A Biophilic Calumet

Robert Meder | Spring 2010

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The living machine will be located in the Calumet Lake region of Chicago. Using biophilia as the source for the evidence based design; the project will completely integrate the flora, fauna, and people of the site. Calumet Lake has been heavily polluted over the years during its occupancy by the industrial industry. The need for remediation of this site is visually important. The site is capable of revitalizing the Lake, adjacent sites, fauna, and people. The rehabilitation centers will use biophilia to connect guests with discomfort in physical therapy, mental illness, and stress. Connecting each of these guests with the improved ecological revitalization will minimize stress; shorten length of stay, and improve overall well being of both guests and workers.

01

Project Intro.

Executive Summary

After using Chicago's bird agenda (2006), Lake Calumet has been identified as the largest problem area of Chicago. The redevelopment of the site will allow for an integrated rehabilitation center to spur remediation of the land and integrate biophilic design. Biophilia is an evidence based design with heavy reinforcement from scientific research. It shows a correlation that a connection with nature will foster human health, productivity, and well-being. The rehabilitation center will become a living machine cleaning both waste produced by the architecture and the currently contaminated site. Refining the current building practices by using: rainwater harvesting, greywater treatment, phytoremediation, and natural power production, the center for rehabilitated health will help all aspects of the ecosystem.

The definition of ecology focuses on organisms and their specific reactions with their environment. As a profession we have often overlooked ecology in the built sense, often ignoring both the reactions of the indoor and outdoor occupants. Each of these reactions has a hierarchy of relationship and integration with new building technology, including but not limited to, green technologies, circulation spaces, pre-space, functional spaces, public space, bird migration, and other site specific strategies. The project will discover the different behaviors of the occupants, visitors, as well as, address public health and habitat conservation. The rehabilitation center will focus on the therapy for mental illness, stress related disorders, and physical therapy, allowing an open retreat atmosphere. The site, living ecology, and building occupants will be tied together using biophilia, or evidenced based design that shows a correlation between nature, human health, productivity, and well-being. The users will be defined and the arrangement of landscape and building will begin accordingly. The site will be developed into a living machine that brings natural processes and human health into one collective setting.

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Statements

[elevator statement]

A living machine for rehabilitating the users of the site. The flora, fauna, and people will be used to eliminate the harsh line between natural systems and built architecture.

[case statement]

The current development of cities has left a gaping hole in the ecosystems which once existed. As architects, we have the ability to change how buildings operate and provide a platform to help build a more sustainable city. With our archaic building practices have destroyed many ecosystems and halted the growth of many habitats. The need to join the natural and manmade way of living is important and combining the natural and human ecologies will only provide improved living for both.

In order to create a more sustainable planet it is necessary to develop coexistence between people and nature. We have currently destroyed the ecosystems with our focus of building on capital gain. Chicago is the center of a large migratory pattern of over 14 million birds. The current expansion of Chicago and vacant industrial land has vastly impacted the thousands of species that occupy and utilize our shared ecosystem.

[process statement]

After using Chicago's bird agenda (2006), Lake Calumet has been identified as the largest problem area of Chicago. The redevelopment of the site will allow for an integrated rehabilitation center to spur remediation of the land and integrate biophilic design. Biophilia is an evidence based design with heavy reinforcement from scientific research. It shows a correlation that a connection with nature will foster human health, productivity, and well-being. The rehabilitation center will become a living machine cleaning both waste produced by the architecture and the currently contaminated site. Refining the current building practices by using: rainwater harvesting, greywater treatment, phytoremediation, and natural power production, the center for rehabilitated health will help all aspects of the ecosystem.

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Statements

[goal statement]

- Integrating built architecture with landscape architecture and ecology
- The rehabilitation of the ecology of Chicago
- Allowing the Chicago environment to be adaptive to the large amount of migratory birds

[guiding principles]

Biophila - Using nature to aid in design. With scientifically tested concepts in the integration of natural elements into healthcare, biophilia is a simple concept for better well-being.

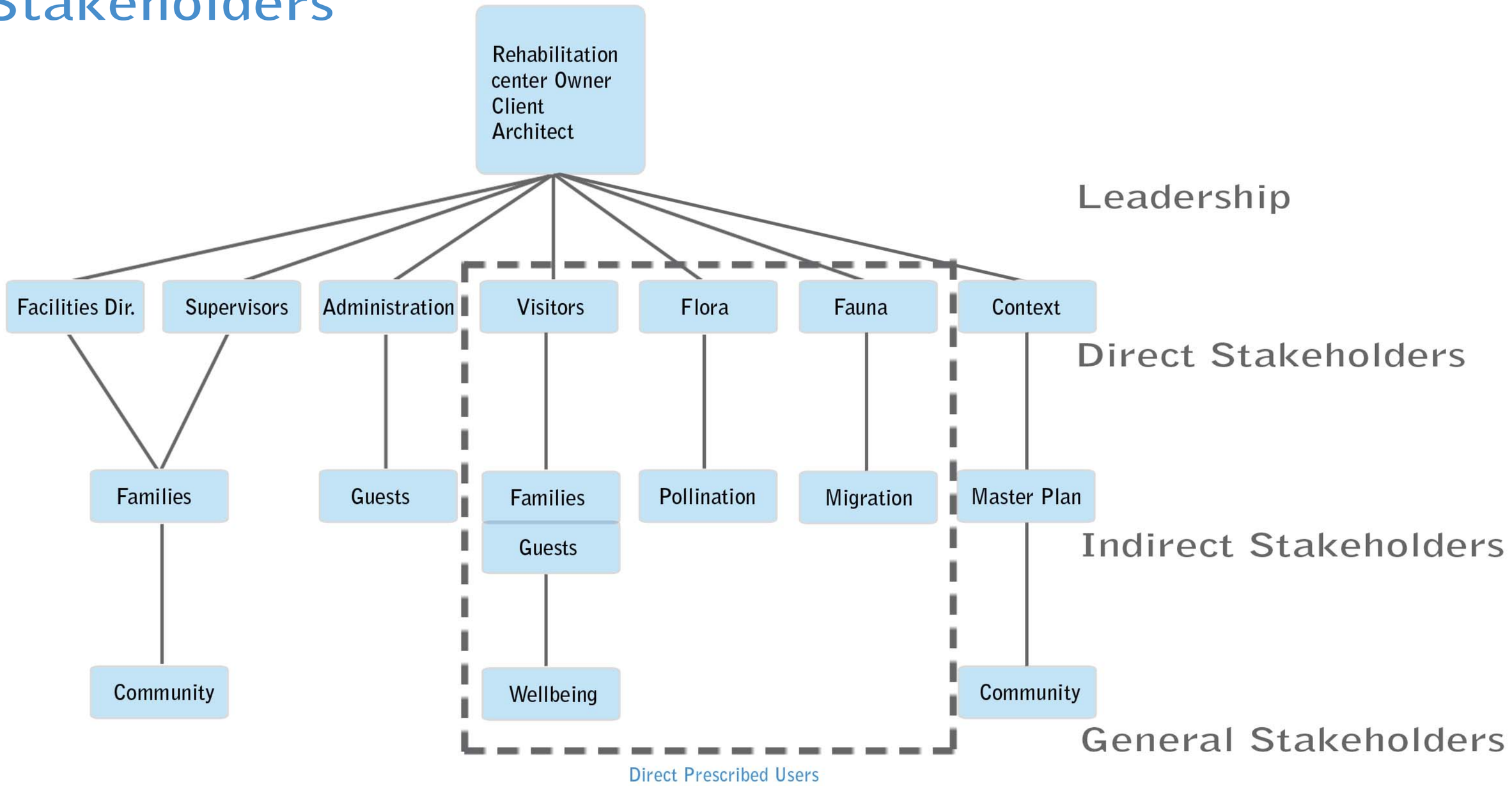
Integration - Using a living machine, the users of the site will be rehabilitated. Ecology will be used as a catalyst for better well-being.

Remediation - The current Lake Calumet site is abandoned Industrial Site with heavy pollution, cleaning the land and providing a platform for good ecological growth.

Sustainability - Going beyond the typical LEED process into total ecological integration.

Rehabilitation - The Chicago built environment has led to the degradation of the natural ecology of the area. The ecology has begun to adapt to the significant changes in habitat and with the new developments in habitat design Chicago will be able to support the 14 million birds that currently migrate.

Stakeholders



02

Precedents

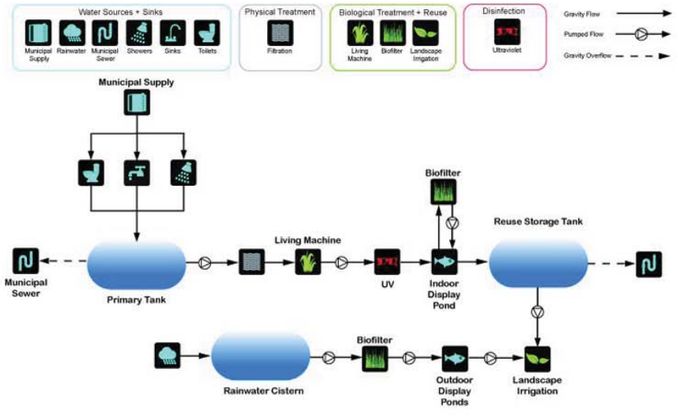
The precedents studied were selected for their various amenities and how their principals could be integrated into the design of the site and the living machine. Studying how different sites have incorporated different aspects of the living machine will help to inform the design of this new site. Looking at the water flow patterns, treatment of the water, and the reuses, the new living machine will utilize many of the same aspects that make each of these projects successful. Although many hospitals do not use biophilia, many of their green practices can be used in the new development. Using methods to help eliminate unnecessary waste and practices that modern day hospitals use, the new rehabilitation center can use these same ideas to help mitigate unnecessary wastes. The new living machine and site, will use some of these tested practices but will also combine theory with these site tested ideas.

El Monte Sagrado

- Spa and Retreat center
- 4,000 gallons of water treated and brought into re-use
- Energy independent heating and cooling systems
- Onsite production of food
- Uses earth-based building materials
- Nature and human needs blended

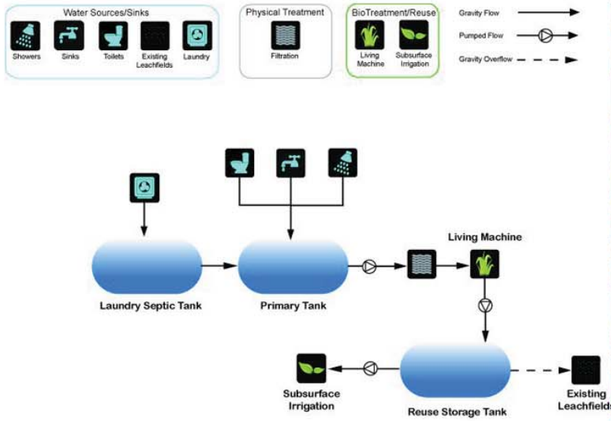
The El Monte Sagrado Resort uses a wastewater treatment system as a thriving ecology. It is a AAA four diamond award winning spa and resort with integrated engineered wetlands. The combination of hydroponic plants and engineered wetlands work together to cleanse wastewater and rainwater for reuse. The Resort contains natural spas that are fed with natural rainwater. The living machine treats water form two sources: the wastewater from the resort's kitchens and bathrooms, and seasonal rainwater collected to a cistern. Water from each of these sources is treated separately, and ultimately bound for both diplay and re-use in landscape irrigation.

Wastewater from the resort is treated by a series of hydroponic reactors. The partially treated water then passes through a series of plant-covered hydroponic tanks, whose root zones contain engineered films of beneficial microbes. The final stage of the treatment is applied by paired indoor and outdoor vertical flow wetlands. After treatment the collected water is disinfected using ultraviolet light.



El Monte Sagrado Resort, Taos, NM
System Design By: Worrell Water Technologies + Living Designs Group

Esalen Institute

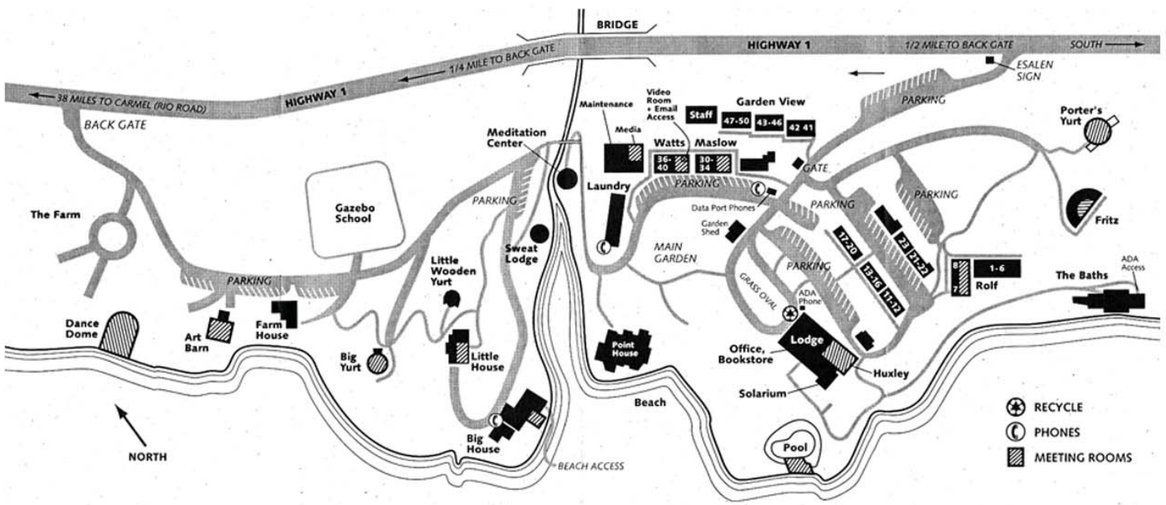


- Educational Center focused on human potential and living in the world with wisdom

- Treats up to 7,000 gallons of wastewater a day

- Uses native wetland plants to fit into the natural landscape

The Esalen Institute uses a tidal designed wetland to cleanse wastewater. By mimicking the tidal flow an abundant supply of oxygen to the plants of the system that do most of the cleaning. This system is much more efficient than a mechanical aerator. The system recycles water from the sewer system and the laundry facility. Using a 10,000 gallon tank, the solids will be allowed to settle and the pressure of the system is equalized. The tidal system uses different mediums to clean the water, starting with gravel and ending with indigenous wetlands plants. The water is moved through the wetlands basins and enters the final stage where it is disinfected and stored in an underground tank. The living machine is designed to grow with the needs of the facility.



Yawkey Center for Outpatient Care

-Natural light and views of the city beyond improve the morale of both patients and staff.

-A well-designed healing garden at an outpatient cancer center provides a refuge for patients and their families.

-Increase the bed-to-chair ratio in chemotherapy suites.

-Think hard and test the equipment before installing electrically controlled faucets.

Like many big-city hospitals, MGH had grown piecemeal over the years. Although its core was strong—a handsome 1930s structure called the White Building, designed by Shepley Bulfinch Richardson—it had become an ad hoc collection of facilities, rather than an efficient or attractive health-care campus. It also needed a new ambulatory-care building to bring together various outpatient services scattered throughout the hospital complex.

"Words cannot describe how beautiful and serene this healing garden is. It is truly breathtaking. It really lightens up my day and spirits when I come here. I love it. Thank you!" one patient wrote. "I love to come here when I bring my wife for chemotherapy. This place always gives me strength and hope that all will be well," the husband of another patient explained. Someone else noted the "beautiful views" and said the garden is "really delightful, a wonderful idea; it is calm, relaxing, and really appreciated." Commenting on the garden's "total serenity," another patient said: "Body, mind, and spirit are at peace. A beautiful addition to this hospital." Dozens more wrote similar things. Clearly the garden strikes just the right chord with people when they feel most vulnerable.

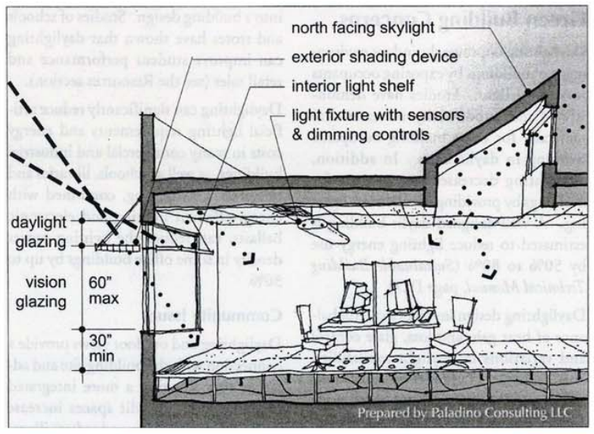
To bring daylight and views into medical areas, the architects organized clinics and waiting rooms along a single-loaded corridor just inside the building's glazed curtain wall. Clear- and opaque-glass partitions separating clinics and medical offices (designed by Perkins + Will and Steffian Bradley Associates) from the corridor allow daylight to filter deep inside.

Boulder Community Hospital

- Energy efficiency measures resulted in energy savings of 30.6% compared to a minimally-compliant local code building.

- Exemplary indoor air quality was achieved through by specifying low-VOC materials, installing all materials in proper sequence, and performing a two-week building flushout prior to occupancy.

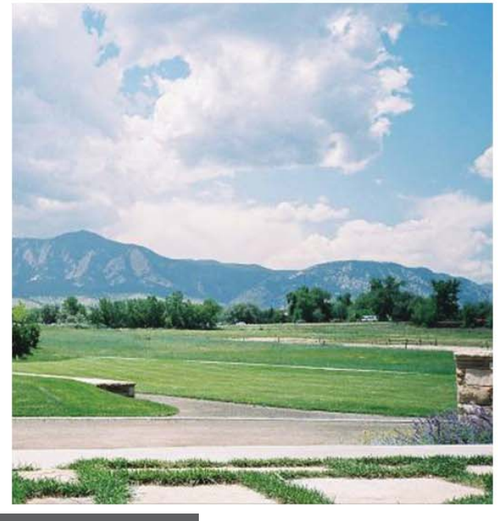
- 64% of the construction waste was recycled on the project.
Building materials such as concrete, gravel, brick, and sandstone were locally harvested and manufactured.



- In public areas (non-medically critical), water saving fixtures were installed. In the public restrooms, waterless urinals were used, marking the first installation in the City of Boulder.

- A 53% reduction in potable water use was achieved through drought resistant landscaping. Exemplary encouragement of alternative transportation was achieved through minimum parking exceedance, bus passes for all employees, construction of new bus-stops and provision of numerous bicycle racks.

Boulder Community Foothills Hospital is a women and children's center in Boulder, Colorado. Designed and built by a local team, sustainability and environmental sensitivity were top priorities. The first hospital in the nation to earn LEED® Certification, Boulder Community Foothills Hospital's LEED® Silver sets the standard for energy and environmentally responsive healthcare facility design. The project included use of environmentally-friendly materials, an extensive construction waste management plan, use of native plantings, and exceptional attention to indoor air quality. The result is a facility that maximizes patient comfort while minimizing environmental impacts and operational costs.



03

Location Summary

The chosen site for the development of the living machine is the site of Lake Calumet in Chicago, Illinois. Lake Calumet has been has been modified over the years to create an environment that was more conducive to the shipping industry. The steel mills, oil refineries, and grain processing industries plagued the land and water with contaminants and byproducts from each of the industries. Calumet is the location for one of the largest shipping industries in the country. Chicago's current plans in sustainable city planning provide a good platform for the ecological living machine to be developed. With the extension of the red line train in Chicago, the site will be accessible by train, car and have water access. With the heavy pollution of the Calumet Lake area, this site is ideal for the implementation of a living machine and phytoremediation.

Macro Map

Micro Map


Lake Michigan
Rockford
Chicago
Calumet Lake Site
Naperville
Joliet
Davenport
Galesburg
Peoria
Champaign
Springfield
St Louis

04

Program

The program has been developed around the integration of nature. The structure of the program is developed around active spaces, yoga studios, art studios, cooking studio, outdoor gardening, and rehabilitative exercise. Each of the spaces has been identified by square footage and relationship. After developing the amount of spaces per rehabilitative guests, a bubble diagram was devised to show the basic relation between the larger components of the program, or level 1. The level 2 bubble diagram shows the correlation between all of the interior components of a specific function. The spatial diagrams use the sizes of the spaces and add a level of complexity onto the bubble diagram, separating the spaces and joining them where necessary. Using biophilia to fuel the design of the spaces each level of the program will be heavily integrating both programmatically and ideologically.

Progam Spreadsheet

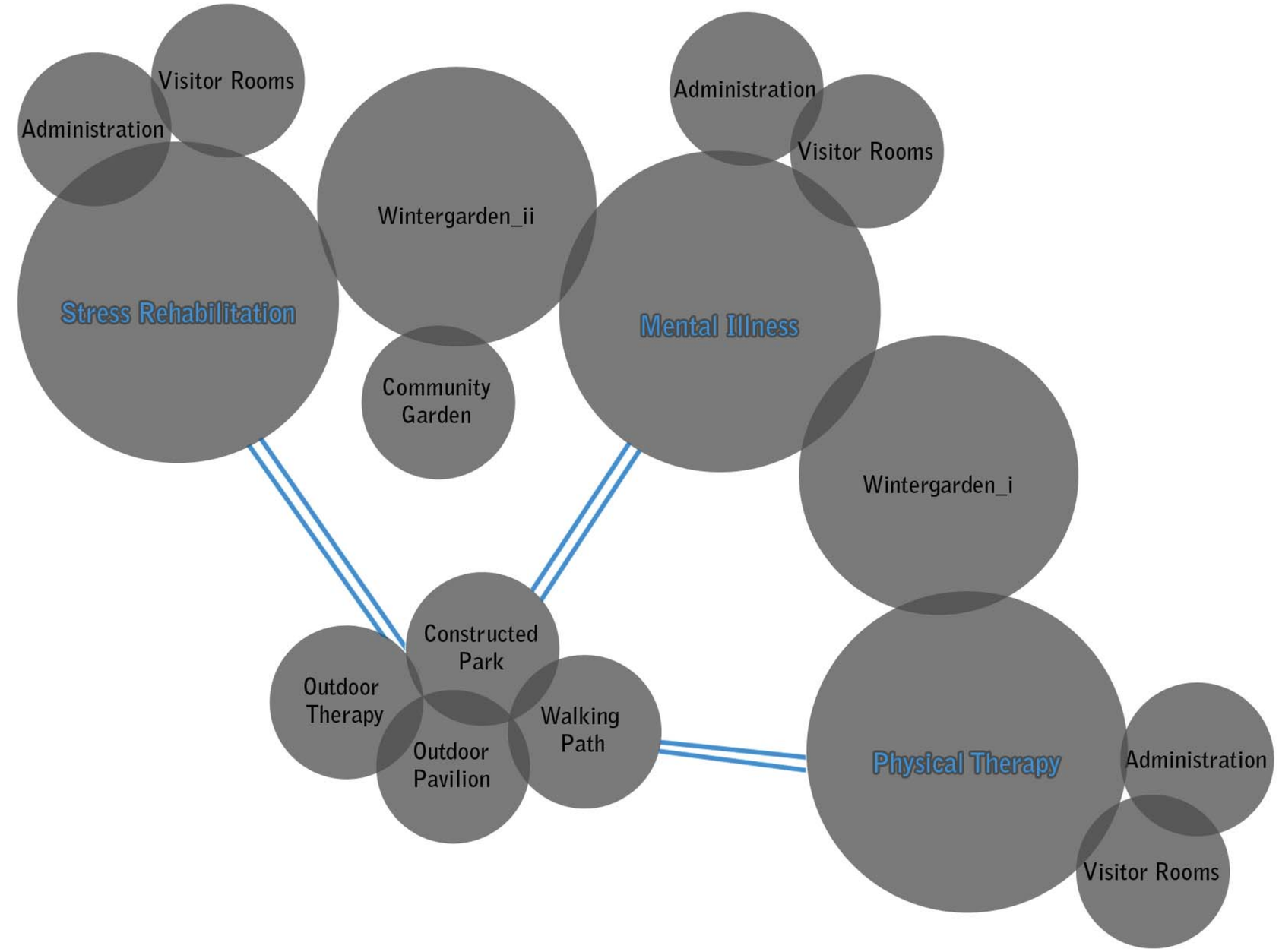
Type	Stress Rehabilitation		Qty.	Net sf	Total Net sf
1.00	Exam Room		8	150	1200
1.01	Consult		8	135	1080
1.02	Restroom		4	75	300
1.03	Waiting		2	175	350
1.04	Supply		1	125	125
1.05	Conference Room		2	400	800
1.06	Storage		2	200	400
1.07	Preparation		2	125	250
1.08	Receptionist		2	350	700
Type	**Stress_Administration**		Qty.	Net sf	Total Net sf
1.10	Director		1	220	220
1.11	Assistant Director		1	180	180
1.12	Manager		1	180	180
1.13	Secretary		1	180	180
1.14	Medical Records		1	550	550
1.15	Supply		1	100	100
1.16	Lounge		1	275	275
1.17	Storage		1	200	200
1.18	Pharmacy		1	1000	1000
Type	**Stress_Rooms**		Qty.	Net sf	Total Net sf
1.20	Bed Only [long-term stay]		0	330	0
1.21	Bed and Couch [short to long-term stay]		75	400	30000
1.22	Bed and Bath [long-Term stay]		50	730	36500
1.23	Storage		2	500	1000
1.24	Supply		2	100	200
1.25	Receptionist		2	350	700
1.26	Restroom		4	300	1200
1.27	Lounge		2	700	1400
1.28	Conference Room		4	725	2900
1.29	Small Yoga Room		2	1000	200
Type	**Service Areas**		Qty.	Net sf	Total Net sf
1.90	HVAC 10% of Total Building Area		1	8219	8219
1.91	Elevator Room		1	400	400
1.92	Electrical Room		1	500	500
1.93	Trash Room		1	600	600
1.94	Biohazard Disposal		1	400	400
1.95	Circulation Space 10% Total Floor Area		1	8219	8219

Type	Mental Illness		Qty.	Net sf	Total Net sf
2.01	Large Activity Room		1	1800	1800
2.02	Small Activity Room		2	1000	2000
2.03	Art Studio		1	700	700
2.04	Music Studio		1	700	700
2.05	Cooking Studio		1	700	700
2.06	Yoga Studio		1	700	700
2.07	Receptionist		2	350	700
2.08	Storage		2	700	1400
2.09	Supplies		2	200	400
Type	**Mental Illness_Administration**		Qty.	Net sf	Total Net sf
2.10	Director		1	220	220
2.11	Assistant Director		1	180	180
2.12	Manager		1	180	180
2.13	Secretary		1	180	180
2.14	Medical Records		1	550	550
2.15	Supply		1	100	100
2.16	Lounge		1	275	275
2.17	Storage		1	200	200
2.18	Pharmacy		1	1000	1000
Type	**Mental Illness_Rooms**		Qty.	Net sf	Total Net sf
2.20	Bed Only [long-term stay]		35	330	11550
2.21	Bed and Couch [short to long-term stay]		35	400	14000
2.22	Bed and Bath [long-Term stay]		35	730	25550
2.23	Storage		3	500	1500
2.24	Supply		3	100	300
2.25	Receptionist		3	350	1050
2.26	Restroom		6	300	1800
2.27	Lounge		3	700	2100
2.28	Conference Room		3	725	2150
Type	**Service Areas**		Qty.	Net sf	Total Net sf
2.90	HVAC 10% of Total Building Area		1	7198	7198
2.91	Elevator Room		1	400	400
2.92	Electrical Room		1	500	500
2.93	Trash Room		1	600	600

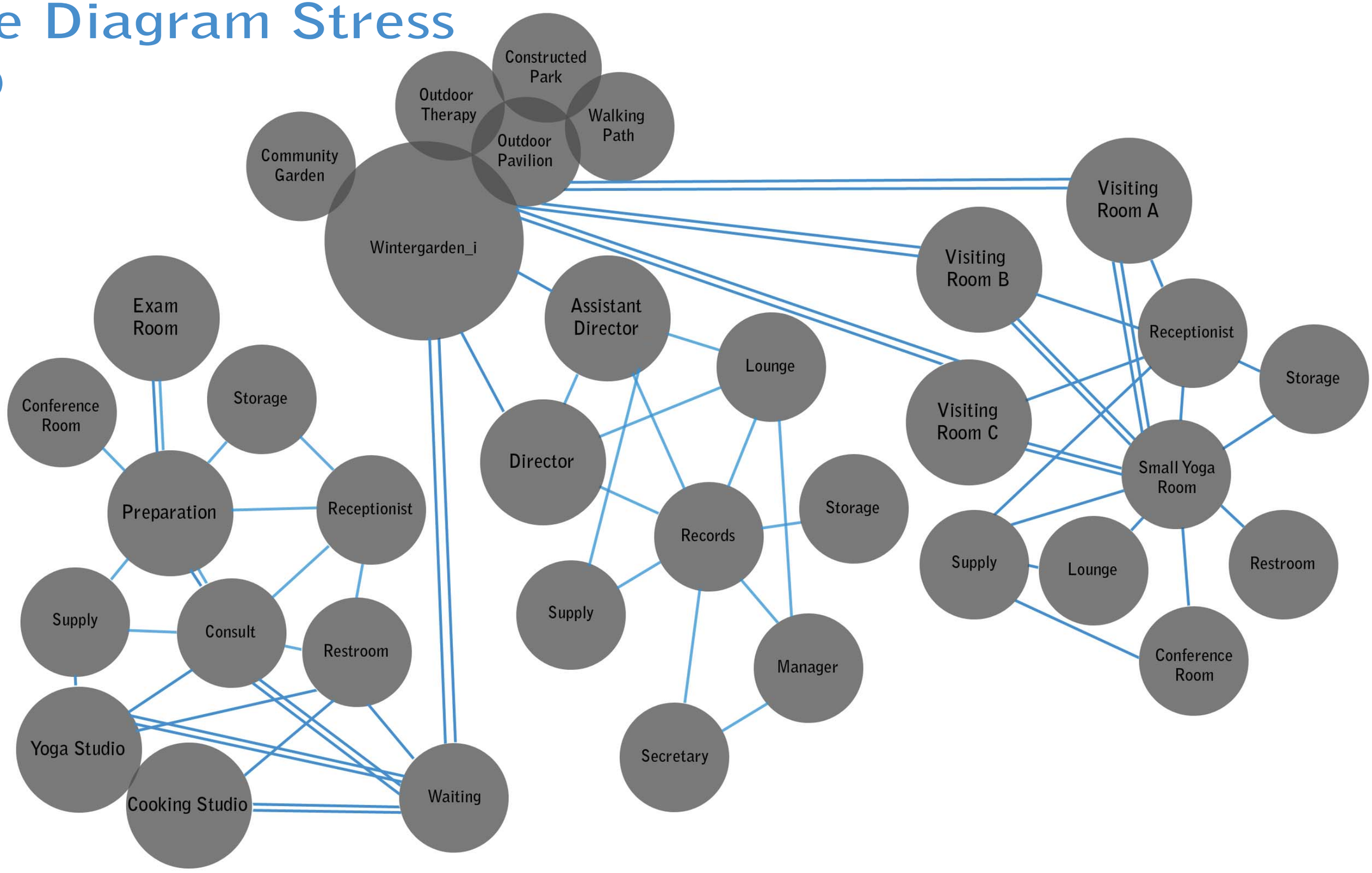
2.94	Biohazard Disposal		1	400	400
2.95	Circulation Space 10% Total Floor Area		1	7198	7198
Type	**Physical Therapy**		Qty.	Net sf	Total Net sf
3.01	Large Rehabilitation Exercise		1	2200	2200
3.02	Individual Rehab Rooms		6	175	1050
3.03	Office		4	200	800
3.04	Lounge		2	320	640
3.05	Waiting Room		1	320	320
3.06	Storage		1	620	620
3.07	Restroom		2	300	600
3.08	Chaning Rooms		2	600	1200
Type	**Physical Therapy_Administration**		Qty.	Net sf	Total Net sf
3.10	Director		1	220	220
3.11	Assistant Director		1	180	180
3.12	Manager		1	180	180
3.13	Secretary		1	180	180
3.14	Medical Records		1	550	550
3.15	Supply		1	100	100
3.16	Lounge		1	275	275
3.17	Pharmacy		1	1000	1000
3.18	Storage		1	200	200
Type	**Physical Therapy_Rooms**		Qty.	Net sf	Total Net sf
3.20	Bed Only [long-term stay]		0	330	0
3.21	Bed and Couch [short to long-term stay]		75	400	30000
3.22	Bed and Bath [long-Term stay]		75	730	54750
3.23	Storage		2	500	1000
3.24	Supply		2	100	200
3.25	Receptionist		2	350	700
3.26	Restroom		4	300	1200
3.27	Lounge		2	700	1400
3.28	Small Yoga Room		2	1000	2000
Type	**Service Areas**		Qty.	Net sf	Total Net sf
3.90	HVAC 10% of Total Building Area		1	10156	10156
3.91	Elevator Room		1	400	400
3.92	Electrical Room		1	500	500
3.93	Trash Room		1	600	600

3.94	Biohazard Disposal		1	400	400
3.95	Circulation Space 10% Total Floor Area		1	10156	10156
Type	**Wintergarden_i**		Qty.	Net sf	Total Net sf
6.01	Wintergarden		1	2200	2200
6.02	Café		1	1200	1200
6.03	Restroom		4	300	1200
6.04	Storage		2	600	1200
6.05	Bird Tower		4	500	2000
Type	**Wintergarden_ii**		Qty.	Net sf	Total Net sf
7.01	Wintergarden		1	2200	2200
7.02	Café		1	1200	1200
7.03	Restroom		4	300	1200
7.04	Storage		2	600	1200
7.05	Bird Tower		4	450	1800
Type	**Imaging**		Qty.	Net sf	Total Net sf
5.01	Lab		1	520	520
5.02	Imaging Room		1	540	540
	Booth		1	65	65
	Out		1	90	90
	Main		1	300	300
5.03	Storage		1	800	800
5.04	Lounge		1	425	425
5.05	Waiting Room		1	300	300
Type	**Exterior Spaces**		Qty.	Net sf	Total Net sf
8.00	Outdoor Therapy		1	na	na
8.01	Walking Path		1	na	na
8.02	Constructed Parks		1	8000	8000
8.03	Outdoor Pavilion		1	1500	1500
8.04	Community Garden		2	4000	8000

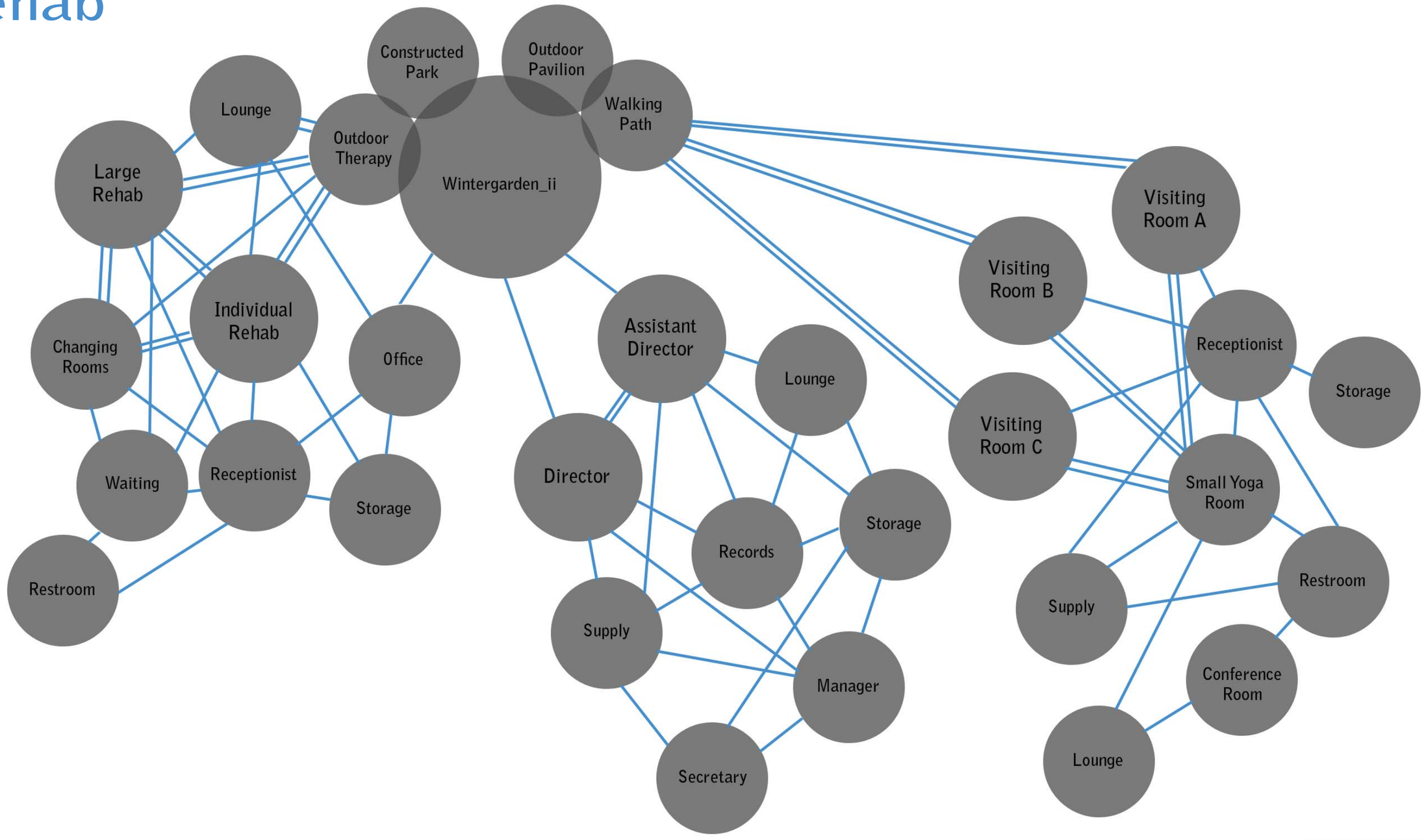
Bubble Diagram Level 1



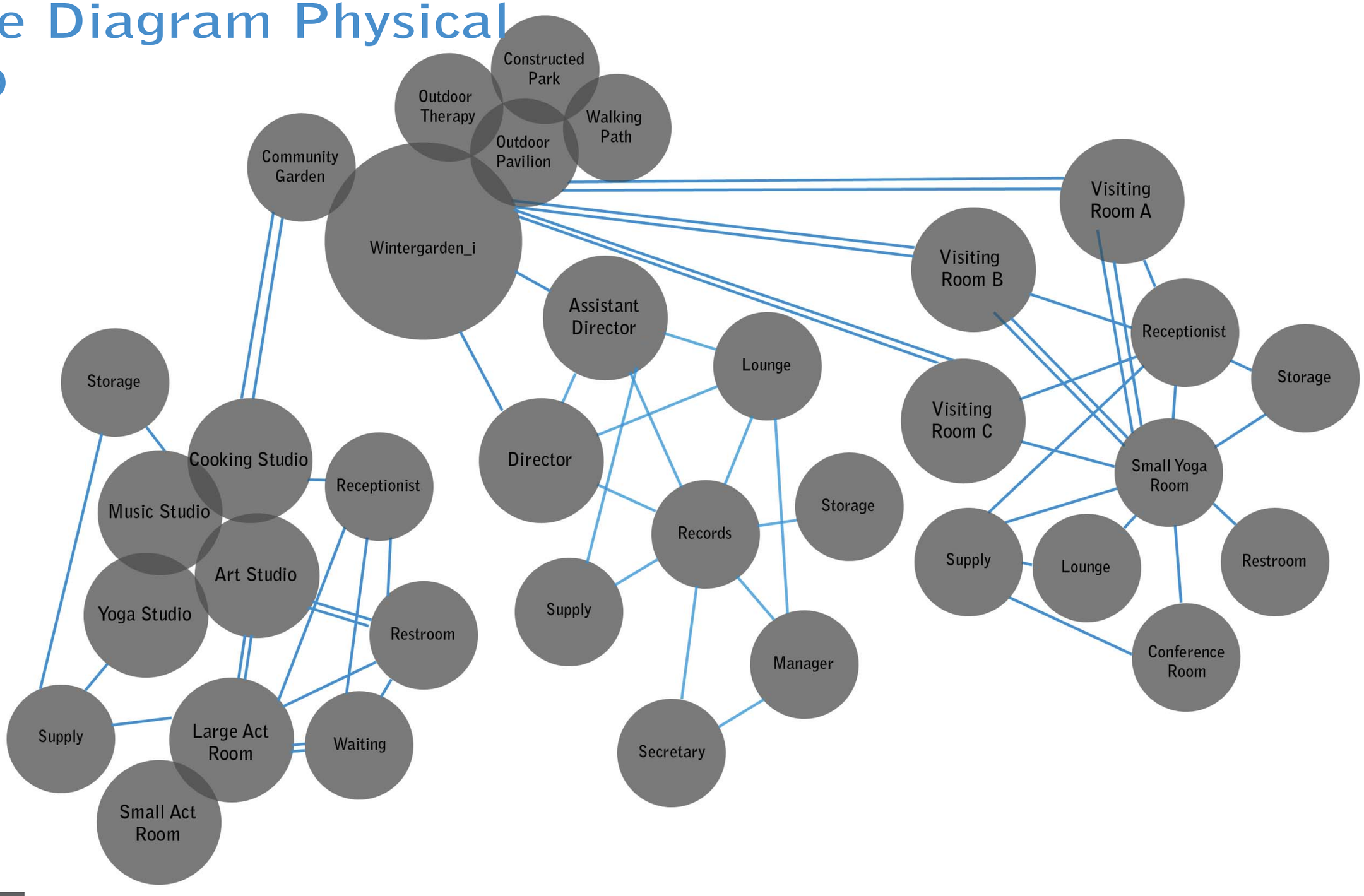
Bubble Diagram Stress Rehab



Bubble Diagram Mental Rehab



Bubble Diagram Physical Rehab



05

Analysis Diagrams

The accompanying diagrams are an analytical analysis of the projects location. Chicago is home to the 14 million birds that migrate throughout the region in a year. Following the Mississippi River to the great lakes the birds migrate north in the summer and south again in the winter. Chicago's Bird agenda of 2006 outlines the locations of improvement areas and the areas that are suitable for habitats. With most of the areas being woodland park settings, the ecological consideration of fauna has been ignored. The habitats of the site are blended between the different levels of ecology. There will be several areas of interaction between all of the ecologies. The architecture will be designed to incorporate nature in its design, but will also incorporate gardens and natural lands for its complete integration.

Migration

Spring Season

April-May 7 Million Birds Migrate

Fall Season

September-October 7 Million Birds Migrate

Totals:

250 Species of Migrating Birds

14 Million Birds Migrate through Chicago

Flora

Woodland / Forest
1,772 acres in Chicago
- An area possessing more than 50 percent tree cover

Wetland
535 acres in Chicago
- An area saturated with water for a sufficient part of the year that supports emergent reeds, grasses and other aquatic plants

Riparian / Water Edge
290 acres in Chicago
- A transitional area between dry and wet environments

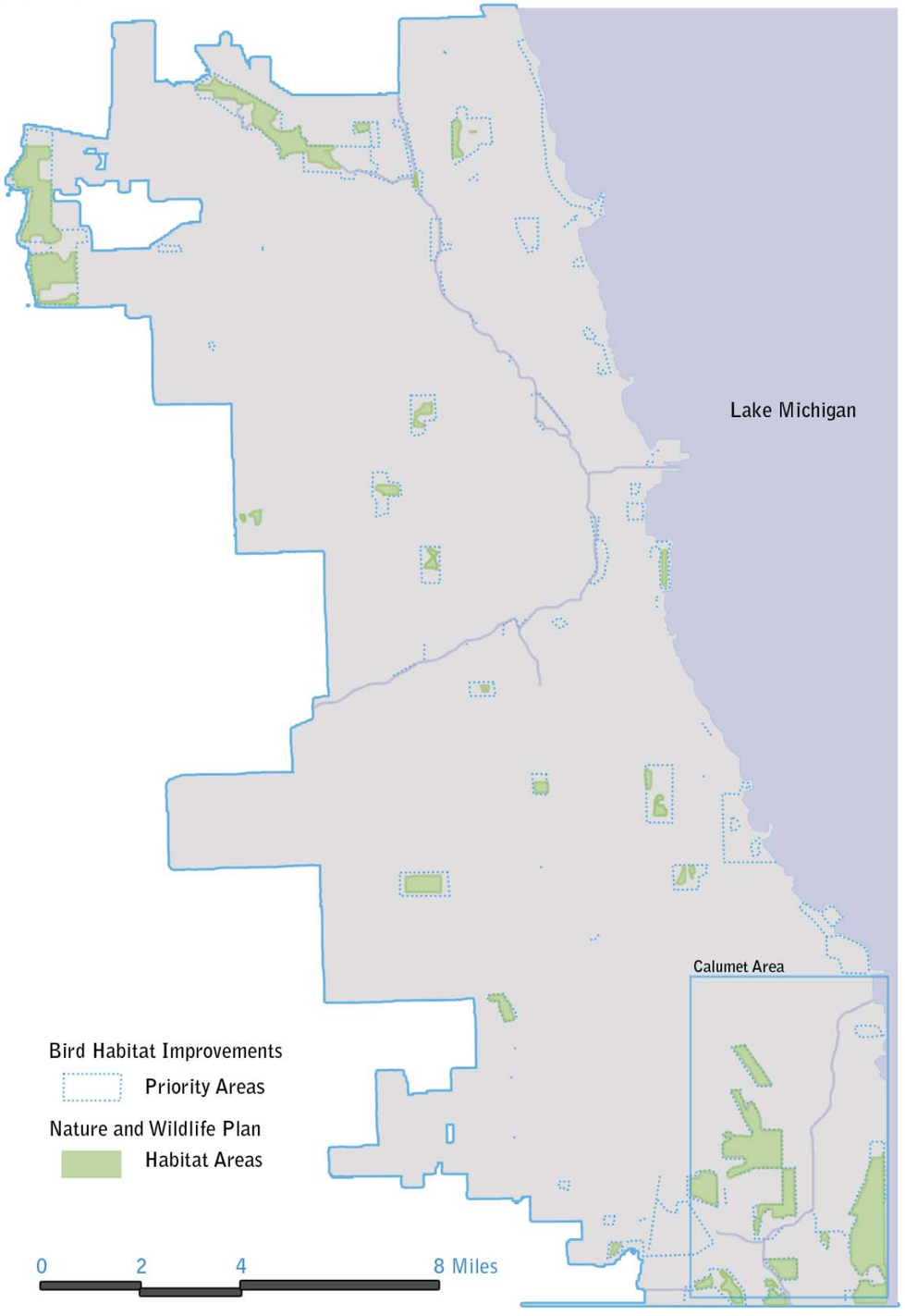
Beach / Dune
22 acres in Chicago
- A hill or ridge of sand piled by the wind that supports plant life

Prairie / Grassland
170 acres in Chicago
- An area dominated by grasses or one possessing less than 10 percent tree cover

Savannas
36 acres in Chicago
- An area with 10 to 50 percent tree cover and a native grass and wildflower understory

Birds
3,800 acres for habitat in Chicago
- 400 species, and over 14 million migrating through Chicago in one year

Habitat


Lake Michigan
Calumet Area
Bird Habitat Improvements
Priority Areas
Nature and Wildlife Plan
Habitat Areas
0
2
4
8 Miles

Habitat

Birds and the Forest
There are three levels of the forest that support bird life. The canopy, understory, and forest floor. Each of these provides different nutrients and habitats for animals.

Canopy
Many songbirds use the canopy for habitat and nutrients.

Understory
Birds such as woodpeckers use this layer of the canopy to hunt for bugs. They are considered cavity nesters.

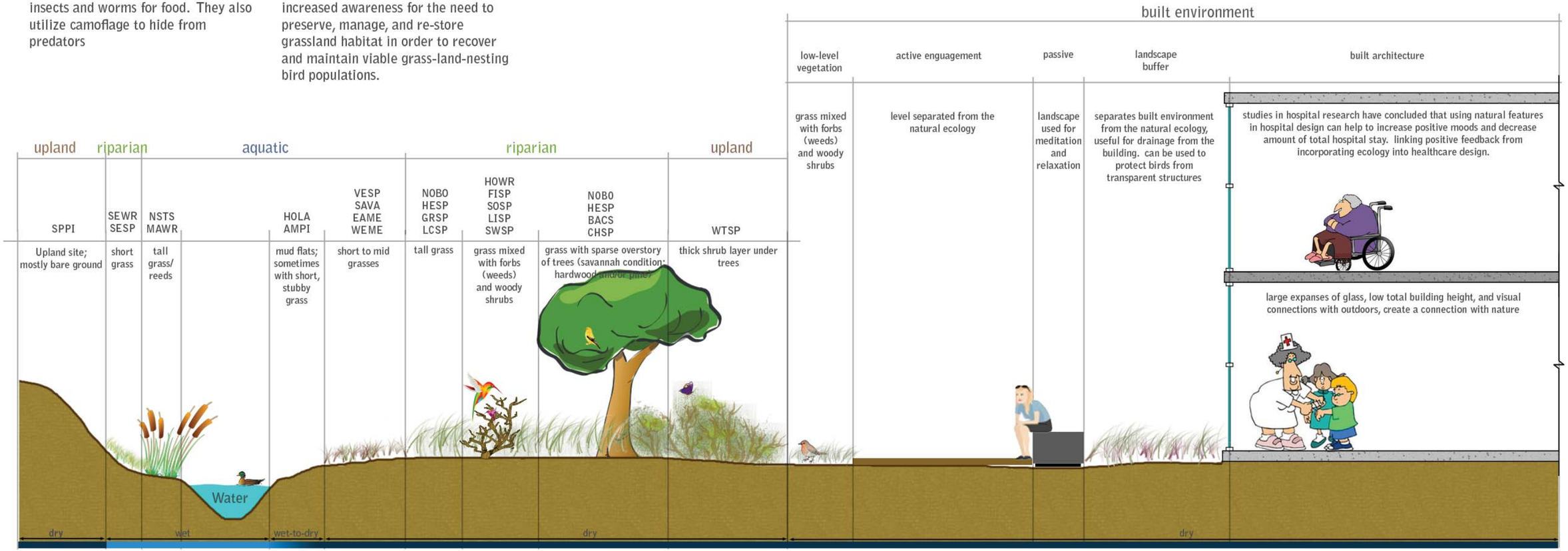
Forest Floor
These birds rely on fallen nuts, seeds, insects and worms for food. They also utilize camoflage to hide from predators

Grassland Birds
Grassland birds, or those birds that rely on grassland habitats for nesting, are found in each of the 50 United States and worldwide. Various species of waterfowl, raptors, shorebirds, upland gamebirds and songbirds rely on grasslands for nesting and other habitat func-tions. Historical population fluctuations in grassland-nesting bird species have coincided with changes in land uses and agricultural practices. Many North American grassland-nesting birds species have experienced marked population reductions in recent decades. Continued nationwide declines in some grassland-nesting bird species have increased awareness for the need to preserve, manage, and re-store grassland habitat in order to recover and maintain viable grass-land-nesting bird populations.

Wetland Birds
Wetlands with both dense and sparse stands of vegetation provide food and cover for specific types of birds. Some wetland cover types include dense cattail stands, grassy meadows, and wooded swamps. Sedge fields, wet meadows, mud flats, and beaches all provide good food sources, including insects and seeds, for a variety of wetland birds. The food and cover needs of many bird species also varies by seasonal activity. Migration stop-over, pair bonding, nesting, and brood rearing often require different components of a wetland.

Codependance of Ecology
Health care and ecology can work together to improve interior and exterior environments. The current studies of biophilia have established a positive link between the interaction of ecology and mental health. Involvement of natural surroundings in architecture leads to a more productive and stress free environment for the habitats. The most important connection to architecture and ecology is a visual one. The different types of healing gardens target separate areas of healing. Using various techniques like meditation to reduce stress and help the thinking process; landmarks in a continuous path to help build cognitive skills back, most effective in dementia and brain cancer patients; and sanctuary gardens to help with acceptance and therapy. Each of these gardens is useful to help treat different types of illnesses. This integration is helpful for both birds and humans. The birds have adapted to a constant surrounding of people. When people are watching birds they stop feeding and begin to watch for predators, when people are not focused on the habitat the birds will continue to feed.

Built Environment
Many of the advances in integrating green technologies and architecture have fell short of the actual incorporation of the natural ecology of an area. Many new buildings incorporate the LEED principals without considering the site / area in which they are building. By incorporating 'green' technologies and ecological considerations the quality of the architecture and people who it is inhabited by.



Biophillic Design

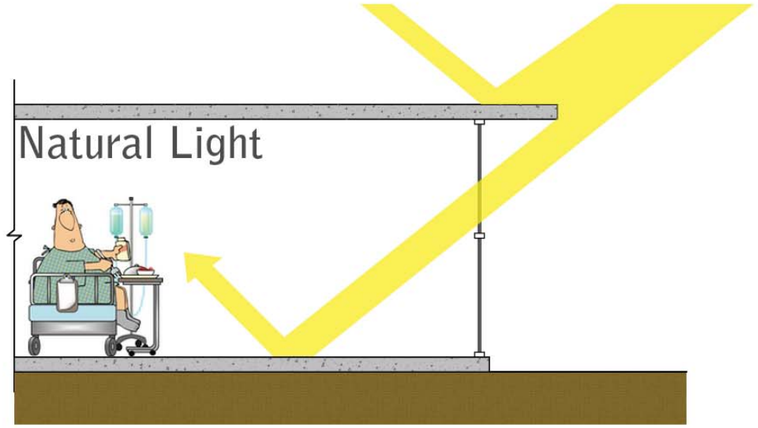
06

Biophilic design is the practice of including nature into the design of buildings. This evidence based design shows large improvements in overall well being. Biophilia will be incorporated into the rehabilitative center to improve the overall well being of the visitors and of the ecology in the Calumet Lake area. Beginning with the remediation of the land, Calumet Lake will begin its reclamation by using phytoremediation to clean the land and help the migratory pattern of the 14 million birds that currently utilize the area. The site will be designed to utilize the current weather patterns to readapt the site to flora. The readapted flora will revitalize the ecology of the area creating an atmosphere that is capable of supporting the biophilia theory. Using the new divisions of ecology to fuel the design of the rehabilitation center, the architecture will be integrated into the built ecology. The program of the rehabilitation center will utilize many design features that support the theory of biophilia. Integrating many features such as community gardens, and interactive spaces with nature the rehabilitation center will explore new ways in connecting with nature.

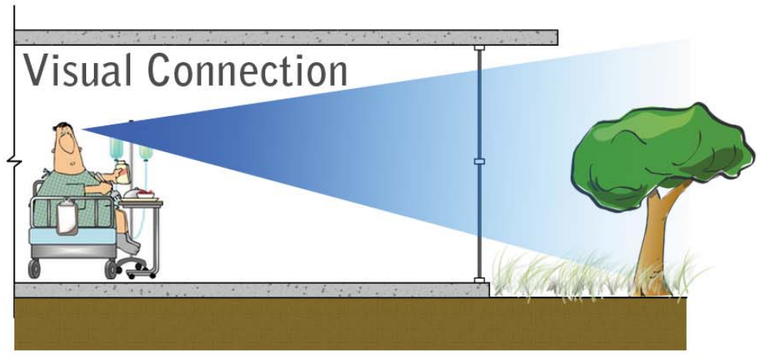
Biophilia

theory

Scientific research has produced evidence that shows a correlation that a connection with nature will foster human health, productivity, and well-being. Humans posses a basic need for contact with nature. Entomologist E.O. Wilson in 1984 coined the term biophilia to describe the need for human contact with nature. Wilson believed that there is a particular connection with life and natural ecosystems. Steven Kellert and Judith Heerwagen explain their research as conclusive to showing a direct relationship with the natural surroundings and their therapeutic benefits as well as a comprehensive approach to integrating nature references at all level of building design from organization to materials.



Recent studies in hospital research demonstrate that natural features, including gardens, sunlight, and landscape views, have positive effects on both patient and financial outcomes. Sunlight in patient rooms is also associated with a reduction in pain, stress, and depression, more positive moods, and/or shorter stays. In a study of patients hospitalized for sever depression, Beauchemin and Hays (1996) found that patients in sunny rooms remained in the hospital fewer days than those in dimly lit rooms. Patients assigned to a sunny critical-care room had lower mortality rates than those in north-facing rooms lacking sunlight.



Over the past several decades, research in a variety of fields has shown that contact with nature generates emotional, physiological, social, and cognitive benefits in a wide array of contexts. Specific benefits at the individual level include improved emotional functioning, improved attention capacity and feelings of self-worth, and reduced mental and physical stress. Spaces with large trees, water features, birds and a variety of shrubs and flowers are perceived more positively than spaces with only grass.

Biophilic Design Elements

Environmental features
- Natural Materials
- Natural Colors
- Sunlight
- Water
- Natural Ventilation
- Plants and Animals
- Natural views and vistas
- Facade greening
- Geological and landscape forms
- Habitats and ecosystems
- Fire

Natural Shapes and Forms
- Botanical motifs
- Animal motifs
- Shell and spiral forms
- Egg, ovular, and tubular forms
- Arches, caults, domes
- Columns and treelike supports
- Shapes that resist right angles
- Simulation of natural features
- Biomorphism
- Natural morphology
- Biomimicry

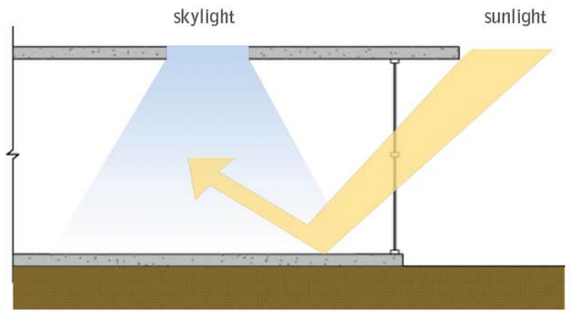
Natural patterns and processes
- Sensory variability
- Information richness
- Time, aging and change
- Growth and efflorescence
- Central focal point
- Patterned whole
- Bounded spaces
- Transitional spaces
- Complimentary contrasts
- Dynamic balance and tension
- Similar forms at different scales
- Hierarchically organized scales
- Ordered complexity
- Relation and integration of parts to whole
- Linked series of chains

Light and Space
- Natural light
- Filtered and diffused light
- Light and shadow
- Reflected light
- Light pools
- Warm light
- Light as shape and form
- Spatial variability
- Spaciousness
- Space as shape and form
- Spatial harmony
- Inside and outside spaces

Place-based relationships
- Historical connection to place
- Cultural connect to place
- Geographical connection to place
- Ecological connection to place
- Use of indigenous materials
- Compatible orientation to landscape
- Landscape features that define building form
- Landscape ecology
- Integrating culture and ecology
- Sense or spirit of place
- Avoiding placelessness

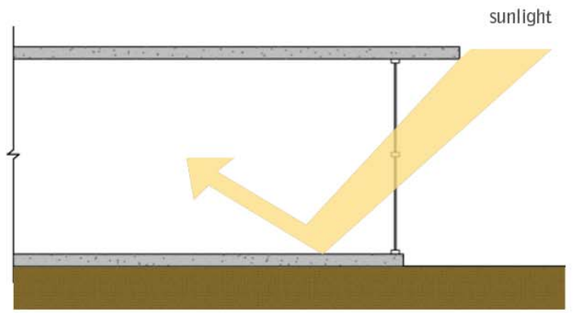
Evolved human relations to nature
- Prospect and refuge
- Exploration and discovery
- Mystery and Enticement
- Order and complexity
- Change and metamorphosis
- Information and cognition
- Attraction and attachment
- Fear and awe
- Reverence and spirituality

Biophilic Design



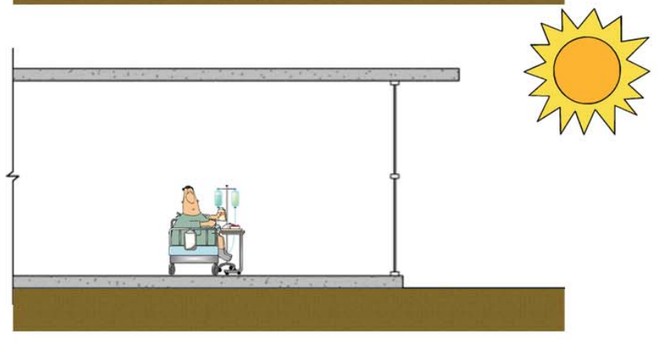
Brighter Rooms

Brighter Patient Rooms have led to 21% less pain medicine intake. Utilizing natural light reduces stress and tension that can be relayed as pain.



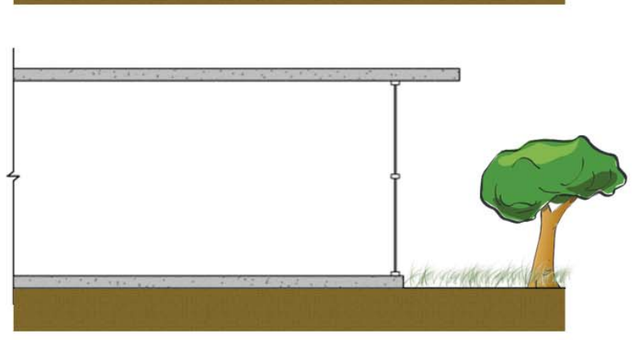
Natural Sunlight

The physiological effects of natural sunlight extend through the central nervous system. These hormonal effects are responsible for increasing the health of bones through a natural increased production of Vitamin D.



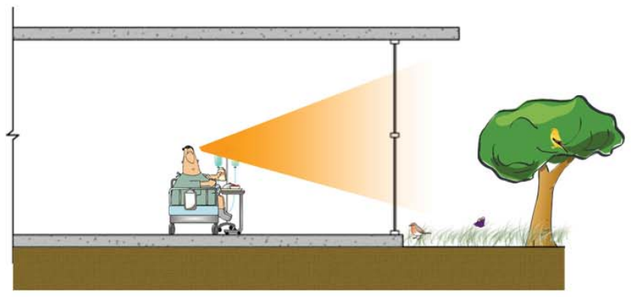
South Facing Rooms

The south facing rooms in the intensive care unit have a lower mortality rate than the north facing views. Using the sun as the means of connecting with nature has led to higher survival rates.



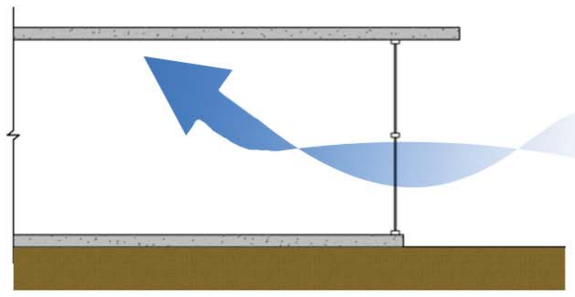
Natural Views

Natural views have been attributed to both positive effects on patients and financial outcomes in healthcare. The incorporation of natural views has been avoided until recently.



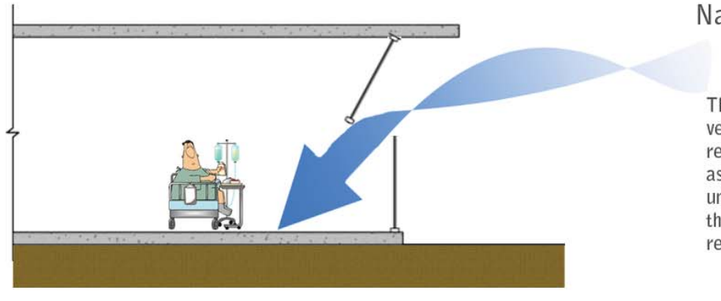
Connection to Nature

As an extension of natural views a direct connection to nature helps to remove stress related disorders. The connection to nature is directly related to the observation of an ecosystem from patient rooms.



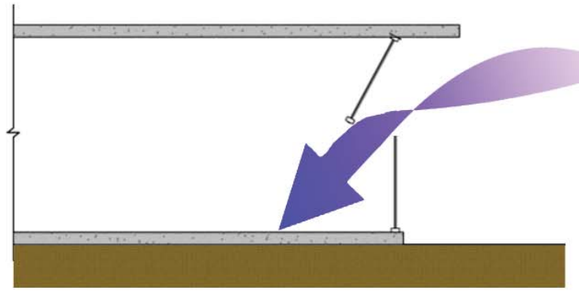
Natural Ventilation

Increased outside air has led to a reduction in symptoms for various illnesses. The flu symptoms are reduced by 87.3%. SBS symptoms are reduced by 67%. Respiratory symptoms are reduced by 46%. Providing significant gains in patient health with simple addition of natural air.



Natural Ventilation

The individual control over the natural ventilation in a room have led to a reduction in headaches most commonly associated with stress and being uncomfortable. With individual control the symptoms of a headache were reduced by 23.5%.



Natural Ventilation

Moisture control is directly related to the amount of natural ventilation and artificially cooled air allowed to enter a space. By allowing the patient to monitor and adjust this there is a 72.5% reduction in asthma and a 15% reduction in symptoms.

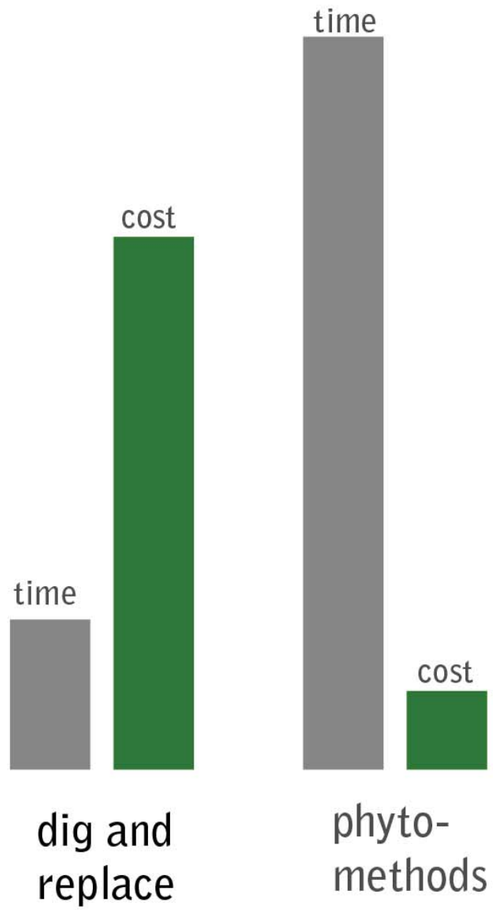
07

Remediation

The remediation of the land starts with the analysis of its previous inhabitants and the assumed contamination. The four different types of phytoremediation (phytodegradation, phytoextraction, phytostabilization, and phytovolitization) will be classified by their effectiveness and in treating the different types of pollution. Analyzing the top of the site and working downward to remediate the land adjacent to the river. The remediation will begin in phase 1, which will allow for the river and the lake beds to be planted first. Planting along the beds first allows all contaminated water runoff, within the watershed, to be retarded in its progress into the water. This halting of water will allow the plants to begin to remove compounds from the soil allowing for the waterways to become cleaner throughout time. The second phase, will simply step back from the waters edge and incorporate sites of complete contamination. The third and final phase of remediation, will encapsulate the rest of the land that was previously used for industrial purposes. The most effective treatment for the sites lies within the use of phytoextraction, and phytodegradation. The phytoextraction sites will utilize prairie grasses, which will be harvested and used as biofuel for the rehabilitation center.

Remediation

Bioremediation that utilizes plants as the catalyst for change in purifying the soil and groundwater of a previously industrial occupied site is called phytoremediation. Many industrial sites can be remediated with the use of plants naturally. There is no advantage other than time with the dig and replace method. This is a much longer process than the dig and replace method but also much more ecologically friendly and cost effective. Dig and replace methods cost between $10 and $1000 per cubic yard where in-situ methods cost approximately $0.05 per cubic yard.



Remediation Methods

- Ex-situ Methods - dig and replace
- In-situ Methods

Phytostabilization

Used for remediation of soil, sediment and sludges and depends on roots ability to limit contaminants movement in the soil. With this process the contaminants remain in the soil so is ineffective in completely riding the soil in a bioremediaion process

Phytoextraction

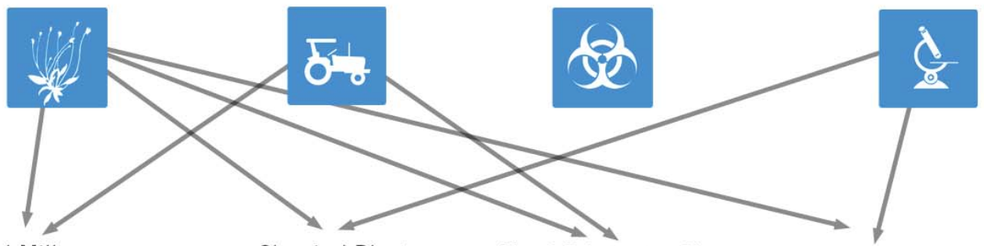
The best approach to remove the contamination primarily from the soil and isolate it without destroying the soil structure and fertility. Uses hyperaccumulator plant species to boost this current technology. Useful in removing a heavy metals* from the soil and produces large amount of biomass.

Phytovolatilization

This process utilizes plants transporting chemical compounds from the ground and releasing them into the atmosphere as volatile forms. Used primarily for mercury, but when removed it diluted by precipitation and redeposited into the ecosystem. Successful tests with tritium took approx. 12 years to be fully remediated.

Phytodegradation

Breaks down organics taken up by the plant to simpler molecules that are incorporated into the plant tissues. This is a much faster process than rhizodegradation. This process removes most fuels and solvents. Uses yeast, fungi, bacteria and other microrganisms to remove these components.



Steel Mill
Small Amounts of Metal Debris
Fuels: Petroleum

Coke Ovens
Phenols
Cyanide
Ammonia

Best approach - Phytoextraction

Chemical Plants

Best approach - Phytodegradation

Metal Fabrication Shops

Best approach - Phytoextraction

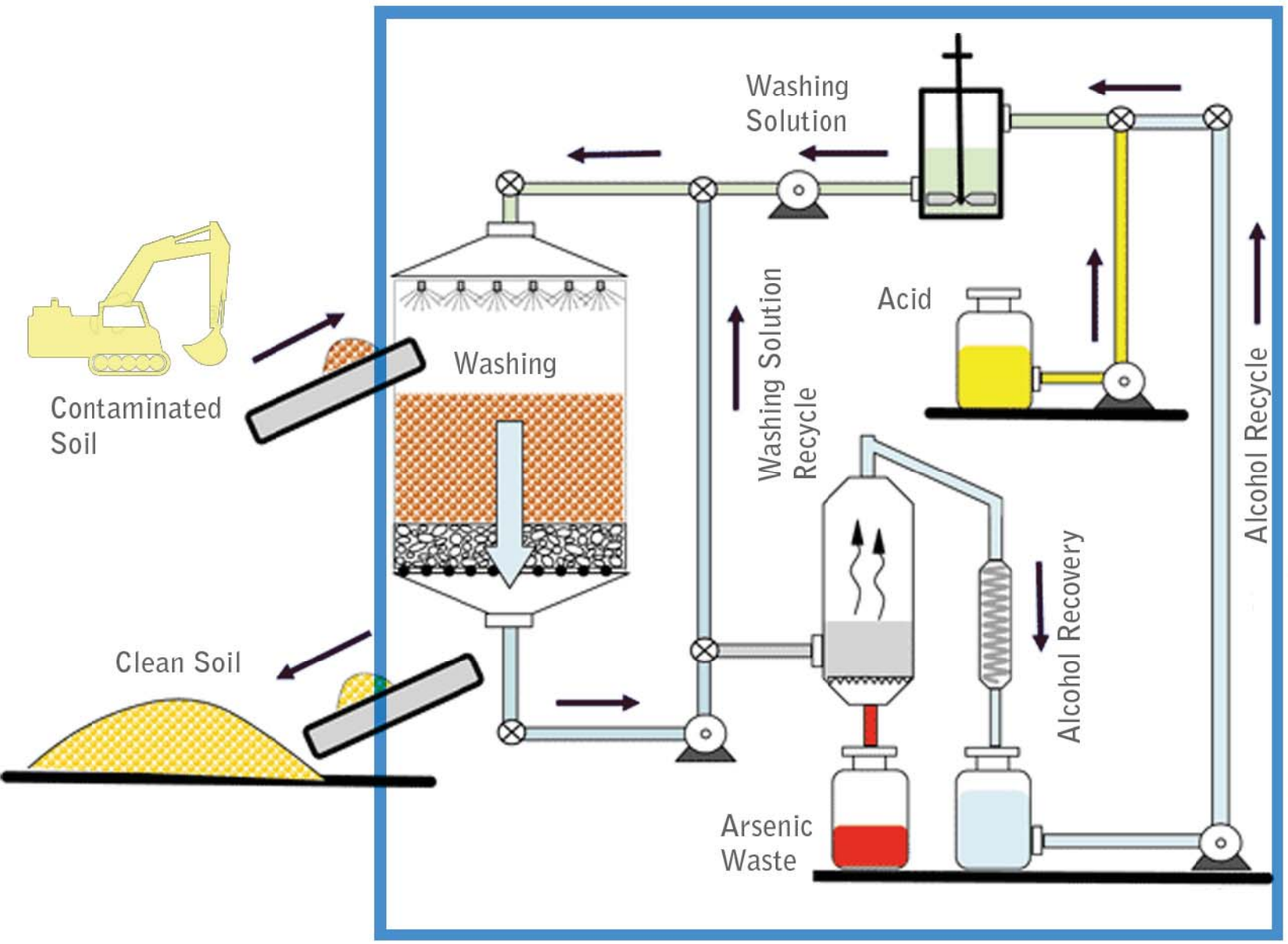
Oil Refineries
Sludges
Complex Hydrocarbons
Insoluble Salt and Sediments
Sodium Carbonate
Sodium Phenolate
Sodium Thioarsenate
Potassium Phospate
Mono or Diethenol Amines
Sulfides
Mercaptans
Napthenic
Acids
Phenols
Amines

Best approach - Phytodegradation

*Heavy Metals have atomic weight between 63.54 and 200.59

Site Methods

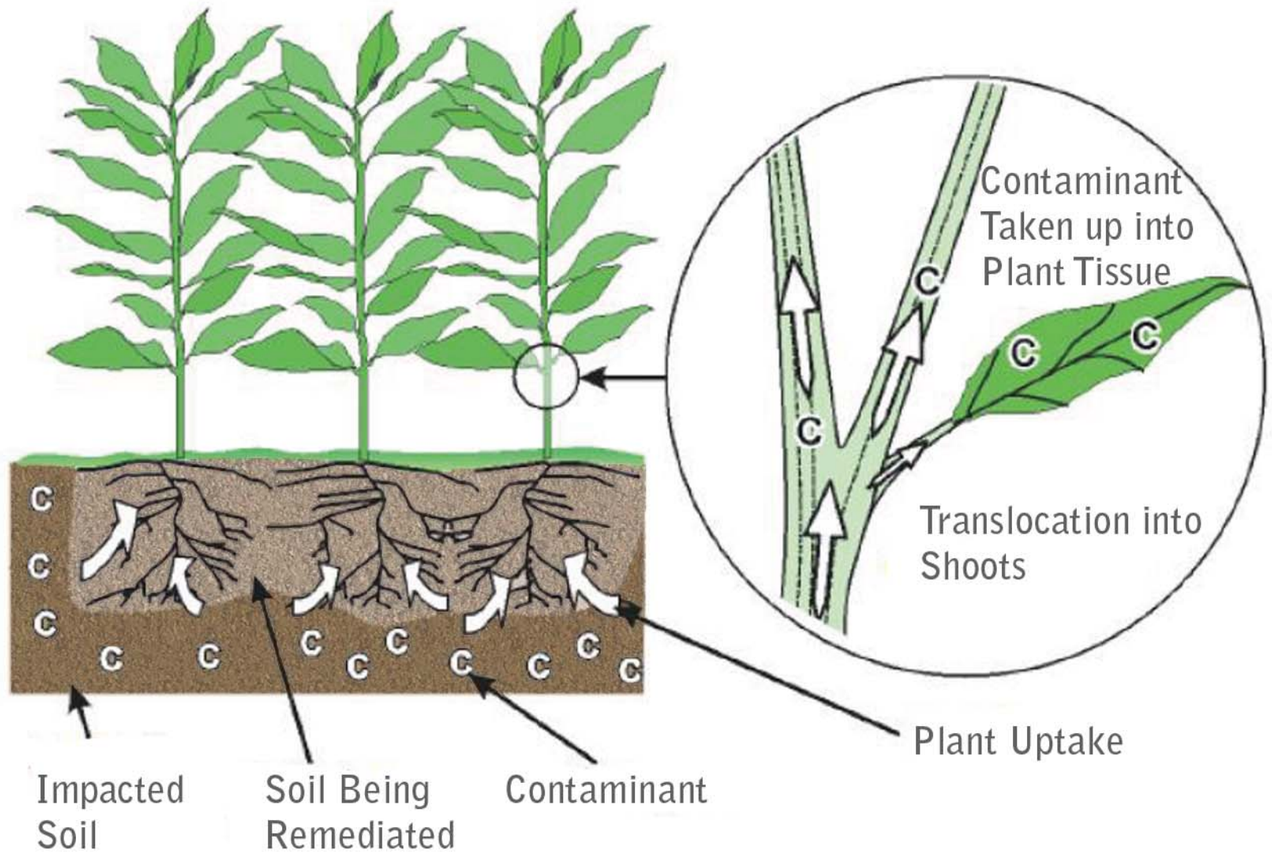
Off Site Conservation or Ex-situ



Byproducts of Dig and Replace

Costs_between $10-$1000 per cubic yard

On Site Conservation or In-situ



Costs_between $0.05 per cubic yard

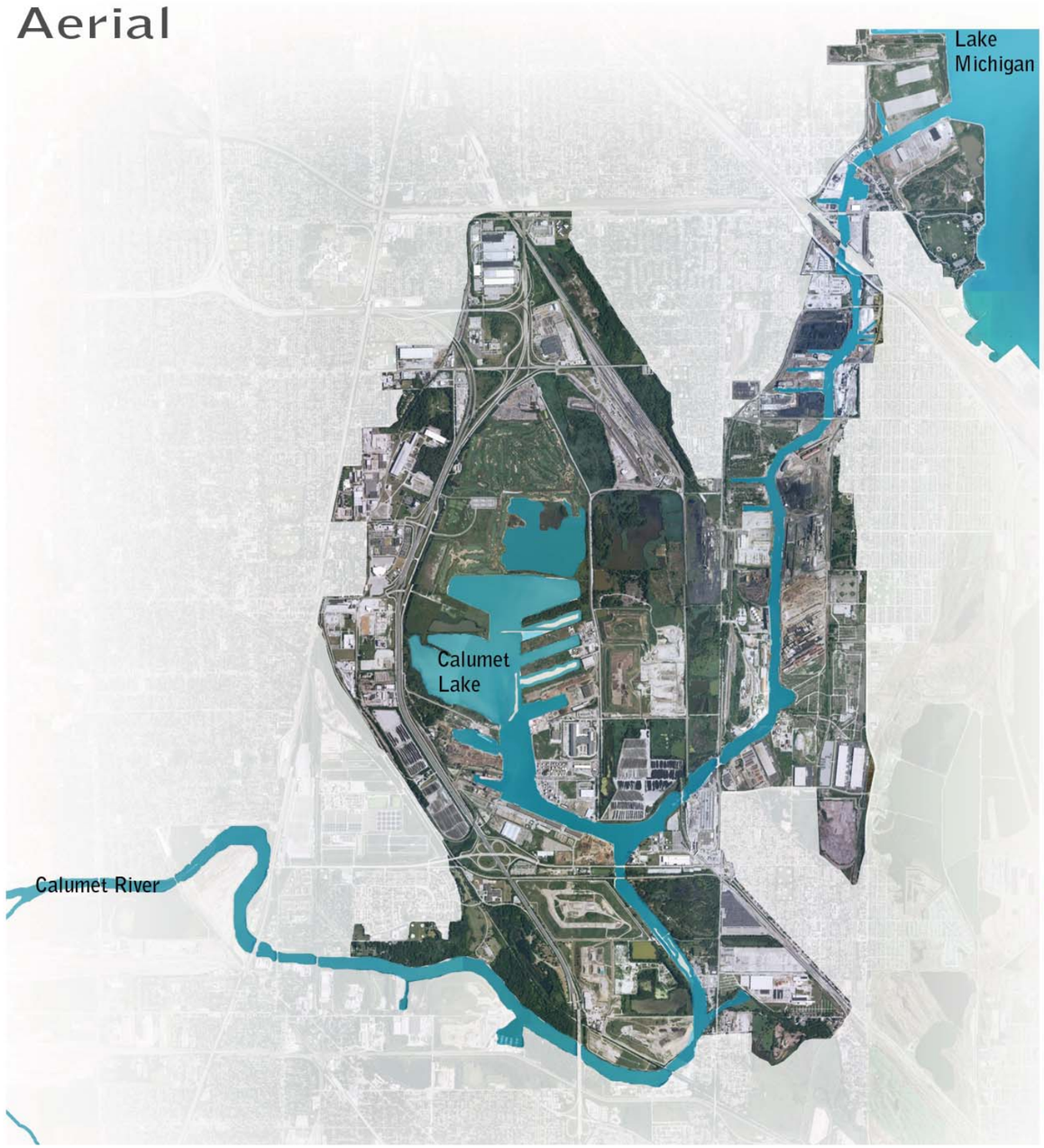
The Lake Calumet area has been devastated by the industrial market. Lake Calumet started as a normal lake formed by the receding glacier. Starting as a low level lake, it has been dredged, reformed, and reshaped by landfills, creating the skeletal remain of what was a natural ecosystem. The lake is a major part of the Des Plains River and on the macro scale the Mississippi River. To create better shipping opportunities the lake was reformed and grain elevators were added to improve the shipping environment. The Lake lies mostly barren, with few industries left. Many of the landfill sites are filled with slag creating a pollution problem for the area. Reminisces of the industrial sites still plague the area, with many industrial sites and hardscapes pointed out in the accompanying diagrams. The site contains few natural woodland areas and some planted woodland areas. The golf course located adjacent to the lake is not considered to be a woodland site, with all of the fertilizers, and polluted run off from golf course care.

08

Site Analysis

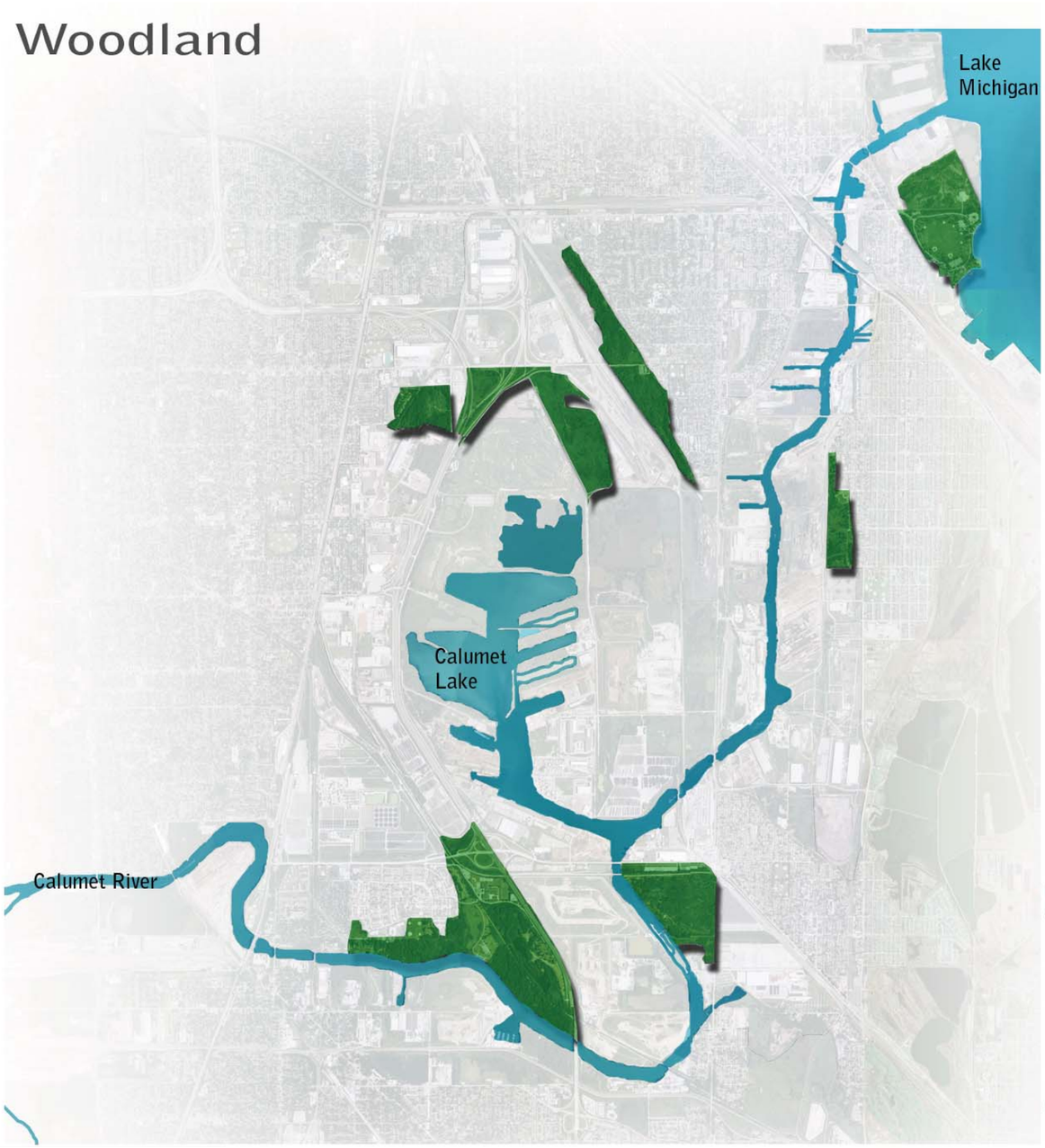
Aerial_Industrial

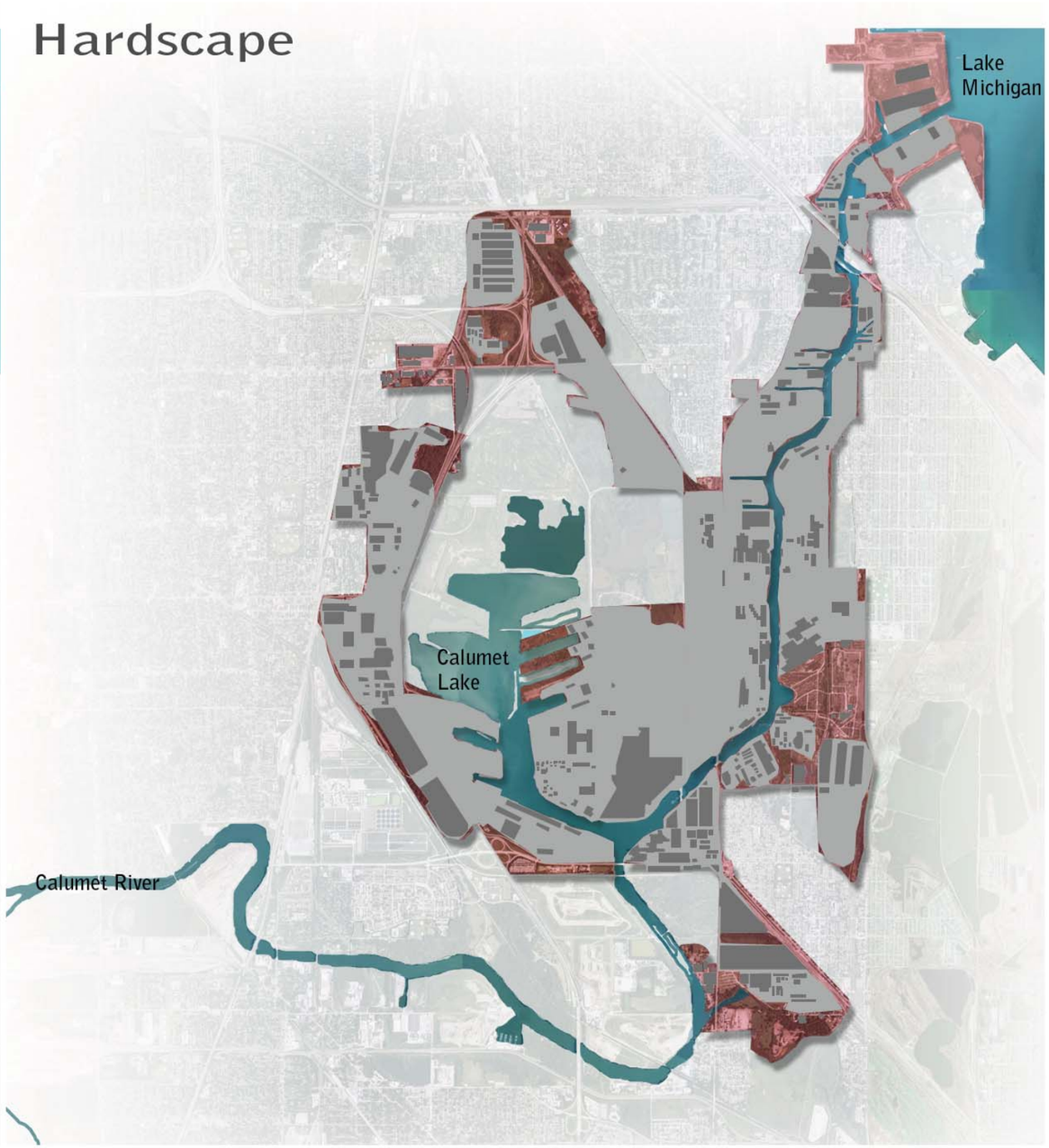
Aerial



Industrial

Woodland_Hardscape



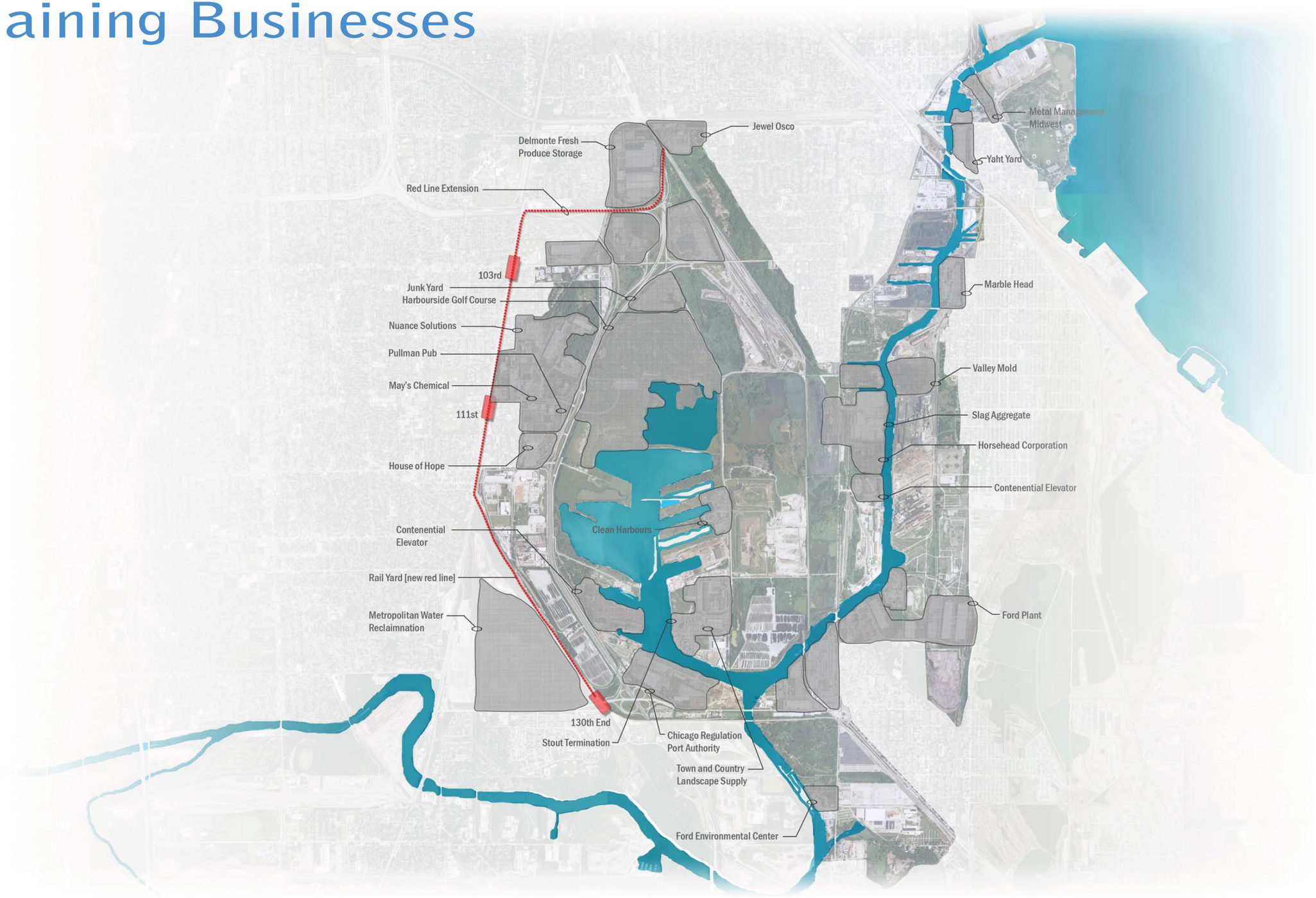


The master plan of the site has designated new parks and developments to work around the current industrial use of the area. Although much of the area has been destroyed by the manufacturing industry, with more stringent standards and the incorporation of natural systems to remediate the land, parks and the remaining businesses will be able to work together to clean the heavily polluted land. Since the land has been left vacant for many years the slower and more natural process of phytoremediation has been chosen to heal the landscape. After a period of 20 years the land will be fully recovered, and will be formed into an active park and research area for Chicago. As an important element in the master plan, the rehabilitation center will spur the green development and allow guests to the site to partake in its regeneration. With phytoremediation, the land, habitats, fauna, and useable acreage will all be reestablished.

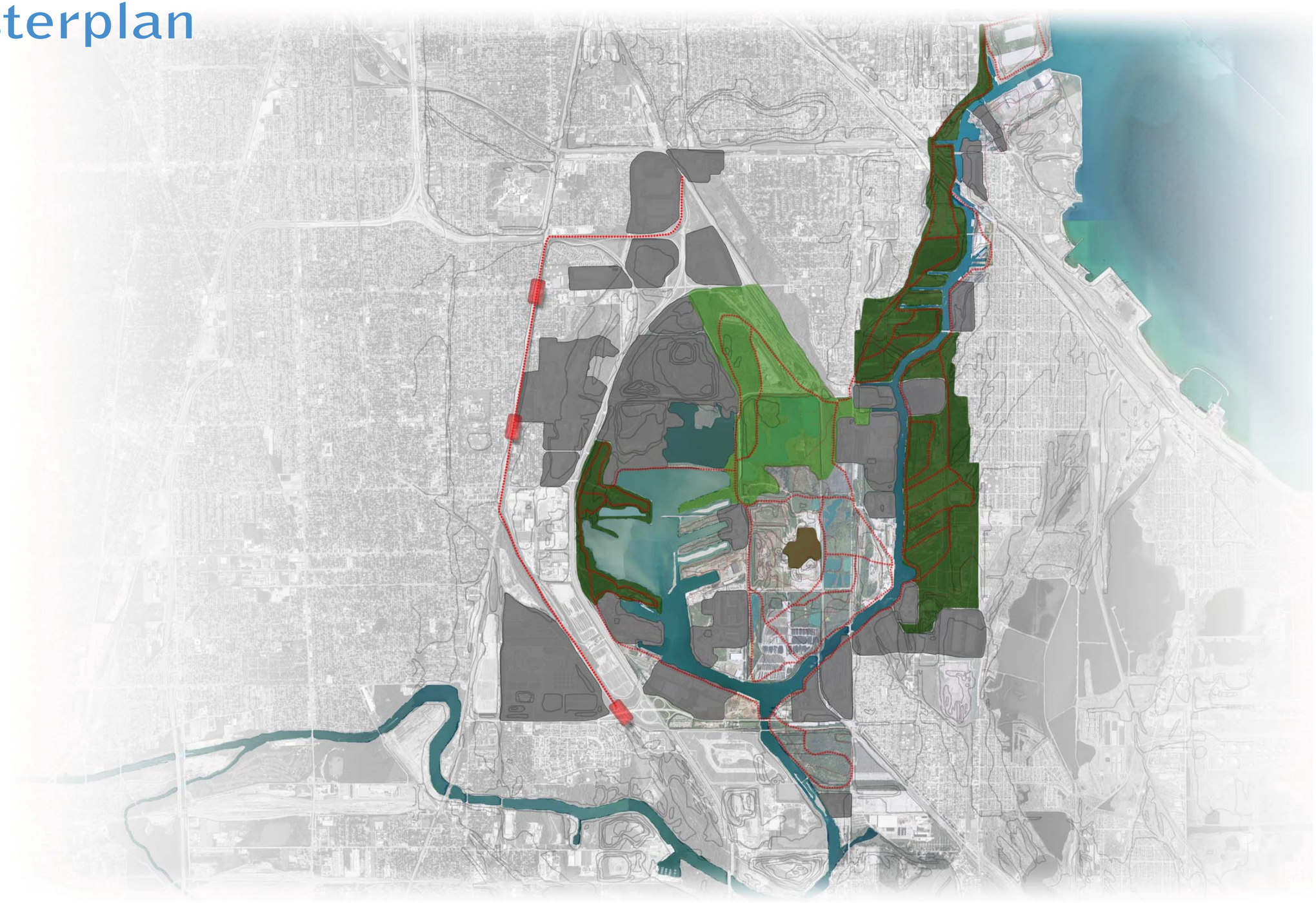
09

Master Plan

Remaining Businesses



Masterplan

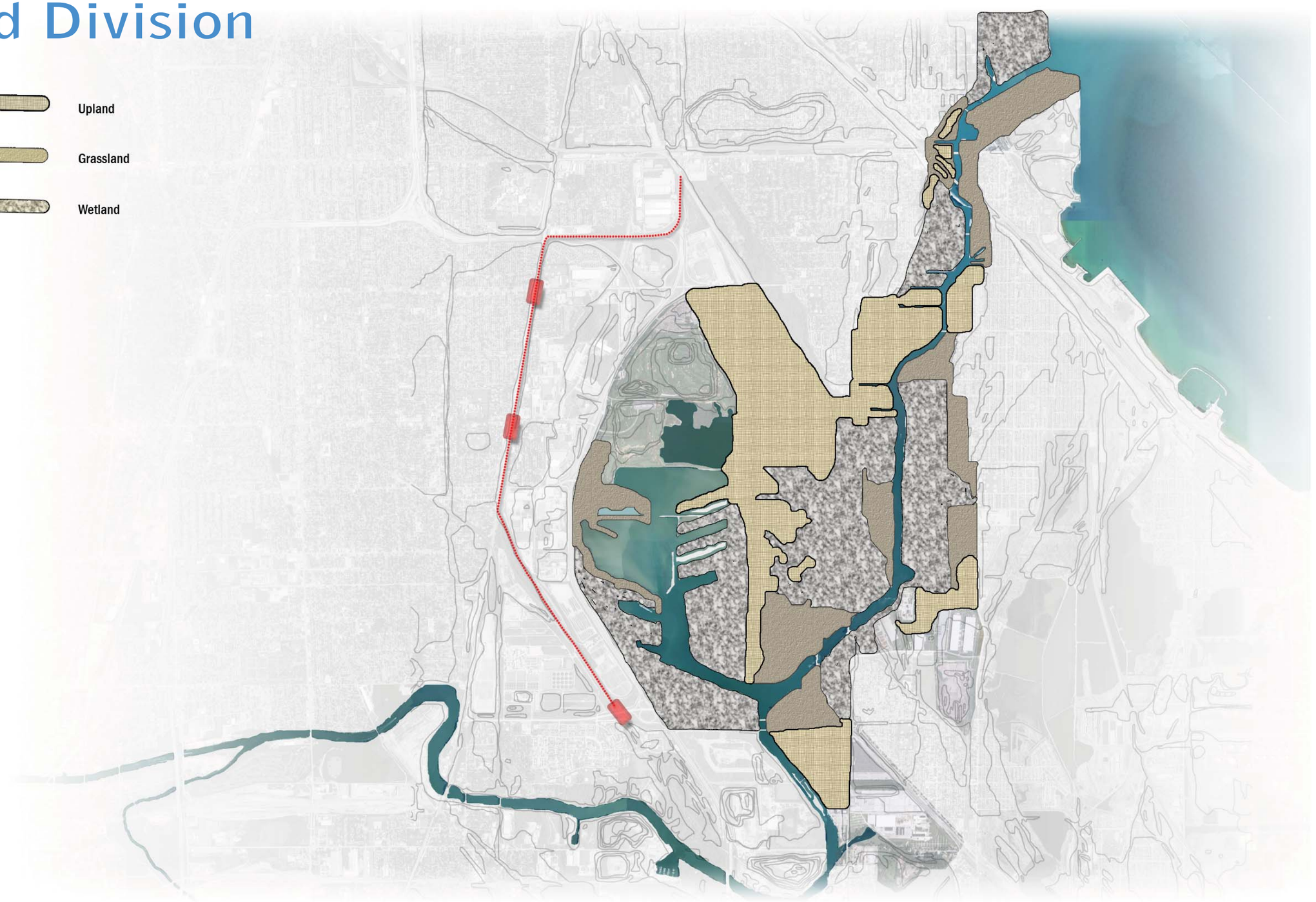


Land Division

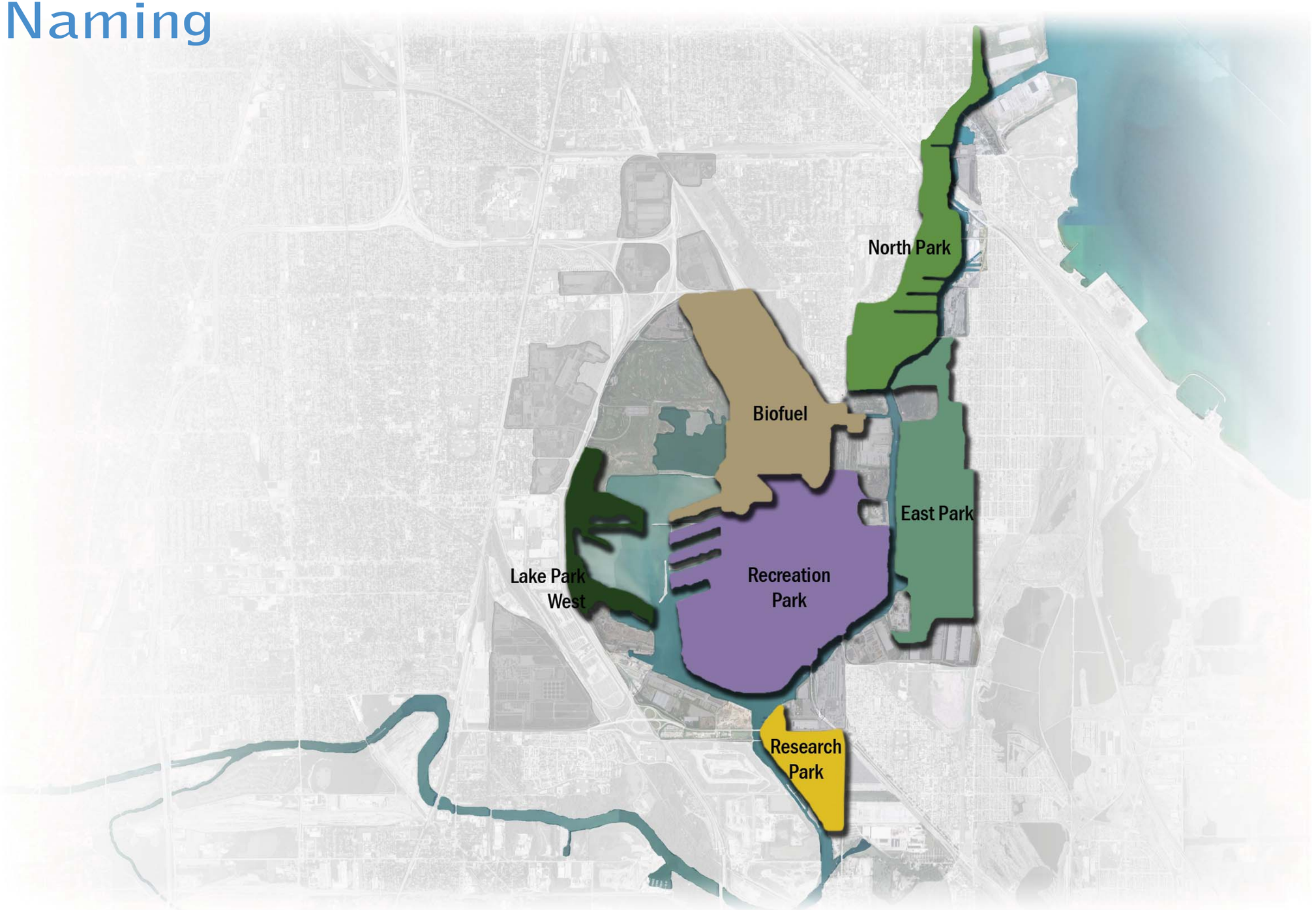
Upland

Grassland

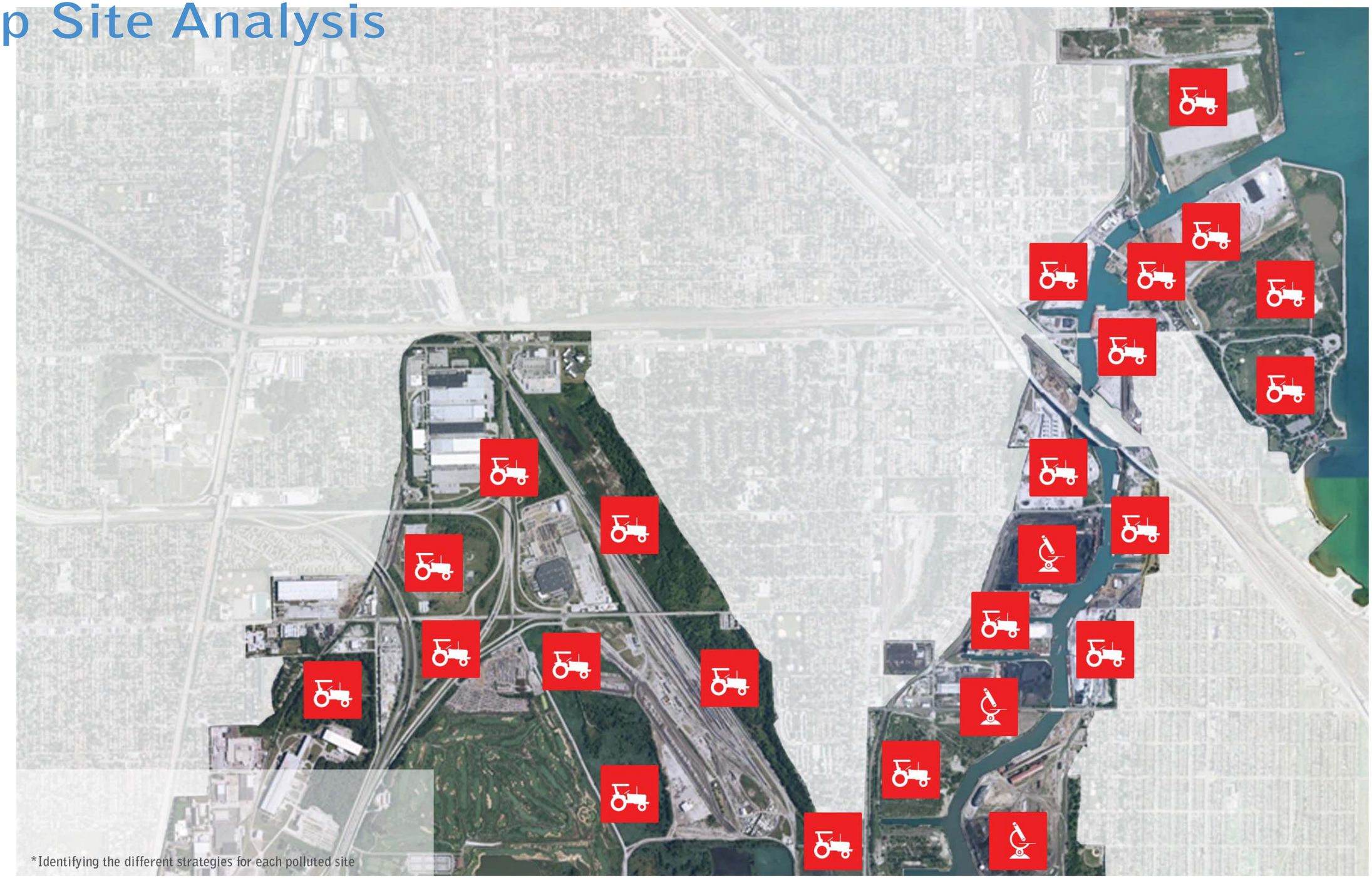
Wetland



Site Naming

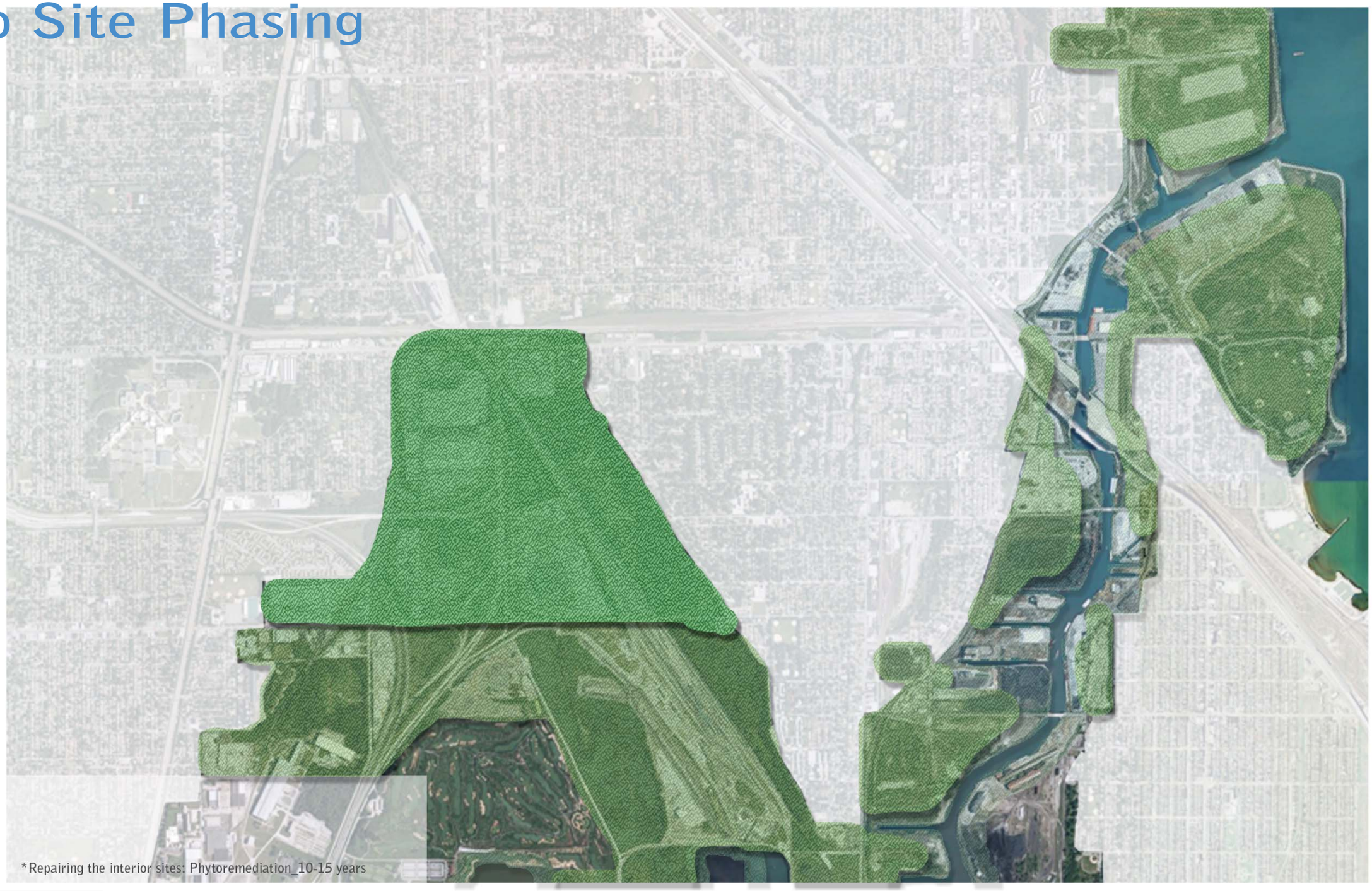

North Park
Biofuel
East Park
Lake Park
West
Recreation
Park
Research
Park

Top Site Analysis



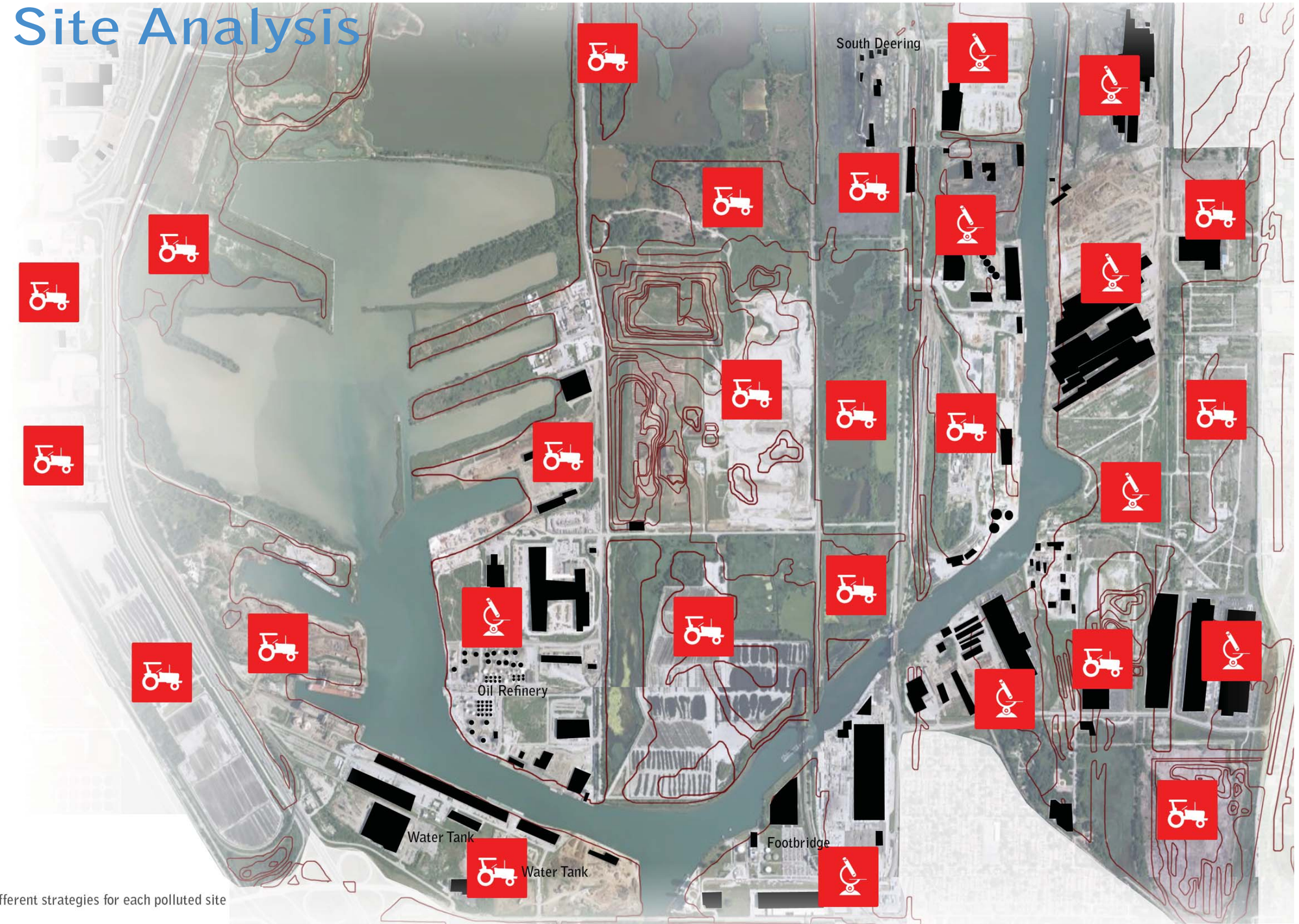
*Identifying the different strategies for each polluted site

Top Site Phasing



*Repairing the interior sites: Phytoremediation_10-15 years

Middle Site Analysis



*Identifying the different strategies for each polluted site

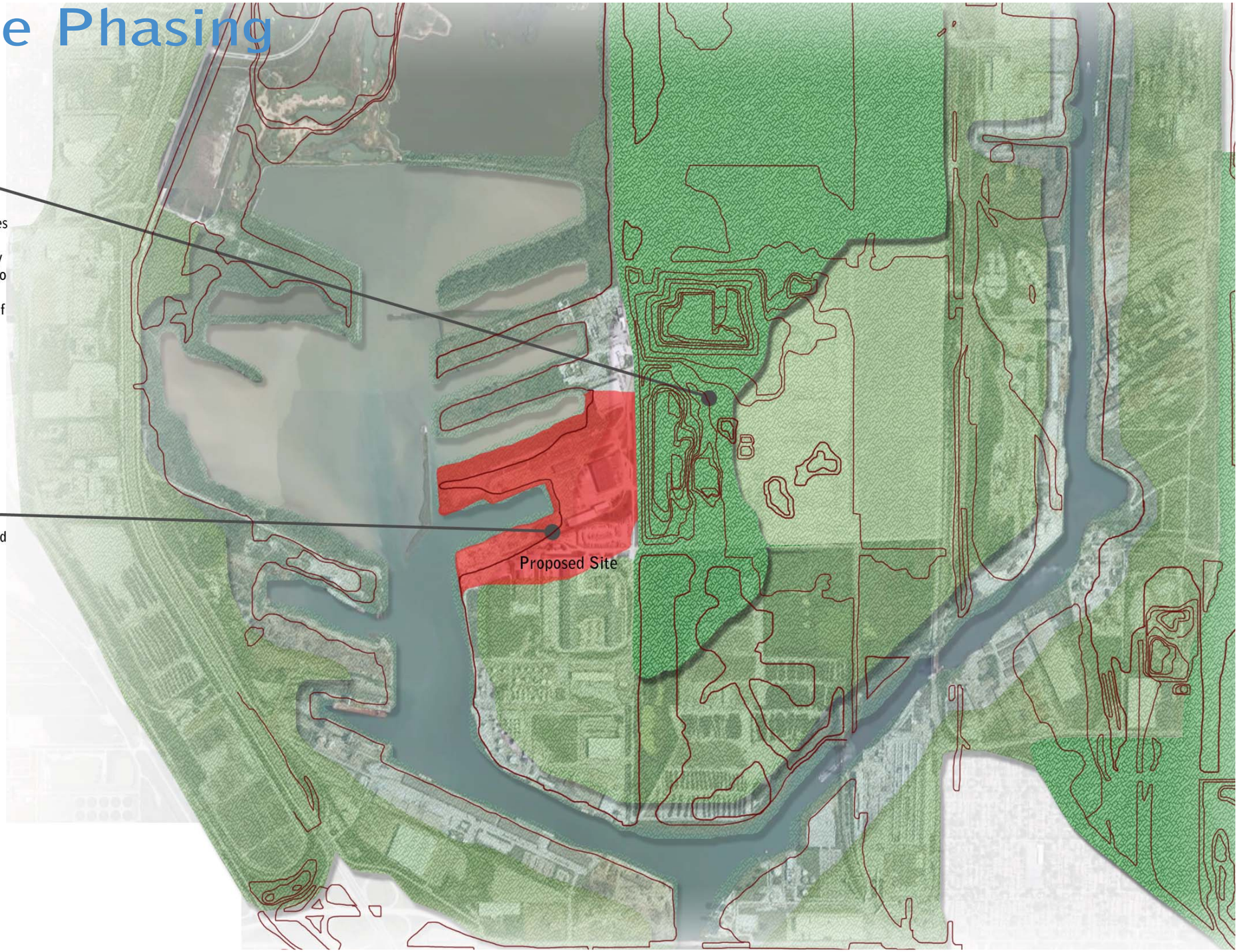
Middle Site Phasing

Interior Sites

The interior sites during the third phase of the project the interior sites will be rehabbed. These interior sites have been the least affected by the industrial companies that used to own the property. These interior sites will be used to tie the center of the project together.

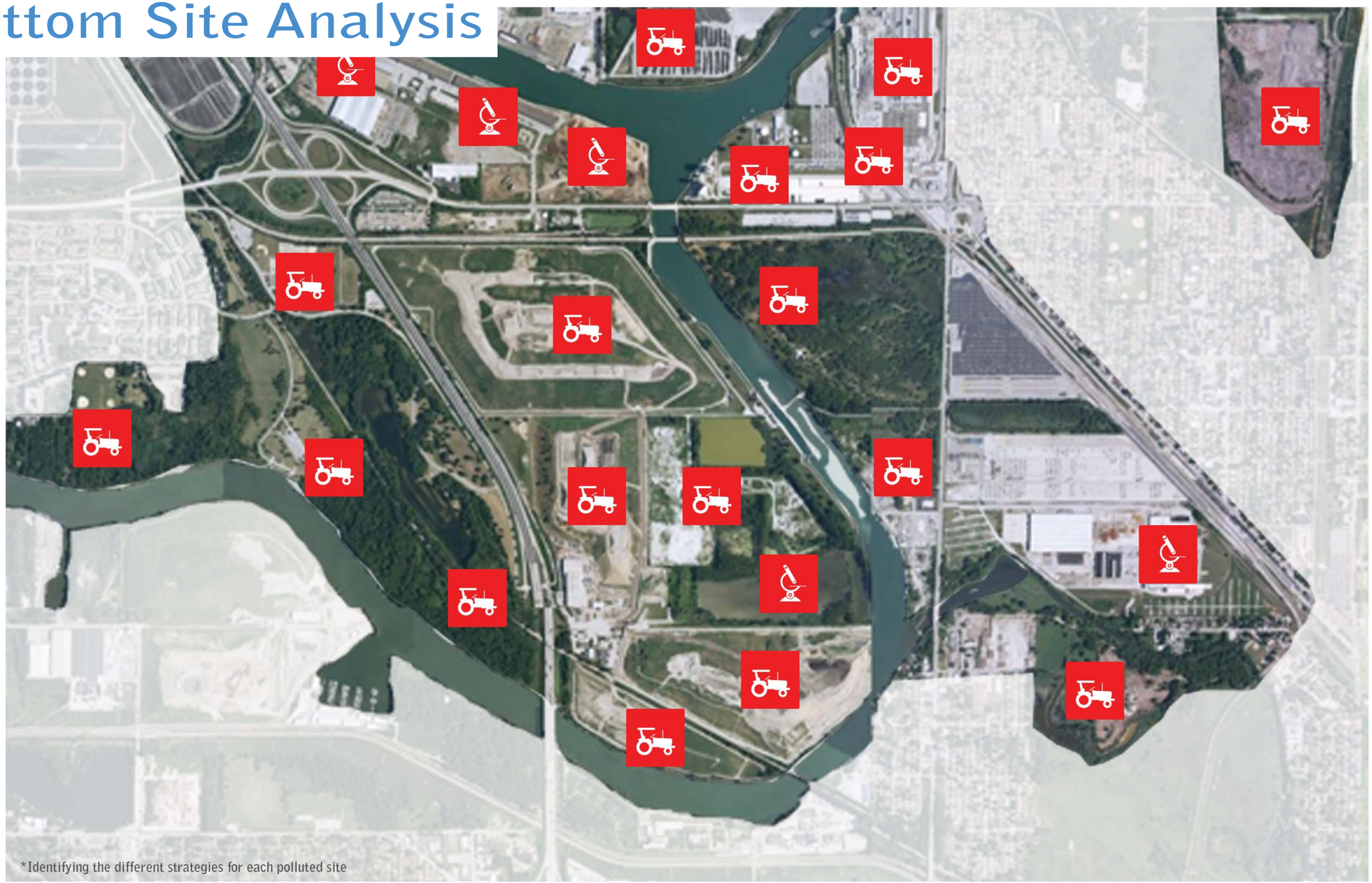
Selected Site

During this phase the building should be mostly complete. Using a series of strategies the architecture will blend between the human constructed ecology and the rehabilitated ecology of Lake Calumet. The building will use a series of constructed gardens, wetlands, and walkable paths to integrate the architecture.



*Phytoremediation_1-15 years

Bottom Site Analysis

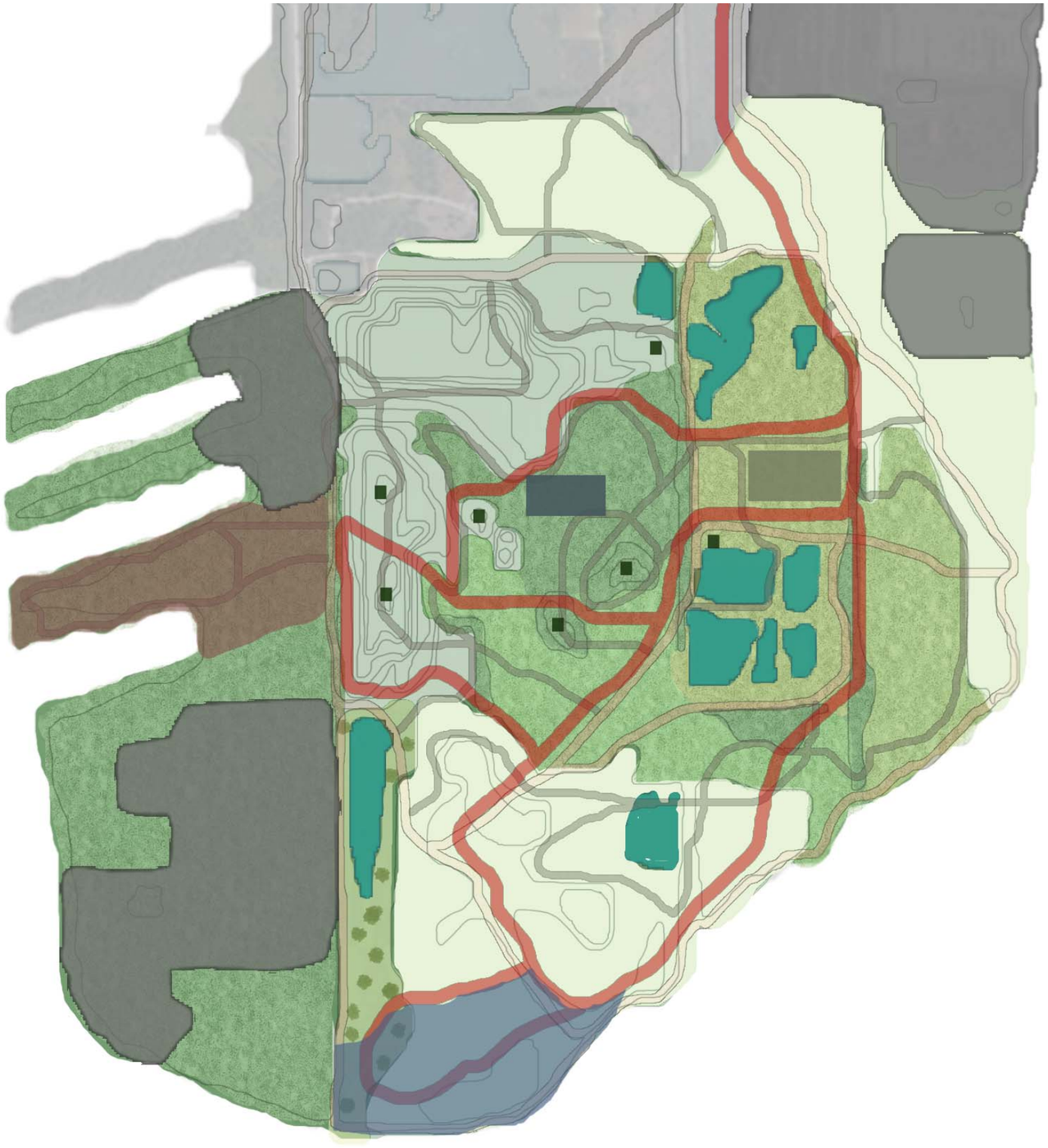


*Identifying the different strategies for each polluted site

Bottom Site Phasing

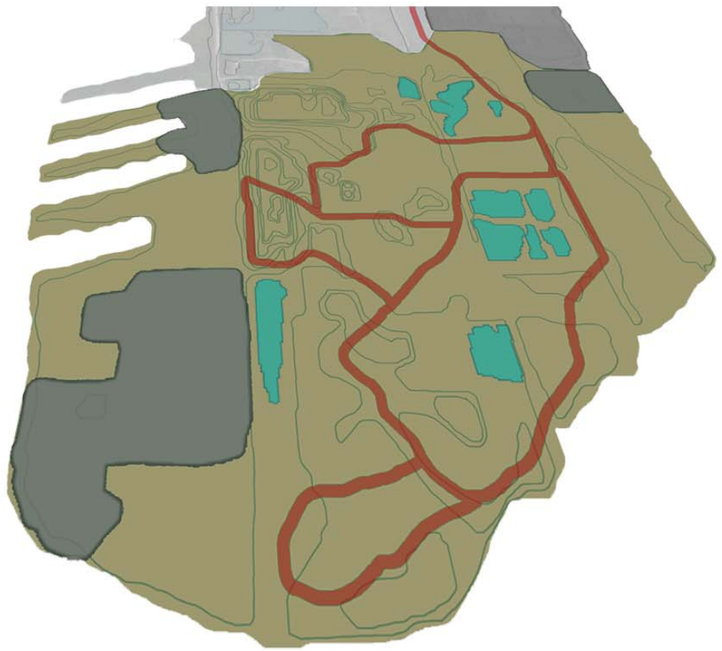
*Repairing the interior sites: Phytoremediation_10-15 years

- Woodland Forest
- Grassland
- Wetland
- Woodland Swamp
- Marsh
- Fen
- Bog
- Auto Path
- Primary Path
- Secondary Path
- Bird Tower
- Bird and Wildlife
- Rehab Center
- Recreation Center
- Boating Center
- Lake
- Topography
- Existing to Remain



Key Plan

Phase 1: Phytoremediation



1-5 Years of Development

Initially the site will be planted with prairie grass to help remove toxins from site. Prairie grass will be used to absorb pollutants then be harvested and used to fertilize the biofuel park. The automobile path will be constructed to allow access to the site. The new framework will incorporate the existing structures to remain.

Phase 2: Vegetation Establishment

5-10 Years of Development

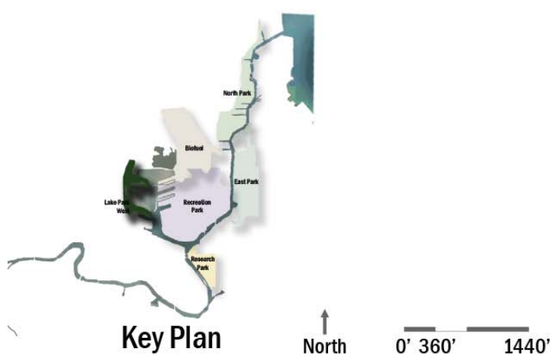
After cleansing the site, the permanent vegetation for the site will be planted. Expanding on the current topography, the site will be planted around 3 classifications: Wetlands, Grasslands, and Woodland Forest.

Phase 3: Architectural Development

10-20 Years of Development

Utilizing the topography the architecture will be developed to work with the land and plants. This portion of the master plan will include: bird and wildlife center, boating center, recreation center, and rehabilitation center. Each of the buildings will incorporate biophilia and work with the living machine.

- Woodland Forest
- Grassland
- Wetland
  - Woodland Swamp
  - Marsh
  - Fen
  - Bog
- Auto Path
- Primary Path
- Secondary Path
- Park Facility
- Topography
- Existing to Remain

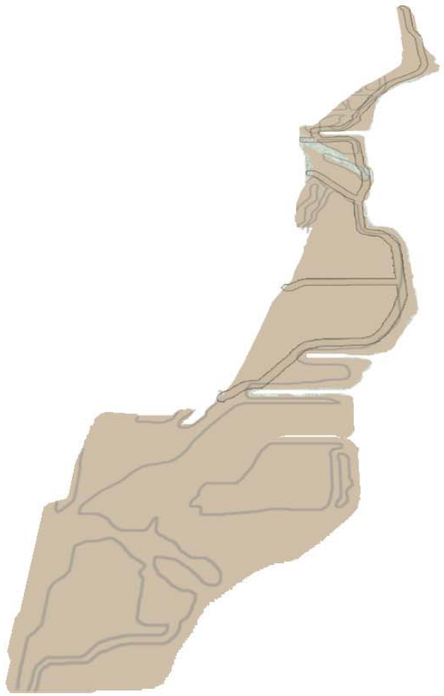


Key Plan

North

0’ 360’ 1440’

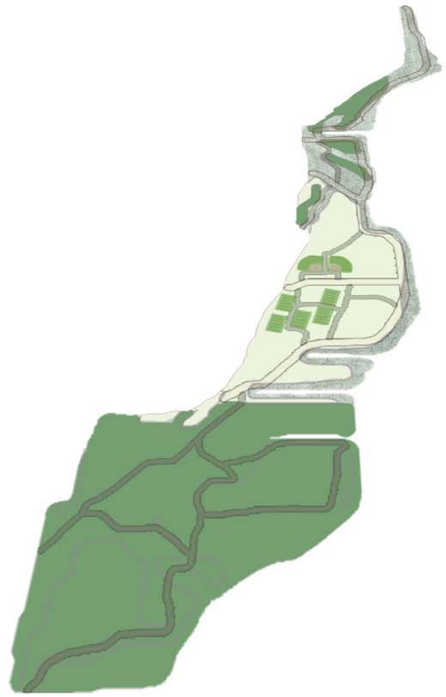
Phase 1: Phytoremediation



1-5 Years of Development

Initially the site will be planted with prairie grass to help remove toxins from site. Prairie grass will be used to absorb pollutants then be harvested and used to fertilize the biofuel park.

Phase 2: Vegetation Establishment



5-10 Years of Development

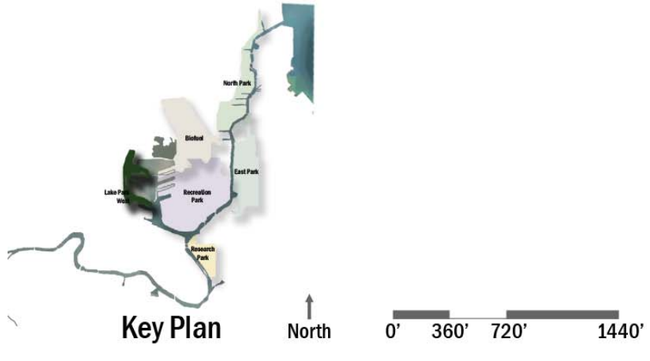
After cleansing the site, the permanent vegetation for the site will be planted. Expanding on the current topography, the site will be planted around 3 classifications: Wetlands, Grasslands, and Woodland Forest. This is the primary stage for this park, being left mostly natural preserve allows phytoremediation to occur with the run off from the adjacent neighborhoods.

Phase 3: Park Development

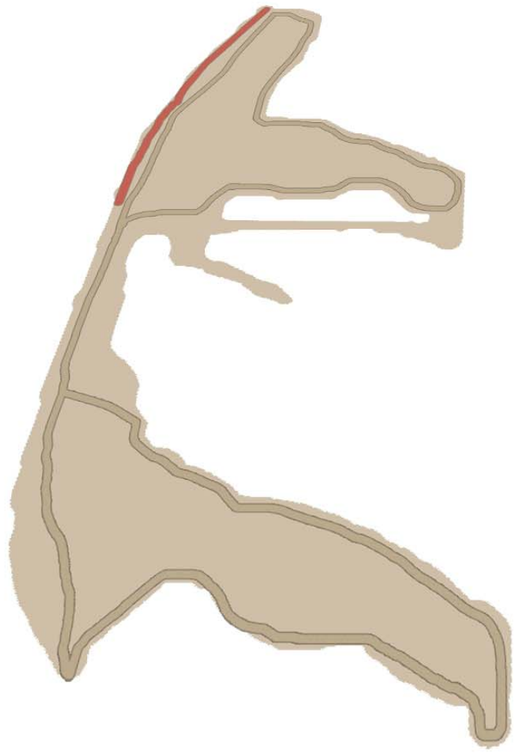
10-20 Years of Development

Utilizing the topography the architecture will be developed to work with the land and plants. This portion of the master plan will include: natural and constructed parks. The park facility allows for on site storage and management. The park has been developed around the current topography and using the middle elevation to house all of the constructed portions of the park.

Woodland Forest
Grassland
Wetland
Woodland Swamp
Marsh
Fen
Bog
Auto Path
Primary Path
Secondary Path
Park Facility
Topography
Existing to Remain



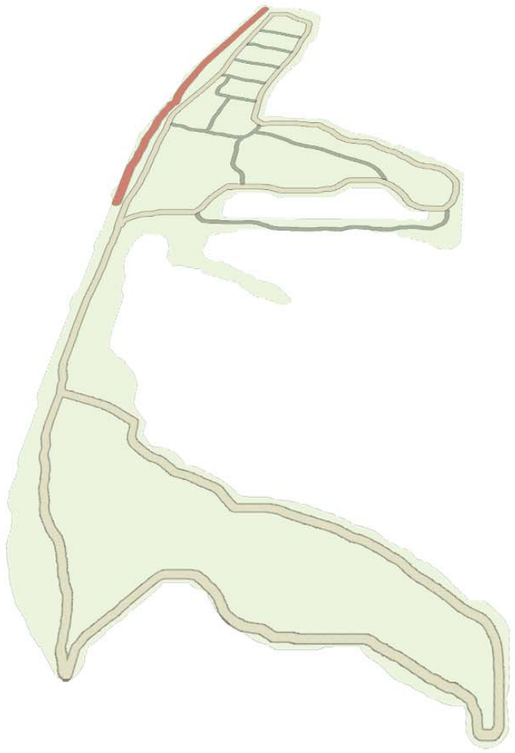
Phase 1: Phytoremediation



1-5 Years of Development

Initially the site will be planted with prairie grass to help remove toxins from site. Prairie grass will be used to absorb pollutants then be harvested and used to fertilize the biofuel park. The automobile path will be constructed to allow access to the site.

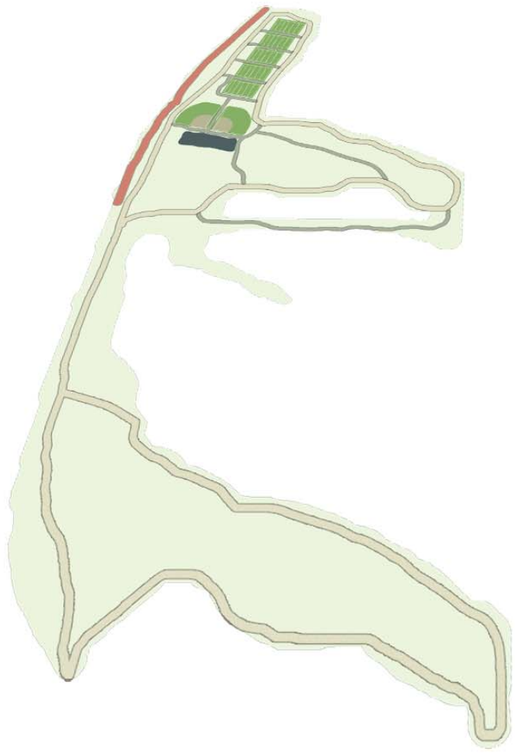
Phase 2: Vegetation Establishment



5-10 Years of Development

After cleansing the site, the permanent vegetation for the site will be planted. Expanding on the current topography, the site will be planted with prairie grass in the designated natrual areas and the recreation parts of the park will be planted with grass.

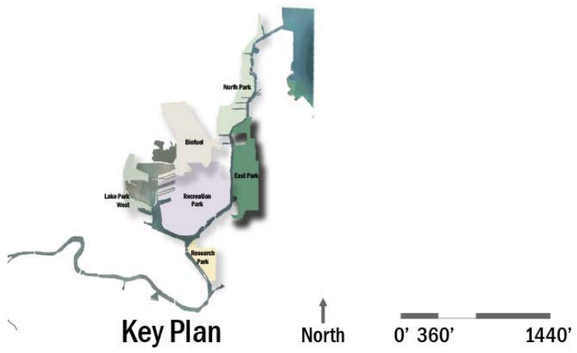
Phase 3: Park Development



10-20 Years of Development

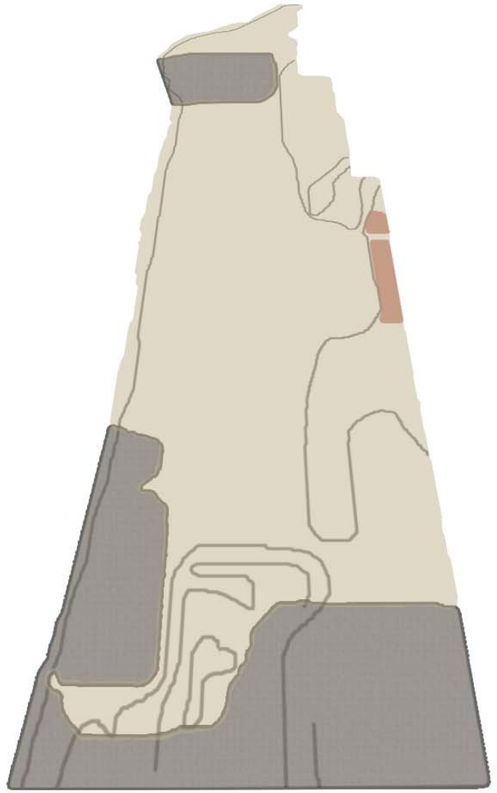
Utilizing the topography the architecture will be developed to work with the land and plants. This portion of the master plan will include: recreations parks and natural parkland. The paths will be expanded on over time allowing for growth of the park. During this phase of the park the park faciltity will be constructed to allow for on site management and storage.

- Woodland Forest
- Grassland
- Wetland
  - Woodland Swamp
  - Marsh
  - Fen
  - Bog
- Auto Path
- Primary Path
- Secondary Path
- Park Facility
- Topography
- Existing to Remain



Key Plan North 0’ 360’ 1440’

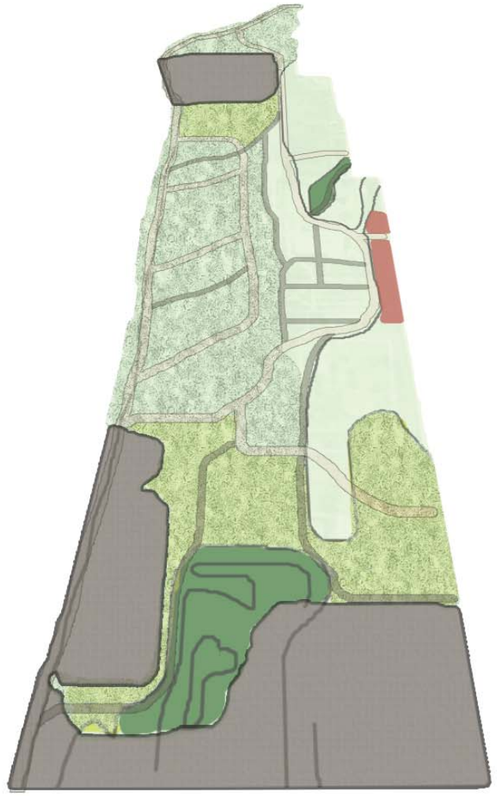
Phase 1: Phytoremediation



1-5 Years of Development

Initially the site will be planted with prairie grass to help remove toxins from site. Prairie grass will be used to absorb pollutants then be harvested and used to fertilize the biofuel park.

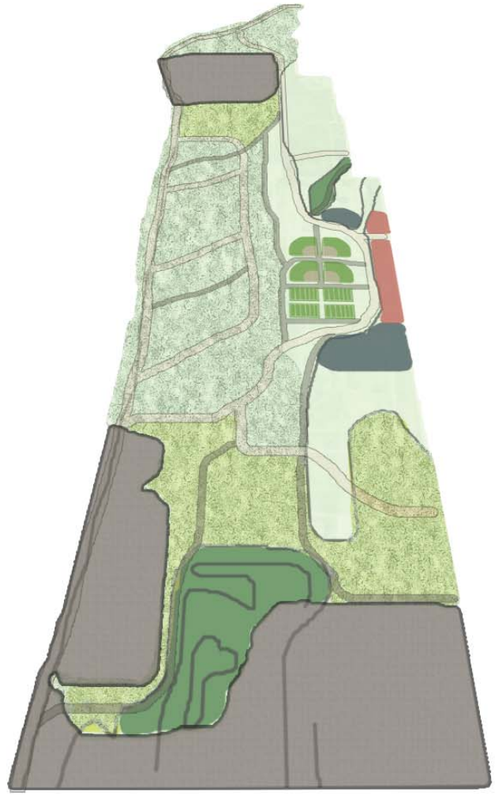
Phase 2: Vegetation Establishment



5-10 Years of Development

After cleansing the site, the permanent vegetation for the site will be planted. Expanding on the current topography, the site will be planted around 3 classifications: Wetlands, Grasslands, and Woodland Forest. This is the primary stage for this park, being left mostly natural preserve allows phytoremediation to occur with the run off from the adjacent neighborhoods. Constructed wetlands will be created to treat runoff and waste from the existing to remain.

Phase 3: Park Development



10-20 Years of Development

Utilizing the topography the architecture will be developed to work with the land and plants. This portion of the master plan will include: natural and constructed parks. The park facility allows for on site storage and management. Using the elevation of the land to determine it's use, this park will remain a preserve that will allow for outdoor activities including fishing and camping.

Woodland Forest

Grassland

Wetland

Woodland Swamp

Marsh

Fen

Bog

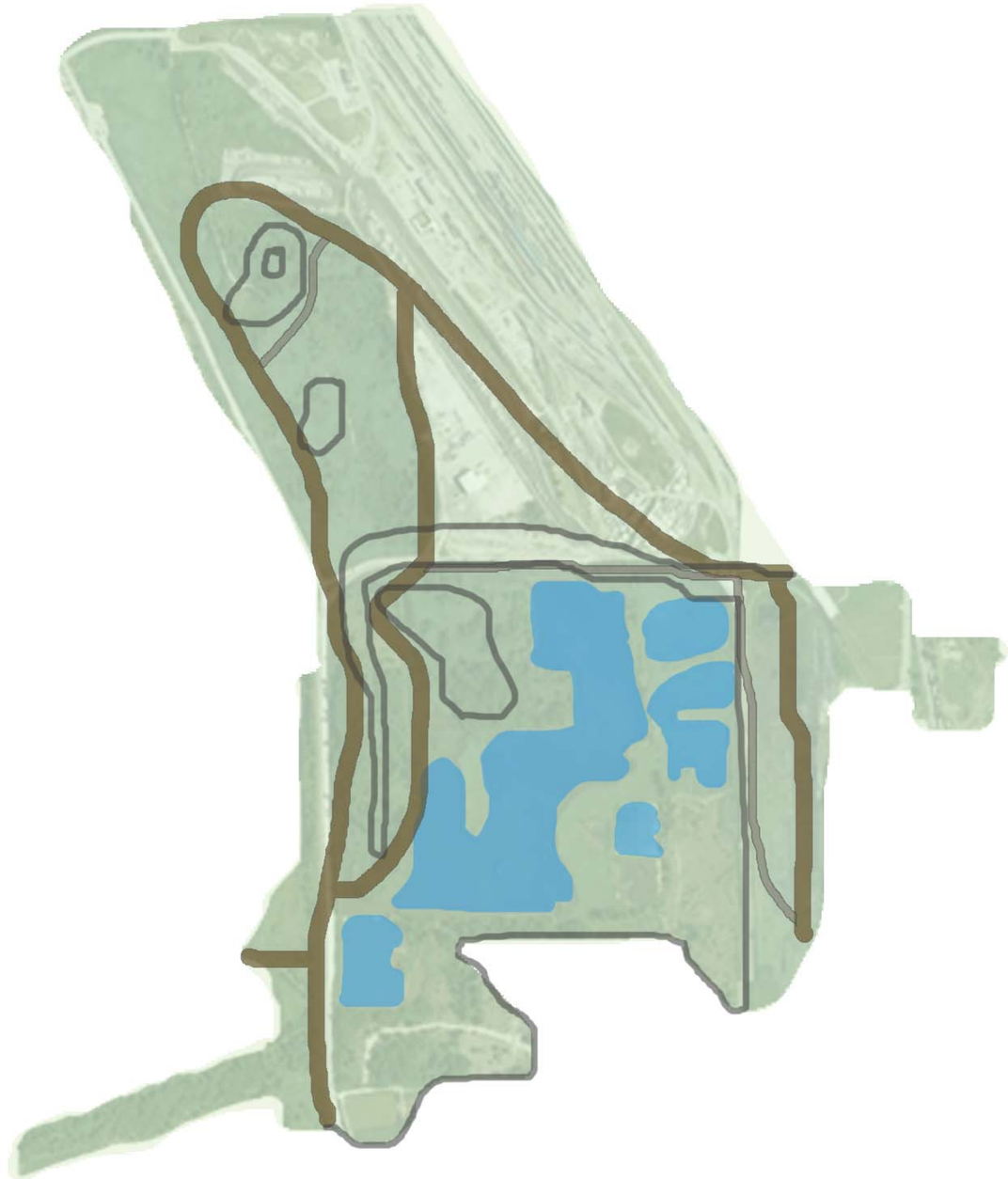
Auto Path

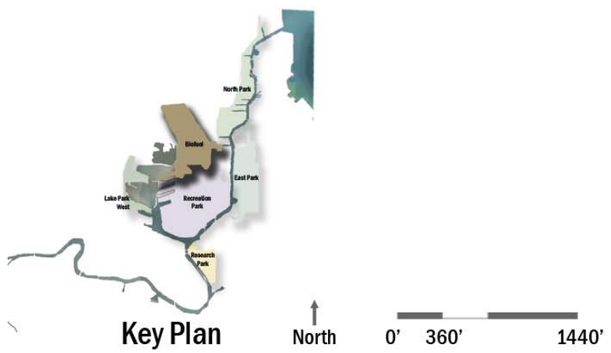
Primary Path

Secondary Path

Topography

Existing to Remain





Key Plan

North

0’ 360’ 1440’

Phase 1: Phytoremediation

1-5 Years of Development

Initially the site will be planted with prairie grass to help remove toxins from site. Prairie grass will be used to absorb pollutants then be redistributed along with other collected grasses to create fertilizer and compost piles.

Phase 2: Vegetation Establishment

5-10 Years of Development

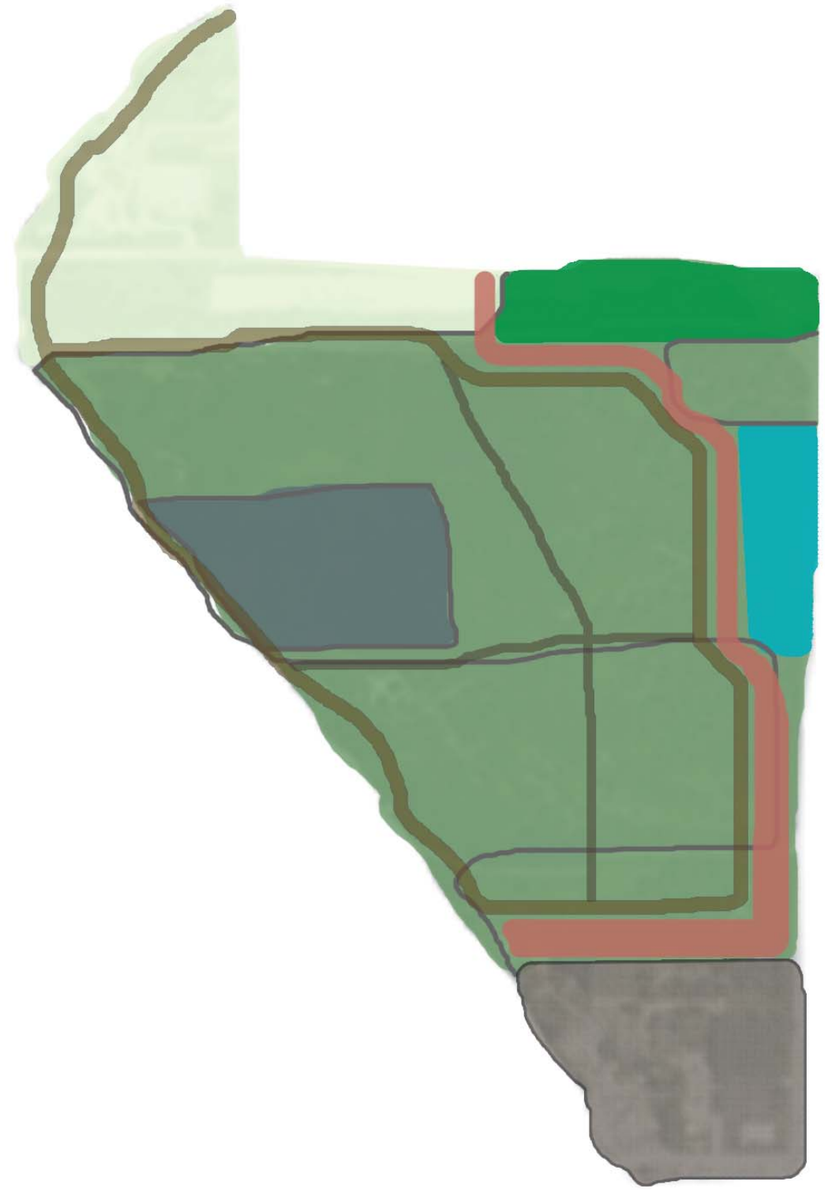
After cleansing the site, the permanent vegetation for the site will be planted. This site will mainly use prairie grass. Not only will the prairie grass be used to remediate the land, the runoff from adjacent developments will be treated before entering Calumet Lake. During this stage the paths will be construed but will only serve as circulation, with no personal activity taking place in this area.

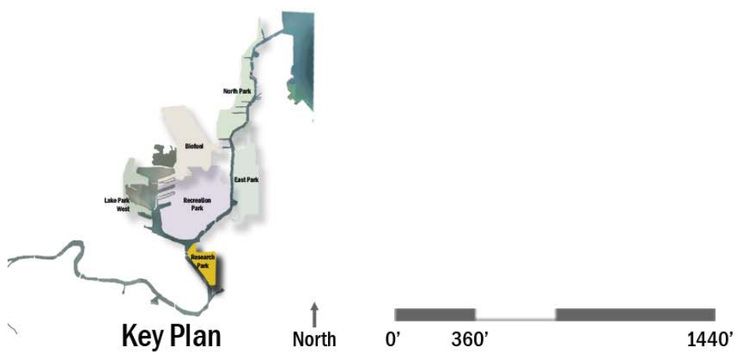
Phase 3: Biofuel Harvest

10-20 Years of Development

During this phase the grass and soil be stabilized enough to start harvesting and allow for the development of the harvesting patterns to begin. The biofuel area will serve many buildings of the new master plan.

- Woodland Forest
- Grassland
- Wetland
  - Woodland Swamp
  - Marsh
  - Fen
  - Bog
- Auto Path
- Primary Path
- Secondary Path
- Birding Center
- Reseach
- Green Construction
- Topography
- Existing to Remain





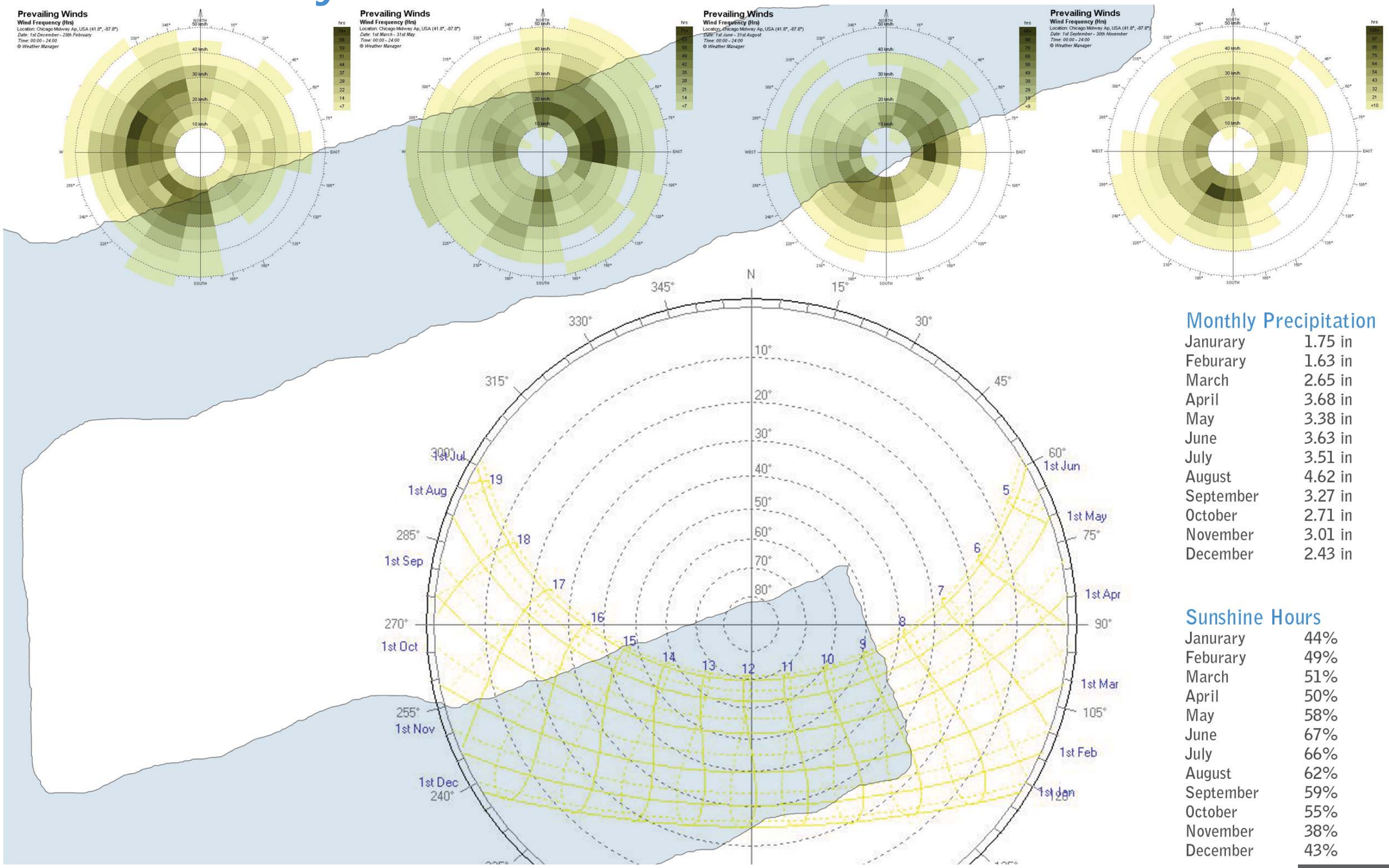
Key Plan North 0’ 360’ 1440’

10

Focused Site

The accompanying diagrams show the correlation between the site and its economics. The architecture will be developed into a series of buildings that will be integrated into the ecology of the site. These new low level buildings will be spread out to utilize the different aspects of biophilia. The distance diagram uses 1320' (the amount of feet walked by the average person in 5 minutes) to show the amount of time required to walk across the site. Using the existing building as the center, with a direct path the site will be accessible in as little as 15 minutes by walking. The shuttle diagram shows how the site will be connected by the electric powered shuttle. The path diagram shows where the new path will run and how it will be related to the site.

Weather Analysis



Monthly Precipitation

Janurary	1.75 in
Feburary	1.63 in
March	2.65 in
April	3.68 in
May	3.38 in
June	3.63 in
July	3.51 in
August	4.62 in
September	3.27 in
October	2.71 in
November	3.01 in
December	2.43 in

Sunshine Hours

Janurary	44%
Feburary	49%
March	51%
April	50%
May	58%
June	67%
July	66%
August	62%
September	59%
October	55%
November	38%
December	43%

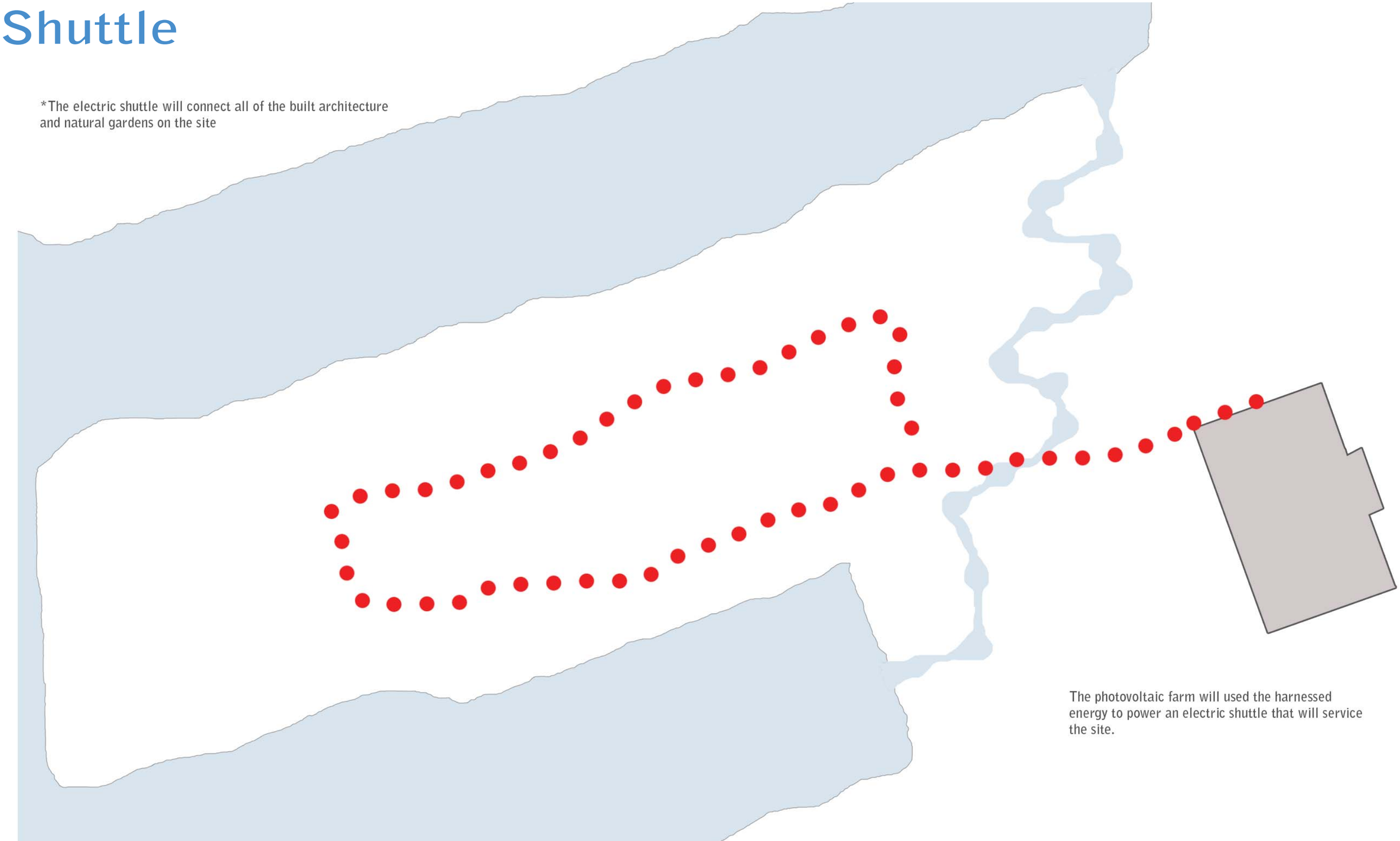
Distances

*The average person can walk 1320′ in 5 minutes

The existing building will be converted into a parking garage with a photovoltaic farm on the roof. The PV panels will power electric golf carts that will be used as shuttles and transportation throughout the site.

Shuttle

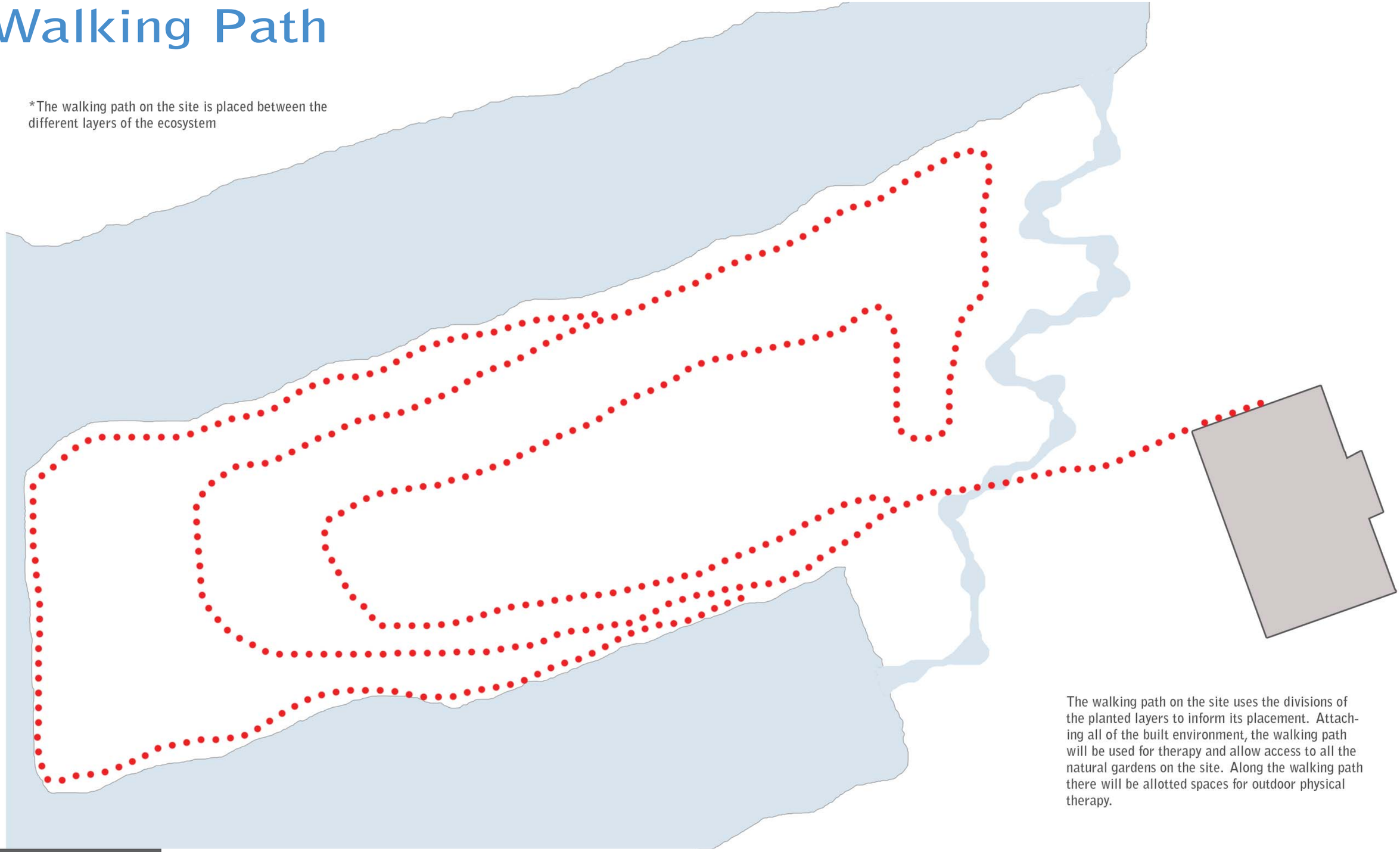
*The electric shuttle will connect all of the built architecture and natural gardens on the site



The photovoltaic farm will used the harnessed energy to power an electric shuttle that will service the site.

Walking Path

*The walking path on the site is placed between the different layers of the ecosystem



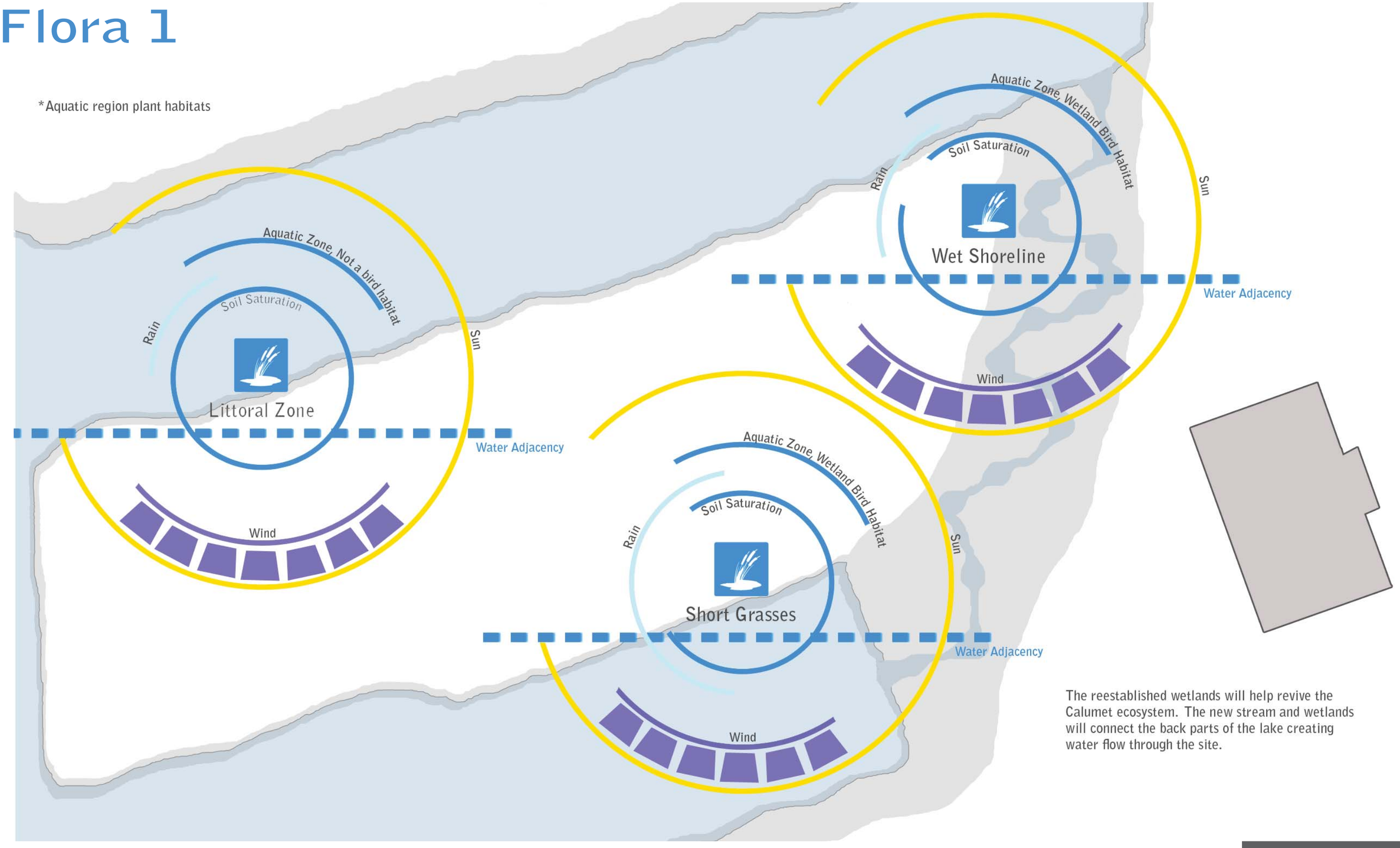
The walking path on the site uses the divisions of the planted layers to inform its placement. Attaching all of the built environment, the walking path will be used for therapy and allow access to all the natural gardens on the site. Along the walking path there will be allotted spaces for outdoor physical therapy.

The prescribed users of the site include the flora, fauna, and people. The flora of the area is described in 8 similar diagrams. The diagram compiles all of the seasonal information: amount of sun per day, tolerance of wind, adjacency to water, amount of rain needed, type of zone and bird habitat, and the amount of soil saturation. The habitat diagrams show the need for adjacency to water, the zones in which they habitat, and if they are a migrating species. The people diagrams show the compilation of walk able distances, types of paths, size of buildings, biophilia integration, days of activity a year, and what types of ecology are favorable for viewing. The users of the site are arranged to create a pinch point and direct views across the site. These diagrams were used to help arrange the site and design for its inhabitants.

Prescribed Users

Flora 1

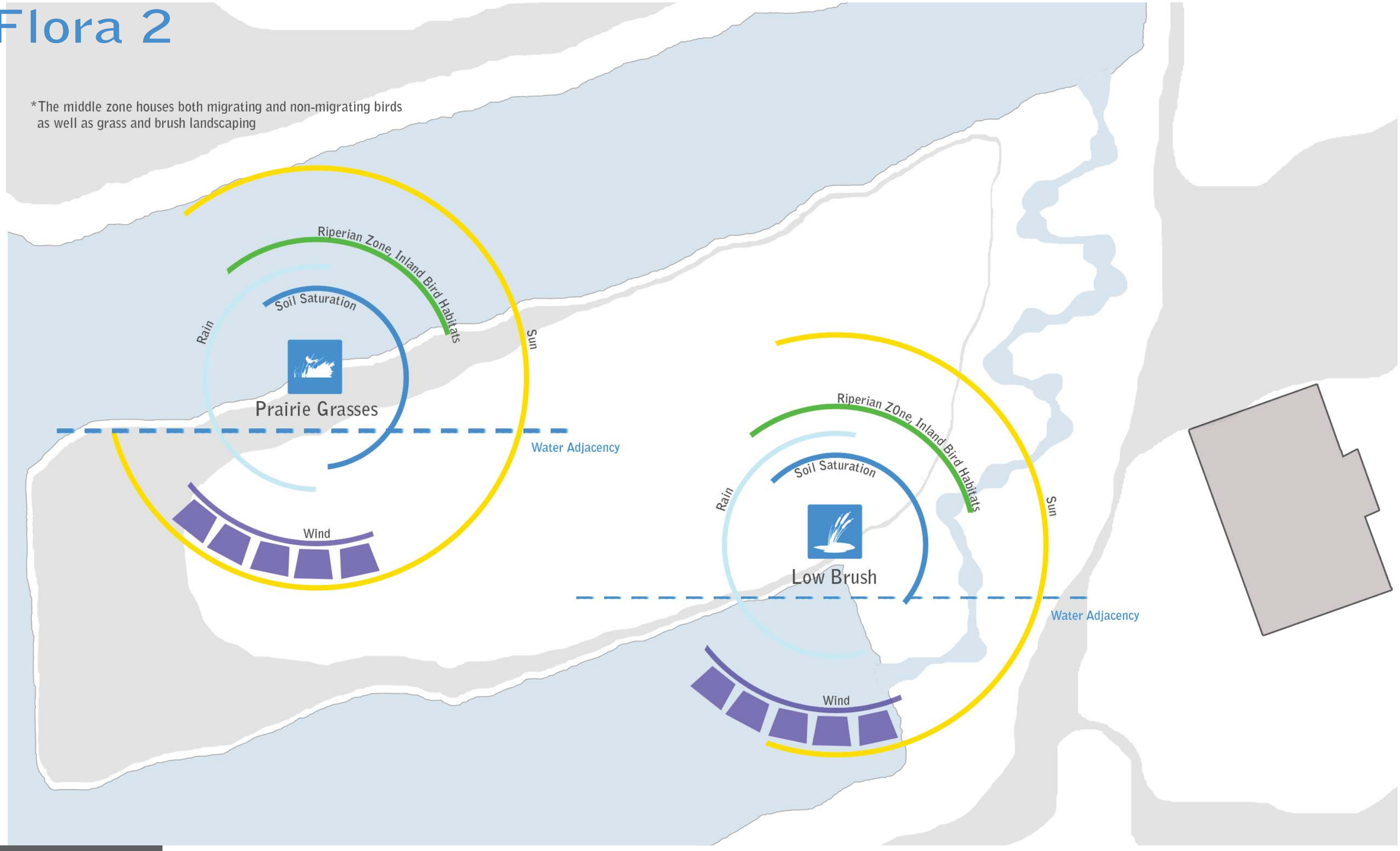
*Aquatic region plant habitats



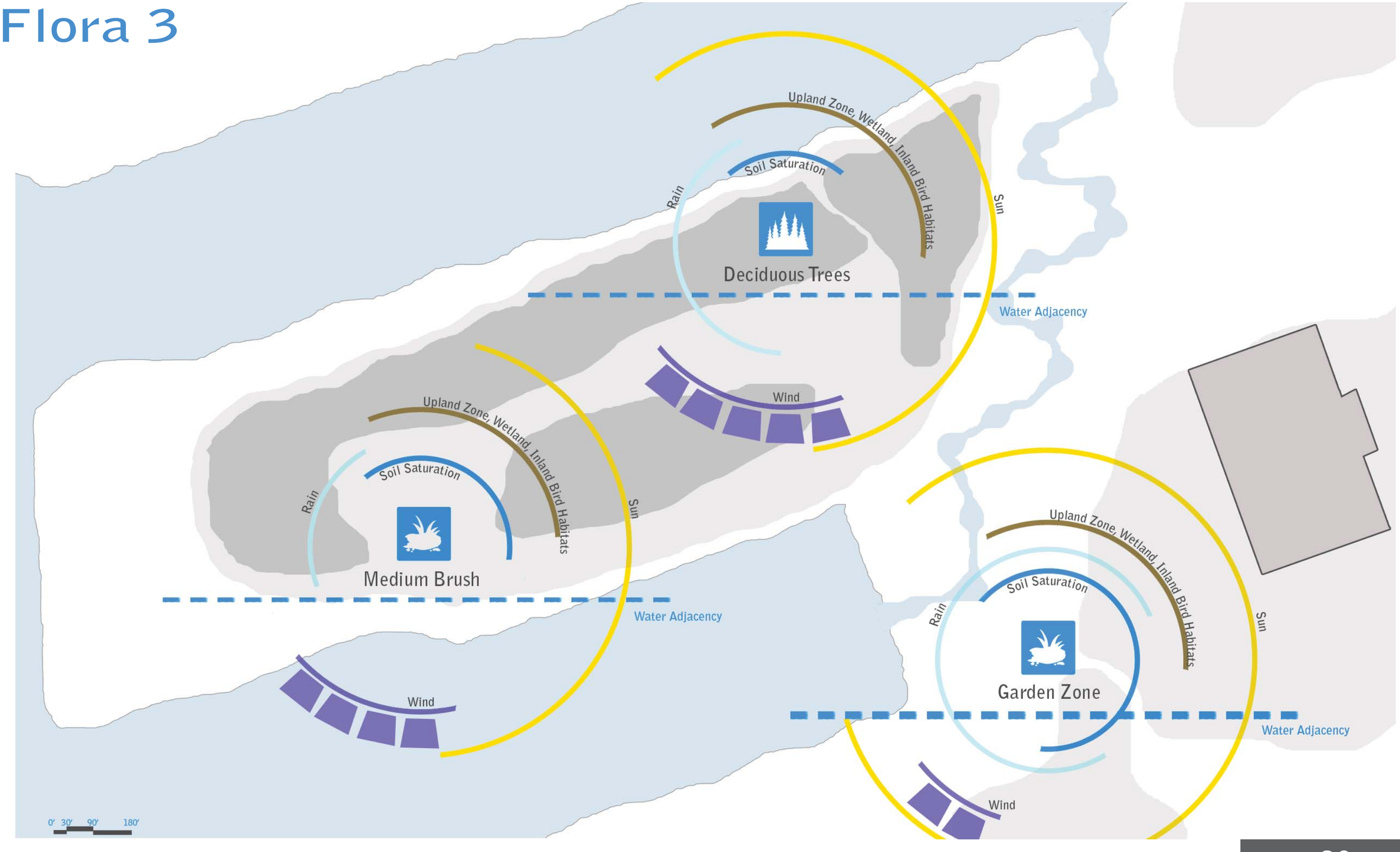
The reestablished wetlands will help revive the Calumet ecosystem. The new stream and wetlands will connect the back parts of the lake creating water flow through the site.

Flora 2

*The middle zone houses both migrating and non-migrating birds as well as grass and brush landscaping



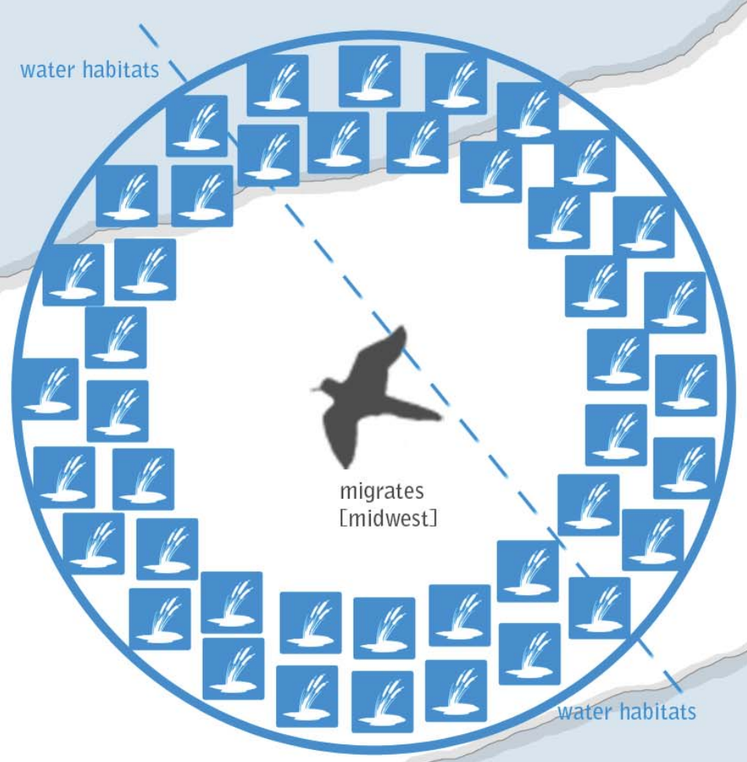
Flora 3

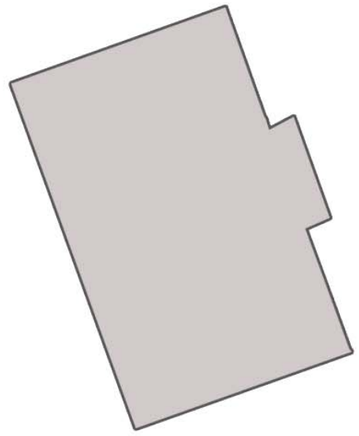

Upland Zone, Wetland, Inland Bird Habitats
Soil Saturation
Rain
Sun
Deciduous Trees
Water Adjacency
Wind
Upland Zone, Wetland, Inland Bird Habitats
Soil Saturation
Rain
Sun
Medium Brush
Water Adjacency
Wind
Upland Zone, Wetland, Inland Bird Habitats
Soil Saturation
Rain
Sun
Garden Zone
Water Adjacency
Wind
0′ 30′ 90′ 180′

Fauna 1

*Wetland birds will be able to nest in these areas of the site

Ducks
Geese
Wading Birds
Gulls and Terns
Herons
Cranes
Fish Eagles
(Smaller Birds) like:
Kingfishers
Weavers
Warblers
Finches





The reestablished wetlands will help revive the Calumet ecosystem. The new stream and wetlands will connect the back parts of the lake creating water flow through the site.

Fauna 2

*Temperate deciduous forest birds will be able to nest in these areas of the site

Bobwhite
Dove
Nighthawk
Woodpecker
Flicker
Wood-Pewee
Flycatcher
Kingbird
Martin
Swallow
Blue Jay
Crow
Chickadee
Titmouse
Nuthatch
Wren
Thrush
Bluebird
Robin
Catbird

water habitats

water habitats

non-migrating
[midwest]

water habitats

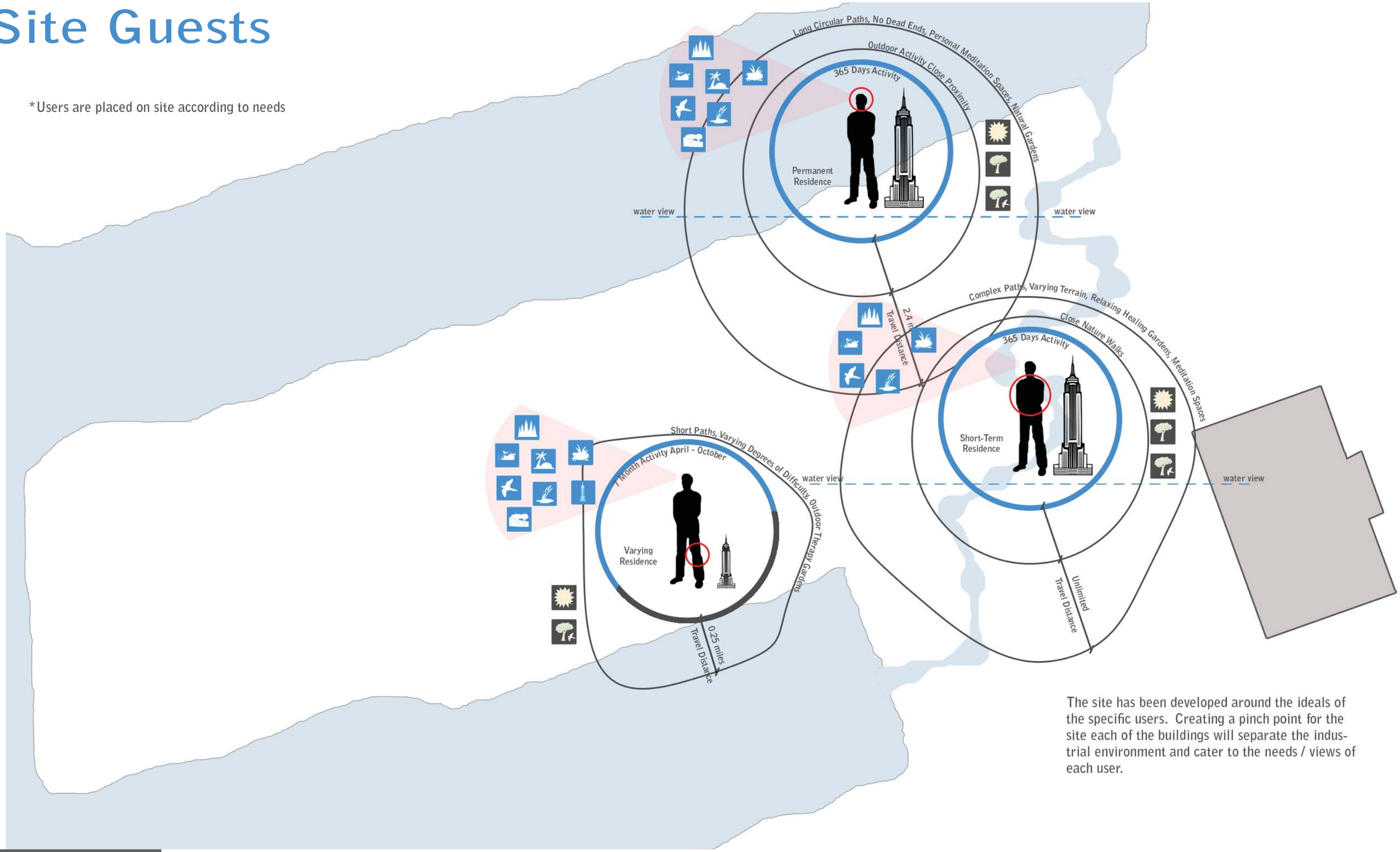
migrates
[midwest]

water habitats

The temperate deciduous forest will the innermost layer of the ecosystem. It will also be the layer that is integrated into the built environment the most. The birds of this habitat will use the trees as a source of food and for nesting.

Site Guests

*Users are placed on site according to needs



The site has been developed around the ideals of the specific users. Creating a pinch point for the site each of the buildings will separate the industrial environment and cater to the needs / views of each user.

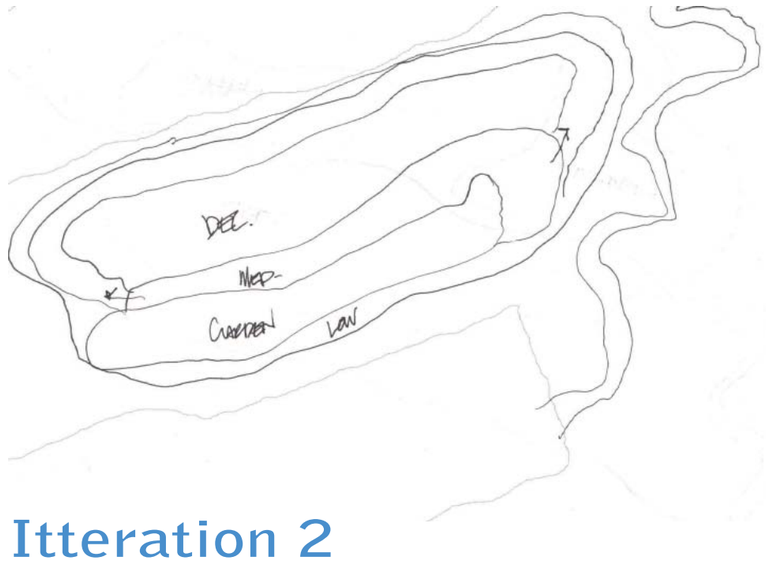
The site design is based around the use of the weather patterns and the necessity to fuel the ecology with varieties of flora and fauna. Beginning with several iterations of site ideals the analysis of the site the final site was laid out using a combination of the ideas (including the prescribed users). The nine different zones work in a gradient from the waters edge of the site to the sites interior. Given the heights of the different zones the site utilizes separate placements for each zone of flora. Looking at the erosion pattern and small currents of the lake and river, the ecology will be placed accordingly. Using the sun path diagram, the heights of the plants will determine their placement. Walking paths and outdoor therapy will be integrated into the different ecology separations. A main aspect of the site will be the connection between the waters. The transformation of the lake provides an atmosphere that is non-conducive to the remediation of the water. Connecting the point of the lake with a small stream, the stream will also help remediate the land using swale and swell development. The stream will be powered by wind generators, which will only run with the breeze. The on-site warehouse will be converted into parking and will use a solar panel array to power the shuttles for the site.

12

Site Design

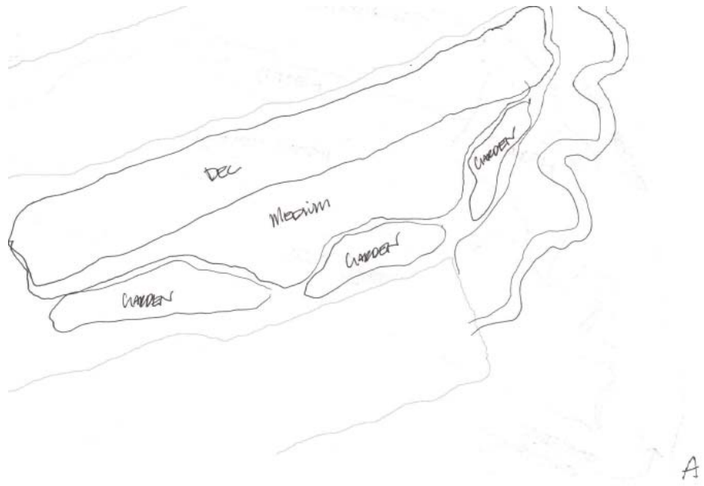
Sketches

Itteration 1



Itteration 2

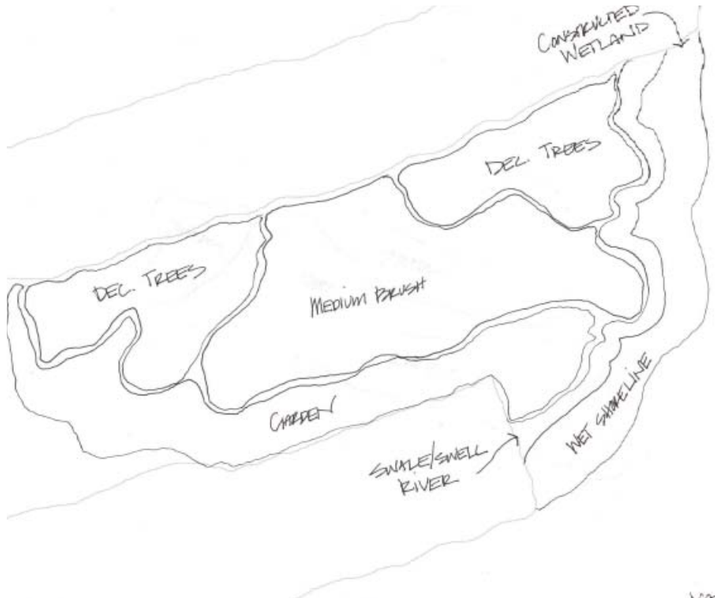
Itteration 3



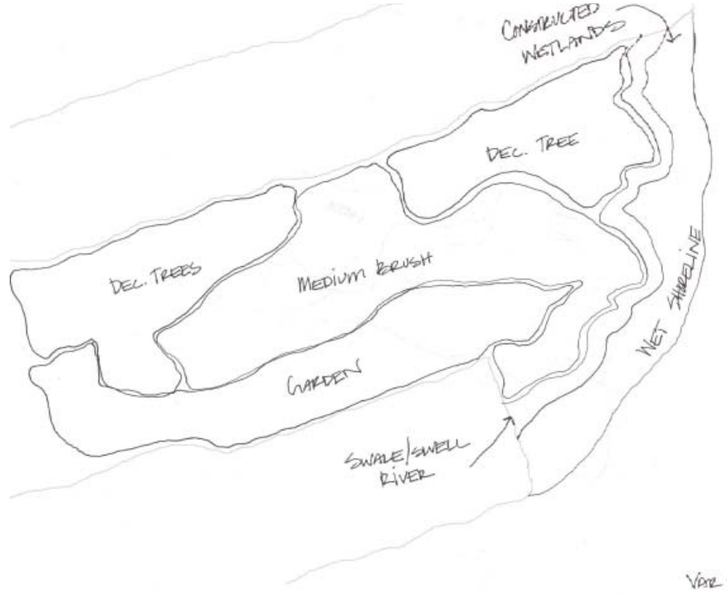
Design a

Design b

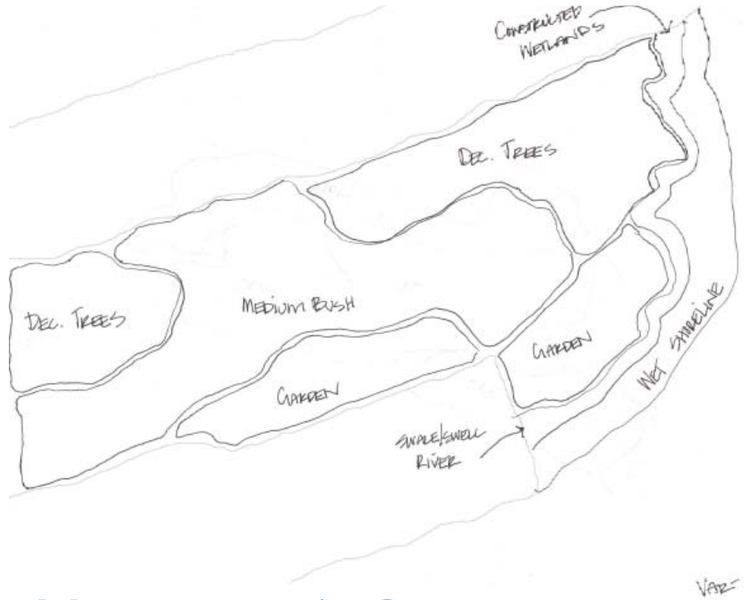
Sketches



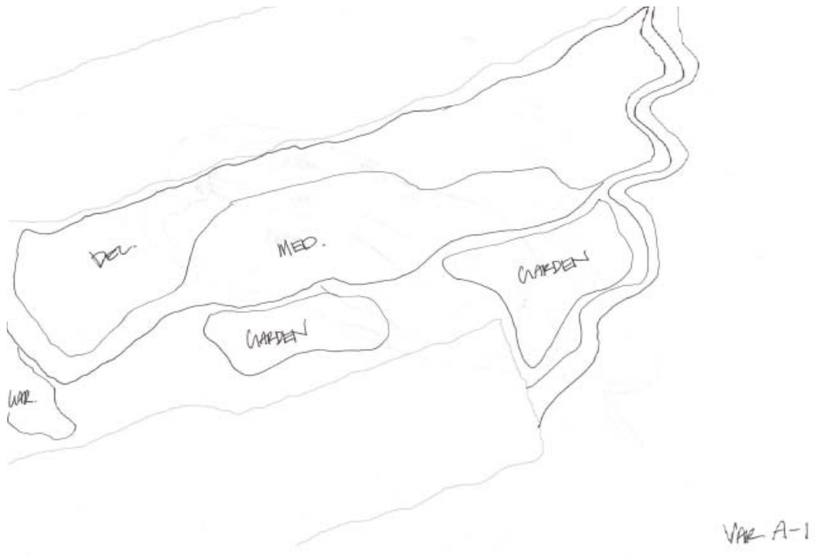
Variation b-1



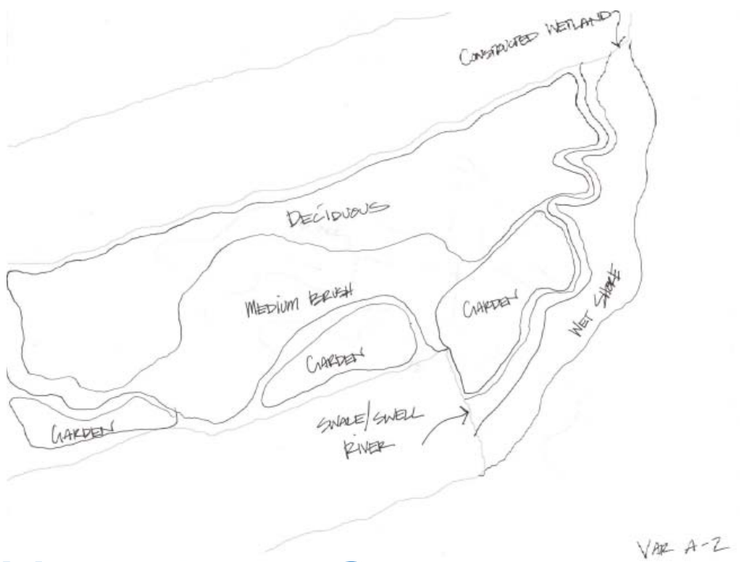
Variation b-2



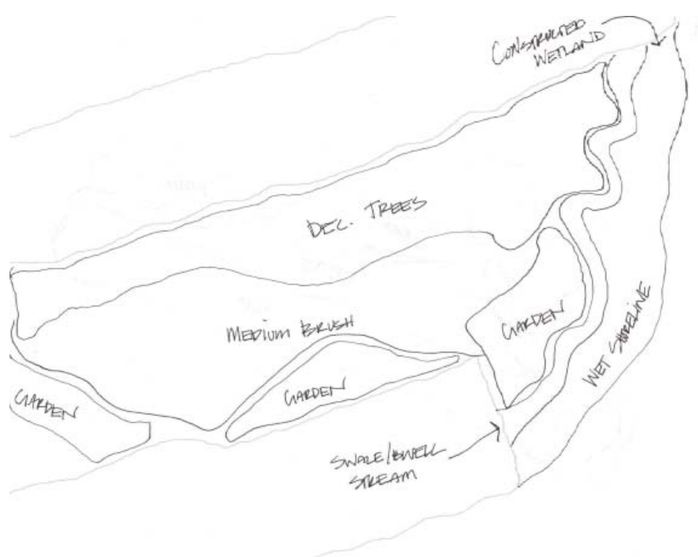
Variation b-3



Variation a-1

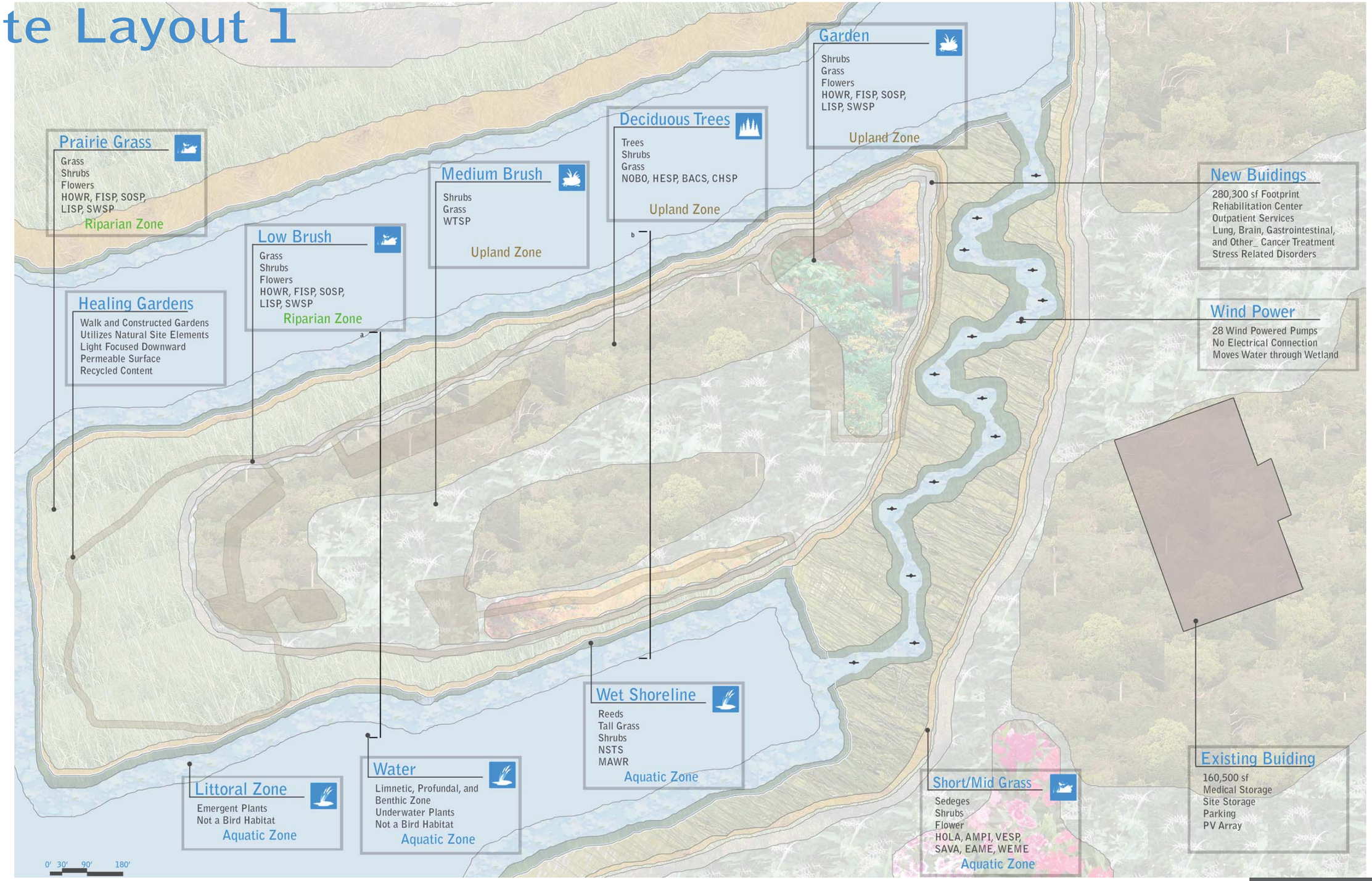


Variation a-2

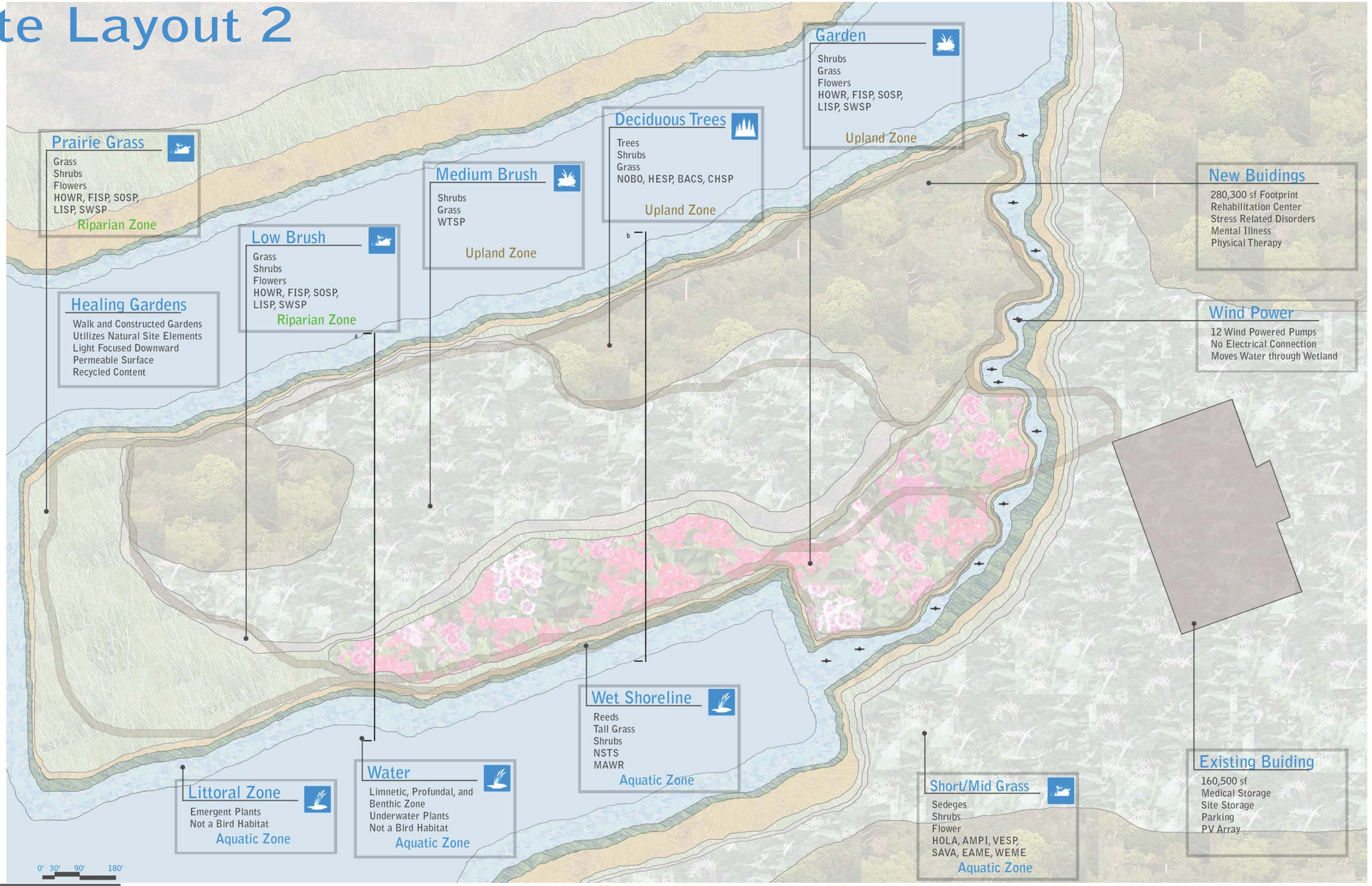


Variation a-3

Site Layout 1



Site Layout 2



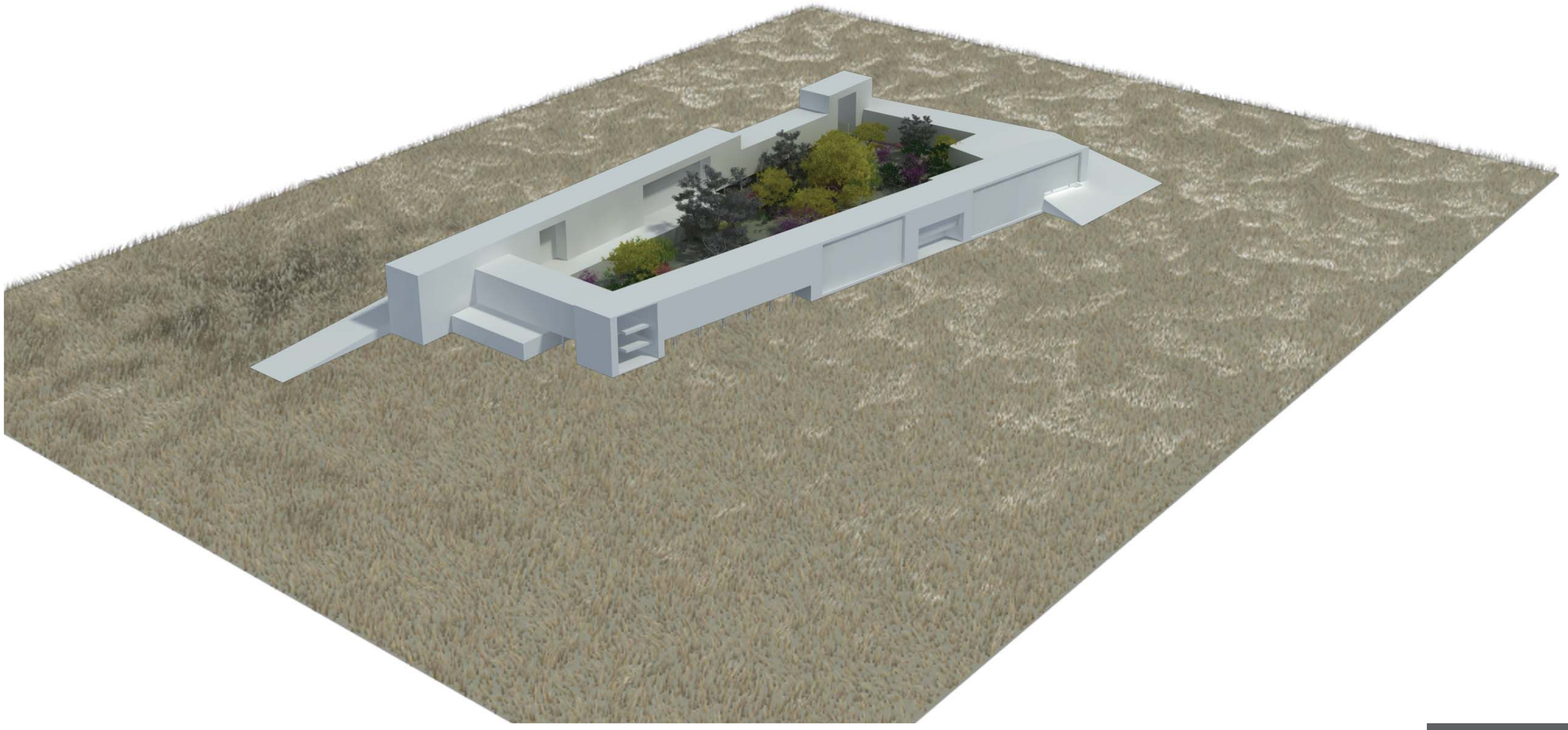
Sections a_Site 2

The building was designed around a courtyard. Using a courtyard to surround the inhabitants with nature, each room will have an inner focused view and a view focused along the outside natural landscape. The courtyard was designed with the intent for use by guests. With many designed exercise spaces and paths for circulation the courtyard will serve as a transfer point and a destination. The paths from each room will find their way through the courtyard and along the different paths. Each path has been designed for a separate exercise time and incorporates plots of land where the guests are able to help remediate the land while exercising. The biophilic design of the building will help the guests to recover in a natural environment that is more conducive to healing.

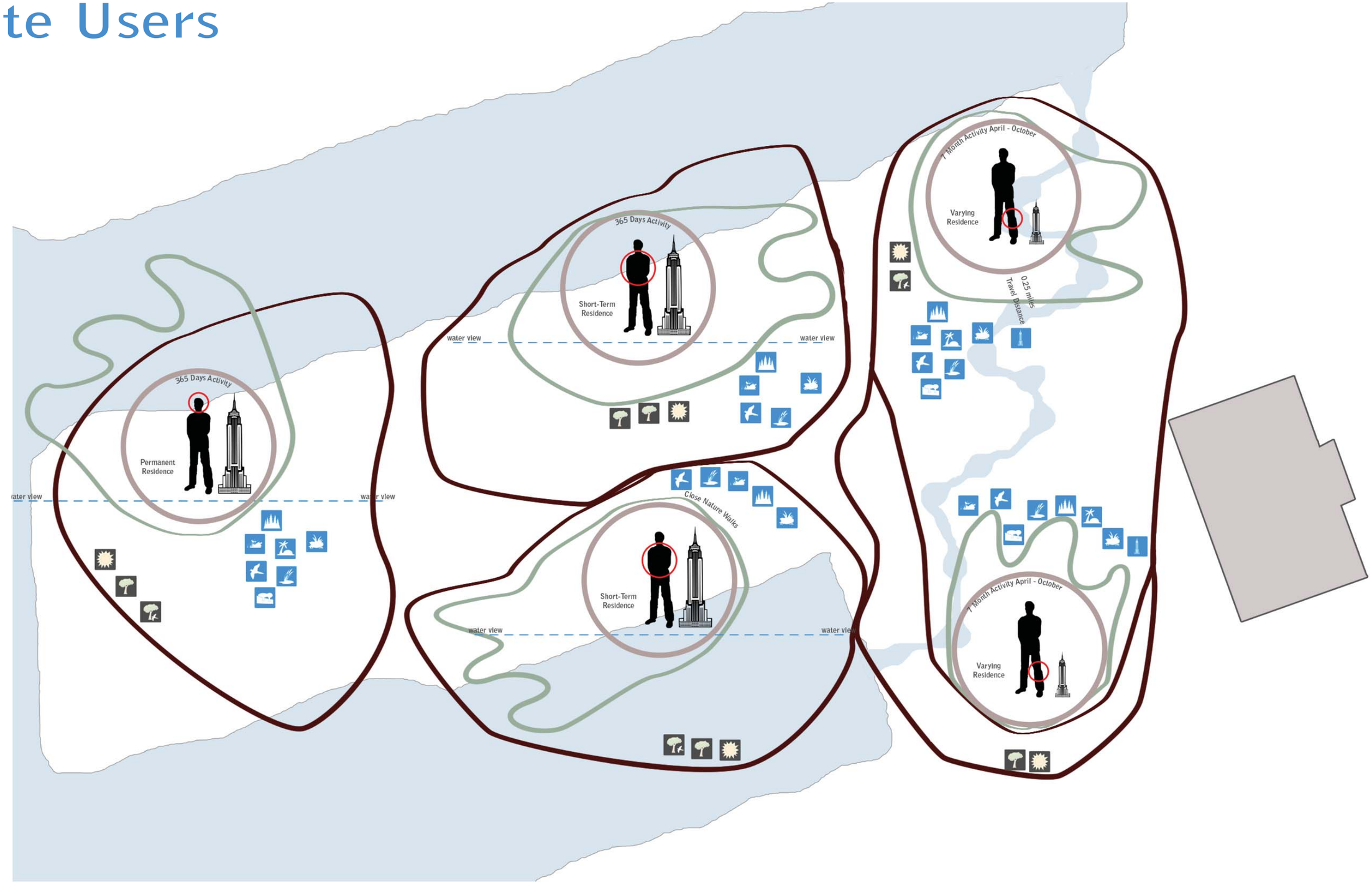
13

Building Design

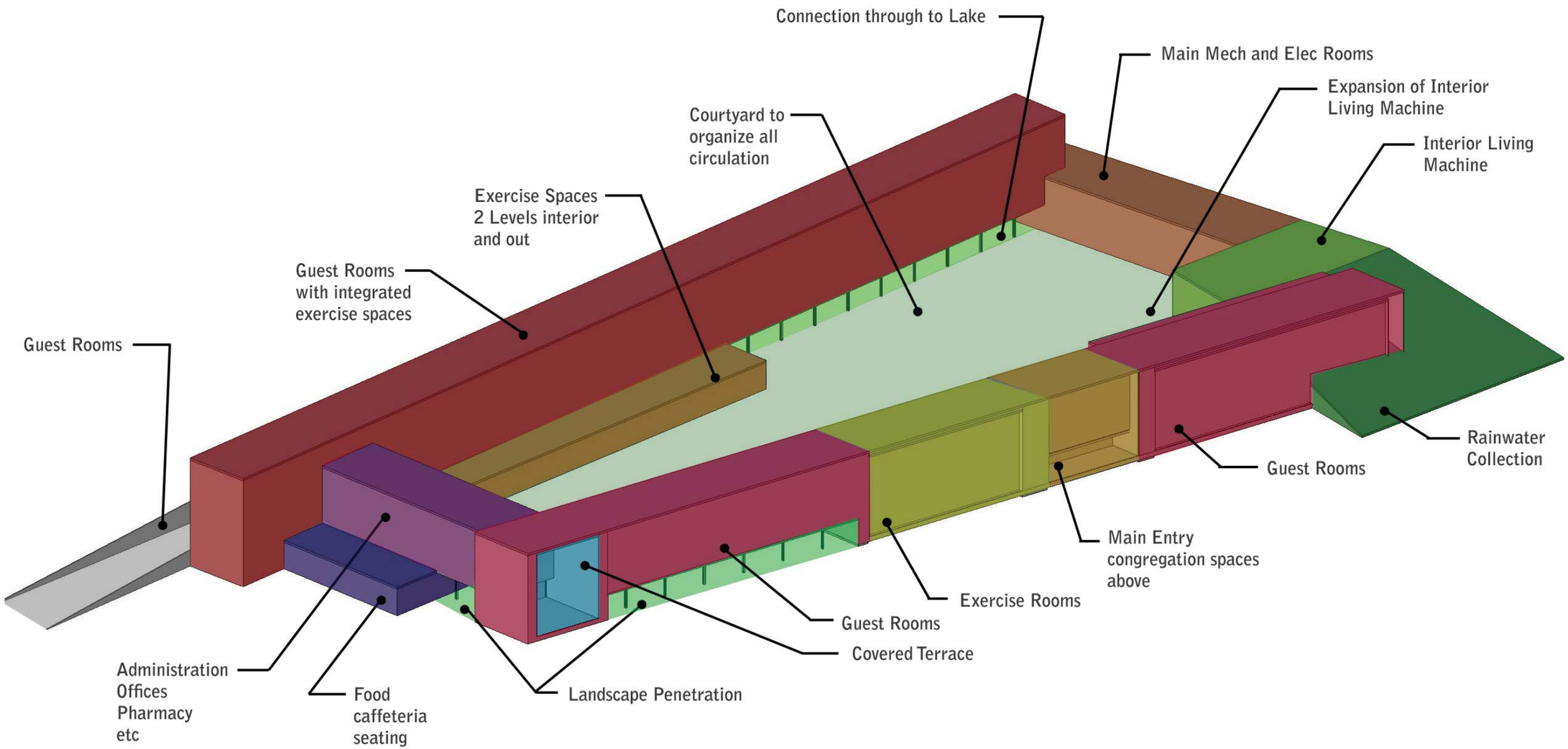
Courtyard Massing



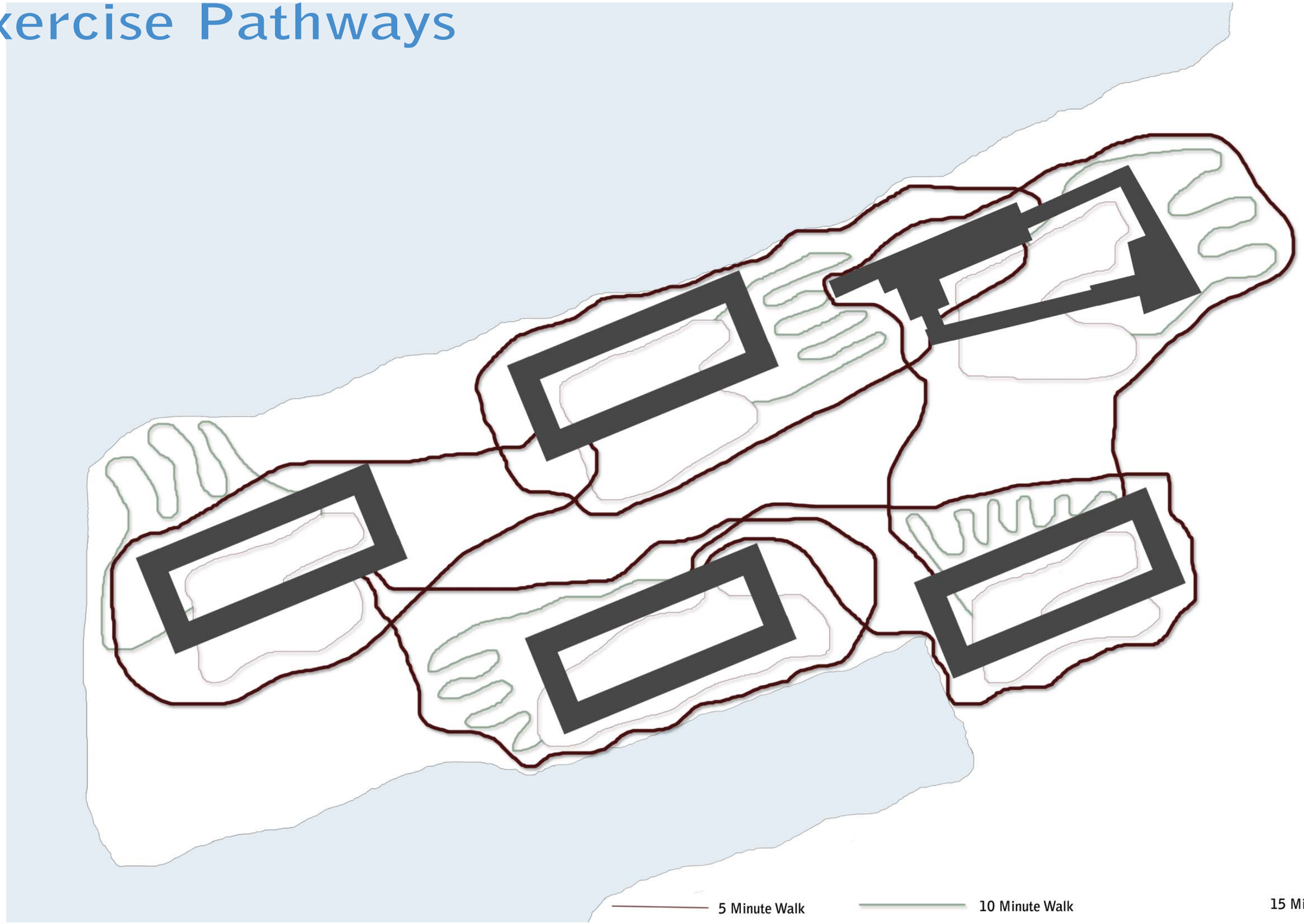
Site Users


365 Days Activity
Permanent Residence
water view
water view
365 Days Activity
Short-Term Residence
water view
water view
7 Month Activity April - October
Varying Residence
0.25 miles Travel Distance
Close Nature Walks
Short-Term Residence
water view
water view
7 Month Activity April - October
Varying Residence

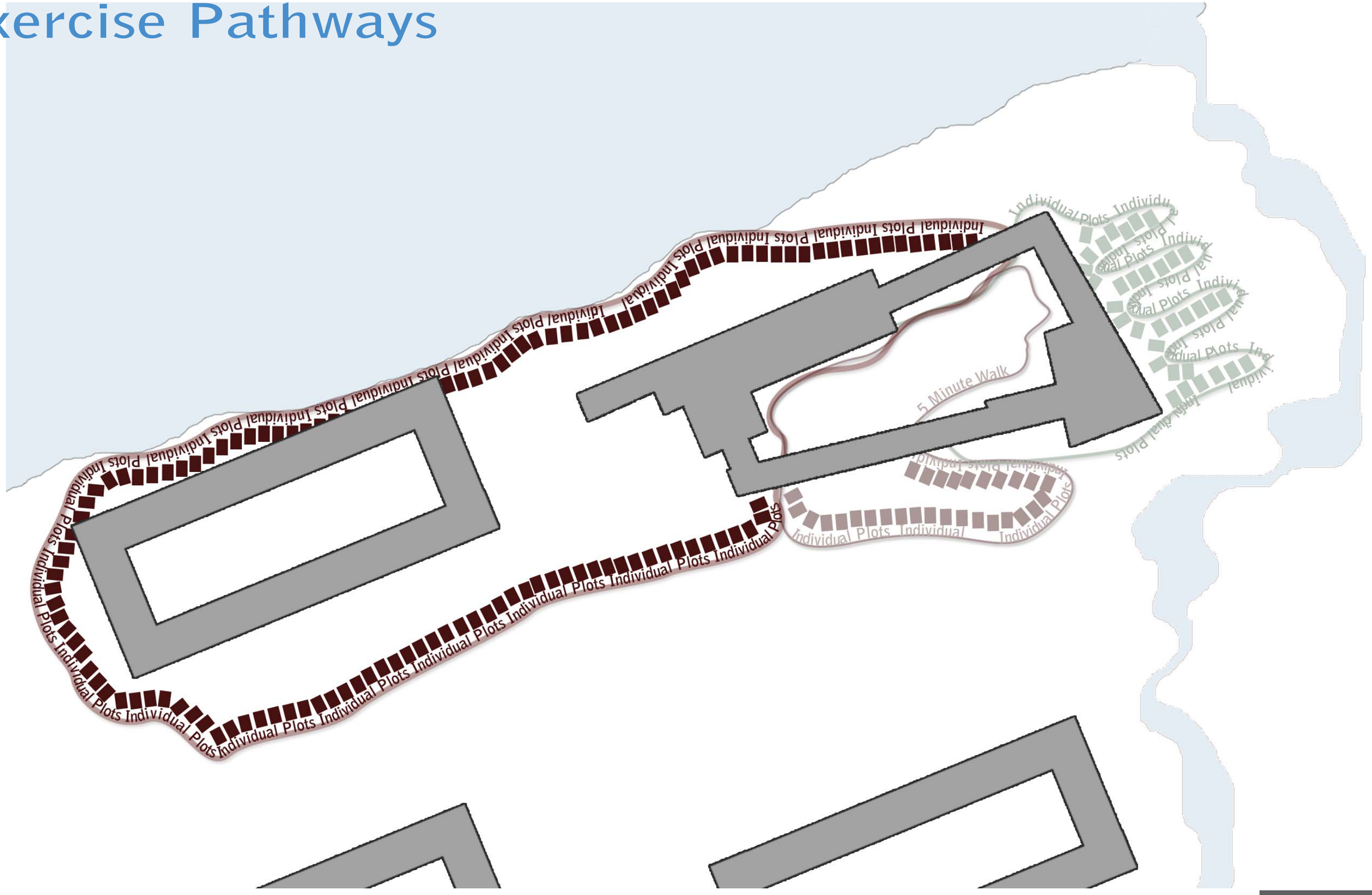
Building Program



Exercise Pathways



Exercise Pathways



Site Plan

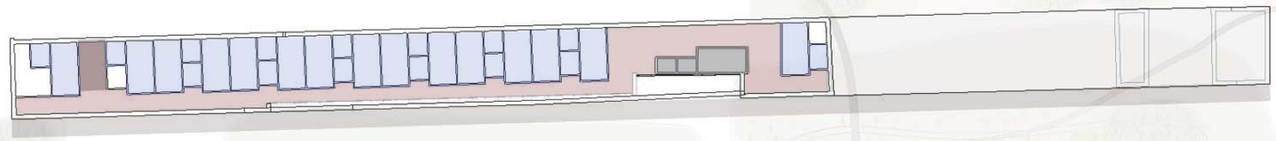

15 Minute Exercise Path
10 Minute Exercise Path
5 Minute Exercise Path
0′
25′
75′
150′
Scale

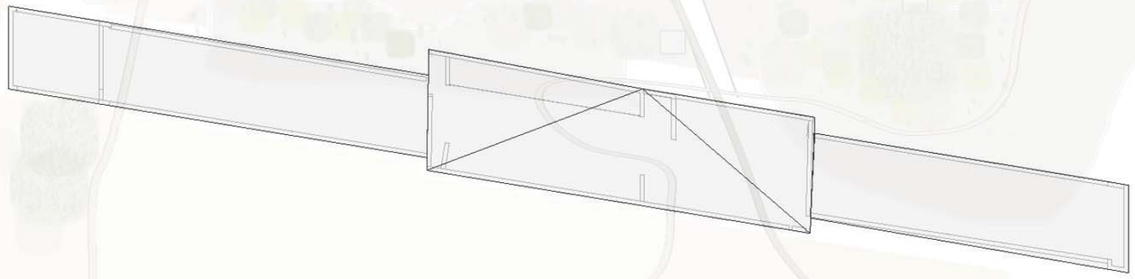
First Floor Plan

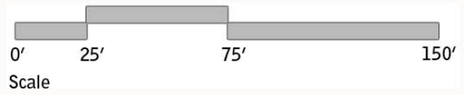
Second Floor Plan

Third Floor Plan

Fourth Floor Plan







Guest Rooms

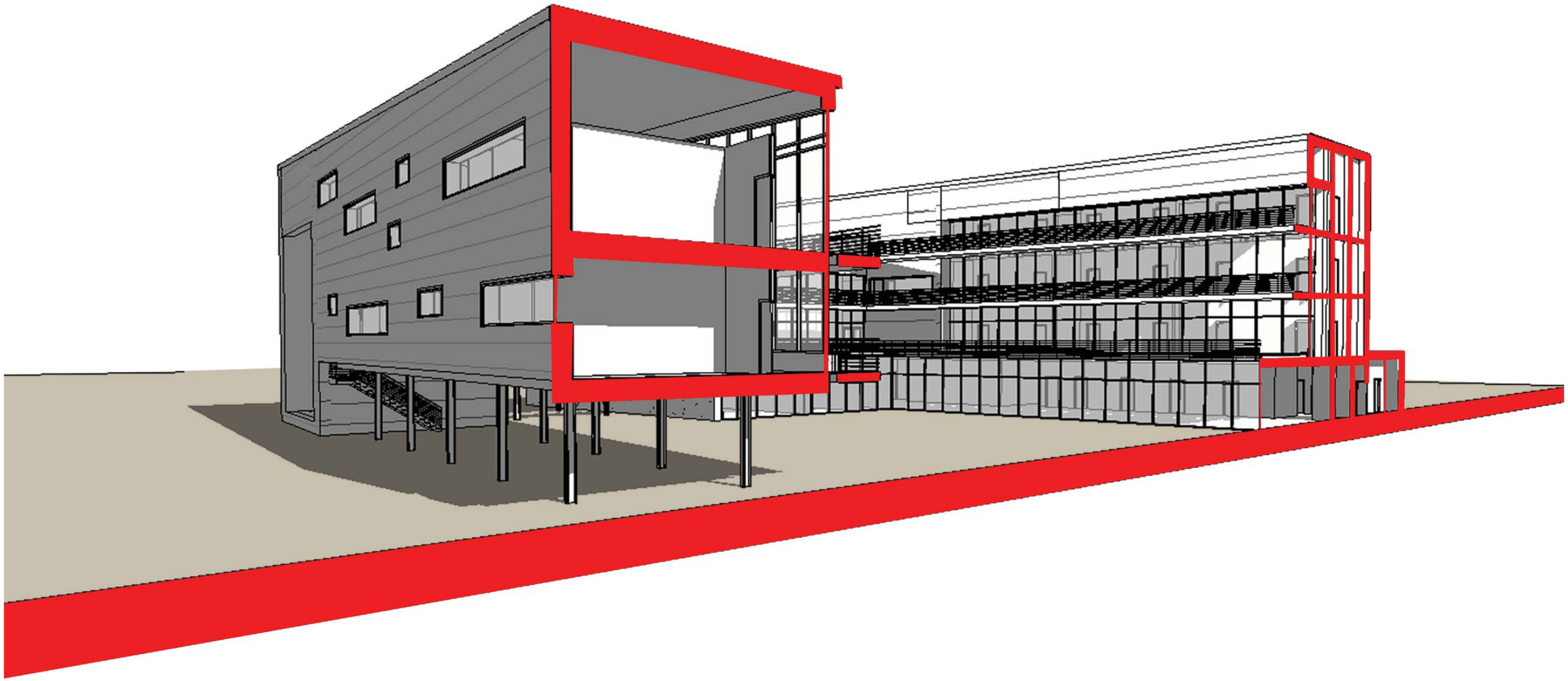
Interior Circulation

Offices

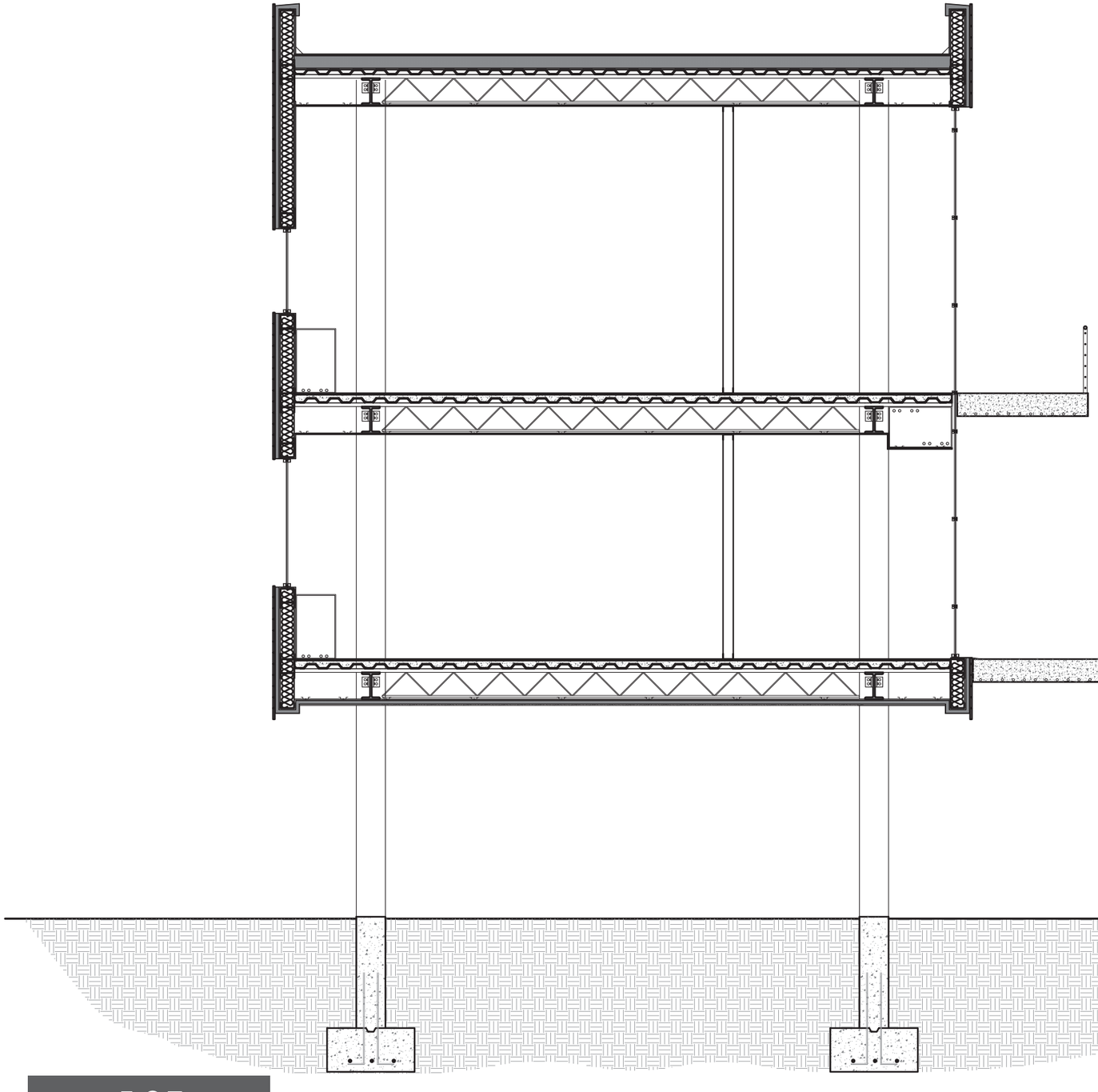
Vertical Circulation

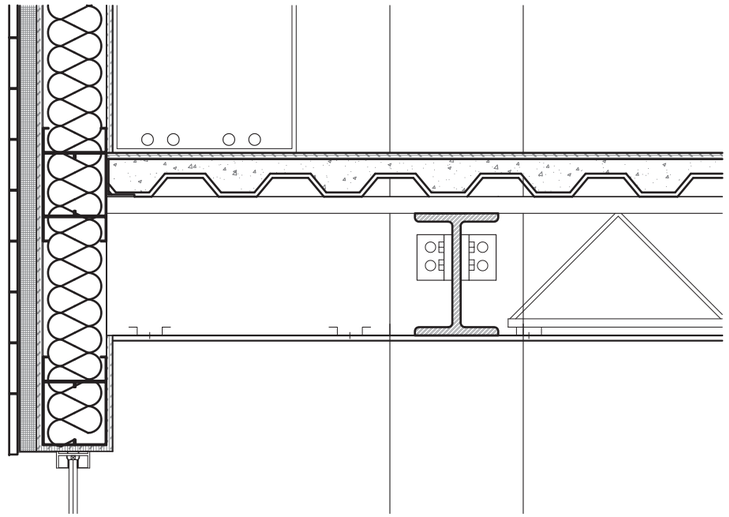
Living Machine

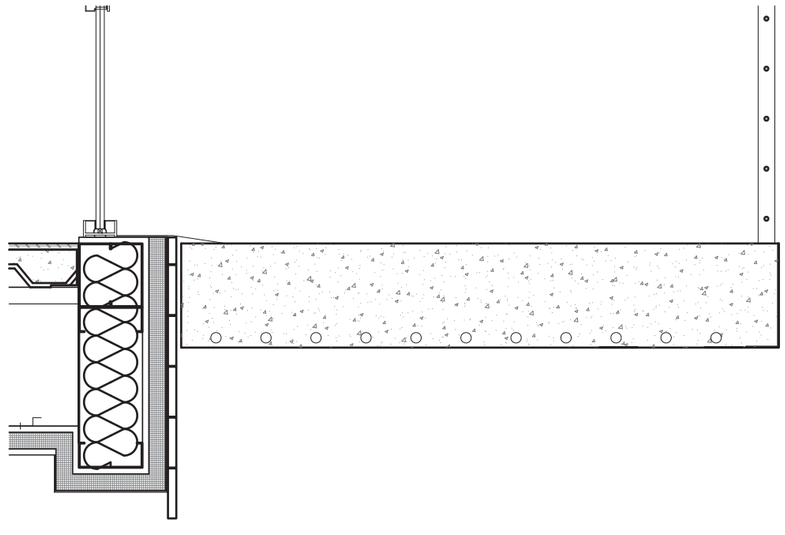
3d Building Section

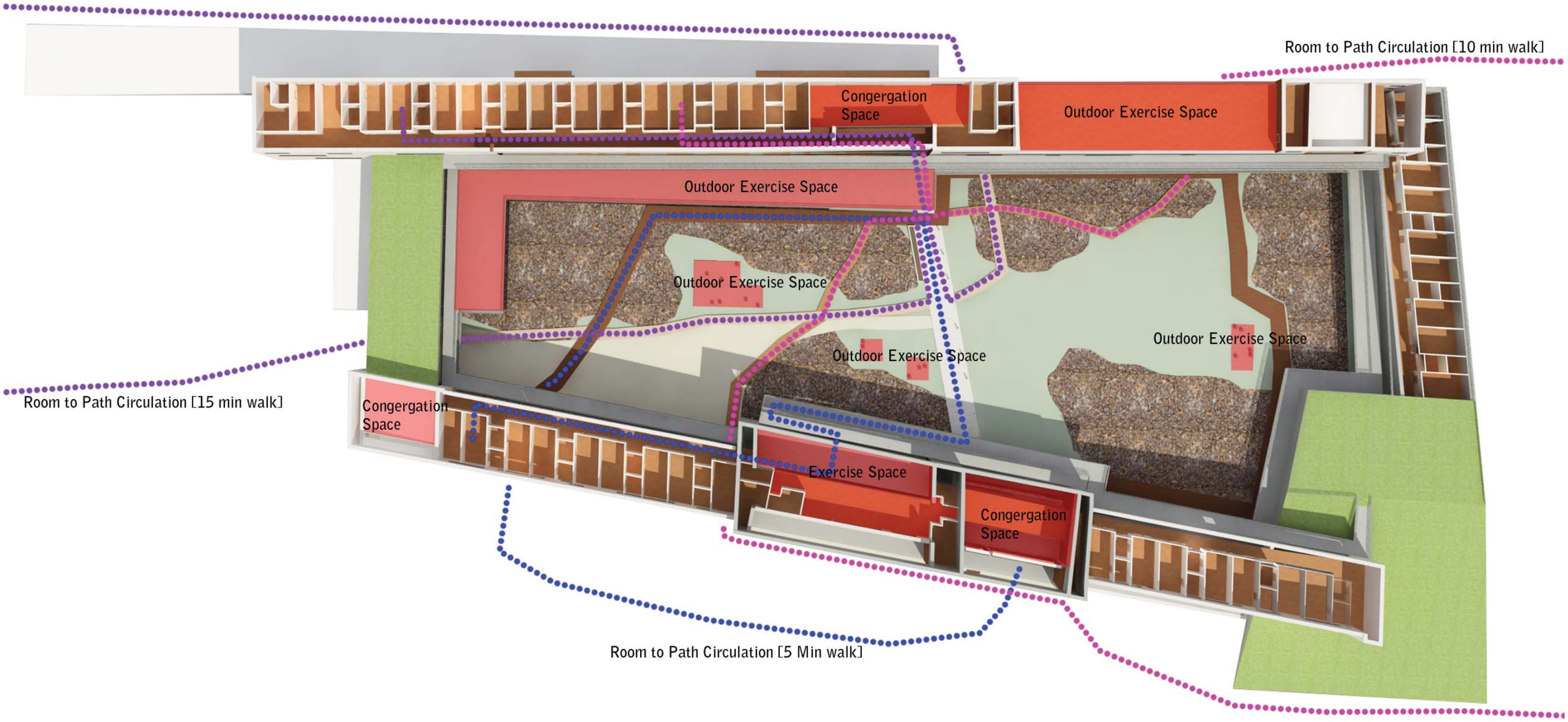


Building Section

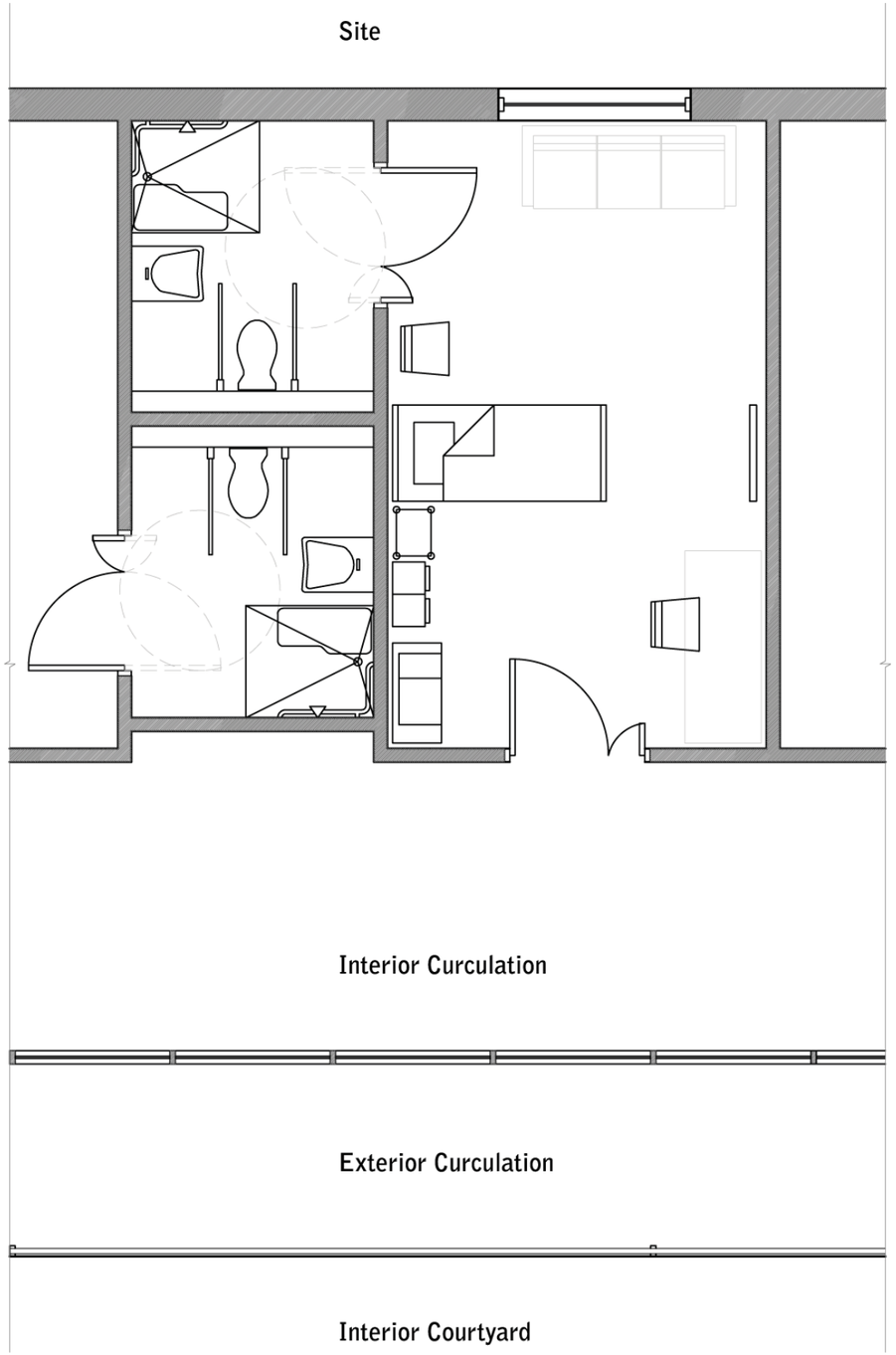


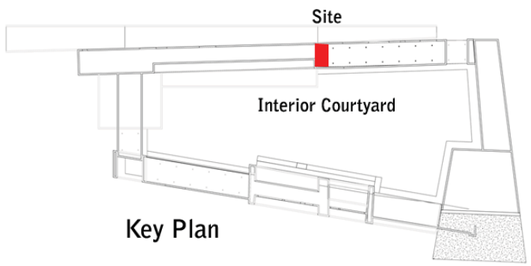




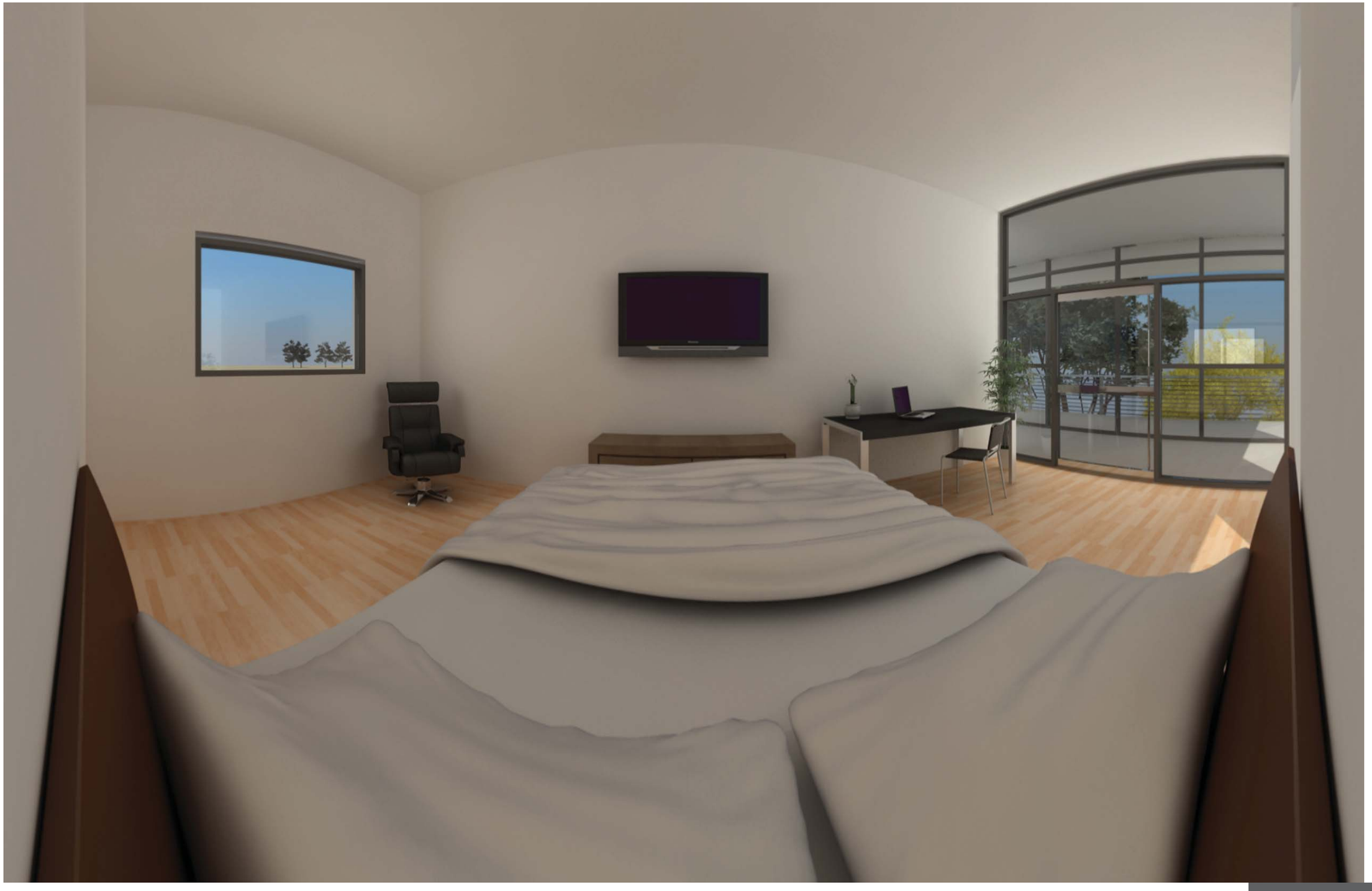

Room to Path Circulation [10 min walk]
Congergation Space
Outdoor Exercise Space
Outdoor Exercise Space
Outdoor Exercise Space
Outdoor Exercise Space
Outdoor Exercise Space
Room to Path Circulation [15 min walk]
Congergation Space
Exercise Space
Congergation Space
Room to Path Circulation [5 Min walk]

Room Design





Typical Guest Room Layout
Scale: 1/4″ = 1′-0″



| Exercise Room | Robert Meder

Robert Meder | Front Perspective |

Appendix

Lead Plant_Amorpha Canescens
Category: Shrubs
Height: 24-36in
Bloom Color: Blue/Purple

Pasque Flower_Anemone Patens
Category: Flower
Height: 6-30in
Bloom Color: Light Purple

Heath Aster_Aster Ericoides
Category: Shrubs
Height: 12-36in
Bloom Color: White/Yellow

Silky Aster_Aster Sericeus
Category: Shrubs
Height: 18-30in
Bloom Color: Purple/Yellow

Cream Wild Indigo_Baptisia Leucophaea
Category: Shrubs
Height: 18-24in
Bloom Color: Yellow

Sand Croeopsis_Coreopsis Palmata
Category: Flower
Height: 24-36in
Bloom Color: Yellow

Prairie Coreopsis_Coreopsis Palmata
Category: Flower
Height: 12-24in
Bloom Color: Yellow

Pale Purple Coneflower_Echinacea Pallida
Category: Flower
Height: 24-36in
Bloom Color: Pale Purple

Rattlesnake Master_Eryngium Yuccifolium
Category: Shrubs
Height: 48-54in
Bloom Color: Greenish/White

Prairie Smoke_Geum Triflorum
Category: Shrubs
Height: 6-18in
Bloom Color: Pink/Purple

Western Sunflower_Helianthus Occidentalis
Category: Flower
Height: 24-48in
Bloom Color: Oragne/Yellow

False Boneset_Kuhnia Eupatorioides
Category: Shrubs
Height: 24-36in
Bloom Color: Cream

Round Headed Bush Clover_Lespedeza Capitata
Category: Shrubs
Height: 12-24in
Bloom Color: Cream/Magenta

Rough Blazing Star_Liatris Aspera
Category: Flower
Height: 12-18in
Bloom Color: Purple

Cylindrical Blazing Star_Liatris cylindracea
Category: Flower
Height: 18-24in
Bloom Color: Rose Purple

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

Pale Spiked Lobelia_Lobelia Spicata
Category: Shrubs
Height: 12-48in
Bloom Color: White

Wild Quinine_Parthenium Integrifolium
Category: Flower
Height: 24-48in
Bloom Color: White

Prairie Cinquefoil_Potentilla Arguta
Category: Shrubs
Height: 12-36in
Bloom Color: White/Yellow

Deam's Rosin Weed_Silphium Integrifolium
Category: Shrubs
Height: 24-84in
Bloom Color: Yellow

Gray Goldenrod_Solidago Nemoralis
Category: Shrubs
Height: 18-24in
Bloom Color: Yellow

Riddell's Goldenrod_Solidago Reddellii
Category: Flower
Height: 24-36in
Bloom Color: Yellow

Golden Alexanders_Zizia Aurea
Category: Flower
Height: 18-36in
Bloom Color: Yellow

Big Bluestem Grass_Andropogon Gerardii
Category: Grass
Height: 48-84in
Bloom Color: Purpleish-Red

Little Bluestem Grass_Andropogon Scoparius
Category: Grass
Height: 24-48in
Bloom Color: Purplish Bronze

Sideoats Gramma_Bouteloua Curtipendula
Category: Grass
Height: 18-36in
Bloom Color: Purplish

Switch Grass_Panicum Virgatum
Category: Grass
Height: 36-72in
Bloom Color: Pink-tinged

Porcupine Grass_Stipa Spartea
Category: Grass
Height: 24-36in
Bloom Color:

Indian Grass_Sorghastrum Nutans
Category: Grass
Height: 36-64in
Bloom Color: Light Brown

Prairie Dropseed_Sporobolus Heterolepis
Category: Grass
Height: 24-36in
Bloom Color: Pink and Brown

Prairie Cord Grass_Spartina Pectinata
Category: Grass
Height: 18-24in
Bloom Color:

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

Nodding Wild Onion_Allium Cernuum
Category: Shrubs
Height: 12-18in
Bloom Color: Pink

Prairie Thimbleweed_Anemone Cylindrica
Category: Flower
Height: 12-24in
Bloom Color: White

Butterfly Weed_Asclepias Tuberosa
Category: Shrubs
Height: 12-30in
Bloom Color: Yellow/Orange

Smooth Blue Aster_Aster Axureaus
Category: Flower
Height: 24-36in
Bloom Color: Purple

Sky Blue Aster_Aster Laevis
Category: Shrubs
Height: 24-48in
Bloom Color: Violet

New England Aster_Aster Novae-angliae
Category: Flower
Height: 36-72in
Bloom Color: Deep Purple/Pink

White Wild Indigo_Baptisia Leucantha
Category: Flower
Height: 24-48in
Bloom Color: White

Showy Tick Trefoil_Desmodium Canadense
Category: Flower
Height: in
Bloom Color: Purpleish-Red

Shooting Star_Dodecatheon Meadia
Category: Flower
Height: 8-18in
Bloom Color: White/Pink/Purple

Purple Coneflower_Echinacea Purpurea
Category: Grass
Height: 24-60in
Bloom Color: Purplish

Wild Bergamot_Monarda Fistulosa
Category: Flower
Height: 24-48in
Bloom Color: Pink/Lavender

Foxglove Beard Tongue_Penstamon Digitails
Category: Flower
Height: 36-48in
Bloom Color: Pinkish/White

Obedient Plant_Physostegia Virginiana
Category: Flower
Height: 36-48in
Bloom Color: Pink/White

Black-eyed Susan_Rudbeckia Hirta
Category: Flower
Height: 24-36in
Bloom Color: Yellow/Orange

Ohio Goldenrod_Solidago Ohiensis
Category: Shrubs
Height: 24-36in
Bloom Color: Yellow

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

Spiderwort_Tradescantia Ohioensis
Category: Shrubs
Height: 24-36in
Bloom Color: Deep Blue

Heart-Leaved Meadow Parsnip_Zizia Aptera
Category: Flower
Height: 12-36in
Bloom Color: Yellow

Common Wood Reed_Cinna Arundinacea
Category: Grass
Height: 36-54in
Bloom Color: Redish

Canada Wild Rye_Elymus Canadensis
Category: Grass
Height: 24-60in
Bloom Color: Greenish

Virginia Wild Rye_Elymus Virginicus
Category: Grass
Height: 24-36in
Bloom Color: Yellow

Fowl Meadow Grass_Glyceria Stiata
Category: Grass
Height: 24-42in
Bloom Color: Greenish

Bottlebrush Grass_Hystrix Patula
Category: Grass
Height: 30-36in
Bloom Color: Green/Brown

Wild Columbine_Aquilegia Canadensis
Category: Flower
Height: 24-36in
Bloom Color: Pink/Red

Jack-in-the-Pulpit_Arisaema Atrorubens
Category: Shrubs
Height: 6-12in
Bloom Color: Purplish Brown

Wild Ginger_Asarum Canadense
Category: Shrubs
Height: 6-12in
Bloom Color: White/Pink

Dutchman's Breeches_Dicentra Cucullaria
Category: Flower
Height: 24-48in
Bloom Color: Pink/Lavender

Yellow Trout Lilly_Erythroniuim Americanum
Category: Flower
Height: 4-10in
Bloom Color: Yellow

Wild Geranium_Geranium Maculatum
Category: Shrubs
Height: 18-24in
Bloom Color: Pink

Virginia Waterleaf_Hydrophyllum Virginianum
Category: Shrubs
Height: 18-24in
Bloom Color: Blue

Virginia Bluebells_Mertensia Virginica
Category: Shrubs
Height: 6-18in
Bloom Color: White

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

May Apple_Podophyllum Peltatum
Category: Shrubs
Height: 12-18in
Bloom Color: White

Solomon's Seal_Polygonatum Peltatum
Category: Flower
Height: 36-48in
Bloom Color: Green/White

Bloodroot_Sanguinaria Canadensis
Category: Flower
Height: 6-9in
Bloom Color: White

Trillium_Trillium Spp.
Category: Shrub
Height: 12-18in
Bloom Color: White

Swamp Milkweed_Asclepias Incarnata
Category: Shrub
Height: 48-54in
Bloom Color: White/Pink

Blue Joint Grass_Calamagrostis Canadensis
Category: Grass
Height: 24-36in
Bloom Color: Green/Brown

Common Lake Sedge_Carex Lacustris
Category: Grass
Height: 6-12in
Bloom Color: Brown/Green

Sedges_Carex Sp.
Category: Grass
Height: 6-12in
Bloom Color: Green

Spotted Joe Pye Weed_Eupatorium Maculatum
Category: Shrubs
Height: 48-84in
Bloom Color: Purple

Common Boneset_Eupatorium Perfoliatum
Category: Shrubs
Height: 48-54in
Bloom Color: White

Common Cattail_Typha Latifolia
Category: Shrub
Height: 48-54in
Bloom Color: Yellow/Green

Dark Green Rush_Scirpus Atrovirens
Category: Grass
Height: 36-60in
Bloom Color: Green

Great Bulrush_Scirpus Validus
Category: Grass
Height: 54-96in
Bloom Color: Green/Brown

Prairie Cordgrass_Spartina Pectinata
Category: Grass
Height: 36-84in
Bloom Color: Green

Great Angelica_Angelica Atropurpurea
Category: Shrubs
Height: 36-120in
Bloom Color: Greenish White

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

Porcupine Sedge_Carex Hystericina
Category: Shrubs
Height: 12-18in
Bloom Color:

Turtlehead_Chelone Glabra
Category: Flower
Height: 24-36in
Bloom Color: White

Fen Thistle_Cirsium Muticum
Category: Flower
Height: 6-9in
Bloom Color:

Narrow-Leaved Loosestrife_Lysimachia Quadriflora
Category: Shrub
Height: 12-18in
Bloom Color:

Hornwort_Ceratophyllum Demersum
Category: Shrub
Height: 48-54in
Bloom Color:

Common Rush_Juncus Effusus
Category: Grass
Height: 24-48in
Bloom Color: Yellowish-Green

Rice Cut Grass_Leersia Oryzoides
Category: Grass
Height: 3in
Bloom Color: White

Small Duckweed_Lemna Minor
Category: Shrub
Height: 24-48in
Bloom Color: Green

Pickerel Weed_Pontederia Cordata
Category: Shrubs
Height: 12-48in
Bloom Color: White

Common Arrowhead_Sagittaria Latifolia
Category: Grass
Height: 48-60in
Bloom Color: Purplish-Red

Shagbark Hickory_Carya Ovata
Category: Tree
Height: 70-90ft
Bloom Color: Green

New Jersey Tea_Ceanothus Americanus
Category: Shrubs
Height: 36-48in
Bloom Color: Greenish Yellow

American Hazelnut_Corylus Americana
Category: Shrubs
Height: 10-16ft
Bloom Color: Brown/Red

Purple Love Grass_Eragrostis Spectabilis
Category: Grass
Height: 12-24in
Bloom Color: Reddish Purple

June Grass_Koehleria Cristata
Category: Grass
Height: 18-24in
Bloom Color: Green

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

Rough Blazing Star_Liatris Aspera
Category: Shrubs
Height: 24-36in
Bloom Color: Purple

White Oak_Quercus Alba
Category: Tree
Height: 50-80ft
Bloom Color: Yellowish-Green

Bur Oak_Quercus Macrocarpa
Category: Tree
Height: 60-80ft
Bloom Color: Yellowish-Green

Black Oak_Quercus Velutina
Category: Tree
Height: 50-60ft
Bloom Color: Yellowish-Green

Indian Grass_Sorghastrum Nutans
Category: Grass
Height: 36-60in
Bloom Color: Light Brown

Siver Maple_Acer Saccharinum
Category: Tree
Height: 50-80ft
Bloom Color: Greenish-Yellow

Hackberry_Celtis Occidentalis
Category: Tree
Height: 40-60ft
Bloom Color: Green

Green Ash_Fraxinus Pennsylvanica Subintegerrima
Category: Tree
Height: 50-70ft
Bloom Color: Purple

Elderberry_Sambucus Canadensis
Category: Tree
Height: 5-12ft
Bloom Color: White

Sugar Maple_Acer Saccharum
Category: Tree
Height: 40-80ft
Bloom Color: Greenish

Pennsylvania Sedge_Carex Pensylvanica
Category: Grass
Height: 6-12in
Bloom Color: Reddish Brown

Red Oak_Quercus Rubra
Category: Tree
Height: 50-75ft
Bloom Color: Greenish Yellow

American Elm_Ulmus Americana
Category: Tree
Height: 60-80ft
Bloom Color: Reddish-Green

Basswood_Tilia Americana
Category: Tree
Height: 50-80ft
Bloom Color: Pale Yellow

Plants

*Figure ground diagram of the central part of the site

full sun | full/partial sun | full shade | winter | fall | spring | summer

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