REIMAGINING LEMIEUX ISLAND

by

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ABSTRACT

This thesis explores the preservation and adaptive re-use of Ottawa's Lemieux Island Water Purification Plant, incorporating new programs – biological water purification, aquaponics, water-based recreation, and education. Recently, rising water levels in the Ottawa River have led to flooding and threatened the operations at this plant. Extreme weather conditions, along with the public's accessibility to new options in water treatment in the future, may mean that the original function of the plant will become obsolete, offering opportunities for the facilities to be repurposed.

Based on current scientific information about increasing precipitation and ongoing climate instability, as well as on the existing flood patterns of the Ottawa River, the thesis design incorporates changes to the island's topography in order to protect the historical buildings that are at lower elevations from flooding. Simultaneously, I propose a utilization of the industrial settling and filtering buildings with large water-holding capacities at higher elevations to test and study methods of bioremediation of water from the Ottawa River.

This reimagined filtration plant will supply various other programs within the adapted historical building that include recreation, agriculture, and education. The main water bioremediation method used is Dr. John Todd's "Living Machine" system, that mimics the cleansing function of natural wetlands. The recreational element of the project includes natural swimming pools with separate water cleansing components. The agricultural element of the project centers on an aquaponics system. The educational

component of the project enables the public to engage with processes involved in the "Living Machine", the natural swimming pool, and aquaponics systems.

The goal for the thesis is to create an architectural design for the future re-appropriation of this historical industrial building, integrating the bioremedial, recreational, agricultural, and educational programs of the project in a cohesive and humanistic manner.

ACKNOWLEDGEMENTS

To my advisor, Catherine Bonier, for your guidance, encouragement, and patience, which have been integral throughout my thesis journey.

To Ozayr Saloojee, for his constant support during my four years at the Azrieli School of Architecture and Urbanism.

The drawings of the existing facility are based on CAD files from Gore & Storrie Ltd. I am grateful to André Bourque for sharing this information and explaining the facilities and systems to me.

To Eric Montpetit for organizing a tour of the Lemieux Island Water Purification Plant, and Maxime Lafrance for taking time to give me a thorough and informative tour.

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INTRODUCTION: THE SITE AND ITS CHALLENGES

The Lemieux Island Water Purification Plant was constructed in 1932, and is one of two water purification plants currently servicing Ottawa – the other one being the Britannia Water Purification Plant. Each of these water purification plants provide approximately half of Ottawa's 275 million liters of drinking water per day. Lemieux Island is located in the middle of the Ottawa River, immediately upriver of Chaudiere Falls.

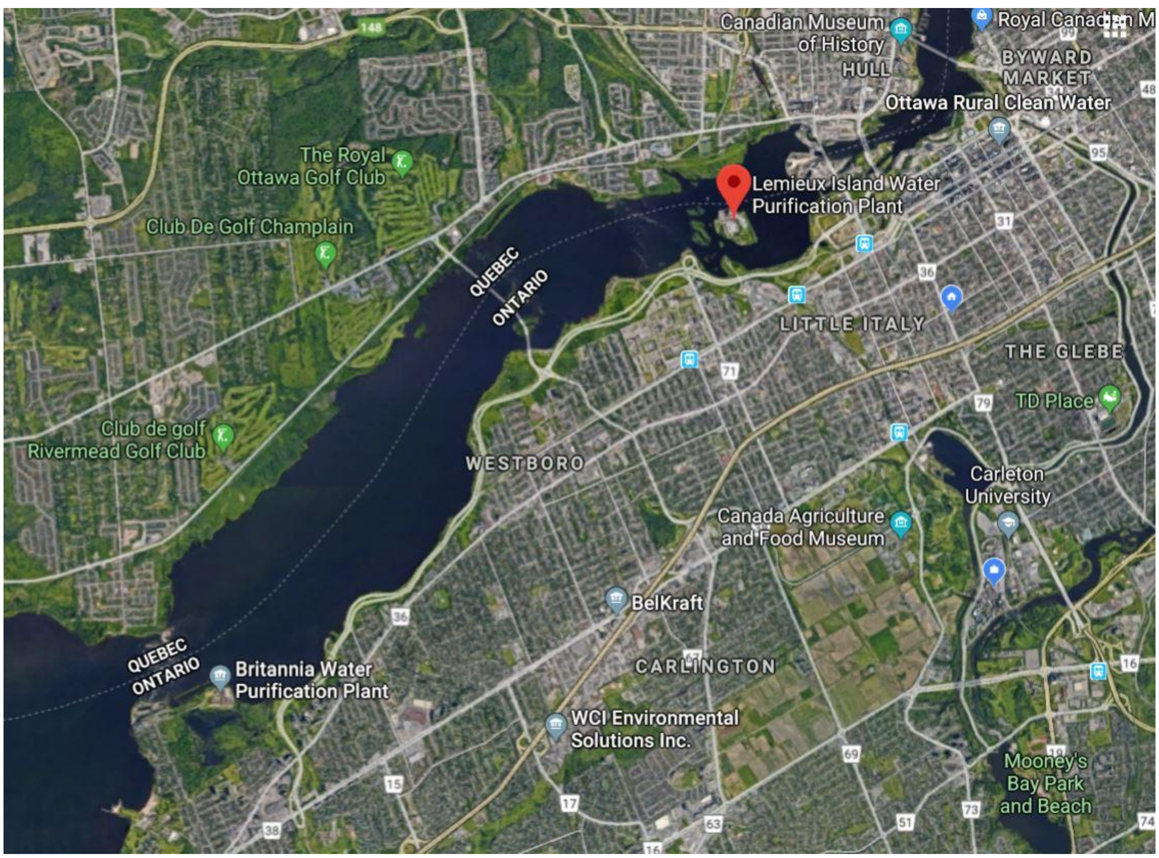

Figure 1: Locations of Lemieux Island Water Purification Plant and Britannia Water Purification Plant.
https://www.google.com/maps

Lemieux Island as it is currently known, is a combination of what used to be Lyons Island on the North and Lemieux Island on the South, with the small channel between them that was filled up incrementally between 1880 and 1995. Lemieux Island currently encompasses an area of approximately 11 hectares.[1]

Figure 2: Arial view of the Lemieux Island Water Purification Plant, 1936.
Libraries and Archives Canada.

Figure 3: Arial view of the Lemieux Island Water Purification Plant, 2009
https://nacsworld.com/content/lemieux-island-wpp-filter-expansion

[1] Regional Municipality of Ottawa-Carleton, *The Historical Development of Lemieux Island*, 1995, p.2.

Figure 4: Floods near Britannia Water Purification Plant in Spring 2019
https:// www.cbc.ca/news/canada/ottawa/climate-change-adaptation-city-ottawa-explainer-1.5124436

Figure 5: The Administrative Building at the lower elevation (54.5m) of Lemieux Island.
Photograph by author.

Figure 6:Water level in July 2019 at Lemieux Island (approximately 53m above sea level).
Photograph by author.

According to the 2019 Canada's Changing Climate Report, since 1948, Ontario and Quebec have experienced higher spring temperatures and increased winter and spring precipitation. This means that, in the Ottawa River watershed, there has been more snow in the winter, which melted more quickly in the spring, combined with increased spring rainfall - the three factors that contribute to flooding. Furthermore, the report predicts that occurrences of extreme precipitation will become more likely in the future.[2]

[2] Hodgson, Charles, *Explainer: Is Climate Change the Cause of the 2019 Ottawa River Flooding?*, Ecology Ottawa, 2 May 2019. https://ecologyottawa.ca/2019/05/02/explainer-is-climate-change-the-cause-of-the-2019-ottawa-river-flooding/

Region	Change in Temperature, °C				
	Annual	**Winter**	**Spring**	**Summer**	**Autumn**
Ontario	1.3	2.0	1.5	1.1	1.0
Quebec	1.1	1.4	0.7	1.5	1.5

Figure 7: Observed changes in annual and seasonal mean temperature between 1948 and 2016
From Table 4.1, Canada's Changing Climate Report 2019, p.127.

Region	Change in Precipitation, %				
	Annual	**Winter**	**Spring**	**Summer**	**Autumn**
Ontario	9.7	5.2	12.5	8.6	17.8
Quebec	10.5	5.3	20.9	6.6	20.0

Figure 8: Observed changes in normalized annual and seasonal precipitation between 1948 and 2016.
From Table 4.4, Canada's Changing Climate Report 2019, p.158.

Figure 9 Illustrates the Ottawa River water levels at 53 meters, and Figure 10 depicts the extent of flooding on the island should the water rise to 55 meters.

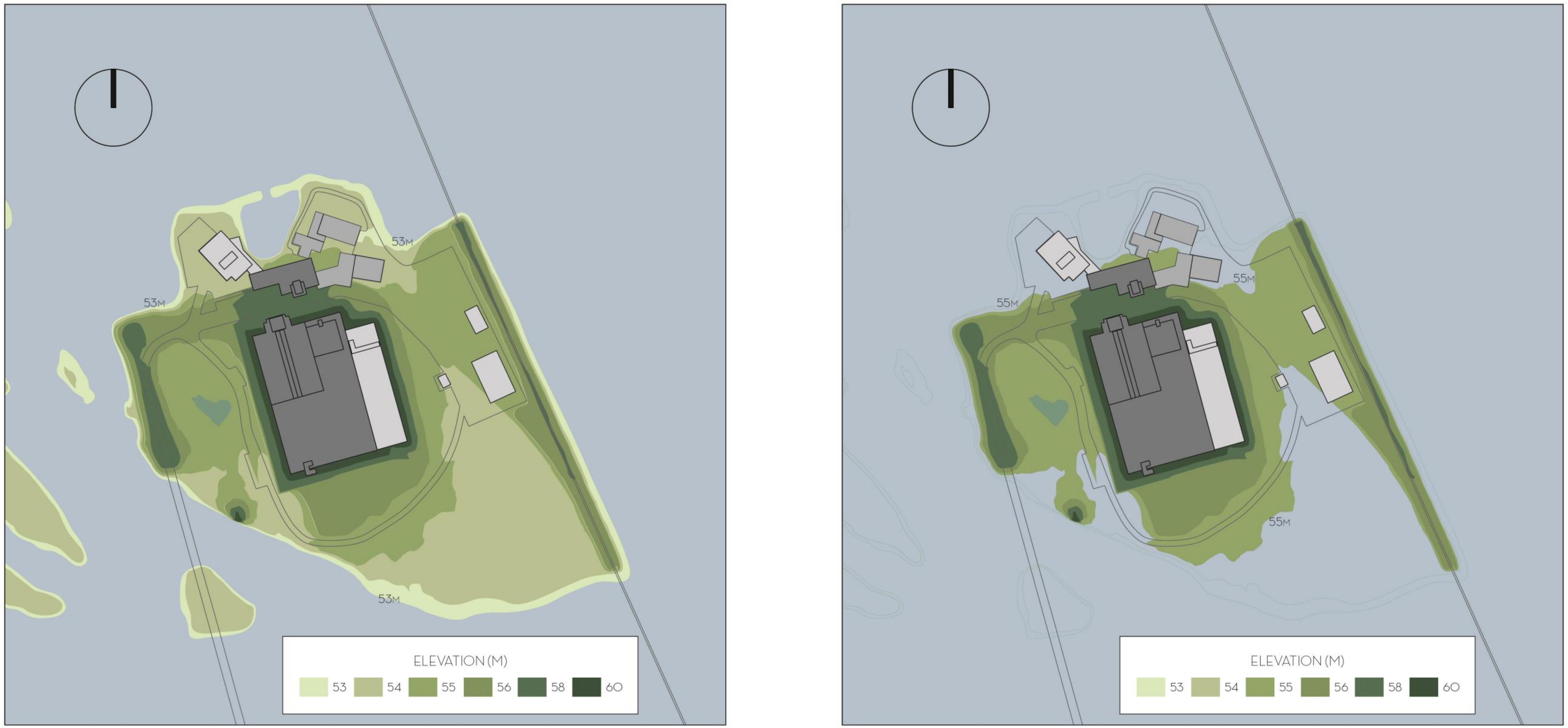

Figure 9:: Lemieux Island at regular water levels (53m) vs at possible flood water conditions (55m).

In addition to the flooding challenges, new technologies for water filtration have been developed that have the potential to replace the current filtration system at the Lemieux Island Water Purification Plant. These new technologies can allow for water filtration to be more cost-effective, environmentally friendly, and create smaller facility footprints. They include, but are not limited to, membrane technology such as ultrafiltration, nanofiltration, and reverse osmosis, ozone technology, and capacitive deionization technology.[3] These technological advances would allow localized and efficient water treatment to be employed at neighborhood levels instead of maintaining the current expensive, centralized treatment and distribution system.

Given the combination of technological advancements in methods of water filtration with scientific data which points towards an increased likelihood and intensity of floods occurring in the Ottawa River watershed, this thesis is written based on the assumption that the Lemieux Island Water Purification plant will be decommissioned and replaced by smaller, localized water treatment facilities. It is beyond the scope of this thesis to analyze and accurately predict when the Plant's decommissioning would occur. However, this thesis proposes an architectural alternative for the Lemieux Island Water Purification Plant in the event of its closure, that conserves its historic buildings, envisions a pilot project for natural and healthy water remediation for the surrounding neighborhoods of LeBreton Flats, Hintonburg, and Mechanicsville. The redesign also supports new programs for public use, taking advantage of the unique site and structure of the Plant. These reimagined programs will be elaborated in the following chapters.

[3] LePree, Joy, *Improved Water Treatment Technologies Make Waves*, Chemical Engineering, 1 November 2019. https://www.chemengonline.com/improved-water-treatment-technologies-make-waves/?printmode=1

UNDERSTANDING THE LEMIEUX ISLAND WATER PURIFICATION PLANT

The Lemieux Island Water Purification Plant was opened on 30 April 1932, and was built in the Art Deco style. The buildings were constructed of reinforced concrete, with exterior brick veneers and Queenston limestone trim, and the interior of the filter gallery was lined with Hauteville marble and Roman Travertine floors.[4]

Figure 10: Administrative Building - exterior brick veneer with limestone trim.
https://www.flickr.com/photos/jessflickr/4673587184/

Figure 11: Chemical Tower - exterior brick veneer with limestone trim.
Photograph by author.

[4] Regional Municipality of Ottawa-Carleton, *The Historical Development of Lemieux Island*, 1995, p.25.

Figure 12: Hauteville marble filter gallery.
https://app06.ottawa.ca/include/doors/Lemieux.jpg.

At its completion, the plant housed a low lift and high lift pumping station, 3 spiral flow mixing chamber sets, 3 settling basins, 10 functioning filter units (with a foundation for an additional 14), and clearwater well capacity of 6 million gallons. Throughout the operation of the plant, another 8 filter cells and 2 mixing chamber sets and 2 settling basins were added, along with a new chemical and new administrative building. Figure 13 depicts the periods when the buildings were constructed.

Figure 13:Exterior of the high lift pumping station and chemical tower, 2019.
Photograph by author.

Figure 14: Interior of high lift pumping station.
Photograph by author.

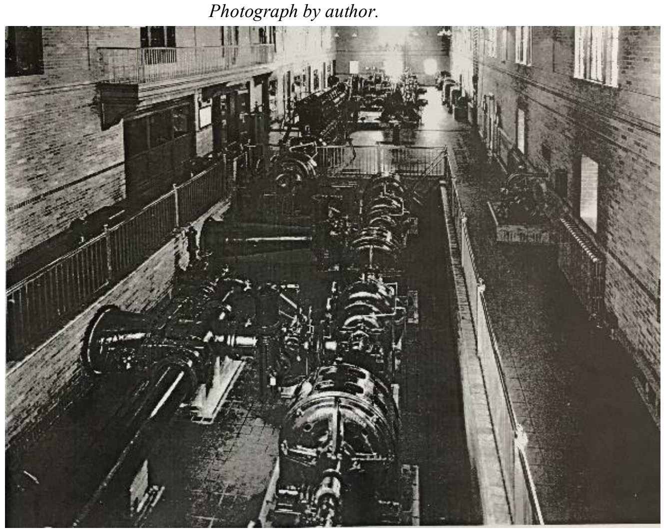

Figure 15: Interior of the high lift pumping station, 1932.
Regional Municipality of Ottawa-Carleton, *The Historical Development of Lemieux Island*, 1995, p129.

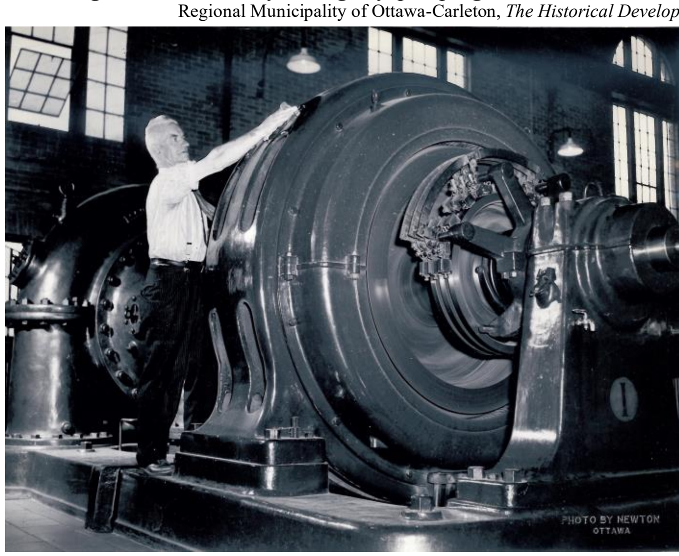

Figure 16: Interior of the high lift pumping station, 1946.
Libraries and Archives Canada.

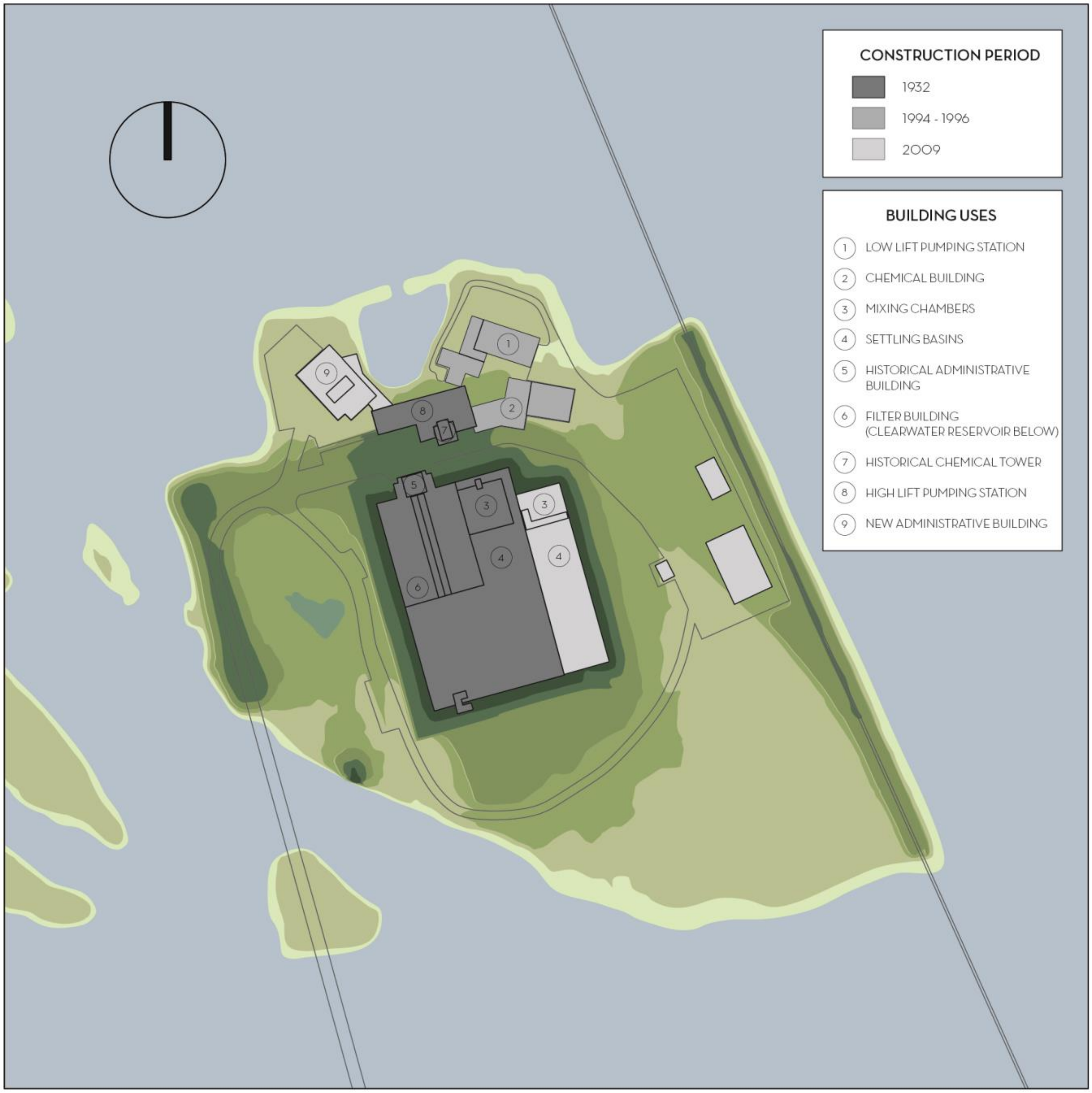

Figure 17: Building construction period and uses.

Figure 18: The Low Lift Pumping Station.
Photograph by author.

Figure 19: The Chemical Building
Photograph by author.

Figure 20: Mixing Chambers and the start of the Settling Basin.
Photograph by author.

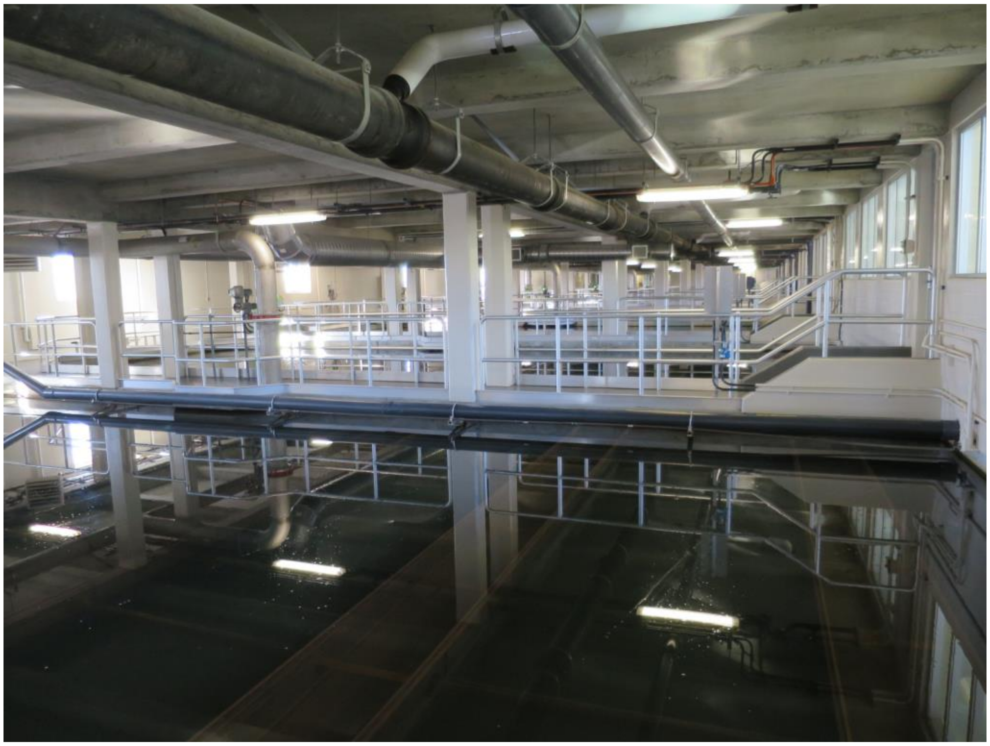

Figure 21: Filter Pools.
Photograph by author.

Figure 22: Filter Pools.
Photograph by author.

Figure 23: The Filter Gallery.
Photograph by author.

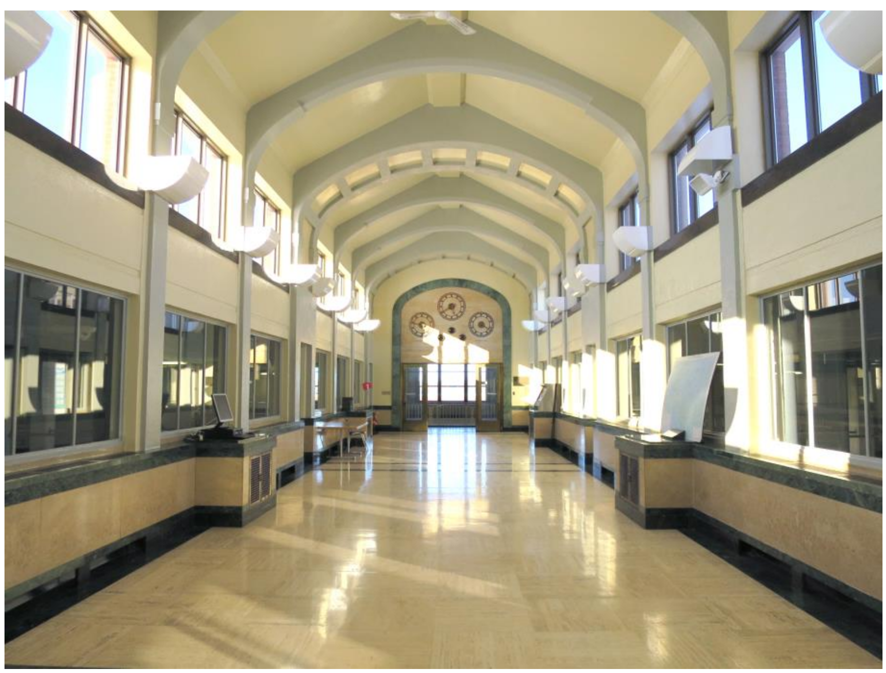

Figure 24: The Filter Gallery.
Photograph by author.

Figure 25: The Pipe Gallery underneath the Filter Gallery.
Photograph by author.

Figure 26: The Pipe Gallery underneath the Filter Gallery.
Photograph by author.

Figure 27: Clearwater Reservoir Effluent Pipes.
Photograph by author.

Figure 28: The High Lift Pumping Station.
Photograph by author.

Figure 29 illustrates the current water purification process of the Plant, described as follows[5]:

(1) Water from the Ottawa River is drawn at the low lift pumping station, through an intake pipe with a screen to help separate large objects like fish and seaweed from the water.

(2) Coagulants and flocculants are added to the water as it is agitated in 3-4 pairs of mixing chambers, each mixing chamber measuring approximately 4.2m x 4.5m x 9m. Coagulation neutralizes the negative charge on suspended particles in the water. This enables the particles to stick together to form larger particles called microflocs. A flocculant is a long polymer with a positive charge that helps gather these microflocs together to form larger flocs that will then be able to settle.[6] At this stage, small impurities like organic matter, algae, and bacteria are captured.

(3) The heavy particles sink to the bottom of a long settling basin, measuring approximately 92m x 4.5m x 9m. The clear water was drawn off the top, at the end of each settling basin.[7] Approximately 95% of impurities would have been removed from the water.

(4) The water is sent to the filter cells (each about 16.8m x 7.7m x2.3m), which remove 99.99% of particles in the water.

(5) Chlorine is added to the filtered water as it enters the clearwater reservoirs beneath the filters, to eliminate other remaining microorganisms. The pH level

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[5] City of Ottawa, *Water purification, quality and distribution*, https://ottawa.ca/en/living-ottawa/water/drinking-water/water-purification-quality-and-distribution

[6] Minnesota Rural Water Association, *Chapter 12: Coagulation and Flocculation*, in Minnesota Water Works Operations Manual, Summer 2009. https://www.mrwa.com/mnwaterworksmnl.html

[7] Regional Municipality of Ottawa-Carleton, *The Historical Development of Lemieux Island*, 1995, p.26.

is adjusted in order to prevent pipe corrosion and fluoride is added to the water as it leaves the clearwater well.

(6) The water is tested before distributed to the City's pipes through the high lift pumping station.

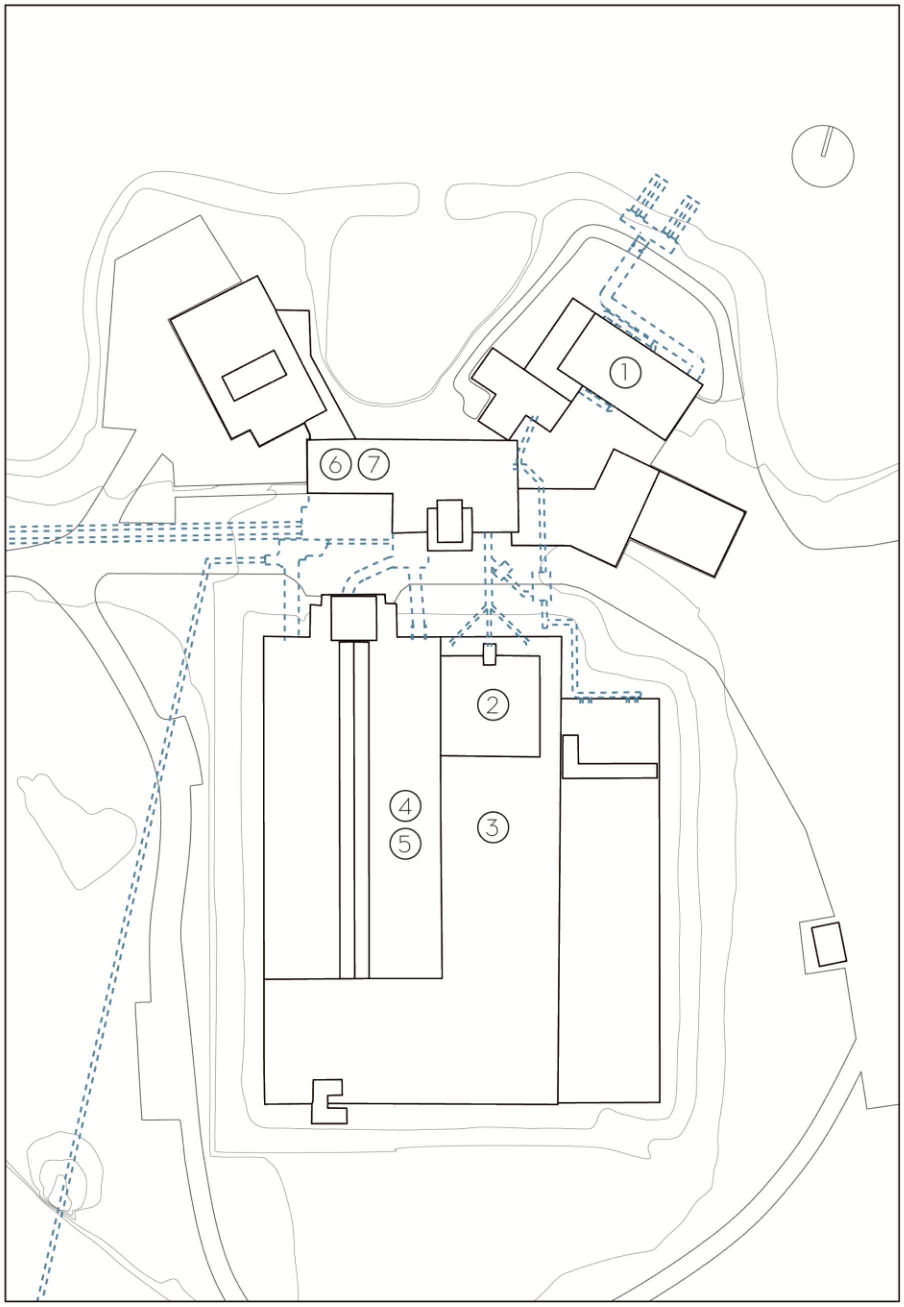

Figure 29: The water purification process: (1) Intake, (2) Coagulation and flocculation, (3) Sedimentation (4) Filtration, (5) Disinfection, pH correction, and fluoridation, (6) Testing, and (7) Distribution.

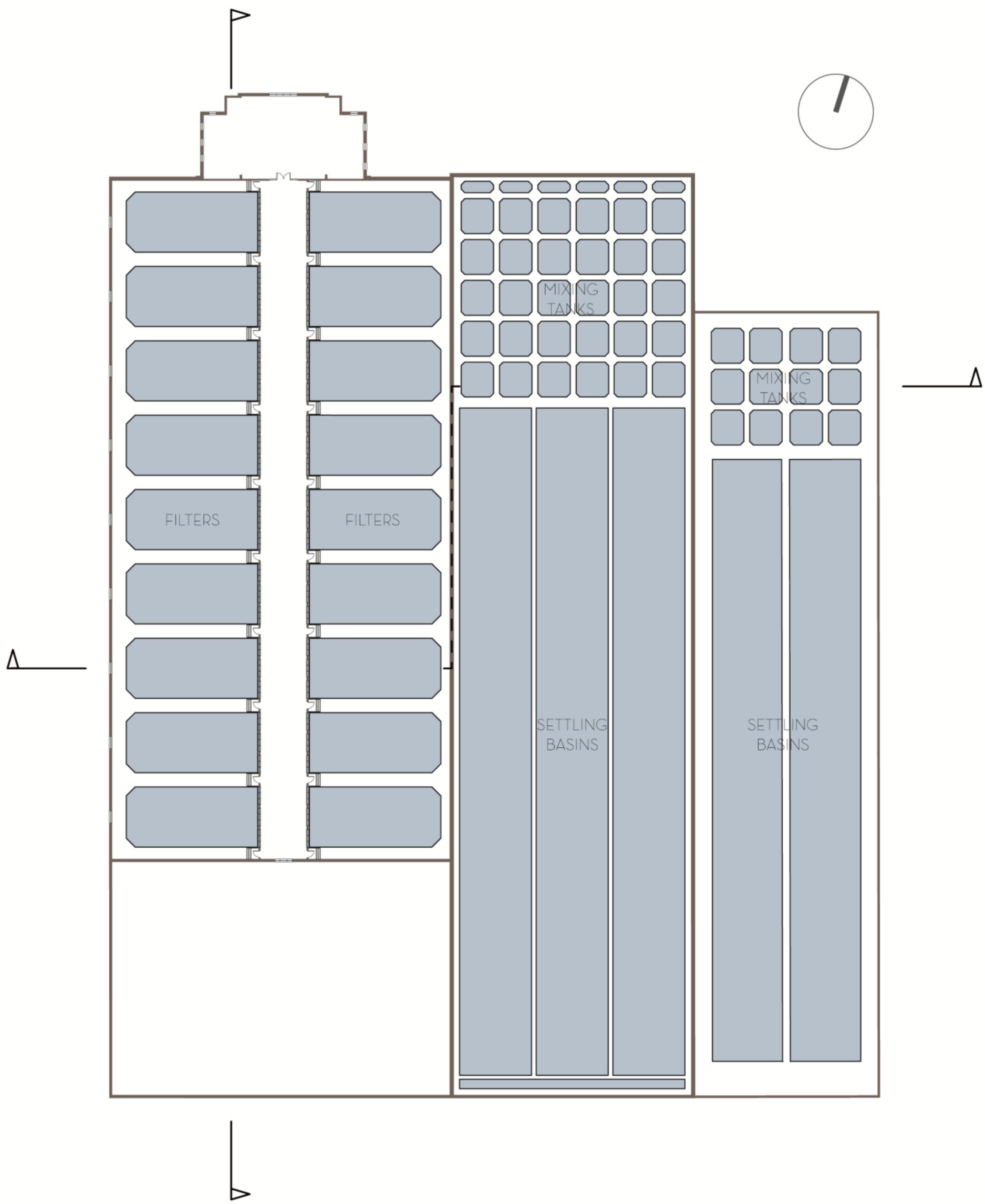

Figure 30: Floor plan (existing) of the filter and settling basin buildings.

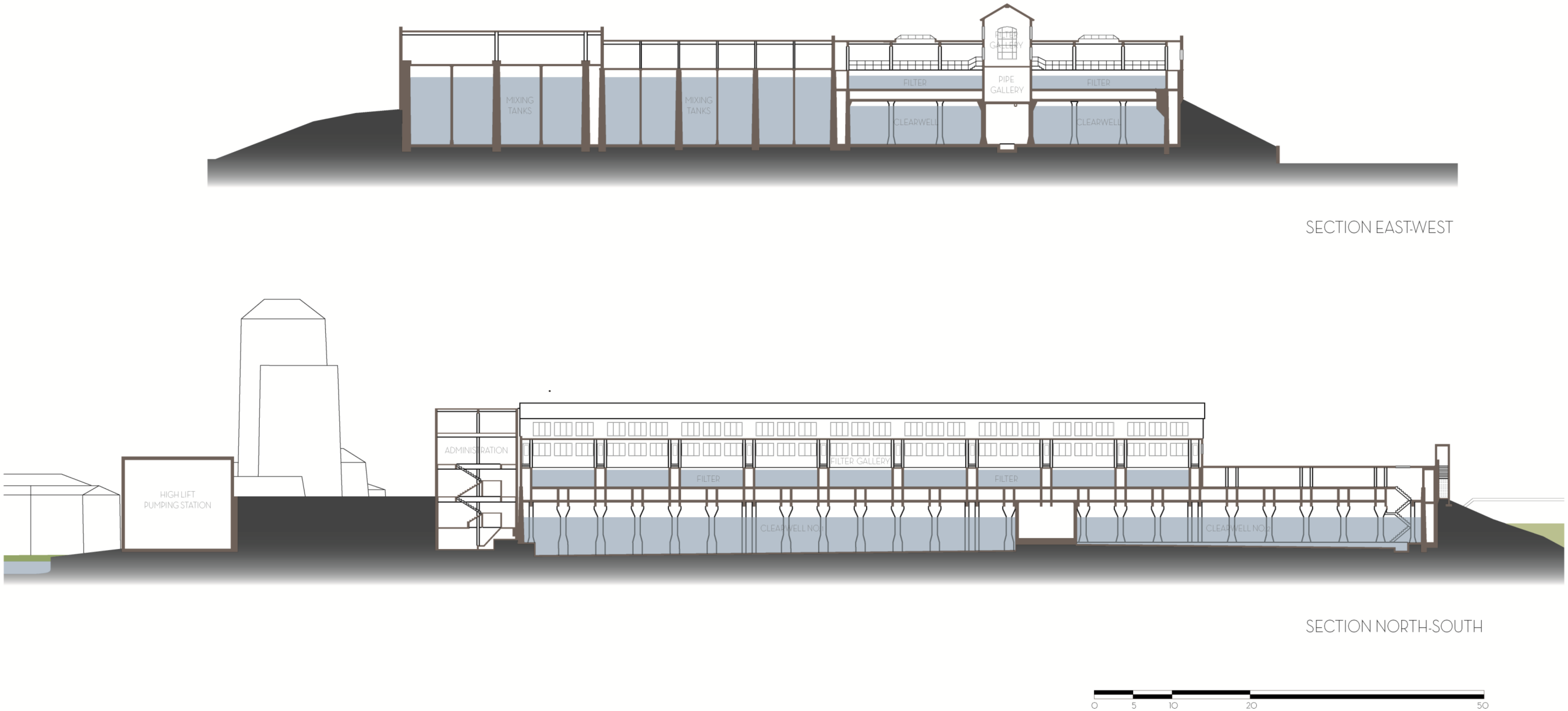

Figure 31: Sections (existing) of the filter and settling basins.

EXISTING STRUCTURE & PROGRAMS

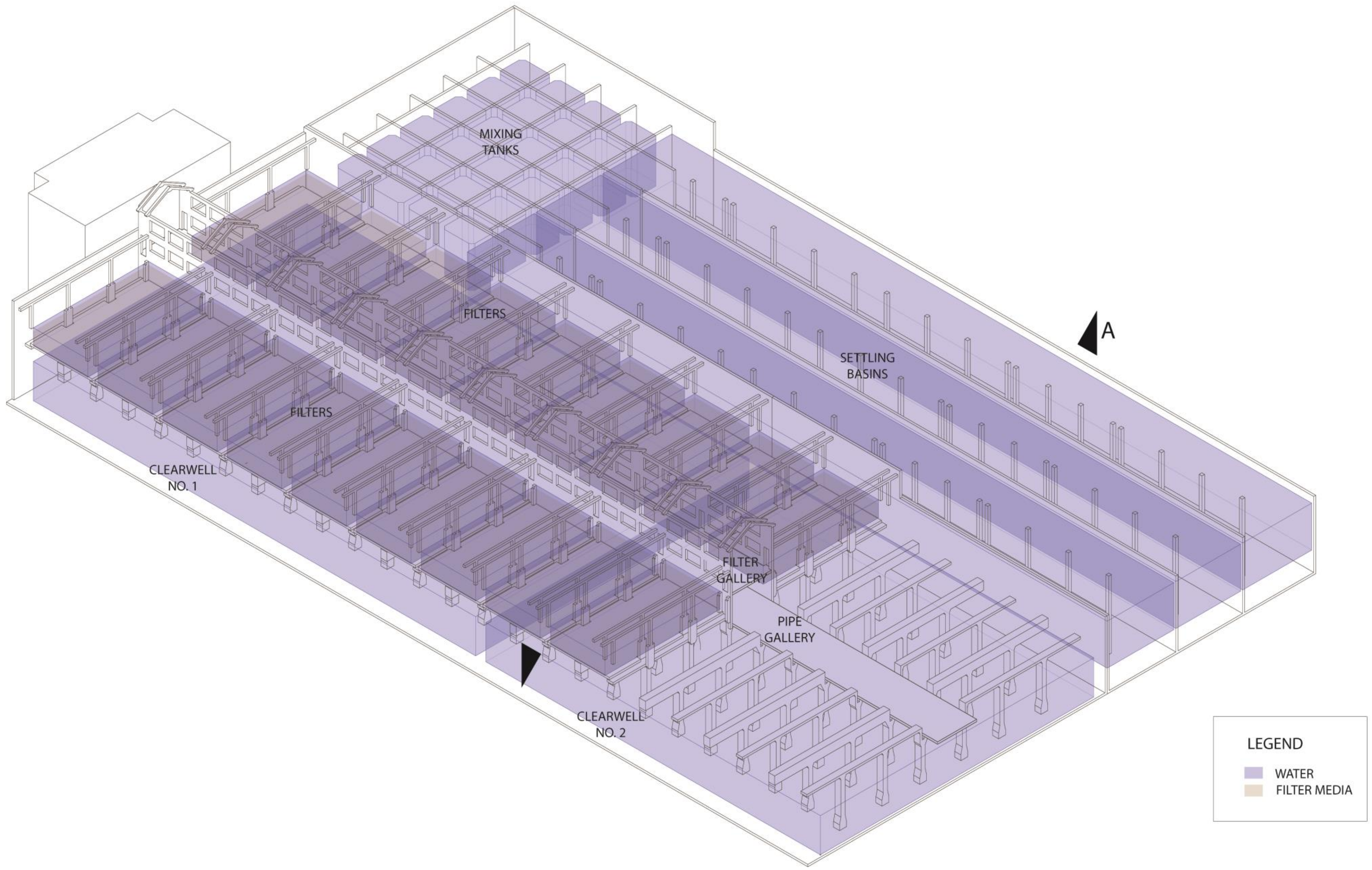

Figure 32: Structure and program (existing) diagram.

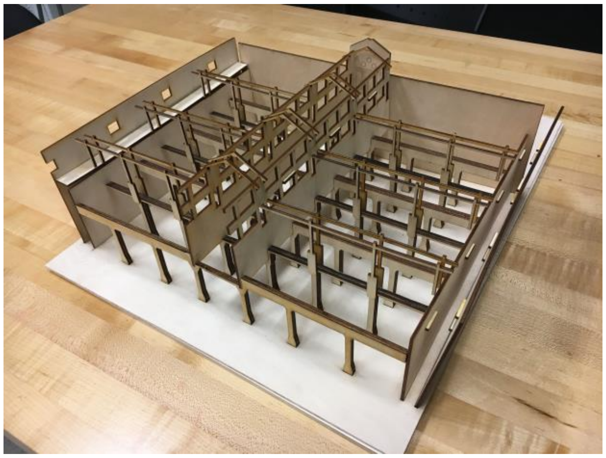

Figure 33: Model of filter pools and clearwater reservoir

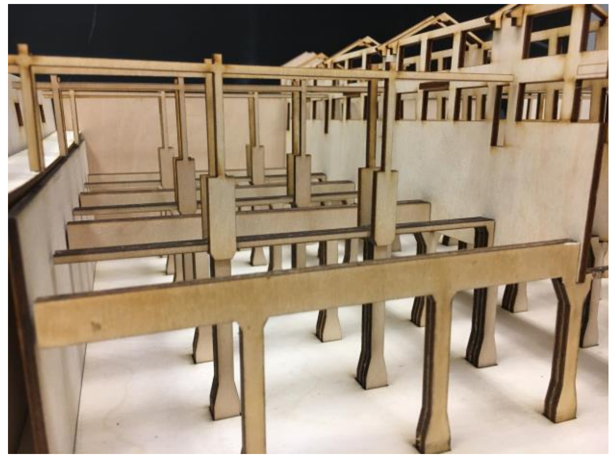

Figure 34: Model of filter pools and clearwater reservoir

Figure 35: Model of filter and pipe galleries.

UNDERSTANDING THE NEW PROGRAM ELEMENTS

The high lift pumping station and chemical tower buildings that were built in 1932, sit on the northern part of Lemieux Island, at a lower elevation. Large scale site manipulations at this part of the island would be needed in order to protect these historical buildings from flood waters. The settling and filtering buildings, which can hold larger volumes of water are situated at a higher elevation, and are suitable to be repurposed for programs in water bioremediation, recreation, agriculture, and education, as elaborated in the following sections. The filter bed area along the main corridor is especially well suited to a new public program.

Figure 36: Filter pools

Photograph by author.

Figure 37: Filter pools and filter gallery windows.
Photograph by author.

BIOREMEDIATION

This thesis proposes the testing and studying of Dr. John Todd's "Living Machine" system for wastewater bioremediation, which mimics the way a natural wetlands clean water. In this system, the water is processed through a series of tanks which house micro-organisms like bacteria and protozoa, algae, fungi, higher animals such as snails, and a variety of plants[8] which facilitate in degrading nutrients, separating heavy metals, and breaking down toxic compounds to purify water [9]. In the case of Lemieux Island, the new systems would largely be treating water from the Ottawa River, as is currently the case for the chemical treatment systems at the Plant. With John Todd's system, however, any black or grey water generated on site could also be remediated.

There are 6 stages to the Living Machine system[10] (See Figure 38), as follows:

(1) The wastewater is stored in an <u>anaerobic reactor</u>, which operates similarly to a septic tank. It facilitates the reduction of solids in the wastewater.

(2) the water is transferred to an <u>anoxic reactor</u>, where there are floc forming microorganisms. This helps settle the larger particulates in the water.

(3) next, a <u>closed aerobic reactor</u> helps reduce the amount of odorous gases and stimulates nitrification in the water;

(4) an <u>open aerobic reactor</u> completes the process of nitrification;

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[8] Singh, Timon, *Omega Center Achieves LEED Platinum Certification*, Inhabitat, https://inhabitat.com/omega-center-for-sustainable-living-opens-in-upstate-new-york/
[9] Green Vision, *John Todd Living Machines*, 16 May 2012. https://benvitalisgreenvision.wordpress.com/tag/living-machines/
[10] United States Environmental Protection Agency, Wastewater Technology Factsheet: *The Living Machine,* 2002, p.2.

(5) the water then rests in a clarifier, which acts as a settling tank, where the remaining solids are allowed to separate from the treated wastewater; and finally

(6) the water goes through ecological fluidized beds, which act as a final polishing filter.

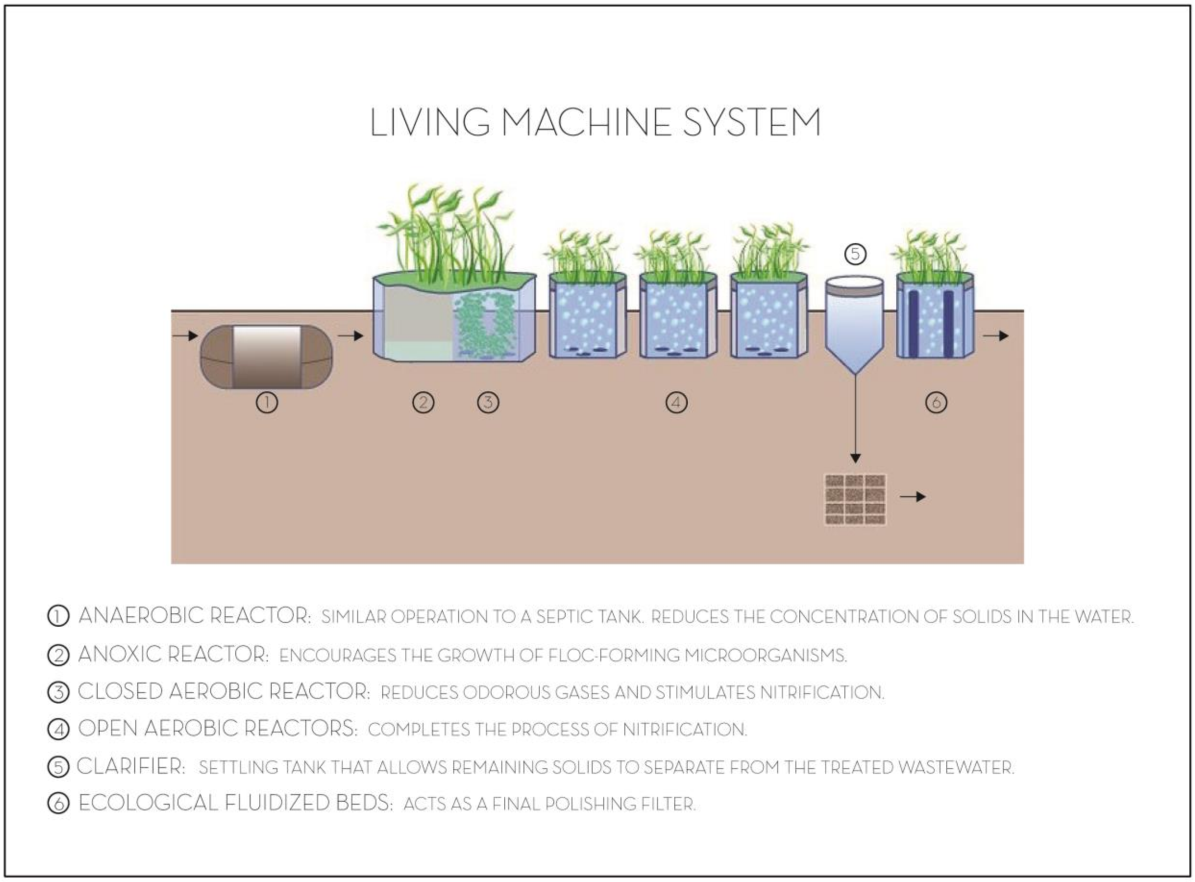

Figure 38: The water purification process in the "Living Machine" system.

https://www3.epa.gov/npdes/pubs/living_machine.pdf

The Living Machine system was used in South Burlington, Vermont to treat municipal wastewater for approximately 1,200 residents[11] and is currently being used at the Omega Center for Sustainable Living to treat wastewater for an educational institution campus.[12] Part of the filter building at the Lemieux Island Water Purification Plant can operate a Living Machine system to treat wastewater produced in the facility itself. The settling basin buildings could accommodate a Living Machine system large enough to supply water in support of other programs within the facility, and in addition, can serve as a pilot program to supply naturally purified water to a small community or neighborhood in Ottawa.

Figure 39: Living Machine in South Burlington, Vermont

https://urbanecologycmu.wordpress.com/2015/11/18/wastesystem_south-burlington-municipal-eco-machine/

Figure 40: Living Machine in Rhinebeck, New York.

https://inhabitat.com/wp-content/blogs.dir/1/files/2010/10/Certified-Living-Buildings-Omega-Center-3.jpg

[11] Ocean Arks International, *South Burlington Eco Machine*. https://www.oceanarksint.org/portfolio/south-burlington-eco-machine/
[12] Omega Institute, *Eco-Machine*. https://www.eomega.org/eco-machinetm

RECREATION

The recreational component of the project would include a natural, public swimming pool. The system that would be employed would be similar to the one used at Borden Park Natural Swimming Pool in Edmonton, Alberta. The public swimming pool would be chemical-free, with the water cleaned through a pool of gravel and sand filters, and then a pool with a combination of plants, algae, and zooplanktons that eliminate bacteria, viruses, and micronutrients, and oxygenate the water.[13] Since the Borden Park Natural Swimming Pool is outdoors, that system would have to be adapted to suit the indoor facilities at the Lemieux Island Water Purification Plant so that the pools are accessible all year.

Figure 41: Borden Park Natural Swimming Pool

https://www.gh3.ca/work/natural-swimming-pool-02

Figure 42: Borden Park Natural Swimming Pool.

https://www.gh3.ca/work/natural-swimming-pool-02

[13] Simons, Paula, *Risk and rewards at revolutionary Borden Park Natural Pool,* Edmonton Journal, 9 July 2018. https://edmontonjournal.com/opinion/columnists/paula-simons-risk-and-rewards-at-revolutionary-borden-park-natural-pool

AGRICULTURE

The agricultural portion of the project focuses on an aquaponics system. Aquaponics combines aquaculture (fish farming) with hydroponics (growing plants in water), in a symbiotic relationship. The fish produce ammonia waste in the water, which in large amounts, turns the water toxic for them. This wastewater is supplied to the plants grow beds, where bacteria break down the ammonia and turn it into nitrates that are nutrients for the plants, also purifying the water in this process. The cleaned water can then be returned to the fish tank. This indoor, closed system eliminates the need for chemical pesticides and fertilizers and wastewater runoff, and enables up to 98% of water to be recycled.[14] Since both the fish and vegetables can be consumed, aquaponics provides an efficient way to produce food locally and sustainably.

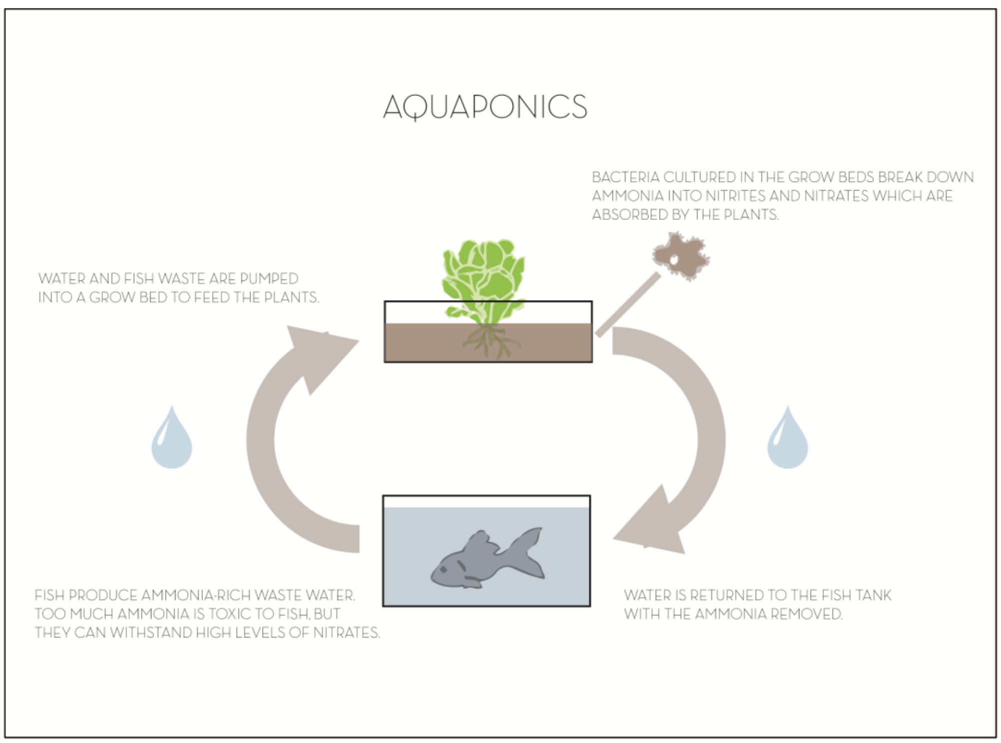

Figure 43: Processes in an aquaponics system.
http://www.projectfeed1010.com/blog/2014/07/15/aquaponics-components/

[14] Institute for Systems Biology, *Aquaponics*, Project Feed 1010. http://www.projectfeed1010.com/what-is-aquaponics/

EDUCATION

The project will be an educational instrument as it would allow the public to view and engage with these alternative methods of water treatment and sustainable systems in the Living Machine, the natural swimming pool, and aquaculture components. The facilities can be especially useful in providing first-hand experience for students in ecology, wastewater strategies, and environmental sciences and inform them on possible research applications for these natural processes.

PROGRAMMATIC ORGANIZATION

Given the wide range of functional elements, it is essential to consider the flows of water processing and people throughout the large building. Adjacencies would have to be deliberately placed to create a sense of continuity and connection while maintaining several different points of interest.

Figure 44:A possible program overlap between recreation and aquaponics.

One of the precedents that was examined to assist in organizing the programs was the Seattle Central Library, where there is a strategic positioning of programmatic clusters in overlapping platforms and optimization of the use of interstitial zones (Figures 45 - 47).[15]

[15] OMA, *Seattle Central Library*. https://oma.eu/projects/seattle-central-library

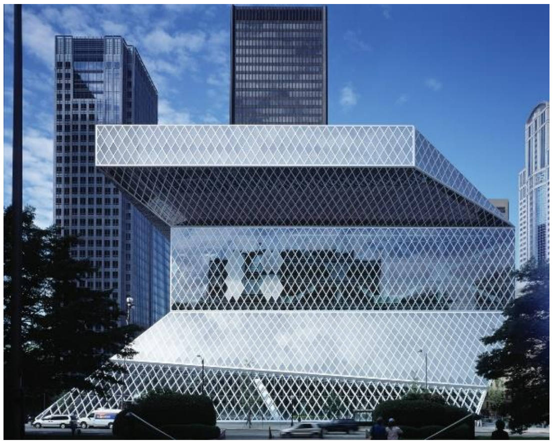

Figure 45: Seattle Central Library.

https://www.archdaily.com/11651/seattle-central-library-oma-lmn/572187ede58ece2292000011-seattle-central-library-oma-lmn-photo

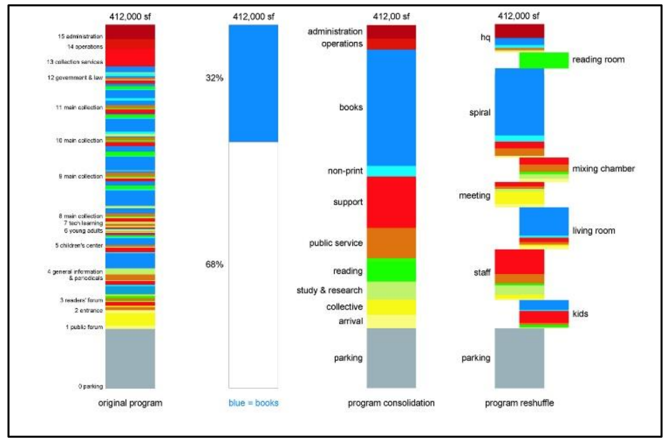

Figure 46: Program types in the Seattle Central Library.

https://www.archdaily.com/11651/seattle-central-library-oma-lmn/57219542e58ece408a000002-seattle-central-library-oma-lmn-seattle-

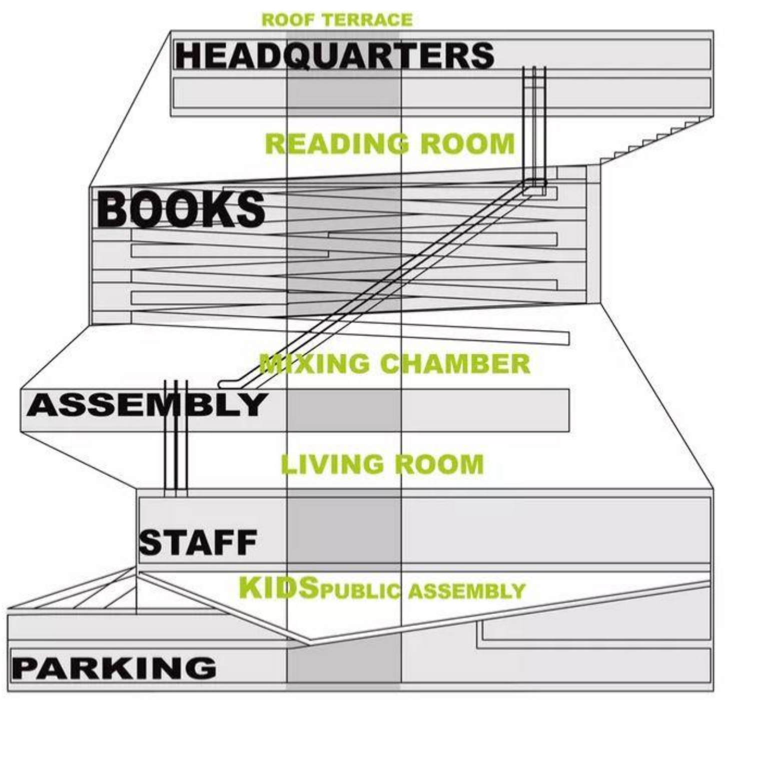

Figure 47: Program organization strategy in the Seattle Central Library.

https://cdn.sanity.io/images/5azy6oei/production/a6cab9732a999f8725a63d711fbbd9558d54d5d2-

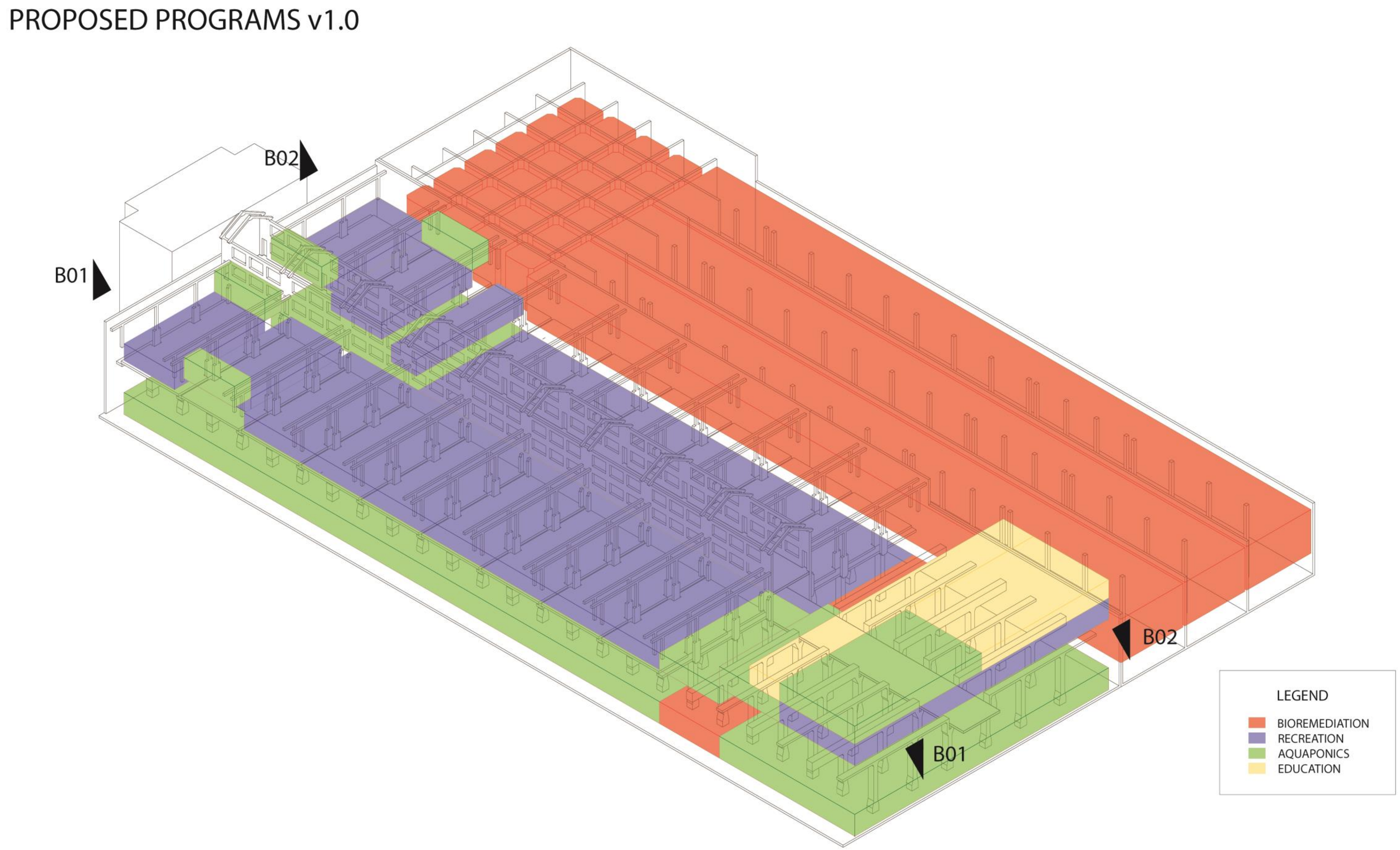

Figure 48: Draft proposed program layouts.

THE PLANT, REIMAGINED

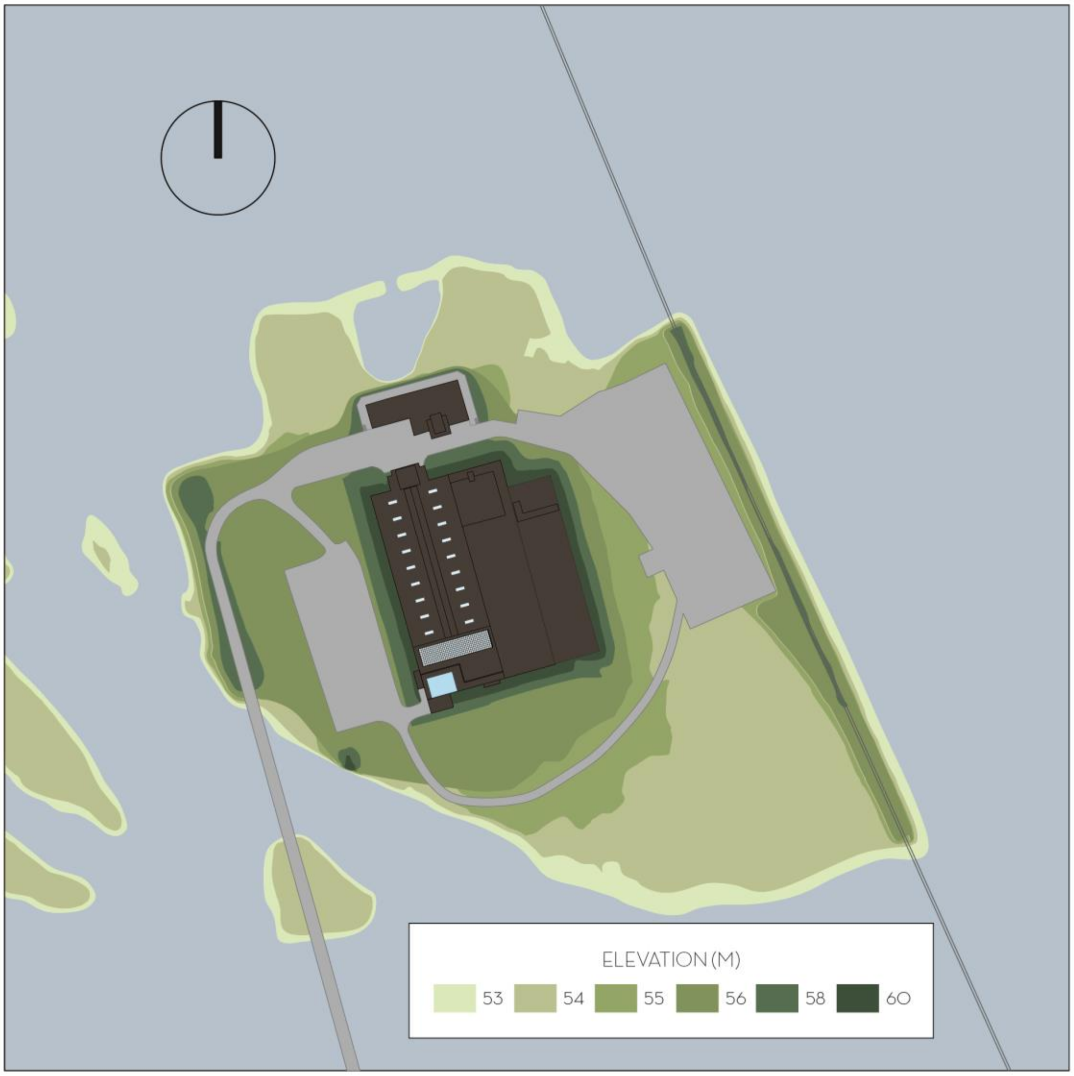

Figure 49: Site plan (water level at 53m).

The filter building has a combined area of approximately 9,600m^2, with 5,000 m^2 at the filter pool level, and 4,600 m^2 the clearwater reservoir level. This chapter describes and illustrates the architectural intervention to the filter building and how it is refitted with the new adaptive programs for public use, turning it into the *Lemieux Island Natural Water Remediation and Recreational Center* (Figures 57 - 61).

Figure 50: Brass entry door to the Administrative Building.
Photograph by author.

RECREATIONAL SWIMMING

As visitors arrive at the Center, they enter through the beautifully engraved brass doors of the original administrative building (Figure 50). The entrance lobby, as well as the grand, split staircase is lined with cream-coloured Hauteville marble, with a dark green marble trim (Figure 51). Once one reaches the top of the stairs, they can see what was once the filter gallery, a 5.9-meter wide, hallway lined with the same marble as the entrance lobby. The hallway is filled with light from the strips of large clerestory windows, and a bright atrium at its end. This entry area of the original water filtration plant is largely preserved, but opens up to reveal the modifications that take advantage of the long, window-lined corridor.

Figure 51: Marble stairway

Photograph by author.

Figure 52: View from stairwell into the marble hallway.

Photograph by author.

Figure 54: Filter control unit from 1932.

Photograph by author.

Figure 53: Marble hallway with clerestory windows.

Photograph by author.

Immediately to the right of the hallway's entrance, and visible through another strip of windows, are two aggregate filter pools and a plant purification pool that are outfitted from the original filter cells. Above them are skylights that illuminate the area. The filter pools are separated by walkways lined with towers of growing produce. At the edge of the plant filter pool, there is an aquarium that spans its length, housing tilapia fish. One can see through this aquarium that separates the recreational swimming pools from the filter pools that feed them.

Beyond the aquarium there is the expansive recreational swimming pool area. This area accommodates a whirlpool and a shallow children's pool, which fit in what used to be a filter cell. There is also a large swimming pool, which takes up the area of approximately four combined filter cells, and a resting area where poolside lounge chairs are lined up. The large swimming pool measures 34m x 14m. The floor in the recreational swimming pool area is tiled with travertine slabs, to prevent slippage, and to provide visual continuity from the cream-colored marble in the hallway. In addition to the skylights above, the windows that line the three sides of the recreational swimming pool area – the marble hallway, the adjacent atrium, and the exterior wall overlooking the west side of the Island – bring in plenty of natural light.

THE OBSERVATION DECK

Immediately to the left side of the marble hallway, there is a travertine observation deck that overlooks the 50-meter long lap pool at the basement level, in what was once the clearwater reservoir area of the plant. The observation deck sits atop the main structural columns and beams that used to support the filter cells' walls. The filter cell walls and floors were stripped away to expose these massive structural elements, which are now visible from the observation deck as the visitor peers over the edge to view the lap pool.

At the end of the observation deck, there are two aggregate filter pools that serve to clean the lap pool's water. The walkways surrounding these filter pools are accessible from the observation deck. Filtered water from the second aggregate pool pours down a waterfall that is surfaced with green marble, to supply a plant purification pool below. If a visitor listens carefully, they can hear the cascading water right from the entrance of the marble hallway.

THE ATRIUM

The end of the marble hallway seems especially bright, and when visitors make their way to the end of the hallway, they find out why. This area, which was originally reserved for future filter cells, but were never fitted, has now become a 16-meter high atrium with a skylight spanning the width of the building. This is an interstitial zone that permits views to all of the learning and recreational opportunities that the Center has to offer.

To the right of the atrium's entryway, there is an aquaponics demonstration area. A filter cell spot is fitted with a tilapia pool. Water from the tilapia pool is cleaned by the rows of double-height produce towers adjacent to it, and subsequently fed back to the tilapia pool. There is plenty of sunlight here for the produce to grow large and healthy.

To the left of the entryway, the visitors can see straight down to the basement level. Here they can see the tops of Living Machine system tanks, rafts of plants which are populated by tropical and semi-tropical varieties. It looks like a microcosm of jungles from up here. The little jungles can be accessed by either a staircase or a glass elevator, both located in the atrium.

Looking straight ahead, they would see public change rooms, and above the change rooms they would see access to a staff break room, a café with a patio overlooking the Ottawa River, and a rooftop swimming pool for the warmer months of the year. If the visitor looks back, they'd see windows with views to the recreational swimming area and observation deck.

THE LIVING MACHINE SYSTEM

John Todd's Living Machine system is located at the basement level, which used to be a clearwater reservoir. The system is used to treat wastewater from the Center, that is not from the aquaponics or the swimming pool systems. The system's anaerobic reactors are tucked away, under the southeast end of the building. The other components of the system are housed in five-foot high, translucent, fiberglass cylinders, placed in the atrium for more accessible light. The cylinders are filled with a complex and carefully selected combination of rock minerals, various algae, bacteria, fungi, and protozoan species. Plants from every continent except Antarctica are rafted at the top of the cylinders, hosting animals like snails in its brushes. The latter tanks in the system even have crayfish and carp in them.[16] All of this is can be examined by visitors through the translucent cylinder walls, and are great learning tools for school groups and researchers in bioremediation.

The Living Machine system is positioned at this juncture in the atrium so that it is visible to every visitor to the Center. Anyone who visitor who wishes to use the lap pool or view the aquaponics facility would also inevitably walk by it, at least providing them with an awareness of the natural, sustainable processes for water treatment.

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[16]Todd, Nancy Jack and Todd, John, *From Eco-Cities to Living Machines: Principles of Ecological Design*, North Atlantic Books, Berkley, p167-168.

THE LAP POOL

The lap pool is also located at the basement level, on its east side. The floor was raised to create the depth of this 50-meter long swimming pool. Travertine slabs envelope the pool, and its surface is clad with white stoneware tiles. At one end of the pool visitors can get close to the waterfall that fills the translucent, fiberglass plant purification pool, and observe its contents. At the other end of the pool are built-in bleacher seats for visitors to rest on. As one looks up, they can see the grand structures that hold this colossal building together, and maybe a curious visitor gazing down from the observation deck at the main floor. The swimming lanes pass through these large supporting columns. The skylights above bring in the daylight, but in the evenings, the brass lighting fixtures softly wash the walls and columns with light to accentuate them even more. While the recreational swimming pool is family-oriented, the lap pool area caters to exercise-focused individuals, and has a more composed and luxurious ambience, which is also in keeping with the original Art Deco design of the water treatment plant.

Figure 56: Art Deco style wall sconce.

Photograph by author.

Figure 55: Art Deco style chandelier.

Photograph by author.

AQUAPONICS

The aquaponics component of the Center occupies the majority of the west side basement level. Behind glass walls, the aquaponics production portion consists of alternating rows of produce planting units and large fiberglass fish pools. They are arranged this way so that nutrient levels and pathogens can be controlled efficiently. The floors and walls are sealed concrete, and the ceiling is lined with panels of LED grow lights that provide an optimized spectrum of light for plant growth all year round. A small open area in the middle of the production section allows for people to gather and learn about the inner workings of this new form of urban food production. Once the produce and fish are harvested, they are transported to a cleaning and packing area at the southwestern end of the basement, and are prepared for shipment to the local markets.

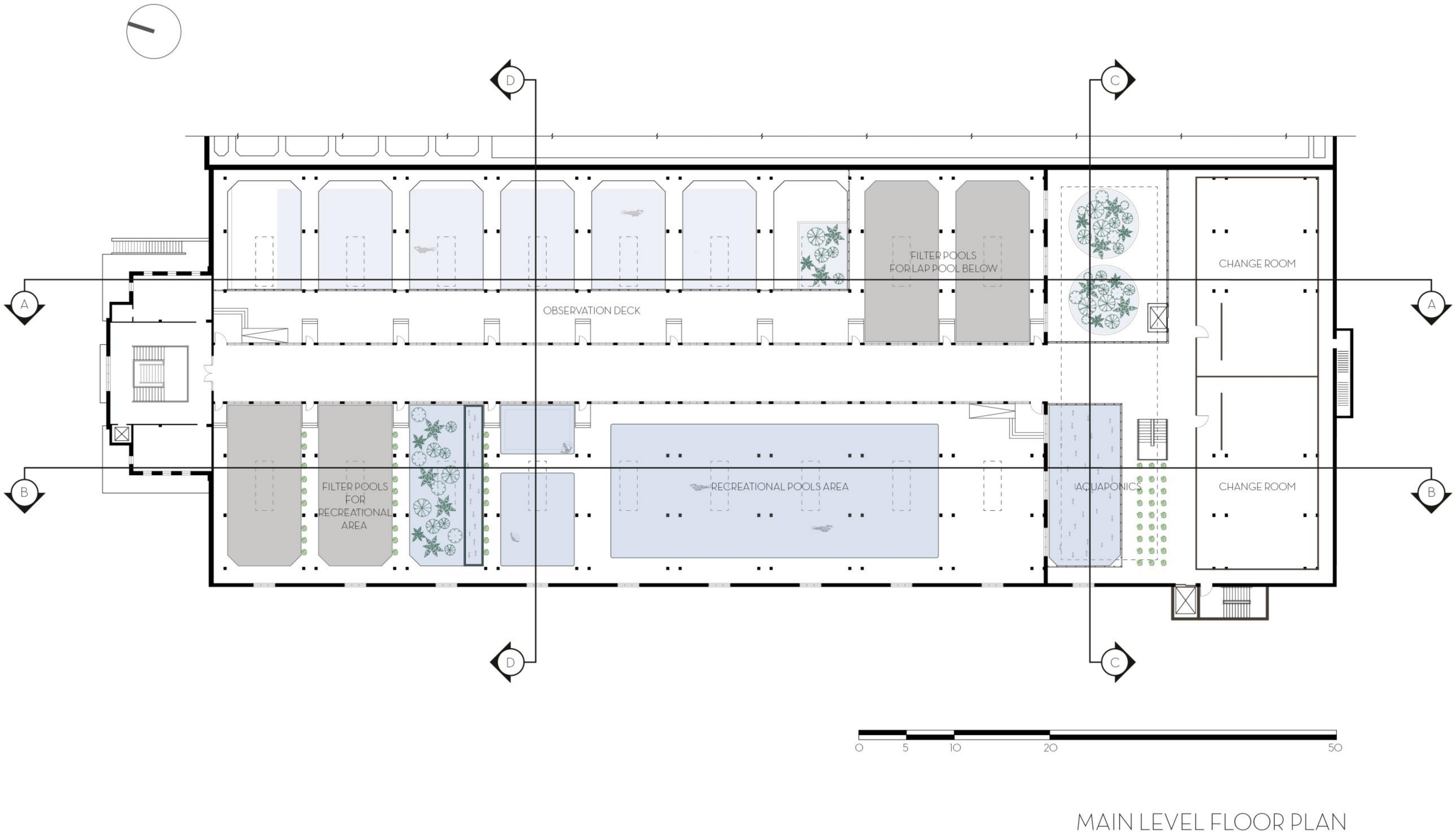

Figure 57: Main level floor plan.

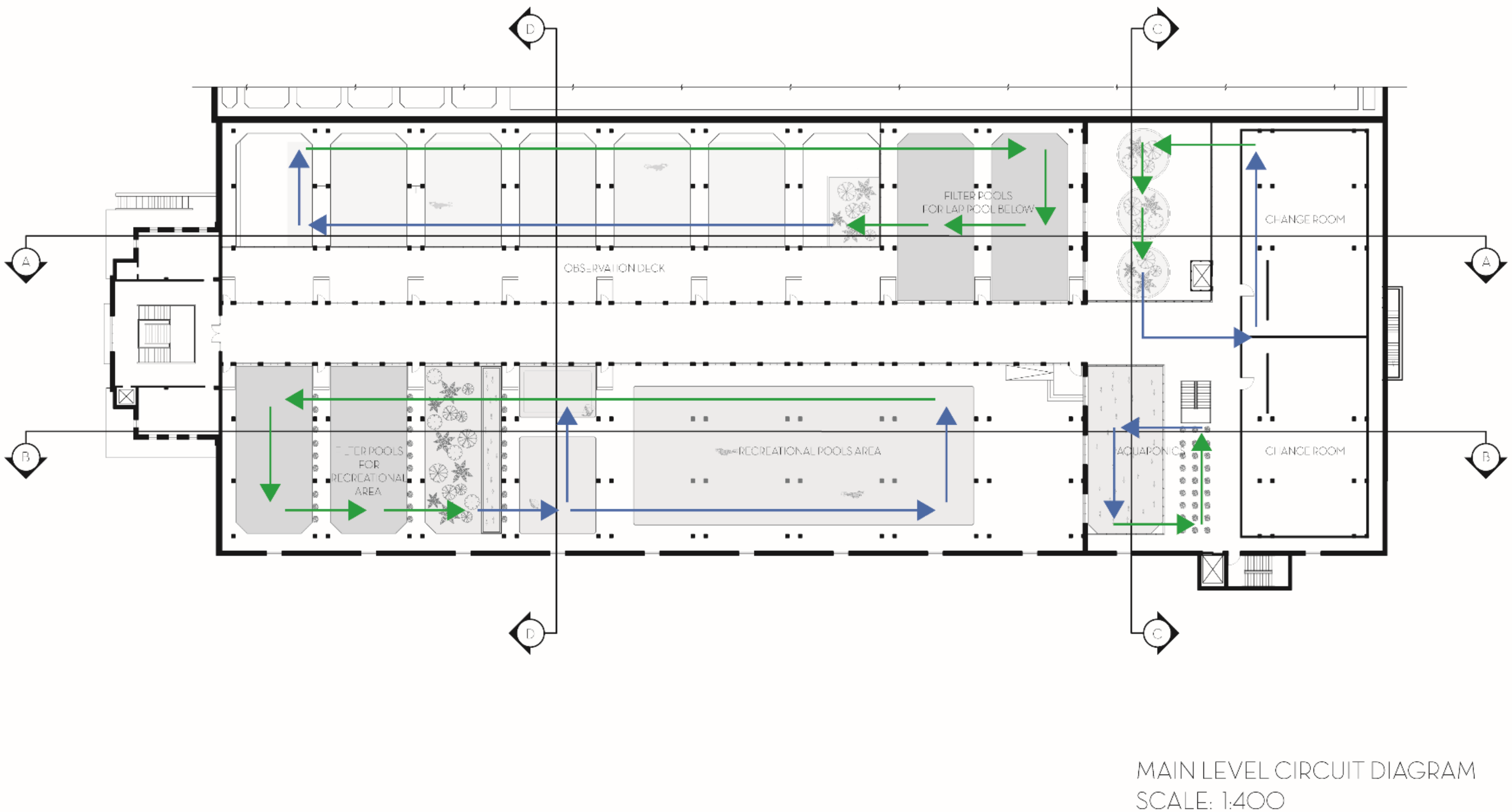

Figure 58: Main level water circuit diagram.

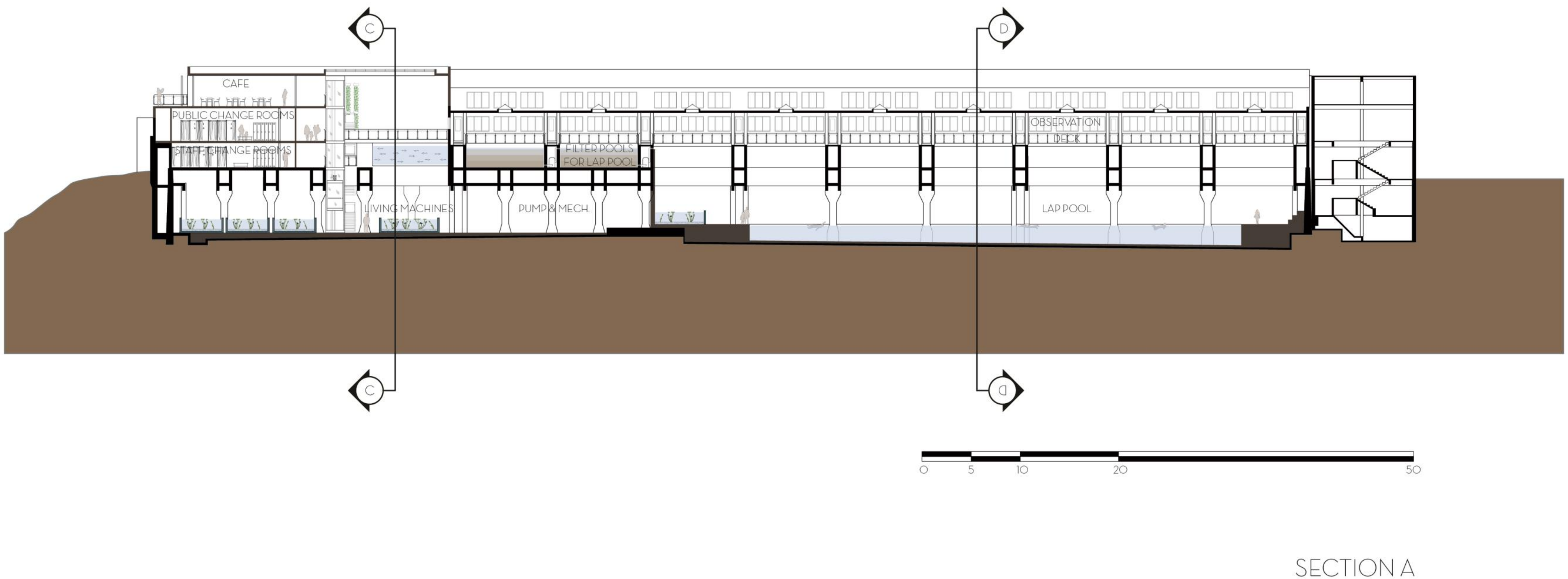

Figure 59: Section A

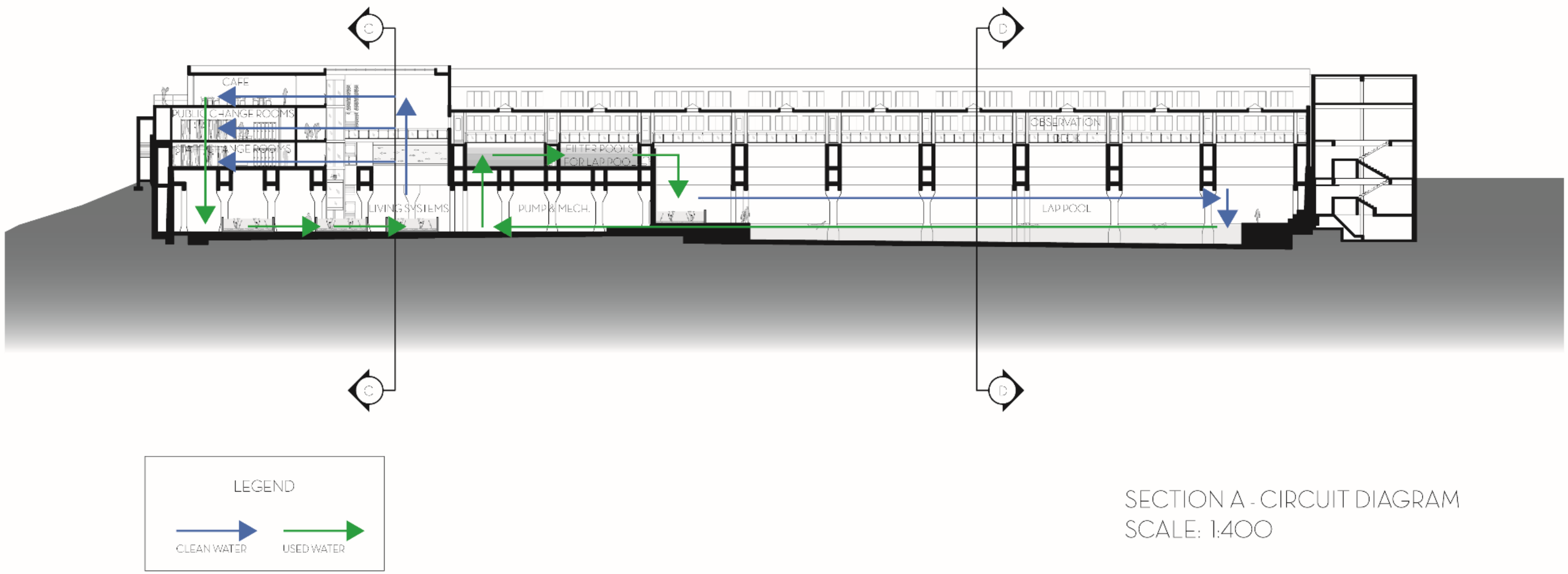

Figure 60: Section A Water Circuit Diagram

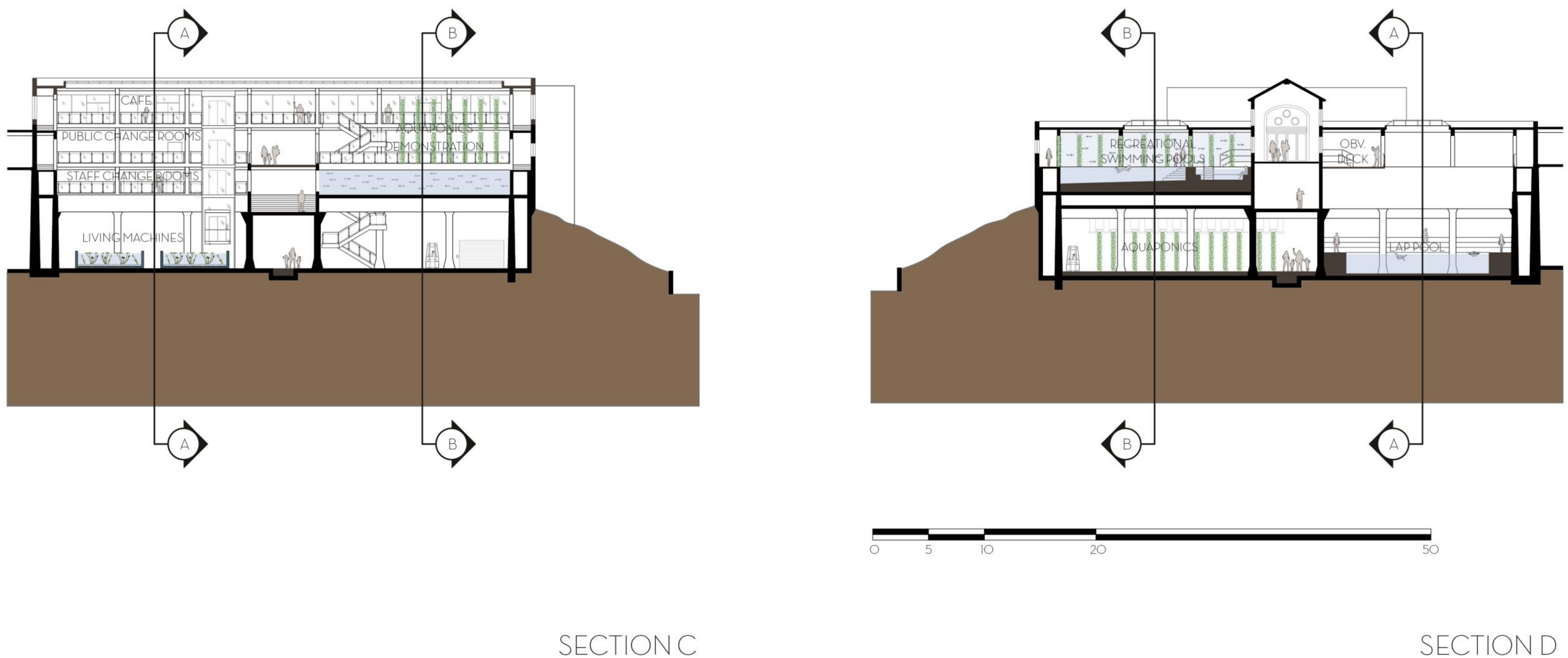

Figure 61: Sections C and D

A NEW PUBLIC ENTRANCE

A future endeavor of this thesis would include a new public entrance to the Center. This new entrance would be constructed at the southern end of the building, where modern additions are to be made; the atrium, public change rooms, and café. As the Art Deco style of architecture of the Northern entrance and the marble filter galleries are preserved as a commemoration to the building's history of industrial remediation, the new entrance would showcase contemporary remediation that supports human and environmental health.

The new entrance would also serve as a convenient, alternative access point into the building from the parking lot to the West, the Prince of Wales Bridge to the East, and the park grounds to the South. Perhaps if the Prince of Wales Bridge were to be re-opened for public use, a footbridge could connect it directly to the Southern Entrance. In addition to being a popular spot for dog walkers, the vast park area at the South of the island also delivers the potential to incorporate additional public programs that engage the site such a rain garden or a water playground.

NEWS ITEM

Local News

The aquaponics demonstration and recreational swimming pools at the Lemieux Island Natural Water Remediation and Recreational Center

Lemieux Island Natural Water Remediation and Recreational Center Now Open to the Public

Ottawa Citizen
15 June 2040

The long-awaited adaptation of the decommissioned Lemieux Island Water Purification Plant was finally completed on 26 April, and the Lemieux Island Natural Water Remediation and Recreational Center was officially open to the public on 1 June.

The former plant's filter building has been renovated to include a natural, recreational swimming pool and a natural, 50m lap pool, and an aquaponics produce center. The building also has a water bioremediation system that treats its own wastewater – a miniaturized version of the system in the adjacent building (the former purification plant's settling basins), which naturally purifies water for the LeBreton Flats, Hintonburg and Mechanicsville neighborhoods.

Aside from these new programs, the aesthetics of the building makes it worthy of a visit in itself. The historic buildings were built in the Art Deco architectural style, and the designers decided to continue that style of luxury and decadence throughout the new additions as well.

"We are very excited to offer the public the opportunity to experience an environmentally friendly alternative to chemically treated water for recreational uses and urban food production," said the Center's manager, Mark Benoit. "We've already had several school groups come to study these sustainable systems, and we have full bookings for the next two months."

"I like the thought of being part of the solution for a more sustainable world, so I volunteer my time here to collect data from the Living Machine system. I would like to research the potential for application of these bioremedial systems in even more densely populated cities in Canada." said Emmanuel Pinsker, a fourth-year undergraduate in environmental science from Carleton University. "Besides that, at the end of the day, I like to grab a drink at the café upstairs and relax while enjoying the views over the Ottawa River."

Researchers taking lab samples to test water quality from the Living Machines system.

When asked what she liked about the Center, Molly Bernard, a sixth-grader from Elmdale Elementary School, replied, “I came here with my science class to check out how we can grow tomatoes from fish water. It was cool to see the fish swimming around in the tanks, and learn where our food comes from, but I really wanted to play in the swimming pools also. So I made my mom bring me back here with my bestie!”

“I’ve been coming here every day to do laps in the evenings since the Center opened,” said Marina Lee, a resident of Hintonburg. “There’s something about the swimming pool here that transports me to another time and place… like I’m at a spa from the 1930s. And I love how soft the water feels. It’s much gentler on my hair and skin that the chlorine swimming pools.”

The waterfall at the plant purification pond that cleans water for the lap pool.

The Center has activities for everyone’s enjoyment, so it’s worth a visit. At the very least, one can go home with a bag of fresh produce and tilapia fish fillets.

CONCLUSION

The objective of this thesis is to combine the disparate programs – bioremedial, recreational, agricultural, and educational – to form an architectural design that is cohesive and humanistic. The program placement in this project's architectural design takes advantage of the building's existing structural capacity to contain water and moisture and strategically features elements that demonstrate the value of natural processes.

The program placements offer a variety of ways to experience water and plants – the demonstration of the cycles of aquaculture production, exploration of filter pools as one walks along their sides, viewing the lap pool from up above in the observation deck, observing the rafts and canopies of vegetation from the atrium, or examining them up close at the basement level, hearing the waterfall upon entering the building, splashing around or exercising in the pools, or just feeling and breathing in the moist air. These enjoyable experiential elements provide dynamism and interest in the building.

The facility, reimagined into *Lemieux Island Natural Water Remediation and Recreational Center*, also allows the public to receive the benefits of biophilia all year round. The Center offers a unique space where people can go to fulfil their need for connections to nature and natural processes through being surrounded by water, greenery, and sunlight. Views to the natural surroundings of the small dog park on the island and the tranquil flow of the Ottawa River bridge visitors to the outdoor natural environment. Meanwhile, the lush tropical and sub-tropical vegetation and abundance of water indoors and skylights deliver an environment of comforting humidity, warmth, pleasing visual and auditory cues that are soothing and uplifting for visitors. In a place like Ottawa, where the long winter months can be bleak and harsh, the Center can become a restorative sanctuary for health and wellbeing.

Being in the Center is a positive and captivating experience in itself. At the same time, the program adjacencies and overlaps encourage curiosity, learning and interaction with the processes and cycles of water cleansing and food production, therefore also inherently educating visitors on the importance and benefits of natural processes and environmental health.

Along with and expanded Southern entrance that would allow greater integration with the site, some possible further considerations for the project might include explorations for the use of the high lift pumping station and its connected chemical tower, which are a part of the conserved historical buildings. The pumping station hall would be particularly well suited for a museum, and the tower has spectacular views overlooking Ottawa's and Gatineau's riverside landscapes.

The focus of the thesis has been to accomplish an effective adaptive re-use of a historical building and integration of water, plants and natural processes while nourishing human occupation inside the Center. This re-design has demonstrated that the strategies employed can achieve technical success while creating spaces that are relaxing, appealing, as well as educational. It is reasonable to believe that the strategies implemented in the building can be used to also support a humanistic public, outdoor space on the site. On a wider scale, the model is a compelling pilot project that can be applied in whole or in parts, to the create similar facilities that would enrich communities by improving both human and environmental health.

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