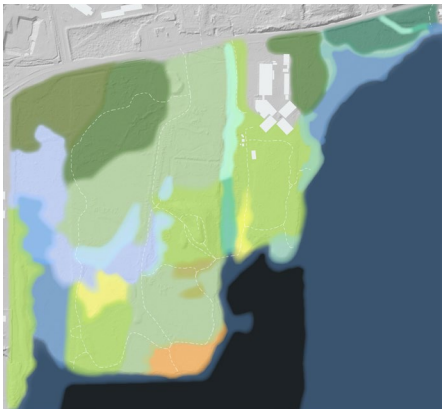


Figure B: Map of observed ecosystems
(Full resolution map in Appendix)

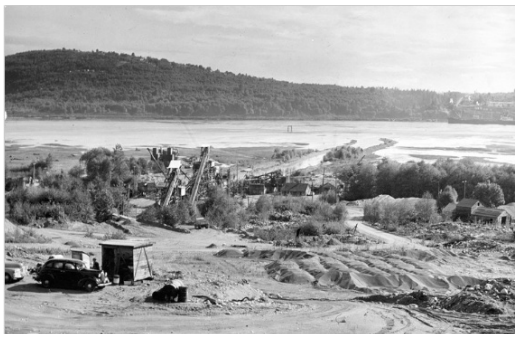
MWF is on the unceded lands and waters of the səlilwətaɬ Tsleil-Waututh Nation and Coast Salish Peoples adjacent to the TWN community and village site. The mudflats provided food security for the Nation with food such as: fish, shellfish and waterfowl. "According to Tsleil-Waututh community members, Maplewood Flats were once home to significant eelgrass and kelp beds." [5] For thousands of years, it has been stewarded by and sustained by the people of the TWN. This relationship between the site and the TWN was upended in the 1900s when settler colonists took control of the unceded site and used it for industrial activities.[6] "Some of these destructive industrial activities included clear-cutting in the early 1900's, the operation of a sand and gravel quarry and mill up to the mid-1900's which saw the construction of the Barge Channel".[7] This had detrimental impacts to the native ecology and disrupted the way of life the TWN had for thousands of years.

"The Maplewood Conservation Area, in North Vancouver east of the Seymour River, was established in 1992 with agreement from the Vancouver Port Authority, Environment Canada, Fisheries and Oceans Canada and District of North Vancouver." [8] In 1993, the Wild Bird Trust of BC (WBT) was founded to manage the Conservation Area. Presently, the site is owned by the Vancouver Fraser Port Authority and leased to Environment and Climate Change Canada who has an agreement with WBT to manage the site until 2041.

Historic and current stewardship plays a major role in shaping the present ecosystems. The site's eastern coastline contains many native plants and McCartney Creek. This area was not as heavily disturbed by the gravel operation as other parts according to historical photographs. As a result, many native plants are still present today compared with other spots that were developed.

3 "About WBT - Wild Bird Trust of British Columbia."
"green area", has been critiqued by WBT as misleading. "The Maplewood Flats has sometimes been referred to as a "jewel", the last piece of undeveloped saltmarsh habitat on the Northshore, or a "pristine" green space. For many years the WBT operated under this assumption and did little to no public education or outreach that contradicted this rhetoric, as it served the narrative of the white environmental conservationist saviour mentality. This narrative lacks context and obscures Maplewood Flats' true identity which is that of a post-industrial "brown" site. Furthermore, at present even though Maplewood Flats can be considered a "green area", it is still a product of historical stressors and is currently surrounded by a mix of light to heavy industrial activity, including a chlorine manufacturing plant on the western edge of the site." "About WBT - Wild Bird Trust of British Columbia."
4 Dobert, "Flyway Heroes.", 28
5 Tsleil-Waututh Nation, "Burrard Inlet Action Plan: A Tsleil-Waututh Perspective.", 7
6 "Looking Way Back and Looking Forward."
7 "Records and Archives Intern - Wild Bird Trust of British Columbia."
8 "Burrard Inlet Environmental Indicators Report"





Images 1-3: Photos of the gravel operation at Maplewood Flats. 1948, 1948, 1900s
City of Vancouver Archives & City of North Vancouver Archives

Development from the gravel industry disturbed the site in three major ways. Starting in the mudflats, large piles were driven into the flats and a deep channel was dredged out of the mudflats in the southern part of the site. The channel in the mudflats connected to a narrow barge channel cut out from the land. This long channel extends from the water almost to the highway, bisecting the site. During construction of the channel, the dredged fill was deposited adjacent to the channel to create a large mound. The change in depth of the mudflats fundamentally altered the ecosystem and species able to survive there.

Parts of the site were also clearcut to make way for the gravel operation. This disrupted the soil and the established ecosystem that was there. What returned has been a mix of pioneer species and invasive species that are well adapted to disturbed sites, unlike many native species.

Finally, two artificial wetlands were created by the WBT and landscape architect, Patrick Mooney, to the west of the channel through excavation and a freshwater pump. These provide added habitat for many birds and other life that rely on wetlands. This assisted flow of water and forming of wetlands has created new riparian ecosystems on site. The intervention has, according to Mooney, "transformed (MWF) from derelict industrial site into naturalized wetlands; bringing a richer level of biodiversity to the area and providing tremendous psychological and physical health benefits for residents." [9]

Embedded throughout the property are also facilities operated by the WBT such as the Nature House, Coast Salish plant nursery, a storage area, native plant nursery, and walking trails. Environment Canada also has an office on site and parking lot.

Over the past 30 years, WBT has stewarded the land in various ways. Recreational pathways have been installed that wind through the site. They have worked on invasive species mitigation, cultivated and planted native plants, constructed buildings, and created wetlands. In recent years, the planning of this work has changed leadership. "Since 2017 the WBT has acknowledged that although the site was saved from Vancouver Port Authority development plans, its subsequent designation in 1993 to a conservation area essentially served to exclude and restrict the TWN from the site for a second time (after initial colonization)".[10] "In 2017, the WBT Board of Directors determined the need for the development of a long term management plan to address reconciliation with the Tsleil-Waututh Nation and to focus on emerging ecological issues at the site. This will be reflected in the Habitat and Cultural Use Plan for the site, which we are in the process of developing."[11]

9 "News | Media | David Suzuki Foundation."
10 "Records and Archives Intern - Wild Bird Trust of British Columbia."
6 Ibid

Credit: Sam Kohlmann

Methods

Transect Survey

Due to the many ecological zones on the site and the projected sea level rise, the future of the site will change dramatically. In order to better understand ecosystems and the vegetation present at the Flats, plant surveys were taken along seven transects. A transect is a path along which one counts and records occurrences of the objects of study, in this case; plant species. Transect locations were chosen based on where sensitive and unique ecosystems existed and where, based on general topographical understanding, inundation could impact the site. Seven transects were conducted, labelled 'A' to 'G', cutting through various sensitive and unique ecosystems in an attempt to capture the diversity of the site.

Transect 'A' was taken across the barge channel and included the slope of the infill hill and the small eastern meadow.
Transect 'B' was taken from Dollarton Hwy across the salt marsh to the intertidal zone.
Transect 'C' was taken likewise from the intertidal zone towards Dollarton Hwy allow the bank.
Transect 'D' was taken on the eastern peninsula from the intertidal zone to a trail confluence.
Transect 'E' runs through the west pond marsh.
Transect 'F' runs from the North Western Black Cottonwood forest to the wetland bush at the north end of the Brackish Marsh.
Transect 'G' cuts from the intertidal zone to the Western Loop Trail through the young Black Cottonwood forest.`

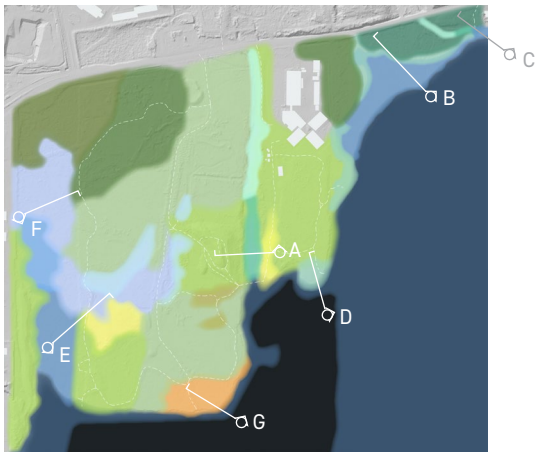


Figure C: Map of observed ecosystems and transect lines (Full resolution map in Appendix)

Transacts varied in length from 100m to 125m in order to be able to capture the transitions and connectivity that neighbouring ecosystems have and to gain a more holistic understanding of the site. Plant surveys were conducted using a generalized quadrant methodology and were conducted along each transect at approximately 5m intervals. This method was adapted from the general scientific standard for plant surveying due to time constraints. Using a "long tape measure" transects were walked by foot and at each interval plants were identified within a 4 m diameter. Plant names were documented but plant heights and the count of each instance of a species were not recorded. Plant identification was conducted using the research team's existing plant knowledge as well as using references including Pojar Mckinnon's "Coastal BC plants" and websites such as Eflora BC. Plant species were identified and a dataset created noting location of and along transects as well as common, Latin, and hən̓q̓əmin̓əm̓ names in addition to whether the plant is classified as a native, non-native or invasive plant species. The full dataset of our transacts are attached in Appendix C.

GIS Methodology

An inundation analysis was conducted as part of the project in an attempt to understand the impacts inundation will have on Maplewood Flats and its ecosystems. In order to obtain inundation elevations on a site a DEM base was used and reclassified. A .5m base DEM for the site was extracted from Metro Vancouver LiDAR. In order to model inundation levels, ArcGIS was used specifically using the Raster

Images 4-7: Sam Kohlmann, Benji Eisenberg, and Diego Lozano conducting site transects using a tape measure
Credit: Benji Eisenberg, Sam Kohlmann

Functions tool. Within the tool, the Remap function was used to re-classify the DEM using the high tide elevation as the baseline for calculating inundation levels. This tool allowed for the extraction of different values from a baseline value which in this case was the high tide line not the raster 0m value as the 0m value is associated with the median water level that is approximately between the high and low tide line, instead we used the high tide line level to calculate inundation values. Following Metro Vancouver's projected sea level rise depths a model was created for .5m, 1m, 1.5m, 2m and 2m + 1mSS. These value represent the estimated local sea level rise values for the Vancouver area including Burrard Inlet and are based on a probability threshold to which the province considers acceptable. Modelling estimates .5m SLR by 2050, 1m by 2100, 1.5 by 2150, 2 by 2200. [12, 13]

Methodology - Ecosystem Mapping

As part of the project, updating existing ecosystem maps was an important part of the project. Existing research conducted by Metro Vancouver was used to gain a general understanding of ecosystems on the site and research methods were acknowledged and critiqued. The main takeaway is that previous mapping attempts fall short in representing the site due to the methodology used. Generally the methodology used to create ecosystems and their corresponding polygons was overly general as it was conducted using a remote sensing techniques.[14] Remote sensing does give useful general results when paired with groundtruthing but it is unclear if previous mapping groundtruthed data at Maplewood flats which at the scale of this study is crucial. Updating ecosystems mapping required a site walk through and analysis of transect plant surveys to understand plant populations age serial stages of ecosystems. As a part of this project understanding the site as a series of connected systems was paramount to guiding the project. Mapping standards dictate that ecosystems should be divided into polygons with hard boundaries; this methodology works against the project's goals. As a result when ecosystems were being represented in GIS boundaries were feather and softened in an attempt to represent the connectivity even if that isn't the standard methodology. Ecosystem classes were created based on plant age and populations.

12 City of Vancouver, "Climate Change and Sea Level Rise."
13 Northwest Hydraulic Consultants, "CFRA Phase 1 Final Report Maps."
14 Caslys Consulting Ltd., "Metro Vancouver Regional District Regional Land Cover Classification and Sensitive Ecosystem Inventory Update."

Analysis

Ecosystem zones

Resulting ecosystems zones were determined based on ecosystems mapping as well as transects taken and revealed a complex and interconnected site. Maplewood flats consists of what we identified as 17 unique ecosystems ranging from fully terrestrial to fully marine. Although the scope of the project was mainly focused on the high tide line and up land it was important to acknowledge, understand and include marine ecosystems into our work as it is a key influencer both to the site and its ecosystems and will largely shape the future of the flats. Being a highly disturbed site we saw a large presence of exotic and in many cases invasive plant species such as Himalayan blackberry, tansy, and English ivy. The quantity of invasive and exotic species poses a large threat to many of the sensitive ecosystems in the area that provide niche habitat to unique flora and fauna and therefore high invasive density had to be identified in the mapping process. Additionally due to the high level of disturbance on site there is also a diversity in ecosystem seral stages especially for Black Cottonwood ecosystems that later transition into Coastal Western Hemlock forests that are largely found in the surrounding area and in a few locations at maplewood flats. Black Cottonwood is a key ecosystem that will transition to coastal western hemlock given the time which would be the ecosystem found on site before being disturbed among coastal. Other key ecosystems include meadows, that provide important support for local pollinators and food sources for many bird species, but also marsh and coastal fringe ecosystems. There are a variety of marshes present on site ranging from essentially no salt content water to tidal marshes. Each of these ecosystems provides unique habitat to many species and also provides many ecological benefits such as water attenuation, erosional protection and food resources. These ecosystems however are the ones that are at the most risk; rapidly increasing water levels could destroy coastal marshes and fringe ecosystems at a rate which they could not adapt to leading to their loss. Additionally, an important representation method that was a key to this project was the representation of ecosystems identified. Standard mapping practices don't visualize ecosystem transition and will often represent ecosystems with solid edges when in reality ecosystems have transitions and are interconnected. This project attempted to highlight those transitions between ecosystems visually.

Ecosystem Definitions

1 Brackish Marsh: Marsh defined by a presence of both saline and freshwater marsh plants indicating a moderate saline content and remaining wet if not submerged year round.

2 Coastal Fringe: Noted as a 'layer' of vegetation found at forest - coastal convergence areas, denoted by lower vegetation that can cope with exposed sites. This is an ecosystem that represents a native transition zone.

3 Early Coastal Western Hemlock: Represents the native and contextual ecosystem found on the eastern side of North Vancouver at an early successional stages. Stage identified by presence of young Coastal Western Hemlock and Western Red Cedar as well as mature but declining presence of Black Cottonwood.

4 Early Cottonwood: High presence of young Black Cottonwood with most early successional plants present and mid successional plants still growing

5 Freshwater Pond: Ecosystem denoted by body of water with high density of vegetation found in freshwater and remains with water year round.

6 Intermediate Coastal Western Hemlock: Likely the most mature ecosystem at Maplewood Flats found exclusively on the eastern corner. Consists of mature conifers such as Western Red Cedar, Coastal Western Hemlock, and Douglas fir. DBH of a Douglas Fir suggests an age of 100+ years.

7 Intermediate Cottonwood: Black Cottonwood stands that are of intermediate age and accompanied by presence of mid and early successional plants.

8 Intertidal: Intertidal zone comprises the area below the high tide line that sees plant population consisting mainly of seaweed species.

9 Lower Estuarine: Lower Estuarine delineates the lower portion of a greater estuarine ecosystem that is identified as the zone where creeks or moving bodies of fresh water drain into the ocean. Usually these areas are tidally influenced and in some cases flow will reverse.

10 Mature Cottonwood: These stands consist of mature Black Cottonwood and can be differentiated from intermediate Black Cottonwood by the size of the specimens and by the presence of conifer saplings and decreased presence of early successional species.

11 Meadow: Noted by a lack of trees and shrubs this ecosystem consists of a variety of grasses/sedges/rushes, perennials, and annuals. Distinctly, meadow ecosystems are controlled by lower soil moisture than wet meadows.

12 Mixed Forest: Mixed Forest were noted as areas that had a very high presence of non-native tree species that have fully matured. These were often paired with non-native mid and understory. A large presumption is that these areas are the result of historical infill in the area that could have contained seed from non-native species.

13 Salt Marsh: Salt marshes are found on the upper end of intertidal zones and can often be inundated by saline water. As a result high salt content in the soil and harsh conditions limit the amount of species that can grow in this area. Key ecosystem species were used to identify the ecosystem. Additionally, distinct salt marsh benches help distinguish the ecosystem although high erosional rates are depleting this ecosystem.

14 Upper Estuarine: Upper estuarine ecosystems have moving fresh water and are minimally tidally influenced and contain a lower saline content. Additionally they do not immediately drain to the ocean.

15 Wet Meadow: Conversely to the meadow ecosystem, the Wet Meadow Ecosystem is home to wet soil for most of the year that allows unique species to grow in the area when compared to meadows.

16 Wetland Brush: Wetland Brush has similar characteristics to Coastal Fringe Ecosystem but with unique species and represents important transition zones between native ecosystems. Plant species consist of many shrubs and low level plants that house a rich source of shelter and food.

17 Deep Water: This area is consistent with areas that are always submerged and house marine species that cannot typically cope with intertidal conditions.

Ecological Zones

Images of different ecosystems overlaid on their locations

10 Mature Cottonwood

1 Brackish Marsh

5 Freshwater Pond

12 Mixed Forest

16 Wetland Bush

11 Meadow

4 Early Cottonwood

2 Coastal Fringe

14 Upper Estuarine

9 Lower Estuarine

13 Salt Marsh

Credit: Benji Eisenberg, Sam Kohlmann, Google Earth

Inundation Mapping

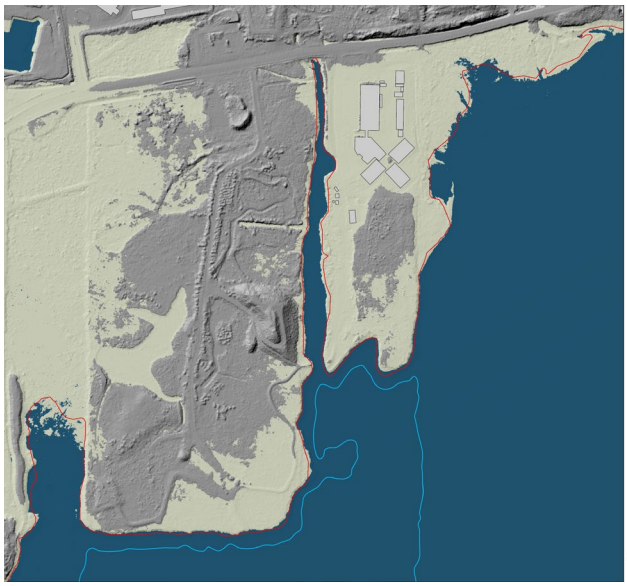


Figure D: 2m inundation (Full resolution map in Appendix)

As noted in the Methods sections 4 water levels were modelled from a base value of 0m within the DEM. This allowed us to model the movement of water on site in order to understand which ecosystems and areas at Maplewood Flats would be affected at different stages of inundation. Inundation is inclusive of sea level rise in the future but also storm surge from king tide events. The different inundation levels mapped encompass a wide variety of flooding events.

At .5m of inundation we see minimal impact on upland ecosystems and infrastructure due to raised uplands constructed at the time of site development. We do however see that there is a very significant increase in movement of water inland along the western marsh. Additionally there is notable movement upland on the eastern marsh. This tells us that even at .5m of inundation, critical sensitive ecosystems will begin to be affected. It is very likely that these marshes will be lost due to the increased amount of time that they would theoretically spend submerged and eroded by saline water. This could exacerbate future sea level rise as well as erosion due to the fact that the ecosystems lost are those that are the best at naturally absorbing storm wave action and temporary increases in water level, acting like a sponge. At 1m inundation we see that the marshes are now completely submerged and that there begins to be coastal squeeze on off site infrastructure. Located at the north end of both the west and east marsh water level reach infrastructure such as roads that could be eroded. Additionally we start to see certain upland areas begin to be periodically submerged. Along the inner barge channel and on the inside of the raised path in the central zone. Critically certain buildings along the inner barge channel could be affected by this increase in sea level.

At 1.5m of inundation we start to see that many of the upland ecosystems start to periodically take water, especially along the east bank of the inner barge channel and along the entire eastern coast. Buildings along the barge channel will be inundated and larger federal buildings will have to face erosion and potential occasional flooding. Along the eastern coast however the most undisturbed ecosystem will be inundated and likely lost.

At 2m of inundation the entire site east of the barge channel, with the exception of a small portion south of the buildings. All buildings on site will also be inundated. This area hosts all the buildings on site. All coastal fringe and upland ecosystems on the eastern side will be lost with the expiration of a small inland portion. The site west of the Barge channel will also face extensive inundation and fresh or brackish water marshes will take on saline water that would destroy the freshwater ecosystem. All the salt marsh area would be lost and water would begin to infiltrate the older Black cottonwood areas. Along the southern shore young black cottonwood areas would also be inundated.

Exploring the 2m of inundation scenario with a 1m storm surge shows how much inundation could impact the site. The entire site would be inundated save some raised walkways and the central constructed meadow. This would see a paradigm shift in the site and would see a total loss of

ecosystems and buildings.

In summary, we can see that even a small amount of inundation could see the destruction of the ecosystem and that any increase could pose increasing threats to the site as a whole. The summary maps show the movement of water at different levels on site and tells an important story of how inundation will impact the site and where.

Sections

Due to the many ecological zones on the site and the projected inundation, the future of the site will change dramatically. We chose seven areas we wanted to learn about based on their ecological zone and projected change of sea level rise.

To visualize and synthesize the data collected from the transects and inundation levels, sections were created. For accurate heights of plants, sections were cut from the LiDAR data used in the inundation mapping. Examples of the results are shown in Figure F and G. These provided a guide for tree heights and ground elevation. From there, the species of plants were filled in based off of the transect data. Inundation levels were overlaid on top using the elevation markers.

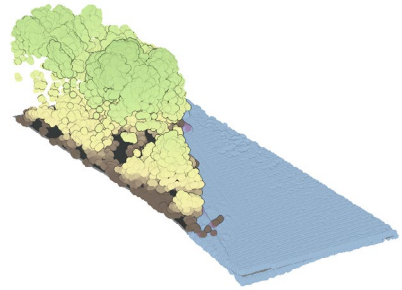


Figure E: LiDAR Point Cloud Data 3D View

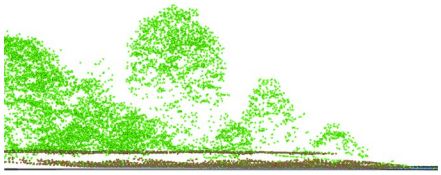


Figure F: LiDAR Point Cloud Data Section View

Summary of Predicted Ecological Site Change

Given the modelling that this project has conducted there could be several likely outcomes as to how the site and it's ecosystem would likely change and which of those ecosystems would be the most affected by inundation.

Ecosystems that have low elevation relief and are located along the shore line are those that will be affected by inundation the most. This includes areas such as the western marsh and eastern marsh. This ecosystem area is characterized by a low relief elevation gain which allows water to travel inland faster. While these ecosystems are adapted to deal with cyclical flooding they are not adapted to being permanently submerged. As a result it is likely that these ecosystems will disappear, reduce in size or retreat further inland if the conditions are adequate.

Additional increases in inundation many of the more ecologically valuable forests impacted. Namely the Black Cottonwood forest of the northwest and the Hemlock Forest of the northeast. These two areas contain a lower proportion of invasive species possibly due to a lower level of historical modification such as infill as well as being areas that do not see frequent human presence as there are no trails. Additionally the freshwater marsh and the barge channel meadow also see inundation at higher inundation values. These areas also provide valuable habitat on site. Although the pond is used to a high level of water the plants are not adapted to saline water and would result in the death and displacement of many plant species and therefore many faunal species. Other ecosystem such as the meadow is not adapted to being inundated and would likely be lost.

There is a clear pattern of impacts on site that seem to disproportionately affect the more

ecologically sensitive and unique sites at Maplewood Flats such as the salt marsh. It is very unlikely that these ecosystems would be able to adapt as fast as the sea level rises and would most likely lead to their loss. Additionally, invasive species may spread throughout the site as other ecosystems are lost. As highly adaptable and opportunistic species it is likely they will take over lost ecosystems. As a result Maplewood Flats under these scenarios could lose many of the ecosystems that make it so unique.

Here is a summary of the effects of different increases in sea level:

0.5m Sea Level Inundation
Ecosystems inundated by sea water at high tide (west):
- Salt marsh
- Brackish marsh
- Wetland bush
- Mixed forest
- Part of the wet meadow

Ecosystems inundated by sea water at high tide (east):
- Salt marsh
- Upper estuarine
- Coastal fringe

Significant Species Lost:
- Pacific crabapple trees in the west wetland bush

1m Sea Level Inundation
Additional ecosystems inundated by sea water at high tide (west):
- Parts of the wet meadow
- Early cottonwood

Additional ecosystems inundated by sea water at high tide (east):
- Meadow
- Mixed forest along the barge channel
- Parts of the early and intermediate coastal western hemlock

Infrastructure impacted:
- Coast Salish Nursery
- Trail from parking lot to Westcoast bridge

Significant Species Lost:
- Mature Big leaf maple, Western red cedar, Sitka spruce, and Douglas fir in the eastern early and intermediate coastal western hemlock ecosystems

1.5m Sea Level Inundation
Additional ecosystems inundated by sea water at high tide (west):
- Wetland bush
- Part of the intermediate and mature cottonwood

Additional ecosystems inundated by sea water at high tide (east):

- Coastal fringe
- Most of the early and intermediate coastal western hemlock ecosystems
- Parts of the mixed forest
- Meadow

Additional Infrastructure impacted:
- Environment Canada's Pacific Environmental Science Centre
- Corrigan Nature House
- Part of the parking lot
- Parts of the western trail

Significant Species Lost:
- Mature black cottonwood trees and in the East
- More mature Big Leaf maple, Western red cedar, Sitka spruce, and Douglas fir in the eastern early and intermediate coastal western hemlock ecosystems

2m Sea Level Inundation
Additional ecosystems inundated by sea water at high tide (west):
- Wetland meadow
- Parts of the mature and intermediate cottonwood
- Fresh water pond
- Part of the inland wetland bush

Additional ecosystems inundated by sea water at high tide (east):
- Early and intermediate coastal western hemlock ecosystems
- Parts of the mixed forest

Additional Infrastructure impacted:
- Entire parking lot
- Most trails on the east side of the barge channel
- Parts of the western trail

Significant Species Lost:
- More mature Big Leaf maple, Western red cedar, Sitka spruce, and Douglas fir in the eastern early and intermediate coastal western hemlock ecosystems

Suggested Next Steps

Based on the analysis of areas at risk to different inundation levels and the plant ecosystems present, we propose five locations that are suitable for coastal adaptations. See Figure G for locations.

Area A contains wet meadow and mature cottonwood ecosystems. The large mature cottonwoods provide valuable habitat for birds and other animals. Notably, the dense shade in this area has limited the vigor of invasive species to take hold compared with other locations. This area is at risk to inundation levels over 1m because it is protected by a dyke-like landform in the upper part of the marsh/wetland bush.

Area B is located near the fresh water pond which is at risk of flooding at 1.5 metres of sea level

increase however it is blocked by a dyke. At 2 metres of sea level increase, the water circumvents this dyke and floods the pond. This pond provides important habitat for many species and would be important to preserve. The western trail is also at risk of flooding at 1.5 metres of inundation and up. This would prevent visitors from accessing this area during high tides. This area is notably not at risk from waves attributed to storm surge because of its protected location.

Area C is in the early cottonwood zone and is at risk to inundation levels of 1m and above. It is especially at risk to storm surge inundation levels because of its exposure to waves and winds from the east. This area also has many invasive species and is good bird habitat. The walking trails here are frequently used and offer sweeping views across the Burrard Inlet.

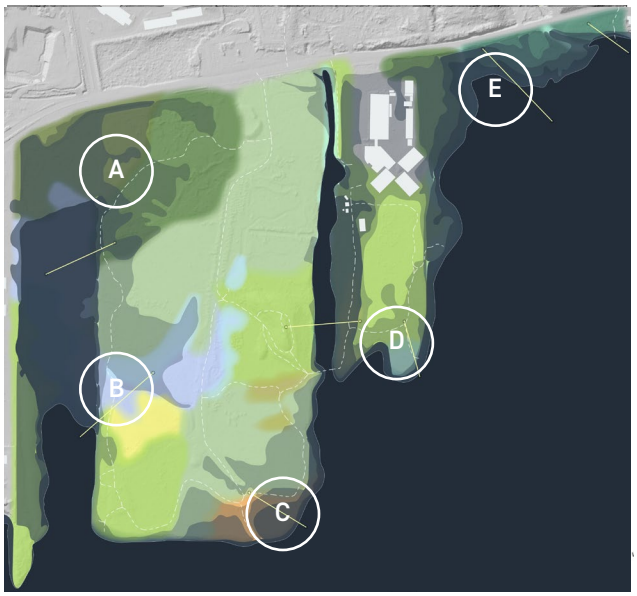


Figure G: Suggested Pilot Project Locations

Area D includes the meadow, mixed forest, and coastal fringe ecosystems. It faces many of the same risks as area C being exposed to winds and waves while also having many invasive species.

Area E includes the largest diversity of native plants and significant trees on site. The ecosystems present include early and intermediate coastal western hemlock, coastal fringe, brackish marsh, and salt marsh. The bluff leading up to Dollarton highway is a vertical barrier preventing the marshes from migrating backwards. This places these marshes at great risk to coastal squeeze. The largest western red cedar, sitka spruce, and Douglas fir trees on site are also located here. These trees hold cultural and ecological importance but they are at risk to inundation levels. This area is also at risk to additional inundation from storm surge from the east.

On the road of designing and implementing a comprehensive adaptation strategy, small experimental pilot projects could provide helpful insights to guide larger adaptations. These small scale pilot-restoration projects could utilize the dedicated community Maplewood Flats has built around itself to involve them in stewardship. Activities could include restoration efforts using traditional technologies and practices, removing invasive species, re-establishing culturally significant species, and monitoring success of restoration efforts over time to determine scaling up potentials. This approach would build community around land-based stewardship while learning valuable insights into how larger coastal adaption strategies could be designed and implemented. The nature of stewardship is neither individualistic nor conclusive, this work requires community and is perpetually ongoing. We recognize this and these findings, data, and graphics are intended to inform and start conversations among the Tsleil-Waututh Nation and the Wild Bird Trust of BC as they continue to work together in creating and implementing a long-term stewardship plan for Maplewood Flats.

Bibliography:

"About WBT - Wild Bird Trust of British Columbia," October 17, 2018. https://wildbirdtrust.org/about-wbt/.

Caslys Consulting Ltd. "Metro Vancouver Regional District Regional Land Cover Classification and Sensitive Ecosystem Inventory Update," December 2022. https://metrovancouver.org/services/regional-planning/Documents/mv-land-cover-classification-sei-update-2022.pdf&ved=2ahUKEwjkkaKvpPCHAxV0ODQIHVAtFAYQFnoECBYQAQ&usg=AOvVaw0mQm-gXRxoOFHHjB6rsnik.

City of Vancouver. "Climate Change and Sea Level Rise." City of Vancouver. Accessed August 12, 2024. https://vancouver.ca/green-vancouver/climate-change-and-sea-level-rise.aspx.

Dobert, Timm. "Flyway Heroes." Wingspan, 2023.

Jacques Whitford AXYS Ltd. "Burrard Inlet Environmental Indicators Report Public Consultation Document," February 8, 2008.

Make Policy Live: Nature Lifts Maplewood Flats from Derelict to Diverse, 2011. https://www.youtube.com/watch?v=IRyAmymTyDE.

"MONOVA - Archives of North Vancouver - Record Details." Accessed August 11, 2024. https://eloquent.dnv.org/webcat/request/Action?ClientSession=-7b8b4b5a:190bc0b1cdd:-7971&TemplateProcessID=1004_3355&CMD_(DetailRequest)[0]=&ProcessID=1004_3363(0)&KeyValues=KEY_4839.

"News | Media | David Suzuki Foundation," February 7, 2015. https://web.archive.org/web/20150207001205/http://www.davidsuzuki.org/cgi-bin/mt1/mt-search.cgi?search=&IncludeBlogs=18&year=2011&month=01&day=01&archive_type=Yearly&template_id=3295&limit=12&page=1.

Northwest Hydraulic Consultants. "CFRA Phase 1 Final Report Maps." City of Vancouver, 2014. https://vancouver.ca/files/cov/cfra-phase-1-final-report-maps.pdf.

"Records and Archives Intern - Wild Bird Trust of British Columbia," May 3, 2021. https://wildbirdtrust.org/2021/05/02/records-and-archives-intern/.

Tsleil-Waututh Nation. "Burrard Inlet Action Plan: A Tsleil-Waututh Perspective." Tsiel-Waututh, January 2016. https://twnsacredtrust.ca/wp-content/uploads/2023/01/TWN-Burrard-Inlet-Action-Plan-Draft-Report.pdf&ved=2ahUKEwiRjZD1n_CHAxUIGTQIHRjSCwEQFnoECBUQAQ&usg=AOvVaw2NAlzu1w9LLGuDtBq3tKW4.

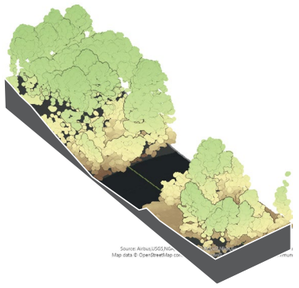
Wingspan. "Looking Way Back and Looking Forward: Wild Bird Trust Marks 25 Years in 2018." n.d.

Appendix A: Sections

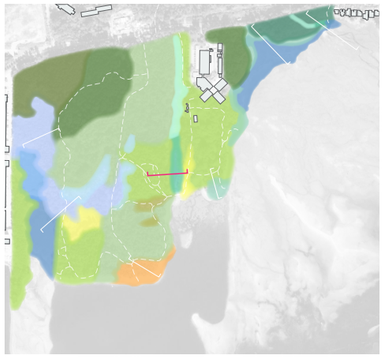
Credit: Benji Eisenberg

Section A

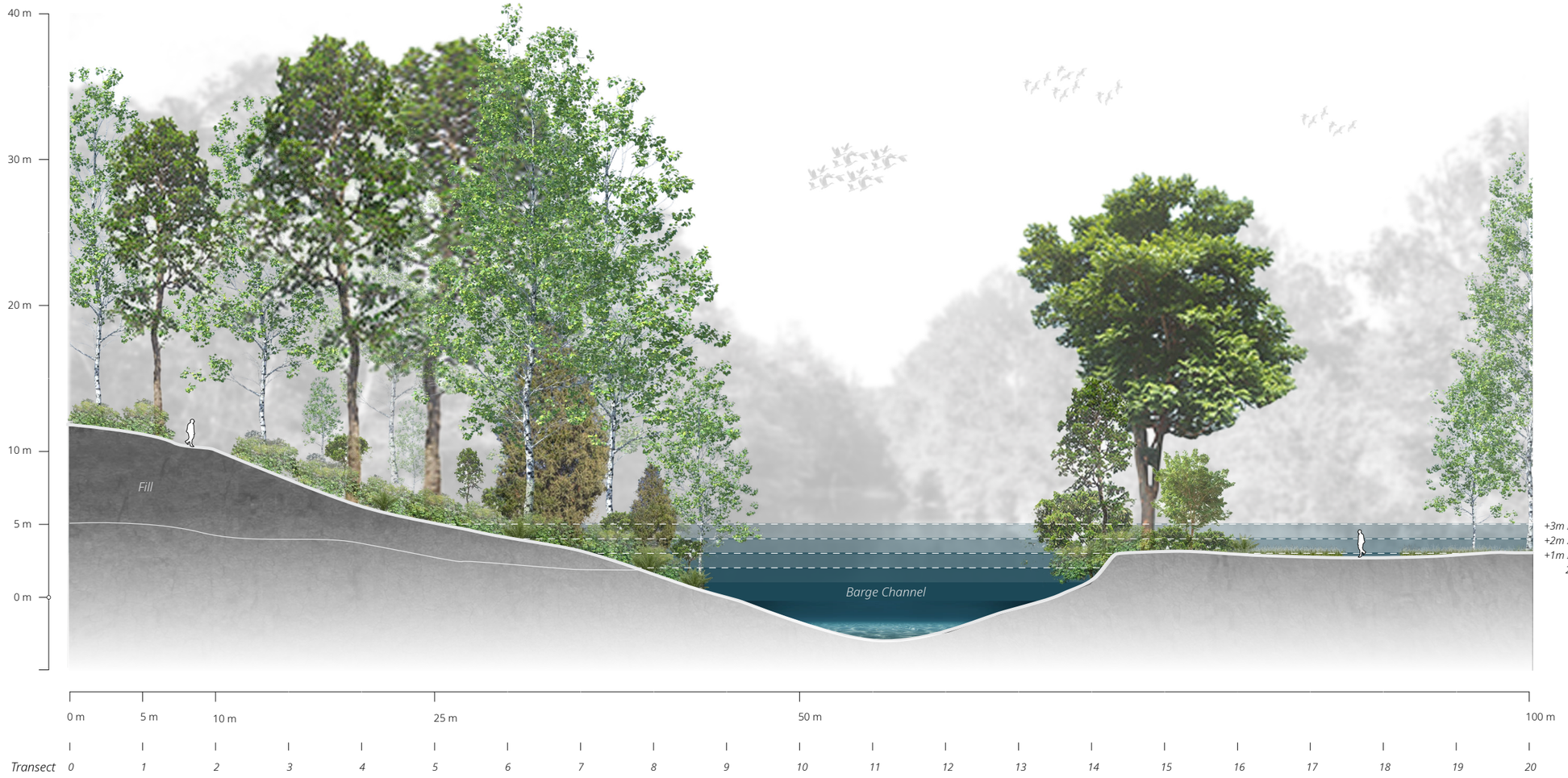
Barge Channel Looking North Towards Parking Lot



Section Area - LiDAR Point Cloud



Reference Map



Description:

This shows the observed ecosytems and the plants found within it along a transect taken in the barge channel. Increases in water depth are also shown at 1, 2, and 3 metres above the 2025 high water line. Plants at risk of different levels of sea level rise can be seen in areas of overlap.

The transect is 100 metres with data taken every 5 metres. Each transect point recorded all plants and some animals within a 2 metre diameter. Transect points are indicated in a horizontal axis. A full dataset is available.

Mixed Forest

tsəəw'iiłp	*Black cottonwood*
q'ayx	*Cascara*
cseyəłp	*Douglas fir*
kʷəxʷsi:ɬp	*Red alder*
	Arborvitae
	English oak
	European ash
t'thikwəəkw	*Elderberry*
táats'əəłp	*Hardhack*
saniʔəłp	*Oregon grape*
lileʔəłp	*Salmonberry*
pəpqəyasəłp	*Snowberry*
tqʷəməłp	*Thimbleberry*
sθχeləm	*Western sword fern*
məłχʷələłp	*Wild plum*
	Himalayan blackberry
	Holly
	St. John's Wort
sxəə m'xəəm'	*Horsetail*
	Creeping Buttercup
	English ivy
	Morning glory
	Broad-leaved hellaborine
	Roberts Geranium

Lower Estuarine

	Barnacle
	Blue mussel
kw'éʔqəəq	*Rock weed*
kw'éqeq	*Sea lettuce*

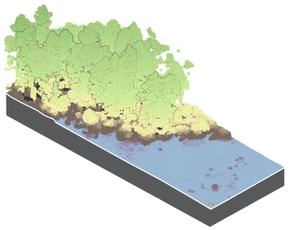
Meadow

q'ayx	*Cascara*
kʷəxʷsi:ɬp	*Red alder*
	European ash
	Hawthorn
	Mountain Ash
	Red oak
qáthəəłp	*Ocean spray*
	Twinberry
məłχʷələłp	*Wild plum*
	Himalayan blackberry
	Lupine
	Plantain
sθχeləm	*Western sword fern*
	Buttercup
	Geranium
	Hellebore
	Roberts Geranium
	St. John's Wort
	Tansy

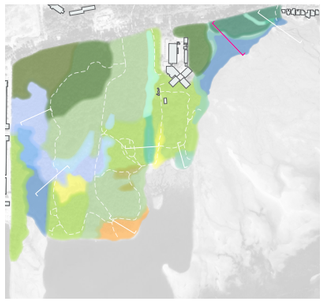
MAPLEWOOD FLATS

Section B

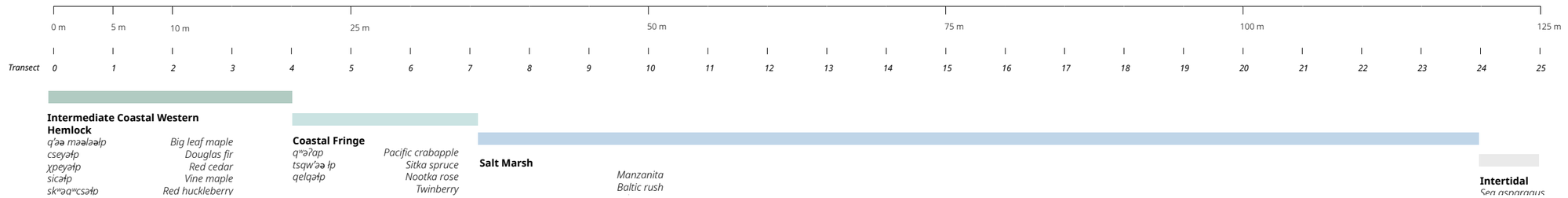
Northeastern Marsh Looking Northeast



Section Area - LiDAR Point Cloud



Reference Map



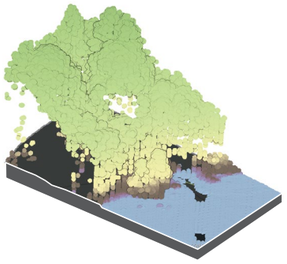
Description:

This shows the observed ecosytems and the plants

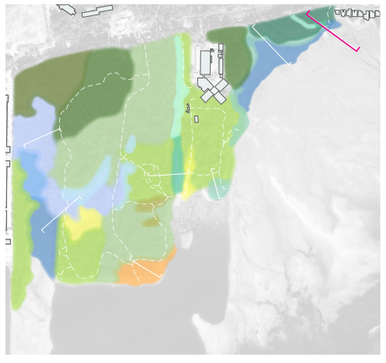
MAPLEWOOD FLATS

Section C

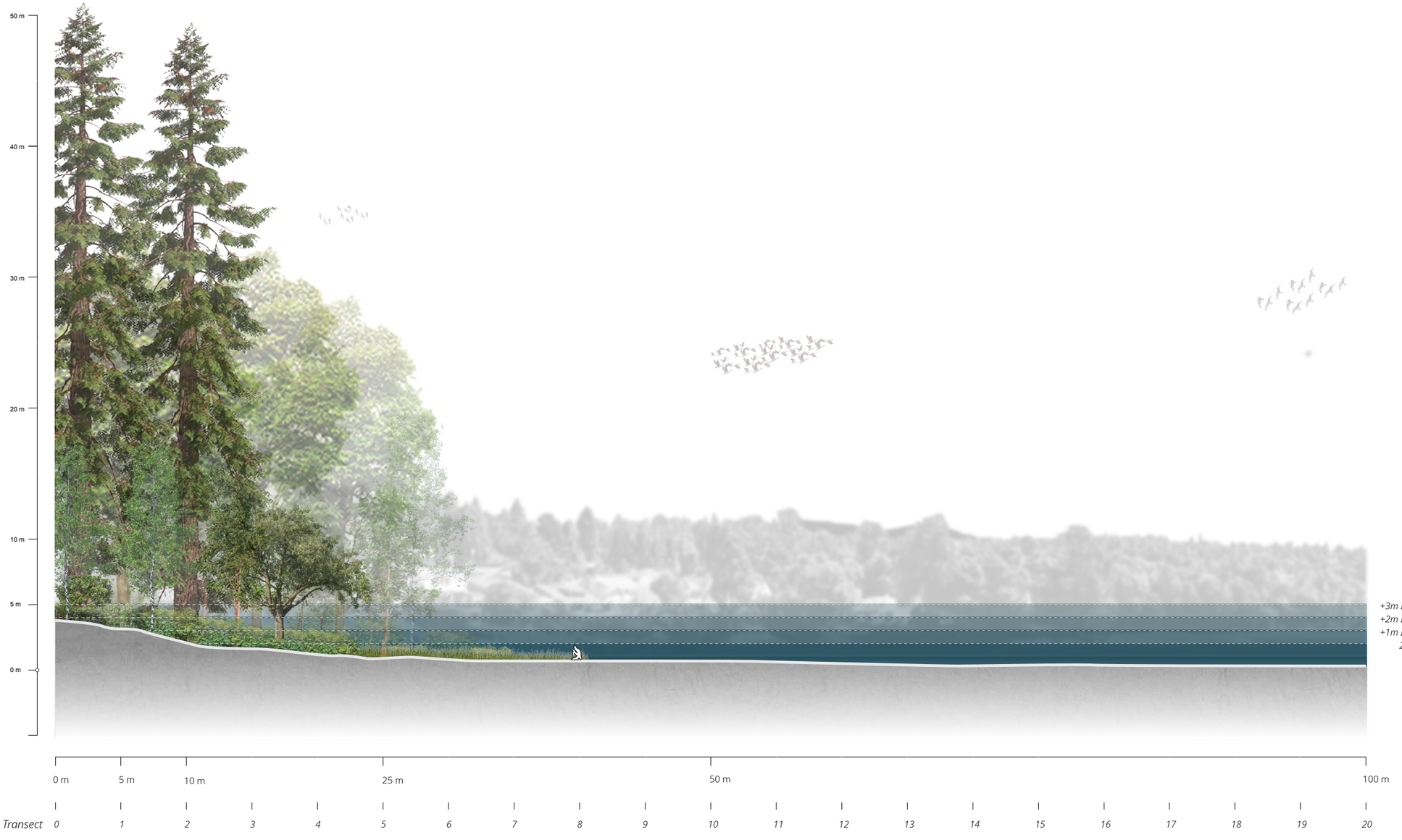
McCartney Creek Looking Northeast



Section Area - LiDAR Point Cloud



Reference Map



Intermediate Coastal Western Hemlock

q'əə məələəɬp	*Big leaf maple*
t'ɬthɬqínɬp	*Hemlock*
qʷəʔap	*Pacific crabapple*
kʷəxʷsiːɬp	*Red alder*
χpeyəɬp	*Western red cedar*
t'ɬhíkwəəkw	*Elderberry*
qelqəɬp	*Rosa nutkana*
lileʔəɬp	*Salmonberry*
pəpqəyasəɬp	*Snowberry*
	Twinberry
məɬχʷələɬp	*Wild plum*
	Himalayan blackberry
skʷʷiilməəxʷ	*Trailing blackberry*

Salt Marsh

Baltic rush
Buttercup
Sea-milkwort
Silverweed
Morning glory
Reed canary grass
Thistle

Intertidal

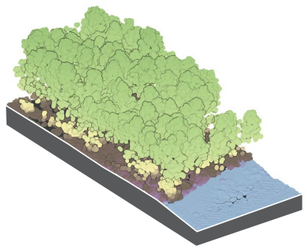
Description:

This shows the observed ecosytems and the plants found within it along a transect taken along the east bank of McCartney Creek. Increases in water depth are also shown at 1, 2, and 3 metres above the 2025 high water line. Plants at risk of different levels of sea level rise can be seen in areas of overlap.

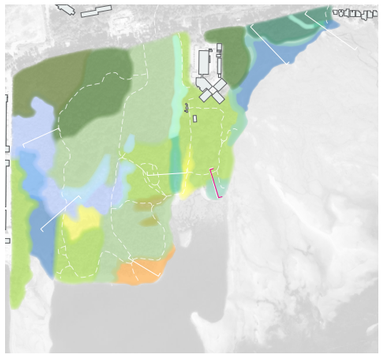
The transect is 100 metres with data taken every 5 metres. Each transect point recorded all plants and

Section D

Barge Channel Looking North
Towards Parking Lot



Section Area - LiDAR Point Cloud

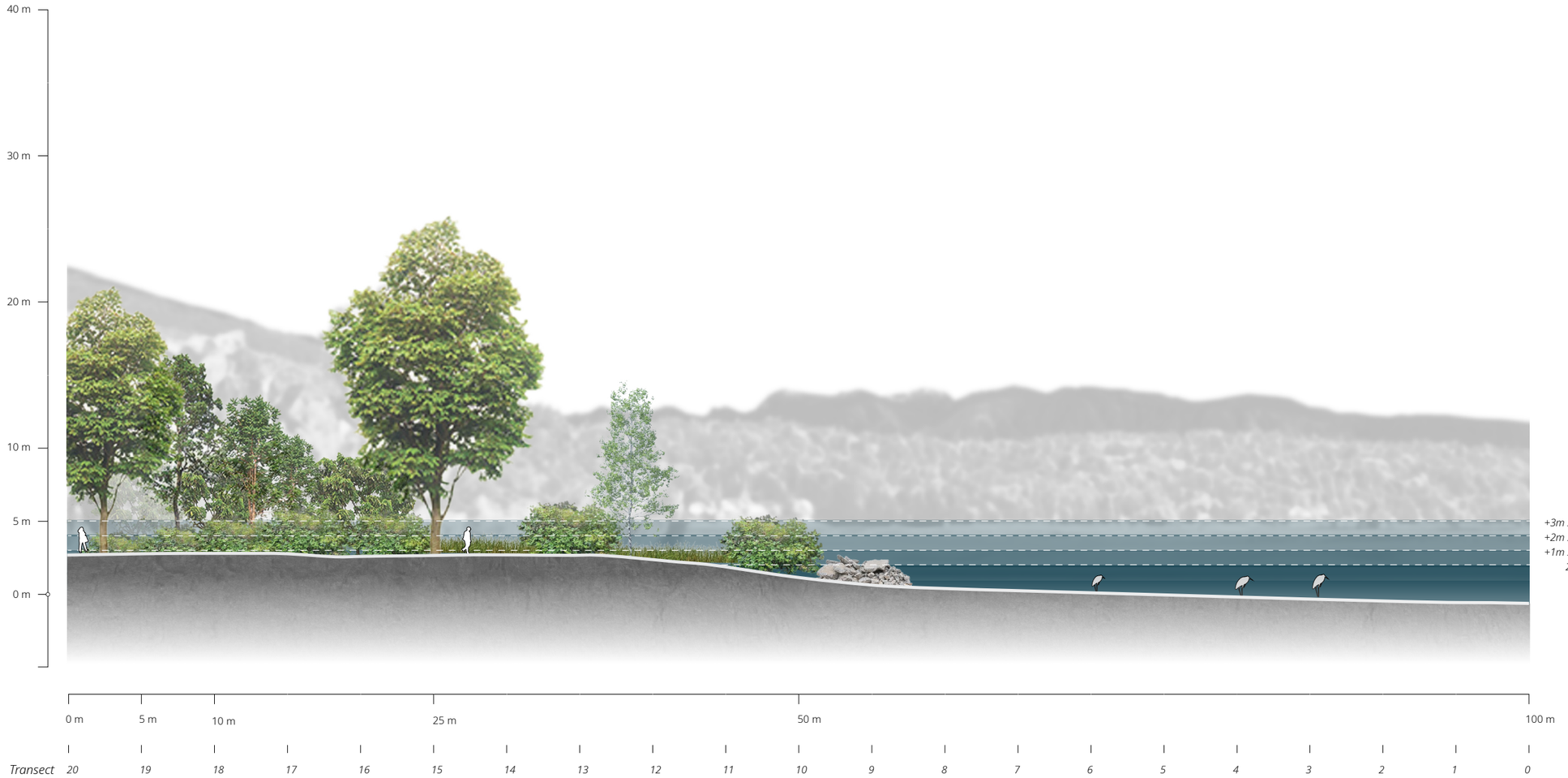


Reference Map

Description:

This shows the observed ecosytems and the plants found within it along a transect takenat the southeast tip of the landform east of the barge channel. Increases in water depth are also shown at 1, 2, and 3 metres above the 2025 high water line. Plants at risk of different levels of sea level rise can be seen in areas of overlap.

The transect is 100 metres with data taken every 5 metres. Each transect point recorded all plants and some animals within a 2 metre diameter. Transect points are indicated in a horizontal axis. A full dataset is available.



Mixed Forest

tsəəw'iiłp	*Black cottonwood*
qwəəʔápəəłp	*Pacific crabapple*
st'ə ləəm	*Domestic Cherry*
	Mountain Ash
táats'əəłp	*Hardhack*
lileʔəłp	*Salmonberry*
məɬχʷələłp	*Wild plum*
	Himalayan blackberry
	Hawthorn
	Long leaf hellebore
	Western buttercup
	Creeping Buttercup
	English ivy
	Dandelion
	Dock
	Globe buttercup
	Hathfinder
	Roberts Geranium

Coastal Fringe

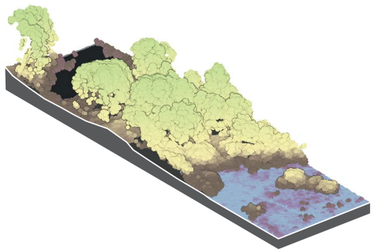
tsəəw'iiłp	*Black cottonwood*
qwəəʔápəəłp	*Pacific crabapple*
táats'əəłp	*Douglas' Spirea*
sháalʔəəłp	*Red osier dogwood*
	Himalayan blackberry
	Hawthorn
	Buttercup
spánxw	*Camas*
	Clover
saaqw'	*Cow parsnip*
sxəə m'xəəm'	*Horsetail*
	Orchard grass
	Dandelion
	Medicago
	Meticagao
	Plantain
	Sweet pea
	Thistle
	Vetch

Intertidal
Barnacles

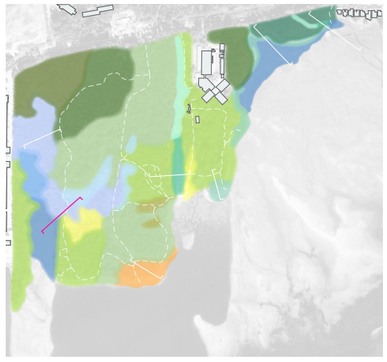
MAPLEWOOD FLATS

Section E

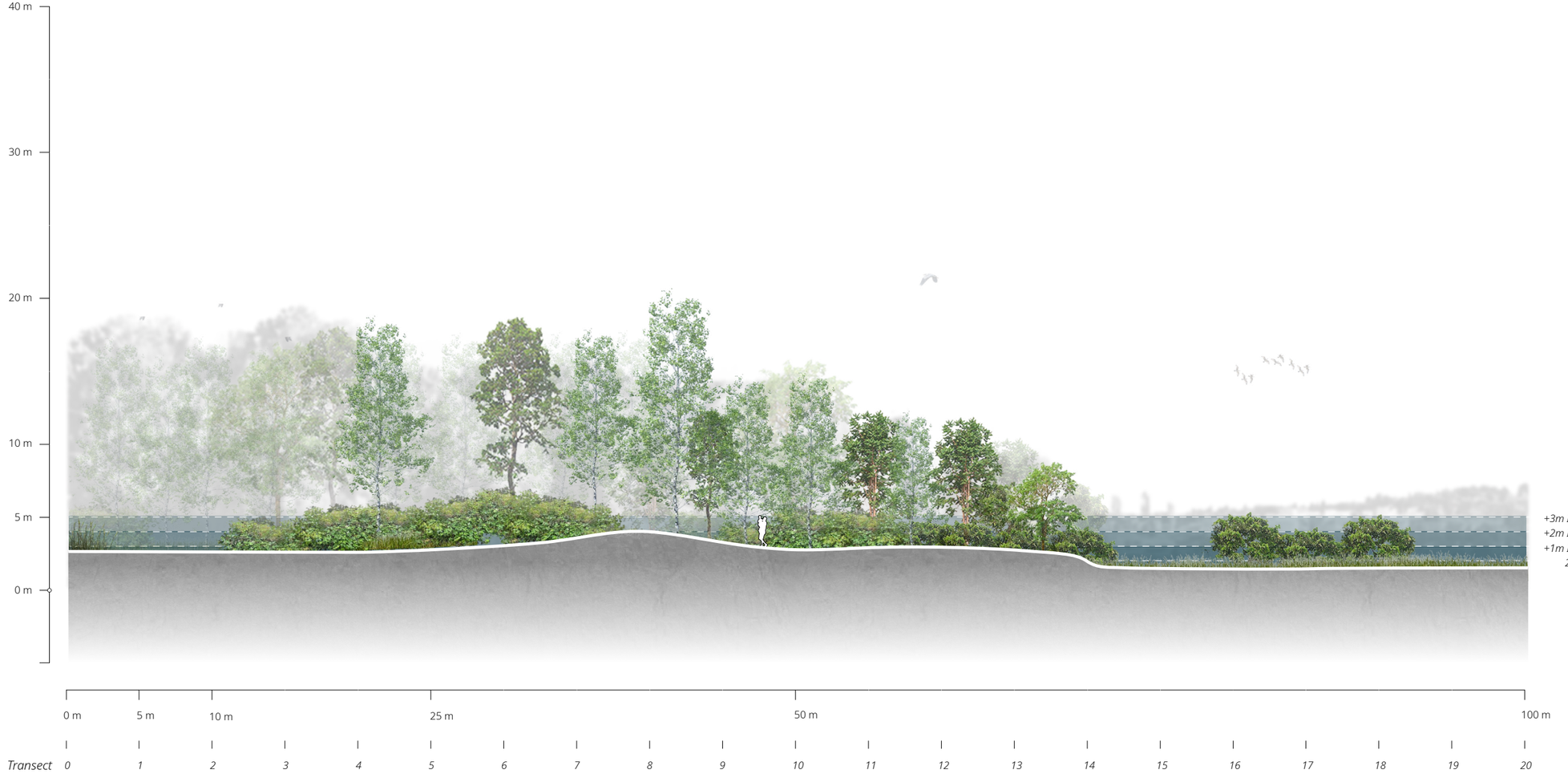
West Pond to West Marsh Looking Southeast



Section Area - LiDAR Point Cloud



Reference Map



Description:

This shows the observed ecosytems and the plants found within it along a transect taken from the west pond to the western salt marsh. Increases in water depth are also shown at 1, 2, and 3 metres above the 2025 high water line. Plants at risk of different levels of sea level rise can be seen in areas of overlap.

The transect is 100 metres with data taken every 5 metres. Each transect point recorded all plants and some animals within a 2 metre diameter. Transect points are indicated in a horizontal axis. A full dataset is available.

Fresh Water Pond

tsəəw'iiłp	*Black Cottonwood*
xwálaʔałp	*Pacific willow*
	Scouler's willow
táats'əəłp	*Hardhack*
	Myrica gale
stl'áʔqəən	*Cattail*
pspháy̓ʔ	*Flat leaf sedge*
sxəə m'xəəm'	*Giant bull rush*
sxəə m'xəəm'	*Horsetail*
	Dock
	Himalayan blackberry

Wetland Bush

kwəəlálaʔəəłp	*Alnus rubra*
tsəəw'iiłp	*Black cottonwood*
	Mountain Ash
qwəəʔápəəłp	*Pacific crabapple*
	Scouler's willow
	Cherry
	English oak
	White poplar
táats'əəłp	*Hardhack*
	High bush cranberry
lileʔəłp	*Salmonberry*
	Twinberry
	Himalayan blackberry
	Hawthorn
	Angelica
	Douglas aster
sxəə m'xəəm'	*Horsetail*
	Arctic rush
	Common Rush
	Silverweed
	Tule

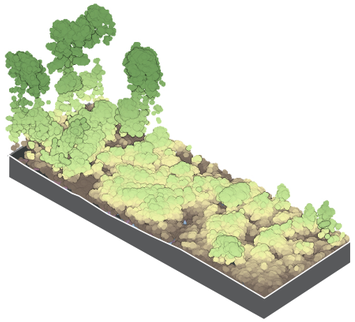
Salt Marsh

qwəəʔápəəłp	*Pacific crabapple*
	Angelica
	Arctic Rush
	Douglas aster
	Drummond's rush
	Grass
	Gum weed
	Sea asparagus
pspháy̓ʔ	*Sedge*
tl'əəlíqw'əəłp	*Yarrow*
	Dodders
	Lambs quarter
	Thistle
	Tule
	Vetch
tl'əəlíqw'əəłp	*Yarrow*
	Creeping Buttercup
	Clematis
	Lambs quarter

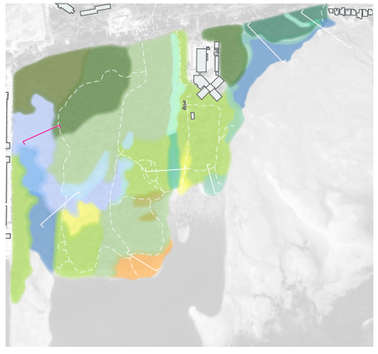
MAPLEWOOD FLATS

Section F

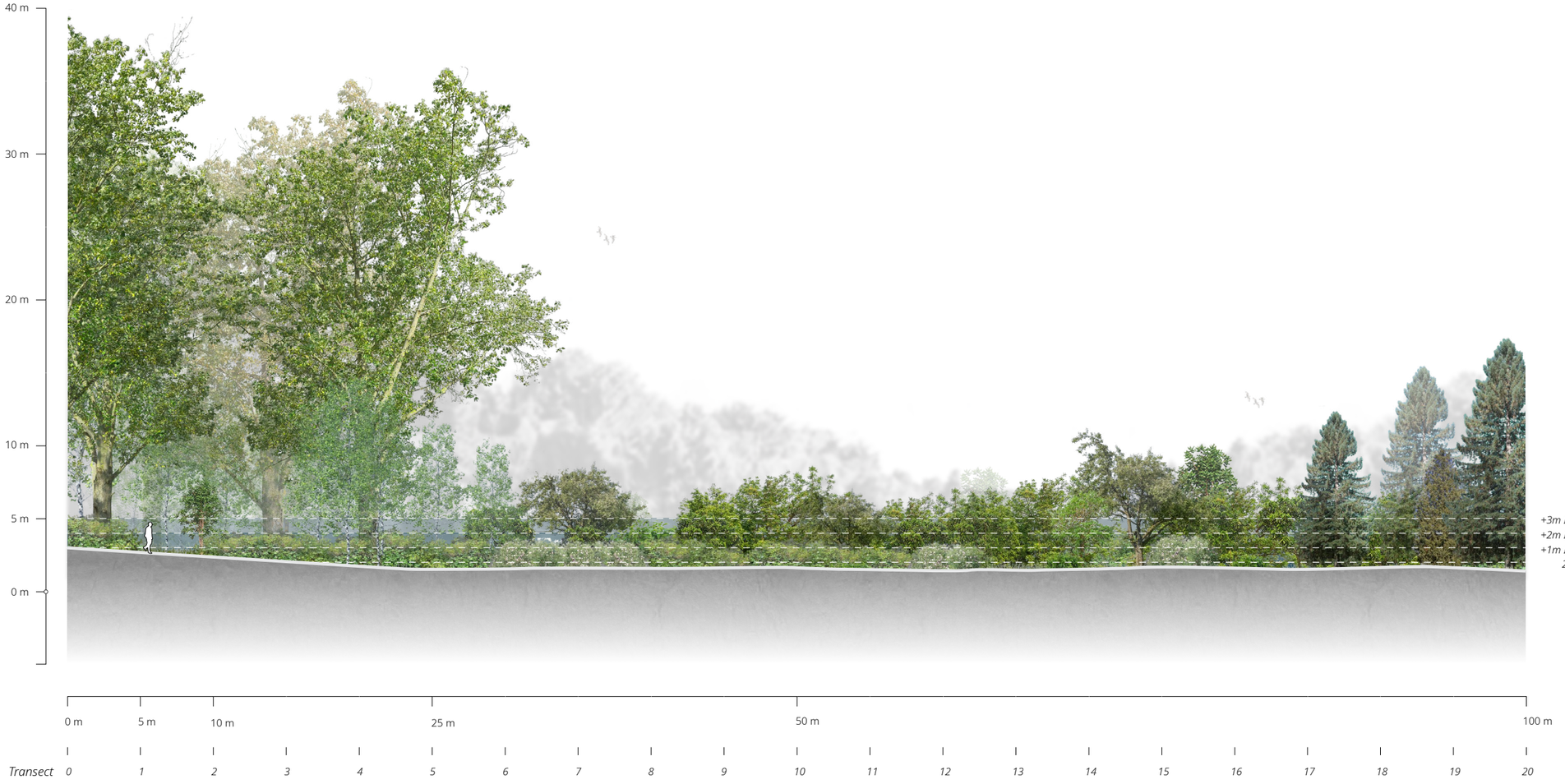
West Trail to West Marsh Looking Southeast



Section Area - LiDAR Point Cloud



Reference Map



Description:

This shows the observed ecosytems and the plants found within it along a transect taken at the west trail to west marsh looking southeast. Increases in water depth are also shown at 1, 2, and 3 metres above the 2025 high water line. Plants at risk of different levels of sea level rise can be seen in areas of overlap.

The transect is 100 metres with data taken every 5 metres. Each transect point recorded all plants and some animals within a 2 metre diameter. Transect points are indicated in a horizontal axis. A full dataset is available.

Mature Cottonwood

tsəəw'iiłp	*Black cottonwood*
st'əə ləəm	*Domestic Cherry*
	English ivy
	Grass
táats'əəłp	*Hardhack*
	Himalayan blackberry
	Morning glory
	Nightshade
	Phlox
kwəəlálaʔəəłp	*Red alder*
	Reed canary grass
	Roberts Geranium
lileʔəłp	*Salmonberry*
	Twinberry
	Wall lettuce
sθχeləm	*Western sword fern*
məłχʷələłp	*Wild plum*

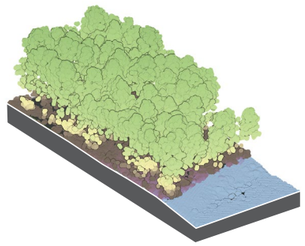
Wetland Bush

tsəəw'iiłp	*Black Cottonwood*
qwəəʔápəəłp	*Pacific Crabapple*
tsqw'əə łp	*Sitka spruce*
páshəələəqw	*Yellow cedar*
táats'əəłp	*Hardhack*
	Red huckleberry
qelqəłp	*Nootka rose*
teqeʔəłp	*Salal*
lileʔəłp	*Salmonberry*
	Twinberry
skw'iilməəxw	*Trailing blackberry*
pshóyʔ	*Slough Sedge*
	Grass
łəə q'ləəqʔey'	*Lady fern*
tł'əəsíip	*Licorice fern*
	Water celery
	Water parsley
	Yellow flag iris
	Creeping Buttercup
	English ivy
	Cleaver
	Nightshade

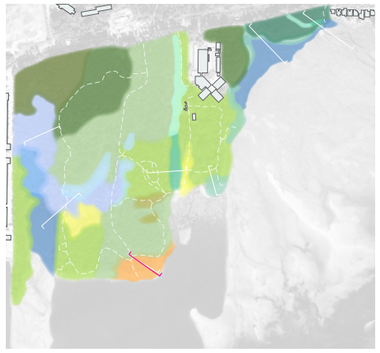
MAPLEWOOD FLATS

Section G

Southwest Corner on West Side of the Barge Channel Looking Northeast



Section Area - LiDAR Point Cloud



Reference Map

Description:

This shows the observed ecosytems and the plants found within it along a transect takenat the southwest tip of the landform west of the barge channel. Increases in water depth are also shown at 1, 2, and 3 metres above the 2025 high water line. Plants at risk of different levels of sea level rise can be seen in areas of overlap.

The transect is 100 metres with data taken every 5 metres. Each transect point recorded all plants and some animals within a 2 metre diameter. Transect points are indicated in a horizontal axis. A full dataset is available.

Early Cottonwood

tsəəw'iiłp	*Black cottonwood*
qwəəʔápəəłp	*Pacific Crabapple*
kwəəlálaʔəəłp	*Red alder*
	Shining Willow
	Spruce
	Canadian Plum
	Domestic apple
	English oak
	Mountain Ash
táats'əəłp	*Hardhack*
skʷəqʷcsəłp	*Highbush cranberry*
	Pacific ninebark
sháalʔəəłp	*Red osier dogwood*
pəpqəyasəłp	*Snowberry*
sθχeləm	*Western sword fern*
	English hawthorn
	Himalayan blackberry
	Hollyberry Cotoneaster
	St. John's Wort

Upper Estuarine

	Barnacles
	Shore crabs
kw'éʔqəəq	*Rock weed*
kw'éqeq	*Sea lettuce*
q'amʔ	*Sugar kelp*

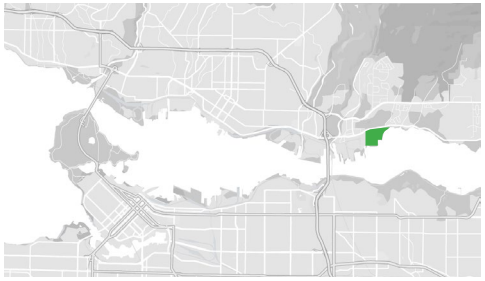
Appendix B: Mapping

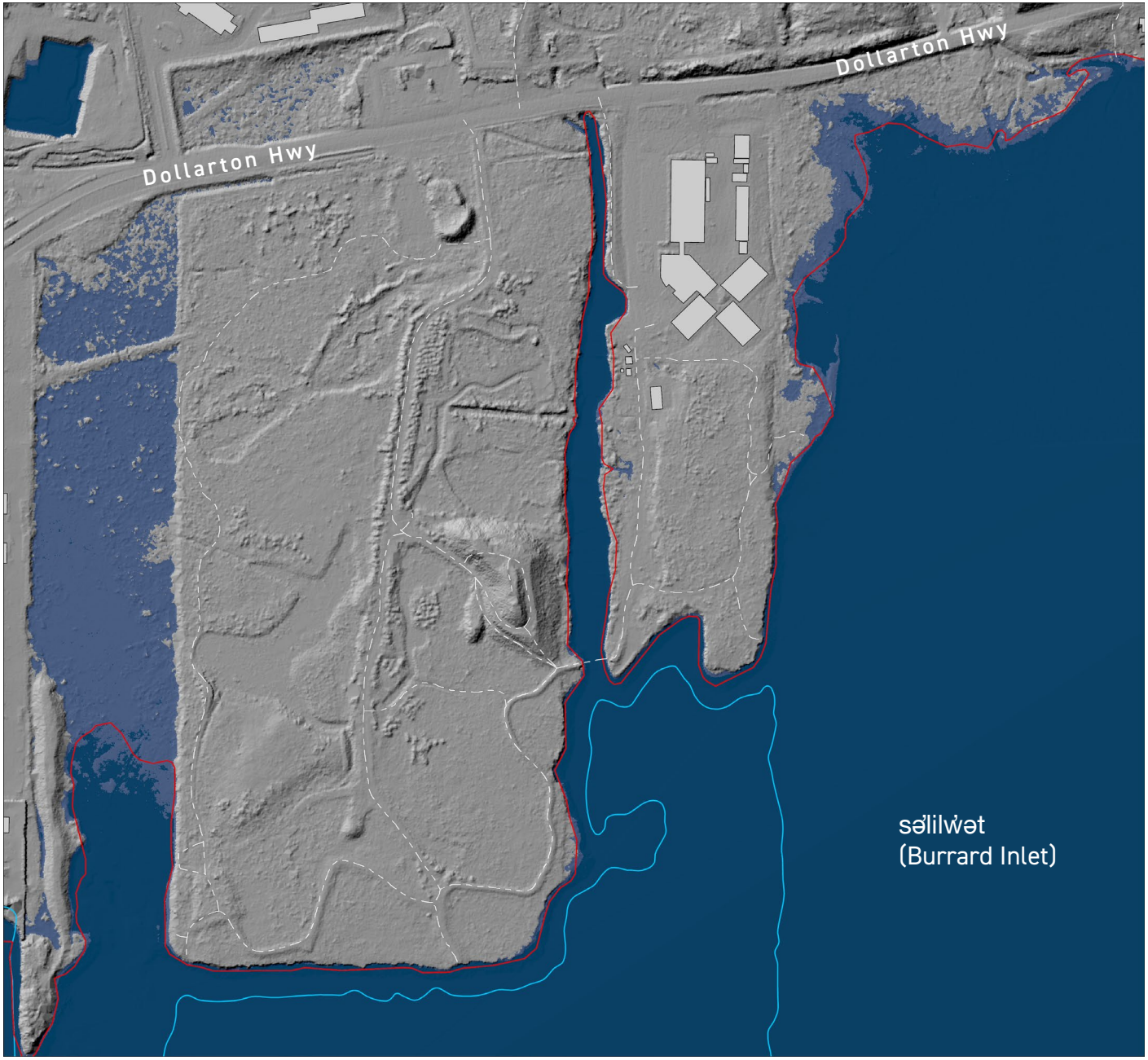
Credit: Sam Kohlmann

0.5m of Inundation

Maplewood Flats
Traditional səlilwətaɬ Territory

- Buildings
- High Tide Line
- Low Tide Line
- 0.5m Inundation
- 2022 High Water Line





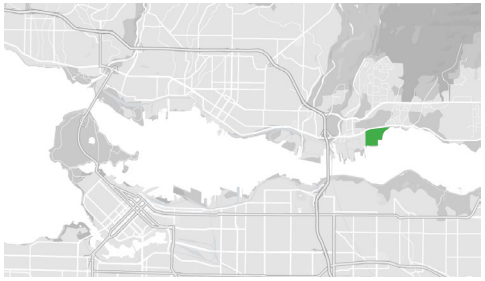
N

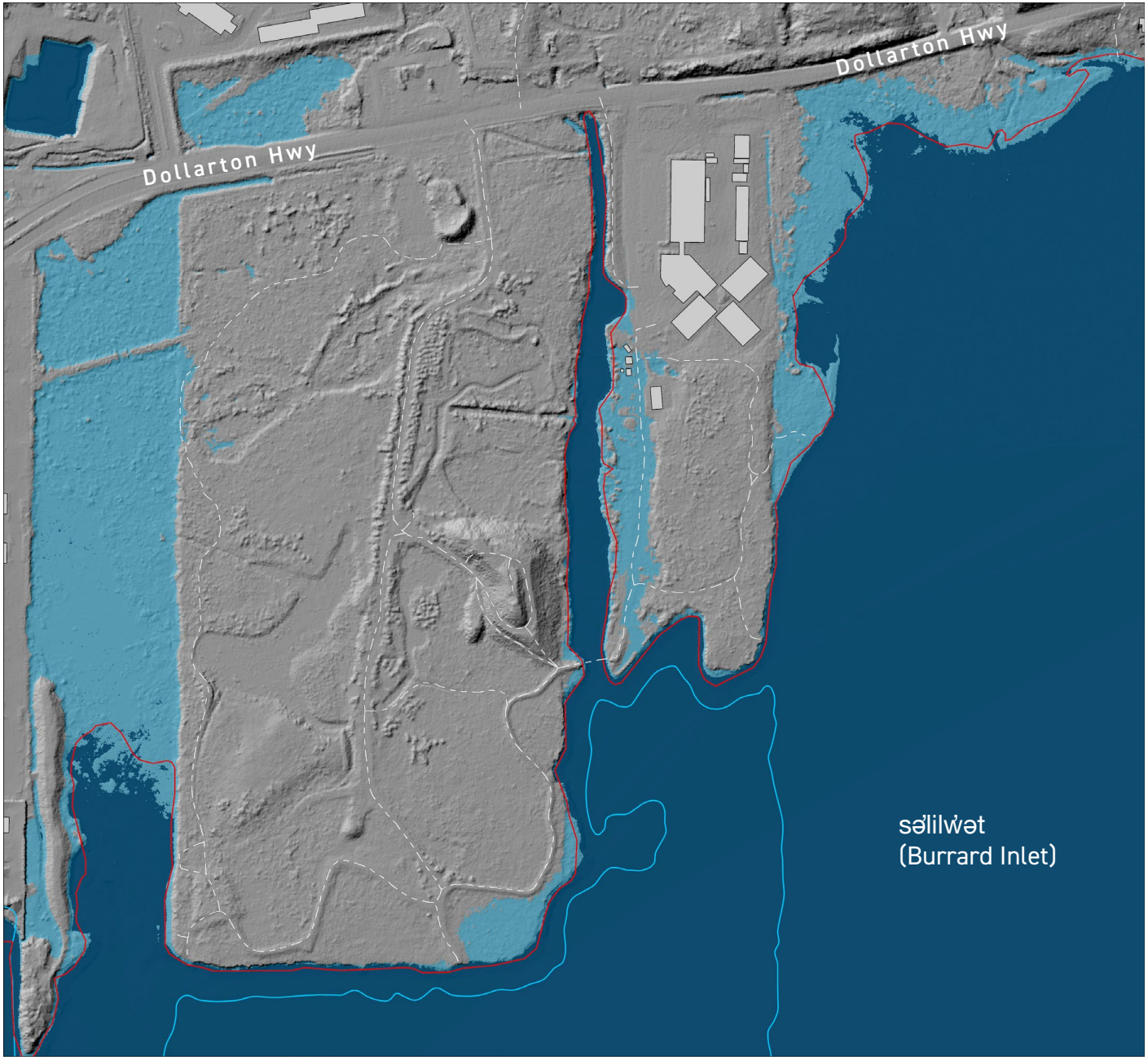
0 100 200 m

1m of Inundation

Maplewood Flats
Traditional səlilwətaɬ Territory

- Buildings
- High Tide Line
- Low Tide Line
- 1.0m Inundation
- 2022 High Water Line





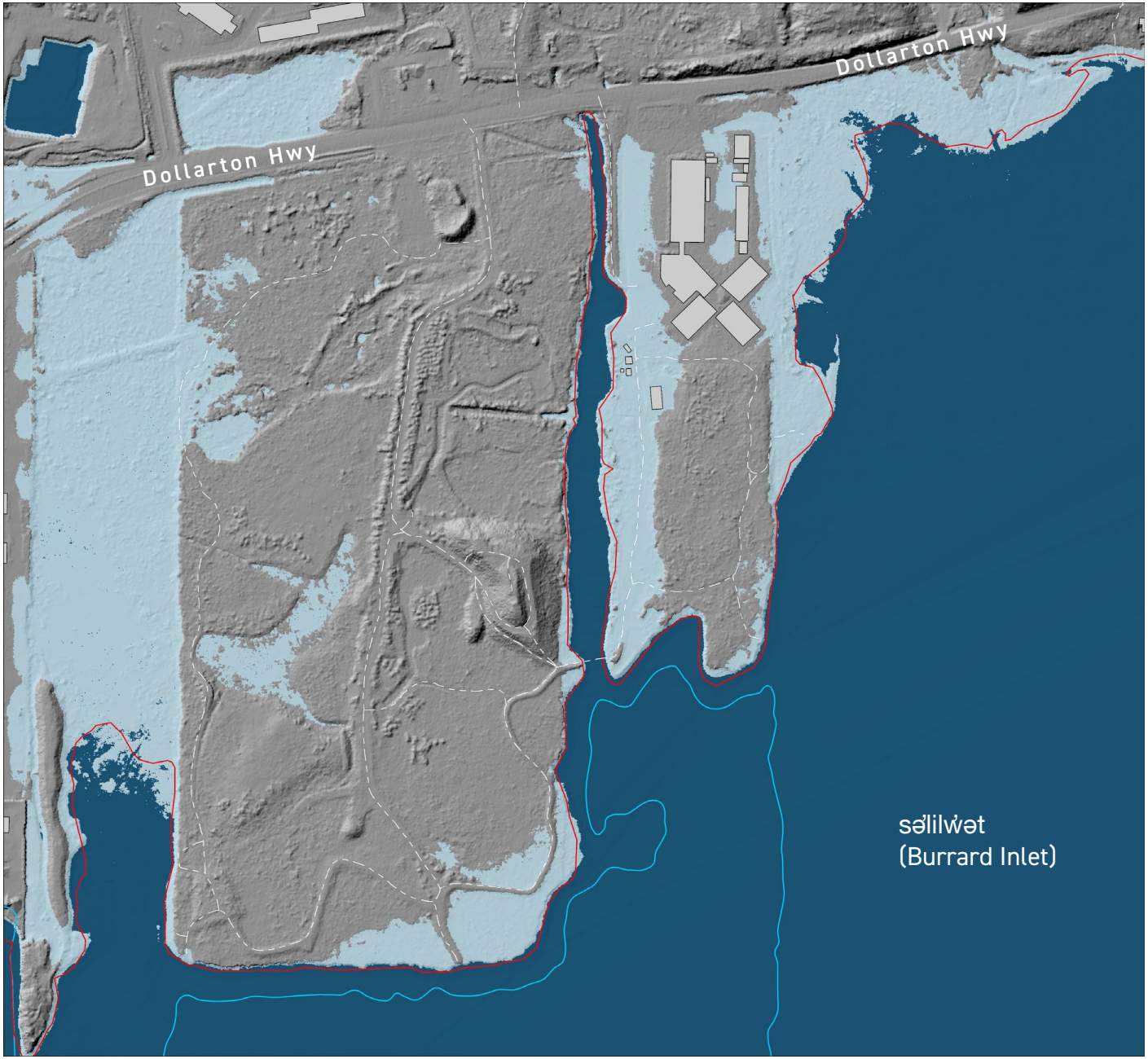
N

0 100 200 m

1.5m of Inundation

Maplewood Flats
Traditional səlilwətaɬ Territory

- Buildings
- High Tide Line
- Low Tide Line
- 1.5m Inundation
- 2022 High Water Line



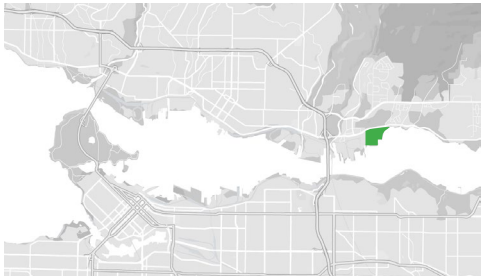
N

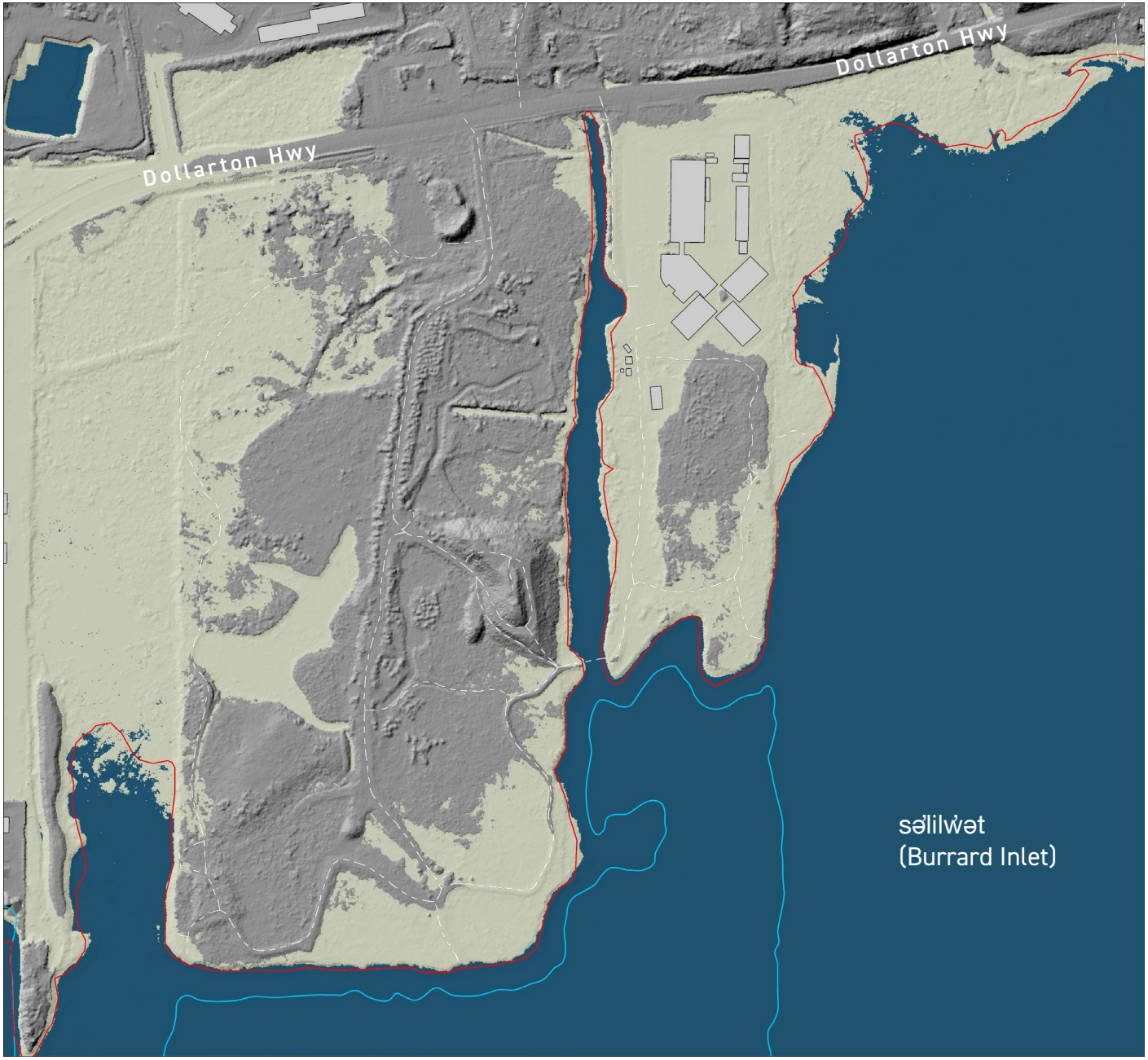
0 100 200 m

2m of Inundation

Maplewood Flats
Traditional səlilwətaɬ Territory

- Buildings
- High Tide Line
- Low Tide Line
- 2.0m Inundation
- 2022 High Water Line



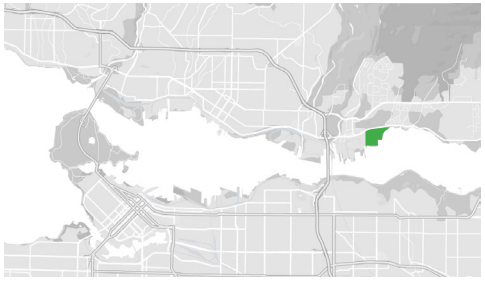


N
0 100 200 m

3m of Inundation

Maplewood Flats
Traditional səlilwətaɬ Territory

- Buildings
- High Tide Line
- Low Tide Line
- 3m Inundation
- 2022 High Water Line



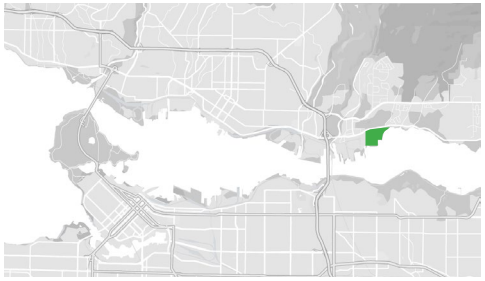
N

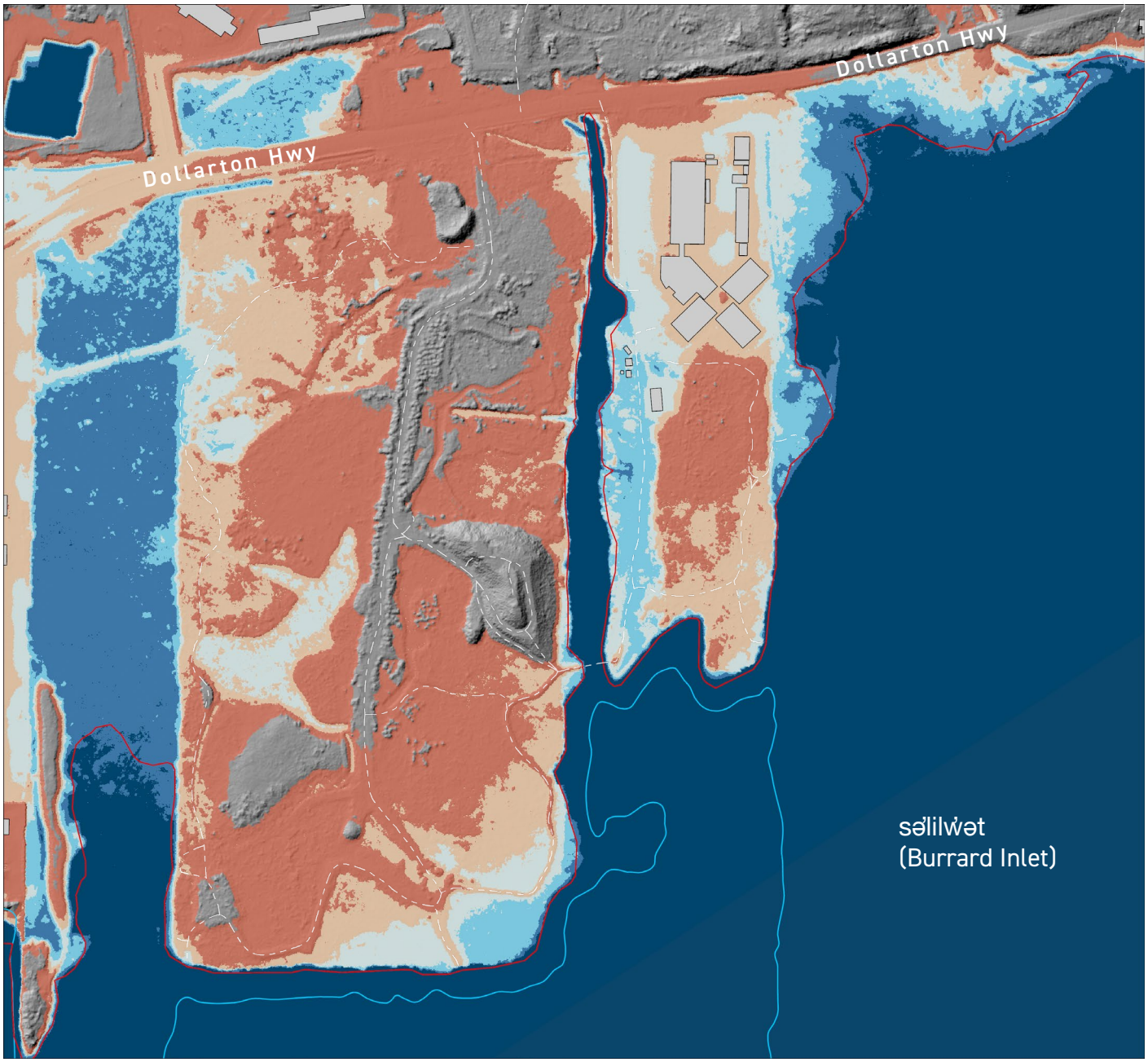
0 100 200 m

Sea Level Rise Scenarios

Maplewood Flats
Traditional səlilwətaɬ Territory

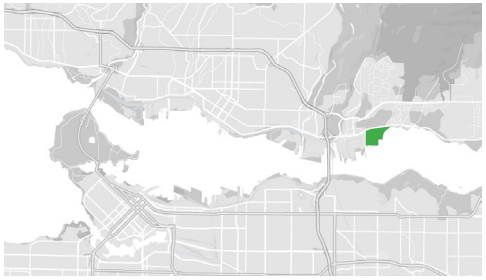
- Buildings
- High Tide Line
- Low Tide Line
- 0.5m Inundation
- 1m Inundation
- 1.5m Inundation
- 2m Inundation
- 3m Inundation
- 2022 High Water Line

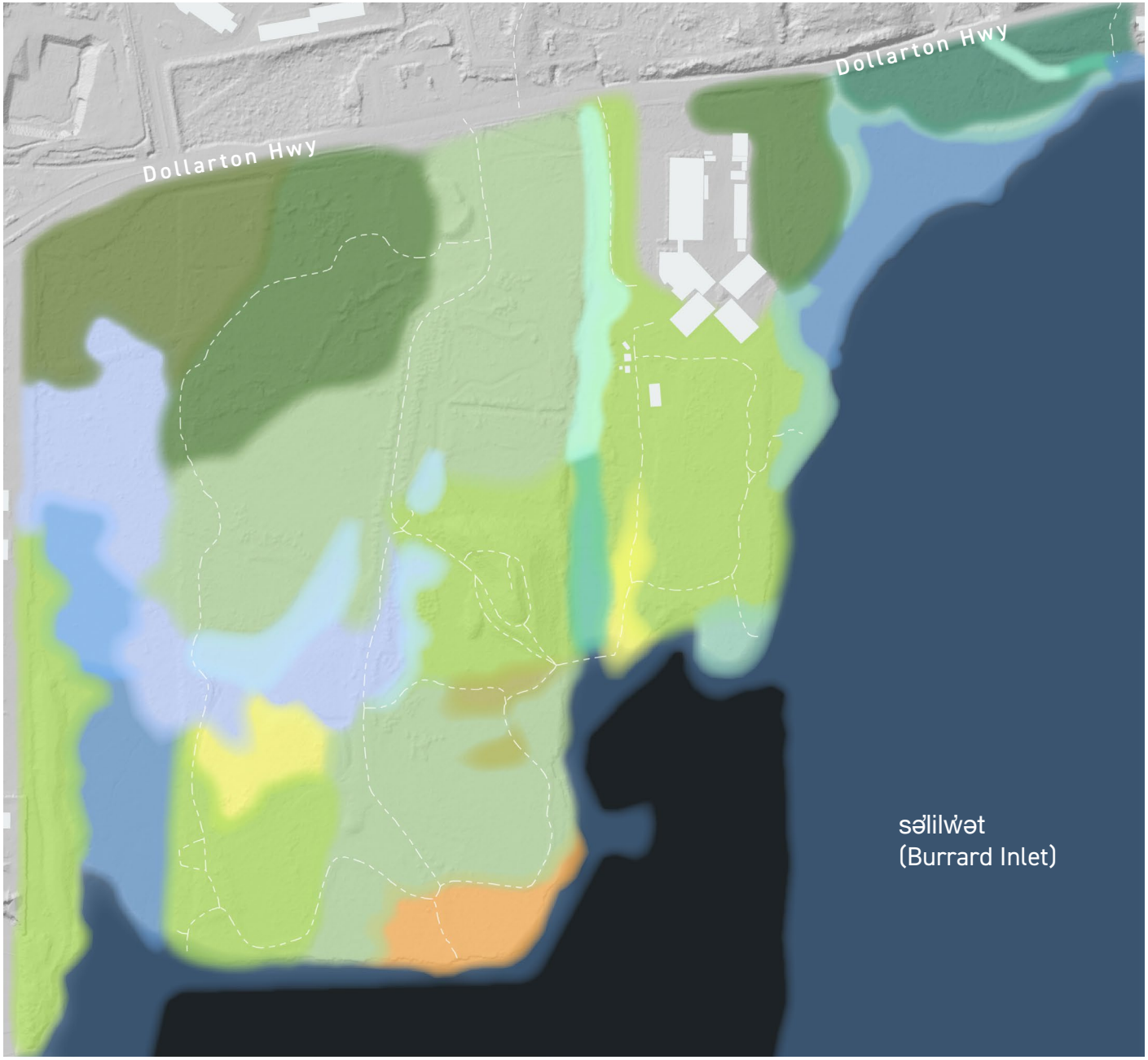




Observed Ecosystems

- Buildings
- Brackish Marsh
- Coastal Fringe
- Early Coastal Western Hemlock
- Early Cottonwood
- Fresh Water Pond
- Intermediate Coastal Western Hemlock
- Intermediate Cottonwood
- Intertidal
- Lower Estuarine
- Mature Cottonwood
- Meadow
- Mixed Forest
- Salt Marsh
- Upper Estuarine
- Wet Meadow
- Wetland Bush



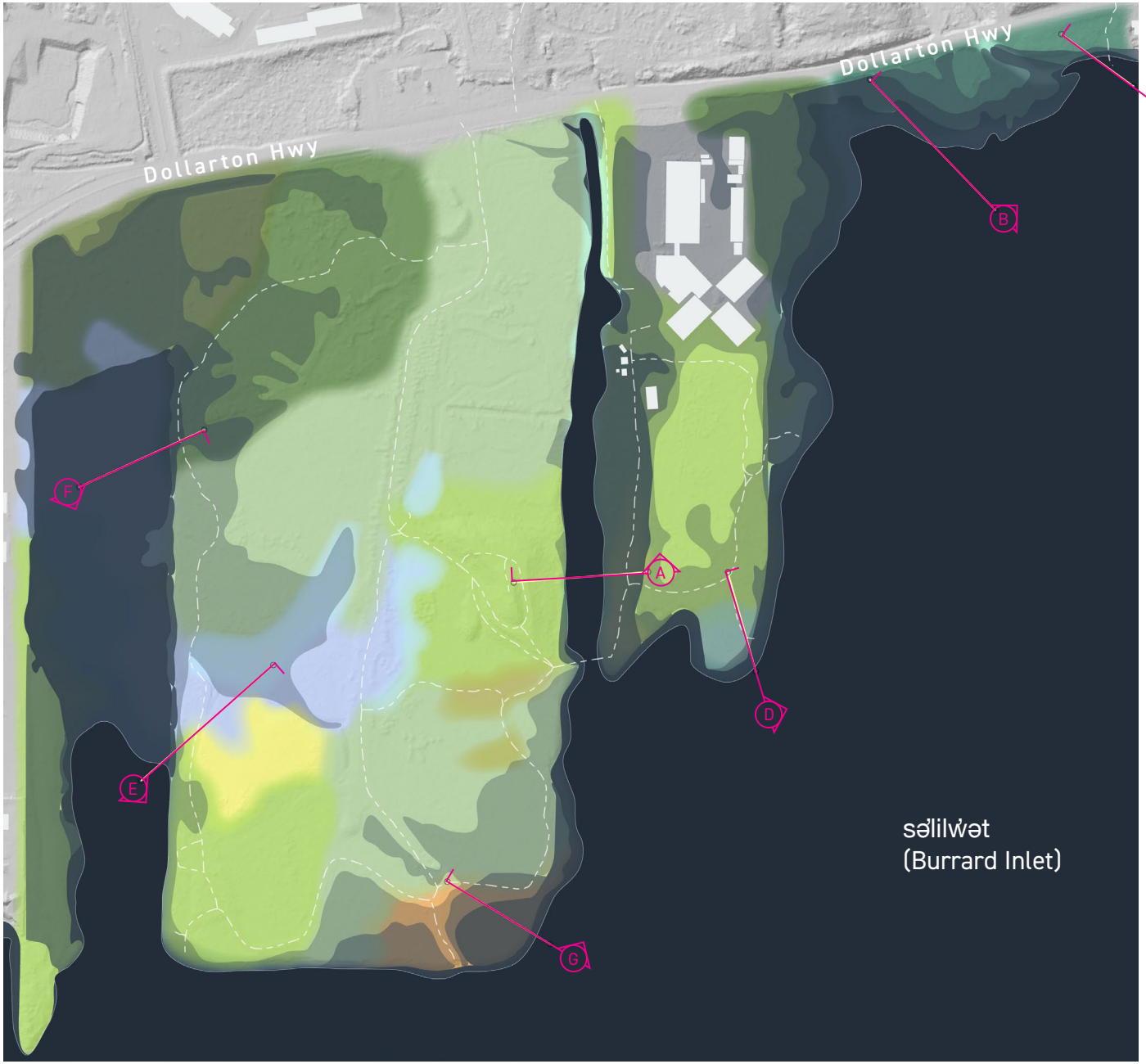


N

0 100 200 m

Observed Ecosystems: Sea Level Rise Overlay

- Transects
- Trails
- Buidlings
- Brackish Marsh
- Coastal Fringe
- Early Coastal Western Hemlock
- Early Cottonwood
- Fresh Water Pond
- Intermediate Coastal Western Hemlock
- Intermediate Cottonwood
- Intertidal
- Lower Estuarine
- Mature Cottonwood
- Meadow
- Mixed Forest
- Salt Marsh
- Upper Estuarine
- Wet Meadow
- Wetland Bush
- 2022 High Water Line
- 0.5m Inundation
- 1m Inundation
- 1.5m Inundation
- 2m Inundation



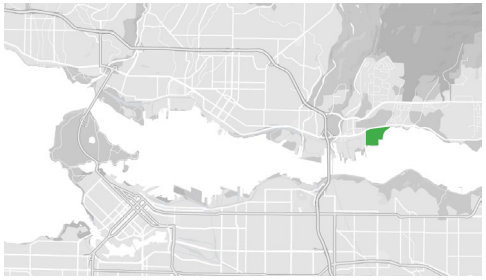
N

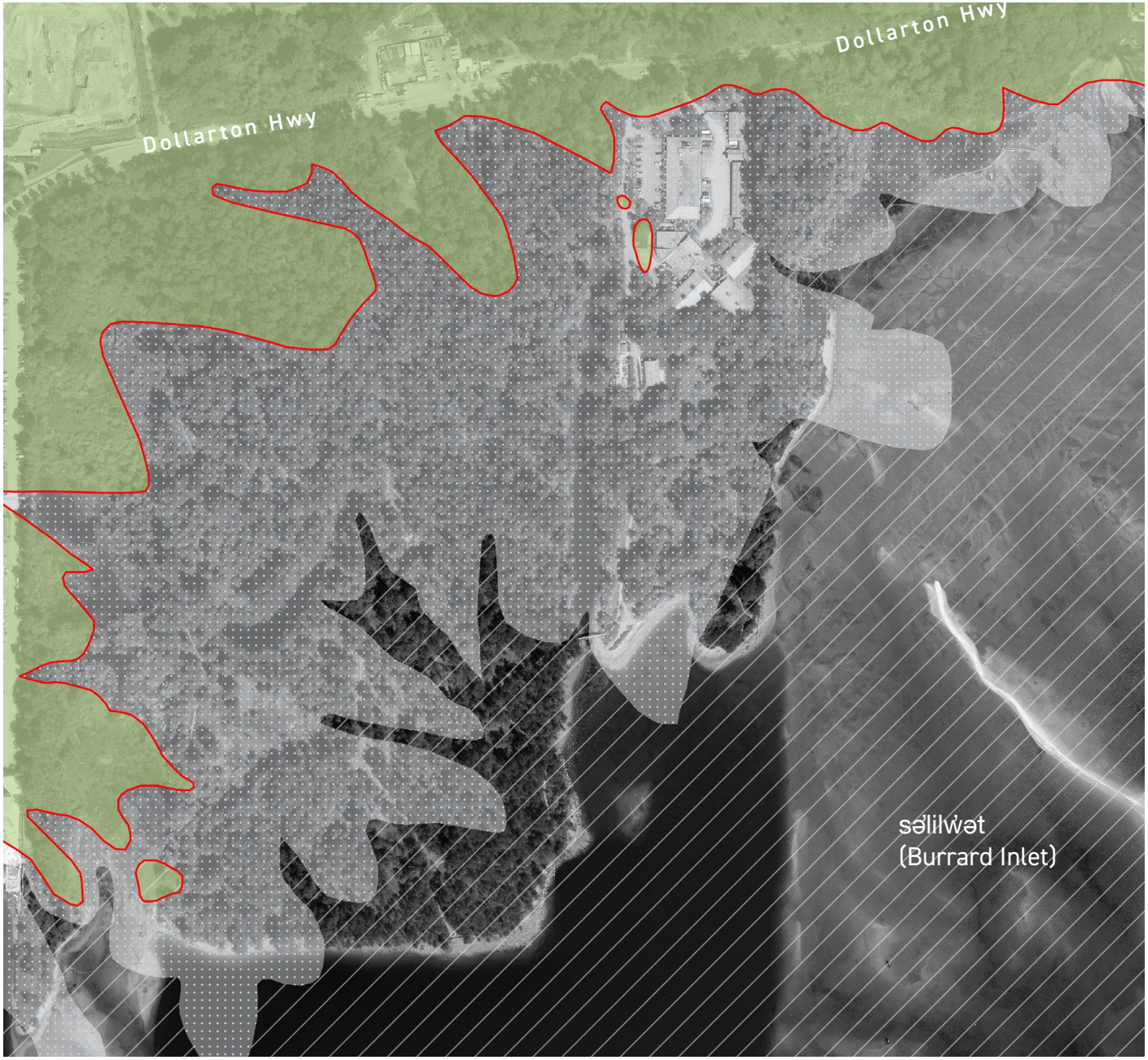
0 100 200 m

Historic Context Circa 1921

Maplewood Flats
Traditional səlilwətaɬ Territory

- Upland
- Marsh
- Intertidal
- Historic High Tide Line





N

0 100 200 m

Appendix C: Full Dataset

Credit: Sam Kohlmann

Appendix C

Transect	Point	Common Name	*Latin Name*	Notes
A	1	Buttercup	*Ranunculus spp.*	
A	1	English ivy	*Hedera helix*	
A	1	Himalayan blackberry	*Rubus armeniacus*	
A	1	Red alder	*Alnus rubra*	
A	1	Roberts Geranium	*Geranium robertianum*	
A	1	Roberts Geranium	*Geranium robertianum*	Shoots
A	1	St. John's Wort	*Hypericum perforatum*	
A	1	St. John's Wort	*Hypericum perforatum*	
A	2	Broad-leaved hellaborine	*Epipactis helleborine*	
A	2	Buttercup	*Ranunculus spp.*	
A	2	Himalayan blackberry	*Rubus armeniacus*	
A	2	Oregon grape	*Mahonia aquifolium*	
A	2	Snowberry	*Symphoricarpos alba*	
A	2	Western sword fern	*Polystichum munitum*	
A	2	Wild plum	*Oemleria cerasiformis*	
A	3	Buttercup	*Ranunculus spp.*	
A	3	European ash	*Fraxinus excelsior*	
A	3	Hardhack	*Spiraea Douglasii*	
A	3	Himalayan blackberry	*Rubus armeniacus*	
A	3	Orchard grass	*Dactylis glomerata*	
A	3	Thimbleberry	*Rubus parviflorus*	
A	4	Broad-leaved hellaborine	*Epipactis helleborine*	
A	4	European ash	*Fraxinus excelsior*	
A	4	Himalayan blackberry	*Rubus armeniacus*	
A	4	Western sword fern	*Polystichum munitum*	
A	4	Wild plum	*Oemleria cerasiformis*	
A	5	English oak	*Quercus robar*	
A	5	European ash	*Fraxinus excelsior*	
A	5	Himalayan blackberry	*Rubus armeniacus*	Fraxinus excels
A	5	Roberts Geranium	*Geranium robertianum*	
A	5	Wall lettuce	*Lactuca muralis*	
A	5	Wild plum	*Oemleria cerasiformis*	
A	6	Arborvitae	*Thuja spp.*	
A	6	Black cottonwood	*Populus trichocarpa*	
A	6	Black cottonwood	*Populus trichocarpa*	
A	6	Himalayan blackberry	*Rubus armeniacus*	
A	6	Western sword fern	*Polystichum munitum*	
A	6	Wild plum	*Oemleria cerasiformis*	
A	7	Black cottonwood	*Populus trichocarpa*	
A	7	Black cottonwood	*Populus trichocarpa*	
A	7	Cascara	*Frangula purshiana*	
A	7	Douglas fir	*Pseudotsuga menziesii*	
A	7	Himalayan blackberry	*Rubus armeniacus*	
A	7	Holly	*Ilex aquifolium*	Ilex aquifolium
A	7	Red alder	*Alnus rubra*	
A	7	Wild plum	*Oemleria cerasiformis*	

A	8	Arborvitae	*Thuja spp.*
A	8	Broad-leaved hellaborine	*Epipactis helleborine*
A	8	Douglas fir	*Pseudotsuga menziesii*
A	8	Himalayan blackberry	*Rubus armeniacus*
A	8	Western sword fern	*Polystichum munitum*
A	8	Wild plum	*Oemleria cerasiformis*
A	9	Elderberry	*Sambucus racemosa*
A	9	English ivy	*Hedera helix*
A	9	Himalayan blackberry	*Rubus armeniacus*
A	9	Horsetail	*Equisetum spp.*
A	9	Morning glory	*Convolvulus arvensis*
A	9	Red alder	*Alnus rubra*
A	9	Salmonberry	*Rubus parviflorus*
A	9	Western sword fern	*Polystichum munitum*
A	9	Wild plum	*Oemleria cerasiformis*
A	10	Barnacle	*Balanus spp.*
A	10	Blue mussel	*Mytilus spp.*
A	10	Reed canary	*Phalaris arundinacea*
A	10	Rock weed	*Fucus distichus*
A	10	Rock weed	*Fucus distichus*
A	10	Sea lettuce	*Ulva lactuca*
A	11	Buttercup	*Ranunculus spp.*
A	11	Cascara	*Frangula purshiana*
A	11	Clover	*Trifolium pratense*
A	11	European ash	*Fraxinus excelsior*
A	11	Hawthorn	*Crataegus spp.*
A	11	Himalayan blackberry	*Rubus armeniacus*
A	11	Mountain Ash	*Sorbus spp.*
A	11	Mountain Ash	*Sorbus spp.*
A	11	Mountain Ash	*Sorbus spp.*
A	11	Plantain	*Plantago spp.*
A	11	Sweet vernal grass	*Anthoxanthum odoratum*
A	11	Tansy	*Tanacetum vulgare*
A	11	Twinberry	*Lonicera involucrata*
A	11	Wild plum	*Oemleria cerasiformis*
A	12	Buttercup	*Ranunculus spp.*
A	12	Clover	*Trifolium pratense*
A	12	European ash	*Fraxinus excelsior*
A	12	Lupine	*Lupinus latifolius*
A	12	Orchard grass	*Dactylis glomerata*
A	12	Red oak	*Quercus rubra*
A	12	St. John's Wort	*Hypericum perforatum*
A	12	St. John's Wort	*Hypericum perforatum*
A	12	Sweet vernal grass	*Anthoxanthum odoratum*
A	12	Tansy	*Tanacetum vulgare*
A	12	Twinberry	*Lonicera involucrata*
A	12	Western sword fern	*Polystichum munitum*
A	13	Clover	*Trifolium pratense*
A	13	Lupine	*Lupinus latifolius*
A	13	Orchard grass	*Dactylis glomerata*
A	13	Plantain	*Plantago spp.*

A	13	St. John's Wort	*Hypericum perforatum*	
A	13	St. John's Wort	*Hypericum perforatum*	
A	13	Sweet vernal grass	*Anthoxanthum odoratum*	
A	13	Tansy	*Tanacetum vulgare*	
A	13	Thistle	*Cirsium spp.*	
A	14	Butter cup	*Ranunculus repens*	
A	14	Ocean spray	*Holodiscus discolor*	
A	14	Orchard grass	*Dactylis glomerata*	
A	14	Roberts Geranium	*Geranium robertianum*	
A	14	Tansy	*Tanacetum vulgare*	
A	15	Alder	*Alnus*	
A	15	Geranium	*Geranium spp.*	
A	15	Hawthorn	*Crataegus spp.*	
A	15	Hellebore	*Helleborus spp.*	
A	15	Himalayan blackberry	*Rubus armeniacus*	
A	15	Western sword fern	*Polystichum munitum*	
A	15	Wild plum	*Oemleria cerasiformis*	
A	16	Himalayan blackberry	*Rubus armeniacus*	
A	16	Red alder	*Alnus rubra*	
A	16	Wild plum	*Oemleria cerasiformis*	
B	0	English ivy	*Hedera helix*	
B	0	Salmonberry	*Rubus parviflorus*	
B	0	Trailing blackberry	*Rubus ursinus*	
B	0	Vine maple	*Acer circinatum*	
B	0	Western sword fern	*Polystichum munitum*	
B	0	Wild plum	*Oemleria cerasiformis*	
B	1	Big leaf maple	*Acer macrophyllum*	
B	1	English ivy	*Hedera helix*	
B	1	Salmonberry	*Rubus parviflorus*	
B	1	Trailing blackberry	*Rubus ursinus*	
B	1	Vine maple	*Acer circinatum*	
B	1	Western sword fern	*Polystichum munitum*	
B	1	Wild plum	*Oemleria cerasiformis*	
B	2	Bracken fern	*Pteridium aquilinum*	
B	2	Douglas fir	*Pseudotsuga menziesii*	Dbh 360cm
B	2	English ivy	*Hedera helix*	
B	2	Red huckleberry	*Vaccinium parvifolium*	
B	2	Salal	*Gaultheria shallon*	
B	2	Western sword fern	*Polystichum munitum*	
B	3	Bracken fern	*Pteridium aquilinum*	
B	3	English ivy	*Hedera helix*	
B	3	False lily of the valley	*Maianthemum dilatatum*	
B	3	Salal	*Gaultheria shallon*	
B	3	Western sword fern	*Polystichum munitum*	
B	4	English ivy	*Hedera helix*	
B	4	False lily of the valley	*Maianthemum dilatatum*	
B	4	Himalayan blackberry	*Rubus armeniacus*	
B	4	Red cedar	*Thuja plicata*	
B	4	Salal	*Gaultheria shallon*	
B	4	Western sword fern	*Polystichum munitum*	
B	5	Crab apple	*Malus fusca*	

B	5	English ivy	*Hedera helix*
B	5	False lily of the valley	*Maianthemum dilatatum*
B	5	Nootka Rose	*Rosa nutkana*
B	5	Sitka spruce	*Picea sitchensis*
B	5	Trailing blackberry	*Rubus ursinus*
B	5	Twinberry	*Lonicera involucrata*
B	5	Western sword fern	*Polystichum munitum*
B	6	Angelica	*Archangelica officinalis*
B	6	Bittersweet	*Solanum dulcamara*
B	6	Douglas aster	*Symphyotrichum subspicatum*
B	6	False lily of the valley	*Maianthemum dilatatum*
B	6	Lambs quarter	*Chenopodium album*
B	6	Nootka rose	*Rosa nutkana*
B	6	Pacific crabapple	*Malus fusca*
B	7	False lily of the valley	*Maianthemum dilatatum*
B	7	Nootka rose	*Rosa nutkana*
B	7	Pacific crabapple	*Malus fusca*
B	7	Twinberry	*Lonicera involucrata*
B	8	Baltic rush	*Juncus balticus*
B	8	Douglas aster	*Symphyotrichum subspicatum*
B	8	Lambs quarter	*Chenopodium album*
B	8	Manzanita	*Arctostaphylos spp.*
B	8	Sea asparagus	*Salicornia pacifica*
B	9	Manzanita	*Arctostaphylos spp.*
B	9	Sea asparagus	*Salicornia pacifica*
B	10	Lambs quarter	*Chenopodium album*
B	10	Manzanita	*Arctostaphylos spp.*
B	10	Sea asparagus	*Salicornia pacifica*
B	11	Lambs quarter	*Chenopodium album*
B	11	Lingby's sedge	*Carex lyngbyei*
B	11	Manzanita	*Arctostaphylos spp.*
B	11	Sea asparagus	*Salicornia pacifica*
B	11	Silverweed	*Argentina anserina*
B	12	Lambs quarter	*Chenopodium album*
B	12	Orach	*Atriplex hortensis*
B	12	Reed canary grass?	*Phalaris arundinacea*
B	12	Sea asparagus	*Salicornia pacifica*
B	12	Sedge	*Carex spp.*
B	13	Douglas aster	*Symphyotrichum subspicatum*
B	13	Lamb's quarter	*Chenopodium album*
B	13	Sedge	*Carex spp.*
B	14	Douglas aster	*Symphyotrichum subspicatum*
B	14	Lambs quarter	*Chenopodium album*
B	14	Sedge	*Carex spp.*
B	15	Douglas aster	*Symphyotrichum subspicatum*
B	15	Lambs quarter	*Chenopodium album*
B	15	Sedge	*Carex spp.*
B	16	Gum weed	*Grindelia squarrosa*
B	16	Lambs quarter	*Chenopodium album*
B	16	Sedge	*Carex spp.*
B	17	Canadian sand spurry	*Spergularia canadensis*

B	17	Gum weed	*Grindelia squarrosa*
B	17	Lambs quarter	*Chenopodium album*
B	17	Sea asparagus	*Salicornia pacifica*
B	17	Sedge	*Carex spp.*
B	18	Gum weed	*Grindelia squarrosa*
B	18	Lambs quarter	*Chenopodium album*
B	18	Sea asparagus	*Salicornia pacifica*
B	18	Sedge	*Carex spp.*
B	19	Gum weed	*Grindelia squarrosa*
B	19	Lambs quarter	*Chenopodium album*
B	19	Sedge	*Carex spp.*
B	20	Gum weed	*Grindelia squarrosa*
B	20	Lambs quarter	*Chenopodium album*
B	20	Sedge	*Carex spp.*
B	21	Sedge	*Carex spp.*
B	22	Canadian sand spurry	*Spergularia canadensis*
B	22	Gum weed	*Grindelia squarrosa*
B	22	Lambs quarter	*Chenopodium album*
B	22	Sea asparagus	*Salicornia pacifica*
B	22	Sedge	*Carex spp.*
B	23	Canadian sand spurry	*Spergularia canadensis*
B	23	Sea asparagus	*Salicornia pacifica*
B	23	Sea Loosestrife	*Lysimacia maritimia*
B	25	Sea asparagus	*Salicornia pacifica*
C	0	English ivy	*Hedera helix*
C	0	Holly	*Ilex aquifolium*
C	0	Snowberry	*Symphoricarpos alba*
C	0	Trailing blackberry	*Rubus ursinus*
C	0	Western red cedar	*Thuja plicata*
C	0	Western sword fern	*Polystichum munitum*
C	0	Wild plum	*Oemleria cerasiformis*
C	1	Big leaf maple	*Acer macrophyllum*
C	1	Elderberry	*Sambucus racemosa*
C	1	English ivy	*Hedera helix*
C	1	Hemlock	*Tsuga heterophylla*
C	1	Horsetail	*Equisetum spp.*
C	1	Nootka Rose	*Rosa nutkana*
C	1	Salmonberry	*Rubus parviflorus*
C	1	Tellima	*Tellima grandiflora*
C	1	Trailing blackberry	*Rubus ursinus*
C	1	Wild plum	*Oemleria cerasiformis*
C	2	English ivy	*Hedera helix*
C	2	Himalayan blackberry	*Rubus armeniacus*
C	2	Red alder	*Alnus rubra*
C	2	Salmonberry	*Rubus parviflorus*
C	2	Wild plum	*Oemleria cerasiformis*
C	3	Crab apple	*Malus fusca*
C	3	Himalayan blackberry	*Rubus armeniacus*
C	3	Horsetail	*Equisetum spp.*
C	3	Purple nightshade	*Solanum dulcamara*
C	3	Twinberry	*Lonicera involucrata*

C	4	Baltic rush	*Juncus balticus*
C	4	Himalayan blackberry	*Rubus armeniacus*
C	4	Horsetail	*Equisetum spp.*
C	4	Silverweed	*Argentina anserina*
C	4	Typha latifolia	*Broadleaf Cattail*
C	5	Baltic rush	*Juncus balticus*
C	5	Buttercup	*Ranunculus spp.*
C	5	Morning glory	*Convolvulus arvensis*
C	5	Reed canary grass	*Phalaris spp.*
C	5	Silverweed	*Argentina anserina*
C	5	Thistle	*Cirsium spp.*
C	6	Baltic rush	*Juncus balticus*
C	6	Sea-milkwort	*Lysimacia martitima*
C	6	Silverweed	*Argentina anserina*
C	7	Sea-milkwort	*Lysimacia martitima*
C	7	Silverweed	*Argentina anserina*
C	8	Sea-milkwort	*Lysimacia martitima*
C-W	1	Baltic rush	*Juncus balticus*
C-W	1	Buttercup	*Ranunculus spp.*
C-W	1	Clover	*Trifolium pratense*
C-W	1	Douglas aster	*Symphyotrichum subspicatum*
C-W	1	Plantain	*Plantago spp.*
C-W	1	Reed canary grass	*Phalaris arundinacea*
C-W	1	Silverweed	*Argentina anserina*
C-W	1	Thistle?	*Cirsium spp.*
C-W	1	Twinberry	*Lonicera involucrata*
D	0	Creeping Buttercup	*Ranunculus repens*
D	0	Hardhack	*Spiraea Douglasii*
D	0	English ivy	*Hedera helix*
D	0	Globe buttercup	*Trollius europaeus*
D	0	Grass	*Poaceae spp.*
D	0	Hawthorn	*Crataegus spp.*
D	0	Himalayan blackberry	*Rubus armeniacus*
D	0	Long leaf hellebore	*Helleborus spp.*
D	0	Mountain Ash	*Sorbus spp.*
D	0	Pacific crabapple	*Malus fusca*
D	0	Roberts Geranium	*Geranium robertianum*
D	0	Salmonberry	*Rubus parviflorus*
D	0	Western buttercup	*Ranunculus occidentalis*
D	0	Wild plum	*Oemleria cerasiformis*
D	1	Creeping Buttercup	*Ranunculus repens*
D	1	Hardhack	*Spiraea Douglasii*
D	1	English ivy	*Hedera helix*
D	1	Globe buttercup	*Trollius europaeus*
D	1	Grass	*Poaceae spp.*
D	1	Hawthorn	*Crataegus spp.*
D	1	Himalayan blackberry	*Rubus armeniacus*
D	1	Long leaf hellabore	*Helleborus spp.*
D	1	Mountain Ash	*Sorbus spp.*
D	1	Pacific crabapple	*Malus fusca*
D	1	Roberts Geranium	*Geranium robertianum*

D	1	Salmonberry	*Rubus parviflorus*
D	1	Western buttercup	*Ranunculus occidentalis*
D	1	Wild plum	*Oemleria cerasiformis*
D	2	Creeping Buttercup	*Ranunculus repens*
D	2	Creeping Buttercup	*Ranunculus repens*
D	2	Hardhack	*Spiraea Douglasii*
D	2	English ivy	*Hedera helix*
D	2	Grass	*Poaceae spp.*
D	2	Himalayan blackberry	*Rubus armeniacus*
D	2	Long leaf hellabore	*Helleborus spp.*
D	2	Pacific crabapple	*Malus fusca*
D	2	Roberts Geranium	*Geranium robertianum*
D	2	Western buttercup	*Ranunculus occidentalis*
D	2	Wild plum	*Oemleria cerasiformis*
D	3	Buttercup	*Ranunculus spp.*
D	3	Dock	*Rumex spp.*
D	3	Grass	*Poaceae spp.*
D	3	Hathfinder	*Hypochaeris radicata*
D	3	Hawthorn	*Crataegus spp.*
D	3	Himalayan blackberry	*Rubus armeniacus*
D	3	Roberts Geranium	*Geranium robertianum*
D	3	Roberts Geranium	*Geranium robertianum*
D	3	Wild plum	*Oemleria cerasiformis*
D	4	Black cottonwood	*Populus trichocarpa*
D	4	Black cottonwood	*Populus trichocarpa*
D	4	Buttercup	*Ranunculus spp.*
D	4	Dandelion	*Taraxacum officinale*
D	4	Domestic Cherry	*Prunus avium*
D	4	Domestic Cherry	*Prunus avium*
D	4	Himalayan blackberry	*Rubus armeniacus*
D	4	Wild plum	*Oemleria cerasiformis*
D	5	Buttercup	*Ranunculus spp.*
D	5	Camas	*Camassia quamash*
D	5	Clover	*Trifolium pratense*
D	5	Crab apple	*Malus fusca*
D	5	Hardhack	*Spiraea Douglasii*
D	5	Grass	*Poaceae spp.*
D	5	Hawthorn	*Crataegus spp.*
D	5	Himalayan blackberry	*Rubus armeniacus*
D	5	Plantain	*Plantago spp.*
D	6	Black cottonwood	*Populus trichocarpa*
D	6	Black cottonwood	*Populus trichocarpa*
D	6	Buttercup	*Ranunculus spp.*
D	6	Grass	*Poaceae spp.*
D	6	Hawthorn	*Crataegus spp.*
D	6	Himalayan blackberry	*Rubus armeniacus*
D	6	Meticagao	
D	6	Plantain	*Plantago spp.*
D	6	Sweet pea	*Lathyrus odoratus*
D	7	Buttercup	*Ranunculus spp.*
D	7	Clover	*Trifolium pratense*

D	7	Cow parsnip	*Heracleum maximum*
D	7	Grass	*Poaceae spp.*
D	7	Hawthorn	*Crataegus spp.*
D	7	Himalayan blackberry	*Rubus armeniacus*
D	7	Horsetail	*Equisetum spp.*
D	7	Medicago	*Medicago lupulina*
D	7	Meticagao	
D	7	Plantain	*Plantago spp.*
D	7	Sweet pea	*Lathyrus odoratus*
D	7	Thistle	*Cirsium spp.*
D	8	Buttercup	*Ranunculus spp.*
D	8	Cow parsnip	*Heracleum maximum*
D	8	Grass	*Poaceae spp.*
D	8	Hawthorn	*Crataegus spp.*
D	8	Horsetail	*Equisetum spp.*
D	8	Medicago	*Medicago lupulina*
D	8	Meticagao	
D	8	Red osier dogwood	*Cornus sericea*
D	8	Sweet pea	*Lathyrus odoratus*
D	9	Clover	*Trifolium pratense*
D	9	Cow parsnip	*Heracleum maximum*
D	9	Grass	*Poaceae spp.*
D	9	Himalayan blackberry	*Rubus armeniacus*
D	9	Sweet pea	*Lathyrus odoratus*
D	9	Vetch	*Vicia cracca*
D	10	Buttercup	*Ranunculus spp.*
D	10	Clover	*Trifolium pratense*
D	10	Cow parsnip	*Heracleum maximum*
D	10	Dandelion	*Taraxacum officinale*
D	10	Himalayan blackberry	*Rubus armeniacus*
D	10	Orchard grass	*Dactylis glomerata*
D	10	Pacific crabapple	*Malus fusca*
D	10	Plantain	*Plantago spp.*
D	11	Ashphalt	*Ashphalt*
D	11	Barnacles	*Balanus spp.*
D	11	Gravel	*Gravel*
D	11	Pacific crabapple	*Malus fusca*
D	12	Barnacles	*Balanus spp.*
D	12	Barnacles	*Balanus spp.*
D	12	Gravel	*Gravel*
D	12	Sand	*Sand*
E	0	Giant bull rush	*Schoenoplectus californicus*
E	0	Rumex	*Persicaria amphibia*
E	1	Cattail	*Typha spp.*
E	1	Flat leaf sedge?	*Carex spp.*
E	1	Giant bull rush	*Schoenoplectus californicus*
E	1	Myrica gale	*Sweet Gale*
E	1	Pacific willow	*Salix lucida*
E	1	Rumex	*Persicaria amphibia*
E	1	Scouler's willow	*Salix scouleriana*
E	2	Black Cottonwood	*Populus trichocarpa*

E	2	Hardhack	*Spiraea Douglasii*
E	2	Himalayan blackberry	*Rubus armeniacus*
E	2	Horsetail	*Equisetum spp.*
E	2	Pacific willow	*Salix lucida*
E	2	Scouler's willow	*Salix scouleriana*
E	3	Buttercup	*Ranunculus spp.*
E	3	Cottonwood	*Populus trichocarpa*
E	3	Crab apple	*Malus fusca*
E	3	Hardhack	*Spiraea Douglasii*
E	3	Himalayan blackberry	*Rubus armeniacus*
E	3	Pacific willow	*Salix lucida*
E	3	Physocarpus	*Ninebark*
E	3	Rush	*Juncus spp.*
E	4	Buttercup	*Ranunculus spp.*
E	4	Grass	
E	4	Himalayan blackberry	*Rubus armeniacus*
E	4	Horsetail	*Equisetum spp.*
E	4	Common Rush	*Juncus effusus*
E	4	Scouler's willow	*Salix scouleriana*
E	5	Alnus rubra	*Red Alder*
E	5	Buttercup	*Ranunculus spp.*
E	5	Clematis?	*Physocarpus spp.*
E	5	Hardhack	*Spiraea Douglasii*
E	5	Grass	*Poaceae spp.*
E	5	Common Rush	*Juncus effusus*
E	5	Tule	*Schoenoplectus acutus*
E	6	Buttercup	*Ranunculus spp.*
E	6	Hardhack	*Spiraea Douglasii*
E	6	Grass	*Poaceae spp.*
E	6	High bush cranberry	*Viburnum trilobum*
E	6	Himalayan blackberry	*Rubus armeniacus*
E	6	Horsetail	*Equisetum spp.*
E	6	Common Rush	*Juncus effusus*
E	6	Vetch	*Vicia cracca*
E	6	White poplar	*Populus alba*
E	7	Buttercup	*Ranunculus spp.*
E	7	Hardhack	*Spiraea Douglasii*
E	7	Grass	*Poaceae spp.*
E	7	High bush cranberry	*Viburnum trilobum*
E	7	Himalayan blackberry	*Rubus armeniacus*
E	7	Horsetail	*Equisetum spp.*
E	7	Common Rush	*Juncus effusus*
E	7	Vetch	*Vicia cracca*
E	7	White poplar	*Populus alba*
E	8	Buttercup	*Ranunculus spp.*
E	8	Hardhack	*Spiraea Douglasii*
E	8	Grass	*Poaceae spp.*
E	8	Hawthorn	*Crataegus spp.*
E	8	High bush cranberry	*Viburnum trilobum*
E	8	Himalayan blackberry	*Rubus armeniacus*
E	8	Horsetail	*Equisetum spp.*

E	8	Common Rush	*Juncus effusus*	
E	8	Rush	*Juncus spp.*	
E	8	Twinberry	*Lonicera involucrata*	
E	8	Vetch	*Vicia cracca*	
E	8	White poplar	*Populus alba*	
E	9	Black cottonwood	*Populus trichocarpa*	
E	9	Buttercup	*Ranunculus spp.*	
E	9	Grass	*Poaceae spp.*	
E	9	Hawthorn	*Crataegus spp.*	
E	9	High bush cranberry	*Viburnum trilobum*	
E	9	Himalayan blackberry	*Rubus armeniacus*	
E	9	Horsetail	*Equisetum spp.*	
E	9	Salmonberry	*Rubus spectabilis*	
E	9	Vetch	*Vicia cracca*	
E	10	Alnus rubra	*Red Alder*	
E	10	Buttercup	*Ranunculus spp.*	
E	10	Cherry?	*Populus trichocarpa*	
E	10	Hardhack	*Spiraea Douglasii*	
E	10	Grass	*Poaceae spp.*	
E	10	Hawthorn	*Crataegus spp.*	
E	10	Himalayan blackberry	*Rubus armeniacus*	
E	10	Horsetail	*Equisetum spp.*	
E	11	Alnus rubra	*Red Alder*	
E	11	Himalayan blackberry	*Rubus armeniacus*	
E	12	Alnus rubra	*Red Alder*	
E	12	Himalayan blackberry	*Rubus armeniacus*	
E	13	English oak	*Quercus robar*	
E	13	Pacific crabapple	*Malus fusca*	
E	13	Salmonberry	*Rubus parviflorus*	Triple 13 distar
E	13	Twinberry	*Lonicera involucrata*	
E	14	Angelica	*Archangelica officinalis*	
E	14	Cherry	*Prunus spp.*	
E	14	Douglas aster	*Symphyotrichum subspicatum*	
E	14	Arctic Rush	*Juncus arcticus*	
E	14	Lambs quarter	*Chenopodium album*	
E	14	Mountain Ash	*Sorbus spp.*	
E	14	Mountain Ash	*Sorbus spp.*	
E	14	Mountain Ash	*Sorbus spp.*	
E	14	Silverweed	*Argentina anserina*	
E	14	Twinberry	*Lonicera involucrata*	
E	14	Yarrow	*Achillea millefolium*	
E	15	Angelica	*Archangelica officinalis*	
E	15	Grass	*Poaceae spp.*	
E	15	Arctic Rush	*Juncus arcticus*	
E	15	Lambs quarter	*Chenopodium album*	
E	15	Thistle	*Cirsium spp.*	
E	15	Yarrow	*Achillea millefolium*	
E	16	Douglas aster	*Symphyotrichum subspicatum*	
E	16	Grass	*Poaceae spp.*	
E	16	Arctic Rush	*Juncus arcticus*	
E	16	Lambs quarter	*Chenopodium album*	

E	16	Pacific Crabapple	*Malus fusca*
E	17	Douglas aster	*Symphyotrichum subspicatum*
E	17	Grass	*Poaceae spp.*
E	17	Arctic Rush	*Juncus arcticus*
E	17	Lambs quarter	*Chenopodium album*
E	17	Pacific Crabapple	*Malus fusca*
E	17	Rush	*Juncus spp.*
E	17	Yarrow	*Achillea millefolium*
E	18	Drummond's Rush	*Juncus drumondii*
E	18	Lambs quarter	*Chenopodium album*
E	18	Pacific crabapple	*Malus fusca*
E	18	Sea asparagus	*Salicornia pacifica*
E	18	Sedge	*Carex spp.*
E	19	Drummond's rush	*Juncus drummondii*
E	19	Gum weed	*Grindelia squarrosa*
E	19	Arctic Rush	*Juncus arcticus*
E	19	Lambs quarter	*Chenopodium album*
E	19	Sea asparagus	*Salicornia pacifica*
E	20	Dodders	*Cuscuta spp.*
E	20	Grass	*Poaceae spp.*
E	20	Lambs quarter	*Chenopodium album*
E	20	Sea asparagus	*Salicornia pacifica*
E	20	Sedge	*Carex spp.*
F	0	Black cottonwood	*Populus trichocarpa*
F	0	Black cottonwood	*Populus trichocarpa*
F	0	Hardhack	*Spiraea Douglasii*
F	0	English ivy	*Hedera helix*
F	0	Himalayan blackberry	*Rubus armeniacus*
F	0	Nightshade	
F	0	Red alder	*Alnus rubra*
F	0	Salmonberry	*Rubus parviflorus*
F	1	Hardhack	*Spiraea Douglasii*
F	1	English ivy	*Hedera helix*
F	1	Himalayan blackberry	*Rubus armeniacus*
F	1	Red alder	*Alnus rubra*
F	1	Salmonberry	*Rubus parviflorus*
F	2	Domestic Cherry	*Prunus avium*
F	2	Domestic Cherry	*Prunus avium*
F	2	Hardhack	*Spiraea Douglasii*
F	2	English ivy	*Hedera helix*
F	2	Grass	*Poaceae spp.*
F	2	Himalayan blackberry	*Rubus armeniacus*
F	3	Domestic Cherry	*Prunus avium*
F	3	Domestic Cherry	*Prunus avium*
F	3	English ivy	*Hedera helix*
F	3	Himalayan blackberry	*Rubus armeniacus*
F	3	Reed canary grass	*Phalaris arundinacea*
F	3	Twinberry	*Lonicera involucrata*
F	4	Domestic Cherry	*Prunus avium*
F	4	Domestic Cherry	*Prunus avium*
F	4	English ivy	*Hedera helix*

F	4	Himalayan blackberry	*Rubus armeniacus*	
F	4	Morning glory	*Convolvulus arvensis*	
F	4	Reed canary grass	*Phalaris arundinacea*	
F	4	Wild plum	*Oemleria cerasiformis*	
F	5	Domestic Cherry	*Prunus avium*	
F	5	Domestic Cherry	*Prunus avium*	
F	5	English ivy	*Hedera helix*	
F	5	Himalayan blackberry	*Rubus armeniacus*	
F	5	Phlox	*Phlox spp.*	
F	5	Reed canary grass	*Phalaris arundinacea*	
F	5	Roberts Geranium	*Geranium robertianum*	
F	5	Roberts Geranium	*Geranium robertianum*	
F	5	Wall lettuce	*Lactuca muralis*	
F	5	Western sword fern	*Polystichum munitum*	
F	5	Wild plum	*Oemleria cerasiformis*	
F	6	Cottonwood	*Populus trichocarpa*	
F	6	Hardhack	*Spiraea Douglasii*	50 m south
F	6	English ivy	*Hedera helix*	
F	6	Pacific Crabapple	*Malus fusca*	
F	6	Nootka Rose	*Rosa nutkana*	
F	6	Twinberry	*Lonicera involucrata*	
F	7	Hardhack	*Spiraea Douglasii*	
F	7	English ivy	*Hedera helix*	
F	7	Pacific Crabapple	*Malus fusca*	
F	7	Nootka Rose	*Rosa nutkana*	
F	7	Twinberry	*Lonicera involucrata*	
F	8	English ivy	*Hedera helix*	
F	8	Pacific Crabapple	*Malus fusca*	
F	8	Nootka Rose	*Rosa nutkana*	
F	8	Salmonberry	*Rubus spectabilis*	
F	8	Trailing blackberry	*Rubus ursinus*	
F	9	English ivy	*Hedera helix*	
F	9	Grass	*Poaceae spp.*	
F	9	Licorice fern	*Polypodium glycyrrhiza*	On apple
F	9	Pacific Crabapple	*Malus fusca*	
F	9	Nightshade		
F	9	Trailing blackberry	*Rubus ursinus*	
F	9	Twinberry	*Lonicera involucrata*	
F	9	Water parsley	*Oenanthe sarmentosa*	
F	10	English ivy	*Hedera helix*	
F	10	Lady fern	*Athyrium filix-femina*	
F	10	Pacific Crabapple	*Malus fusca*	
F	10	Salmonberry	*Rubus parviflorus*	
F	10	Twinberry	*Lonicera involucrata*	
F	10	Water parsley	*Oenanthe sarmentosa*	
F	10	Yellow flag iris	*Iris pseudacorus*	
F	10	Yellow flag iris	*Iris pseudacorus*	
F	11	Pacific Crabapple	*Malus fusca*	
F	11	Twinberry	*Lonicera involucrata*	
F	11	Yellow flag iris	*Iris pseudacorus*	
F	11	Yellow flag iris	*Iris pseudacorus*	

F	12	English ivy	*Hedera helix*	
F	12	Lady fern	*Athyrium filix-femina*	
F	12	Pacific Crabapple	*Malus fusca*	
F	12	Nightshade		
F	12	Nootka Rose	*Rosa nutkana*	
F	12	Salmonberry	*Rubus parviflorus*	
F	12	Yellow flag iris	*Iris pseudacorus*	
F	12	Yellow flag iris	*Iris pseudacorus*	
F	13	Creeping Buttercup	*Ranunculus repens*	
F	13	English ivy	*Hedera helix*	
F	13	Grass	*Poaceae spp.*	
F	13	Lady fern	*Athyrium filix-femina*	
F	13	Pacific Crabapple	*Malus fusca*	
F	13	Nightshade		
F	13	Nootka Rose	*Rosa nutkana*	
F	13	Salmonberry	*Rubus parviflorus*	
F	13	Water celery	*Oenanthe javanica*	
F	13	Yellow flag iris	*Iris pseudacorus*	
F	13	Yellow flag iris	*Iris pseudacorus*	
F	14	Slough Sedge	*Carax obnupta*	
F	14	English oak	*Quercus robar*	
F	14	Red huckleberry	*Vaccinium parvifolium*	
F	14	Nootka Rose	*Rosa nutkana*	
F	14	Twinberry	*Lonicera involucrata*	
F	15	Slough Sedge	*Carax obnupta*	
F	15	Cleaver	*Galium aparine*	
F	15	Licorice fern	*Polypodium glycyrrhiza*	On apple tree
F	15	Pacific Crabapple	*Malus fusca*	
F	15	Nootka Rose	*Rosa nutkana*	
F	15	Twinberry	*Lonicera involucrata*	
F	15	Water celery	*Oenanthe javanica*	
F	15	Yellow flag iris	*Iris pseudacorus*	
F	16	Grass	*Poaceae spp.*	
F	16	Pacific Crabapple	*Malus fusca*	
F	16	Twinberry	*Lonicera involucrata*	
F	16	Water celery	*Oenanthe javanica*	
F	16	Yellow flag iris	*Iris pseudacorus*	
F	17	Slough Sedge	*Carax obnupta*	
F	17	Pacific Crabapple	*Malus fusca*	
F	17	Nightshade		
F	17	Twinberry	*Lonicera involucrata*	
F	17	Water celery	*Oenanthe javanica*	
F	17	Yellow flag iris	*Iris pseudacorus*	
F	18	Slough Sedge	*Carax obnupta*	
F	18	Hardhack	*Spiraea Douglasii*	
F	18	Pacific Crabapple	*Malus fusca*	
F	18	Sitka spruce	*Picea sitchensis*	
F	18	Water celery	*Oenanthe javanica*	
F	19	Slough Sedge	*Carax obnupta*	
F	19	Hardhack	*Spiraea Douglasii*	
F	19	Pacific Crabapple	*Malus fusca*	

F	19	Sitka spruce	*Picea sitchensis*	
F	19	Water celery	*Oenanthe javanica*	
F	20	Slough Sedge	*Carax obnupta*	
F	20	Hardhack	*Spiraea Douglasii*	
F	20	Pacific Crabapple	*Malus fusca*	On mound
F	20	Red huckleberry	*Vaccinium parvifolium*	On mound
F	20	Salal	*Gaultheria shallon*	
F	20	Sitka spruce	*Picea sitchensis*	
F	20	Water celery	*Oenanthe javanica*	
F	20	Yellow cedar	*Callitropsis nootkatensis*	
F	20	Yellow flag iris	*Iris pseudacorus*	
G	0	Barnacles	*Balanus spp.*	
G	0	Barnacles	*Balanus spp.*	
G	0	Sea lettuce	*Ulva lactuca*	
G	0	Sea lettuce	*Ulva lactuca*	
G	0	Shore crabs	*Carcinus spp.*	
G	0	Sugar kelp	*Laminaria saccharina*	
G	1	Barnacles	*Balanus spp.*	
G	1	Rock weed	*Fucus distichus*	
G	1	Sea lettuce	*Ulva lactuca*	
G	1	Shore crabs	*Carcinus spp.*	
G	2	Barnacles	*Balanus spp.*	
G	2	Rock weed	*Fucus distichus*	
G	3	Barnacle	*Balanus spp.*	
G	4	Sea plantain	*Plantago maritima*	
G	5	Dock	*Rumex spp.*	
G	5	Hardhack	*Spiraea Douglasii*	
G	5	Fringe buttercup	*Ranunculus repens*	
G	5	Himalayan blackberry	*Rubus armeniacus*	
G	5	Pacific Crabapple	*Malus fusca*	
G	5	Snowberry	*Symphoricarpos alba*	
G	5	St. John's Wort	*Hypericum perforatum*	
G	5	St. John's Wort	*Hypericum perforatum*	
G	5	Tansy	*Tanacetum vulgare*	
G	6	English hawthorn	*Crataegus monogyna*	
G	6	English ivy	*Hedera helix*	
G	6	Himalayan blackberry	*Rubus armeniacus*	
G	6	Common Rush	*Juncus Effusus*	
G	6	Pacific ninebark	*Physocarpus capitatus*	
G	6	St. John's Wort	*Hypericum perforatum*	
G	6	St. John's Wort	*Hypericum perforatum*	
G	6	Vetch	*Vicia cracca*	
G	7	Creeping Buttercup	*Ranunculus repens*	
G	7	English hawthorn	*Crataegus monogyna*	
G	7	Goldenrod	*Solidago canadensis*	
G	7	Grass	*Poaceae spp.*	
G	7	Himalayan blackberry	*Rubus armeniacus*	
G	7	Horsetail	*Equisetum spp.*	
G	7	Pacific ninebark	*Physocarpus capitatus*	
G	7	Vetch	*Vicia cracca*	
G	8	Black cottonwood	*Populus trichocarpa*	

G	8	Creeping Buttercup	*Ranunculus repens*
G	8	Hardhack	*Spiraea Douglasii*
G	8	Grass	*Poaceae spp.*
G	8	Hawthorn	*Crataegus spp.*
G	8	Himalayan blackberry	*Rubus armeniacus*
G	8	Mountain Ash	*Sorbus spp.*
G	8	Red alder	*Alnus rubra*
G	8	Shining Willow	*Salix lucida*
G	8	St. John's Wort	*Hypericum perforatum*
G	8	Twinberry	*Lonicera involucrata*
G	8	Vetch	*Vicia cracca*
G	9	Creeping Buttercup	*Ranunculus repens*
G	9	Domestic apple	*Malus domestica*
G	9	Grass	*Poaceae spp.*
G	9	Highbush cranberry	*Viburnum trilobum*
G	9	Hornemann's willow herb	*Epilobium hornemannii*
G	9	Horsetail	*Equisetum spp.*
G	9	Common Rush	*Juncus effusus*
G	9	Rush	*Juncus spp.*
G	9	Shining Willow	*Salix lucida*
G	10	Buttercup	*Ranunculus spp.*
G	10	Grass	*Poaceae spp.*
G	10	Hawthorn	*Crataegus spp.*
G	10	Highbush cranberry	*Viburnum trilobum*
G	10	Himalayan blackberry	*Rubus armeniacus*
G	10	Horsetail	*Equisetum spp.*
G	10	Mountain Ash	*Sorbus spp.*
G	10	Red osier dogwood	*Cornus sericea*
G	10	Shining Willow	*Salix lucida*
G	10	St. John's Wort	*Hypericum perforatum*
G	10	Twinberry	*Lonicera involucrata*
G	10	Willow herb	*Epilobium spp.*
G	11	Cottonwood	*Populus trichocarpa*
G	11	Creeping Buttercup	*Ranunculus repens*
G	11	Grass	*Poaceae spp.*
G	11	Hawthorn	*Crataegus spp.*
G	11	Himalayan blackberry	*Rubus armeniacus*
G	11	Hollyberry Cotoneaster	*Cotoneaster bullatus*
G	11	Common Rush	*Juncus effusus*
G	11	Spruce	*Picea spp.*
G	12	Cottonwood	*Populus trichocarpa*
G	12	Creeping Buttercup	*Ranunculus repens*
G	12	Grass	*Poaceae spp.*
G	12	Hawthorn	*Crataegus spp.*
G	12	Highbush cranberry	*Viburnum trilobum*
G	12	Himalayan blackberry	*Rubus armeniacus*
G	12	Hollyberry Cotoneaster	*Cotoneaster bullatus*
G	12	Common Rush	*Juncus effusus*
G	12	Red osier dogwood	*Cornus sericea*
G	12	Vetch	*Vicia cracca*
G	13	Canada lettuce	*Lactuca canadensis*

G	13	Catone aster	*Cotoneaster bullatus*	
G	13	English ivy	*Hedera helix*	
G	13	Grass	*Poaceae spp.*	
G	13	Hawthorn	*Crataegus spp.*	
G	13	Highbush cranberry	*Viburnum trilobum*	
G	13	Baltic Rush	*Juncus balticus*	
G	13	Canadian Plum	*Prunus nigra*	
G	13	Shining Willow	*Salix lucida*	
G	13	Vetch	*Vicia cracca*	
G	13	Willow herb	*Epilobium spp.*	
G	14	Black cottonwood	*Populus trichocarpa*	
G	14	Canada lettuce	*Lactuca canadensis*	
G	14	Red Osier Dogwood	*Cornus sericia*	
G	14	English ivy	*Hedera helix*	
G	14	Himalayan blackberry	*Rubus armeniacus*	
G	14	Baltic Rush	*Juncus balticus*	
G	14	Shining Willow	*Salix lucida*	
G	14	Vetch	*Vicia cracca*	
G	14	Wall lettuce	*Lactuca muralis*	
G	15	Creeping Buttercup	*Ranunculus repens*	
G	15	Domestic apple	*Malus domestica*	
G	15	English ivy	*Hedera helix*	
G	15	Hawthorn	*Crataegus spp.*	
G	15	Highbush cranberry	*Viburnum trilobum*	
G	15	Himalayan blackberry	*Rubus armeniacus*	?
G	15	Rush	*Juncus spp.*	
G	15	Twinberry	*Lonicera involucrata*	
G	15	Willow herb	*Epilobium spp.*	
G	16	Catone aster	*Cotoneaster bullatus*	
G	16	Creeping Buttercup	*Ranunculus repens*	
G	16	Creeping Buttercup	*Ranunculus repens*	
G	16	Domestic apple	*Malus domestica*	
G	16	English ivy	*Hedera helix*	
G	16	Goldenrod	*Solidago canadensis*	
G	16	Himalayan blackberry	*Rubus armeniacus*	
G	16	Common Rush	*Juncus effusus*	
G	16	Mountain Ash	*Sorbus spp.*	
G	16	Spruce app.	*Picea spp.*	?
G	16	St. John's Wort	*Hypericum perforatum*	
G	16	Vetch	*Vicia cracca*	
G	17	Black cottonwood	*Clematis spp.*	
G	17	Himalayan blackberry	*Rubus armeniacus*	
G	17	Rush	*Juncus spp.*	Big crown
G	17	Morning glory	*Convolvulus arvensis*	
G	17	St. John's Wort	*Hypericum perforatum*	
G	17	Thistle	*Cirsium spp.*	
G	17	Vetch	*Vicia cracca*	
G	17	Willow herb	*Epilobium spp.*	
G	18	Black cottonwood	*Populus trichocarpa*	
G	18	English ivy	*Hedera helix*	
G	18	Hawthorn	*Crataegus spp.*	

G	18	Himalayan blackberry	*Rubus armeniacus*
G	18	Common Rush	*Juncus effusus*
G	18	Mountain Ash	*Sorbus spp.*
G	18	Shining Willow	*Salix lucida*
G	18	Sweet pea	*Lathyrus odoratus*
G	18	Vetch	*Vicia cracca*
G	18	Western sword fern	*Polystichum munitum*
G	19	Black cottonwood	*Populus trichocarpa*
G	19	Creeping Buttercup	*Ranunculus repens*
G	19	Creeping Buttercup	*Ranunculus repens*
G	19	English oak	*Quercus robar*
G	19	Himalayan blackberry	*Rubus armeniacus*
G	19	Prunus paniculata	*Japanese Plum*
G	19	St. John's Wort	*Hypericum perforatum*
G	19	St. John's Wort	*Hypericum perforatum*
G	19	Sweet pea	*Lathyrus odoratus*
G	19	Twinberry	*Lonicera involucrata*
G	19	Vetch	*Vicia cracca*
G	19	Western sword fern	*Polystichum munitum*
G	20	Bugle	*Ajuga spp.*
G	20	English oak	*Quercus robar*
G	20	Hawthorn	*Crataegus spp.*
G	20	Himalayan blackberry	*Rubus armeniacus*
G	20	Oxeye daisy	*Leucanthemum vulgare*
G	20	Shining Willow	*Salix lucida*
G	20	Snowberry	*Symphoricarpos alba*
G	20	St. John's Wort	*Hypericum perforatum*
G	20	Sweet pea	*Lathyrus odoratus*
G	20	Tansy	*Tanacetum vulgare*