

**Weaving Access:**  
Ecological Architecture for Refuge  
along the Welland Canal

by

Jacob Arthur Smith

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Architecture (M.Arch)

The Office of Graduate Studies  
Laurentian University  
Sudbury, Ontario, Canada

© Jacob Smith, 2023



**THESIS DEFENCE COMMITTEE/COMITÉ DE SOUTENANCE DE THÈSE**  
**Laurentian University/Université Laurentienne**  
Office of Graduate Studies/Bureau des études supérieures

Title of Thesis Titre de la thèse	Weaving Access: Ecological Architecture for Refuge along the Welland Canal		
Name of Candidate Nom du candidat	Smith, Jacob		
Degree Diplôme	Master of Architecture (M.Arch)		
Department/Program Département/Programme	Architecture	Date of Defence Date de la soutenance	April 12, 2023

**APPROVED/APPROUVÉ**

Thesis Examiners/Examineurs de thèse:

Kai Wood Mah  
(Thesis Advisor / Directeur(trice) de thèse)

Lara Rivera  
(Thesis Second Reader / Deuxième lecteur(trice) de thèse)

Richard de la Riva  
(External Examiner / Examineur(trice) externe)

Approved for the Office of Graduate Studies  
Approuvé pour le Bureau des études supérieures  
Tammy Eger, PhD  
Vice-President, Research (Office of Graduate Studies)  
Vice-rectrice à la recherche (Bureau des études supérieures)

**ACCESSIBILITY CLAUSE AND PERMISSION TO USE**

I, **Jacob Smith**, hereby grant to Laurentian University and/or its agents the non-exclusive license to archive and make accessible my thesis, dissertation, or project report in whole or in part in all forms of media, now or for the duration of my copyright ownership. I retain all other ownership rights to the copyright of the thesis, dissertation or project report. I also reserve the right to use in future works (such as articles or books) all or part of this thesis, dissertation, or project report. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purposes may be granted by the professor or professors who supervised my thesis work or, in their absence, by the Head of the Department in which my thesis work was done. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that this copy is being made available in this form by the authority of the copyright owner solely for the purpose of private study and research and may not be copied or reproduced except as permitted by the copyright laws without written authority from the copyright owner.



# Weaving Access:

Ecological Architecture  
for **Refuge**  
Along the **Welland Canal**

To engage everyone, human and non-human, and provide refuge, is an act of kindness. If the world we chose to create will be accessible to everyone, we must design it this way. Sensually, and socially, architecture can act as the tool we use as a community to create a landscape that engages us, while still connecting us to our biographical and geographical history. All within our control, some things, such as the industrial revolution, have forced communities including the indigenous, to move and develop around these infrastructures. Although economical, some infrastructures out of our control were a result of compromises, such as the Welland Canal and the Niagara Escarpment.

## Abstract

### Keywords

a c c e s s

b i o d i v e r s i t y

e c o l o g y

r e c r e a t i o n

r e f u g e

h e a l i n g

Which begs the question, how can we provide refuge for the people who built our communities, the specially-abled, and the wildlife we depend on? Perhaps by reclaiming a site that has close ties to this industrial prominence from colonization, and making it our own again. Resembling a community space for healing, and recreation, activities we already informally participate in, and providing a sense of place to the site. In this case, the Welland Canal, and the site adjacent to the West of Lock 4.

..... a means of **approaching** or **entering** a space

..... the variety of life in the world or in particular **habitat** or **ecosystem**

..... the branch of biology that deals with the relations of **organisms to one another** and to their physical surroundings

..... **activity** done for **enjoyment** when one is not working

..... a condition of being **safe** or **sheltered** from pursuit, danger, or trouble

..... the **process** of making or **becoming** sound or **healthy** again.

Oxford Languages, 2023

**T**o my mom, for having the strength to carry me for 9 months, raising me to have good manners, and always making sure I remember to bring my coat when I leave the house, without having to remember to always wear my heart on my sleeve. My Dad, for always being there to talk, teaching me to be the man I am today, having the courage and willpower to persevere through tough times, raising me with good taste in music I can't live without, and teaching me how to enjoy the outdoors from camping to long road trips.

To my brother Ben, for encouraging me to follow my dreams, and making me feel like I'm one of a kind when it comes to my talent. Always being there to tell my deepest secrets, and being the best big brother a kid could ask for. To my sister Ashley, for inspiring me to be where I am today, full of life and pursuing a career that could help someone like you someday, to believe anything is possible, and that I can change the world. I think about you all the time, and hope we see each other in heaven someday.

## **Acknowledgements**



To my best friend Cullan and your family for always being there when I got home from Sudbury to hang out with and have deep conversations, play old video games, and relic in the good times.

To my Grandma, Auntie Erika and Uncle Dan, and Rob and Anne, for always believing in me. To my Aunt Christy and Uncle Thom, for always looking after me when I felt alone up north, giving me a place to reset my mind, and providing me with some of the best meals I've ever had. Your artwork and work ethic has taught me to never give up.

I would also like to thank my thesis advisor and friend, Kai Wood Mah, for the best guidance a student like me could ask for, your attitude and drive towards the profession of architecture continue to inspire me. To my second reader, Lara Rivera, for helping me be confident about my work, and understand the depth of the landscape we design for.

Jake Smith  
Sudbury, March 2023



# Contents

Introduction

1

## Greater Site

- i. Land Acknowledgment
- ii. Photography
- iii. St Lawrence Seaway

---

## HISTORY

2

- i. Origin
- ii. Place & Identity
- iii. Phases Over Time
- iv. Construction
- v. Design Research Question

---

## ECOLOGY

3

- i. Geology
- ii. Biology
- iii. Water
- iv. The Human User

---

## SITE

4

- i. The Welland Canal & Urban Context
- ii. Site Investigation
- iii. Creation Led Research
- iv. Case Studies & Program

---

## STRATEGIES

5

- i. Research Led Creation
- ii. Artifact - Handmade Object
- iii. Year 1 M.Arch Final

---

Conclusion

Bibliography

# List of Figures

**Figure 1:** Photo by Author.

**Figure 2:** Photos by Authors Family.

**Figure 3:** Photos by Author.

**Figure 4:** Photo by Author.

**Figure 5:** Photos by Author.

**Figure 6:** Photo by Author.

**Figure 7:** Map drawn by Jacob Smith, based on “Key features of the GLSLS system.” The St. Lawrence Seaway Management Corporation, the Saint Lawrence Seaway Development Corporation. P. 30. Fall 2007, accessed October 22, 2022. <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>.

**Figure 8:** Photo by Author.

**Figure 9:** “Schematic of the profile of the GLSLS in steps from Lake Superior to the Atlantic Ocean.” The St. Lawrence Seaway Management Corporation, the Saint Lawrence Seaway Development Corporation. P. 31. Fall 2007, accessed October 22, 2022. <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>.

**Figure 10:** Port Dalhousie Oblique Aerial photographs. 1920. Accessed October 15, 2023. <https://dr.library.brocku.ca/handle/10464/13446>

**Figure 11:** Ibid.

**Figure 12:** Great Canadian Art & Artists, J.D. Kelly 1862-1958 - 11. “Great Canadian Heritage Treasure.” Accessed December 1, 2022. [https://thecanadasite.com/art/art2c\\_kelly11\\_create2.html](https://thecanadasite.com/art/art2c_kelly11_create2.html)

**Figure 13:** Information Services, The St. Lawrence Seaway Management Corporation. March 2003. p.1-12. Accessed November 30, 2022. <https://great-lakes-seaway.com>

**Figure 14:** Archives & Special Collections, Brock University Library - [archives@brocku.ca](mailto:archives@brocku.ca). Accessed April 26, 2023. <https://exhibits.library.brocku.ca/s/st-catharines-standard-niagara-falls-review-photograph-collection/media/14168>

**Figure 15:** “Park at Port Dalhousie Beach.” June 1930. Brock Archives. Accessed December 1, 2022. <https://dr.library.brocku.ca/discover?scope=%2F&query=port+dalhousie+1920&submit=&rpp=10&view=list>

**Figure 16:** Looking at Lake Ontario in Port Dalhousie,” July 1920. Brock Archives. Accessed December 1, 2022. <https://dr.library.brocku.ca/discover?scope=%2F&query=port+dalhousie+1920&submit=&rpp=10&view=list>

**Figure 17:** Rough logs – Douglas Fir for Unwatering Gate Timbers, n.d. . Welland Canal Lantern Slide Collection, 1914-1931, n.d. (non-inclusive) RG 583. Accessed March 20, 2023. <http://hdl.handle.net/10464/12548>

**Figure 18:** Welland Ship Canal - Timber Unwatering Gate Lock No 1, East Leaf, partially open position 10102. Welland Canal Lantern Slide Collection, 1914-1931, n.d. (non-inclusive) RG 583. March 20, 2023. <http://hdl.handle.net/10464/12563>

**Figure 19:** Historic map showing the First and Second Welland Canal from Lake Erie to Lake Ontario at Port Dalhousie along with proposed changes to the course. Accessed December 1, 2022. <https://dr.library.brocku.ca/handle/10464/10789>

**Figure 20:** “Oblique aerial photographs showing north view of downtown St. Catharines, the 2nd Welland Canal valley, including the Glenridge Bridge.” Brock University Archives. Accessed May 1, 2023. <https://dr.library.brocku.ca/handle/10464/13435>

**Figure 21:** “Welland Canal” brochure. Tourism St. Catharines, Accessed November 5, 2022. [www.tourismstcatharines.ca](http://www.tourismstcatharines.ca)

**Figure 22:** Historical map showing the Second and Third Welland Canal with their locks, sections, tunnel and bridge. Includes lot and concession numbers, township boundaries, railways, major roads. Scale [ca. 1:30,480] Map date: 1916. Digital reproduction of map (70 x 264 cm.) in the Brock University Map, Data & GIS Library collection. Georeferenced and modified from Brock call# G 3462 W45 1916 B75 by Map, Data and GIS Library, Brock University. Accessed, November 13, 2022. <http://hdl.handle.net/10464/10795>

**Figure 23:** Historical map showing street, transportation, cultural and recreational features, street numbering, ground cover, points of interest, indexes, legend. Scale [ca. 1:12,000] Map date: 1964. Digital reproduction of map (95 x 55 cm.) in the Brock University Map, Data & GIS Library collection. Georeferenced and modified from Brock call# G 3464 S35 1964 P3 by Map, Data and GIS Library, Brock University. Accessed November 13, 2022. <http://hdl.handle.net/10464/10799>

**Figure 24:** A photograph of the construction of the railway bridge in Port Colborne, Ontario over the Welland Ship Canal. Brock University Archives. Accessed March 19, 2023. <http://hdl.handle.net/10464/17047>

**Figure 25:** “New Welland Ship Canal Built for Deep-Draft Vessels” - Engineering News-Record, September 4, 1930. Accessed March 5, 2023. <https://historicbridges.org/truss/glendale/welland.pdf>

**Figure 26:** Photo by Author.

**Figure 27:** Photo by Author.

**Figure 28:** Welland Ship Canal - Site Twin Locks No 4, looking South, from CNR Maintenance crossing Bridge 6.3B28. Welland Canal Lantern Slide Collection, 1914-1931, n.d. (non-inclusive) RG 583. Accessed March 20, 2023. <http://hdl.handle.net/10464/12562>

**Figure 29:** “Aerial view of the Welland Canal”. Theis Bogner, photographer. The St. Lawrence Seaway Management Corporation, the Saint Lawrence Seaway Development Corporation. P. 35. Fall 2007, accessed October 22, 2022. <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>.

**Figure 30:** “Closer view of the locks 4, 5 and 6 at Thorold (Welland Canal). Theis Bogner, photographer. The St. Lawrence Seaway Management Corporation, the Saint Lawrence Seaway Development Corporation. P. 35. Fall 2007, accessed October 22, 2022. <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>.

**Figure 31:** Photo by Author.

**Figure 32:** Photo by Author.

**Figure 33:** Photo by Author. Welland Canal Museum Exhibit.

**Figure 34:** Photo by Author. Fallen Workers Memorial at Lock 3, Welland Canal Museum.

**Figure 35:** Ibid.

**Figure 36:** Niagara Escarpment Commission. Interactive Map. Accessed March 10, 2023. <https://escarpment.org/planning/interactivemap/>

**Figure 37:** Department of Geology - Buffalo, Accessed December 7, 2022. <http://www.glyfac.buffalo.edu/Faculty/jorgm/WebJorg07/gly103trip.htm>

**Figure 38:** Trees and Shrubs - Native Species. Accessed December 2020. Ontario Trees and Shrubs - List of Native Species. [ontariotrees.com](http://ontariotrees.com)

**Figure 39:** Photo by Author.

**Figure 40:** Photo by Author.

**Figure 41:** “Northern Dusky Salamander,” Ontario Nature, Programs, Community Science. Accessed December 1, 2020. <https://ontarionature.org/programs/community-science/reptile-amphibian-atlas/northern-dusky-salamander/>

**Figure 42:** Photo by Author.

**Figure 43:** Douglas A. Wilcox, Todd A. Thompson, Robert K. Booth, and J.R. Nicholas - USGS Document, Circular 1311, Lake-Level Variability and Water Availability in the Great Lakes

**Figure 44:** Photo by Author.

**Figure 45:** Athens, Emily. “Nature’s Water Purifiers Help Clean up Lakes.” BBC Future. BBC, September 25, 2012. Accessed Nov. 20, 2022. <https://www.bbc.com/future/article/20120925-natures-water-purifiers>.

**Figure 46:** GH3 - Borden Park Natural Swimming Pool. Accessed November 20, 2022. [gh3.ca/work/natural-swimming-pool-02](http://gh3.ca/work/natural-swimming-pool-02)

**Figure 47:** Seine-Nord Europe Projectm The Seine-Nord Europe Canal. Accessed December 1, 2022. <https://www.canal-seine-nord-europe.fr/en/>

**Figure 48:** “Niagara Priority Profiles - Disabilities - Niagara Region.” Accessed October 19, 2022. <https://www.niagararegion.ca/health/equity/pdf/priority-profile-disabilities.pdf>

**Figure 49:** Ibid.

**Figure 50:** “Lavender Farms in Ontario for a Day Trip,” - To Do Canada, June 14, 2022, Accessed October 22, 2022, <https://www.todocanada.ca/lavender-farms-ontario-day-trip/>

**Figure 51:** “Yellow Cedar and Pink Salt - So Fresh,” - Circle Wellness Spas via Instagram, Accessed October 19, 2022. <https://www.instagram.com/p/CP3ixO-s5q1/?hl=en>

**Figure 52:** “There’s a hidden thermal spa tucked away in the heart of industrial Vancouver, and it’s absolute heaven,” accessed October 13, 2022, <https://www.instagram.com/reel/Ci8U4y8gx-3U/?hl=en>

**Figure 53:** Illustration drawn by Jacob Smith, based on Figure 2.6, “Profile of the Welland Canal,” The St. Lawrence Seaway Management Corporation, the Saint Lawrence Seaway Development Corporation. P. 24. Fall 2007, accessed October 22, 2022. <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>.

**Figure 54:** Illustration by Jacob Smith. Based on maps from ARCGIS. Accessed November 15, 2022. <https://learnis2.maps.arcgis.com/apps/mapviewer/index.html>

**Figure 55:** Satellite View of Niagara Region. Google Earth. Accessed January 20, 2023.

**Figure 56:** Illustration by Author.

**Figure 57:** Ibid.

**Figure 58:** “Ontario Topographic Map,” Topographic-Map. Accessed April 14, 2023. <https://en-ca.topographic-map.com/map-zvx9m/Ontario/?center=43.13555%2C-79.19049&zoom=14>

**Figure 59:** Illustration by Author.

**Figure 60:** Ibid.

**Figures 61:** Strava - Segment Explore. Via; Natural Earth Data, Mapbox, Open Street Map. Accessed April 20, 2023. <https://www.strava.com/location/Sudbury%20Ontario%20/type/Ride/min/0/max/5/center/43.1407,-79.1943/zoom/16>

**Figure 62:** Ibid.

**Figure 63:** Ibid.

**Figure 64 - 74:** Photos by Author.

**Figure 75:** “Bell Park 1975 - Sudbury, Ontario”

Pinterest. Accessed March 12, 2023. <https://www.pinterest.ca/pin/340444053061452116/>

**Figure 76:** Niagara Navigator. Accessed March 15, 2023. <https://navigator.niagararegion.ca/portal/apps/webappviewer/index.html?id=4500745f3cd141ddb707913a444e7886>

**Figure 77:** “Bell Park Walkway (TGT - Jim Gordon Walkway).” Rainbow Routes Association. Accessed March 12, 2023. <https://www.rainbowroutes.com/bell-park-pathway-tgt>

**Figure 78:** Ibid.

**Figure 79:** “The Therme Vals / Peter Zumthor” 11 Feb 2009. ArchDaily. Accessed 7 Mar 2023. <https://www.archdaily.com/13358/the-therme-vals>

**Figure 80:** Ibid.

**Figure 81:** “History of The McMichael” - McMichael Canadian Art Collection - Our History, 2021. Accessed March 5, 2023. <https://mcmichael.com/about/history/>

**Figure 82:** “Outdoors: Grounds & Art” - McMichael Canadian Art Collection - 2021. Accessed March 5, 2023. <https://mcmichael.com/collection/outdoor-art/#>

**Figure 83:** Illustration by Author.

**Figure 84:** Illustration by Author.

**Figure 85:** Photos by Author.

**Figure 86:** Ibid.

**Figure 87 - 108:** Illustrations by Author.



**T**his project is dedicated to my sister Ashley, born and raised in Port Dalhousie, a town in St. Catharines and historically the entrance of the first Welland Canal from Lake Ontario, my brother, sister, and I although stricken with what may seem like a burden, with Ashley having a rare diagnosis called Cerebral Palsy, in turn, led us to discover the privileges our family had in terms of access to moments of refuge in our town and surrounding place, and ultimately my own personal journey of discovering how architecture and water have shaped not only family's like ours but also the origin of the place the majority of people in the Niagara Region call home.

... An amazing little girl who blessed us for 17years, Ashley and children who are born like her are brought into this world and into our lives to set an example. She knew no sin, no selfishness, no pride, no fear, no anger, no frustration, she was love, all about love. She would like to remind us all that life passes way too quick and that everyday should be an opportunity to show the world some love. Let's all be a little more kind to those who are difficult to love and never take for granted those who are easy to love.

## **Preface**





“Our little angel”  
**Ashley Hannah Smith**

1995 - 2013



*Ashley was diagnosed with cerebral palsy very early, in fact, the day she was born, a nurse noticed something that might indicate an issue and the hospital performed a brain scan. Without going into all the details, it was determined that Ashley would have developmental delays and only time would tell the extent of her abilities.*

*- Blake Smith*

Growing up, we would walk my sister Ashley along the path to the piers along Lakeside park in Port Dalhousie, and take the various paths that lead to different sidewalks from our house and the beach. There weren't many places we could take Ashley because we required wheelchair access, but this park was one of those accessible places, which made it even more special to my family and I'm sure the community in general. It makes me wish there were more places to take her nearby. She loved being outside, as a family we will always remember how happy it made her to just sit outside under the large trees in the wind next to the Lake. That being said, this brings the scope of the project to understand how proximity to water has shaped the greater site in relation to the town we grew up. In recent years, discovering my passion for these special places around town, and falling in love with photography, cemented the vivid landscape that shaped my family and communities life over the years.

Where the Welland Canal reaches the Escarpment, bypassing Niagara Falls, a multitude of corridors containing ships, trains, vehicles, and pedestrians all meet, which provides an opportunity to weave these paths and create an environment that provides **access** for inclusivity and community gathering. The Canal, a human-made corridor between two of the Great Lakes, Erie and Ontario, breaches once-connected ecosystems, creating unexpected consequences and introducing slowly evolving changes that have had a drastic impact on the culture and biological balance of this area. The bridging caused non-native species of wildlife and vegetation to infect the waterways and surrounding land and forced local communities to adapt to this new norm. Families in the Region, including mine, have been navigating around bodies of water for hundreds of years. This begs the question,

## Introduction

*how can a place known for its innovation in engineering and allowing for major economic routes, not also set a high standard for **ecology** and community well-being simultaneously?*

Although the Welland Canal is by far the most sustainable option in terms of methods of shipping compared to truck, train, or plane, it is important to understand the ecological impact of the Canal not only on non-human species but also how it has affected our communities culturally. By using the lens of family biography, and understanding the biography of a place, we can get a vision of how each has shaped one another over time.

Informal pathways and **recreational** activities have existed parallel to the Canal for nearly a century, so why not create a place that promotes the existing identity of the silent majority, while **healing** the land, and those that may use the site and may need healing afterwards? Building upon the existing use and creating functional programs that compliment the site, will allow for seamless **refuge** of community activity and allow for integration of wildlife.

Rooting the program through a few simple, yet significant gestures such as a cafe for annual mixed use will complement the Southern and fast-paced recreational

portion of the site, where people traditionally toboggan and skateboard. In the middle, a bathhouse with saunas and aromatherapy will connect the Northern and more tucked away a portion of the site with a field house.

Overall, extending the Niagara Escarpment into a site historically used industrially and informally for recreation, can bring people closer to the water and foster the biodiversity of the land. By intervening with an approach of landscape healing developed in coordination with bodily healing, we can address the historical impact of industrial land use along the Welland Canal.



1  
2  
3  
4  
5

# Greater Site

HISTORY  
ECOLOGY  
STRATEGIES

**B**eginning with a land acknowledgement, it is important to identify that the land the Welland Canal sits on was never paid for to the original land owners, the First Nations who lived here before European and American Colonization. Next is the global scale of Canada, the size of the Great Lakes, the connection to the St Lawrence River, and the Atlantic Ocean, and the proximity to Sudbury Ontario, ranging nearly 500km away from the local site.

Port Dalhousie, although what used to be the original location of lock one of the Welland Canal, was a crucial link along the Great Lakes St. Lawrence Seaway, although phased out over time, this town and many others along the Welland Canal would not have been developed (or colonized) if it weren't for the introduction of water as a corridor from lake to lake for the shipment of goods we rely on as a country today. When zooming in on the scale of the current and fourth phases of the Canal, many of the communities strung together hold links to historical programs, infrastructures, and materiality.

*Between **1829 and 1835, Six Nations' land** was **expropriated** for the construction of the Welland Canal. Compensation for the land taken was not made to the Six Nations, even though compensation was paid to other land owners affected by the construction of canal. The canal lands were assumed by the government of Canada in 1867. The government of Canada undertook a number of valuations of the lands taken but **compensation was never paid.***

*Starting in 1834, and continuing for many years, the Province of Upper Canada invested Six Nations money to support the speculative adventures of the Grand River Navigation Company (GRNC), and granted to the GRNC lands of the Six Nations **without consent** or payment. These investments were for the benefit of private promoters of the GRNC. The GRNC was formed for the stated purpose of constructing dams and carrying out other works in order to make the Grand River more navigable and therefore provide a better public transportation link between the Welland Canal and the City of Brantford. The irony is that Six Nations were opposed to this project and yet the government used Six Nations' trust funds without Six Nations' knowledge or consent to finance and support the project. The GRNC failed and Six Nations' monies and **lands were lost.** The Crown has failed to rectify this breach of trust.*

**- Six Nations Lands & Resources, 2008**



**Niagara Region is situated on treaty land.** *This land has a rich history of First Nations such as the **Hatiwendaronk**, the **Haudenosaunee**, and the **Anishinaabe**, including the **Mississaugas of the Credit First Nation**. There are many First Nations, Métis, and Inuit people from across Turtle Island that live and work in Niagara today.*

- Niagara Priority Profiles - Indigenous, 2021

A place with weeping willow trees, sand, a large green field, an alley with old abandoned bars, little brick-building coffee shops, an Irish bar with old wooden patio benches, and an old candy store that we went to as kids and seemed it was out of a movie, old metal staircases tucked away that lead to hidden roads and park benches, large solid rocks perfect for sitting on and watching the sunset, a dirt road in the marina where people fish for lake salmon and bass, and a marina with a pier about 50 feet longer than the other with not one, but two lighthouses along it.

Why is all of this important? It might seem like I'm rambling, but this is important to my discovery of a greater gesture I intend to make through my thesis, which is not only representing these moments of solitude I experienced growing up, but also an accessible place for people like my sister, and those that didn't have the same privilege as us living near a body of water.

Over the years, travelling with my film camera allowed me to discover the importance of the symbiotic relationship we have with animals, at my aunt's house in Wanup, Ontario, there is a close connection to nature, where the whole house is made of timber, a natural material, and has a wood burning furnace. The main window of the house overlooks a couple of upturned wooden crates used to feed birds and squirrels and a wetland pond in the distance, giving the person inside the



The east Pier with original North lighthouse,  
over one hundred years old



Neil Peart (of famous rockband RUSH) pavilion in  
Lakeside Park  
**Port Dalhousie, Ontario**

In recent years, I started taking my hobby of photography seriously and began practising shooting film, and while doing this, I would ride my bike about 15 blocks or so towards the “downtown” of Port Dalhousie if you will, the most well know part of St. Catharines, since our house is on the outskirts of the town, but parallel to the Lake, it is always a very calming journey to travel. These bike rides with my camera led me to discover some of the reasons Port is such a special place to me, my parents, and the tourists who visit here.



Sunset at the bonfire spot  
**Port Dalhousie, Ontario**



**Figure 4**

dining room a direct connection to nature. Sudbury was the first place I ever shot film, and the place I found myself travelling on foot the most was the alleyways. Mostly downtown, cold, and completely made of concrete, although I felt a sense of calm, due to the lack of vehicular traffic and sound barrier. It wasn't until I moved to one of the older neighbourhoods that I discovered the same system of alleyways, just with a lot less graffiti, and dark areas, but with more overgrown areas, leading to detached garages that look like a village of little houses.

Night photography is also something that reveals the pedestrian-friendly nature of buildings, using the McEwen School of Architecture we can see that the site becomes illuminated at night for safely navigating around or identifying from a distance. This idea speaks to the difference between public and private spaces, another theme this thesis is going to incorporate, however, these occurrences are not only clearly visible at night. A place such as my family's living room, a pet-friendly place which helps calm the anxieties of specially-abled individuals such as my sister, can be transformed depending on the type of service engaged in that space. When a personal support worker was present, the space felt as if it was a common ground between private and public.



Warm Alleyways,  
Return to Nature  
**Sudbury, Ontario**



The Night Feeling,  
Warmth Inside and Out  
**McEwen Architecture,**  
**Sudbury, Ontario**

Most of the places within the town are hidden in plain sight, but can really only be seen if you take your time or are on foot, or bike, basically from a pedestrian point of view. As I got older, and even while beginning to write this thesis, I began to not only understand why I chose the field of architecture as a profession but also how I look for these moments of solitude everywhere I travel now and certainly have found places that remind me of home in Sudbury, whether it be an old overgrown alleyway or the warm library at the school of architecture, all of which moments I discovered through my exploration with photography.



Wildlife Nurturing, Symbiosis  
- **Wanup, Ontario**





**Figure 6**

Systematic enhancements designed to move ships easily across a vast expanse of territory in which water falls more than 180 m (600 ft) as it flows from Lake Superior to the Atlantic Ocean.<sup>1</sup> Since most of this change in elevation occurs over rapids or falls, a series of canals and locks have been built to raise and lower vessels across these natural barriers. Main waterways: the five Great Lakes, the St. Marys River, Lake St. Clair, the Detroit River, the St. Lawrence River and the Gulf of St. Lawrence, waterway and port infrastructure: 6 canals, and locks located at 16 different sites, serving 15 major international ports and more than 50 regional ports on both sides of the border.<sup>2</sup>



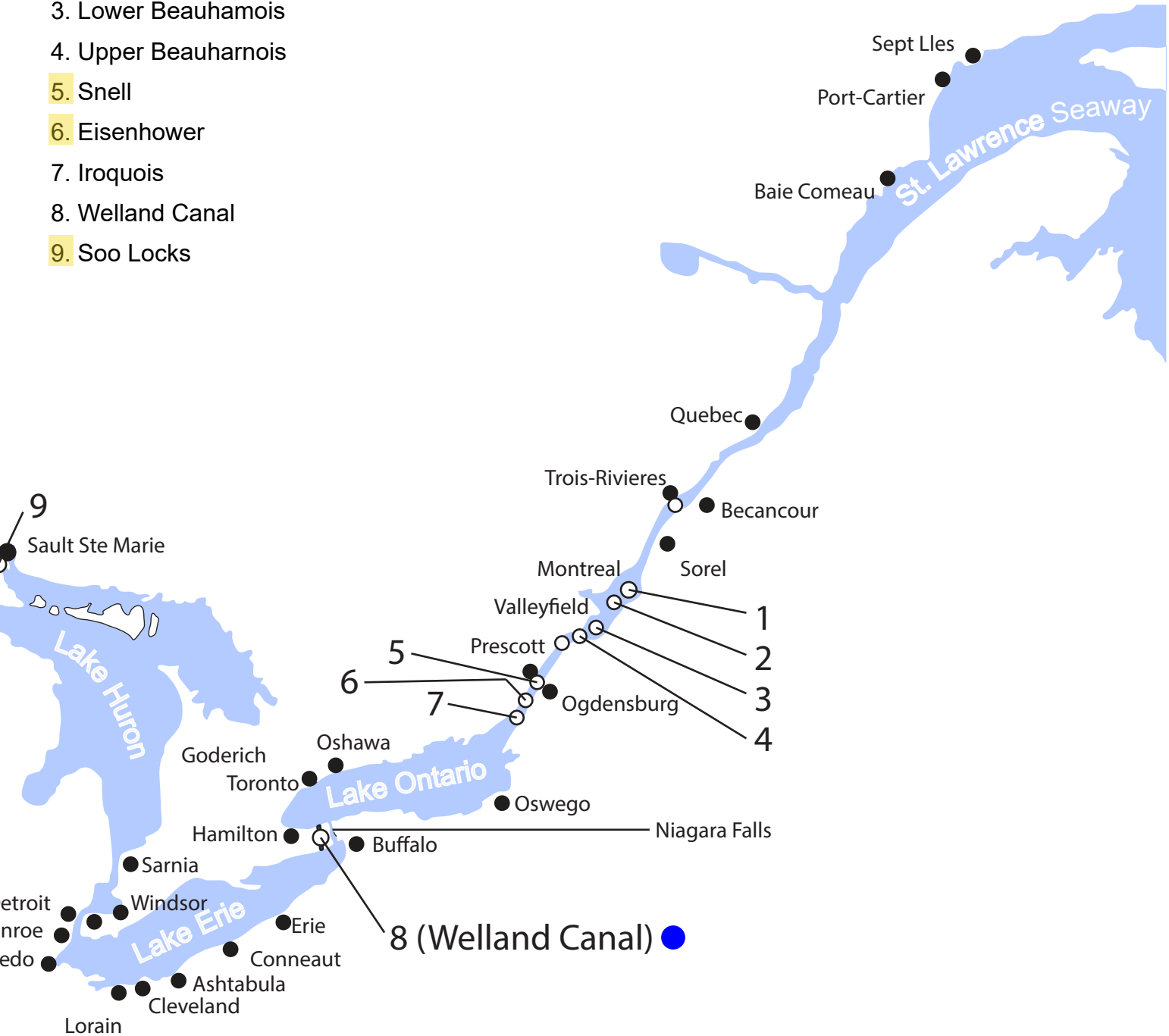
1 "Great Lakes St Lawrence Study - Seaway. dot.gov." ACR Communications Inc., Fall 2007, accessed October 22, 2022 <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>.

2 Ibid.

# Locks

1. St. Lambert
2. Cote Ste. Catherine
3. Lower Beauharnois
4. Upper Beauharnois
5. Snell
6. Eisenhower
7. Iroquois
8. Welland Canal
9. Soo Locks

- Ports
- American Locks

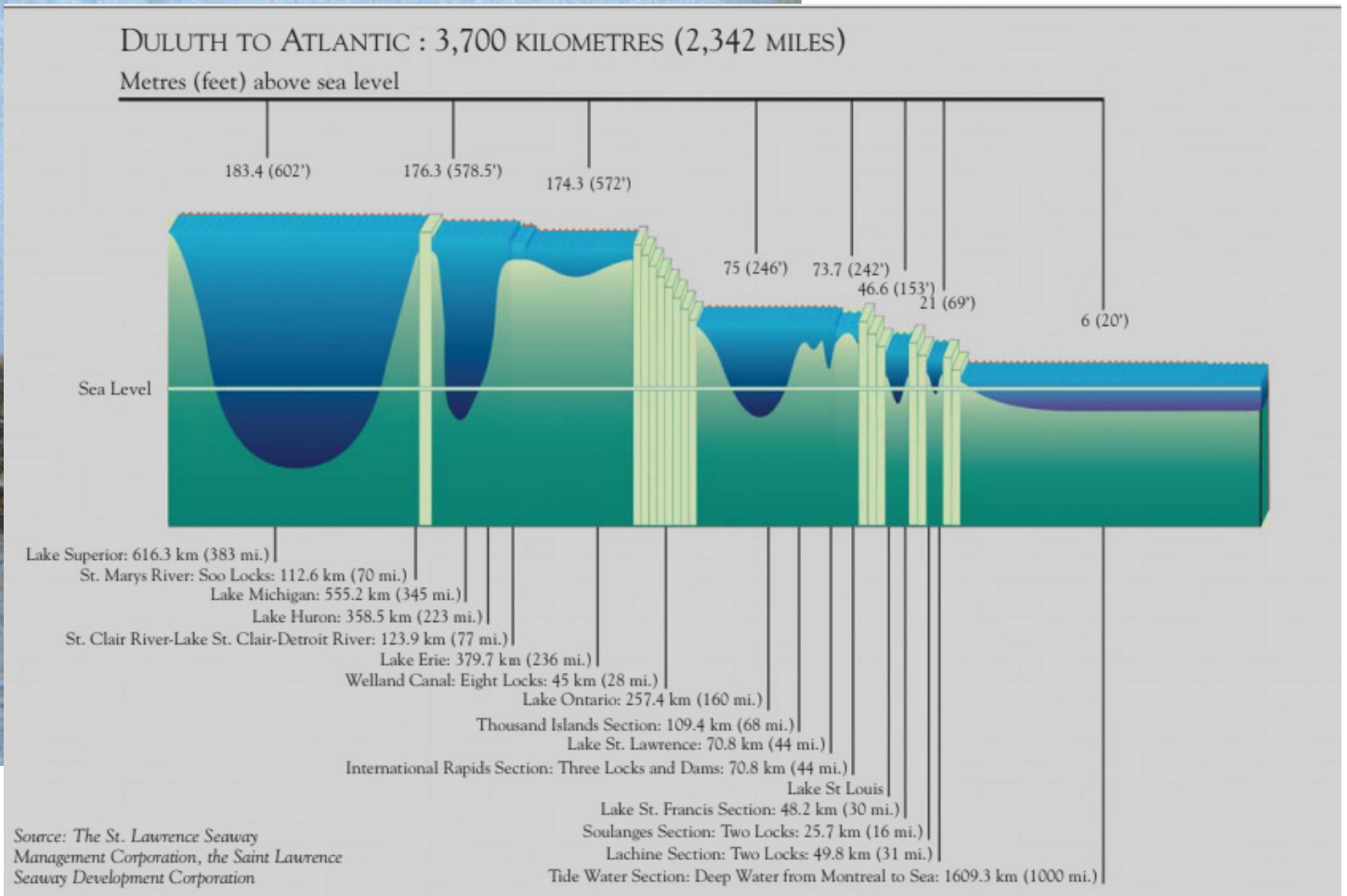
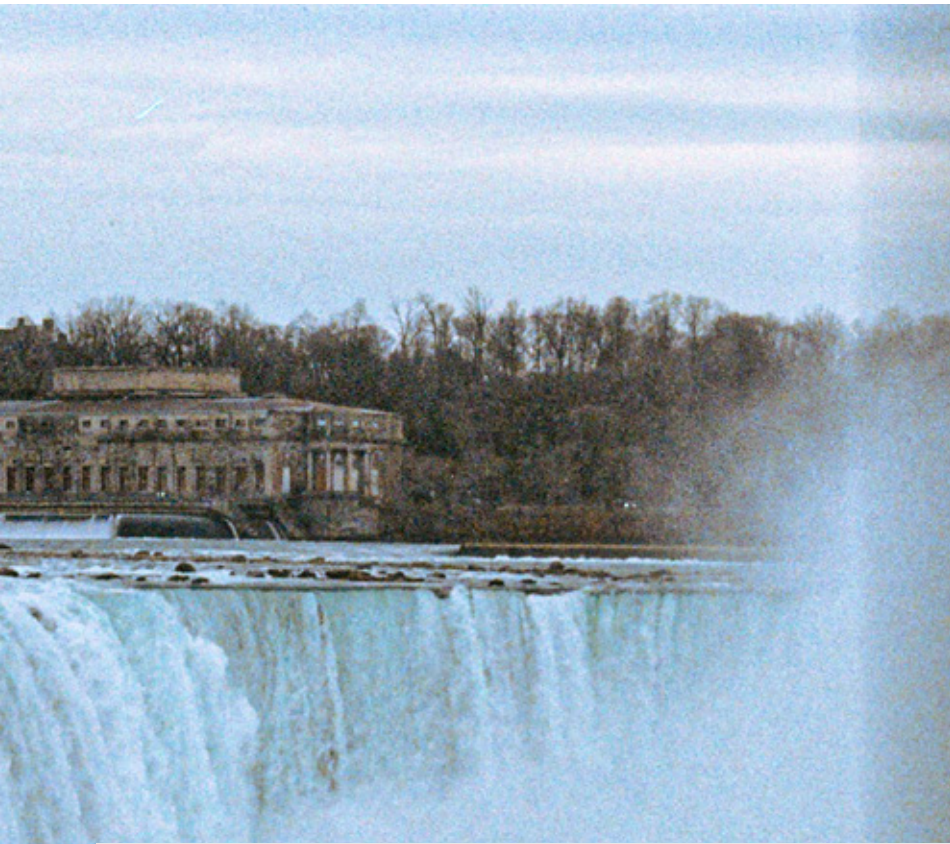


Ecological Architecture for Refuge Along the Welland Canal

**Figure 7:** Key features of the GLSLS system



**Figure 8:** Niagara Falls mid winter in January, 2023



**Figure 9:** Schematic of the profile of the Great Lakes St. Lawrence Seaway System in steps from Lake Superior to the Atlantic Ocean

1

Greater Site

2

# HISTORY

3

ECOCOLOGY

4

STRATEGIES

5

The identity and place of Port Dalhousie, the original location of the first lock of the first Welland Canal, from the 19th Century, and how the place soon became centred around interaction and recreation, created the heritage of the place the whole city cherishes. Community members use the same Lakeside Park for leisure as it is today. Over 3000 vessels travel through the Welland Canal each year via the St Lawrence Seaway and contribute a major percentage of Canada's economic value. There are many ports along the Great Lakes and Seaway System, mainly Canadian, but a few American. A section of each of the Lakes and Lock Systems shows how the Welland Canal contains contributes to more than half of the total height difference between the highest water level on Lake Superior and Sea level, this is important to note for the introduction of an ecological control point for invasive species.

A timeline of the history behind the Canal reveals the socio-political significance behind its construction, a result of economics, culture, and land optimization. A drawing of the first and second Canals reveals its original dynamic shape, pierced together with different prints the same way the Canal was formed over time. The evolution of the Canal, although today is more sustainable compared to shipping by means of trucking or plane, which will always be a result of human sacrifice. Although unintentional, many men lost their lives during the construction of the fourth and final phase of construction.

Weaving three  
histories  
together



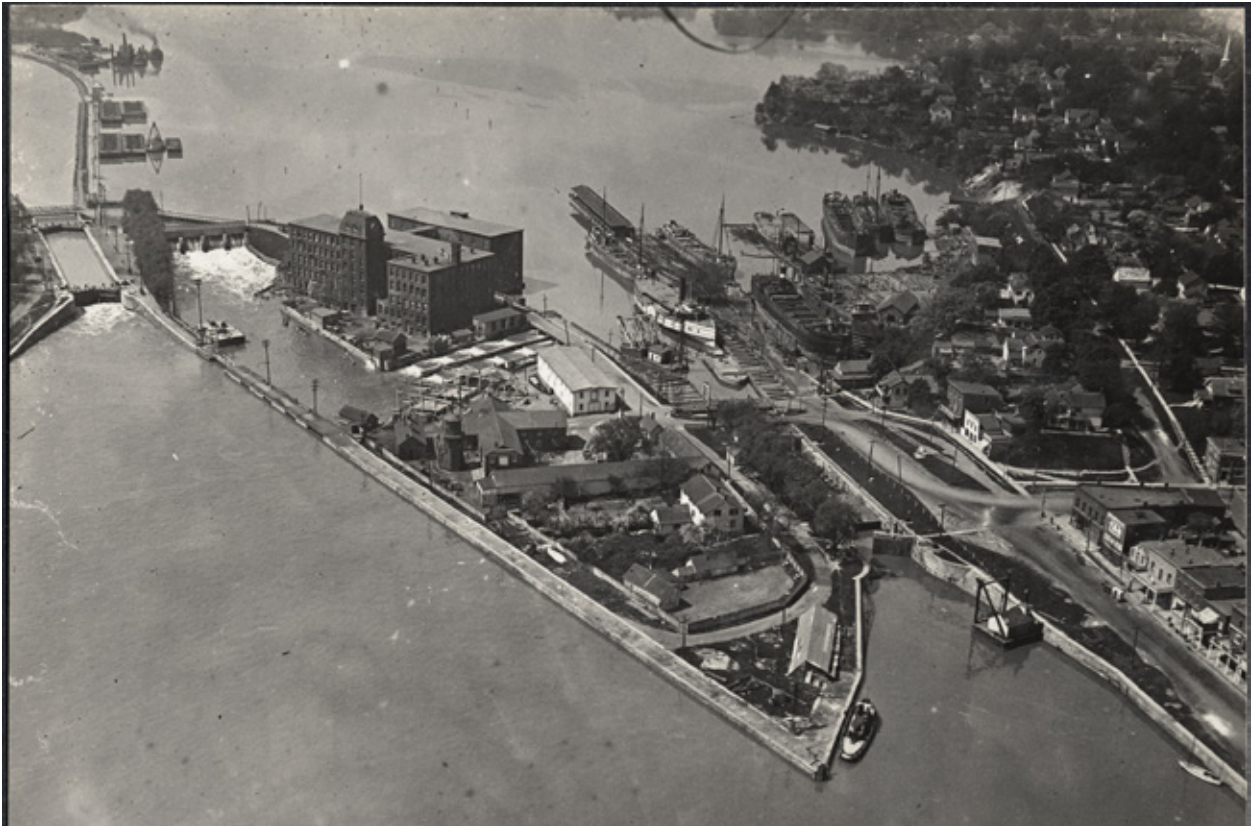
**Canal  
Human  
Natural**

Port Dalhousie was the location of the entrance to the first canal, built in 1824 and finished in 1829. William Hamilton Merrit, an owner of two mills along the Twelve Mile Creek in St Catharines, proposes a canal from the creek to the Welland river, which would bypass Niagara falls. The Welland canal company is formed after Merritt begins raising funds for a survey of his proposed route. Next, the Welland canal company is formed and sod is turned for the first canal. Much of the credit for building the first canal goes to the enterprising businessman, as well as the Province of Upper Canada. It was the need for a regular flow of water to his mills, coupled with the proximity of the Erie Canal, in the United States, that prompted Merrit to undertake initial engineering studies.<sup>1</sup> In 1824, convinced that the construction of a canal was feasible, he founded the Welland Canal Company which was financed by government and private sources. The first sod was turned on November 30, 1824, at Allanburg. Today, a commemorative cairn located at the west end of Bridge No. 11 marks the location of that historical event. The Welland Canal Company pressed on with the gigantic tasks of earth excavation and marine construction, made so much more arduous by the limited tools available at that time.

---

1 "The Great Lakes Seaway." - Information Services, The St. Lawrence Seaway Management Corporation. March, 2003. p.1-12. Accessed November 30, 2022 <https://greatlakes-seaway.com>





**Figures 10,11:** Port Dalhousie Oblique aerial photograph. 1920



Orig. Personal Artist's Proof - Size - 34 x 47 cms  
 Found - Aberfoyle, ON  
 Titled in JD Kelly's hand, Original printer registration  
 marks, Prov - JD Kelly friend collection

Five years later, the schooner “Ann and Jane” completed the first upbound transit, a two-day voyage.<sup>2</sup> One of JD Kelly’s most famous prints - the opening of the Welland Canal - was issued for the Confederation Life series. This was the personal proof print used by JD to ensure quality control on the wide variety of colours he used on this complex and highly detailed composition.<sup>3</sup> The biggest obstacle to sea-going ships on the Great Lakes of Ontario had always been the Niagara River and Falls which connected Lakes Erie and Ontario.<sup>4</sup> The First Canal, built from 1824 to 1829 by Merritt, had to be transhipped by wagons on a portage route.<sup>5</sup> Large ships could now sail from the Atlantic Ocean all the way to the end of the Great Lakes.<sup>6</sup> Perhaps the fourth Canal, although following a very land disruptive route, was another ode of optimism, similar to the first Canal, but rather for engineering. Anyone reading the letters, memoranda, and reports relating to the building of the First Welland Canal cannot help being struck by the optimism of Merritt and the Welland Canal Company. Time and again they expressed great confidence in the success of the Welland, echoing and reinforcing Merritt’s own faith in the future of the enterprise.<sup>7</sup>

---

2 Ibid.

3 “Great Canadian Heritage Treasure” - Goldi Productions Ltd. - 1996, 1999, 2005, Accessed February 28, 2023, [https://thecanadasite.com/art/art2c\\_kelly11\\_create2.html](https://thecanadasite.com/art/art2c_kelly11_create2.html)

4 Ibid.

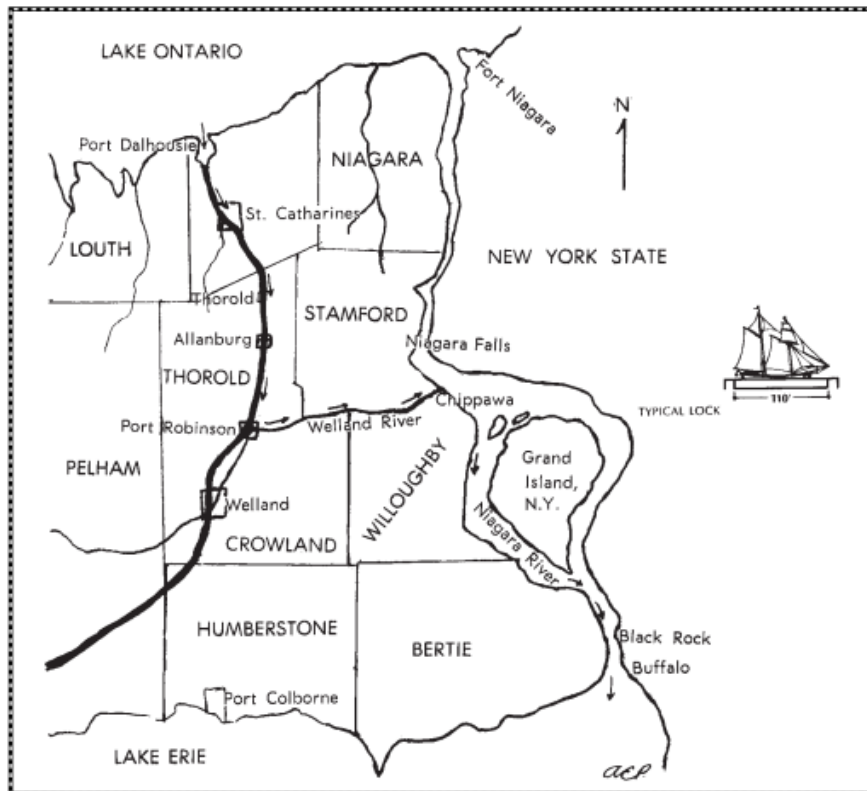
5 Ibid.

6 Ibid.

7 Styran, Roberta M., and Robert R. Taylor. “Digging the Ditch.” In *This Great National Object: Building the Nineteenth-Century Welland Canals*, 120–57. McGill-Queen’s University Press, 2012. <http://www.jstor.org/stable/j.ctt1283qt.9>.



**Figure 12:** Opening the First Welland Canal (detail) - JD Kelly



**Figure 13:** Map of the First Welland Ship Canal

Recreation and leisure were relatively new concepts in the late 19th century, but the activities caught on quickly. What first started as a beach for swimming and paddling grew to become a sprawling amusement park.<sup>8</sup> After the attractions were purchased by the NS&T railway, Lakeside Park began to boast many food concessions, and amusement rides, including a roller coaster, bumper cars, row boats and water bicycles, as well as a 24-foot wooden water slide, bandstand, dance pavilion, and of course its own carousel.

<sup>8</sup> History from Here: Lakeside Park at Port Dalhousie. St. Catharines Museum, Youtube. Accessed November 1, 2022. [https://www.youtube.com/watch?v=Ak0N3n76aas&ab\\_channel=St.CatharinesMuseum](https://www.youtube.com/watch?v=Ak0N3n76aas&ab_channel=St.CatharinesMuseum)

Weaving Access



**Figure 14:** Lakeside Park Beach



**Figure 15:** Park at Port Dalhousie Beach, June 1930



**Figure 16:** Looking at Lake Ontario in Port Dalhousie, July 1920  
Children playing with canoes, wooden water slide and Lighthouse in the background

In 1824, construction of the first canal around Niagara Falls was undertaken as a private enterprise where a channel extended from Port Dalhousie on Lake Ontario to Port Robinson Chippawa Creek, where small vessels could descend to the Niagara River and up the Niagara River to Lake Erie which was completed in 1829.<sup>9</sup> The Canal had 40 locks 110ft long by 22ft wide and 8ft deep over the sills and was later extended to Port Colborne on Lake Erie to save distance and eliminate the difficult navigation of the open channels in Chippawa Creek and the Niagara River.<sup>10</sup> In 1841 the Canadian government bought the canal and built new stone locks (150ft long by 26ft wide and 9ft deep over the sills, reducing the number of locks to 27 and In 1853 the navigable depth of the canal was increased to 10ft.<sup>11</sup>

*Contracts for the construction of a new ship canal were let in the fall of 1913, but within less than a year the World War started and by 1916 it had caused an almost complete cessation of the work. In 1918 the original contracts were cancelled. From 1919 to 1921 work continued on a cost-plus basis with many interruptions due to labour and other troubles. By 1921 conditions in the construction industry had become more stabilized, and new unit price contracts were let in 1921 and the following year. Thus, while 17 years have elapsed since the construction was started, actually only about 10 years have been required for the completion..<sup>12</sup>*

Wherever possible, natural waterways became part of the

9 "New Welland Ship Canal Built for Deep-Draft Vessels" - Engineering News-Record., p 357. September 4, 1930. Accessed March 5, 2023. <https://historicbridges.org/truss/glendale/welland.pdf>

10 Ibid.

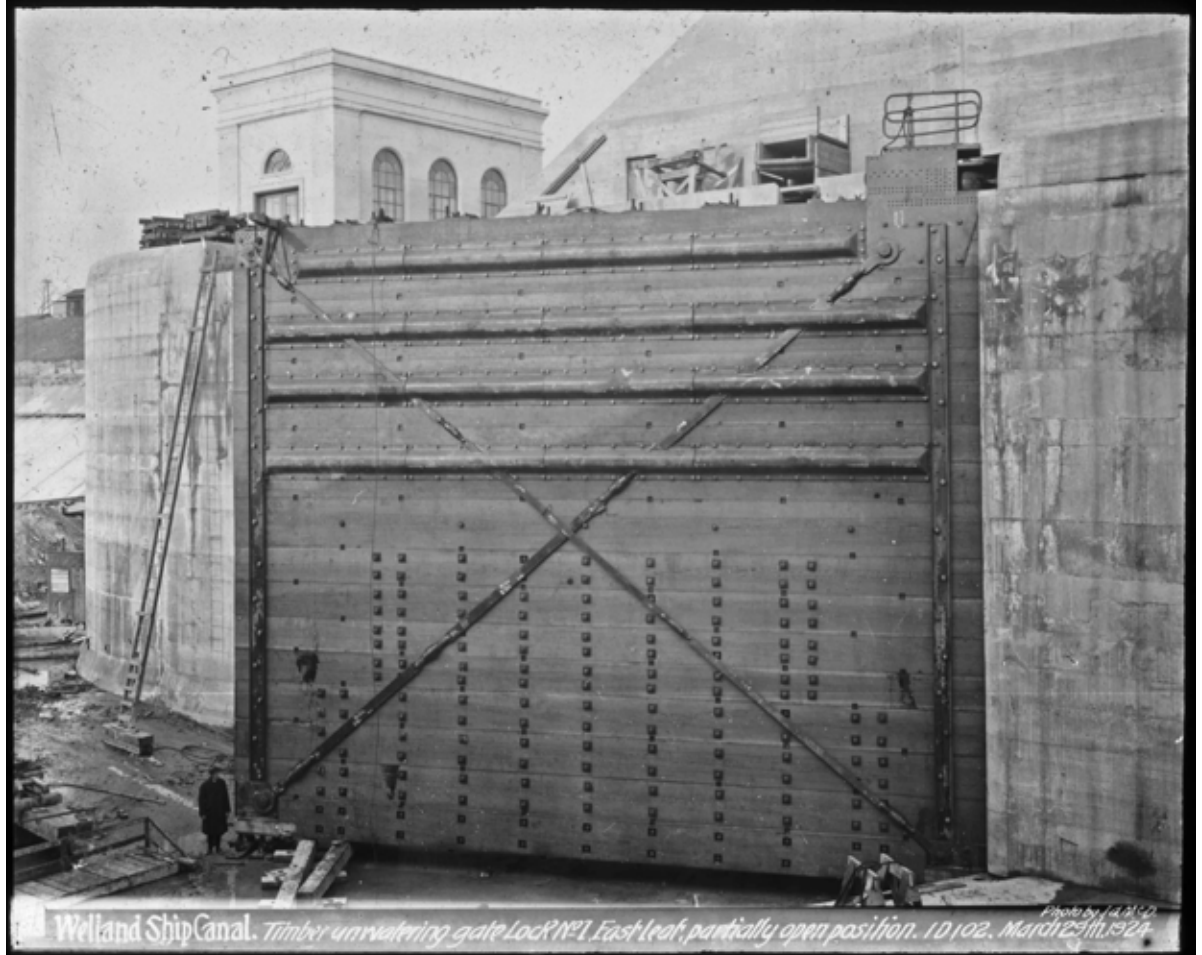
11 Ibid.

12 Ibid., 356



**Figure 17:**  
Rough logs –  
Douglas Fir for  
unwatering gate  
timbers, n.d.

**Figure 18:**  
Welland Ship Canal - Timber  
Unwatering Gate  
Lock No 1, East  
Leaf, partially  
open position





canal. From Port Dalhousie, on Lake Ontario, the canal followed the route of Twelve Mile Creek through St. Catharines to Merritton, and up the escarpment to Thorold.<sup>13</sup> In those early years of operation, the canal terminated 8 km (5 miles) south of Thorold, at Port Robinson on the Welland River. Ships then proceeded east on the Welland River to Chippawa, and continued up the Niagara River to Lake Erie. As traffic increased, the canal was extended directly to Lake Erie from Port Robinson in order to avoid the strong currents of the Niagara River.<sup>14</sup>

At a cost of \$120,000,000, the fourth canal to be built between Lake Erie and Lake Ontario to provide slack-water navigation around Niagara Falls is now nearing completion.<sup>15</sup> “An almost straight canal with only eight locks which will permit vessels with draft up to 25ft., whereas heretofore no vessel drawing more than 14ft could pass up or down from lake to lake and then only through a tortuous channel having 26 small locks.”<sup>16</sup>

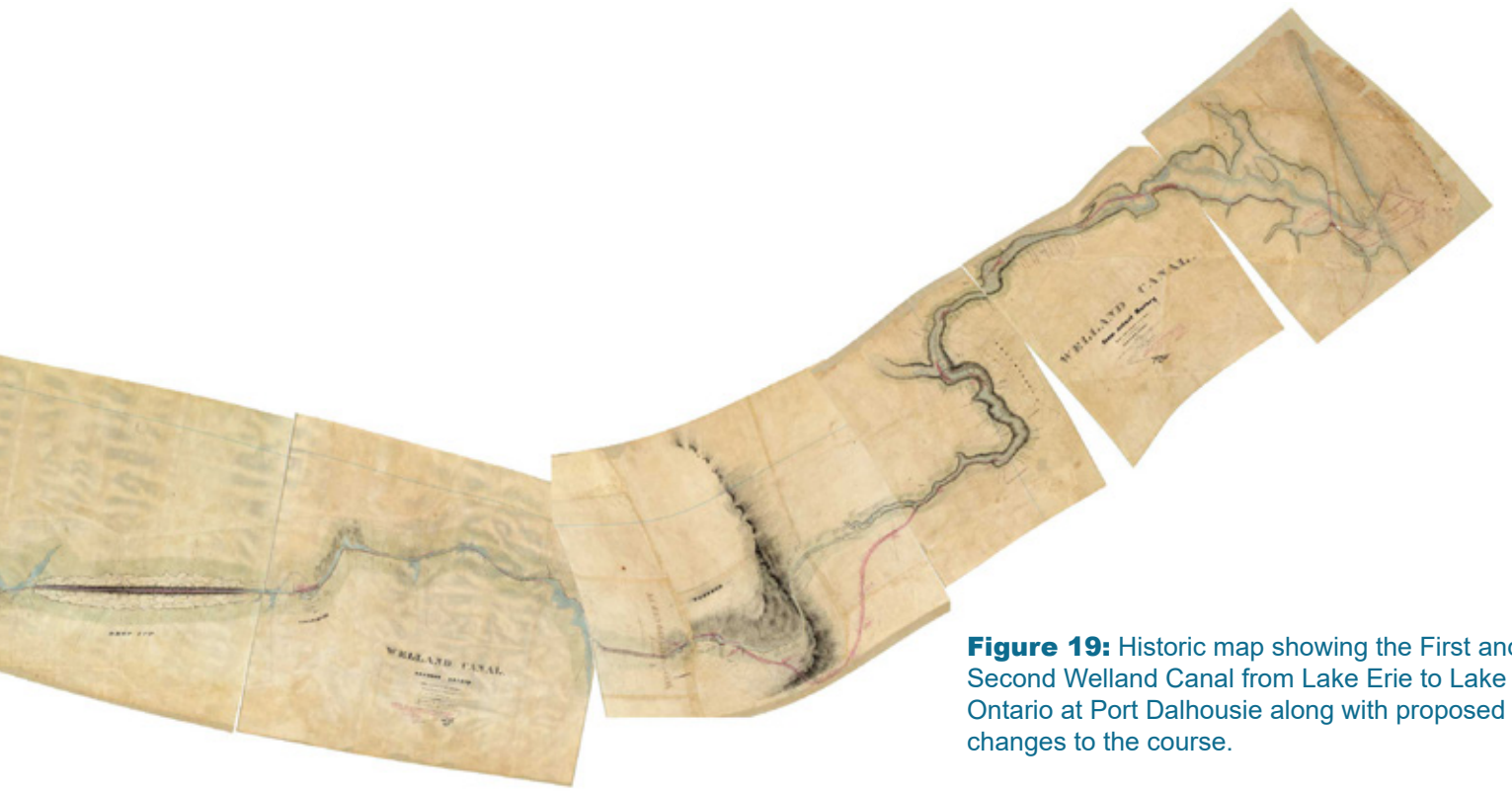
13 “The Great Lakes Seaway.” - Information Services, The St. Lawrence Seaway Management Corporation. March, 2003. p.1-12. Accessed November 30, 2022 <https://greatlakes-seaway.com>

14 Ibid.

15 - “New Welland Ship Canal Built for Deep-Draft Vessels” - Engineering News-Record., p 356. September 4, 1930. Accessed March 5, 2023. <https://historicbridges.org/truss/glendale/welland.pdf>

16 Ibid.

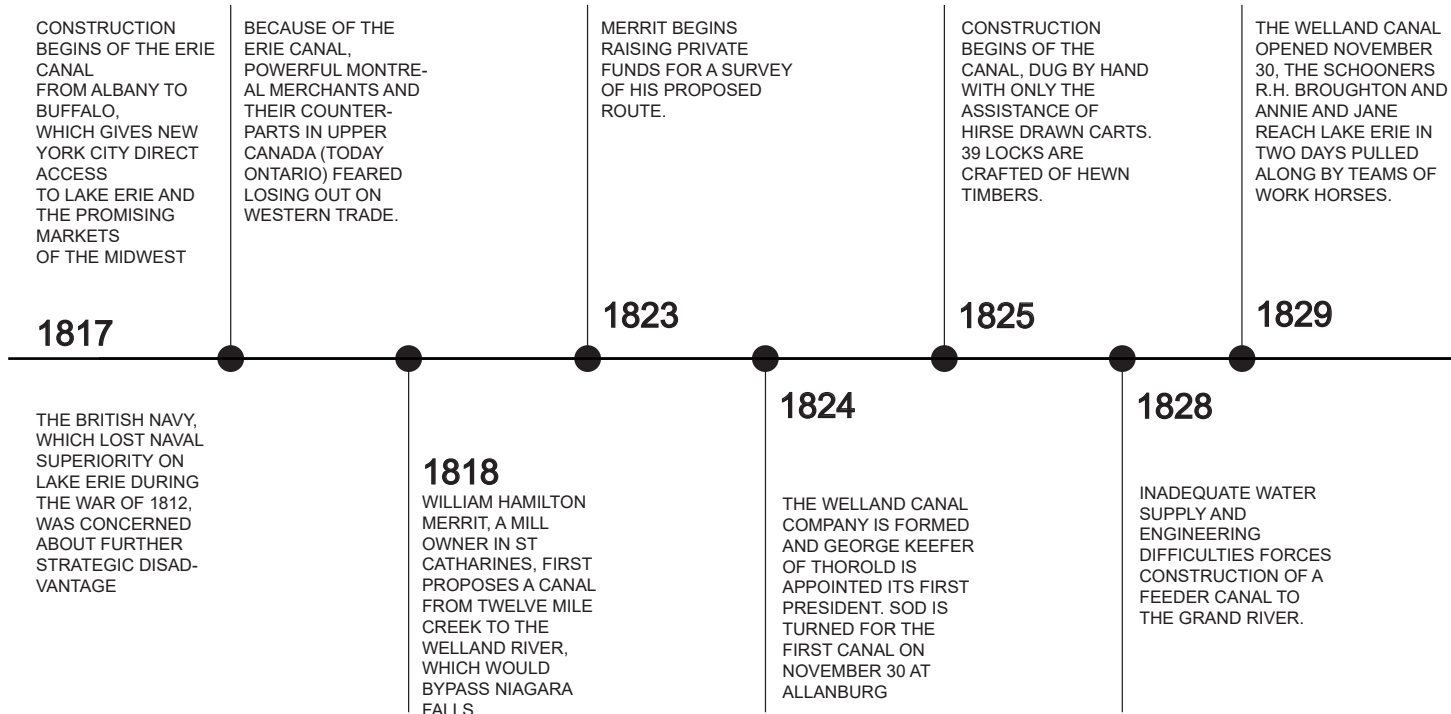




**Figure 19:** Historic map showing the First and Second Welland Canal from Lake Erie to Lake Ontario at Port Dalhousie along with proposed changes to the course.

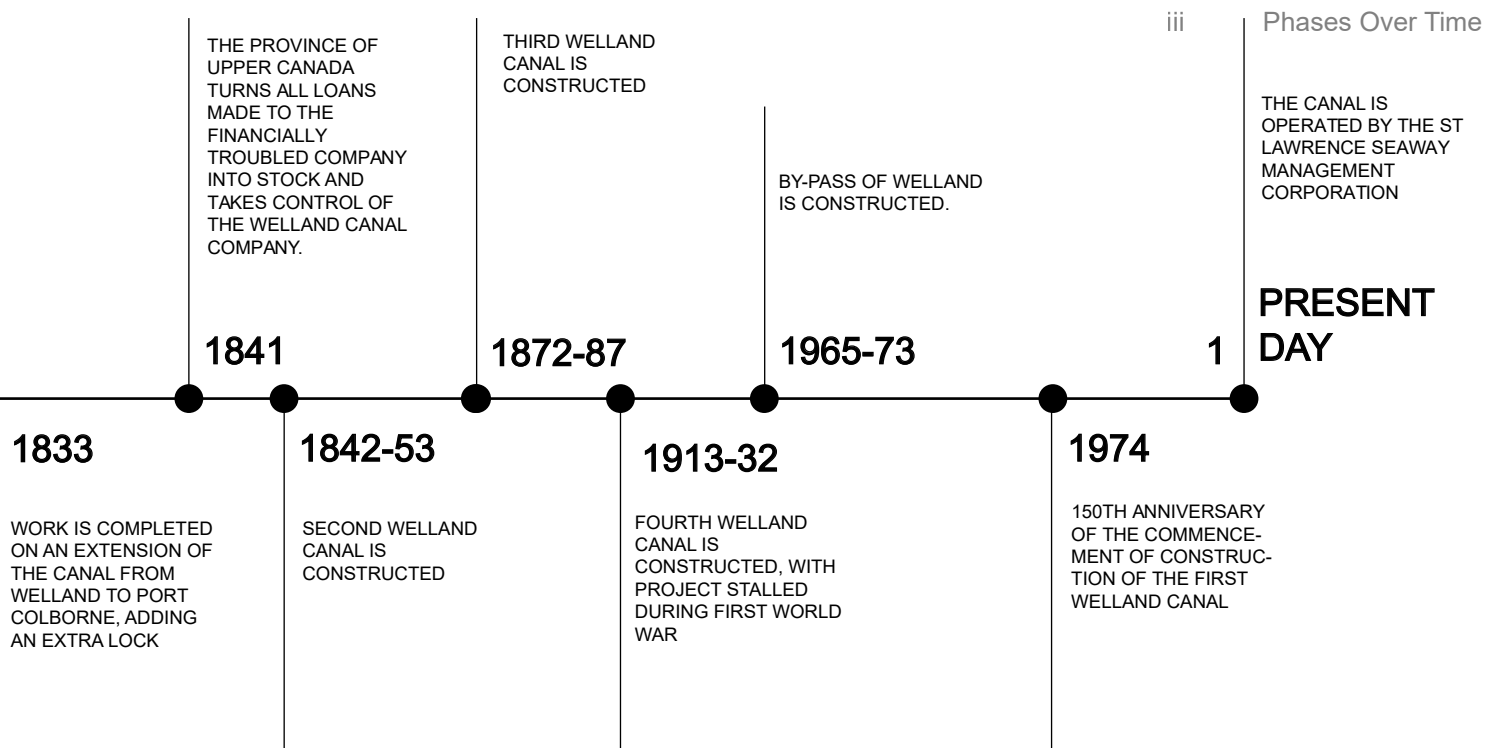


**Figure 20:** Aerial photo of Downtown St Catharines and with Canal running through

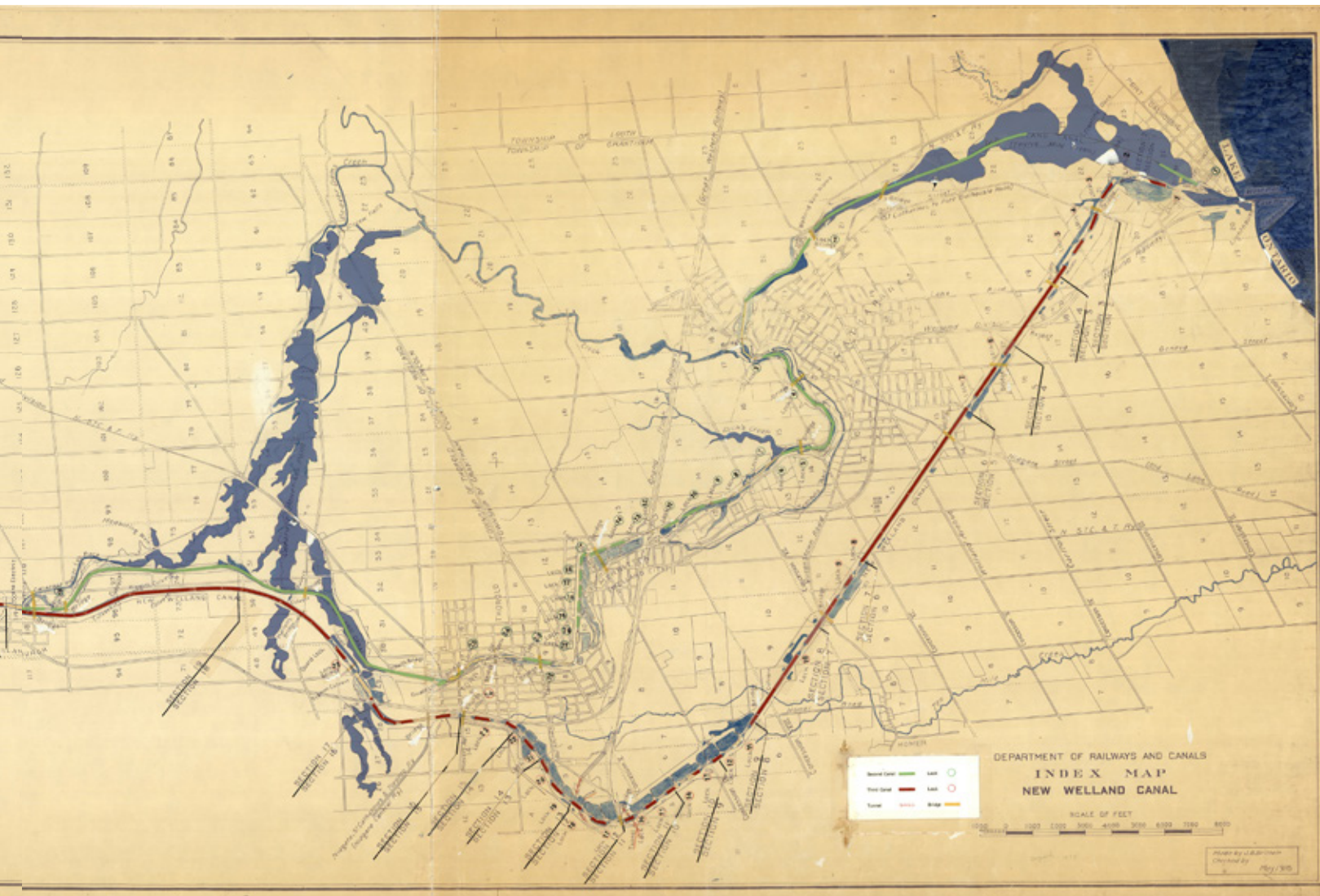


**Figure 21:** Timeline of the Welland Canal

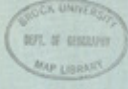




**Figure 22:** Historical map showing the Second and Third Welland Canal with their locks, sections, tunnel and bridge. Includes lot and concession numbers, township boundaries, railways, major roads. Scale [ca. 1:30,480] Map date: 1916. Digital reproduction of map (70 x 264 cm.)



MAP AND STREET GUIDE 65c  
*St. Catharines*  
ONTARIO, CANADA



PATHFINDER  
AN SURVEYS LTD.  
1000 GERRARD ST. E.  
TORONTO, ONT. CAN.

- SEE YOUR OWN  
• HOME  
• STREET  
• SCHOOL  
• CHURCH  
• SHOPS

DISTRIBUTED BY  
VANDY KEYS COMPANY LTD.  
10 NORTH ST.  
ST. CATHARINES, ONT.



**REFERENCE MAP**

- STREETS: Main, Branch, & Common
- RAILWAYS: Main Line, Branch
- TRAINS: Passenger, Freight
- ROADS: Main, Branch
- TRAMWAYS
- POSSIBLE ROUTES
- RAIL CROSSINGS
- TRAM CROSSINGS
- POSSIBLE CROSSINGS
- TRAM CROSSINGS
- RAIL CROSSINGS

**CHURCHES**  
[List of churches and their locations]

**HOSPITALS**  
[List of hospitals and their locations]

**CEMETERIES**  
[List of cemeteries and their locations]

**PARKS**  
[List of parks and their locations]

**POINTS OF INTEREST**  
[List of points of interest and their locations]

**THOROLD**  
[List of streets and landmarks in Thorold]



As the same route of the canal hasn't changed much since its original location, before ever a tree was felled, a sod turned, or a shovelful of soil removed, the canal planners had to determine a route for the Niagara Canal. Given the challenges of swamps, forests, intractable ground, escarpments, east-west watercourses, and storm-battered coastlines, surveyors had difficulty choosing the most suitable line for an artificial channel across the peninsula. In addition, the interests of local landowners, businessmen, and the military had to be considered. While many early nineteenth-century settlers recognized the advantages of connecting lakes Ontario and Erie, no one route was an early favourite.<sup>17</sup> In the same way the First Welland Canal was optimistic, the Fourth Canal was a great challenge, many lives were lost. An ode to optimism, and a great engineering challenge, obviously, no canal could be built without the services of surveyors, engineers, and contractors.<sup>18</sup> While the land surveyors reported on possible routes, and the contractors were essential for managing the actual work, the role of the engineers was pivotal.<sup>19</sup> They were responsible for laying out the lines that had been chosen, checking the soil conditions, dividing the work into sections, overseeing and measuring the contractors' work and authorizing payments for work done, solving the many problems the contractors would encounter, and judging when a contract had been successfully completed.<sup>20</sup>

17 Styran, Roberta M., and Robert R. Taylor. "Choosing the Route." In *This Great National Object: Building the Nineteenth-Century Welland Canals*, 49–75. McGill-Queen's University Press, 2012. Accessed April 20, 2023. <http://www.jstor.org/stable/j.ctt1283qt.7>.

18 Styran, Roberta M., and Robert R. Taylor. "Surveyors, Engineers, and Contractors." In *This Great National Object: Building the Nineteenth-Century Welland Canals*, 76–119. McGill-Queen's University Press, 2012. Accessed April 20, 2023. <http://www.jstor.org/stable/j.ctt1283qt.8>.

19 *Ibid.*

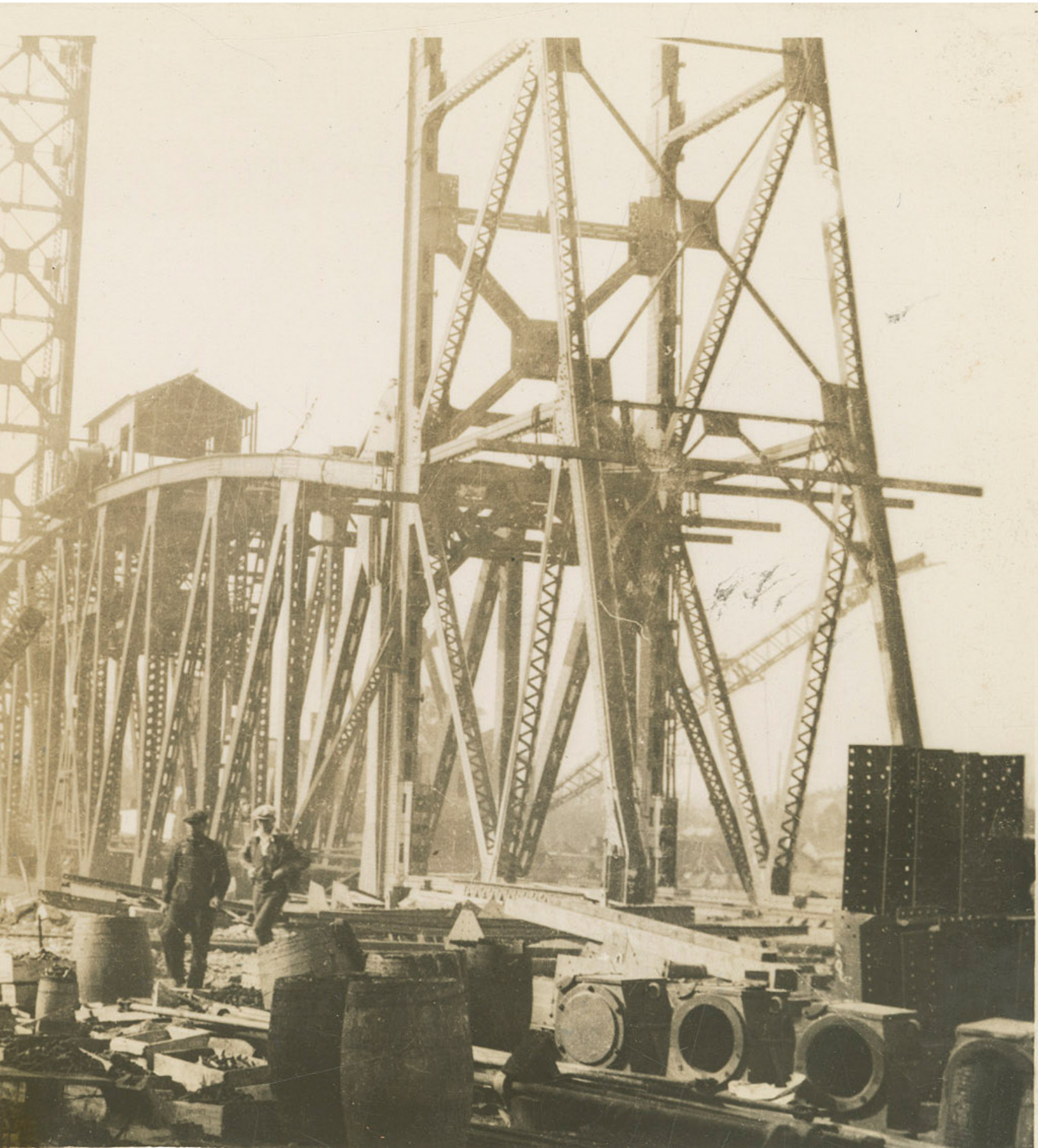
20 *Ibid.*

Site: 

**Figure 23:** Historical map showing street, transportation, cultural and recreational features, street numbering, ground cover, points of interest, indexes, legend. Scale [ca. 1:12,000] Map date: 1964. Digital reproduction of map (95 x 55 cm.)



Railway Bridge Construction in  
**Port Colborne Ontario, 1927**



**Figure 24**

The Glendale Avenue Bridge is an example of a standard truss vertical lift bridge over the Welland Canal.<sup>21</sup> The actual bridge span is a Parker through truss that has nine panels, and connections are riveted, and numerous built-up beams are present including v-lacing on the verticals and lattice is on the bottom of the top chord.<sup>22</sup> The bridge retains excellent historic integrity, there are no guardrails for cars (curbs only), which is how the bridge was built.<sup>23</sup> There are ornate lattice guardrails with scrollwork designs on top for the cantilevered pedestrian sidewalks on both sides of the bridge which can be found on many Welland Canal Bridges, including on some of the other bridge types found on the canal, and signs near the vertical lift bridge indicate that the bridge is now remotely controlled, using cameras.<sup>24</sup> Apparently, thanks to computers, one person can operate any number of bridges from one location these days. Originally, a bridge tender would have been on-site to operate the bridge.<sup>25</sup>

Weaving Access



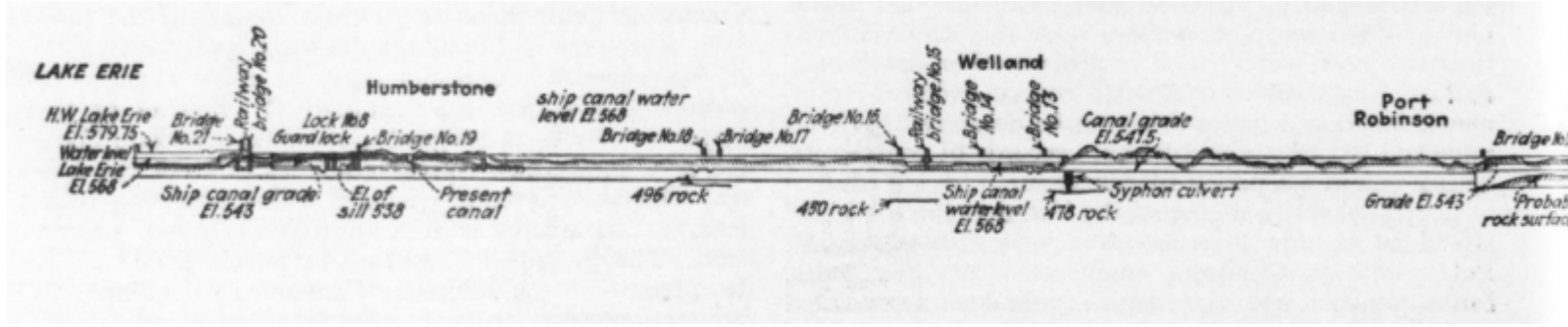
**Figure 26:** Drained Canal in January, at the base of Lock 4



**Figure 27:** Ornate lattice guardrails along the vertical lift bridge 5

21 “Glendale Avenue Bridge - Welland Canal Bridge #5” Accessed March 5, 2023. <https://historicbridges.org/bridges/browser/?bridgebrowser=truss/glendale/>  
 22 Ibid.  
 23 Ibid.  
 24 Ibid.  
 25 Ibid.

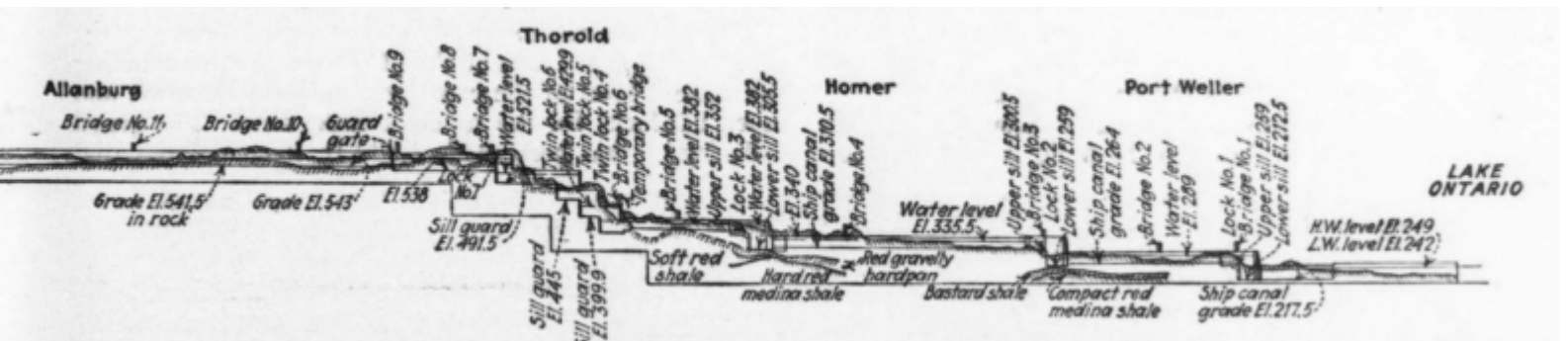
**Figure 25:** Profile of New Welland Ship Canal Built for Deep-Draft Vessels







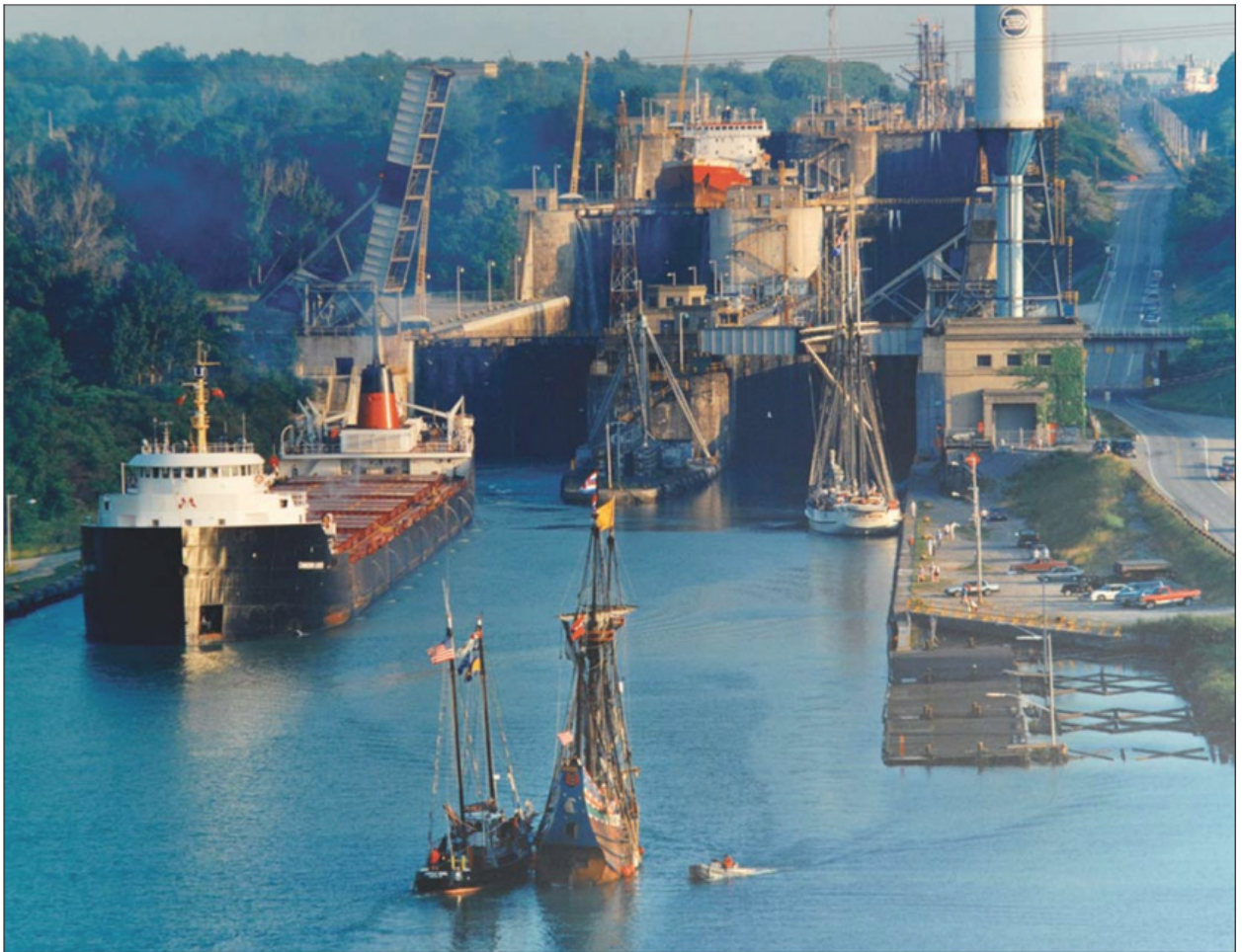
**Figure 28:** Welland Ship Canal, Site Twin Locks No 4, looking South, from CNR Maintenance crossing Bridge





**Figure 29:**  
Aerial View of Canal

**Figure 30:** Closer view of  
the Locks 4,5, and 6 or  
Thorold (Welland Canal)



Weaving Access

Overall length of canal - **43.4 km**

Total lift - **99.5m**

Average lift of locks - **14.2m**

Size of locks (breast wall to gate fender) - **233.5m** long **24.4m** wide

Depth of water (over the sill) - **9.1m** (in channels) - **8.2 m**

As construction went on over time, between each update of the canal, materials were also updated, first wood, masonry and steel, and finally reinforced concrete. On a larger scale, the 715-kilometre Escarpment has been designated as a heritage site and now remains as a refuge for wildlife and designated as protected land, however, with agricultural lands retracting over the past hundred years, on a more zoomed-in scale, we see that residential and industrial land has consumed a significant portion of the Niagara Escarpment and had a longing impact that needs to be addressed. With this history in mind, identifying and revealing an approach

to these effects, a geological understanding of the infrastructure, and documenting the history and existing conditions of the canal system, have the potential to create ecological commons for wildlife, vegetation, and cultural interaction. The design approach may begin by formalising the informal use of the site, optimizing the existing topographical and vegetation features, and mitigating existing conditions that steer people away from safety concerns. Next, to maintain a sustainable design and implement non-extractive architectural solutions, it is imperative to consider the vast history of the Welland Canal.



**Figure 31:** St. Lawrence Seaway Management Corporation Lock 4 Powerhouse building



**Figure 32:** Remnants of masonry construction found along traintracks around Lock 4 Site.

The Niagara Region and Welland Canal developed hand in hand and are considered diverse based on their socio-political, physical, community, and cultural landscape and the story of their innovation. Waves of settlement and its proximity to the Niagara Escarpment caused a unique junction of natural elements and international relations.<sup>26</sup> The physical landscape of St. Catharines, the largest city in the region, is broken down into the canal, transportation, natural features, cycle of development, built heritage, and parks and green space. It is important to note that 138 men lost their lives during the fourth and current phase of construction, which led to health and safety legislation.<sup>27</sup>

Horses were used before heavy machinery was made available for the dredging of dirt and towing of boats through the canal. As the fourth canal was constructed a devastating impact of the new machinery, the influence of the first world war and poor working conditions led to the fatality of 138 men.



Fig. 1 An elevating grader fills a nearby bottom dump wagon at the east embankment for Lock 2, September 1915.

**Figure 33:** Horses grading the Canal, 1915



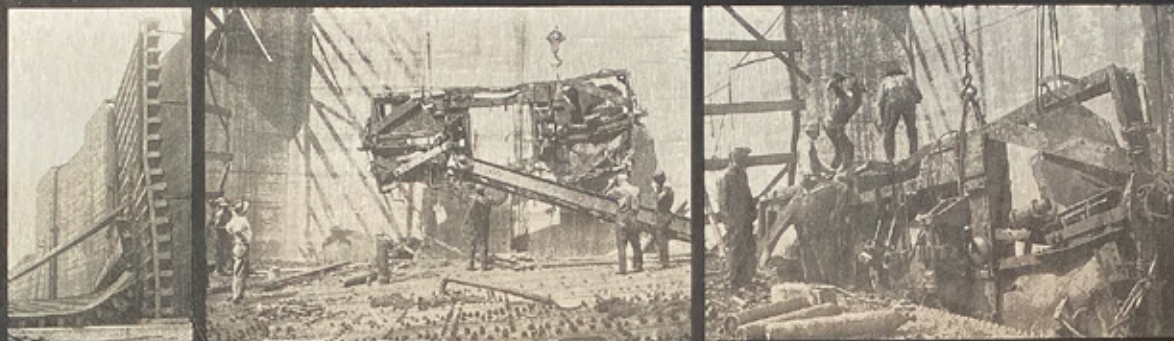
**Figure 34:** Fallen Workers Memorial, On Welland Canal Museum Grounds at Lock 3

<sup>26</sup> “Niagara’s Welland Canal.” - Welland Canal Brochure - April 15, 2016. Accessed Nov. 5, 2022. [www.niagarawellandcanal.com](http://www.niagarawellandcanal.com)

<sup>27</sup> Ibid.

# WELLAND CANAL FALLEN WORKERS MEMORIAL

MONUMENT DÉDIÉ AUX OUVRIERS DÉCÉDÉS À LA CONSTRUCTION DU CANAL WELLAND



This memorial honours the 138 men who were killed while building the current Welland Canal. Thousands of workers were employed in Niagara during the Canal's construction, which lasted from 1913 to 1935. They were from 16 countries, many new to Canada: their arrival and industry reflected a time of nation-building. The names of the Fallen stand as a testament to all of the workers and their families who were tragically affected by loss of life, fatal illness, or injury.

Dedicated on November 12, 2017. To learn more about the Fallen Workers and the history of the Welland Canal visit the St. Catharines Museum and Welland Canals Centre.

Ce monument commémoratif rend hommage aux 138 hommes ayant perdu la vie lors de la construction de l'actuel canal maritime de Welland. Entre 1913 et 1935, des milliers de travailleurs sont venus dans la région de Niagara. Originaires de 16 pays différents, plusieurs étaient de nouveaux au Canada. Leur venue et leur contribution s'inscrivent dans une époque d'édification du pays. Les noms de ceux qui ont péri témoignent des pertes de vie, de la maladie et des blessures qui ont si tragiquement touché tous ces ouvriers et leurs familles.

Inauguré le 12 novembre 2017. Visitez le Musée de St. Catharines et le Centre des Canaux de Welland pour obtenir de plus amples renseignements relatifs aux ouvriers décédés.

Memorial designed by / Conception du monument: Dereck Revington Studio

1. The Plinth - A place to pause and remember.

2. The Veil - Above a cut in the earth a wall of steel hovers; its southern face, reflective and black, addresses the events of the past; the northern face, mirrored and polished, reflects the present and looks to the future.

3. The Lock and The Timeline - The Lock recalls the cut of the canal into the earth while The Timeline marks in stone the number of fatalities per year of construction.

4. The Gates - Like a book of steel into whose pages the names of the Fallen are cut, The Gates of Remembrance rise from the The Lock bed, echoing the partially opened mitre gates of the flight locks.

1. Le Socle - Un endroit pour se recueillir et méditer.

2. Le Voile - Au-dessus d'une entaille dans la terre plane un mur d'acier; son versant sud, contemplatif et sombre, se tourne vers les événements du passé; son versant nord, poli tel un miroir, reflète le présent, le regard tourné vers l'avenir.

3. L'Écluse et La Ligne de Temps - L'Écluse rappelle l'entaille du canal dans la terre, alors que la Ligne de temps indique, de par des pierres, le nombre de décès au cours de chacune des années de construction.

4. La Porte - Tel un livre d'acier dans lequel sont gravés les noms des ouvriers décédés, la Porte du souvenir s'élève du bassin de l'écluse, faisant écho aux portes jusqu'aux écluses étagées, légèrement entrouvertes.

This memorial was made possible with funding, time and tireless commitment from / Ce monument commémoratif a été rendu possible grâce au financement et à l'engagement inlassable des personnes et groupes suivants:

Canada

St. Catharines

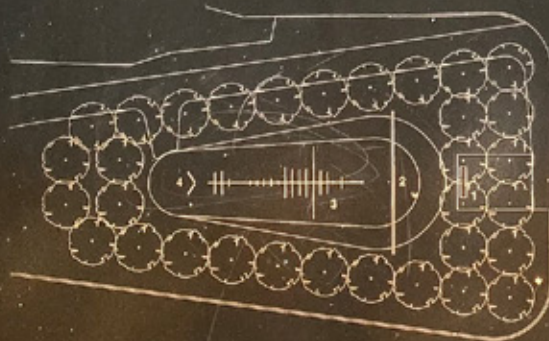
Niagara Region

Algoma Central Corporation  
ArcelorMittal Dofasco  
Canada Steamship Lines  
Canadian Merchant Service Guild  
Fednav  
Groupe Desgagnés  
Heddie Marine Service Inc.  
McKell Marine

Niagara Regional Labour Council  
Ontario Paper Thorold Foundation  
Rankin Construction Inc.  
Seafarers' International Union of Canada  
St. Catharines Standard  
St. Lawrence Seaway Management Corporation  
Union Local #4212

EMS-Tech  
Great Lakes Pilotage Authority  
Kirkpatrick Stoneworks Ltd.  
Letko, Broseau & Associates

Lower Lakes Towing & Rand Logistics  
Rotary Club of St. Catharines  
Sterling Fuels



Many communities came together to make this memorial. Thank you to the individuals, businesses, and labour associations who made donations; to the Cities of Port Colborne, Thorold, and Welland; and to the many dedicated volunteers and families of the Fallen who helped to bring the stories of the Fallen Workers to light.

Plusieurs communautés ont collaboré à la réalisation de ce monument. Merci à tous les individus, à toutes les entreprises, et à tous les regroupements syndicaux qui ont fait des dons, aux municipalités de Port Colborne, de Thorold et de Welland, ainsi qu'aux nombreux bénévoles et aux familles des ouvriers décédés, qui ont contribué à mettre en lumière leurs récits.

The contents of my methodology are based on a non-traditional family story and recreating moments of refuge we experienced growing up until today. Through understanding my exploration with photography, that my mom taught me at a young age, which led me to discover hidden gems in the town by use of my bike or taking paths only meant for people on foot, to growing a deep connection to nature and water, and being able to access recreational space with my friends. Within ageing, and disability, where my original title was “embracing the inevitable,” meaning that, not only are we all faced with the fact that we’re all constantly ageing, but we are all likely to face some sort of disability in our lifetime, which is best addressed by preparing the way we access the world around us.

This is where I plan to step in with the use of design, centring around healing, creating services and programs that begin to address some of these main issues, such as mental health, addiction, mobility, flexibility, sensory loss, and so on. Means that have been proven to benefit users either born with these circumstances or not, such as aromatherapy, designated sheltered areas, pathways, recreational areas, and educational workshops.

The human species are not the only thing affected by unfortunate circumstances, wildlife and plant species are forced to create habitats around places that we have disrupted infrastructurally. The Welland Canal is not short of these places. Natural habitats have been scarred as much as the landscape where the Canal has been dug. This brings me to ask, how can these non-human species such as those endangered, at risk, or invasive, be simultaneously addressed in a cohesive and sustainable way?

How can we change the **narrative** of a place, devastated by its industrial past, for a **refuge** of human and non-human species?

Ecological Architecture for Refuge Along the Welland Canal

Industrial  
Compromise

**Concept**



**Land Based  
Design**

Hard  
Engineering

**Environment**



**Natural  
Habitat**

Concrete

**Material**



**Wood**

Masonry

1

2

Greater Site  
HISTORY

3

**ECOLOGY**

4

STRATEGIES

5

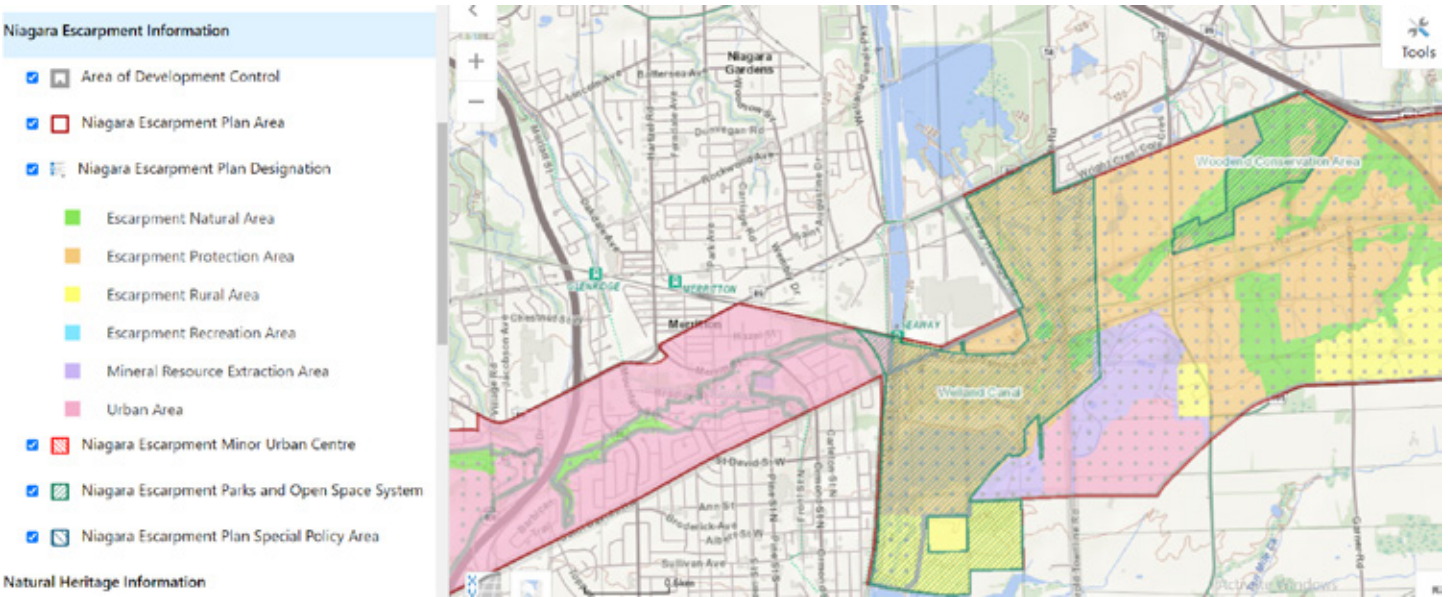
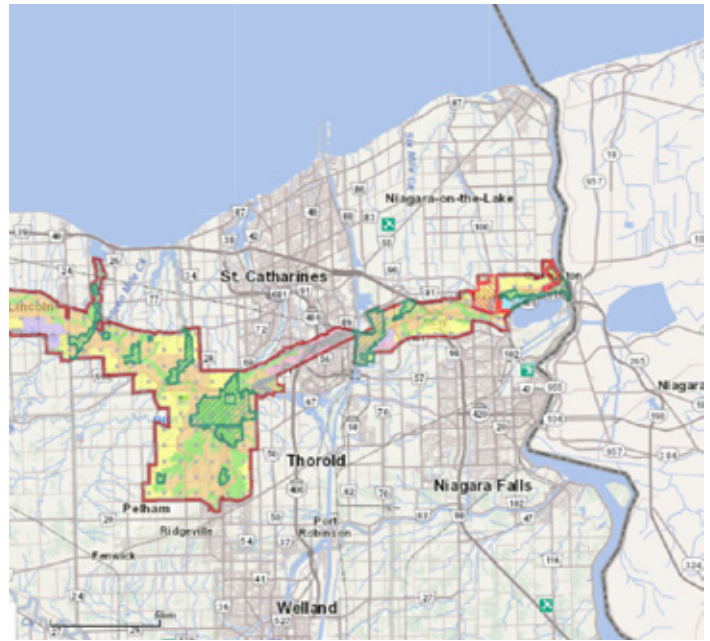
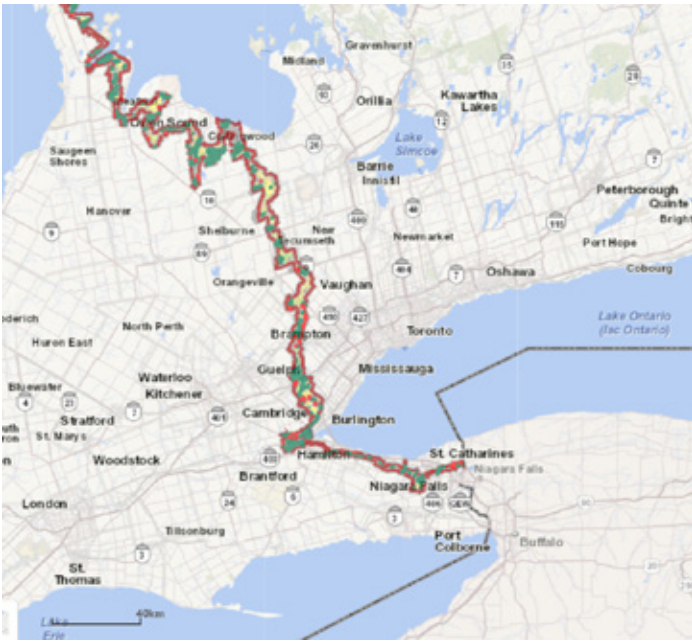


In this chapter, we discuss the ecological facts about the Welland Canal, as well as plant species, both invasive and native, that are intended on being used in the biodiversity of the land use in and around spaces to facilitate human interaction. Some native plant species can be used for other healing services such as aromatherapy and water detoxification. Wildlife species local to the region, some endangered, have the potential to live in a symbiotic relationship with the human users of the site by creating natural habitats where various native species can thrive and invasive species can be controlled.

In terms of the existing qualities of the site, and designating the importance of the Niagara Escarpment, as well as the watershed that forms on the post-industrial site along the Welland Canal, we can start to view the complexity of the ground-level attributes. In *Gateway, Visions for an Urban National Park*, Kate Orff describes the Hudsons Bay in New York as a layered ecology where, “Looking at the bay not as a preexisting nature to be protected or a refuge for wildlife, but as a complex metropolitan watershed that supports people, plants and animals - and placing the communities that influence it at the center of the solution - has the potential to inspire a new type of ground-up revolution.”<sup>1</sup> Although not in the same region, the same ecological mindset can be applied to the site along the Welland Canal because of its many outside factors, but also the layers of human and non-human coexistence.

---

1 Brash, Alexander, Jamie Hand, and Kate Orff. *Gateway : Visions for an Urban National Park*. New York: Princeton Architectural Press, 2011. (p.67) Accessed Feb 29, 2023.



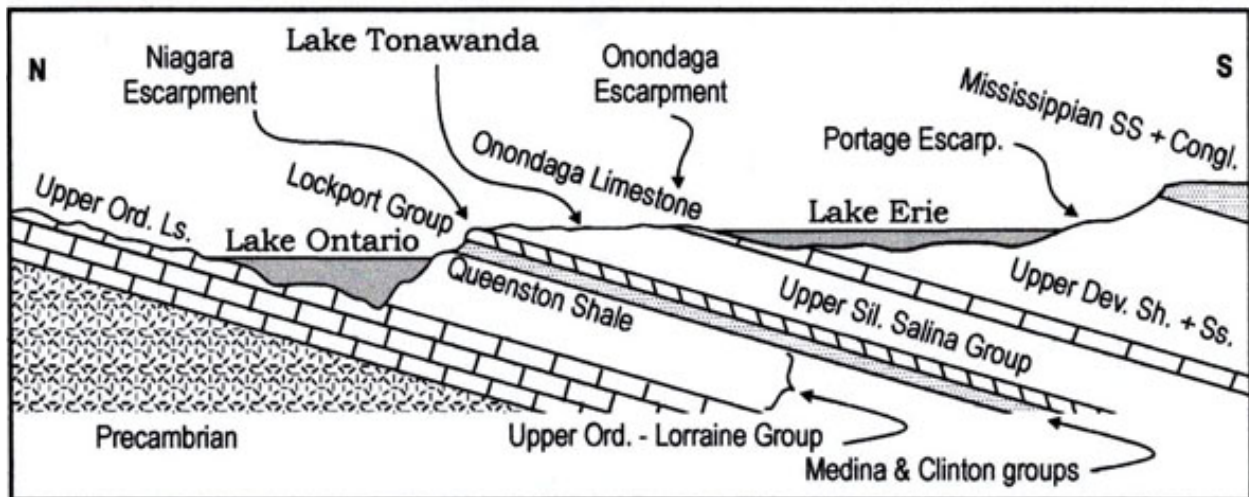
**Figures 36:** Niagara Escarpment Commission. Interactive Map

*The Niagara Region is fortunate in having large deposits of sand, gravel, stone and shale as illustrated on Schedules D1 through D4. These mineral resources play a significant role in the Region’s economy in providing necessary raw materials for buildings, roads and other construction projects. Policies for mineral resources are intended to ensure that these natural resources are available for future use and that their management is compatible with the natural and human environment.*

- “Resources” - Niagara Region, Living. Chapter 6. Accessed March 4, 2023. <https://www.niagararegion.ca/living/icp/pdf/2015/Chapter-6-Resources.pdf>

The uneven nature of glacier erosion, some higher hills became Great Lakes islands. The Niagara Escarpment follows the contour of the Great Lakes between New York and Wisconsin.<sup>1</sup> The Great Lakes are the largest group of freshwater lakes on Earth by total area and are second-largest by total volume, containing 21% of the world's surface freshwater by volume.<sup>2</sup> The oldest exposed rocks lead us back more than four hundred and fifty million years, to a time when much of the Precambrian Shield of Paleozoic North America, called Laurentia was submerged and covered by shallow tropical seas. A variety of rocks, sandstones, shales, and carbonates were produced during this time interval and are now exposed in the Niagara Gorge.<sup>3</sup>

1 "Welcome to the GLY 103 Niagara Falls Field Trip." Department of Geology - Buffalo, Accessed December 7, 2022. <http://www.glyfac.buffalo.edu/Faculty/jorgm/WebJorg07/gly103trip.htm>  
 2 Ibid.  
 3 Ibid.



**Figure 37:** Schematic geological cross section through the western end of the Lake Ontario basin to the eastern end of the Lake Erie basin, showing the locations of the lakes relative to the southward dipping Ordovician to Mississippian stratigraphic succession.

Many ecological ideas in design can incorporate recreation and there are many uses for a pond that can be enjoyed, including wildlife observation, and skating.<sup>4</sup> If the pond is intended for public use it is especially important to have vehicle access roads near by in the case of an emergency and sanitary facilities should also be available.<sup>5</sup> Therefore, with the intention of building new ponds on site, one intended for wildlife and the other skating, one must be accessible by vehicle and pedestrain. The size and depth of your pond will be determined by the type and quantity of fish you wish to stock it with, and It is important to enhance the habitat of your pond to provide a healthy environment for your fish.<sup>6</sup> Piles of stone, large rocks and anchored logs provide hiding places for predator fish, and anchored brush piles give minnows appropriate habitat until aquatic vegetation can grow. Shallow areas should be available for spawning.

4 "Pond Uses, Site Selection, Design, Construction, and Maintenance." - Monroe County Soil & Water Conservation District. July 22, 2013. Accessed March 3, 2023 <https://www.yumpu.com/en/document/view/17974242/pond-uses-site-selection-design-construction-and-maintenance>

5 Ibid.

6 Ibid., 7

Terrestrial Invasive Flora that pose a threat to native biodiversity;

- Garlic Mustard
- European Buckthorn
- Common Reed
- Dog-strangling Vine



Trillium - noat



Lavender



Solomons seal



Virginia Creeper

Native Species:



Elderberry (Common)



Rosemary - Bog



Dogwood



White Ash



Smith

Figures 38



**Figure 39:** Large Oak tree found on the Lock 4 site adjacent to Canal



**Figure 40:** Red Shale found at the bottom of the drained Welland Canal in the winter months

### Terrestrial Eco region -

- Eastern Temperate Forests
- Eco-zone: Mixed Wood Plains
- Lake Erie Lowland

### Climate

- Upper half: Humid Continental  
Hot summers  
with Year-round Precipitation
- Humid Continental Mild  
Summer, Wet All Year

### Common Species

Evergreen Pine  
Oak  
Maple  
Beech

In the case of the site along the canal, and my design intention furthering the notion of what's public and private, an excavated pond is often built on level terrain and its depth is achieved solely by excavation.<sup>7</sup> An excavated pond is relatively safe from flood damage, is low maintenance and can be built to expose a minimum water surface area in relation to volume. This is beneficial in areas of high evaporation losses and a limited amount of water supply.<sup>8</sup> Ponds can create an invaluable habitat for wildlife, since they provide resting places for migratory waterfowl, breeding places for ducks and watering holes for all types of wildlife.<sup>9</sup> In addition, they enhance water quality and landscape diversity, and it is important to provide an

7 Ibid.  
8 Ibid.  
9 Ibid.

## Invasive Terrestrial Fauna:

- Gypsy Moth (*Lymantria Dispar*)
- Beech Bark Disease
- EAB - Asian beetle
- Negative impact on;
  - Ash trees - dying due to infestation



**Figure 41:** Northern Dusky Salamander is one of the most endangered species that is native to Niagara

## Aquatic

Thought to have dispersed through the Welland Canal from Lake Ontario to Lake Erie;

- American Eel (*Anguilla Rostrata*) in 1850
- Sea Lamprey (*Petromyzon Marinus*) in 1921
- Alewife (*Alosa Pseudoharengus*) in 1931
- White Perch (*Morone Americana*) in 1950

Thought to have dispersed through the Welland Canal in Ballast water;

- Threespine Stickleback (*Gasterosteus Aculeatus*)
- Ruffe (*Gymnocephalus Cernua*)
- Tubenose Goby (*Proterorhinus Marmoratus*)

Current invasive species that pose a risk on the Great Lakes;

- Asian Carp
- Eurasian Water Milfoil
- European Frog-bit
- Yellow Iris
- Round Goby
- Zebra and Quagga Mussels
- Rusty Crayfish
- Golden Mussel
- Asian Clam
- Sea Lampre

Weaving Access

## *Native animals to southern Ontario Niagara Region*



*338 species of birds  
102 species of fish  
35 species of mammals  
14 species of reptiles  
17 species of amphibians  
12 species of mussels  
734 specials of plants*

*of these species 59 are  
protected federally in Canada  
and 70 provincially in Ontario*

**Figure 42:** Blue Jay in Cicada Tree in St. Catharines

environment that is attractive to the wildlife it is intended for, since large amounts of vegetation including tall grasses and other plants should surround the pond, and should have both shallow and deep areas and be in a somewhat quiet and secluded location.<sup>10</sup> The strategies that could be implemented in order to achieve a more sustainable future in coastline areas of Niagara for both human population and wildlife, due to the large population of shorebirds found near the Niagara River, it is considered an important tourism attraction for bird watching, that could be expanded to inland water shorelines.<sup>11</sup> Ecotourism through bird watching allows coastal communities to improve their economic status while obtaining support for conservation of their natural areas.<sup>12</sup>

10 Ibid.

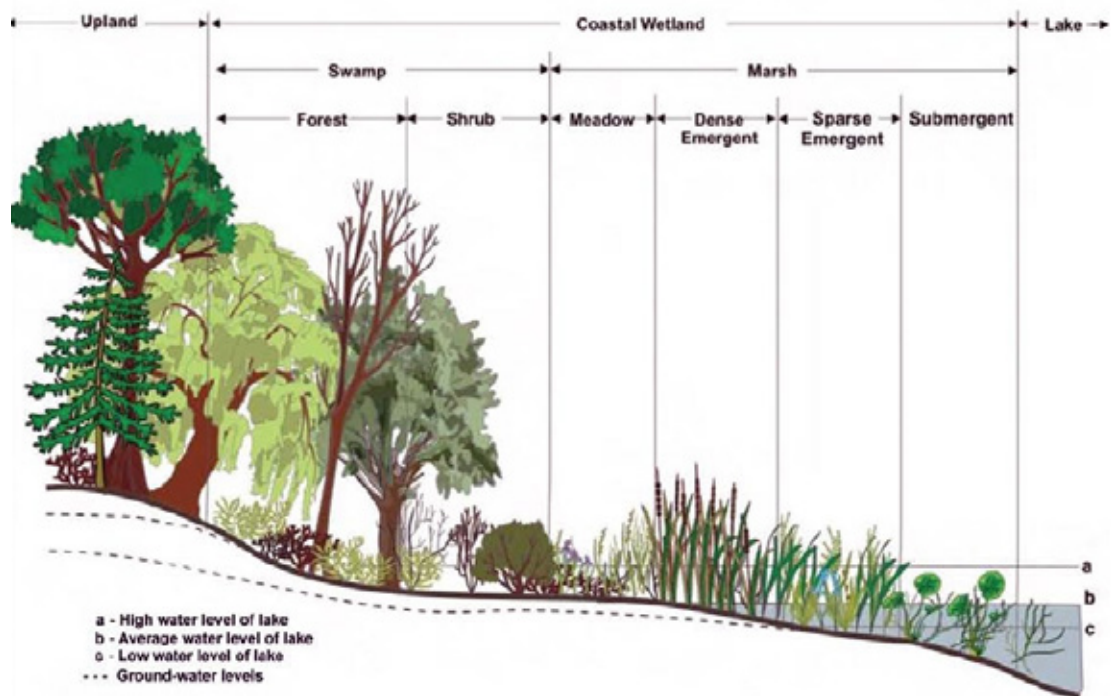
11 "Ecosystem-based Adaptation to Protect Avian Species in Coastal Communities in the Greater Niagara Region, Canada." Samantha Gauthier, Bradley May and Li, June 4, 2021. Accessed March 2, 2023. <https://doi.org/10.3390/cli9060091>

12 Ibid.

## Common Species

Squirrels  
 Skunks  
 Raccoons  
 White Tailed Deer  
 Weasels  
 Rabbits  
 Red Foxes  
 Muskrats

**Figure 43:** Generalized schematic of Great Lakes waterline ecosystem





Monarch Butterfly on Milkweed  
**Sudbury, Ontario**





**Figure 44**

An important precedent for addressing toxic chemicals associated with climate change in polluted water is a project where Fish Fry Lake in Montana contained high levels of nitrogen and phosphorus, similar to the Welland River upstream from the Twin Flight Locks, as a result of agricultural fertilizers and animal waste.<sup>13</sup> Developed by a company called Floating Islands International, a BioHaven island, starts with layers of mesh made from recycled plastic and is assembled this mesh into a floating raft and top it with soil and plants.<sup>14</sup> This bacterial biofilm is the secret to a floating island's cleansing power since overgrowth of algae from nitrogen and phosphorus pollution can cause several problems, preventing sunlight from reaching subaquatic plants and starving a body of water of the oxygen needed to sustain fish populations and other animal life.<sup>15</sup> With the idea of extending the escarpment, topography can be optimized not only with the drainage but also around the crown to create a green corridor, which may be accessible for both human and non-human species. A great precedent for this idea is the Fielding Park Memorial bird sanctuary in Lively Ontario, just outside of Sudbury, which holds some of the key values of this thesis project and can be further explored in terms of land preservation and bodily healing, rooted in recreation.

---

13 Athens, Emily. "Nature's Water Purifiers Help Clean up Lakes." BBC Future. BBC, September 25, 2012. Accessed Nov. 20, 2022. <https://www.bbc.com/future/article/20120925-natures-water-purifiers>.

14 Ibid.

15 Ibid.



**Figure 45:** “BioHaven island”



**Figure 46:** GH3 - Borden Park  
Natural Swimming Pool

**Figure 47:**  
Seine-Nord Europe  
Canal Project

Building pool systems, fish ladders, fish locks, elevators and artificial channels to enable migrating fish to get past dams.<sup>16</sup> Whenever possible, using “soft” engineering techniques instead of civil engineering approaches to bank protection, including measures to promote the development of indigenous vegetation on the canal and river banks.<sup>17</sup> Establishing game and beaver passages along canals to prevent animals from drowning; openings are made in the bank protection, below normal water level, to provide animals with “footholds” that allow them to reach the top of the bank, and “biological corridors” guide beavers and other mammals towards natural paths to keep them from crossing roads.<sup>18</sup>

Protecting and restoring natural environments e.g. rehabilitating fish spawning grounds), and drafting documents detailing objectives

16 Inland Waterways and Environmental Protection - OECD. August 17, 2006. Accessed December 2, 2022. P52 <https://www.itf-oecd.org/sites/default/files/docs/06waterenv.pdf>

17 Ibid.

18 Ibid.

related to the Natura 2000 network. Inclined banks will have to be planted with suitable trees and shrubs, and where lagoons separate navigation channels from banks they will be seeded with aquatic plants. To control water pollution, measures will be needed to avoid pollution due to surface water run-off, drainage, and contamination by organic matter and minerals from waste water. The plans should also include fish spawning and rearing areas.<sup>19</sup>

---

19 Ibid.



## Opportunities for Engagement & Public Participation

- Developing educational materials (e.g., interpretive signage, pamphlets, brochures, training modules)
- Engaging the public in community events such as guided field trips or basic invasive species control activities
- Organizing and facilitating workshops
- Timing (e.g., time between contractor spraying and public Garlic Mustard pulls, effective time for controlling plant, engaging volunteers outside of key vacation months/ holidays)
- Ability (e.g., hand pulling of an easily-identifiable species, level of training/ experience of participants)
- Health and Safety (e.g., no contact with toxic materials (plant or herbicidal), avoidance of work on steep slopes, water hazards, working alone)
- Accessibility (e.g., sites easily accessible; generally flat areas are best for a wide range of groups)

- City of Mississauga Invasive Species Management Plan. Accessed November 15, 2022. <https://www.mississauga.ca/wp-content/uploads/2021/02/18112420/Invasive-Species-Management-Plan.pdf>

The hidden atypically abled population can also be simultaneously addressed through special amenities at a site along the Welland Canal. Since “We are all likely to experience a disability in some way,” spaces that may engage the ageing population, those recovering from an injury, not just those born with disabilities, will be the main focus of this project.<sup>20</sup> The St. Catharines-Niagara Census Metropolitan Area (CMA) has 90,500 persons with disabilities (28.9%), St. Catharines-Niagara CMA has a higher proportion of individuals with disabilities compared to Ontario (24.1%), who are typically excluded from what some would consider basic amenities, such as urban parks and spaces of healing and wellness.<sup>21</sup> Community and ecological-centred design with direct links to more intimate scales of architecture will serve the users of both human and non-human elements. Users such as my sister who was born with cerebral palsy, born blind and unable to walk, are not something we dwelled on as a family but rather took the opportunity to provide for her the best environments possible.

20 Claire Eason. (2020). Design Thinking: Steps Toward Accessible Architecture. Accessed October 21, 2022. P. 77

21 “Niagara Priority Profiles - Disabilities - Niagara Region.” accessed October 19, 2022. <https://www.niagararegion.ca/health/equity/pdf/priority-profile-disabilities.pdf>.

Growing up in Ontario has led me to discover many different parks, and understand how there is an indirect or “hidden” link between different types of pathways, and also essential services such as water and shelter or something as simple as a place with appropriate materials and sound. The typical user would not particularly require a high level of thought and consideration in the design of public spaces because ultimately, like William H. Whyte once said, “People like to sit where there are places for them to sit.”<sup>22</sup> However, users such as my sister, and many other individuals are faced with daily accessibility challenges and do require a higher level of thinking to create barrier-free spaces. Ironically, these thoughtful spaces in design ultimately become the new standard once adopted so freely. Modernization isn’t about making something cheaper and more functional, it’s about adopting a new way of thinking that saves time and money to use for relative issues in our daily environment. This generated space for the accessibility of users becomes more complex with its location. That being said, how we achieve this is not limited by people, but rather by the atmosphere and existing condition of the location. By using a kit of parts methodology, we can implement a unique strategy,

22 “A Primer on Seating.” Project for Public Spaces, December 31, 2008. <https://www.pps.org/article/generalseating#:~:text=%22This%20might%20not%20strike%20you,as%20they%20could%20sit%20somewhere.>

map, or structure to improve the engagement between different individual living things and the built environment.

*Barrier-removal is the process by which disabling conditions are eliminated. When barriers pass unnoticed and are not removed, people with disabilities are prevented from participating fully, and stereotypes about what people with disabilities can and cannot do are perpetuated.*

- Ontarians with Disabilities Act, 2001. (2002). (P. 6)

Discovering the difference between land use and accessibility, I am choosing to develop a concept that allows a mismatch or “hurdle” if you will, to be seen as an advantage, where edges become softened, lanes become designated, and a more experiential sequence of spaces becomes available for users.

This thesis aims to address the rising need of social refuge for the hidden atypically abled population through special amenities along the Welland Canal Parkway in the Niagara Region. Since “We are all likely to experience a disability in some way,” spaces that may engage the ageing population, those recovering from an injury, not just those born with disabilities, will be the main focus of this project. Those who are typically excluded from what some would consider basic amenities, such as urban parks and spaces of healing and wellness, therefore a community hub or “field house,” with direct links to more intimate scales of the building will serve them while simultaneously tackling the industrialization and given standards of the existing life along the site.

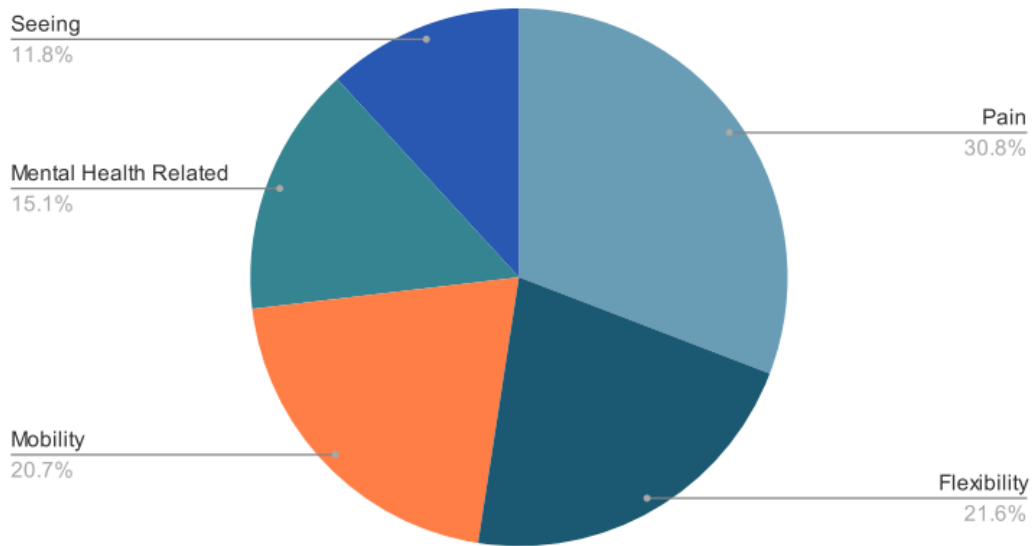
Although not all users in the Niagara region are suffering from the same circumstances, based on Statistics Canada’s survey from 2017, the top five disabilities in Ontario are pain (67.8%), flexibility (47.5%), mobility (45.5%), mental health related (33.1%), and seeing (26.0%), many people are facing consequences that may be assisted through architecture.<sup>23</sup>

---

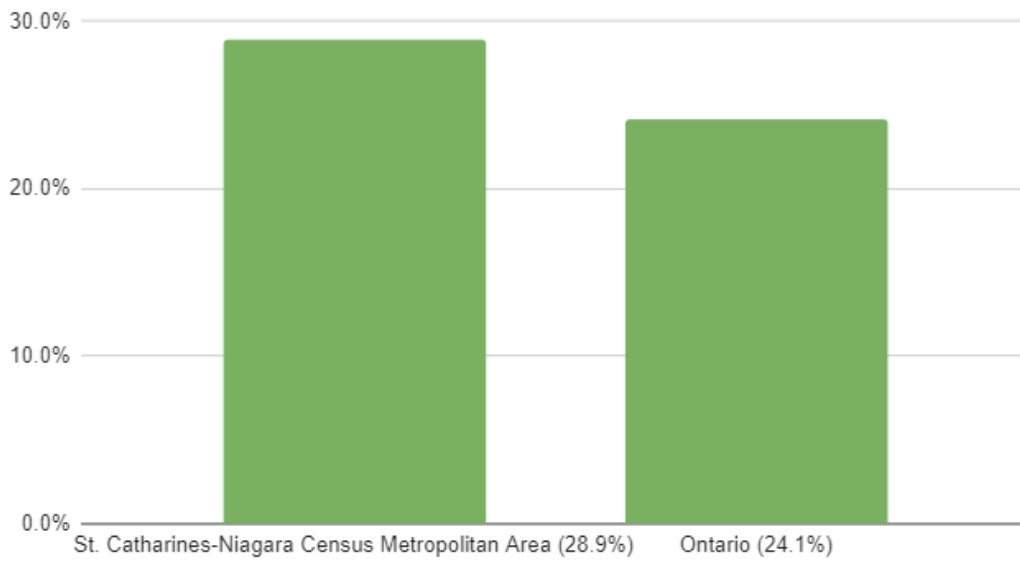
23 Statistics Canada (2018). Canadian Survey on Disability, 2017. Accessed October 19, 2022. Retrieved from <https://www150.statcan.gc.ca/n1/daily-quotidien/181128/dq181128a-eng.htm>



### Top Disabilities in Ontario



### Proportion of Individuals with Disabilities



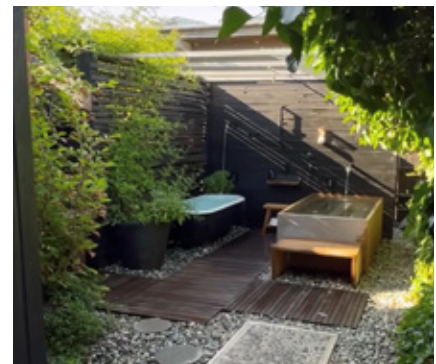


**Figure 50:** Lavender Farm in Niagara-On-The-Lake

Another strategy is using aromatherapy to create nodes of wellness such as lavender exposure, pink salt, and cedar wood, as well as saunas, to help ease the stress of users along the sequential journey through the building. In chapter 5, this aspect of aromatherapy will be explored by creating an object that could be used for healing within the proposal. This idea is important because unlike a cold plunge or hot bath like typical saunas, lavender aromatherapy can affect the senses similar to pink salt in the way that you don't need to touch it to be healed.



**Figure 51:** Pink salt and cedar wood



**Figure 52:**  
Circle Wellness Studios  
Vancouver Spa

**Anthropocene:** the current geological age, is viewed as the period during which human activity has been the dominant influence on climate and the environment.

“some geologists argue that the Anthropocene began with the Industrial Revolution”

Oxford Languages 2023

What is the experience of the site for a fish, a bird, etc?  
What can/do these entities do for humans and vice versa?  
What are their (site) relationships? Maybe there are areas of the site that are voluntarily unoccupied or blocked for humans, left unplanned?

*In anthropology, then, we go to study with people. And we hope to learn from them. What we might call ‘research’ or even ‘fieldwork’ is in truth a protracted masterclass in which the novice gradually learns to see things, and to hear and feel them too, in the ways his or her mentors do. It is, in short, to undergo what the ecological psychologist James Gibson calls an education of attention (Gibson 1979: 254; cf. Ingold 2001). But besides subjecting themselves to this kind of education, many fieldworkers are committed to documenting the lives and times of their host communities. This work of documentation is known as ethnography.*

- Ingold, Tim. Making, Anthropology, archaeology, art and architecture. 2013. Routledge. Knowing from the Inside.

1

2

3

4

5

Greater

Site

HISTORY  
ECOLOGICAL

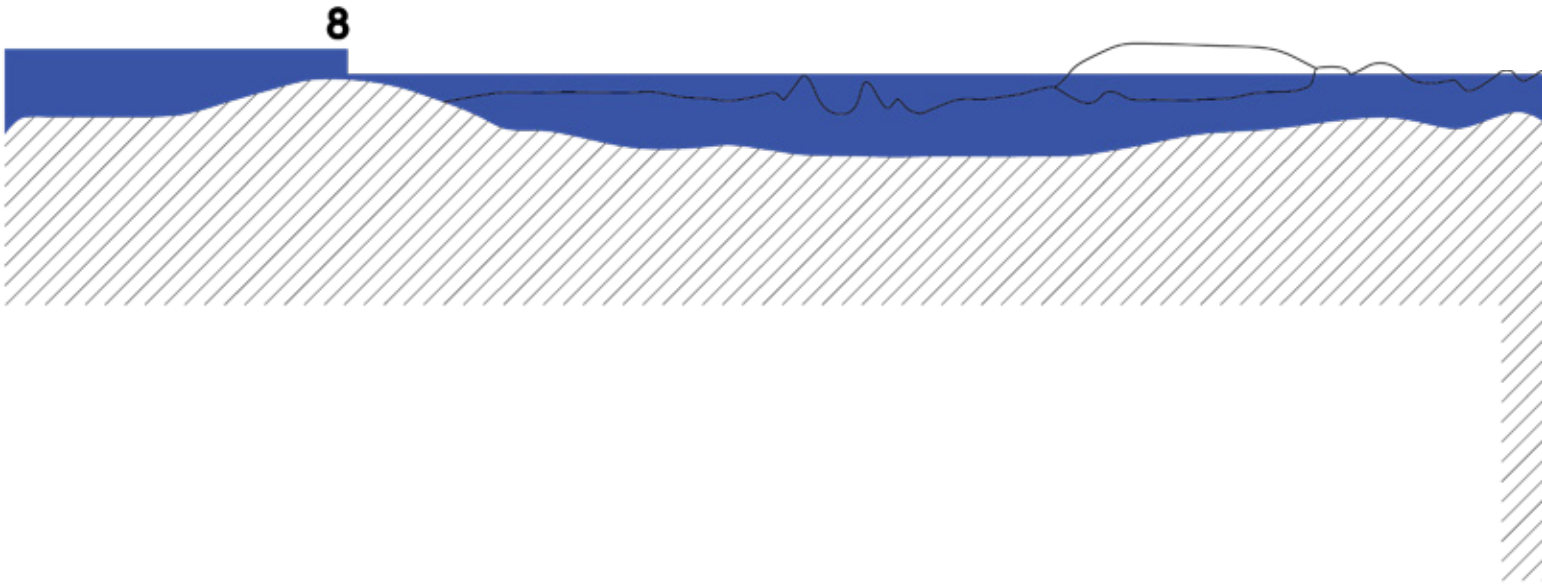
**s i t e**

STRATEGIES

**T**he local site that is the Welland Canal, and how the exact location of a site that best acts as a control point for invasive species, the existing identity of the canal from an outsider's perspective, and the existing conditions that are problematic for the current informal use of the site, due to hard engineering and overall industrial proximity. When we zoom further into the site and begin layering land uses onto a map, we can understand the many factors that play a role in the existing function of the area, including the intersection of railway, street, ship, and the Bruce Trail. During the winter, many people come here to go sledding, and in the summer, longboarders use the slope to descend the hill. Potential programs for the project complement the existing use and foster the demand for the ageing and disabled population while centring around ecologically based design.

Since the area chosen is owned by the St Lawrence Seaway Management Corporation, however, is and has always been an open field, it is the perfect location not only because it is sandwiched between two different industrial sites, but also because of its adjacency to the most heavily engineered section of the Welland Canal, and has the potential to change the narrative culturally, and ecologically.

Weaving Access

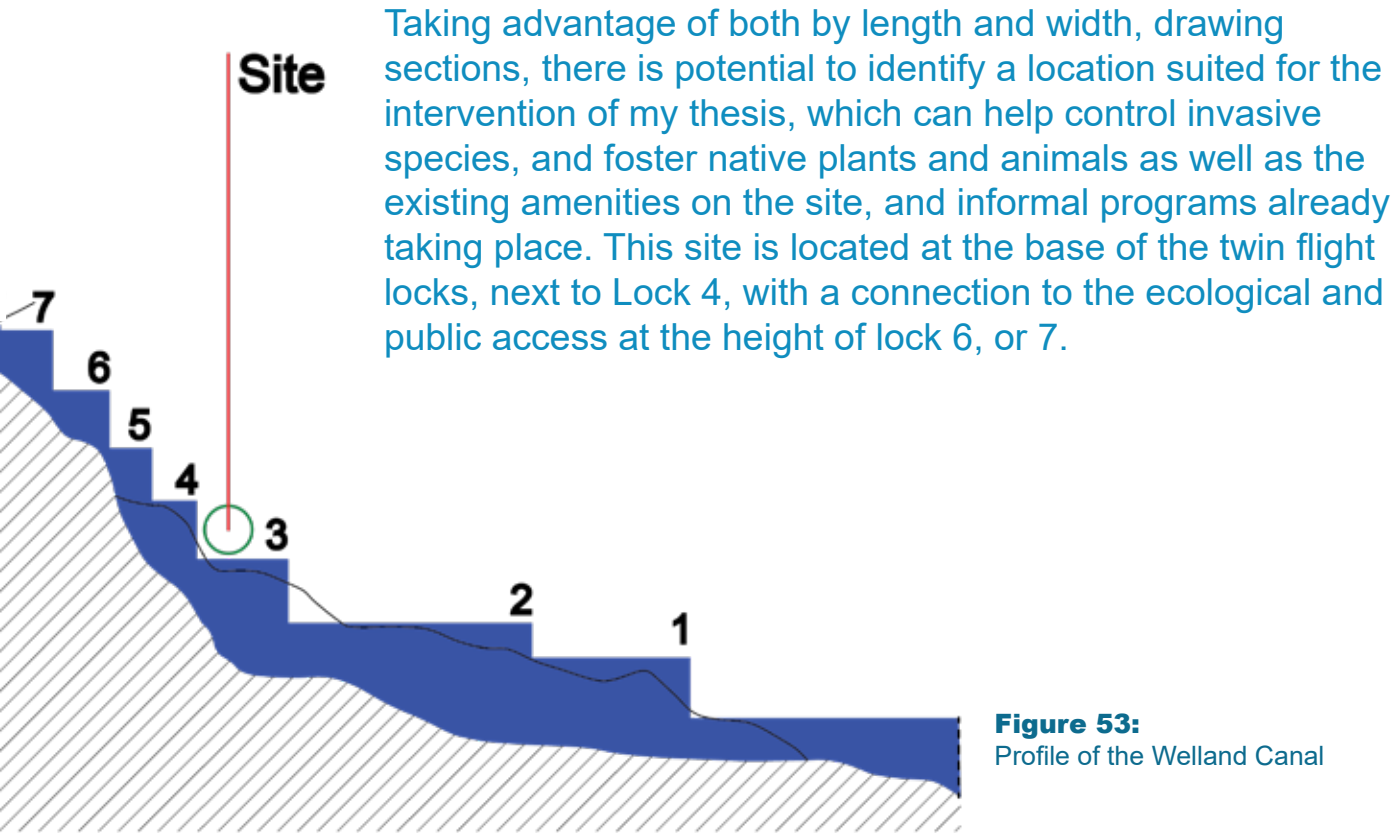


### 4th Canal (present day)

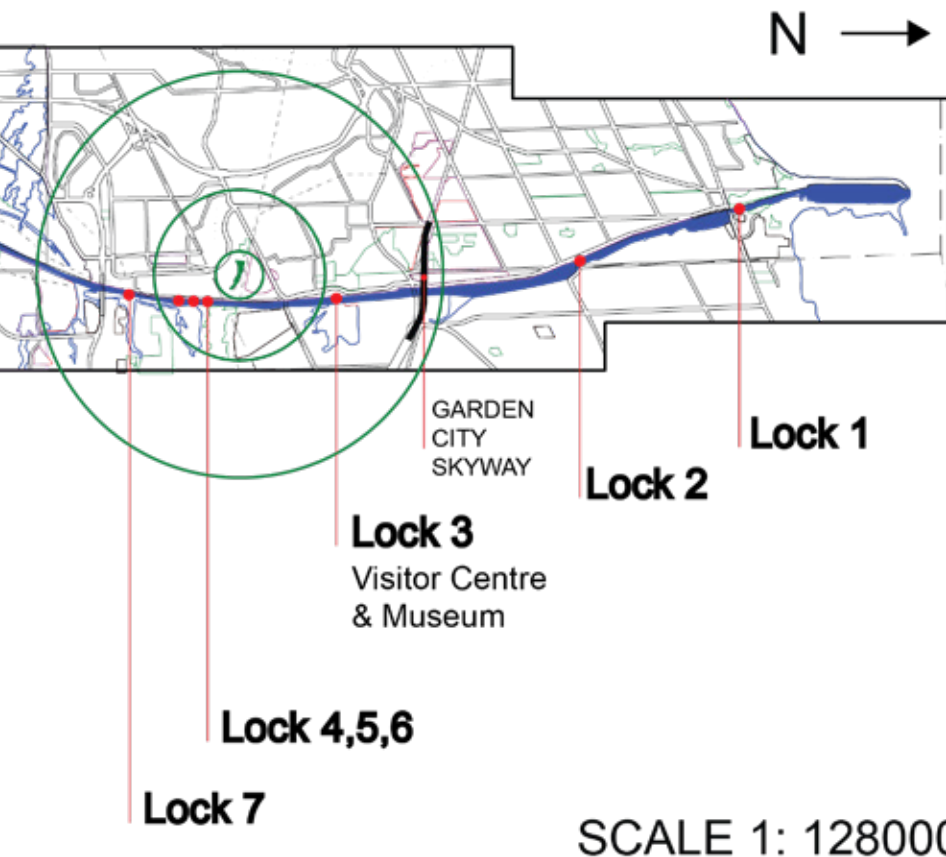


**Lock 8**

This keymap shows the location of each lock, as well as the top-down profile of the fourth, and existing Welland canal, where north and St Catharines, the densest urban city, are oriented to the east, and a sense of scale is revealed between the Garden City Skyway and the site I've chosen to the east.

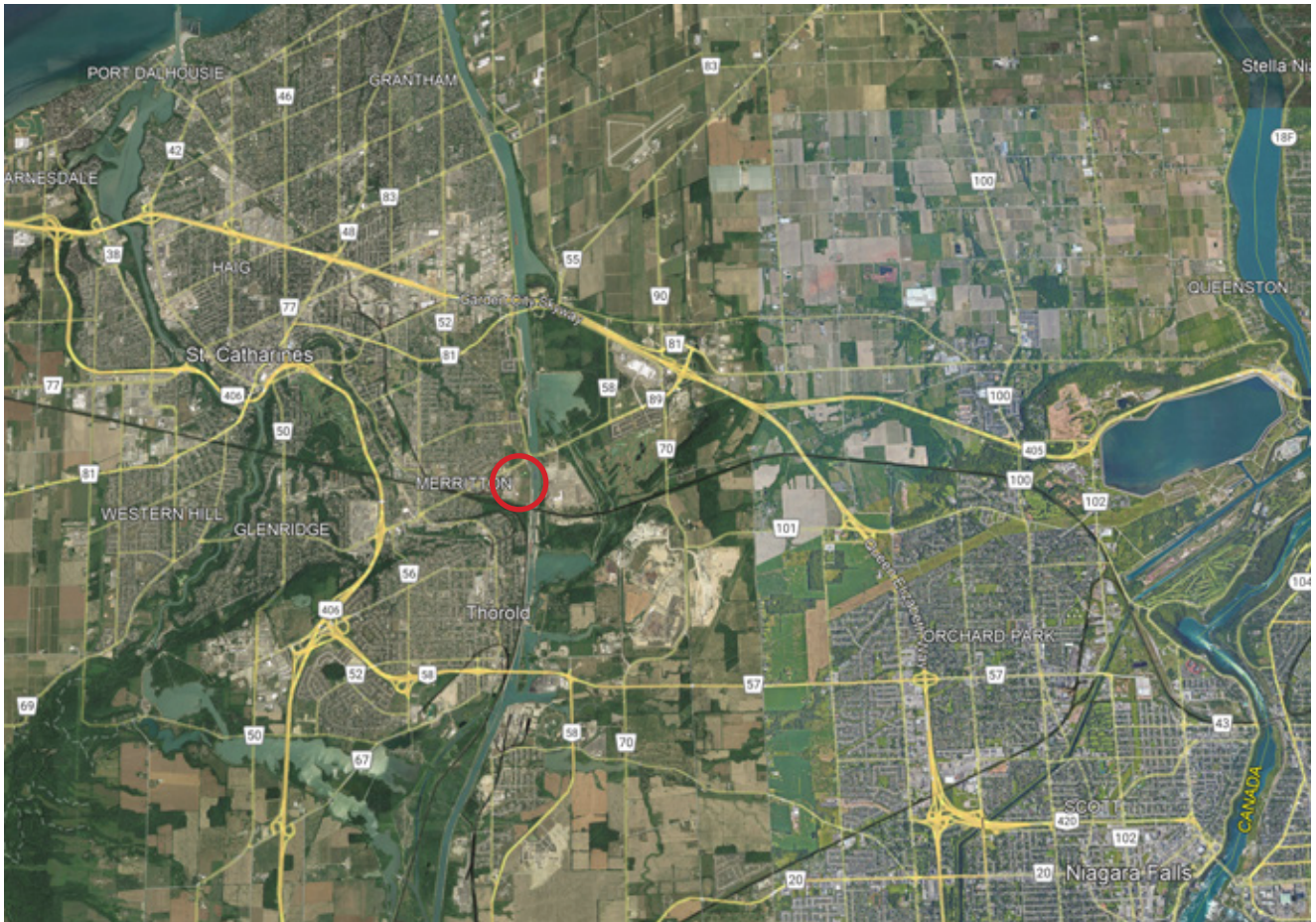


**Figure 53:**  
Profile of the Welland Canal



**Figure 54:**  
Kep Map of Welland Canal

Taking advantage of both by length and width, drawing sections, there is potential to identify a location suited for the intervention of my thesis, which can help control invasive species, and foster native plants and animals as well as the existing amenities on the site, and informal programs already taking place. This site is located at the base of the twin flight locks, next to Lock 4, with a connection to the ecological and public access at the height of lock 6, or 7.



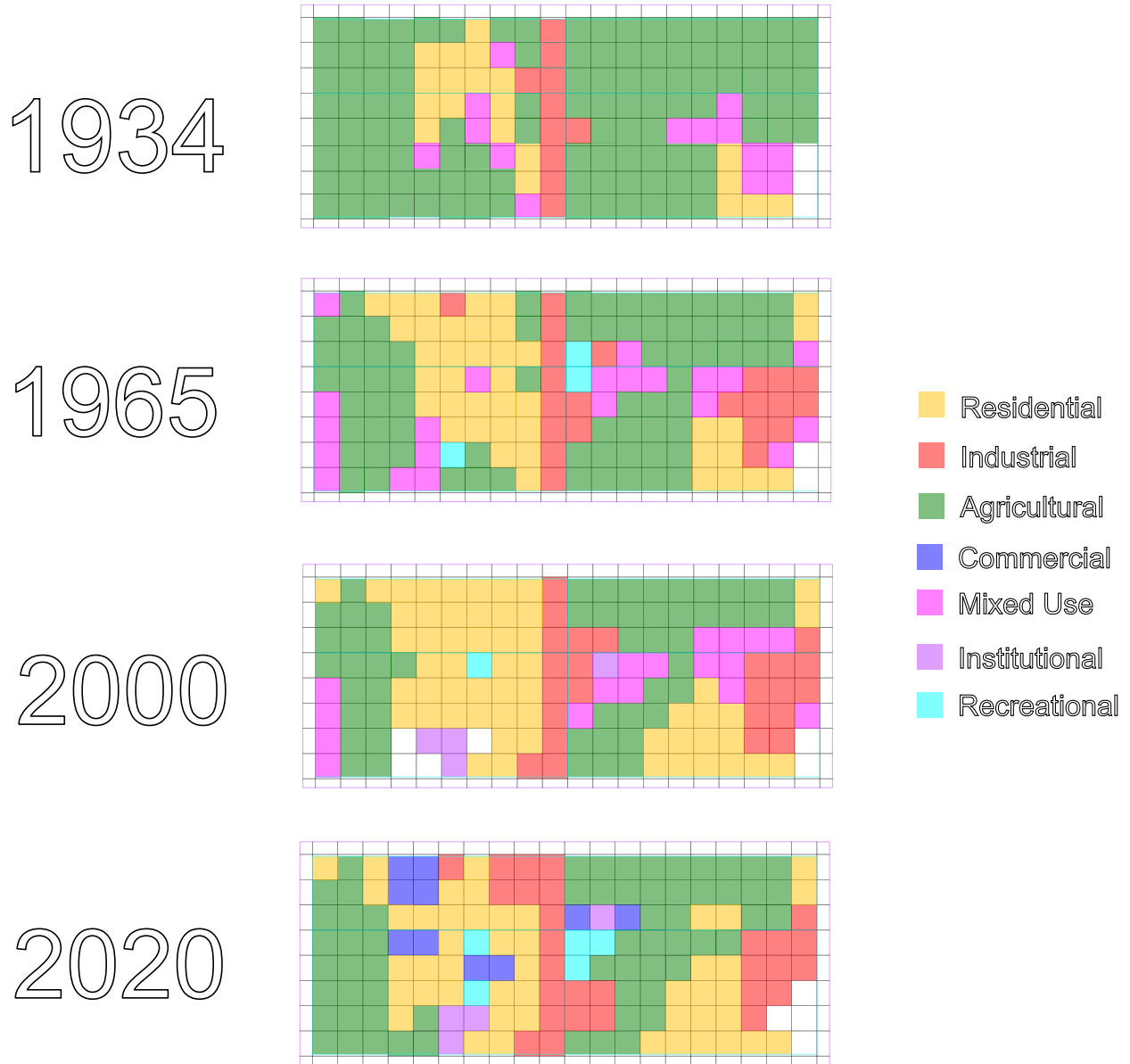
**Figure 55:** Satellite View of Niagara Region

**Site:** ○

A junction of four municipalities, St. Catharines, Thorold, Niagara-on-the-Lake, and Niagara Falls all meet, and the region is divided by the Queen Elizabeth highway and Canadian National Railway system, where the GO train from Toronto will eventually meet Niagara by 2040.

From this scale, and looking at satellite imagery over time, we can understand the zoning of land use, which had a major shift from agriculture to residential. From the current land use layers and the oldest imagery we can view, there is a major difference in how the Niagara Escarpment has been affected over time, with residential land encroaching on this now protected land over time.





**Figure 56: Zoning Over Time**

2020

Green Spaces & Escarpment



Niagara Escarpment



1934

**Figure 57: Difference in Niagara Escarpment Green Space over Time**

The train tracks running through the site create more of a divide between the residential neighborhoods than the municipal boundaries, giving the sense of industrial influence on the site. The green space within what's left of the Niagara Escarpment is encroached by the industrial boundaries and surrounded by residential neighborhoods in St. Catharines (North) and Thorold (South).

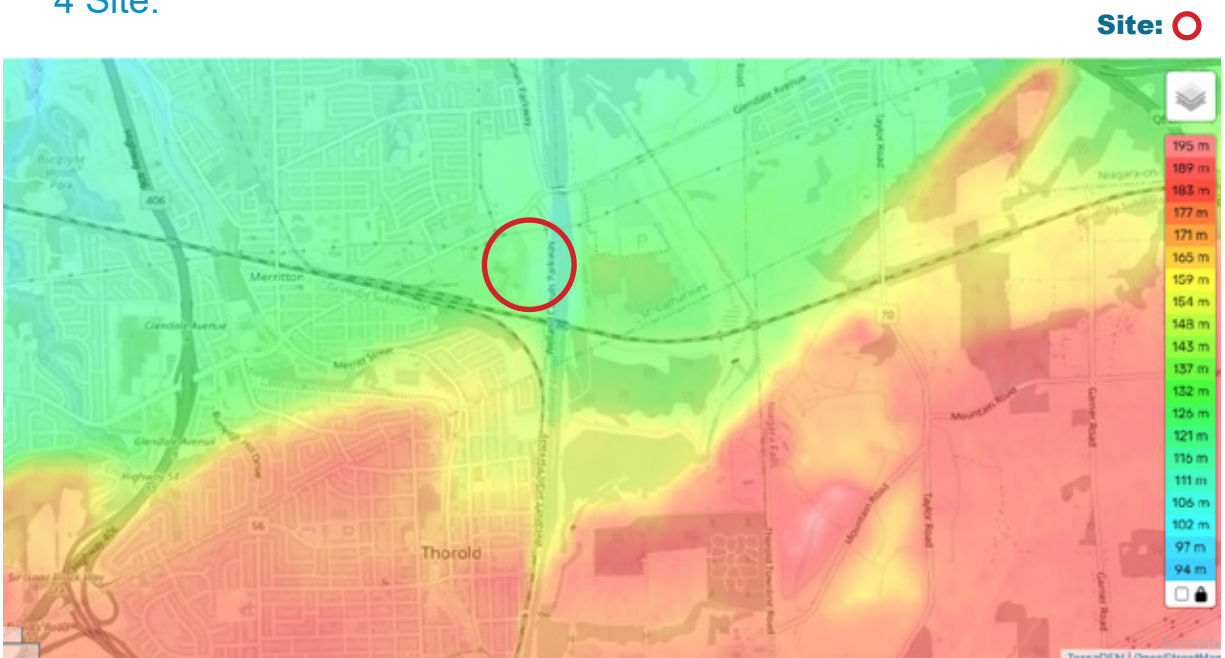
The layers that fill the gaps between these major influences are weaved together with the current Welland Canal, what's left of the historical third ship canal, mostly small trail systems, and major roads that connect each municipality. Major commercial buildings such as the Pen Centre shopping mall and many old restaurants and hotels are situated within the context of the Lock 4 Site.

**Figure 59:** Site Boundaries Map

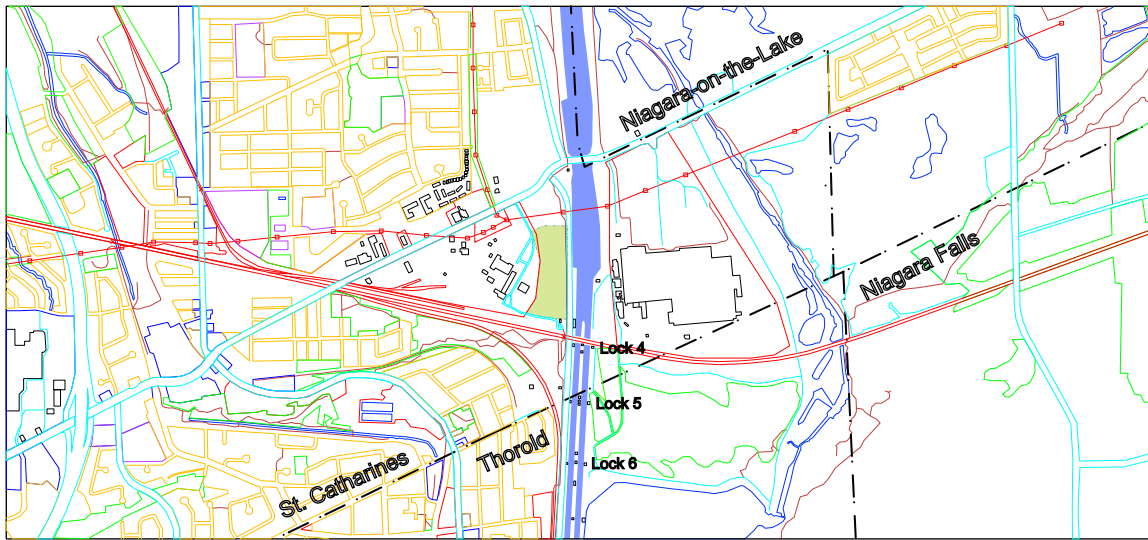
Here, along the Niagara escarpment, the site contains a multitude of corridors. Ships, trains, trails, and roads all form a junction here, while people from around St Catharines and Thorold have traditionally used this site for tobogganing, and now it is blocked off. Here we see the junction between the four municipalities, and the scale of the site almost acting as a wedge between each of the layers.

**Figure 60:** Urban Layers

When exploding them, we see the major land use is residential and industrial, and is strung together with what's left of the escarpment. The major road running to both significant commercial shopping centres, and major roads leading to both major institutions including Brock University, and Niagara College, the two major institutions in the Niagara Peninsula, weaved together by informal and small formal trail systems blindly linking one another.



**Figure 58:** Topographical Map of Urban Context

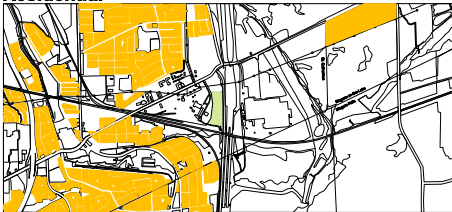


- MUNICIPAL
- INDUSTRIAL
- COMMERCIAL
- RESIDENTIAL
- TRAILS
- WELLAND CANAL
- WATER
- PARKS
- PROTECTED LAND/FORESTS
- HIGHWAYS
- ROADS
- RECREATIONAL
- RAILWAY
- NIAGARA ESCARPMENT
- BUILDINGS
- HYDRO LINES



# Site Boundaries

**Residential**



**Industrial**



**Green Spaces & Escarpment**



**Railways**



**Canal (Purple) & Water (Blue)**



**Institutional**



**Trails**



**Major Roads**



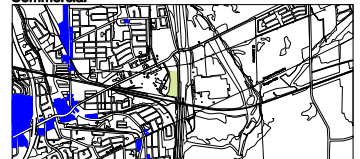
**Highways**



**Adjacent Buildings**



**Commercial**



# Urban Layers

From different scales, and using an American internet service that tracks physical exercise that tracks cycling and running routes called Strava, elevation changes, green, urban, rail and water information, we can decipher the most commonly used methods of approach to the site. For running, the main routes are as follows:

The **“Twin Flight Locks”** route, with a 2.03km distance, 2.6% grade, and 53m elevation gain, this trail has been attempted 706 times.

The **“Glendale - Canal to Hartzel”** route, has a distance of 1.78km, and only a grade of 0.4%, with an 8m elevation gain, and 636 attempts.

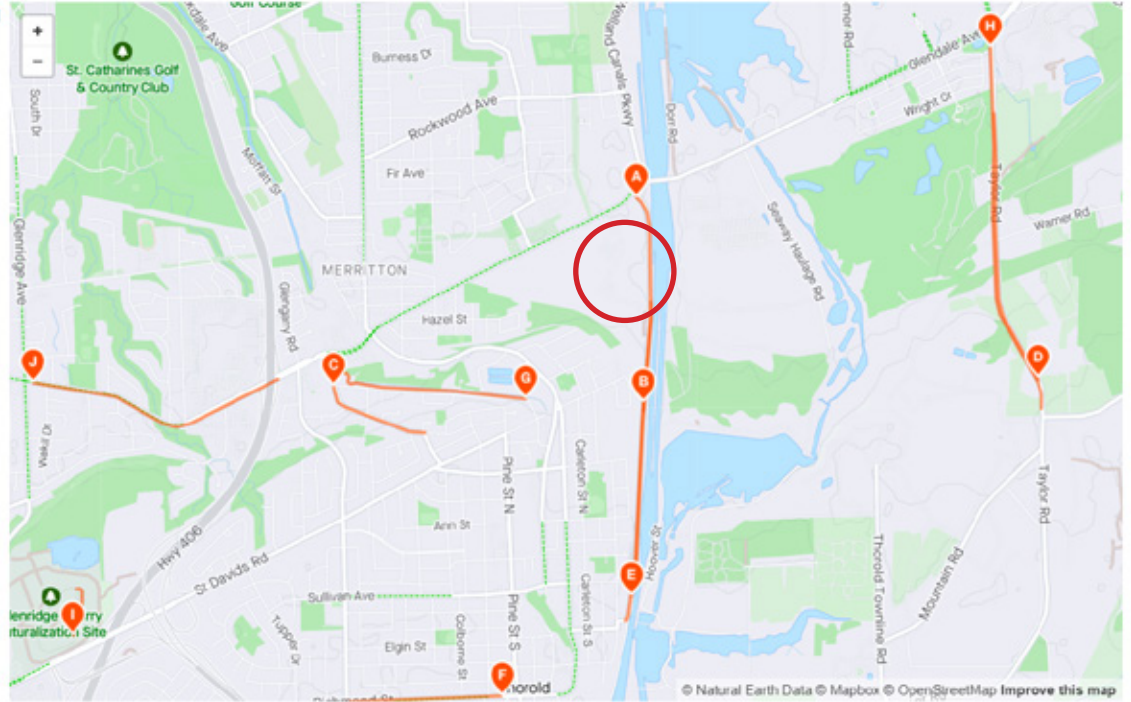
**“DQ to Tims up Merrit”** to the West, connecting St. Catharines and Thorold, has a distance of 2.77km and a grade of 1.6%, but has a 45m elevation gain, and only 17 attempts.

The **“Taylor - Glendale Bruce”** trail to the East, has a distance of 2.28, a grade of -1.2%, 32m in elevation gain, and 426 attempts.

**“Glendale to Lock 3,”** has a distance of 1.26km, a -0.5% grade, 6m elevation gain, and a whopping 2160 attempts. This trail of course starts at Glendale next to the vertical lift bridge and continues along the Welland Canals Parkway Trail that extends 40km along the entire Canal. It is safe to say this trail is the most heavily used by foot traffic within just over a 1square kilometre radius.

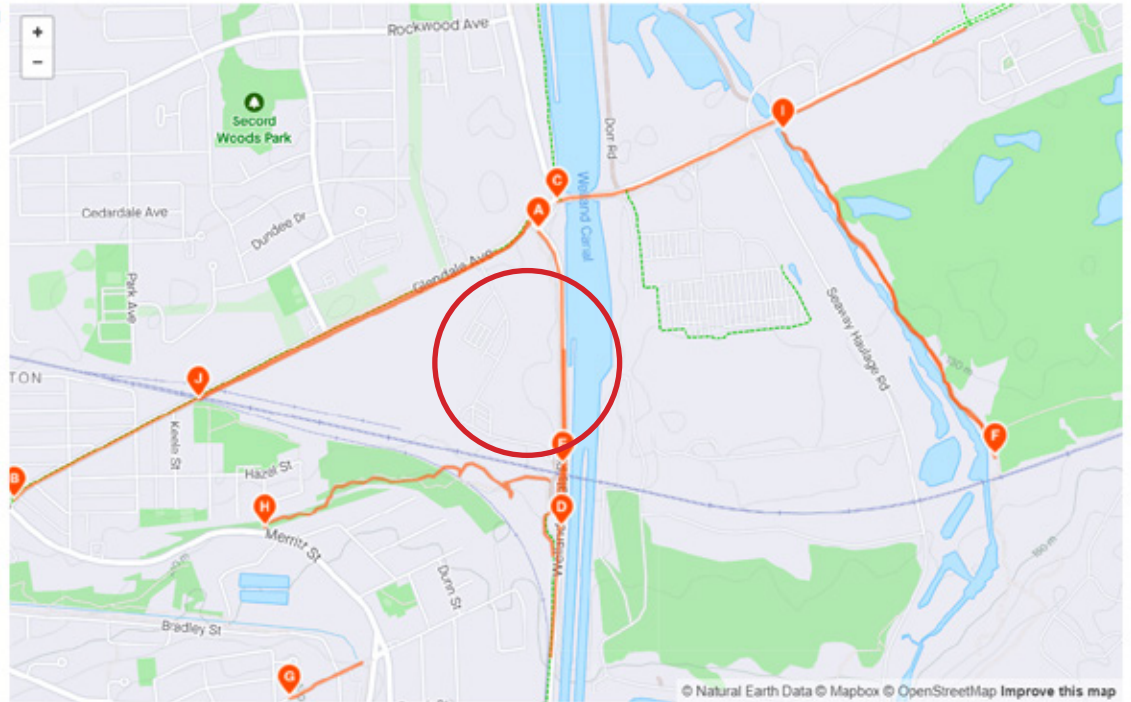
**Segments**

- A** lower canal climb  
1.29 km 1.1%
- B** Upper Canal Climb  
1.31 km 2.0%
- C** Mountain St. in St. Cath...  
0.65 km 6.2%
- D** Downhill Sprint  
1.64 km -3.4%
- E** Canal Descent w/o flat s...  
1.75 km -2.9%
- F** Between Two Lights  
0.93 km 0.4%
- G** Bradley Gravel Descent  
1.22 km -2.3%
- H** Short and Spicy  
2.22 km 2.6%
- I** Summit Overlook Climb  
0.32 km -0.1%
- J** Pen Centre  
1.58 km 0.5%



**Segments**

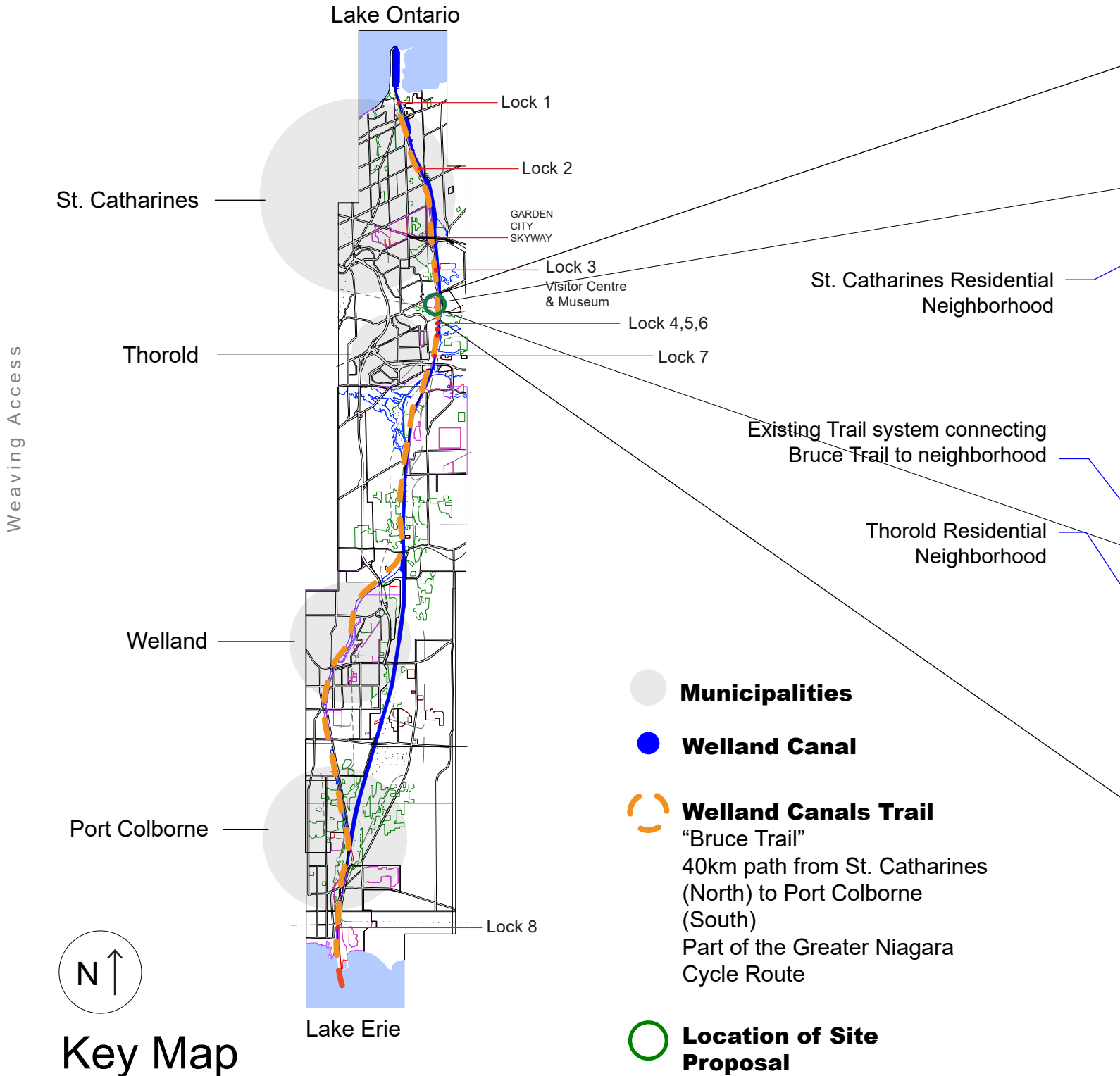
- A** lower canal climb  
1.29 km 1.1%
- B** Glendale Merrit to the c...  
1.79 km -0.4%
- C** Welland Canal Bump  
1.33 km 0.0%
- D** Canal Descent Upper  
0.53 km -4.0%
- E** Short n sweet  
0.30 km 6.9%
- F** Skirting the golfcourse  
1.14 km -1.1%
- G** The Skinny  
0.24 km -3.7%
- H** Bruce to Canal Sprint  
1.10 km -0.7%
- I** Old canal single track  
1.15 km 1.1%
- J** Punching in  
1.17 km -0.2%



**Site:** ○

**Figures 61:** Map of Running Routes along Site

**Figure 62, 63:**  
Key Map & Location Plan



# Key Map

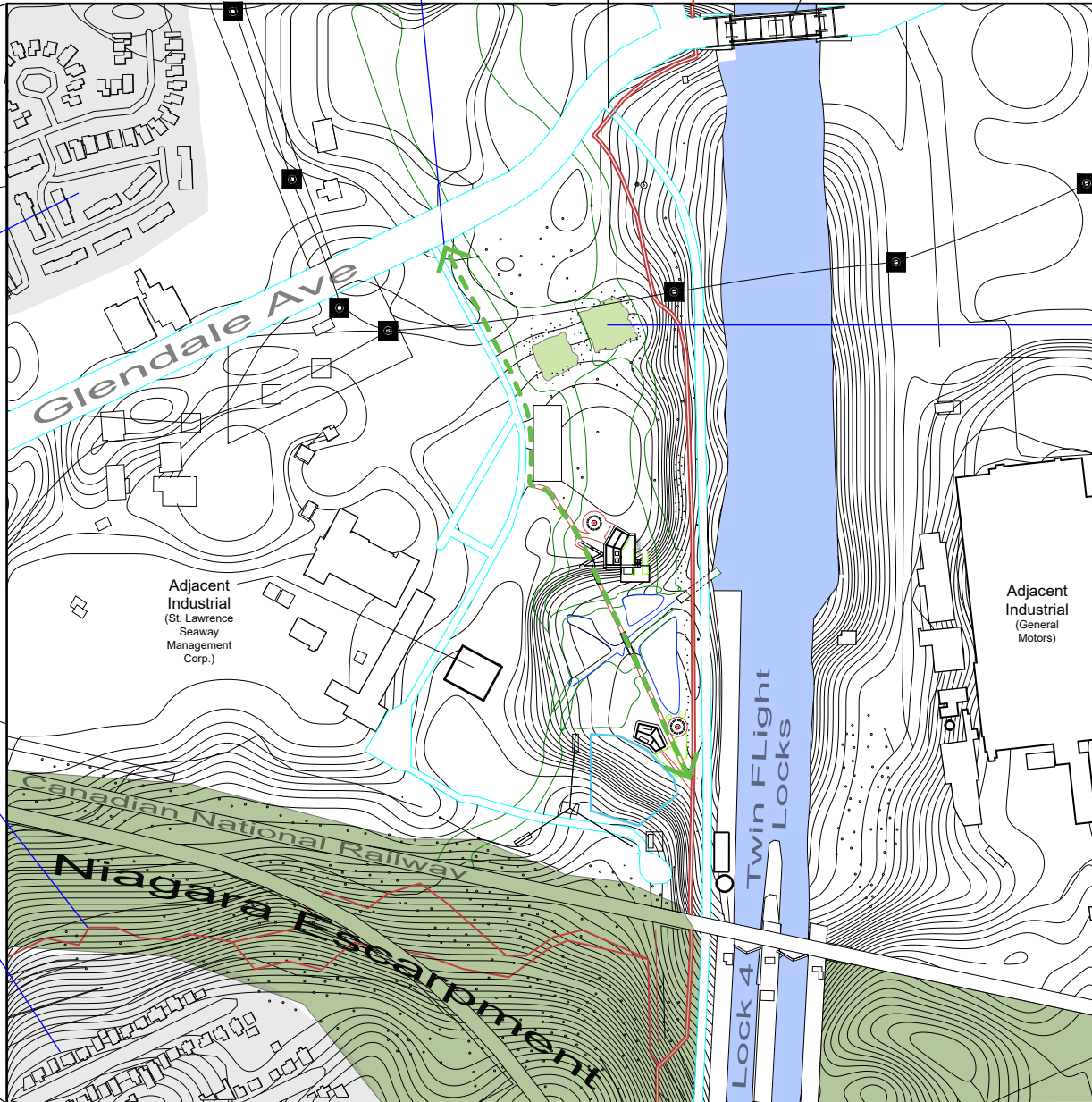
SCALE 1: 100,000<sub>m</sub>

# Welland Canals Parkway (Road)

“Short cut” from Bruce Trail to Glendale Avenue (links St. Catharines & Niagara-on-the-Lake)

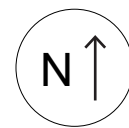
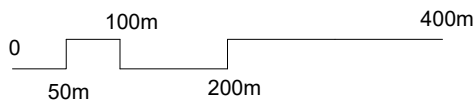
↑ Bruce Trail towards Lock 3 & Welland Canal Museum (1.2km)

Bridge 5 (Vertical Lift)



Existing Ponds

Ecological Architecture for Refuge Along the Welland Canal



## Location Plan

↓ Bruce Trail towards Lock 5,6,7 and Thorold Residential Neighborhood

# Site Visit

## 1/1/2023

The canal has a total lift of 99.5 m through a series of eight locks that enable ships to ascend and descend the Niagara Escarpment to bypass Niagara Falls.<sup>1</sup> The locks are 233.5 m long by 24.4 m wide, with an average lift of 14.2 m. They can accommodate vessels up to a maximum of 225.5 m in length and 23.8 m in width.<sup>2</sup> Water from the canal can be introduced into the site by creating an aqueduct between the existing drainage on the site which already aims towards the canal. This would not only allow water to filter through the site and exchange water detoxification but also allow animals to travel inland safely from underneath the Welland Canals Parkway road from the canal, instead of the existing hard-engineered concrete walls. This idea although just one ecological gesture of many will set the foundation for wildlife and vegetation to coexist with humans on the site and allow for the growth of existing species to thrive.

1 "Assessing the potential movement of invasive fishes through the Welland Canal." Kim, J., & Mandrak, N. E., August 5, 2016. *Journal of Great Lakes Research*. Accessed November 13, 2022, [https://www.sciencedirect.com/science/article/abs/pii/S0380133016301058?fr=RR-2&ref=pdf\\_download&rr=769ca3704e05714a](https://www.sciencedirect.com/science/article/abs/pii/S0380133016301058?fr=RR-2&ref=pdf_download&rr=769ca3704e05714a)

2 Ibid. p. 5-6







**Figure 64:** View from Toboganning Hill, looking North towards Vertical Lift Bridge 5 (Glendale Bridge) on the Welland Canal

Photos by Author  
The following were photos were  
taken February 20, 2023



**Figure 66:** View from Welland Canals Parkway Trail facing South

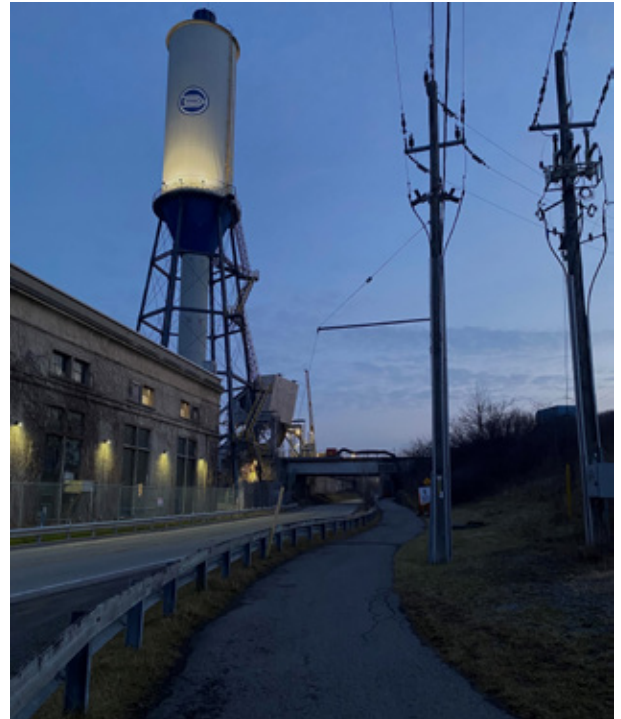
In the book, *Landform Building*, Bjarke Ingles, Stan Allen, and Marc McQuade have a “Five Questions Interview,” that summarizes the intent of this thesis quite accurately. For a post-industrial site, it is essential to denote a significance that will serve the community rather than represent a project that resembles similar industrious qualities as the previous development, to prevent a cyclical timeline. Regardless of the community project, “We always attempt to create seamless links between the territories within our control - and the surrounding city - spanning across the traditional boundaries of indoor and outdoor, public and private, building and landscape.”<sup>3</sup> And “...Whatever we end up doing will form part of our future city and such will contribute to the urban domain - whether our client is interested in it or not.”<sup>4</sup> However, what makes this project essential is the fact that it will not just serve human nature in the community, but also the wildlife in the region, promote the extension of the biodiversity from the

3 Allan, Stan., and Marc. McQuade. *Landform Building : Architecture's New Terrain*. Baden: Lars Muller, 2011. (132). Accessed March 16, 2023.

4 Ibid., 132



**Figure 65:** South view along Bruce Trail path with drained Welland Canal to the Left



**Figure 67:** Bruce Trail path view of Train Bridge & St. Lawrence Seaway Management Corp. Hydroelectric Tower

# Site Visit

2/20/2023

Niagara Escarpment into our cities, and weave them through our urban fabric. When taking a long walk through and around the post-industrial site shown in these photographs, I experienced various barriers, abrupt land use changes, and a series of desire paths that have been used by people informally over the years. Whether it be a shortcut, or the local dirt bikers' playground, besides the historical dumping grounds, not to mention the current use as a construction site for train bridge repair, this site has been historically used for personal gain. Where are animals expected to migrate between the anthropocene we have created?

This begs my response as to the role landscape architecture could play on this site and the surroundings. Barrier-free and eco-friendly design strategies would not only create a safe area for pedestrians to cross, rather than endless fences and crossing railroad tracks, properly lit for nighttime use, which most people have taken advantage of the slope from the Escarpment for the use of tobogganing, but also allow for the expansion of the Escarpments natural environment and allow animals to create habitat within the site.

Weaving Access



**Figure 68:** View of drained Welland Canal and Vertical Lift Bridge 5 over the Canal, from Welland Canals Pkwy looking Northeast



Figure 69: **View from Welland Canals Parkway Road of informal Tobogganing Hill**

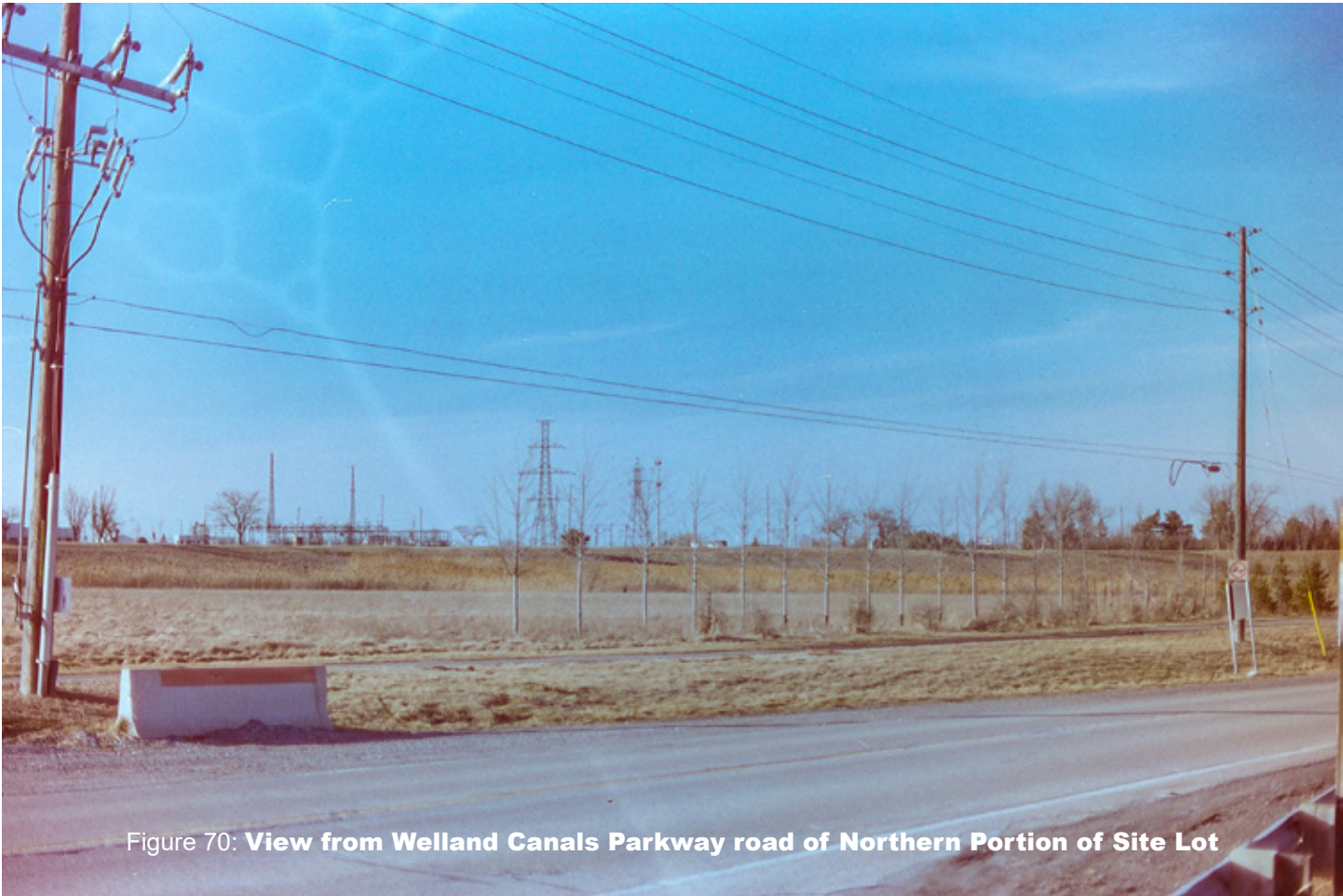


Figure 70: **View from Welland Canals Parkway road of Northern Portion of Site Lot**



Figure 71: **View of Niagara Escarpment and Tobogganing Hill from Northern slope within Site Lot**

Weaving Access



Figure 72: **View of Existing Wetland Drainage running towards Welland Canal and General Motors factory in the horizon**



Figure 73: **View of Canadian National Railway and Train Bridge in distance  
Graffiti'd retaining walls**

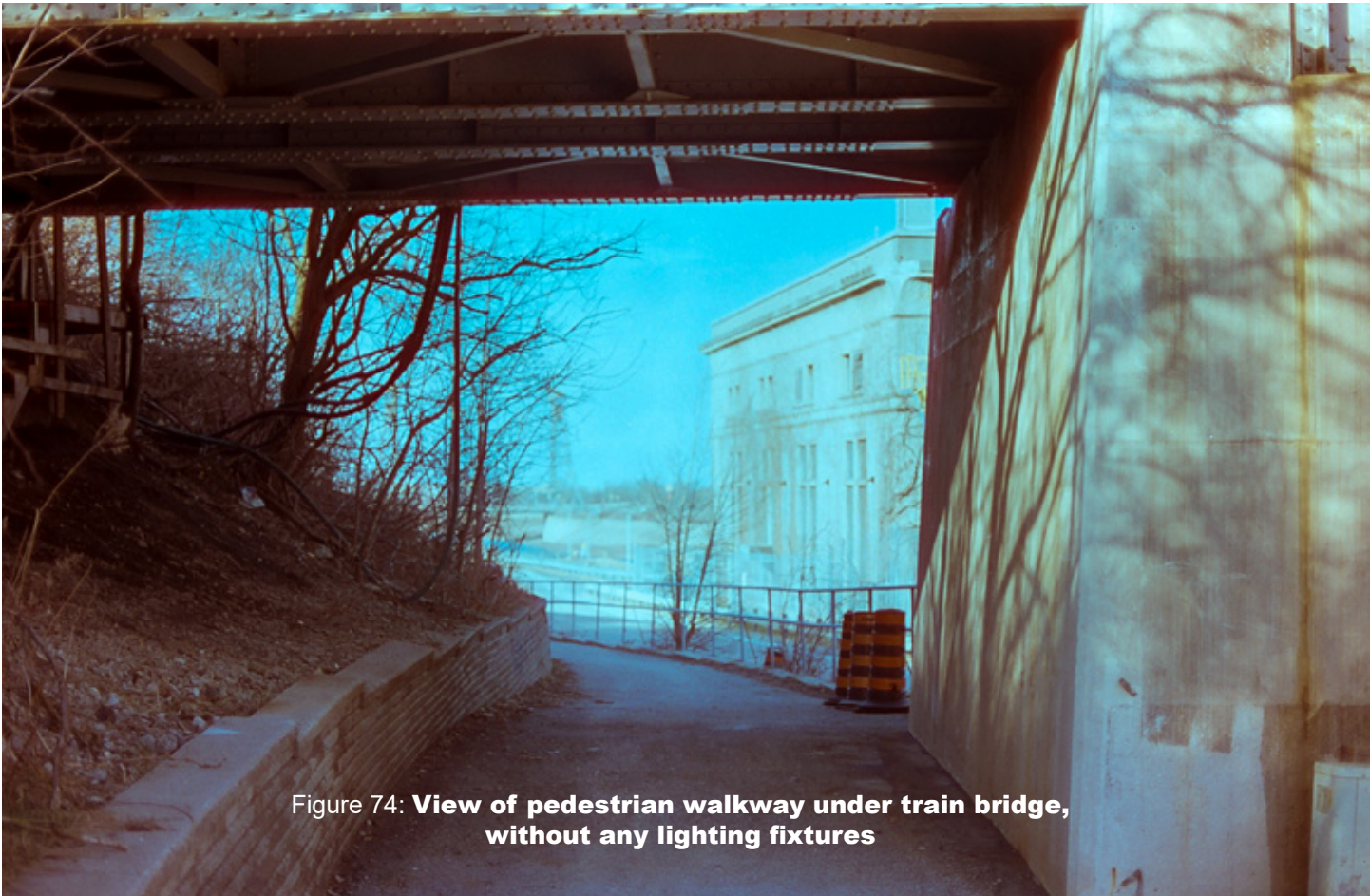


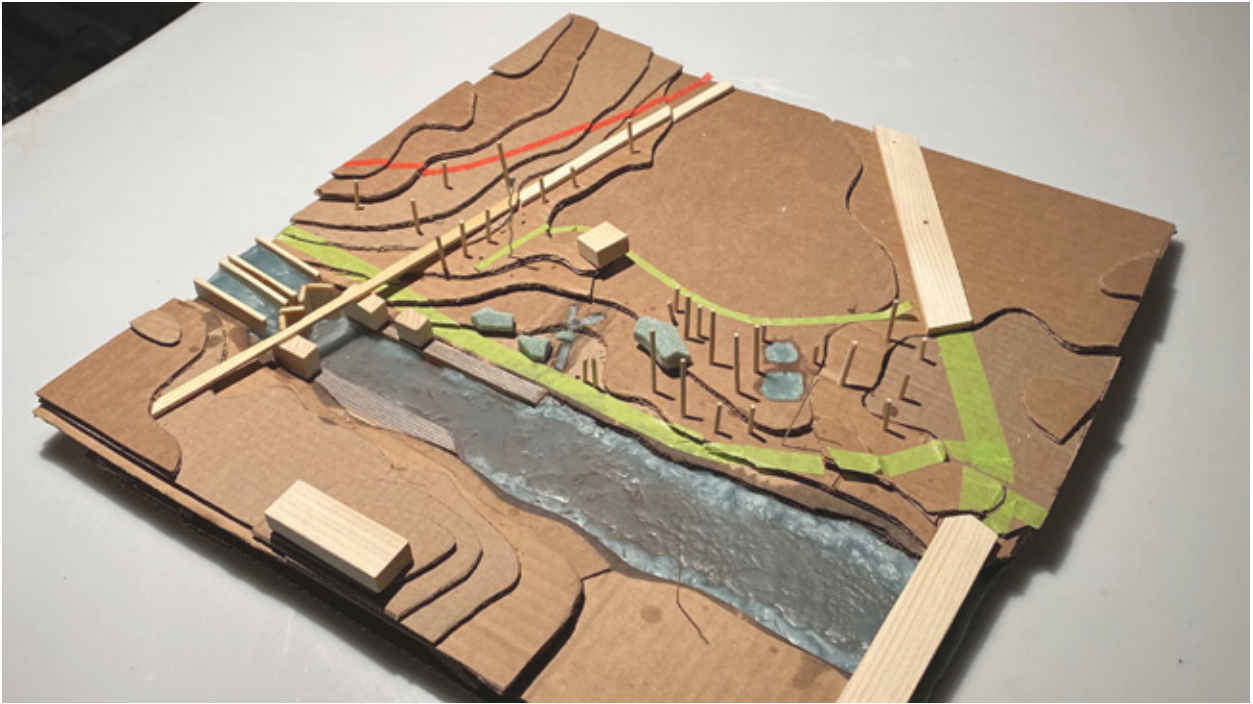
Figure 74: **View of pedestrian walkway under train bridge,  
without any lighting fixtures**

In the process of physical modelling, I began to learn how the site changes three-dimensionally, and how each layer of the urban fabric ties into one another. The process began with creating a 1:2000 topographical working model, that helps describe a 1-kilometre radius of the site. To communicate that the Welland Canal runs through the site, I melted blue and white candle wax to create a water-looking substance, which fills the lowest contour of the site boundary. Before pouring, I used aged pieces of pine that appear grey like the concrete piers that run along a portion of the canal for about 250m. This same wax was used to create the existing ponds found within the lot of the site. Next, I layered in the main roads, and points of access by vehicle, which are the Welland Canals Parkway running parallel to the Canal and Glendale Avenue that crosses the Canal. The gates of Lock 4, the first lock in the grouped “Twin Flight Locks,” are built in just before the bascule train bridge that crosses overhead (splits in the middle and lifts for ships to pass). After that, the Canadian National Railroad crosses the site from St. Catharines, into Niagara Falls. Following the main

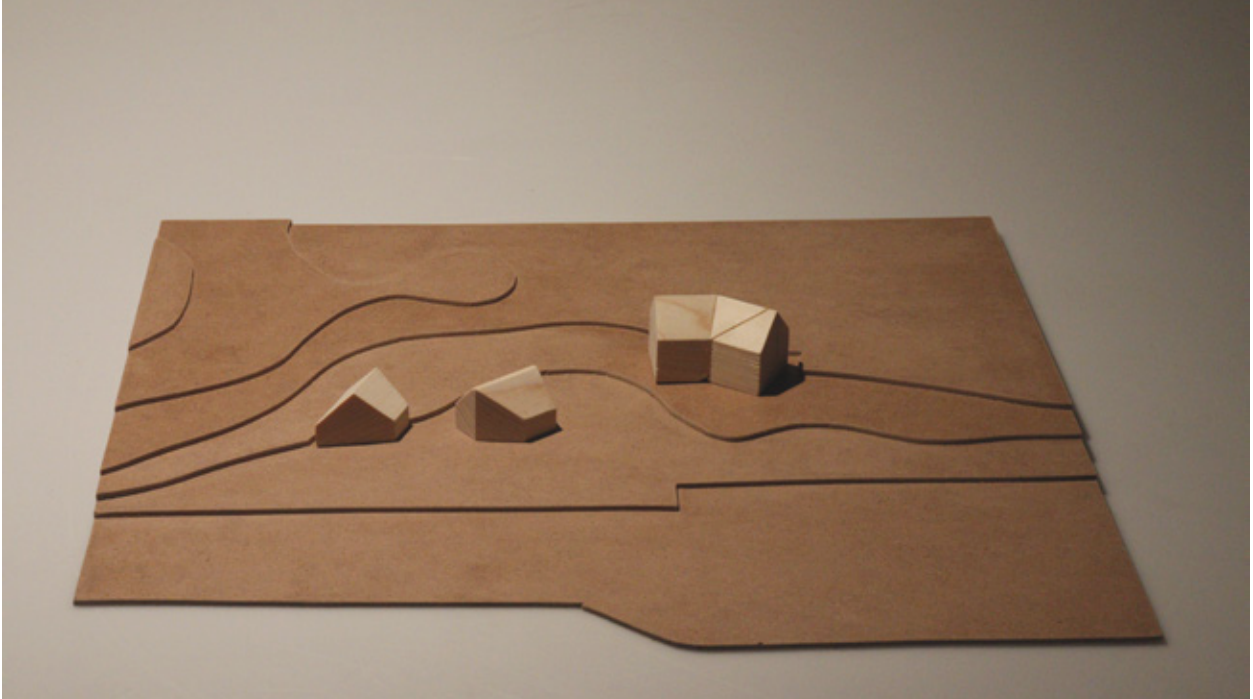
corridors, I placed the main blocks of buildings adjacent to the site, which are the General Motors Factory (left), and the St. Lawrence Seaway Management Corporation (right).

Following this process, I chose to develop a 1:1000 massing model to get a better understanding of the geometry of the project and proposed buildings. This helped me realize that the thesis is not just simply the buildings, but rather how they are situated within the existing landscape. Since the project is not about adding further to the industrial nature that surrounds the site, this model was only useful to demonstrate sun angles. Although messier, the working model proved more helpful in demonstrating the multitude of corridors that exist within the site, including vegetation, and the Niagara Escarpment.

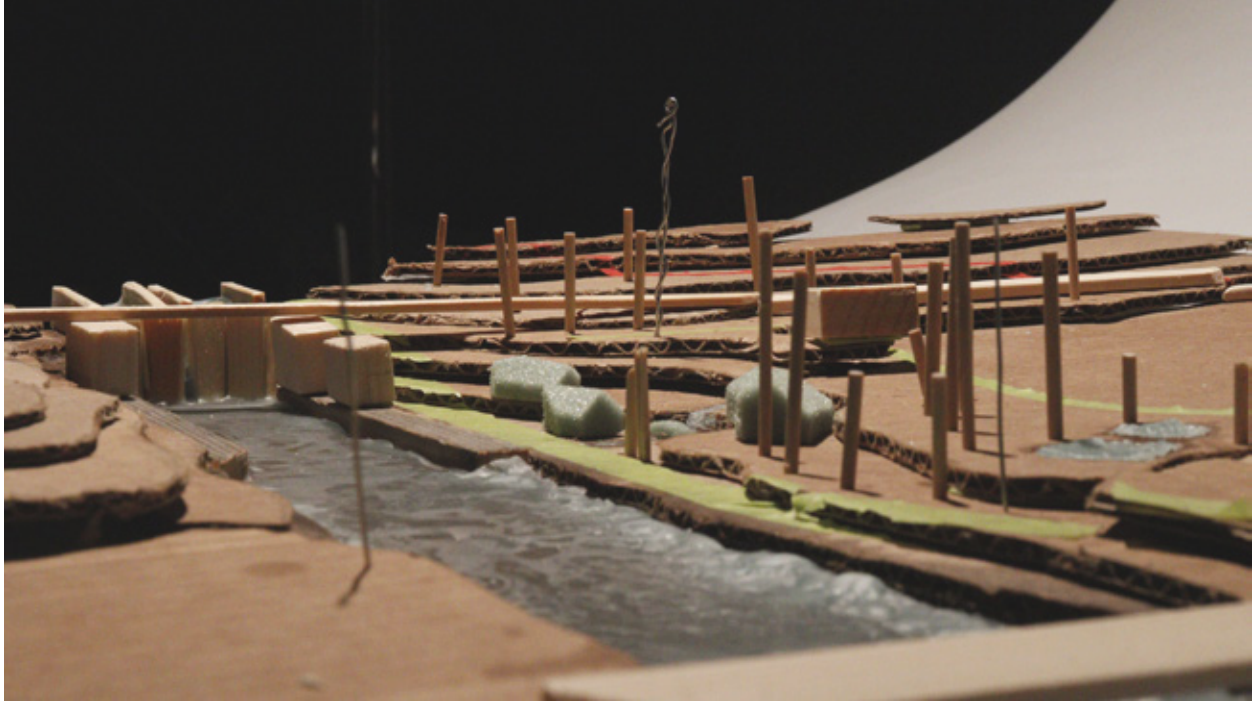




1:2000 Topographical + Immediate Context working Model



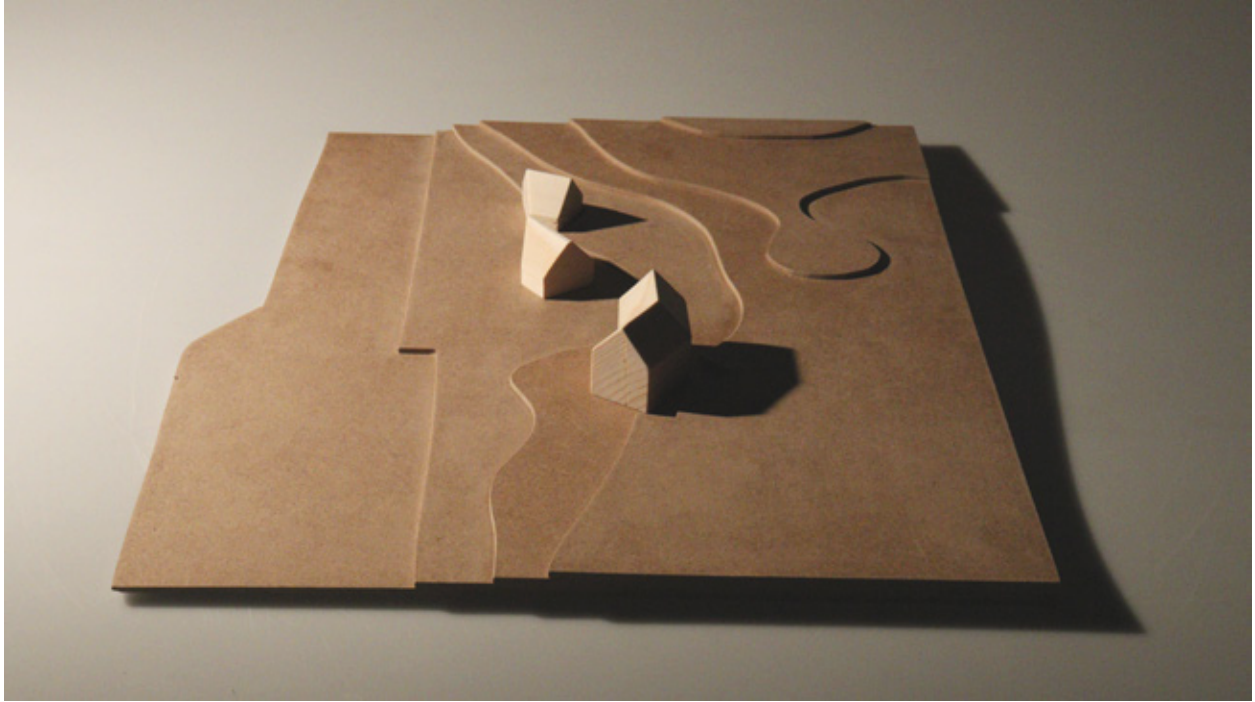
1:1000 Massing Model - View from Canal



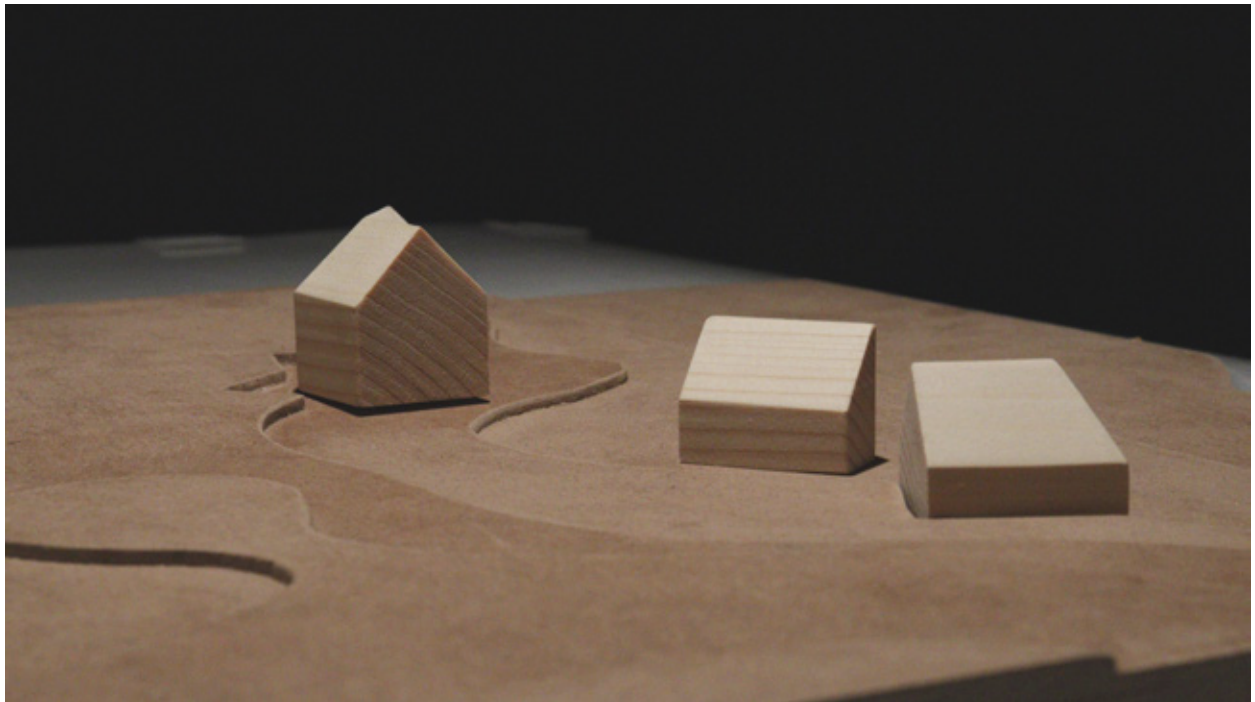
View of Vertical Lift Bridge 5 Along Welland Canal



View from Nigara Escarpment and Existing Trail System



Morning Sunlight



View from Escarpment

# **Case Studies** (precedents)

## **Bell Park**

Sudbury, Ontario

## **Thermal Baths**

Vals, Switzerland

## **McMichael Canadian Art Collection**

Toronto, Ontario



**Figure 75:**  
Bell Park 1975 - Sudbury, Ontario

# Bell Park

Sudbury, Canada

Weaving Access

Even for a place with such a short warm portion of the year, Bell Park in Sudbury, Ontario, does not fall short of taking advantage of the climate, and even in 1975, the land. The main entrance of the Park traditionally hosts active recreational activities, such as slopes people informally use for tobogganing and a music festival during the summer. This same active inspiration could be applied to the site people informally use along the Welland Canal. When the tobogganing hill at Lock 4 is not in use, during the warmer and

summer months, the hill could be used as a natural amphitheatre that looks onto a stage connecting to the proposed cafe, in order to be a year-long restaurant that serves the community. Furthermore, the hill could be lined with newly implemented vegetation commonly found on the existing site, in order to allow access from the Niagara Escarpment towards the inner site safely, and either into the canal or across and find habitat within the existing wetland drainage or ponds beyond.



**Figure 76:**  
Bell Park, Parking, Path,  
and Amphitheatre.

**Figure 77,78:**  
“Bell Park Walkway (TGT -  
Jim Gordon Walkway)



# Thermal Baths

Vals, Switzerland

**Figure 79,80:**

The Therme Vals / Peter Zumthor, 11 Feb 2009

Like all of Peter Zumthor's projects, he designs an experience rather than simply a visually appealing building, which he does by working with space and time. Giving the user an experience from a sequence of spaces from outside to the deepest space within, each material and lighting is carefully choreographed. Scott Murray beautifully describes the user's experience in his book titled, *Material Experiences: Peter Zumthor's Thermal Baths at Vals* describing how, "...the architecture does not immediately announce itself from the exterior. This is partly because of trees planted between the village's main road and the building, but is primarily the result of Zumthor's decision to engage the building with the land such that it is built partially underground."<sup>5</sup> The unique combination of materials extracted from the surrounding area, stone and water, ties the building to the site, which mediates its history and geology.<sup>6</sup>

5 Murray, Scott. "Material Experiences: Peter Zumthor's Thermal Baths at Vals." *The senses & society* 2, no. 3 (2007): 364. Accessed March 22, 2023.

6 Ibid., 365

Before one arrives on the main floor of the baths, the main pool is visible, along with glimpses of the landscape through large glazed openings.<sup>7</sup> The pool connects directly to the outside through an opening in the large glass wall that divides the two, allowing users to swim inside to outside while submerged in water, as if swimming out of a cave.<sup>8</sup> "The village of Vals served as Zumthor's client for the design and paid for the construction of the Bath... Zumthor credits the villagers for their progressive architectural sensibility and their desire "to do something special," (Spier 2001: 22).<sup>9</sup>

The structure of the building is also interesting as, "The walls of the building are primarily a load-bearing composite of natural gneiss stone and site-cast concrete, which Zumthor refers to as "poured stone."<sup>10</sup>

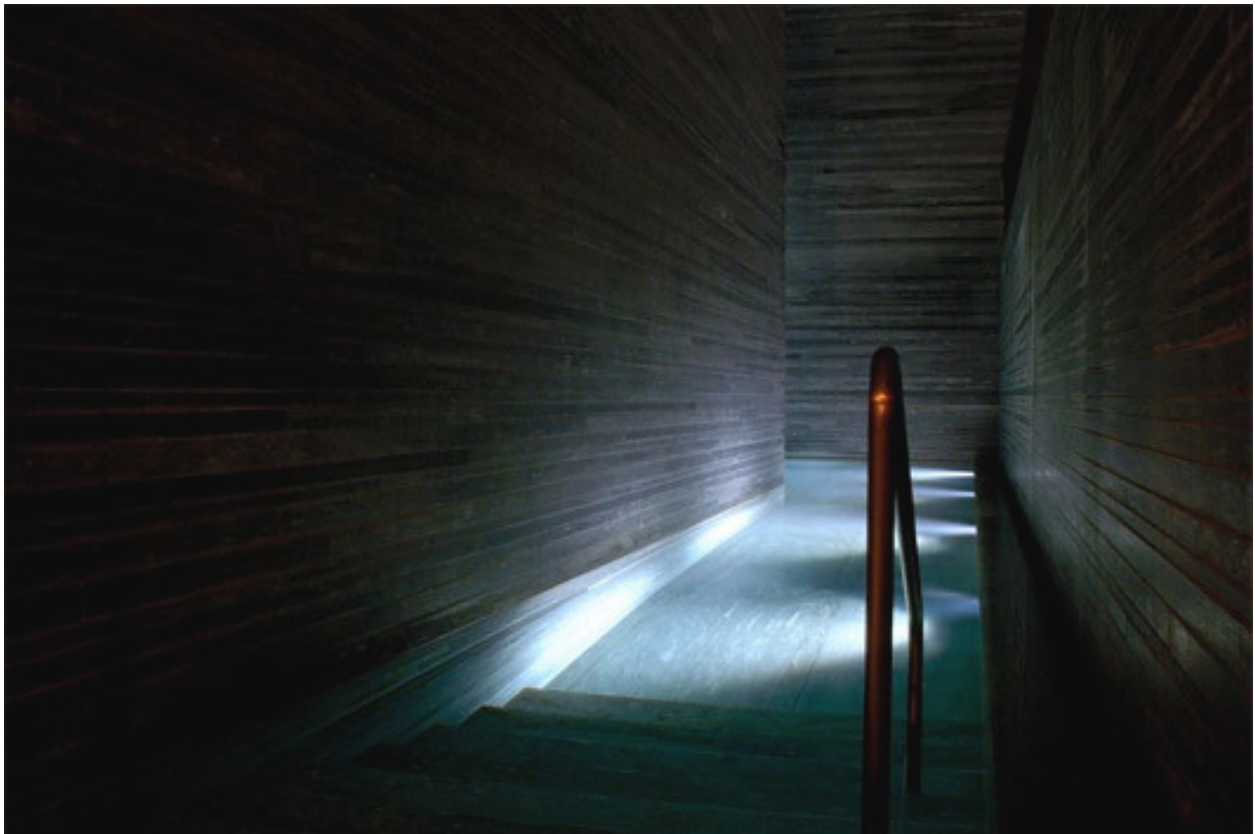
7 Ibid.

8 Ibid., 366-367

9 Spier, Steven. 2001. "Place, Authorship and the Concrete: Three Conversations with Peter Zumthor," *ARQ Architectural Research Quarterly*, 5 (1) 22.

10 Ibid., 18





# McMichael Canadian Art Collection

Kleinberg (Toronto), Canada

**Figure 81:**  
McMichael Art Gallery Main Hall

**Figure 82:**  
Tom Thomson Shack

“Our enthusiasm had been infectious and persuaded many of those who shared our vision to give us their paintings. It was an extraordinary demonstration of trust that turned our plans from a personal desire for the fulfillment of our ideas to a deeply felt moral obligation.”

– Robert McMichael, *One Man's Obsession* (Prentice-Hall Canada Inc., 1986)<sup>1</sup> p.148

Moved by the natural environment, the McMichaels began collecting works of art by Tom Thomson and the Group of Seven, artists who also drew inspiration from the natural landscape.<sup>2</sup> By the early 1960s, hundreds of people were visiting the McMichaels' growing private gallery.<sup>3</sup> In 1965, the collection comprised 194 paintings, some purchased by the McMichaels, others donated by generous donors as well as by the artists themselves.<sup>4</sup>

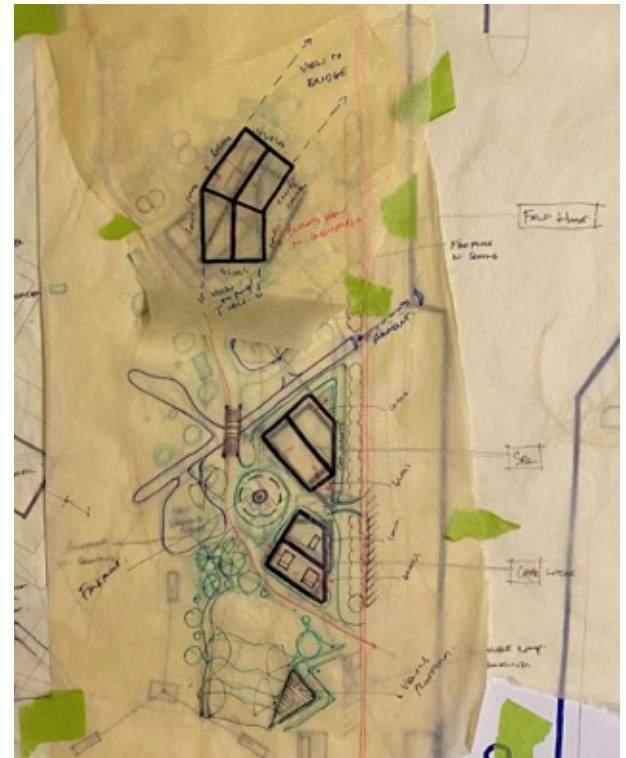
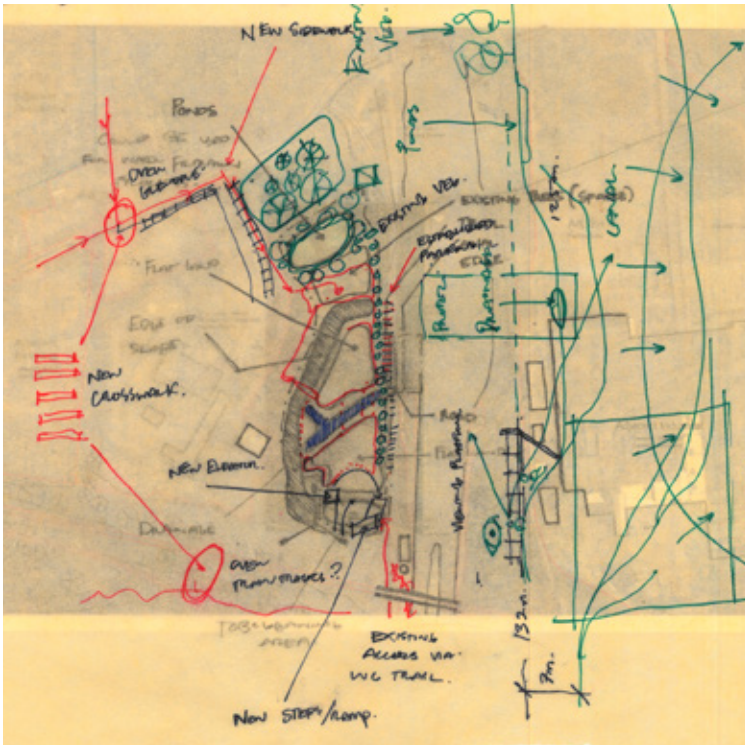
1 “History of The McMichael” - McMichael Canadian Art Collection - Our History, 2021. Accessed March 5, 2023. <https://mcmichael.com/about/history/>

2 Ibid.

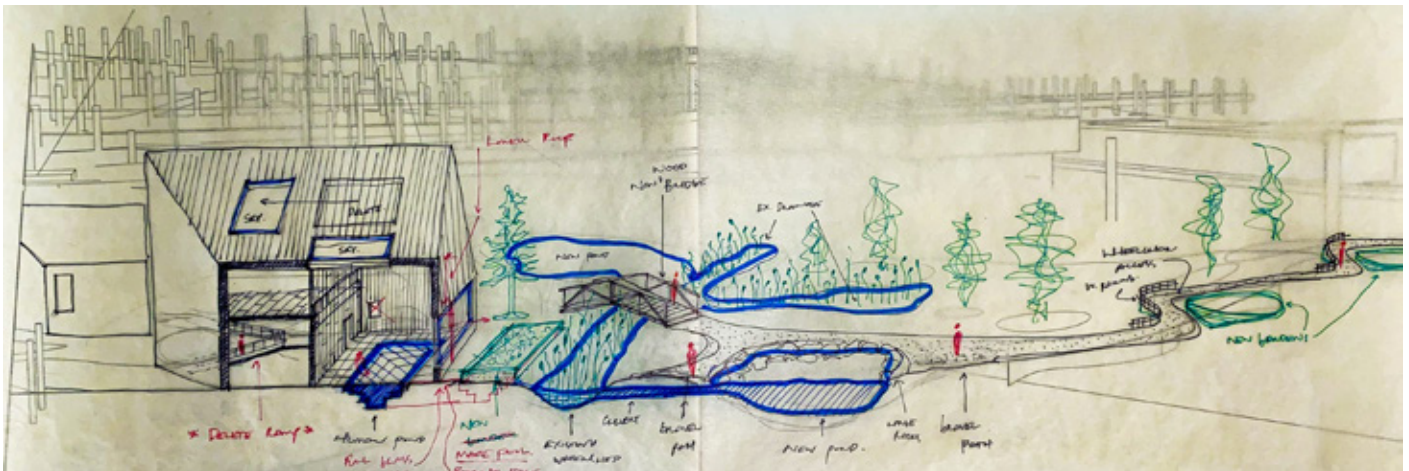
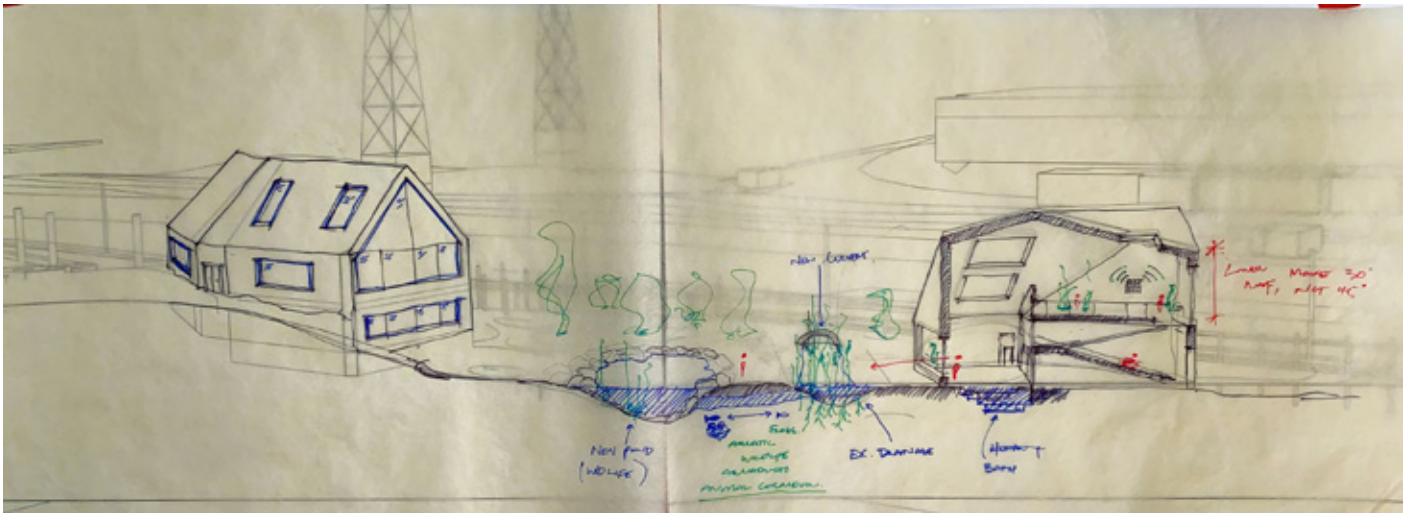
3 Ibid.

4 Ibid.





Weaving Access





Figures 84: Process Work



**Figure 83:** Final Site Perspective Drawing

Since the physical modelling stage, within the creation led research, and gaining a better understanding of more focused case studies that can drive the ideas behind the design, an iteration was landed upon to develop a more respective proposal. This proposal included two main buildings instead of three, in order to maintain views of the Canal along the site and embrace the land by having the bathhouse built into the ground, and combining it with the field house. The cafe, on the South portion of the site, will create a refuge for recreational users along the site, and frame views of the historic lift bridge, as well as the existing tobogganing hill. These two buildings are mainly crafted of timber, masonry, and concrete, the same materials used to craft the Welland Canal over time.

*North Side:*

**Field House**

- Flexible interior space for weddings, community gathering, dancing.
- Outdoor patio with fireplace that bridges interior and exterior, with garden beds and stairs to below.
- Outdoor firepit with seating

**Bathhouse**

- Reception, Coats, and Storage
- Washrooms, Changerooms, and showers.
- Accessible Interior and Exterior Pools.
- Outdoor patio for activities such as yoga, meditation, sunbathing.

**Pond**

- Strictly for wildlife habitat, connected to existing wetland drainage on site, planted with large rocks, wetland vegetation, and trees.

**Accessible Ramp**

- Access to Bathhouse (below Field House) with Stairs

**Parking**

- Off of Glendale Road, and St. Lawrence Seaway Management Corporation Private Road.
- 30+ spots regular
- 4+ spots handicap

*South Side:*

- Formalized existing Tobogganing Hill

**Pond**

- Shallow with gradual slope to allow for skating in the winter season connected to existing wetland and collects drainage from site

**Cafe**

- Wrap around wooden deck
- Plant Garden
- Firepit with seating

**On-Street Parking**

- Formalized existing informal parking on Welland Canals Park way.

1

2

3

4

5

Greater

Site

HISTORICAL GEOGRAPHY

**STRATEGIES**



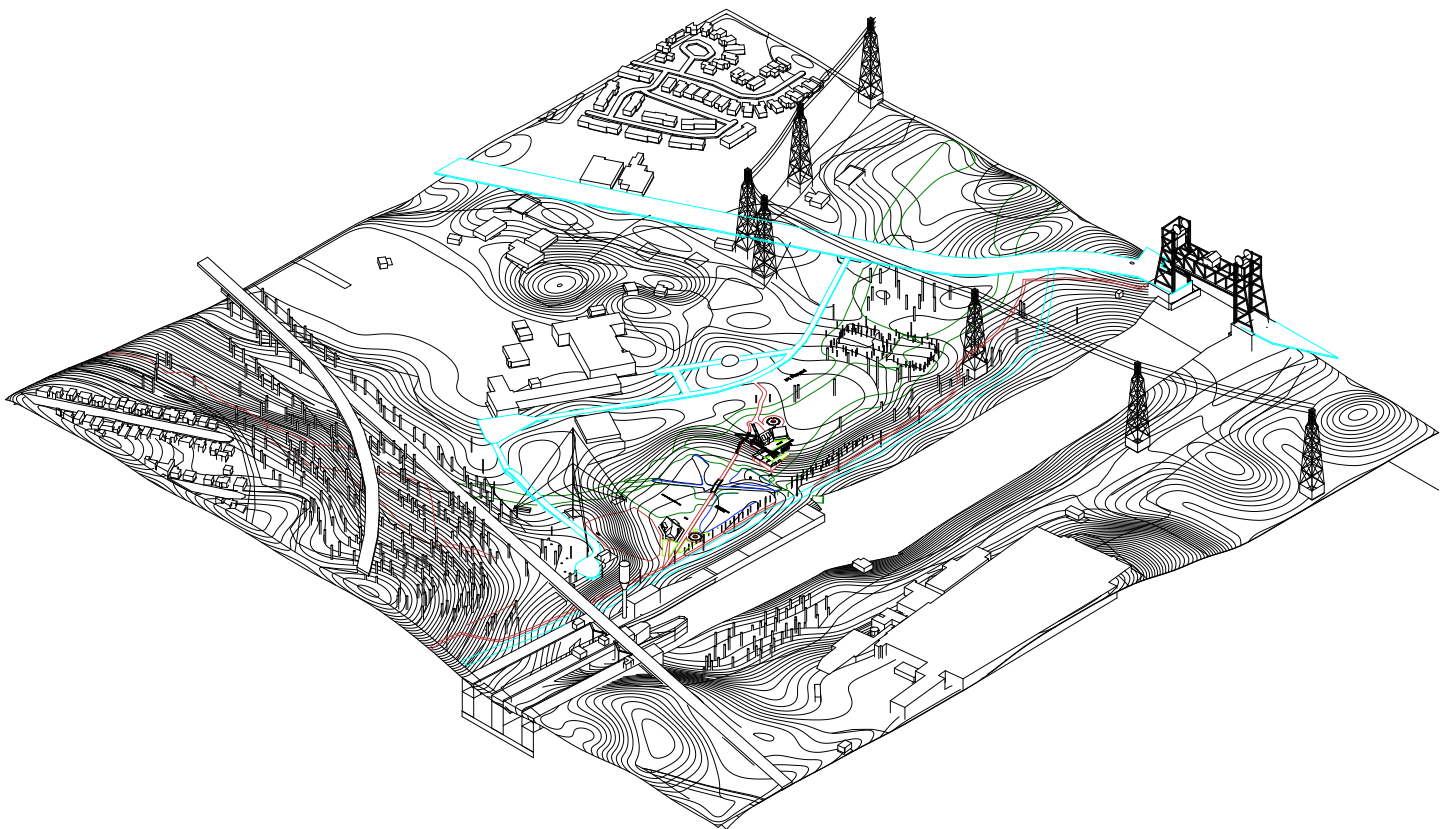
**S**trategies that can be used to achieve the various programs involved in the thesis. While there are many ideas involved, it is important to reference relevant design techniques and precedents that have a similar cause and effect. Although the site context and history are different between each project, the over-arching theme and design intention strongly relate to what this thesis is trying to achieve. In regards to my family, and personal stories that led me to this point, strategies ranging from land qualities that address native biodiversity, and water qualities that lead to treatment, and reuse on-site, begin to change the narrative of the historical significance in terms of environmental effects the Welland Canal has been made to the land over time, and in turn, allowing for a holistic approach to foster human interaction and independence.

To summarize, the main strategies in this project involve blue, green, and black corridors, to restore ecosystems and increase hydrology, natural building materials to foster aromatherapy, and filter the air that flows between the relationship between land and (non) human species.

Beyond the use of appropriate materials within the project, inside and out, when it comes to the built environment, local material such as wood and earth can only be truly appreciated by everyone if it is applied appropriately as well. From the scale of landscape design, providing habitat to wildlife, to the access to the complimentary programs within buildings, there are opportunities to apply soft edges and give users a sequential experience. Even if users are travelling by vehicle to the site, at one point or another, they must get out and travel by foot, or wheelchair. This is the beginning of the experience for the user, even if they are not intending on entering the proposed buildings or outdoor recreational activities, they will experience the land and a sense of the site. The sound of gravel beneath their feet or wheels, to a wooden boardwalk around the cafe, or fieldhouse, after travelling between newly planted gardens. If going to the bathhouse, users will travel through the land, and merge with a path created to formalise a link between the two main roads around the lot, Glendale Ave, and Welland Canals Pkwy, instead of using existing desire paths that are unsafe and force companies to build never-ending fences. This ramp will be built of masonry on the ground and concrete for the retaining walls that

slightly cut through the earth. Using concrete for the walls provides an opportunity for implementing an educational tool as well, where local types of vegetation species, and can be inlaid into the faces of the concrete panels, adding a subtle touch of place to the proposed infrastructure. When the user is greeted with the approach of the building, they will see the facade composed of solid concrete, tinted with the red shale earth that lies below the surface, which is visible when the Canal is drained in the Winter. This will also mimic the surrounding industrial buildings, the only difference from the outside is that they will be in a shed roof geometry, which will appear as if an extension of the residential neighbourhood, clearly denoting community buildings, and taking cues from Peter Zumthor's Thermal Baths, in Vals Switzerland. Giving the user the sense of a building that comes out of the ground, an extension of the landscape. Inside, a warm, wooden interior will greet the user, similar to the McMichael Art Gallery in Toronto, Ontario. With framed views of the landscape, and newly planted wildlife habitats and ponds, the user will not only have a sense of seclusion within the site but also require glass, and large panels of window glazing which will allow natural light to enter deep into the spaces. In a new site plan, we can understand a proposal for the site

that maintains a connection to the water by proposing two new ponds, one strictly for wildlife habitat, and one that could be used for skating in the winter, as well as a path that has a bridge spanning the existing wetlands, acting as a safe short cut between the major roads rather than users having to cross the railroad. An animal corridor would preserve the land and designate it to refrain from the future building, and allow animals to safely cross the site or find refuge within it.



1 Sq. Km. of site in an Isometric View from the Southeast

Here we can understand a proposal for the site that maintains a connection to the water by proposing two new ponds, one strictly for wildlife habitat, and one that could be used for skating in the winter, as well as a path that has a bridge spanning the existing wetlands, acting as a safe short cut between the major roads rather than users having to cross the railroad. An animal corridor would preserve the land and designate it to refrain from the future building, and allow animals to safely cross the site or find refuge within it.


### **Proposed Animal Corridor**

- Collides with existing fenced off ponds (acts as habitat for wild-life)
- Links Niagara Escarpment and adjacent residential neighborhoods
- Provides a safe space for wild-life refuge
- Weaves together the proposed site strategies, and creates a relationship between human - non humans

### **Proposed Field House @ Elevation 127m**

### **Proposed Bathhouse @ 124m**

### **Proposed Cafe @ 121m**

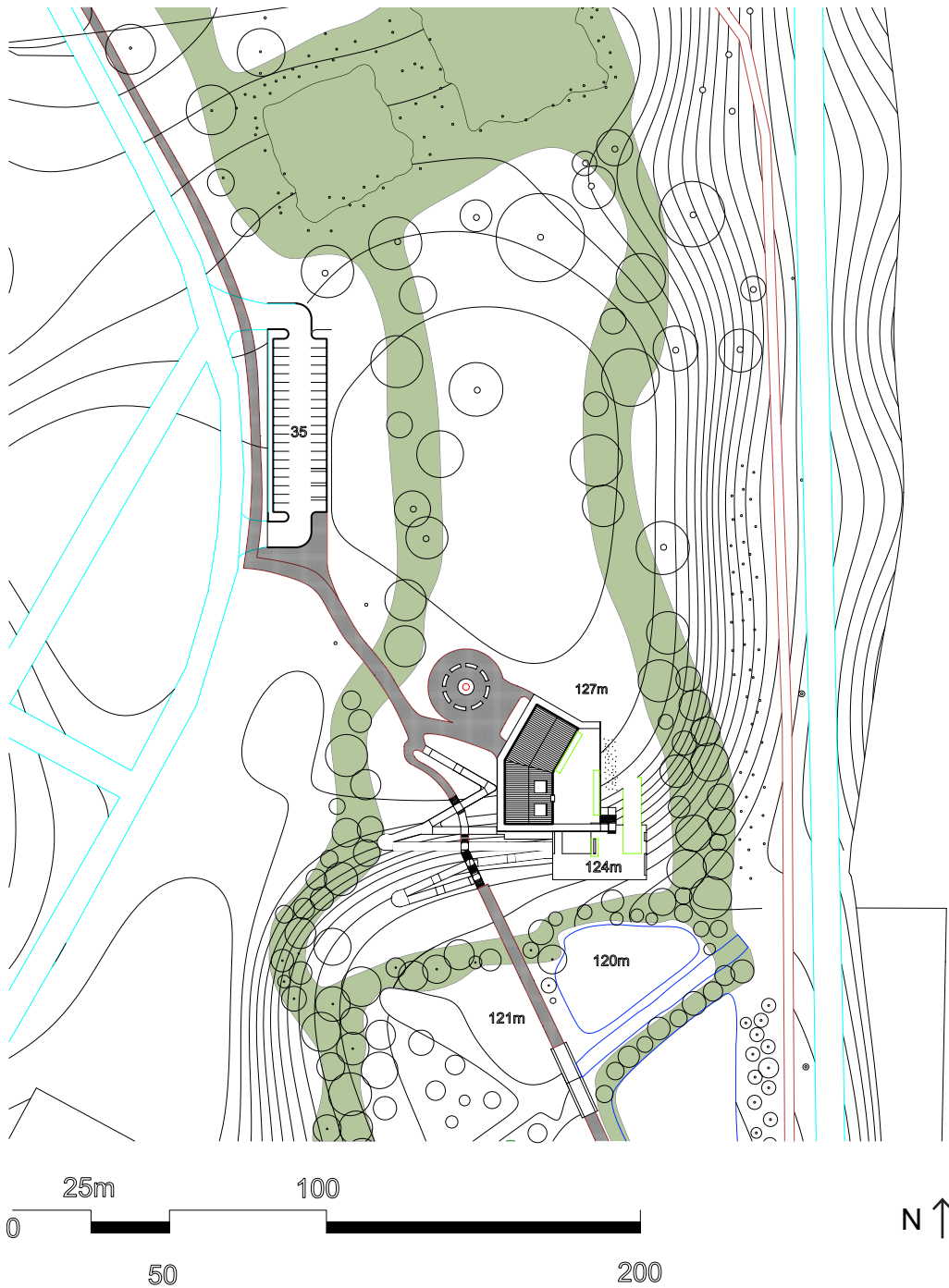
Adjacent to WCP Road,  
Proposed Short Cut,  
and Existing  
Tobogganing Hill 

### **Proposed Outdoor Firepits with Seating**



# Site Plan

Figure 88



## Building & Surroundings: North

Users can leave their cars by the edge of the lot in a parking lot, with accessible space, and cross into the site on foot and use the same shortcut path to travel towards the fieldhouse or an accessible ramp that leads them towards the wetlands. This will allow for more interaction between those simply passing by, and those finding refuge within the programs.








## South

we can understand how users will have the option of travelling through the site on foot, and begin to have a sense of seclusion in the community, and the feeling of a recreational site.

The legend appears in the order that the user would approach each supporting program within the buildings. From the parking lot, towards the Field house, the users will travel along the proposed pathway shortcut from the Bruce Trail, where they will be met with a large fire pit with seating, and a large wooden deck that connects the West face of the building, and wraps around towards the South, and the East Patio where there is a dining area with garden beds.

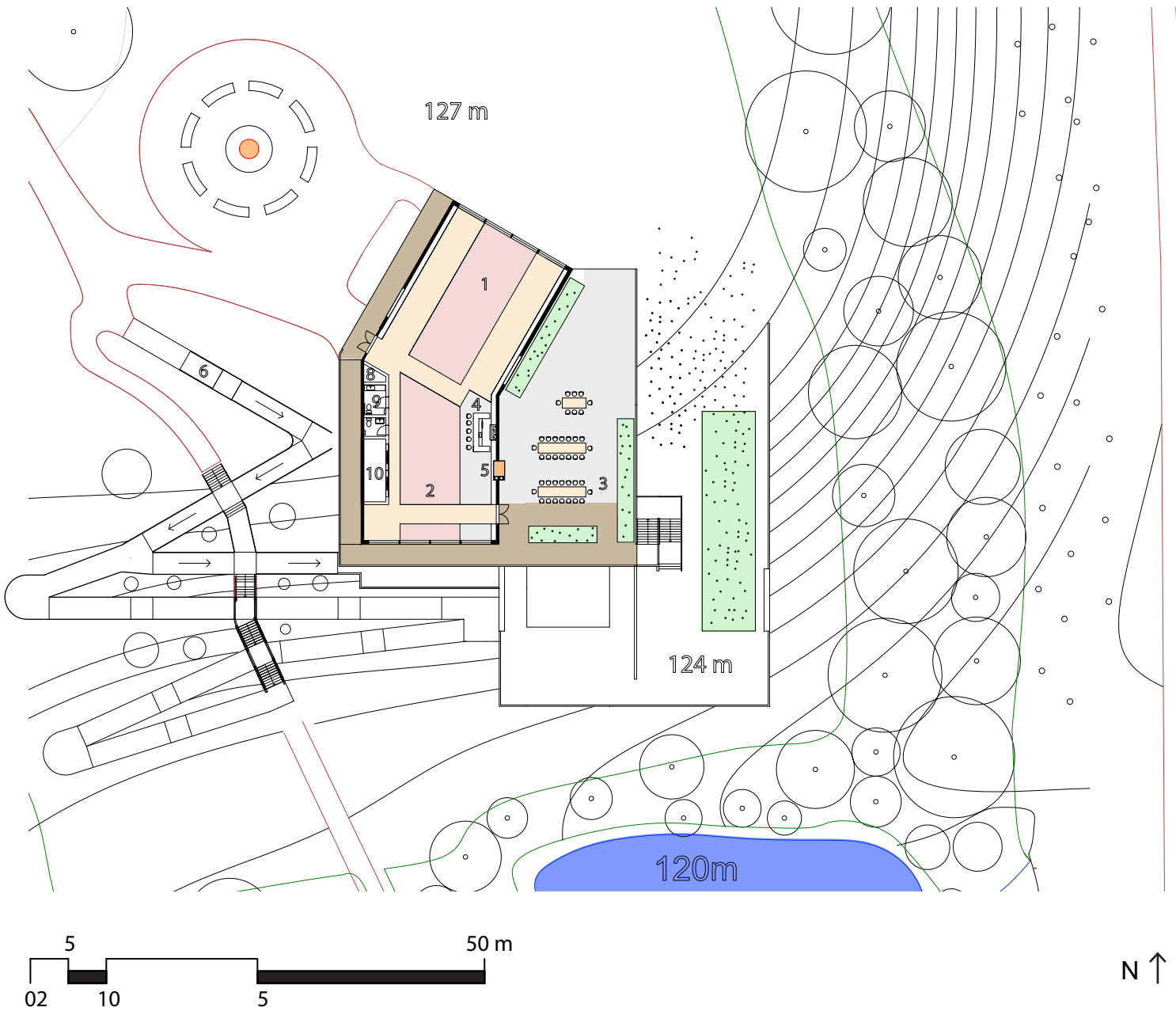
If the users wish to enter the building, large doors facing the path are easily accessible and will draw them into the centre of the field house. Here, a coat check and washrooms will be available, as well as views through very large windows of the historic vertical lift bridge over the Welland Canal, towards the Northeast. This backdrop is intended to be an ode to the history of the site, and provide an amazing framed view ideal for weddings, community meetings, and other gathering activities. To the South, the existing Tobogganing Hill and the Niagara Escarpment will be visible, and access to the dining patio is available through a set of doors. The fireplace will connect the interior, tiled open floor, ideal for dancing, to the outdoor dining patio. If the user wishes to stay indoors, the bar adjacent to the fireplace will greet the user.

- North Hall** 1
- South Hall** 2
- Patio w. Dining** 3
- Bar** 4
- Fireplace** 5
- Ramp to Bathhouse** 6
- Garden Beds** 7
- Coats** 8
- Washrooms** 9
- Storage** 10

- Wood (Indoor/Outdoor)** 
- Concrete** 
- Tile** 
- Water (Shallow to Deep)** 
- Fire** 

Outside, users can travel to the surrounding topography from the concrete patio to the wooden deck down a set of stairs towards a large garden bed and an outdoor wooden deck that is more secluded, and ideal for meditating.





## Field House - Ground Floor Plan

**Figure 90:** There are two main gathering spaces, ideal for weddings, with a bar, washrooms and storage, as well as a patio that is weaved together with a fireplace that connects the interior and exterior. Users would be level with the existing elevation at about 127m.

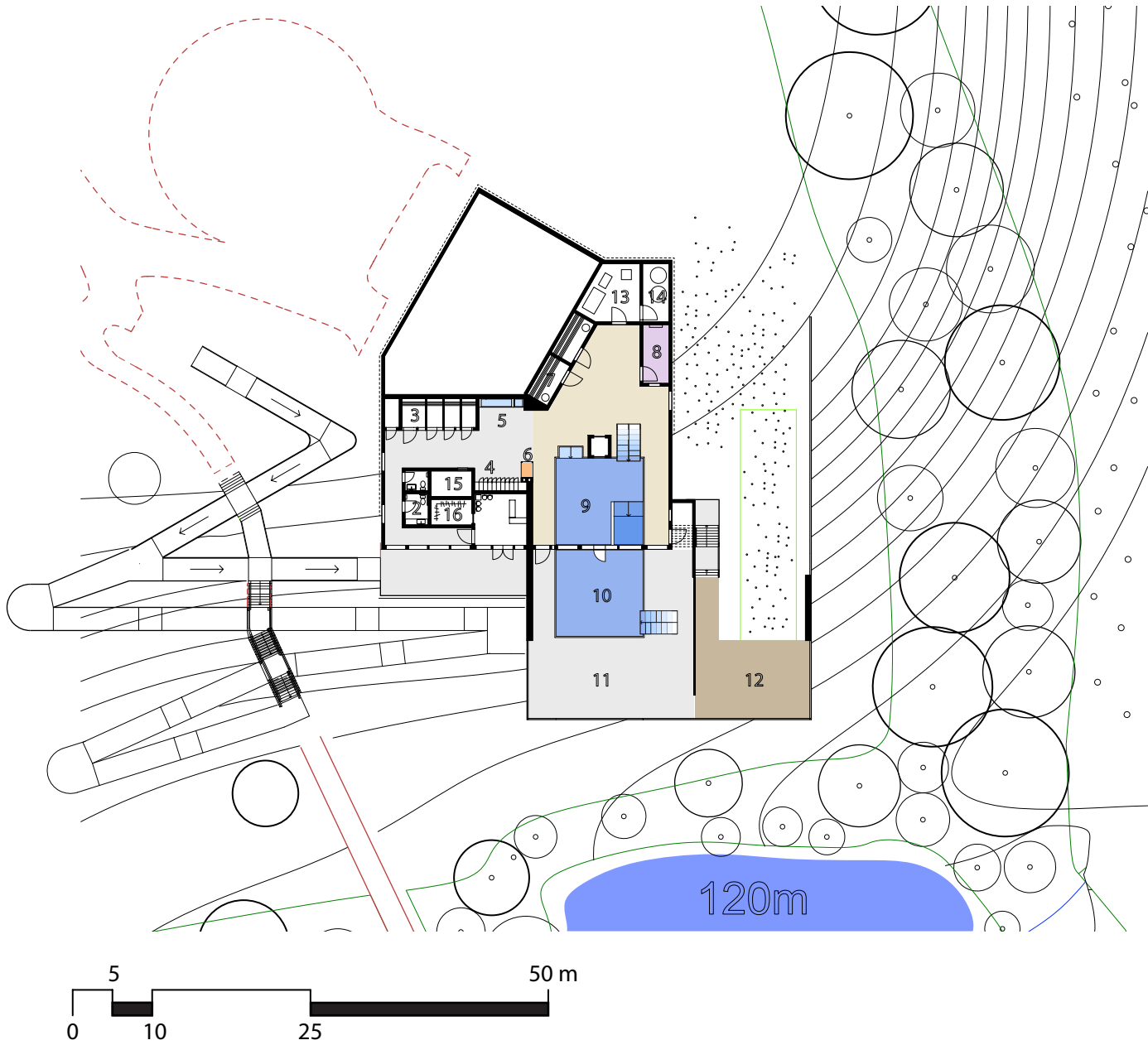
The process will lead the user from the outdoor ramp and staircase towards the lower level of the Field house, where they will find a set of doors that lead into the reception, from there they will have a place to check their coats. Next, a hallway guided by natural light will lead them to a set of universal washrooms, followed by a set of change rooms. Next, a fireplace that connects the open pool room and the lockers, and showers, will greet the user from the changing rooms. Although an open room, the public nature of the showers, will foreshadow the gender notion of the bathhouse, where adults and children are safe and the only place the user will be nude is the change rooms or washrooms, similar to a water park.

From there, users will travel into the open pool room, where in addition to the wrap around fireplace, users will have a glimpse of the access to the pool, and transfer from polished concrete to a warm polished wooden floor. A ledge for simply just putting your legs in the water, a lift into the water for specially-abled persons, and elongated stairs will provide access to the water. Behind them, the user will have access to saunas, and an aromatherapy room if they wish to calm their senses without going into the water. Large window glazing along the South wall of the pool will allow tons of natural light

<b>Reception</b>	1
<b>Washrooms</b>	2
<b>Change rooms</b>	3
<b>Lockers</b>	4
<b>Showers and Tubs</b>	5
<b>Fireplace</b>	6
<b>Saunas</b>	7
<b>Aromatherapy</b>	8
<b>Indoor Pool</b>	9
<b>Outdoor Pool</b>	10
<b>Bathhouse Patio</b>	11
<b>Lower Field house Patio</b>	12
<b>Mechanical</b>	13
<b>Pool Pump/Heaters</b>	14
<b>Storage</b>	15
<b>Coats</b>	16

- Wood** 
- Concrete** 
- Water (Shallow to Deep)**   
- Fire** 

in, and provide views of the Niagara Escarpment, as well as the outdoor pool and patios.



## Bathhouse - Ground Floor Plan

**Figure 91:** Users have the option of taking the accessible ramp, or stairs, towards a deck that faces the Escarpment, and enter a reception, and following a path that is guided by natural light, with washrooms, changerooms, lockers and showers, and the same pillar of a fireplace that connects the main indoor pool room with the changeroom portion, and have access to saunas, aromatherapy, and an outdoor pool deck.



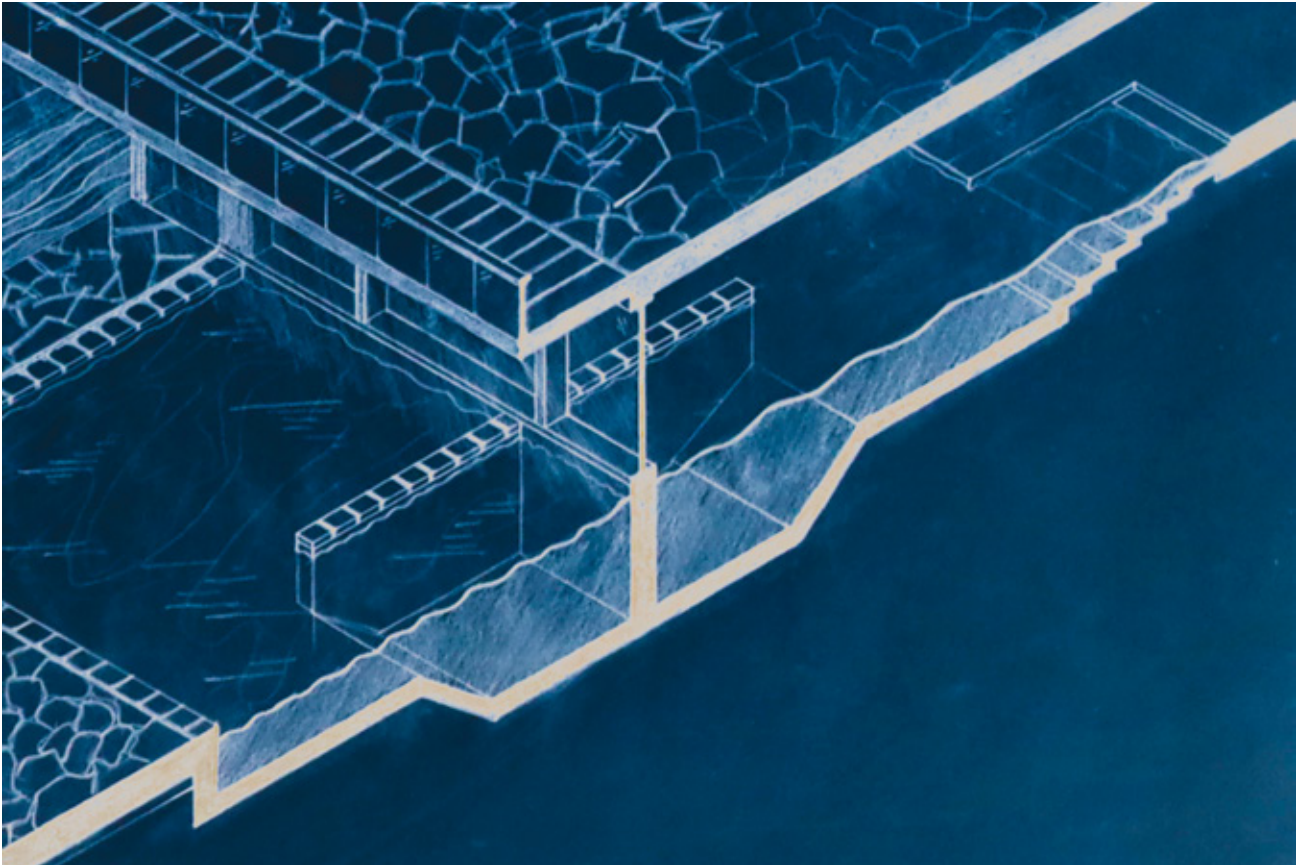
Southeast Isometric Section  
**Field House & Bathhouse**



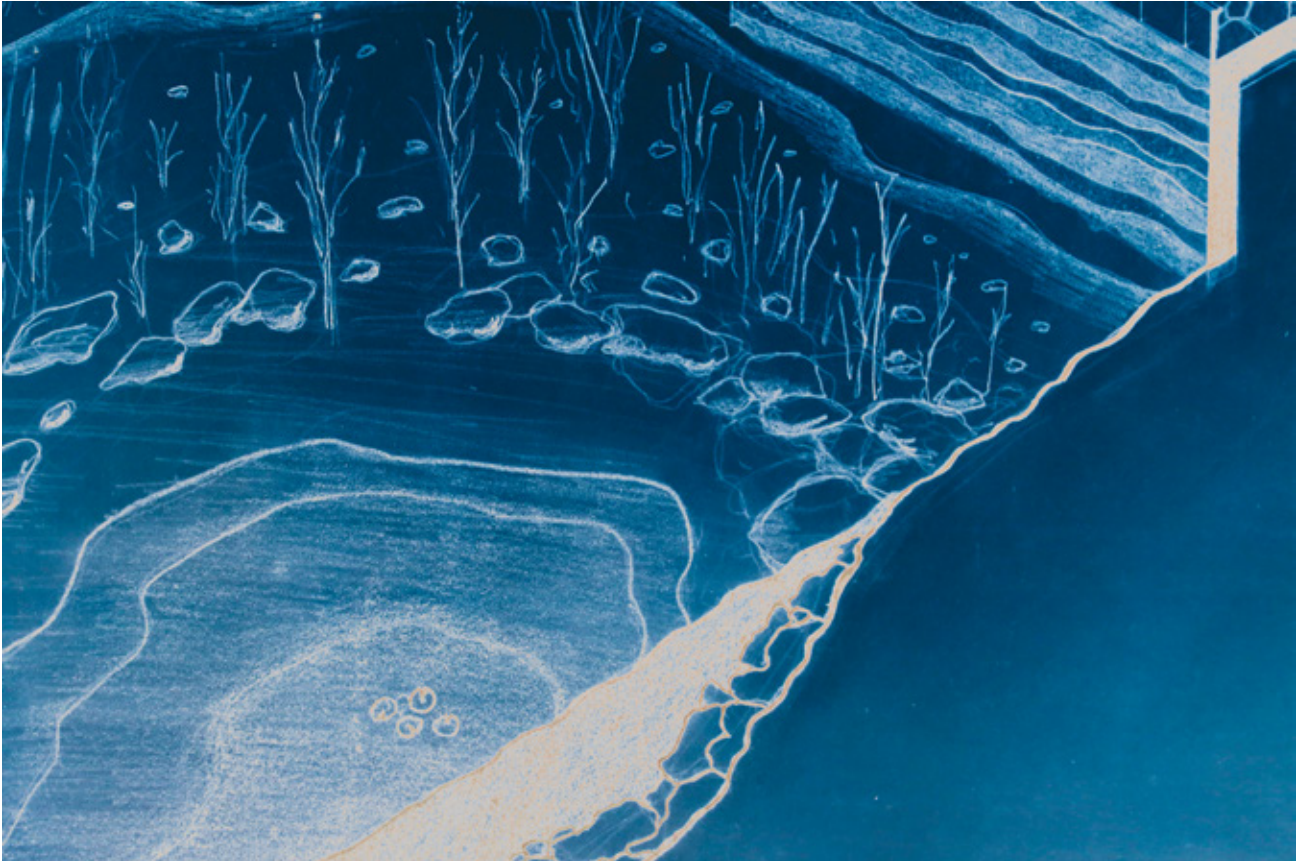
Figure 92

In a negative, we can dive into the details of the drawing, which starts with one of my favourite moments of the project, including an indoor and outdoor pool, accessible for individuals with special abilities. This is where warm water and tiles lining the pool will be found, as well as natural limestone shale from the escarpment creating the exterior pool deck. In the non-human pond, strictly for wildlife, large stones and a grade of at least 20% will create a habitat for aquatic and land wildlife such as turtles, frogs, and geese.

Smooth concrete stones for the patio, warm in the summer sunlight, and good for the green garden beds built into the deck. For the Field House above, large light beige masonry bricks for the vertical walls signify the history of the canal and how the previous locks were built whose remnants still exist around the urban context.



Indoor-Outdoor pools with deep ends, shallow staircase and patio above

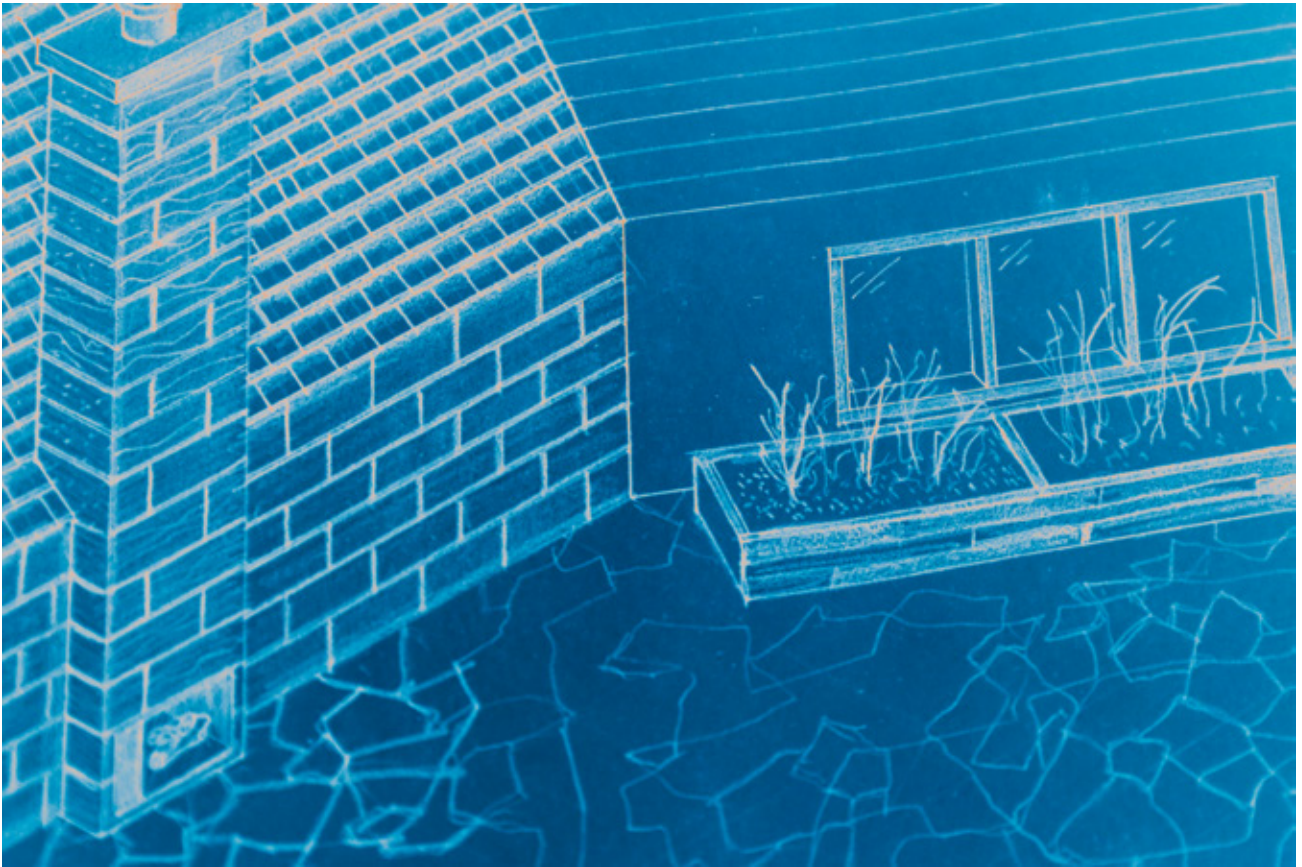


Wildlife pond with large rocks and vegetation

There are gardens and flower beds between each turn of the path up the slope, built up with earth. Cedar shingles that resemble regular black shingles on the roof denote that these buildings are for the community and an extension of the adjacent neighbourhoods. Inside, and through the large windows at each end, one facing the Escarpment and the other the vertical lift bridge, you will see the glulam timber beams as the frame of the building.

The burgundy rammed earth for the Bathhouse, signifies that it is built into the ground. On the wrap-around porch, a cedar boardwalk is warm and smooth for walking without your shoes. In addition, the non-humans will be able to inhabit the punched concrete wall and find refuge within and around the proposed pond, planted specifically in a way that denies access to people, denoting that parts of the site are completely designated for wildlife.

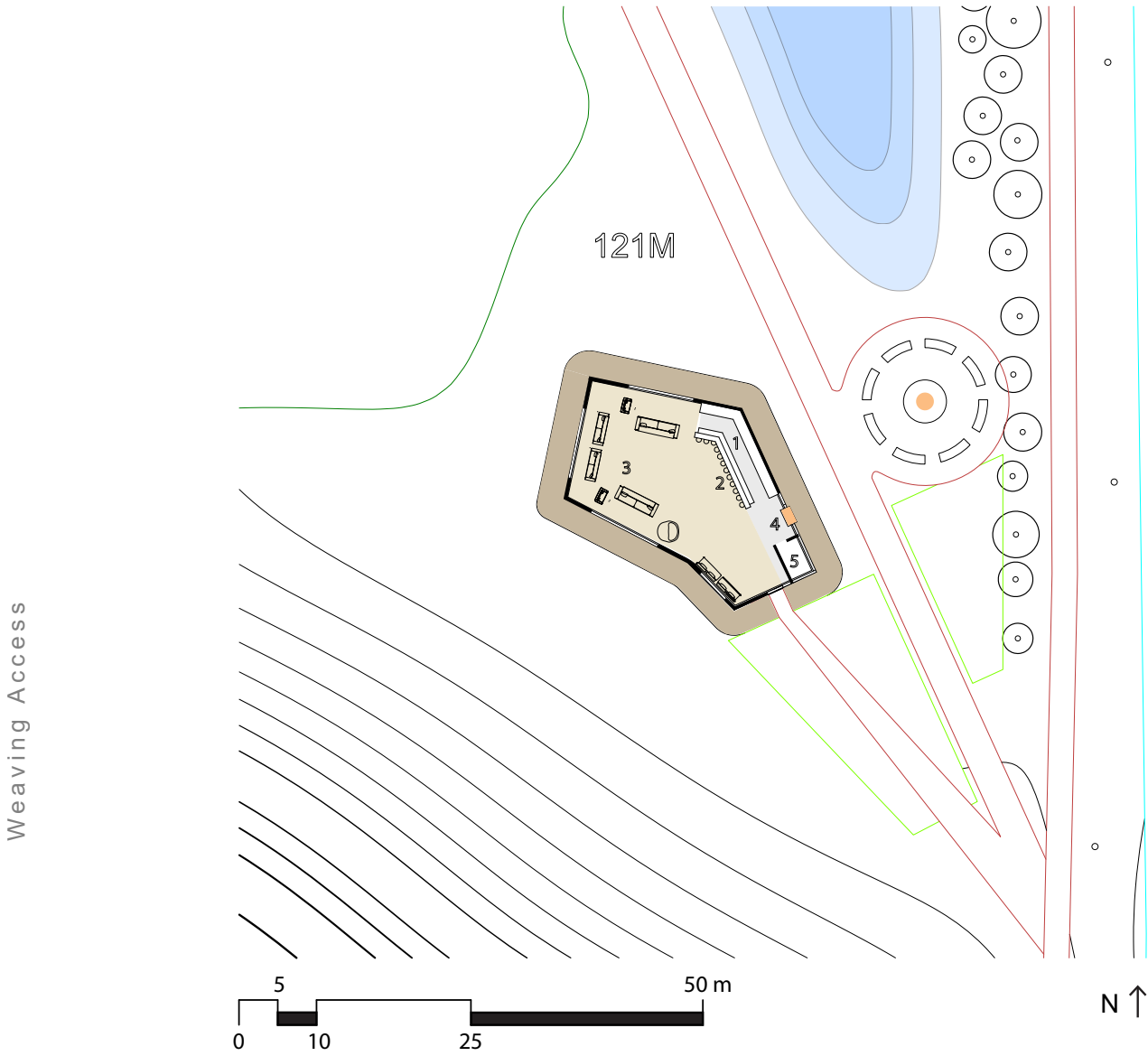




Field house patio with fireplace and garden beds

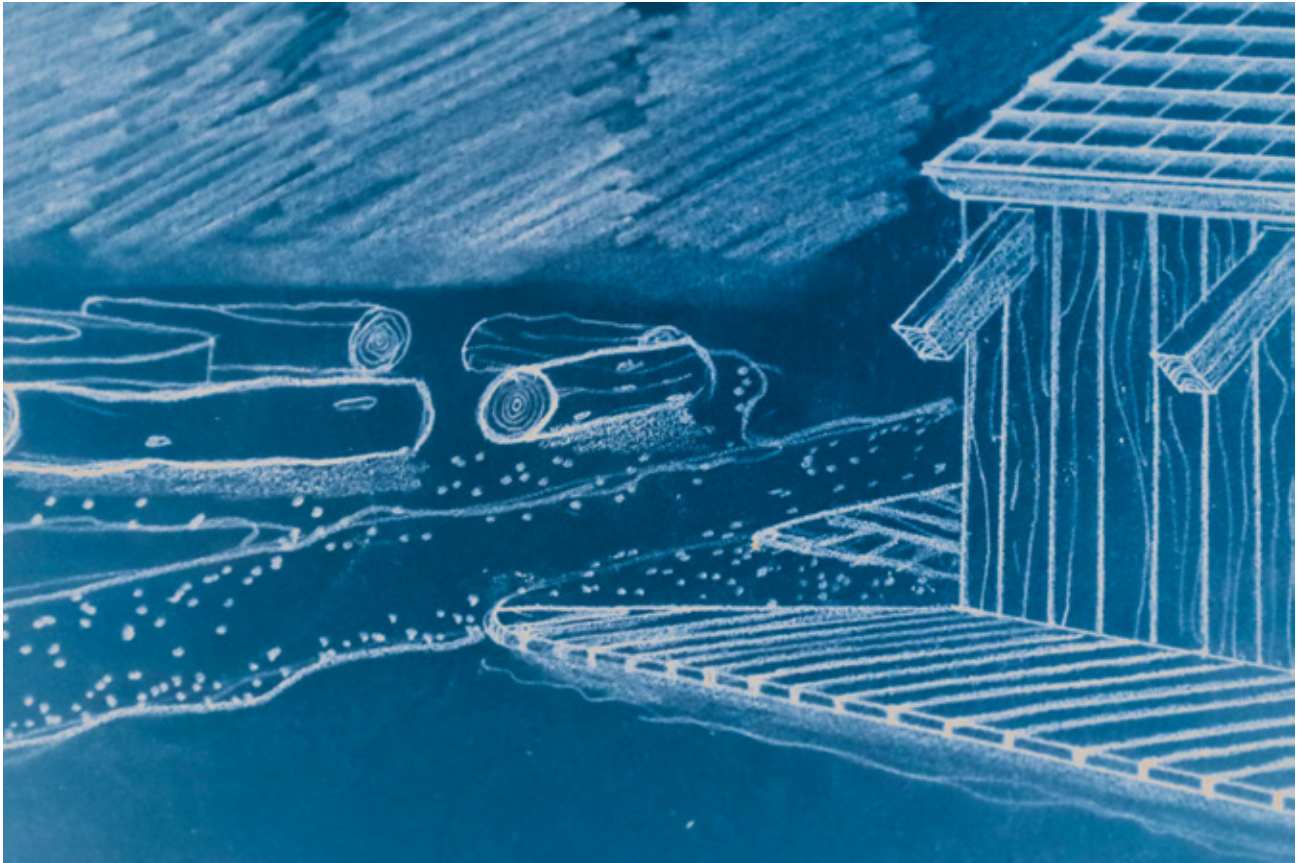


Accessible ramp to bathhouse, and lower wetland topography through the proposed short cut

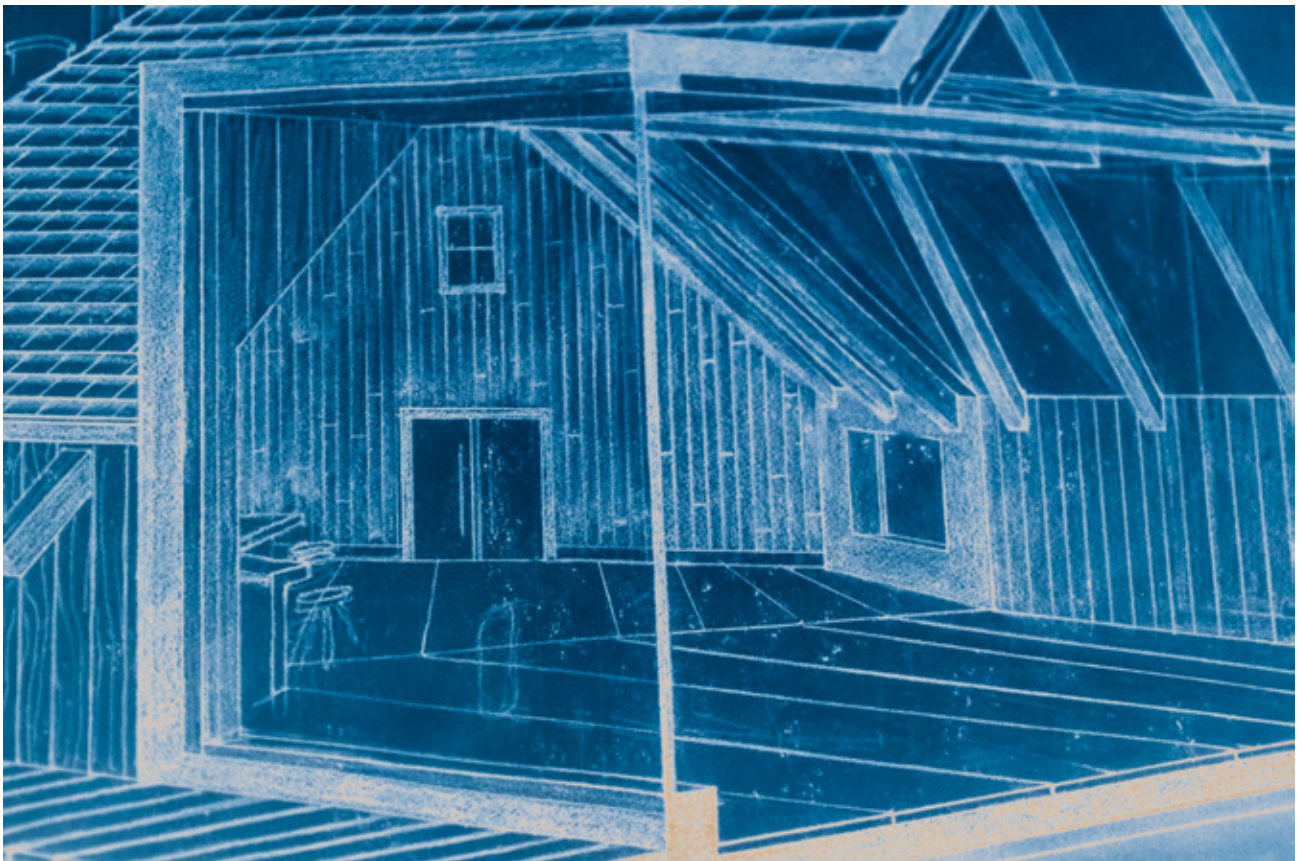


## Cafe - Ground Floor Plan

**Figure 95:** In plan, the main walls will face the tobogganing hill, the existing Welland Canals Parkway Trail, for easy access, and the next face a proposed firepit with seating, and the historic vertical lift bridge.



Outdoor natural wood log firepit seating, and wooden boardwalk to gravel path connection, for easy access for wheelchairs

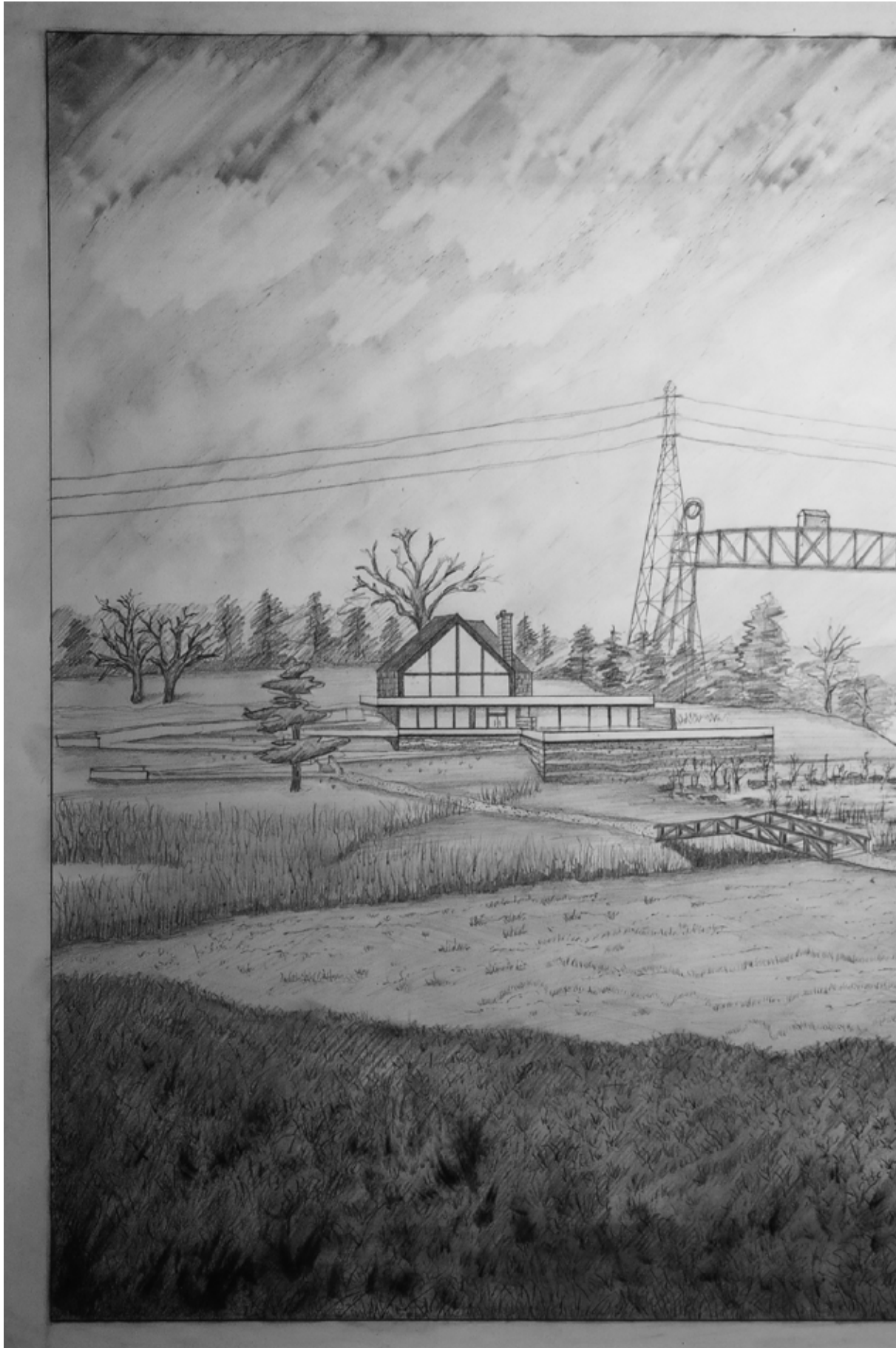


Cabin like cafe with large window openings and clear entrances that face the main points of access





Figure 97



Perspective Render  
**Overview of the Site**



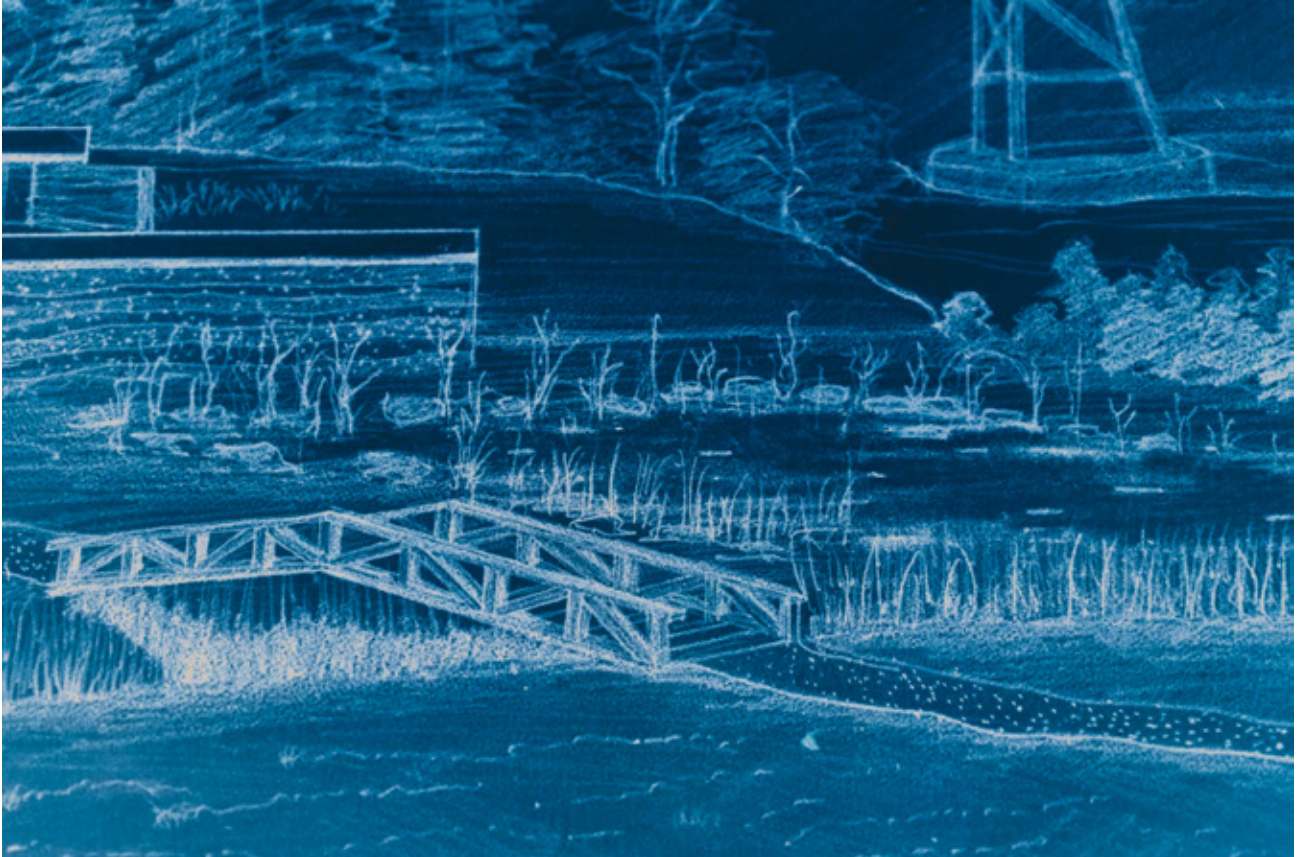
Figure 98

For the fieldhouse and bathhouse, the intention was to create a sense of community, by first breaking up the skyline from flat industrial, to shed roof, similar to the adjacent neighbourhood community residents along the Welland Canal. My next idea was to extend the existing informal use of the site, by creating programs and a typology that is centred around healing. This is important because a balanced part of the design is building not only into the landscape, quite literally by using local red shale dredged from the Canal parallel to the site, but also for wildlife, by limiting access to humans in certain areas from the approach of the building. This was done by having clearly designated concrete stone accessible ramps, for users that may be in wheelchairs, and a gravel path that crosses the wetland on the lower topography of the site. Mixing typologies not only found in Ontario, but also around Scandinavia, the fieldhouse and bathhouse building is level with the topography above, to allow for easy access, with the shed roof, and below a blend of thermal baths found in Switzerland, built into the landscape. This part of the program built into the landscape will have the locally mixed shale into the rammed earth giving it a burgundy colour, as part of a new building material technique that has never been done in this region. The roof of this bathhouse may be flat because it is the floor of the fieldhouse, and from a distance, approaching the site, users will see the shed roof from a distance, and then a new building style coming quite literally out of and from the landscape, foreshadowing that above it is clearly public and community, and below, a more secluded space that allows for the same public refuge, since they are connected.





The field house-bathhouse combined building in the background



The proposed bridge that links the North and South portions of the site, going over the wetland and ponds

This typology is important because what is essentially happening on the most highly active and southern portion of the site, the tobogganing hill, there is a proposed cafe in a completely wooden inside and out, with cedar strip boards and cedar shingles on the exterior, cabin-like typology of building, this being the easiest to access, and the smallest of the three main programs. While users are already coming to the site to toboggan or simply to use as a shortcut between major pathways, users will now find an extended reason to stay within the site, where the program shifts from the cafe, warm and completely wood, to the field house, wood interior and masonry exterior, to the bathhouse, concrete and rammed earth, with wooden saunas and more intimate spaces for reflection and healing, all made by local craftsmen and materials. What makes these buildings special, is how they minimize a footprint by having three separate buildings for each program, but also how they leave the existing site for wildlife as it is, and allow for rigid foundation walls and large pathways to clearly denote where people and wildlife have access. This also allows for the implementation of new ponds, extending the site's hydrology and allowing there to be an aquifer recharge for the existing wetland, and collecting water from the Niagara Escarpment.



The existing passerby ships travelling through the Welland Canal to or from the Twin Flight Locks



The proposed cafe and barstool seating within

## OBJECT: **Sound & Aroma Diffuser**

There are three main components to the artifact assignment, besides simply making an object that relates to the thesis, whether it be metaphorical, or literal, which in my case, I took on building a literal 1:1 scale object that would be used if this thesis proposal was ever realized.

**Detail Design** - *the ability to assess, as an integral part of design, the appropriate combinations of materials, components, and assemblies in the development of detailed architectural elements through drawing, modeling, and/or full-scale prototypes.*

**Materials** - *basic principles used in the appropriate selection and application of architectural materials as it relates to fundamental performance, aesthetics, durability, energy, resources, and environmental impact.*

**Project Management** - *the relationships among key stakeholders in the design process; the methods for selecting consultants and assembling teams; building economics and cost control strategies; the development of work plans and project schedules; and project delivery methods*

- The three main outcomes from the Canadian Architectural Certification Board (CACB), in regards to student performance criteria (SPC).



**Figure 101:** Final Artifact Standing in the Photo Lab

My original idea started with creating a door handle. One of the most intimate experiences can be when the user passes through the threshold of a building, and “A door handle is the handshake of a building,”<sup>1</sup> however, this idea although intimate, is rooted in ableism. Users such as my sister who was born with mobility difficulties would never have been able to open a door, let alone walk through a threshold. That is when the idea for an artefact to represent my thesis became something that does not have to be touched in order to be experienced. Ashley loved calming aromas such as lavender, or sweet grass, simply placed near her would help her sleep and calm her nerves. This is where the beginning of my next idea comes into play: instead of needing a nightstand with a vase and a bushel of lavender,

1 Juhani Pallasma - The Eyes of The Skin, Architecture and the Senses. p.62, John Wiley & Sons, 1996.

Weaving Access

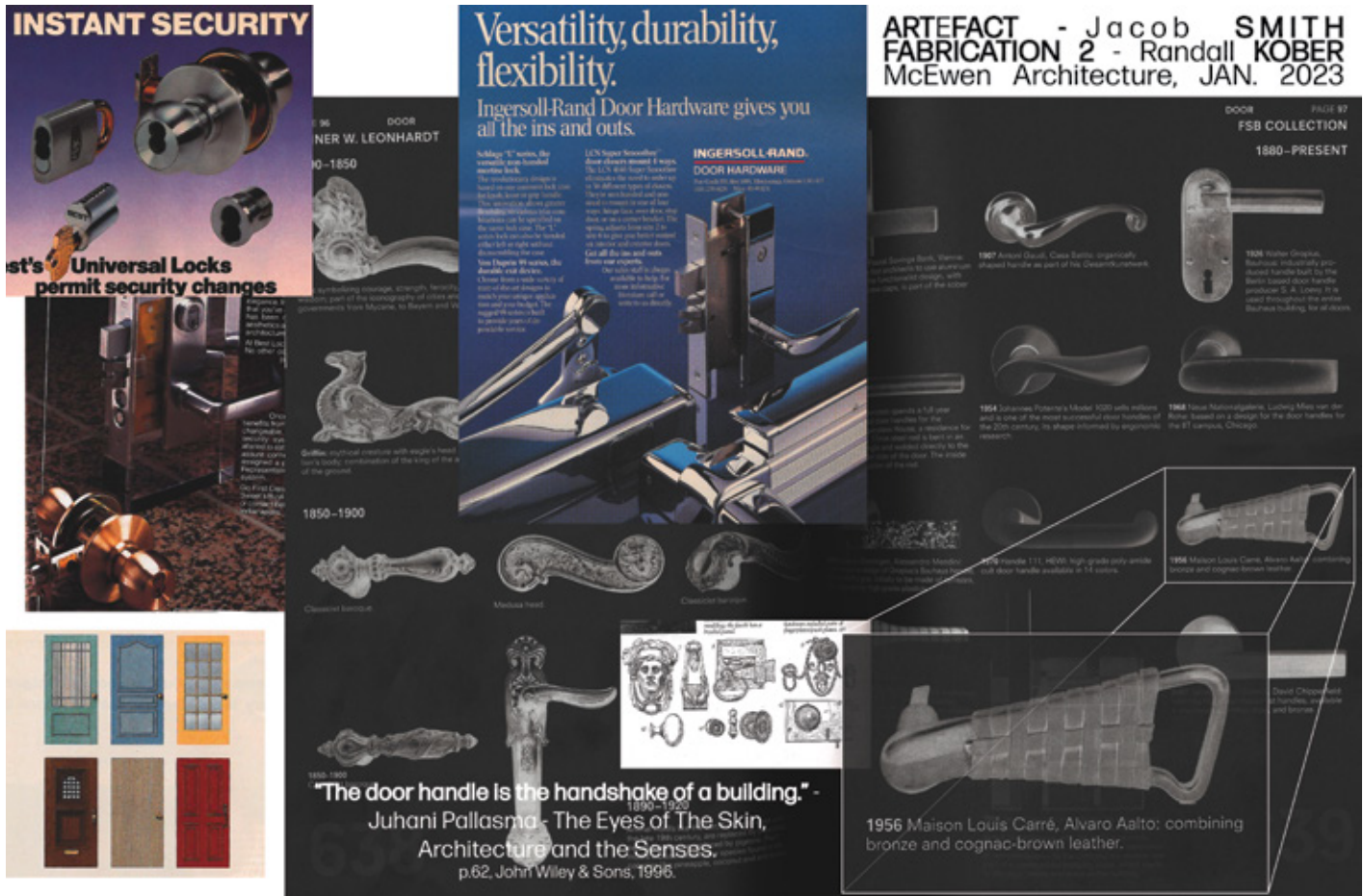


Figure 102: Initial Idea

it could be built into the actual space the user is occupying. Ecology and healing go hand in hand, with the overall intention of site remediation, applying a solution that solves a more intimate and smaller scale, aimed towards the user, the design of healing amenities can complement the recreational aspect of the existing site. For users with heightened sensitivity, such as my sister Ashley, typical building programs such as a sauna may not be suitable. This is where my idea was born in the hopes of creating a room temperature sauna designed to affect the senses through aroma, and sound. Lavender has been known to help ease stress and help calm its users. The contrast in pace between recreation and recovery can be solved by incorporating healing elements in the architecture. The traditional spa can also be challenged as a program for this thesis.

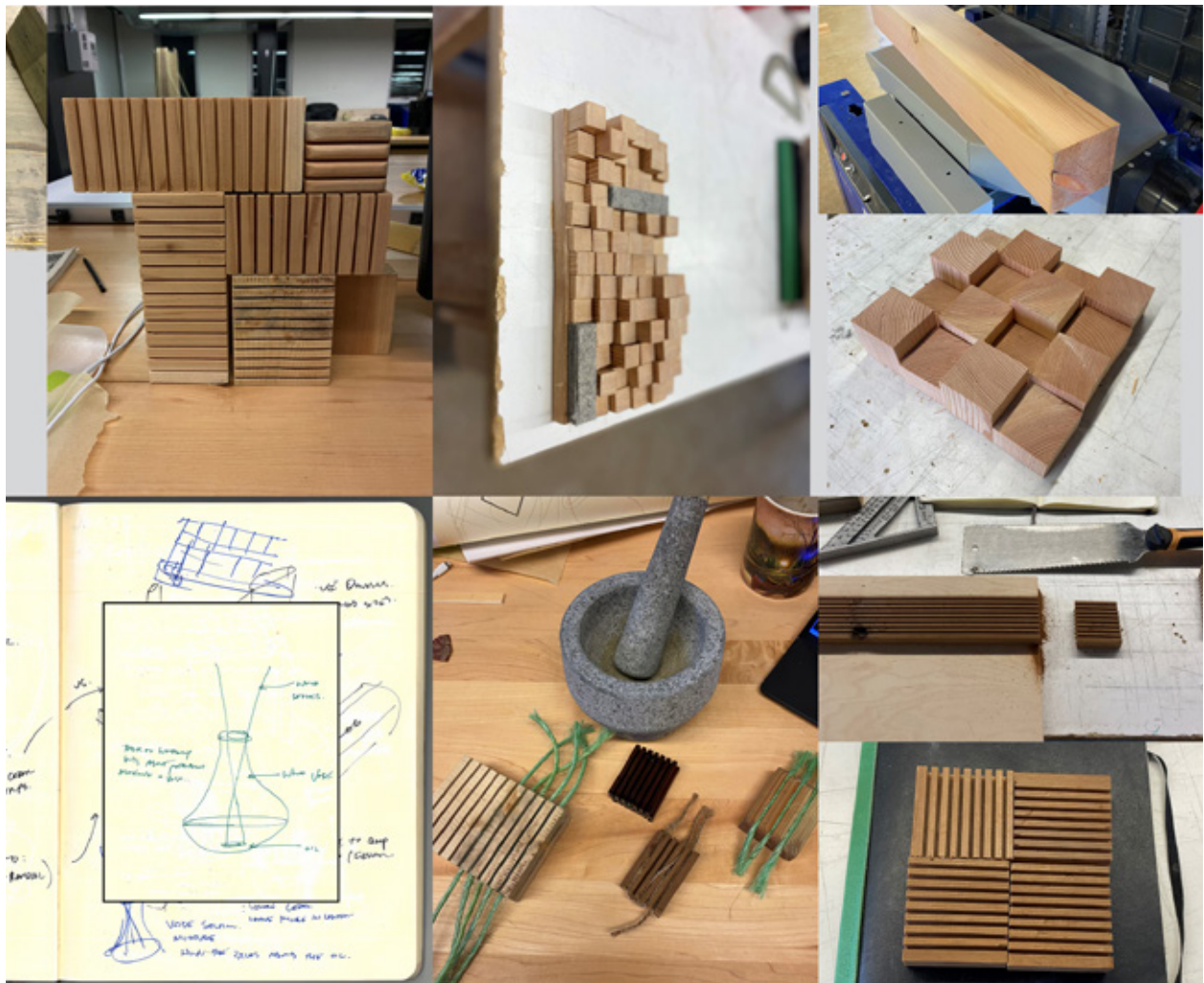


Figure 103: Process Work

### Initial Object Description:

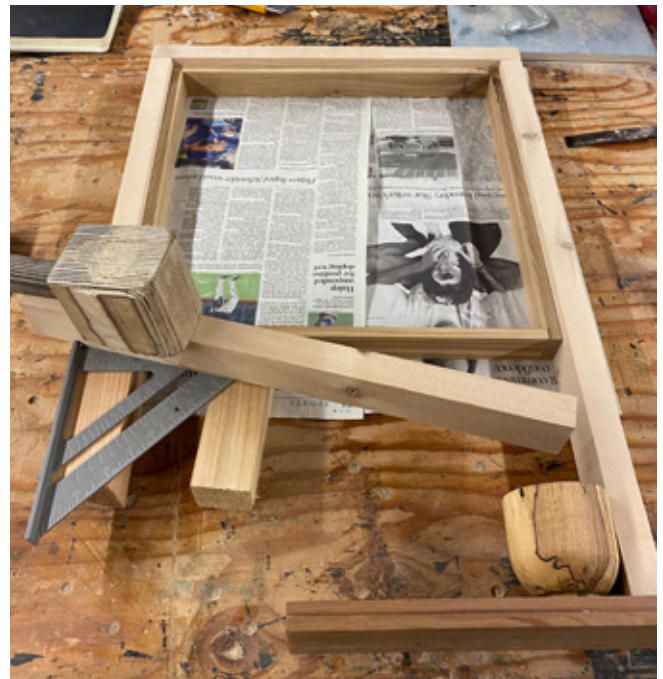
The design of a wall panel that could be used on the wall of certain rooms and has the potential to diffuse sound and aroma, the diffuser would complement the space since both may be constructed of wood. Cedar for the panel, with strips, cut into the wood to create more surface area, set at different heights to absorb more sound, weaved together with twine, and blended in with felt at the edges might allow for a greater sound reduction. They use a pestle and mortar to grind lavender, mixed with unscented mineral oil (or baby oil) to create an essential oil that may be mixed with water in a vase, where thin sticks of cedar wood will slowly absorb the mixture and release it into the atmosphere over time will calm the senses and allow for a smooth recovery process.



Off cut block of Spalted Maple that was milled at the McEwen Architecture School by Mark Beachler



Cup made on the wood turning lathe designed to catch oil, made from Spalted Maple

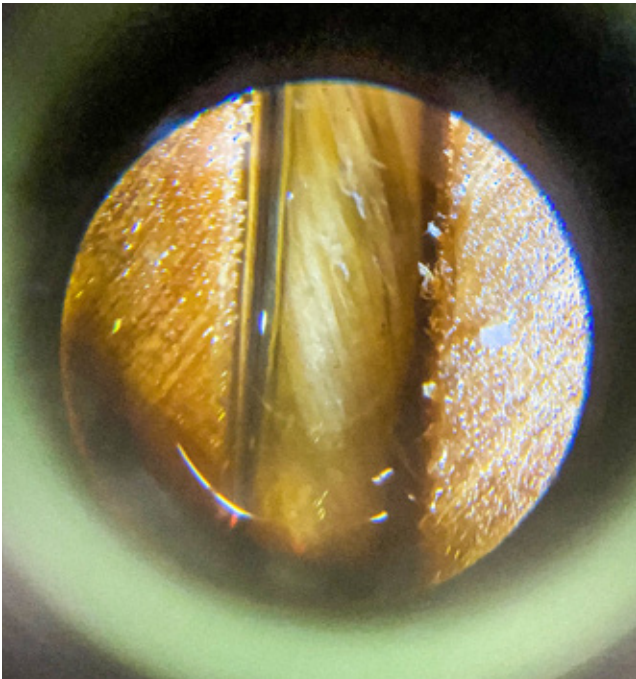


Laying out the case for the diffuser, and calculating the angle for the drip trough (15 degrees to match the dovetail joinery)

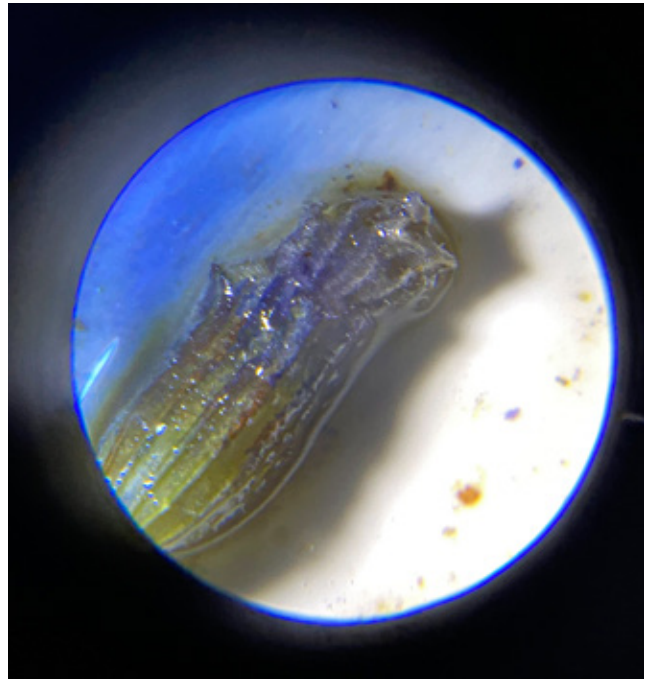




2x2" Cedar block weaved together with 1/8" twine



Microscopic image of twine carrying the lavender infused mineral oil around the cedar blocks



Microscopic image of lavender bud infused with mineral oil

From the global scale to the urban context to the site relationships, to the landscape plan, to the ground floor plan, to the room layout, each plan fits into one another and the sequence of spaces we design leads its users into particular places for specific experiences. How do we tie the things we craft at 1 to-1 scale, to the plans we create 100 times that size? Perhaps by using the same design language with patterns, or considering a wider range of users, including wildlife and the site's ecology. How can the sensual experience of wildlife outside the buildings we create have the same refuge consideration and healing experience inside them? To engage everyone, human and non-human, and provide refuge, is an act of kindness. Although economical, some infrastructures out of our control resulted from compromises, such as the Welland Canal and the Niagara Escarpment. Which begs the question, how can we provide refuge for the people who built our communities, the specially-abled, and the wildlife we depend on?

My idea was born in the hopes of creating a sensual experience for the user without them having to see or touch the object. For users with heightened sensitivity, such as my sister Ashley, typical programs designed for healing such as a sauna or hot bath are unsuitable, and artifacts such as a custom door

handle are not accessible. When recalling what helped Ashley, a vase with raw lavender comes to mind. Proven to reduce the stress of individuals within close proximity, this memory led me to create the foundation of my artifact. Lavender essential oil is known to be rich in medicinal properties like antimicrobial activity, anxiolytic, anti-inflammatory, antinociceptive, and antioxidant properties.<sup>1</sup> But what is a diffuser? In physics, it means to become or cause (a fluid, gas, individual atom, etc.) to become intermingled with a substance by movement, typically in a specified direction or at a specified speed.<sup>2</sup> It works for light, sound, and smell. Essential oils are proven to help air quality as well, and vapours of essential oils have good antimicrobial activity against respiratory pathogens, including influenza virus and offer an alternative strategy for disinfecting the indoor air and when dispersed in the air, can significantly reduce the microbial levels indoors.<sup>3</sup> These are all things that affect those blind, and immobile, such as my Sister.

1 Kajari S, Joshi RS, Hugar SM, et al. The Effects of Lavender Essential Oil and its Clinical Implications in Dentistry: A Review. *Int J Clin Pediatr Dent* 2022;15(3):385-388.

2 Oxford Languages. Google, March 2023.

3 Kalaiselvan P, Yasir M, Kuppusamy R, Willcox M, Vijay AK. Ability of Essential Oil Vapours to Reduce Numbers of Culturable Aerosolised Coronavirus, Bacteria and Fungi. *Antibiotics (Basel)*. 2022 Mar 15;11(3):393. doi: 10.3390/antibiotics11030393. PMID: 35326856; PMCID: PMC8944824.

So, why not combine these aspects of our environment into one object? The design of a wall panel has the potential to diffuse sound and aroma would complement a space for therapy. Wooden wall panels are typically used as sound diffusers, and in particular, this artifact is innovative in its variability from affecting the senses through sound, and aroma diffusers. Similar to a skyline diffuser, but instead of a randomized pattern with square inch blocks, there is a set pattern of 4 blocks, 16 of each, 2 square inches, with a strip cut around on each side in like every half inch on centre.<sup>4</sup> Easy to build with robustness, wood is ecological, and has great acoustic properties.

4 Jeefs, Tom. DIY: How to build a wooden Skyline Diffuser. Accessed February 28, 2023. <https://www.thepointofcreation.com/blog/do-it-yourself-skyline-diffuser-build/#:~:text=Material%20and%20Planing&text=Even%20styrofoam%20is%20used%20every, frequencies%20to%20a%20small%20degree.>



Routed trough with naughted twine, soaked in lavender buds and mineral oil mixture



Dovetail joinery holding the case together

To combine lavender, the aroma, and wood, for sound, twine can be used to carry tie the wood together and carry an unscented oil mixed with lavender to create an essential oil. Using cedar for the panel, a light wood, native in the Ontarian context, with strips cut into the wood to create more surface area to diffuse more aroma, set at different heights to absorb more sound and weaved together. In a similar way that the wood blocks are configured, softening the exterior concrete facade with punched blocks would not only allow for the non-humans to inhabit the wall and have a refuge within and around a proposed pond but also take a material heavily used in the industrial revolution, especially to construct the 4th and current Welland Canal, a step forward in the environmental direction. In the same context that my artifact is weaved together, the punched concrete blocks will extend out of the landscape and be weaved together with vegetation and wildlife over time.

My masters architecture thesis titled, *Weaving Access: Ecological Architecture for Refuge along the Welland Canal*, is deeply interconnected to a sensual, healing

experience, for both humans and non-humans, not only as an act of Kindness to those specially abled but the landscape we thrive upon. Throughout the process, I learned how to properly use multiple tools that will help me in future woodworking projects. Chisels and a pull saw, and proper marking tools to create dove-tail joinery for the case, as well as mortise and tenon joints, and the table saw for notching lines for the twine while setting up a jig to have precise cuts. The drill press, to drill holes to weave the twine through the reveal, separating the blocks from the case, and adding depth to the project. The plunge router, for precisely cutting a trough for the oil to sit in before it seeps through the twine and into the blocks, as well as the drip trough at the bottom. Next, the lathe for carving a cup to catch the oil that exceeds the twine and blocks, dripping from the bottom and angled trough. Hand carving a ladle (spoon) to collect the oil from the cup and precisely drip the oil back into the top trough, without creating a mess. Overall, this project helped me understand the importance of safety, etiquette, and time management in the woodshop, as well as a multitude of tools that will help me create future projects.



**Figure 106:** Live edge Spalted Maple base for the cup, made from the same block locally milled, with a hand carved beech wood spo and the drip edge along the bottom cedar trough

# Acts of Kindness

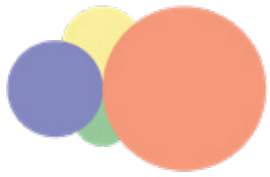
Year 1 M.Arch Final

Advisor: Kai Mah

## Note -

I chose to include this project because it acknowledges the majority of the edge condition along the Canal where the 40km walking, cycling, and running path extends from Lake Ontario to Lake Erie, and provides refuge with the same design research question and similar strategies.

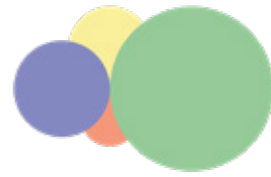
This proposal addresses the rising need for social refuge, and how we shape society through remote access. The hope is to remove the stigma and increase productivity in existing public areas that lack social diversity. In one of my recent exercises, I conducted two short films identifying places in my neighbourhood and around the city of St. Catharines that highlight major accessibility qualities amongst other things, such as playgrounds and bike paths. The reason I chose to map out these observations was to key in on what happens in social environments when it intersects with the needs of all. For example, the most accessible local playground in the city where I was raised is Lester B. Pearson Park, also the location of a new Kiwanis Aquatic Centre which is a public building with a library. When I spoke with a gentleman with his 5 year old son, at the adjacent playgrounds, he said they go there because of this new building. My first conclusion is how the inverse relationships between various used public spaces can link the creativity of those individuals that use these spaces that share these qualities, and attract users for different reasons, allowing them to discover a sense of community regardless of race, gender, or ability. This generated space for the accessibility of users becomes more complex with its location. That being said, how we achieve this is not limited by people, but rather by the atmosphere and existing condition of the location. By using a kit of parts methodology, we can implement a unique strategy, map, or structure to improve the engagement between different individual living things.



Industrial Land  
Prioritized

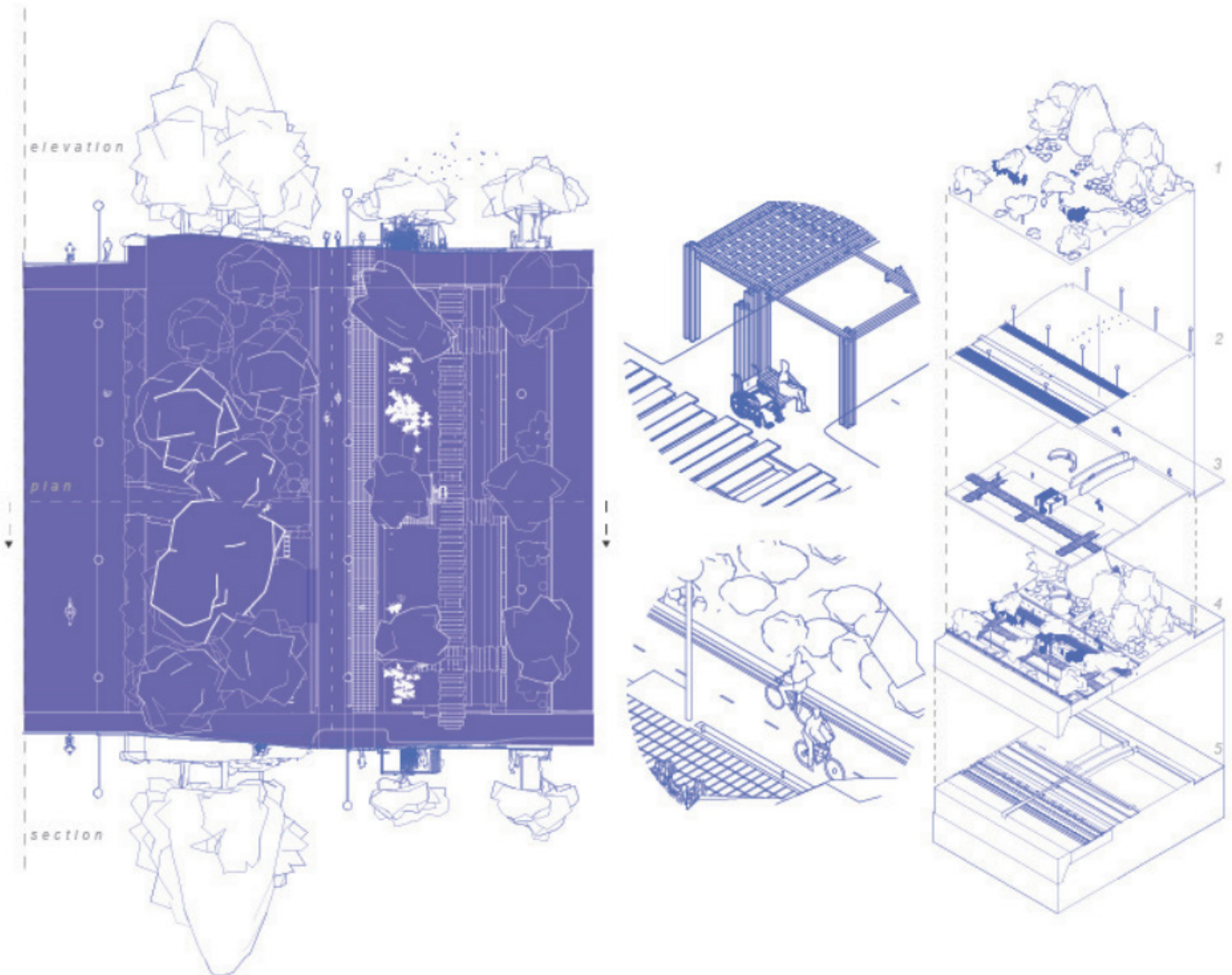


Land Use & Influence  
on  
Accessibility



Green Public Space  
Prioritized

- Industrial
- Water
- Green Space
- Health



In an attempt to discover the difference between land and accessibility, I chose to develop a concept that allows a mismatch to be seen as an advantage, where edges become softened, lanes become designated, and shelter is acknowledged.

Users like my sister who were born with cerebral palsy, where conditions ranged from blindness to handicapped, reflected the sensibility to many external forces displaying or exerting movements that affect one's perception of a site through hearing, and feeling.

Derived from the transition of water across the land, the Welland Canals serve the community and to connect people. However, although this site may be seen as one side of the border, it may also be seen as the remains from an industrial revolution that took place one hundred and fifty years ago in the same place.

The idea behind this proposal is to create an oasis for individuals with particular needs who may have differing perception and various sensory conditions, in turn creating space where public access is at the utmost priority, forming what would become a refugee landscape along the remains of industrial compromise.





View of pavilion from water feature



View of intersecting pathways

# Conclusion

Overall, this thesis aims to reverse the impact and foster the biodiversity of the industrial site that is the Welland Canal, by intervening with an approach of landscape healing developed in coordination with the idea of bodily healing. The human-made corridor between the two Great Lakes Ontario and Erie, created unexpected consequences and introduced slowly evolving changes that had a drastic impact on the culture and biological balance of this area. To identify and reveal an approach to these effects, a geological understanding of the infrastructure, and documenting the canal system's history and conditions, have the potential to create ecological commons for wildlife, vegetation, and cultural interaction.

In conclusion, the proposal of weaving access along the Welland Canal for refuge of human and non-human species, including disabled individuals, is a transformative approach to reclaiming a post-industrial landscape. By proposing a cafe to complement the existing informal tobogganing hill and a field house for community gatherings, connected to a bathhouse built into the landscape designed for healing, the vision for this project is all about inclusivity and community.

The proposed design not only creates a welcoming environment for individuals with disabilities but also serves as a catalyst for the remediation of the historically neglected landscape along post-industrial sites of the Welland Canal. By incorporating elements of nature and local culture into the design, the proposed café and field house will offer a unique experience for visitors and locals alike. The bathhouse, built into the landscape, will provide a serene and peaceful space for healing and rejuvenation. The ecological restoration plan prioritizes the preservation and enhancement of the natural habitat, creating a biodiverse and resilient ecosystem. The proposal focuses on reducing water pollution and promoting the regeneration of native vegetation and wetlands, contributing to a healthier environment.

Ultimately, the proposal for the weaving access for refuge along the Welland Canal offers a vision of a more sustainable and equitable future, one that celebrates the diversity of life and creates spaces for healing and community-building. Architecture can play a vital role in creating such a future and offers a model for how we can approach design in a more inclusive and holistic way.

# Bibliography

- Allan, Stan., and Marc. McQuade. *Landform Building : Architecture's New Terrain*. Baden: Lars Muller, 2011. (132). Accessed March 16, 2023.
- Athens, Emily. "Nature's Water Purifiers Help Clean up Lakes." BBC Future. BBC, September 25, 2012. Accessed Nov. 20, 2022. <https://www.bbc.com/future/article/20120925-natures-water-purifiers>.
- Brash, Alexander, Jamie Hand, and Kate Orff. *Gateway : Visions for an Urban National Park*. New York: Princeton Architectural Press, 2011. (p.67) Accessed Feb 29, 2023.
- City of Mississauga Invasive Species Management Plan. Accessed November 15, 2022. <https://www.mississauga.ca/wp-content/uploads/2021/02/18112420/Invasive-Species-Management-Plan.pdf>
- Claire Eason. (2020). *Design Thinking: Steps Toward Accessible Architecture*. Accessed October 21, 2022. P. 77
- Geology - Buffalo, Accessed December 7, 2022. <http://www.glyfac.buffalo.edu/Faculty/jorgm/WebJorg07/gly103trip.htm>
- History from Here: Lakeside Park at Port Dalhousie. St. Catharines Museum, Youtube. Accessed November 1, 2022. [https://www.youtube.com/watch?v=Ak0N3n76aas&ab\\_channel=St.CatharinesMuseum](https://www.youtube.com/watch?v=Ak0N3n76aas&ab_channel=St.CatharinesMuseum)
- History of The McMichael" - McMichael Canadian Art Collection - Our History, 2021. Accessed March 5, 2023. <https://mcmichael.com/about/history/>
- Ingold, Tim. *Making, Anthropology, archaeology, art and architecture*. 2013. Routledge. *Knowing from the Inside*.
- Inland Waterways and Environmental Protection - OECD. August 17, 2006. Accessed December 2, 2022. P52 <https://www.itf-oecd.org/sites/default/files/docs/06waterenv.pdf>
- Juhani Pallasma - *The Eyes of The Skin, Architecture and the Senses*. p.62, John Wiley & Sons, 1996.
- Kim, J., & Mandrak, N. E. (2016, August 5). Assessing the potential movement of invasive fishes through the Welland Canal. *Journal of Great Lakes Research*. Retrieved November 13, 2022, from [https://www.sciencedirect.com/science/article/abs/pii/S0380133016301058?fr=RR-2&ref=pdf\\_download&rr=769ca3704e05714a](https://www.sciencedirect.com/science/article/abs/pii/S0380133016301058?fr=RR-2&ref=pdf_download&rr=769ca3704e05714a)
- Murray, Scott. "Material Experiences: Peter Zumthor's Thermal Baths at Vals." *The senses & society* 2, no. 3 (2007): 364. Accessed March 22, 2023. *Niagara Environmental Background Study Report*. September 27, 2019. Accessed October 19, 2022, <https://www.niagararegion.ca/projects/rural-and-natural-systems/pdf/natural-environment-work-program-study.pdf>.

- Spier, Steven. 2001. "Place, Authorship and the Concrete: Three Conversations with Peter Zumthor," *ARQ Architectural Research Quarterly*, 5 (1) 22.
- Statistics Canada (2018). Canadian Survey on Disability, 2017. Accessed October 19, 2022. Retrieved from <https://www150.statcan.gc.ca/n1/daily-quotidien/181128/dq181128a-eng.htm>
- Styran, Roberta M., and Robert R. Taylor. *This Great National Object: Building the Nineteenth-Century Welland Canals*, McGill-Queen's University Press, 2012. Accessed April 20, 2023. <http://www.jstor.org/stable/j.ctt1283qt.8>.
- "A Primer on Seating." Project for Public Spaces, December 31, 2008. <https://www.pps.org/article/generalseating#:~:text=%22This%20might%20not%20strike%20you,as%20they%20could%20sit%20somewhere.>
- "A Unique Natural Resource," Accessed December 2020. A Unique Natural Resource | Niagara River Remedial Action Plan (<https://ourniagarariver.ca/niagara-river-ecology/>)
- "Ecosystem-based Adaptation to Protect Avian Species in Coastal Communities in the Greater Niagara Region, Canada." Samantha Gautheir, Bradley May and Li, June 4, 2021. Accessed March 2, 2023. <https://doi.org/10.3390/cli9060091>
- "Great Canadian Heritage Treasure" - Goldi Productions Ltd. - 1996, 1999, 2005, Accessed February 28, 2023, [https://thecanadasite.com/art/art2c\\_kelly11\\_create2.html](https://thecanadasite.com/art/art2c_kelly11_create2.html)
- "Great Lakes St Lawrence Study - Seaway.dot.gov." ACR Communications Inc., Fall 2007, accessed October 22, 2022 <https://www.seaway.dot.gov/sites/seaway.dot.gov/files/docs/Army%20Corps%20-%20Great%20Lakes%20Seaway%20Study.pdf>
- "Invasive Species Management Plan & Implementation Strategy - Mississauga." The Corporation of the City of Mississauga. February 18, 2021. Accessed November 20, 2022, <https://www.mississauga.ca/wp-content/uploads/2021/02/18112420/Invasive-Species-Management-Plan.pdf>
- "New Welland Ship Canal Built for Deep-Draft Vessels" - Engineering News-Record., p 356. September 4, 1930. Accessed March 5, 2023. <https://historicbridges.org/truss/glendale/welland.pdf>
- "Niagara Priority Profiles - Disabilities - Niagara Region." Accessed October 19, 2022. <https://www.niagararegion.ca/health/equity/pdf/priority-profile-disabilities.pdf>
- "Niagara Priority Profiles - Indigenous" - Niagara, Health, Equity. September 23, 2021. Accessed December 6, 2022. <https://www.niagararegion.ca/health/equity/pdf/priority-profile-indigenous.pdf>

- “Niagara’s Welland Canal.” - Welland Canal Brochure - April 15, 2016. Accessed Nov. 5, 2022. [www.niagarawellandcanal.com](http://www.niagarawellandcanal.com)
- “Pond Uses, Site Selection, Design, Construction, and Maintenance.” - Monroe County Soil & Water Conservation District. July 22, 2013. Accessed March 3, 2023 <https://www.yumpu.com/en/document/view/17974242/pond-uses-site-selection-design-construction-and-maintenance>
- “Resources” - Niagara Region, Living. Chapter 6. Accessed March 4, 2023. <https://www.niagararegion.ca/living/icp/pdf/2015/Chapter-6-Resources.pdf>
- “Six Nations Lands & Resources” - Litigation, Six Nations of the Grand River v. Canada & Ontario. Accessed December 7, 2022. <https://www.sixnations.ca/LandsResources/lsuSNvCo.htm>
- “The Great Lakes Seaway.” - Information Services, The St. Lawrence Seaway Management Corporation. March, 2003. p.1-12. Accessed 30, 2022 <https://greatlakes-seaway.com>
- “Welcome to the GLY 103 Niagara Falls Field Trip.” Department of Geology - Buffalo, Accessed December 7, 2022. <http://www.glyfac.buffalo.edu/Faculty/jorgm/WebJorg07/gly103trip.htm>
- “Welland Canal” brochure. Tourism St. Catharines, Accessed November 5, 2022. [www.tourismstcatharines.ca](http://www.tourismstcatharines.ca)