Resurfacing the Flats: Agency in Revealing the Natural Landscape of False Creek

by

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Dalhousie University is located in Mi'kmaq'i,
the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

To Dale Staples and Brenda Crouse, BEDS 1984 and B.Arch 1986, Technical University of Nova Scotia.

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Abstract

The False Creek Flats in Vancouver, Canada, was originally an estuary condition, where salt and fresh waters mixed creating one of the most productive ecosystems. In the 1850s, its protected water access was appropriated and in the early 20th century it was infilled taking advantage of its topography for industrial purposes. Now this connection needs to be re-established to complete the water cycle system and create a space for people and water. Freshwater, Vancouver's most abundant natural resource, flows directly into the ocean. In revealing and re-establishing the water cycle's natural systems, their services are utilized, reinvigorating and reconnecting the city to nature and people to water. Architecture inspired by the natural and built shoreline celebrates temporalities, captures, and activates thresholds between hydrological, ecological, and people flows. The programs of water, stormwater treatment, bridges, and boardwalks reconnect the generations of the Flats to the environmental and cultural past and future.

Acknowledgements

Thank you to my supervisor, Catherine Venart. The guidance you have provided throughout the process of research and design has opened my eyes to the vibrance of urban infrastructure and the impact of design simplicity.

Thank you to my advisor, Matthew Brown. The knowledge of natural design processes you have divulged has inspired me to push the architectural boundaries within my design.

Chapter 1: Introduction

Relationship of People to Water

Historically, the False Creek Flats were occupied by water. This area provided natural flood mitigation, as it accounted for daily tidal fluctuations, monthly precipitation changes, and yearly storm surges. The presence of the Coast Salish First Nations did not disturb the natural environment. However, when the settlers arrived in the 1850s, False Creek was a fruitful shoreline to exploit.

The access to protected water made False Creek an ideal location for shipbuilding, and so the appropriation of the shoreline to suit the needs of the industrial colonizers began. In 1913, the move to industrialize the shoreline further meant that the Flats were infilled to make room for railways. This is when the human presence took precedent over the natural environment, exploiting of the natural resources on the land and in the water.

Now with climate change, rising sea level, and more drastic seasonal precipitation and storms, a reconnection to the ocean, streams, and estuary will complete the water system and create space for overflow. This gives the fresh water an outlet into the ocean, and it gives the salt water a new tidal floodplain. Human population continues to grow, which leaves even less space for water and makes it crucial to thoughtfully reincorporate water before the land is developed further. There needs to be more adaptable spaces within the city so that the city, including people and wildlife, can adapt to the fluctuating needs of climate change.

Photograph of False Creek Flats from Lee Building at Broadway and Main showing the original extent of coastline and the Main Street trestle bridge (Moore 1913)

The pre-existing architectural components of False Creek – circulation, containment, threshold – are used to re-establish the flow of water and people in the Flats. This creates a neighbourhood that integrates water into its outdoor public spaces in order to foster a community identity around education of the natural water systems. The return of water will reconnect the flow of people between the existing greenway of the Seawall and the green spaces of the eastern neighbourhoods – community gardens, bike routes, and parks.

The ideas of how water moves, through circulation, containment, and threshold, translate to the ways in which architecture controls the movement of people – porous and non-porous materials and design. Three key elements on the site address each of these architectural translations: the pedestrian bridge at the saltwater pool within the channel; the boardwalk and marsh in the brackish pool within the channel; and the stormwater treatment facility pool that controls the freshwater flow into the channel.

The stormwater treatment facility is vital in controlling the flow of both people and water, as it is a place that determines movement and rest. The facility is a threshold for all generations of the community to congregate within the Flats that facilitates the deliberate interaction between people and water. The water centre teaches children the science behind stormwater treatment, as well as the history of the tidal land belonging to the Coast Salish people; the café provides a place for family to gather and eat while they wait for their kids; the seawall extension acts as both a place of rest for people to tend to the community gardens and a place of movement for cyclists and runners along the channel.

The stormwater treatment facility is designed to not only purify but control the freshwater that meets the ocean water within the pools. The pools are designed to mix the saltwater of False Creek with the freshwater of China Creek, thus they become a gradient made up of separate containers. The western pools are designed to fill with saltwater from the ocean. The eastern pools are designed to move freshwater from the stormwater facility. The central pools are designed to contain the overlap of both saltwater and freshwater. The pools have three designed edge conditions that consider different quantities of water. The innermost edge is for the average lowest quantity of water, which occurs daily, during low tide, and seasonally, during the dry summer months. The middle edge is for the average highest quantity of water, which occurs daily, during high tide, and seasonally, during the wet winter months. The third and most outer edge is designed for the absolute maximum quantity of water, which is up to nearly 5m in elevation. This edge is for instances in which precipitation is extremely abundant, and storm events bring in high tide.

The reconstructed edge condition is designed to adapt to the different water flows that occur on a daily, seasonal, and yearly basis. It is a ground element that is constant against the changes in water and people over time. The edge is punctuated by moments of above-ground reprieve. These are architectural interventions that use historical materials to elevate human experience and highlight the water. The stormwater treatment facility is designed to be both ground and above the ground. It controls the movement of water from the underground city pipe network to the surface-level pools. At the same time, it controls the movement of people above the ground into the elevated café.

Photograph of China Creek ravine on shoreline of False Creek Flats showing the estuary conditions (Matthews 1904b)

Site of Opportunities

Before the large impact of westernization, the False Creek Flats used to be a rich and fertile estuary. Now it is an area in the center of the city that is the opposite – it is a barren industrial landscape that lacks social and environmental communities. This project is an opportunity to bring life back to this site, both in terms of people and water. Where people and water intersect are some of the most socially fertile areas, which is evidenced in the successful Seawall that Vancouver is known for. The Flats are slated to be developed in the next few years. It is one of the last and largest parcels of industrial land in the center of Vancouver and the city plans to create a high-density mixed-use community. Some of the construction has already begun, like the new St. Paul's Hospital, Emily Carr University of Art and Design, and the new underground rapid transit line. Since the development is inevitable, there is an opportunity for the city to redevelop the Flats in a dramatic way that focusses on the management of Vancouver's biggest natural resource – water – to ensure that the Flats not only have a present, but a future.

Photograph of existing train tracks on False Creek Flats in the location of the tidal estuary

Site of Obstacles

With a site the size of the Flats, there are many proposals and equal limitations for redevelopment. The piece of land that the Flats resides on is not only expansive, but it is also centrally located in Vancouver. This is part of what made it a valuable piece of land in the first place when it was infilled and redeveloped over a century ago, and even long before that. Presently, the dense downtown lies just north of the False Creek Flats, and the vibrant communities flow south down Main Street. To the west is the newly popular Olympic

Village, and to the east are neighbourhoods of single and multi-family houses. The Flats rests at the intersection of all of those popular and expensive communities. Its proximity to the water and clear view of the mountains to the north only reaffirm the high real estate value of a site of such a location in the middle of Vancouver. It is understandable that the city would want to wait until the zoning bylaws allowed for relatively high-density construction to offset the cost of building on such expensive land. This indicates that the city's plan is to use every square foot of the Flats as efficiently as possible and suggests that a proposal to return some of the land to a natural ecosystem would not be favourable. However, this project proposes to do more than simply waste valuable space. In fact, it seeks to do the opposite – to carve out a multi-programmed corridor that enables the intersection of natural ecological processes, habitat for wildlife, and human interaction, which at the same time cleans and processes the stormwater of the city for each of these actor groups to utilize. Not only will this project provide a space for wildlife and nature in a dense urban center unlike Vancouver has seen before, but through those efforts, it will also help to decontaminate the land that was infilled. The process of infill brought in displaced material to cover up the tidal mudflats of False Creek, which could contaminate the existing substrate and water. In order to now restore and reveal the water and natural landscape of the Flats, the ground must be decontaminated, which is a positive ecological achievement that is in line with Vancouver's approach to the environment and climate change. A reversal of environmental damages due to contamination of the landscape, and the creation of intersectional space for wildlife and stormwater innovation in the middle of the city are what set this proposal apart from other strategies to develop the area. Development will still exist around this corridor, but the history of the Flats proves that this land is more than simply an opportunity for high-density buildings.

Chapter 2: Theories

People and Nature

Urban infrastructures and pathways are major public spaces that are utilized year-round. Parks and water elements are additional spaces in between, which encourage public engagement. The relationships between these human and natural systems create dynamic spaces that provide experiential opportunities for future generations to learn from.

Due to its natural geography and history, Vancouver incorporates nature as part of the everyday lifestyle within the city. Successful urban design integrates the natural environment with the urban landscape. Ideas founded in nature have become key design principles for public urban architecture. Jane Jacobs discusses how cities have successful public spaces when neighbourhoods are filled with multiple park spaces and varied functions (Jacobs 1961, 101). Parks need to be multi-programmed spaces. They need to host small events, such as users that walk their dogs and take leisurely strolls. They need to host medium events, like sports and group activities. Additionally, they need to have the capability to host large events, like farmers markets and concerts. Moreover, successful parks are used at all times of the day and by all types of people. In the early morning they are used by commuters and runners. In the mid-morning parents with children and seniors take over the space. At noon the parks are used by people on their lunchbreaks. In the mid-afternoon, children, parents, and seniors return. In the evening, commuters once again pass through the area and recreational activities occur. These variations in program and people are what make parks populated at all times of day, which makes them more accessible to everyone (Jacobs 1961, 108). This entices people to use them more regularly, which therefore makes them integral public spaces. Additionally, parks need to be surrounded by a variety of architectural programs, which activates them; a park alone does not encourage people to use it, rather, it must be supported by a network of public and private spaces. Residential, commercial, office, and community buildings each draw in different types of people, from a variety of cultures, ages, and economic backgrounds. These programs involve these different people at staggered times of day and week, which increases the overall useability of the parks. Locations of parks are important too – if placed strategically, green spaces link up to form a patchworked public corridor that runs through a neighbourhood. Parks become places of intersection for the community; they are a place to stop or slow down as people circulate through the city.

Jan Gehl also discusses the idea of time as a crucial element to diversified public space. People have the ability to walk, stand, and sit for different lengths of time, and therefore each of these activities requires different designs. Moreover, different people have different needs for each of these activities; children require more stimulation, adults require viewpoints, and seniors require more comfortable rest spots (Gehl 2011, 131). The engagement of the human senses is important in order to draw in people for different durations of time. Parks, water, and streets are all spaces that human activities occur. The overlap of activities in these areas not only foster vibrant human ecologies, but also opportunities to showcase natural ecologies. Natural ecologies, like the grasses of shoreline and water of ponds, and help to diversity the urban environment. They provide moments of protection and view, which make edge conditions habitable (Gehl 2011, 149). Public spaces of parks, water, and streets have become integral to successful human ecologies within urban centers

Similar to how space is made for public parks within cities to allow communities of people to thrive, space needs to be made for natural ecologies to allow water systems to thrive.

Water – like infrastructures and pathways – is another public space that benefits from the intersection of urban elements. The main difference is the shoreline is more restricted in its community reach due to its fixed location. Urban elements brought up by these theorists are diversity, movement, and focal points. Urban shorelines address diversity in the variations of edge conditions – walls, steps, terraces – because these different typologies encourage multiple people, programs, and scales, as well as push boundaries – which altogether, increases the amount of time that this public space is used. The shoreline addresses movement in the primary circulation of pedestrians and cyclists along its path, in the secondary circulation of boats along the water, and in the tertiary circulation of the vehicular bridges that rise above the water. The edge conditions influence the types of circulation and have an impact on the interaction between land, water, and types of movement adjacent to these systems. How we intersect with these systems depends on these relationships. Walls create a separation between the people and the water; therefore, this separateness encourages continuous movement parallel to the water. Steps create opportunities for people to access the water; steps lead down to the gravel beach, that people interchangeably share with the ebbs and flows of the tide. This connection to the water fosters movement that meanders along the shoreline. Terraces are an extension of the steps; these exaggerated stairs create a vertical public plaza for people to gather. This adaptable space encourages a pause in movement for people alongside the water. The more these edge conditions are given space, the more resilience they provide, and as well the more programs they contain. The shoreline addresses focal points in the thresholds created at the intersection of the different types of movement. Where people are brought in contact with the water, and where people rise above the water are locations of community interest; these are typically public parks, markets, beaches, and marinas. The edge conditions work together with the thresholds to create points for the community to gather along the shoreline, and therefore help to connect people to the water. Walls are typically used in the gaps between thresholds, and where protection from the tide is key, public markets. Steps are seen in areas where integration of people and water is important, like at park spaces and beaches. Terraces are use in areas where the buildings and urban plazas are located near the water. These spaces of natural ecologies are celebrated when we connect to these different types of urban thresholds.

The intersection of circulation and places of threshold are revealed through the visual overlay of Vancouvers public spaces. The process of mapping from James Corner uncovers historical pasts to highlight the nuanced relationships of public spaces that are otherwise lost in the urban landscape (Corner 2011, 213). Maps are a tool to reveal the systems within a city. Layers of human interaction natural elements bring the specifics of their relationships to the surface. They show that people gravitate to the same conditions that natural ecologies thrive in. Intersections of water and land are not only fertile for the evolution of plants and animals, but also for the development of human communities. Moreover, the inevitable changes in the shoreline allow for an adaptable living condition. When the tide is low, the water exposes these natural systems and enables further human movement and engagement. When the tide is high, the water protects its natural landscape and the space for people is limited. The movement of water across the land generates an edge condition that becomes a space in between urban and natural phenomena. This is a valuable public space in an urban context as it fluctuates so that it is occupiable by both people and water ecologies; however, it is unable to be taken over by either one completely due to the respective detrimental environmental affects and the developmental disregard. Parks are ideal public spaces for shorelines, as they accommodate both human interaction and natural systems. The dynamic relationships that are revealed between parks and waterfront reveal the importance of a blue-green space to relink people, ecology, and water. The integration of urban and landscape design principles creates a city system based on the relationships between human and natural ecologies.

Image highlighting layers of natural and industrial history, with coastal vegetation and railways underneath canoers

Chapter 3: Methodologies

Geology and Hydrology – Environmental Analysis

Humans borrow design principles from water and green spaces to create architectural landscapes. The materials and formation of the natural shoreline influence how people inhabit the edge between water and land. Geology and hydrology have shaped the shoreline and provide insight into how to use these different formations presently, and for future generations.

The processes of rock formation – erosion and deposition – and the cycles of water systems – saltwater and freshwater – are what create a shoreline. Erosion is the process through which a material is broken down through consistent friction – the waves of the ocean, the current of a river, the gust of wind, the movement of rocks. Deposition is the process that causes a build up of material. These same types of movement that cause erosion are what carry the material that results in deposition (National Geographic 2022). These two processes both occur in instances of water because they rely on movement, which creates friction that both carries and releases particles (Panchuk 2019). In saltwater, erosion occurs along the shoreline where there are constant tides, waves, and winds that wear down the natural materials of the edge condition. In freshwater, erosion happens on the banks of rivers where there is friction from the current. In saltwater, deposition is seen at places where the shoreline is protected, and the elements are calmer – natural coves and shallow tidal areas provide this shelter. In freshwater, deposition occurs at places where the current slows. This happens at the location where the river meets a larger body of water or overflows into an expansive floodplain. Erosion causes new forms to be created in the negative space left behind by the water. Likewise, deposition causes new forms to be created in the additional space made by the water.

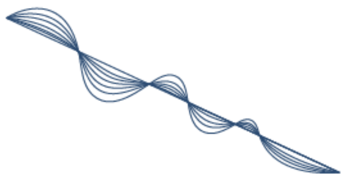


Diagram of meander development in a stream due to erosion and deposition

Meanders occur throughout the length of a river or stream. A young stream is a channel that is relatively straight and ungraded. Although they can have steep gradients at their outset, once the stream reaches a valley its gradient becomes low and so does the velocity. These low velocity streams develop meanders, which is a pattern of bends in the stream path (Panchuk 2019). Meanders become exaggerated over time through erosion of the outside edge of the bend and deposition of sediments on the interior of the bend. Friction determines the amount of erosion and deposition that occurs along the edges of a stream. The less friction there is, the faster water flows. Therefore, water at the bottom of the stream flows the slowest because it is restricted by the friction of the rocks and stones on the stream bed (Panchuk 2019). The water that moves along the inside edge of a meander is slower than the water that moves along the outside. Sediments build up along this interior edge when they are deposited by the slow flow of water. Comparatively, the water flow on the exterior of the stream bend is fast, which is where erosion occurs. The meander becomes exaggerated over time since erosion and deposition continue to happen.

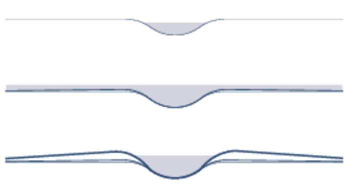


Diagram of levee formation on riverbanks due to flooding and sediment deposit

Levees are natural formations on the banks of rivers that are created through deposition of sediments. They occur when the bank full stage – is the stage in which a river has reached its maximum capacity of water – is surpassed. In the event of a flood, the sediments are deposited on the riverbanks according to size and density of particles; the largest and heaviest sediments are deposited first on the edge closest to the river, and the smallest and lightest sediments are deposited further away. When floods repeat in the same area, levees continue to develop and grow in size over time. The water level in the river increases as the levees grow in height. As a result of this flood pattern, the floodplain becomes fertile ground due to the sediments deposited (Panchuk 2019). Levees are a natural retaining wall as they mitigate future flooding because of how they increase the amount of water that has to accumulate in the river before it floods over.

The pattern of erosion and deposition within a stream creates a composition of niches that become inhabitable space. The fertile land that remains on the interior bank of a meander is made up of softer sediments and has a low slope that recesses into the water. On the opposite bank of the meander is a harder surface that typically has a steep approach to the stream. These two edge conditions juxtapose each other and create spaces that serve different functions – protection and exposure. The continuous pattern of this hard and soft edge along the meander provides design insight into the types of architectural interventions that each enable.

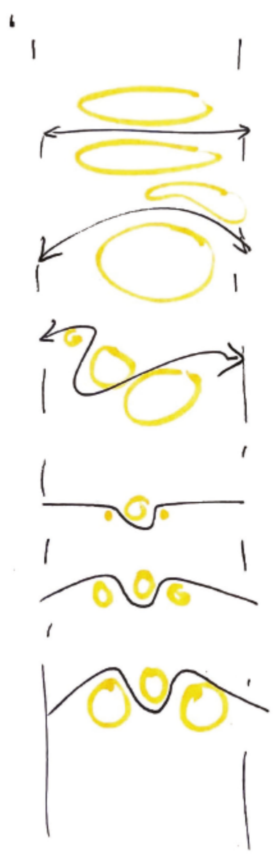
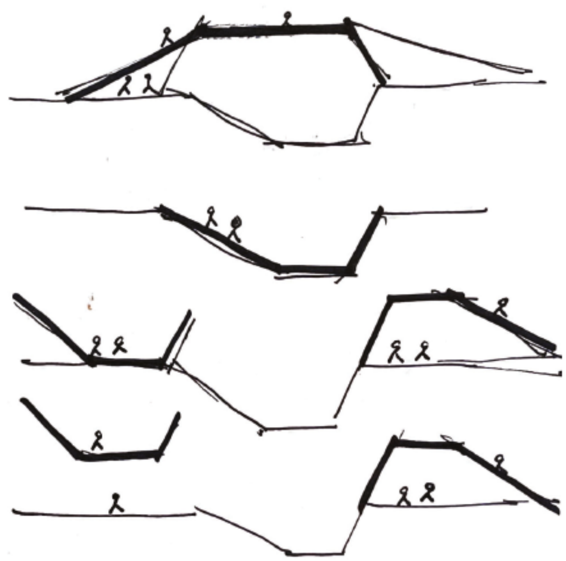


Diagram of inhabitable spaces created in meander and levee forms

The way in which sediment deposit occurs gives levees a distinct shape. The side closest to the river becomes a high point with a sharp and short slope down towards the river and the side furthest from the river has a gradual long slope down and away from the high bank. When broken down into simple angles, this natural shape becomes an architectural form that is inhabitable in multiple ways – over, under, and on – and allows for different types of water movement – flow, containment, and change.

Erosion and deposition of the shoreline create specific types of edge conditions. Edges are the most ecologically and socially fertile areas within urban environments. Therefore, the ecologies and urban context must be in balance in order to create a productive public space. The physical results of erosion and deposition of freshwater streams – meanders and levees – create opportunities for different types of inhabitation along the edge condition.

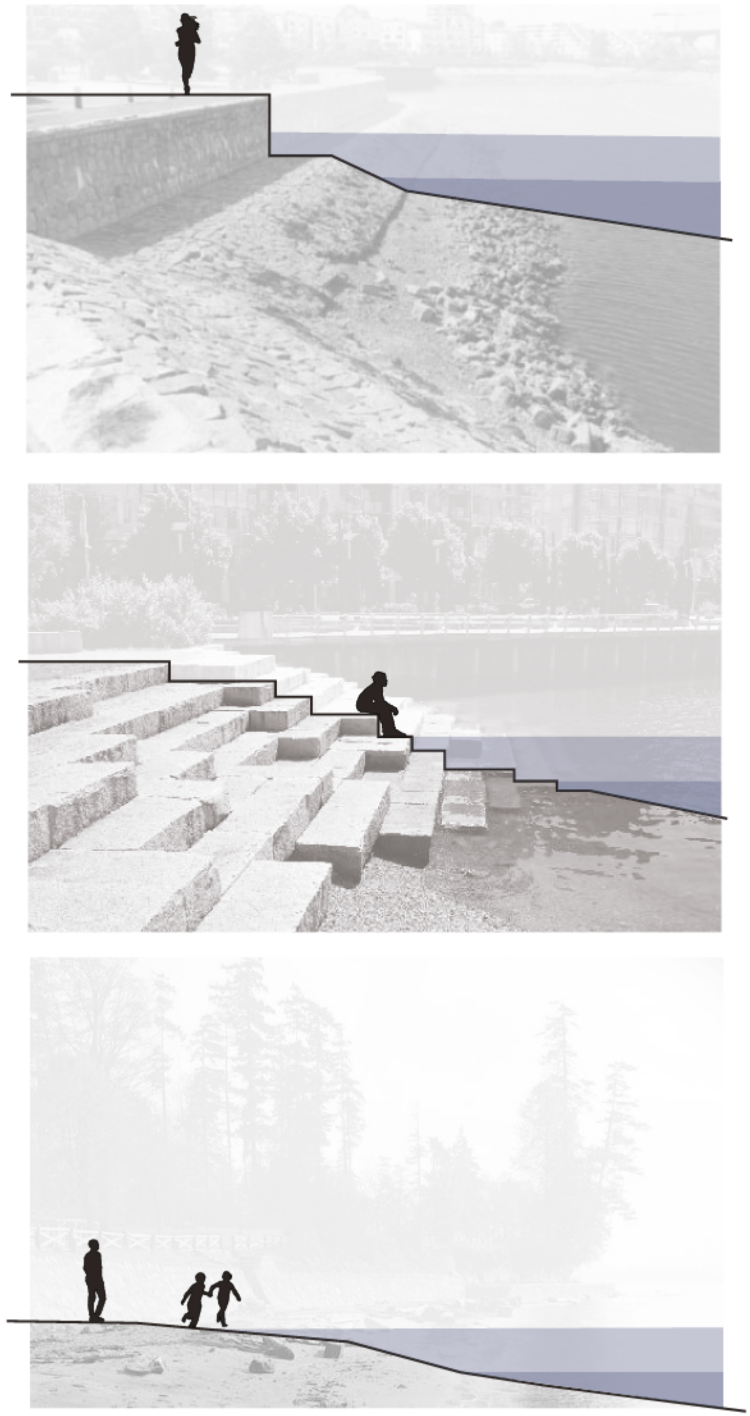


Section diagram of angles created by levees, which become the inhabitable spaces of this project. The levee is inhabitable as a volume, it is ground, roof, and wall and therefore can become an element of ciruclation, threshold, and containment.

Communities – Architectural Precedents

Redevelopment of urban centers requires analysis and consideration of green spaces, water elements, and human circulation. The intersection of these three components happens at all scale – the city, the site, and the building. Through these intersections new relationships are revealed that create key moments of threshold and flow.

Diagram of inhabitation that forms in the bends of a meander. These bends become moments of threshold and containment along the path of water that ciruclates through False Creek. Within these moments of public gathering are markets, marinas, boat launches, and beaches. Photograph of aerial view of False Creek (Vancouver Engineering Services 1951)



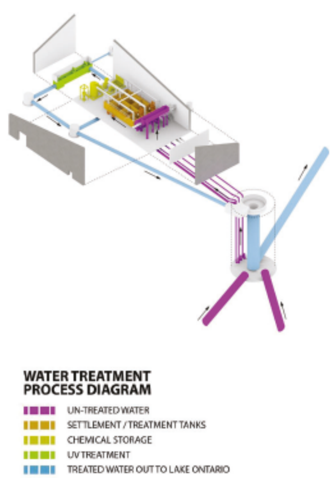
Diagrams showing the existing connections between people and water along False Creek. The wall, steps, and beach are the main typologies for these moments of connection. From top to bottom photograph of False Creek Seawall between Stamp's Landing and Cambie Bridge (Vancouver Engineering Services 1978-1983d); photograph of steps in Olympic Village (False Creek Excursion n.d.); photograph of Stanley Park beach (Lindsay 1940-48)

The Cheonggyecheon River is an urban project in Seoul completed in 2005, which daylighted a stream that had been covered in an 18-lane highway. The aim of the project was to revitalize the urban center of the city. The downtown was overrun with vehicular infrastructure, which caused a large decrease in population. In order to increase the number of people in the downtown area, the city sought to revitalize a main urban thoroughfare: the Cheonggyecheon River. Not only did this strategy exposed the water of the river, but it also created public plazas and green spaces for the people of Seoul to enjoy. In the project they considered the social and historical aspects, as well as water and sewage management (Landscape Performance Series n.d.a).

Conceptual site plan of Cheonggyecheon River in Seoul done by Mikyoung Kim Design (Landscape Performance Series n.d.a). This plan shows the integrated relationship of water and green spaces as key to the overall design. How this project plays with elevation changes between the sunken channel and the raised street level and bridges demonstrates how the manipulation of topography can act as a design tool to bridge the gap between natural systems and the built environment.

The Lower Dons Master Plan is a development proposal on former industrial land in the southeastern part of Toronto. It is located between the waterfront to the south and the railyards to the north. In addition to the residential development, recreational paths for cyclists and pedestrians are incorporated into the master plan and commuter paths for future rapid transit lines are established. Connections between the people and the water are made through the creation of these paths. There is a path that runs along the

Site plan of Lower Don Lands redevelopment in Toronto (Michael Van Valkenburgh Associates Inc. 2010). This plan shows how the organic forms of a river meander can be a catlyst for development. The reconstructed landscape becomes a mode of pedestrian and water circulation and containment, and creates moments of threshold.



Building diagram for the Stormwater Facility in Toronto (GH3 2020). The elements of circulation, threshold, and containment are displayed in this system.

waterfront and connects into downtown Toronto. Additionally, there is a path and park system that follows the constructed marshland within the site. There is also a path that links up to the existing Don Valley Trail. At the centre of this development, a new water flow is created that meanders through the site (Michael Van Valkenburgh Associates Inc. 2010).

The plans for development of the Lower Dons are supported by the existing Stormwater Facility by GH3, which collects, filters, and redistributes stormwater from the lakeside industrial neighbourhood. It addresses its industrial location through the addition of bike routes and commuter streets around the site. The main components of this project are the network of pipes, the treatment building, and the storage tank (GH3 2020).

Dockside Green is a residential project currently under development on the industrial waterfront of Victoria. Victoria is a city with an abundance of shoreline. It is also a city that has experienced a large increase in population as people relocate from expensive Vancouver to buy property. With this population increase, underdeveloped areas of the city are targeted to increase density, and also to emphasize the nature-centric and community-based lifestyle of Victoria. For a long time, industrial blocks have taken up large portions of the shoreline, and now these areas are important nodes to reclaim in order to strengthen the connection of people to the ocean. Dockside Green is a multi-building development that features a central greenway along a constructed stream. The community incorporates various public green spaces in addition to access points that lead down to the waterfront. The idea is to create a community based on the connection

Site plan for Dockside Green, Victoria (PWL Partnership 2009). This plan shows the relationship of the two water systems: the stormwater treatment channel that runs through the length of the project, and the saltwater ocean that is parallel to it. The way that stormwater, freshwater, and saltwater interact and are contained separately is key to designing flows of water and people.

The Dockside Green project has factored in the effects of climate change and the necessary steps that need to be taken in order to reduce their footprint on the environment. It has a district energy system and system of energy transfer stations that work together to recover heat from the sewage and grey water on site, which is redistributed back into the residential buildings. Additionally, Dockside Green has an onsite wastewater treatment facility that collects, filters, and redistributes water throughout the community. Grey water is cycled through the wastewater treatment facility so that it can be reused in toilets and to irrigate the landscape. The central water stream that meanders through the buildings collects rainwater from the site, and provides grey water to feed into the wastewater system (PWL Partnership 2009).

Olympic Village is a recently established neighbourhood on the previously industrial shoreline of southeastern False Creek. In preparation for the 2010 Vancouver Winter Olympics, the blocks of warehouses in this area of Vancouver were redeveloped to house the athletes, in addition to one of the main stations on the newly constructed underground rapid transit line – the Canada Line. Since the Olympics, the athlete village has been transformed into a series of

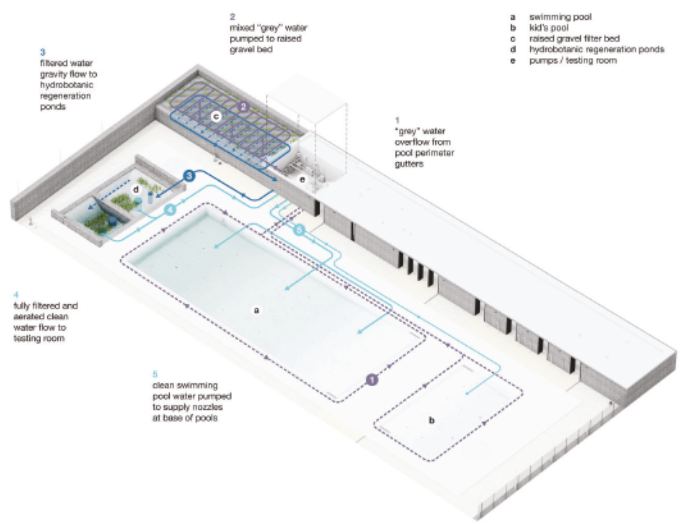
Photograph of Habitat Island, Olympic Village (City of Vancouver n.d.). The strip of land that connects Habitat Island to the Seawall is a low outcropping of rocks and sand. The size of this piece of land changes when the tide rises and lowers and the accessibiltiy of the island is limited to certain times of day.

Photograph of Hinge Park, Olympic Village (Pechet Studio 2010). The combination of water and vegetation in this park show the importance of a holistic ecological system. Water becomes a catalyst for growth as well as a means for sustainability.

residential and commercial buildings interspersed with green spaces and public plazas. This community along the shoreline has also been a catalyst for the revitalization of this portion of the Seawall and the natural ecosystem within Hinge Park and Habitat Island.

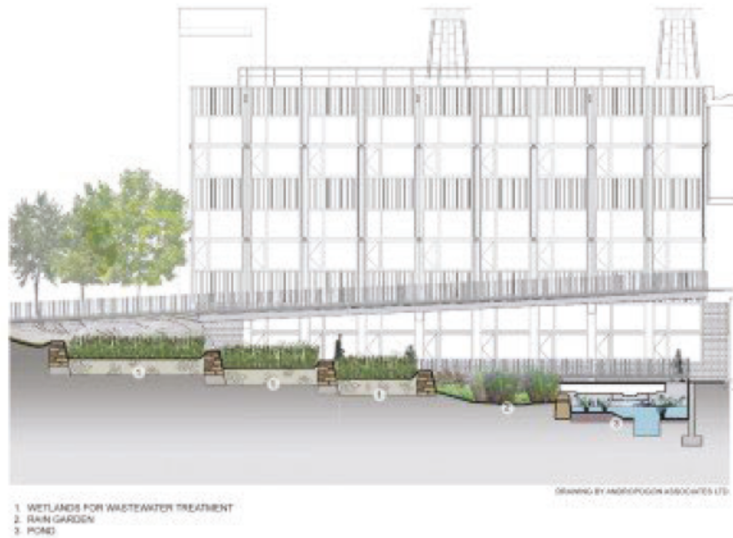
Additional emphasis has been placed on the management of stormwater within Olympic Village. The construction of a wetland in hinge park, and soft-scaped boulevards all help to absorb the rainwater on site. As Olympic Village was developed recently, the future climate impact was considered. The False Creek Neighbourhood Energy Utility (NEU) was built in 2006 and expanded in 2010 in order to more sustainably support the energy needs of the higher density community. This building, located on the western edge of the site, underneath the south side of the Cambie Street Bridge, recovers heat from sewage and grey water that is reused throughout the residential buildings of Olympic Village. The main components of the NEU are the False Creek Energy Centre – where the sewage and grey water are filtered through a heat pump – and the energy transfer stations that redistribute the heat and hot water into each building (False Creek Neighbourhood Energy Utility n.d.).

The Borden Park Natural Swimming Pool by GH3 is an outdoor public pool whose design achieves both circulation of water and people. Water is circulated through a system of pipes, ponds, and pools. The main spaces are the gravel filter bed, the regeneration ponds, the water testing room, and the swimming pools. The gravel filter bed first filters the water through aeration, then the regeneration ponds purify the water with bacteria-eating zooplankton. The water testing room checks the water quality before it is pumped into the pools. The overflow water from the swimming pools is then fed back into the first stage of the system (GH3 2018).



Building diagram of water system at Borden Park Natural Swimming Pool in Edmonton (GH3 2018). When broken down, the components of the water treatment system, are circulation, threshold, and containment elements. The series of pools demonstrate a way to architecturally separate and punctuate each step in the treatment process, and allow people to visually interact with the more technical aspects of the building.

The Sidwell Friends School renovation in Washington, DC includes an expansion of the middle school in addition to the construction of a wastewater treatment facility. The building uses an onsite sewage treatment system, which is composed of a series of wetlands, that filter and clean the water. The effluent grey water is also reused in the school for toilets and irrigation for the landscaping. The sewage treatment is completed first underground, before the wastewater is pumped into the terraces of reed beds. Microorganisms in the gravel of the reed beds clean the water of bacteria. A trickle filter and a sand filter are used in addition to the wetland at the bottom of the terraces (Landscape Performance Series n.d.b). Rainwater is also collected in a pond next to the wetland; when there are heavy rains, this pond overflows into the wetland.



Building diagram of water system at Sidwell Friends Middle School (Kieran Timberlake n.d.). The use of topography and check dams show the capabilities of simple intervention in the process of a complex system like that of water treatment.

To daylight a river, as seen in Cheonggyecheon, reveals not only the water underneath the urban surface, but it also creates new opportunities for urban and ecological engagement. The Cheonggyecheon River is set below the level of the road, which makes it appear as a channel. It is a space for both the circulation of water and people, as well as a space with moments for people to gather. It is punctuated by bridges that cross over the top of the channel, which help to keep traffic flow regular. Some areas of the reconstructed river have an architectural edge, whereas other are made to appear more natural. This variation creates a visual interest and dynamic quality to the project, as the river itself is about movement of people and water.

The projects in Toronto, Victoria, and Vancouver each redevelop the waterfront in order to re-establish ecologies in the urban context and to reconnect people to these ecologies. The Lower Dons, Dockside Green, and Olympic Village each reimagine water features on their respective sites as organic forms that cut through the urban context. They are surrounded by networks of paths to facilitate engagement. The emphasis of these developments is on the people and the outdoor public blue-green spaces.

The corresponding mechanical water systems on each of these sites are composed of elements that determine control and flow. Pipes to and from the buildings transport water and energy around the site. The treatment facilities are central locations that activate the flow through the network of pipes. These elements of control are key thresholds on the site where urban infrastructure and natural flows intersect.

The natural systems at Borden Park Natural Swimming Pool and Sidwell Friends Middle School clean the water so it is useable for both ecological and human purposes. In order to treat water, micro-digestive operations are required, which are the processes that separate or eradicate the organic matter – bacteria and fungi – from the water (Margolis and Robinson 2010, 100). Water filtration happens both by these active agents, and also passively, through the gravitational movement of water through different materials. Circulation of people occurs around these water systems that creates moments of reconnection. These processes interact with public architecture to not only create more sustainable designs, but also to engage people with natural systems.

Chapter 4: History

Natural Ecology

The people and priorities of Vancouver have changed dramatically over the past three centuries. From the natural shoreline of the Coast Salish First Nations to the industrial shoreline of the western colonizers, and finally the recreational shoreline of modern occupants, False Creek has played a vital role in the development of Vancouver. These changes have dictated the shift in shoreline, which has resulted in the increase of manmade land, and reduction of water.

Photograph of James, Herbert and Hugh Matthews in a canoe on the south shore of False Creek (Matthews 1902)

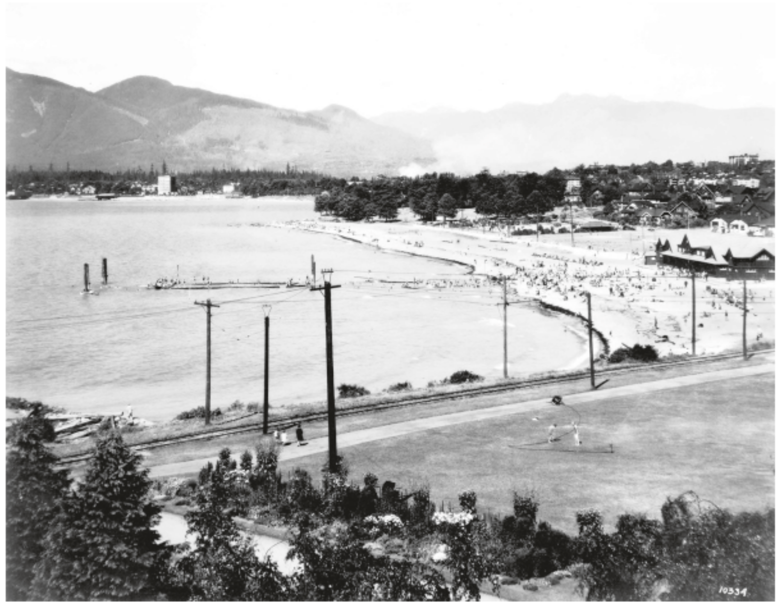
When the Coast Salish inhabited the land, the priorities were to live with the natural environment. The Musqueam, Squamish, and Tsleil-Waututh First Nations lived on the land for more than 3000 years (CityStudio Vancouver n.d.). They had little impact on the landscape, so the shoreline remained in its natural state – made up of cliffs, beaches, and mudflats. The Flats were an entirely tidal zone that connected the freshwater streams to the saltwater ocean. Furthermore, they took advantage of the natural formations of the landscape in their daily lives. Their camps and villages were located predominantly along the coast for ease of movement on the water and access to hunting and fishing points. Specifically, the main inhabitation was around the present day Kitsilano Beach area. Additionally, the Coast Salish set up camp at a vital stream outlet into the tidal mudflats within False Creek – China Creek (Artmap Vancouver n.d.). This not only was an important location for freshwater, but it also created a fertile marsh for plants and animals to thrive.

Cultural History

When Vancouver was colonized in the 1850s, the priorities of the new occupants were to industrialize the land (CityStudio Vancouver n.d.). They exploited the natural resources of the old growth forests and appropriated the shoreline to fit their industrial needs. The shoreline became occupied by docks and warehouses for shipbuilding, slaughterhouses, and more. Portions of the shoreline were even infilled in order to accommodate further industry. The largest area that was infilled was the original tidal mudflats, in order to make room for the construction of the Canadian Northern Railway.

Photograph of rebuilt West Coast Shipbuilders in present day Olympic Village (Matthews 1939)

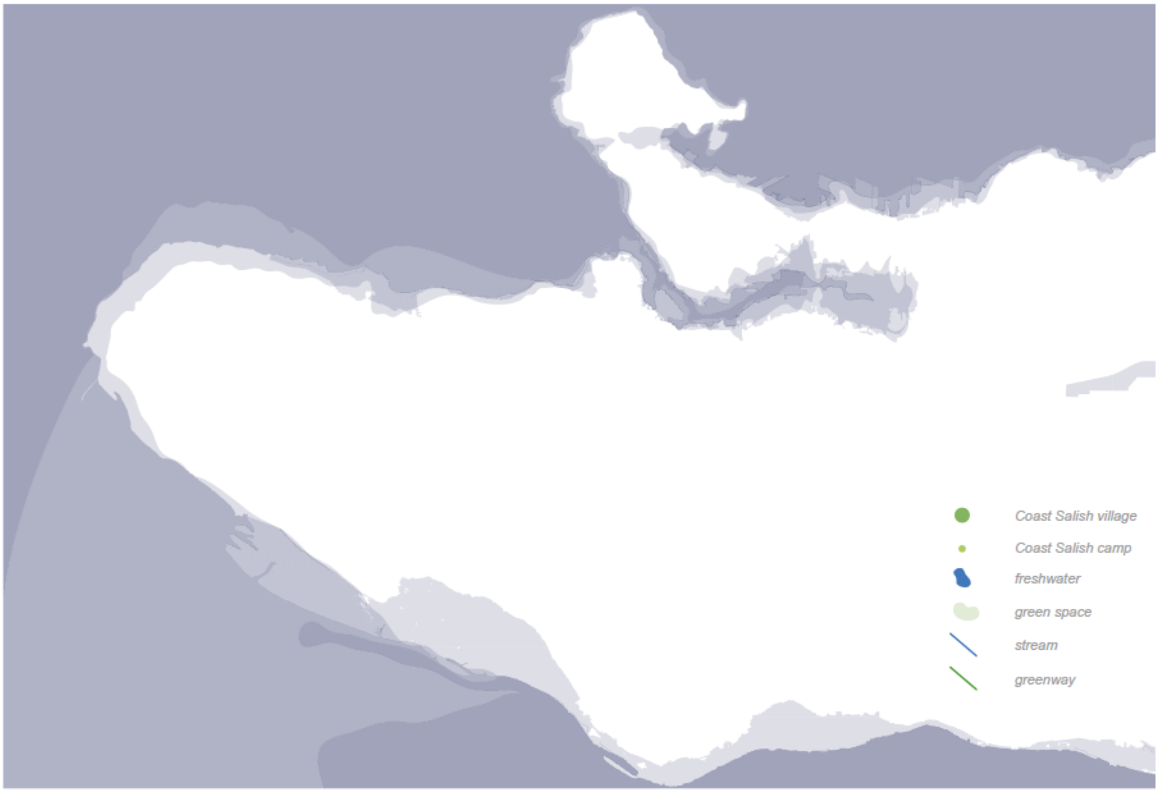
When WWII ended, Vancouver underwent a shift in priorities from industry to recreation. The shoreline that had evolved from a varied natural edge condition to a solid retaining wall became a point of revitalization (CityStudio 2021). Industry was fully removed from False Creek so that the water would become clean once again, and the Seawall was established as a place of leisure for pedestrians and cyclists. Additional recreational spaces were added along the shoreline loop, such as grassy parks, sandy beaches, boat launches, and public markets. By this point, the history of infill had been left in the shadow of urban development.



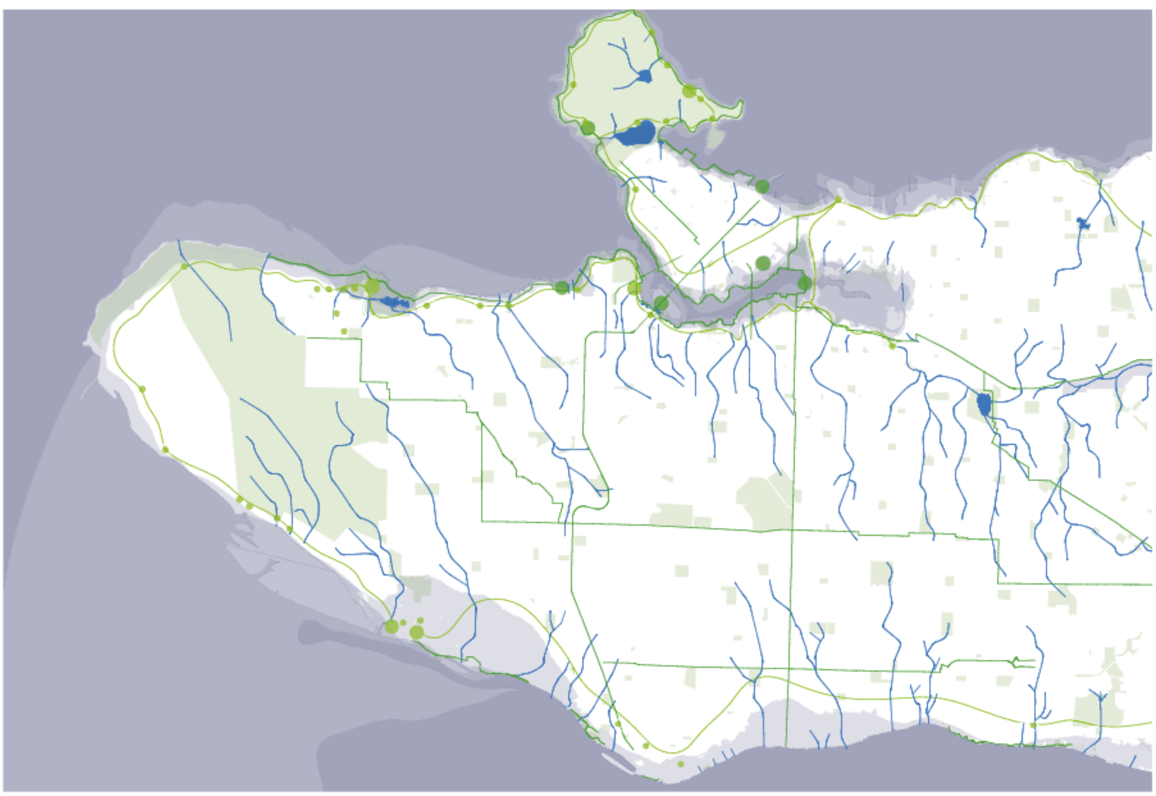
Photograph of Kitsilano Beach (Matthews 1928)

Presently, the priorities of Vancouver have shifted yet again, to include the consideration of climate change. This shift has impacted the shoreline as the types of construction along the shoreline are more thoughtfully considered, both in buildings and in the edge condition of the Seawall. The composition of the Seawall has been adapted in certain places to accommodate the inevitable rise in sea level. There are now different variations on the original retaining wall, like architectural steps that act as a public plaza when the tide is low. Certain sections are built out over top of the water to allow water flow underneath. Additionally, constructed wetlands have been created that reconnect old streams to False Creek in order to mitigate stormwater.

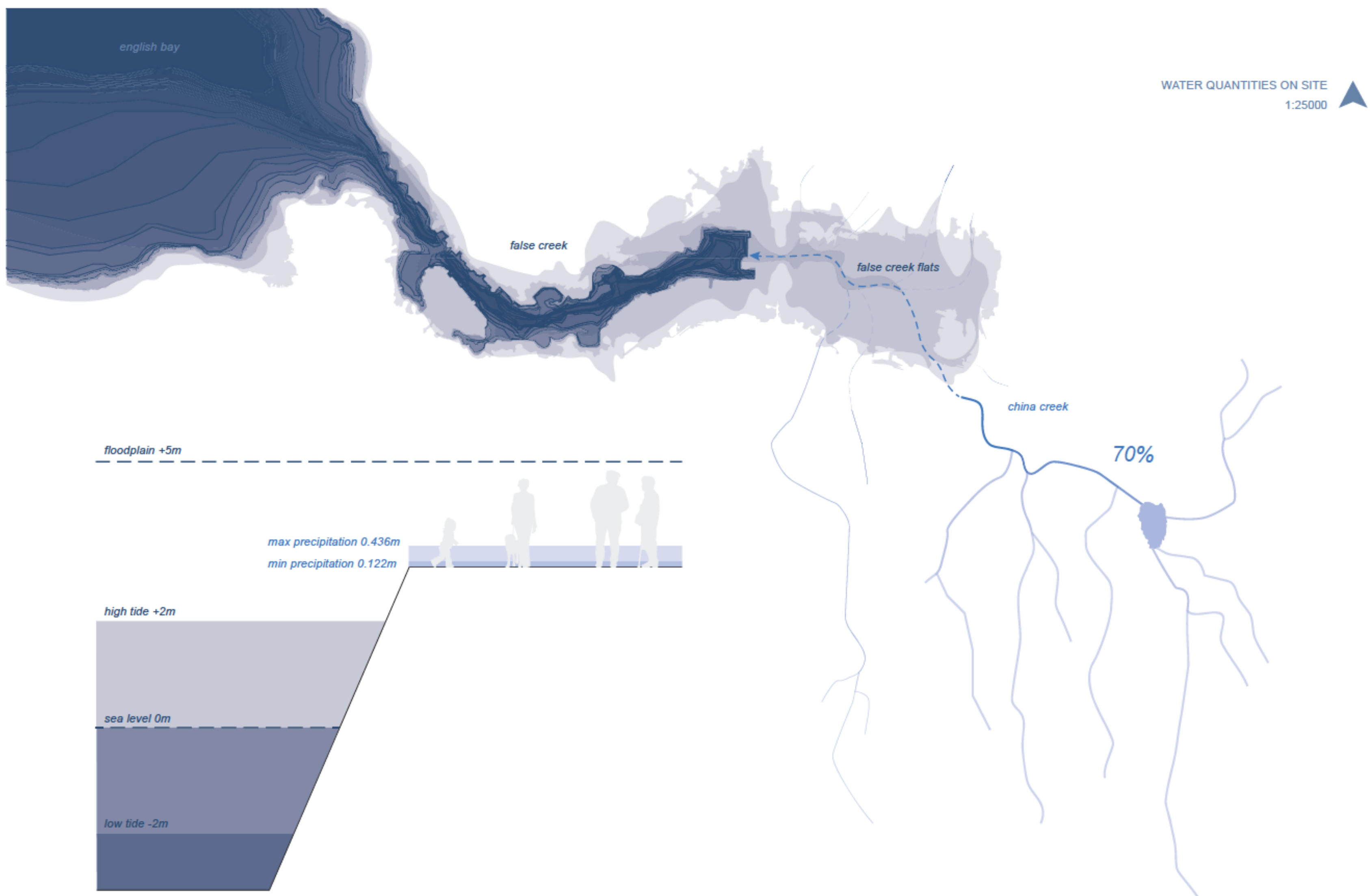
The development that began in the west has worked its way east, which has left the Flats as the final piece yet to be transformed into a community that incorporates residential development. It is still infilled with industrial warehouses, and up until recently, portions of the railways were still in use. The priorities of modern Vancouverites now not only



Map of Vancouver showing past, current, and future shoreline edges



Map of Vancouver showing past, and current areas of inhabitation along the shoreline. (Data from City of Vancouver 2022b)



Map showing quantities of water that flow into the False Creek Flats. Diagram of different types of water quantities include a recreational lifestyle, but also the environmental cost of that lifestyle. The urban drive to be more sustainable presents an opportunity for the Flats to be reconnected to False Creek through the natural cycle of water.

Landscape as Infrastructure

Processes and forms found in nature have been translated into urban strategies and design elements. This translation of elements is visible in the design of the Seawall along Vancouver's original shoreline. The natural shoreline edge conditions of cliffs, beaches, and mudflats serve a similar function as the architectural False Creek loop with its walls, steps, and terraces. Analysis of the material composition of Vancouver's shoreline reveal the logic behind the Seawall construction, both in terms of structure and materials.

The shoreline of Vancouver is made up of predominantly metamorphic and sedimentary rock. Metamorphic rock is harder and less easily eroded, whereas sedimentary rock is more susceptible to erosion. The cliffs, which still surround UBC and Stanley Park today, are made up of the hard metamorphic rock. This dark basalt material helped to protect the shoreline from tidal erosion. Erosion from stream flow cut into the top layer of glacial till (Armstrong 1990, 40). The cliffs are comprised of layers of basalt that are metamorphized through volcanic processes, which gives the rock their distinct fracture pattern. The beaches, as seen along Spanish Banks, some parts of Stanley Park, and the original shoreline of False Creek, are made up of softer sedimentary rock. This brown sandstone and shale are more easily eroded by the tidal changes and often appeared to have a ribbed pattern due to different levels of hardness within the material (Canadian Geoscience

Photograph of Siwash Rock in Stanley Park (Matthews 1890s)

Education Network 2022). This sandstone and shale were deposited by glacial movement 35-50 million years ago (Armstrong 1990, 40). The sand also comes from river flow from the Fraser River and the consequent erosion of nearby cliffs. The mudflats, which filled the original False Creek Flats, were made up of very fine sedimentary rock and with water flow from both fresh and salt water, the flats eroded.

Photograph of shoreline area of False Creek Flats (Matthews 1904)

Before the infill of False Creek, the Flats were a protected and shallow area affected by seasonal runofff from rivers, streams, creeks, and the tides. This flow of water not only deposited silt and mud in the Flats, but it also created a nutrient rich tidal ecosystem (National Park Service n.d.). The cliffs slowly eroded over time and added to the material deposited in the beaches. The finest particles in the beaches eroded over time and contributed to the mud and silt deposited in the mudflats. The cliffs also protected the beaches from major erosion. Likewise, the long channel of beaches acted as a buffer for the habitat created in the soft mudflats. These three edge conditions have a long history of a symbiotic relationship, and each has served a purpose in the maintenance of the natural landscape.

Vernacular of Vancouver and its Relationship to Water

As a result of the city's history, there are key elements that have become ingrained in the lifestyle and identity of Vancouver. Vancouver is a city with a strong relationship to the environment, which has established an architectural vernacular that blurs the boundaries between indoor and outdoor life. The public infrastructure of Vancouver consists of the Seawall, railways, and bridges. These are all elements that serve a dual purpose or have shifted purpose to accommodate the changes in lifestyle. Their original purposes were more functional, and now they have been reclaimed for various recreational purposes. This has established a vernacular of urban elements that focus on a recreational lifestyle that are ingrained in how the city functions at its most basic level. Elements that the city was built around – the Seawall, the railways, the bridges – have become recreational arteries that circulate people around Vancouver. As the climate crisis continues and the presence of water grows, the next step is to integrate the circulation of water into these elements. This has begun in the form of constructed wetlands and seaside swimming pools. The more that the circulation of people and water are connected, the more prepared the city will be for future generations.

The Seawall is a path that lines the shoreline around False Creek. It was built as a functional retaining wall for protection of the shoreline of Stanley Park from erosion. This path now connects the south side of False Creek to the north side of Stanley Park. Although the first portion of the Seawall to begin construction was in Stanley Park in 1917, it was not until 1980 that the Stanley Park portion was completed, and construction began on the rest of False Creek (City of Vancouver 2022a). In preparation for Expo 86, there was significant construction of public architecture along False Creek – BC Place Stadium, Expo Centre which became Science World, and the Skytrain. This emphasized the Seawall's recreational function by drawing large crowds to the waters edge. The development along the edge of False Creek made the Seawall's function as a retaining wall even more imperative. There was a desire to bring people as close to the water as possible while the urban vernacular established in the city was maintained. However,

Photograph of a beach and part of the Seawall at Stanley Park (Lindsay 1940-1948)

Photograph of South False Creek Seawall with BC Place Stadium in background (Vancouver Engineering Services 1978-1983c)

Photograph of South False Creek Seawall (Vancouver Engineering Services 1978-1983a)

Photograph of Olympic Village sea steps (Future Landscapes 2008)

this emphasis on the wall did not foster an authentic connection between the people and the water. The most updated portion of the Seawall, which opened in 2008, runs along the south-eastern edge and is part of Olympic Village. Today, the Seawall is a 28km long uninterrupted path along the Pacific Ocean (City of Vancouver 2022a).

The Seawall has since become an extended pedestrian and cyclist path with community nodes that branch off to create moments of social interest. It is made up of more than a simple retaining wall. The Seawall is now a composition of architectural steps, cobbled slopes, and beaches (Vancouver Engineering Services 1978-1983). The shoreline has undergone a shift in the past century from a wall meant to keep people and water separate, to a series of architectural elements that connect people to the water. This shift of the Seawall from function to recreation was caused by the change in lifestyle of the people of Vancouver. As the city became denser, the waterfront became more desirable land for residential buildings.

The railways that run through Vancouver culminate around the waters' edge. The False Creek Flats specifically have a large portion of the railways as the original Canadian Northern Railway station was located there (Matthews 1918). When they were constructed at the turn of the 20th century, the original function of the railway was for the transportation of goods that were produced along the industrial shoreline. No longer in use, sections of these railways have become greenways for cyclists and pedestrians as well as space for community gardens. The gardens were unofficially begun by the residents of communities along the old railway, who saw these overgrown train tracks as valuable green space. Eventually, the city of Vancouver followed the direction of its residents and created a project to revitalize the railway as dedicated public space.

Photograph of False Creek Canadian Northern Railway station under construction (Matthews 1918)

The most popular example of this is the Arbutus Greenway that runs north-south across the city and connects to the waterfront in False Creek. Over decades of disuse, this land shifted from the hard steel of railways to the soft vegetation of gardens. This shift from functional to recreational was caused by the change in priority of industries in Vancouver. As railways became outdated and the urbanization occurred, people needed a connection to green spaces.

Photograph of aerial view of False Creek (Vancouver Engineering Service 1951)

The bridges that run north-south across False Creek are vital circulation routes within the city. Originally, low-profile trestle bridges were constructed across False Creek in order to provide ease of movement for early settlers and industries. These trestle bridges were located at in the present-day neighbourhood of Kitsilano, Granville Street, and Main Street. In the early 20th century, these were replaced by more substantial bridges made of steel arches and concrete foundations (Matthews 1908). These new bridges allowed for taller boats to pass underneath, as well as supported the transportation of vehicles and light rail overtop. The new bridges were located roughly in the same places as the trestle bridges – the Kitsilano trestle became the Burrard Street Bridge; and the Granville trestle became the Granville Street Bridge. However, once the False Creek Flats were infilled, there was no longer a need for the Main Street trestle. A third bridge was eventually constructed between Granville Street and Main Street: the Cambie Street Bridge.

Aerial photograph of present day Arbutus Greenway (Vancouver Courier 2022)

Photograph of community gardens along Arbutus Greenway (Streets Reconsidered 2022)

The pattern of bridges in False Creek has created a vernacular unique to Vancouver. Transportation happens both above and below the bridges; however, these two paths

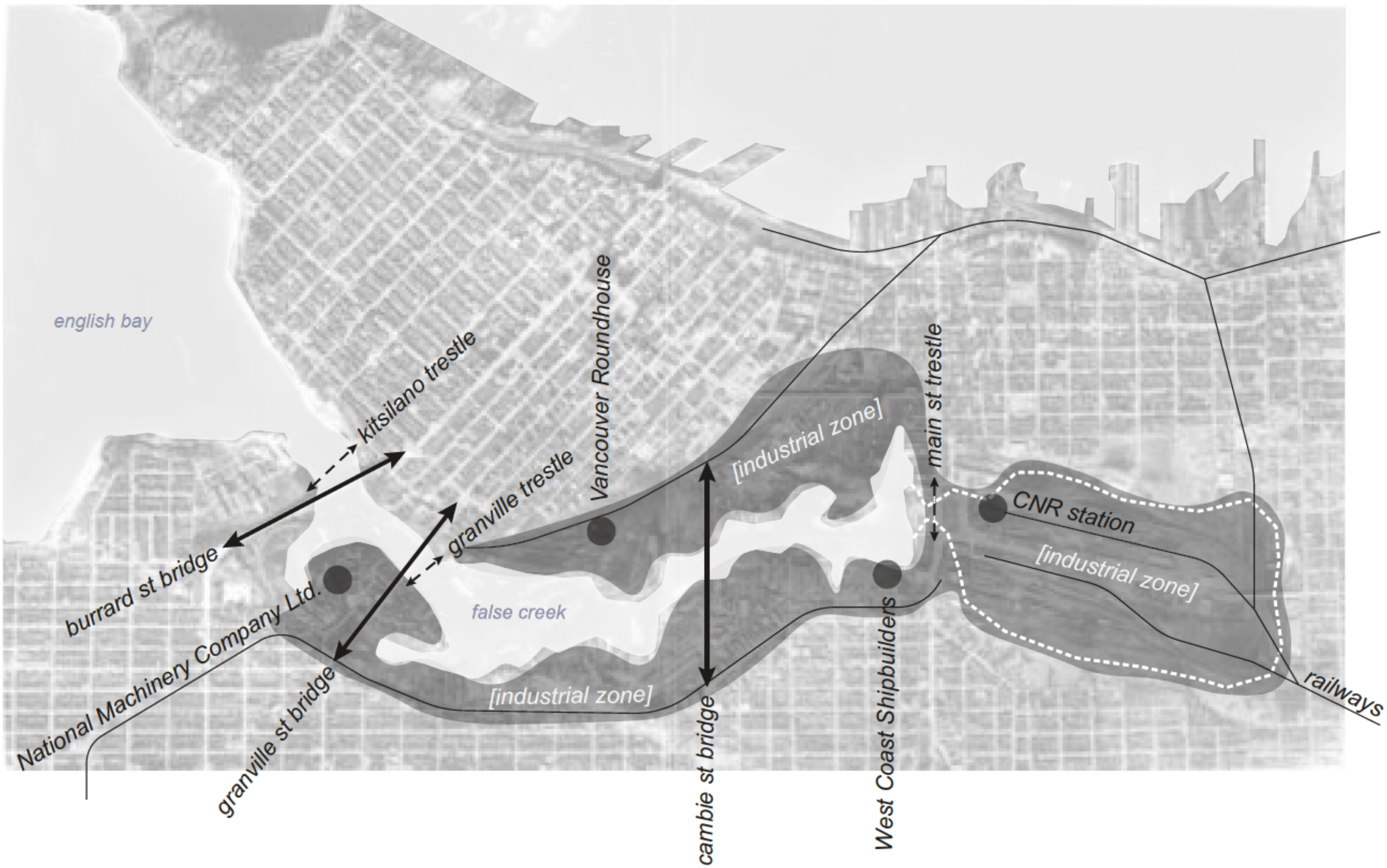


Diagram showing past trestles and present bridges that span False Creek. The locations of these crossings reveal key locations for cultural and industrial history. Photograph of of aerial view of False Creek (Vancouver Engineering Services 1951)

Photograph of Granville Street Bridge under construction (Matthews 1908)

Photograph of the Burrard Street Bridge, Kitsilano Trestle Bridge, and the new Granville Street Bridge and old Granville Trestle Bridge (Matthews 1954)

Photograph of chandelier underneath Burrard Street Bridge (William-Ross 2019)

Photograph of Granville Island entrance underneath the Granville Street Bridge (Planner 2019)

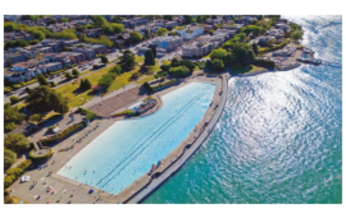
of circulation run perpendicular to each other. Primarily vehicular traffic and cyclists move on the roads above the bridges, while pedestrians and cyclists move along the Seawall that spans underneath the bridges. The moment of intersection of these two directions of circulation creates a community node. These bridges become thresholds through which people stop to gather. This is seen at the Granville Island market, under its namesake bridge, and in the public art under the Cambie Street Bridge. The dual purposes at the bridges of False Creek fulfill both the need for function and recreation that Vancouver requires.

Infrastructural elements that focus on water help to reconnect people to the natural cycles of salt and fresh water in False Creek. Instances of this are the beaches that surround English Bay, the constructed wetland in Hinge Park, and the outdoor Kitsilano swimming pool. The beaches along False Creek are predominantly located where the water opens up into English Bay. These beaches are all recreational areas for people of the city to swim, gather, and play sports. They are most often accompanied by large green spaces nearby. Because of their expansive nature, and the addition of these green spaces, these areas are not only important locations for people to stop along the Seawall, but they are also crucial areas for rainwater absorption and tidal overflow. The constructed wetland within Hinge Park is a recent addition to False Creek that gives excess stormwater a designated outlet into the ocean. This park branches off from the Seawall in Olympic Village and provides people with a place to gather, walk their dogs, and view downtown. This park is important to both the circulation of people and water and also to the mitigation of stormwater. The outdoor swimming pool in Kitsilano is a seasonal public pool built directly

Photograph of Stanley Park with aerial view of Second Beach Pool (Matthews 1930s)

Photograph of Second Beach in Stanley Park (Thomas 1917)

Photograph of Habitat Island in Olympic Village (City of Vancouver n.d.)



Photograph of Kitsilano Pool along shoreline (Smith Bros. and Wilson Ltd. 2017)

against the shoreline of Kitsilano Beach. It is designed for the community to gather and use throughout the summer months. Its location next to the ocean provides a functional wall to protect against storm surges. Additionally, the beach and park that neighbour this pool create a space for water absorption. These are all examples of how the Seawall has been adapted to fit additional public water programs. Therefore, the key to future water awareness is to use the tools that already exist along False Creek and add on to them, rather than erase their history.

Chapter 5: Site Design

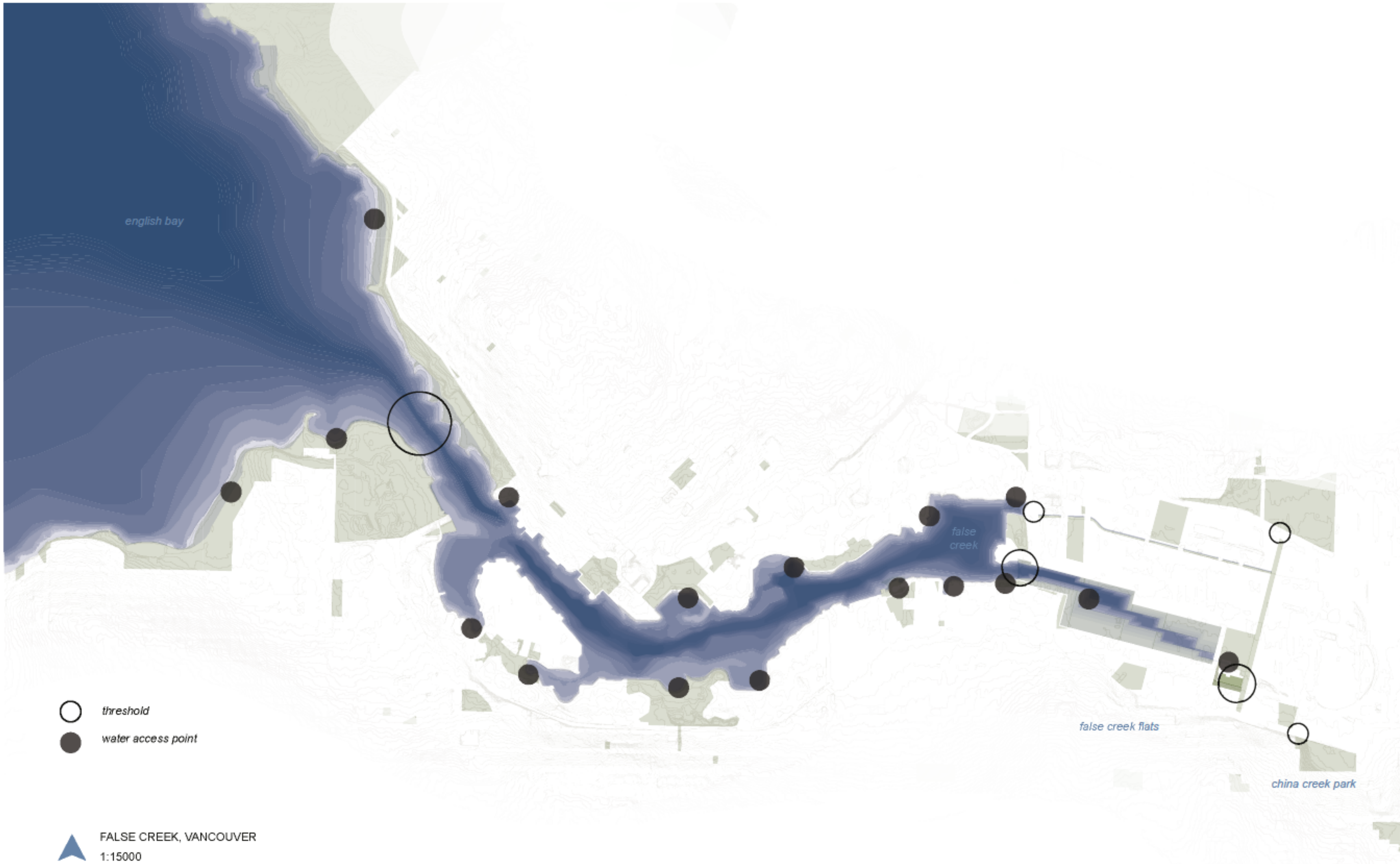
Actors and Programs

By learning more about the flows of people and water throughout history in False Creek, it confirms that the Flats are a fertile site for redevelopment. Moreover, it reveals that the site needs a reconnection between the fresh water to the east and the salt water to the west to help re-establish flows of people and water in order to educate inhabitants about the history and thoughtfully harness the natural resource that is stormwater.

The actors at play on the site are water and people. The water in the Flats represents the different increments of time. Tidal saltwater, which comes from the ocean to the west, changes daily. Fresh stormwater, which comes from the land to the east, changes seasonally. Brackish water occurs where the salt and fresh waters mix.

The people on the site represent multi-generational families, from childhood to adulthood and old age. This project is designed for a child, such as my niece, who is a visitor of the city, impressionable and needs the city to exist beyond sea level rise and climate change. Accompanying her are her grandparents, who are retired and downsizing in the city. They seek a neighbourhood that is accessible as they age and allows them to be in close proximity to nature as they are eager to enjoy the landscape as they never knew it in their lifetime. As an adult and architect who resides in the city, I redesign the Flats in order to make a change that will last for generations.

The current and future water on the site is the key design strategy. The quantities of water that the Flats deal with



Map of entire False Creek with master plan of the Flats, showing the connection re-established with China Creek and the relationships between green spaces and water includes seasonal precipitation changes, daily tidal changes, and yearly storm events, and therefore the strategy of reconnection must address each of these types of water flows.

China Creek, the stream at the south-eastern most corner of the site, contributes to 70% of the total stormwater that feeds into the Flats, due to the shear size of its collective tributaries. The southern side of the Flats has four stream outlets, which in total makes up approximately 90% of the stormwater on site. This side of the site also has a large and steep slope, which impacts the quantity of stormwater that flows into the Flats. Comparatively, the north side of the Flats has five stream outlets, however due to their short flows and relatively low topography, they contribute to less than 10% of the stormwater on site.

Precipitation quantities fluctuate drastically in Vancouver and depend on the season. The summer months – July, August, and September – experience the lowest amount of precipitation all year. The winter months – January, February, and March – experience the highest amount of precipitation, which is nearly four times that of the summer as it rains almost every day.

In terms of saltwater changes, the tide rises and falls twice daily. The two-metre difference repetitively hides and reveals the ocean floor and is a space shared by both marine life and humans.

These different types and flows of water are the basis for the programs on the Flats. A stormwater treatment facility is not only where the stormwater is processed and cleaned before it enters the site, but it is also where people and water intermingle. A café rests atop the stormwater facility

Map of False Creek Flats showing existing context and the subsequent actors that will use this project for people to gather and rest. A series of pools throughout the site is connected to both the stormwater facility and the ocean and becomes the location for saltwater and freshwater to mix, which helps to re-establish the fertile estuary conditions that once occurred on the Flats.

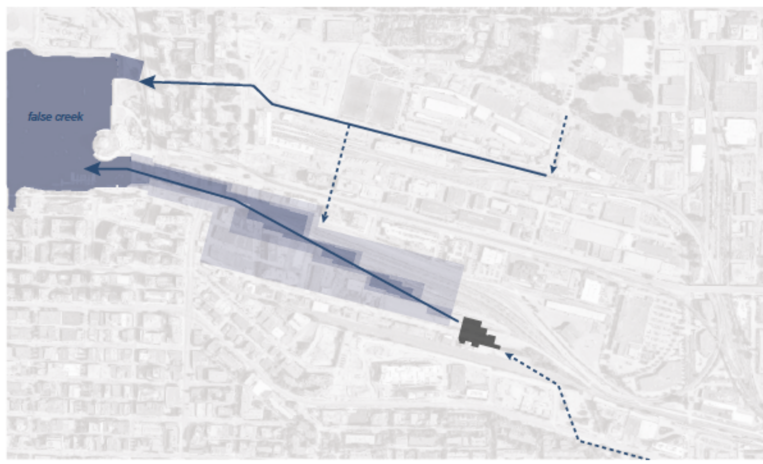
Master Plan

The ways in which water flows establish the movement patterns of both people and water on the site of the Flats. The flow of a meander creates different edge conditions of soft and hard materials that form a pattern of inhabitable niches. Levees develop in similar ways, with erosion and deposition of materials to create new edge conditions at various elevations. Both meanders and levees enable circulation, establish thresholds, and form moments of containment.

The master plan links the saltwater of False Creek to the freshwater of China Creek. The strategy moves east to west to increase cross-community connection. This creates a public corridor for the movement of people in addition to the movement of water. Three types of connections are made in the Flats: a green connection, a water connection, and a human circulation connection.

Green refers to the public park spaces on the site. A path created for pedestrians and cyclists along the water on the south side of the site becomes an extension of the Seawall. This connects to the north side of the site, where there are secondary water elements. Additionally, there is a park corridor that houses community gardens loops through the site of the Flats. This connects the north and south sides of the site and occupies the space where the old railway was located. These green elements expand on the community

The following site diagrams show circulation according to green, water, and human flows. In the above diagram green spaces are shown, including parks, greenways, and community gardens.



Water spaces include the constructed pools, and channels, and flood zones.

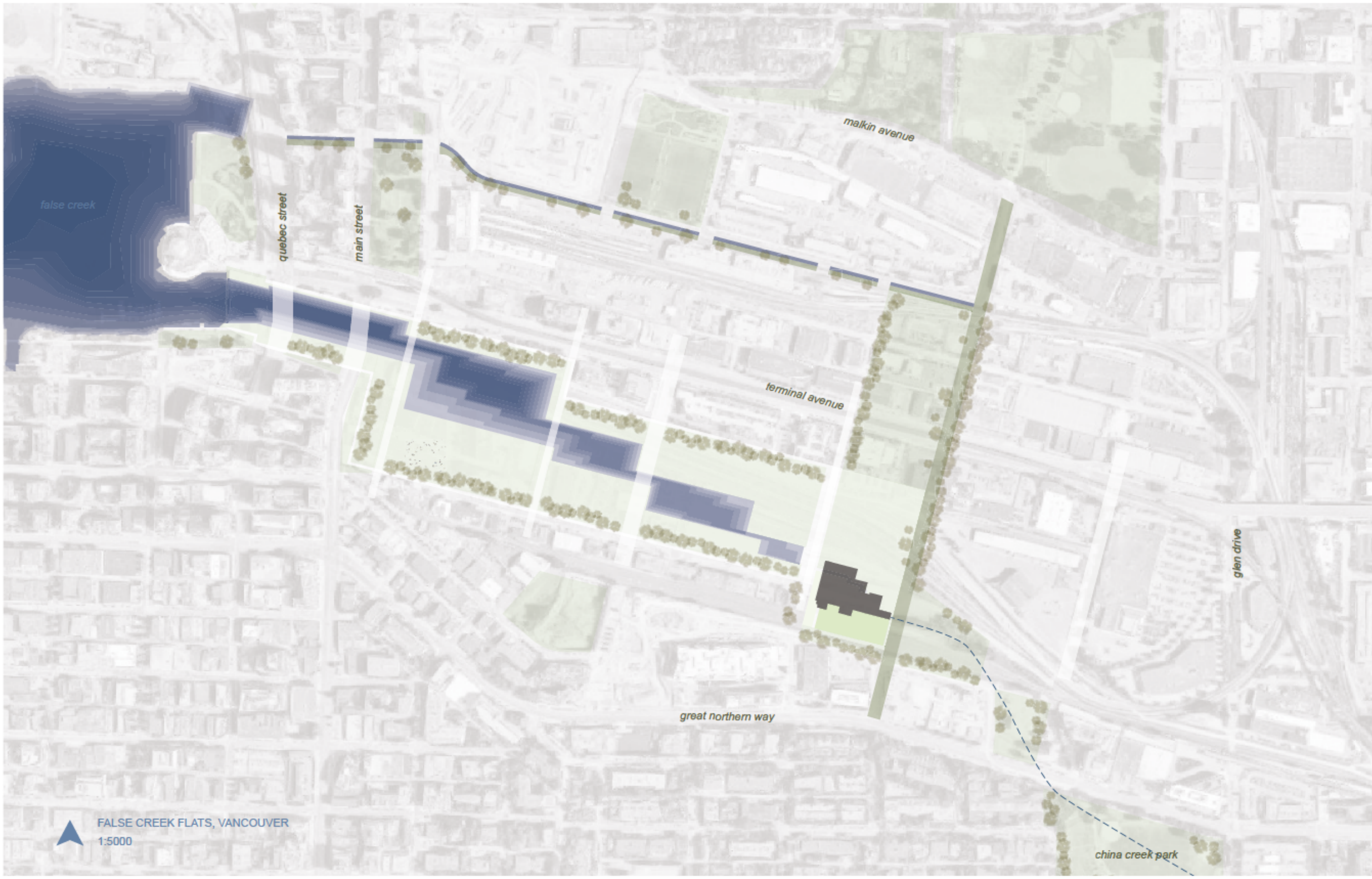
Human flows consist of vehicular, bike, pedestrian, and rapid transit and is comprised of elements both above ground and on the ground.

gardens and public parks that are already established around the boundaries of the Flats. Participation in the existing gardens and recreational spaces have fostered a sense of connection in a dense urban neighbourhood. Within the Flats, there are no green spaces, so this connection needs to be established from north to south.

The main water elements on site are the series of pools that interlock connect the outlet of China Creek to False Creek. A secondary water route on the north side of the site addresses the excess stormwater. This incorporates water features like fountains and small ponds. Together they connect the north and south sides of the site through the use of the same elements at different scales. On the south side of the site are the large-scale pools because the majority of freshwater in the Flats comes from China Creek. On the north side of the site are small scale fountains because of the smaller streams. Moreover, the north end of the Flats has more established architecture and community spaces that align with the overall goal of community connection.

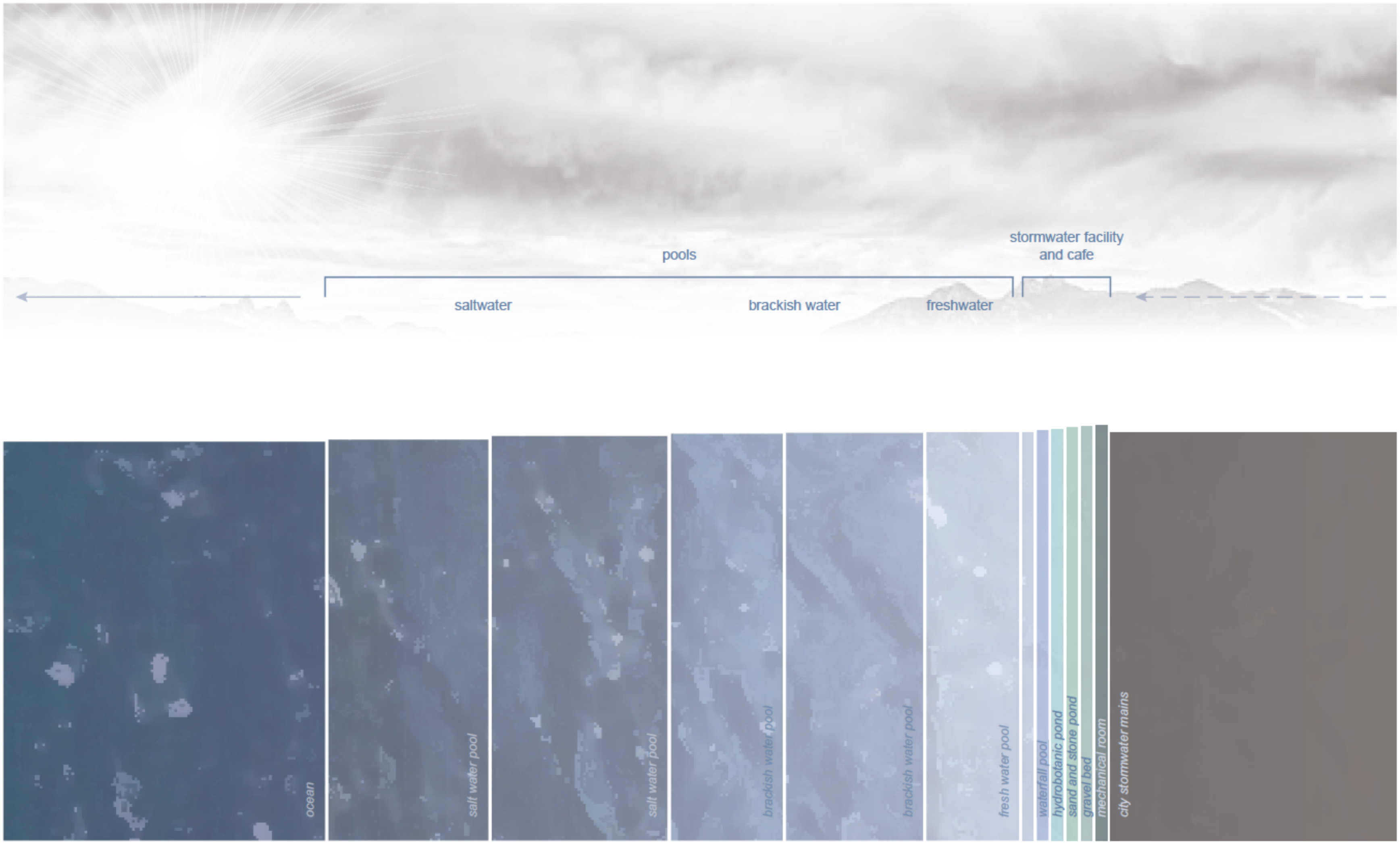
Human connections are the vehicular transportation around the Flats. This is a series of bridges that run north-south across the site. These bridges are architectural elements that enable the circulation of people in all directions on the site. Since green and water connections predominantly concern movement of people east-west, crossover elements are therefore required. This considers the movement of vehicles as well as pedestrians and cyclists. Quebec Street and Main Street are vital vehicle routes, so those are maintained in bridge form. Within the middle of the site, there is only one vehicle bridge established that runs north-south. This is because there are not any pre-existing main roads that run north-south through this area, and there is no need to

Site plan of the Flats showing inner edge of water in the pools. This level of water occurs during low tide and in the drier summer months.



Site plan of the Flats showing middle edge of water in the pools. This level of water occurs during high tide. It allows the tide to rise up to 3 metres.

Site plan of the Flats showing outer edge of water in the pools. This water level occurs during storm events that bring large quantities of precipitation as well as potential tide rises. The outer edge protects up to 5 meters in elevation.



Long section diagram from west to east showing the progression of water types in the Flats proposal

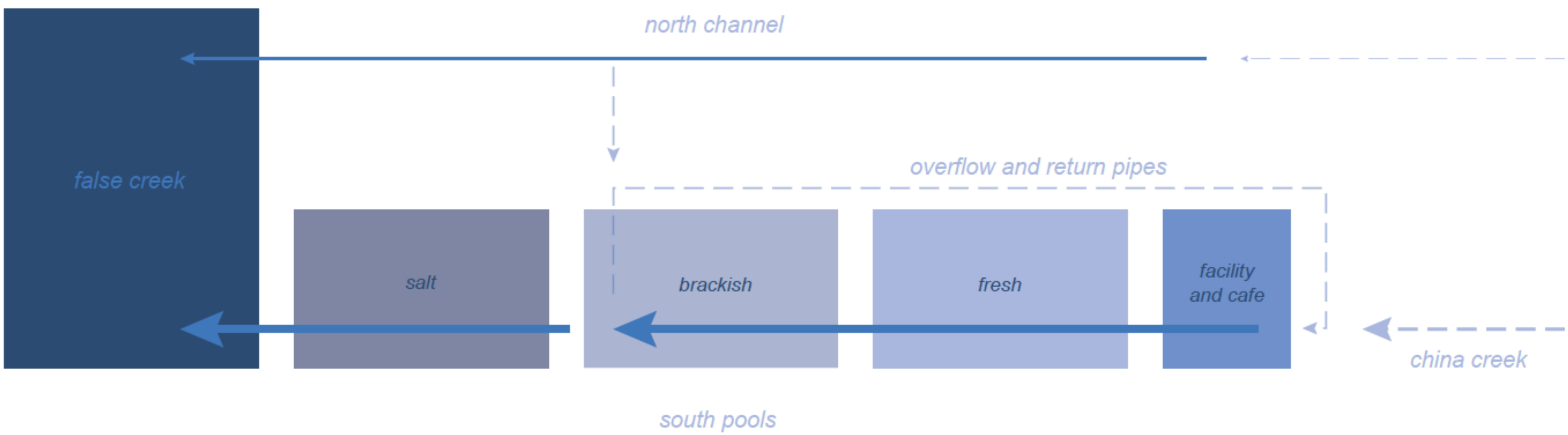


Diagram of water system on the site of the Flats. The water system is broken down into circulation - flows of water - thresholds - pauses between each transition - and containers - the individual pool programs.

North-south cross section of the Flats showing the relationships between water and parks, and existing and proposed buildings. Three edges of water containment are shown.

introduce more as the point is to create a neighbourhood that is centered around pedestrian and cyclist movement.

The master plan employs the use of angles to create connections between all areas of the Flats. Angles are an architectural translation of the curves formed by the movement of water, such as meanders with their point bars and cut banks, and levees with their dual slopes.

The overall composition of parks and gardens on the site is made up of three branches – two that run parallel to each other, and one placed at an angle that connects them all together. This intersection of branches creates oblique and acute spaces for public connection. Within the community gardens, the planters are arranged so to facilitate dynamic movement along the route, which forces people to meander through the public gardens.

Angles are present at the bridges in order to elevate segments so that boats and people pass underneath while vehicles and cyclists cross overtop. Angles are also visible in the details of their construction. The short spans of trestle bridges use repetition of angles to support the structure. Bridges require simple and complex angles to be structurally sound. This also helps them to encourage visual engagement. On the site, the bridges cut across north-south, which intersects the other directions of circulation established by the green and blue elements. Therefore, the bridges create angles within these intersections for inhabitation and public space. Angles create both dynamic movement and niches for reprieve. The change in angles create a juxtaposition between narrow and wide spaces; they act as a threshold that controls the amount of people and water that flows through a space. Not only do they dictate flow, but they also control containment.

The circulation of people and water is the primary goal of this intervention on the Flats. The green, water and human circulation elements connect all sides of the site through different modes of transportation and movement patterns. This holistic circulation of people and water makes the site used more frequently and regularly because it draws on all directions and types of movement. The intersection of these elements creates spaces for public and private programs to develop, which shows that diversity of circulation is a catalyst for diversity of community. Therefore, the establishment of thresholds because of the intersections of modes of circulation is equally as important as the circulation itself.

Natural and architectural interventions on the Flats manipulate the landscape in order to create moments of containment on the site. These are moments that contain both water and people, as they are two entities that constantly evolve. Containment areas are adaptable spaces that highlight the change in time and experiential nature of water and people.

Angles are used to create a series of pools that connect from China Creek to False Creek. This mimics the natural formations that occur due to the movement of water, such as meanders and levees. Within these pools the changes in water height reveal three different edge formations. When there is high tide, the water fills the channel and leaves the pools with a uniform edge. When the tide is low, the water recedes to reveal a varied architectural shoreline. In the event of a storm, with high precipitation and sea level, the water overflows into the floodable plazas and green spaces. The three different edge conditions are influenced by the shoreline typologies that exist along False Creek – the retaining wall, the rocky slopes, and the beaches.

Parks are moments of both threshold and containment. They are adaptable spaces that serve as reprieve from circulation throughout the city, and have the ability to hold water and people. In instances of dry weather, parks contain more people than water, they are areas where city dwellers gather, formally and informally. On occasions of precipitation, these green spaces serve as rain gardens, and absorb water primarily rather than people. In the event of high precipitation and even flooding, these green spaces adjacent to the pools become areas of overflow for water. The parks on the Flats contain water and people in different capacities, in different weather events.

Pools and parks are thresholds that are adaptable to different capacities of people and water, which makes them containers. Additionally, in order to contain people and water, they require elements that limit or slow down movement. For people these are elements that draw people in, like benches, tables, views, and shelter. In the case of water, these are boundaries that restrict the extent of flow, like walls and slopes. The benefit of adaptable public spaces is that they facilitate connections between different actors that otherwise would not share the same space. This increases opportunities for education and awareness of natural, cultural, and technical processes.

Chapter 6: Building Design

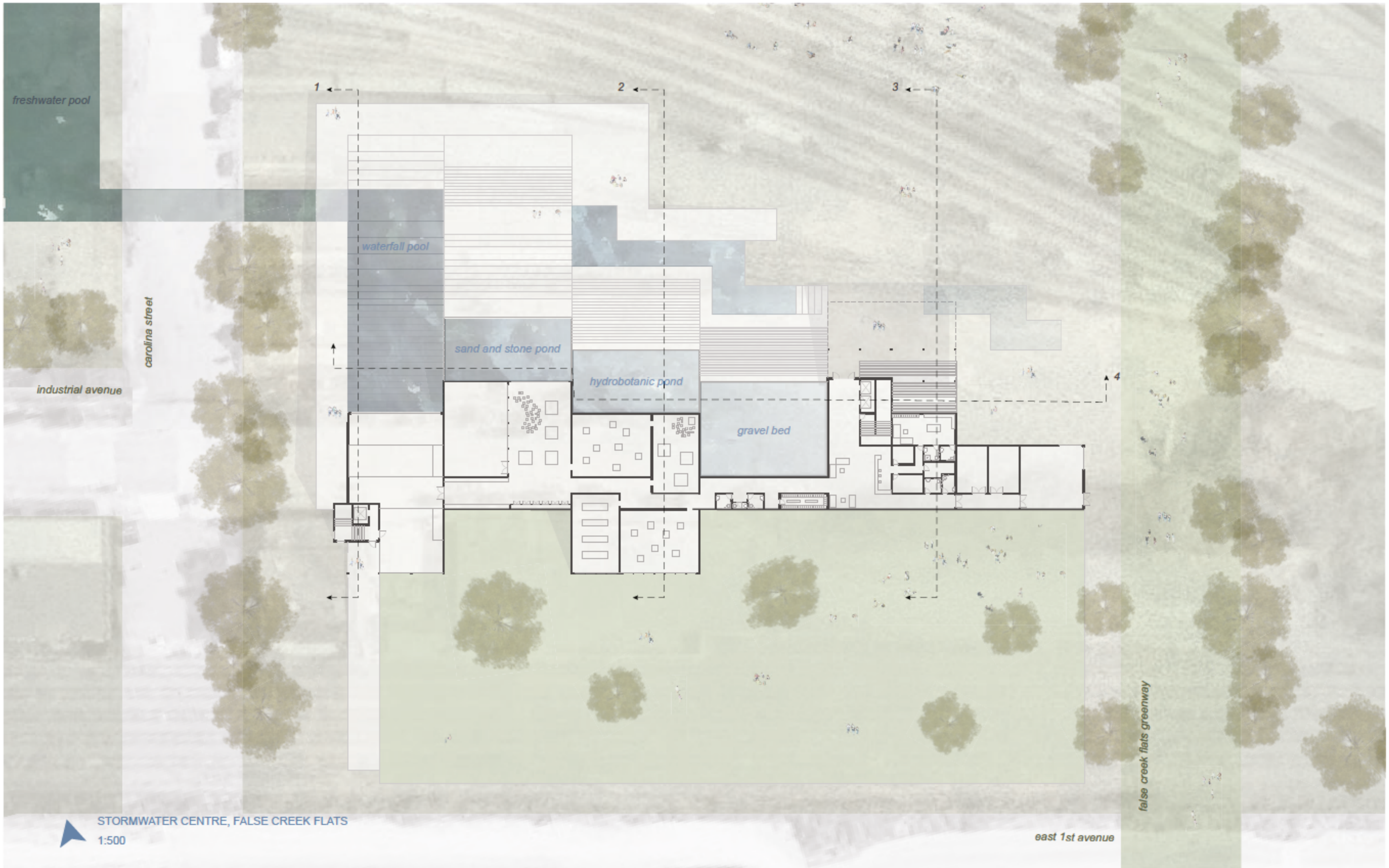
Architectural Form and Flows of People and Water

On the site scale, the main architectural form comes from the manipulation of the topography. The ground becomes a place for water and people to move, gather and rest. At the building scale, these components of circulation, threshold, and containment are also visible in the architectural form. In addition to the ground element, the building is composed of anchor and frame elements. Altogether, these three elements create a harmonious structure whose design speaks to the natural and cultural history of the Flats.

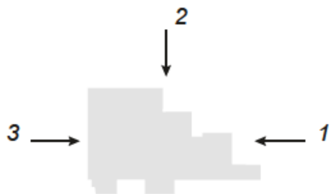
Design elements are used at three key moments on the site to implement programs of movement and rest for the community. The design elements, derived from the research of False Creek and public spatial design, become the site materials. The key moments each highlight a different type of water harnessed on the site – salt, brackish, and fresh water. The programs facilitate community engagement through different uses of circulation and threshold. The design elements influenced by the history of False Creek create a juxtaposed material palette. These a broken down into ground, anchor, and frame elements.

Photograph of South False Creek Seawall rockwall (Vancouver Engineering Services 1978-1983b)

The ground elements are made up of both porous and non-porous materials: earth and concrete. The boat launch, the topography of the marsh, and the stormwater facility are all sunken into the ground. In this project they are synonymous with the ground surface, whether it be natural or architectural. Inspiration is taken from the natural and urban edge condition of False Creek. The earth is from the sand, rocks,



Building plan of Stormwater Facility on ground level



View 1 of east elevation of Stormwater Faciltiy

View 2 of north elevation of Stormwater Faciltiy

View 3 of west elevation of Stormwater Faciltiy

Photograph of China Creek Gully (Matthews 1936)

and vegetation that occupied the original shoreline of False Creek, and still remains in select portions of the coast. The concrete and stone take inspiration from the natural cliffs of the shoreline and the modern composition of the Seawall. The ground elements have the ability to contain water and people.

The anchor elements are directly connected to the ground. They rise above the ground as vertical structures that serve both as mechanical and circulation cores for the stormwater facility. Although there are paths of meandering circulation around the perimeter of the building, these anchor elements provide more direct access between the different elements above and below. They move people in a variety of ways, up, down, and through, in order to physically create accessibility, and to visually anchor the building. Despite their rigid appearance, the anchors foster a variety of flow patterns, which mirrors the different patterns seen in the meanders and levees. The anchor elements provide circulation for people on the site.

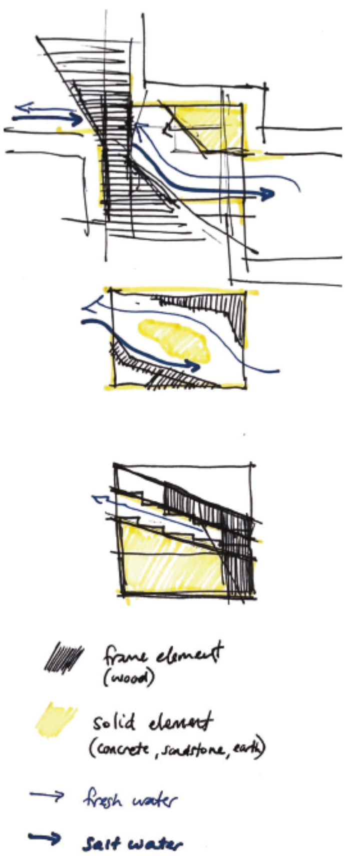
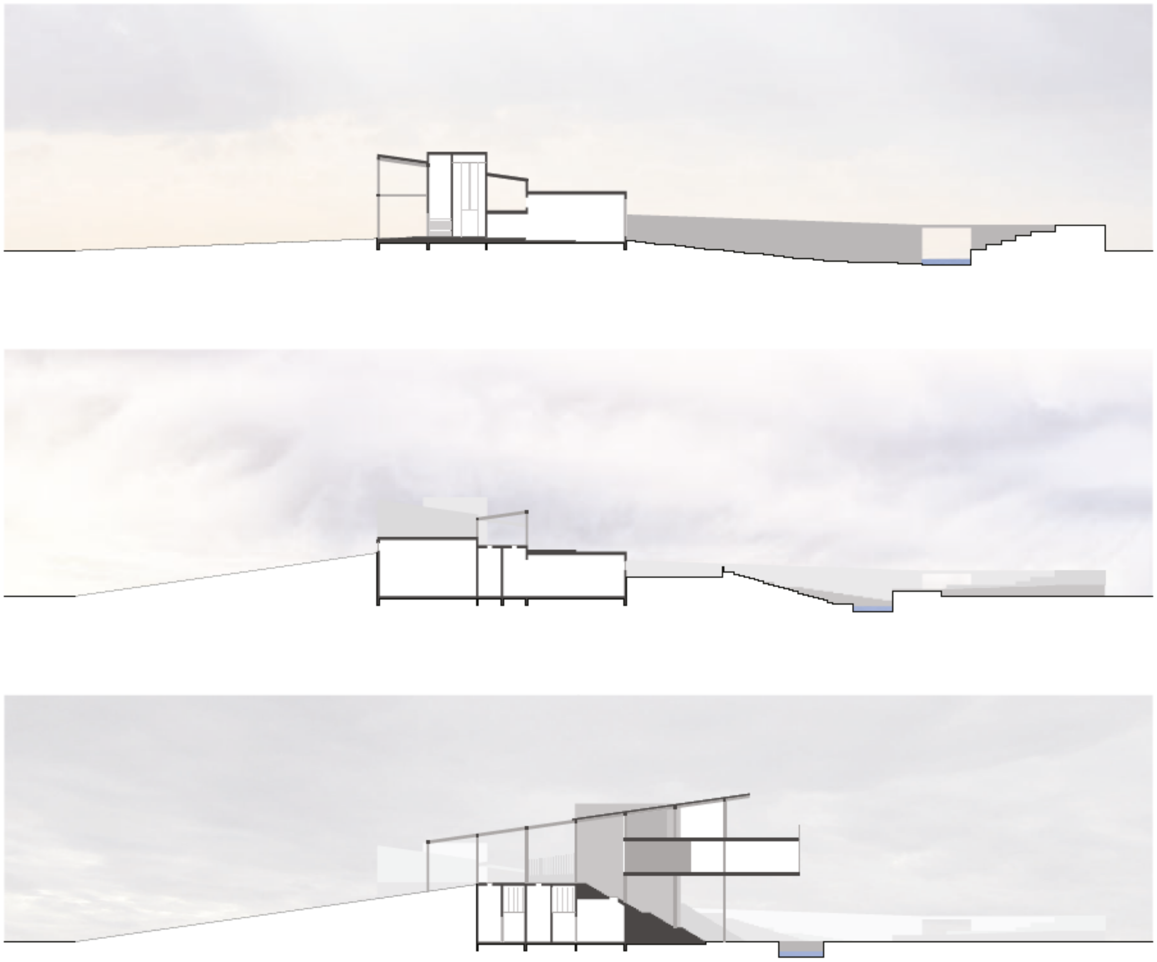


Diagram of solid and frame elements used on site

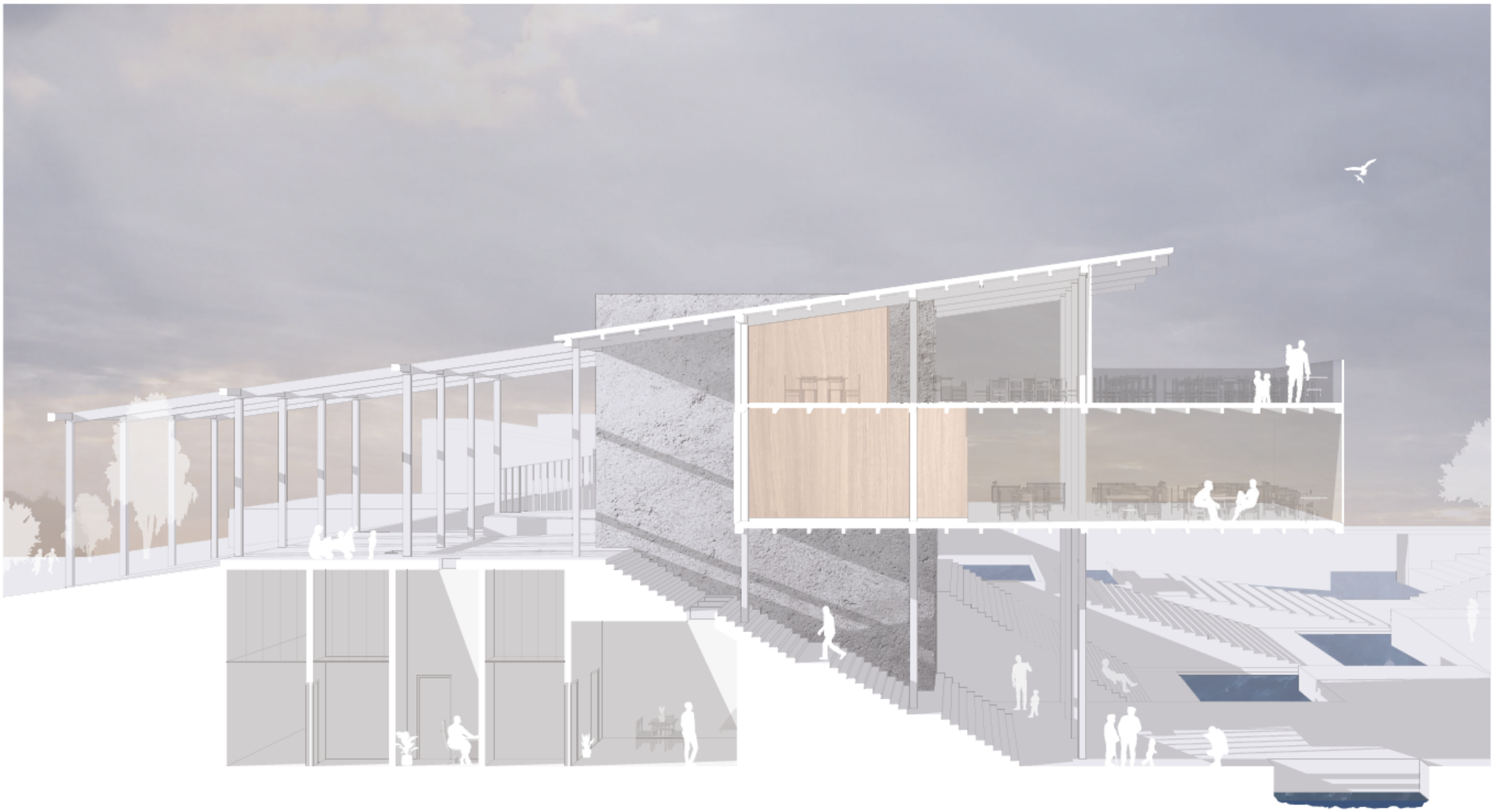
Similar to the ground elements, the frame materials have porous and non-porous counterparts: wood and steel. These are above-ground elements – the bridge, the boardwalk, and the café are all raised off the ground. They rise above the ground, or hover over the water, but in all instances, they are elements detached from the ground surface, connected only by the anchor. Inspiration is taken from the wood and steel construction along False Creek throughout history. Primarily, the wooden and steel trestle bridges that crossed the water in the late 19th and early 20th centuries. Additionally, the larger steel and concrete bridges that replaced these first bridges in the mid-1900s to accommodate advancements in vehicular transportation and the increase in population. The frame elements are moments of intersection and reprieve: they are threshold moments on the site.

This combination of material and form influences the programs within the site. Some elements focus on the circulation of water, whereas others focus on the circulation of people. The bridge circulates people across the pool, so that the north and south sides of the site are easily reachable. The boat launch circulates water under the pool. It shows the circulation of water through the tidal fluctuations against the boat launch slope. The terraced steps are only usable by people at certain times of the day. The boardwalk circulates people above the pool. It encourages passive connection of people to water through visual engagement and proximity. The lack of access to the marsh limits the circulation people to around the pool. This zone is more focussed on the circulation of water than people, as it acts as a boundary between people and the brackish ecosystem. The café circulates people above the pool, which creates viewpoints down the newly constructed channel to False Creek. The stormwater facility circulates water into the pool – it is the outlet for the filtered freshwater into the network of pools. Through its architectural form, the facility also circulates people to the café.

The elements that focus on the circulation of people connect people to water visually – they provide a vantage point of each pool that otherwise is unavailable. Some of these elements also demonstrate qualities of threshold. The bridge, boardwalk, and café are all elements that water moves under. They are also elements that people move over, and in some instances, even move under. It is important to have these elements of threshold to create moments of engagement on the site. Circulation is important, but



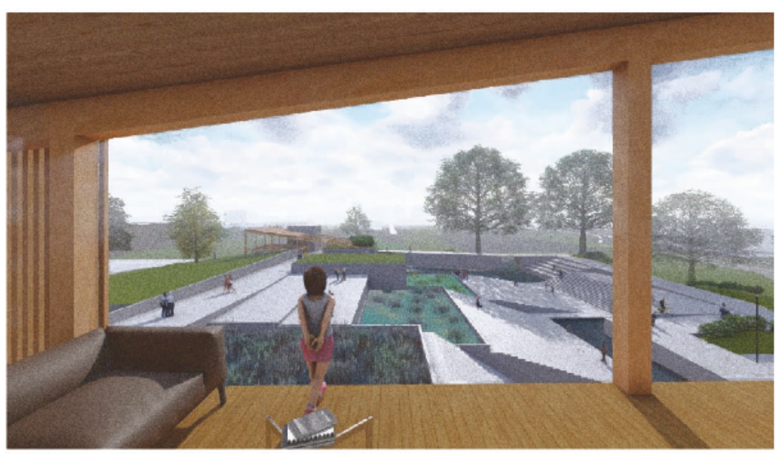
From top to bottom, building sections 1, 2, and 3 through Stormwater Facility showing ground, frame, and anchor elements



Building section through recessed Stormwater Facility and elevated cafe, showing inhabitation below, on, and above the ground plane

Perspective view 1 standing on top of the Stormwater Facility path looking west

Perspective view 2 standing underneath Cafe with view out towards ponds and up towards the green roof



Perspective view 3 from inside the Cafe looking out to the gravel bed, hydrobotanic pond, and sand and stone pond moments of reprieve are also imperative to create public space for the community to rest, gather, and learn.

The largest point of community engagement on the site is at the stormwater treatment facility. This is not only where the stormwater is purified – a key program in and of itself – but it is also where lessons are taught to the community about the process of this water filtration. Children also learn about the history of False Creek and the Flats so that the presence of water is ingrained for future generations. The café supports the stormwater facility as a place for the community to gather. Parents and grandparents come to wait for their children in stormwater center, while cyclists and pedestrians along the pools come to enjoy a break of food and water. The intersection of circulation and threshold elements is important in the creation of public programs that focus on community history and community future.

Water Forms and Systems

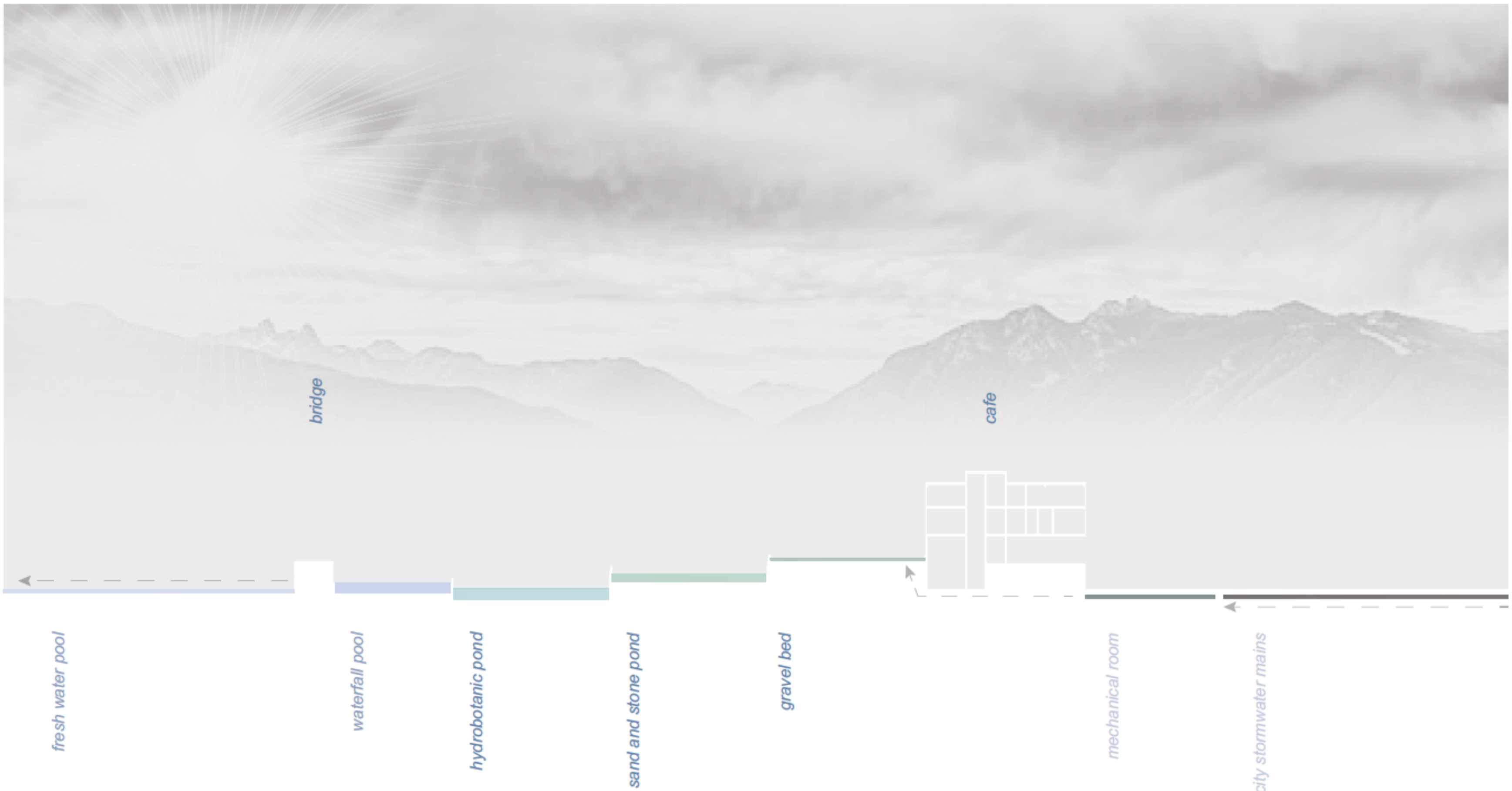
The system of water within the Flats fosters a place for education and community. The entirety of the Flats is a learning centre of the community to discover the rich and powerful qualities of different types of water. Each type of water on the site serves a purpose for the community, whether it is social or ecological.

The design elements are implemented at three key moments to dictate architectural form. The three key moments on site are salt, brackish, and fresh water because they represent the natural connection between the saltwater ocean and the freshwater creeks. Furthermore, the brackish water recognizes the erased marsh ecosystem of the mudflats. These three water types are also utilized in different ways: the salt pool is a space to show off the daily evolution of the tide; the fresh pool demonstrates the seasonal precipitation quantities; and the brackish pool shows the impact of both of these changes in time.

Over the saltwater pool is a steel bridge. It borrows its design from the historic trestle bridges that once crossed False Creek. These short spans create an intricate design for a simple structure. The rhythm of repeated elements mimics the rhythm of the ocean tide and river current. A boat launch is part of the concrete ground plane in the saltwater pool. The slope descends into the water at a low angle, so that the rise and fall of the tide is dramatically visible throughout the day. There are portions of the slope that are terraced to allow people to gather as they watch people on the water, or to rest after they finish on the boat launch.

Over the brackish pool is a wooden boardwalk. The idea is taken from the wooden docks that populated the industrial False Creek shoreline. The natural material of wood is apt for the natural landscape of the brackish pool, and its low profile disappears into the environment. Within the brackish pool is the earthen substrate of the wetland. The vegetation that once inhabited the False Creek mudflats is returned to this pool. The topography is reconstructed to channel the flow of water around a small island – meanders within the pool create sheltered areas for different parts of the ecosystem to thrive.

Above the freshwater pool is a café lifted on steel and wood. The design is inspired by the trestle bridges; the repetition of supporting and spanning elements extends up from the ground to create a framework that cradles a café. From the earth rises the stormwater facility with a green roof. Within the concrete structure is housed the water treatment



Building section diagram showing the different steps in processing the water before it moves west into the pools machines – pumps, testing rooms, filters, collection and distribution pipes, and a storage tank. On top of the concrete structure there are two different roof conditions. One side is a low-sloped green roof that descends to meet the ground. The other side also slopes down into the ground; however, it is comprised of a series of pools that filters rainwater down.

The water comes into the building from the city stormwater pipes on the east end of the site. The grey water enters the mechanical room where larger debris, such as leaves and garbage, that has fallen into the street drains is removed and recirculated into the civic waste pipe network. The water is then ready to enter the natural filtration system within the building. The water is pumped into the first stage of filtration: the gravel bed. This area uses sprinklers to trickle the water across a gravel and sand substrate. Gravity causes the water to move downward, and the different sized particles filter out small debris (Delft University of Technology n.d., 83). Once the filtered water has made its way through the substrate, it is to onto the next stage. The second stage to clean the water is the planted hydrobotanic pond. This is a shallow pool of water that utilizes vegetation to purify the water. After the first pond the water is gravity fed into a deep sand and stone pond. Here, the vegetation is fully submersed, and microorganisms like zooplankton clean the bacteria from the water (GH3 2018). The water is then drained into the testing room, where its cleanliness is approved before it enters the rest of the site. From the testing room, the water is pumped outside into the waterfall pool. This is a gently stepped exterior room that descends down to connect with the network of pools on the rest of the site. By this point, the water is clean enough for people to swim.

The initial greywater room and testing room are the stages of the system that are located internally to the building and involve mechanical intervention. The testing room is on display to the visitors of the education center to highlight the technical system components. The gravel bed and two ponds are exposed on the exterior of the building. They are visible along the pedestrian pathway that circumferences the building. They display the natural processes of water filtration and purification. The gradient of water environments that each of these exterior rooms showcase mirrors the different pools that are visible on the larger site. This building acts as the headwater to the water system on the site of the Flats. It captures, purifies, and releases water, which creates useable urban rooms of water for both human and natural ecologies.

The stormwater building controls the freshwater that flows into the pools, mixes with the salt water, and flows out into the ocean. In this way, the stormwater building is the main threshold within the project. The pools and their three edges are the main containment elements of the project. They utilize the natural topography and build up architectural edges to determine the extent of water flow within the site. These spaces adapt over time to accommodate different levels of water as well as different groups of people. The infrastructure that transports the water to and around the site are the main circulation elements. These are comprised of the city stormwater pipes that enter the building to the east, and the overflow and return pipes that reroute water from the north side of the site to the building.

Time

The revitalized Flats is a place for all generations to engage with and learn from. With the procession from the stormwater facility to the ocean, people of all ages and backgrounds experience the changes in water that the Flats reveal. Children, like my niece, experience the stormwater facility through day visits and class field trips. The café is a place for family and friends to congregate on their mid-day excursion. Passersby and tourists alike run, bike, and paddle along the pools and Seawall on site.

In various weather conditions, the Flats are activated in different ways. The three edges of the pools put the impacts of water fluctuations on full display. The exterior of the stormwater treatment facility is a spectacle in the rainy winter months and a playful destination in the dry summer months. As the years pass, and generations age, the pools and stormwater treatment facility only enhance the educational opportunities. The Flats are a living water experience in the center of urban Vancouver.

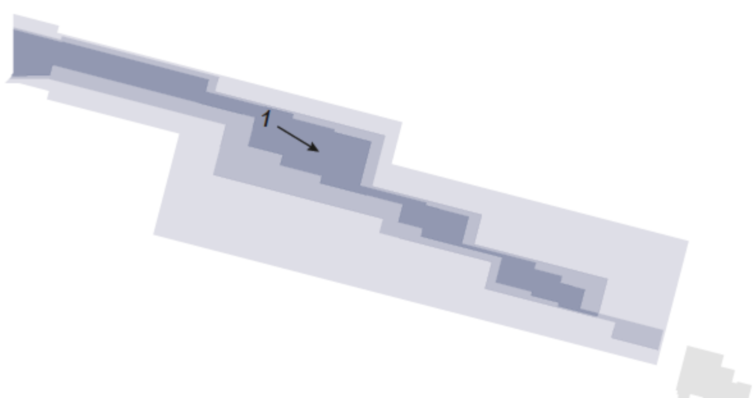
Perspective view from northwest corner of site, with the ponds of the Stormwater Facility full of water due to high precipitation

Perspective view from northwest corner of site, with the ponds of the Stormwater Facility with low levels of water due to dry weather

Chapter 7: Conclusion

The progression of time, as shown through the history of the Flats, can change drastically within a few generations, erasing water and its important processes from the site and our memory. Over time, the natural environment that was once a productive estuary zone was covered up by industry. Just as time affected the Flats in this negative way, time has the ability to also return some of these estuary conditions, if the landscape is given the right circumstances. This thesis returns natural water processes to the Flats to catalyze change both within the community and the environment, which provides conditions for its evolution over time. The adaptable edges and the different quantities of water that the site accounts for reinforce fish, birds, and plant species as well as bring back various people and customs. Fertile conditions are not only productive for wildlife, but also draw in other actors. The intersections of the various ecological and cultural actors with urban infrastructure creates moments of community engagement amongst the ever-evolving circulation of the city. Flows of people and water within the Flats are coordinated to foster vibrant thresholds and fertile moments of containment. These moments of circulation, threshold, and containment become sites for intersections of human ecologies with natural ecologies, which makes them ideal education opportunities. Education of the natural and cultural past, the climate change of the present, and the infrastructural innovations of the future will highlight the importance of the landscape for generations to come. Not only does this project re-establish a fertile landscape but it is also a springboard for opportunities of future land renewal and development. Public space and its supporting architectures need to both adapt to the temporal-spatial challenges of change and bridge between the built and natural environments. This project sets the precedent for any development within the Flats, as a typology of public programming and architecture that combines blue-green spaces with technical innovations and natural processes, which creates a more sustainable community for the increasingly dense centre of Vancouver. The renewal of the Flats harnesses the temporal power of Vancouver's water to complete the natural system and service the community, which creates a new mode of city-dwelling in the time of climate change.

Perspective view from the water looking east towards the Stormwater Facility



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