Designing for Sensitive Sites: Enabling Sustainable Interaction In Ecologically Sensitive Sites

by

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Submitted in partial fulfilment of the requirements
for the degree of Master of Architecture

at

Dalhousie University
Halifax, Nova Scotia
March 2015

CONTENTS

ABSTRACT

To design for a sensitive ecological site while promoting interaction with that site requires a clear understanding of where the site's fragility lies and what measures would be most appropriate to minimize intrusion while encouraging interaction. The Witless Bay Ecological Reserve, off the eastern coast of Newfoundland, is an ideal case study to test this method. Its complex, dynamic and sensitive ecosystem, combined with the human need to explore, experience and understand the site, defines a clear framework for any possible intervention and adaptation.

The new architecture would have a focus on research and interpretation, leading to a greater understanding of the habitat and inevitably to a more well-rounded conservation management plan. The systems, spaces and experiences of the architecture should serve to deepen an understanding of the human relationship with the site from the aspect of conservation research and also from the aspect of tourism/community interaction. Interaction with the site through the architecture should be educational and supportive for all, while minimizing any short or long term impact on the local ecology or landscape.

ACKNOWLEDGEMENTS

Thank you to Jeri Graham (Manager of Natural Areas Program, Parks and Natural Areas), Dr. William A. Montevecchi (University Research Professor of Psychology, Biology and Ocean Sciences, Memorial University of Newfoundland), Suzanne Dooley (Co-Executive Director, Canadian Parks and Wilderness Society), Joshua Mailhiot (Environmental Assessment Coordinator, Canadian Wildlife Service, Environmental Stewardship Branch) and Dr. Robert Ronconi (Killam post-doctoral fellow and NSERC post-doctoral fellow, Dalhousie University) for their support and intellectual contributions to this thesis. Their own passion and care for the reserve and the birds that nest there not only informed but also inspired my work and my own affection for the site.

Thank you to Talbot Sweetapple, Cristina Verissimo, Nick Herder and Jonathan Mandeville for their support and criticism. Their guidance has allowed me to push this thesis to a wonderful resolution for which I am incredibly proud.

Thank you to my friends and colleagues, Maxwell Schnutgen, Nuala O'Donnell, Logan Brown and Emily Finkelstein for their help in model making and printing during the final days of thesis.

Last, and certainly not least, endless love and thanks to my wonderful family that have supported me throughout this thesis and my greater academic career, through the good and the bad. It is no small statement to say that I would not have made it this far without their unwavering support.

CHAPTER 1: INTRODUCTION

Designing for Sensitive Sites

How can architecture enable sustainable interaction in ecologically sensitive sites?

The concept of designing for sensitive sites is one that is coming more and more into the light as sensitive ecologies continue to be encroached upon from unhindered urban spread and from economies of tourism; people wishing to experience a pristine habitat and in so doing require architecture to support the experience. How to mediate a built structure in connection with a sensitive ecology is a goal I believe is under expressed in today's built forms and their program. How can man build in connection with nature without the inherent destruction that building brings to the natural world? How can architecture minimize its impact on not only the landscape but also on the plants and animals that reside at the site? How can architecture be beneficial too and support an individual's or groups experience and understanding of a sensitive site? How can architecture support and promote the conservation and protection of a sensitive site? Designing for sensitive ecological sites is not a simple task, all these questions and more arise and require answering to ensure the most suitable and beneficial intervention.

This thesis will seek to propose these questions and answer them through developing a built architecture in connection with the Witless Bay Ecological Reserve and the town of Witless Bay. The reserve is an almost pristine habitat located on the eastern coast of Newfoundland & Labrador and has some of the most stringent government regulations associated with building and interacting with the reserve. To develop an intervention at this sensitive site, I believe, is a worthwhile venture to forward the discourse and understanding of how architects can now and in the future create interactive and exploratory architecture in unison with sensitive ecology and landscape.

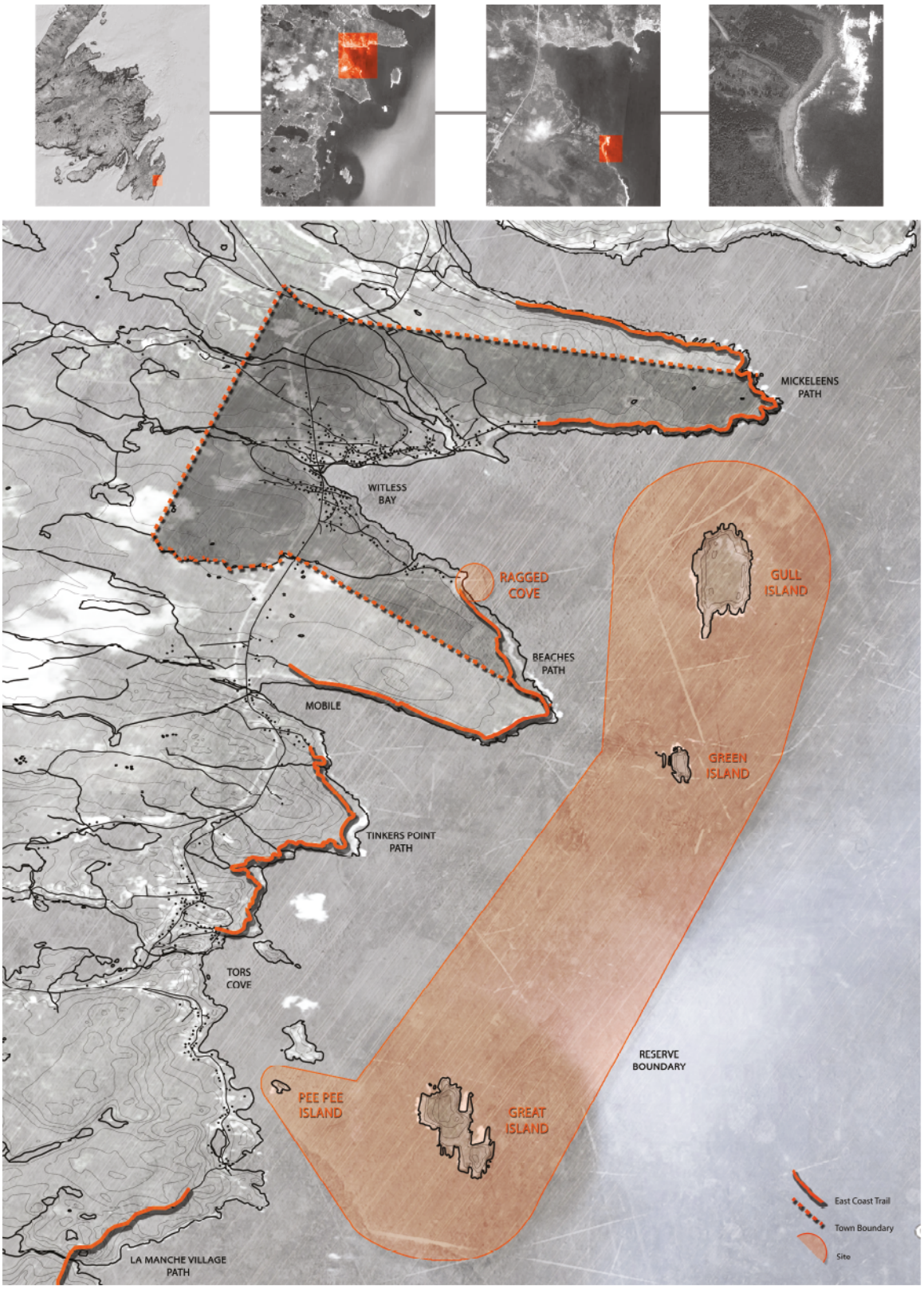

Figure 1: Primary elements of site: Witless Bay Ecological Reserve, town of Witless Bay, East Coast Trail, intervention siting; Ragged Cove. (Department of Energy, Mines and Resources, Natural Resources Canada, Google Maps)

CHAPTER 2: DESIGN

Aspects of Research

My research into developing a sensitive and appropriate architecture for the Witless Bay Ecological Reserve can be broken down into five categories; local ecology and the reserve, community and the reserve, architectural siting, architectural program/interaction with site and sensitive intervention.

Local Ecology and the Reserve

The reserve is home to a plethora of sea bird species, most notably that of the Atlantic Puffin. Nesting Puffins are the primary focus for visitors of the reserve and are also the provincial bird of Newfoundland. The puffins nest within the reserve from the summer months into the early fall; from April to September.[1] During this time almost 100, 000 puffins nest at the site living in harmony with the variety of other seabird species.[2] At the peak of the season some 1.5 million birds of varying species nest at the reserve.

The east coast of Newfoundland hosts the intersection of two major Atlantic Ocean currents; the cold Labrador Current and the warm Gulf Stream. The combination of these two currents creates one of the richest fishing grounds in the world. The birds are drawn to the reserve by the spawning of caplin and other fish species along the Newfoundland coast.

For the remainder of the year the puffin lives it life alone at sea. This migration of the puffin over the course of a year is an amazing journey. A puffin pair mates during the summer months, burrow a 3 foot deep nest in the islands soft soil and lays a single egg, nurturing the egg until the chick is capable of leaving the nest. Puffins then leave the reserve, spending the remainder of the year traversing the ocean, only returning to land the next mating season to the same partner and burrow.

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1. Department of Environment and Conservation, *Witless Bay Ecological Reserve*, accessed September 13, 2014, http://www.env.gov.nl.ca/env/parks/wer/r_wbe/.
2. Ibid.

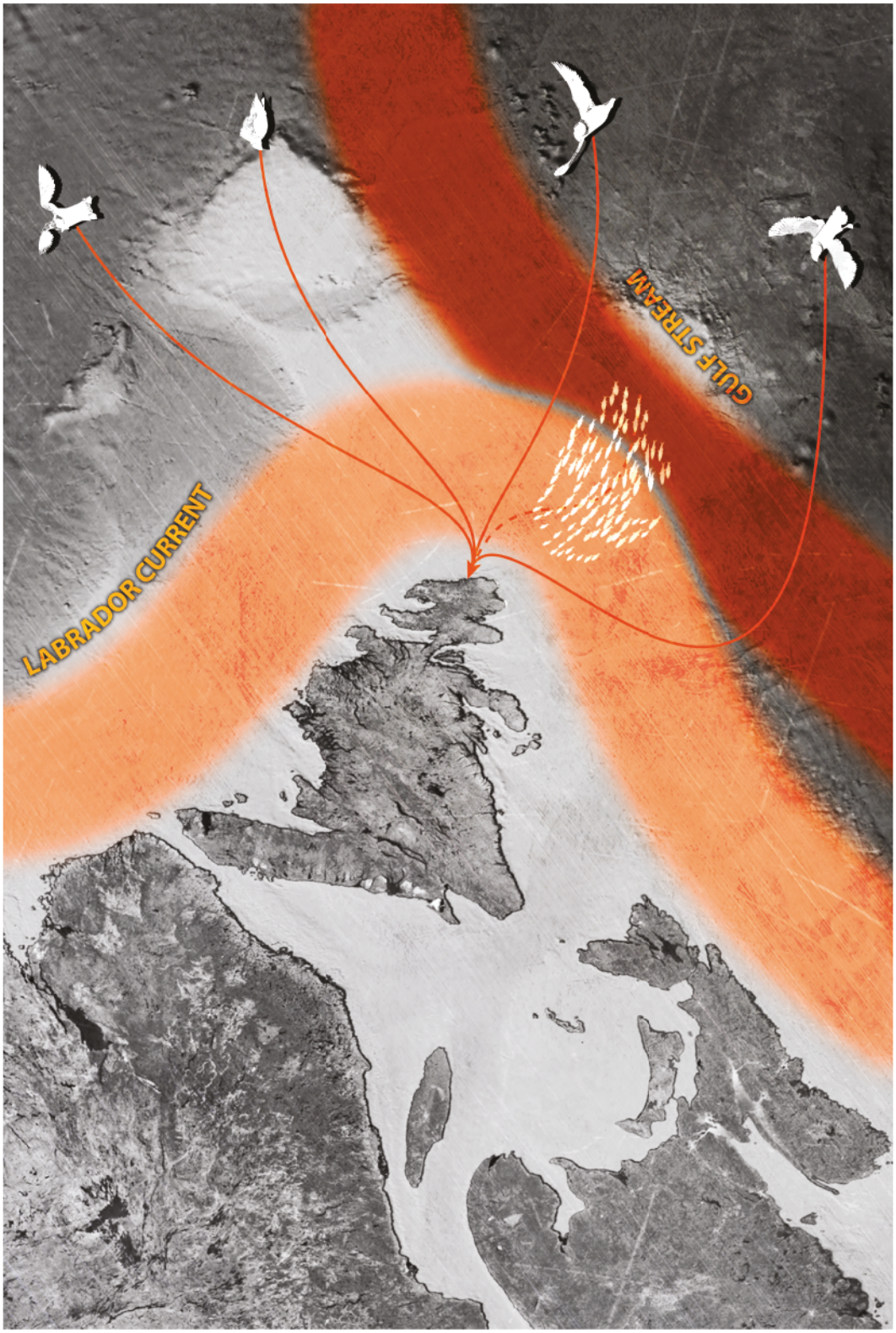


Figure 2: Meeting of the cold Labrador Current and the warm Gulf Stream. (Google Maps)

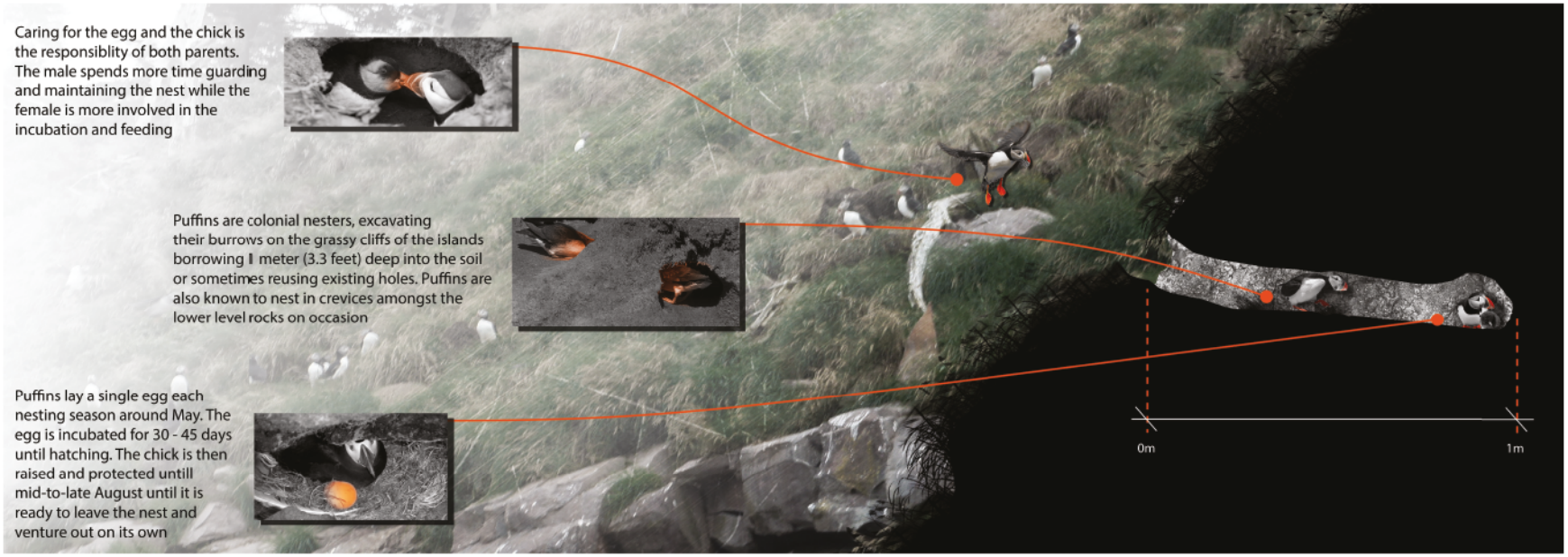


Figure 3: Informative section, puffin nesting. (Widescreen Arkive, Alaska Science Center, Dusty Roads)

Figure 4: Puffin nesting. (Wikipedia)

Figure 5: Puffin group. (Wikipedia)

Figure 6: Puffin flying. (Audubon Puffin Project)

Figure 7: Puffin flying. (Gallery Hip)

Figure 8: Migration routes of male / female puffin, extents of Atlantic puffin migration routes.

The summer months would be the focal time frame for any interactive programmatic elements in the proposed intervention, while the remainder of the year the intervention would potentially aid in education and conservation initiatives that benefit the reserve and visitors' relationship with it.

Through my discussions with Dr. William A. Montevecchi, research professor for psychology, biology and ocean sciences at Memorial University of Newfoundland, I have found that any proposed intervention with the goal of interaction should keep in mind the need to "reduce the human influence + footprint" at the site. This is due to the fact that puffins are very sensitive to unwanted entry into their nesting areas. Getting too close to a nesting site could potential cause the puffins to abandoning their nests and eggs.[3] Dr. Montevecchi in his book Newfoundland birds: Exploitation, Study, Conservation has noted that puffin populations have been seen on the islands since the 1930's and that their populations have only increased since that time.[4]

3. Frid Kvalpskarmo Hansen, *Tourists Cause Seabirds to Abandon Nests*, Sciencenordic.com. Science Nordic, accessed November 6, 2014. http://sciencenordic.com/tourists-cause-seabirds-abandon-nests.

4. William A. Montevecchi and Leslie M. Tuck, *Newfoundland Birds: Exploitation, Study, Conservation* (Cambridge, Mass.: Nuttall Ornithological Club, 1987), 171.

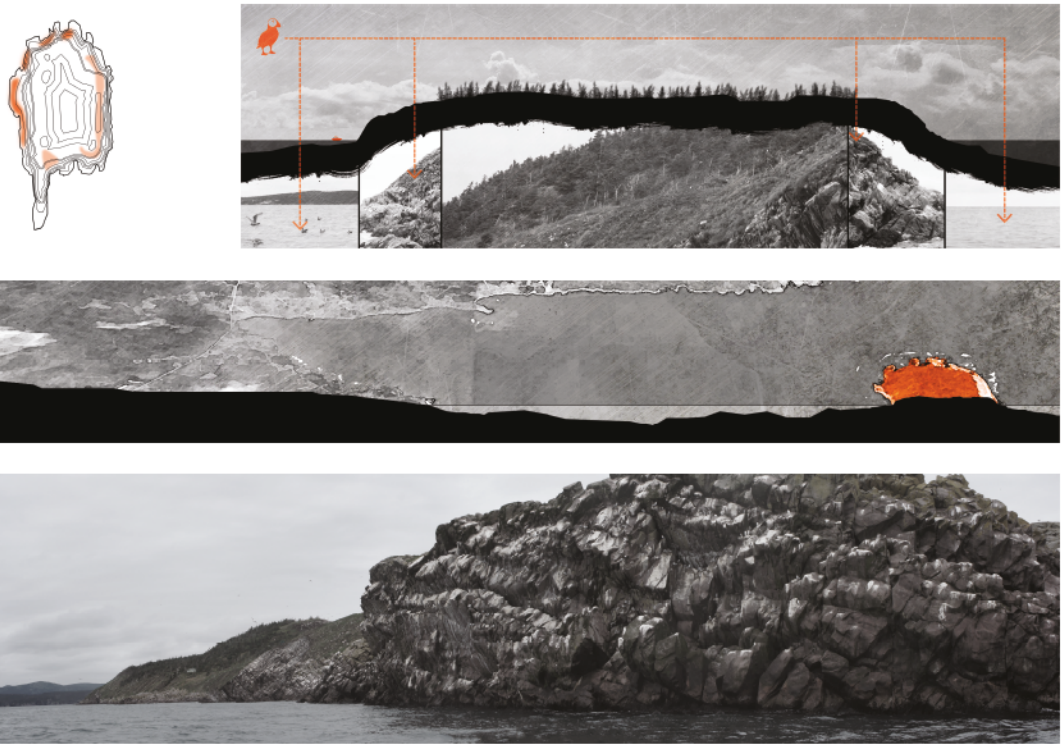
The rise in the population of nesting birds shows the distinct importance the site holds for the seabirds and as such the relationship between bird and site must not be interfered with. Any proposed architectural intervention needs to ensure that a safe distance is kept from the seabirds at all times and that any presence is not a detrimental factor.

The reserve is composed of four islands; Gull, Green, Great and Pee Pee Island.[5] Puffins are found to nest on all four, within the grassy soil. Any architectural invention will focus on limited access and experience of these nesting areas and as such must have a means to access all four islands. This will most likely be done through boats launched from the proposed intervention, the intervention acting as a static element, while the boat a dynamic one, delicately entering the reserve and then leaving without interrupting the sites natural processes. Puffins hunt within the waters surrounding the islands and as such these waters are also protected. An area of 1km around each island as well as the waters between the islands is incorporated into the reserve.[6] The architectural intervention must also ensure minimal interference with these surrounding waters.

My findings from my exploration of the ecology and wildlife of the site resulted in the conclusion that any intervention must need to have a focus on aiding in the experience and interaction between people, bird and site, though any interaction must be tempered and controlled.

5. Department of Environment and Conservation, http://www.env.gov.nl.ca/env/parks/wer/r_wbe/.
6. Ibid.

Gull Island



Green Island

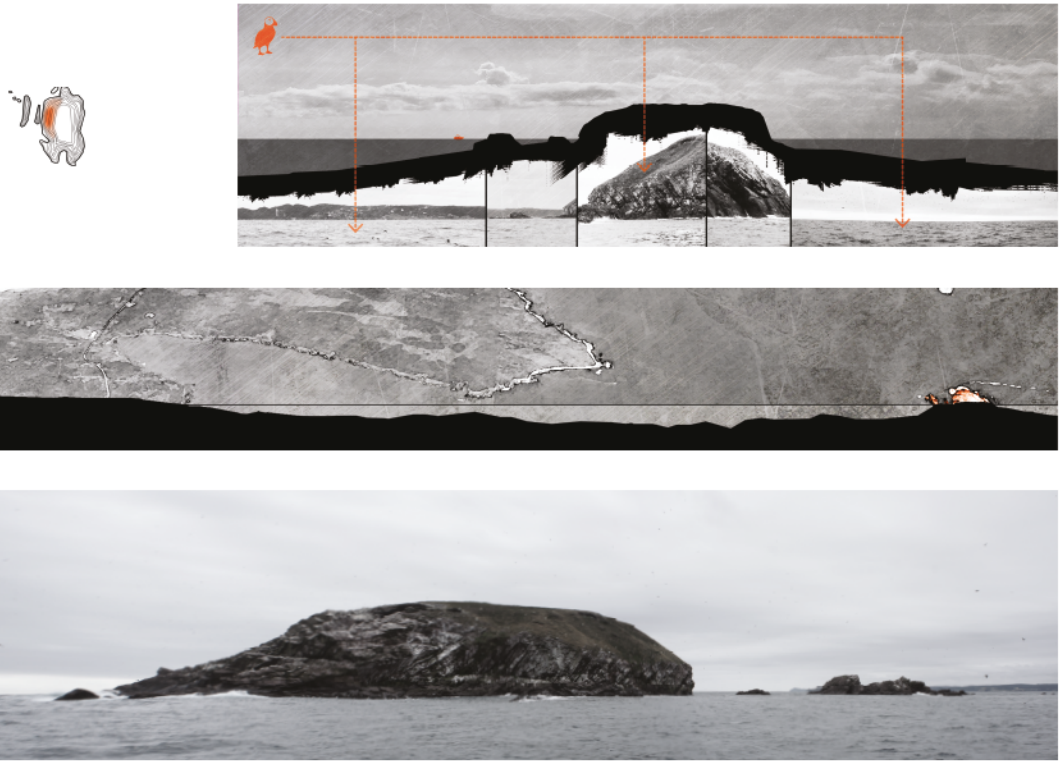
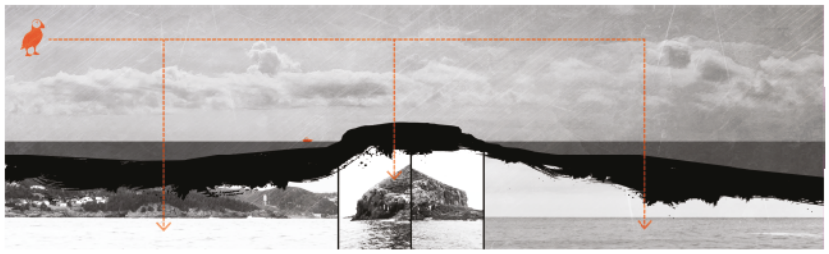


Figure 9: Gull / Green Island studies depicting - nesting areas, sections through site and island sections, island conditions. (Natural Resources Canada, Google Maps)

Pee Pee Island



Great Island

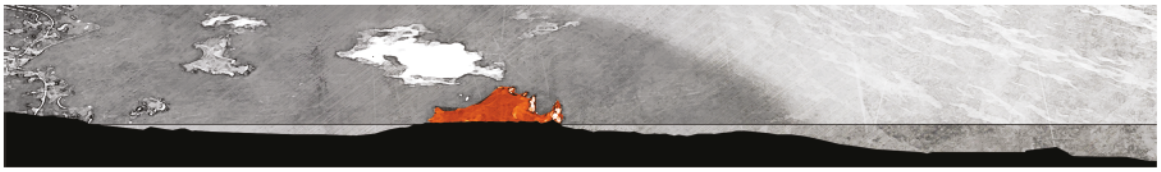


Figure 10: Pee Pee / Great Island studies depicting - nesting areas, sections through site and island sections, island conditions. (Department of Energy, Mines and Resources, Google Maps)

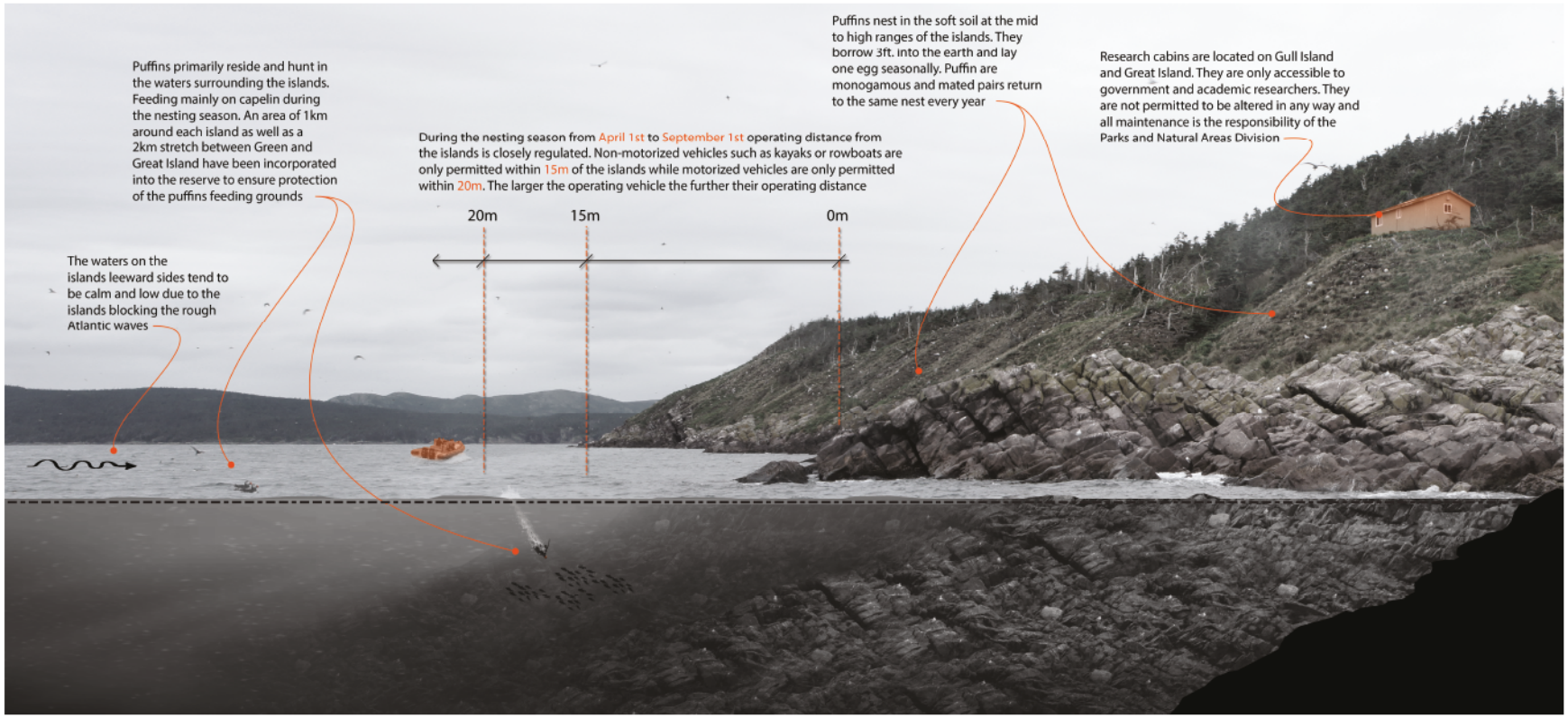


Figure 11: Informative section through island coast.

Community and the Reserve

The town of Witless Bay is a small coastal community with a population of around 1100 people. Founded in 1675 the community started as a small fishing village, trolling the cod rich waters off the Newfoundland coast. The people no longer heavily fish the area since the collapse of the cod fishery in 1992 but now find much of their pride, identity and economic stability stems from their connection with the reserve. The people have a deep connection to the site, with a goal and focus to protect it from any detrimental influence.

Figures 12 - 17: Witless Bay.

ROADS

BUILDINGS
RESIDENTIAL
COMMERCIAL
RELIGIOUS

WATER
&
LAND

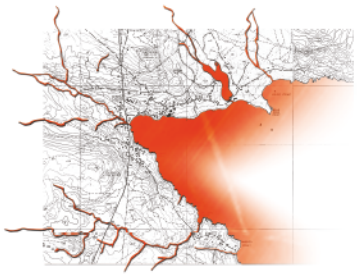


Figure 18: Witless Bay mapping data - roads, buildings, waterways. (Department of Forestry and Agriculture)

One possible negative influence is due to an increase in oil production in the provinces coastal waters.[7] Many communities are seeing population surges due to the jobs this boom has created, one such community is Witless Bay. With this increase in population comes a potential increase in interaction and interference in the reserve. Any architectural intervention proposed should have a focus on researching, understanding and managing this change and its potential impact on the reserve.

Witless Bay and the reserve also host over 10,000 visitors each summer that wish to experience the islands and ecology.[8] Several tour boats operate out of the town allowing these tourists to visit the water locked reserve. I myself took part in one of these tours, Ecotours: Zodiac Adventures. The trip took place in late August and consisted of a boat tour around the reserves four islands as well as other notable geological landmarks. During an interview with Jeri Graham, manager of the Witless Bay Reserve for Parks and Natural Areas, I learned that these tours are incredibly important for people and the reserve; she believes that “access to the site is important – gives people a sense of place and connectedness to the site.” This “connectedness to site” nurtures a respect and a personal stake in the reserve and in turn a drive to support and protect it. Any architecture should have an emphasis on promoting that connection, allowing tourists, researchers and locals to visit the reserve in a controlled and informative manner, promoting public interest and support for the sites conservation.

Figures 19 - 20: Ecotours: Zodiac Adventures.

7. Suzanne Dooley (Co-Executive Director for Canadian Parks and Wilderness Society), telephone interview, October 28, 2014.
8. Jeri Graham (Manager, Natural Areas Program), telephone interview, September 17, 2014.

Witless Bay also has some volunteer driven programs that aid in supporting the reserve and its ecology. One of the most prominent programs is that of the Puffin & Petrel Patrol. Through my discussions with Suzanne Dooley, Co-Executive Director for the Newfoundland and Labrador Chapter of the Canadian Parks and Wilderness Society and a directing member of the Puffin & Petrel Patrol, I was able to learn a great deal about the worth wild program. The Puffin & Petrel Patrol is a volunteer initiative that works to rescue stranded puffins in the local coastal towns and also works toward lowering light pollution in the area. Young puffins leaving the nest at night can sometimes get disoriented by the town lights, confusing them with the moon, which they use to navigate.[9] This issue is more prominent during days with overcast and can result in any number of bird deaths.[10] The patrol works primarily from mid-August till late November. This is the time of year when fledglings are hatching and leaving the nest for the first time.

The program is volunteer based, with a core group of 10 organizers and sometimes up to 100 participants with oversight from a Canadian Wildlife Services (CWS) representative.[11] The group travels the roads at night with flashlights, picking up stranded birds that are then checked, measured and tagged by the CWS rep.[12] The birds are then stored in local garages, in the dark, overnight and released the following morning. Suzanne informed me of some of the success the group has had, stating that in 2013, the group managed to save over 800 fledgling chicks. The patrol brings all levels of the communities together. The deputy mayor of Witless Bay, Deanna Wiseman, is a huge supporter of the cause and gets involved personally ever year.[13] The volunteer base comes primarily from local residents, tourists, tour boat operators and government officials.[14]

9. Joshua Mailhiot (Environmental Assessment Coordinator, Canadian Wildlife Service, Environmental Stewardship Branch), email interview. September 26, 2014.
10. Dooley, telephone interview, October 28, 2014.
11. Ibid.
12. Ibid.
13. Ibid.
14. Ibid.

Figure 21: Founder, Juergen Schau, a semi-retired film executive from Berlin. (The Telegram)

Figure 22: Puffin storage kennels. (Facebook)

Figure 23: Volunteers releasing rescued birds the following morning. (Alternatives Journal)

The program has also worked to lower light pollution in the area.[15] Through their efforts many of the local businesses have come on board to turn their lights off at night and many residents are conscious of the light pollution. The town during the late summer months becomes a community of minimal lighting, a "town of darkness." The proposed architectural intervention must follow the communities' lead, to establish an architecture that will not interfere with the puffin's way finding at night, an architecture that is "dark" to the puffins.

Figure 24 - 25: Pre-Puffin Patrol / Post-Puffin Patrol lighting conditions.

Any architectural intervention should incorporate a portion of its program in support of these community lead initiatives such as the Puffin & Petrel Patrol and the boat tours to grow and promote the connection between community and reserve.

15. Ibid.

Architectural Siting

As my understanding of the site has changed, so too has my siting for the proposed intervention. The initial concept was to have a floating interpretation centre that was within the reserves boundary, set out amongst the islands. Through discussions with government officials such as Jeri Graham from Parks and Environment and Joshua Mailhiot, Environmental Assessment Coordinator for the Canadian Wildlife Service, I realized this was not a suitable siting strategy. There were several reasons for reaching this conclusion; any intervention within the reserve would without a doubt have a negative impact on the nesting bird populations as well as interfere with boat travel and fish populations.[16] Any floating intervention in the reserve would most likely end up being occupied by the nesting birds, at which point the intervention itself would be off limits to people.[17] The seas in the area are also very rough, a floating centre would most likely not hold up well against the turbulent waters, and during stormy weather the intervention would most likely not be occupiable. Another concern was one of aesthetics; the vista the reserve offers to people in the surrounding communities is breathtaking. To place an intervention within this landscape would interrupt the natural and serene beauty of the site and as such must be avoided.

Figure 26: Discarded floating intervention option.

16. Mailhiot, email interview, September 26, 2014.

17. Ibid.

As a result of these influences the siting was repositioned to Ragged Cove on the outskirts of the Witless Bay coast. The site was chosen for a number of reasons; the cove is being proposed as a protected area; placing an ecologically conscience intervention at the site would help mitigate any future developments for the area that could negatively affect local ecology.[18] The cove is also the closest buildable site within the community of Witless Bay, of which the reserve takes its name and is also an access point for Beaches Path a route on the East Coast Trail, which thousands of backpackers hike every year. In addition, Ragged Cove is also fairly protected from the areas predominant west-south-westerly winds. Since the site is proposed as a protected area any intervention will need to ensure a sensitive impact on the existing conditions and ecology so as to conserve the situated coastline and the reserve in equal measure.

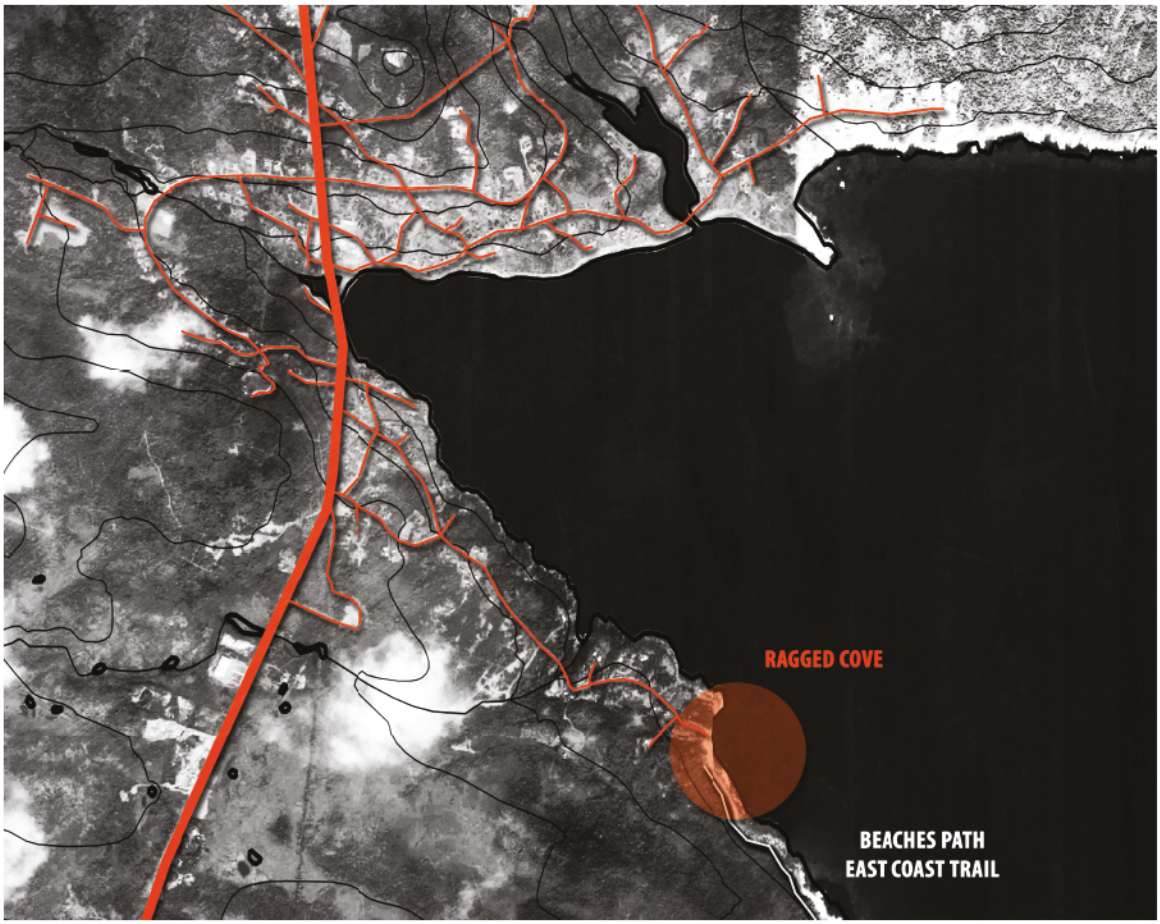


Figure 27: Ragged Cove siting within Witless Bay. (Natural Resources Canada, Google Maps)

18. Graham, telephone interview, September 17, 2014.

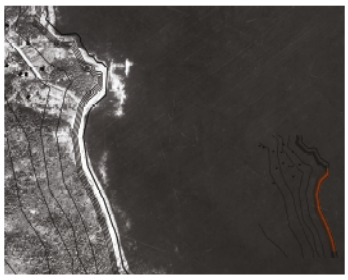


Figure 28: Ragged Cove topography. (Google Maps)

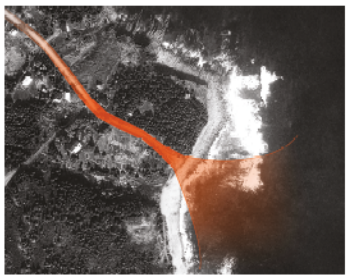


Figure 29: Entry compression. (Google Maps)

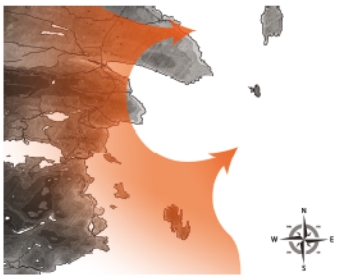


Figure 30: Predominant winds. (Natural Resources Canada)

Figure 31: Section through Ragged Cove.

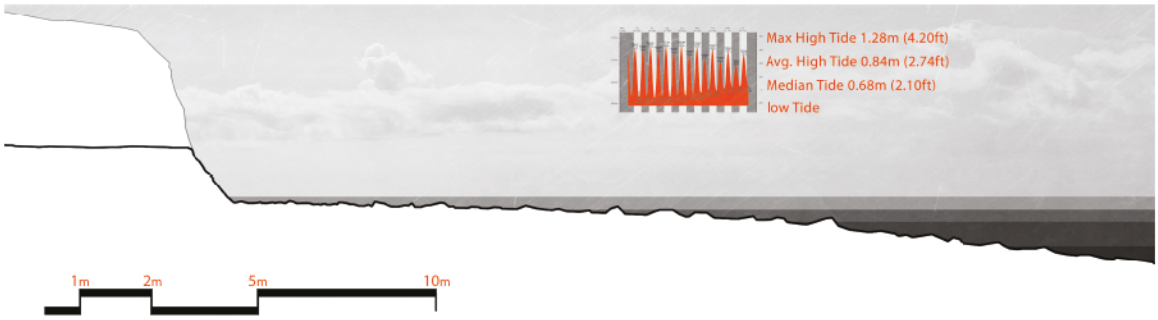


Figure 32: Ragged Cove tidal study.

Figure 33: Ragged Cove.

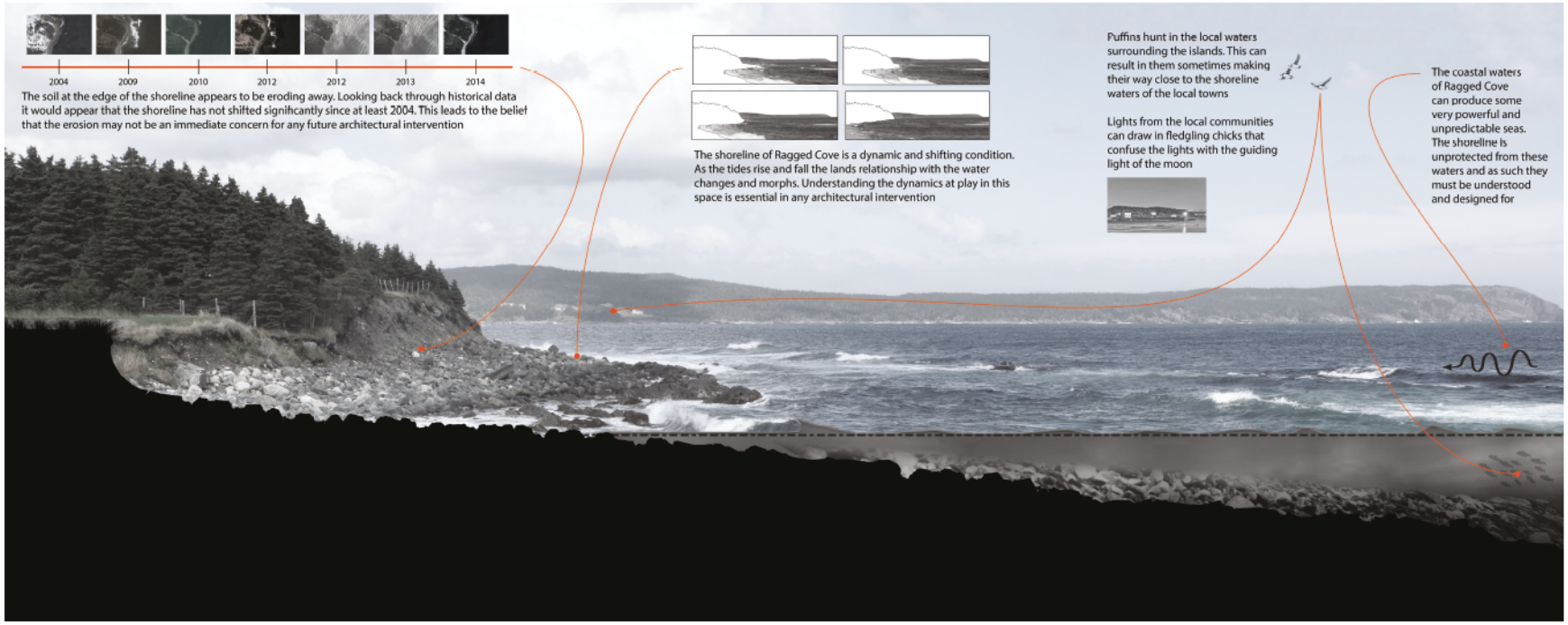


Figure 34: Informative section through coastal condition.

Architectural Program and Interaction with Site

The program for the intervention has developed and shifted as my research into the community and the reserve has progressed. The first proposed program for the site was that of an interpretation centre. A centre where people could come and see exhibits, take part in informative classroom sessions and tour the reserve. This concept was eventually shifted to that of an ecological research centre focused on promoting, understanding and conserving the habitat.

This shift came about as the result of several different factors. The first being, that I found there really isn't any need for an interpretation centre in the community or reserve. Departing the land, traveling over the water to the islands, experiencing the habitat and ecology unfiltered is where the true worth of experience resides, not within a classroom or exhibition space. This type of in-situ, educational, and experiential relationship to ecology that uses a framework of learning about nature in nature is seen all over the world and has ample precedent. Examples can be seen in Eko Tracks, a tour program that takes visitors into the heart of the Namibia wilderness guided by a local wildlife ecologist.[19] Also, a researcher lead hiking tours through the Chingaza National Park in Columbia, of which I have personally taken part in 2012. To accommodate this need, the centre will facilitate educational expeditions around the islands allowing visitors to engage with the habitat through researcher lead tours.

Figure 35: Eco Tracks mobile ecologist led tours. (Eko Tracks)

Figure 36: Researcher led hike through Chingaza National Park.

19. Eko Tracks, *Special Interest Tours*, accessed January 1, 2014, http://www.ekotracks.com/special-interest-tours/.

To better understand how to properly implement these research tours within a sensitive ecology and not negatively affect it, I spent time researching eco-tourism and conservation tourism. There are several prominent authors on the subject for which I have taken cues. These authors include David Fennell and his book *Ecotourism: An Introduction*, in which David promotes the idea of including a strong foundation of research in tourism that can help inform tourism bounds and underling ethics in experiencing nature. Ralf Buckley and his book *Conservation Tourism*, in which he promotes the idea that while conservation focused tourism is a subset of the overall market, its importance will only continue to grow as man continues to encroach on pristine habitats. Finally, Jeffrey A. McNeely in his book *Culture and Conservation: The Human Dimension in Environmental Planning,* which expresses the idea that environmental planning and conservation should pay closer attention to cultural context and grassroots movements. An example of grassroots conservation tourism and its benefits to a small community in Zimbabwe are found in the book:

> An area of 274 ha of wooded savannah with a river flowing through it, which was once scheduled for housing development, has been lease for $2 a year to a non-profit conservation association by the municipality, and is being stocked with indigenous animals, most of them already family totems of many people living nearby. It offers a unique opportunity to educate some 100,000 school children every year and an innumerable number of adults. This will generate a positive interest in the animals, and is, therefore, an opportunity to encourage further interest in wildlife and conservation as a whole.[20]

This is a similar situation to my proposal for the Witless Bay Reserve; the building site was at one time proposed for a housing development, the puffin is the provincial animal and holds an important place in the locals mindset just as the animals in the example are family totems for locals, and there is a demand for access and interaction to a sensitive site where an intervention can aid in conservation. This example was constructive in understanding how the proposed centre can help prosper a tourism program that is beneficial to visitors and the reserve.

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20. Jeffrey A. McNeely, *Culture and Conservation: The Human Dimension in Environmental Planning* (London: Croom Helm, 1985), 253.

Another factor for shifting program came through speaking with Jeri Graham of Parks and Environment, and understanding that there is a crucial need for data collection and monitoring of the reserve. The oil boom in Newfoundland has caused many communities to grow and expand; one of these communities is Witless Bay, as stated prior. The toll, if any, which an increase in population has on the reserve is an issue that needs to be monitored, explored and understood. This is a programmatic influence that is better suited to a research centre then an interpretive centre. Beyond the effect an increase in population would have on the reserve, any effect the existing tour boats and traditional fishing (which is allowed in the reserve limits) have on the site are not fully understood.[21] A centre focused on furthering an understanding of the human/site dynamic could potentially answer some of these unknowns and in turn lead to a better management plan for the reserve.

The Puffin & Petrel Patrol is also in need of a more secure and dedicated facility. A programmatic addition of a fully stocked dedicated centre to store rescued puffins and the patrols supplies as well as having consistent educated oversight by on site researchers would be a huge boost to this worth wild program.

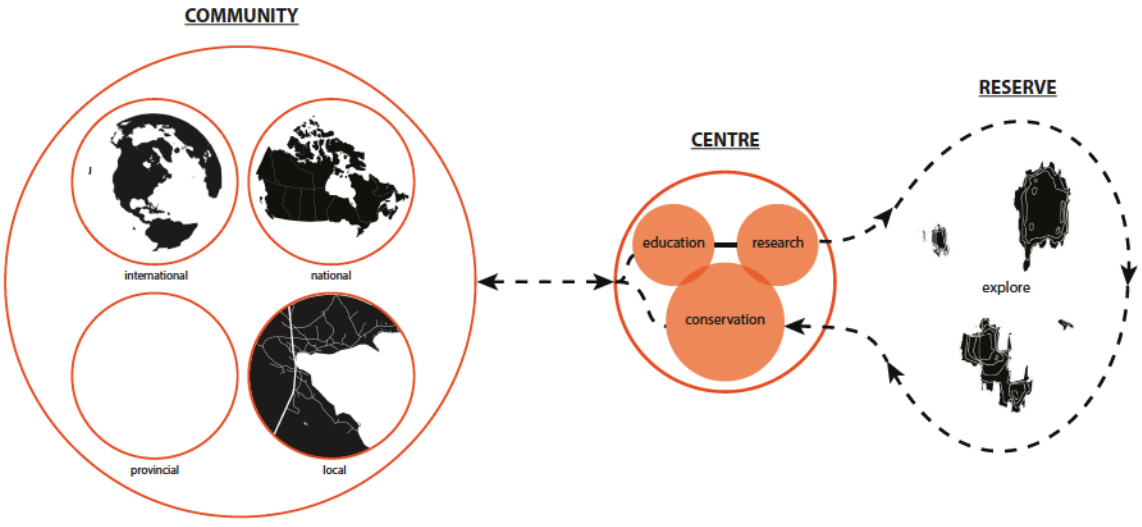


Figure 37: Centre as a nexus for conservation promotion.

21. Graham, telephone interview, September 17, 2014.

In addition to interacting with a site through programmatic elements such as research, tourism and volunteer efforts (the Puffin & Petrel Patrol), I have also explored the idea of interacting with a sensitive site through the built architecture. There is a clear precession infused in the journey from land to sea to island; A journey where there are clear thresholds and moments that can aid in interacting and experiencing. It is important that the architecture establishes these moments and allows the user to experience them through the built form.

Figures 38 - 43: Exploration of experiential precession from approach through to boat and bird.

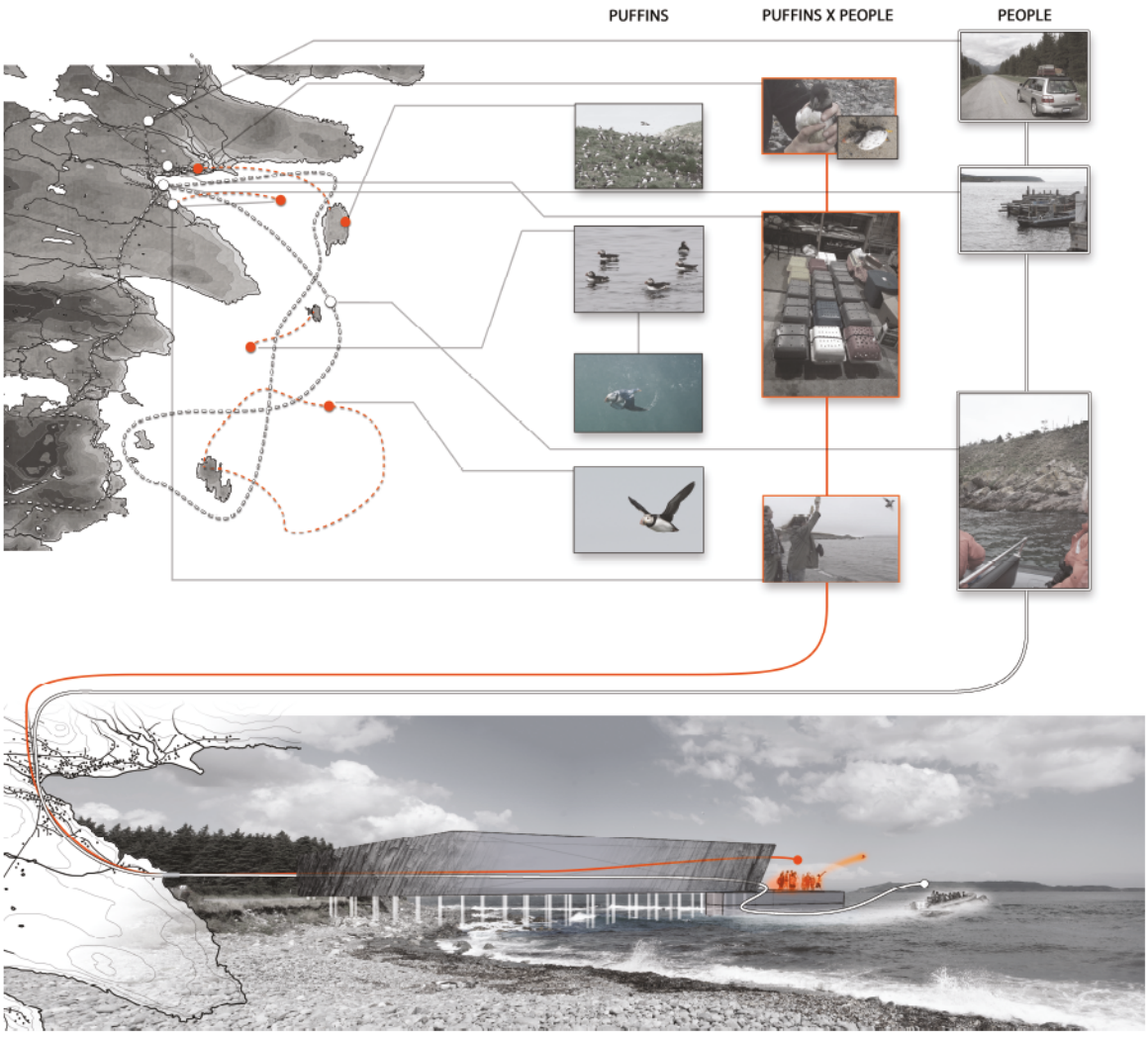


Figure 44: How the architecture and program can act as a link for community, ecology and landscape. (Department of Energy, Mines and Resources, Natural Resources Canada)

My research into procession and the local communities' connection with the site has been instrumental in developing a supportive and collaborative program for the architectural intervention, that of an ecological research centre, and in turn, understanding moments in that architecture that can aid in a visitors sensitive experience of a site.

Sensitive Intervention

In order to understand sensitive architectural intervention we must first understand and frame what it entails to be sensitive to site and ecology. For the purposes of this thesis we will view sensitivity as; any built or interactive intervention that has a minimal impact on the existing site conditions. Built structures should have a focus on ease of removal from site and if this is not possible should be built so that they can naturally degrade without harming the site. The goals being to have an architecture whose construction, life and deconstruction have a minimal impact on the existing conditions.

To develop an intervention that fulfills these requirements I have explored existing concepts of site sensitive architecture; buildings that leave minimal to no impact on the landscape. Several authors have been of notable importance in my understanding of site sensitive building. Peter Buchanan and his *Book Ten Shades of Green*, explores the idea of designing with an ambition for environmental responsibility in all facets of the creative process. Buchanan explains the cultural issues involved with building sensitive architecture that mediates with site as opposed to the current mindset of building apart from nature with nature in mind.

> American environmentalism in architecture to date, has been largely focused on technical fixes, on figuring out how to build essentially the same building that have always been built… …if we focus on narrowly technical questions and never confront, in a profound way, the cultural attitudes and appetites that have brought use to where we are.[22]

Another author, James Steele and his book *Ecological Architecture* charts the rise of a new consciousness in the role of architecture and its interaction with nature, assess the current state of affairs and identifies positive future directions. These books have been essential in understanding the current mindset of sensitive architecture and the role the built environment has with the natural world.

22. Peter Buchanan, *Ten Shades of Green: Architecture and the Natural World* (New York: Architectural League of New York, 2005), 5.

In addition to these readings I have also explored varying precedents to understand how they related to the site in a low impact manner, weighing both the pros and cons in their approaches.

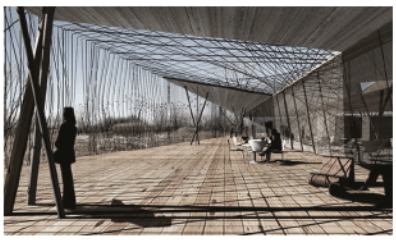
Some examples of these precedents include the Brockholes Nature Reserve Visitor Centre by Adam Khan Architects, which employs a floating structure to minimize its impact on existing ecology.


Figures 45, 46: Brockholes Nature Reserve Visitor Centre. (The Wildlife Trusts)

The Norwegian Wild Reindeer Centre Pavilion by Snøhetta that employs a minimal footprint on the landscape and a large reflective window that “camouflages” the pavilion from the migrating reindeers view.

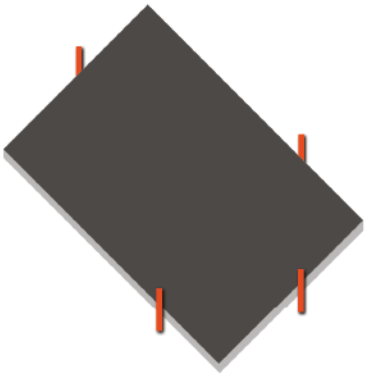

Figures 47, 48: Norwegian Wild Reindeer Centre Pavilion. (Snøhetta)

The Ford Calumet Environmental Center by Studio Gang Architects uses wire meshing over the windows to ensure migrating birds do not fly into the glass.




Figures 49, 50: Ford Calumet Environmental Centre. (Studio Gang Architects)

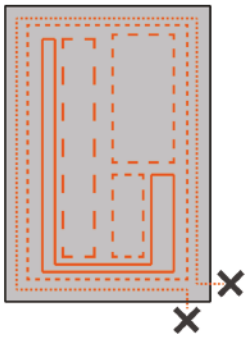
The center floats on top of the marsh on a frame of pontoons, this minimizes the destructive impact of constructing a solid entreched foundation



Ouside of the two access walkways that attach at the waters edge, the only connections the floating platform makes with the marsh is through four restraint posts anchored into the marsh bed

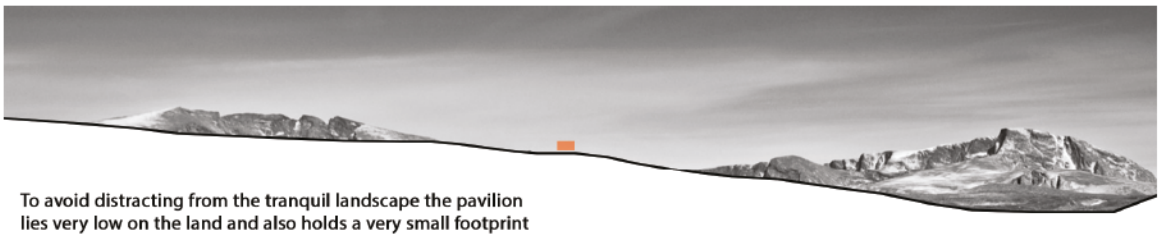
The platform changes with the tides moving up and down along the restraint posts

Human interaction with the site is contained to the floating platform. This limits the human interaction and footprint on the site allowing the site to develop and evolve with a level anonimity

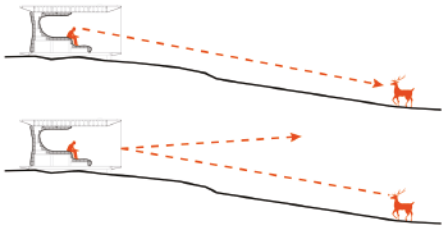


All the plumbing and cirulcation systems are contained within the the pontoon frame. There is not connection to the shoreline. Unfortunatly the water for the toilets is pumped for the marsh waters

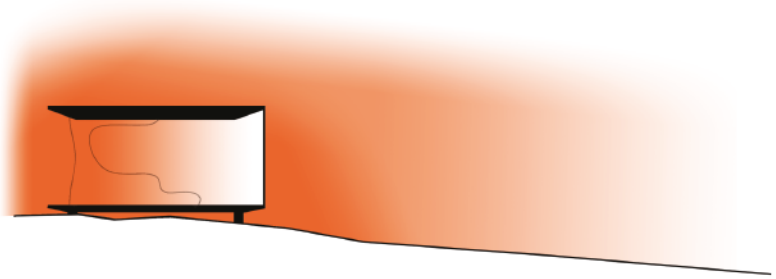
Figures 51: Brockholes Nature Reserve Visitor Centre, sensitivity exploration. (The Wildlife Trusts)



To avoid distracting from the tranquil landscape the pavilion lies very low on the land and also holds a very small footprint



The glazed wall allows an uninterrupted view of the landscape and wildlife while also serving to mask or camouflage the pavilion by reflecting the surrounding landscape from the exterior



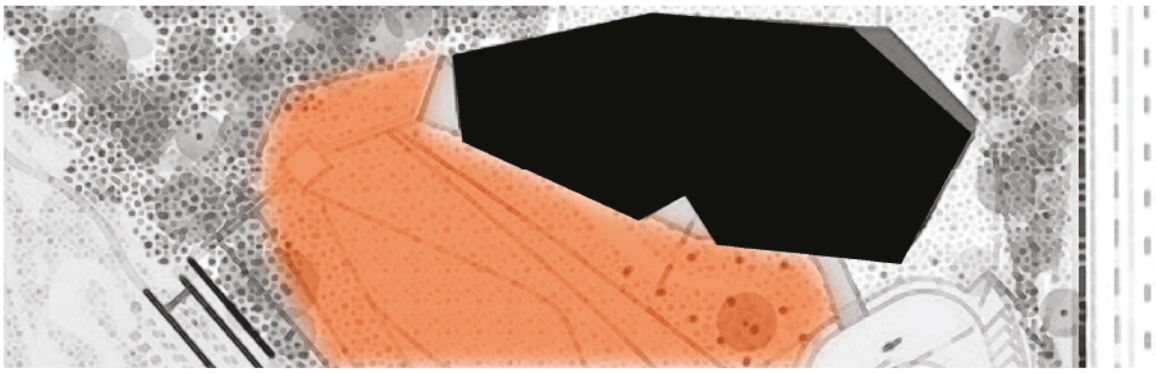
The pavilion is also open to the surrounding elements. While the front viewing wall is closed the back of the structure is always open. This allows the pavilions interior environment to be in harmony with the exterior

1.5 km

To avoid any destruction of the natural landscape vehicles are not permitted within 1.5 km of the site

All access to the sight is on foot. To avoid excessive transit over the site throughout the year the pavilion is closed in the winter months

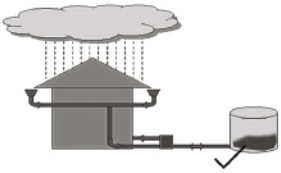
Figures 52: Norwegian Wild Reindeer Centre Pavilion, sensitivity exploration. (Snøhetta)



The centre is positioned right on the edge of the marshland. Birds are free to roam the surrounding site with no interference from man or building.

A prominent portion of the centre is built as a floating viewing platform. The walkway/viewing area will float above the marsh, doing away with the need for destructive foundation construction and minimizing the impact the centre will have on the ecology

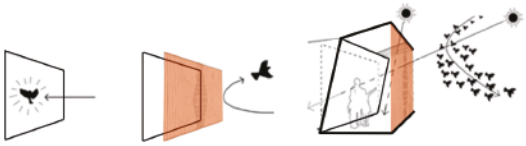
biomass bioler



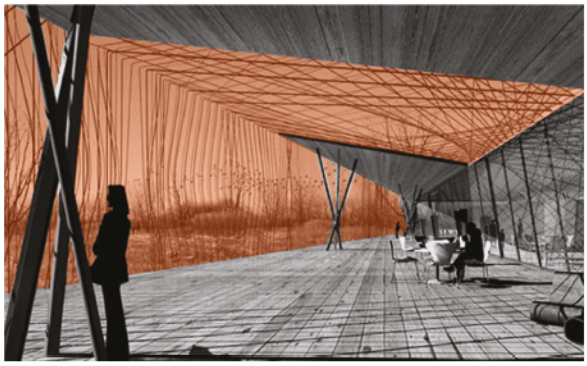
water collection systems

earth tubes

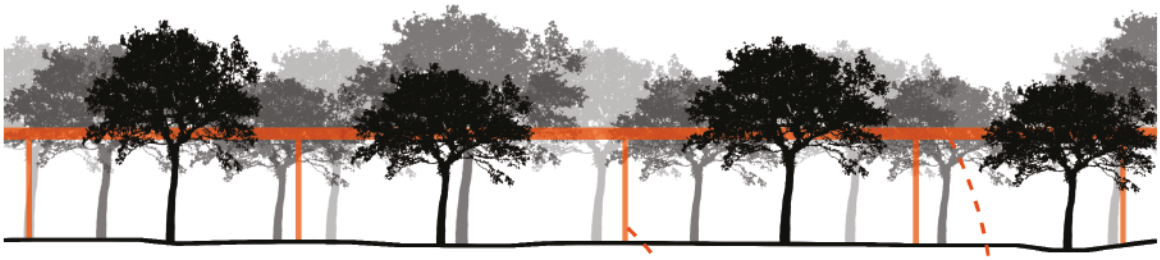
A biomass boiler, and water collection systems are integrated into the design. Unfortunately geothermal heat pumps and earth tubes are also present. These systems while being energy sensitive are systems that are destructive to the existing landscape and ecology during installation



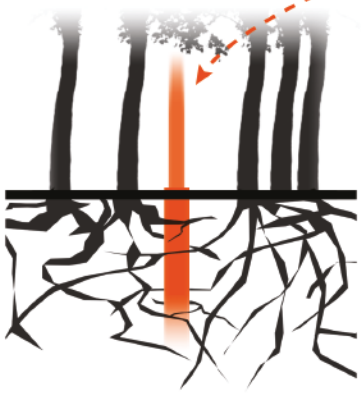
The centres most prominent feature is that of a wire frame mesh that covers the south facing glass. The mesh acts to break up the reflective glass that would normally appear invisible to the birds. This feature helps to limit the interaction of the built form with that of the migrating birds



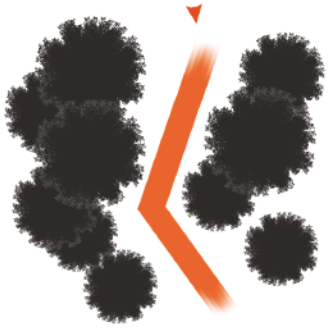
Figures 53: Ford Calumet Environmental Center, sensitivity exploration. (Studio Gang Architects)



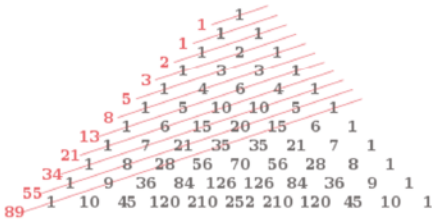
The walkway weaves itself through the surrounding tree canopy connected to the ground through sparingly placed columns. The walkway is intended to be a "visually light and discreet presence."



The walkway is supported by steel posts connected to pile footings. The piles are strategically placed avoid major root systems and avoid interference with the surrounding trees

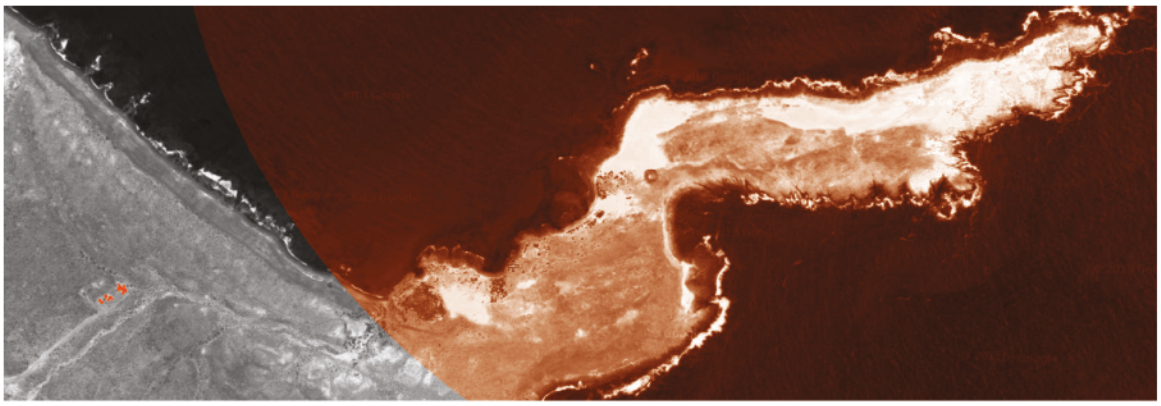


The walkway is set back from the surrounding canopy and maneuvers through to avoid any unnecessary human interaction and interference

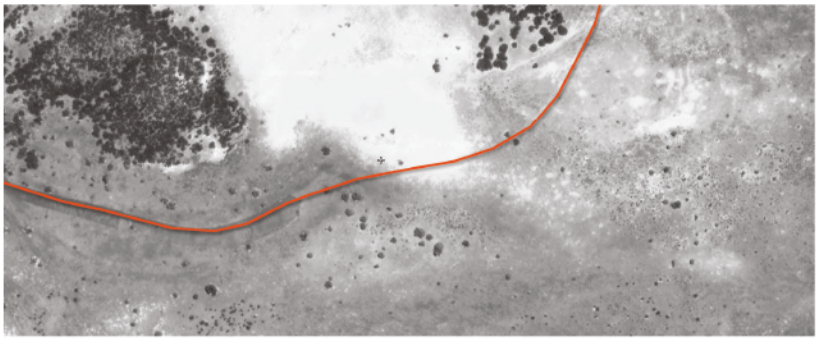


When designing the handrail for the walkway drew the architects drew on the Fibonacci sequences. Fibonacci sequences appear in many biological settings, such as branching in trees. Through the sequence they were able to create a 'Fibonacci grid' along a typical walkway truss, resulting in a higher density of elements near the truss ends where the vertical loads are highest. The architects were able to solve a structure issue as well as mediate closures in the walkway through understanding the natural world

Figures 54: Kew Gardens Tree Top Walkway, sensitivity exploration. (Mark Barfield Architects)



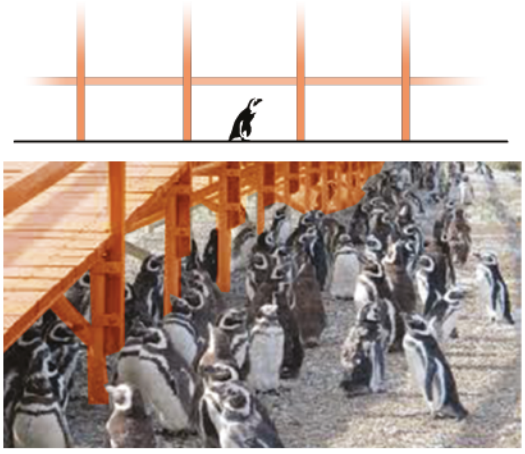
The visitor centre is located on the edge of the protected area.
The building itself has no impact on the local penguin population



Over the expansive coastline of the point, the only built intervention is a wooden walkway that travels the extent of the coastline.

1.5 km

To avoid any destruction of the natural landscape, vehicles are not permitted on the point. There is parking lot located at the entrance to the walkway



To minimize inference with the penguin population, areas of high crossing traffic are elevated to allow the penguins to walk through unimpeded

Figures 55: Penguins Visitor Center, sensitivity exploration. (Punta Tombo)

Through exploring these precedents I was able to come to some generalized conclusions about how architecture can interact with an ecologically sensitive site.

- Interventions should hold a small footprint on the site so as to minimize any distracting presence.

- Measures must be taken to minimize connections with ground. Employing post supported structures or even floating structures is a way to ensure minimal impact on existing conditions.

- Situating the intervention on the fringe of a sensitive area is a measure to ensure that the habitat is not negatively affected through the built presence.

- Making the structure invisible or “camouflaged” from the local wildlife is a measure to ensure that natural processes and routines are not interfered with.

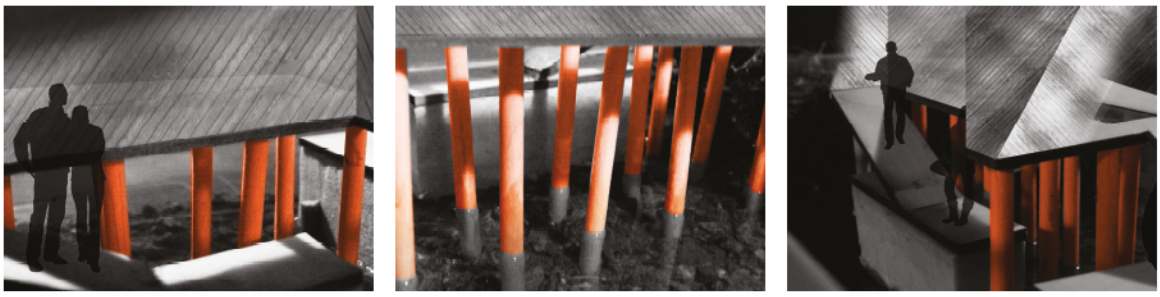
- Employing local materials and making the intervention “of the site” is a means to mitigate the “alien” presence of a building and also minimizes bringing in any harmful, additive or subtractive materials.

- When the structure is built within the site it should be “permeable” or it should minimize interference with the existing wildlife. Creating a structure that is permeable or non-intrusive is essential in reducing the impact on local ecology.

- There should be no vehicle access allowed within the site. All access should on foot or another means of low impact entry.

- Seasonal occupancy of the intervention and site is also a beneficial measure to minimizing human interaction and impact on the local ecology.

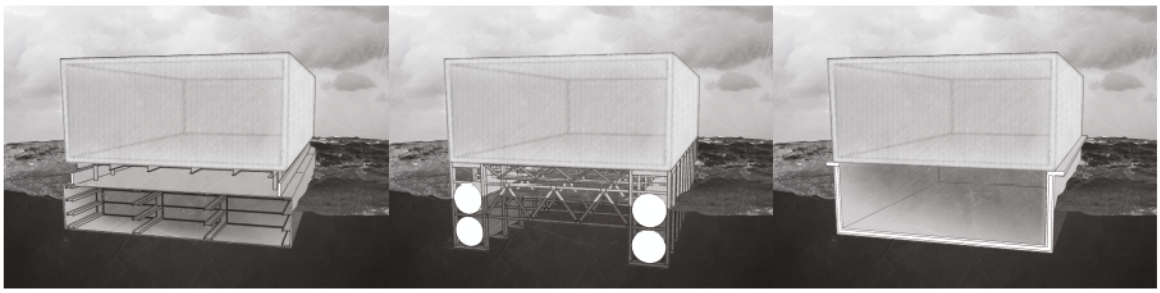
Through these general conclusions I was able to explore a possible sensitive intervention for the proposed ecological centre. The intervention was a shoring foundation system. Shoring foundations are a traditional construction method for Newfoundland, are low impact on the surrounding environment, variable in construction to allow for flexibility in built form and will eventually degrade away if left unattended.



Figures 56 - 58: Exploration of the sensitivity of atmosphere created underneath a structure through use of structural shores.

Another prominent contributor of note to my research on sensitivity has been that of Ankie Stam from Watertudio.NL, a firm working exclusively with floating architecture to solve site sensitive issues. Through my discussion with her I have seen the potential environmental merits of building on the water, such as the concept of a “scarless” development. A building on water has no need of a foundation and in turn no need to “scar” the existing landscape.

One goal of this thesis is to look at sensitivity through an architectural intervention that not only has the importance of technical sensitivity but also represents sensitivity and conservation of the environment through form and precession, to develop a mindset of understanding, connection and sensitivity to site in the architecture itself. A building, that is not only “sustainable” but is also considerate and respectful of its situated context.



Figures 59 - 61: Exploration of structural floating options - barge, pontoons, concrete.

Developing the Architecture

In order to understand the design the research centre would take I began by explore the local and regional building traditions and forms. Newfoundland has always had a rich and distinct building tradition. Much of that tradition stems from a history of building alongside the rough coastal conditions. Any built structure needed to be pragmatic in form and function, built for purpose and able to withstand the unforgiving weather. The traditional Newfoundland fishing shed is a clear example; low standing, gable roofed, wood-framed buildings that skirt the coastline, built to weather and formed to function. To explore this distinct construction tradition I began a form study of the local buildings in the town of Witless Bay, looking to distill the built environment so as to inform my own design.

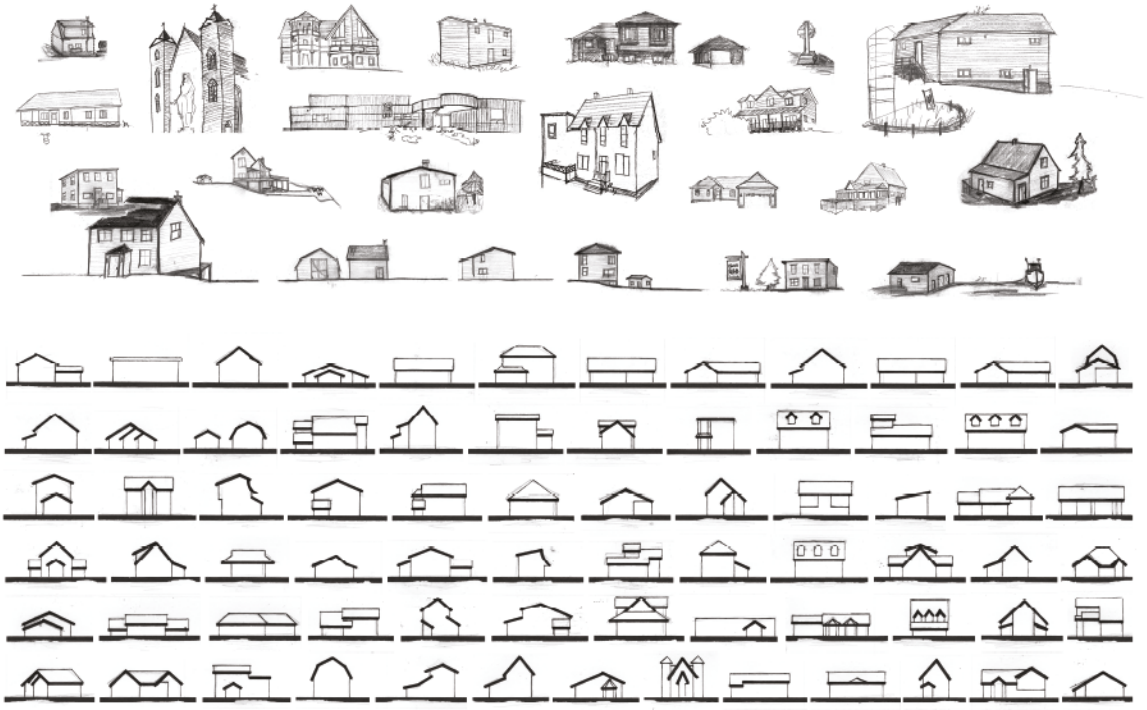


Figure 62: Design studies - local community - Witless Bay, heritage, form studies.

In addition to studying local building types I also explored the nature of the built form as it connects land to water. A major component of this thesis is the goal of having people sustainably interact with and explore the islands and waters of the reserve. This ultimately means a need to understand and implement an appropriate built form to connect and transition people from land to sea.

To examine this concept I began looking at how the communities, local to the reserve and in Newfoundland as whole, connect land and water through built form. I began by conducting a design study on regional and local boat wharfs and fishing stages. Wharfs and stages have always been the primary construction that connects community to ocean in Newfoundland. Understanding the assembly, forms and nature of these traditional stages is essential in understanding and informing my own appropriate design responses.

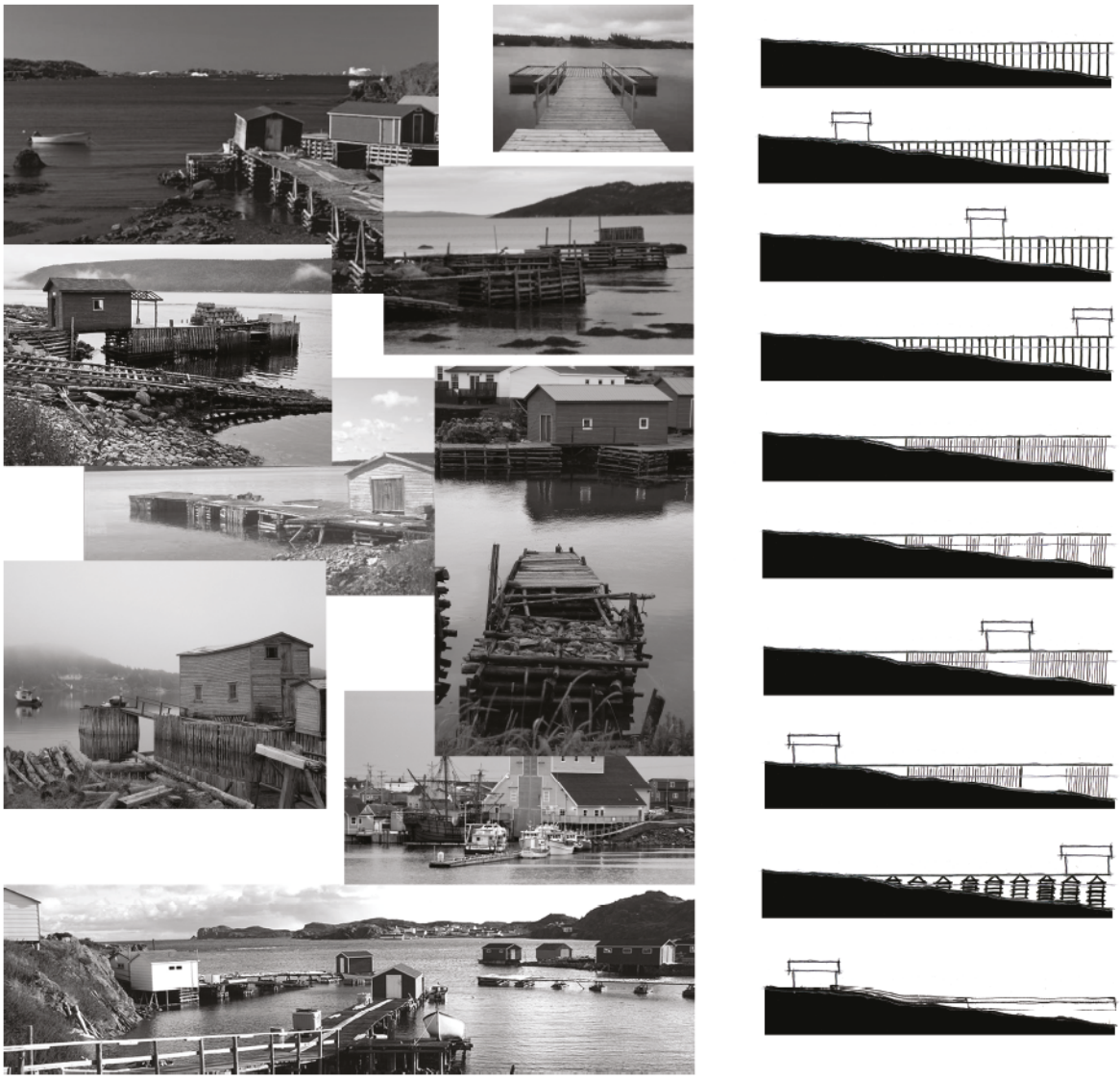


Figure 63: Exploration of traditional Newfoundland boat wharfs and fishing stages, typology study.

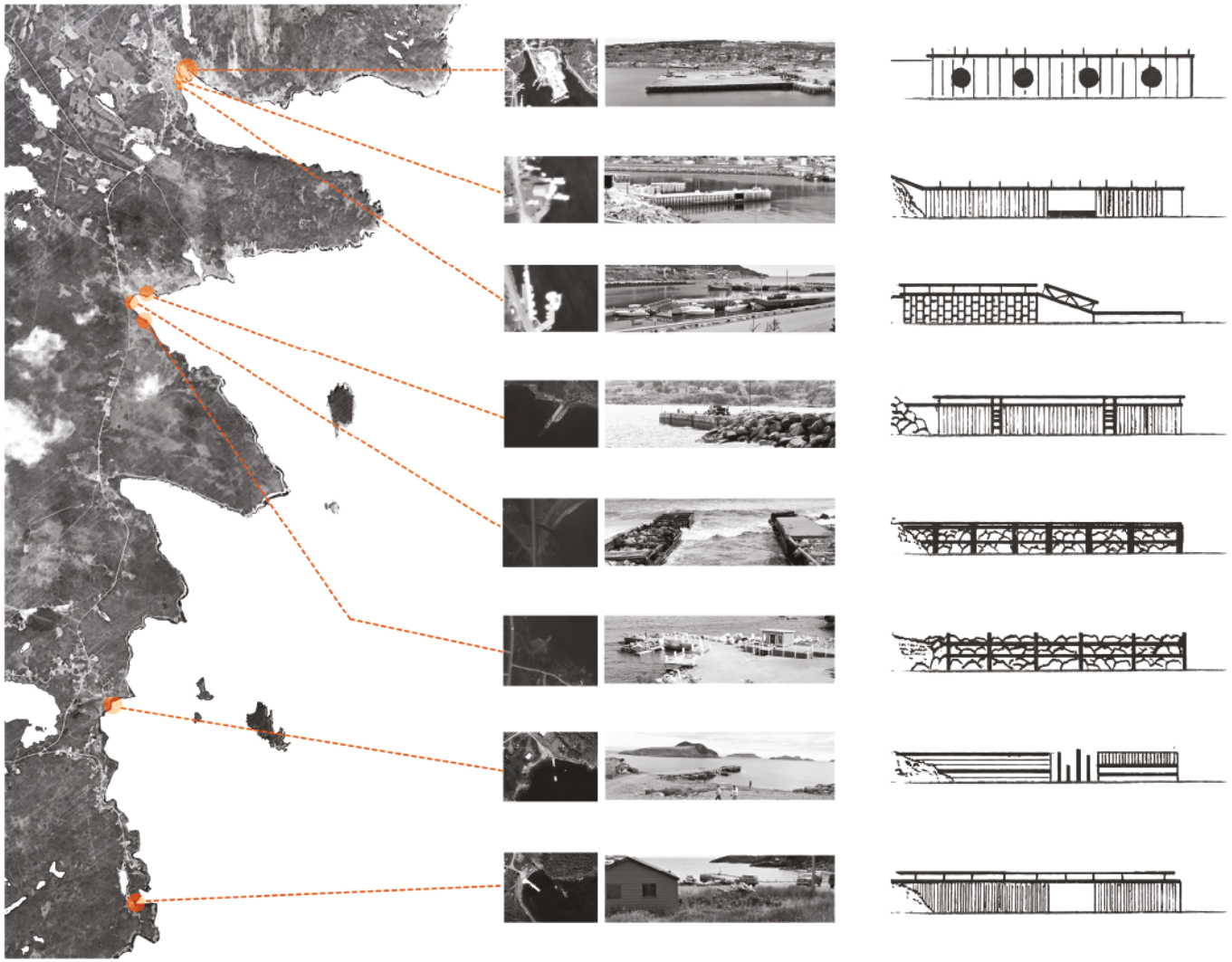


Figure 64: Exploration of wharf structures within the coastal communities; Bay Bulls, Witless Bay, Mobile, and Tores Cove. (Department of Energy, Mines and Resources, Natural Resources Canada, Google Maps)

Through these design studies and in conjunction with my other aspects of research I was able to develop a site appropriate architecture; a research center that is supportive of human interaction and also sensitive to the existing delicate ecologically, all while being respectful and inspired by the rich local building traditions.

The Village

As I began laying out and expanding on the programmatic elements of the research center with the help of Dr. Robert Ronconi, a local seabird researcher (Killam post-doctoral fellow and NSERC post-doctoral fellow from Dalhousie University), who I interviewed in regards to specific requirements for on-site research centers, I found that the footprint of the center was beginning to become unmanageable. Through my discussions with Dr. Ronconi the scale of the research center ended up doubling compared to initial layouts. One of the main sensitivity rules established through my earlier research was the need to minimize any interventions footprint; the center was now pushing that requirement. To help meditate this growth I split the centers program into three distinct buildings, establishing a shoreline “village” as opposed to a singular center. This splitting resulted in moving a major bulk of the program and floor area away from Ragged Cove, the centers primary siting, and transplanting it to less sensitive sites further inland.

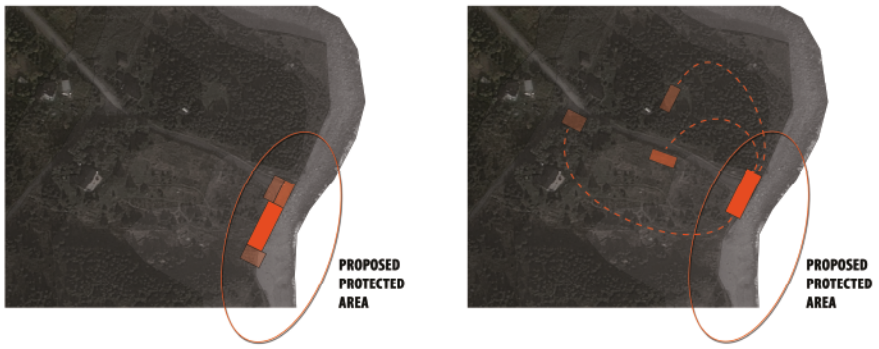


Figure 65: Segmentation and resiting of program. (Google Maps)

These buildings that now establish the village are the entry pavilion, the research cabins, the community center / tower and the research centre. These four building types are spaced apart along the dirt path starting at the end of Gallows Road, connecting the outskirts of Witless bay to the coastline at Ragged Cove.

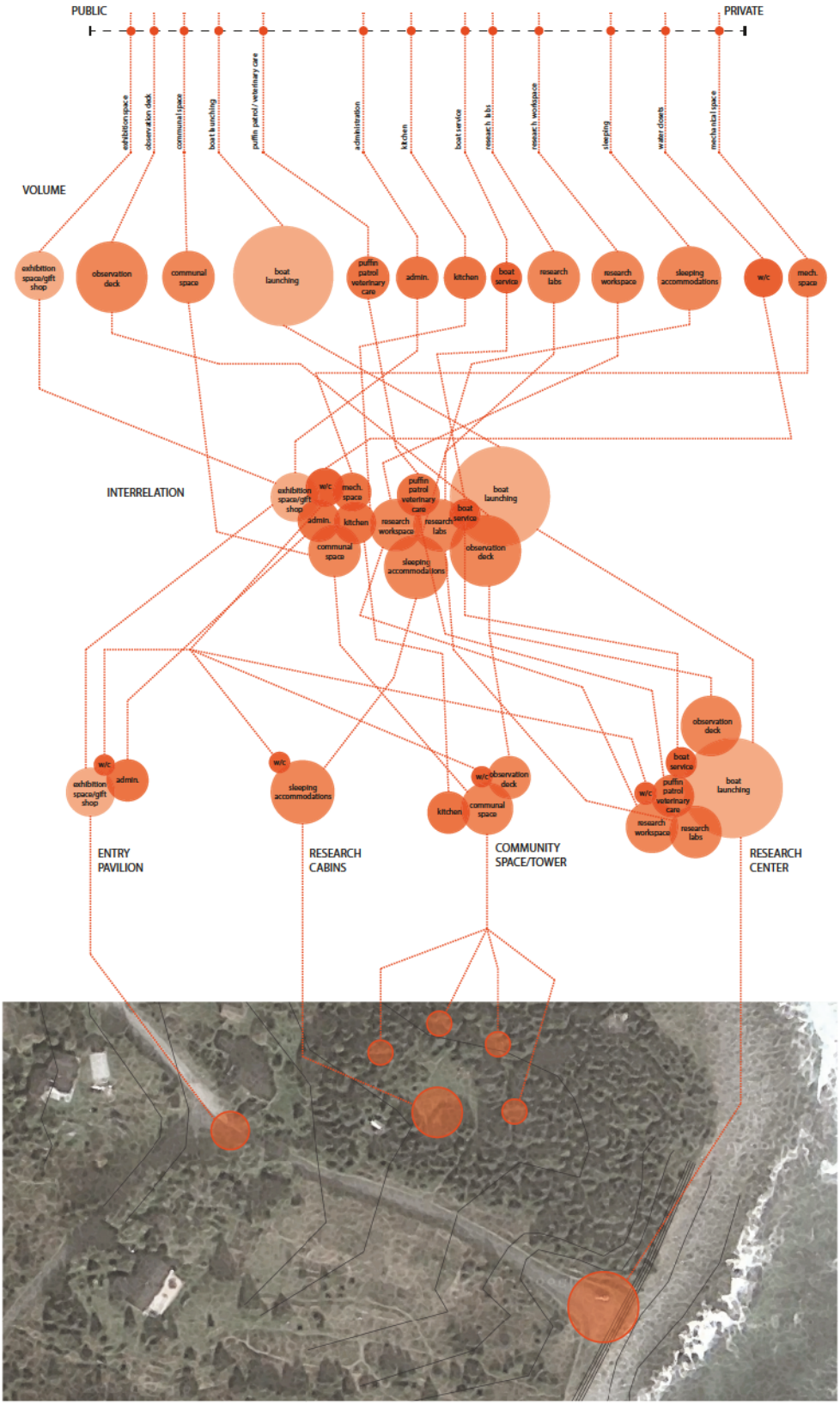


Figure 66: Ecological research centre, program study - expansion of drawing shown on pages 39, 40. (Natural Resources Canada, Google Maps)

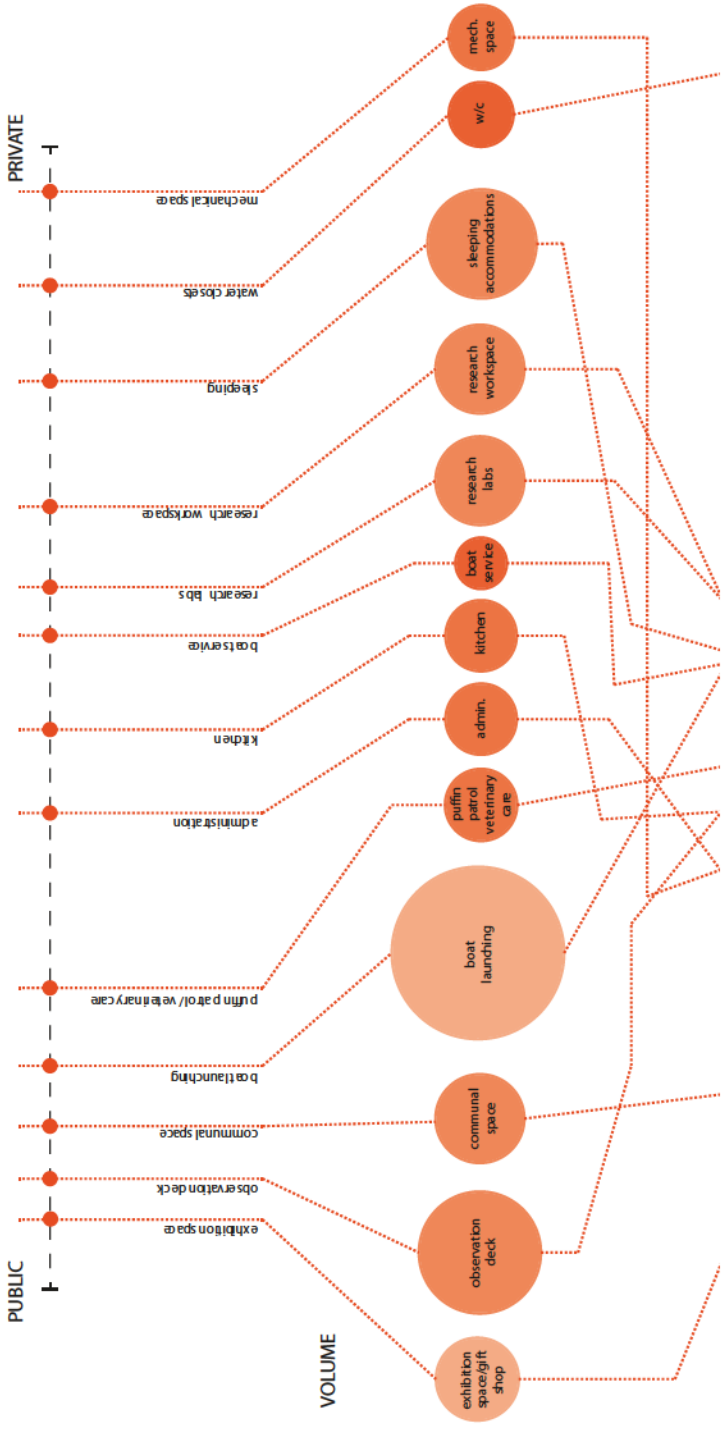


Figure 67: Ecological research centre, program study, public to private spaces, volume of spaces.

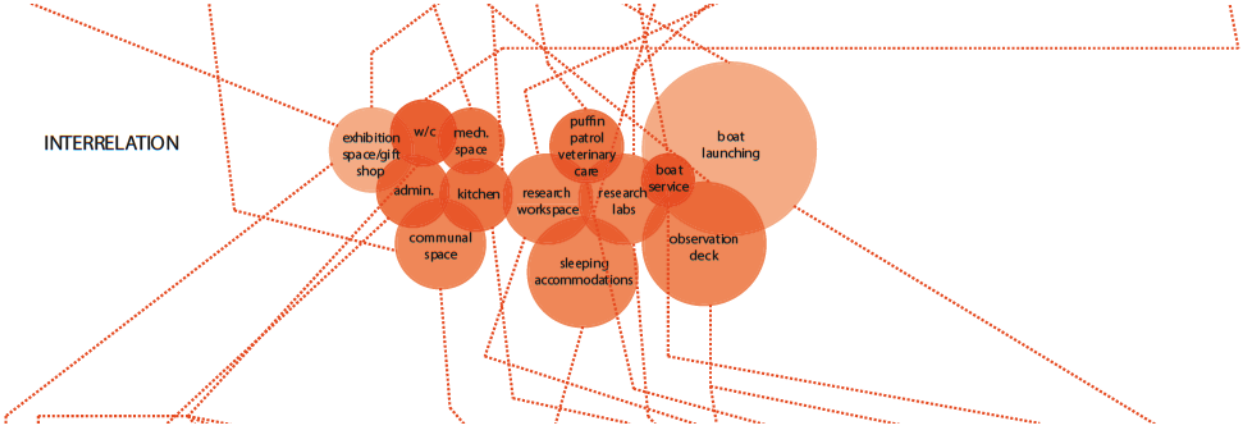


Figure 68: Ecological research centre, program study, interrelation of spaces.

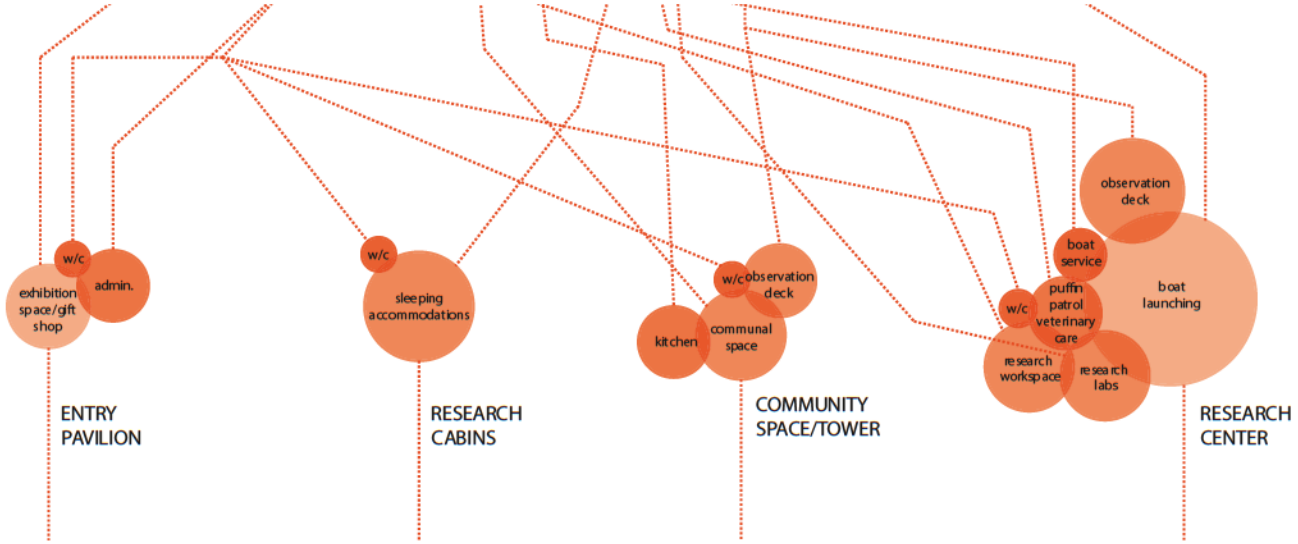


Figure 69: Ecological research centre, program study, separation of spaces.

Figure 70: Siting, the village. (Natural Resources Canada, Google Maps)

Figure 71: Siting section, the village.

The entry pavilion is positioned at the entrance of the dirt road, the cabins and community space is sited down a separate dirt road, set back into the woods, while the research center is located at the coastal condition, transitioning from the land out into the ocean. Initial, the goal of segmenting the program was to establish a more sensitive footprint at Ragged Cove, but in doing so it also created opportunities that lead to a more expressive interaction with the site. The transplanting of program and architecture farther inland allows for an earlier interaction with the reserve through built structure and allows for the creation of a more crafted and experiential precession from land to sea, heightening the journey, and in turn, the connection a person has with the reserve.

Each element of the village; the entry pavilion, the research cabins, the community space and the research center are fundamentally founded in their sensitivity to site and are also crafted to be expressive and supportive in a person's experience and understanding of the reserve. Working independently and also in unison to support the Witless Bay Ecological Reserve and a visitors interaction with it.

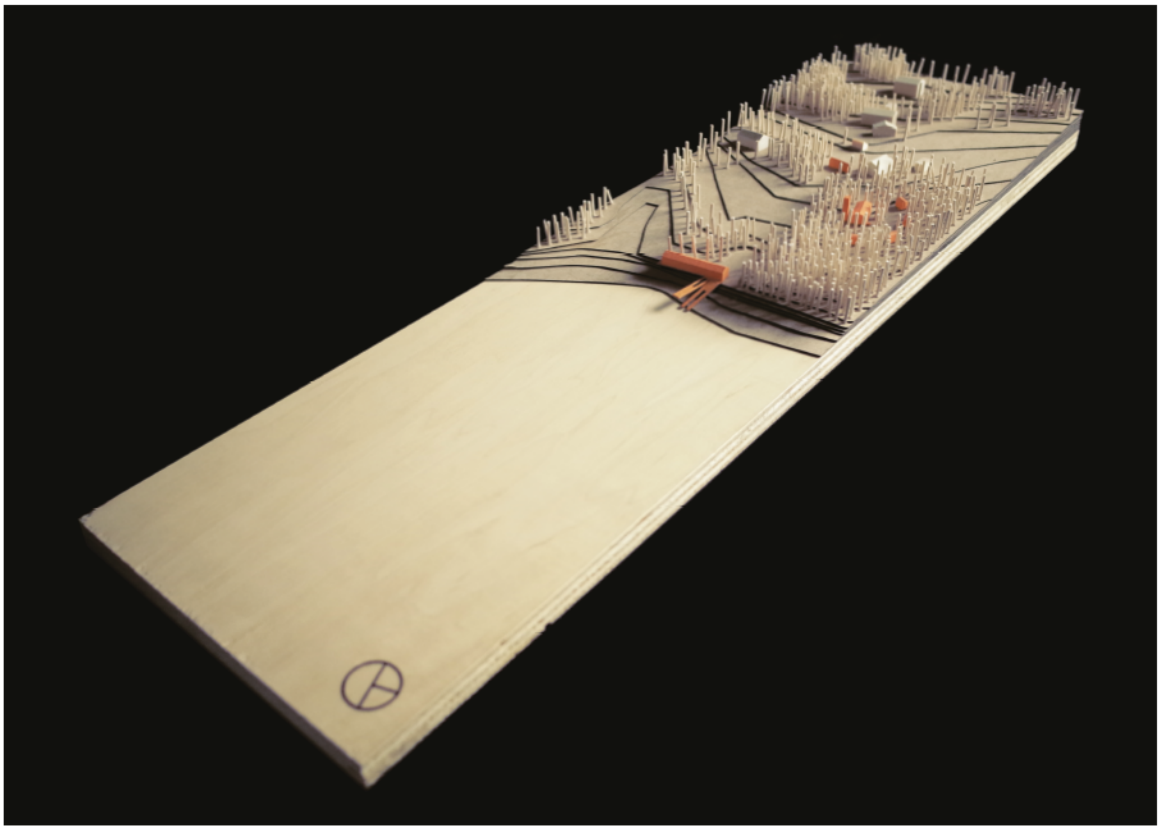


Figure 72: 1:750 Siting model, the village.

The Entry Pavilion

The entry pavilion is an extended, low standing, gable roofed building, with a bi-secting walkway. It is composed, programmatically, of elements that are primarily public in nature or would benefit the most from a closer proximity to the town. The program consists of; a small “museum” for the promotion of the reserve, focused around a centralized scale model. A gift shop, whose merchandise would raise funds for the centers research initia-tives and also for the local Puffin & Petrel Patrol. Ticketing for the tour boat operations would also be located at the pavilion as well as a dedicated Puffin & Petrel Patrol admin-istrative office.

Siting for the entry pavilion is at the mouth of the dirt road, the access point to the research dormitory, the research center at Ragged Cove and from there to the Witless Bay Ecological Reserve.

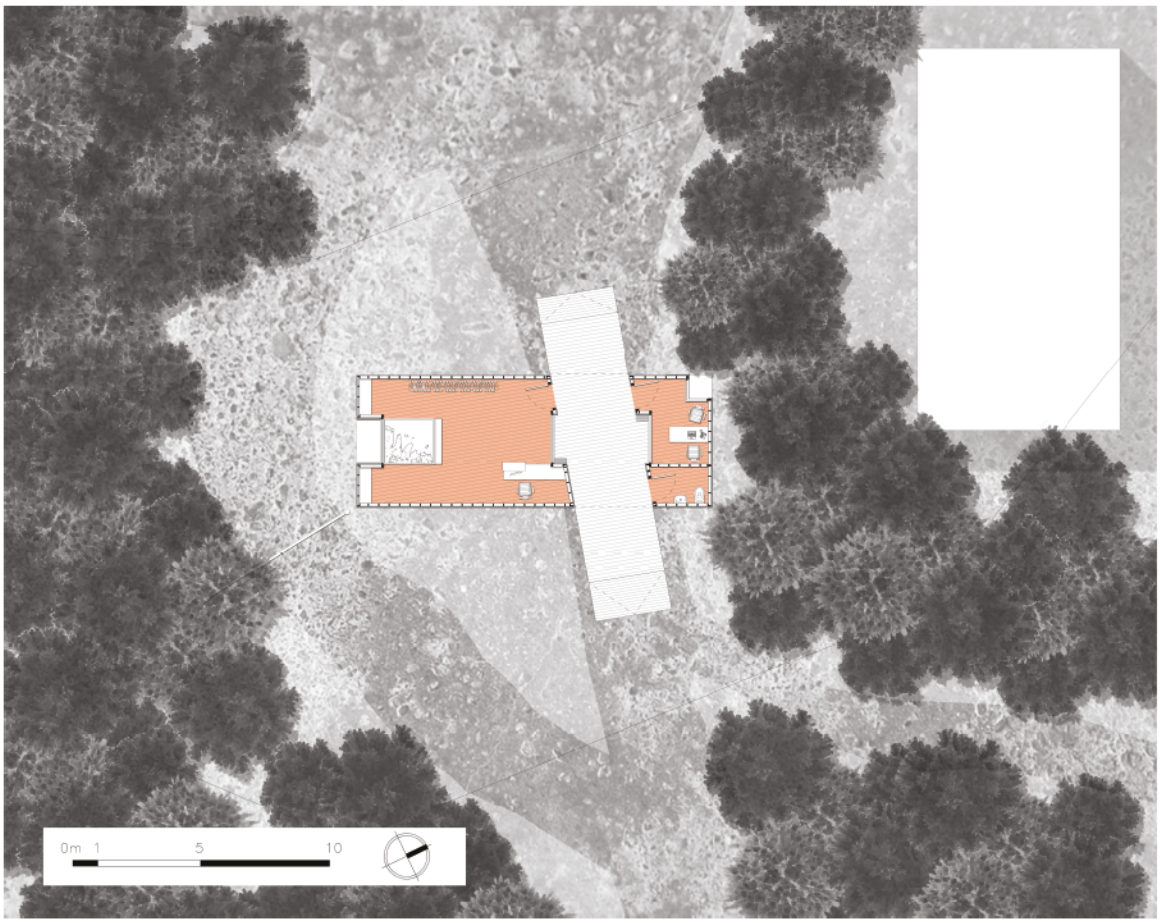


Figure 73: Entry Pavilion, plan.

Figure 74: Entry Pavilion, front.

The entry pavilion is sited here specifically for sensitivity and processional purposes. The pavilion acts as your first step in your expedition from town to research centre to reserve and back again. The pavilion acts as clear line in the sand, a threshold that announces your access to the reserve and the beginning of your journey. The pavilion itself is positioned in parallel to the road, expressing itself as the gate between “town” and “site,” while the bisecting walkway is in line with the dirt road. This off-axis alignment draws attention to the dirt path, clearly denoting your route.

The siting also plays a key role in protecting the sensitive site (Ragged Cove) from unwanted or harmful traffic. One of the sensitive interventions explored earlier was the idea of restricting vehicle access at the site; encouraging foot traffic and experience while protecting the area from the destructive influence of vehicles. The pavilion blocks the main access point to the dirt road, adding a small side road with an operable gate. The side road and gate where added for any needed vehicle traffic; emergency health services, fire trucks, transportation of equipment, etc.

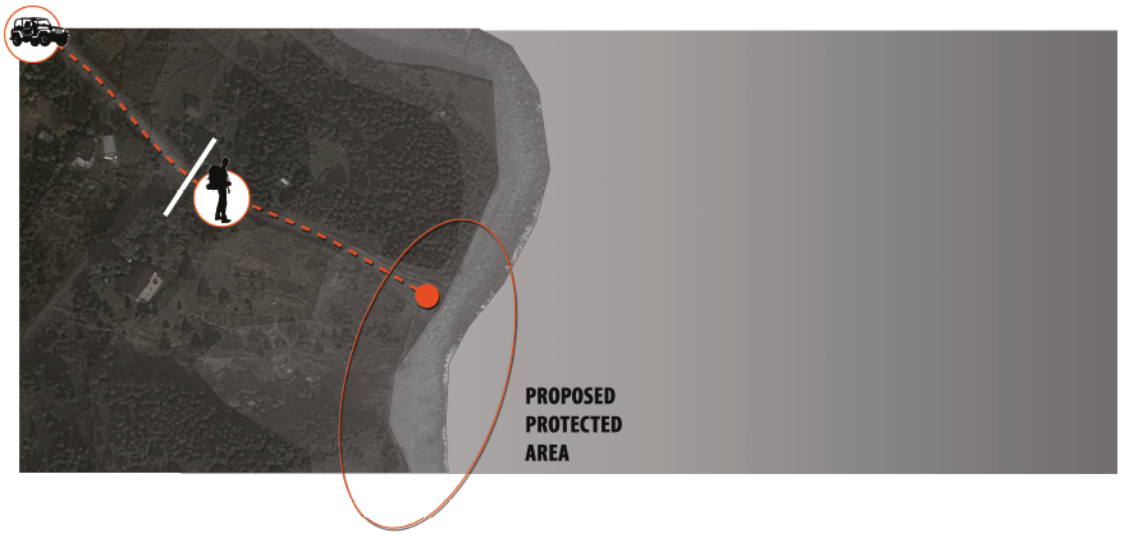


Figure 75: Entry Pavilion, barrier to damaging vehicle traffic. (Google Maps)

The entry pavilion also presents sensitivity to site through its built construction and form, employing one of two types of wall typologies seen throughout the villages’ construction. The first wall type seen in the pavilion is employed in sealed habitable areas.

Figure 76: Entry Pavilion, interior.

The windows in this wall types are recessed back into the building and incorporate window shutters. The purpose of recessing the windows and incorporating window shutters is to minimize the amount of light that can exit the building at night, protecting the local seabirds from the lights disorienting effects. This recessing gives the impression of a "thicker" wall, sealing the habitable interior off from the exterior site. The areas alongside the recessed windows can now be used for storage space or the like. Expressed here in the pavilion, the spaces next to the window are used for gift shop shelving. The pavilion also employs a raised post foundation, allowing the structure to minimize its connection with the ground and in turn minimize the destructive impact the building will have on the existing conditions.

The pavilion as well as the research cabins, community building and research center will also employ LED lighting bulbs to help mitigate harmful lighting effects on the bird species. Through my discussions with Suzanna Dooley, I learned that if light pollution is unavoidable then the use of downward lit LED bulbs is necessary to ensure light sensitivity to the bird population.[23] LED lights have been shown to not attract the fledgling chicks as other varieties of bulbs do.

23. Dooley, telephone interview, 28 Oct. 2014.

The dirt road is also a great opportunity to employ and encourage interactive elements in a site sensitive manner. Along the route, panels featuring informative text and pictures can explain aspects of the site such as history and ecology as you move towards the reserve. They can be positioned in specific places to draw attention to visible site features or simply placed to inform on general knowledge, encouraging an educational and interactive procession from entry pavilion to the research center. The panels would be of untreated wood construction, spruce or fir, the major tree species in the area. This would allow for a simple, interactive component that can broaden a visitors experience and has no negative effect on the existing landscape.

Figure 77: Processional path from entry pavilion to research center.

The Research Cabins

The research cabins are low-standing, hipped roofed housing units. They are the primary living/sleeping quarters for any residing researchers, each cabin contains two beds with, a water closet and living space.

Siting for the cabins is along a separate dirt path that circles around the existing field where the community building is situated. The cabins are sited here specifically for sensitivity. They are set back into the woods concealed from the reserve through the thick treeline. This siting allows for minimal impact on the existing bird species and at the same time maintains a level of privacy from the primary public procession.

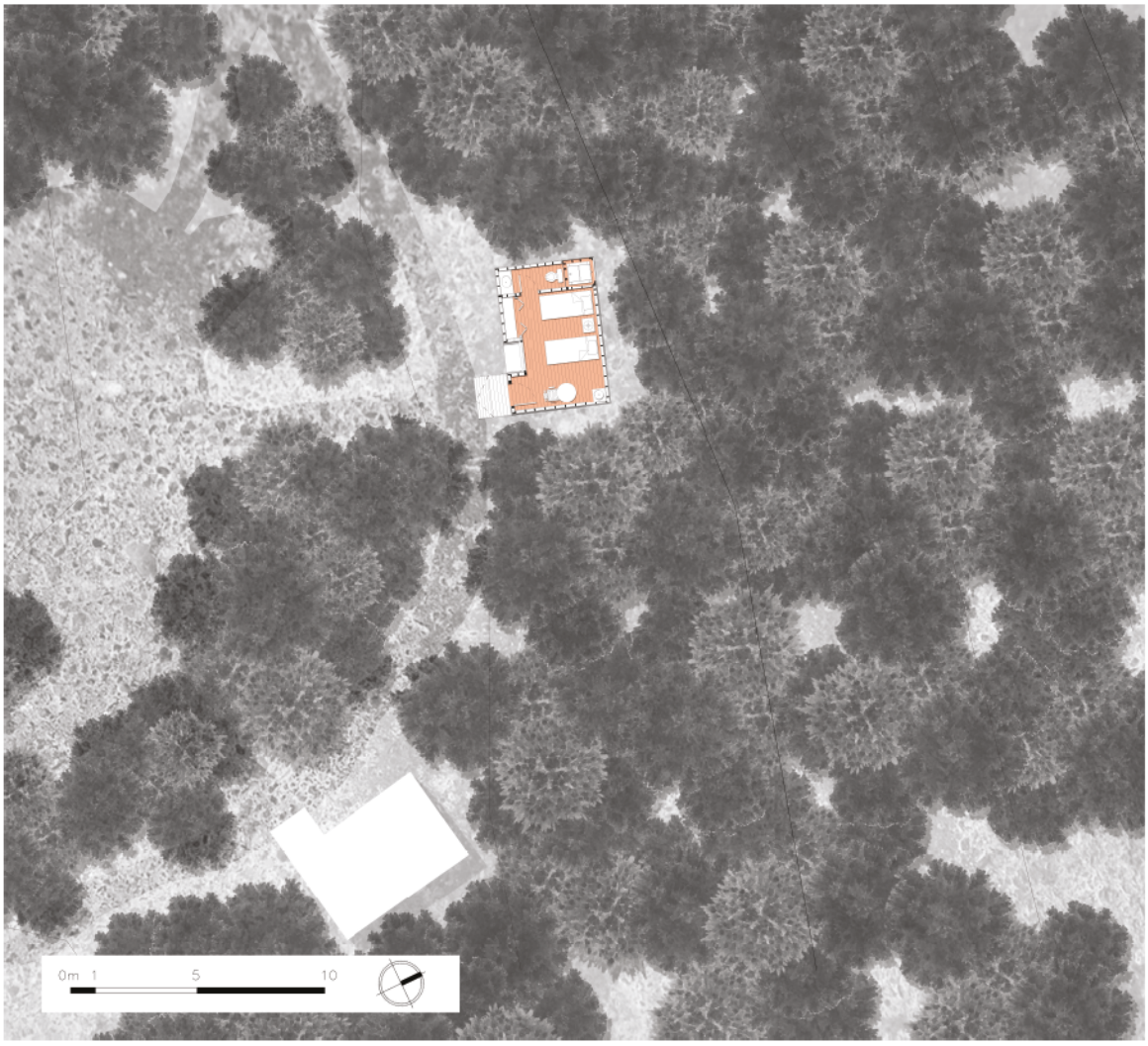


Figure 78: Research cabin, plan.

Figure 79: Research cabin, front entry.

The cabins employ many sensitive features through technical additions and the architectural construction and form. The cabins, being a contained habitable area employ the same initial wall type seen in the entry pavilion. The recessed window and shutters, again, help mitigate light pollution towards the reserve and help to create usable storage space along the wall. The cabins also employ a post structure to help ensure minimal destructive connection with the landscape.

Technical additions to the cabins include rainwater collection barrels, an incinerator toilet (an electric or gas powered toilet that burns away waste in areas that it cannot otherwise be dumped), solar panels, wood burning stove and LED lights. These were all features suggested to me by Dr. Ronconi, as necessities, to ensure that buildings set on the site are self-sufficient and minimize their additive or subtractive influence on the existing habitat.

Though the primary use of the cabins are an on-site living space for researchers during the summer working months there are also opportunities for the cabins to be used in the off-season; the fall, winter and spring. The cabins could be rented out to visitors and travelers; people visiting the community of Witless Bay and/or the reserve that need a place to stay for a night or longer. Backpackers walking the East Coast Trail could also rent a room for the evening then have a quick and easy access back onto the trail the following morning. There are many opportunities for the cabins to function as rental income when not being occupied by researchers.

The Community Building / Tower

The community building is a low-standing, gable roofed construction with a bi-secting entrance walkway that connects to an exterior tower, overlooking the treeline, out to the reserve. The community building is composed programmatically of a kitchen/dining area, showers, washer/dryer, storage space, viewing tower and an open unprogrammed space.

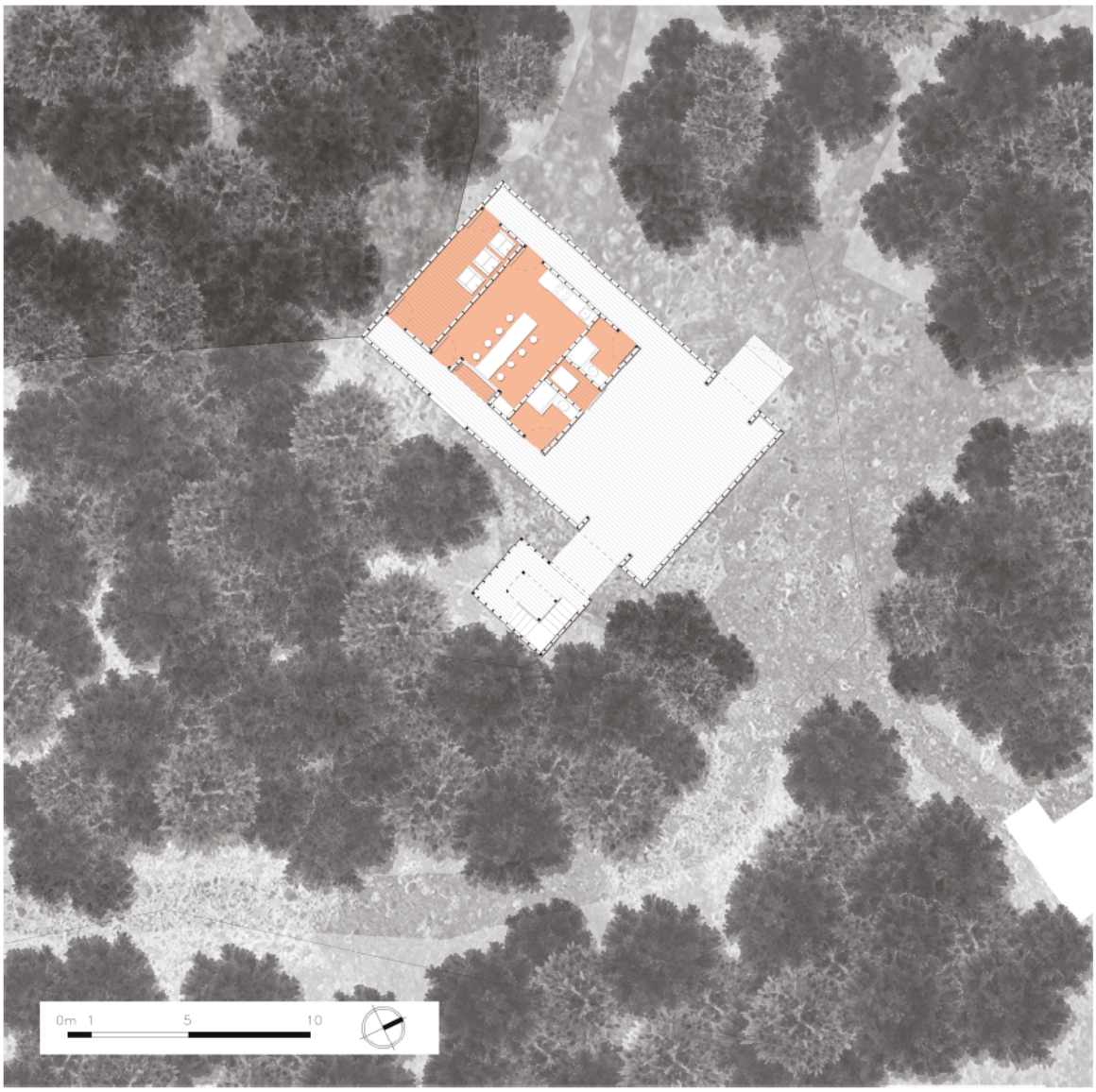


Figure 80: Community space/tower, plan.

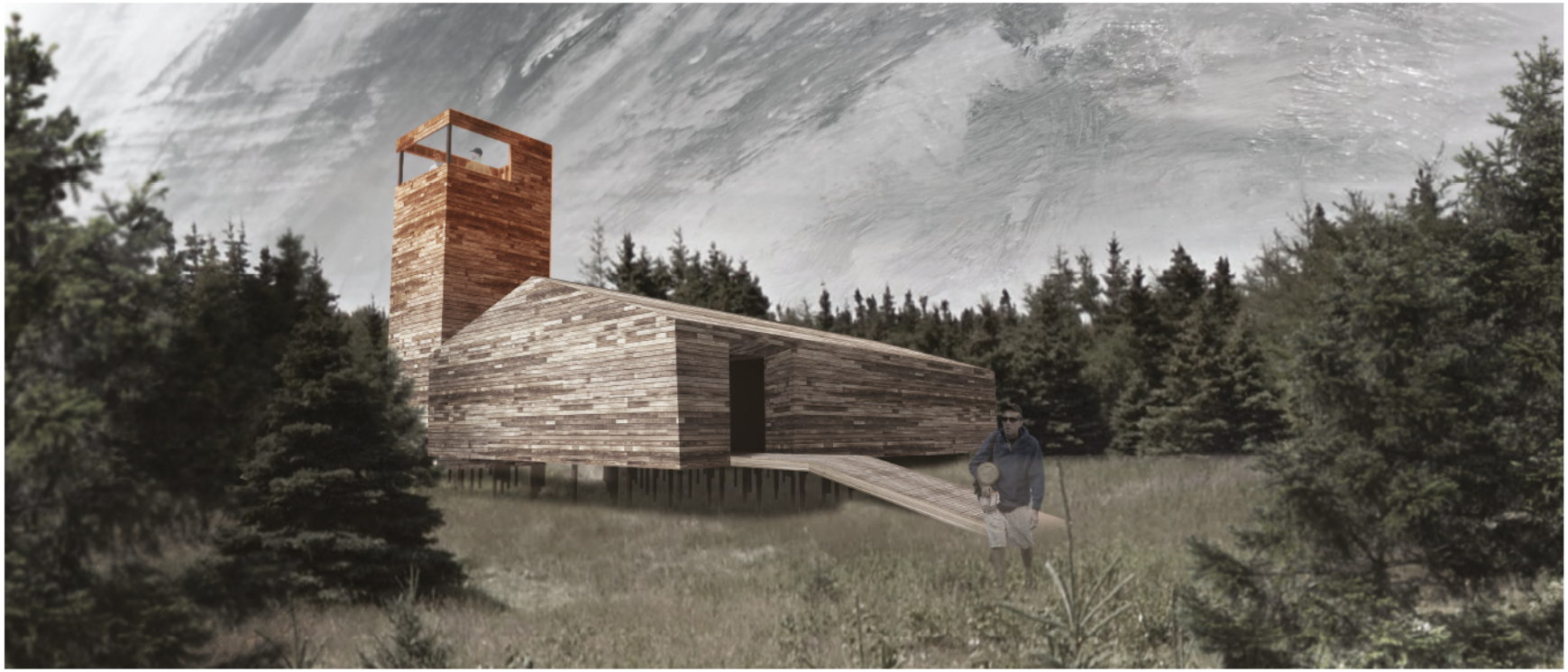


Figure 81: Research dormitory, living space.

Siting for the community building is about 70 meters down the dirt path and set back into the woods another 30, concealed behind the treeline in an open field. This siting is the connection point between the main processional path from entry to center and also the focal point for the encircling research cabins. The field was chosen for its ability to hold a larger built structure without uprooting or removing any of the existing fauna. Hidden behind the treeline the building is camouflaged from the reserve, the only viewable component being the observation tower which extends up above the enveloping treetops.

The community buildings sensitivity to site, like the entry pavilion and research cabins, is not only expressed through its position on the landscape but also through its architectural form and technical inclusions. The building is built on post foundations, employs the recessed windows wall type, seen in the pavilion and cabins and in addition, employs another secondary wall type.

The secondary wall type is a containing wall that is meant to separate interior from exterior but also maintain permeability to the outside. This wall type encloses the building but does not separate you from the outside world. The walls are carved through with openings in specific areas; the entrances and exits of the bisecting walkway and also cut through in areas where recessed windows are present in the interior. This wall type creates an inside/outside space; a space that is climatized to the site. This expression in the architecture expands on the habitable area of the building but does not remove you from the situated environment nor increase the buildings need for heating or lighting. Technical additions in the building includes solar panels, rain water collection barrels and LED lights.

The unprogrammed space in the community building is an area that can be used by researchers for any number activities; from meetings to classroom sessions to a general lounge. This space also has the possibility to be employed by local community members, for any number of events. The room is meant to act as an open ended space for on-site researchers and also for the local residents; a space to give back to the community of Witless Bay. A community that has shown an incredible love and support for the reserve and the efforts that go into conserving it.

Figure 82: Community building, unprogrammed space.

While the unprogrammed space can draw in the local residents and expose them to the research and the work that goes on there, the major interactive component of the community building is the observation tower. The tower acts as the one point throughout the processional path from entry to center where you can look out over the reserve. The tower is strategically placed to bridge the divergent paths you take from the entry pavilion. It is nestled deep behind the treeline positioned where you feel the most cut off from the rest of the site. It is an opportunity to ascend out of the constraining forest and be greeted by the grand vista of the reserve and the Atlantic Ocean.

Figure 83: Community building, view from tower.

The Research Center

At the end of the dirt road, on the edge of the coast, sits the research center. The center is composed of two primary axes; the enclosed gable roof axis that runs parallel to the coastline and the bisecting stage axis, which extends out into the shallows of the coast. Programmatically, the center is composed of researcher workspace, lab, Puffin & Petrel Patrol overnight storage, boat repair, viewing platforms and boat slide for island access and tours. Each of these program elements works independently and in unison so as to be a benefit to one another, visitors and the reserve.

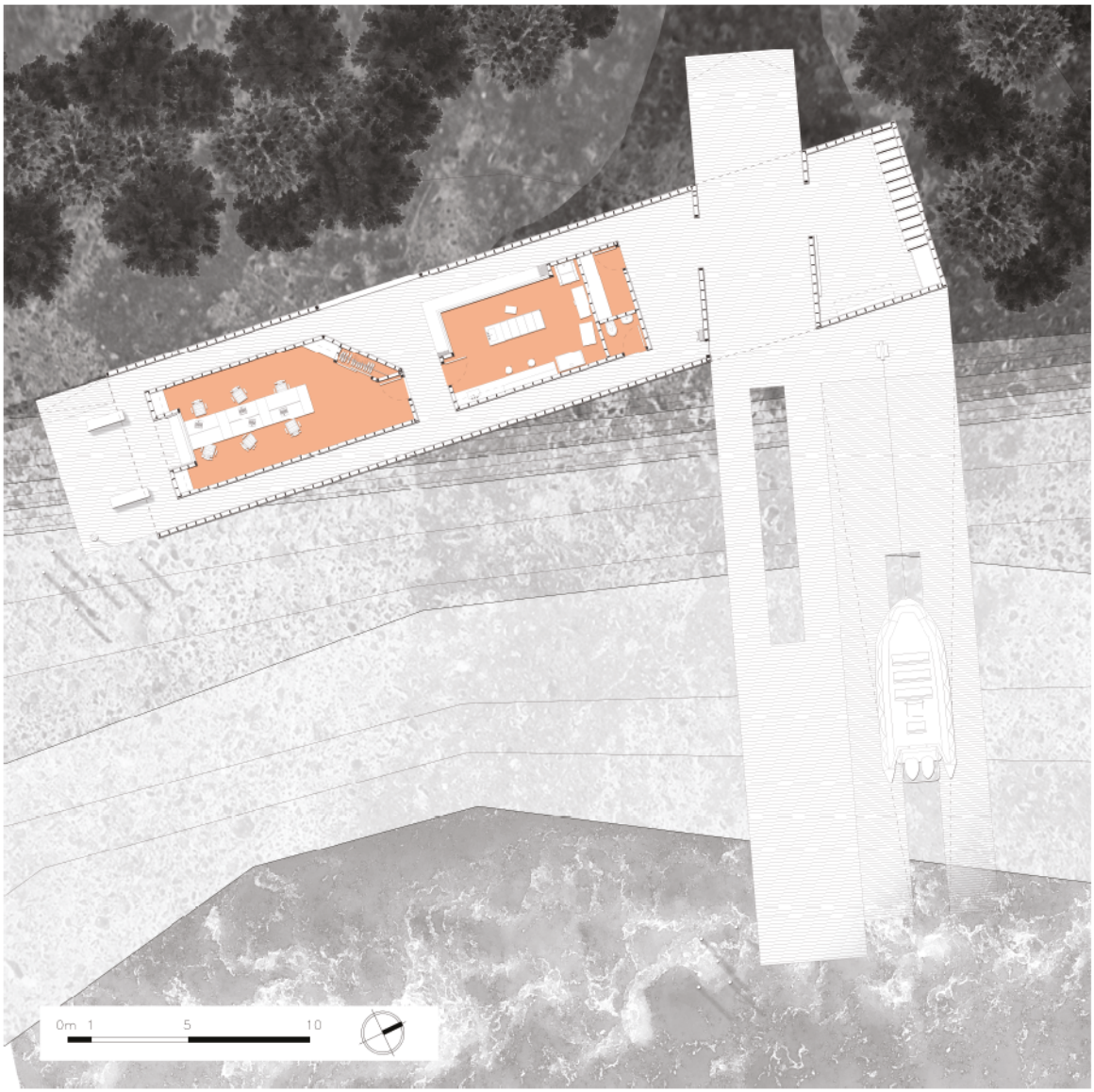


Figure 84: Research center, plan.

Figure 85: Research center, view from Ragged Cove.

General siting for the research center has been explored earlier in Aspects of Research - Architectural Siting, though the direct positioning of the research center takes heavy influence from the existing site. The stage axis of the center cuts through the main enclosed axis and is positioned in line with the entry path and Gull Island. This positioning creates a framed view of the island as you approach the center, allowing the center to act as a threshold to the reserve, much like the entry pavilion. The entry pavilion acting as a threshold for approach, while the research center acting as a threshold to the reserve proper.

While the stage connects the entry path to the ocean, the enclosed axis follows the line of the coast, directing you towards the entrance for Beaches Path, of the East Coast Trail and a viewing platform for Ragged Cove and the southern Green Island.

This siting is very important for maintaining sensitivity to the reserve. One of the sensitivity guidelines set out earlier was the need to site any intervention on the fringe of the sensitive area. While the center is sited on a proposed protected area, it is also located on the outskirts of the reserve; a fringe siting that maintains an association with the reserve while not being directly connected to it.

Figure 86: Fringe siting diagram. (Natural Resources Canada)

The center's sensitivity to site is also accomplished through the built architecture and sustainable features. The center employs both wall typologies in its construction much like the community building. Recessed windows and walls can be found in the interior work areas. These spaces receive light through cuts in the exterior walls, placed to allow direct light and indirect light into the center.

Other sensitive features of the center are the inclusion of an incinerator toilet, rain water collection barrels, LED lights and roof mounted solar panels. The construction material of the center is also paramount to ensure a sensitive intervention. The center will be extensively wood construction, built of spruce and fir; a wood species that is also employed in the entry pavilion, cabins and community building. This is to ensure the buildings are "of the site" as the primary wood species of the reserve are spruce and fir. Through the use spruce and fir, you can also ensure that and natural decomposition of the buildings will not harm the existing landscape or ecology. As the building naturally deteriorates it results in nutrients from the wood being released into the local soils and water, an additive process, supportive of the reserve.

One of the most paramount aspects of a buildings sensitivity to site, is the nature in which it connects to the ground. As mentioned earlier, the center will employ a wood shoring foundation system to ensure a non-subtractive impact on the site during construction and also to ensure a non-polluting degradation into the reserve.

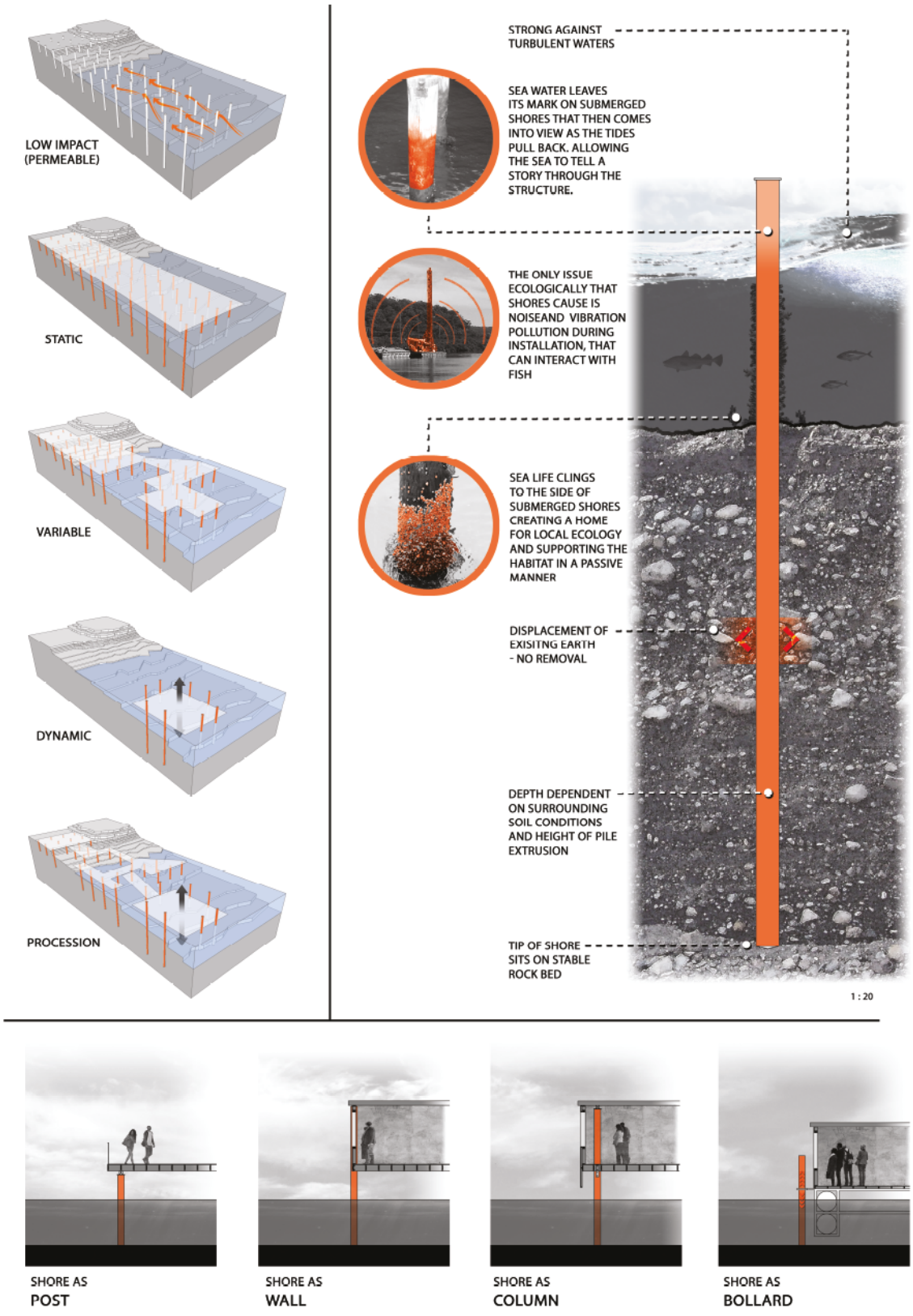


Figure 87: Sensitivity and interactivity study on the use of shores as a structural foundation.

Figure 88: Expressions of sensitive through the architecture - inclusion of both wall types, climitized interior, wood frame construction, shoring foundation.

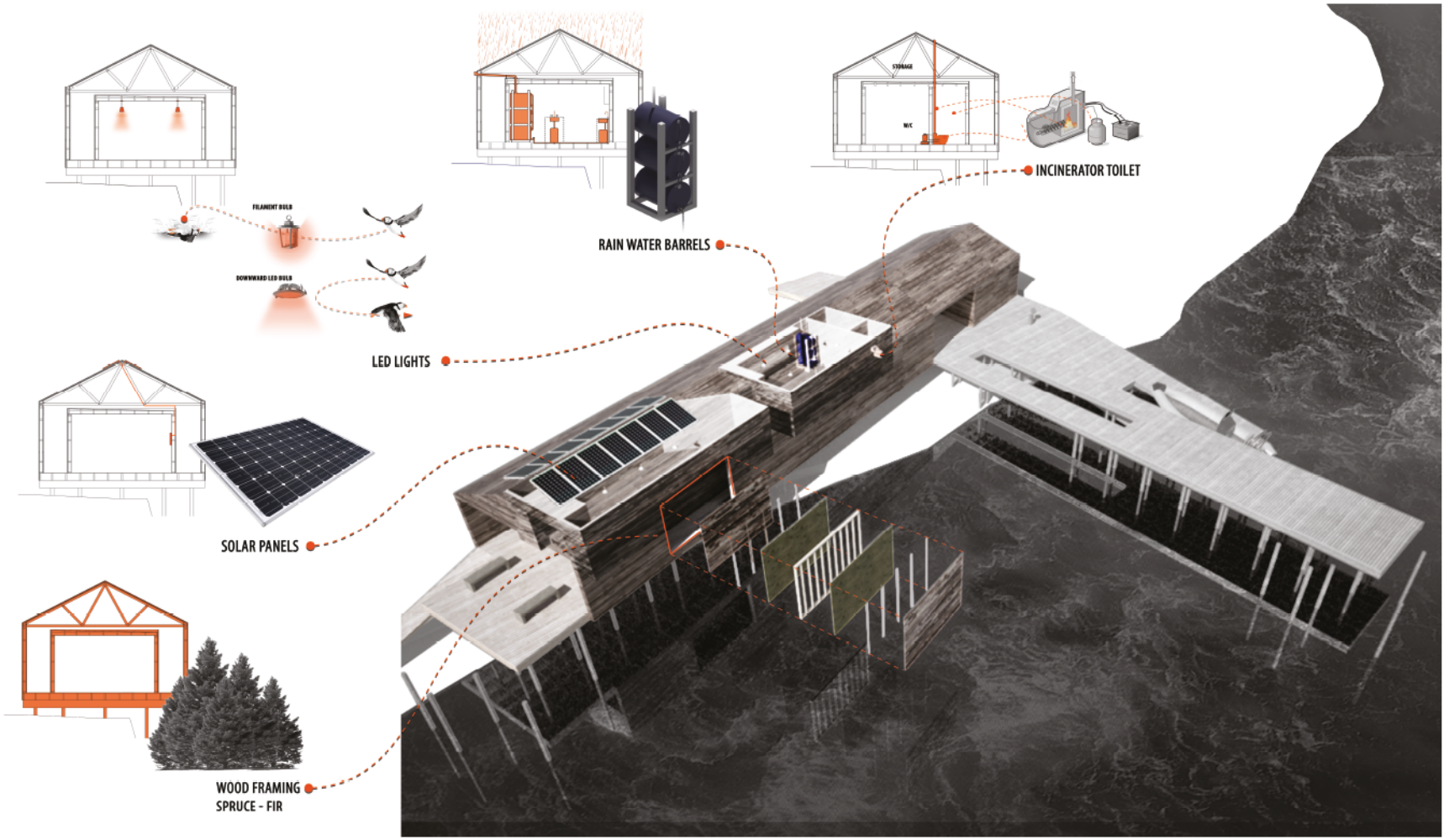


Figure 89: Expressions of sensitive through sustainable features

These expressions of sensitivity in the built form can now ensure that a sustainable interaction with the site can be established through the architecture. The first interaction you make with the reserve through the center is from the framed view to Gull Island created by the bisecting stage. This view is your first established connection with the reserve through the center's architecture; a view to the offset of a journey from land to sea.

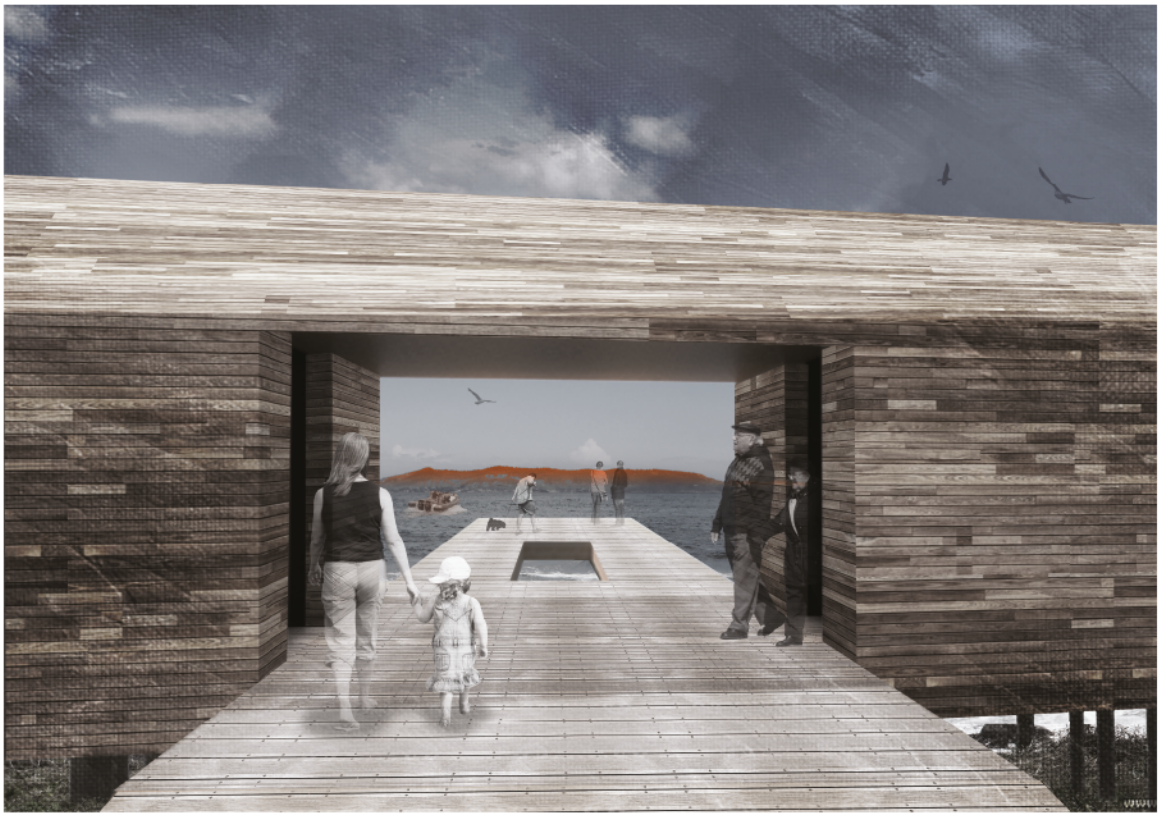


Figure 90: Research center, entry view of Gull Island.

This "framed" connection with site is also established at the southern end of the center where a platform extends out from the building, opening the center up to a view of the Ragged Cove coastline and beyond that, of Green Island.

This platform is an opportunity to take in and connect with the site. The foundation shores extend out past the structure, presenting a raised area for local birds to perch and rest. At the same time, benches are set up for visitors to sit and take in the view. This platform creates a condition where man and bird can share a space with one another through the architecture in a sensitive and unforced manner.

Figure 91: Research center, view from platform to Ragged Cove and Green Island.

At the edge of the platform also sits a set of standing binoculars, where you can get a closer look at the elements of the serene vista laid out before you.

This viewing platform also acts as an access point for Beaches Path portion of the East Coast Trail. The platform incorporates a ramp that transitions down to Ragged Cove and from there onward to the trial. This incorporation of access to the trail into the center means the building can act as a port for not only the Witless Bay reserve but also for a portion of the East Coast Trail, bringing not only tourists through the center but also hikers and travellers.

Figure 92: Research center, view to platform from Ragged Cove.

Within the center there are also interactive and educational opportunities for visitors that help connect them with the reserve. The research lab employs a large viewing window that allows visitors to look on as researchers perform their work. On the other side of the space is an information wall that explains and explores the work the researchers are doing at the site. This moment allows people to connect with the researchers and their work; giving them an opportunity to better understand the crucial role research plays in the wellbeing and conservation of the reserve.

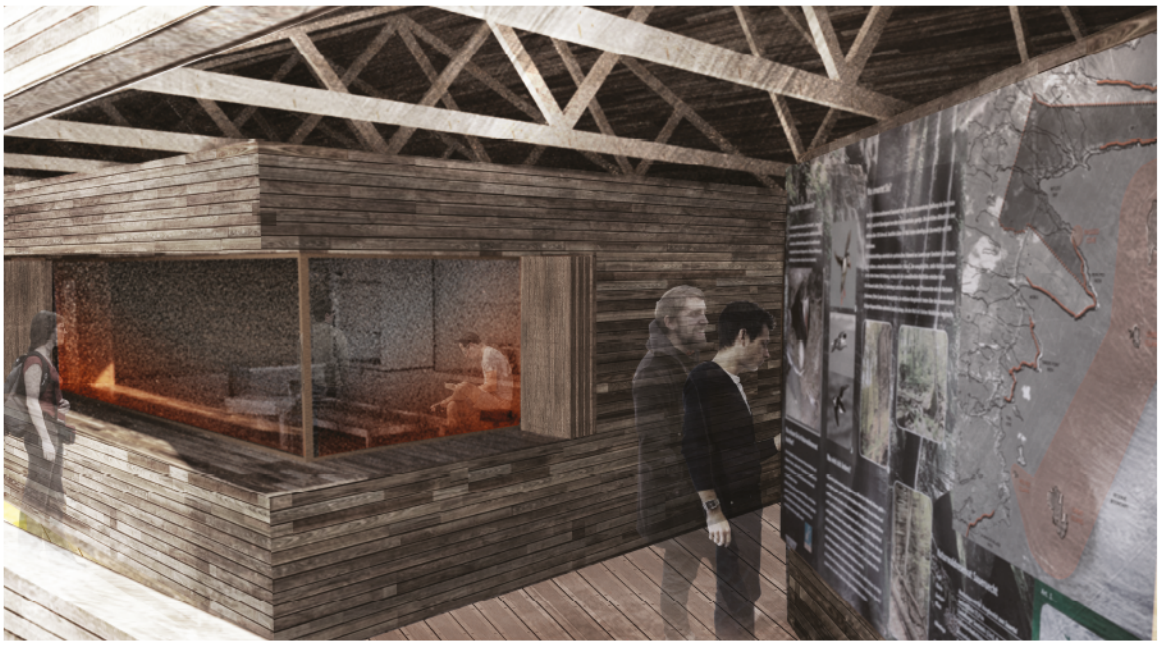


Figure 93: Research center, visitor view into research lab.

In addition to the research portion of the center the building also houses the Puffin & Petrel Patrol overnight bird storage. This room contains a number of different elements that support and promote the community based endeavor.

The primary feature of the space is the overnight storage wall. The wall is a series of stacked hexagonal storage shelves, each 3 feet deep. The hexagonal form is meant to express the puffin's burrows and also reflect the hexagonal frame of the plastic carrying kennels the patrol uses. The depth of these "wall burrows" imitates the depth of a puffin's natural nesting burrow; creating a safe, dark, recessed hole meant to calm the birds as they are held overnight. Each "wall burrow" incorporates a pull out shelve that allows for quick and easy inserting and removing of the kennels.

This feature wall is employed to grab the attention of visitors; informative panels are featured above the wall, giving details about the patrol, the work they do and how people can get involved in the cause. Incorporated into the wall is also a large storage locker for the patrol's variety of tools and gear. On the other side of the room is a fold-out work table that allows researchers or the patrol to engage in any necessary work with the birds. After the puffins have been held overnight, they can then be taken out onto the center's stage, where they can be easily released back to the reserve.

Figure 94: Research center, Puffin & Petrel Patrol room.

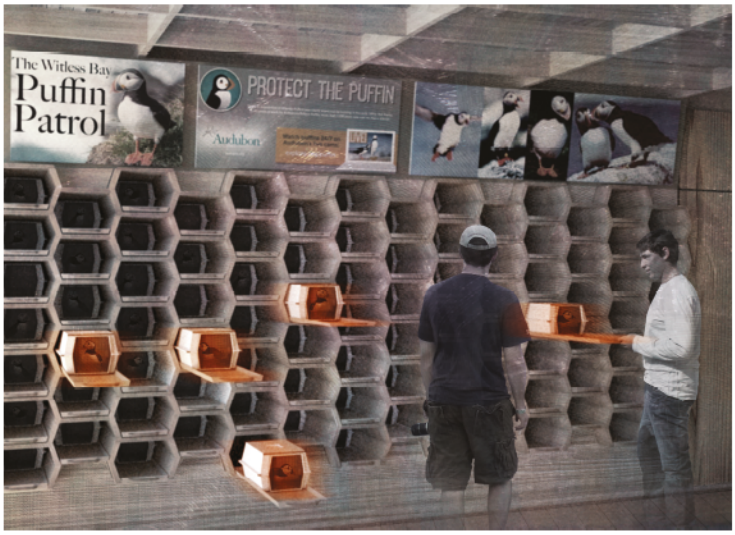


Figure 95: Research center, Puffin & Petrel Patrol storage wall.

Figure 96: Research center, storage wall diagram. (Geograph)

Figure 97: Research center, stage with views to Gull and Green Island from stage, boat slide.

The center's stage is the moment in the journey where you transition from land to sea, a moment where the architecture opens to the ocean and you are present with the expansive vista of the reserve. When you first step out onto the stage there is a prominent opening situated over the "transformational" region of the coastline, the area where water and rock blend. As you walk over the stage you can look down to the shoreline and watch as water sloshes and mixes with the rocky coast, drawing attention and connecting you to the natural processes that exist at the site.

At the end of the stage, the shoring foundations move out past the main structure, creating the same condition as the Green Island viewing platform. This creates another opportunity for local ecology and people to sensitively interact with the backdrop of an expansive and unfiltered seascape.

Incorporated into the stage on the northern side is the boat slide. The boat slide is a necessity to allow the tour boat a raised platform above the rough and unforgiving Atlantic waters. This is the critical moment, when a visitor leaves the architecture and the land and sets out onto a new journey, into a pristine and rugged habitat.

Figure 98: Gull Island, experienced from tour boat.

Exploring sustainable and sensitive interaction doesn't end when the boat leaves the center. There is also a need to understand and resolve a viable route for the researcher led tours that can encourage and maximize interaction and experience, while at the same time minimize the intrusive human presence.

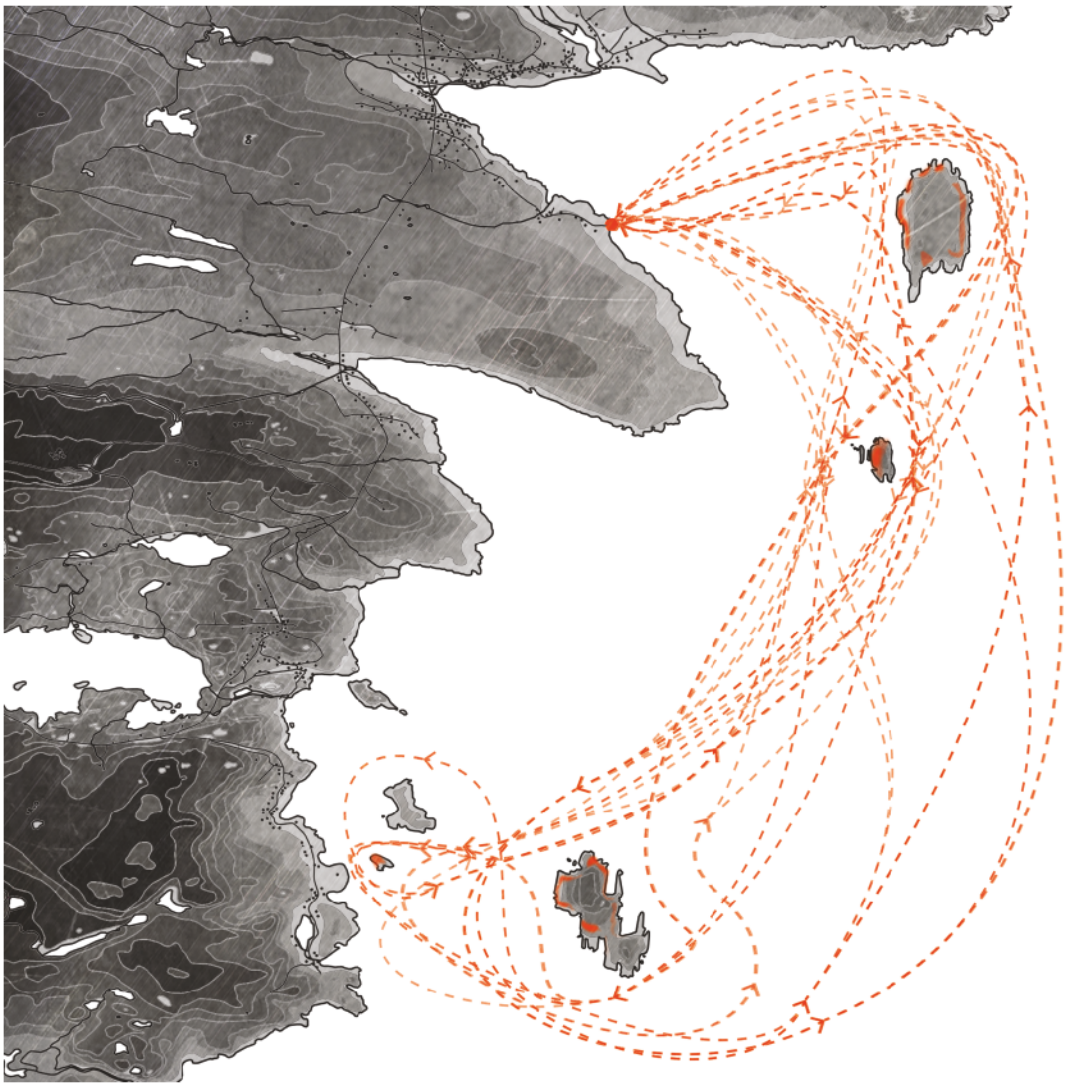


Figure 99: Potential tour boat routes along side puffin nesting areas.(Department of Energy, Mines and Resources, Natural Resources Canada)

To examine a potential route I tested different possible paths alongside major areas for puffin nesting. This exploration was also informed by my own personal experience in touring the reserve. This examination allowed me to develop a potential route that could maximize the experiential impact on the visitor and at the same time minimize the visitor's impact on the reserve.

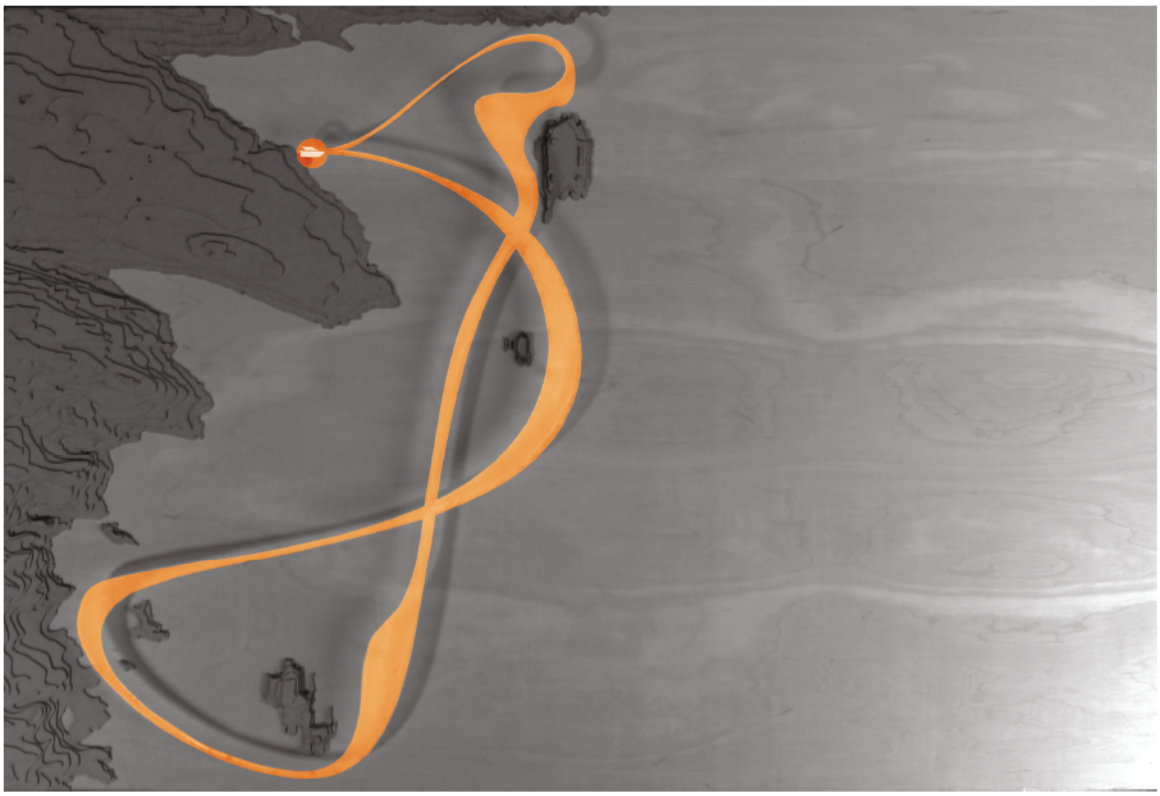


Figure 100: Tour boat route model, width of route denotes time spent (comparatively) in each location.

When a visitor finally returns from this expedition, they will return to the same architecture as they departed from, though now, they will hopefully have a new outlook on the need to protect and conserve sensitive ecological sites. Having experienced a journey of exploration, interaction and education through the site and the architecture, they will have a better appreciation for conservation and sensitivity. This journey should hopefully encourage them to understand and respect the natural world and to support the efforts that go into protecting sensitive sites like the Witless Bay Ecological Reserve.

Figure 101: Research center, 1:50 model.

CHAPTER 3: CONCLUSION

Designing architecture can enable and support sustainable interaction in ecologically sensitive sites means understanding the components and dynamics of what make each specific site delicate and sensitive. In terms of the Witless Bay Ecological Reserve the delicate and sensitive aspects of the site are found within the nesting bird species and their interaction with the local communities and vice versa.

Understanding the existing relationships at the site will ensure that any architectural intervention will conserve the sites sensitivity and at the same time ensure that the beneficial relationships that exist are supported and even fostered while the negative are impeded and stifled. A sensitive and interactive architecture for the Witless Bay reserve is not one of a simple “light touch” but one that expresses and encourages the existing dynamic relationships and the ideals found in those relationships, ideals such as; research, exploration, education, understanding and most importantly protection and conservation.

This thesis has proposed and developed an architecture that’s sensitivity and connection to site is directed and catered to the Witless Bay reserve. When dealing with sensitive sites, a catch all solution is not the answer, one must extensively examine the specific dynamics to ensure the most appropriate intervention is established. For the Witless Bay reserve an architecture whose sensitivity and interaction is expressed not only through technical features but also through the very nature of the built architecture and through the development of a beneficial and contributory program. An architecture that’s holistic presence is focused on not only sensitivity to site but also on interactive support and conservation of the site and its existing beneficial relationships.

Designing for sensitive ecological sites like the Witless Bay reserve will always walk the line between the need to connect people with a site and its ecology and at the same time protect it from that same relationship. Careful study, interpretation, and accommodation of a sites dynamics and relationships can lead to a sensitive architecture, an architecture that allows people to sustainably interact with one of the world’s sensitive and beautiful ecosystems.

APPENDIX

Siting Models

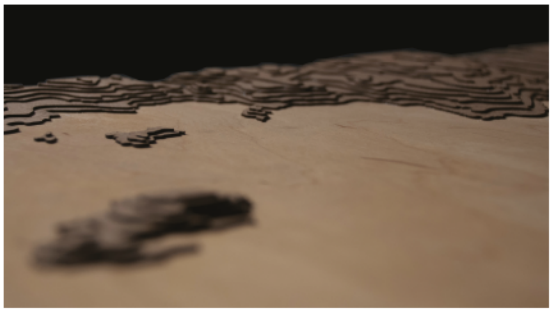


Figure 102: Site model - Great Island, Pee Pee Island, Tors Cove.

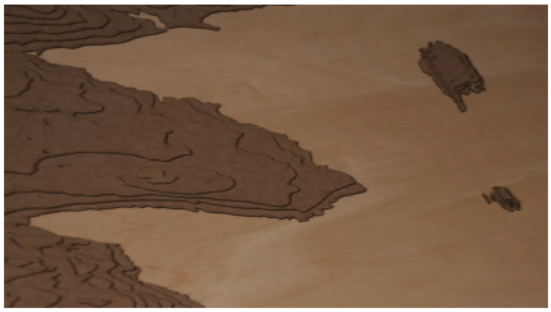


Figure 103: Site model - Gull Island, Green Island, Witless Bay, Mobile.

Figure 104: Site model - extents.

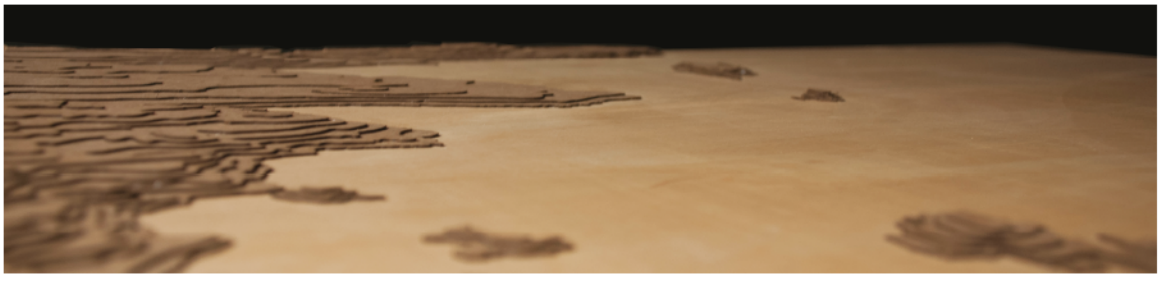


Figure 105: Site model - shoreline, island relationship.

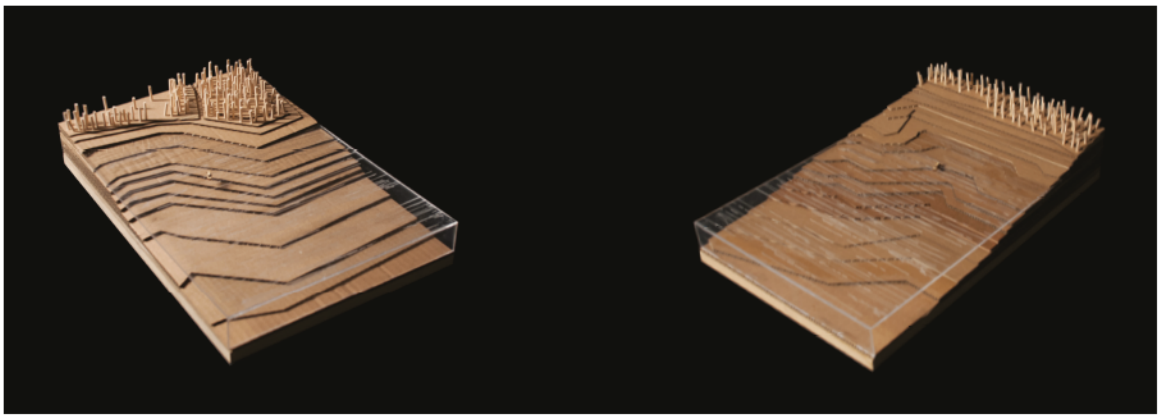


Figure 106: Satellite models - Ragged Cove coast, Gull Island coast.

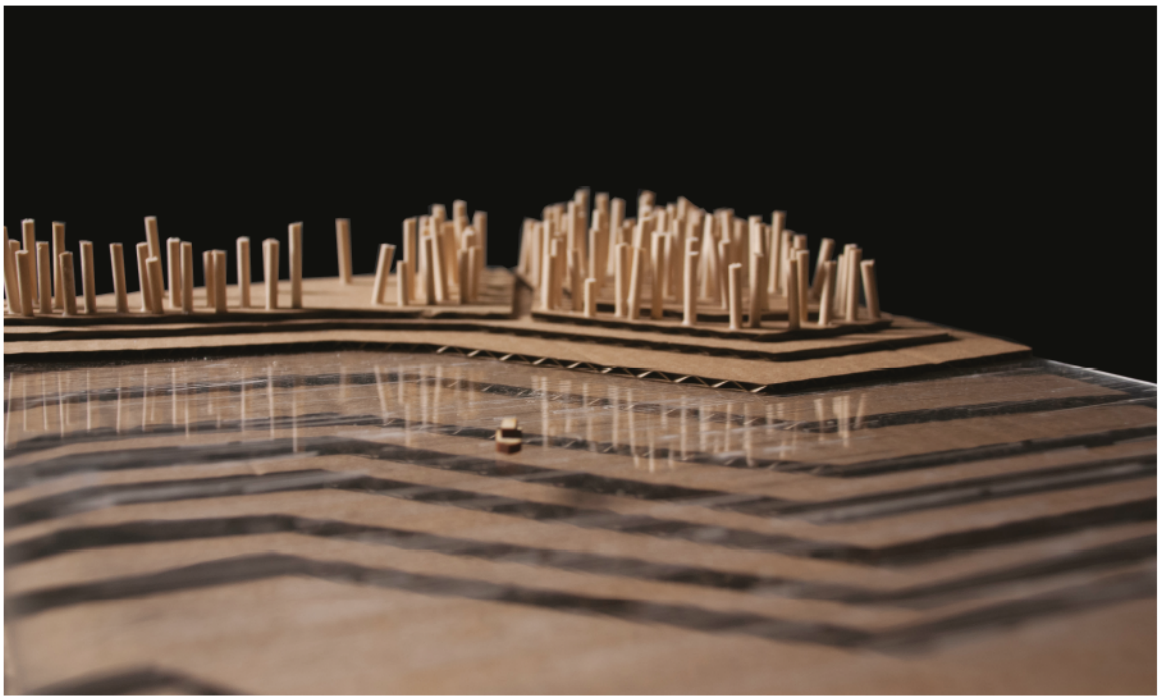
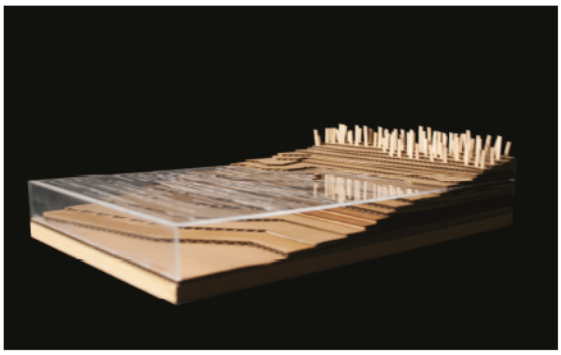


Figure 107: Satellite models - Ragged Cove coast.



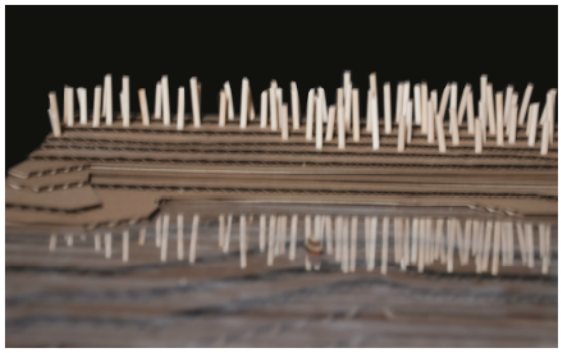


Figure 108 - 109: Satellite models - Gull Island coast.

Architectural Models

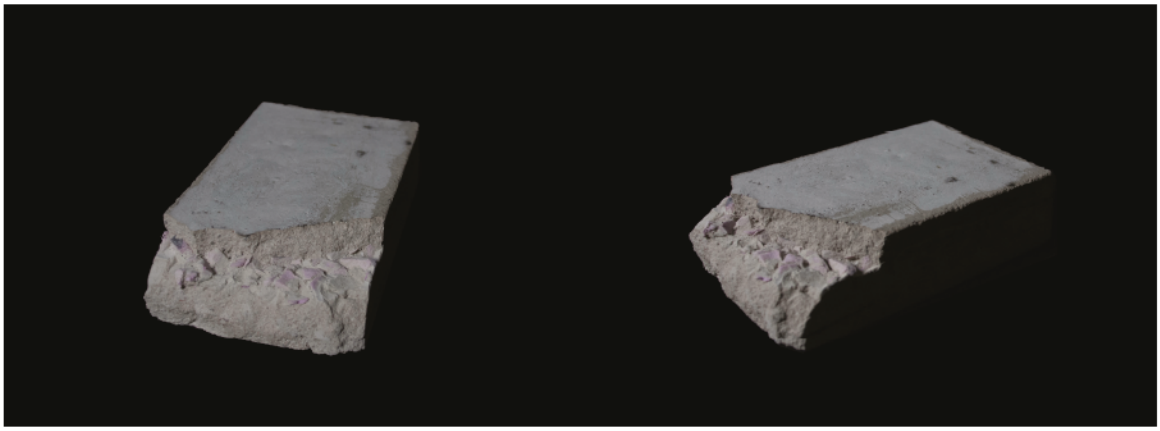


Figure 110 - 111: Exploration of floating concrete foundation.

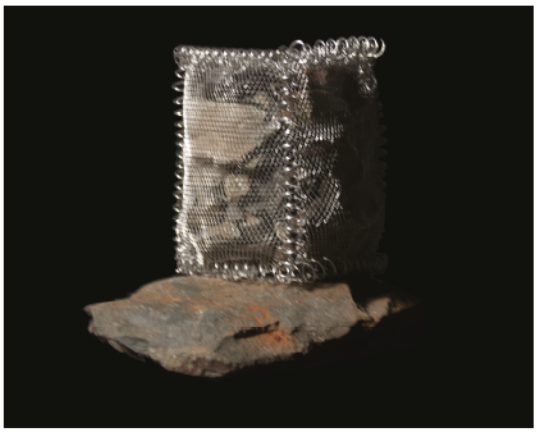


Figure 112: Exploration of gravity based rock pile foundation.

Figure 113: Exploration of carbonized (charred) siding for waterproofing.

Figure 114: Exploration of segmented floating structure to help mediate turbulent waters.

Figure 115: Tour route model - boat icon.

Figure 116: Tour route model.

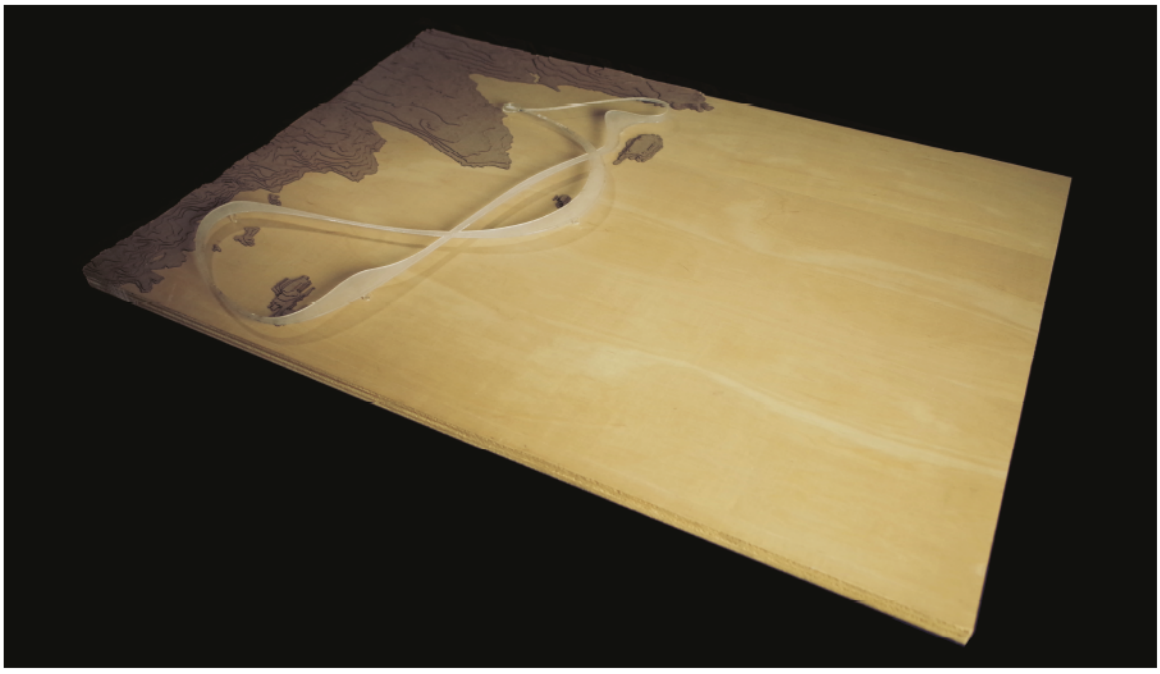
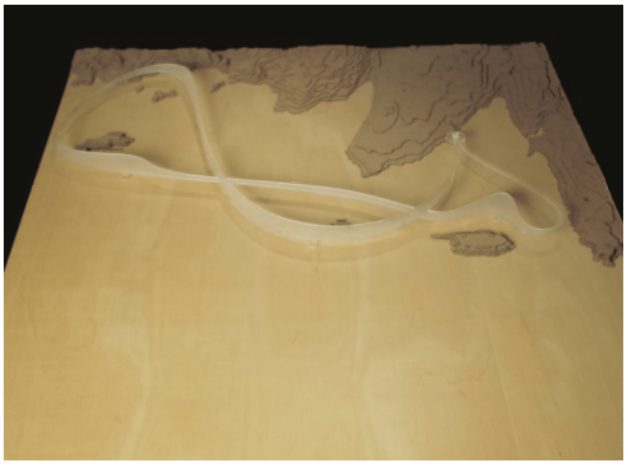


Figure 117: Tour route model - extents.



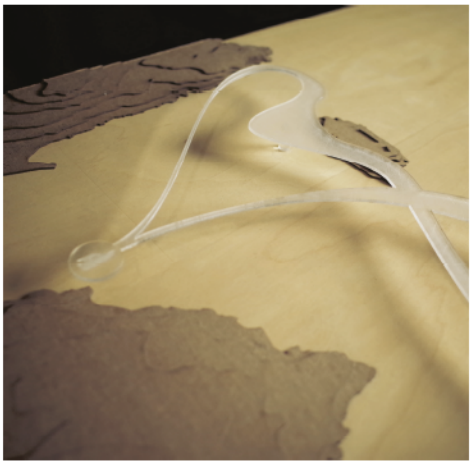
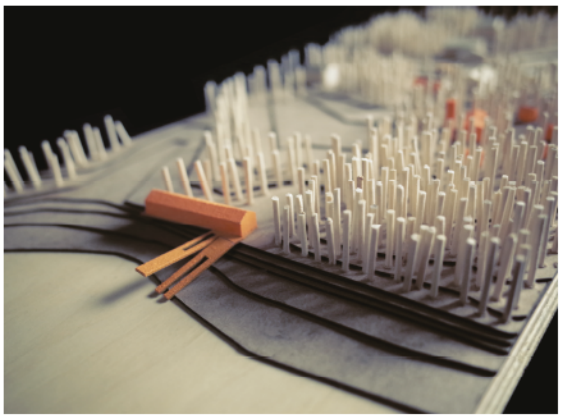


Figure 118 - 119: Tour route model.



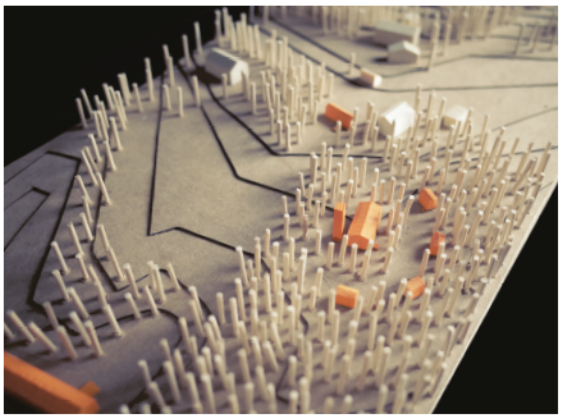


Figure 120 - 121: 1:750 Village model.

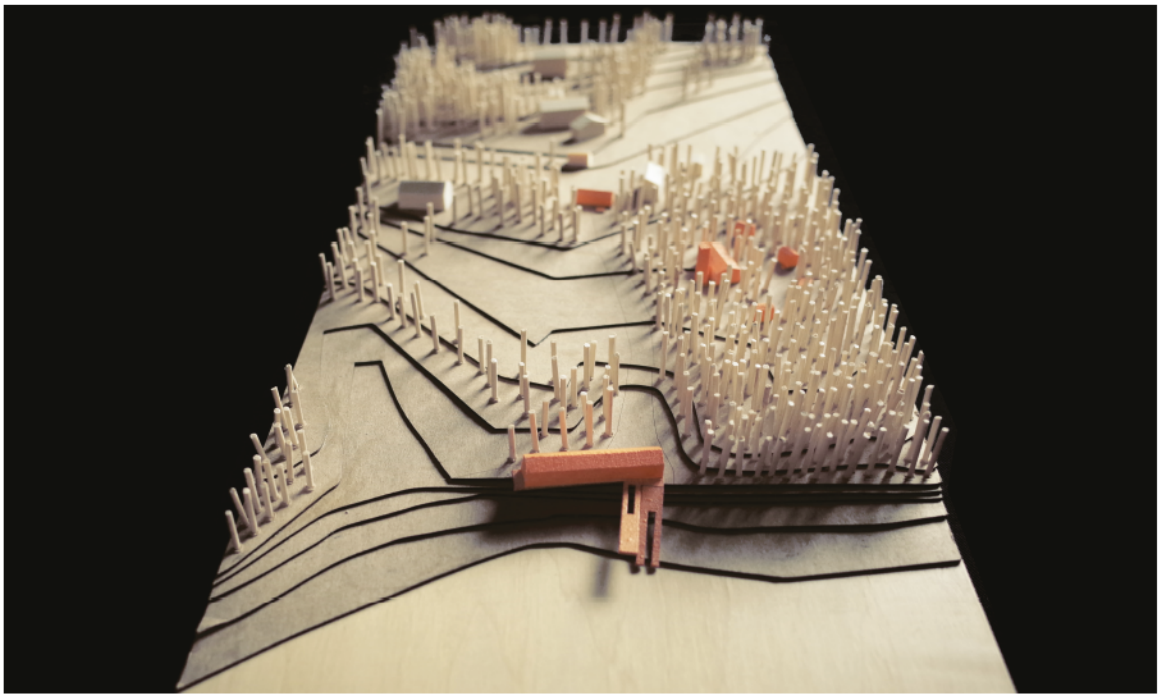
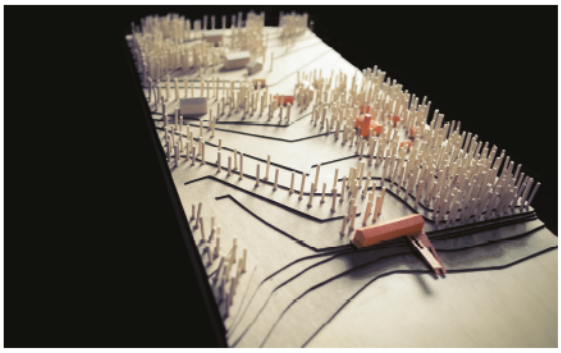


Figure 122: 1:750 Village models.



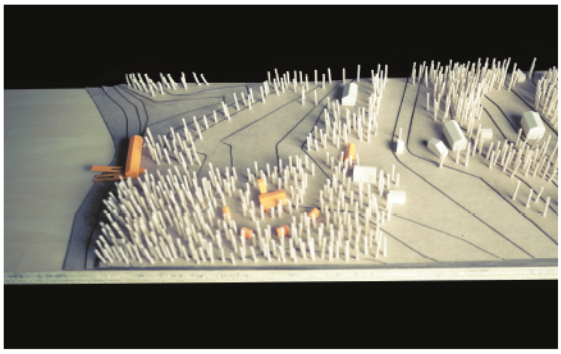


Figure 123 - 124: 1:750 Village models.

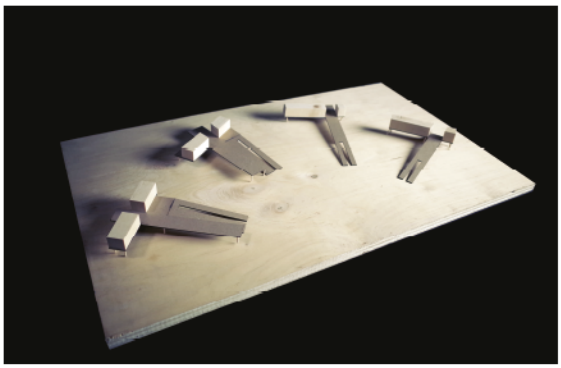
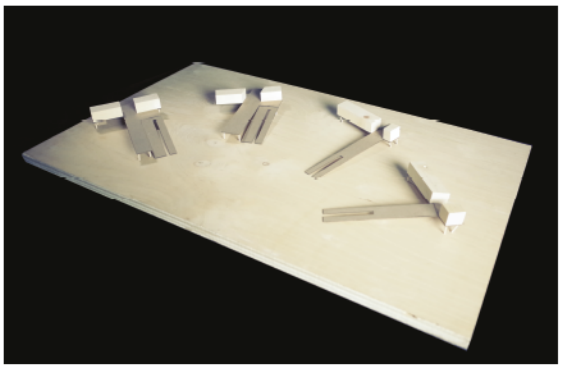



Figure 125 - 126: Research center models - iterations.

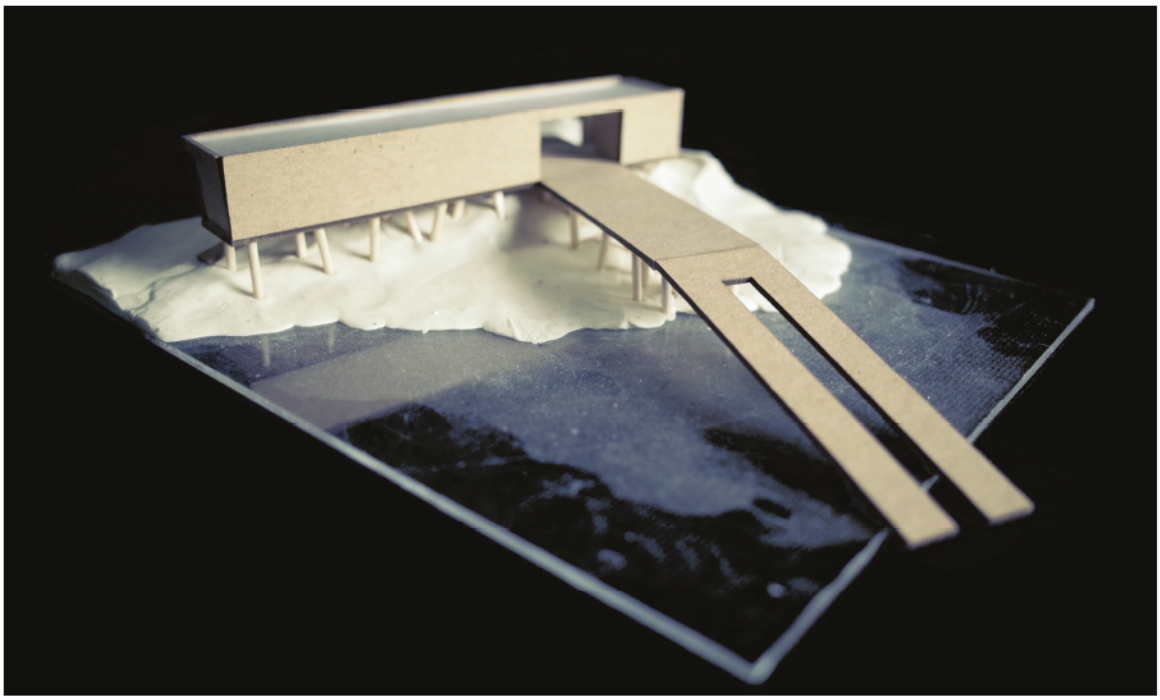


Figure 127: Research center model - initial concept.

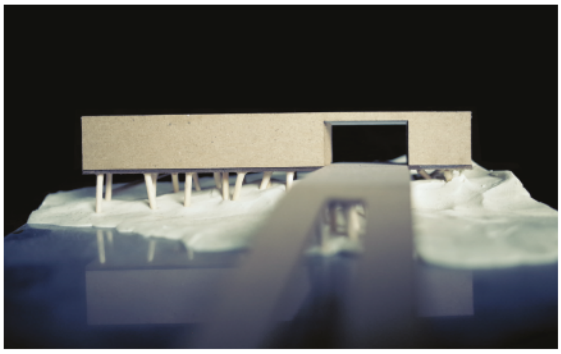



Figure 128 - 129: Research center model - initial concept - top, front.

Figure 130: Research center 1:50 model - stage and boat slide.

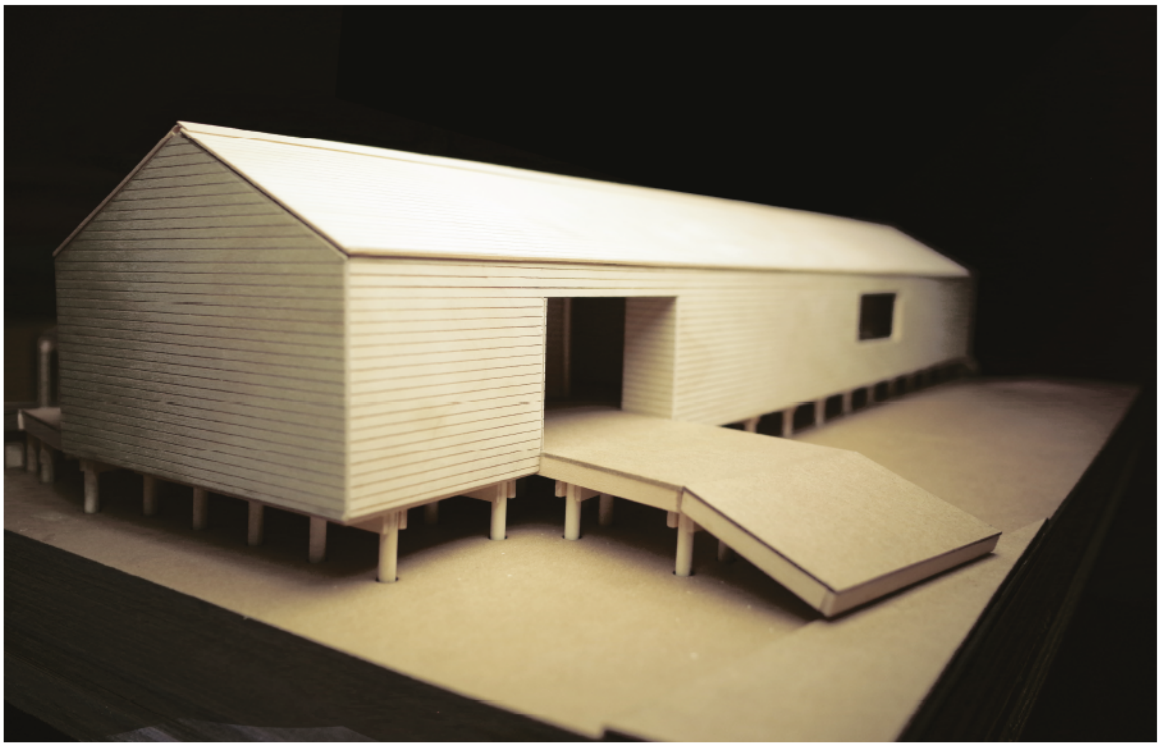


Figure 131: Research center 1:50 model - rear view.

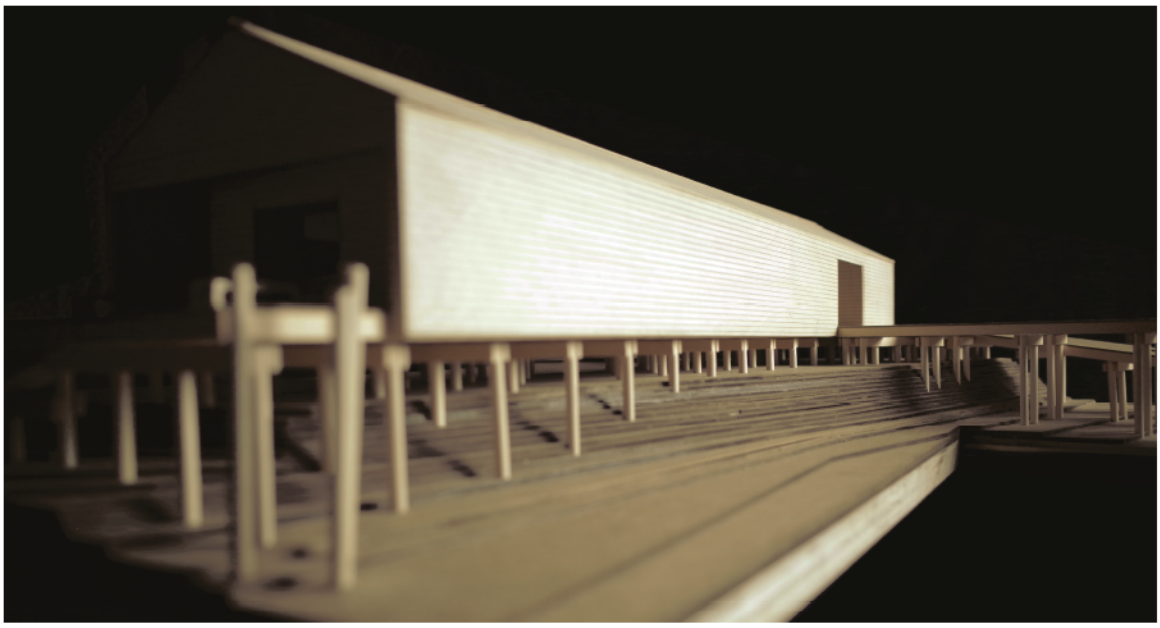


Figure 132: Research center 1:50 model - south view.

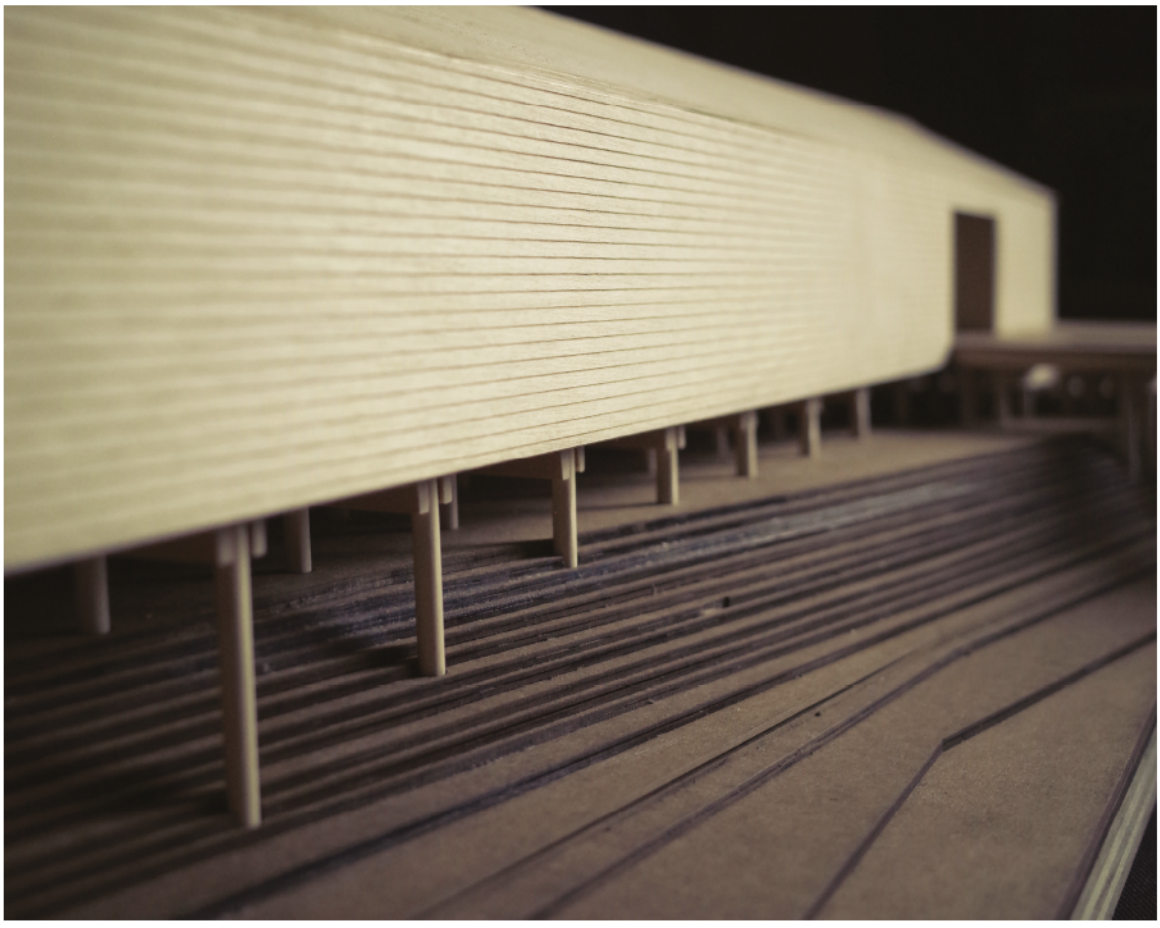


Figure 133: Research center 1:50 model - shoring foundation.

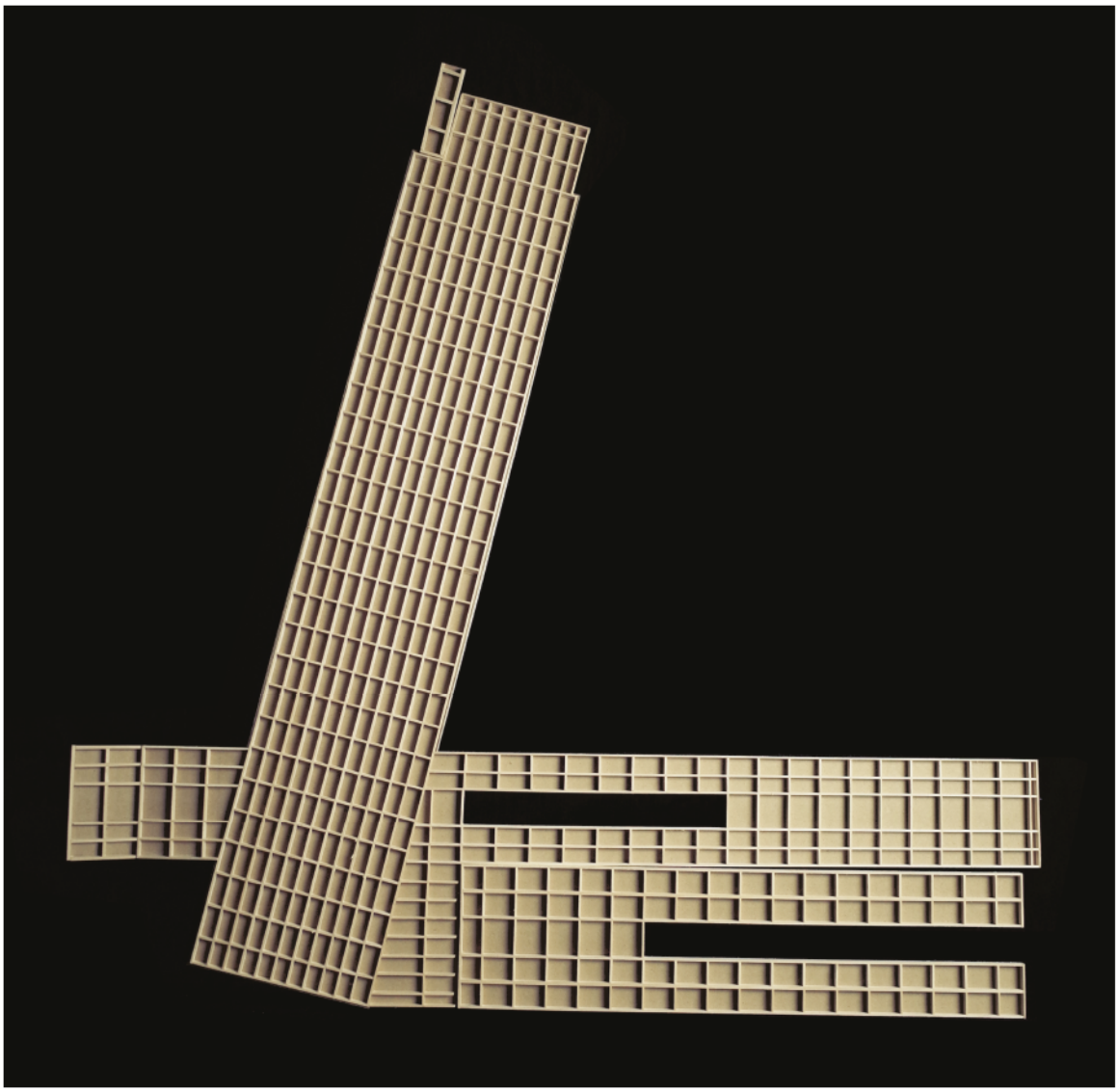


Figure 134: Research center 1:50 model - floor framing.

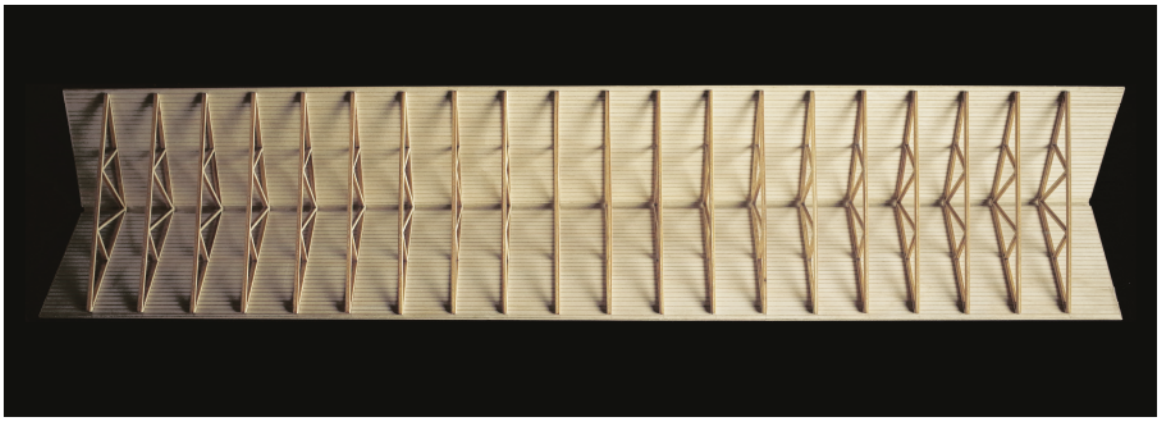


Figure 135: Research center 1:50 model - roof trusses.

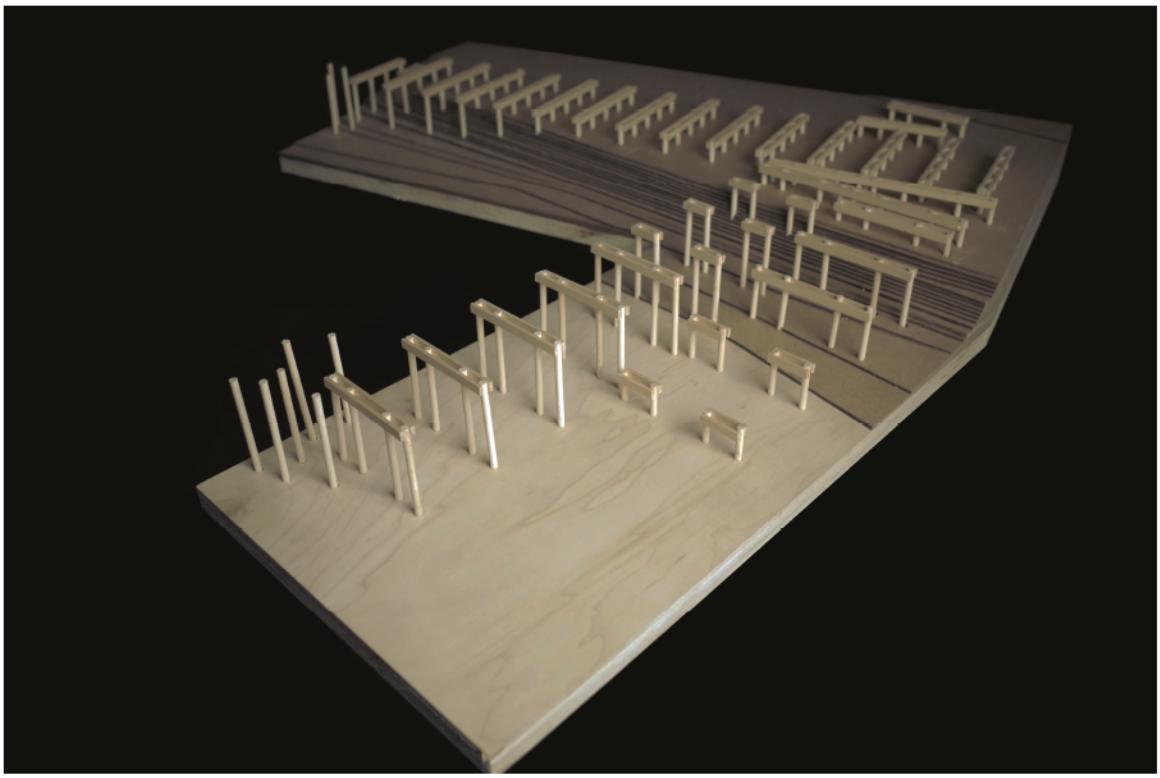


Figure 136: Research center 1:50 model - shoring foundations.

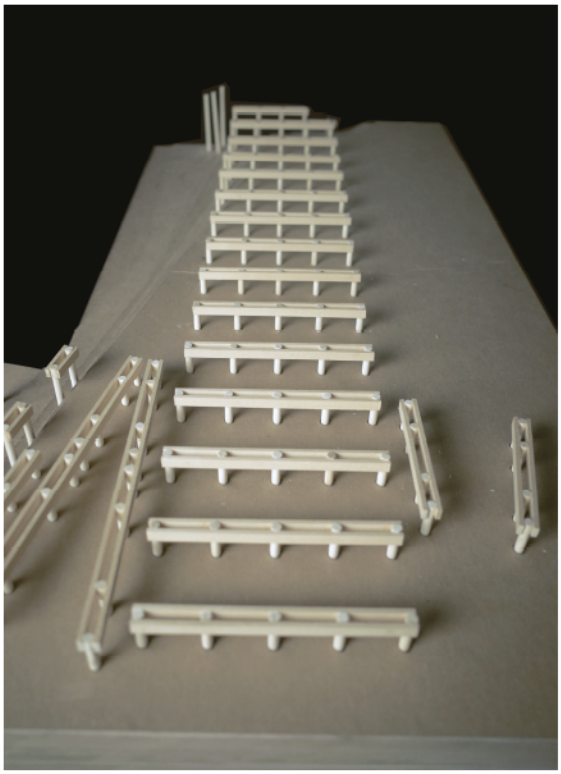


Figure 137: Research center 1:50 model - shoring foundations.

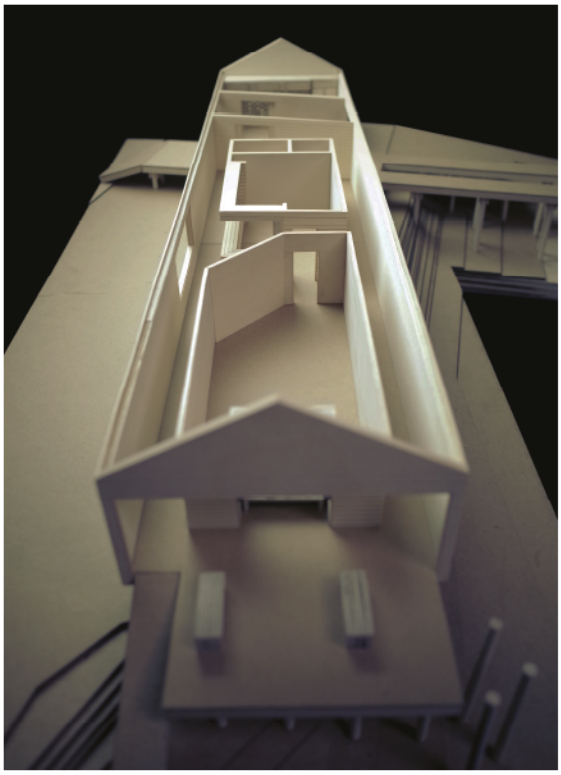


Figure 138: Research center 1:50 model - interior layout.

Figure 139: Research center 1:50 model - interior.

Figure 140: Research center 1:50 model - rear entry.

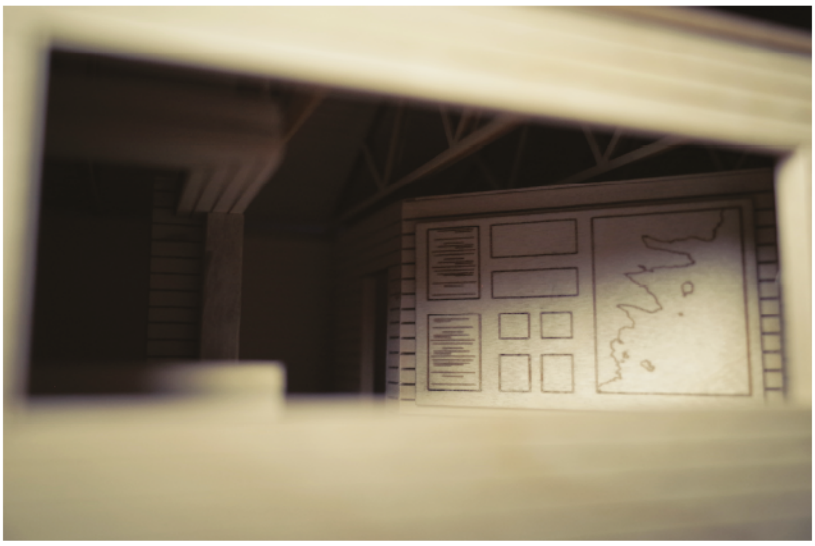


Figure 141 - 142: Research center 1:50 model - interior - lab / info wall / hallway.

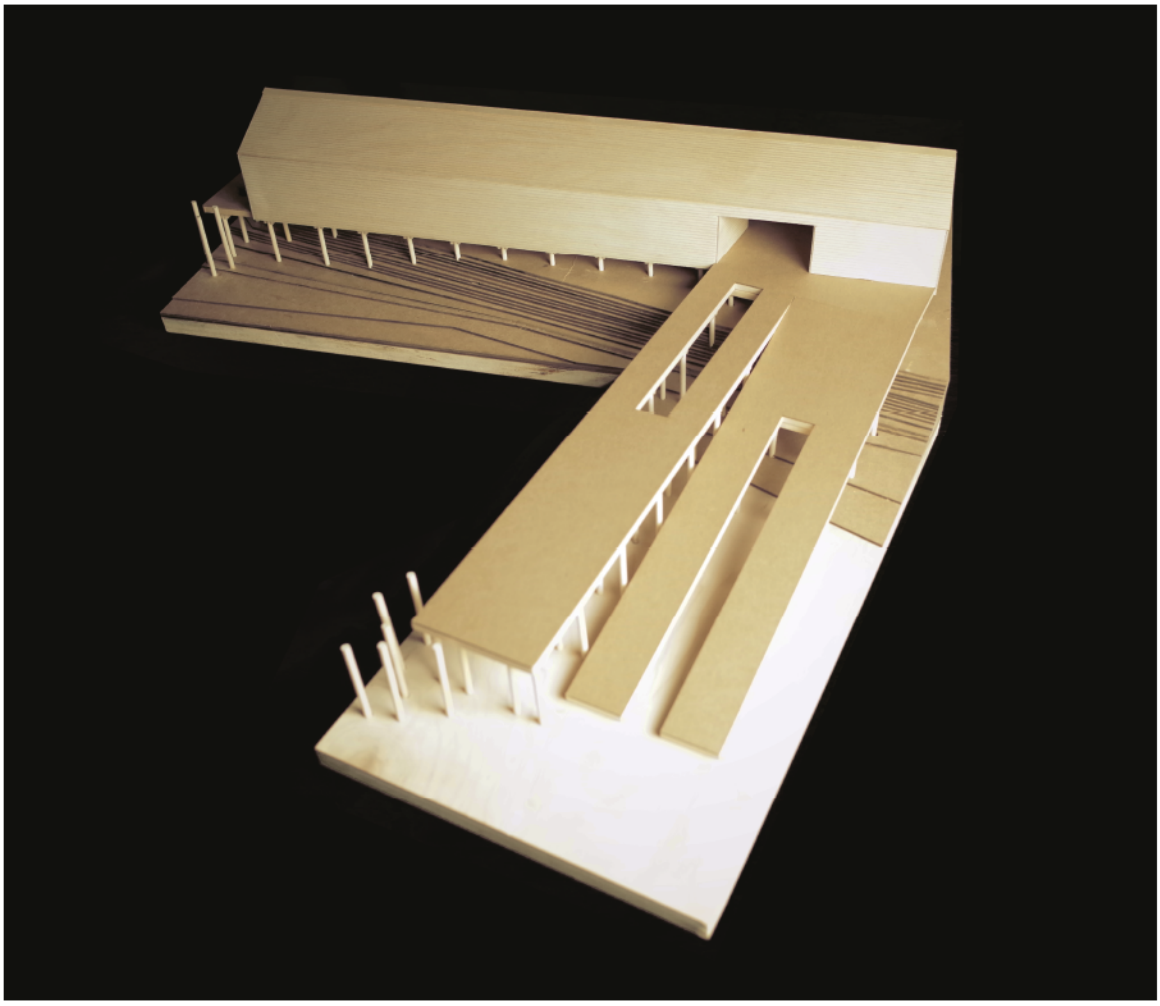


Figure 143: Research center 1:50 model - top view.

BIBLIOGRAPHY

Alaska Science Center. *Tufted Puffin and Egg in Nest*. Last modified December 03, 2014. http://alaska.usgs.gov/science/biology/seabirds_foragefish/photogallery/Picture_of_Month/pom.php?pomid=52.

Alternatives Journal. *Puffin Protectors*. Last modified November 28, 2013. http://www.alternativesjournal.ca/community/blogs/wild-side/puffin-protectors.

Arkitrek Batu Batu Reef Islands. "Batu Batu Resort Long Beach Diving & Nature Activity Centre." Study Centre Comments. Arkitrek. Last modified July 28, 2011. http://arkitrek.com/http:/arkitrek.com/batu-batu-reef-islands-study-centre/.

Audubon Project Puffin. *History of Project Puffin*. Accessed November 8, 2014. http://projectpuffin.audubon.org/history-project-puffin.

Berkes, Fikret. "Rethinking Community-Based Conservation." *Conservation Biology* 18 (2004): 621-630.

Brebbia, C. A.. *Eco-Architecture IV: Harmonisation between Architecture and Nature*. Southampton: WIT, 2013.

Buchanan, Peter. *Ten Shades of Green: Architecture and the Natural World*. New York: Architectural League of New York, 2005.

Buckley, Ralf. *Conservation Tourism*. Wallingford, Oxfordshire, UK: CAB International, 2010.

Department of Energy, Mines and Resources. 001n02 Ferryland, Newfoundland and Labrador. Scale 1:50,000. National Topographic Data Base. 1984.

Department of Environment and Conservation. "Witless Bay Ecological Reserve." Accessed September 13, 2014. http://www.env.gov.nl.ca/env/parks/wer/r_wbe/.

Department of Forestry and Agriculture. *Province of Newfoundland*. 1:12,500. sheet 0225. Ottawa, Ontrario: General Photogrammetic Services,1975.

Dooley, Suzanne (Co-Executive Director for Canadian Parks and Wilderness Society). Telephone interview, October 28, 2014.

Dusty Roads. *Perishing Puffins*. Last modified July 27, 2013. aroundustyroads.com/2013/07/27/perishing-puffins/.

Eko Tracks. "Special Interest Tours." Accessed January 1, 2014. http://www.ekotracks.com/special-interest-tours/.

Eko Tracks. "Wildlife Safaris: Namibia." Accessed November 13, 2014. http://www.ekotracks.com/ws-namibia/.

Facebook. *Witless Bay Puffin Patrol*. Accessed January 23, 2015. https://www.facebook.com/pages/Witless-Bay-Puffin-Patrol/156013017813145.

Factor. "Floating Cities: Is The Ocean Humanity's Next Frontier?." Accessed September 13, 2014. http://www.factor-tech.com/future-cities/6645-floating-cities-is-the-ocean-humanitys-next-frontier/.

Fennell, David A. *Ecotourism an Introduction*. London: Routledge, 1999.

Gallery Hip. *Puffin Bird Flying*. Accessed February 21, 2015. http://galleryhip.com/puffin-bird-flying.html.

Geograph. *Flannan Isles: Puffin Burrows*. Accessed January 28, 2015. http://www.geograph.org.uk/photo/3088294.

Google Maps. "Map of Newfoundland." 2014. http://maps.google.ca.

Google Maps. "Map of Witless Bay." 2014. http://maps.google.ca.

Google Maps. "Map of Witless Bay Ecological Reserve." 2014. http://maps.google.ca.

Graham, Jeri (Manager, Natural Areas Program). Telephone interview, September 17, 2014.

Hansen, Frid Kvalpskarmo. *Tourists Cause Seabirds to Abandon Nests*. Accessed November 6, 2014. http://sciencenordic.com/tourists-cause-seabirds-abandon-nests.

Harris, M. P. *The Puffin*. Calton, Staffordshire: T. and A.D. Poyser, 1984.

Inhabitat. "Rotterdam's Solar-Powered Floating Pavilion is an Experimental Climate-Proof Development." Accessed September 13, 2014. http://inhabitat.com/rotterdams-floating-pavilion-is-an-experimental-climate-proof-development/.

LaGro, James A. *Site Analysis: Linking Program and Concept in Land Planning and Design*. New York: John Wiley, 2001.

Mailhiot, Joshua (Environmental Assessment Coordinator, Canadian Wildlife Service, Environmental Stewardship Branch). Email interview, September 26, 2014.

Mark Barfield Architects. *Kew Treetop Walkway*. Accessed October 10, 2014. http://www.marksbarfield.com/#/projects/kew-treetop-walkway/?filter=alphabetical.

McNeely, Jeffrey A. *Culture and Conservation: The Human Dimension in Environmental Planning*. London: Croom Helm, 1985.

Mellin, Robert. *Tilting: House Launching, Slide Hauling, Potato Trenching, and Other Tales from a Newfoundland Fishing Village*. New York: Princeton Architectural Press, 2003.

Montevecchi, William A., and Leslie M. Tuck. *Newfoundland Birds: Exploitation, Study, Conservation*. Cambridge, Mass.: Nuttall Ornithological Club, 1987.

Natural Resources Canada. 001n07 Bay Bulls, Newfoundland and Labrador. Scale 1:50,000. CanMatrix. April 7, 2010.

Olthuis, Koen, and David Keuning. *Float!: Building on Water to Combat Urban Congestion and Climate Change*. Amsterdam: Frame, 2010.

Parks and Natural Areas Division. "Witless Bay Ecological Reserve Management Plan." Accessed September 13, 2014. http://www.env.gov.nl.ca/env/publications/parks/witless_bay_ecological_reserve.pdf.

Project Puffin. "Puffin FAQs." Accessed September 13, 2014. http://projectpuffin.audubon.org/puffin-faqs.

Punta Tombo. *Penguins Visitor Center*. Accessed October 25, 2014. http://www.puntatombo.com/en/.

Ronconi, Dr. Robert. (Killam Post-doctoral Fellow and NSERC Post-doctoral Fellow, Dalhousie University). Interview. January 26, 2015.

Serrats, Marta. *Eco-architecture: 1000 Ideas by 100 Architects*. Barcelona: Promopress, 2012.

Snøhetta. *Norwegian Wild Reindeer Pavilion*. Accessed October 10, 2014. http://snohetta.com/project/2-tverrfjellhytta-norwegian-wild-reindeer-pavilion.

Steele, James. *Ecological Architecture: A Critical History*. London: Thames & Hudson, 2005.

Studio Gang Architects. *Ford Calumet Environmental Center*. Accessed October 10, 2014. http://studiogang.net/work/2003/fordcalumetenvironmentalcenter.

The Telegram. *Protecting Puffins for Posterity*. Last modified August 30, 2011, http://www.thetelegram.com/News/Local/2011-08-30/article-2732980/Protecting-puffins-for-posterity/1.

Thurston, Harry, and Wayne Barrett. *The Atlantic Coast: A Natural History*. Vancouver: Greystone Books: 2012.

Town of Witless Bay. "Witless Bay Seabird Ecological Reserve." Accessed September 13, 2014. http://www.townofwitlessbay.com/ecologicalreserve.htm.

Walpole, Matthew J., and Nigel Leader-Williams. "Tourism and Flagship Species in Conservation." *Biodiversity and Conservation* 11 (2002): 534-537.

Weiss, Marion, and Michael A. Manfredi. *Site Specific: The Work of Weiss/Manfredi Architects*. New York: Princeton Architectural, 2000.

Widescreen Arkive. *Puffin (Fratercula Arctica)*. Accessed February 25, 2015. http://www.arkive.org/puffin/fratercula-arctica/image-A22280.html.

Wikipedia. *Atlantic Puffin*. Last modified February 7, 2015. http://en.wikipedia.org/wiki/Atlantic_puffin.

Wikipedia. *Faroese Puffin*. Last modified August 26, 2014. http://en.wikipedia.org/wiki/Faroese_puffin.

The Wildlife Trusts. *Architecture Oscars triumph for Brockholes*. Last modified June 25, 2012. http://www.wildlifetrusts.org/news/2012/06/25/architecture-oscars-triumph-brockholes.

Wylson, Anthony. *Aquatecture: Architecture and Water*. London: Architectural Press, 1986.

YouTube. "TEDxVilnius - Koen Olthuis - Top 10 trends Towards Floating Cities." Accessed September 21, 2014. https://www.youtube.com/watch?list=UUbVAtHlGyVNn8FSdVloqTJg&feature=player_embedded&v=0IkfWjHHEHM.