Building ecoSystems Integration: An Approach to Building with Nature

by

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CONTENTS

ABSTRACT

This thesis investigates the relationship between architecture and nature and is positioned with the understanding that human beings are not separate from nature and therefore, our processes of design and construction are tied to nature. Humans are one of many species operating within a given ecosystem and recognizing that we - and our processes of design and construction - are a part of that natural system is fundamental to the design process.

In its design and construction, architecture can act to nurture the healthy functioning of the ecosystem as a whole and reduce the destructive impacts of current design and construction processes. Investigating perceptions of our relationship to nature will be tested through the design of a community centre on a site adjacent to the recently restored salt marsh in Cheverie, Nova Scotia. The method for designing aims at addressing issues of perception, education and mediation in an attempt to structure healthier relationships between people and the land they inhabit.

ACKNOWLEDGEMENTS

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CHAPTER 1: INTRODUCTION

Thesis Question

How can architecture construct more synergistic relationships between people and the natural environment?

Overview of Thesis

The interest leading to this thesis began when the community of Cheverie, Nova Scotia (Fig. 1) declared their intent to build an interpretive centre adjacent to the recently restored salt marsh. It seemed counter-intuitive to build on such an environmentally-sensitive site in a larger effort to promote the preservation of these sites. This prompted me to question the role of the architect in this scenario - is the appropriate response to quarantine/preserve of these sites or to investigate a different approach for building around these sites?

● Cheverie, Nova Scotia

Fig. 1 - Map of Nova Scotia. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

To this end, this thesis proposes a design method for the integration of construction and human activity into the eco-cultural fabric of a given site. This requires analyzing our human position within the larger ecosystem and looking at the natural environment as a system in which we play one role in relation to many others; the flourishing of the entire system requires a symbiotic relationship between all the elements and organisms involved.

This will be tested in the design of a community centre adjacent to the recently restored Cheverie Creek Salt Marsh in Cheverie, Nova Scotia (Fig. 2).

------- Salt Marsh Boundary

Fig. 2 - Panorama of site adjacent to the salt marsh and Bay of Fundy.

Ecological Design

> What is wrong with our culture is that it offers us an inaccurate conception of the self. It depicts the personal self as existing in competition with and in opposition to nature. [We fail to realise that] if we destroy our environment, we are destroying what is in fact our larger self. [1]

European settlement in North America came accompanied with the perception that man is separate from nature. These perceptions are deeply embedded in Western cultural tradition and evident in our built environment. Primary consideration is typically given to the economic, political, and social implications of design and construction with the environment being considered last. As the climate crisis becomes increasingly urgent and with natural resources rapidly disappearing, the “green movement” is gaining momentum and more emphasis is being placed on renewable energies and sustainable technologies. As important as it is to address the sustainability of buildings as objects, it is equally important to address our own social values and perceptions. In *Ecological Design*, Sim van der Ryn and Stuart Cowan state that design is a manifestation of culture, and culture “rests firmly on the foundation of what we believe to be true about the world”.[2] This would mean that technology and design are not solutions in and of themselves, these are simply tools. A shift in our perceptions concerning our relationship to nature is required first and foremost and subsequently a shift in our perceptions of how design and technology can reflect an acknowledgement of our interdependent relationship with any given ecosystem.

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[1] J. Kelvin Richards, *Social Ecology: A Discourse*, last modified October 2011, http://www.kelvynrichards.com/.

[2] Sim van Der Ryn and Stuart Cowan, *Ecological Design*, (Washington, D.C.: Island Press, 1996), 24.

Ecology is broadly defined as the study of relationships between organisms and their physical surroundings. Using ecological principles to study any given natural environment not only changes the way that environment is perceived - as a series of intderdependent elements/organisms functioning together as one whole system - but also presents an opportunity to reconsider our role within that environment.

> Culture - a system of shared beliefs, values, customs, behaviours, and artifacts that members of a given society use to cope with their world and with one another, and that are transmitted from generation to generation through learning.[3]

The term ‘culture’ is typically applied in description of human beings; however, natural environments can be considered to have culture in the same way. Over millennia geologic and climatic processes create dynamic environments that support multitudes of plant and animals species. In this sense, natural environments can be analyzed in the same manner that our built environment are analyzed, for example: demographics and infrastructure. Each individual element has a specific role to play and is necessary for the healthy functioning of the entire system.

Identifying the Connection Between the Individual and the Whole System

A trophic cascade is an ecological term that describes a phenomenon where the addition or removal of a species - typically a predator - changes the behavioral patterns and population sizes of prey which subsequently impacts the flora in a trickle-down effect. This effect changes the entire ecosystem structure.[4]

This phenomenon is indicative of the interdependent nature of relationships between species and elements within the natural world. Any one species does not exist independently of any other - each affects (directly or indirectly) and is affected by the others. A change in one species can instigate changes in the way the entire system operates. This phenomenon can be observed within the built environment. Building development does not have an effect on our populations alone but has an impact on the whole ecosystem. In a cascading effect, this type of ecosystem transformation occurred on the thesis site, the Cheverie salt marsh, when the Cheverie Creek causeway was built in the 1960s, which will be discussed in a later chapter.

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[3] Herve Varenne, *The Culture of Culture,* Accessed April 2014, http://varenne.tc.columbia.edu/hv/clt/and/culture_def.html.

[4] Stephen Carpenter, *Trophic Cascade*, last modified 2014, http://www.britannica.com/EBchecked/topic/1669736/trophic-cascade.

Methodology

> The real voyage of discovery consists not in seeking new landscapes, but in having new eyes.[5]

The method established for the development of this thesis is based on the understanding that human development is a natural process. In the same way a beaver builds a dam and ants construct ant hills, we build buildings to support our species. This methodology involves re-thinking our role as humans as having a functional role within the larger ecosystem.

> To a large extent, the physical form and the habits of the earth's vegetation and its animal life have been molded by the environment... the opposite effect, in which life actually modifies its surroundings, has been relatively slight. Only within the moment of time represented by the present century has one species - man - acquired significant power to alter the nature of his world. [6]

This methodology requires acknowledging that the ecosystem of which we are a part - plants, mammals, natural systems included - are inextricably linked. To this end, I disagree with Rachel Carson's statement above. Every species, to greater or lesser degree, alters the nature of its world. We as a human species have altered our world at such an unprecedented scale because new technologies have enabled us to do so. However, technology in and of itself is not the culprit - the issue is in our perceptions. Re-evaluating our approach to building in landscape involves re-evaluating our perceptions of our role within the natural world and learning to use ecological principles to read landscapes as a network of interdependent relationships. The intention is to take a more ecologically integrated approach to design and construction in an effort to merge more fluidly into the ecosystem and enable the community and environment to flourish.

Systems

> The stability of an ecosystem depends on its biodiversity; on the complexity of its network of relationships.[7]

Understanding the landscape begins with analyzing the processes by which the landscape supports life. The types of species and organisms that exist on the site are a direct result of and supported by these processes. These systems are dynamic and create an environment that is constantly changing.

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[5] Marcel Proust, *The Prisoner and the Fugitive*, trans. by Carol Clark (London: Allen Lane, 2002), 149.

[6] Rachel Carson and Lois Darling, *Silent Spring* (Boston: Houghton Mifflin, 1962), 5.

[7] Fritjof Capra, *Centre for Ecoliteracy: The New Facts of Life*, last modified summer, 2008, http://www.ecoliteracy.org/essays/new-facts-life

History of the Cheverie Creek Salt Marsh

The Cheverie Creek Salt Marsh has a history of alteration by human activity. The French Acadians arrived in this coastal area (Fig. 3) around 1685 and built a dyke using a specialized sod-construction technique, drained the marsh and converted it to agricultural land. After the Acadian Expulsion in 1755, the dyke fell into disrepair and the creek eventually eroded through, allowing the marsh to return to its original state.

In the 1960s a causeway was built, cutting across the mouth of the marsh as it opens into the Bay of Fundy. The 1.5m x 1m wooden culvert installed in the road bed on the south end of the causeway restricted the flow of the tides into the marsh. At this time, the incoming tides were only able to cover 4-5 hectares of the original 43 hectare salt marsh.[8] The marsh lost its salinity and the native marsh plants eventually disappeared and fresh water plants invaded. The marsh was no longer capable of serving as a nursery for fish and much of the wildlife that relied on the salt marsh, and food it produced, disappeared.

Fig. 3 - Photograph overlooking site adjacent to the salt marsh and the Bay of Fundy (marsh to the left).

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[8] Tony Bowron, Nancy C. Neatt, Jennie M. Graham, Jeremy Lundholm, and Danika Van Proosdij, *Post-Restoration Monitoring (Year 3) of the Cheverie Creek Salt Marsh Restoration Project (*Halifax: CB Wetlands and Environmental Specialists, 2009), 15.

Marsh Restoration

Plans to restore the Cheverie Creek Salt Marsh began in 2002 when a monitoring program to document the pre-restoration conditions of the marsh was set in place. The purpose of the monitoring was to collect data for comparison during the period of restoration - this included data relating to hydrology, soils and sediments, vegetation, fish, and benthic invertebrates (organisms living in the sediments).[9] The marsh restoration and monitoring was established and carried out by CB Wetlands and Environmental Specialists (CBWES).

In 2005 the Nova Scotia Department of Transporation and Infrastructure Renewal (DTIR), the Ecology Action Centre (EAC), and Ducks Unlimited began construction on the causeway to replace the existing culvert with a much larger one. The larger culvert allowed the Fundy Tides to flow freely into the marsh, once again covering the entire 43 hectares, and the marsh began the process of recovery.

Post - Restoration

It was stated in the 2009 Post-Restoration Monitoring report that the new culvert continues to restrict tidal flow into the marsh with tides greater than 7.11m, which are seen during spring tide and neap tide. However, the “break-out” tide height (flooding beyond the main channel, is approximately 5m. At this height, the tides are able to flood the full extent of the 43 hectare marsh. Post-restoration monitoring also indicated with the increased frequency and levels of tidal flooding have made the marsh more accessible for fish. Observation in changes to water salinity, depth to ground water, sediment accretion rates, soil characteristics and vegetation communities indicate the marsh is responding positively to the restoration. [10]

The Marsh and the Community

The marsh restoration was prompted by school children in Cheverie who became interested in the salt marsh and were motivated to learn more about the ecology of the marsh. The community decided to form the Cheverie Salt Marsh Society with an overall vision to make Cheverie a stop-off for tourists passing through the area and simultaneously educate the public on the ecological significance of the salt marsh (Fig. 4).

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[9] Ibid., 5.

[10] Ibid., 8.

Part of this endeavour involved the construction of nature trails around the marsh and a camera obscura pavilion designed by professor Ted Cavanagh. The camera obscura was built over the course of several semesters by groups of Dalhousie Architecture students with the help of several community members. These developments are part of a larger plan to design and build an interpretive centre adjacent to the marsh for tourism purposes.

Fig. 4 - Panorama overlooking the salt marsh from the nature trail installed by the community.

Ecological Importance of Salt Marshes

> Estuaries in general and salt marshes in particular are unusually productive places. None of the common agriculture, except possibly rice and sugarcane production, comes close to producing as much potential animal food as do the salt marshes. The agricultural crops which approach this high figure are fertilized and cultivated at great expense. The marsh is fertilized and cultivated only by the tides.[11]

Salt marshes are highly productive, self-sustaining systems that also contribute to the larger terrestrial and marine area on various levels. Marsh plants support various invertebrate species that burrow in the marsh mud. These plants also provide food and shelter for a variety of animal visitors and act as nurseries for various species of fish. The vegetation also indirectly supports predatorial species in the area by sustaining the animals they prey on.[12]

Beyond supporting a multitude of plant and animal species, the salt marsh also protects the coastline against erosion, purifies the air and water and detoxifies and decomposes wastes.[13] In rough and stormy weather, the mud and vegetation of the marsh is able to absorb the impact and though parts may be washed away, the marsh is able to slowly recover, collect sediments and allow the re-growth of vegetation (Fig. 5). The marsh border

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[11] John Teal and Mildred Teal, *Life and Death of the Salt Marsh* (Boston: Little, Brown and Company, 1969), 194.

[12] J.P. Doody, *Saltmarsh Conservation, Management, and Restoration* (Dordrecht, Netherlands: Springer, 2008), 9.

[13] Ibid., 57.

is able to reposition itself in response to weather and sea-level rise. [14] This is unlike man-made seawalls or levees that are installed to protect coastlines from erosion and storm surges which require alterations and maintenance sometimes at a costly expense.

Fig. 5 - Photograph overlooking the salt marsh looking towards the Bay of Fundy.

Why This Site?

> Over the centuries we have treated salt marshes as something to be despised and "reclaimed", not something to be nurtured and treasured... since the arrival of Champlain in 1604, between 75% and 85% of the original Fundy marshes have been destroyed or converted into something else. Furthermore, a large proportion of what remains is severely degraded because of impeded tidal exchange [due to coastal construction].[15]

Given the statistics concerning the disappearance of salt marshes, the main reason being human intervention, and how these disappearances impact the stability of the ecosystem, this idea seems counterintuitive - even irresponsible - to propose a design that builds on this site. However, plans to build a community centre on this site are real and zoning by-laws and regulations do not restrict construction in these areas (Fig. 6). This fact encouraged

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[14] John A. Percy, "Salt Marsh Saga: Conserving Fundy's Marine Meadows." *Fundy Issues Online 16* (2000), http://www.bofep.org/saltmarsh.htm.

[15] Ibid.

pursuing this thesis for the purpose of investigating how the role of the architect and traditional methods of design and construction , can indeed be implemented as a means to test both the architecture, building methods and materials as well as the ecology. Can architecture be used to monitor changes in the ecosystem and be used to learn from those changes and apply that learning to future design processes.

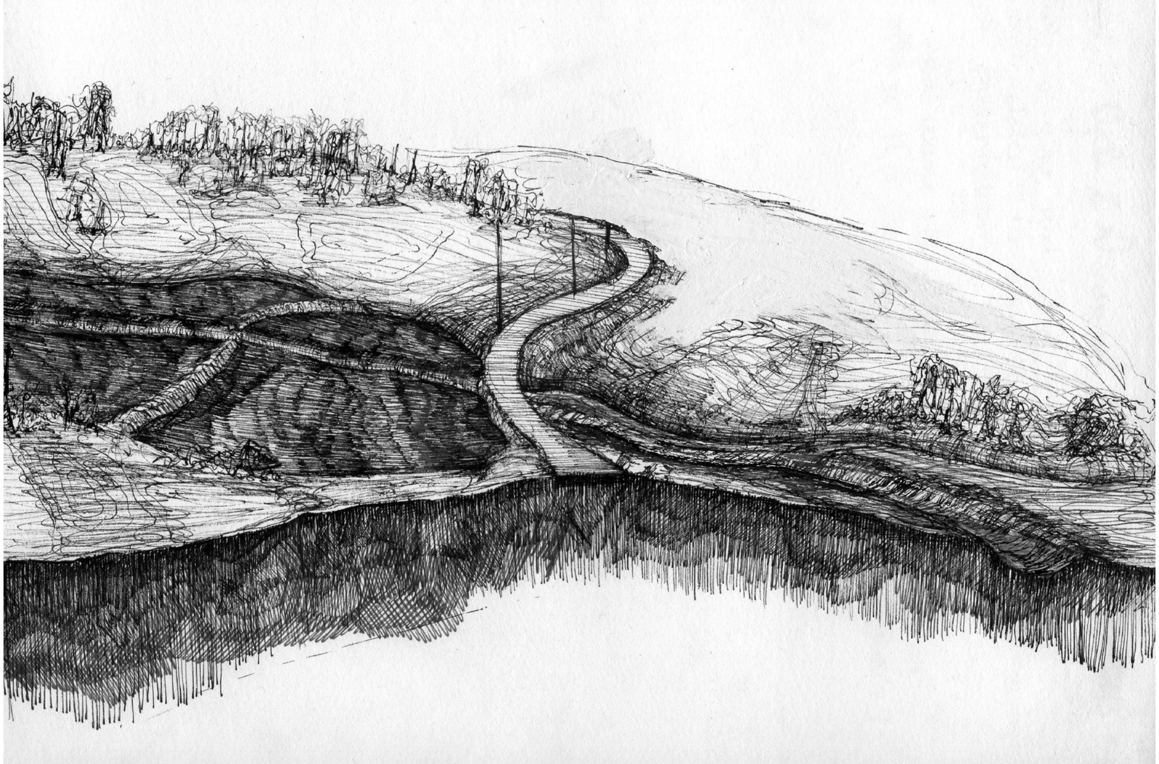

Fig. 6 - Interpretive section sketch of the thesis site.

> It remains for the biologist and ecologist to point out the interdependence which characterizes all relationships, organic and inorganic, in nature. It is the ecologist who points out that an ecological community is only able to survive as a result of interdependent activity between all of the species which constitute the community... Each one of these is a source of stimulus; each performs work; each is part of a pattern, a system, a working cycle... This interdependence common to nature - common to all systems - is in my own view the final refutation of man's assumption of independence. It appears impossible to separate man from nature. [16]

This thesis begins with acknowledging that humans are a part of this ecological community and have a functional role to play.

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[16] Frederick R. Steiner, ed., *The Essential Ian McHarg: Writings on Design and Nature* (Washington, D.C.: Island Press, 2006), 12.

CHAPTER 2: SITE ANALYSIS

Bay of Fundy

The Cheverie Creek Salt Marsh is located along Highway 215 in Cheverie, Nova Scotia on the Minas Basin coast of the Bay of Fundy (Fig. 7).

The 270km long Bay of Fundy stretches between Nova Scotia and New Brunswick and has the highest tides in the world. In one tide cycle (low tide - high tide - low tide) over 100 billion tonnes of water flows into and out of the Bay.[17] The high tidal ranges are a result of the size of the Bay (270 km in length) being just enough for resonance to exist. The fundy tides oscillate at a greater amplitude because they are in rhythm with the frequency of the orbit of the moon.[18]

Fig. 7 - Map of Nova Scotia indicating the Minas Basin region of the Bay of Fundy. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

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[17] Bay of Fundy Tourism Partnership, *Bay of Fundy: Horizontal Tidal Effect,* accessed November 21, 2013, http://bayoffundytourism.com/tides/horizontal/.

[18] Chignecto Creative Services, Independent Information on the Bay of Fundy, last modified 2011, http://www.bayfundy.net/hightides/hightides.html.

Migration Staging Grounds

The Upper Bay of Fundy serves as a staging ground for millions of shorebirds each summer as they migrate south for the winter. The mudflats provide the shorebirds with a stopover to feed, providing what they need to sustain the remainder of their migration (Fig. 8).

Fig. 8 - Photograph overlooking the Bay of Fundy mudflats at low tide in Cheverie, Nova Scotia.

Various species converge on these mudflats, however one species in particular, the Semipalmated Sandpiper, arrives in the largest numbers. Most of the global population of Semipalmated Sandpipers rely on these shores for a period of 10-20 days in the late summer during which time they feed and effectively double their weight to continue their non-stop journey to the north-east coast of South America where they winter (Fig. 9). The Bay of Fundy is the only stopover during their migration and is therefore a crucial component to their survival.[19]

The sandpipers are drawn to the Bay of Fundy particularly because it is one of the only

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[19] Nova Scotia Department of Natural Resources, *The Sandpipers of Fundy*, (2005): 2, http://www.speciesatrisk.ca/fundyshorebirds/pdf/SandpipersofFundy_regular.pdf.

Fig. 9 - South-bound migration route of the Semipalmated Sandpiper. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

places that supports a specific species of mud shrimp, known as *Corophium volutator.* These mud shrimps feed on organic matter carried and deposited by the tides, making them energy-rich. A single square meter of mud may contain 10,000-20,000 mud shrimp. They are the primary source of food for the sandpipers.[20] The sandpipers rely on a healthy population of mud shrimp, which rely on healthy mudflats and a regular supply of organic matter, a bulk of which is produced in the salt marshes.

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[20] Nova Scotia Department of Natural Resources, "The Sandpipers of Fundy", (2005): 3, http://www.speciesatrisk.ca/fundyshorebirds/pdf/SandpipersofFundy_regular.pdf.

Minas Basin

Many coastal areas along the Basin with shallow sloping beaches experience a horizontal tidal effect. Low tide reveals a vast expanse of ocean floor which becomes completely

Fig. 10a - View overlooking the mud flats from the salt marsh at low tide.

Fig. 10b - View overlooking the mud flats from the salt marsh at high tide.

submerged at high tide (Figs. 10a and 10b).[21] Average time between high and low tide is 6 hours and 13 minutes. Cheverie experiences 15m horizontal tidal ranges.

Cheverie is located in what is known as the Southern Bight region of the Minas Basin, where 80% of the Basin's salt marshes are located (Fig. 11). As the incoming tides are propelled into the Basin they erode the coastline and the sediments are churned into the water turning it a red-brown colour. These sediments are carried into and deposited in the salt marshes.

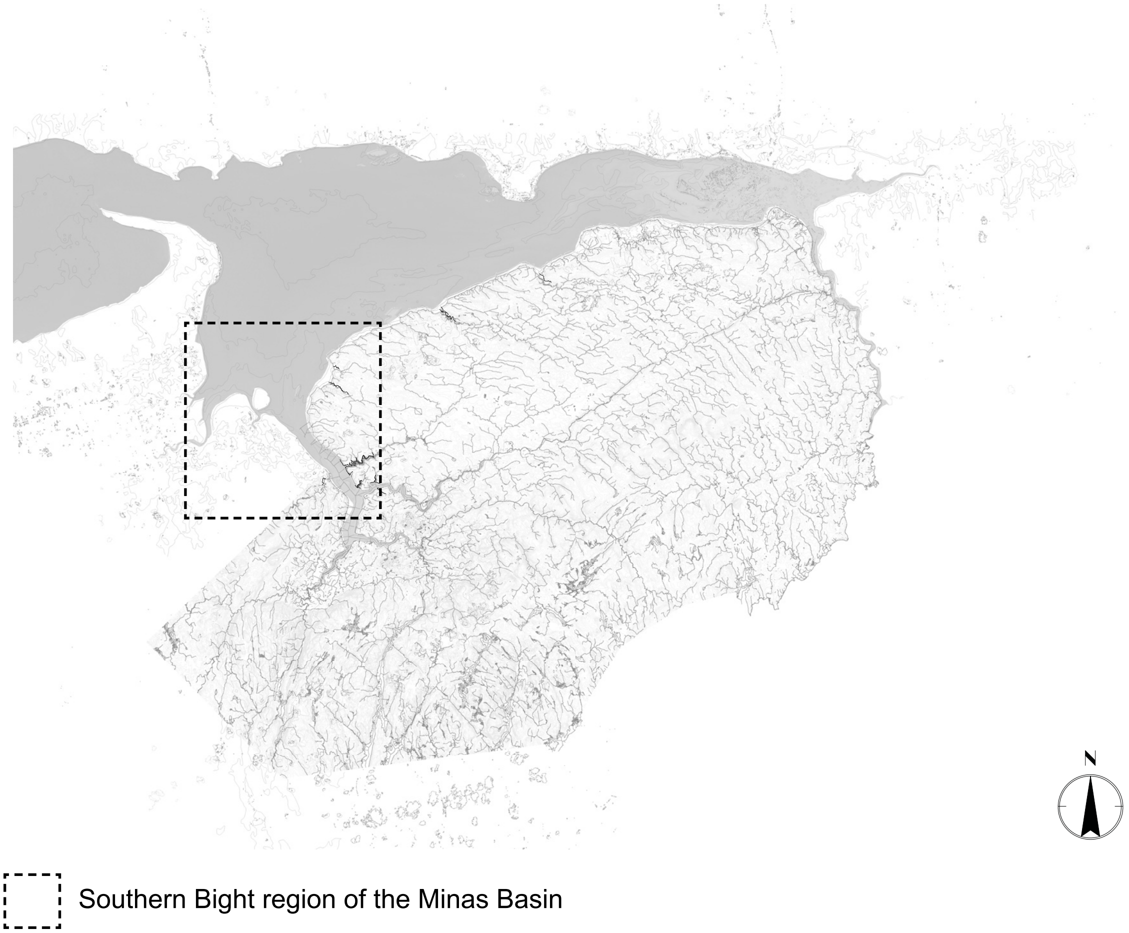

Fig. 11 - Map highlighting location of the Cheverie Creek salt marsh within the Minas Basin and neighbouring salt marshes. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

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[21] Bay of Fundy Tourism Partnership, *Bay of Fundy: Horizontal Tidal Effect,* accessed November 21, 2013, http://bayoffundytourism.com/tides/horizontal/.

River Systems

Within the Southern Bight, there are five major river systems - the Avon, the Gaspereau, the St. Croix, the Kennetcook, and the Cogmagun. The Cheverie Creek is part of the Cogmagun river system (Fig. 12). These systems serve to carry drainage and groundwater from surrounding watersheds out into the Bay.

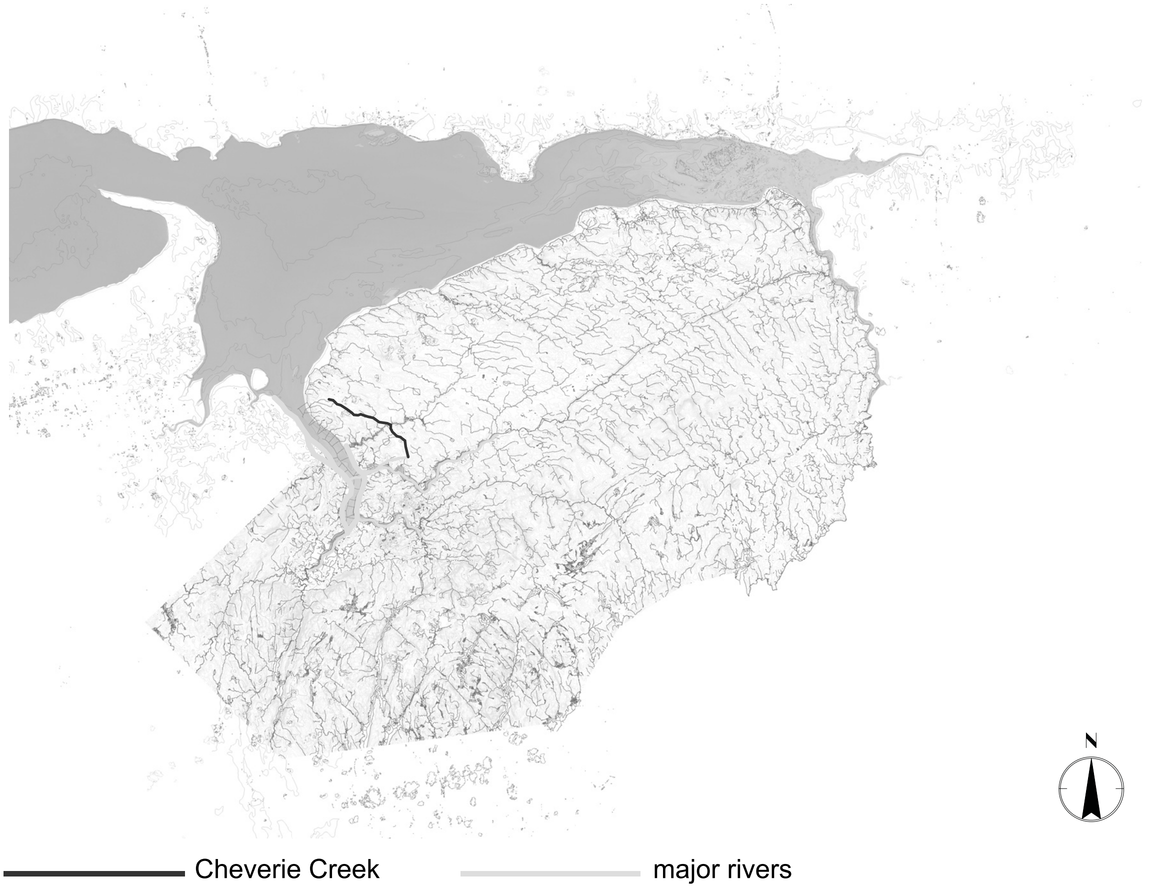

Fig. 12 - Map highlighting main stem rivers and tributaries in the Hants County region. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Geology

Cheverie is located in West Hants County. The geologic deposits in this area are smaller amounts of limestone (calcium carbonate) and vast amounts of gypsum (calcium sulphite). These deposits are believed to have been formed during the Lower Carboniferous Age and over many millennia tectonic forces and glacial movement altered the landscape and contributed to the formation of lagoons.[22] The limestone and gypsum is believed to have developed in these areas from concentrations of sea water washing into the lagoons.[23]

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[22] Gwendolyn V. Shand, *Historic Hants County (*Halifax: McCurdy Printing Co. Ltd., 1979), 80.

[23] Ibid., 81.

The deposits underwent a process of deformation as the earth's crust shifted and faulted - a process known as diastrophism - so the area is now characterized by vast, low-lying, undulating gypsum bedrock.[24] Large amounts of red clay collect in pockets in the valleys of the gypsum bedrock. It is in these valleys that the salt marshes form (Fig. 13).

Fig. 13 - Illustration of geological layers based on description in *Historic Hants County* by Gwendolyn Shand.

Topography and vegetation growth hints at changing soil conditions on the thesis site. The salt marsh is characterized be a peat that is a combination of silts and clays mixed with organic matter from decomposing plants - these conditions are unstable as the decomposition causes uneven settling. As the ground slopes upwards away from the marsh, the ground conditions become more stable with more compact silts and clays (Fig. 14).[25]

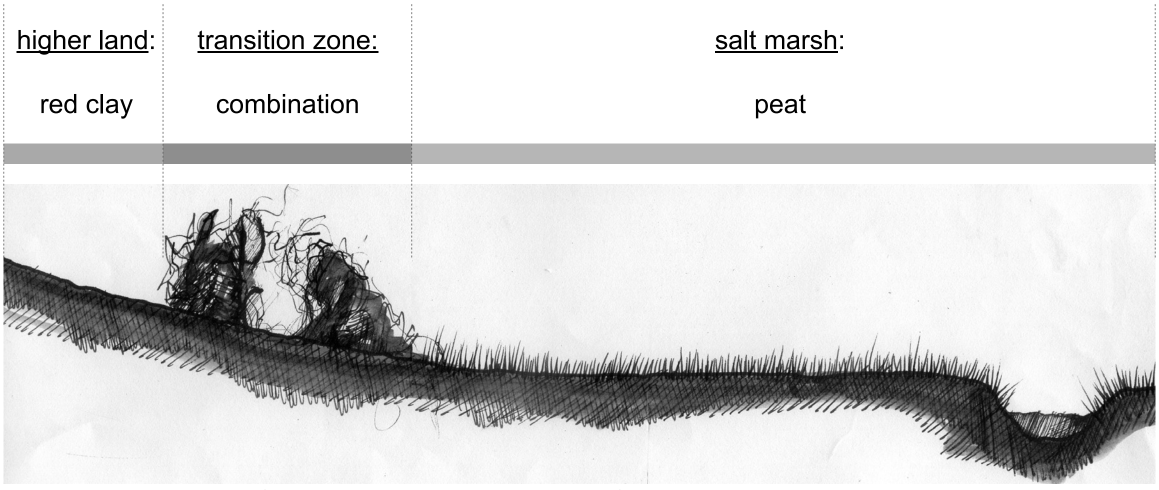

Fig. 14 - Illustration of changing ground conditions from the marsh to higher land. Data retrieved from Nova Scotia Department of Natural Resources, Map 92-3: Surficial Geology of the Province of Nova Scotia.

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[24] Ibid., 79.

[25] Nova Scotia Department of Natural Resources: Mines and Energy Branches, Map 92-3: Surficial Geology of the Province of Nova Scotia. 1992. http://novascotia.ca/natr/meb/download/mg/map/htm/map_1992-003.asp.

Cheverie Creek Salt Marsh

Remnants of an Acadian dyke can be seen slicing across the mouth of the marsh (Fig. 15a and 15b). To this day several salt marshes within the Minas Basin are still dyked, drained and the fertile soil is used for agricultural purposes. This particular dyke, however, fell into disrepair after the Acadian Expulsion in 1755 and eventually the Cheverie Creek eroded through.

▬ ▬ ▬ ▬ Remnants of Acadian dyke

Fig. 15a - View overlooking the salt marsh at low tide.

▬ ▬ ▬ ▬ Remnants of Acadian dyke

Fig. 15b - View overlooking the salt marsh at high tide.

Sediment Deposition

The salt marsh is a self-sustaining system where resources (sediments) are supplied, processed (through plant growth and decay) and distributed to support itself and the surrounding area. Sediment deposition (Fig. 16) results in three ways - Fundy tides propelling into the marsh, rivers running into the Bay, and movement of coastal waters.[26]

Twice daily, the incoming Fundy tides flood the 43 hectare salt marsh. Tide tides carry sediment from eroded sea cliffs into the marsh. Simultaneously, the Cheverie Creek carries eroded sediment from the upper elevated land through the marsh into the Bay. Longshore drift, the movement of sediments along the shore by waves, also contributes to deposition within the marsh.[27]

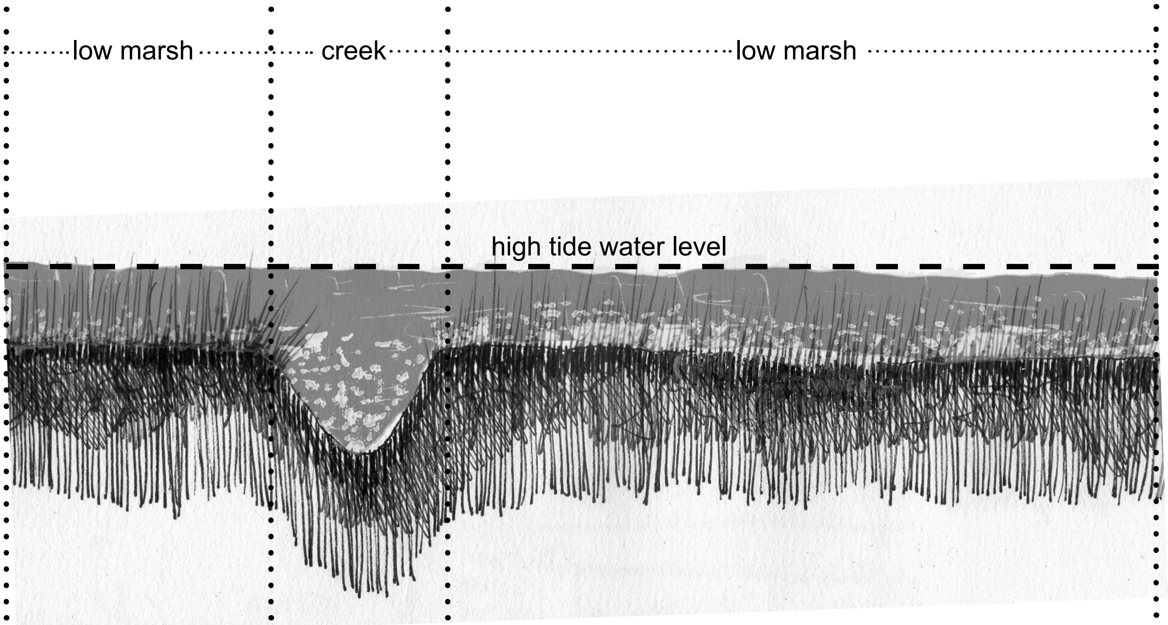

Fig. 16 - Sketch of tides carrying and depositing sediments in the marsh.

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[26] J.P. Doody, *Saltmarsh Conservation, Management, and Restoration* (Dordrecht, Netherlands: Springer, 2008), 1.

[27] Ibid.

Vegetation Growth

> The [salt] marsh is defined by the kinds of plants that grow on it. They are responsible for the very existence of these wetlands...[28]

The boundaries of the marsh are defined by the various types of vegetation that grow because fewer species of plants have adapted to thrive in these conditions. The vascular plants are able to cope with a continual cycle of being submerged in salt water for a six-hour period followed by a six-hour period of exposure to air (Fig. 17).

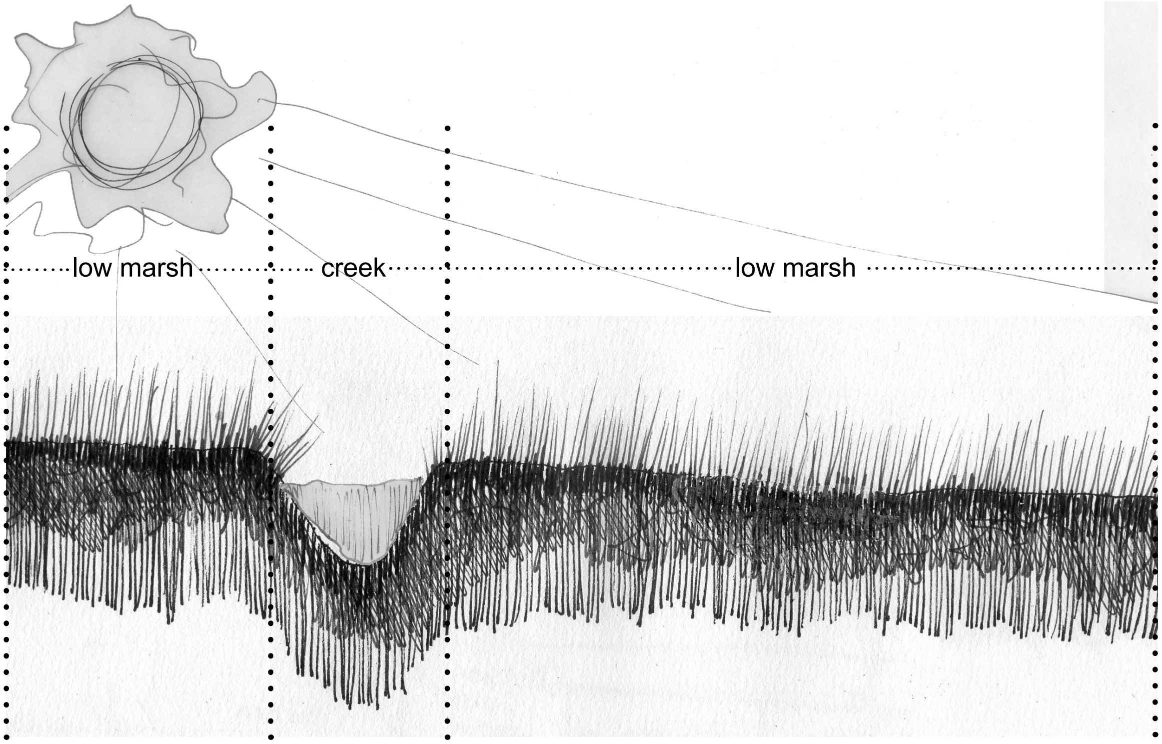

Fig. 17 - At low tide the vegetation is able to photosynthesize.

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[28] John Teal and Mildred Teal, *Life and Death of the Salt Marsh* (Boston: Little, Brown and Company, 1969), 62.

Dominant Plant Species

The dominant plants in the salt marsh grow in visible patterns and these are indicative of changes in ground conditions and sediment deposition patterns (Figs. 18 and 19). Deformations in the land are caused by a build up of sedimentation forming a dam which prevents the water from draining properly - this can be the result of tidal activity or human activity. Spartinas cannot grow in standing water with roots continually submerged and will eventually die off.[29] Aquatic plants such as algae or Ruppia (widgeon grass) will commonly begin to flourish here. These pools are also inhabited by small fish and become important feeding grounds for migratory water fowel.[30]

The two Spartina species dominate different areas of the marsh and this indicates differences in sediment deposition. *Spartina Patens* dominate in areas where the flooding tides are not high enough to carry a lot of sediment. Alternately, the *Spartina Alterniflora* thrives better in conditions where the flooding carries enough sediment for an adequate build up of the marsh surface.[31]

The settlement of plant species in the marsh is determined by variations in sediment deposits (which could also be considered a variation in the distribution of resources). The different plant species thrive in these different areas because they are the best equipped to use those resources available. The demographics of a city could be analyzed in a very similar way, but in economic terms and the distribution of resources or wealth. Human

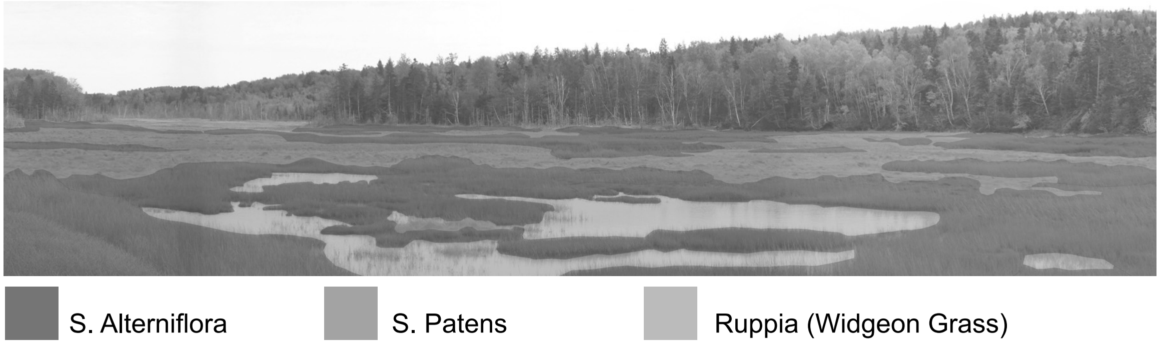

Fig. 18 - Photograph of the salt marsh illuminating patterns of vegetation growth.

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[29] Ibid.,62.

[30] ”Environmental Fact Sheet: What is a Salt Marsh?” New Hampshire Department of Environmental Services. Accessed September 16, 2013. http://des.nh.gov/organization/commissioner/pip/factsheets/cp/documents/cp-06.pdf.

[31] John A. Percy, “Salt Marsh Saga: Conserving Fundy’s Marine Meadows.” Fundy Issues Online #16 no. 16 (2000), http://www.bofep.org/saltmarsh.htm.

populations typically settle where they can financially afford to settle, but not necessarily where they thrive.

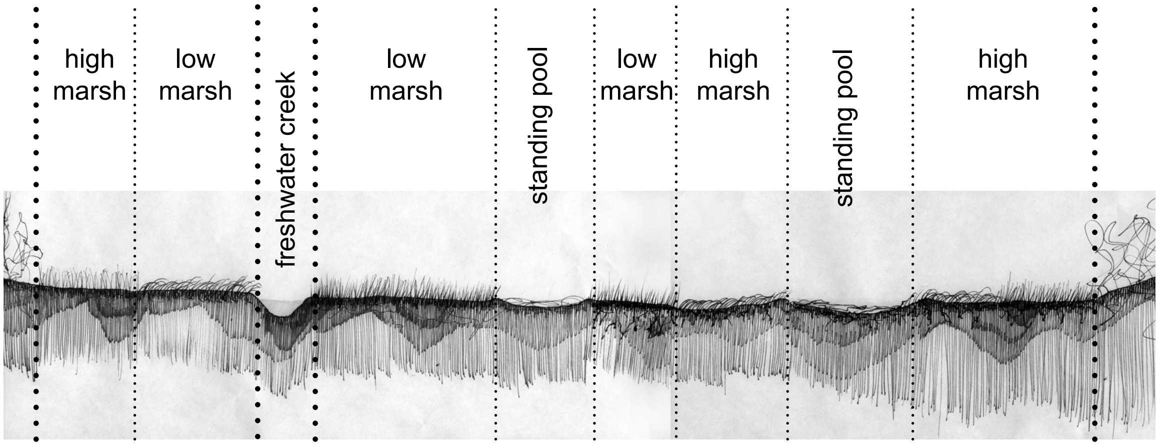

Fig. 19 - Sketch of the salt marsh showing different zones.

Spartinas - Alterniflora and Patens

S. Alterniflora (Fig. 20) inhabit the “low marsh” where tidal currents are stronger and flooded more regularly. *S. Patens* (Fig. 21) blanket the “high marsh” where tidal currents are weaker. This species grows densely, making it it difficult for decaying organics to be washed away. This keeps the mud of the high marsh fertile.[32]

Fig. 20 -
S. Alterniflora

Fig. 21 -
S. Patens

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[32] Ibid.

The Spartinas have developed specialized methods for getting the fresh water and oxygen they need for growth. A sap within the plant allows it to absorb fresh water from the sea with minimal salt absorption. What excess salt is absorbed is secreted through glands scattered over the surface of the leaves where it crystalizes and is washed away by the outgoing tides.[33]

The plant roots require fresh oxygen; however, the small amounts of oxygen available in the mud is quickly absorbed by the organisms living there. To compensate for this, a set of hollow tubes run from the leaves down to the roots, supplying them with fresh oxygen.[34]

Widgeon Grass ('ruppia maritima')

Widgeon Grass (Fig. 22) is an aquatic, perennial plant that thrives in standing pools of water in the high marsh. They provide food and shelter for salt marsh fish which draw migratory water fowel.

Algae

Algae (Fig. 23) also begins to flourish where deformations in the land create standing pools of water.

Cattails

Cattails (Fig. 24) are freshwater plants that can be seen in areas bordering the marsh.

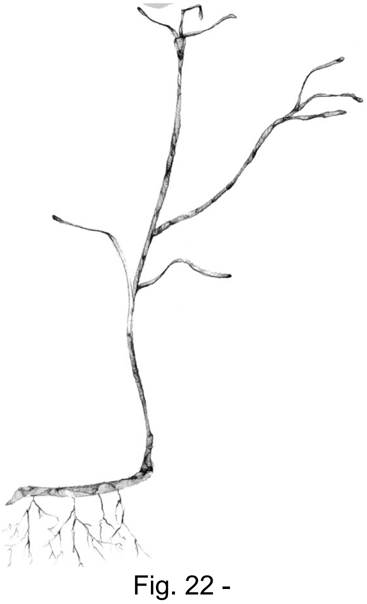

Fig. 22 -
Widgeon Grass

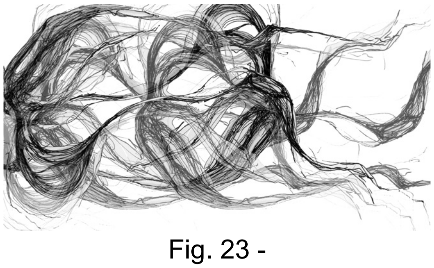

Fig. 23 -
Algae

Fig. 24 -
Cattails

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[33] John Teal and Mildred Teal, *Life and Death of the Salt Marsh* (Boston: Little, Brown, 1969), 93.
[34] Ibid., 97.

Demographics

Catalogue of Marsh Inhabitants

The tidal shifts are accompanied by a major demographic shift (Fig. 25). There are fewer animals and plants that can survive submerged in salt water for several hours followed by several hours of exposure to the sun/wind.

Permanent Marsh Inhabitants

The vast majority of animals that permanently inhabit the marsh are burrowers found in the sand and/or mud. The mud regulates the changes in temperature and salinity providing a much more stable environment for the organisms living there.[35]

Marsh plants, on the other hand, have adapted to survive in these constantly changing conditions. The dominant plants are the Spartina Alterniflora and Spartina Patens which are able to metabolize salt water through osmosis; extracting the fresh water and secreting excess salts. Other types of vegetation include Ruppia (widgeon grass) and algae, which are found in standing pools of salt water where deformations have formed so the water is not able to drain with the receding tides - small animals such as Crangon, are also found here. While the Spartinas only grow in the warmer months, the algae grows year-round providing a steady supply of nutrients to the marsh inhabitants.[36]

Visitors at High Tide and Low Tide

Other animals supported by the marsh are aquatic visitors at high tide and terrestrial visitors at low tide. Various species of fish and crabs navigate into the marsh with the incoming tides to feed. They recede with the tides or will otherwise die from exposure if they become stranded on dry land.

At low tide, the marsh is visited by various insects and animals that feed off the plants and other marsh organisms. These have adapted to manage the high salt content by excreting the excess salt they take in from their food and seawater into a cavity in their bodies - mammals, for example, will excrete into their urine.[37]

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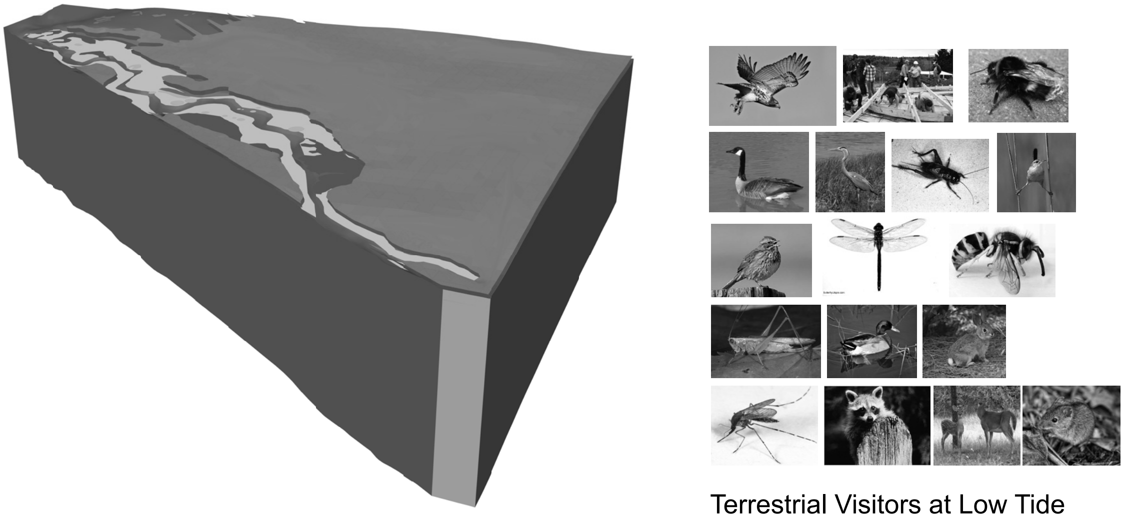
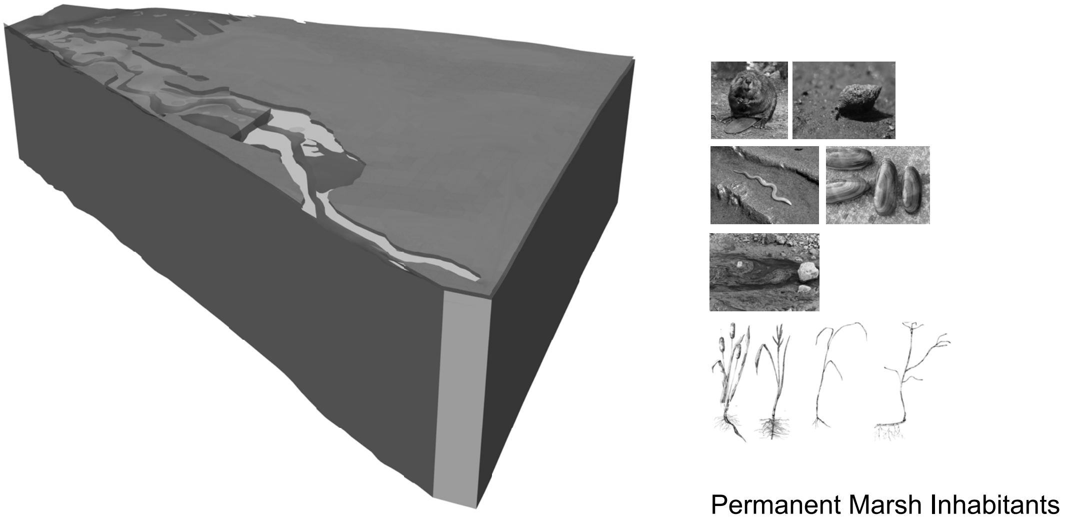
[35] Ibid.,124.

[36] Ibid., 199.

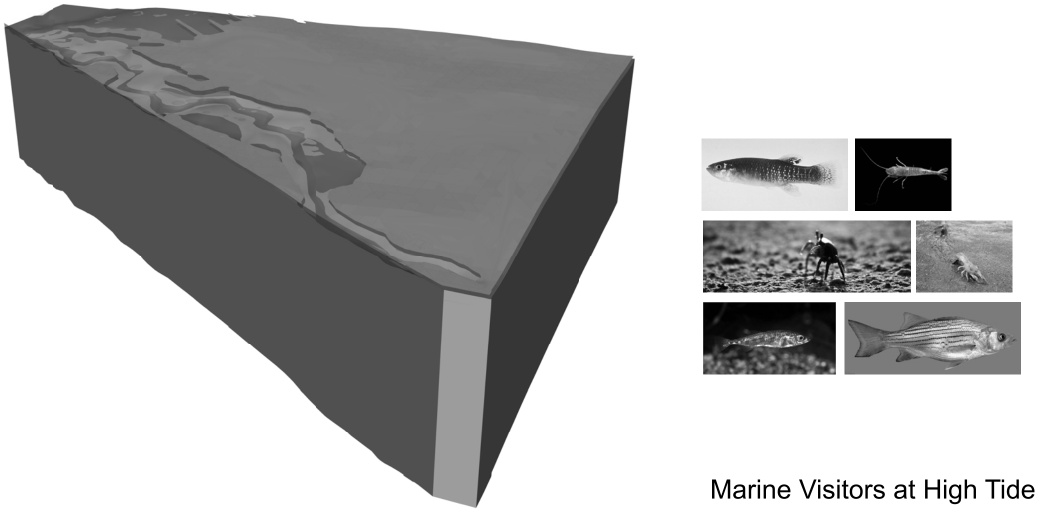
[37] Ibid., 146.



Terrestrial Visitors at Low Tide



Permanent Marsh Inhabitants



Marine Visitors at High Tide

Fig. 25 - Catalogue of salt marsh inhabitants. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Human Settlement Patterns

Mapping the road networks and buildings show a concentration of human settlement along the coastline (Fig. 26). Permanent settlement along the coastline was initially established for industrial purposes when gypsum mining/exportation and shipbuilding were the largest industry.

10,000 BCE

Archaeological evidence indicates the Mi’kmaq were the first human inhabitants in this area and lived in semi-nomadic tribes (Fig. 27). A deep understanding of the natural environment (seasons, climate, plants, and animals) was crucial for survival and this knowledge was passed down generationally.

1685

The French Acadians were the first permanent human settlers along the Minas Basin coast.

Primary industry: gypsum mining and exportation (Fig. 30).

The Acadians also developed a unique system for dyking the marshes (aboiteau) to use for agricultural purposes (Fig. 28a and 28b).

1755

By the mid-18th century, the British occupied mianland Nova Scotia and settled along the Minas Basin coast after the Acadian Expulsion in 1755.

Major industry in the mid to late 19th century was shipbuilding (Fig. 29).

2014

As with many coastal Nova Scotian communities, industry has disappeared and the majority of the Cheverie community reside there and commute elsewhere for work.

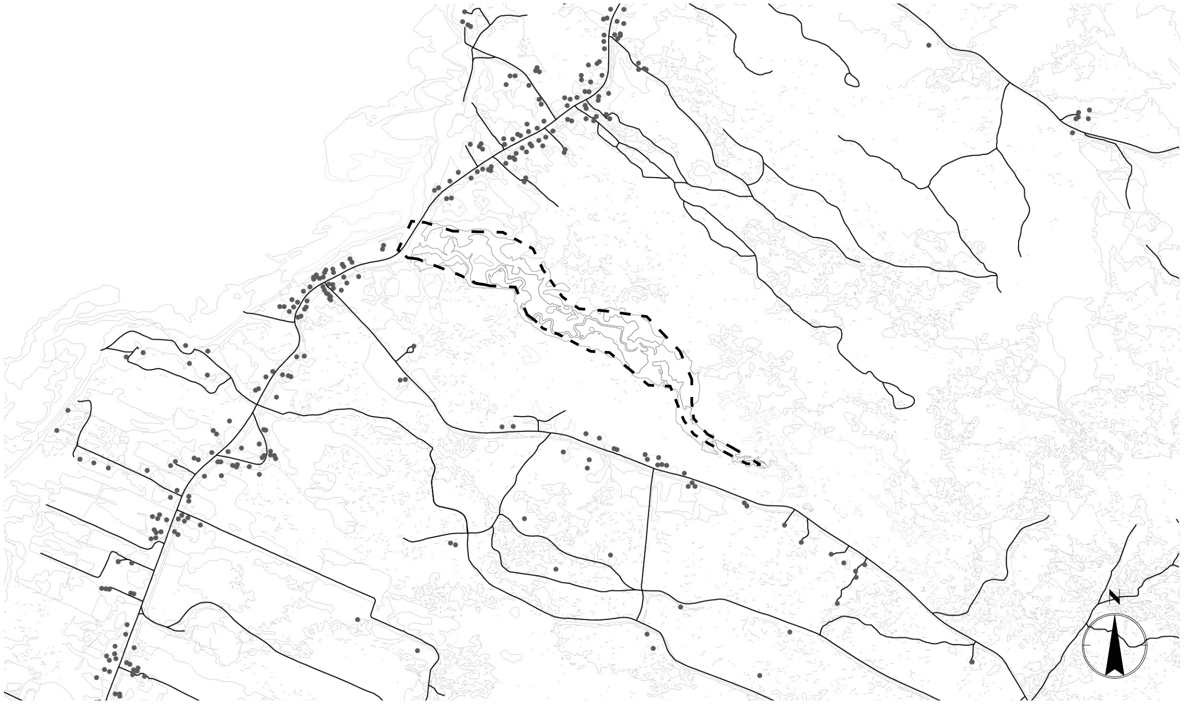


Fig. 26 - Current mapping of roads and buildings in Cheverie, Nova Scotia. Base map from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Fig. 27 - Richard Levinge, *Micmac Indians Poling a Canoe Up a Rapid, Oromocto Lake, New Brunswick,* 1835-1846; From Collections Canada.

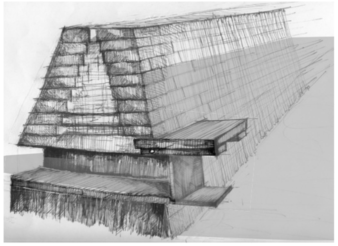


Fig. 28a - Dyke construction (high tide).

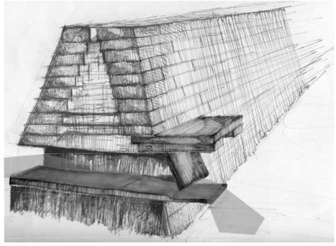


Fig. 28b - Dyke construction (low tide).

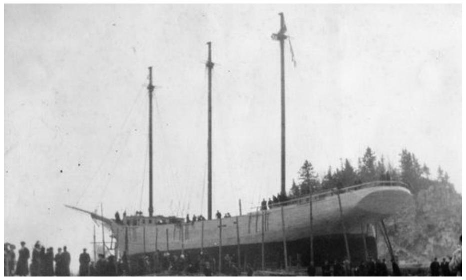


Fig. 29 - Ship at Cheverie, NS, N.d.; from West Hants Historical Society, Windsor.

Fig. 30 - Gypsum Quarry, NS, N.d.; from West Hants Historical Society, Windsor.

With few exceptions these buildings are mainly residential. The community is no longer self-sufficient and residents typically commute into larger towns, and even Halifax, for work.

Tourism

In 2012, Nova Scotia received an estimated 1,993,300 tourists.[38] Cheverie is located along the Glooscap trail, one of Nova Scotia's eleven scenic routes, making it a prime stop-off for visitors passing through. The main tourist attractions along this route are concentrated towards eastern end around Maitland, popular for tidal bore rafting (Fig. 31). Aside from the Peterson's Festival Campground in neighbouring Summerville, there are few reasons to stop off along this stretch of highway.

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[38] Nova Scotia Tourism Agency, "Research: Historical Tourism Activity", accessed November 20, 2013, http://novascotiatourismagency.ca/historical-tourism-activity-0.

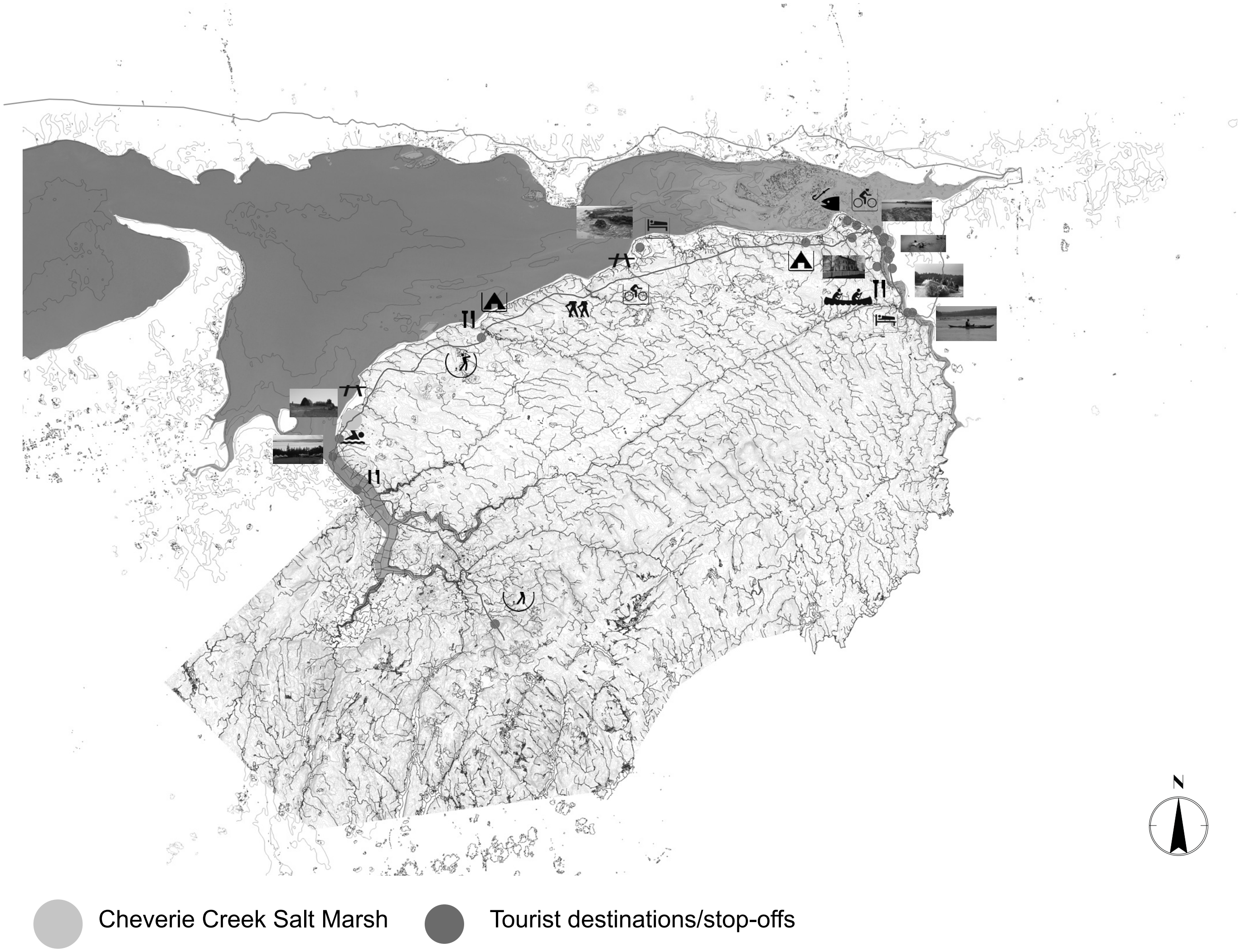


Fig. 31 - Map of Glooscap trail along the Hants County, Minas Basin coast, pinpointing tourist activities along the way. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Zones, Boundaries, Corridors, and Forces

The site analysis revealed an alternate method for land zoning based on major ecological boundaries, zones, and corridors. These include various zones of vegetation, watersheds, drainage channels, flood zones, and forces such as solar path, wind direction, and tidal forces.

Overlaying maps as a method for site analysis and organizing visual information was first introduced by Ian McHarg. McHarg was a key influence in the graphic organization and visual display for this thesis.

Vegetation

Cheverie is heavily forested with more clearing along the coastline where the majority of the residents (Fig. 32). The forest is habitat to multitudes of animal species and, for the human residents of Cheverie, is used for recreational purposes, such as hunting and four-wheeling.

Rivers and Lakes

The rivers and lakes highlighted in the map below (Fig. 33) indicate where the topographical low-lying areas are in Cheverie, Nova Scotia. These areas serve to collect run-off and drainage from the watersheds and carry it out into the Minas Basin.

Wetlands and Flood Zones

The rivers and lakes highlighted in the map below (Fig. 34) indicate where the topographical low-lying areas are in Cheverie, Nova Scotia. These areas serve to collect run-off and drainage from the watersheds and carry it out into the Minas Basin.

Drainage Channels

The salt marsh is situated in a low-lying valley. The watersheds and drainage channels are revealed by the topographical lines and illustrate how water drains into the salt marsh (Fig. 35).

Solar Path, Wind Direction, and Tidal Forces

Major climatic forces include the sun, wind, and tidal flow. These factors will be critical considerations in the siting and orientation of the design (Fig. 36).

Fig. 32 - Map highlighting forested area in Cheverie, Nova Scotia. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Fig. 33 - Map highlighting rivers and lakes in Cheverie, Nova Scotia. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Fig. 34 - Map of wetlands and flood zones. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Fig. 35 - Map highlighting drainage channels surrounding the Cheverie Creek Salt Marsh. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

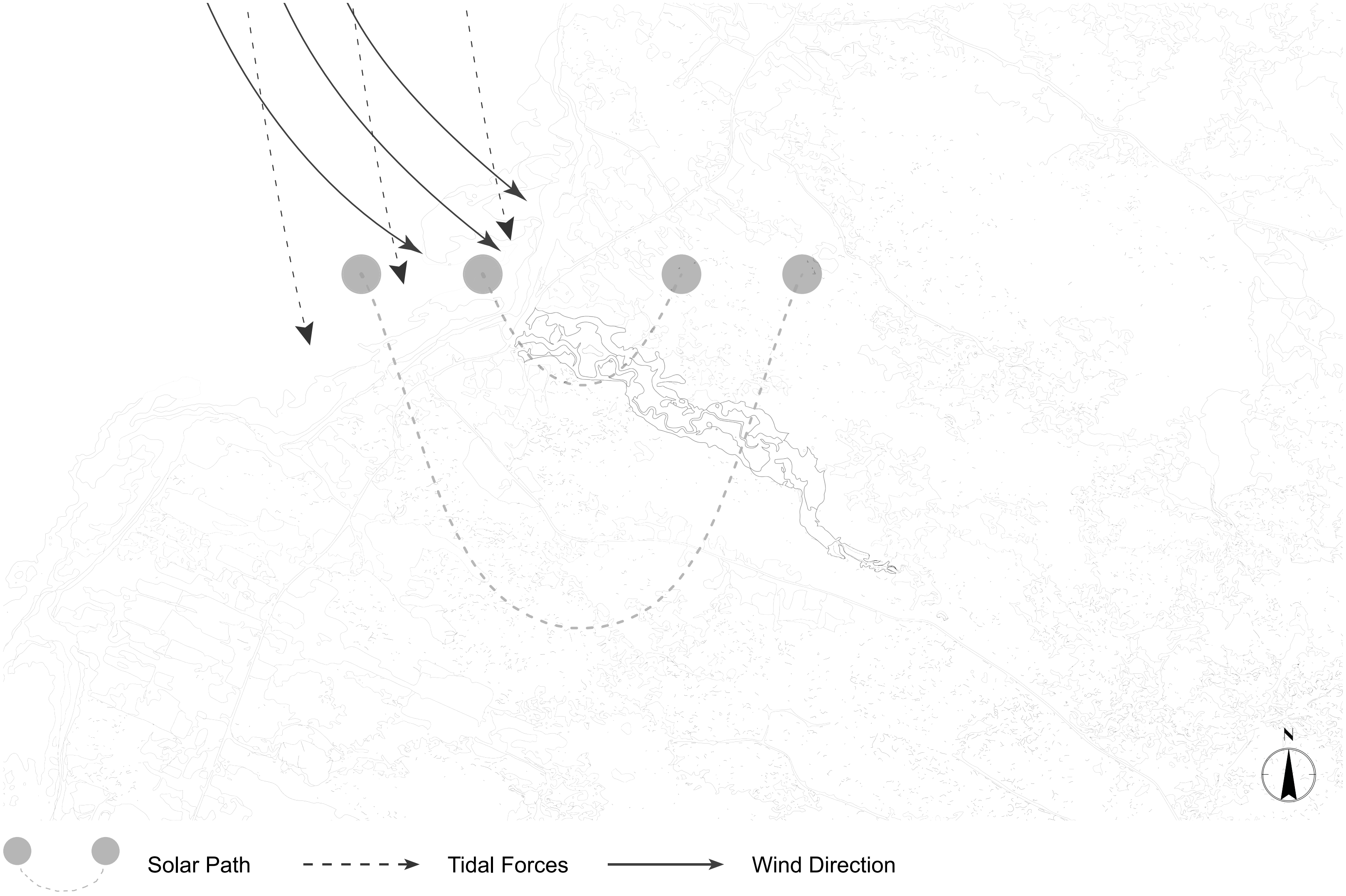


Fig. 36 - Map of Cheverie Creek Salt Marsh with tidal forces, wind direction and solar path diagram overlaid. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

CHAPTER 3: DESIGN PROPOSAL

Overview

The salt marsh environment and land surrounding is highly sensitive and, as revealed in the site analysis, supports a vast amount of life. Building around this marsh will have an effect on the natural systems that support this life and establishing ecological goals for designing is important. Two primary goals for this design are:

1) To create habitat

2) To foster diversity on multiple levels – plant/animal life, tourism (cultural diversity)

This requires acknowledging the dynamic nature of the natural systems of this environment and working with them. From my site analysis, three processes emerged as being fundamental for this environment to function properly and support life. These are: water movement (water being a vehicle for moving and distributing resources), air movement, and sediment deposition. Any type of building construction will have an impact on these systems but the intention for this thesis is not to avoid direct interaction with this environment. The intention is to develop a dialogue between the building and the natural systems of this environment and see the interact with these systems as being a potential opportunity to create habitat and foster diversity.

Concept - Architecture as a Marker for Monitoring Change

With the official restoration the Cheverie Creek salt marsh became a test site for monitoring the effectiveness of the recovery process. This begged to question whether the architecture could be considered in a similar manner - as a vehicle for monitoring and assessing changes within the environment so it can respond to those changes over time. This places a different value on architecture and its ability to strengthen the relationship between people and the land they inhabit. Thus, the interpretive centre was envisioned as a series of markers pinpointed in specific locations around the salt marsh, linked together by a nature trail (Fig. 37). From this point, the interpretive/community centre became understood as an interpretive/community marker.

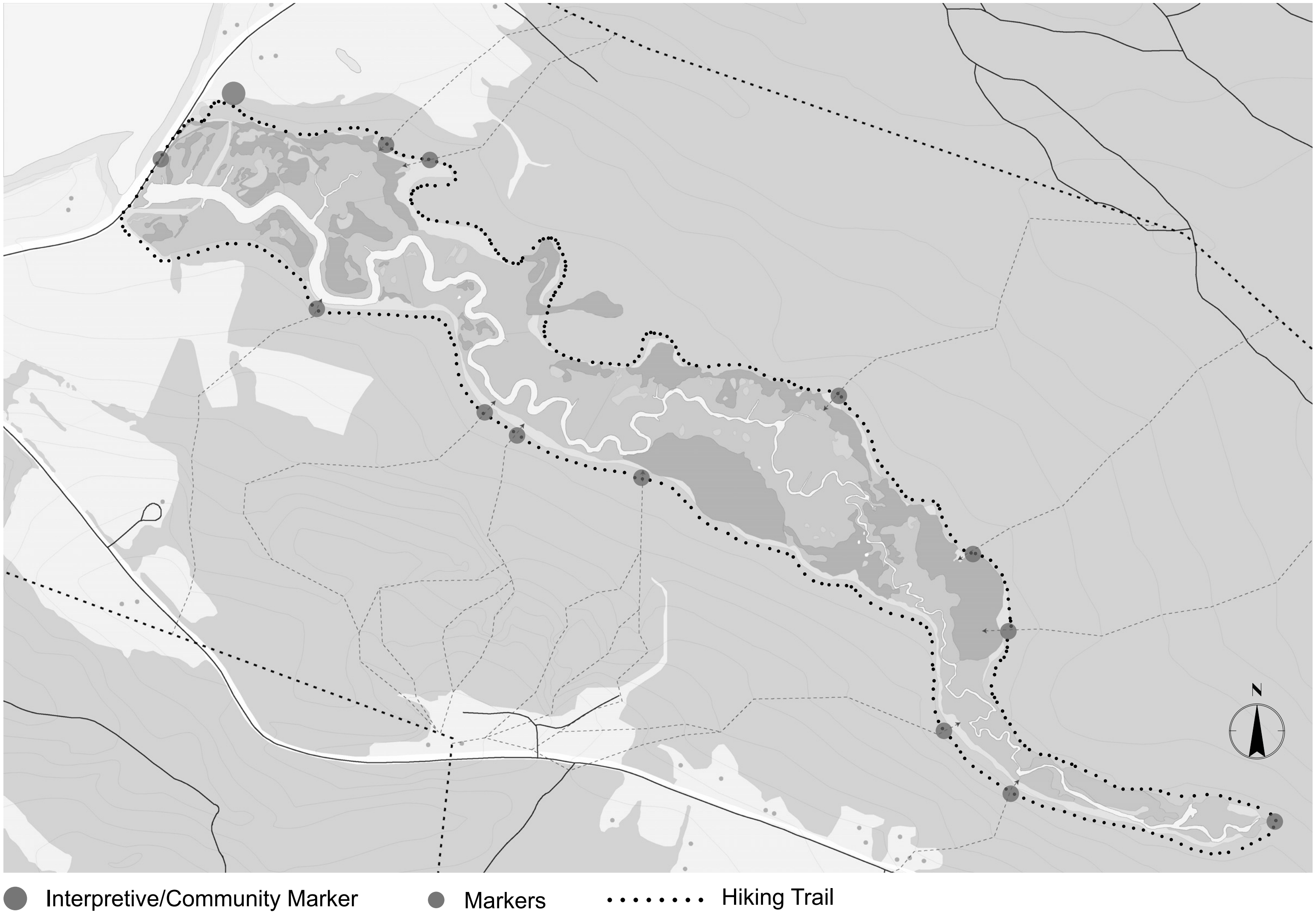


Fig. 37 - Site Plan differentiating zones of vegetation and showing hiking trail and marker locations. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Marker One - The Bridge

The first design decision made to open the causeway and replace it with a bridge, opening the mouth of the marsh and allowing it more room to return to its natural state. Opening the causeway changes the nature of the immediate environment. The tides will be able to move more freely and rapidly into the marsh. The impact of the tides will gradually erode the dyke and the marsh will eventually expand.

Sedimentation Studies

The bridge is a steel structure supported on steel piles surrounded by gabion piers. Sedimentation studies were used to determine the configuration and orientation of the piers. These studies analyze how various configurations may affect the deposition of sediments. The intention is for the causeway/bridge to impose minimal tidal restriction and aim to not congest the mouth of the marsh with sediment build-up around the bridge supports.

Study A

The first study (Fig. 38) looked at simply adding a second culvert beneath the causeway.

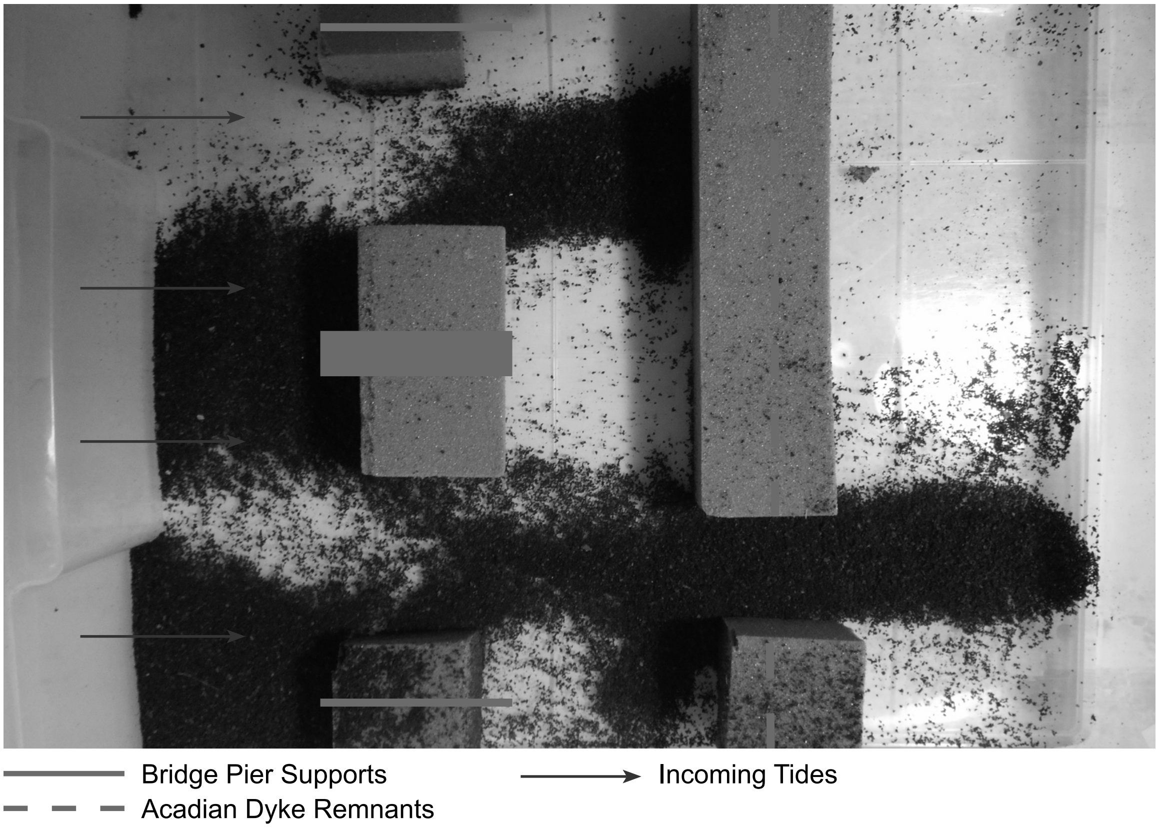


Fig. 38 - Sedimentation Study A.

Though it would slightly lessen the tidal restriction, there would still be a lot of sedimentation build-up at the mouth of the marsh.

Study B

Removing the causeway completely would require a more structurally sophisticated bridge but would be the least invasive option (Fig. 39). The tides would be able to flow completely unrestricted and the sediments would be carried, uninterrupted, into the salt marsh.

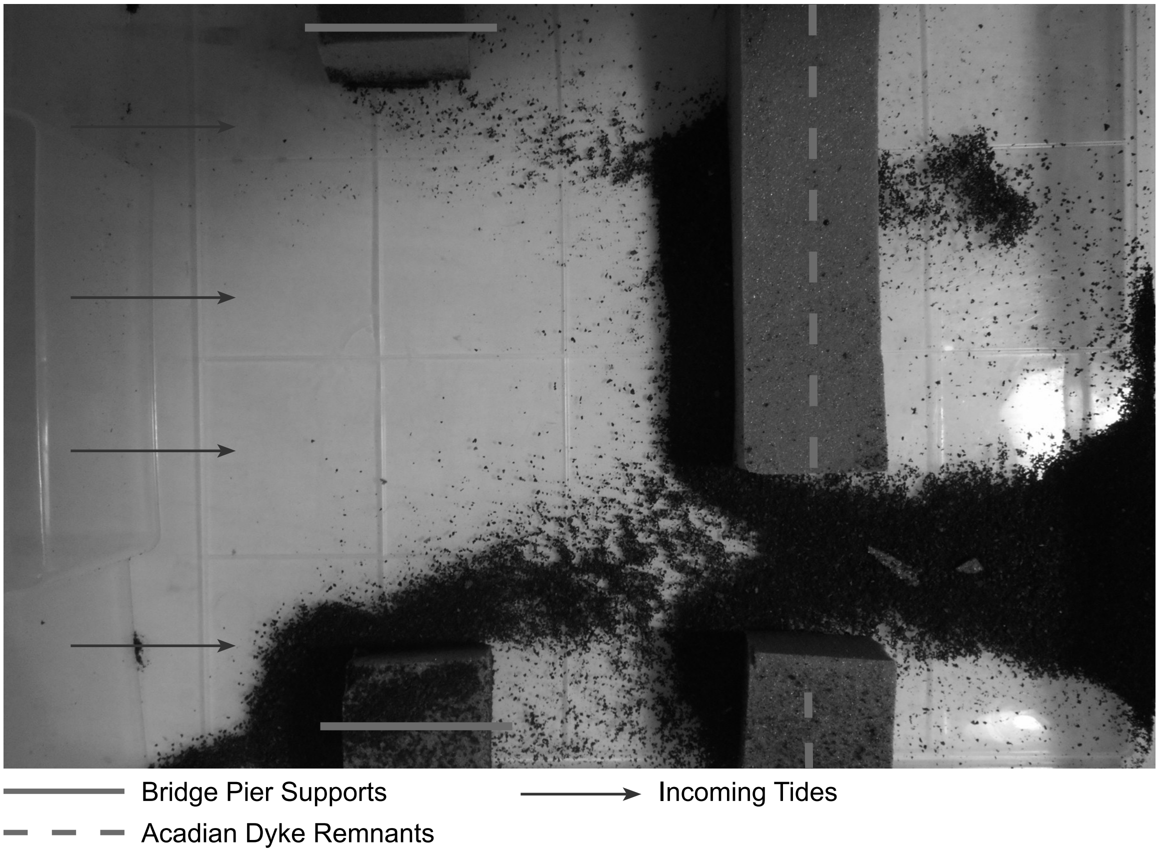


Fig. 39 - Sedimentation Study B.

Study C

Piers spaced equally and oriented in the direction of the current lessens the restriction of the tidal flow and allows the sediments to be carried into the marsh more easily (Fig. 40). Eventually the remnants of the Acadian dike will erode through.

Pedestrian Footbridge

The bridge structure also supports a pedestrian footbridge, which is below the level of vehicular traffic (Fig. 41). This footbridge provides visitors with a view of the most dynamic part of the salt marsh. From the footbridge, visitors or avid birdwatchers will also be able to

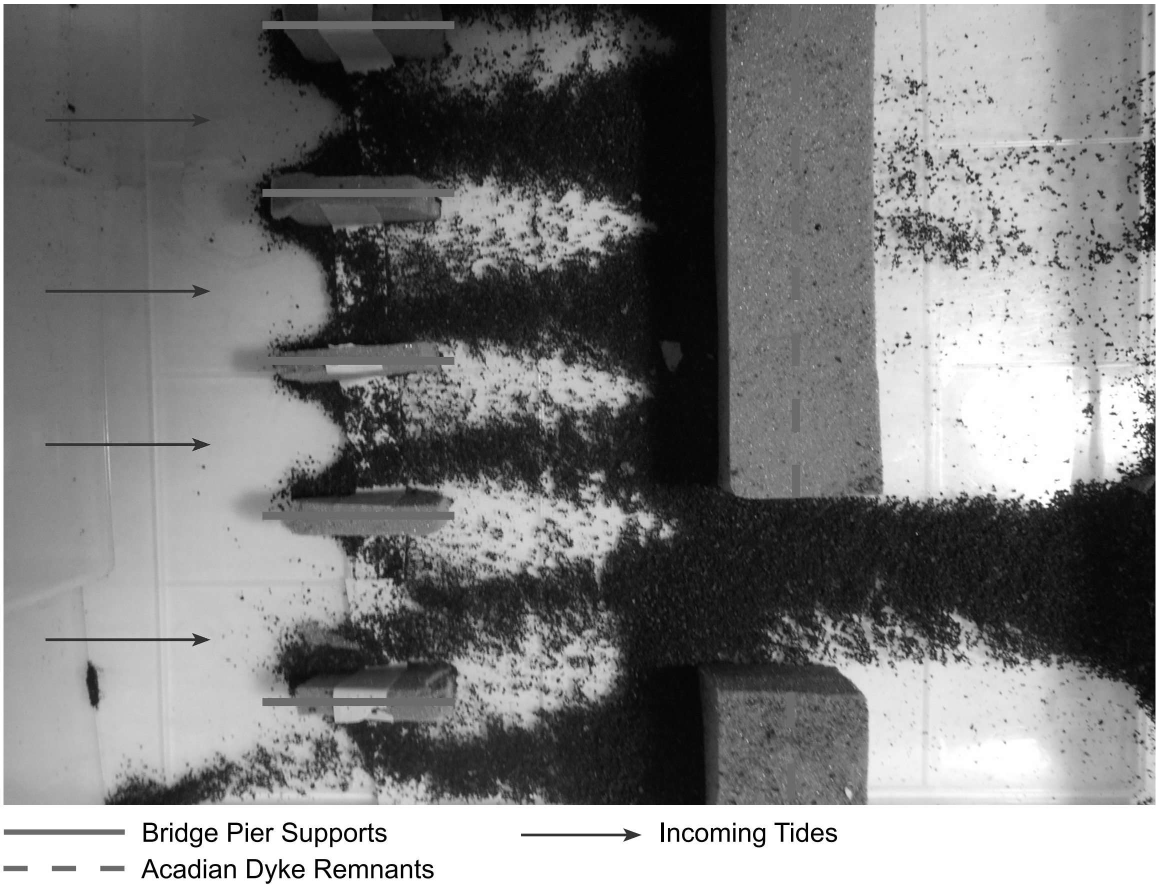


Fig. 40 - Sedimentation Study C.

witness the massive flocks of Semipalmated Sandpipers during their southern migration. The footbridge is a safe distance from the flats so as not to upset the birds during this time.

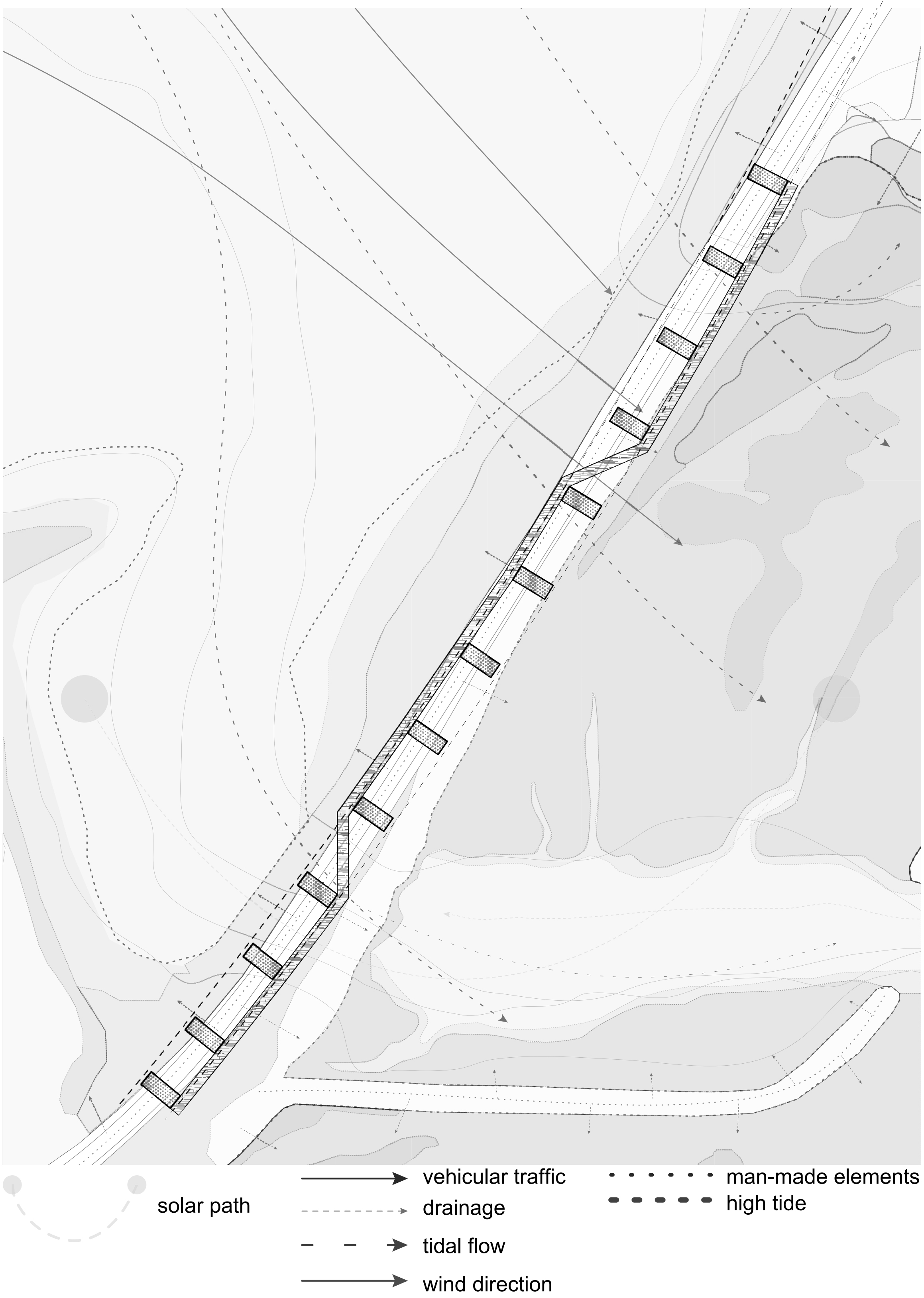


Fig. 41 - Site Plan showing the location of Marker D, the causeway. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Marker Two - Interpretive/Community Centre

The decision was made to locate the interpretive/community marker on the site adjacent to the salt marsh (Fig. 42) for three key reasons:

1) The intention is to actively and boldly engage with the site. Rather than situate this marker further up and away from the marsh and highway, it is approximately 30 metres from the marsh border.

2) The area around the mouth of the marsh is the most dynamic, is flooded more frequently and absorbs the strongest impact from storms, wave action, and wind action. For this reason it is also the most resilient. Conceptually, the interpretive/community marker is the most dynamic, will experience the most usage with the widest programmatic variety.

3) In this location, the marker can be seen clearly from the highway as people approach from both directions. This marker acts as the gateway to the rest of the site.

● Interpretive/Community Marker ········ Hiking Trail

Fig. 42 - Site Plan: Nature Trail and Interpretive/Community Marker Location. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Siting - Speculative Marsh Expansion

The specific siting of the interpretive/community marker required consideration of how the marsh may eventually expand. We can never be certain of how exactly the marsh will expand but we can speculate on how the marsh may expand and how it would interact with different foundation types based if it were to expand past the interpretive/community marker.

Speculation A - Foundation Wall

If the foundation is typical concrete construction, this speculation assesses how the land would interact with the community/interpretive marker over time (Figs. 43a, 43b, and 43c).

Fig. 43a - Speculation A: Foundation Wall, Year 0.

Fig. 43b - Speculation A: Foundation Wall, Year 10-20.

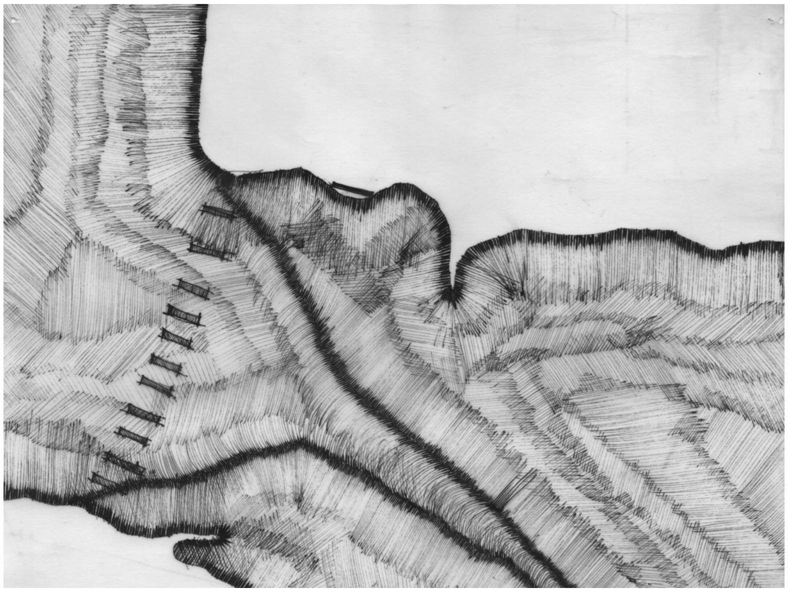


Fig. 43c - Speculation A: Foundation Wall, Year 20-30.

Over an undetermined amount of time, the marsh expansion may reach the marker. A concrete foundation wall would encourage sediments to deposit against it and impede the flow of water.

Speculation B - Pile Foundation

If the interpretive/community marker has a steel pile foundation, this speculation assesses how the land would interact with this marker over time. Unlike a typical concrete foundation, the piles would accommodate any uneven settling in the ground that may be a result of changing ground conditions that accompany the marsh expansion (Figs. 44a, 44b, and 44c).

Fig. 44a - Speculation B: Foundation Piles Year 0.

Fig. 44b - Speculation B: Foundation Piles Year 10-20.

Fig. 44c - Speculation B: Foundation Piles, Year 20-30.

Over an undetermined amount of time, the expansion may reach the marker. The piles, similar to the bridge piers, will encourage sediments to deposit around them but not as much as a concrete foundation. They also impose less of a restriction over the flow of water.

Piles Over Time

Investigating different foundation types led to an exploration of what a piled foundation could potentially contribute to this ecosystem. The piles would be installed on the site and over time would become embedded in the marsh as it expands (Figs. 45a, 45b, and 45c).

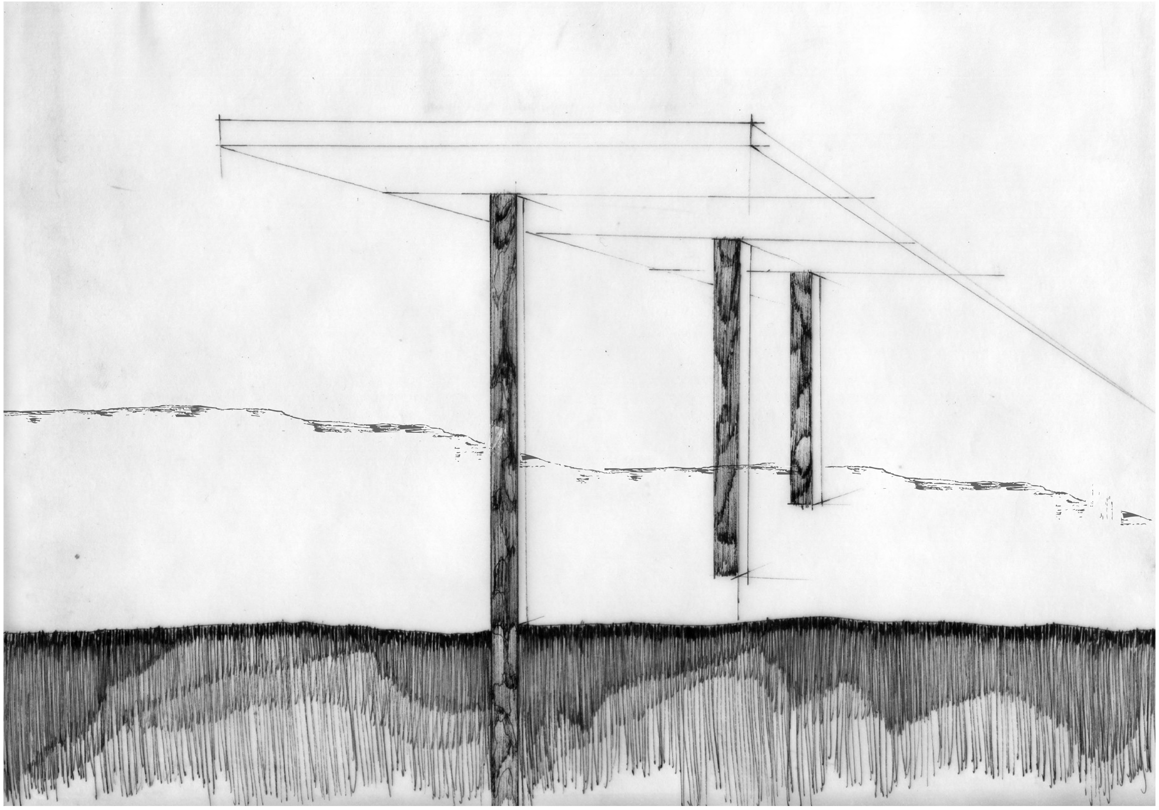


Fig. 45a - Phase 1 illustration of the interaction between the piles and ground over time.

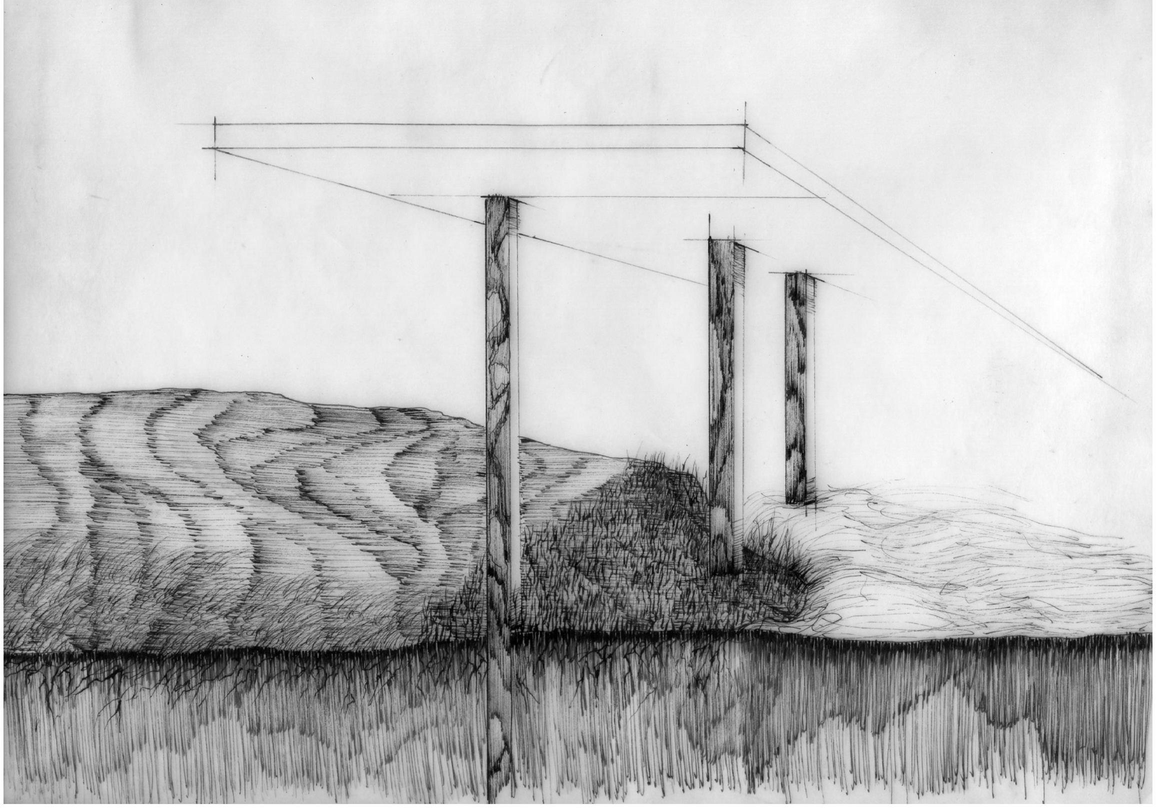


Fig. 45b - Phase 2 illustration of the interaction between the piles and ground over time.

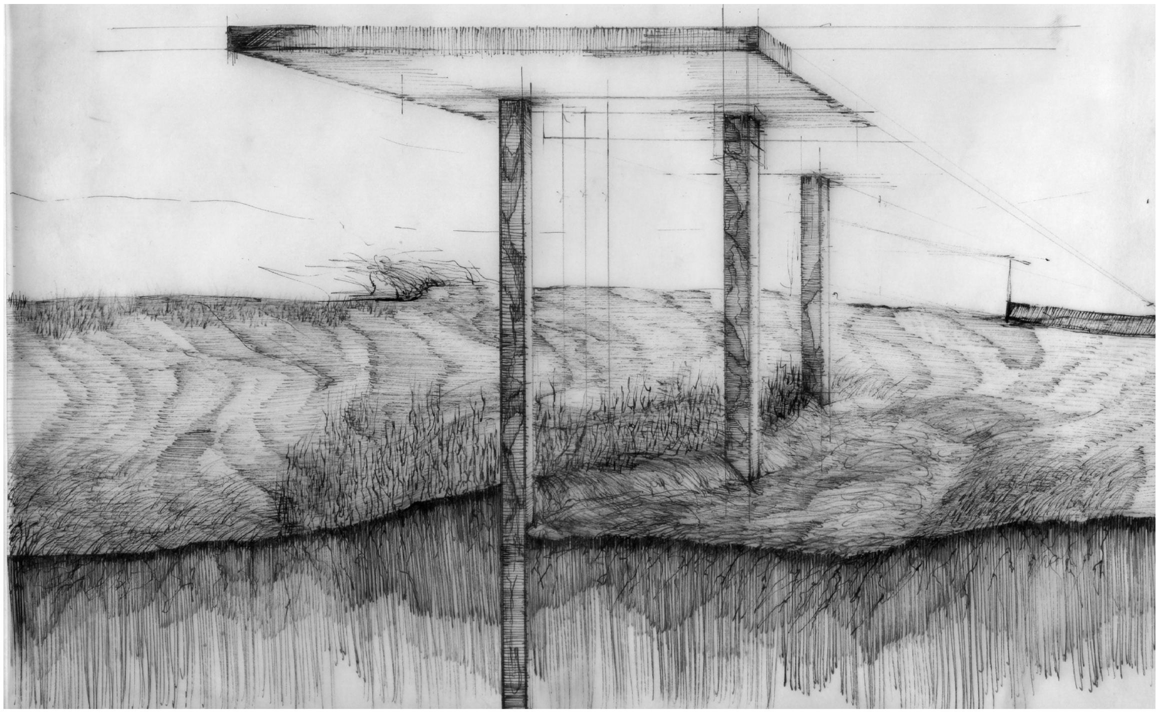


Fig. 45c - Phase 3 illustration of the interaction between the piles and ground over time.

The piles will act similarly to plant roots and encourage sediments to deposit around them. This deposition will encourage further vegetation growth, creating more habitat. There is still a question of whether these piles will create the right kind of habitat for the organisms native to the marsh but they are a component of the over all marker and they mark the creation of habitat.

Analyzing the Plan in Layers

Rather than discuss the design in parts (concept, program, structure, systems, etc.), it is discussed in a series of layers starting with the roof and moving towards the foundation.

Roof Layer

The roof is the first layer of the interpretive/community marker (Fig. 46). It acts as the canopy, sheltering the internal mechanical and social operations.

This roof is a green roof that addresses the first stage in water collection and storage for the marker. It is a butterfly roof that slopes towards a single point over an interior wall. The water drains down a pipe within this wall and is stored in a cistern in the mechanical room. The green roof acts to filter the water before it is drained and stored. Towards the eastern edge the roof becomes more porous over an outdoor gathering space. The green roof ceases and eventually just the roof structure is left exposed.

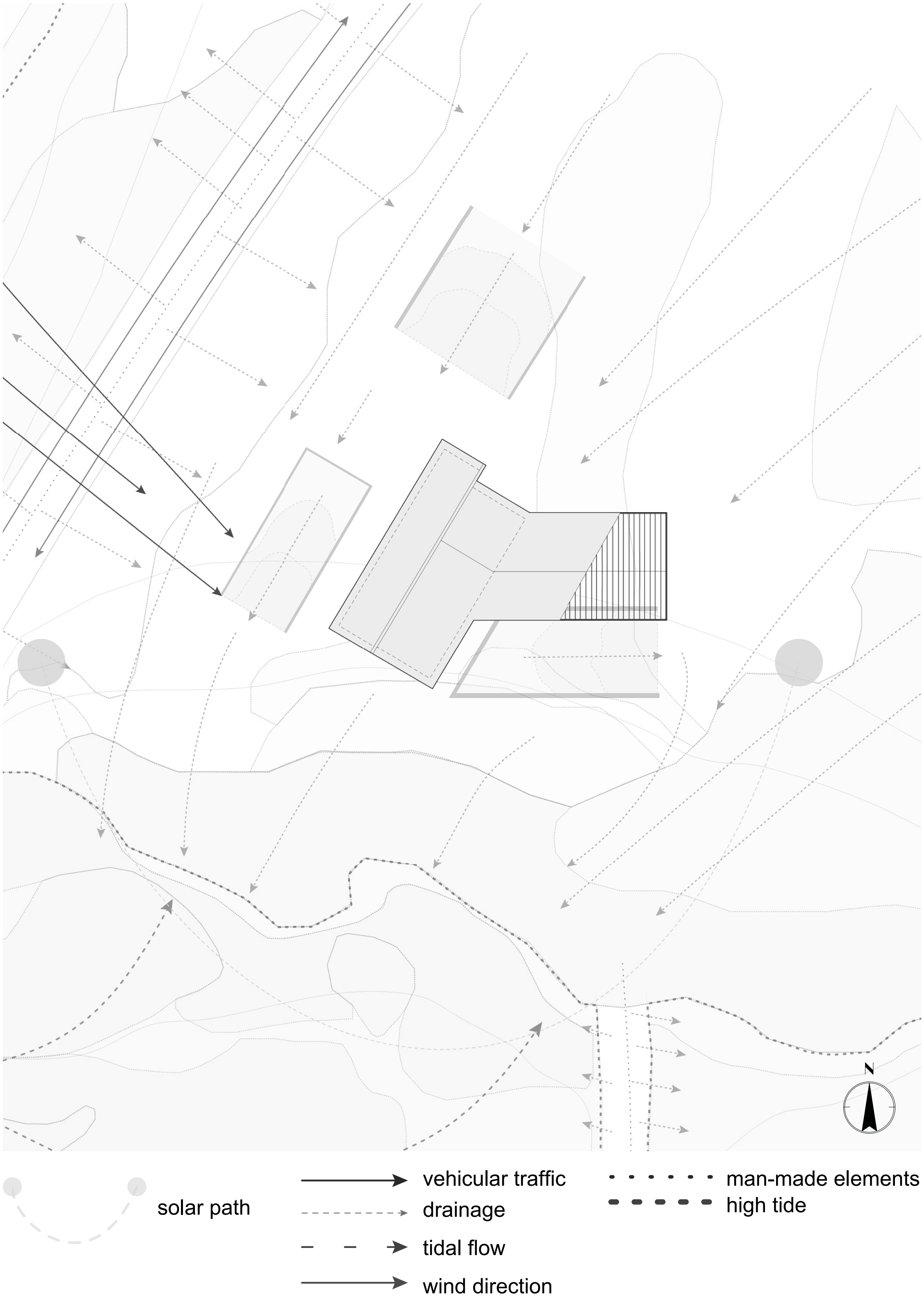


Fig. 46 - Site plan with roof layer. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Ground Level

The community/interpretive marker is the first marker that visitors encounter and acts as a gateway to the rest of the site (Fig. 47). The parking lot is slightly sloped towards a greywater marsh where reeds will be planted to help filter run-off from vehicles. Visitors walk along a boardwalk to the north-facing, front entrance of the building.

Orientation

The community/interpretive marker is oriented primarily to shelter the eastern most outdoor gathering space from the wind coming off the Bay.

The marker is situated along a small, natural wetland that borders the salt marsh. This is the speculated extent of the marsh expansion.

Service Core

Programmatically, the community/interpretive marker differentiates the support/service spaces from the space for social activity (Fig. 48).

The support spaces - washrooms, mechanical/electrical, and a kitchen - are situated together in a west-facing “service core”. This core reveals the functional processes of the building. The intention is to place these processes on display as part of the educational component of the interpretation centre. Revealing the processes by which the building functions primarily in terms of water collection/distribution and waste processing is a way of revealing how the salt marsh functions because they function in very similar ways. This is valuable because what makes this landscape so fertile and diverse are the natural systems that are invisible to our eyes. Likewise mechanical rooms in a building are typically hidden but buildings cannot function without them. The mechanical room becomes a viewing gallery with windows that allow visitors a look into the internal processes of the building. The transparent pipe channeling water from the roof down into the cistern can also be seen at the ground floor level. On a particularly rainy day, water will be seen pouring down.

The “service core” is wood construction with a gabion veneer cladding. The gabion cladding baskets give the facade a porous appearance and help to absorb the impact of the wind coming off the Bay. This cladding spreads across the entire western facade and provides cover over windows in the mechanical room as well as the washrooms. This provides privacy but allows natural daylight to filter through.

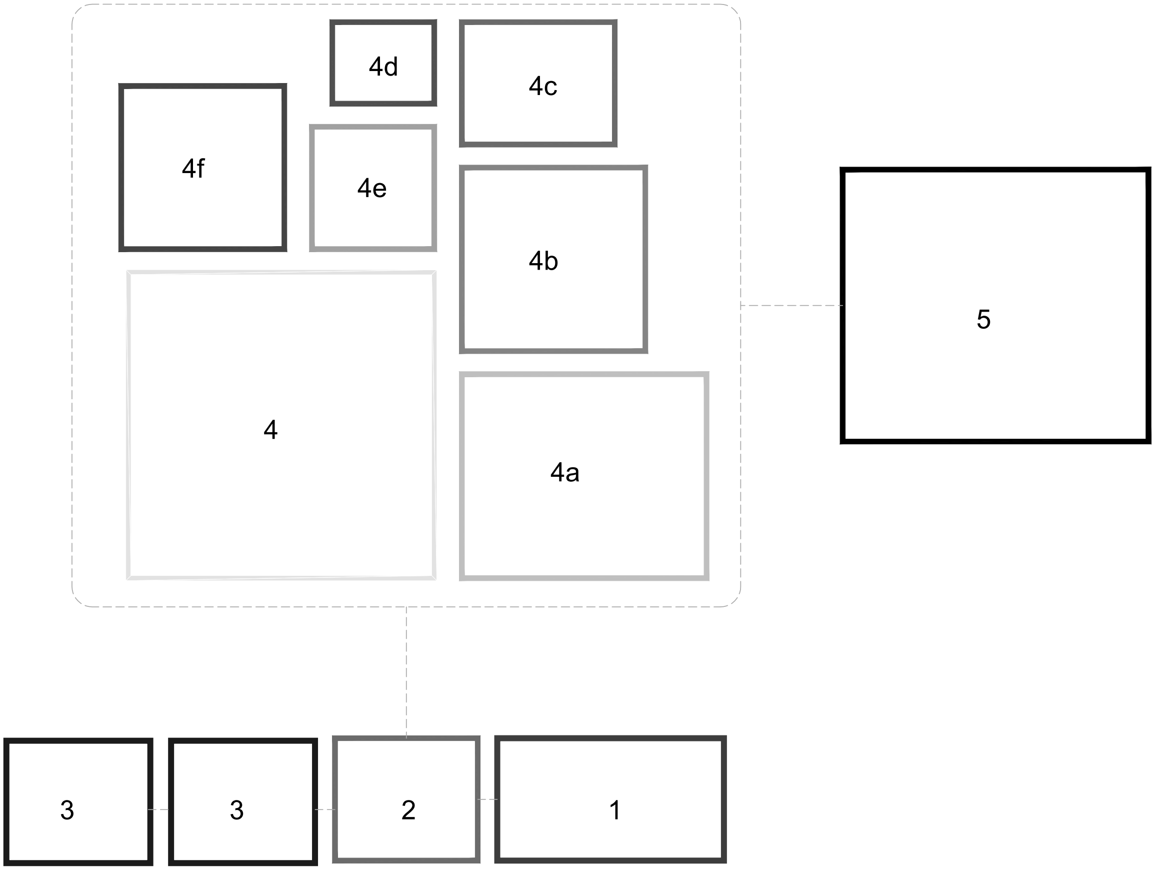
Flexible Space - Interior and Exterior

Cheverie is a small but social community - the thesis site is currently used for social gatherings during the summer. Rather than design formal spaces for each activity the community undertakes, the interior is designed as one large open space with moveable walls. The space can be oriented various ways depending on what it may be used for at any given time. A portion of the east facing wall opens onto the outdoor gathering space. The outdoor gathering space is a series of platforms with movable walls similar to those in the interior space. This outdoor space is mainly for summer activity but a fire pit can also be incorporated to make it more welcoming during the winter.

The flexible spaces are wood construction and the interior is clad with horizontal wood slats.

The outdoor gathering space marks the beginning and end of the nature trail around the marsh. Two boardwalks lead off, one towards the bridge at the mouth of the marsh and the other south-east along the edge of the marsh.

Fig. 47 - Site Plan with Ground Layer. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.



1 - Kitchen (40 sq.m.)
2 - Mechanical/Electrical (25 sq.m.)
3 - W/C (25 sq.m.)

4 - Flexible Space (225 sq.m.)
  4a - workspace
  4b - jam space
  4c - meeting space
  4d - storage
  4e - dining
  4f - tourist information/displays

5 - Outdoor Gathering Space (175 sq.m.)

Fig. 48 - Programmatic adjacencies diagram.

Mechanical Layer One

Aside from the mechanical room, the building is elevated off the ground (Fig. 49). The washrooms have composting toilets that empty into a composter in the mechanical room which is two metres below the level of the toilets.

Mechanical Layer Two

The mechanical room burrows into the ground and it is here that water is collected and distributed, and waste exits the building. The composter allows solid waste to dry out and any liquid is channeled out into the nearby blackwater marsh for filtration.

The storage container for the solid waste is emptied when full and removed from site. The blackwater goes through several stages of filtration, passing through different clusters of plants with toxins being progressively filtered along the way. All greywater is channeled out from the mechanical room into the greywater marsh for filtration (Fig. 50). Similar to the blackwater marsh, the greywater goes through several stages of filtration.

Foundation Layer

The piled foundation is in preparation for the marsh expansion. As the marsh expands the piles will accommodate the uneven settling as the ground conditions become more unstable (Fig. 51).

Layered Model

Overlaying the plans shows the building as whole system (Fig. 52a). The path of water through the building is illuminated (Fig. 52b).

Fig. 49 - Site plan with mechanical layer one. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

1a^1 – 1a^3 Different plants are used for different stages of filtration for water run-off from parking lot.

5a^1 – 5a^3 Different plants are used for different stages of greywater filtration.

3a^1 – 3a^3 Different plants are used for different stages of blackwater filtration.

Fig. 50 - site plan with mechanical layer two. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

Fig. 51 - Site plan with foundation layer. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

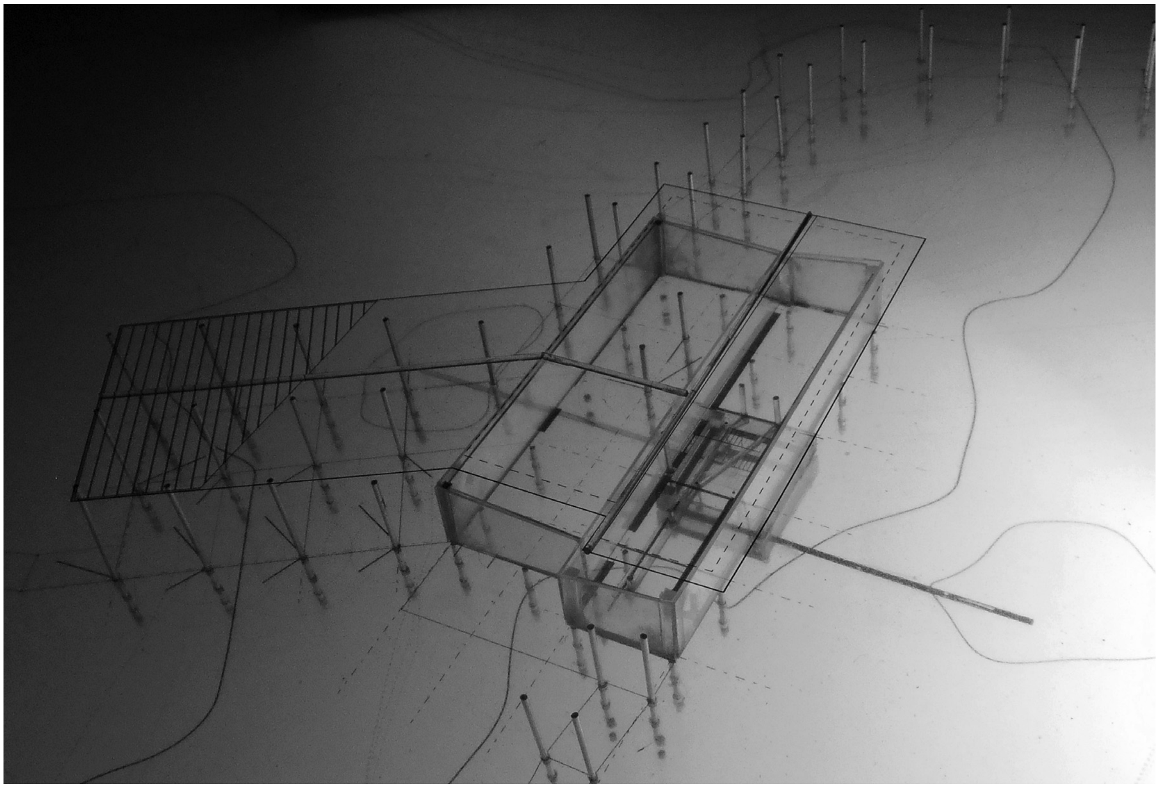


Fig. 52a - Plans printed on acetate and layered between sheets of 1/8” acrylic. Steel and acrylic verticals.

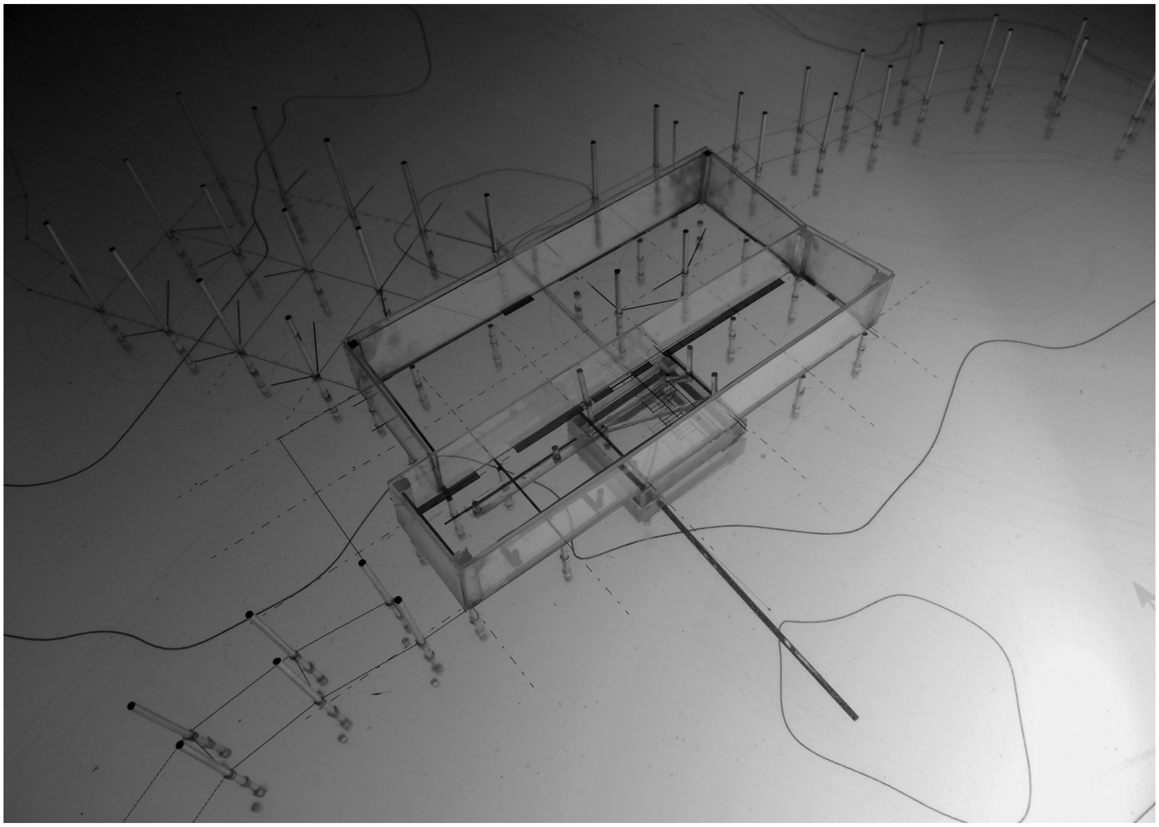


Fig. 52b - Blue acrylic dowels illuminate the path of water through the building.

Analyzing the Section in Layers

Four sections were taken through the marker (Fig. 53). In sequence these sections (Figs. 54a, 54b, 54c, and 54d) show how the building moves from outdoor to indoor and its position in relation to the salt marsh.

Overlaying the sections show the layers of the community/interpretive marker together and its relative position to the marsh (Fig. 54e).

Fig. 53 - Key plan showing section cuts. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

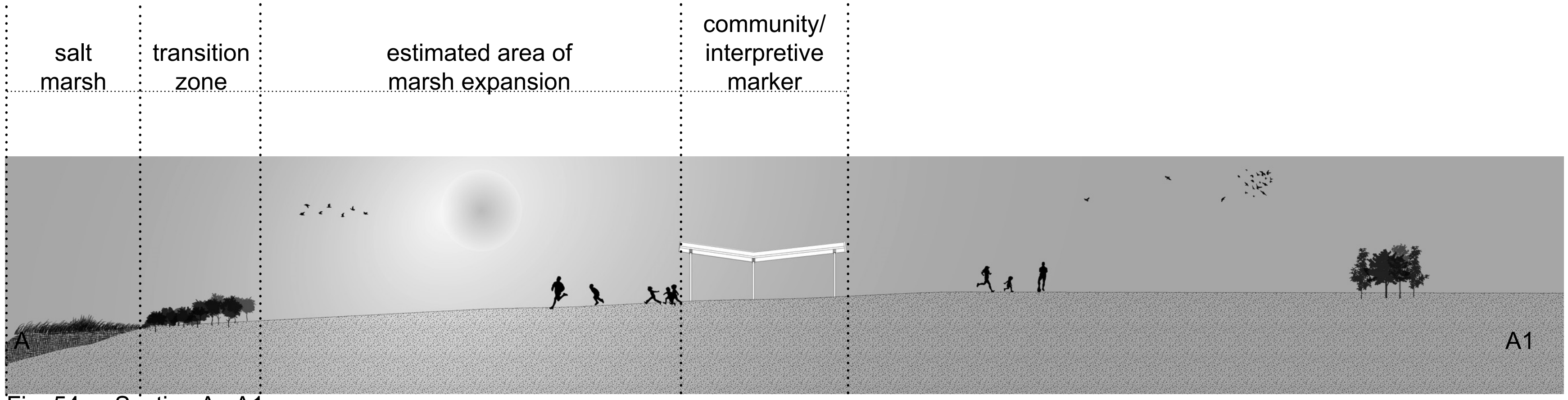


Fig. 54a - Section A - A1.

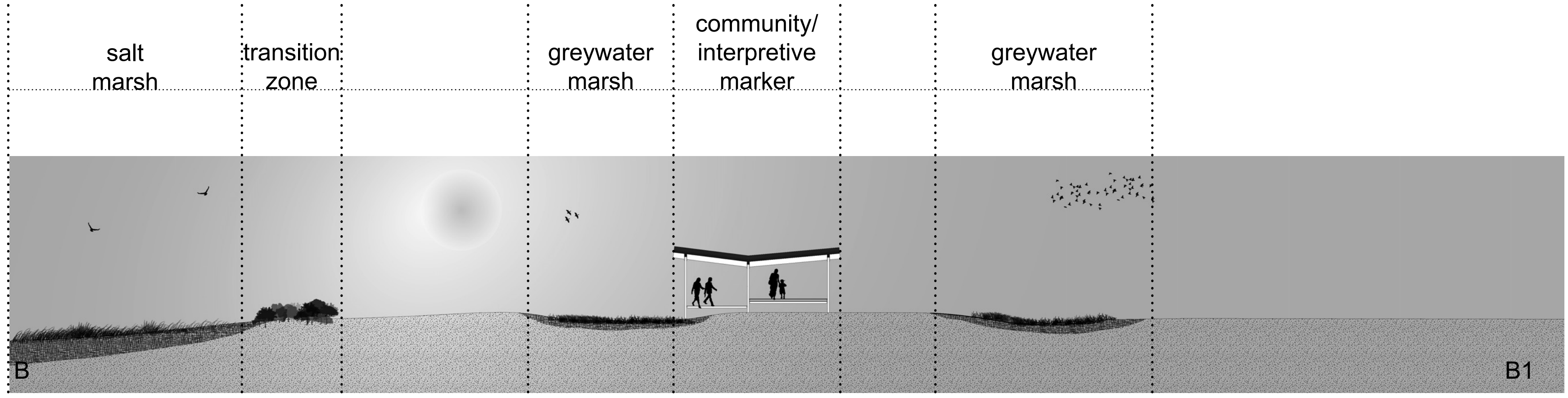


Fig. 54b - Section B - B1.

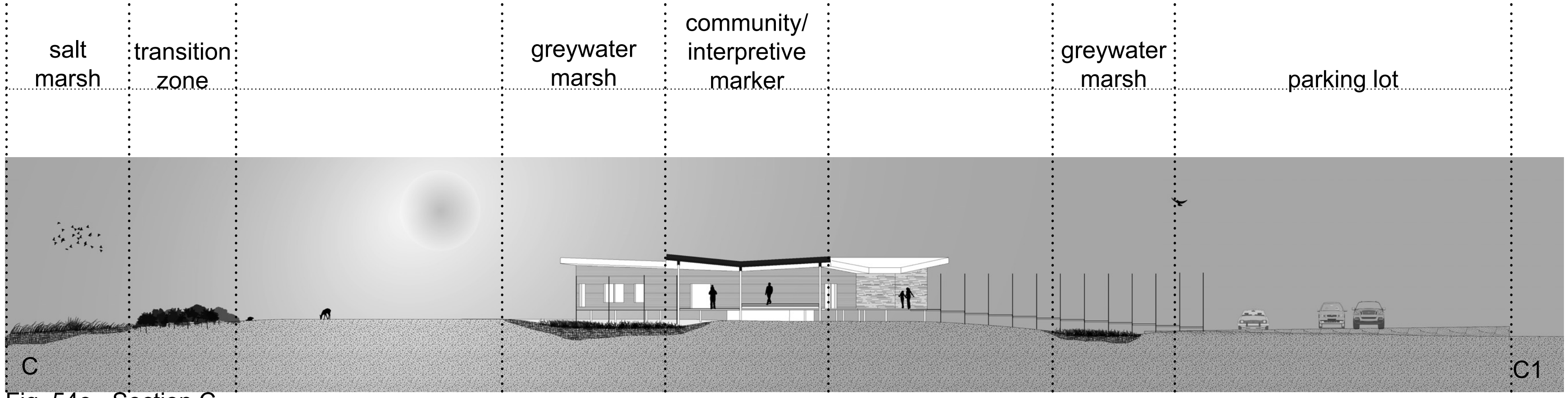


Fig. 54c - Section C.

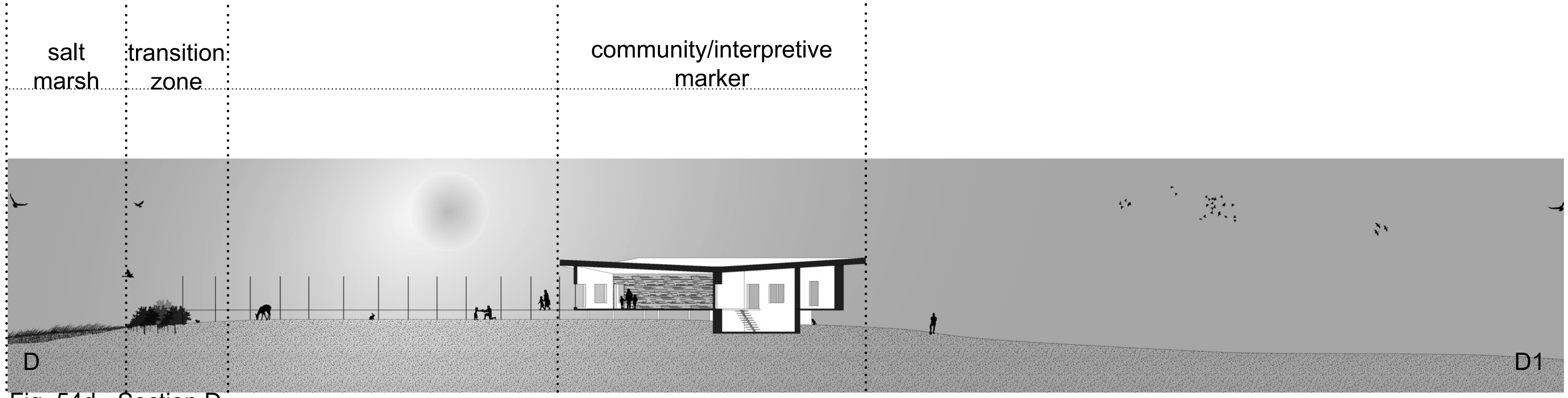


Fig. 54d - Section D.

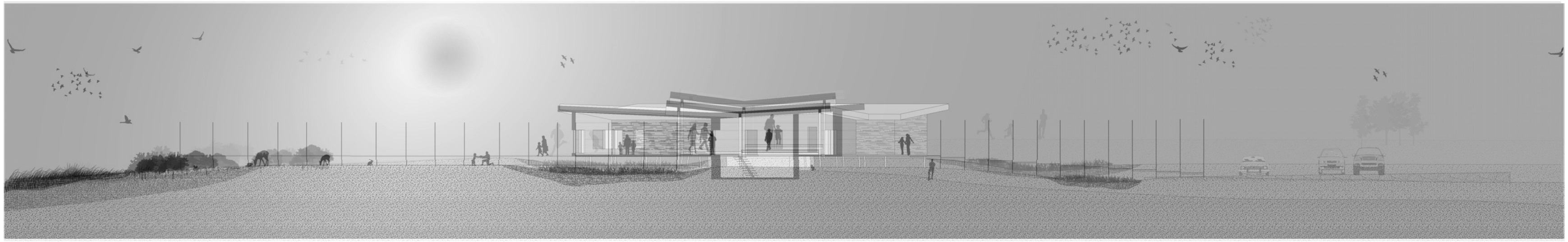


Fig. 54e - Sections A, B, C, and D, overlaid.

Wall Sections

Wall sections were developed to show specific details concerning light, water, and changeability of interior space.

Wall Section 1

Wall Section 1 shows the interior wall where water drains down from the green roof into a cistern in the mechanical room (Fig. 55). The green roof filters the water as it trickles through the layers of soil into the drainage pipe. A viewing window at ground level provides a glimpse of the drainage pipe before it descends down into the mechanical room and empties into the cistern.

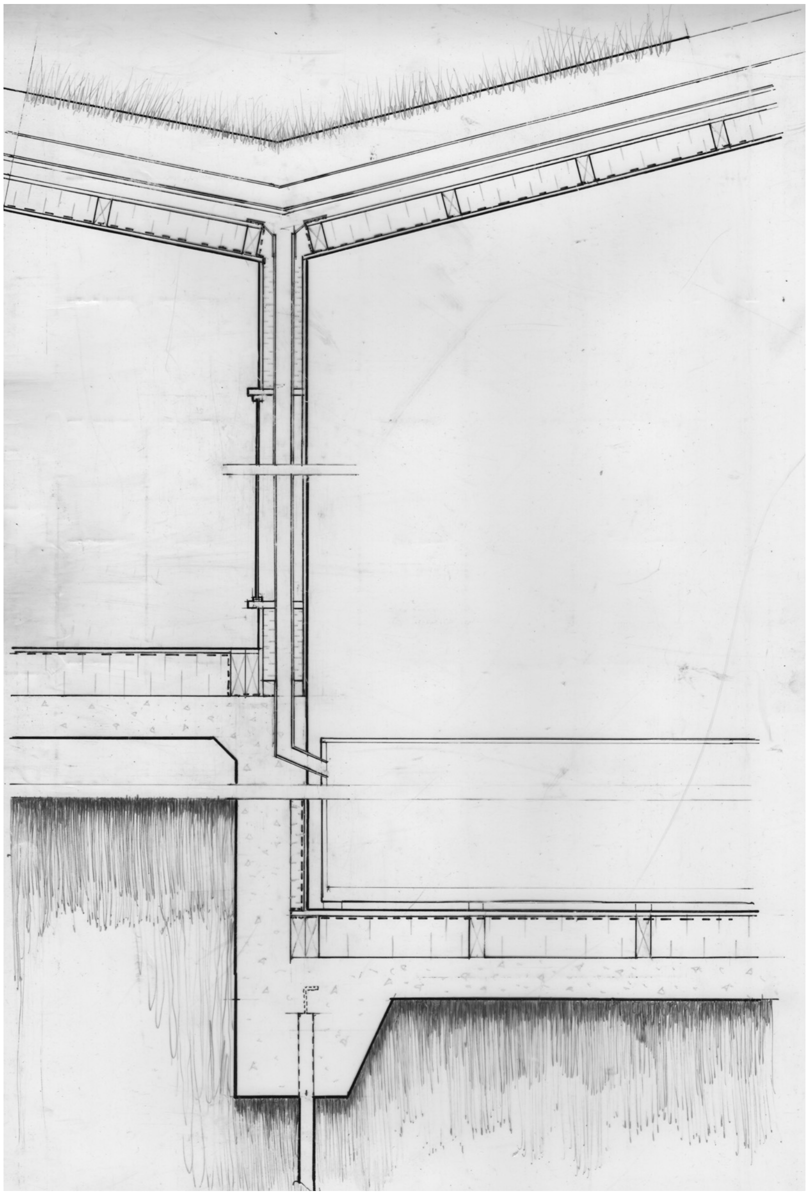


Fig. 55 - Wall section one: interior drainage wall

Wall Section 2

Wall Section 2 shows a section of the building from one of the interior moveable partitions to the exterior wall that opens onto the outdoor gathering space (Fig. 56). The exterior facade is wood slat rain screen system and the foundation is a concrete slab on steel helical piles.

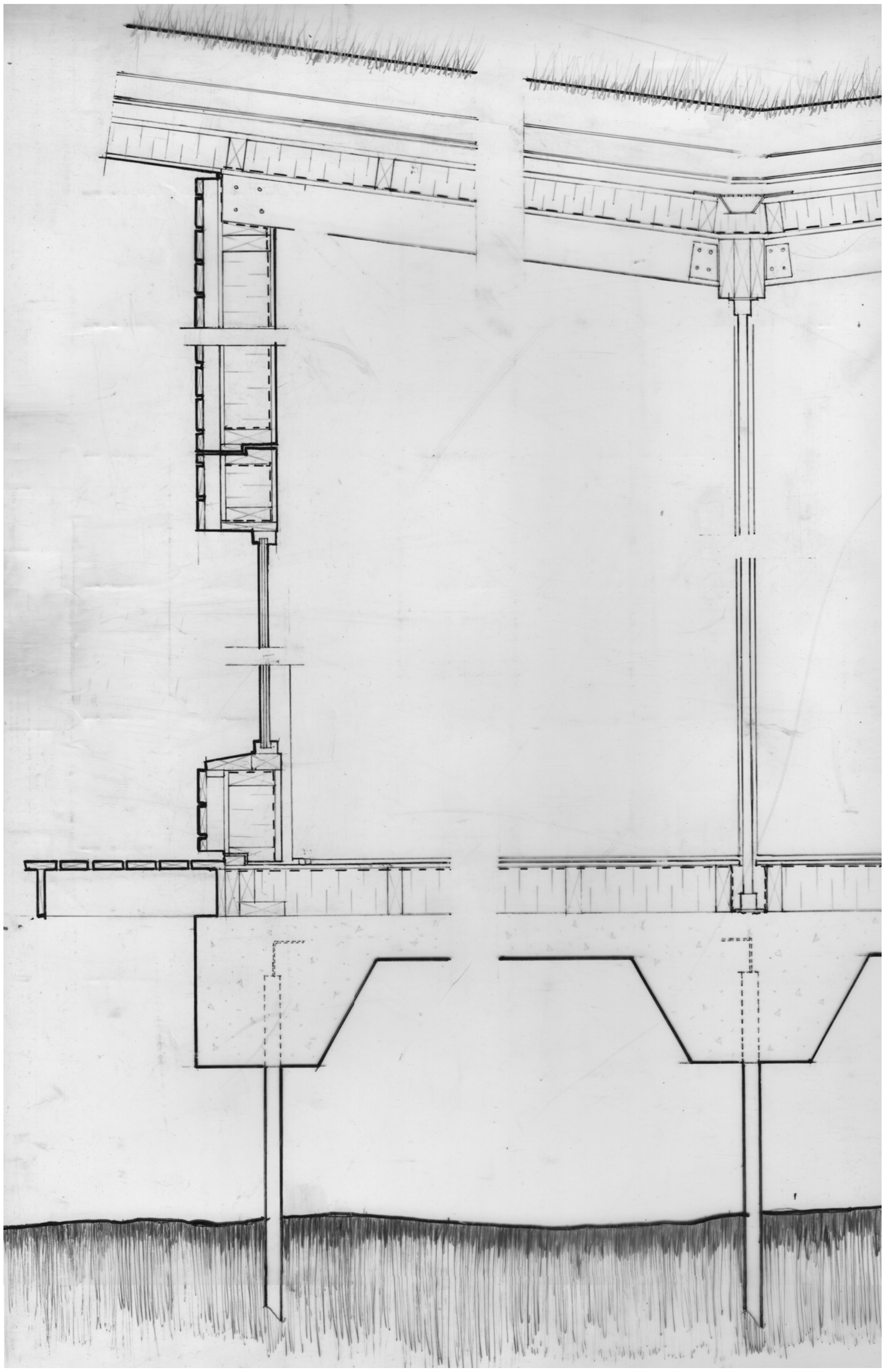


Fig. 56 - Wall section two: interior moveable wall to exterior facade

Wall Section 3

Wall Section 3 shows a section through the exterior facade of one of the washrooms in the service core (Fig. 57). Gabion veneer cladding covers the window acting as a screen for privacy while allowing natural light to filter through.

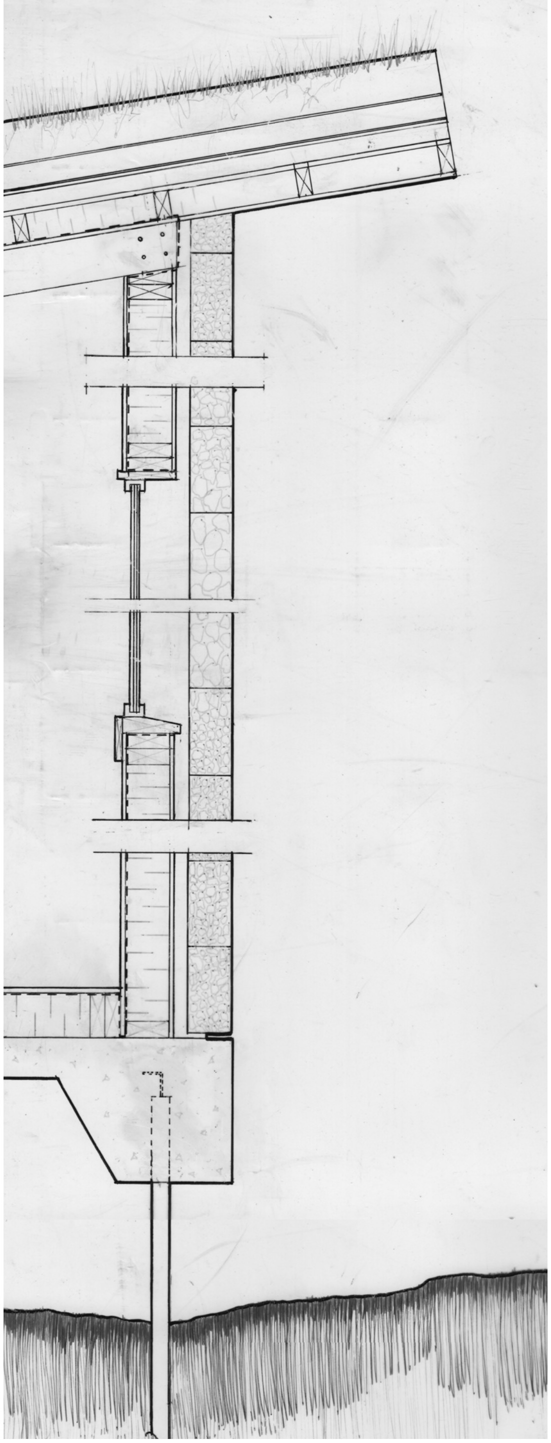


Fig. 57 - Wall section three: exterior facade of service core.

In Perspective - Shifting Planes

Over time as the marsh begins to expand, the land will change. Where the marker is originally built on dry land, it may eventually become partially or fully immersed in the marsh. The boardwalks are built in five metre sections and as the marsh expands, the platforms are able to be raised on the columns using engineered column jacks (Figs. 58a 58b, and 58c). In this way the marker will track and respond to changes in the landscape over time.

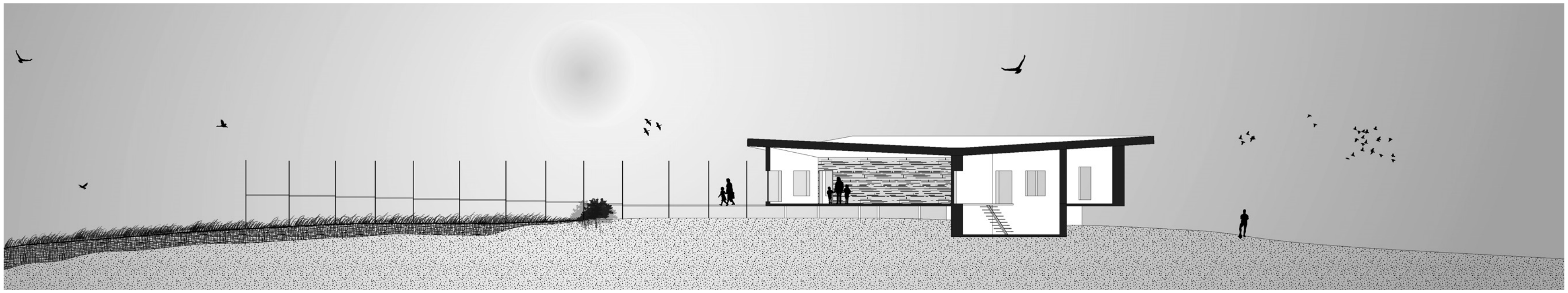


Fig. 58a - Phase 1 of marsh expansion.

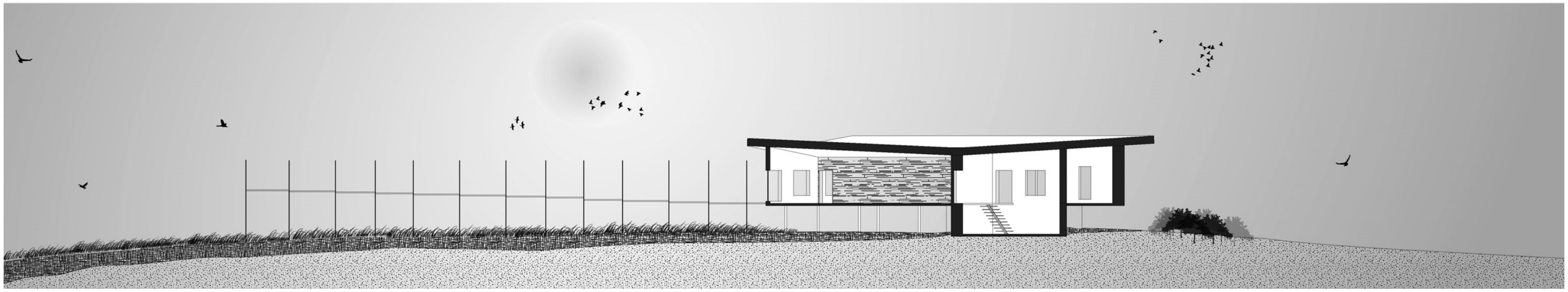


Fig. 58b - Phase 2 of marsh expansion.

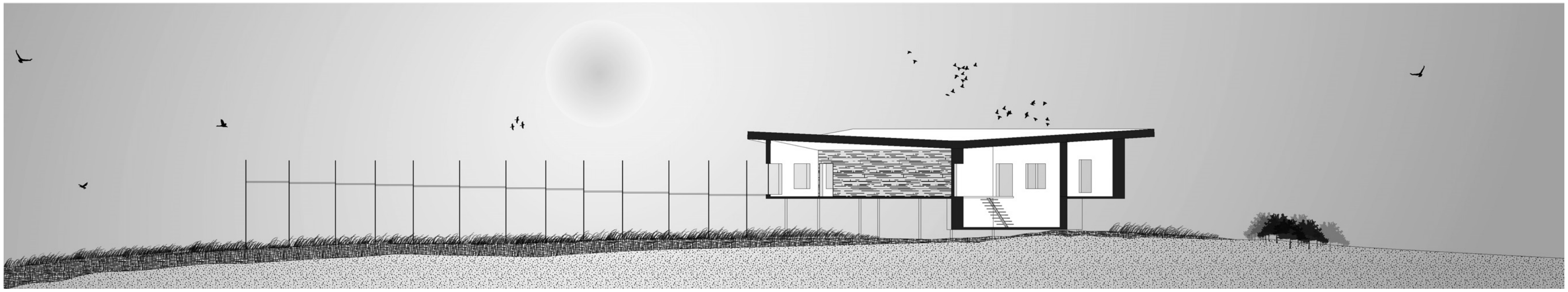


Fig. 58c - Phase 3 of marsh expansion.

Select Additional Markers

Additional markers are situated at specific points around the marsh, linked together by a nature trail (Fig. 59). Each marker is specifically located where a drainage channel meets the marsh and each serves a different purpose.

Marker Three - Neighbourhood Boundaries

Marker Three marks the boundary between two zones of vegetation - cattails, a freshwater plant, and Spartina Alterniflora, one of the common salt marsh plants (Fig. 60a). This platform is supported by piles similar to the interpretive/community marker.

The speculation for this area is that as the marsh opens up, the cattails will become flooded by the tides and eventually die, being replaced by salt marsh plants. An alternative scenario is that this area of the marsh will follow a standard path of succession and the cattails will eventually be replaced by larger freshwater plants and eventually trees.

The intention for Marker Three is to have the platforms gradually retreat as the speculated scenario unfolds and the marsh begins to advance. Platforms are removed and only the piles are left, leaving a trace of where the marker used to extend to (Fig. 60b). The removed platforms are intended to be repurposed as walls so eventually the boardwalk becomes a pavilion.

Marker Four - Skirting the Edge

Marker Four marks the end of the 43 hectare marsh (Fig. 61a) by bridging the Cheverie Creek. This area of the marsh is expected to shift and expand and as it does, platforms can be moved, providing the bridge with more length (Fig. 61b).

Marker Five - Nursery Pool

Marker Five marks the potential location of a man-made nursery pool (Fig. 62). The idea is to create nursery habitat for fish that normally spawn in this salt marsh.

The platform is meant to remain stationary in the midst of the changes this environment may experience. If the marsh expands, the platform may become partially or full submerged during high tide.

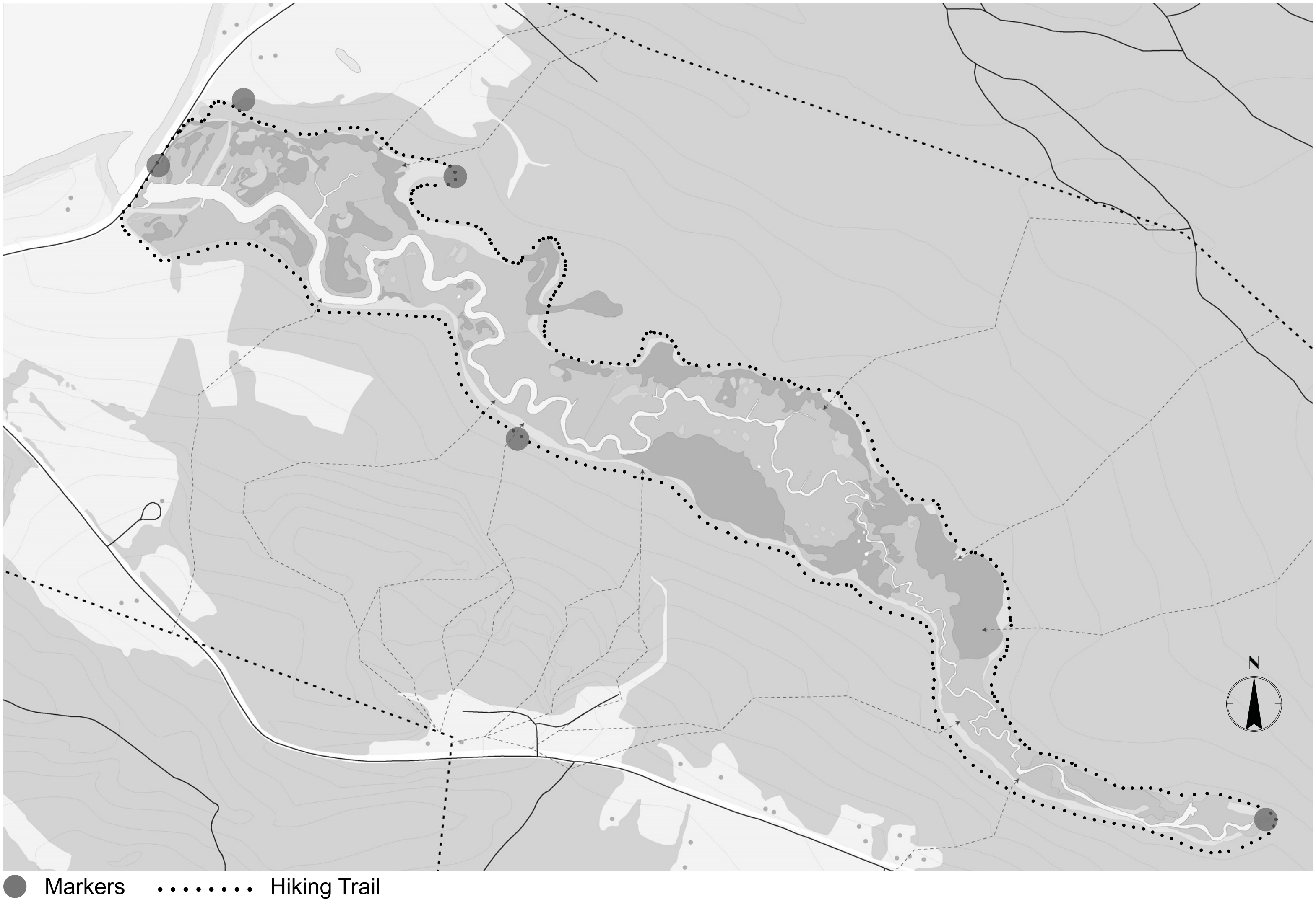


Fig. 59 - Site plan: nature trail and location of five markers. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

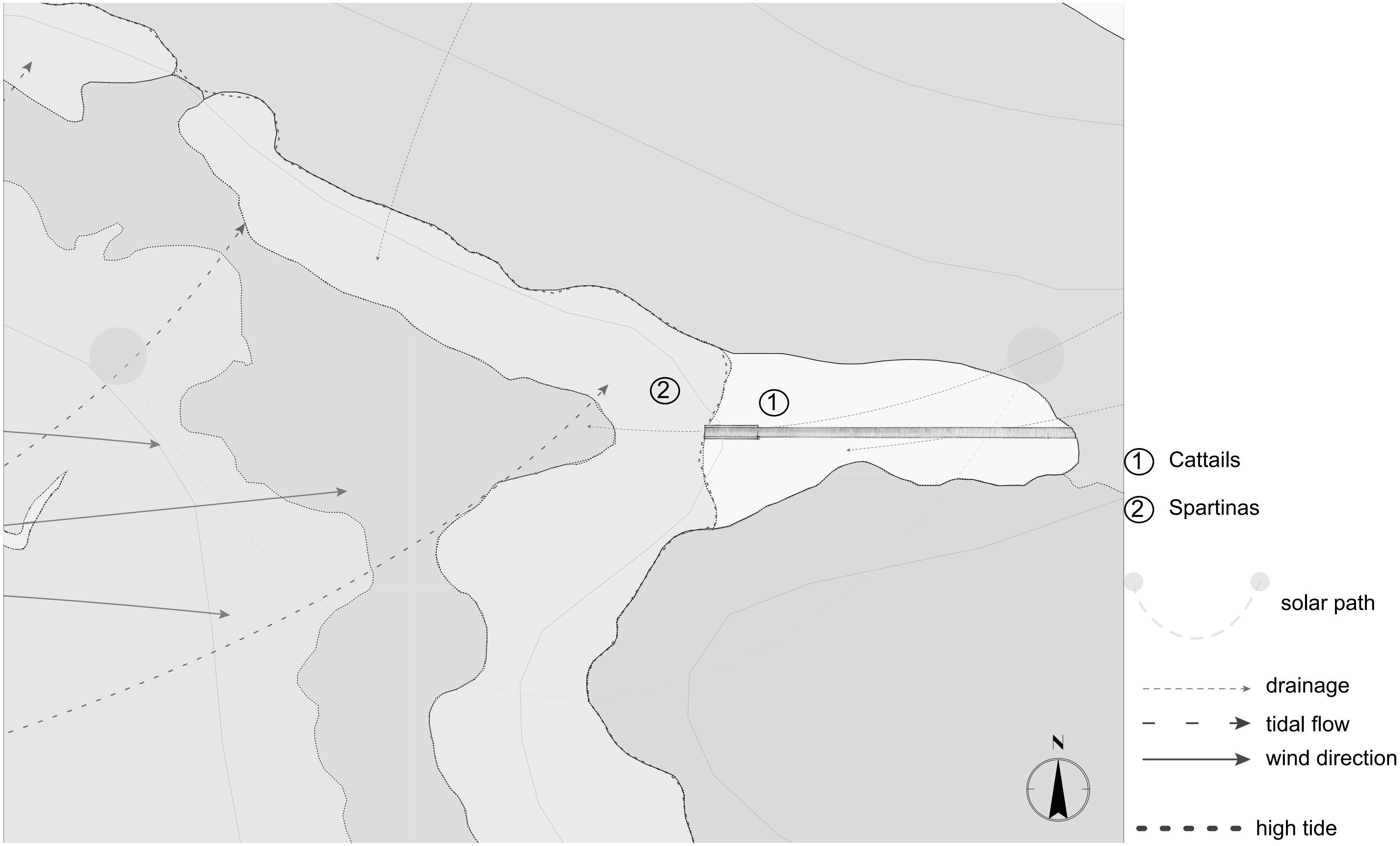


Fig.60a - Site plan showing the location of marker three. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

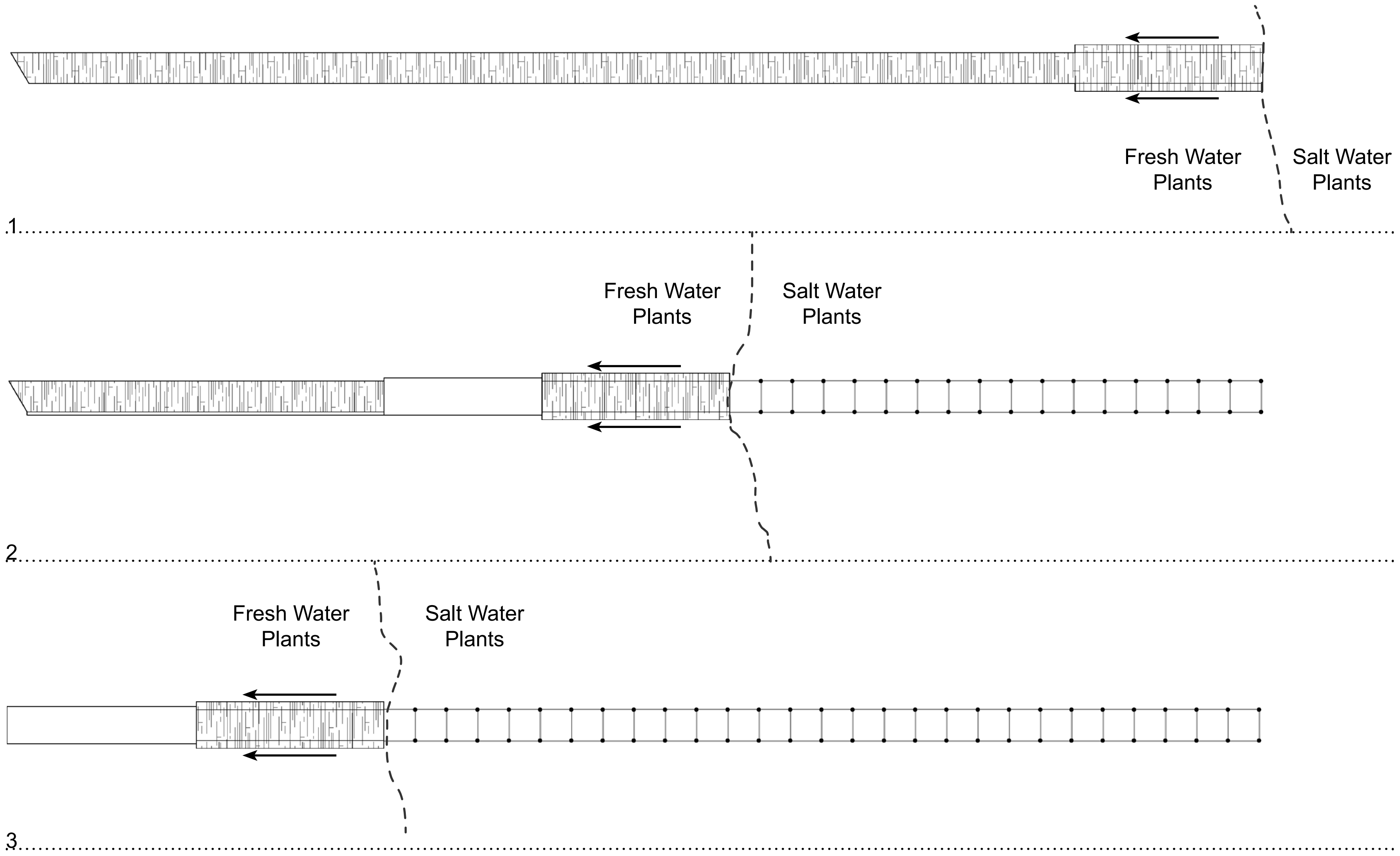


Fig.60b - Diagrams showing how Marker Three will gradually change over time.

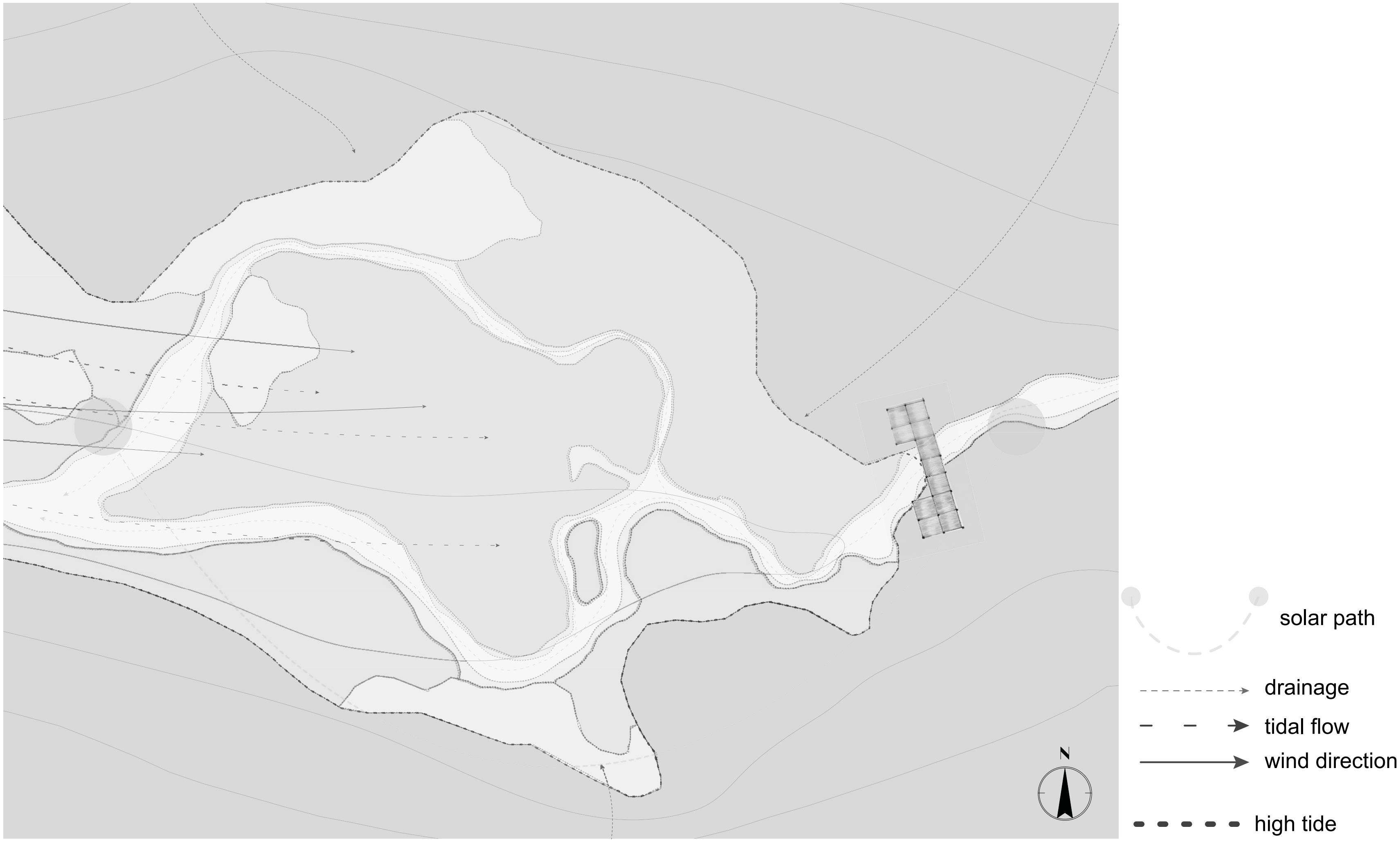


Fig. 61a - Site plan showing the location of Marker Four. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

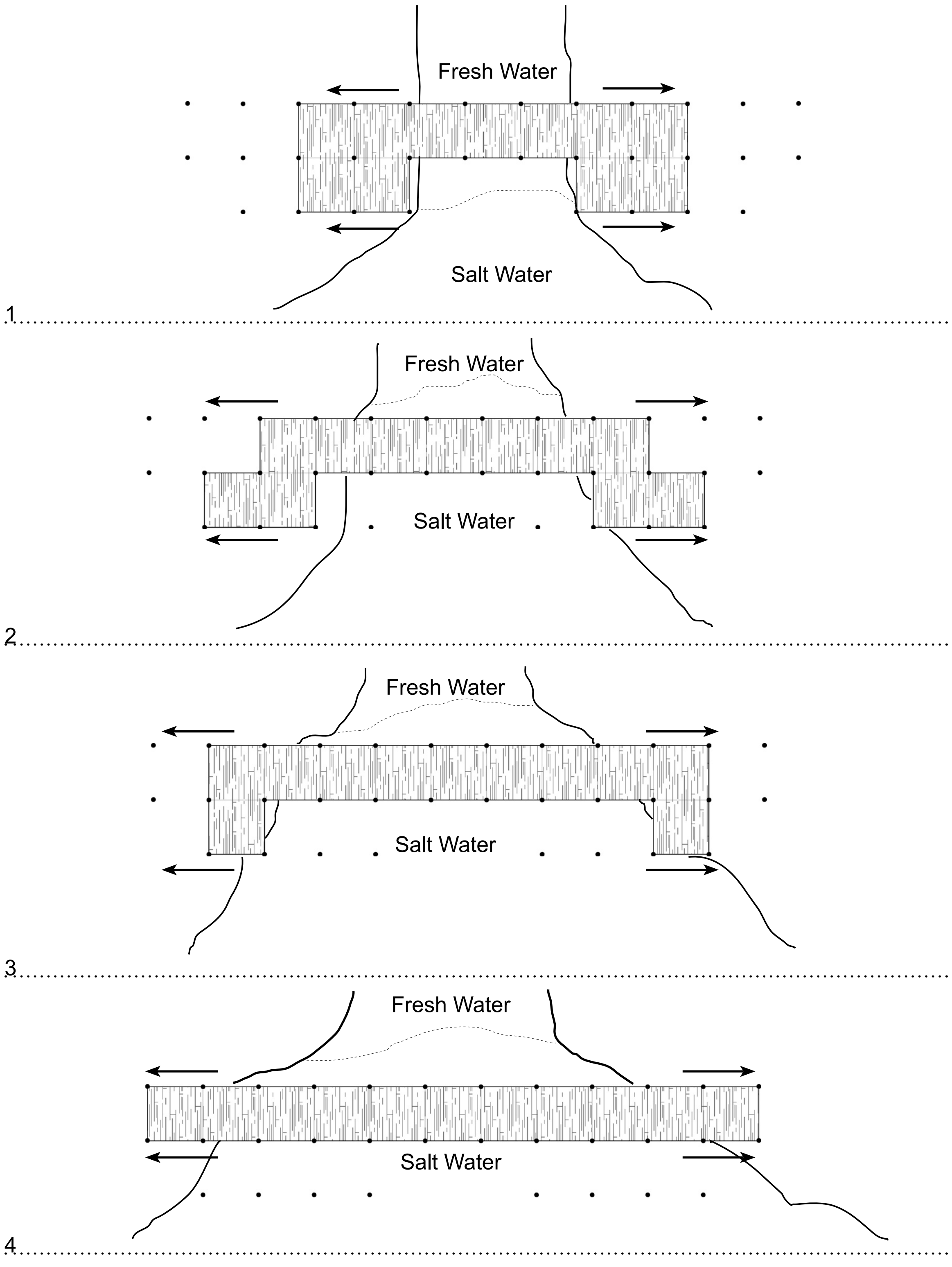


Fig. 61b - Diagram showing how Marker Four will gradually change over time.

Fig. 62 - Site Plan showing the location of Marker Five. Base map data from Dalhousie University GIS Centre database. NSTDB10000_Hants2012.gdb.

CHAPTER 4: CONCLUSION

The Intention - Reflecting on the Question

Question

How can architecture construct more synergistic relationships between people and the natural environment?

This question required an exploration of the traditional relationship between people and nature. Establishing the argument that the current environmental crisis disputes the predominantly Western philosophy that man is separate from nature was the beginning of the exploration. Architecture is not separate from nature and this is not a matter of philosophy, it is a matter of cause and effect. Every action imposed on the landscape has an effect and the thesis explored the natural systems of the site to understand how it functions and subsequently how the design and construction could potentially work with these systems and contribute something to this natural environment. Changing the way we relate to our landscapes through the built environment will hopefully help to fix the disconnect caused by the old paradigm that man is separate from nature.

Cross-Discipline Collaboration - Diversity in the Process

In Chapter 1, I quoted Fritjof Capra:

> The stability of an ecosystem depends on its biodiversity; on the complexity of its network of relationships.[39]

The same can be said for the diversity of the team involved in the design process. In the case of this thesis, the process was a gold mine of discovery concerning similarities between the systems of buildings and systems of the natural environment. These discoveries may not necessarily have been made without the diversity of the team involved. Ecology is a vast field and having an ecologist on the design team was valuable. Architecture is a collaborative profession and this lesson in collaboration with an expert in a different field was a major learning experience. It was an opportunity to share knowledge and ideas openly; to grasp new concepts and apply them to the design process.

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[39] Fritjof Capra, *Centre for Ecoliteracy: The New Facts of Life*, last modified summer, 2008, http://www.ecoliteracy.org/essays/new-facts-life

Pushing the Envelope

This thesis knowingly pushed the envelope and the value in doing so is in the method - to use the architecture as a means for testing and learning. This site is already being used to test methods for rehabilitating salt marshes. Using it as a site to test whether design can be used to the mutual benefit of humans and the natural environment is equally as valuable. As a marker for monitoring change, the architecture acts as a signal, allowing us to adapt in a predictive and more effective way as the environment begins to change.

Summary Statement

This thesis develops a design method that considers how both design and construction methods can merge more seamlessly with the natural systems of a site.

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