AWAKING WATERS

CENTRAL LAKES LIMNOLOGY SCIENCE CENTER

CHARLOTTE HAUGH

AWAKING WATERS

Creating the Central Lakes Limnology Science Center in Brainerd, MN by drawing design conclusions from the ecosystems and energy of Minnesota's in-land waterways.

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TABLE OF CONTENTS

TABLES AND FIGURES

68.1 - Crow Wing River Settlement - Crow Wing County Historical Society
71.1 - Site Map - Google maps
72.1 - Photo Location Map - Google Maps
73.1 - Site Photo - Personal Photo
74.1 - Photo Location Map - Google Maps
75.1 - Site Photo - Personal Photo
76.1 - Photo Location Map - Google Maps
77.1 - Site Photo - Personal Photo
78.1 - Photo Location Map - Google Maps
79.1 - Site Photo - Personal Photo
80.1 - Drawn topography map - Google Maps
81.1 - Topography Map - Google Maps, Sketchup
83.1 - Shade and Shadow study - Google Maps
85.1 - Shadow study - Google maps, Sketchup
85.2 - Shadow study - Google maps, Sketchup
85.3 - Shadow study - Google maps, Sketchup
87.1 - Shadow study - Google maps, Sketchup
87.2 - Shadow study - Google maps, Sketchup
87.3 - Shadow study - Google maps, Sketchup
89.1 - Built Feature Study - Google Maps
90.1 - Eastern Red Cedar - MN DNR
90.2 - Eastern White Pine - MN DNR
91.1 - Vegetation Study - Google Maps
92.1 - Laurentian Forest Land Use - MN DNR
93.1 - Pine Moraines Subsection Map - MN DNR
94.1 - Aquatic Habitat Use - MN DNR
94.2 - Terrestrial Habitat Use - MN DNR
95.1 - Pine Moraines Studies - MN DNR
97.1 - Watersheds of Minnesota - MN DNR
99.1 - Hydrology study - Google Maps
101.1 - Wind Speed Map - MN DNR
103.1 - Drawn Wind Study - Google Maps
105.1 - Minnesota Soil Map - MN DNR
107.1 - Minnesota Bedrock Geology Map - University of Minnesota
109.1 - Water and Sewer Improvments Plan - City of Baxter
111.1 - Utilities Map - Google Maps
113.1 - Circulaton Map - City of Baxter
115.1 - Drawn Circulation Map - Google Maps
117.1 - Precipitation Map - MN DNR
119.1 - Sun Study - Revit
119.2 - Sun Study - Revit
119.3 - Sun Study - Revit
121.1 - Sun Study - Revit
121.2 - Sun Study - Revit
121.3 - Sun Study - Revit
123.1 - Drawn Sun Path Map - Google Maps
125.1 - Minneosta Habitat Map - MN DNR
125.2 - Habitat Loss - MN DNR
127.1 - Grey Wolf Range - MN DNR

127.2 - Grey Wolf - Retrieved from www.defenders.org
129.1 - White Sucker - Joshua Knuth
129.2 - Bald Eagle - Retrieved from www.nationalgeographic.com
131.1 - Baxter Zoning Map - City of Baxter
133.1 - Baxter Trail Map - City of Baxter
138.1 - Open Desk Concept - Retrieved from www.goinggreefurniture.com
139.1 - Time spent by Researchers - Building Type Basics for Research Laboratories
143.1 - Display Design - Retrieved from www.filmbase.ie
144.1 - Aquarium - Retrieved from www.aquarium.co.za
145.1 - Greenhouse Design - Retrieved from www.thegreenhouseproject.org
147.1 - Open Lab Concept - Retrieved from www.mmrl.edu
147.2 - Open Lab Concept - Retrieved from www.astrazeneca.co.uk
150.1 - Process Sketch - Personal Photo
151.1 - Process Sketch - Personal Photo
153.1 - Floor Plan Sketch - Personal Photo
153.2 - Floor Plan Sketch - Personal Photo
153.3 - Floor Plan Sketch - Personal Photo
155.1 - HVAC Layout Sketch - Personal Photo
155.2 - HVAC Layout Sketch - Personal Photo
156.1 - 3D Structural Model - Revit
157.1 - Structural Layout Sketch - Personal Photo
158.1 - Structure Study - Revit
159.1 - Structure Study - Revit
159.2 - Structure Study - Revit
160.1 - Material Study - Personal Photo
160.2 - Material Study - Personal Photo
163.1 - Section Perspective - Revit
163.2 - Section Perspective - Revit
164.1 - Interior Perspective - Personal Photo
165.1 - Interior Perspective - Personal Photo
166.1 - Detail - Personal Photo
167.1 - Detail - Personal Photo
168.1 - Detail - Personal Photo
169.1 - Exterior Perspective - Revit, Lumion
171.1 - Geothermal Well Literature - Retrieved from www.bryant.com
172.1 - Geothermal Well Literature - Retrieved from www.bryant.com
173.1 - Geothermal Well Literature - Retrieved from www.bryant.com
175.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
176.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com

177.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
178.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
179.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
180.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
181.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
182.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
183.1 - Kawneer Thermal Entrances Literature - Retrieved from www.kawneer.com
185.1 - Kawneer Glassvent Windows Literature - Retrieved from www.kawneer.com
186.1 - Kawneer Glassvent Windows Literature - Retrieved from www.kawneer.com
187.1 - Kawneer Glassvent Windows Literature - Retrieved from www.kawneer.com
189.1 - Kawneer 7500 Wall Windows Literature - Retrieved from www.kawneer.com
190.1 - Kawneer 7500 Wall Windows Literature - Retrieved from www.kawneer.com
191.1 - Kawneer 7500 Wall Windows Literature - Retrieved from www.kawneer.com
192.1 - Kawneer 7500 Wall Windows Literature - Retrieved from www.kawneer.com
193.1 - Kawneer 7500 Wall Windows Literature - Retrieved from www.kawneer.com
194.1 - Kawneer 7500 Wall Windows Literature - Retrieved from www.kawneer.com
196.1 - Kawneer Powershade Literature - Retrieved from www.kawneer,com
197.1 - Kawneer Powershade Literature - Retrieved from www.kawneer,com
198.1 - Kawneer Powershade Literature - Retrieved from www.kawneer,com
199.1 - Firestone Gutter Literature - Retrieved from www.firestone.com
200.1 - Firestone Roofing Literature - Retrieved from www.firestone.com
200.2 - Firestone Skyscape Literature - Retrieved from www.firestone.com
203.1 - Basement Floor Plan - Revit
204.1 - Ground Floor Plan - Revit
205.1 - Second Floor Plan - Revit
206.1 - Site Perspective - Revit, Lumion
207.1 - Section Perspective - Revit
207.2 - Section Perspective - Revit

208.1 - Water Trombe Wall - Revit, Lumion
209.1 - Trombe Wall - Revit, Lumion
210.1 - Water Collection and Venting - Revit
211.1 - Photovoltaic Panels and Sun Shades - Revit
212.1 - Cistern - Revit, Lumion
213.1 - Geothermal Well Field - Revit
214.1 - HVAC Duct System - Revit
216.1 - Elevation - Revit
217.1 - Wall Details - SketchUp
218.1 - Roof Detail and Structure - SketchUp, Revit
219.1 - HVAC Layout - Revit
220.1 - Render - Revit, Lumion
221.1 - Render - Revit, Lumion
222.1 - Render - Revit, Lumion
223.1 - Render - Revit, Lumion
224.1 - Render - Revit, Lumion
225.1 - Render - Revit, Lumion
226.1 - Render - Revit, Lumion
227.1 - Render - Revit, Lumion
228.1 - Render - Revit, Lumion
229.1 - Render - Revit, Lumion
230.1 - Render - Revit, Lumion
231.1 - Render - Revit, Lumion
232.1 - Render - Revit, Lumion
233.1 - Render - Revit, Lumion
234.1 - Render - Revit, Lumion
235.1 - Render - Revit, Lumion
236.1 - Render - Revit, Lumion
237.1 - Render - Revit, Lumion
238.1 - Render - Revit, Lumion
239.1 - Render - Revit, Lumion
240.1 - Render - Revit, Lumion
241.1 - Render - Revit, Lumion
242.1 - Render - Revit, Lumion
243.1 - Render - Revit, Lumion
244.1 - Render - Revit, Lumion
245.1 - Render - Revit, Lumion
246.1 - Exhibit Board - Revit, Lumion
247.1 - Exhibit Board - Revit, Lumion
252.1 - Boathouse Model - Personal Photo
253.1 - Shikaakwa Youth Center Perspective - Personal Photo
254.1 - Tetra-Hex Towers Model - Personal Photo/Joe Miller
254.2 - Woodrow Wilson Animal Center Perspective - Personal Photo
255.1 - Wetlands Research Center - Personal Photo
256.1 - Identification Photo - Personal Photo

A B S T R A C T

Awaking Waters as a thesis project focuses on providing a place for the scientific research of Minnesota's in-land waterways. The project aims to create space that furthers research and is also transparent to the public. The building itself will aim to respond to the landscape it is in and will have a limiting impact on its natural environment. To do this effectively, extensive comparisons and conclusions will be drawn from water ecosystems. The project will aim to create an analogy between the passive qualities of wetlands and the passive systems in a building. This will also be done between active qualities of a river and the active systems of a building. Furthermore, complete integration of building systems will be placed at the highest importance so that a fully functional and cohesive center results. Much like an ecosystem in nature, a building must be treated as a sum of its parts. Through these design considerations, Awaking Waters seeks to provide state-of-the-art research facilities and bring the public in to learn about nature while limiting the building's impact on the landscape.

N A R R A T I V E

"If you love a flower, don't pick it up,
because if you pick it up it dies
and it ceases to be what you love,
so if you love a flower, let it be.
Love is not about possession.
Love is about appreciation."
-Osho

This quote effectively gives meaning to the reasoning behind my thesis project, "Awaking Waters." Why is in our human nature to want to own that which we love? It is not enough for us to gaze upon a beautiful site, take in its loveliness, and leave, the scene unaltered. Our first thought is, "How do I make this thing that I am looking at mine so that I may look at it longer?"

We have come to revere water and the landscapes it cuts through and I believe our humanistic connection with water is because we evolved from the water and still depend on it for life. It makes sense that we would want to be near water and have it as our own. When does that urge to be near water go too far however? My guess is when wetlands are drained for crop land, lakes are lined with million dollar homes, and aquatic vegetation is killed off because it is "icky" to swim in. When so much shore line is locked up because it is private property that you can't get near the water to enjoy for fear of making a land owner angry. When waterways are chocked full of invasive plants and wildlife that you would be hard pressed to find an inkling of a native species. We claim that we love water and yet we treat it like garbage. I believe this is when we have gone too far.

Minnesota's nickname is "Land of Ten Thousand Lakes" and the name Minnesota can be translated to "Land of Water". It goes without saying that Minnesota's waterways are special. That is why the Central Lakes Limnology Science Center is important. We need to learn more about these waters in order to work toward protecting them. Herein lies the first problem I need to solve in my thesis project. How do we encourage the public care about a problem they might not understand or cannot see? It is our human nature to only care about what directly affects us and to solve this my project will have to effectively engage the public. The second problem what will have to be solved is how can design encourage the public see a problem without further contributing to that problem? How can I condemn the homes that line the shore of a lake and then build a center on the bank of a river? The answer is that I cannot, lest the entire project turn into a hypocritical mess.

IMPORTANCE:

To gain more insight on why this research center is important we must first come up with a working definition of what Limnology as a science is. Gerald Cole, the author of "Textbook of Limnology" describes limnology as a synthesis of aquatic ecology, biology, geography, geology, and in-land oceanography (Cole 1994). To put this into a cleaner term, limnology is seen as the study of in-land waterways (meaning lakes, rivers, and streams), their ecosystems, and the flora and fauna that inhabit those ecosystems. The ecosystems found in and water provide many services to the built environment and our economy. These services can be categorized as follows:

Support Services- Regulation of basic infrastructures of life and the regulation o ecological processes. Transportation of energy and the cycling of water and nutrients. Most importantly, soil formation and retention.

Regulation Services- Regulation of climate systems, gases and biochemical cycles. Pollination of crops and the treatment of organic wastes in water or air. Flood and drought regulation.

Provisioning Services: The supply of goods such as food, fiber, wood, water, oxygen, and medicinal resources. These are the most historically focused upon because of the direct economic benefits.

Cultural Services: The support of interactions between humans and nature. A source for science and art alike

Exposure to these services has various benefits to humans such as aesthetic satisfaction, recreation and tourism, and improvement in health and fitness (Losco, Nannan, Asare, Klymaaho, Gilard, Lampinen 2012).

A physical place is needed where the research and active protection of these environments can take place. Furthermore, a center is needed where the public can be engaged and learn more about why these habitats are extremely important to their well-being.

ECONOMICS:

There are two ways to place value on in-land waterways, direct market value and indirect market value.

Direct Market Valuation:
This is the exchange value that ecosystems services have in trade, or mainly the "goods" that are produced by that ecosystem, like wood from trees. However, this also includes some regulatory functions. For example, New York City strived to use natural water regulation services of largely undeveloped watersheds. Through the conservative use of these watersheds, they were able to forgo the purchase of a six-billion dollar water filtration plant. In this way we can place a six-billion dollar valuation on the wetlands used in this project where New York's initial investment was only to purchase the land around the watersheds (De Groot et al. 2002).

Indirect Market Valuation:
This is harder to estimate an economic value for because some attributes, like health benefits to humans, are harder to quantify. However, indirect valuations of ecosystems can be further broken down into seven categories.

Avoided Cost: Services that allow society to avoid costs that would have occurred without the natural environment. Examples are flood control which avoids property damage and waste treatment which avoids health costs. The U.S. Army Corps of Engineers found that protecting wetlands along the Charles River in Boston Massachusetts, save and estimated seventeen million dollars in potential flood damage (EPA 2001).

Replacement Cost: These natural services could be replaced with human-made systems like a natural waste treatment done by marshes which can only partly be replaced by costly artificial systems.

Factor Income: Many ecosystem services enhance incomes. An example of this is natural water improvements which increase commercial fisheries thereby increasing the profits of fisherman.

Travel Cost: The use of ecosystem services may require travel and these travel costs can be seen as a direct valuation of the area because of much people are willing to spend to travel there to see the area.

Hedonic Pricing: Service demand is reflected in the price people are willing to pay for associated goods. This is reflected in the disparities in housing costs between lake homes and other homes not near favorable scenery.

Contingent Valuation: Service demand is elicited by posing hypothetical questions that ask respondents how much they would be willing to pay for an ecosystem service. For example, people may be asked how much they would be willing to pay to protect water quality in a lake or river that is a popular swimming spot.

Group Valuation: This function uses the premise of democratic debate and the hopes that if the public can agree on the valuation of a service then that reflects its true economic value (De Groot et al. 2001)
These valuation methods can be used to determine the economic importance of Minnesota water-ways. Eco-tourism and travel cost is particularly important in the Brainerd area because of the many tourists who come to the area for the surrounding lakes in the summertime. A center needs to be created that can study the impacts from this tourism and research ways to protect the environments that provide the area with income.

Another reason the Central Lakes Limnology Science Center is important as a thesis project is to show the public and reviewers the impact that investing in science once again can have. It has been a recent trend in the scientific community to see that most facilities are too small and outdated in terms of technology. The buildings that house scientific research are often not functional because they were designed static and do not possess the flexibility needed to accommodate a changing profession. This leaves many lab researchers yearning for more space and higher quality facilities. This need is often overlooked because these facilities do not generate a profit like a commercial property would but instead must be funded or invested in. However, as illustrated previously in this section, our natural waterways are a valuable economic source and if protected prevent the need to spend millions of dollars on mechanical treatment systems.

FACTS:
-In 1991, wetland-related ecotourism activities such as hunting, fishing, bird-watching, and photography added approximately fifty-nine billion dollars to the national economy. This number has only increased in recent years (EPA 2001).
An acre of wetland can store between 1 and 1.5 million gallons of water. Building man-made water storage facilities would cost millions (EPA 2001).
Investing in a science center and taking the time to design a flexible and functional research space would mean drawing in top scientists from all over the country who could then develop ways to even further save local economies money. In these ways the Central Lakes Limnology Science Center proves its worth.

THEORETICAL PREMISES:

The hypothesis that will be tested and followed throughout this design is if a functional building can result by creating an analogy between the ecosystem functions that exist in waterways and the functions that humans need out of a building.
Marina Alberti, John Marzluff, Erin Shulenberger, Gordon Bradley, Clare Ryan, and Craig Zumbrunnen talk about the connection humans have lost with nature in their article, “Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems” saying,
“Despite dominating Earth’s ecosystems, humans remain conspicuously excluded as subjects of much ecological thinking and experimentation. Traditional ecological research investigates ecosystems in terms of biophysical, ecological, and evolutionary processes unaffected by human influences. During the last 100 years, formidable strides have been made in the scientific understanding of ecological systems. Evolutionary theory and population genetics have made fundamental changes in the assumptions underlying ecological research. Ecological scholars no longer regard ecosystems as closed, self-regulating entities that “mature” to equilibria. Instead they see such systems as multi-equilbria, open, dynamic, highly unpredictable, and subject to frequent disturbance.”
(Alberti et al. 2003)

Awaking Waters as a project will explore how building integration can be achieved if we begin to consider humans part of the ecosystems around them again and include the built environment as part as our habitat. We see ecology as the study of animals in their habitat but often forget that we are animals too and buildings are our habitat. I believe in thinking this way a more functional and self-sustaining building will result which is highly important for a scientific research center.

The supporting premises of this unifying idea that humans are an integral part of the ecosystem are:

Ecosystems are a series of functions that work together to create an entire habitat. Analogies will be drawn between ecosystem functions and the functions of a building. If all of the parts of the building can function as one then the building has met its goal of having complete system integration.

Although there are many moving parts to a system of wetlands, many of these functions are not perceptible to us and we perceive wetlands as being stagnant. However, wetlands are still performing important ecological functions that support rivers and streams. Because of this, I will reference wetlands as passive

systems and will use the functions of wetlands to inform the passive systems used in my building design.

In contrast, rivers and streams have many active properties that I will use to inform the design of the active systems of the center.

NARRATIVE CONCLUSION:

Awaking Waters will not only aim to integrate building systems into one cohesive system but will also aim to integrate humans back into the natural environment; something that we have excluded ourselves from for a long time. The center will be a hub of research that can study both the positive and negative effects humans have on the ecological properties of the waters around us. Furthermore, the center will be a place where the public can become actively engaged in the study of limnology and learn about human interactions with water and the benefits we can gain from this.

The materials of the physical building will be made out of sustainable products and in keeping with the site. Money will not be the bottom line, instead materials will be chosen for their lasting qualities and their abilities to support the overall design intent of the building. Water will be treated as a material instead of a landscaping after-thought and water will be a major part of the interior of the building. The materials chosen will need to be cohesive and in keeping with the requirements for lab design. Natural woods and stones will compliment the public spaces while harder terrazzo will create most of the surfaces in the lab spaces.

T Y P O L O G Y

The project typology can be defined as educational as it pertains to architecture. On a more specific scale the project would be classified as a scientific research facility that allows the public to come in and see the research that is taking place there. In this way the building is not only educational in nature but also in the type of daily operations that take place there.

The “Whole Building Design Guide” (WBDG-Research Facilities) describes research facilities as complex, technically sophisticated, and mechanically intensive structures that house the everyday functions of research workers.

In recent years this typology has drastically changed and design standards previously used for these building types no longer apply and the precedents have changed. This typology is going through a period of evolution and will emerge drastically different than before. This allows the design of Central Lakes Limnology Science Center to set its own parameters and follow the front runners of research design.

CASE STUDIES

The case studies that are relevant to the project were chosen for specific merits they possess which will be outlined below. They were also split into two groups; buildings I was able to physically visit, and buildings that due to time constraints, did not allow a visit.

Visited:

Regional Science Center- Moorhead State University
Buffalo River State Park- Glyndon, MN
Merits: Similar in size and typology of Central Lakes Limnology Science Center. The center mostly focuses on public spaces and the archaeological importance of Buffalo River State Park.

Tamarac National Wildlife Refuge Headquarters Building
Tamarac National Wildlife Refuge- Rochert, MN
Merits: Similar in size and possesses a good public outreach component of building. While no research is being done at headquarters they actively engage the public and provide support spaces to staff with this building.

Not visited:

University of Wisconsin-Madison Center for Limnology (Hasler Lab)
Lake Mendota- Madison, WI
Merits: This center mostly closely matches the typology of my building. While the center does not have public component, it is also a Limnology science center that is devoted to the research being done on Lake Mendota.

Jackson Laboratory for Genomic Medicine
Farmington, Connecticut
Merits: The Jackson Laboratory is mainly devoted to genetic studies for biomedical research, however because of the designers employment of functional, flexible, and convertible lab spaces, it is a god case study.

Durham Research Center- University of Nebraska Medical Center
Omaha, Nebraska
Merits: The designers of the Durham research Center explain each system used and how they are integrated to work together within the building. They also put sustainable practices at the highest importance and made sure the building would be self-sustaining for a long time.

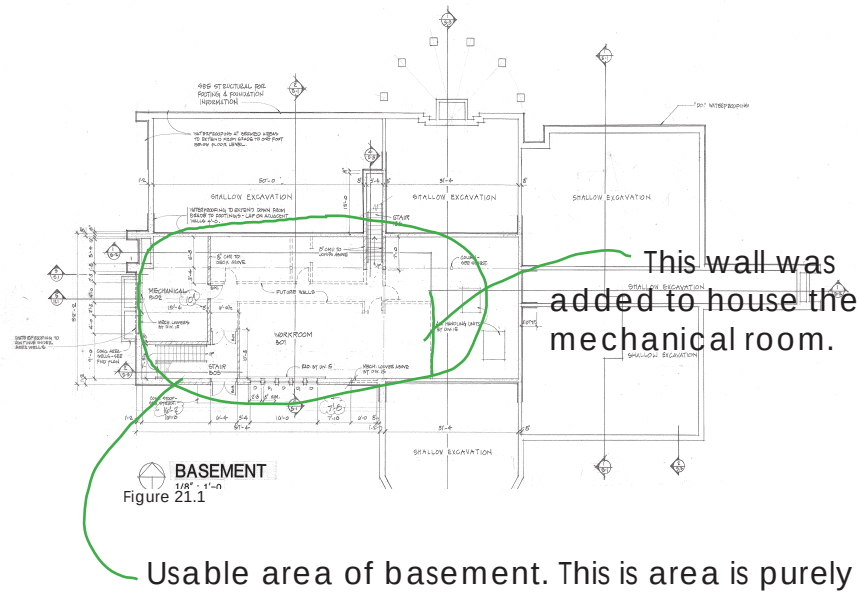
MSUM SCIENCE CENTER

Figure 20.1

The MSUM Regional Science Center was built in 1991 and serves as an extension site for the biology, anthropology, palaeontology, and ecology departments at Minnesota State University Moorhead.
The center is mainly used for public outreach and hosting public events. Otherwise most of the students conducting research only use the facility as a sort of “home base” and conduct the majority of their studies outside at various sites along the Buffalo River in Buffalo River State Park. Classes from the university will meet at the center but actual labs or experiments are not conducted at the center because most students choose to take their work back to the main campus.
I visited the center on a day when a public tour of anthropological digs were being conducted and was fortunate to be allowed to tour the facility and ask questions about the functions being conducted there.

The findings of my visit is that the center is underutilized because of budgetary considerations. Actual classes are never held at he center because there is not enough space for the proper equipment and the spaces are not flexible enough to accommodate the changing needs of the university. However, the center effectively serves the public well and creates a jumping off point for the public who are exploring Buffalo River State Park.

In my experience the center is not open enough. You cannot go in and see the exhibits at any time but instead you must attend a hosted event. The exhibits inside were interesting and informative and if more functions of the university were carried out at the center it could be open to the public more.



This wall was added to house the mechanical room.

Figure 21.1

Usable area of basement. This is area is purely mechanical equipment and storage. The plan shows that walls were planned for future use and to create separate rooms to be used as workrooms but the walls were never added. Instead the floor is painted with a safety walk and equipment is stored in the large open room.

Figure 21.2

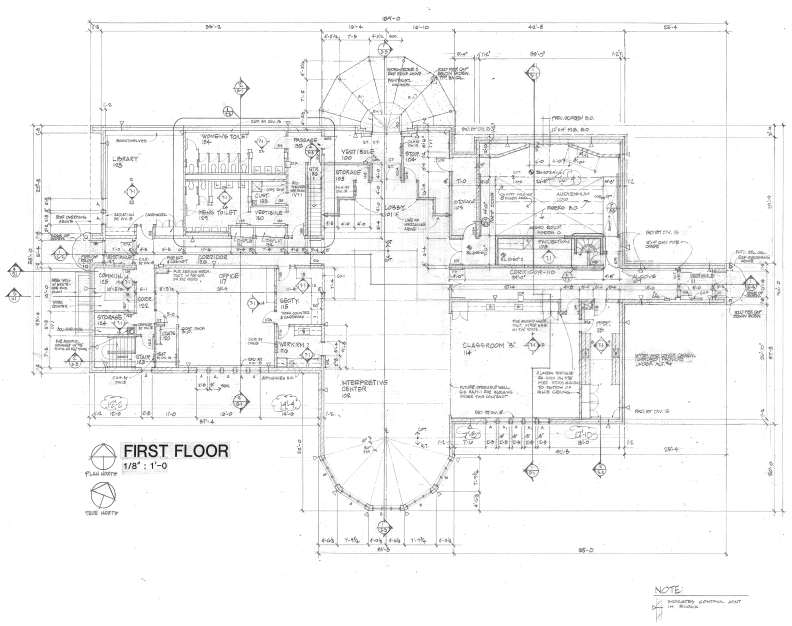


Figure 22.1

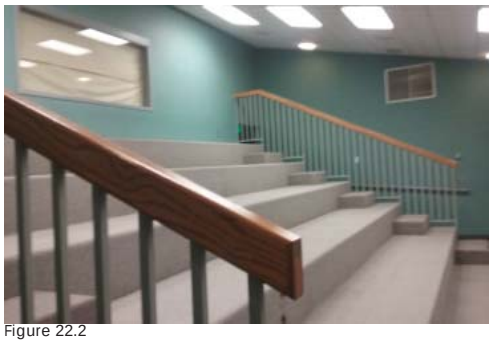


Figure 22.2

The first room addressed was the auditorium. My guide explained that it is never used because visitors to the center do not want to see presentations indoors but instead want to be outside and see the areas being talked about. It is also not handicap accessible and too small to be of any use.

Figure 22.3

The classroom in the center is rarely used because most classes are held on campus where more resources are readily available. The classroom is also open to the public area so the room can be distracting.

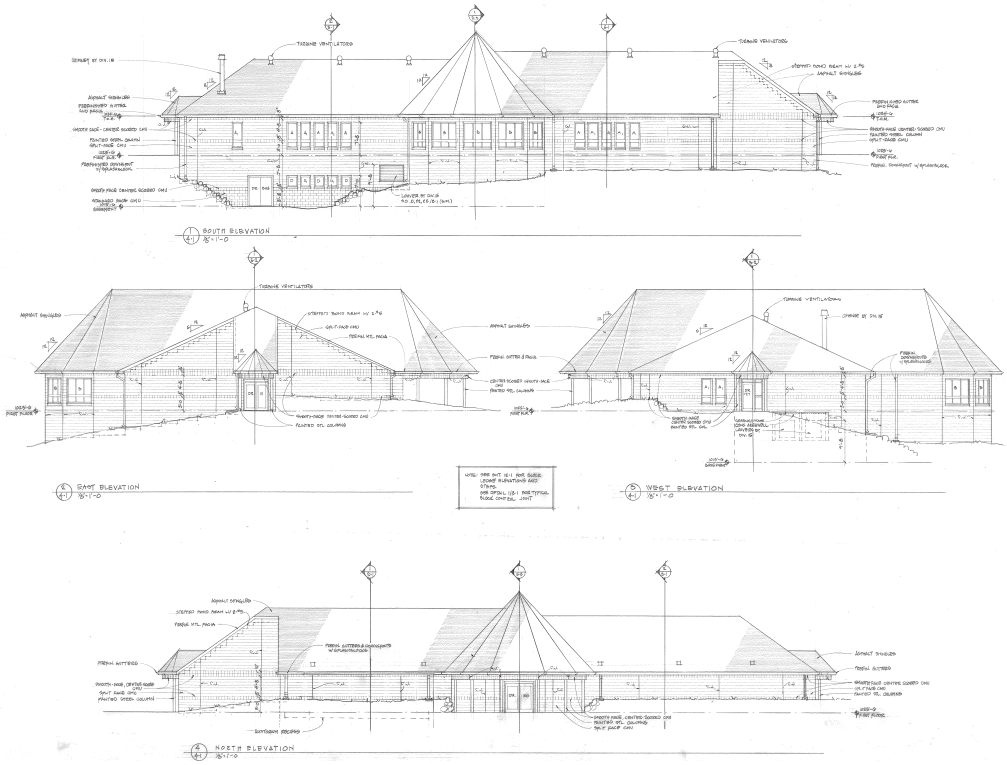


Figure 23.1

The materials used in the construction of the center are concrete block and standing seem metal roofing. These materials respond well to the prairie climate and the roof effectively sheds snow in the winter.

The center is also built into the landscape which helps shield and protects the building from the landscape. In these ways the center responds well to climate conditions and is responsibly built in terms of the environment.


Figure 23.2

The main exhibition area of the center is in my opinion very well-crafted and effectively creates a corridor that leads visitors to the views of the Buffalo River and the bird feeders.


Figure 23.3

The use of glue-laminated beams was interesting in the transition between a pitched roof to the semi-circle in plan. The radial orientation effectively transitions from rectilinear forms to circular forms.

TAMARAC VISITORS CENTER

The Visitor's Center for the Tamarac Wildlife Refuge sits in the side of hill overlooking some wetlands off of highway 26 in Minnesota. The building acts as a jumping off point for guests of the refuge; a place to collect information about the area and to collect one's self before exploring the many trails that lead through the park. Guests can stop at the adjacent discovery center to learn even more about the ecology of the park before setting out.

The Tamarac Visitors Center was chosen as a case study because of the public interaction and the gateway it provides to the nature in the park. While it is not used as a research facility, it is the headquarters for the park and features educational explorations that interact with the public.

Figure 24.1


Figure 25.1

The display area of the center resides on the south side of the building under a sloped mono-pitch roof. The exterior of this roof is positioned in such a way for the solar panels on it to receive optimal south sun. The pitch of the roof also directs rain water straight into a rain garden below.


Figure 25.2

The sloped roof in question provides 3 functions. Collecting energy, harvesting rain water, and shielding the display area inside from sunlight that could either ruin displays or create unwanted glare. It may seem like a simple coincidence but the designers of the building used the landscape to their advantage to create an effective display area that engages the public.

As you move through the display area you are naturally directed up a staircase that brings you outside onto an observation deck that overlooks the wetlands. I consider the path you are directed to be effective because you first learn about the flora and fauna located in the refuge and then are directed outside to see first-hand what the displays set out to teach you about. The building itself informs those inside.

Figure 26.1

The building does not hide anything from the users and makes it very apparent to those who visit it the sustainable practices being used in the design. The figure above showcases the north side of the building which houses the offices of the directors and other workers of the park.

To protect these areas where people spend most of their time from the harsh winter winds coming from the north the building is nestled into the hill and much of the north side is protected with earth. Only the top few feet of the building is exposed to allow room for clerestory windows that provide the offices with diffused north light.

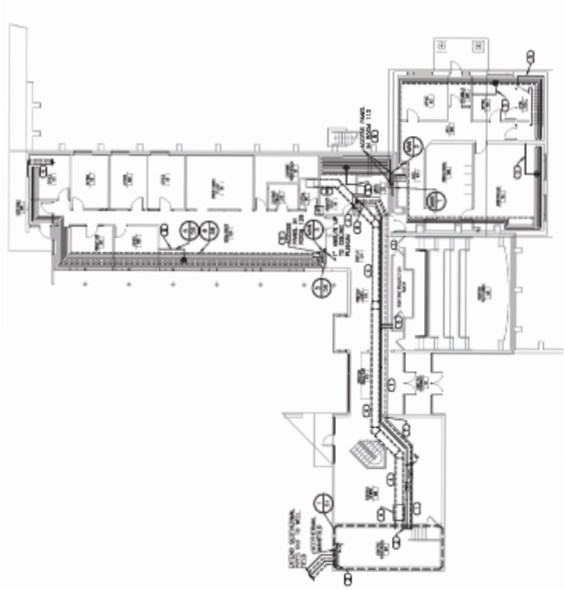


Figure 26.2

Much of the building on this side is also built using fieldstones that not only act as retaining walls holding back the earth, but also act as thermal massing that absorbs the sun's heat during the day and help to keep the building temperature regulated.

The auditorium space (below) seems to be better utilized than that at the MSUM Regional Science Center. The first attribute it possesses over the former is that it is handicap accessible. While it may not be apparent from the photograph below, the two doors into the space enter at the highest point in the auditorium. Just to the side of these two doors are areas that are meant for those in wheelchairs to sit. While it may not be the best solution, providing seating in the back for those with a handicap, it is the best solution for a small visitors center.

Figure 27.1

However, the auditorium is still not flexible enough to compete with today's standards of facility design. While I was at the center a worker was giving a presentation outdoors to a group of students and talking about the plant life of the park. I do not see how the current auditorium could work for presentations where they wish to use other visual aids besides those that can be used with a projector. At the back of the auditorium is a fixed projector screen. Something more useful would be a system of screens, white boards, and interactive boards that could be utilized at different times base on the nature of the presentation being conducted in the room.

After visiting the Tamarac Visitor's Center I think that it is a responsible small building that effectively creates a jumping off point for the public. It also responds extremely well to its climate and uses sustainable practices to help make the building self-sufficient in a remote area.

UW MADISON HASLER LAB

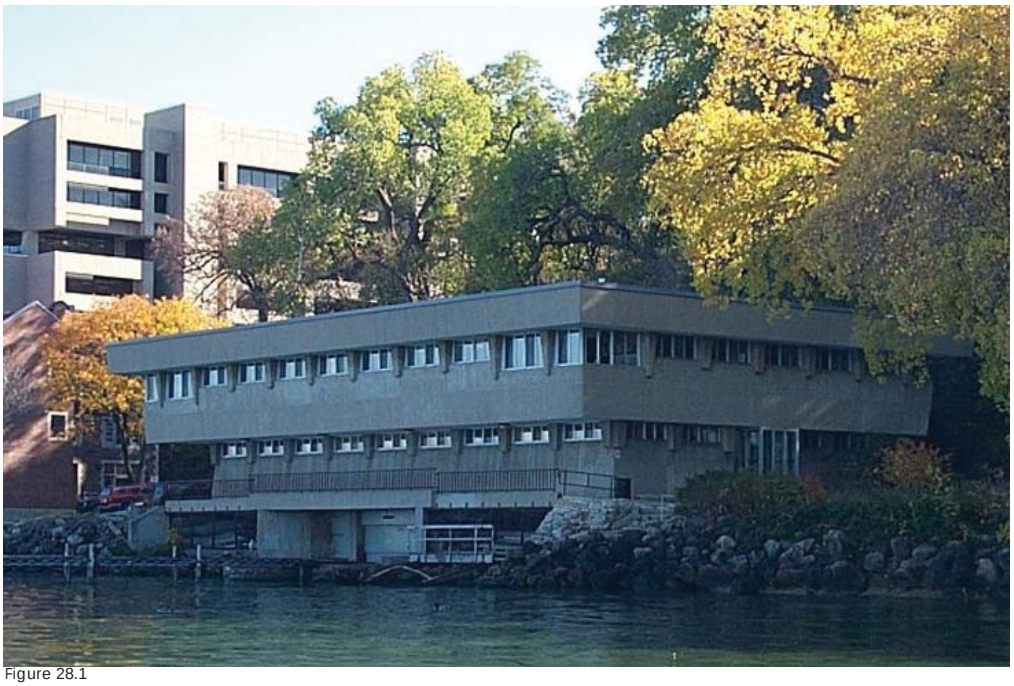


Figure 28.1

Although it may not look like it, the Hasler Lab of the University of Wisconsin Madison, is one of the premiere facilities and front-runners on the study of Limnology. The center also houses the research being done on Lake Mendota, which is the most studied lake in the world because of its properties of freezing and stratification.

Built in 1982, the center provides a place for more than 100 years of Limnology research to take place. The mission of the center is to provide a place where new knowledge about water ecosystems can be presented to the public through outreach and classes. It also provides support for those researching on Lake Mendota and facilities for them to conduct experiments and log data.

In this way the Hasler Lab has become an integral part of the University of Wisconsin Madison campus and draws influential researchers from all over the world.

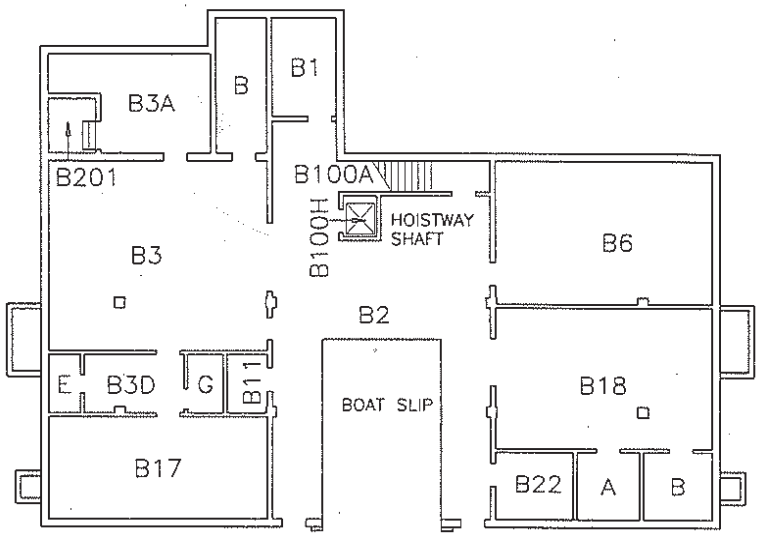


Figure 29.1

Floor	Room Number	Use - Subuse
B1	B11	Rsh Lab Svc - Battery Room
B1	B17	Rsh Lab Svc - Storage
B1	B18	Rsh Lab - Wet Lab
B1	B18A	Rsh Lab Svc - Storage
B1	B18B	Rsh Lab Svc - Storage
B1	B2	Rsh Lab Svc - Boathouse
B1	B22	Rsh Lab Svc - Storage
B1	B3	Rsh Lab Svc - Shop
B1	B3B	Rsh Lab Svc - Storage; Utility/Mech - Elec Equip
B1	B3D	Rsh Lab Svc - Locker Room
B1	B3E	Rsh Lab Svc - Shower
B1	B3G	Rsh Lab Svc - Toilet
B1	B6	Office - Open Ofc; Rsh Lab Svc - Storage

Figure 29.2

The basement of the lab houses many of the mechanical functions and storage facilities as to be expected. However, the Hasler Lab is unique in that it includes a boat slip and is located on the banks of Lake Mendota. This gives researchers easy access onto the lake they study and serves a duel purpose or storing equipment and launching equipment. The boat slip is located on the north side of the building.


Figure 29.3

While this boat slip is convenient it posed questions about the ethical responsibilities a research facility like this would have. Should a building be placed on the edge of the lake? Is that not exactly what those with lake homes do and we condemn them for that act? The edge of the lake had to be modified with rock retaining walls to strengthen the banks and provide support for the building. This could also create problems with moisture coming into the facility and the water would need to be heated to prevent damage to the basement walls. This could change the way the lake itself behaves and over time have detrimental effects that are unseen to researchers now.

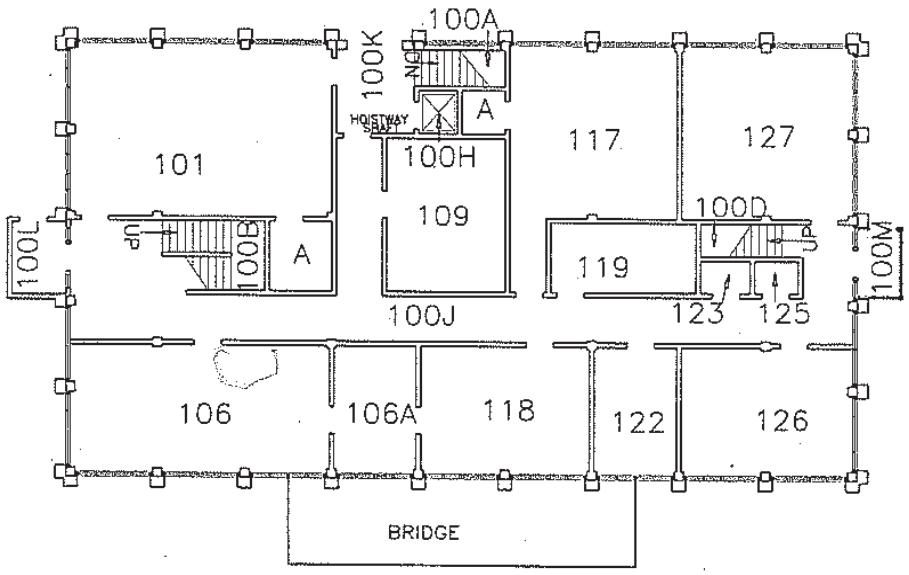


Figure 30.1

01	101	Rsh Lab - Wet Lab
01	101A	Rsh Lab - Dry Lab
01	106	Office - Open Ofc; Rsh Lab - Wet Lab
01	106A	Office - Private Ofc
01	117	Rsh Lab - Wet Lab
01	117A	Rsh Lab - Wet Lab
01	118	Office - Open Ofc
01	119	Rsh Lab - Wet Lab
01	122	Office - Private Ofc
01	125	Rsh Lab Svc - Storage
01	126	Office - Open Ofc
01	127	Office - Open Ofc; Rsh Lab - Wet Lab

Figure 30.2

The first and second floors of the Hasler Lab are relatively the same with the offices being on the north side of the building and lab spaces on the south side. The above drawing of the floor plan is upside down with north being on the side with the bridge.

The lab is interesting in the respect of light control. Many experiments being conducted in wet labs are sensitive to light, especially involving organisms that normally reside deep in the water column where light does not reach. To combat this the labs are put on the south side of the building with no windows. The construction of the building being concrete allows this side to absorb heat from the sun but does not allow light in.

However, the drawback to this is that the windows on the north side in the offices have to be small so as not to lose heat in the winter time. With the winds sweeping across the lake, the offices on the north side would lose a lot of heat and seem to be misplaced. In this respect the center has been placed in an environment and does not respond as well as it could to its landscape.

After speaking with one of the directors of the Hasler Lab it became apparent that the lab is too static and cannot accommodate the changing needs of research being conducted there. The functions being performed at the lab being administrative, research, teaching, and outreach activities directly coincides with the functions that would be carried out at the Central Lakes Limnology Science Center. The building consists of a few labs with one being a wet lab used for chemistry and plankton experiments. Along with these labs are offices and support spaces for each researcher, visiting scientists, and graduate students using the facility to do their thesis.

The director spoke of how the facility is not meeting their current needs and touched on how the building is too small. According the Whole Building Design Guide, this is a common problem among research facilities because many times the funding is not there to plan for future growth. The ability to expand the existing lab does not exist however because of the location of the facility. Being directly on the lake limits the possibilities of expansion and would require activity that could be detrimental to the studies being conducted on the lake if construction were to occur. These space constraints have led to many experiments and samples being held in an off-site storage facility which defeats the purpose of the building being on Lake Mendota.

While the center may be outdated in terms of technology, it successfully houses public activities that teach many kids and adults alike about the kind of research taking place which is what the facility for Awaking Waters will also aim to do.

Figure 31.1

JACKSON LABORATORY

Figure 32.1

The Jackson Laboratory is based in Bar Harbor, Maine and operates on the forefront of genomic research. With genomic research being fairly new in terms of scientific research, there was not many precedents to design from and Tsoi/Kobus and Associates had to design off the cuff. Their main concern was to design a facility that could accommodate the rapidly changing nature of medicine research. They knew with genomic research being so new, that it would change drastically in the coming years and the center had to be able to change with the research. In this way the laboratory is an excellent case study because of the methods employed to create flexible spaces.

The process for the design of the center is unique in terms that it does not fit into the conventional style of design research. Instead of designing from the user's pre-existing notions of what their spaces should look like base on their current research environments. However, those current environments are not sufficient in today's standards so they should not be used as design guides.

Another way that TK&A changed the game when designing the Jackson Laboratory is by getting rid of the conventional wet lab vs. dry lab classifications. They found that this only inhibits researchers from inventing new ways of doing things and they are stuck doing only what the facility can support.

Figure 33.1

Designers of the lab did not make any friends when they at many times denied the requests of high-level researchers who would be bringing in revenue for the center. However, this did this because they wanted to meet the needs of many and future inhabitants of the building, not just a couple researchers who are only thinking of their own needs. In this way the facility can exist past the key researchers and be on the forefront of genomic research for years to come.

They knew they needed to design for the unknown. To do so the center features many movable furniture pieces that would otherwise be fixed in a traditional lab environment. Another feature of the building is the segregation of the auditorium space and the other functions of the building. The needs of offices and labs versus auditoriums is vastly different. Separating them through a lobby connection allowed the spaces to employ different designs that allow them to not only function to their own highest capacities, but also be apparent from the outside that the two spaces perform different functions.

While the facility may cater to the changing research being done, it does not actively engage the public because of the nature of work being done at the facility. Instead the center aims to teach the next generation of medical researchers.

Figure 34.1

The third floor of the Jackson Laboratory showcases the flexible nature of the lab spaces. Each layout is a wet lab design adjacent to a dry lab. Surround these areas are what is called lab support. Each area houses different equipment but is easily accessible to researchers working in the labs. The layout of these spaces reduced the amount of hard-wall supports needed and in turn created spaces that are more conductive to collaboration among the researchers.

Figure 34.2

The furniture itself in the lab spaces became the hard-walls and as seen in the figure above, are self-supporting and are not anchored to the floor. Outlets in the ceiling free up space on work tops for researchers and ensure that equipment can move anywhere within the space. The designers also included MEP connections at strategic places around the building that while not being used at the moment, are simply waiting for the day when the entire function and layout of the building needs to change.

The Jackson Laboratory operates on the forefront of flexible design and can truly accommodate the changing workplace. We have come to the point in design where treating a building as a static entity will simply no longer work.

DURHAM RESEARCH CENTER

Figure 35.1

The Durham Research Center is a facility for the University of Nebraska Medical Center located in Omaha Nebraska. This facility shares many qualities and attributes with the Jackson Laboratory in that they both house medical research and are quite large when compared to the scope of the Central Lakes Limnology Science Center project. The Durham Research Center also does not allow just anyone from the public to tour the facility and does not provide outreach activities.

However, the Durham Research Center achieved is currently working toward a LEED certification for the building because of a push from students to do so. While there is little regulation from LEED on medical buildings, the designers still designed with sustainable practices that were ahead of where LEED regulated. In doing so they changed the standards for medical research buildings.

The facility was also built in two phases with the first tower built and then some time later the second tower was built. The design firm, HDR, was able to use this as an opportunity to learn from the first tower and adjust the design of the second tower. They conducted interviews of those who inhabit that building everyday and used the information gained there to direct the interior of the second tower. This resulted in a stronger design that more readily adapted to the needs of the users. Most designers would jump at a second chance at a building after it has been inhabited.

SUMMARY:

As the project moves forward these case studies will be revisited and looked at in terms of their design attributes which includes but is not limited to, materials, spacial layouts, structure, and mechanical systems relevant for science lab spaces.

The main takeaway from these case studies is that the building as to accommodate future growth and provide flexible work spaces. A successful research center will grow in terms of researchers working there and the building needs to be able to grow with that. Choosing a site that allows future buildings and/ or future additions to the original building footprint will be imperative.

Research facilities and laboratory spaces have changed drastically in their needs since the inception of the modern science building. Furthermore, workers are demanding that their offices and work spaces respond to their needs and are no longer seen as static objects or dead load in a building.

In talking with inhabitants of some of these buildings it became apparent that an auditorium space is not a viable component of the project. They are often too small, inflexible, and not easily made handicap accessible. Both facilities containing a traditional auditorium reported to me that they are rarely used mostly because of ADA issues. These facilities were built in a time when ADA standards were not a top priority. However, that is just simply something you cannot get away now. Modern lab spaces need to be fully ADA accessible without sacrificing any functionality of the building.

The two case studies that will be the most helpful in designing the Central Lakes Limnology Center are the MSUM Regional Science Center because of its public display attributes and the UW Madison Hasler Lab because of its use of research labs for Limnology related work. Both of these buildings are also around the same size as this thesis design will need to be. These two case studies were also helpful in programmatic ways and will help to inform the spaces needed in a Limnology research facility.

LAB SPACE:
This would accommodate any physical research being done in the center. To engage the public better these spaces would need to be highly transparent but yet secure so that researchers can work in peace. The lab spaces also needs to be large enough to be safe and accommodate future growth.

OFFICES:
These are required for administration so that daily operations of the facility can be carried out. Also, offices will be provided to researchers so that they may study their findings and a place to collect their data.

CLASSROOMS:
Being that this center could potentially connected with the local community college, classrooms are provided so that researchers can share their findings and train students. These also be used as spaces where seminars that are open to the public are held. Along with this is a large lecture auditorium where large group discussions and presentations can be held.

VISITORS CENTER/ EXHIBITION SPACE:
This will be a large and centralized space that will accommodate many exhibitions meant to teach the public about the waters of Minnesota. It will need to engage the public and draw them in while still educating.

AQUARIUM:
To study water is to also study the organisms that inhabit it. The aquarium will be open to the public and is meant as a sort of "eye candy" to get them engaged and wanting to learn more about the water that these organisms live in. This feature will need to be integrated with the building so that is flows well with the spaces and does not look like just any fish tank placed in a room. The aquarium will mostly feature freshwater native fish of Minnesota.

USER DESCRIPTION

The users of the center will be split up into two groups, primary and secondary.

The primary users of the Central Lakes Limnology Science Center are the researchers, administration, and students who will be working within the building every day. Their requirements are as follows:

Researchers:
Adequate lab space to conduct data collection and experiments. Offices to collect one's data and prepare educational documents of research to further the common goal of the facility. They will also need support spaces to create an environment that supports long hours spent in the building.

Administration:
The need of support spaces will be the same as the researchers but the need for office space will be greater. Along with this need of office space comes the need for natural lighting and accessible outdoor spaces for staff to take breaks in.

Students:
Here the needs of the students who visit the building can be split into two categories. The first being those students who are at a higher level and conduct full-time research at the center. These students will be treated like the full-time researchers and would have the same needs. The other category is students who wish to take a class or seminar offered at the facility and only have a need of the center for a short time. With this comes the need for a space where students can study, eat, and pass time while waiting for their class. Along with this comes the need for transportation from the main campus of the community college to the center to limit the need of parking at the facility. However, the student needs of the facility will not be great because the main function of the facility is a research center and not an academic hall.

The Secondary users of Central Lakes Limnology Science Center are the general public who wish to visit the center and see its daily operations.
This public will encompass people of all ages and backgrounds. Their needs are as follows:

Public:
The needs of the public are to have ample space to wander around educational exhibitions and the aquarium. The other side to this is to have outdoor spaces that bring the public right into a wetland where they can see field research being conducted along with the ability to easily see the research labs and those working in them. The center will also need to provide public classroom space where public outreach classes can be taught that get people involved with the science of water.

Usage:
The estimated peak usage of primary users of the building is between 25 and 50. This accounts for all researchers, students, and administration. However, as a lot of research will be done in the field this usage will change day to day as people come and go. Parking would need to be provided for 75% of those working in the building everyday.

The estimated peak usage of secondary users of the center is also between 25 and 50. This accounts for small groups of people or families who stop in for a couple of hours and also those who come on school trips and stay all day. Parking would be provided for 50% of expected daily visitors as their needs of the building are much shorter than those working in the center.

Together the people that make up the users of the Central Lakes Limnology Science Center will have one thing in common; they care about water and they want to learn more about water. This commonality will push users to learn and study water and in turn pass that knowledge onto those around them. Minnesota culture has always been centered around water and the use of the waterways. This can continue to be true, however, the center will aim to create a more sustainable culture and one that appreciates the energies of water ecosystems.

SITE INFORMATION

REGION:

The project is located in central Minnesota in the city of Brainerd. This area is just north-west of the twin city metro area and is surrounded by lakes and rivers. Two rivers, the Crow Wing and the Mississippi meet in Brainerd where the Mississippi continues on through the Twin Cities and down the border of Minnesota and Wisconsin. This region of the state has lakes, rivers, streams, and wetlands making it an ideal location for a Limnology Science Center. It is also close enough to the metro area to attract many visitors.

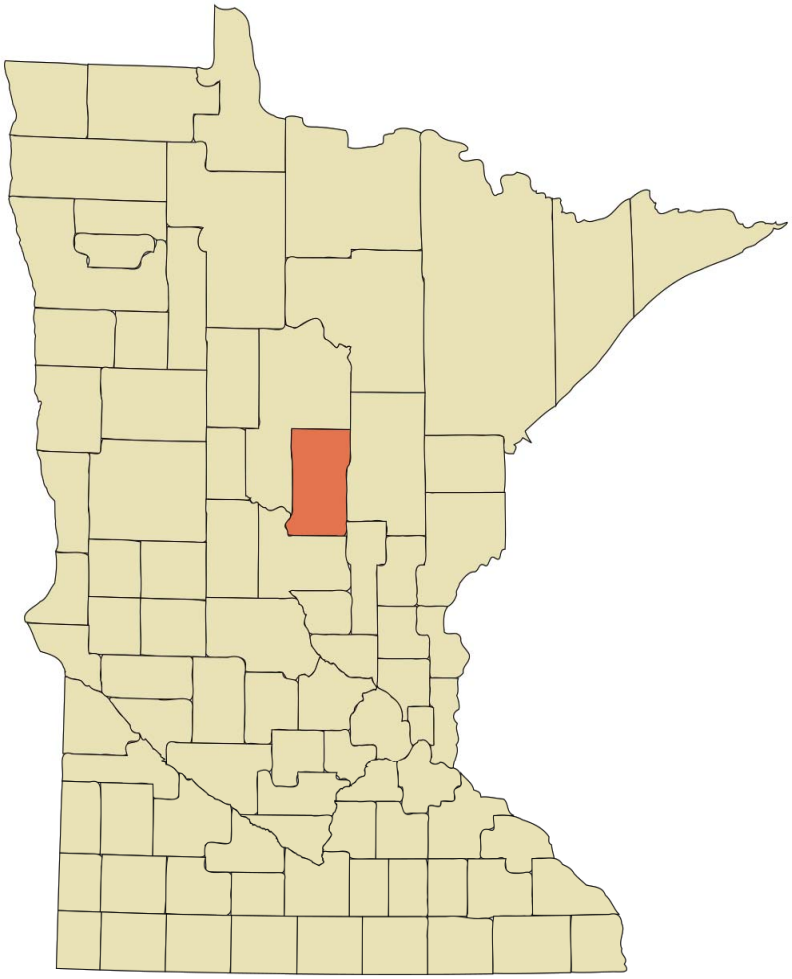


Figure 40.1

CITY:

Brainerd, MN

County: Crow Wing

Population: 13,487

Major Highways: 371 & 210

With a population of 13,487, Brainerd has a big enough population to support a research center but it is still small enough to have a need for such a thing. Brainerd also attracts summer “lakes” tourism and is home to offices of the Minnesota Pollution Control Agency which samples fish from rivers in Minnesota to test water quality.

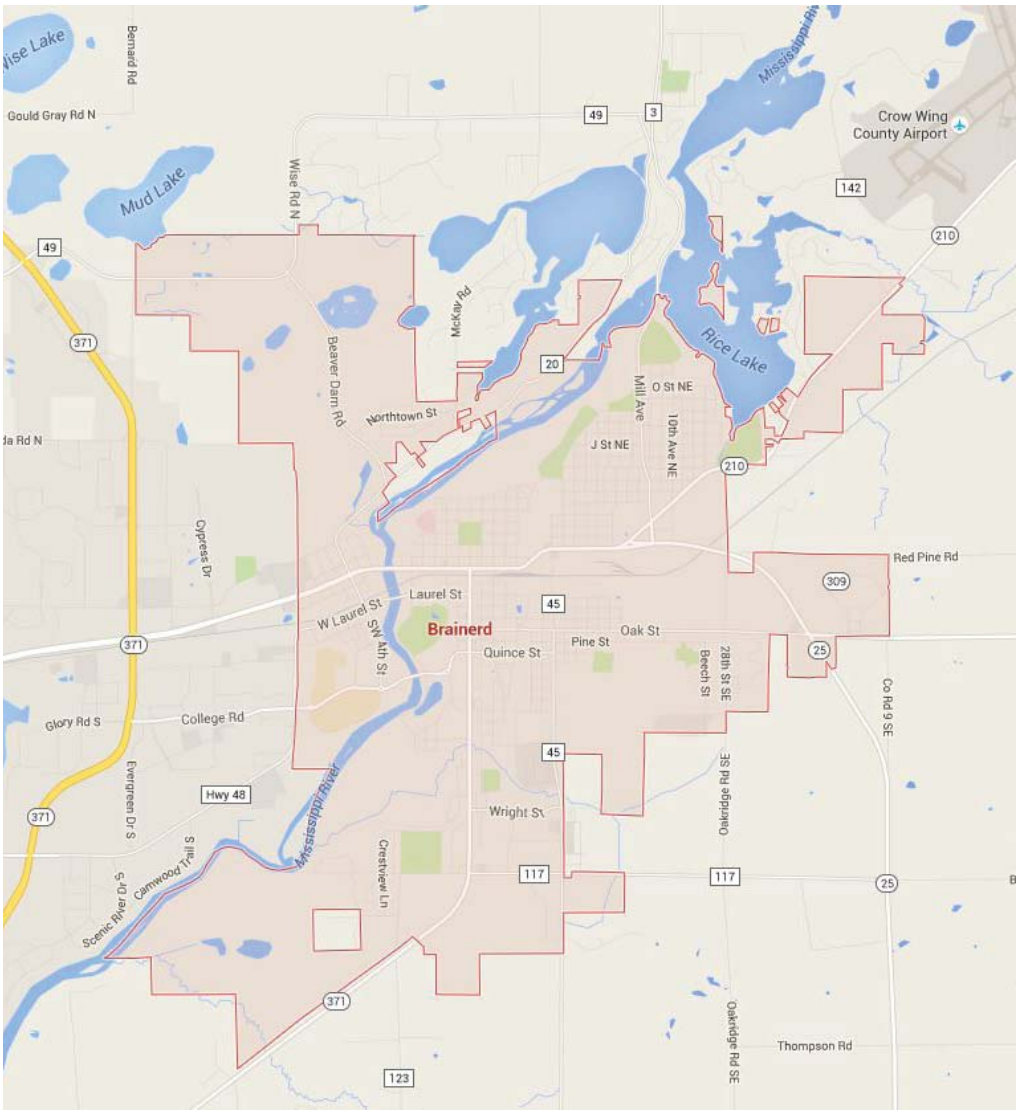


Figure 41.1

SITE:

The Central Lakes Limnology Center will be located at the crossroads of highway 371 and highway 48. The space I will use is approximately one thousand feet by eight hundred feet for a total square footage of eight hundred thousand square feet.

The area is located between Perch Lake and the Mississippi River and the site itself is a wetland making it the ideal location for researchers to be close to the environments they are collecting data from. This also allows guests to become familiar with the bodies of water they will learn about.

There are many challenges to building on this site. First off, because the site is a wetland, it will have to be treated with care and the buildable area will be limited. I intend to leave as much of the site untouched as possible and to push the building to the south-west corner of the site. Sidewalks will have to be high enough so as not to disturb the wetlands but also accessible so guests can easily explore the grounds. Parking will also have to be limited to reduce the impact the center has on the site.

The pros to the site are the reasons the site was chosen and outweigh any negatives that could occur from building on the site. To attract more visitors and be accessible through public transportation, the center is located within the city limits of Brainerd. It may seem counter-intuitive to place a center that revolves around nature in the city but in doing so the building does not contribute to suburban sprawl and limits the impact on the natural environment.

The spirit evoked by the site is calming yet powerful. While the site is undeveloped at the moment, it almost calls to those who visit it to help it return to its more powerful state. It seems to have already pushed the highway to the west because of the wetlands on the property and special care will need to be given to these wetlands so that the site does not also “push” a building away also. At first glance the site is calm and seems void of life but given a closer look, it has the potential to be extremely powerful.

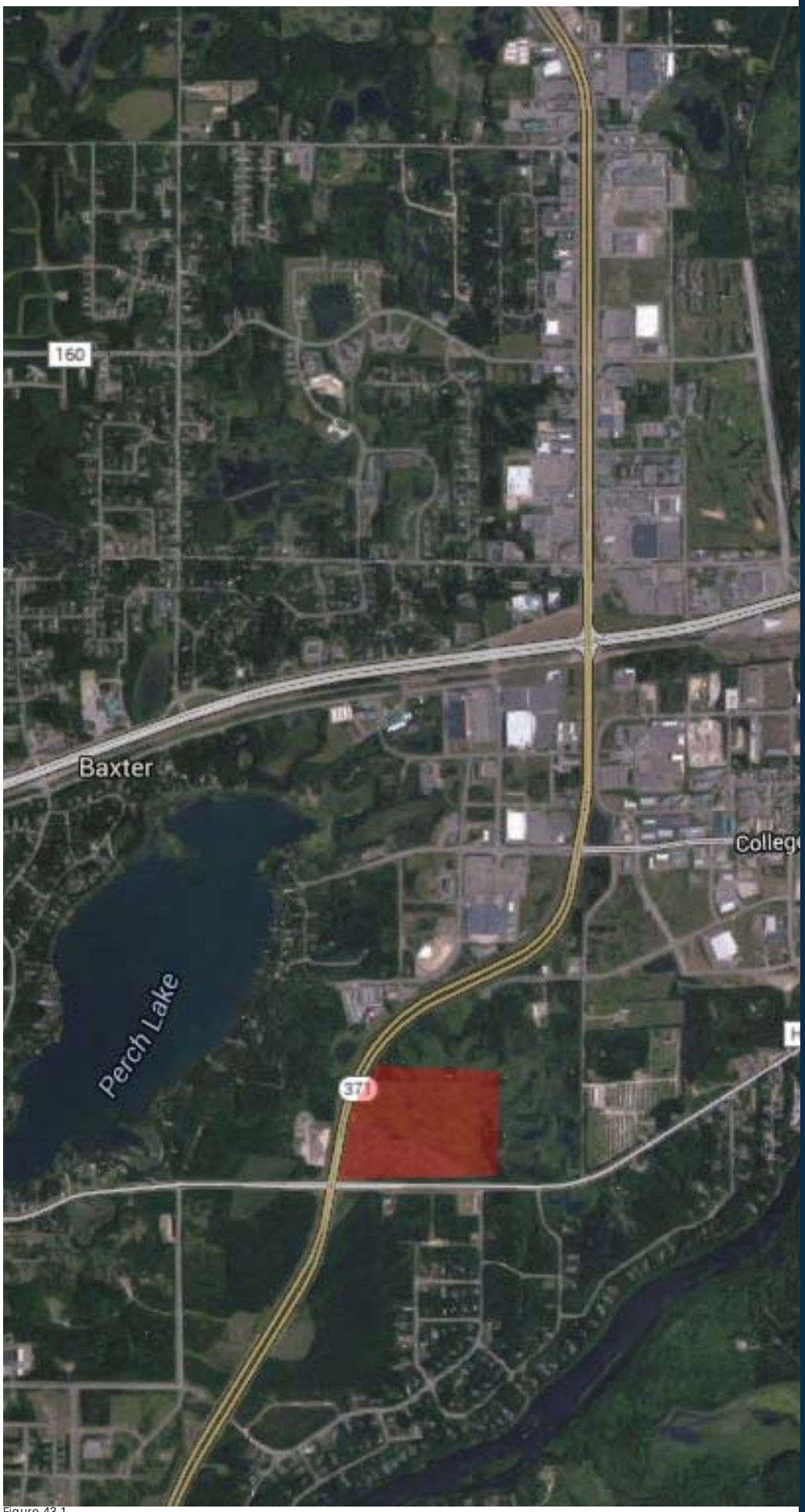


Figure 43.1

PROJECT EMPHASIS

The project will focus on the integration of design systems and the overall integration of the building with its the natural environment surrounding it.

Much like you cannot study water without studying the organisms that inhabit it, the inverse is also true. You cannot study aquatic organisms without studying the quality of water they exist in. In keeping with that premise, this project cannot be treated as just a building. It must be treated like a functioning ecosystem and be the sum of all of its parts.

We as humans, often leave ourselves out of the ecosystems we study. However, we are as much a part of them as any animal and should be studied as such. The same is true for buildings. Many times how humans will interact with the building is an after-thought. The human experience will be part of the design integration process and will be carried through the entire project so that those who work in the center find it functional to their needs.

PROJECT GOALS

The goals of the project shall be split into three categories; academic, professional, and personal. They are as follows:

ACADEMIC GOALS:

The project shall strive to foremost meet the standards set by the architecture department of North Dakota State University, but also the standards set by the university itself as a requirement for graduation. It will also exemplify the standards students in the architecture department place on themselves and the high quality of work that is produced year after year. I will work hard to ensure that my thesis advisor is proud of the project as a whole and has no hesitation in putting their signature on the thesis book.

In addition to fulfilling the general requirements to graduate, I will also work to leave a trail of academic knowledge so that students who come after me may continue and expand upon my research and design. It is our duty as designers to document the resources we used and the process of our design so that there is no doubt left in any observers mind where information came from or how we arrived at our design conclusions.

If these goals are met academically it is my understanding that the project will sufficiently summarize my career in the architecture department at North Dakota State University.

PROFESSIONAL GOALS:

The project shall convey to current and potential employers the level of work that I as an individual can create. I want to show to employers my design and time management skills by having a completed and cohesive project that works as a whole.

In addition to this I want to showcase real-world applications by striving towards complete design integration. I am aware that in a large project such as my thesis that many designers would be present throughout the process and each would contribute what they know best in their respective fields. However, due to a constrained time-line I will not be able to consult other designer and have them work on the project with me.

To circumvent this I will aim to show my basic understanding of the unique systems that go into the design of a sophisticated building. I will show employers that I understand the basic elements of plumbing, electrical, structural, and HVAC systems by designing in a way that incorporates these systems throughout the entire design process.

PERSONAL GOALS:

In doing this project I want to achieve a unique and higher level of thinking about design problems. There are often times that I get stuck and cannot get past the things that cannot be done in my head instead of pushing the limits of what can and cannot be feasible. I want to test my own limits and create something that is buildable but does not fall into any one category and reaches new levels of sustainability.

In doing this I will need to not strive to only chase points but to instead take cues from the environment and design holistically from beginning to end.

By completing these tasks I have set forth I believe I can fulfill numerous goals I have placed in front of myself.

The most important of these goals is to write in a fashion that is keeping with the level of education I have received and will receive. Without fulfilling this my project will have failed regardless of design I have brought forth because of my inability to thoughtfully present that design to my peers, advisors, and university.

PLAN FOR PROCEEDING

RESEARCH DIRECTION:

Research will be conducted in the following areas:

-Theoretical Premise/Unifying Idea

I will further research the inner mechanics of the ecosystems of wetlands and rivers and create analogies between those and the systems of a building.

-Project Typology

Further analysis of case studies will be conducted to better understand the mistakes made and the triumphs of each design. Considerable amounts of research analysis of flexible work environments will inform the spatial layout of the center

-Historical Context

Research facilities are fairly new in terms of the histories of buildings and modern research facilities are even newer. There may not be many precedents to go off of and the needs of the facilities is constantly changing as recent discoveries are made in science. However, I will be conducting research of the environment the center is in and also research the nature of wetlands and rivers in the United States. This in turn will inform the public aspects of my building.

-Site Analysis

Extensive analysis of the site in Brainerd, MN will be conducted to gain further information of how the building can respond to the landscape it is in. To do this I will draw analysis from visiting the site and collecting data. From there I will draw conclusions from that data that will inform the design of the center.

-Programmatic Requirements

Further research into case studies will be conducted to create a comprehensive list of spaces that need to be included in a research facility like Awaking Waters. These will also inform what spaces do not need to be included and will help to eliminate wasted space in the facility.

DESIGN METHODOLOGY:

The design method that will be followed through the design of the Central Lakes Limnology Science Center is a mixed method approach, meaning both quantitative and qualitative data will be collected and conclusions will be drawn from the comparisons and contrasts of these data types.

Graphic and digital analysis will also be employed throughout the design process as the design of the center progresses. This will involve simple models being constructed both physically and digitally and then being tested for various properties. Data will be collected from these studies and will then be used in the quantitative and qualitative analysis of the project.

These types of analysis will be used concurrently with each other throughout the entire design process so that one area of analysis does not overpower another simply because of time constraints.

An area of data that will be researched extensively is scientific data. The typology of the building is scientific in nature so the data that the building follows should also be scientific in nature. This data will be collected through further archival research.

DOCUMENTATION OF THE DESIGN PROCESS:

The process of design will be documented on a weekly basis so as to compile a comprehensive amount of the design process. These will be done in terms of drafting renders, drawings, photos of model studies, and using analytic software to create further studies of the design will be documented.

These various files will be backed up periodically to hard drives so work is less likely to the lost throughout the design process. The work will then be made available to other scholars who continue in our foot-steps through the publication and public use of this thesis and also through contacting me for original documents.

At the conclusion of the design process the work collected will be presented in a sequential format to lead the jury through the entire process of the design.

S C H E D U L E

PHASE	TASK	TIME FRAME
Proposal	Abstract	8/25-8/28
	Narrative	8/28-9/1
	Typological Research	9/1-9/3
	Project Elements	9/3-9/5
	Site Research	9/5-9/7
	DRAFT DUE	9/8
	Case Studies	9/9-9/20
	Book cleanup	9/21-10/14
	PROPOSAL DUE	10/15
Program	Activity Space Allocation	10/16-10-28
	DRAFT DUE	10/29
	Historical Context	12/1-12/5
	Project Justification	12/5-12/6
	Theoretical Premise	12/6-12/8
	Site Analysis	12/9-12/13
	Book Cleanup	12/13
	PROGRAM DUE	12/14

PHASE	TASK	TIME FRAME
Design	Diagramming Concepts	1/11-1/20
	Spatial Relationships	1/20-1/27
	Space Planning Resolution	1/27-2/10
	Structural Systems	2/10-2/19
	Passive Systems	2/19-2/22
	Active Systems	2/22-2/26
	Relationships to Site	2/26-2/29
	Envelope Development	2/29-3/2
	Materials Development	3/2-3/4
	Overall building Integration	3/4-3/7
	MIDTERM REVIEW	3/7-3/11
	Project Revisions	3/11-3/14
	Overall Building Analysis	3/14-3/18
Presentation	Render Character Sketches	3/18-3/23
	Presentation Layout	3/24-4/1
	Model Building	4/2-4/15
	Digital Submission	4/16-4/21
	Print Thesis Book	4/21
	Complete Presentation Boards	4/21
	Install Exhibition	4/25
	Thesis Review	5/2-5/5

THEORETICAL PREMISE RESULTS

To further comprehend the results from the research done involving the unifying idea behind the Central Lake Limnology Science Center, a review of the book, " Living Design, A Daoist Way of Living" by C. Thomas Mitchell and jiangmei Wu has been conducted. This literature furthers explains the disconnect Western Design has from nature and the detrimental effects this can have not only on our ecosystems and landscapes but also our own personal psyches.

Eastern Design

"Living Design" starts by contrasting the design conventions involved in Western Design and those involved in Eastern Design. The main difference between the two conventions, at least as seen by those in Eastern Design, is that Western thinking is object-oriented and that too much of our view is focused on the subject instead of the context. In other terms, we focus too much on the building instead of the site.

Because of the focus on the subject, we view much of our world as dead or meaningless. We do not see our built environment as being alive, but instead as a cold dead object. This may be why it is easy to dispose of building materials and resources without a care. We only see it as disposing of something that can no longer live in the ecosystem. Eastern designs calls for a way of thinking that includes the built environment in the living ecosystem.

It is explained that in Western Design, the world is seen as simply a collection of things. In contrast, Easter Design believes that everything is interconnected processes. We as designers need to shift our focus from nouns to verbs or rather not just address the components of the built environment as objects, but also the processes involved and how they interrelate.

Another notion of Eastern Design that challenges that of traditional Western Design is the distinction between making and growing. The Chinese do not think of nature as something that was made but instead has grown. They apply the same principles in the design of their buildings. We set out to construct or to make a building where the Chinese see the building as a part of nature that will grow and continue to adapt as the environment changes, much like a flower or a tree.

Now, do not get the misconception that Western Design has not already adopted some of these principles. Some of these conventions are already being employed under the umbrella of "green design", which has become a popular and hot topic in today's architecture world.

The East calls for more cohesive and spiritual designs from the West, however we cannot just adopt these conventions wholly. The whole idea is to design with the environment surrounding it. It must be taken case by case. The problem that arises from this is that we do not always have the time develop a spiritual understanding of the proposed site or building. We still have to create a job market for ourselves as designers. This is where the struggle begins. How to develop a sense of place and yet still deliver a project in a reasonable time line.

Qualities of Living Design

The qualities associated with living design have been separated into 6 categories.

1. Harmony at all scales of design
2. Integration with nature
3. Strong cultural connections
4. The importance of shared understanding of environmental meaning
5. An emphasis on the process of experiencing design, not on form alone
6. A focus on place making, not space planning

I think it is agreed among Wester Architects that these principles are important and they strive to achieve as many of these qualities as they can. However, we cannot continually condemn the importance of the functionality of the built environment. We as designers need to definitively figure out what we want. Do we strive for design that is ornamented and truly adds to our quality of life or do we strive for design where function is the highest priority and there is little waste? I would hold that we can have both if we try. I don't think that function should be thrown out the window because it is harder to draw spiritual meaning from a functional building.

If we look to nature again we will see that there is no waste in a natural ecosystem. Everything is there for a specific purpose and everything works together cohesively. A dysfunctional building inhibits those who work and live there and creates a tension in their everyday life. A functioning ecosystem is a beautiful ecosystem. We should celebrate functioning and wasteless buildings instead of condemning them because they do not meet beauty conventions that we have created.

Daoist Principles

Daoist principles are most easily summed up with the Five Elements. These elements were the immediate products of Yin and Yang interactions. The elements created from the interaction between Yin and Yang are metal, wood, water, fire, and earth.

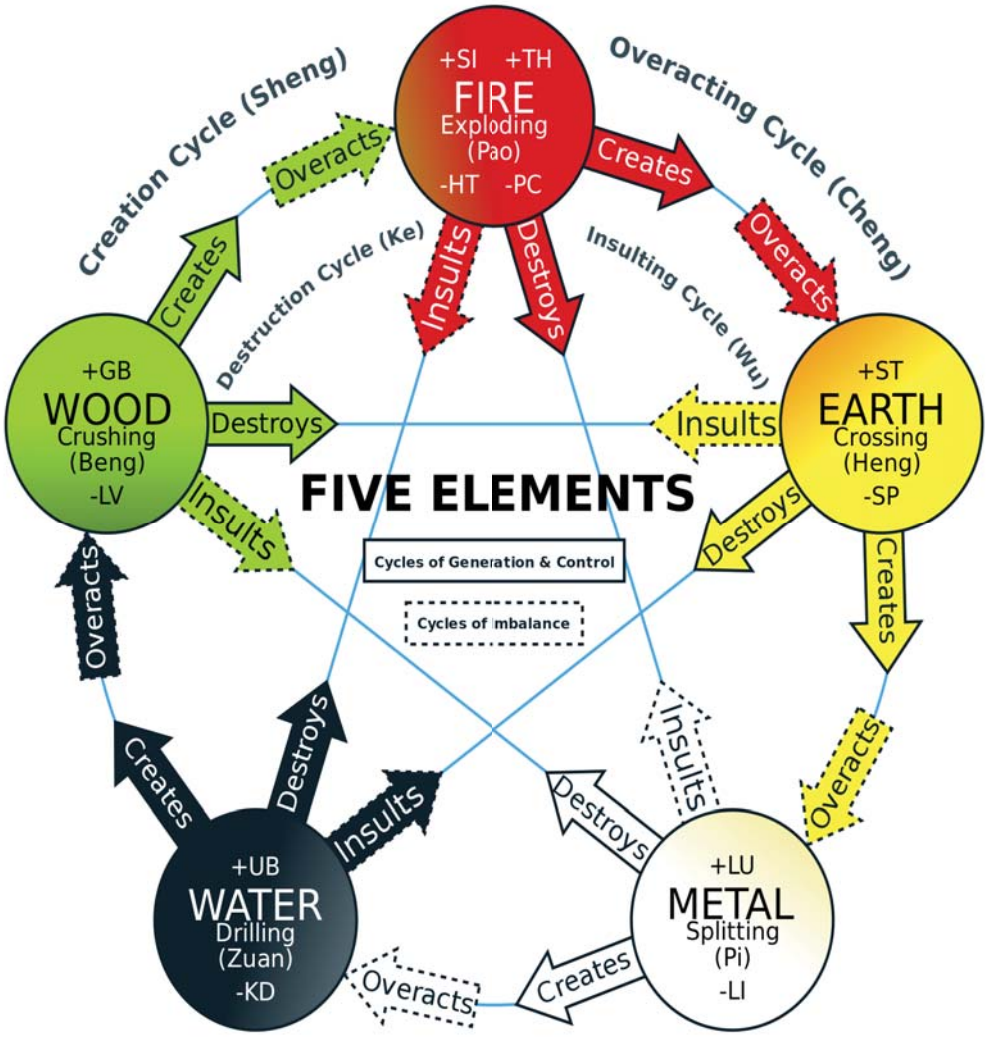


Figure 54.1

These Five Elements produced and destroyed each other successively. Wood caught fire and changed into ashes, the ashes went back to the earth and which, after many years became metal. the metal could then be melted into a liquid, such as water, to breed thousands of trees and begin the whole process again. In the destructive process, the earth made clear water turbid, the water put out fire, which could itself melt metal, and sharp metal could cut wood. Wood got its nutrition from the earth and the process continued.

The circle of the Five Elements could also be arranged with the Earth as the center and all the processes associated with the four seasons. In this way it shows the changes the Earth goes through.

Yin and Yang

Figure 55.1

Associated with the Five Elements principles is the Yin and Yang. This was the association between the positive and negative forces of the world and the results of the interactions between those forces.

The concept of Yin and Yang is not a new one to the Western world of design. Louis Kahn was an architect who expressed the use of Yin and Yang in designs when talking about his design process for his Trenton Bath House saying,

> "I discovered a very simple thing. I discovered that certain spaces are very unimportant and some spaces are the real raison d'tere for doing what you're doing. But the small spaces were contributing to the strength of the larger spaces. They were serving them."

Often times in Western design we tend to think that every aspect of architecture should be a grand gesture. Large cities and college campuses are cited as examples where one tends to see loud statements among projects but no overarching dialogue to bring them meaning or coherence. Kahn realized that one must conceive a hierarchy of different types of spaces, each mutually supporting the other.

In other words, we cannot shy away from the support spaces required in a project, but instead see them as an opportunity to enhance the overall unifying idea of our design. These support spaces can also lend a system in which the other spaces can function around. They can help to protect the other spaces in harsh climate conditions and thus create a more environmentally responsive built environment.

Dao in Design

The aspects of traditional Chinese architecture that have been proven to be helpful in Western Design are as follows:

1. Developing an awareness of the flow of psychic energy, the experimental quality, or, put it in the vernacular, the “vibe” of spaces

2. Gaining an understanding of the presence of symbolism and of forms whose meanings are shared across a culture

3. Addressing the spiritual, as well the pragmatic, aspects of space

4. Considering the harmony of buildings, landscape, and nature

5. Learning about the integration of designing with the patterns of everyday life

6. Adopting a concern with the impact of design on ecological systems of all types

However, adopting these principles does not mean we need to implement a traditional Chinese Garden into every project, but instead apply these considerations to our own projects. We need to give up the notion that we are just designing for ourselves and instead design for future generations.

Green Design

A certain manifesto of Western Green Design was drafted by the architect, William McDonough called the Hanover Principles. These principles exemplify the push for a more responsible and sustainable design criteria for architects in the West. They are as follows:

1. Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.

2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognizing even distant effects.

3. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.

4. Accept responsibility for the consequences of design decisions upon human well-being, the visibility of natural systems, and their right to co-exist.

5. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes, or standards.

6. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the sate of natural systems, in which there is no waste.

7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.

8. Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not an inconvenience to be evaded or controlled.

9. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural process and humans.

These design principles are easier said than done however. It is hard to adopt a new way of thinking or new materials when their impact is still not fully known. We always regard ancient materials as being healthier than new ones, which may not always be rational, but it is a habit. It takes time to adopt new ways of thinking as a designer and even longer for the masses to adopt the same thinking.

The results of the pre-fabicated and quick way of thinking are often times exemplified the most in suburban American. This situation in the United States is summed up by designer and theorist John Rheinfrank,

> "I go through a suburb and see these garbage tract houses that are being built in these neighborhoods with essentially no human contact, even among family members, because of the layout of the house. That's criminal. We somehow have worked ourselves into a frenzy about how extraordinary these $500,000 houses are, but they're ghettos -- just emotional and intellectual ghettos."

Summary

While I do not agree that we as Westerners should completely change our entire way of thinking about design, I do believe that we should strive to adopt certain aspects of Daoist Design conventions. We also can't totally abandon our own way of thinking because while it is important to design cohesively with our own environment, we must also design cohesively with our own culture.

If we integrate ourselves back into the ecosystem and see ourselves once again as a natural piece of the environment, we can begin to create more meaningful architecture that can have less of negative impact on the ecosystems we so desperately need.

Figure 59.1

PROJECT JUSTIFICATION

The Central Lakes Limnology Science Center is needed because of the disconnect between what we perceive as the built and natural environments.

We often times remove ourselves from the ecosystem and only study it from a distance. Sometimes we condemn ourselves for constructing in what we call the natural environment. However, is that not our own natural environment? Is it not our nature as a species to build shelter for ourselves? While we need to find better ways of building with out limited resources, we cannot expect to completely change this nature. Is not a beaver dam a construction of the beaver? Why then is a beaver dam considered part of the natural environment but a house that humans live in is not considered natural.

This disconnection that we create between ourselves and the natural environment is why we cannot see the detrimental effects we can have on the environment as clearly as we could if we considered ourselves a vital part of th ecosystem.

The science center would help to bridge this gap by bringing the public in to see the effects we can have on water quality and in turn on the organisms that reside in those waterways.

We are only now seeing the effects from what we have done to our waterways and it will take time to fully understand and even longer to restore our natural waterways.

The center will not only help to educate the public about these effects but also to provide a place where meaningful research can be conducted. A functional lab facility will help further research and pave the way for bigger water restoration endeavors .

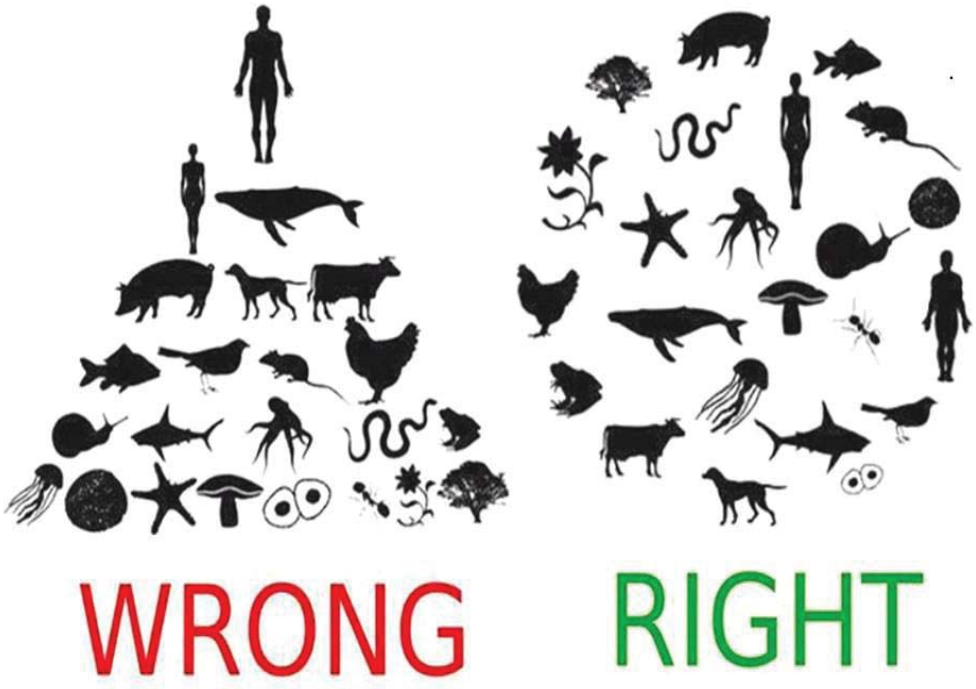


Figure 61.1

HISTORICAL NARRATIVE

Limnology first became known as an established science in 1892 and became an international prominent science in the 1920's. Water preservation became common starting in the 1950's in the U.S. and Minnesota when acts were passed through various levels of government to not only monitor water quality but also to protect it.

1953 - Watershed Protection and Flood Prevention Act

1955 - Commission created to deal with sea lamprey infestation in Great Lakes

1956 - Soil Bank Program created

1957 - 1st Watershed District created in Minnesota

1963 - Land and Water Conservation Fund created

1965 - St. Paul sees highest flood peak on Mississippi River

1967 - Minnesota Pollution Control Agency forms from the Pollution Control Agency

1969 - Shoreland Management Act (Minnesota)

1970 - Floodwall construction begins on Minnesota River in Mankato, Water Quality Improvement Act

1971 - Minnesota creates water pollution control fund

1972 - Federal Environmental Pesticide Control Act

1973 - Minnesota Wild and Scenic Rivers Act

1974 - Federal Safe Drinking Water Act

1975 - Minnesota releases 1st fish consumption advisory due to elevated PCBs

1976 - Minnesota Public Waters and Wetlands Protection

1977 - Federal Clean Water Act

1978 - Minnesota creates Lake Improvement Districts

1979 - Local Floodplain Management (Minnesota)

1982 - Minnesota Metropolitan Surface Water Management Act

1985 - Minnesota County Water Management Act

1986 - Zebra Mussels found in the U.S.

1987 - Eurasian Water Milfoil found in Minnesota

1989 - Minnesota Groundwater Protection Act

1991 - Minnesota Wetland Conservation Act

1992 - Federal Pilot Wetland Reserve Program

1997 - Major Red River Flood

2005 - Minnesota CREP II Established

2006 - Minnesota Clean Water Legacy Act

2012 - Minnesota Comprehensive changes to water planning statues

2014 - Minnesota DNR moves to establish Groundwater Management area

Many of these acts have since been amended as new studies are conducted that bring to light how water quality in the United States is affected by various activities.

HISTORY OF WETLANDS IN THE UNITED STATES

At the time of European settlement in the United States in the early 1600's it is estimated that there were approximately 221 million acres of wetlands. In the mid- 1980's, only about 103 million acres remained. Six states lost 85 percent or more of their original wetland acreage while 11 other states lost 50 percent or more of their wetlands. Even today, not all of the effects of this acreage loss is fully realized.

Wetland drainage began with the permanent settlement of pioneers in as European monarchs encouraged pioneers to create a strong foothold in the states. The effects of this became apparent on the landscape in the 1700's as farming and agriculture took hold. Wetlands were seen during this time as swamp land that only impeded travel and carried diseases. While they do impede travel in some instances and especially in an age when technology was primitive, they are however the exact opposite of a disease carrier.

Technical advancements in the 1800's further aided in wetland conversions. The introduction of the mechanical reaper allowed farmers to farm more land. In turn more wetlands were drained to make way for farmers who wanted to expand their land and turn a large profit. Some wetlands were converted to provide easier travel not only for pioneers on land, but also on water. The Horizon Marsh in Wisconsin was dammed and flooded to create a transportation route and to provide commercial fishing. The 1800's brought many federal acts that allowed the reclamation of wetlands. With these acts brought wide-spread wetland drainage and clearly set the tone that the Federal Government promoted the drainage of wetlands and reclamation.

Many wetlands and river ecosystems were ruined beyond re-pair during the civil war as troops traversed the landscapes. This created many logistical problems for both sides and we began to see engineers designing ways around or over many wetlands and rivers.

The late 1880's brought major western expansion in the U.S. and the prairie pothole region of Minnesota took quite a hit. Today we see this region still coping with restoring these potholes and wetlands. Many of the damages from over-farming cannot be undone in our own lifetime and will take generations to fix.

The first half of the twentieth century saw even more wetland drainage as American went through an industrial revolution. However, after the World Wars the U.S. saw a bigger government and more government spending under the New Deal. The second half of the 20th century brought many conservation acts.

HISTORY OF RIVERS IN THE UNITED STATES

Rivers have always had a powerful hold over mankind. Many of our early settlements are located by major rivers out of pure necessity. However, looking back in history, rivers have typically been treated as a neutral setting rather than a dynamic force. Only in recent decades have rivers been studied for their own history and what stories they can tell about ancient civilizations.

Rivers have seen the same destruction that wetlands have in the U.S. albeit on a different scale. Many rivers in the U.S. have been dammed to provide to water to certain areas that may not get enough or to even prevent flooding further up-stream. One example of this is the Colorado River that carves the Grand Canyon. Without the numerous dams on the river, many cities in California and Nevada would be without water and because of this excessive damming, parts of the Colorado River go down to a trickle during droughts. Today, movements are being made to deconstruct many dams in the United States.

While many of the actions we take on rivers can be seen as natural in some ways, like a beaver damming a river, we take these natural water way controls to astronomical levels. The World Commission on Dams surveyed the globe in 2000 and counted more than 45 thousand large scale dams in the world. This can create problems for wildlife that need to traverse the river as a part of their life-cycle, like fish that return to a certain part of the river to spawn. The same survey also estimated that between 40 million and 80 million people have been displaced by reservoirs and the benefits of dams has been inequitably distributed. Many dams have resulted in the loss of forests and wildlife habitats that diminished aquatic biodiversity.

The apex of global dam building hit in the 1970's where two or three new dams were commissioned each day on average. Many of the negative consequences are only being realized today and it is still unknown what lasting effects these dams could cause to ecosystems that have been around for thousand of years.

Today, the history of rivers is being heavily studied as droughts continue to hit the American West harder each year. We are beginning to realize the detrimental effects we have caused by building huge oasises in the desert and drawing water from hundreds of miles away.

It is the hope of many in the scientific field that the public will come to understand that our waterways are not just plaything for us to manipulate but an pivotal piece of our ecosystem that cannot be damaged without consequence.

HISTORY OF BRAINERD AND CROW WING COUNTY

The area that is now considered the Brainerd area was once a territory inhabited by the Ojibwe. The area was first seen by European settlers in the early 1800's when Zebulon Pike stopped in the area when looking for the headwaters of the Mississippi River.

In these early years the relationship between the settlers and the Native Americans was very complicated. A famous example of this was the so-called "Blueberry War" when a group of Native Americans approached the town. Troops from nearby Fort Ripley were called in to protect the settlers. However the Native Americans only wanted to sell blueberries to the settlers and this all stemmed from the settlers fearing retaliation after two Native Americans were hung for allegedly murdering a missing girl.

Brainerd soon became a hub of the Northern Pacific railroad because of its central location in Minnesota and close proximity to the Twin Cities. The city is also located just north of the confluence of the Crow Wing and the Mississippi Rivers which made it a regional destination of fur trading and steam boat travel on the Mississippi River.

Today, Brainerd has a population of 13,500 and has developed strongly both commercially and residentially. The region has also become known for its tourist attractions and the outdoor Minnesota life with many lakes and rivers in the area. The area itself has very few lakes but there are more the 460 lakes within 25 miles of Brainerd. That being said, water has become an important and integral part of life in the region.

The rich history involved with the two rivers meeting in Brainerd deserve to be commemorated in the research center. To know the history of a waterway gives that much more insight to the research being conducted on said waterway. As the environmental protection attitude becomes more popular, the mentality of wetlands and rivers needs to change from a passive standpoint to an active one. By creating a center to focus solely on the impact that agriculture and industry can have on water quality.

Figure 67.1

Figure 68.1

HISTORY OF THE DAKOTA AND OJIBWAY AND WATER

Minnesota as a state has a special relationship and a debt owed to the Native Americans that lived on the land before European settlers did. Many of our cities and even the state itself are named after Native American words.

Both the Dakota and the Ojibway settled the Crow Wing River territory. Both tribes being hunters fought over the fertile land. The tribes revered the river and its fertility. They realized that without the water in the region, they would not have many of the animals they hunted, and would not be able to live in permanent settlements.

HISTORY OF RESEARCH CENTERS

The history surrounding research centers is not well documented overall. The building type is fairly new and only in recent years have science laboratories become more than an after-thought. Laboratories were many times connected to universities and facilitate the work being done by students and researchers. While this is still very much true today, the scientific community is seeing more research centers being funded by public entities other than universities and even privately funded.

Historically, these centers were closed off to the public. Many times communities did not know what was going on inside the laboratory. Now we are seeing a trend in recent years where research laboratories are more open about the research being done and even bring the public in to educate them.

This is done extensively at the Hasler Lab at the University of Wisconsin Madison. They bring in students and the public to partake in educational activities which increases the public input. This is needed now as many research facilities need public funding to continue.

SITE ANALYSIS

Location: North-east corner of the junction between HWY 371 and Hwy 48 in Baxter, MN.

While the site has been described as being in Brainerd throughout this book, the site is technically within the city limits of Baxter. However, for cultural and naming reasons, the site will still continue to be referred to as a Brainerd site.

The two cities have meshed into one with most new commercial projects that service Brainerd being built in the open sprawl of Baxter.

A site visit was conducted on Saturday, September 19, 2015 at approximately 12:00 PM.

The lot is currently broken into several commercial lots that are for sale.

The site shows sign of once being farmland and being tiled. However, now it is covered in a short, scrub, grass and short, red cedar trees.

The site has potential for extensive constructed wetlands and natural parks due to it being on the outskirts of the city limits. It has been neglected and is in danger of becoming a strip mall as Brainerd and Baxter experience sprawl.

The site needs to be a place that breaks up the two highways and provides a place where the wetlands that were most likely there before the area was drained for farmland.

While the location of the site is not directly adjacent to the major waterways near Brainerd, it is close enough that those waterways can be easily studied. This location was intentionally chosen so as not to do more damage to the waterways that will be studied.


371
371
Highland Scenic Rd
48
371
371
ake Area
n Church
United F
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Figure 71.1

Photo Location

Figure 72.1

To further show the characteristics of the site photos and their locations are mapped out.

The photo below was taken standing just west of the tree line that runs along highway 48 looking to the north-east.

A sign displaying the sale of the commercial property can be seen.

Figure 73.1

Photo Location

Figure 74.1

To further show the characteristics of the site photos and their locations are mapped out.

The photo below was taken standing behind the tree line looking almost straight west.

The intersection of the two highways can be seen in the distance.

The location this photo was taken at would make a good location of a building because of the higher elevation and the distance from the two highways.

The site has capabilities of easily being closed off from the noise and traffic on the highways.

Figure 75.1

Photo Location

Figure 76.1

To further show the characteristics of the site photos and their locations are mapped out.

The photo below was taken almost in the same spot as the previous but was farther back.

This photo shows the proximity the site has with highway 48 which can be seen on the left side of the photo.

Figure 77.1

Photo Location

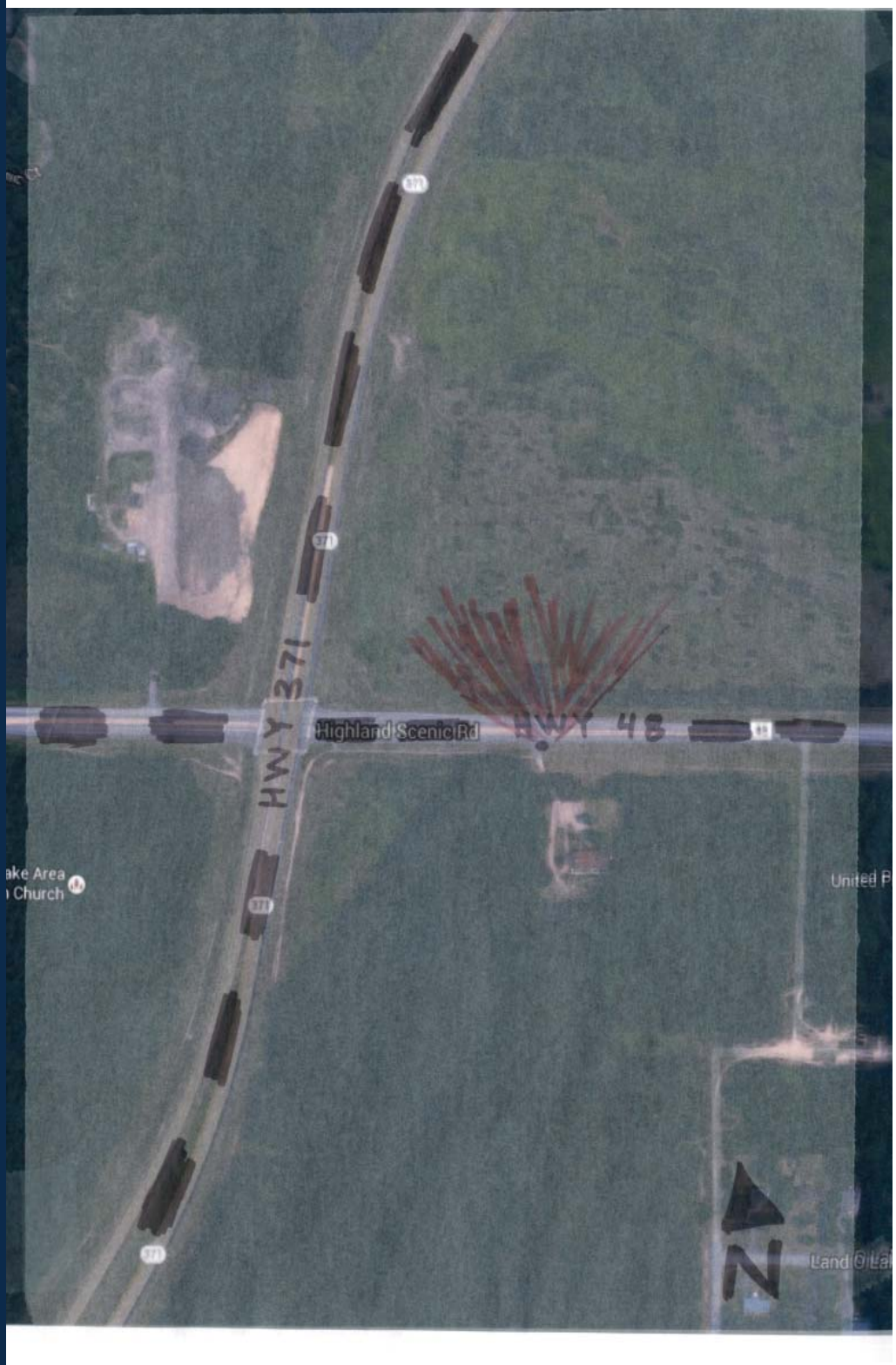


Figure 78.1

To further show the characteristics of the site photos and their locations are mapped out.

The photo below was taken standing on the south side of highway 48 looking directly north.

A stand of white pines lines the road and shields the site from highway 48.

Figure 79.1

TOPOGRAPHY

The site does not have a harsh topography but rather a gentle and almost field like topography.

The figure on the right shows the actual topography lines at two foot increments while the figure below illustrates the topography that I perceived while at the site.

The similarity between the perceived and actual topographys is apparent when looking at the natural bowl that is created on the site from the gentle slopes of the site meeting in one place. This natural bowl would be an excellent location for a constructed wetland that would illustrate how a wetland works to visitors of the site.

The red square on the topography map shows a good location for a building as it is already relatively flat. This location would also be above the bowl created on the site so there would be less of a concern of flooding issues.

Figure 80.1

Figure 81.1

SHADE AND SHADOW

The site is relatively open and only has shadows casted on it from the trees that are on the site.

The buildings located to the west of highway 371 are not tall enough to cast any shadows onto the site.

Heavy pockets of the trees on the site create opportunities for shade and shadows but they are few and far between.

Overall, the site is bathed in light with a good quality of light. However, to protect the building and conserve energy, significant structures or plantings may be used.


371
HWY 371
Highland Scenic Rd
HWY 46
48
Lake Area
Church
United Pent
Land O Lakes
N

Figure 83.1

Winter Solstice - December 21st- 9:00 AM

During the winter solstice the sun path would be significantly lower and the angle of the sun in relation to the earth would be great. This would create long shadows on the site from any buildings.

To illustrate this a mass has been created to represent a building and mass has been created to represent the tree line on the southern side of the site.

At 9 AM the building casts long shadows to the north west. The building is however not in shadow from the treeline

Winter Solstice - December 21st- 12:00 PM

At noon on the winter solstice the building and tree line cast shadows directly to the north.

The building receives adequate light from the south creating a potential for passive lighting and heating

Winter Solstice - December 21st- 3:30 PM

A study was done at 3:30 PM during the winter solstice to illustrate how early the sun would set during this time of the year.

The building would cast long shadows to the north east while still remaining out of the shadows created by the tree line.

Winter solstice - 9:00 AM

Figure 85.1

Winter solstice - 12:00 PM

Figure 85.2

Winter solstice - 3:30 PM

Figure 85.3

Summer Solstice - June 21st- 9:00 AM

During the summer solstice, the sun would be at its highest and the angle of the sun would be almost directly overhead.

At 9AM on the summer solstice the building casts short shadows almost directly to the west.

The east facade of the building would receive ample morning light during this time.

Summer Solstice - June 21st- 12:00 PM

At noon on the summer solstice the sun is at an almost ninety degree angle in relation to the site.

The building casts almost no shadow and would be at its peak of heat gain.

Shading structures would need to be employed on the southern and western facades to shade the building and limit heat gain during this time.

Summer Solstice - June 21st- 6:00 PM

At 6 PM on the summer solstice the building would cast significant shadows to the east as the sun begins to set in the west.

During this time the light would be low and harsh on the west side and any rooms located facing the west would gain heat. These rooms would also require methods of controlling light so that these spaces are still usable during the evening hours.

Summer solstice - 9:00 AM

Figure 87.1

Summer solstice - 12:00 PM

Figure 87.2

Summer solstice - 6:00 PM

Figure 87.3

BUILT FEATURES

Built features and attributes on or near the site are minimal. The map to the right highlights these built features in brown.

On the east side of highway 371 and to the north is a commercial lot that features many small businesses arranged in a strip mall sort of fashion.

To the south of the site is a church and residential home that is set back from highway 48.

Again to the south but farther from the site is a residential development.

All of these features do not directly impact the site itself but rather show how undeveloped the area is. This part of the Brainerd / Baxter is in transition and is in danger of suburban sprawl.

The built features are few and far between but that does not mean the site has been untouched. The areas surrounding the site are heavily forested but the site itself shows signs of farming and tilling.

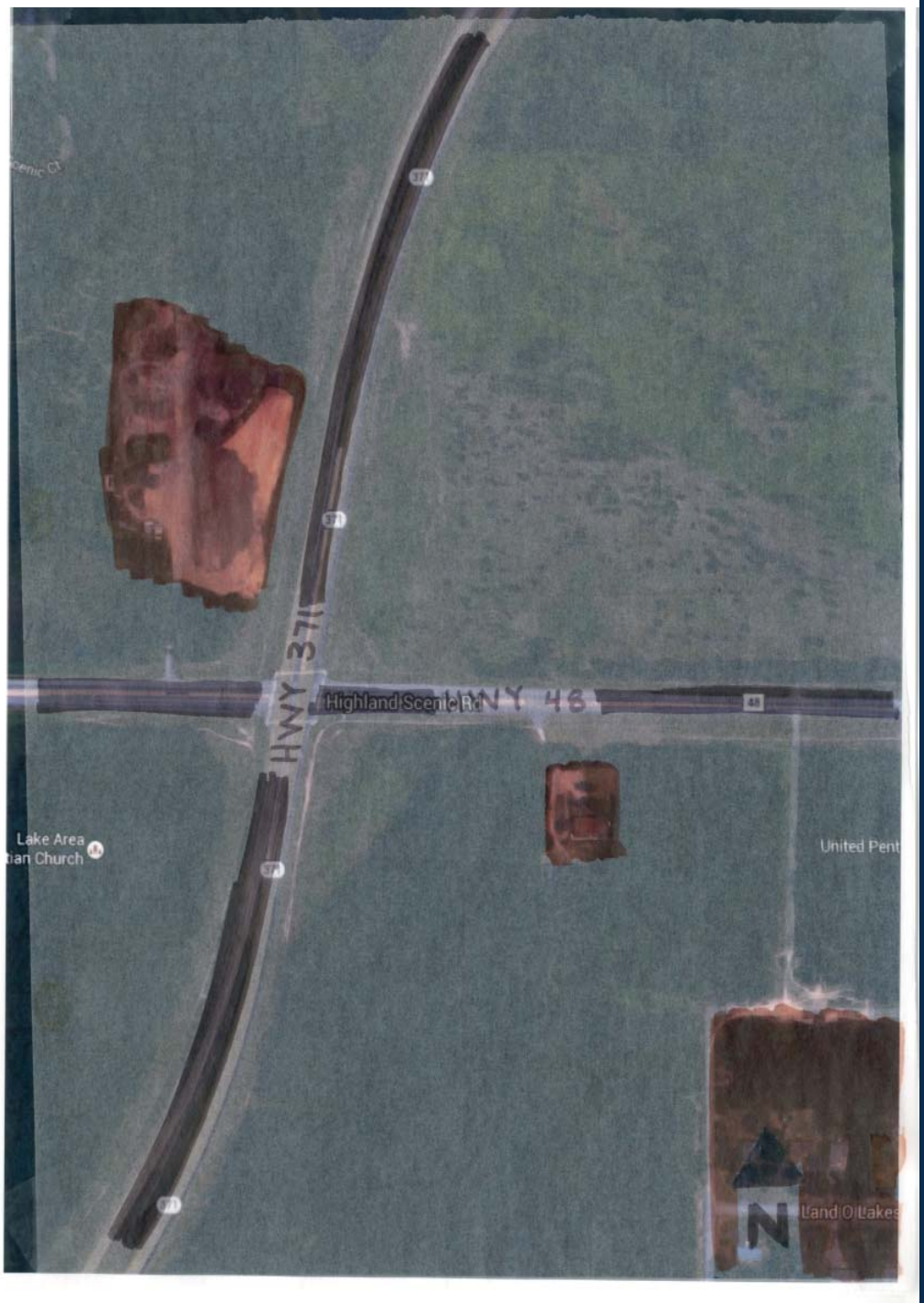

HWY 371
HWY 48
Highland Scenic Rd
Lake Area
United Pent
Land O Lakes
N

Figure 89.1

V E G E T A T I O N

The site contains numerous Easter Red Cedar which are a coniferous tree that is native to central and northeastern Minnesota.

These trees are common in the Lauretian Mixed Forest Province of Minnesota and provide habitat for many mammals like squirrels, and small birds.

Figure 90.1

Figure 90.2

The large tree line on the south side of the site and the forested areas around the site are made up of mostly Easter White Pines.

These trees are also coniferous and are also native to northern parts of Minnesota.

These pines grow significantly taller than the Red Cedars and create habitat for larger birds like red-tailed hawks.


HWY 71
Highland Scenic Rd
Lake Area
United Pent
Land O Lakes
N

Figure 91.1

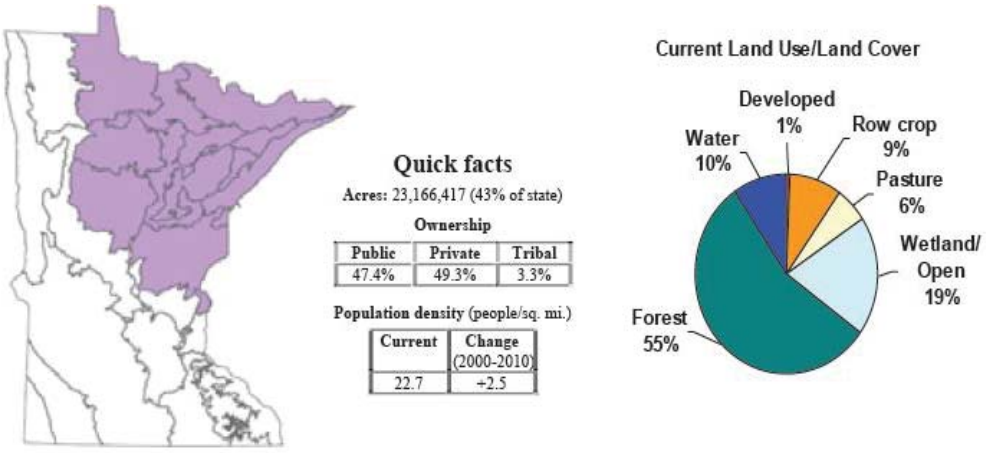


Figure 92.1

The above infographic shows the location of the Laurentian Mixed Forest Province of Minnesota and the land use of that province.

Because of the hilly landscape, sandy soils, and numerous wetlands the land is not suitable for extensive farming like that of southern Minnesota and over half of the region is forested.

However, because only 1% of the region is developed, economies struggle in the region and rely heavily on ecotourism.

To break it down even further, he province is separated into subsections. The figure to the right shows the location of the Pine Moraines and Outwash Plains subsection. Even less is developed in this section and more land is devoted to crop farming when compared to the entire province.

Quick facts

Acres: 3,025,749 (5.6% of state)

Ownership

Public	Private	Tribal
29.6%	69.1%	1.3%

Population density (people/sq. mi.)

Current	Change (2000-2010)
25.6	+4.2

Current Land Use/Land Cover

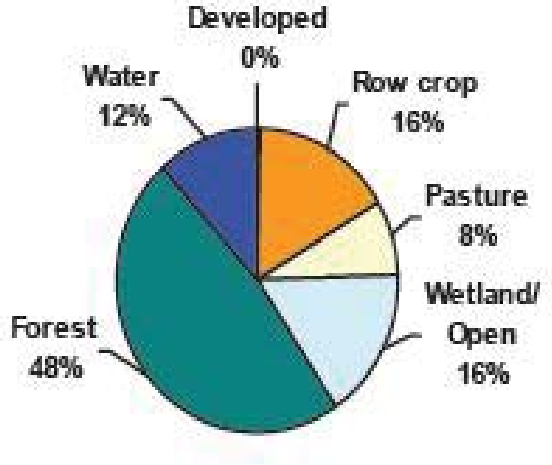


Figure 93.1

While the Mississippi River is located in the Pine Moraines and Outwash Plains subsection, it is not the largest aquatic habitat in the region. The headwaters create habitat because of the transition from lakes to rivers and the diverse vegetation that exists there. The region is also home to many large lakes that have a large number of different aquatic species.

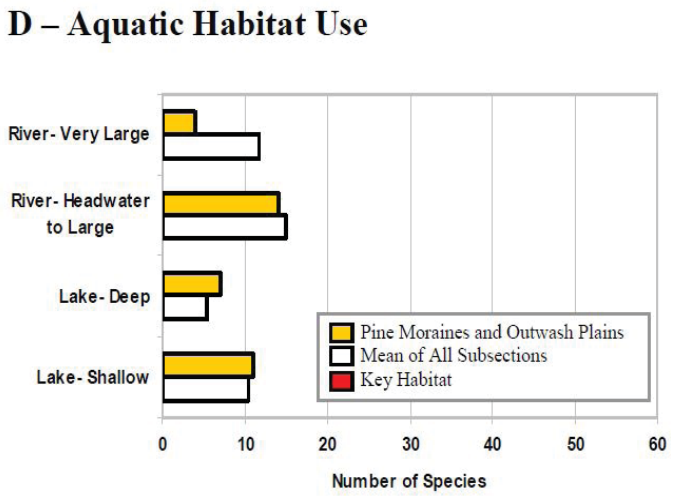


Figure 94.1

One of the key habitats in the region is wetlands. These areas not only provided habitats for animals that can only exist in water but also water fowl and even mammals like beavers and river otters. The wetlands located in the subsection are especially important because of diverse number of specialist species they create habitat for. This includes not only animals but also vegetation, many of which cannot exist in any other environment.

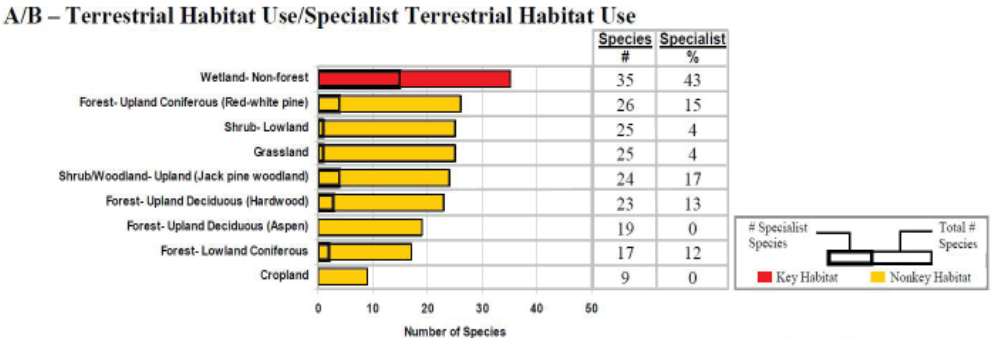


Figure 94.2

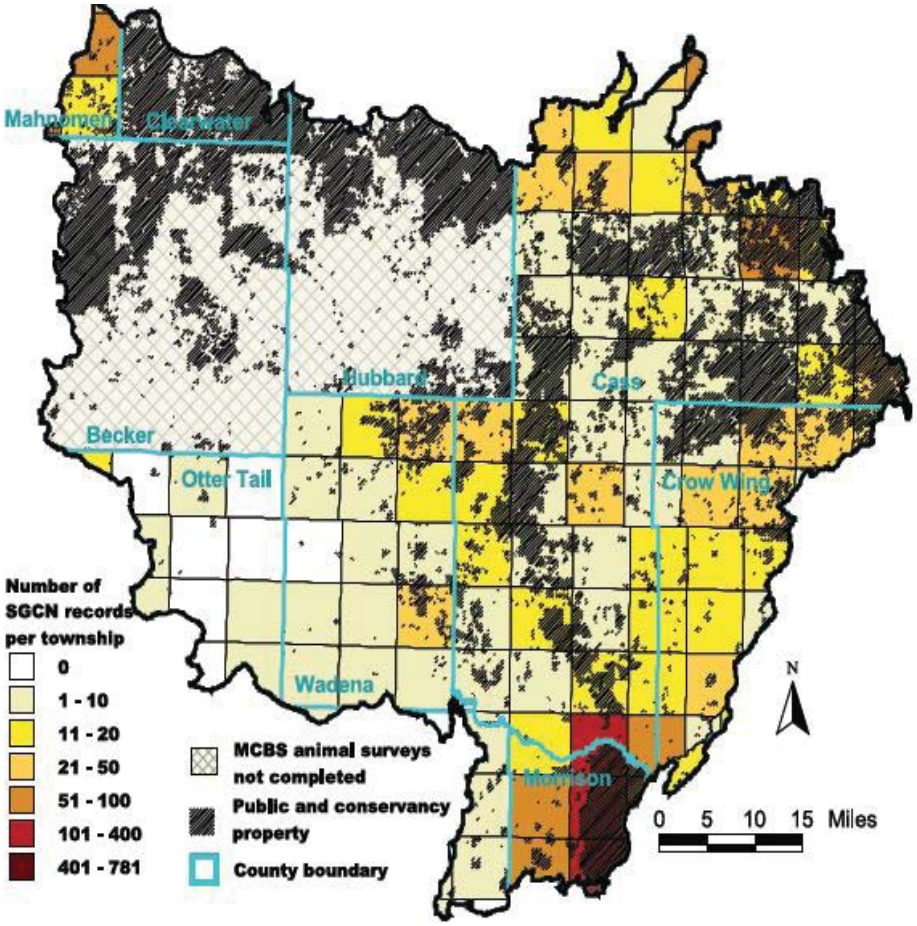


Figure 95.1

Most of the site is covered in short, dry, rough, grass. A soft crunch emanates as you walk across the site and meet the sporadic Red Cedar. However, the vegetation is not as diverse as it should be according to the region it is located in.

To restore the characteristics of the site extensive prairie and wetland restoration should be done and diverse vegetation should brought back to the site.

We often times forget the key roles that certain plants can play in their environment and instead judge them solely on their aesthetic qualities. Native plants like thistle are chemically controlled and soon the environment becomes a boring field of one grass.

Special consideration will be given to ensure the site is diverse but also free of invasive species.

HYDROLOGY

The graphic to the right shows the watersheds of Minnesota with the region that Brainerd and Baxter resides in blue.

The water in the region would eventually make its way into the Mississippi River which is a very important water source for not just the region, but also the state, and the country.

It is important to note that the Mississippi River is not only impacted by its own watershed region, but also the watersheds of numerous other regions.

The Minnesota River turns back in Mankato and flows north, joining the Mississippi in St. Paul. The entire region that flows into the Minnesota River eventually makes its way into the Mississippi also. Since this region is mainly farmland, the water in the Minnesota is quite murky and the regions has problems controlling run-off from farming. This affects the water quality of the lower Mississippi in Minnesota.

Other regions that also flow into the Mississippi are the St. Croix, Missouri, and the Des Moines Rivers watersheds.

It is important to understand the network that is created between large rivers and the compounding effect that water quality pollutants can have.

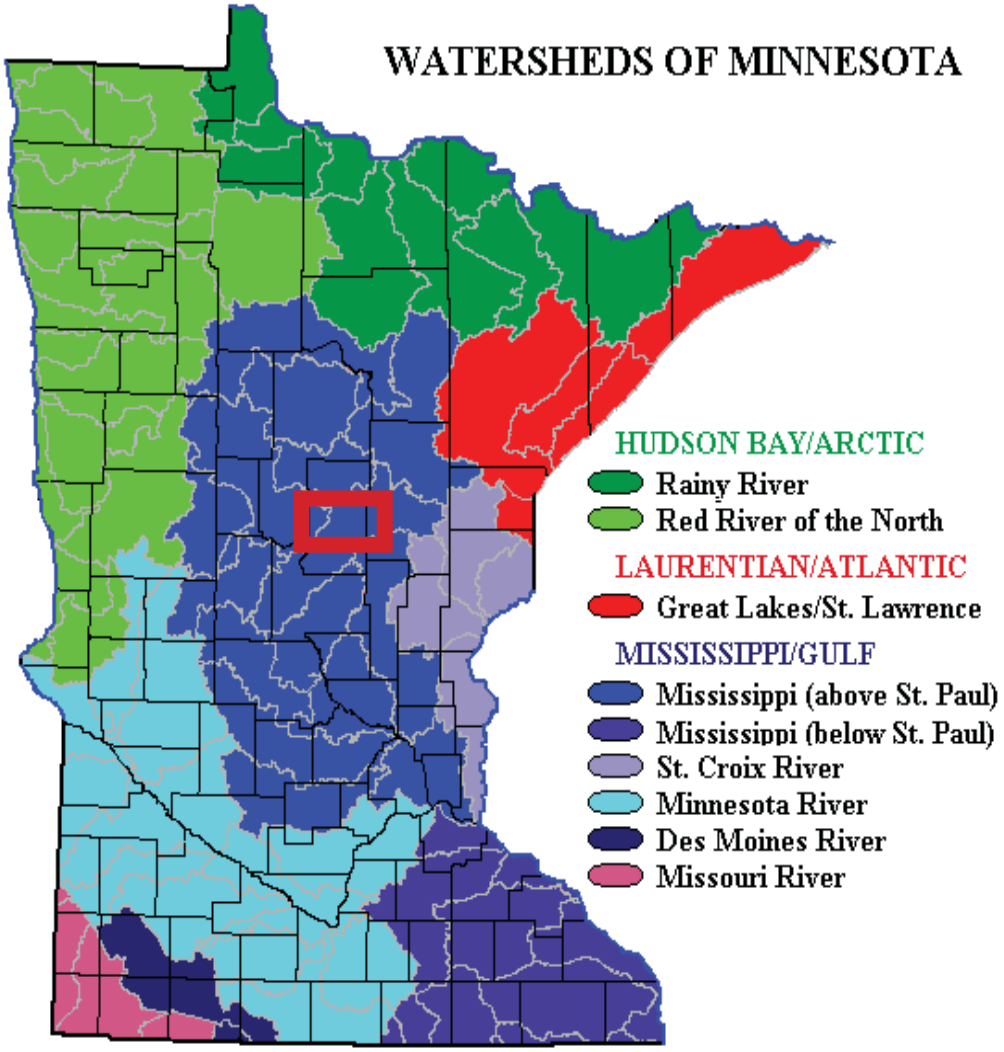

WATERSHEDS OF MINNESOTA
HUDSON BAY/ARCTIC
Rainy River
Red River of the North
LAURENTIAN/ATLANTIC
Great Lakes/St. Lawrence
MISSISSIPPI/GULF
Mississippi (above St. Paul)
Mississippi (below St. Paul)
St. Croix River
Minnesota River
Des Moines River
Missouri River

Figure 97.1

Looking at the site on a smaller scale it is important to take note of the bowl that is created.

This area will naturally collect water which could be problematic. However, my suspicions is that the site was tiled years ago as it was most likely farm land historically.

My goals would be to allow a constructed wetland to form in this area and capture that water in a controlled way. This would allow extensive rainwater harvesting and an opportunity for passive water treatments and remediation.

The land slopes to the north of the site which flows into small pocket wetlands. These small wetlands hold some water from the site and could perhaps control the flow of water on the site.

These natural and constructed wetlands could be used on the site to not only provide places to conduct research in close proximity to the labs, but also to remediate gray water from the building.

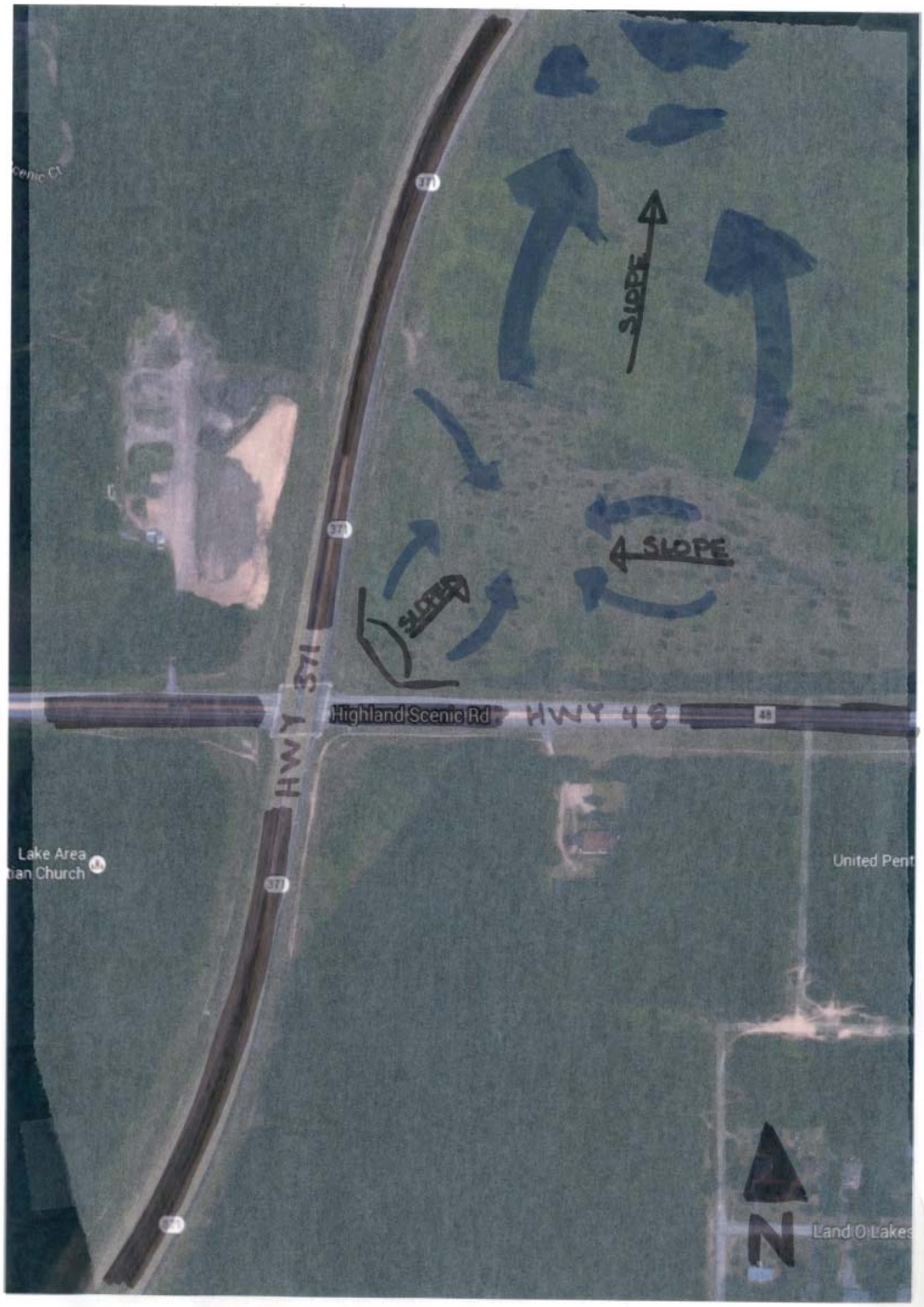

SLOPE
SLOPE
SLOPE
HWY 371
Highland Scenic Rd
HWY 48
Lake Area
ian Church
United Pent
Land O Lakes
N

Figure 99.1

W I N D

Wind speeds for the region are moderate, hovering between 6.1 and 7.3 mph.

This correlates with the main vegetation and region classification that the site is in. The tall pines and coniferous trees of the Laurentian Mixed Forest Province block much of the wind in the region and provide good shelter for the built environment.

Comparing this to the prairie regions of Minnesota (the southern and western regions) you can see a large difference in wind speeds. This is because the prairies (or farmland as we have converted much of it to now) are relatively open and only have sporadic groupings of large trees around rivers, lakes, farms, and shelter belts.

Harvesting wind energy on the site could prove to be problematic because of the lower wind speeds and the amount of trees. These two combined would make wind turbines highly inefficient.

Since the area is also home to many wetlands and lakes, wind turbines would be harmful to migrating waterfowl that use the region as a pit stop. Migratory birds are greatly affected by large wind turbines as the blades rotate at high speeds and create dangerous obstacles in flight paths.

Due to the sensitive nature of the site's habitat and inefficiencies, wind energy should not be the main sustainable source of power and any turbines used should be small and low to the ground.

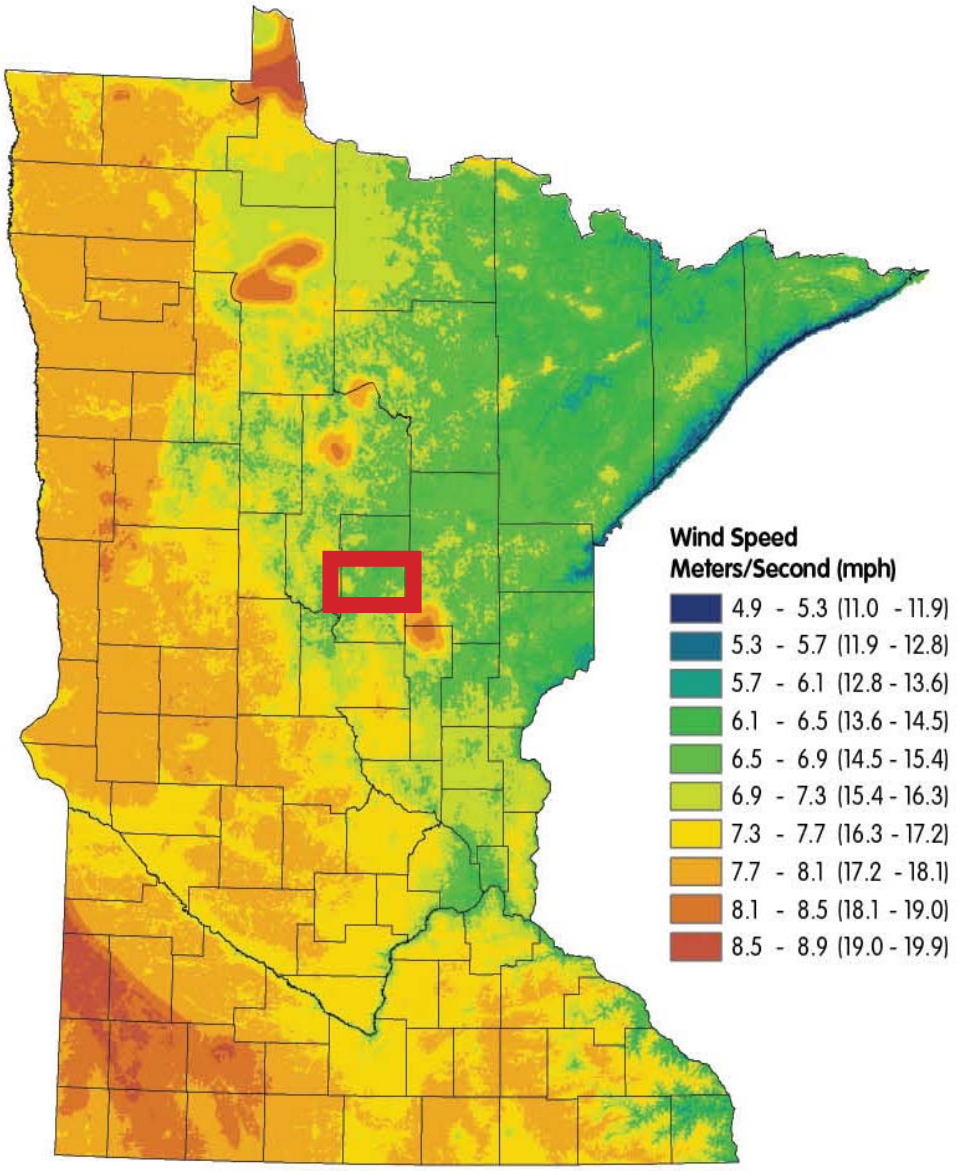

Wind Speed
Meters/Second (mph)
4.9 - 5.3 (11.0 - 11.9)
5.3 - 5.7 (11.9 - 12.8)
5.7 - 6.1 (12.8 - 13.6)
6.1 - 6.5 (13.6 - 14.5)
6.5 - 6.9 (14.5 - 15.4)
6.9 - 7.3 (15.4 - 16.3)
7.3 - 7.7 (16.3 - 17.2)
7.7 - 8.1 (17.2 - 18.1)
8.1 - 8.5 (18.1 - 19.0)
8.5 - 8.9 (19.0 - 19.9)

Figure 101.1

The wind was studied on the site at a smaller once again. While doing a site visit the wind was mild and hardly noticeable.

The blue arrows on the map to the right illustrate the wind direction and travel during the winter months of the year. This air will be colder and sometimes traveling faster. A problem the site has in relation to this winter air is it has relatively no cover from the north west and this air would blow straight into the site.

To contrast this the red arrows on the site illustrate the wind direction and travel during the summer months. This air will be warmer and less violent in general. However, the site has a tree line on the south side that would block most of this southern air.

The site is backwards in terms of protection from north winds and harvesting summer winds. While highway 371 to the west is the larger and thus more traveled highway, it should not be given priority.

The plan will be to remove the tree line on the south side of the site so that the building is not cut off from the warm air coming in from the south east. A buffer of trees will be planted along highway 317 and to the north. This will help to shield the building from cold winter air during the winter months, thus cutting down on the heating load.

Priority will be given instead to highway 48 and the building will attract visitors from highway 371 at the intersection of the two highways with signage and natural attributes.


HWY 371
Highland Scenic Rd
HWY 48
371
48
Lake Area
United Pent
N
Land O Lakes

Figure 103.1

S O I L S

The map to the right shows the dominant soil orders found in Minnesota, with the red square highlighting the region that the site is found in.

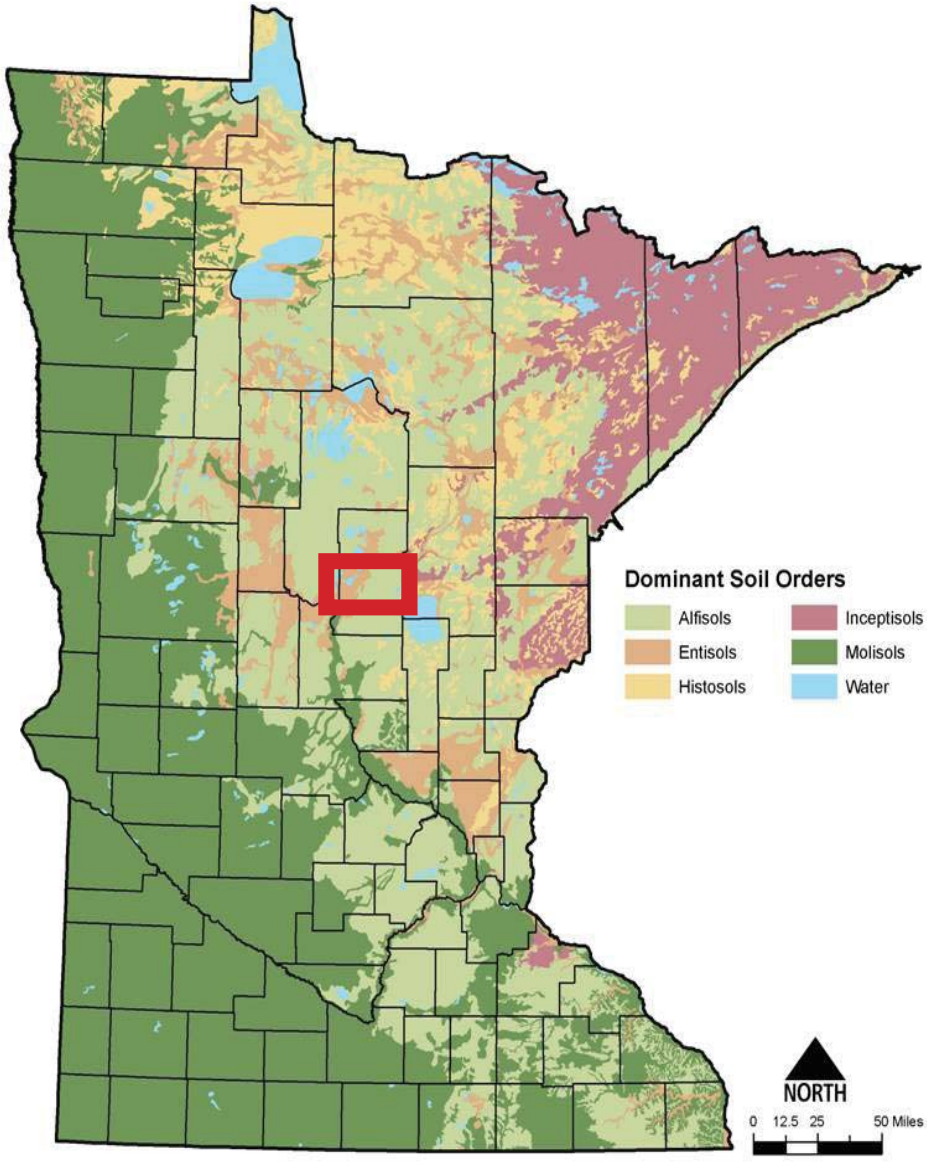
The major soil found in this region is shown as Alfisols. Alfisols is defined as a soil order that forms in semiarid to humid areas and typically under a hardwood forest cover. This is keeping with the forested area of the region. Alfisols also have a clay-enriched subsoil and a relatively high native fertility. “Alf” refers to aluminum (Al) and iron (Fe).

This soil order represents one of the more important soil orders because of its food and fiber production.

Another soil found in the region is Entisols. A small deposit runs through Crow Wing County.

Entisols are defined as soils that do not show any profile development other an A horizon. An entisol has no diagnostic horizons and are basically unaltered from their parent material, which can be unconsolidated sediment or rock.

This soil order is the second most abundant soil order on Earth just after inceptisols.



October, 2005

Sources: NRCS (GIS data available at http://www.ncgc.nrcs.usda.gov/products/datasets/statsgo/data/mn.html), DNR (GIS data available at http://deli.dnr.state.mn.us/)

Figure 105.1

The bedrock of the region that the site is located in can be see illustrated on the map to the right. The first classification is the period of the bedrock deposits with most of the categories found in the region being relatively young deposits. This could contribute to the fertility of the land in the region.

The largest category that makes up the region the site is located in is the dark gray category which translates to quartz deposits. Much of the region has deposits of siltstone and sandstone also.

Being that these are relatively porous rocks, water is able to drain down to underground aquifers easily and is not water logged like in a region made up of clay deposits.

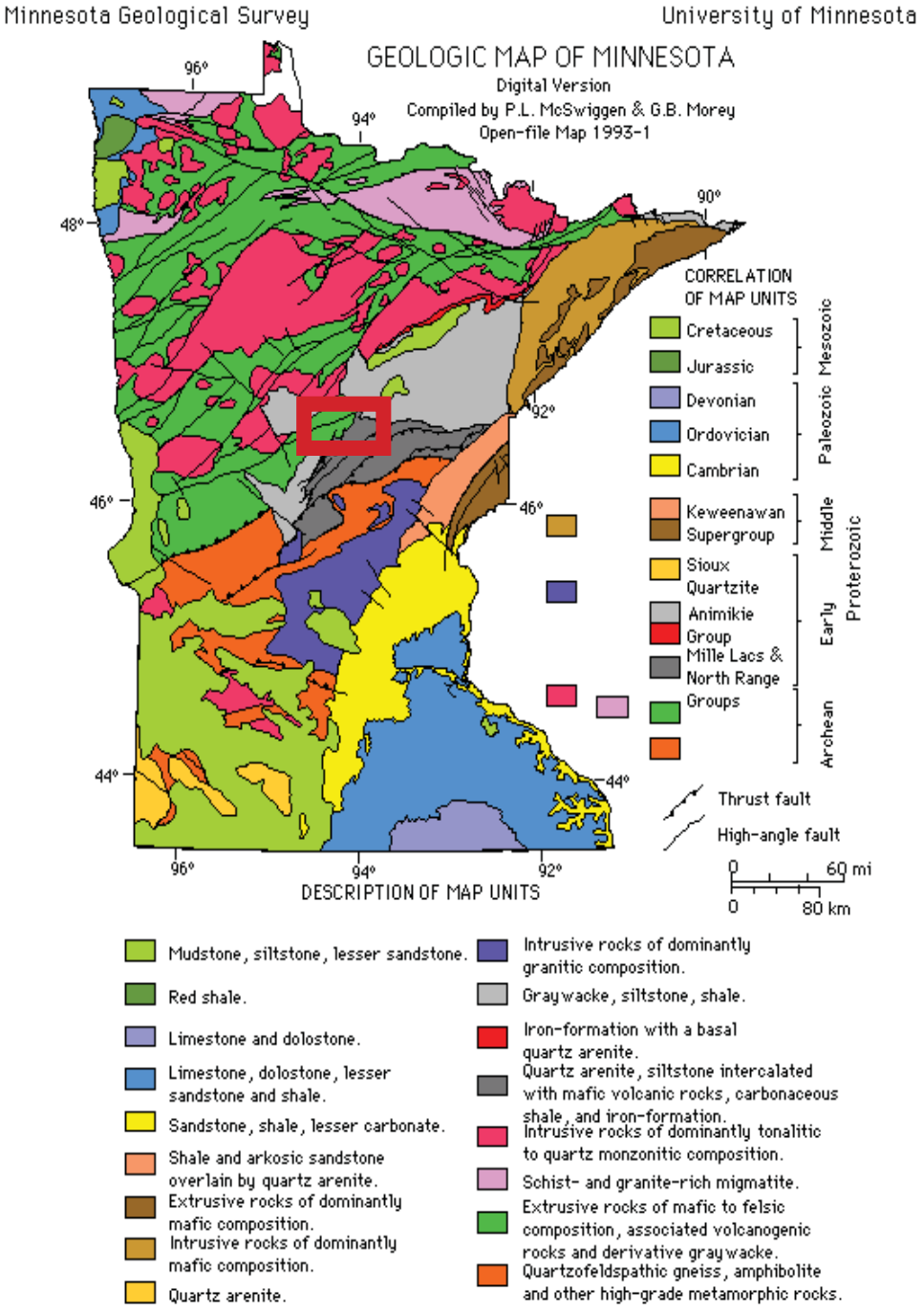

Minnesota Geological Survey
University of Minnesota
GEOLOGIC MAP OF MINNESOTA
Digital Version
Compiled by P.L. McSwiggen & G.B. Morey
Open-file Map 1993-1
96°
94°
90°
48°
92°
46°
44°
CORRELATION OF MAP UNITS
Cretaceous
Jurassic
Devonian
Ordovician
Cambrian
Keweenawan Supergroup
Sioux Quartzite
Animikie Group
Mille Lacs & North Range Groups
Mesozoic
Paleozoic
Middle Proterozoic
Early Proterozoic
Archean
Thrust fault
High-angle fault
0 60 mi
0 80 km
DESCRIPTION OF MAP UNITS
Mudstone, siltstone, lesser sandstone.
Red shale.
Limestone and dolostone.
Limestone, dolostone, lesser sandstone and shale.
Sandstone, shale, lesser carbonate.
Shale and arkosic sandstone overlain by quartz arenite.
Extrusive rocks of dominantly mafic composition.
Intrusive rocks of dominantly mafic composition.
Quartz arenite.
Intrusive rocks of dominantly granitic composition.
Graywacke, siltstone, shale.
Iron-formation with a basal quartz arenite.
Quartz arenite, siltstone intercalated with mafic volcanic rocks, carbonaceous shale, and iron-formation.
Intrusive rocks of dominantly tonalitic to quartz monzonitic composition.
Schist- and granite-rich migmatite.
Extrusive rocks of mafic to felsic composition, associated volcanogenic rocks and derivative graywacke.
Quartzofeldspathic gneiss, amphibolite and other high-grade metamorphic rocks.

Figure 107.1

U T I L I T I E S

The map to the right shows the water and sewer improvement plan for the City of Baxter.

The site proposed for the Central Lakes Limnology Science Center is highlighted with a red square and is listed as a DDP site.

DDP means that water and sewer improvements will be constructed to the site after or when the area is developed.

Currently the site would have not access to water and sewer as it has not been commercially developed yet. However, bringing these amenities out to site would not be a large undertaking because of the large areas that are "currently served" directly to the north.

The site also listed as DDP on the west site of highway 371 has also recently been developed which would bring utilities even closer to the site.

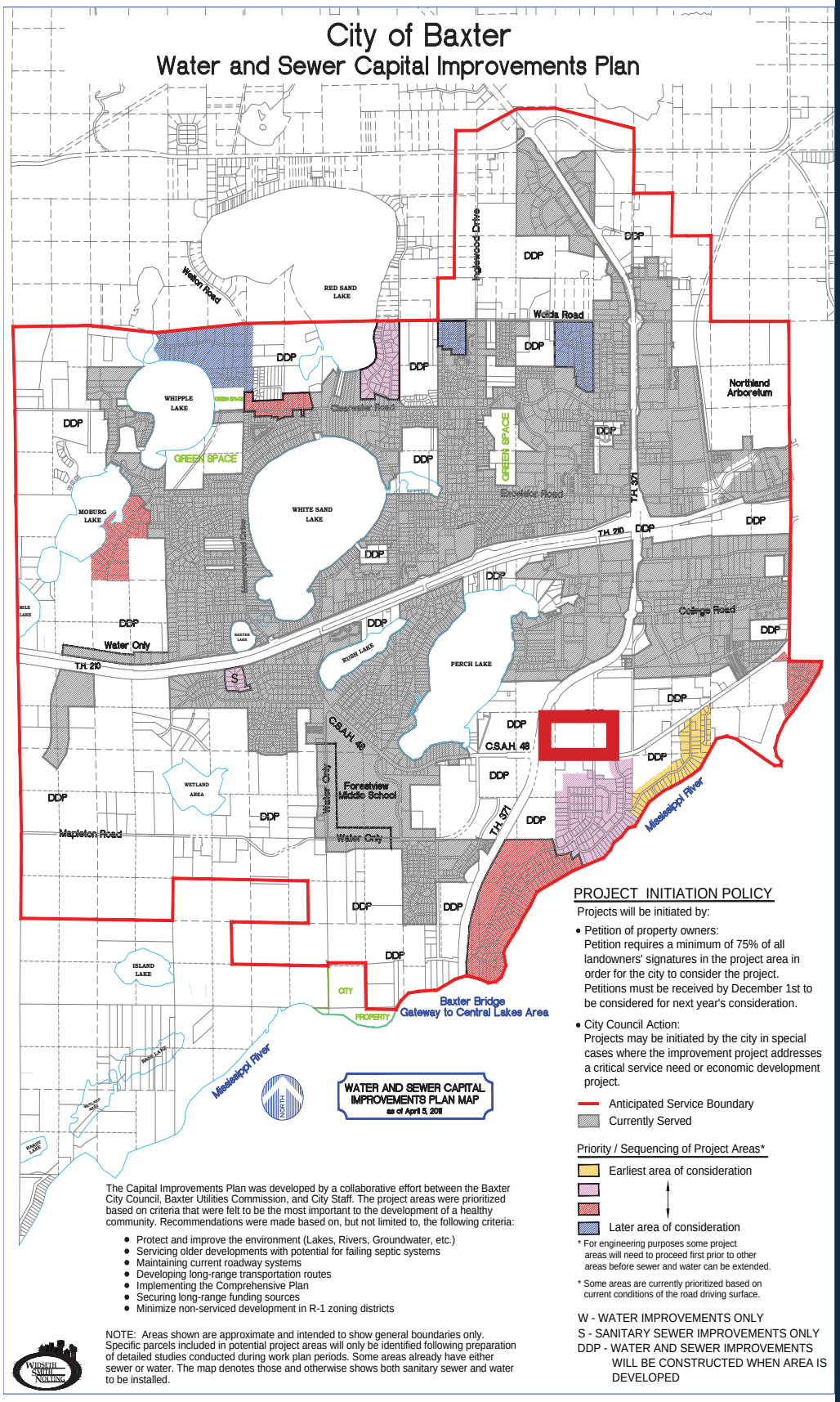

City of Baxter
Water and Sewer Capital Improvements Plan
RED SAND LAKE
WHIPPLE LAKE
WHITE SAND LAKE
MOBURG LAKE
PERCH LAKE
RUSH LAKE
ISLAND LAKE
Watson Road
Inglewood Drive
Wolda Road
Northland Arboretum
Excelsior Road
College Road
T.H. 210
T.H. 371
C.S.A.H. 48
Water Only
Forestview Middle School
Mapleton Road
Mississippi River
Baxter Bridge
Gateway to Central Lakes Area
GREEN SPACE
DDP
WATER AND SEWER CAPITAL IMPROVEMENTS PLAN MAP
as of April 5, 2011
PROJECT INITIATION POLICY
Projects will be initiated by:
• Petition of property owners:
Petition requires a minimum of 75% of all landowners' signatures in the project area in order for the city to consider the project. Petitions must be received by December 1st to be considered for next year's consideration.
• City Council Action:
Projects may be initiated by the city in special cases where the improvement project addresses a critical service need or economic development project.
Anticipated Service Boundary
Currently Served
Priority / Sequencing of Project Areas*
Earliest area of consideration
Later area of consideration
* For engineering purposes some project areas will need to proceed first prior to other areas before sewer and water can be extended.
* Some areas are currently prioritized based on current conditions of the road driving surface.
W - WATER IMPROVEMENTS ONLY
S - SANITARY SEWER IMPROVEMENTS ONLY
DDP - WATER AND SEWER IMPROVEMENTS WILL BE CONSTRUCTED WHEN AREA IS DEVELOPED
The Capital Improvements Plan was developed by a collaborative effort between the Baxter City Council, Baxter Utilities Commission, and City Staff. The project areas were prioritized based on criteria that were felt to be the most important to the development of a healthy community. Recommendations were made based on, but not limited to, the following criteria:
• Protect and improve the environment (Lakes, Rivers, Groundwater, etc.)
• Servicing older developments with potential for failing septic systems
• Maintaining current roadway systems
• Developing long-range transportation routes
• Implementing the Comprehensive Plan
• Securing long-range funding sources
• Minimize non-serviced development in R-1 zoning districts
NOTE: Areas shown are approximate and intended to show general boundaries only. Specific parcels included in potential project areas will only be identified following preparation of detailed studies conducted during work plan periods. Some areas already have either sewer or water. The map denotes those and otherwise shows both sanitary sewer and water to be installed.
WIDSETH SMITH NOLTING

Figure 109.1

The illustration to the right is my perceived and understood location of certain utilities.

However, since visiting the site and researching more from the city of Baxter, I placed a sewer line running along highway 48 in error. I was my own understanding at that time that sanitary sewer and water lines would possibly run along the highway and into the site on the north side of the road. However, without getting the site marked and surveyed, or digging to see for myself, there was no way of knowing while at the site.

The main utility that was seen at the site during the visit was power. Large power lines ran along highway 371 most likely put in place as part of a larger plan to supply power to the blossoming sub-divisions in Baxter.

Arterial power lines run along highway 48 and supply power to the small housing development to the south.

A large transformer box lies on the site just north east of the intersection of highway 371 and highway 48. Because of this, supplying power to the site would be relatively easy.

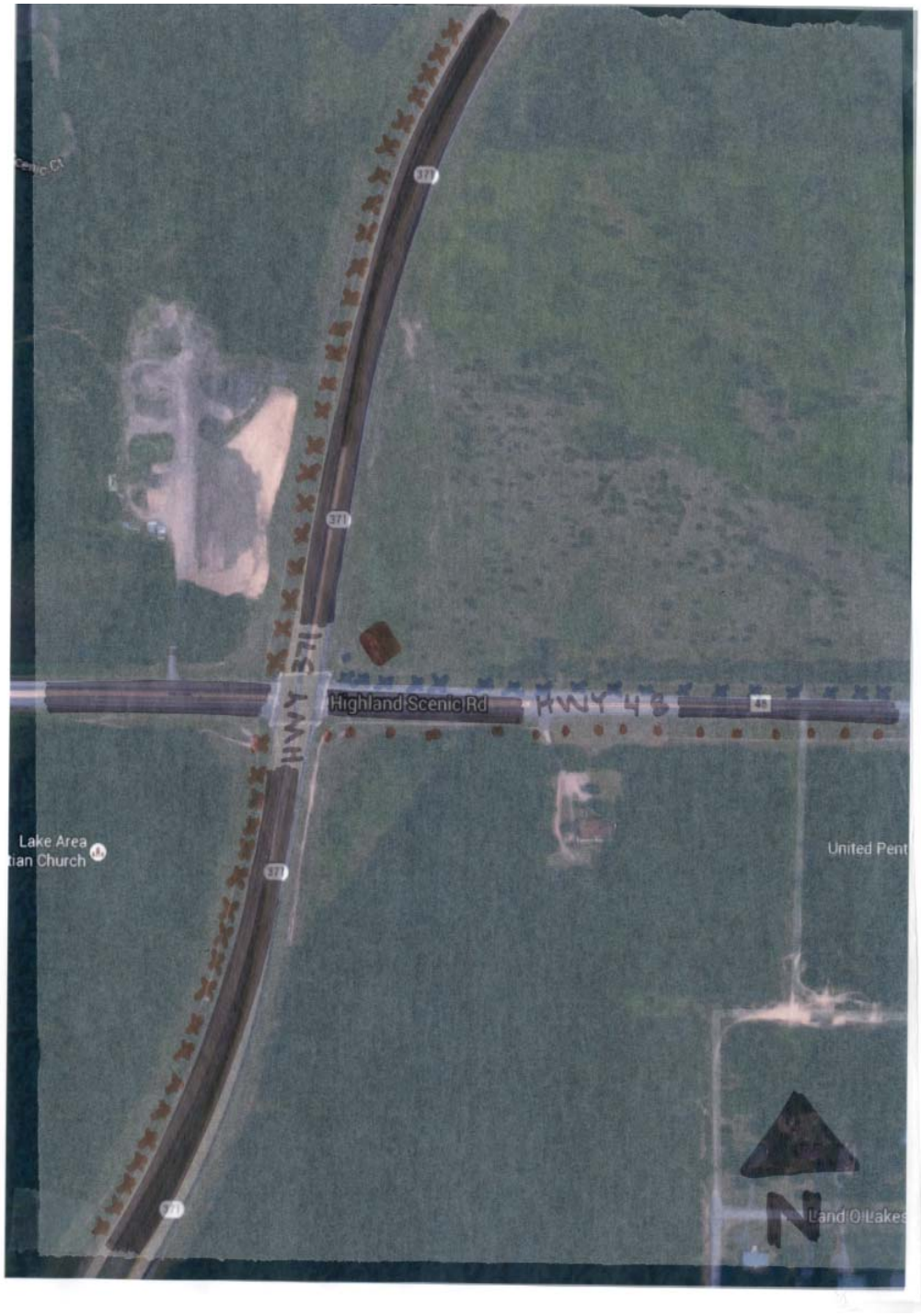

371
Highland Scenic Rd
HWY 48
HWY 371
Lake Area
tian Church
United Pent
371
371
N

Figure 111.1

C I R C U L A T I O N

The map to the right provided by the city of Baxter shows the main roadways going through the city limits.

Per the illustration, highway 371 is shown as a major state highway and highway 48 is a smaller county highway. These two roads are the only access to the site.

The map also does a very good job of showing the major water ways and lakes located adjacent to the site.

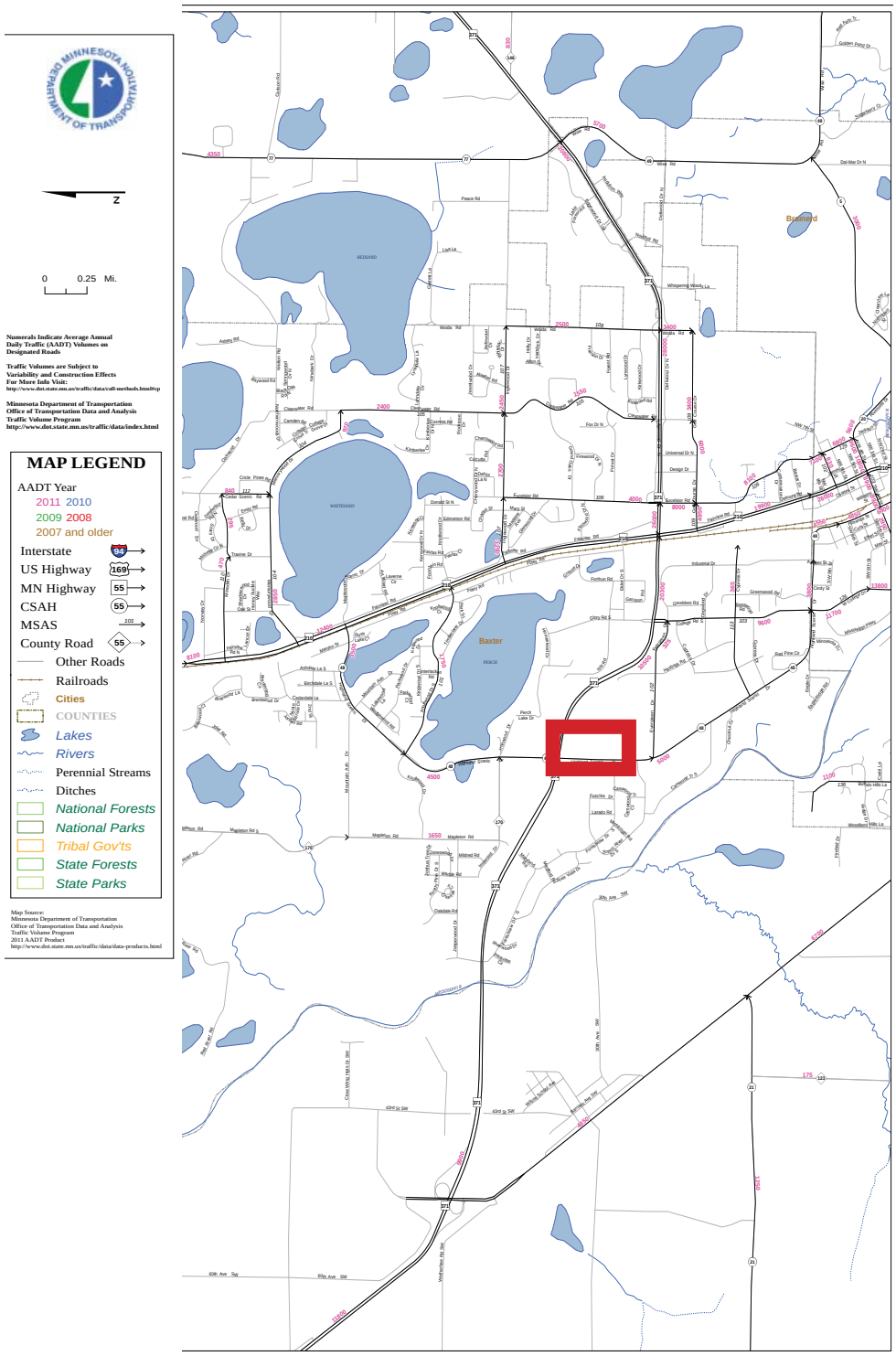

MINNESOTA DEPARTMENT OF TRANSPORTATION
N
0 0.25 Mi.
Numerals Indicate Average Annual Daily Traffic (AADT) Volumes on Designated Roads
Traffic Volumes are Subject to Variability and Construction Effects
For More Info Visit:
http://www.dot.state.mn.us/traffic/data/coll-methods.html#cp
Minnesota Department of Transportation
Office of Transportation Data and Analysis
Traffic Volume Program
http://www.dot.state.mn.us/traffic/data/index.html
MAP LEGEND
AADT Year
2011 2010
2009 2008
2007 and older
Interstate
US Highway
MN Highway
CSAH
MSAS
County Road
Other Roads
Railroads
Cities
COUNTIES
Lakes
Rivers
Perennial Streams
Ditches
National Forests
National Parks
Tribal Gov't's
State Forests
State Parks
Map Source:
Minnesota Department of Transportation
Office of Transportation Data and Analysis
Traffic Volume Program
2011 AADT Product
http://www.dot.state.mn.us/traffic/data/data-products.html
Brainerd
Baxter

Figure 113.1

To the right is a smaller scale and closer look at the site itself and how circulation affects it.

The brown color marks highway 371 and runs north-south on the west side of the site. This highway hosts the heaviest traffic of the site and contributes to the majority of noise created at the site. With the speed limit being 55 mph on this stretch of the highway, cars go by at fast speeds and are driving to reach a destination, not to sight see. This could contribute to visitors overlooking the center because of the nature of the highway.

When walking on the site however, the noise of the cars passing by could only be heard when in close proximity to the road. A short walk to the east and the site felt quiet and secluded, which could be contributed to the tree cover on the site.

Another factor contributing to the noise on the site is the traffic flow on highway 48 which is highlighted in blue on the map. While at the site I would estimate that less than 25 cars traveled on the arterial highway making the road calmer and slower in feeling. The tree line that lines this highway is not needed to help with noise because the road does not have the heavy traffic that highway 371 has.

This is another reason to rotate the tree cover on the site and create a tree buffer along highway 371 instead. This would help to further cancel noise on the site and create a secluded, natural, feel within what could be a bustling commercial part of the city.

There is inadequate pedestrian circulation leading to the site. The two highways do not have sidewalks and are not friendly to bicyclists or those who may be walking. This is most likely because of the distance from the city center and any sort of downtown. Significant improvements would need to be made to the site to increase walkability.


371
HWY 371
Highland Scenic Rd
HWY 48
48
Lake Area
ian Church
United Pent
371
371
N
Land O Lakes

Figure 115.1

C L I M A T E

The climate of the region is indictive of the overall Minnesota climate. It can sometimes be less harsh than that of the plains regions because of the cover the coniferous forests provide. However, that area still experiences harsh winters and unpredictable summers.

The average temperature year-round is 40.6 degrees fairenheit with a high during the summer months of 76 degrees fairenheit and a low during the winter months of -4 degrees fairenheit.

The region is actually relatively moderate compared overall to Minnesota which can be attributed to both the water surrounded the region which helps to regulate air temperature and the dense tree cover of the region.

This will aid any research being done by the science center in the region by provided comfortable working conditions for researchers throughout the entire year.

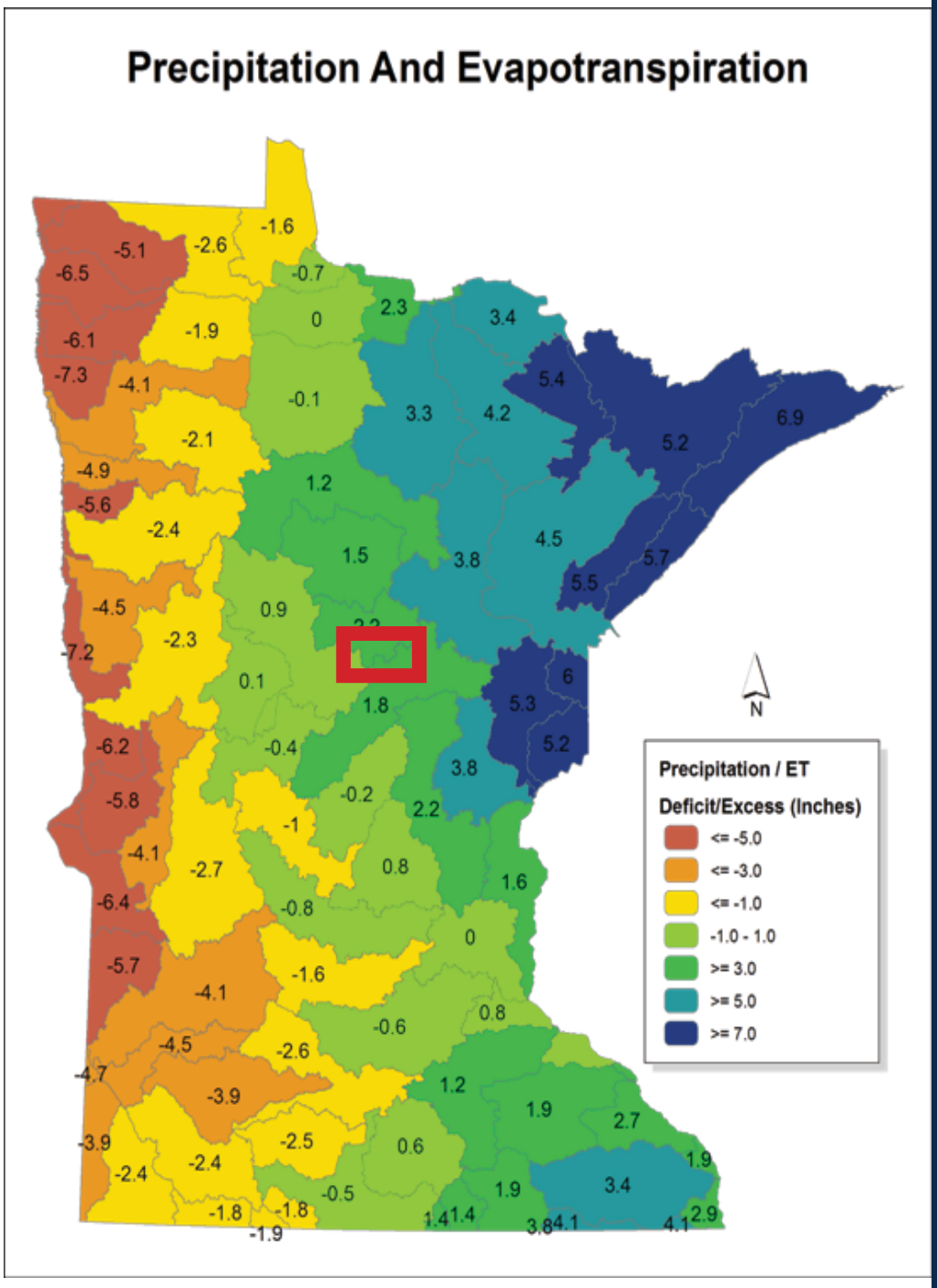

Precipitation And Evapotranspiration
-1.6
-5.1
-2.6
-6.5
-0.7
0
2.3
3.4
-6.1
-1.9
-7.3
-4.1
5.4
-0.1
3.3
4.2
6.9
-2.1
5.2
-4.9
1.2
-5.6
-2.4
4.5
1.5
3.8
5.7
5.5
-4.5
0.9
-2.3
-7.2
0.1
6
1.8
5.3
-6.2
-0.4
5.2
3.8
-5.8
-0.2
2.2
-1
-4.1
-2.7
0.8
1.6
-6.4
-0.8
0
-5.7
-1.6
-4.1
0.8
-0.6
-4.5
-2.6
-4.7
1.2
-3.9
1.9
2.7
-3.9
-2.5
0.6
1.9
-2.4
-2.4
3.4
-0.5
1.9
-1.8
-1.8
1.4
1.4
3.8
4.1
4.1
2.9
-1.9
N
Precipitation / ET
Deficit/Excess (Inches)
<= -5.0
<= -3.0
<= -1.0
-1.0 - 1.0
>= 3.0
>= 5.0
>= 7.0

Figure 117.1

S U N D A T A

Winter Solstice - December 21st- 9:00 AM

Sun studies were conducted of just a proposed building for the site.

At 9 AM the building casts long shadows to the north west. The path of the sun is low and can be seen in the illustration almost directly on the border of the study.

Winter Solstice - December 21st- 12:00 PM

At noon on the winter solstice the building casts significant shadows directly to the north.

The building would receive quality light from the south during this time that would present opportunities for solar heat gain into the building.

Winter Solstice - December 21st- 3:30 PM

A study was done at 3:30 PM during the winter solstice to illustrate how early the sun would set during this time of the year.

The building would cast long shadows to the north east as the sun sets. The sun would still be in a good place to heat the southern side of the building and the low angle of the light would reach far into spaces on the south side.

Winter solstice - 9:00 AM

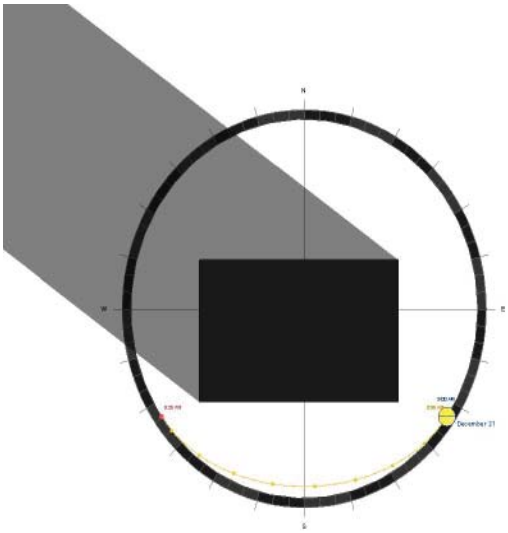


Figure 119.1

Winter solstice - 12:00 PM

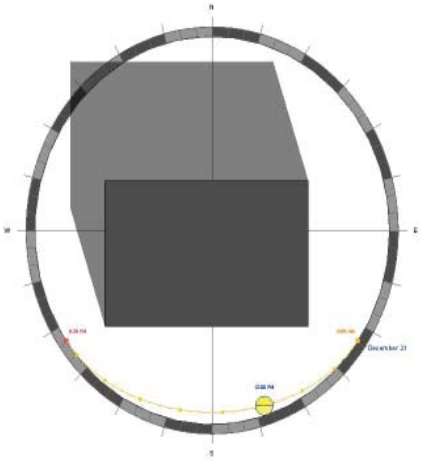


Figure 119.2

Winter solstice - 3:30 PM

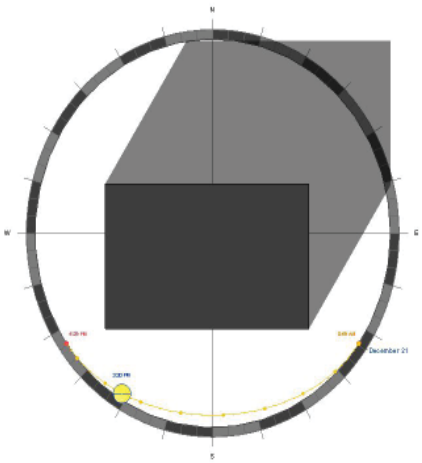


Figure 119.3

Summer Solstice - June 21st- 9:00 AM

During the summer solstice, the sun would be at its highest and the angle of the sun would be almost directly overhead.

At 9AM on the summer solstice the building casts short shadows almost directly to the west.

The east side of the building would be cast in a harsh morning light that would be almost blinding to those working on that side of the building. Shades would be employed so that those working early mornings in the labs could control the amount of light coming in.

Summer Solstice - June 21st- 12:00 PM

At noon on the summer solstice the sun is at an almost ninety degree angle in relation to the building.

The building casts almost no shadow and would be at its peak of heat gain.

Shading structures would need to be employed on the southern side of the building to limit the impact on the cooling load.

Summer Solstice - June 21st- 6:00 PM

At 6 PM on the summer solstice the building would cast significant shadows to the east as the sun begins to set in the west.

During this time the light would be low and harsh on the west side and any rooms located facing the west would gain heat. These rooms would also require methods of controlling light so that these spaces are still usable during the evening hours. Significant heat gain on the west side would happen during this time and would need to be controlled.

Summer solstice - 9:00 AM

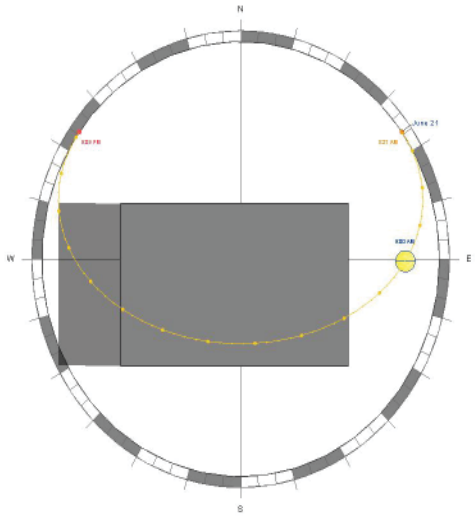


Figure 121.1

Summer solstice - 12:00 PM

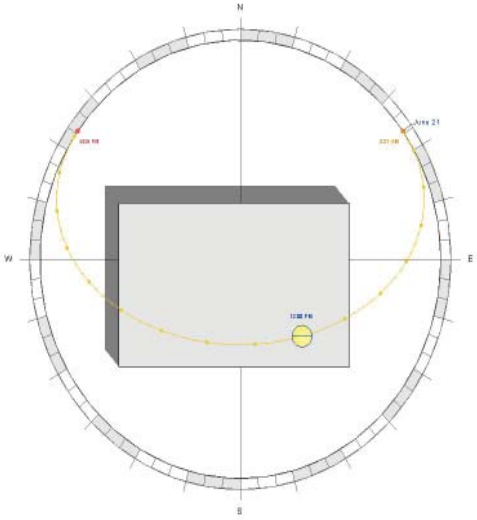


Figure 121.2

Summer solstice - 6:00 PM

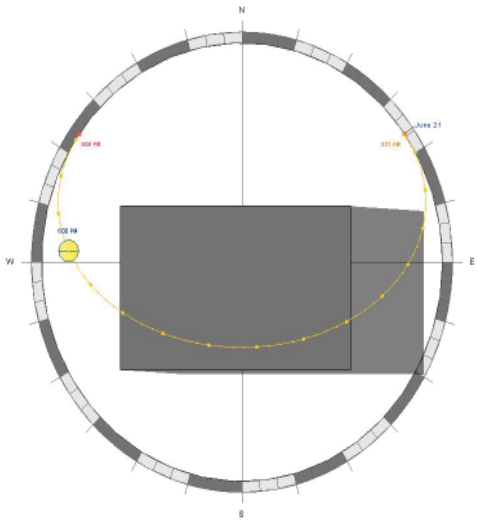


Figure 121.3

The illustration to the right shows my perceived sun data as I conducted the site visit. The brown path on the south side of the site shows the winter solstice pathway and the locations of the sun at different times of the day. The red pathway shows the same data but during the summer solstice.

The site receives adequate light during all times of the year because of the open nature of the site.

Careful consideration will be needed to place a building on the site so that it does not hinder the quality of light that the site already receives.

One of the ways this can be preserved is preserving the site itself. Perhaps we forget about that how we perceive the quality of light that a site not only depends on the light coming onto a site or into a space, but also on what the light hits when it gets there. Simply preserving the natural aspects of the site can preserve the quality of light that is already has. A sun-bathed open grassland populated with small red cedar trees will inherently be more beautiful in the light than a commercial strip mall.

Steps will be taken to ensure that not only is the building itself beautiful, but also meshes well into the landscape so that it looks like it belongs with its environment.

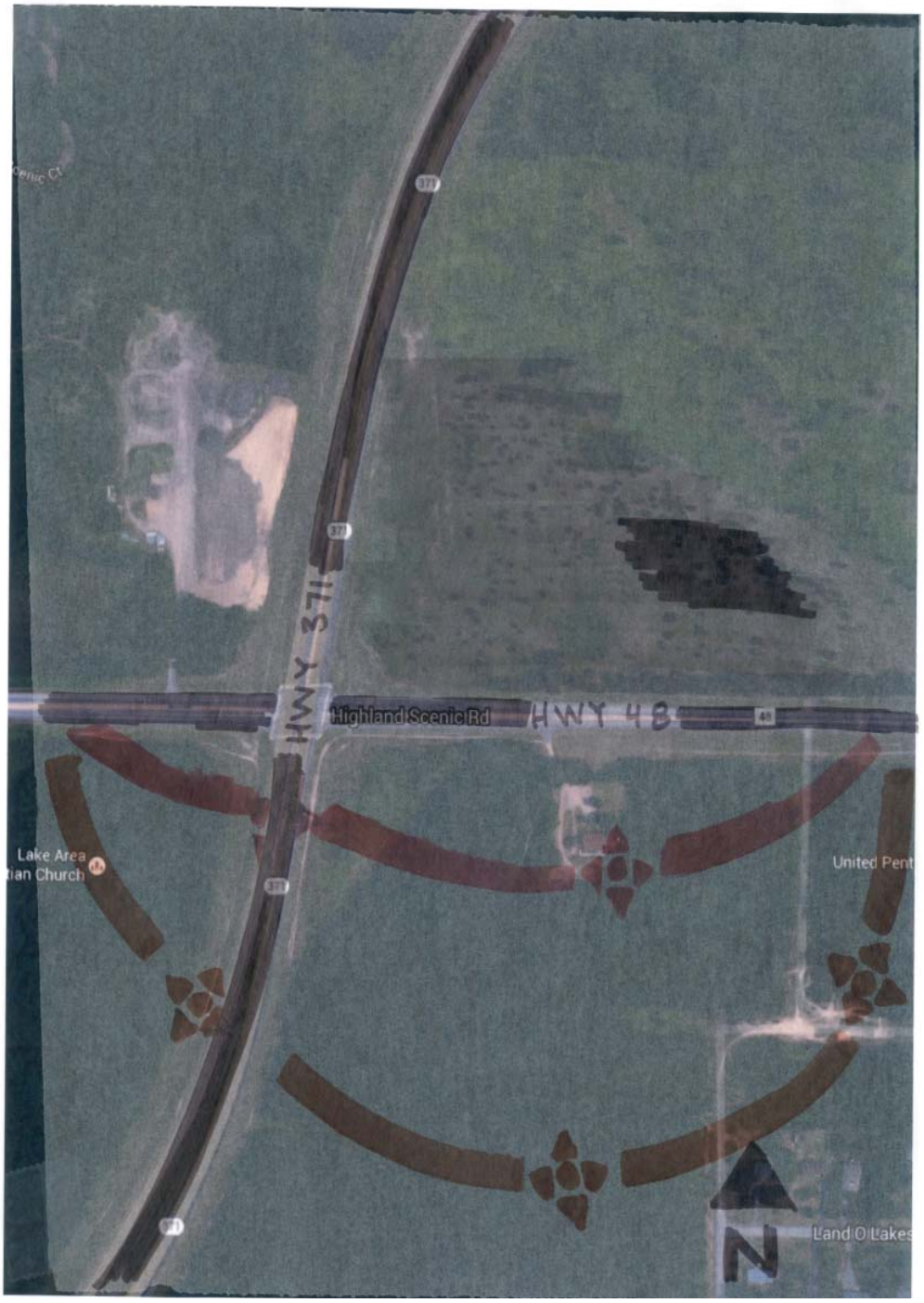

HWY 371
Highland Scenic Rd
HWY 48
Lake Area
United Pent
Land O Lakes
N

Figure 123.1

H A B I T A T

The habitat of the region is classified under the Laurentian Mixed Forest region. Due to forestry, farming, and the growth of cities, habitat loss is a major problem in this region.

It has been stressed throughout this book that we as humans remove ourself from the natural environment and do not study ourselves as a vital part of the ecosystem. In fact, we constantly refer to ourselves and anything we do as unnatural. We could do ourselves and our environment a favor by seeing humans as a natural part of the ecosystem.

We need shelter just like any other animal. The same with food. We have a right as species to shelter and food and I don't believe that we should condemn ourselves for the pursuit of those basic needs to life.

However, we have failed in that pursuit by being unreasonable in our expectations for how much we need. Other animals simply only need a place sleep or shelter of some sort. Humans feel the need for specialized places to live and other places to work, some having numerous places to live. Human habitat is astronomically larger than any other animal's and this is where the problem arises.

We have spread too far and take up too much space for one person. This creates a loss of habitat for other animals which in turn affects any species closely related to that animal on the food chain.

Restoration of these key habitats in Minnesota is underway but there is only so much damage that can be reversed. We will have to come to terms with the damage we have done and try harder in the future to preserve areas where other species other than ourselves reside.

Figure 125.1

Problem	Percentage of SGCN in the Subsection for Which This Is a Problem
Habitat Loss in MN	83
Habitat Degradation in MN	88
Habitat Loss/Degradation Outside of MN	39
Invasive Species and Competition	26
Pollution	30
Social Tolerance/Persecution/Exploitation	20
Disease	3
Food Source Limitations	2
Other	10

Figure 125.2

W I L D L I F E

The habitat of the region directly correlates with the types of wildlife that can exist there.

Site is host to many small mammals like red and grey squirrels, raccoons, rabbits, and other various animals. A few key apex species will be highlighted however because they are key indicators of the health of the region and are overall indicators of all species are surviving.

One animal that has become a symbol of Minnesota is the Grey Wolf (also known as the Timber Wolf). These pack animals do their best not to be seen by humans and spend there time in the coniferous forests mostly in northern Minnesota.

However, as illustrated in the top graphic to the right, their habitat range as been expanding in recent years due to a loss of habitat in the northern half of the state. Due this habitat loss, wolves could theoretically been seen on the site. They most likely would not however because of the busy nature of the site and its proximity to the city.

The expansion of the Grey Wolves' range means that the nature of their species must also change. They live in forested areas and hunt mainly large mammals like elk, deer, and moose. Now they are seen in open areas like prairies and hunting smaller mammals like foxes.

Farmers in these regions have put higher pressure on the wolf population because of this expansion and wolves begin to prey on livestock in the search for food.

In recent years, wolves were on the endangered species list only coming off in the past couple of years. The endangerment of an apex predator like wolves can lead to the overpopulation of the animals they would prey on like deer, which in turn puts a pressure on the plants in the region and biodiversity is threatened.

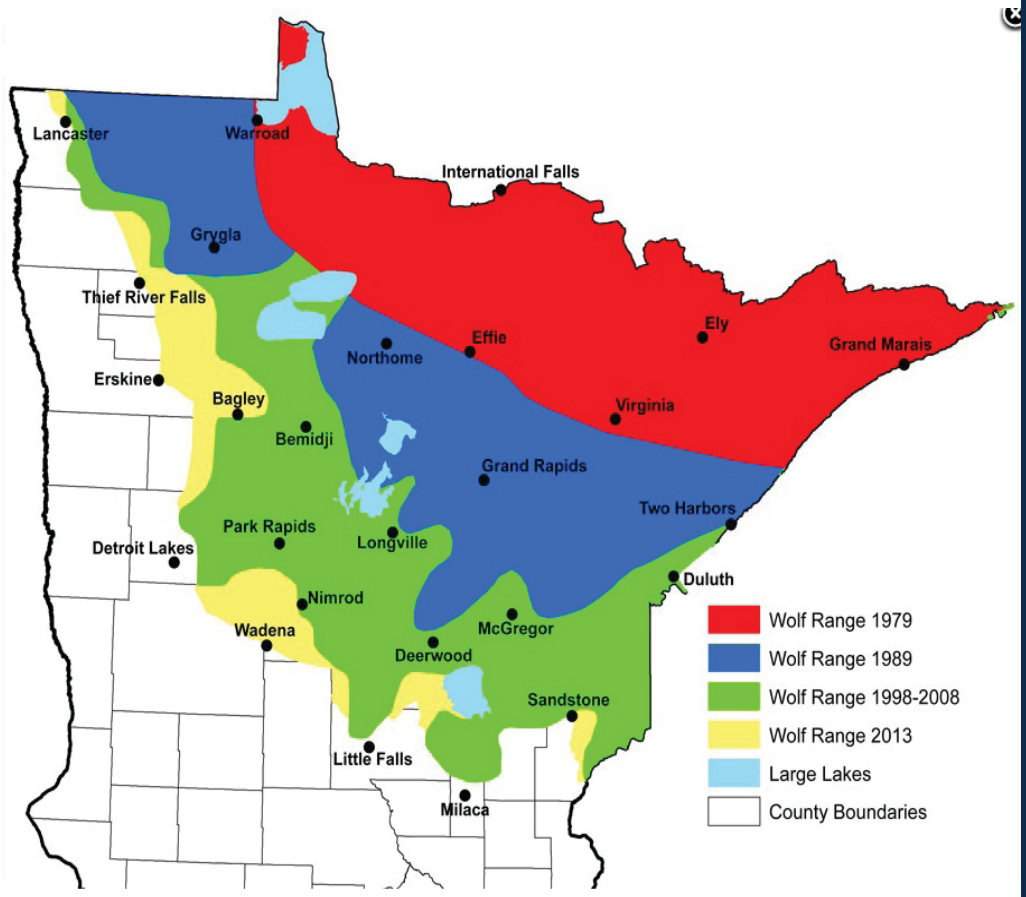


Figure 127.1

Figure 127.2

One key species in the region is the White Sucker (pictured to the right). White Suckers are a freshwater fish located primarily in rivers. They are a key indicator of water quality because they sight feed and therefore need relatively clear water to feed. They also are very sensitive to pollutants and cannot exist in rivers and streams that are overly polluted. This species of fish is found heavily in both the Crow Wing and the Mississippi River. However, it is a rarer find in the lower part of the Mississippi because the water gets less visibility as other watersheds drain into the river.

An apex predator that relies on the White Sucker as a food source is the Bald Eagle. This animal was critical endangered in American in recent years due to pesticides used in farming practices. These pesticides would runoff the fields and into the waterways. The fish in these waterways would become polluted as well but could continue to live. Eagles would eat these fish and become diseased. However, the pesticides did not have a direct affect on the eagle that was eating fish but instead affected the eggs that were being laid by the eagles. The shells of the eggs would become soft and thus crushed by any eagle that tried to nest on the eggs. The species has since rebounded in numbers after the use of certain pesticides was banned in farming. More consideration into run-offs zones and buffer strips is also being employed which helps to protect water quality in regions being farmed.

Bald Eagles need large water sources to feed and thus would be found near the site.

Figure 129.1

Figure 129.2

Z O N I N G

The site is zoned as C1- Neighborhood Commercial. This means the lot is intended for small scale commercial projects that are in or near dense residential neighborhoods. The areas surrounding the site to the east the north are zoned for R3- High Density Residential.

Neighborhood Commercial zoning encourages small retail projects that service the adjacent residential projects and parking is limited to keep in scale with residential projects.

While the Central Lakes Limnology Science Center would not offer retail services to adjacent residential properties, it would offer natural and parks services that are often overlooked in how important that is to dense residential living.

Variances would need to be applied for in order to build a public building on the site. However, due to the relatively undeveloped nature of the site and those around it, variances for this type of project would be easily attained.

Baxter Zoning Map

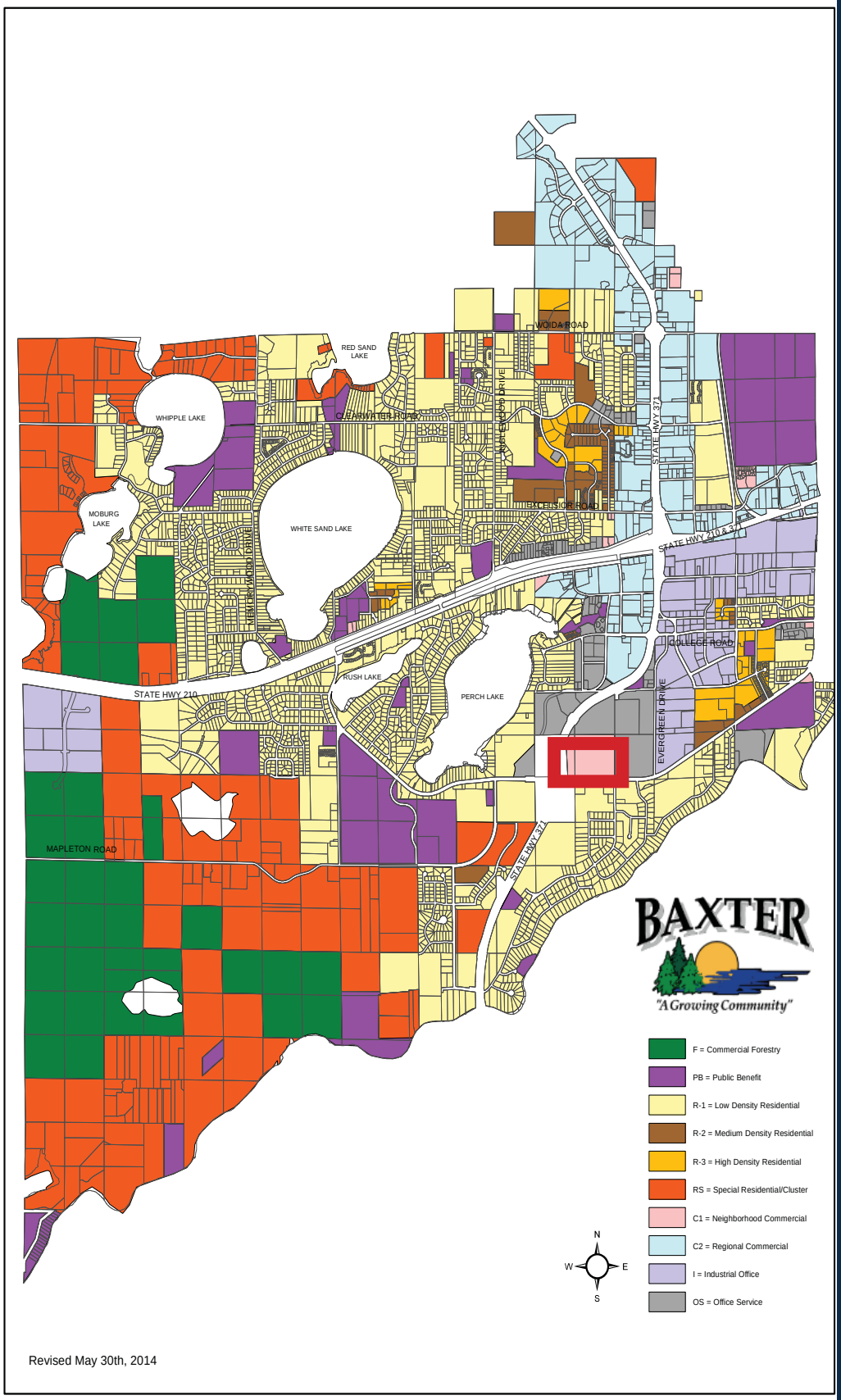


Figure 131.1

P A R K S

Baxter is only a recent development in terms of a city and has given priority to commercial properties instead of to parks and natural features.

The site itself would be devoted to park space also and could help to create green space in a centralized area of relatively no park space.

To the west of the site and located in a heavily forested region is the Paul Bunyan state bike trail. Perhaps bike paths and walking paths could be added to the site to connect to this trail.

A paved bike trail to the south of highway 48 may already connect to the Paul Bunyan trail but it is under utilized. An offshoot of this trial will be brought into the site to create greater pedestrian access.

Baxter Trail Map

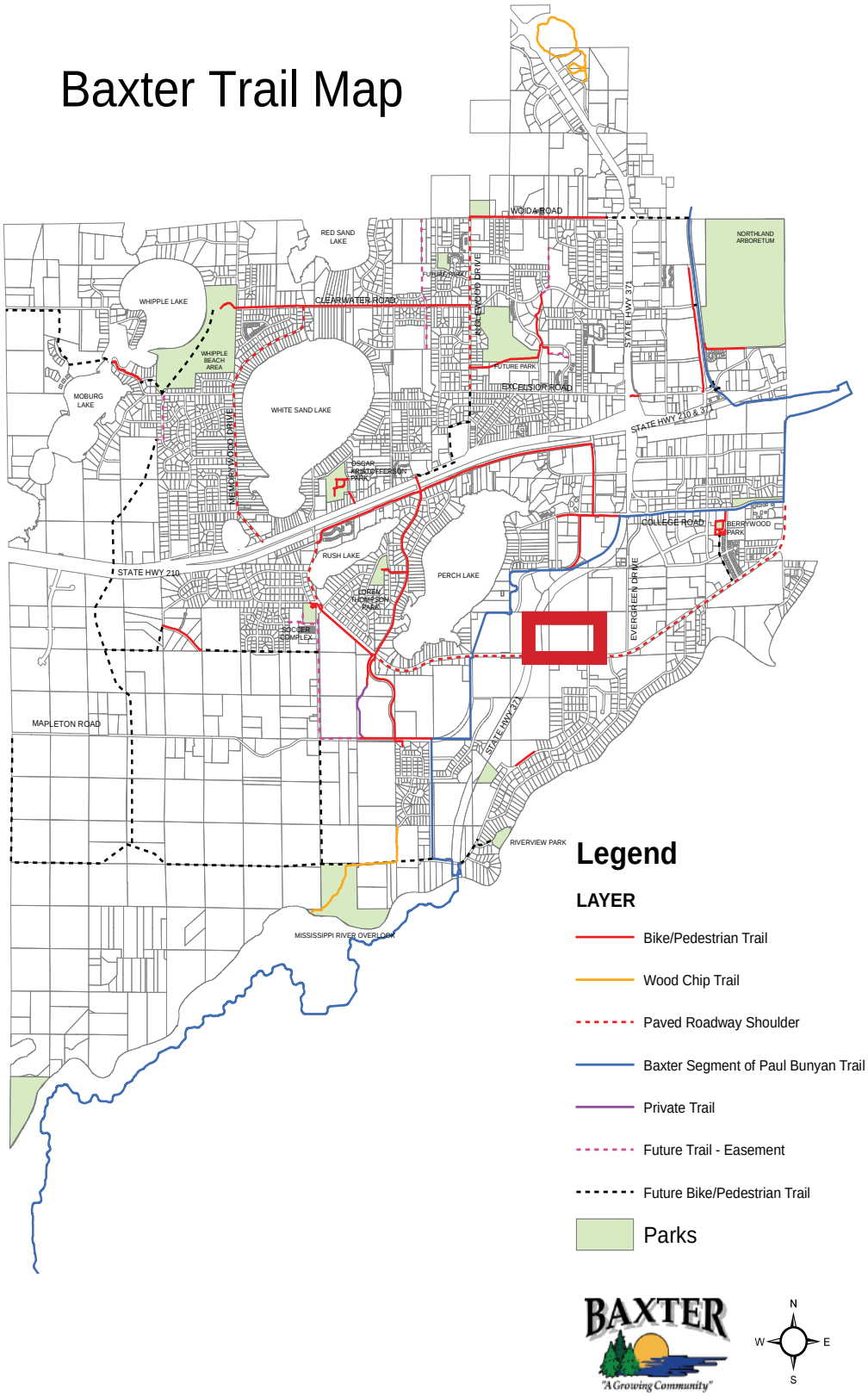


Figure 133.1

SUSTAINABILITY

Being that the site is undeveloped and relatively "virgin" territory, it does not possess what we would label as "green" qualities or qualities that would achieve LEED points.

However, in my opinion the LEED system has become a bureaucratic mess and only leads to designers "point-chasing" in order to get a special little plaque on their building. The guidelines set by LEED are good within themselves but the system used to measure the sustainability of a building is off.

Instead, the building will be measured in terms of sustainability by how much of the site is converted to park space and the efficiencies of the building systems.

If care can be taken to limit the building has on the environment around it then it will be considered sustainable. Other forms of energy harvesting will be employed to do so and careful space planning will ensure that the building does not sprawl and that each space is used to its fullest potential.

Using the site to plan these spaces will also ensure that the building responds to its environment like the wind and sun patterns relating to the region.

It is the utmost duty as a designer to take extra care and precautions in terms of sustainability so that future generations can continue to use the Earth just as I have. This consideration will be at the forefront of the design process.

S U M M A R Y

The site analysis process has created a stronger connection between the site and the designer (myself).

We often times forget however, that each parcel of land can hold its own sense of place. While at the site I felt that the site needed something more than a commercial strip-mall that its zoning is almost calling for. The region itself needs something more, something to connect the are back to water.

In looking at the maps presented Perch Lake can be seen just to the north west. What can also be seen numerous lake homes lining the edge of the lake. Perhaps the Central Lakes Limnology Science Center and its adjoining site can show these home owners what it means to take care of water and to not take it for granted. The center will need to show visitors the power that a wetland can have and that they are not to drained and discarded.

The site is a blank slate which can be troublesome in that it is easy to get carried away. I think that is what has happened in the cities where suburban sprawl has become an issue. Developers look upon what they see as a boring field of grass and forget what that grass means in terms of water harvesting and habitat for other animals.

I will refer back to the information presented in the sight analysis study to not only try to keep from getting carried away but to also keep in mind its sense of place. The land we build on deserves to become something more than a strip mall. We owe the land that gives us a livelihood a purpose.

The Central Lakes Limnology Science Center will pay homage to its past with constructed wetlands and large areas devoted to native plant species on the site.

ACTIVITY SPACE ALLOCATIONS

A building program establishes a building's physical attributes as well as the parameters and connections of the design. These parameters are based on current usage of spaces in the specific typology and the anticipation of future needs within that specific typology.

A building program brings a documented vision to the project that can be used to show a client exactly what they will be getting and will then inform a preliminary budget. The program will act as a guide throughout the course of this thesis as to what spaces are needed and will serve as a benchmark of design.

The Central Lakes Limnology Center will be broken into five different spatial categories as follows:

Administration and Office Spaces:
- -Director and Research Offices
- -Reception Area

Administration Support:
- -Workrooms
- -Mechicanial
- -Conference Rooms
- -Cafeteria
- -Overnight Research Room
- -Custodial
- -Storage
- -Restrooms

Public Space:
- -Exhibition / Public Display
- -Entry / Lobby
- -Aquarium
- -Greenhouse

Research Lab Space:
- -Reseach Labs
- -Greenhouse
- -Aquarium
- -Classrooms

Lab Support:
- -Breakout Research Spaces
- -Mechanical
- -Storage

ADMINISTRATION AND OFFICES

The projected occupancy on a day to day basis for the research center is based off of the case studies conducted and then adjusted for the size of the project and the scope of work.

1- Program Director
6- Research Fellows / Teachers
10- Graduate Researchers
2- Administrative assistants

These will be the main occupants of the building. However, to plan for future expansion and possibly undergrad students or other researchers occupying the space, all lab spaces and research support spaces will be planned for the use of 30 researchers. Each main occupant will receive their own office with Graduate students occupying an open office concept with movable workstations so that they are free to set up something during their time using the facility.

This results in a requirement of 9 permanent offices and 10 floating / movable offices.

DIRECTOR'S OFFICE:

NSF - Approx. 250

The director's office needs to be bigger than the other offices so that it can also serve as a conference room when meetings need to be held with the director. Priority will be given to the director to be located more adjacently to the building entrance so that the director can greet visitors to the center easily. It will not need to be close to the lab functions of the building because the director is seen as more of a background player when it comes to research and instead oversees all of the research being conducted at the facility. South sun exposure is critical as well is noise reduction and fresh air into the office. The office needs to be a habitable and welcoming environment for anyone who conducts work in it.

RESEARCHER OFFICES (6 THUS):

NSF - Approx. 250

Each prime researcher's office will be the same size as the director's office to do away with traditional office hierarchy and invite a more collaborative environment. However, these offices will be intermixed with the lab spaces so that researchers can easily collect data in the lab and return to their own environment to interpret data collected from their experiments.

out are of the highest priority in each office to create a relaxing environment for each researcher. Both the researcher's and director's offices will be mostly transparent so that collaboration among the staff at the center is encouraged and they can better engage the public in an informal setting.

GRADUATE RESEARCHER OFFICE SPACE:

NSF - Approx. 50 per person. 500 total.

The graduate assistants that are asked to conduct their thesis using the facilities will be housed in an open office environment with enough space for 10 people. Less space is needed for each student because of the open concept and the ability to share space. The need for flexibility is important in this space as the users will be changing frequently and demanding different functions out of the space. These work stations will be located adjacent to the lab spaces so that graduate researchers can easily flow between lab work and interpreting data collected and assisting the main research faculty of the center.

Figure 138.1

ADMINISTRATION OFFICES (2 THUS):

NSF - Approx. 250 each

The administration offices will be essentially the same as all other offices inside the center except they will be more open and will be located adjacent to the reception area. In this way the offices will blend into the reception area so that administrators can greet visitors and handle the office operations of the facility. These offices will need to not only be located near the public entry but also to a workroom sot that administrative tasks can easily be carried out while still engaging the public. These support staff will able be located near the director's office so they are able to assists in the daily operations of the research being conducted as well.

RECEPTION:

NSF - Approx. 300

The reception area is hard to calculate because of the dual purpose the reception area will have. It will also serve as public and display space. A number has been allocated to the area needed for this space but it may change as more planning is done. The reception area also meshes into the administrative area so much that it is hard to define the space until the building is studied in plan. Warm materials will be used in this area to create a welcoming environment for not only the public that is received in this space but also those that work there daily.

Typical amount of time spent on various tasks in a day by researchers according to "Building Type Basics for Research Laboratories"

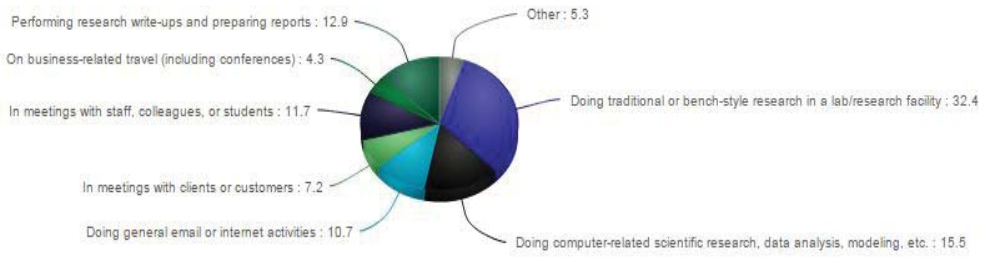


Figure 139.1

ADMINISTRATION SUPPORT

WORKROOMS / BREAKOUT SPACES:

NSF - Approx. 100- 300 each

To segment the offices and lab spaces workrooms or breakout spaces will be provided where researchers can go to relax, collaborate, and hold informal meetings with each other. These spaces will vary in size and formality. Depending on the building layout approximately 4 to 6 break-out spaces will be needed. These spaces can be anything from a bump-out in circulation spaces where researchers can step aside and have a conversation to an enclosed space with desks and tables where undergraduate students can set up informal study spaces. Flexibility between these spaces is important so that they can be converted to other functions if needed in the future.

MECHANICAL:

GSF - Approx. 10% of total building square footage

The mechanical space is fairly straight-forward. It cannot be sized until a gross square footage has been calculated for the entire building footprint. This mechanical space will house equipment meant to service the administration functions of the building or everything but the lab spaces. It will function in the same way as most commercial mechanical spaces in this way. The space will be located on the interior of the building so that views to the outside are not wasted on a mechanical room. However, to more efficiently service the building an exterior wall will be needed to house intake and exhaust grills for the mechanical room. A fine balance of exterior and interior walls will have to be achieved.

CONFERENCE ROOMS (4 THUS):

NSF - Approx. 400 to 600 each

Formal conference rooms will also segment the researcher's offices areas and the lab spaces much like the work rooms. Some of the less formal conference rooms will be integrated into the workrooms so that there is not physical separation between the two and the two spaces can be combined or segregated as the user needs. Much like the offices, the conference rooms will be transparent so that researchers can still keep an eye on the facility even while in a meeting. Priority to outside views will not be given to the conference rooms because of their limited occupancy and needs. The main conference space will need to

CAFETERIA:

NSF - Approx. 600

Only one cafeteria or staff lounge space will be provided to encourage interaction between the researchers and students using the center. It will function as a less formal space with no supporting kitchen or service area. Instead it will feel as more of a large kitchenette and lounge. This area will need to be located far from the lab spaces so that there is not cross-contamination with food and experiments happening in the lab. In most lab scenarios food is not allowed inside the lab itself so a physical distance of the two functions will increase lab safety.

OVERNIGHT RESEARCH ROOM:

NSF - Approx. 200

The overnight research room is simply a space that houses a bed so that researchers who need to conduct sensitive research can stay overnight and monitor their work. However, this space will have a very low usage so it does not necessarily need to be a functional space at all times. Instead this function may be combined with one of the workrooms with movable and space-saving furniture so that it can be easily converted into a pseudo bedroom.

CUSTODIAL:

NSF - Approx. 100

The custodial space will serve as storage for equipment used to the clean the building. Having this located near the lab is important as any spills or other messes created inside the lab need to be dealt with immediately. While this space is fairly unimportant when it comes to the design aesthetic of the building, it is very important in terms of function.

STORAGE:

NSF - Approx. 200

The storage space for the administration functions of the building will be located near the reception area for easy access of those who handle the daily operations of building maintenance. Since the building will be located on its own and not on a campus of any sort it will need to be self-sufficient in some ways. After interviews with those who inhabit some of the case studies it was apparent that lack of storage was one of the biggest drawbacks to some of the facilities. Adequate storage will be provided.

RESTROOMS:

NSF - Approx. 300 each

A public women's and men's restroom will be located near the main entry of the center so that it is easily located by visitors to the center. Consideration will be given to treat the restrooms as part of the design as a whole and not an add-on to the building to meet a requirement. Materials selected for this space will need to be durable and easily cleaned but also dignified in their usage. Smaller and more private restrooms will be provided adjacent to each lab space also so that researchers do not have interrupt their work.

PUBLIC SPACE

EXHIBITION / PUBLIC DISPLAY:

NSF - Approx. 500

The exhibition space and public display area will be integrated into the reception which makes calculating and exact square footage challenging. In order to maximize the functionality of the building, spaces have to be flexible to different needs. The public display space will feature some hard walls to attach static displays to but will also have movable supports so that interactive displays can be made for the public to learn with. Because the display area will need to change as experiments being conducted at the center change, it will be informal and open.

Figure 143.1

ENTRY / LOBBY:

NSF - Approx. 200

The entry space is hard to define in terms of square footages because it occupies much of the same area as the lobby and reception space. By employing flexible space designs, many areas can accommodate different uses. The entry space will consist of a vestibule to protect the building from the weather and cut down on heating / cooling costs and will open into the lobby / reception area. It will be open, airy, and inviting with ample daylighting to welcome visitors into the center.

AQUARIUM:

NSF - Approx. 200

The aquarium is a crucial part of the design because it serves two purposes. Visitors to the center will be captivated and attracted to the aquarium and in turn will learn about the freshwater fish that inhabit Minnesota waterways. Secondly, researchers will be able to use the aquarium to conduct controlled experiments involving fish and their habitats. Visitors will be able to view these experiments taking place within the aquarium and return to see new experiments being conducted. In this way the aquarium will change as the center changes providing new material to engage the public. This will be used as a centralizing attribute in the center and as a focal point of the public display space.

Figure 144.1

Figure 145.1

GREENHOUSE:

NSF - Approx. 300

The greenhouse will act much like the aquarium in that it will serve the public and the researchers at the facility. One side of the greenhouse will be open for the public to view from inside the facility. The main purpose of the greenhouse will be a space for the researchers to conduct experiments on aquatic vegetation. The space will need adequate south sun exposure as well as shielding from the north-west winds so as to limit heat loss. The greenhouse will feature aquatic plants that would be found in wetlands and river ecosystems.

RESEARCH LAB SPACE

RESEARCH LABS:

NSF - Approx. 350 each (4 thus)

The research labs will be split into two groups, wet labs and dry labs. While lab design has changed so much that there is no longer a clear separation of these two different kinds of spaces, the distinction between the two will still be somewhat defined so that different experiments and research conducted can be separated in some way. The labs will need to be open with ample circulation so that those who use the lab are not getting in each other's way.
The labs will need to be adjacent to the work spaces of the researchers and the offices. In this way it will be easy for researchers to keep an eye on the data being collected and to easily access designated research spaces.
Flexibility in the research laboratories will be of the highest priority so that future needs of the labs can be accommodated. To do this space saving and movable furniture will be used and all electrical connections will come from the ceiling.
Material selection in the lab spaces is also very important. Flooring needs to be of a resilient material that is durable and can stand up to corrosive chemicals is spills occur. It also needs to be made of non-slip materials so that researchers can easily walk around with chemicals in their hands without the risk of slipping.
Natural daylight and views out are also very important in the lab spaces. Views looking out on to the site provide eye relief for the researchers and improve the overall moral. South facing views are not the highest priority however because of the amount of sunlight a south facing facade would create. The labs will be given daylight priority from the north side so that a more diffused and constant light is achieved. Light from the north is more easily controlled and will be less likely to interfere with experiments being conducted.

The Aquarium and Greenhouse is considered part of the research lab section of the building because of the experiments that will be conducted in those spaces. However, both serve a duel purpose as being both public and private and so they fall under each category in terms of planning.

Figure 147.1

Figure 147.2

CLASSROOMS:

NSF - Approx. 400-500 (2 thus)

The classrooms in the center will be designed with a flexibility so that they can be combined to act as a large presentation space. These areas will not only house classes on a daily basis but will serve as an interactive space to host presentations to the public and to dignitaries who visit the center. After interviewing various faculty who work in research buildings much like this thesis, a fixed seating auditorium style classroom is not functional and rarely used. Because of this, the classrooms in the Central Lakes Limnology Center will be designed with movable seating and walls so that it can grow to accommodate the functions happening inside. Ample daylighting into this space is important but so is wall space so that projectors can be used. To achieve this, clerestories with operable shading will be employed to allow daylight into the space but to not use valuable wall space.

RESEARCH LAB SUPPORT

BREAKOUT RESEARCH SPACES:

NSF - Approx. 50-100

The breakout spaces will function in much the same way as the workrooms and will be placed intermittently throughout the building. These spaces differ from the workrooms in that they are to be used to support research being conducted instead of the daily operations of the building. Some of these research breakout spaces will house specialty equipment that is used infrequently and will not be located in the labs. The breakout spaces will be also house operations that are hazardous and need to be segregated from the functions of the lab and offices for safety. They will be located in proximity to the labs and offices but will be designed in a way to have separate HVAC systems so that any hazardous materials gone awry are contained.

MECHANICAL:

NSF - Approx. 10% of lab related functions

This second mechanical will house the equipment that is specifically needed for the lab related functions. The HVAC of the lab spaces and the offices and public spaces needs to be completely segregated and separated so that any breach or accident with hazardous materials does not circulate throughout the entire building. This space will be located adjacent to the labs and needs an ample amount of exterior wall space for large intake grills.

STORAGE:

NSF - Approx. 300

This storage space will service the labs specifically and will be a space for samples to be stored. Researchers are not always able to easily visit a site multiple times to collect samples whenever they need them so they most times store the samples so that they may be used for sometimes years at a time. Because of this, storage is almost always lacking and desperately needed in research facilities. A separate garage space will also be provided to house all of the equipment that researchers at the center use to collect data. This is equipment could be boats, ATVs, campers, or mobile research units to conduct experiments in the field.

DESIGN PROCESS

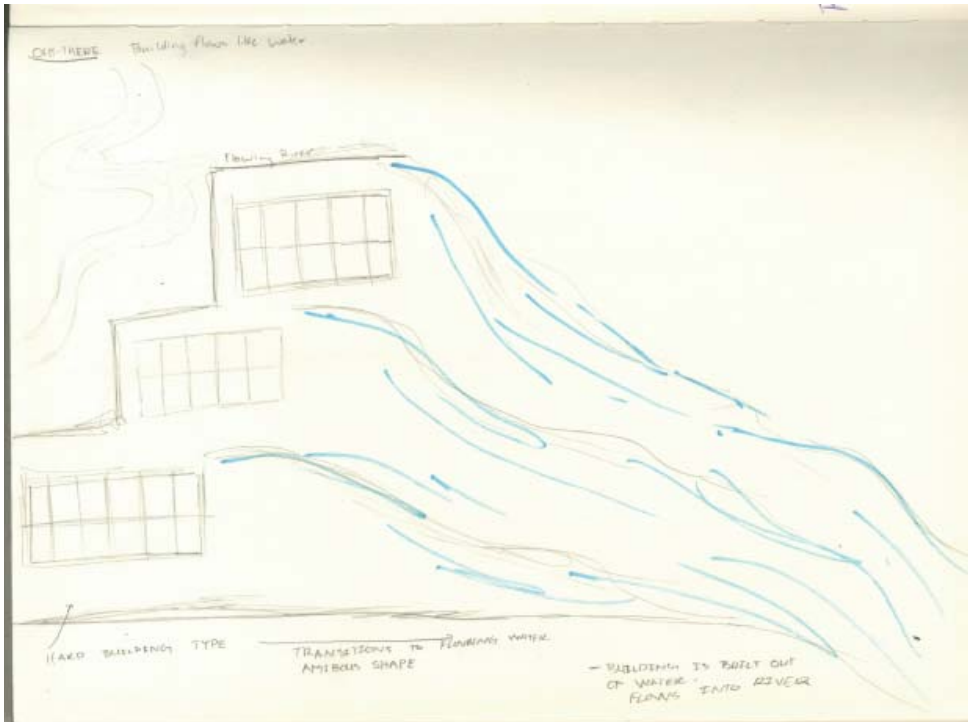


Figure 150.1

The design process of Awaking Waters started with idea sketches that helped to not only narrow my thinking and focus, but also to push the design outwards at first. It was then reeled back to a more managable and appropriate design.

The above sketch is a concept of a building built using water as a physical building material. While this may be reaching and out of the bounds of something that could actually be built, it proved as a useful starting point for using water in unique ways.

The sketch also contrasted a hard and sharp building with the fluidity of water. This idea will be carried through the design in using building elements to contrast the regimented structure and flowing water and active vs. passive energies.

The sketch below is of a building that uses water collected from its roof funnelled into a water feature. Large curved curtain walls would also be used to create a design that is light, and transparent like that of water. This idea was more attainable and manageable as a true design and could be employed easily. As the design progressed, the waterfall in the sketch below was not employed, however, the roof of the building is designed as a water collector using both planted roofs, and gutter systems.

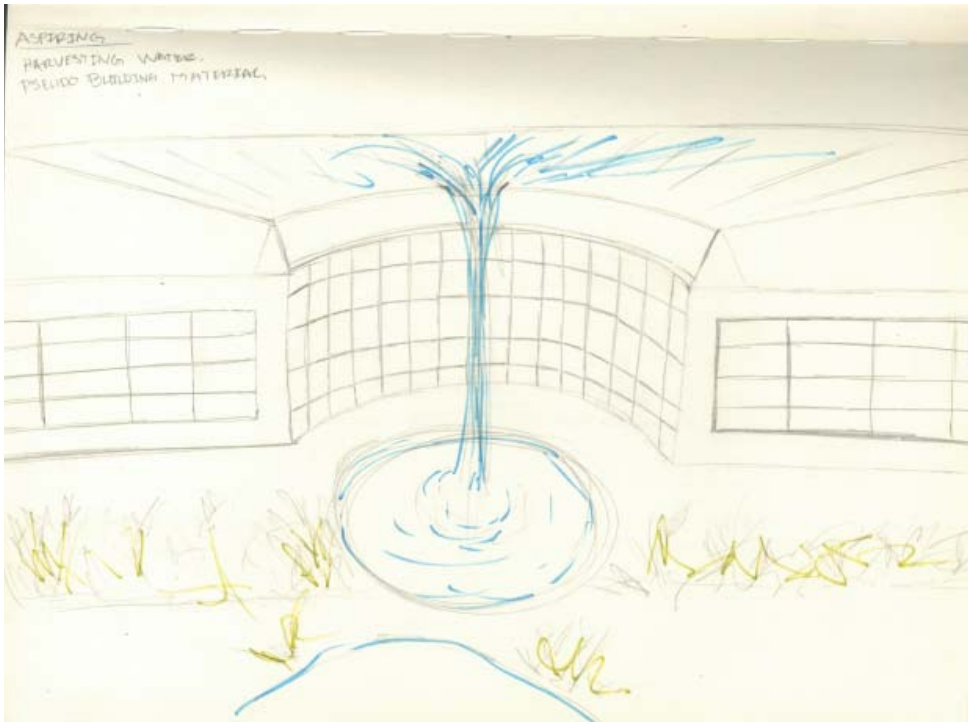


Figure 151.1

The process of design continued first with line drawings of room blocks and then spatial drawings of detail floor plans, which are pictured to the right. The building is split up into three separate floors, each serving different functions in serving the building occupants.

The basement floor of the building serves as mosty long term storage for the lab fucntions. These storage bays would be set up in an open concept with various shelving sizes to house different sample sizes. This floor is also used for large water storage and would have a large mechanical room for the heat pumps that serve the geothermal well field. Separate rooms are set aside for any laboratory storage that is hazardous or must be kept in different lighting to prolong its life. This is done so that a hazardous material is contained if in an accident and the rest of the floor will not be compromised. This floor is only for staff of the building.

The first floor of the building is mostly for the public and administration. Public displays will be set up to educate the public and they will be free to explore the facility. The first floor will also have its own mechanical room that will be transparent to the public and will be used as a teaching mechanism for showing not only how building systems work, but also to create analogies with how water ecosystems work. All offices for the reseachers will be on the first floor so that they are close to the teaching labs and also central to each other for collaboration.

A large part of the second floor is open to the first floor so that the public can see both floors from the atrium. While the second floor is more private in nature and houses the main research labs, the public is still able to explore the second floor. The labs are lined with glass so that researchers may work inside in peace while the public is able to see what is happening in the labs without disturbing the research. A separate mechanical room services the second floor so that the labs are separate from the functions on th first floor. If something were to go wrong in the labs, air would not be circulated out of the labs and down onto the first floor.

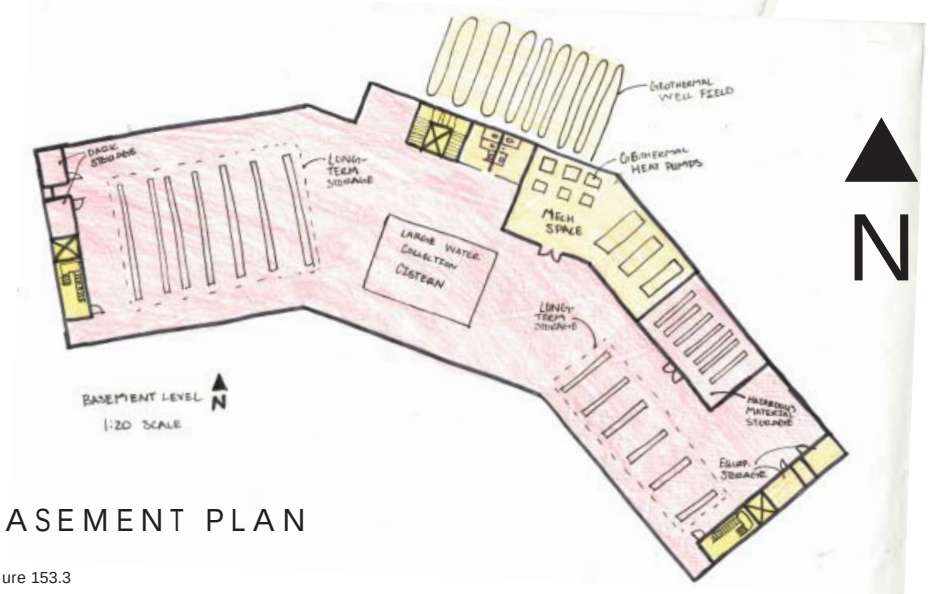
PUBLIC CIRCULATION
LAB-PRIVATE
LAB SUPPORT
BUILDING SUPPORT
PUBLIC SPACE
ADMIN

SECOND FLOOR PLAN

Figure 153.1

FIRST FLOOR PLAN

Figure 153.2



BASEMENT PLAN

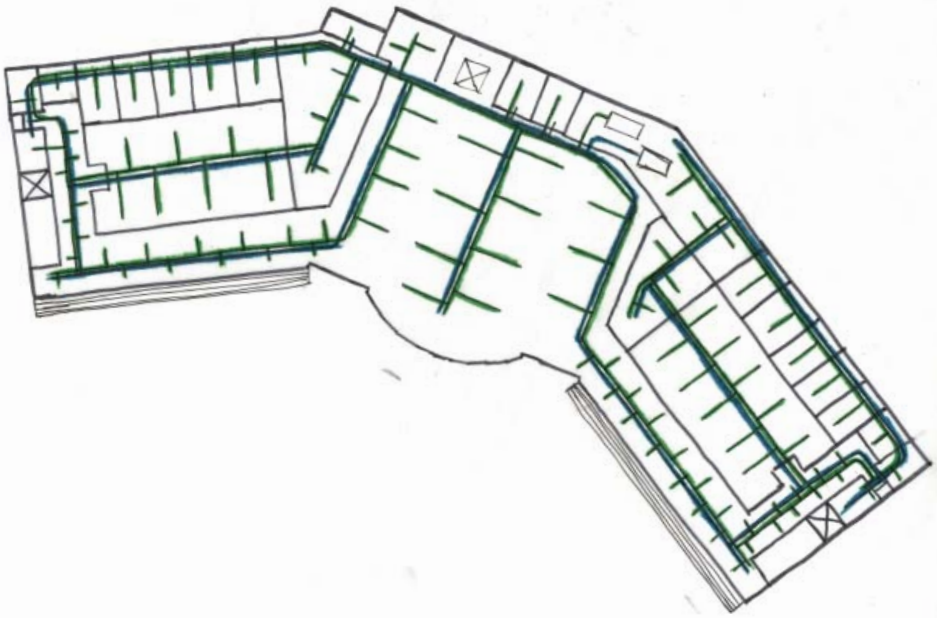
Figure 153.3

The design progressed with the creation of HVAC layouts to service the building. To the right is the layout for both the first and second floors. Supply ducts will be round in cross section and color coded in the building design, while the return ducts will also be color coded but will be rectangular in cross section. Both of the duct systems will be exposed so that it will be apparent in the design exactly what their function is and can be used as an education mechanism.

When walking through the building you as a visitor will be able to look up and see a complex system for delivering and returning air that resemble that of a system of rivers and their tributaries.

RETURN

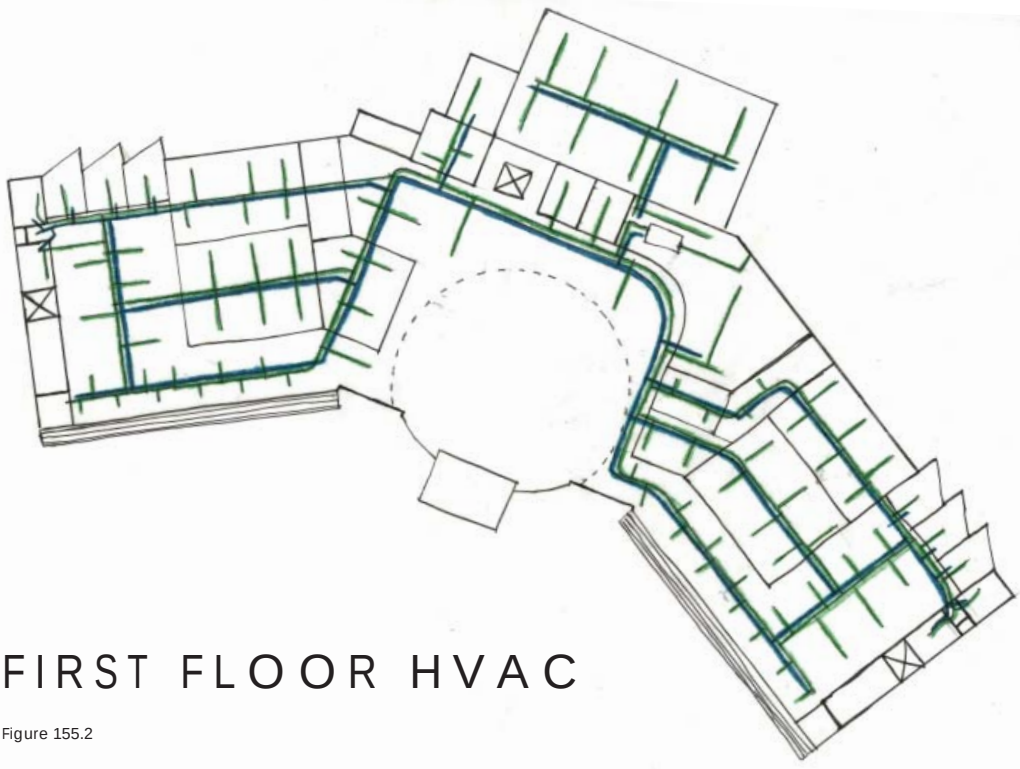
SUPPLY



SECOND FLOOR HVAC

Figure 155.1

N



FIRST FLOOR HVAC

Figure 155.2

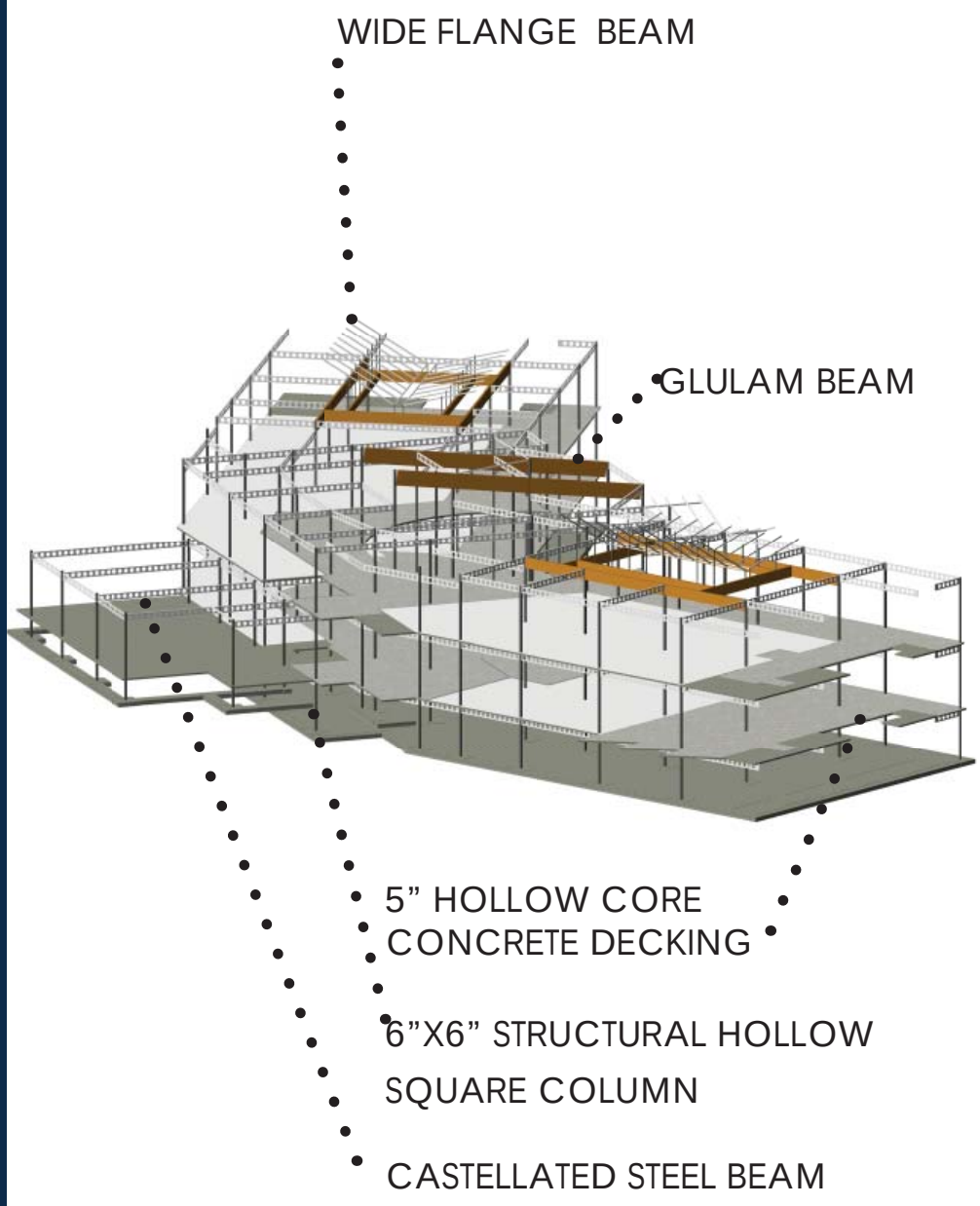

WIDE FLANGE BEAM
GLULAM BEAM
5” HOLLOW CORE
CONCRETE DECKING
6”X6” STRUCTURAL HOLLOW
SQUARE COLUMN
CASTELLATED STEEL BEAM

Figure 156.1

TYPICAL STRUCTURAL FLOOR PLAN

Figure 157.1

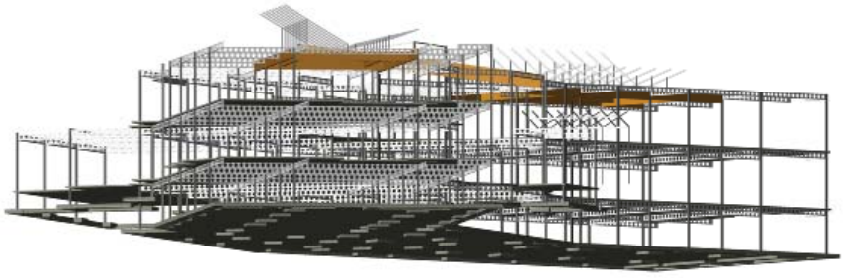
The structure of the building is mainly comprised of hollow square steel columns, castellated steel beams, and hollow core concrete decking. The butterfly roof structures and the structure of roof over the main atrium are highlighted with large glulam beams. The contrast between the castellated steel beams and the glulam beam systems could be considered the same as what exists between what we would consider the natural and built world. But does a castellated beam take any more processing than a glulam beam? While steel must be mined, the wood must be harvested from a forest. Then both must be refined in some way wether that is melting it down or cutting into managable pieces. Each structural system starts as a natural existing entity in this world and must be refined in some way so that we can use it, yet one would undoubtable be labeled as “natural”. Hopefully, by using steel and showcasing its abilities, the building can further educate the public on the processes involved with abtaining building materials.

STRUCTURAL STUDY

Figure 158.1

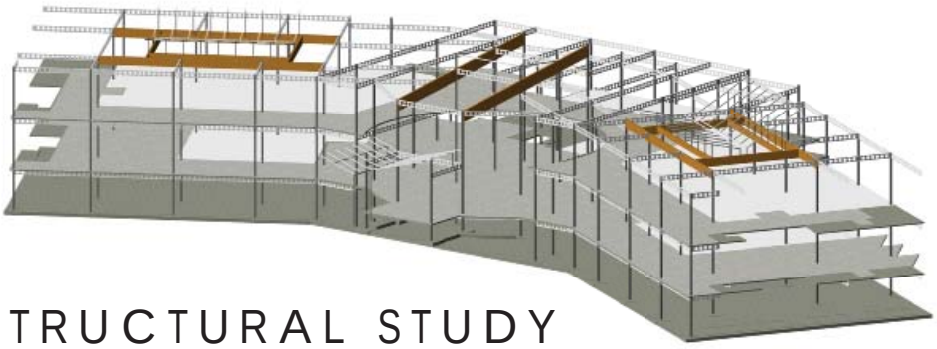
Each structural study done showcases the building skeleton from a different view. The foundation is a slab on grade under the basement level with thickenings under each column and foundation wall. The materials used in creating the structure of the building allows for a larger and more open floor plan which is ideal in a lab situation that must be flexible. The rest of the building materials simply hang from the skeleton creating light and open feeling spaces.

The regimented and repetative layout of structure would cut down labor and building costs and keep the project feasible.



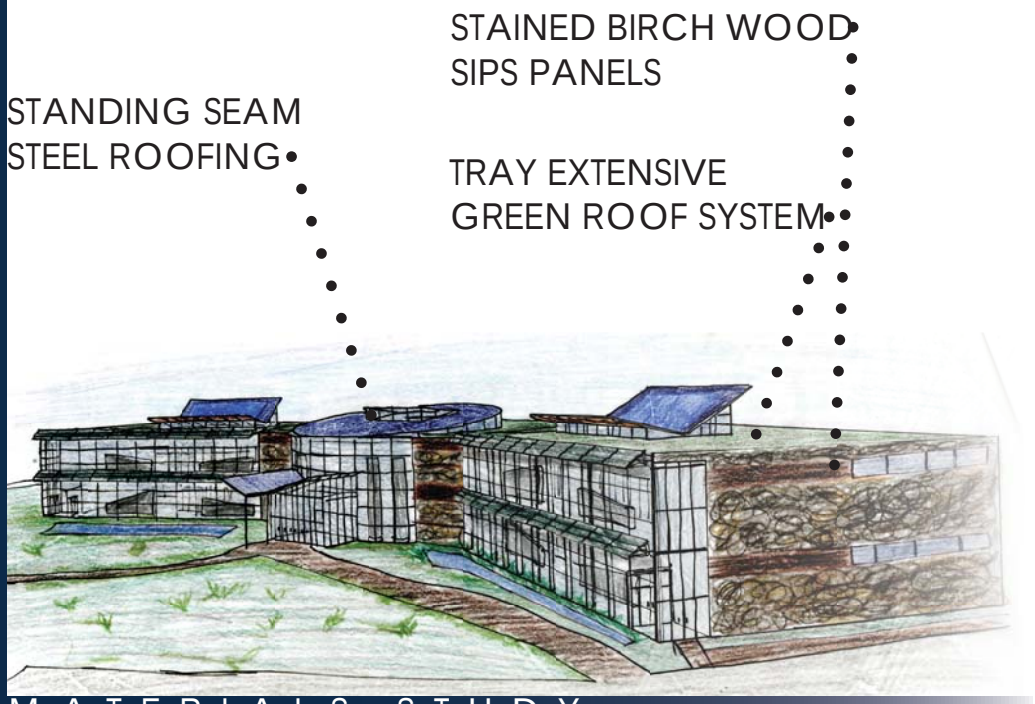
STRUCTURAL STUDY

Figure 159.1



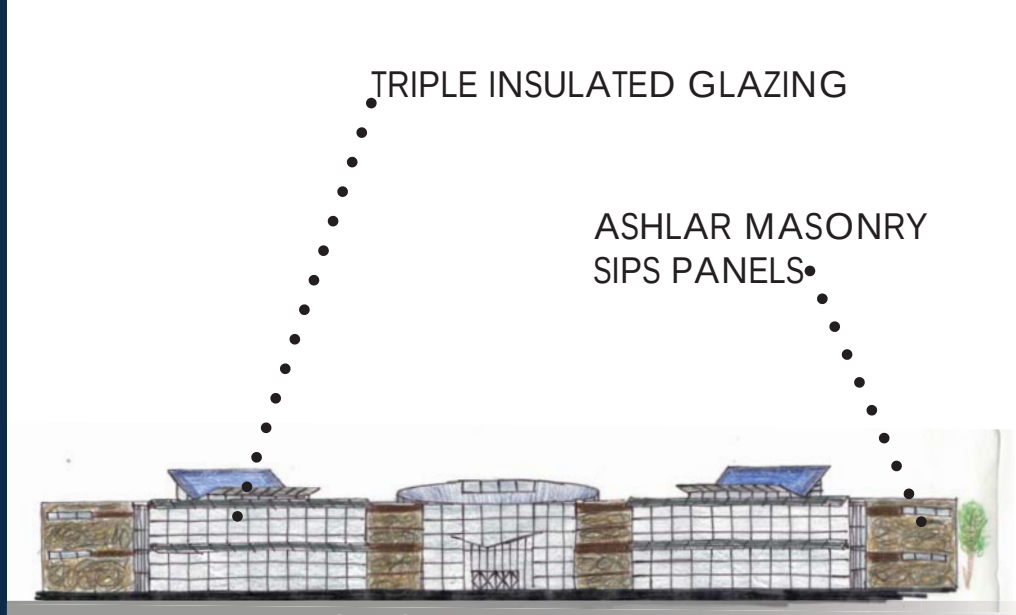
STRUCTURAL STUDY

Figure 159.2



MATERIALS STUDY
PERSPECTIVE

Figure 160.1



MATERIALS STUDY
SOUTH ELEVATION

Figure 160.2

Material studies were done to see how different materials would interact with the building and to study their rythyms and patterns.

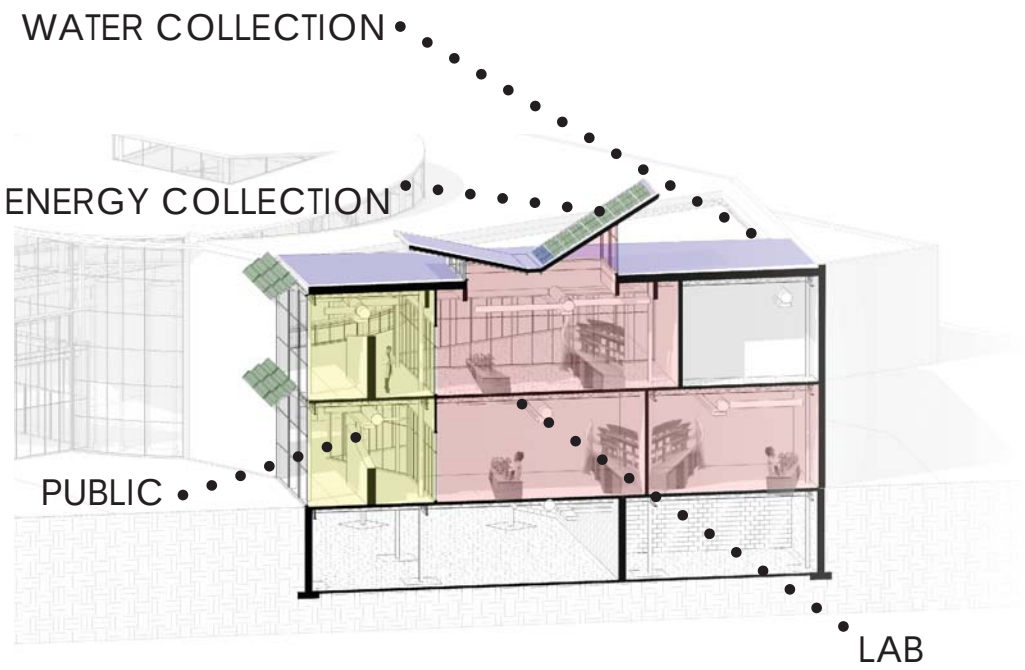
A mixture of birch wood panels and ashlar masonry panels will be used to root the project in northern Minnesota. To contrast this, large expanses of curtain walls will be used to not only bring light and heat into the building but to also lend a “science” feel to the building. There are just some materials that are seen as sleek and scientific and glass is one them.

The roof will be an extensive tray green roof system that will feature of system of gutters and piping that will collect water from the roof slowly and deposit that water back into the constructed wetlands. Standing seam steel roofing is used on any part of the roof that is not flat to further aid in water collection. Gutters will be used to divert water straight from the steel roofing into a large cistern located in the basement. This roofing system will also be a structure for pv panels to the attached to.

Two section perspectives were taken of the building to study how the building would collect water and energy. These section perspectives also show in a vertical orientation how the spaces on each floor would interact with each other.

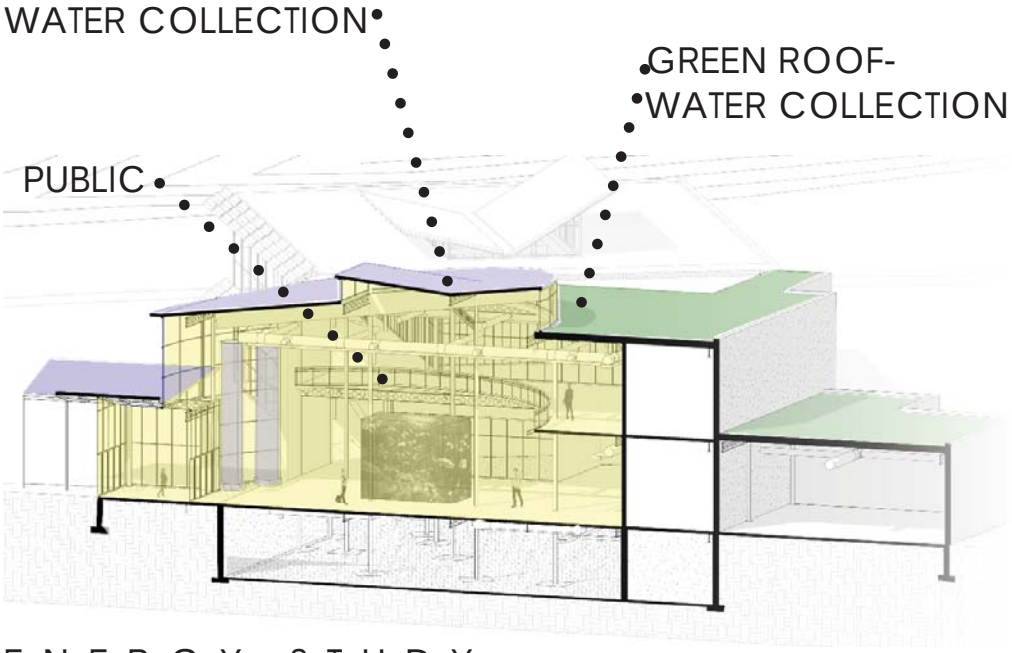
The top perspective is a cut through the lab spaces and highlights the public walkway that lines the lab spaces. The lab becomes transparent and semi-public while still facilitating research.

The bottom perspective showcases the main atrium of the building. This space is entirely devoted to the public and is the main connection between the first and second floors.



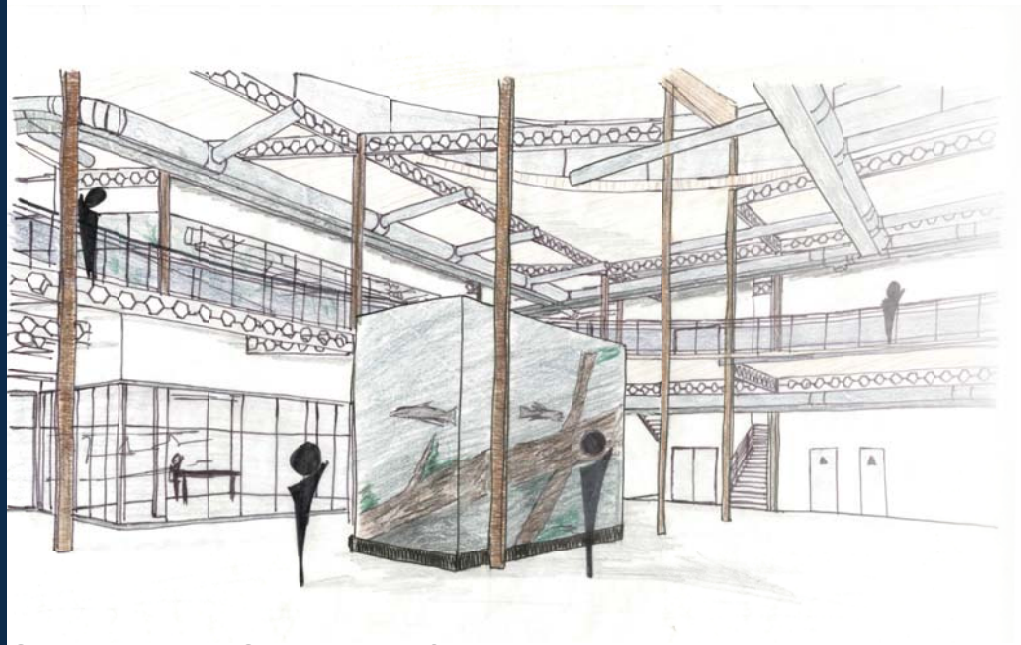
ENERGY STUDY
SECTION PERSPECTIVE

Figure 163.1



ENERGY STUDY
SECTION PERSPECTIVE

Figure 163.1



CHARACTER STUDY
INTERIOR PERSPECTIVE

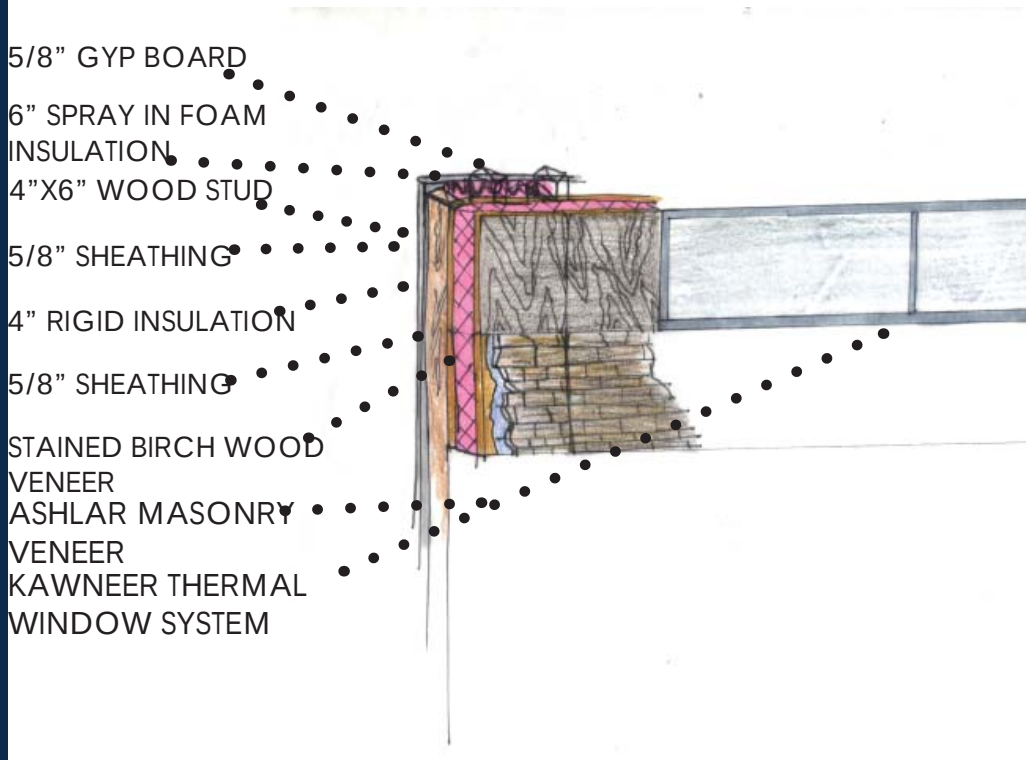
Figure 164.1

LARGE EXPANSES OF GLAZING LINE THE PUBLIC HALLWAYS OF THE CENTER ALLOWING LIGHT TO ENTER THE INTERIOR. HVAC DUCTWORK IS LEFT EXPOSED TO EDUCATE THE PUBLIC ABOUT BUILDING SYSTEMS AND HOW THIS RELATES TO WATER ECOSYSTEMS.

GUESTS OF THE FACILITY ARRIVE IN A LARGE OPEN ATRIUM FLOODED WITH LIGHT FROM CLERESTORY WINDOWS AND SKYLIGHTS. VISITORS CAN LOOK AT EDUCATION DISPLAYS, AQUARIUMS, AND EVEN CATCH GLIMPSES OF THE GREENHOUSE AND LABS FROM THE FIRST FLOOR.

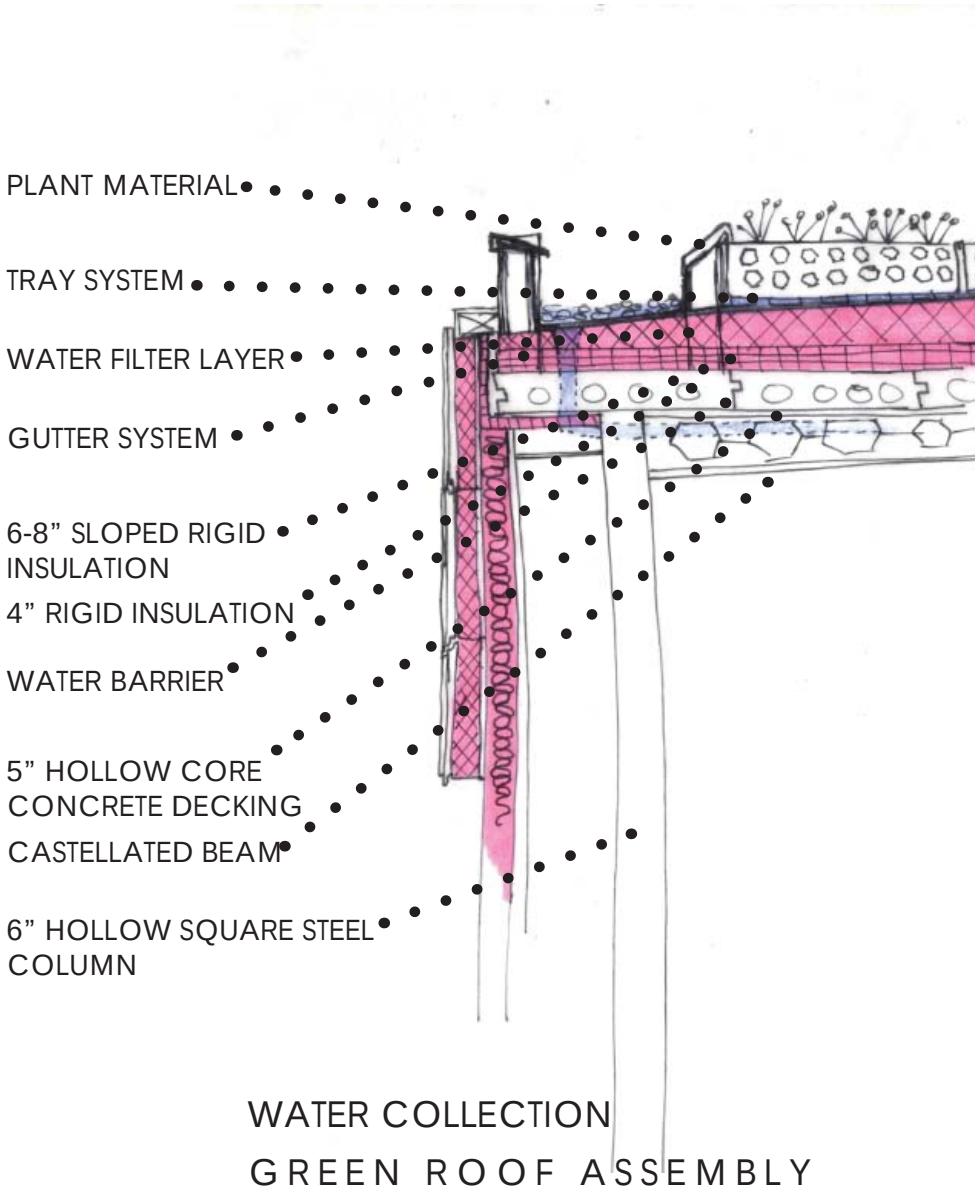
CHARACTER STUDY
INTERIOR PERSPECTIVE

Figure 165.1



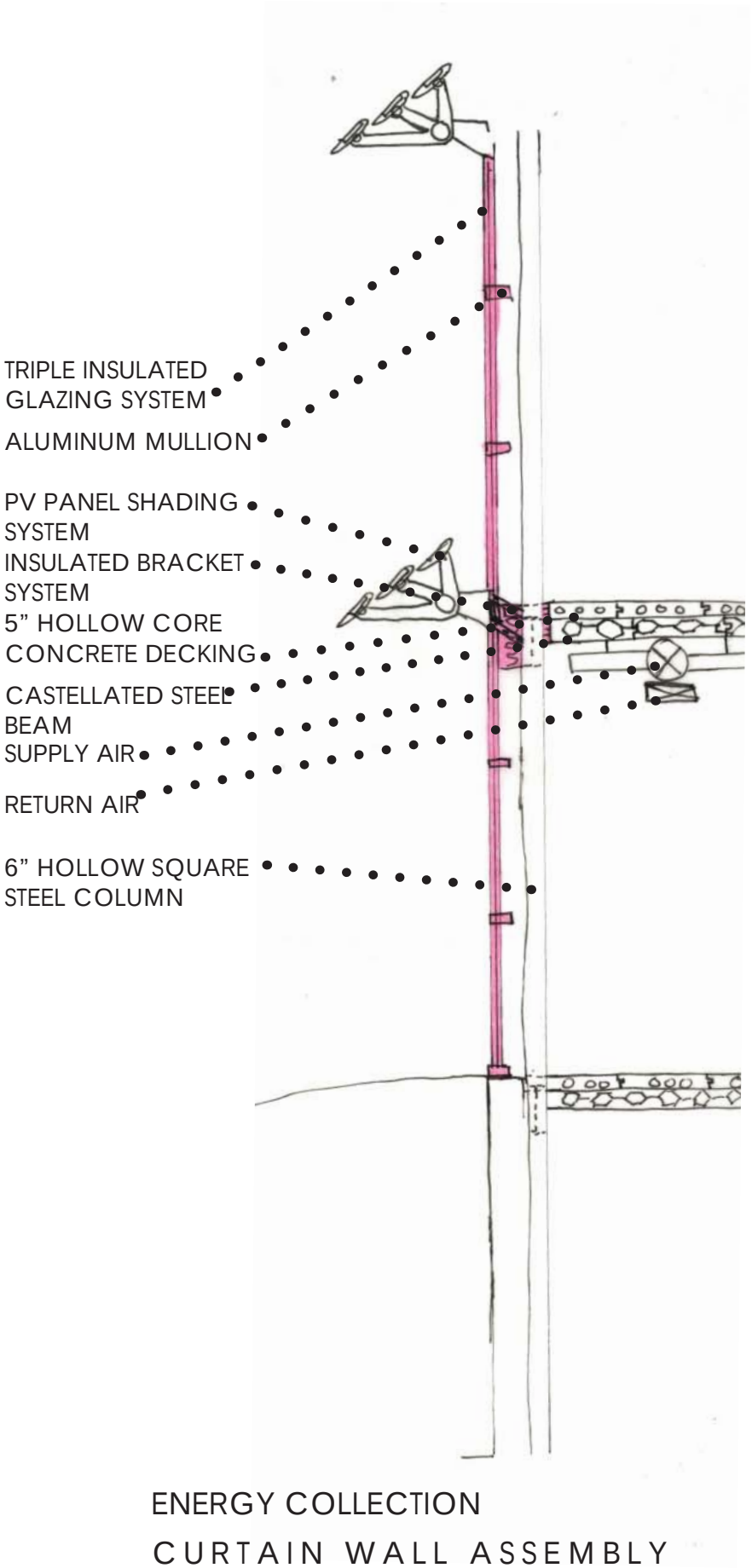
BEARING WALL
SIPS PANEL WALL ASSEMBLY

Figure 166.1



GREEN ROOF ASSEMBLY

Figure 167.1



ENERGY COLLECTION

CURTAIN WALL ASSEMBLY

Figure 168.1

Figure 169.1

PRODUCT RESEARCH

To lend credibility to the design, extensive research was done on each system or technology used throughout the building. These products featured have been tested in the market and proven to work.

The product featured to the right is a series of geothermal heat pumps that can be used in a residential setting. While a residential home may only need 1-3 pumps, a building of the size proposed as a solution to this thesis would need possibly 12-15 heat pumps to keep up with the demand of the building. However, considerable energy would be saved as water is circulated underground at a steady temperature. The use of these heat pumps would greatly reduce the building's dependcy on fossil fuels over its lifespan.

The geothermal wells would need to be placed deeper than normal since they will be under the garage of the building. This way the weight of the vehicles will not crush the piping of the wells. Normally, the piping for the wells needs to only be below the frost line or about 6 feet below ground, but to make sure the piping is not crushed from the extra weight of equipment in the garage the geothermal wells will be placed 12 feet below ground. This limits the amount of vertical piping that needs to be used since the heat pumps will be placed in the basement which is also 12 feet below grade.


GEOTHERMAL COMFORT SYSTEMS
PACKAGED, SPLIT, and WATER-TO-WATER UNITS
bryant
Heating & Cooling Systems
WHATEVER IT TAKES.
Complete Comfort, Energy Savings, and Exceptional Service Provided by Your Bryant Dealer
Models GC, GP, GB, GZ, and GW

Figure 171.1

Save up to 70% in Heating and Cooling Costs[1]

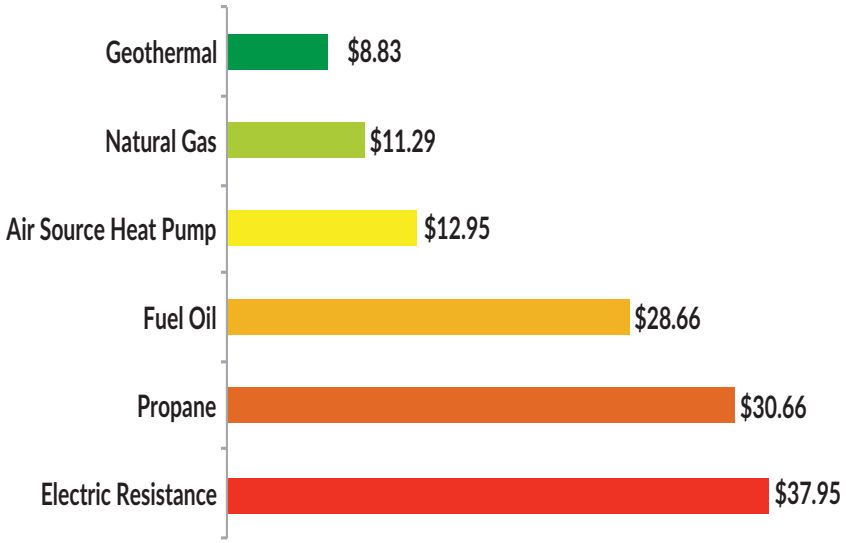
One of the main reasons many homeowners choose geothermal is the benefit of lower operating costs. The cost for heating, cooling and hot water can combine for up to 75% of a home's total utility costs. Therefore, the biggest opportunity to save on utility costs is to improve the efficiency of those systems. That's where geothermal can help in a big way.

For every one unit of energy purchased, a geothermal system can deliver up to four units of energy because it uses energy from the earth. In many scenarios, a geothermal system is significantly less expensive to operate than ordinary forced air heating and cooling systems. Geothermal systems can save up to 70% in heating and cooling costs.[1] And, they can save additional energy on domestic hot water costs.

One way to compare heating efficiency is to calculate the cost for 1 million BTUs of heat transfer. Using a standard formula, an "apples to apples" comparison can be made based on local fuel rates and equipment efficiency. The table below demonstrates a typical savings opportunity with geothermal. To get the full picture for your home, contact your Bryant geothermal dealer.

[1] Savings calculated using LoopLink software. Comparison based on simulation in Dallas, TX. Bryant 6 ton unit vs. standing pilot propane furnace, standard air conditioner and local fuel rates. Actual savings will vary based on configuration, weather and local energy costs.

Cost Comparison for 1 Million BTUs (Heating)



Source of Energy Rates: U.S. Energy Information Administration as of August, 2015

Geothermal – 4.3 COP*, $0.13/kwh
Air Source Heat Pump – 10 HSPF***, $0.13/kwh
Natural Gas – 85% AFUE**, $0.96/ccf
Propane – 85% AFUE, $2.38/gallon
Fuel Oil – 80% AFUE, $3.18/gallon
Electric Resistance – 1.0 COP*, $0.13/kwh

*COP–Coefficient of Performance **AFUE–Annual Fuel Utilization Efficiency ***Heating Seasonal Performance Factor

Figure 172.1

Renewable Energy From the Earth

Geothermal systems use renewable energy from the earth, so the technology is one that can reduce your carbon footprint. On a grander scale, imagine the impact of the reduced emissions resulting from every current geothermal comfort system installation today. The collective result would be a dramatic reduction in carbon footprint.

Loop System Configurations

Geothermal systems can be installed with a variety of loop system configurations. "Closed loops" use re-circulated fluid in a series of pipes installed vertically, horizontally, or in a pond. "Open loops" use well water. Your dealer will determine which design works best for your home.

HORIZONTAL LOOPS

Used on larger lots. Installed using a backhoe or trencher.

VERTICAL LOOPS

Used where land area is limited or soil conditions prohibit horizontal loops. Installed using a drilling rig.

Figure 173.1

Each door leading into the building from the outside will be a Kawneer Thermal Entrance. Any point of the building that opens to the exterior or uses glass for that matter becomes a point of thermal bridging and can then become a point of energy loss.

While there is not way to completely seal up a door, simply using products that are rated as a better thermal barrier can greatly limit the amount of heat transfer into and out of the building envelope.

Features

- AA™250 narrow stile has 2-1/2" (62.5) vertical stiles, 2-1/2" (62.5) top rail, and 3-7/8" (98.4) bottom rail
- AA™425 wide stile has 4-1/4" (108) vertical stiles, 4-1/4" (108) top rail, and 6-1/2" (165.1) bottom rail
- Door is 2-1/4" (57.2) deep
- Door has 1/8" (3.2) typical wall thickness
- Dual welded corner construction
- Polyamide thermal break
- Single acting
- 1" (25.4) insulated glass infill
- Offset pivots, butt hinges or continuous geared hinge
- MS locks or exit device hardware
- Surface mounted or concealed closers
- Architects Classic push/pulls
- Meeting stile astragal has dual pile weathering with polymeric fin
- Polymeric bulb weatherstripping and pile weathering with polymeric fin in door frame
- Permanodic™ anodized finishes in seven choices
- Painted finishes in standard and custom choices

Optional Features

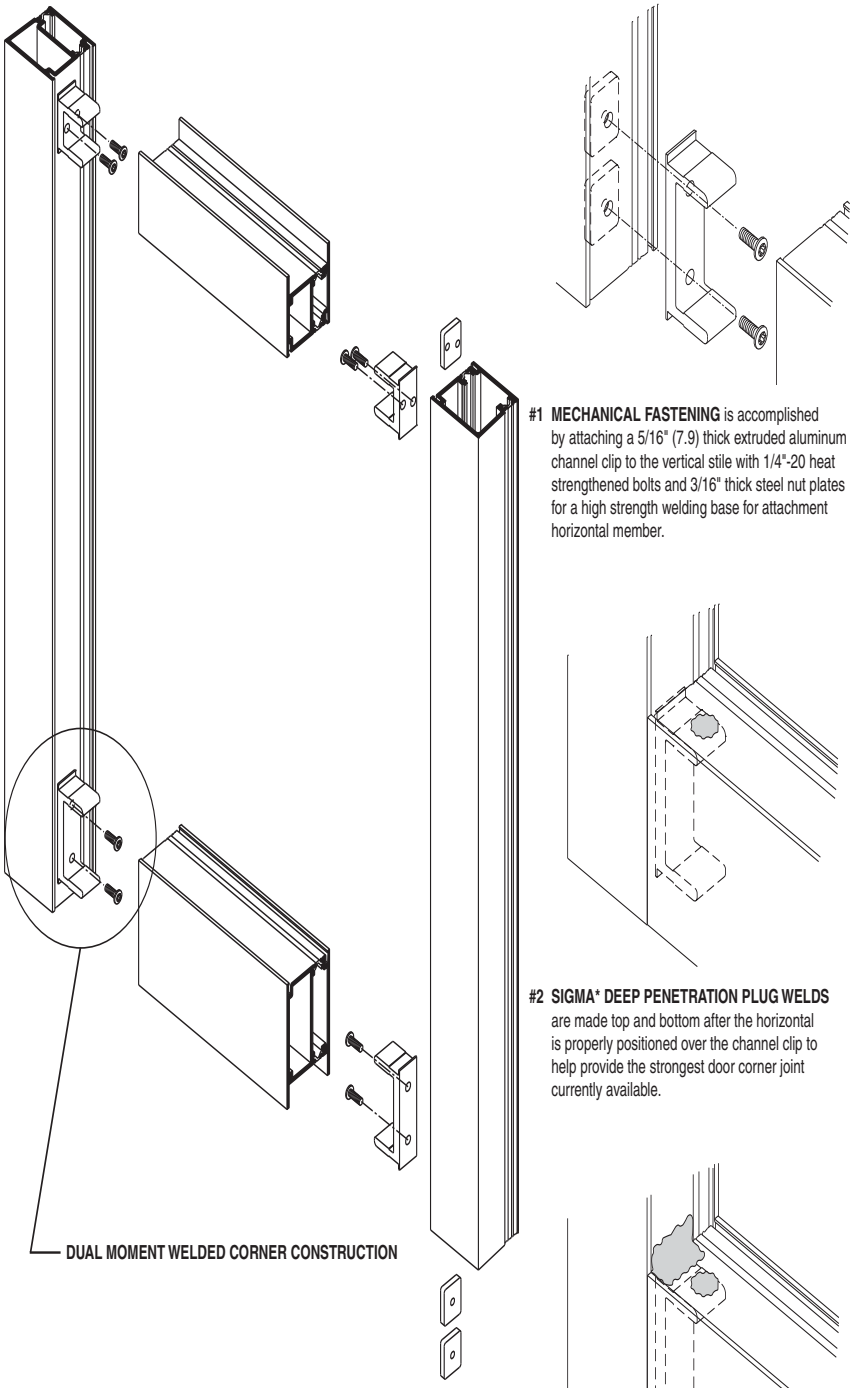
- Variety of top, bottom, and cross rails
- Two color finish capability

Product Applications

- AA™250 - engineered for thermal efficiency in moderate traffic applications such as offices, stores, and apartment buildings
- AA™425 - engineered for thermal efficiency and added strength for schools, institutions and other increased traffic applications

For specific product applications,
Consult your Kawneer representative.

Figure 175.1



DUAL MOMENT WELDED CORNER CONSTRUCTION

#1 MECHANICAL FASTENING is accomplished by attaching a 5/16" (7.9) thick extruded aluminum channel clip to the vertical stile with 1/4"-20 heat strengthened bolts and 3/16" thick steel nut plates for a high strength welding base for attachment horizontal member.

#2 SIGMA* DEEP PENETRATION PLUG WELDS are made top and bottom after the horizontal is properly positioned over the channel clip to help provide the strongest door corner joint currently available.

#3 SIGMA* FILLET WELDS along both top and bottom webs of the rail extrusion complete the Dual Welded corner construction.

*** An arc welding process known as Shielded Inert Gas Metal Arc (SIGMA) or also known as Metal Inert Gas (MIG).**

Figure 176.1

SCALE 3" = 1' 0"

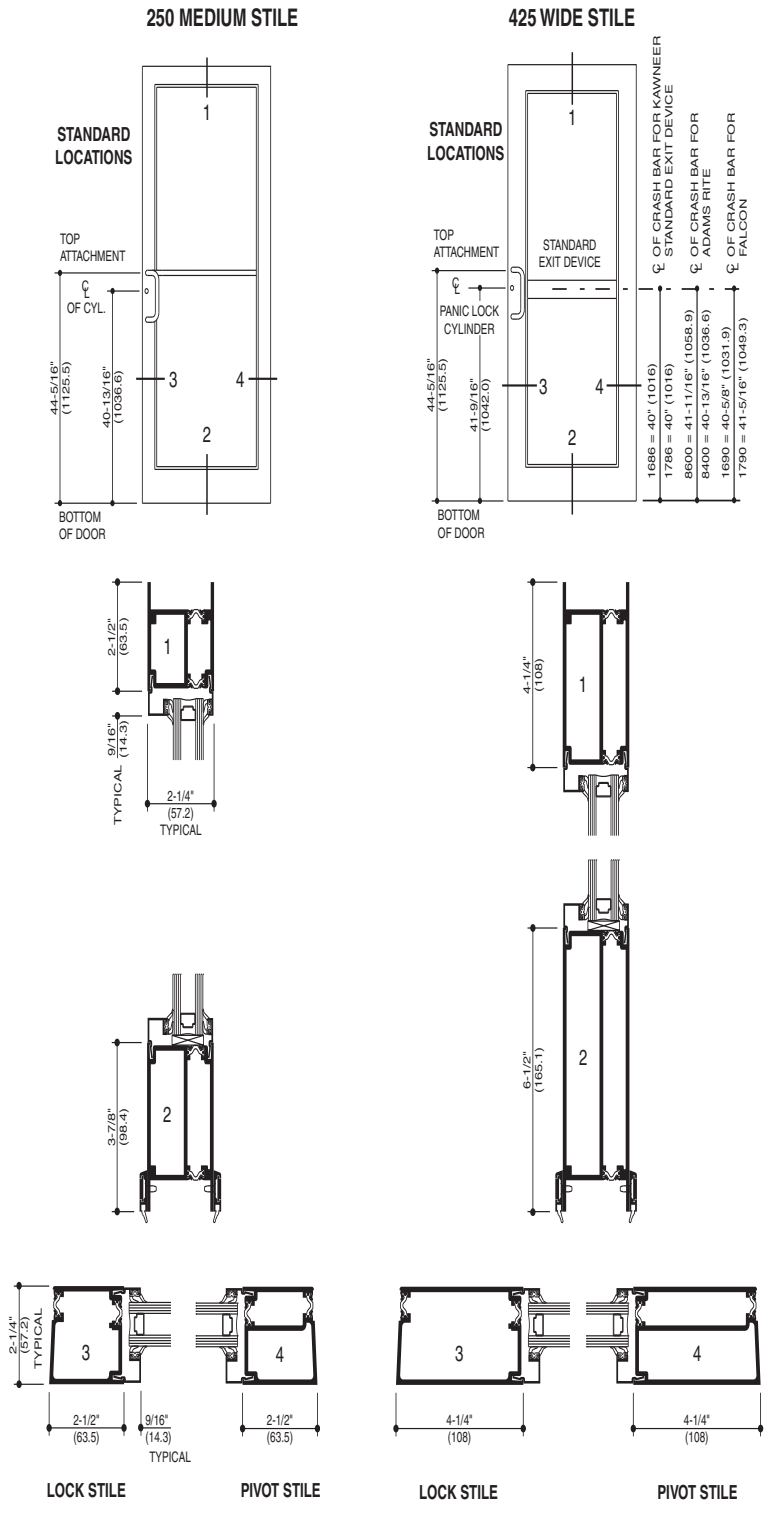


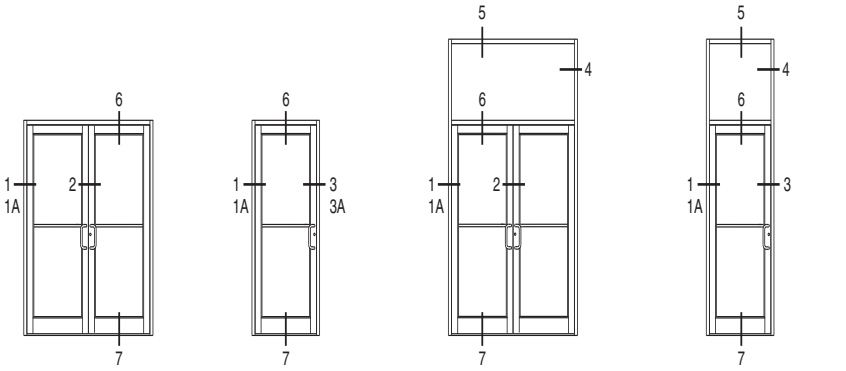
Figure 177.1

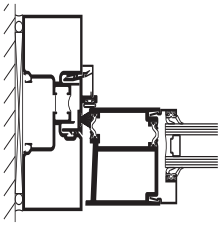
SCALE 3" = 1'-0"

AA™250 THERMAL ENTRANCE DOORS
SINGLE ACTING
TRIFAB™ VG 451T CENTER DOOR FRAMES SHOWN

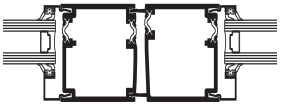
NOTE:

1. MEDIEM STILE AA™250 THERMAL ENTRANCES ARE DETAILED, WIDE STILE AA™425 THERMAL ENTRANCES ALSO MAY BE USED.
2. TRIFAB™ VG 451T CENTER, 2" X 4-1/2" (50.8 X 114.3) FRAMING IS DETAILED WITH THE DOORS FOR REFERENCE. OTHER KAWNEER FRAMING SERIES OR CURTAIN WALL SYSTEMS MAY BE USED. REFER TO THE CATALOG INDEX FOR THE APPROPRIATE DETAIL SECTION.

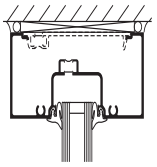




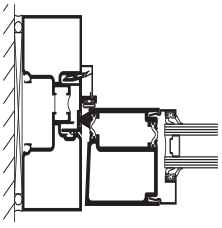
1



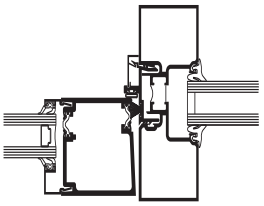
2
PAIR OF SINGLE ACTING DOORS



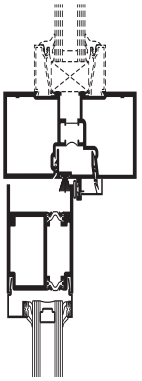
5
TRANSOM HEAD



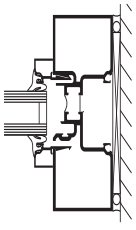
1A



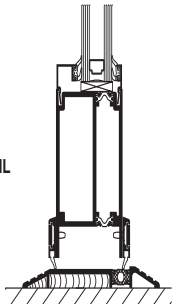
3



6
DOOR HEADER/ TRANSOM BAR



4
TRANSOM INSERT



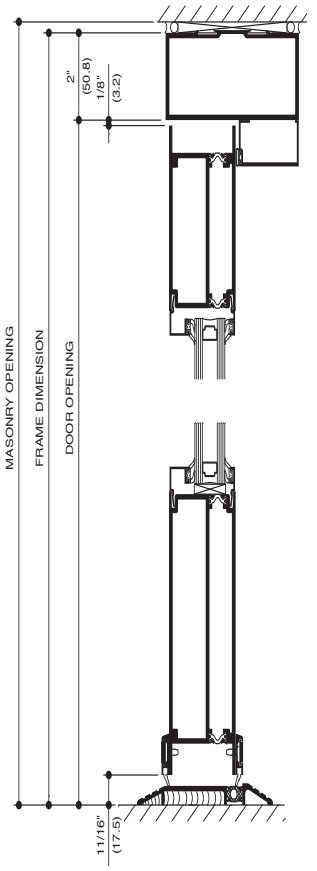
7*
BOTTOM RAIL

***NOTE:** Some building codes limit threshold height to 1/2" (12.7) max.

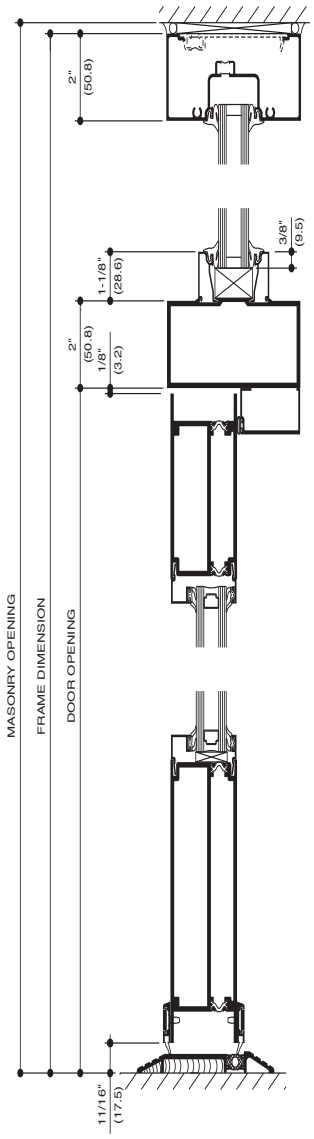
Figure 178.1

SCALE 3" = 1'-0"

TRIFAB™ VG 451T CENTER DOOR FRAMES



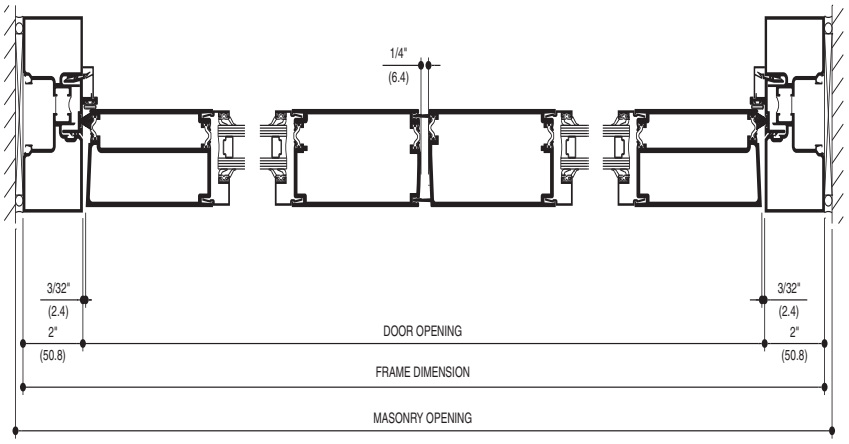
SINGLE ACTING DOOR
WITHOUT TRANSOM



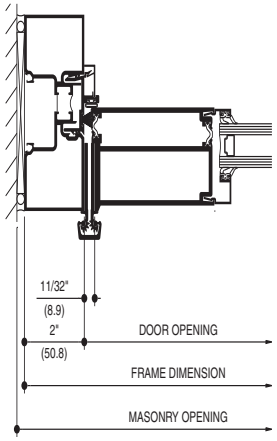
SINGLE ACTING DOOR
WITH TRANSOM

Figure 179.1

SCALE 3" = 1'-0"



SINGLE ACTING DOOR



CONTINUOUS HINGE JAMB

STANDARD SIZES (TRIFAB™ VG 451T CENTER FRAMES)

WITHOUT TRANSOM

Door Opening Dimension	Overall Frame Dimension	Masonry Opening Dimension
3' 0" x 7' 0" (914 x 2134)	3' 3-1/2" x 7' 1-3/4" (1003 x 2178)	3' 4" x 7' 2" (1016 x 2185)
3' 6" x 7' 0" (1067 x 2134)	3' 9-1/2" x 7' 1-3/4" (1156 x 2178)	3' 10" x 7' 2" (1168 x 2185)
6' 0" x 7' 0" (1829 x 2134)	6' 3-1/2" x 7' 1-3/4" (1918 x 2178)	6' 4" x 7' 2" (1930 x 2185)

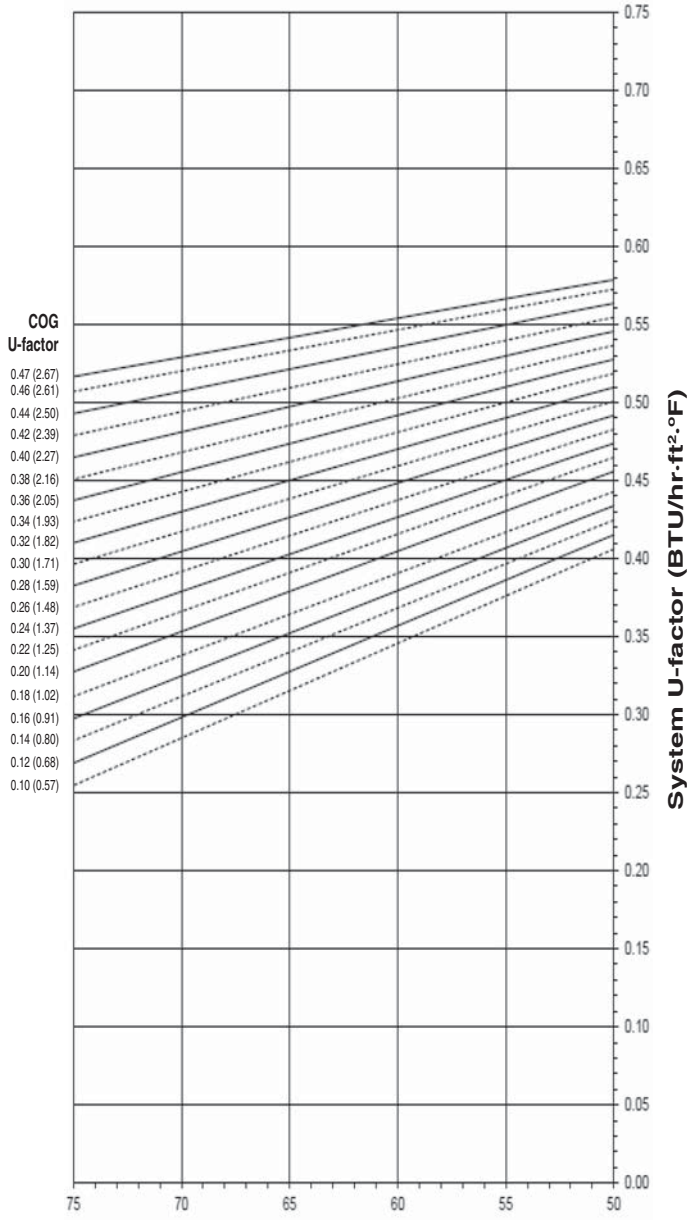
WITH TRANSOM

Door Opening Dimension	Overall Frame Dimension	Masonry Opening Dimension
Unchanged from above.	Add 3' 1-3/4" (959) to above heights.	Add 3' 1-3/4" (959) to above heights.

Figure 180.1

AA™425 (PAIR OF DOORS)

System U-factor vs Percent of Glass Area



Percent of Glass = Vision Area/Total Area
(Total Daylight Opening / Projected Area)

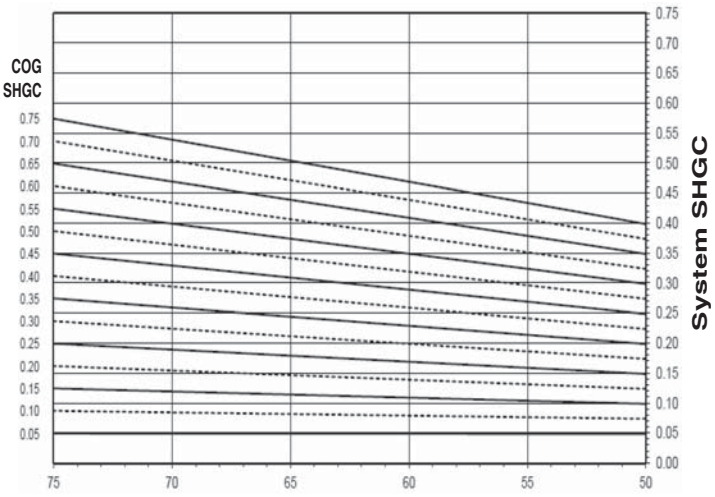
Notes for System U-Factor, SHGC and VT charts:

For glass values that are not listed, linear interpolation is permitted.
Glass properties are based on center of glass values (winter conditions) and are obtained from your glass supplier.

Figure 181.1

AA™425 (PAIR OF DOORS)

System Solar Heat Gain Coefficient (SHGC) vs Percent of Vision Area



System Visible Transmittance (VT) vs Percent of Vision Area

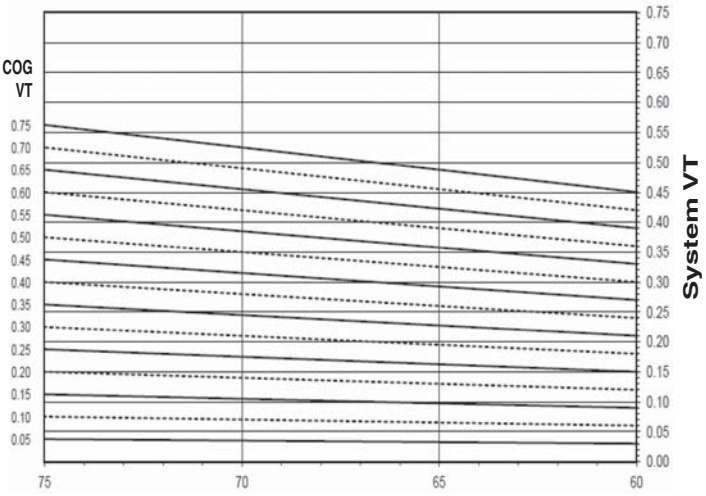


Figure 182.1

AA™425 (PAIR OF DOORS)

Thermal Transmittance [1] (BTU/hr • ft [2] • °F)

Glass U-Factor [3]	Overall U-Factor [4]
0.48	0.57
0.46	0.57
0.44	0.56
0.42	0.55
0.40	0.54
0.38	0.53
0.36	0.52
0.34	0.51
0.32	0.50
0.30	0.49
0.28	0.48
0.26	0.47
0.24	0.46
0.22	0.45
0.20	0.44
0.18	0.43
0.16	0.42
0.14	0.41
0.12	0.40
0.10	0.39

NOTE: For glass values that are not listed, linear interpolation is permitted.

1. U-Factors are determined in accordance with NFRC 100.
2. SHGC and VT values are determined in accordance with NFRC 200.
3. Glass properties are based on center of glass values and are obtained from your glass supplier.
4. Overall U-Factor, SHGC, and VT Matricies are based on the standard NFRC specimen size of 1920mm wide by 2090mm high (75-1/2" by 82-3/8").

SHGC Matrix [2]

Glass SHGC [3]	Overall SHGC [4]
0.75	0.42
0.70	0.39
0.65	0.36
0.60	0.34
0.55	0.31
0.50	0.28
0.45	0.26
0.40	0.23
0.35	0.21
0.30	0.18
0.25	0.15
0.20	0.13
0.15	0.10
0.10	0.07
0.05	0.05

Visible Transmittance [2]

Glass VT [3]	Overall VT [4]
0.75	0.39
0.70	0.37
0.65	0.34
0.60	0.32
0.55	0.29
0.50	0.26
0.45	0.24
0.40	0.21
0.35	0.18
0.30	0.16
0.25	0.13
0.20	0.11
0.15	0.08
0.10	0.05
0.05	0.03

Figure 183.1

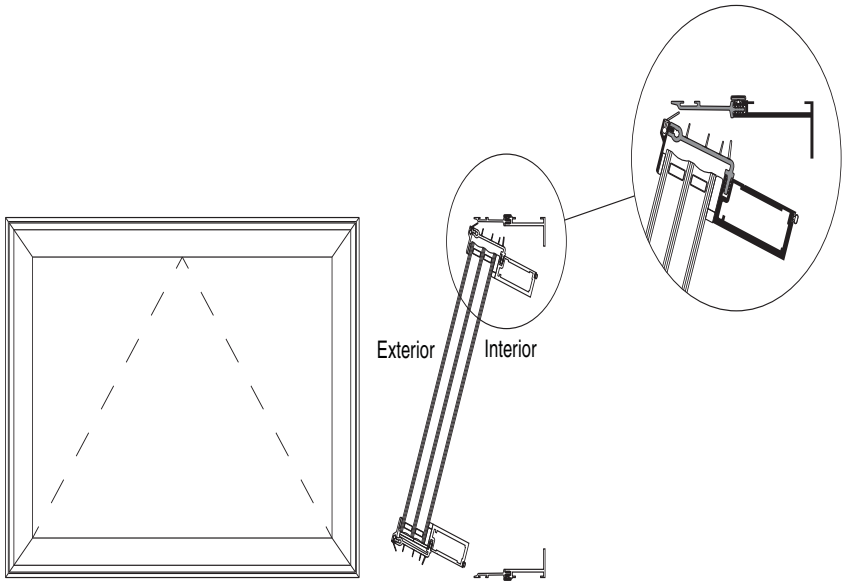
To retain thermal comfort in the offices and to allow air venting in the labs, the Kawneer Glassvent Windows will be used in certain panels of the storefront systems that envelope the offices and in the clerestories that surround the lab spaces under the butterfly roofs.

Each researcher will be able to manually and individually control the amount of air flow they want into their specific office space. They will simply be able to crank a panel of their storefront open and allow air into their office. Again, these windows will need to be thermally highly rated so that they do not become a point of heat transfer.

The vents located within the labs will be mechanical in nature and controlled by switches since they will be used at such a high height. This way, if extra venting is needed other than what can be provided mechanically, a simply system of letting the bad air rise up and out of the building can be used.

Features

- Architectural Grade Window
- Tested to US and Canadian Standards
- 45° Mitered Vent and Frame Corners
- Staked Corner Joinery
- Architectural Anodized Finishes and Applied Coatings
- Blast Mitigation Tested

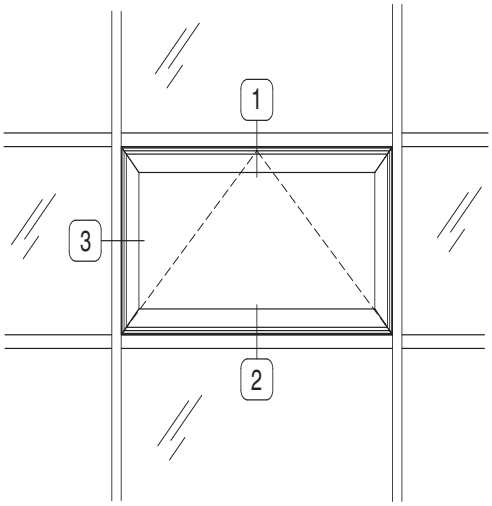


Project-out Window
(1-3/4" infill)

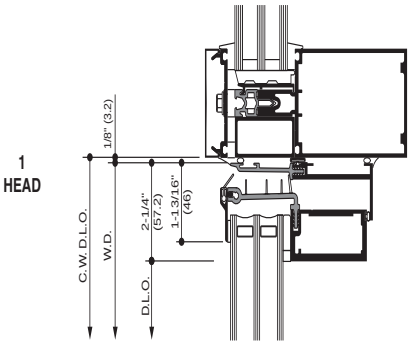
For specific product applications,
Consult your Kawneer representative.

Figure 185.1

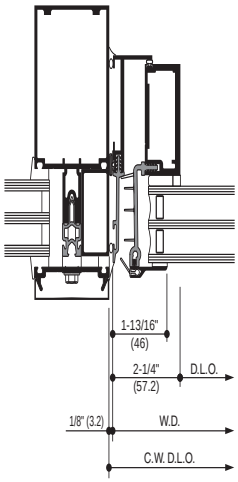
SCALE : 3" = 1'-0"
(Nominal Dimensions Shown)



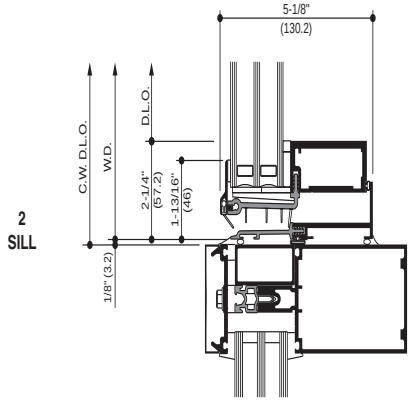
TYPICAL ELEVATION



1
HEAD



3
JAMB



2
SILL

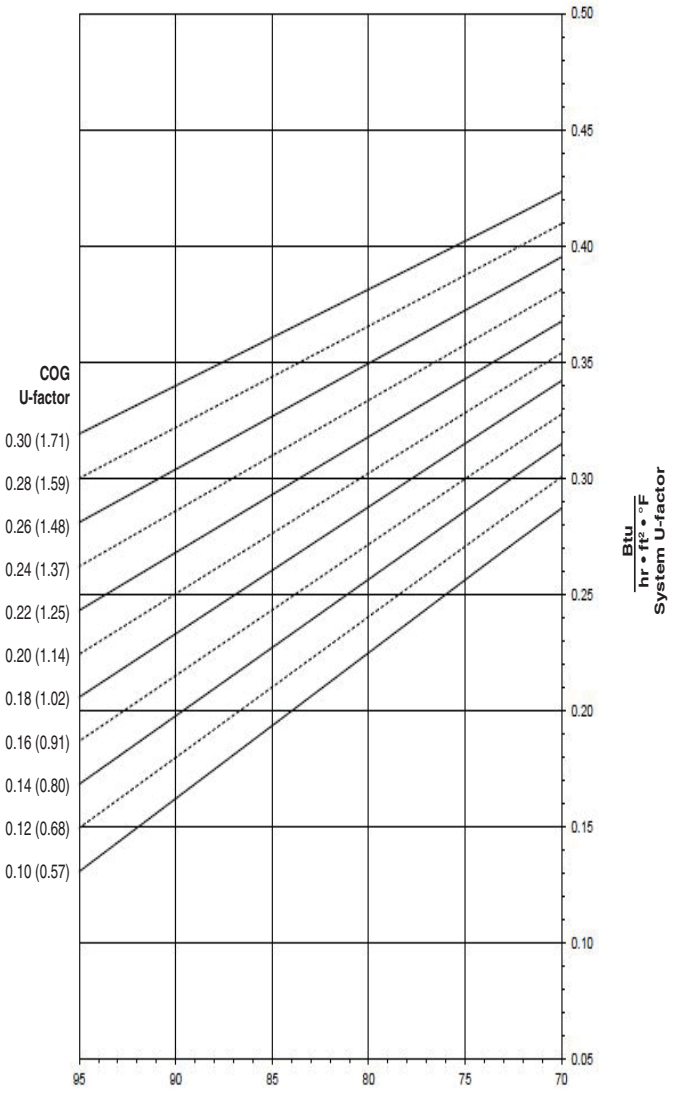
NOTE: THE KAWNEER GLASSvent™ UT WINDOW IS SHOWN IN THESE DETAILS WITH 1600UT SYSTEM™1 CURTAIN WALL FOR REFERENCE. OTHER KAWNEER SYSTEMS CAN BE USED. FOR PRODUCT SPECIFIC APPLICATIONS CONSULT YOUR KAWNEER REPRESENTATIVE.

Figure 186.1

OUTSWING CASEMENT WINDOW WITH 1-3/4" GLAZING

Note:
Values in parentheses are metric.
COG = Center of Glass.
Charts are generated per AMMA 507

System U-factor vs Percent of Glass Area



Percent of Glass Area = Vision Area/Total Area
Daylight Opening / Projected Area

Notes for System U-factor, SHGC and VT charts:
For glass values that are not listed, linear interpolation is permitted.
Glass properties are based on center of glass values and are obtained from your glass supplier.

The largest point of heat loss and heat gain will be in the large expanses of glass used in the curtain wall systems. A triple insulated curtain wall system will be used from Kawneer.

The first layer of glazing will be tinted with a low-e UV blocking coating. This coating will help to limit the amount of heat the wall will let into the building while still allowing light through.

The second layer of glazing will be made of structural tempered glass to protect the occupants of the building.

The final third, interior layer of glazing will be coated in a photochromic coating. This allows the occupants of the building to control the tinting and opacity of the glazing. They can then control the amount of light and heat that is being let in through the glazing. This technology will also be employed in all of the clerestories so that researchers can control the amount of light coming into the labs if working on light sensitive experiments.

Argon gas will fill the gap between each layer of glazing for a total of two argon gas layers. This is the biggest insulating factor of the curtain wall system and will give the system an R-value of R-25 to R-30. While this may not be the highest R-Value or the most insulating wall, energy will be made up in other ways throughout the building. This is also the price paid for allowing natural light into the building in large ways.

7500 WALL™

Tubular mullions and transoms
with shear block construction.
Pressure equalized rain screen design.
High performance IsoWeb™ glass
reinforced nylon thermal break.
7550 Wall shown, 7525 Wall similar.

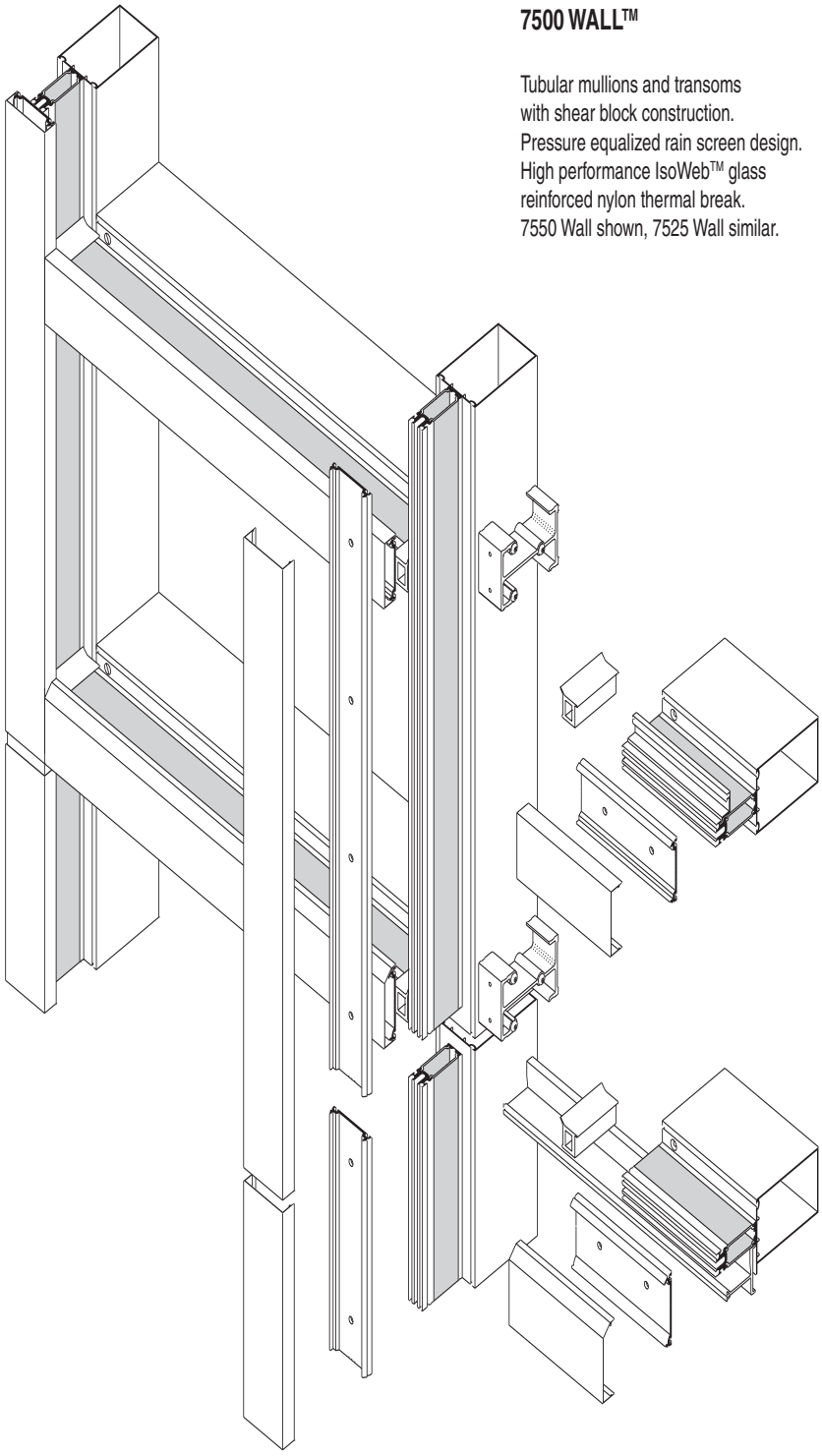
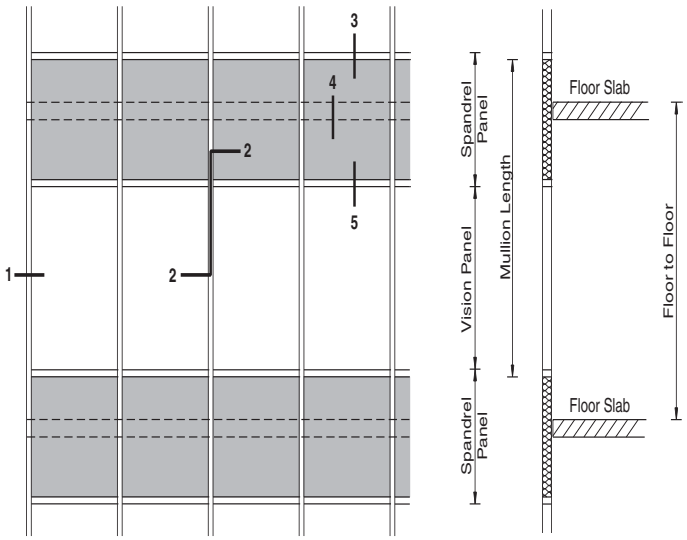


Figure 189.1

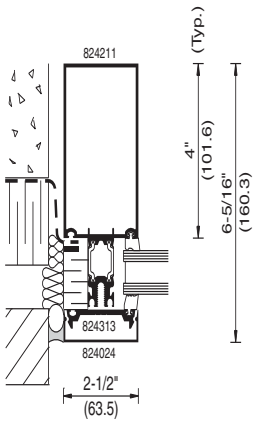
SCALE 3" = 1'-0"



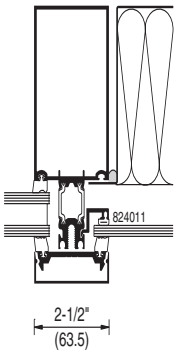
ELEVATION IS NUMBER KEYED TO DETAILS

7525 - 25mm DOUBLE GLAZED

1 JAMB

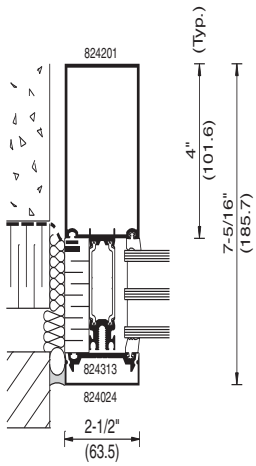


2 MULLION



7550 - 50mm TRIPLE GLAZED

1 JAMB



2 MULLION

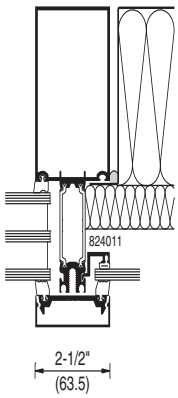
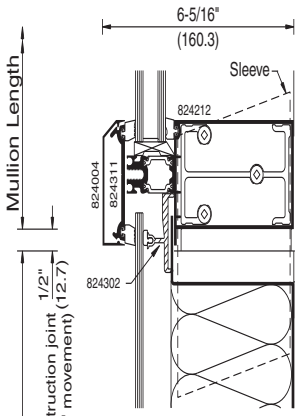


Figure 190.1

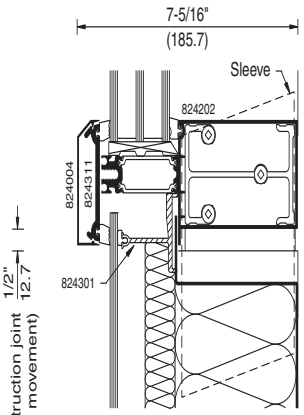
SCALE 3" = 1'-0"

7525 - 25mm DOUBLE GLAZED

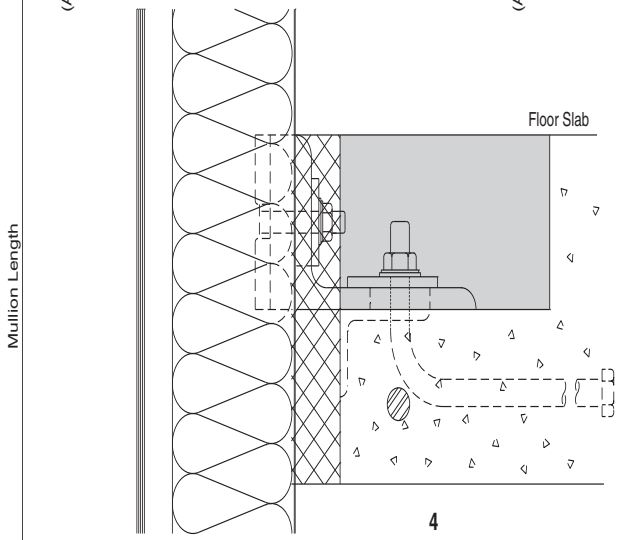


3
SILL - VISION PANEL

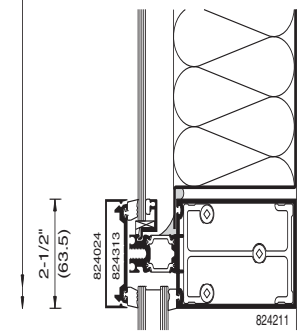
7550 - 50mm TRIPLE GLAZED



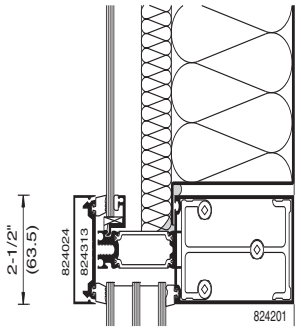
3
SILL - VISION PANEL



4
ANCHOR



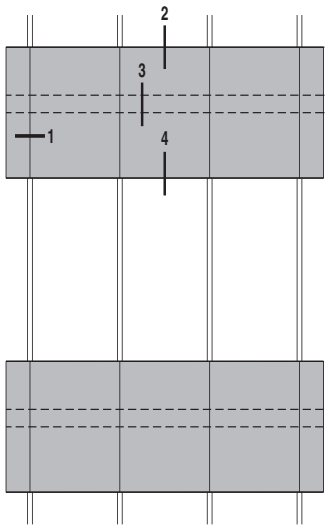
5
HEAD - VISION PANEL

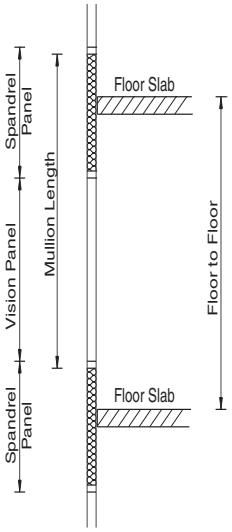


5
HEAD - VISION PANEL

Figure 191.1

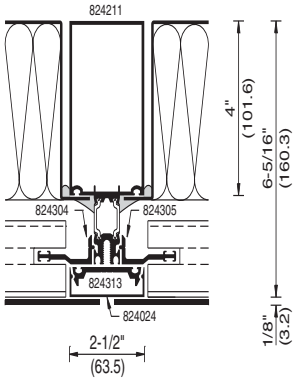
SCALE 3" = 1'-0"





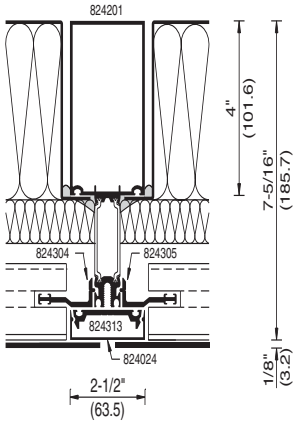
ELEVATION IS NUMBER KEYED TO DETAILS

7525 - 25mm DOUBLE GLAZED



1 MULLION

7550 - 50mm TRIPLE GLAZED



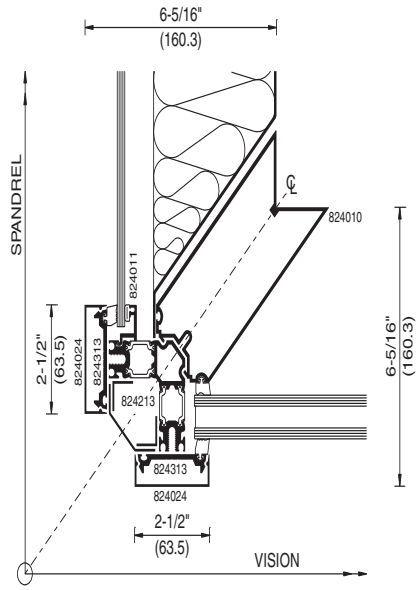
1 MULLION

Figure 192.1

SCALE 3" = 1'-0"

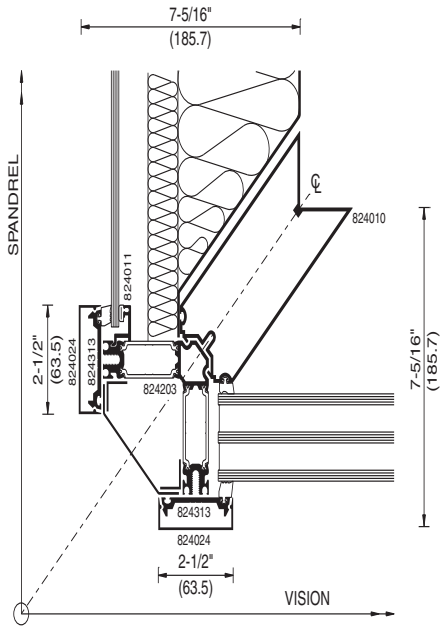
7525 - 25mm DOUBLE GLAZED

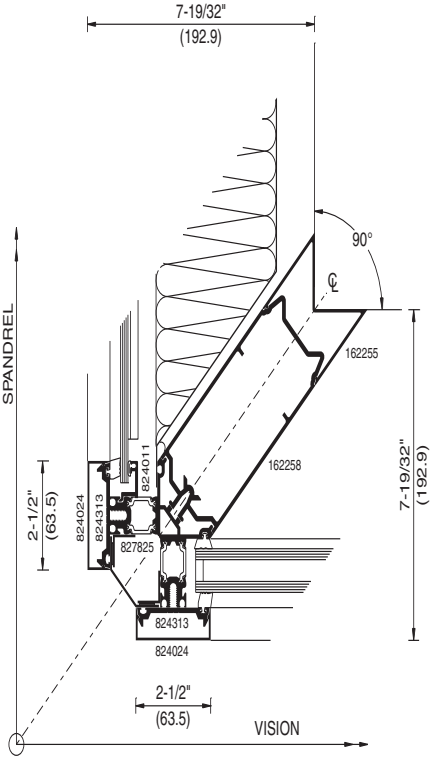
90° OUTSIDE CORNERS



7550 - 50mm TRIPLE GLAZED

90° OUTSIDE CORNERS





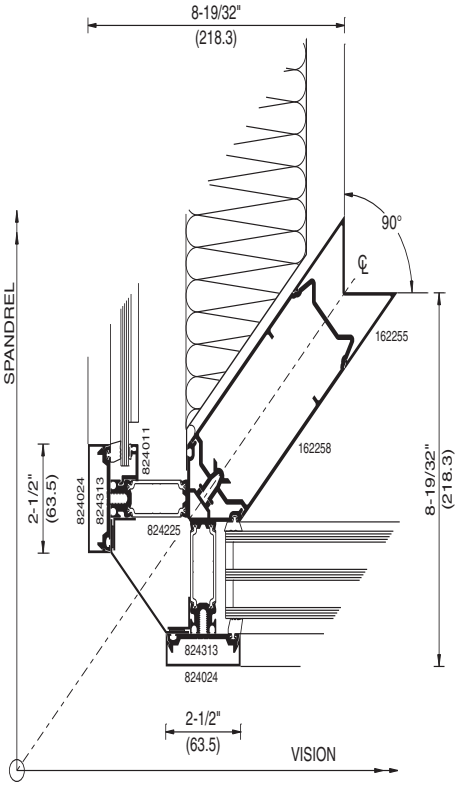
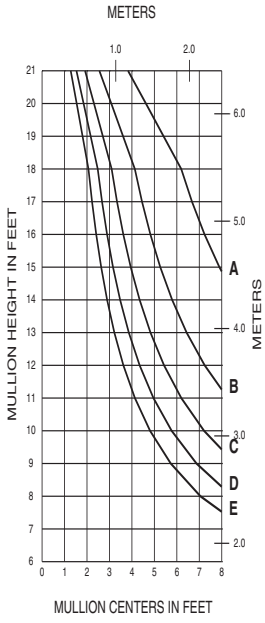
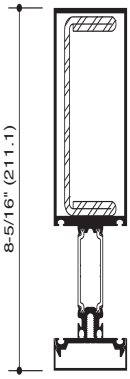


Figure 193.1

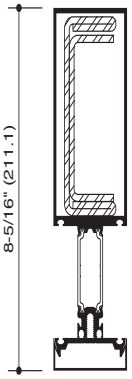
A = 20 PSF (960)
B = 30 PSF (1440)
C = 40 PSF (1920)
D = 50 PSF (2400)
E = 60 PSF (2880)

SINGLE SPAN



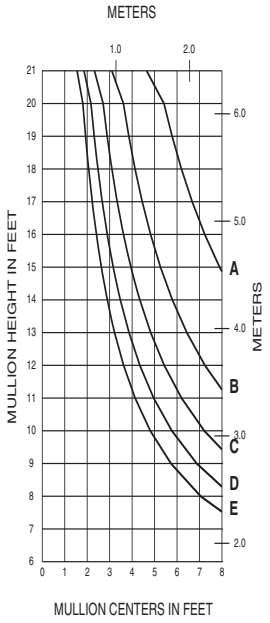


824204
W/162301

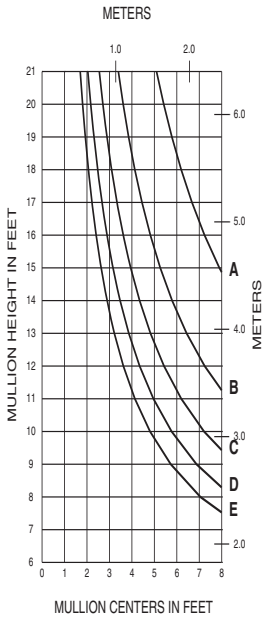


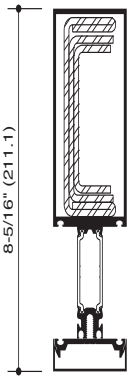
824204
W/162301/302

SINGLE SPAN



SINGLE SPAN





824204
W/162301/302/303

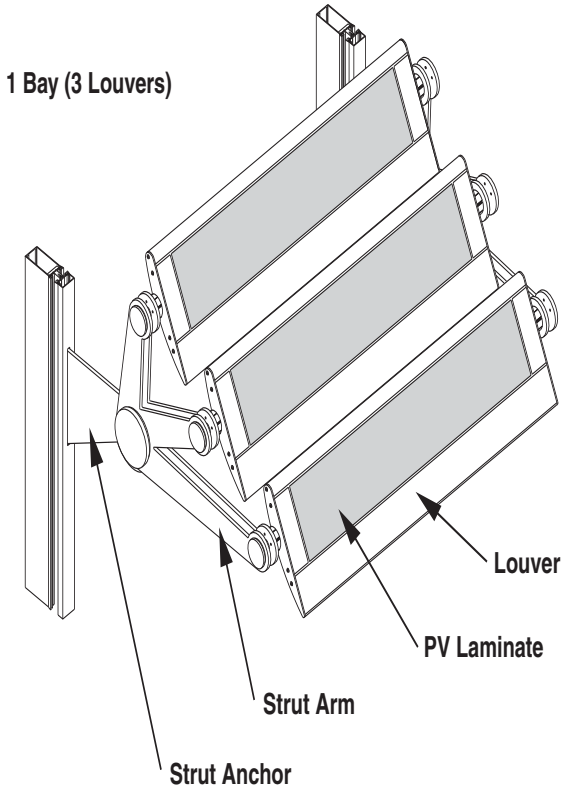
WINDLOAD CHARTS ARE BASED ON COMPOSITE PROPERTIES WHICH ARE CALCULATED IN ACCORDANCE WITH AAMA TIR-8 AND AAMA 505

Figure 194.1

The curtain wall system used in Awaking Waters acts as an energy collection system by allowing sunlight into the building and through trombe walls. To add to this, PV panel shading systems will be attached to the curtain walls. Not only will these PV panels be placed at the optimum angle to efficiently convert sunlight into electricity, but they will also shade the wall during peak heat gain times of the day and help to passively control the temperature of the building..

These shading systems would connect back to the main structure of the building through the aluminum mullion system of the curtain wall. To limit the possibility of heat transfer these connections would be heavily insulated inside the mullions they pass through.

1600 PowerShade™ Sun Shade System



Features

- Clean lines complement curtain wall aesthetics and contemporary architectural applications
- Engineered to meet rigorous structural loads while minimizing material requirements
- Overall design addresses the need for environmentally responsible architecture
- 75 watts of electrical generation per bay (at peak performance)
- Laminate with crystalline photovoltaic (PV) cells structurally glazed into aluminum substrate
- High performance finish on all aluminum components; designed to endure for the life of the building
- Two non-articulating pivot points set tilt to optimize electrical generation and minimize unwanted solar heat gain
- Pre-fabricated Bay Assemblies are efficiently and quickly erected on-site
- No moving parts... Requires little or no maintenance

For specific product applications,
Consult your Kawneer representative.

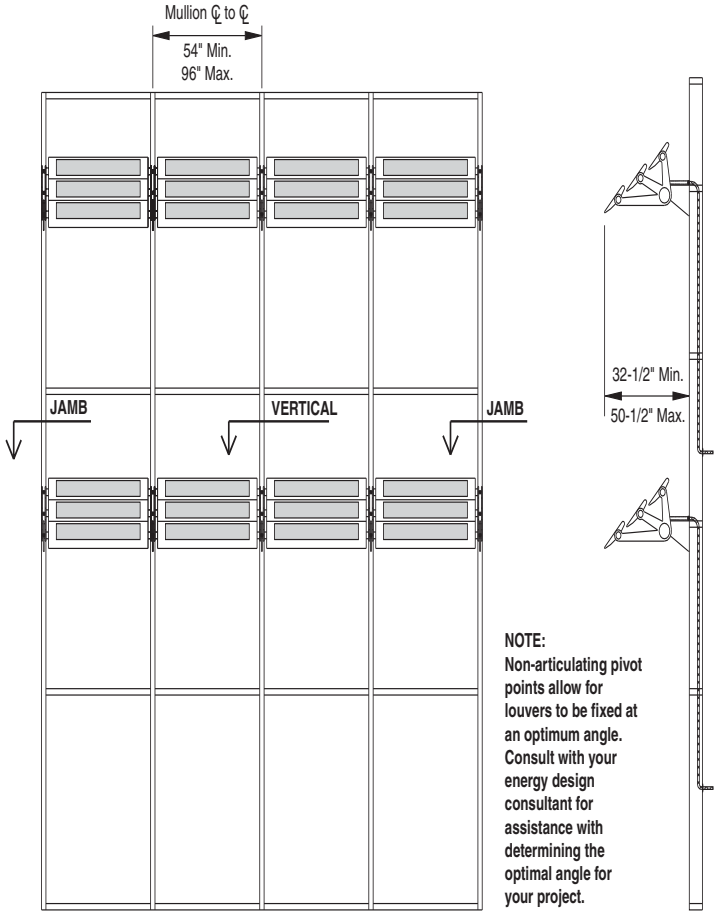
Figure 196.1

1600 PowerShade™ Sun Shade System

JUNE, 2015

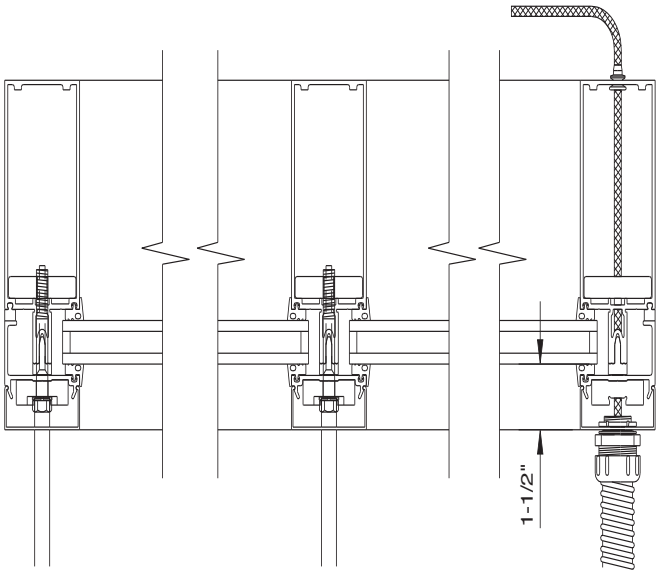
TYPICAL ELEVATION

EC 97911-075



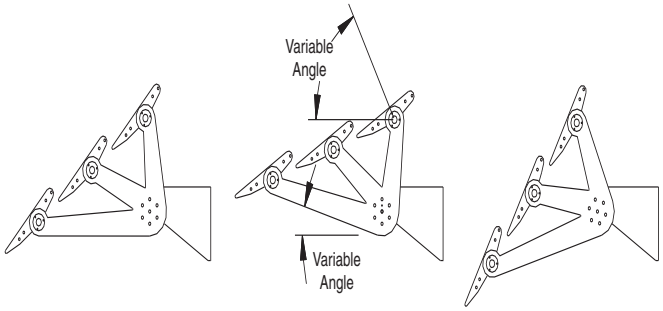
NOTE:
Non-articulating pivot points allow for louvers to be fixed at an optimum angle. Consult with your energy design consultant for assistance with determining the optimal angle for your project.

TYPICAL ELEVATION FACING SOUTH



NOTE:
Structural attachment is not shown in this view in order to highlight wiring integration.

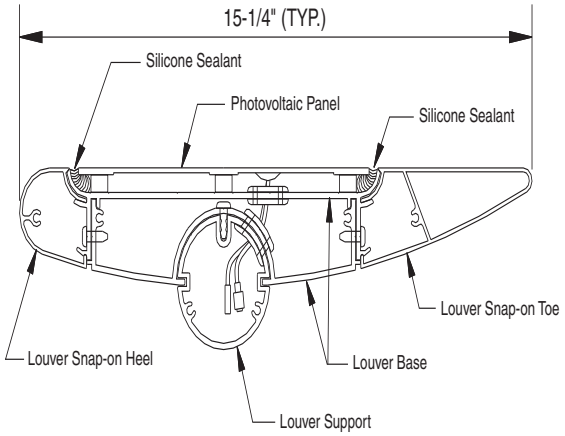
POSITIONING EXAMPLES



NOTE: BLADES ARE NON-ARTICULATING.

LOUVER OPTIONS

LOUVER CROSS SECTION WITH PHOTOVOLTAIC PANEL



LOUVER CROSS SECTION WITH ALUMINUM PANEL

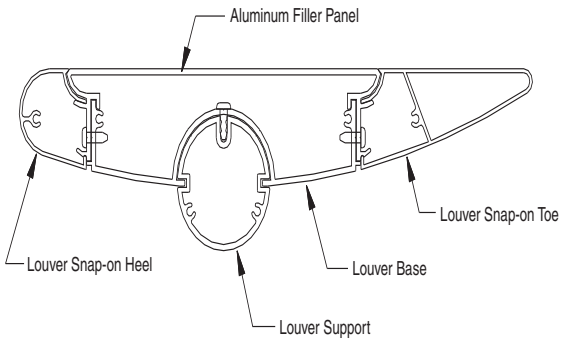


Figure 198.1

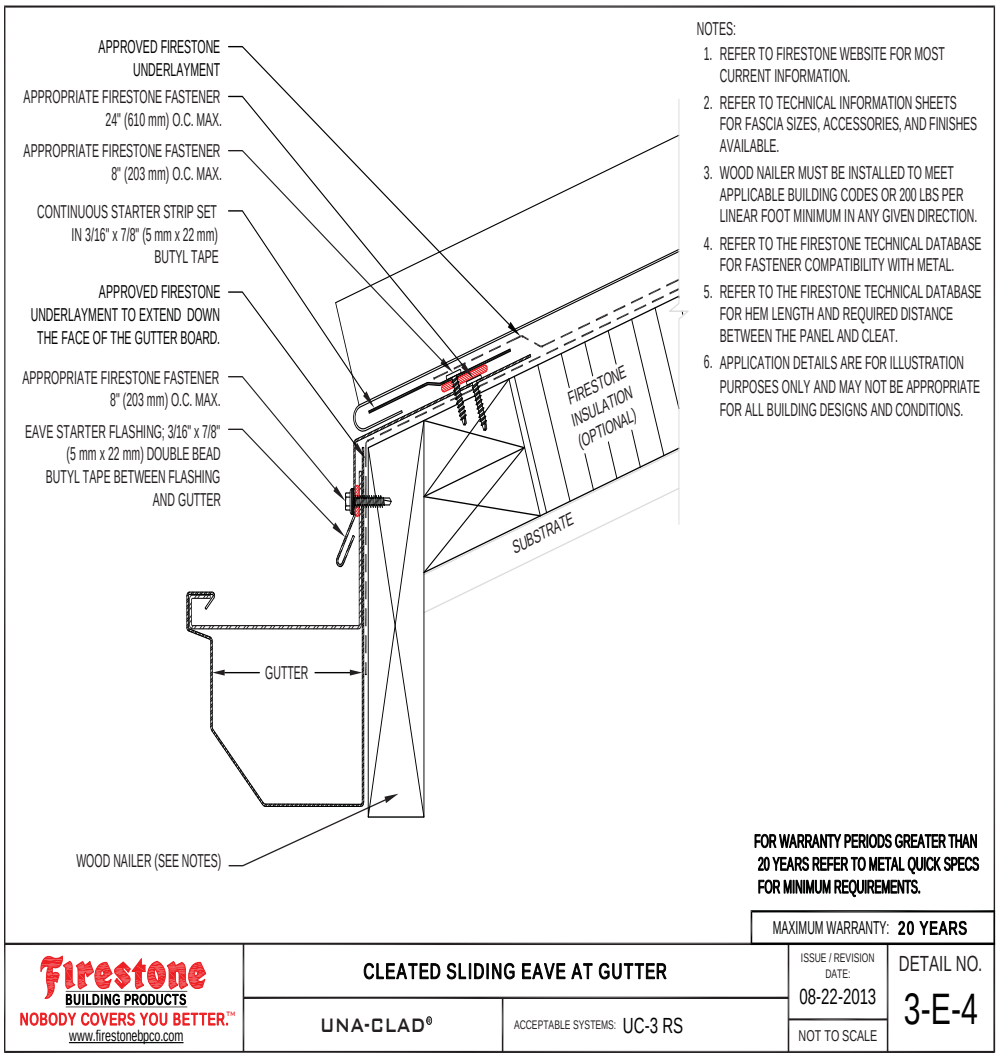


Figure 199.1

All roofing and gutter systems will be based on the Firestone roofing products. The gutter shown above will be used on the edges of the green roofs, in the valley of the butterfly roofs, and around the atrium space. The gutter will have to be adapted to the special scenarios used in the building construction, however the concept of the gutter system will be the same

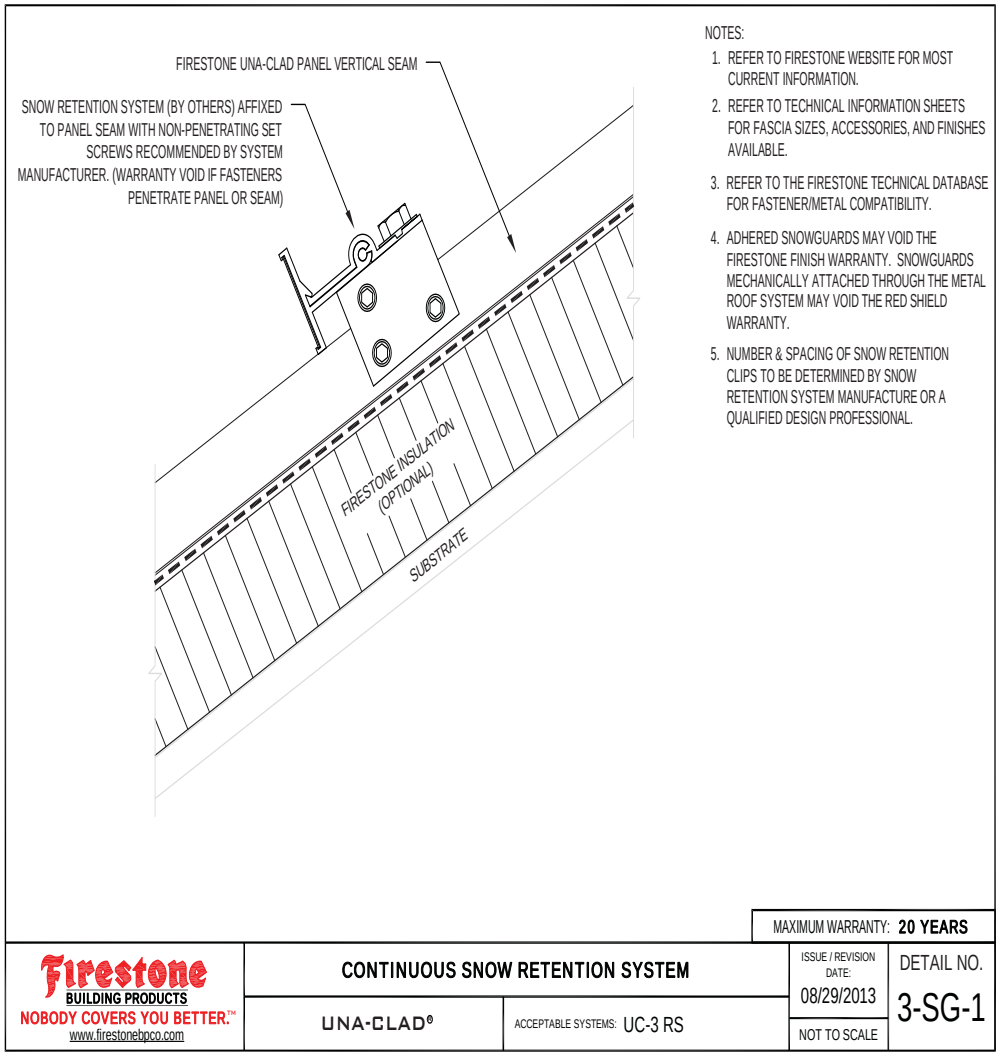


Figure 200.1

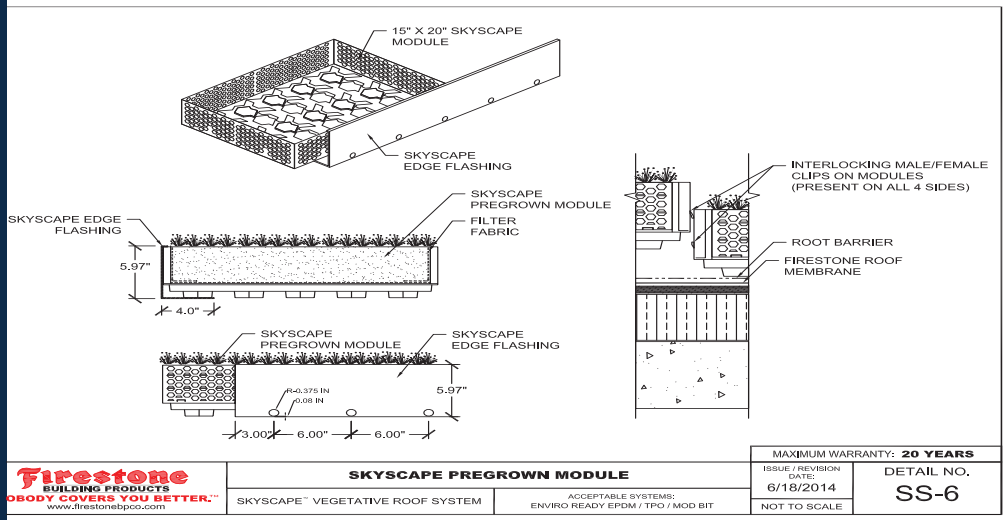


Figure 200.2

FLOOR PLAN KEY

PUBLIC

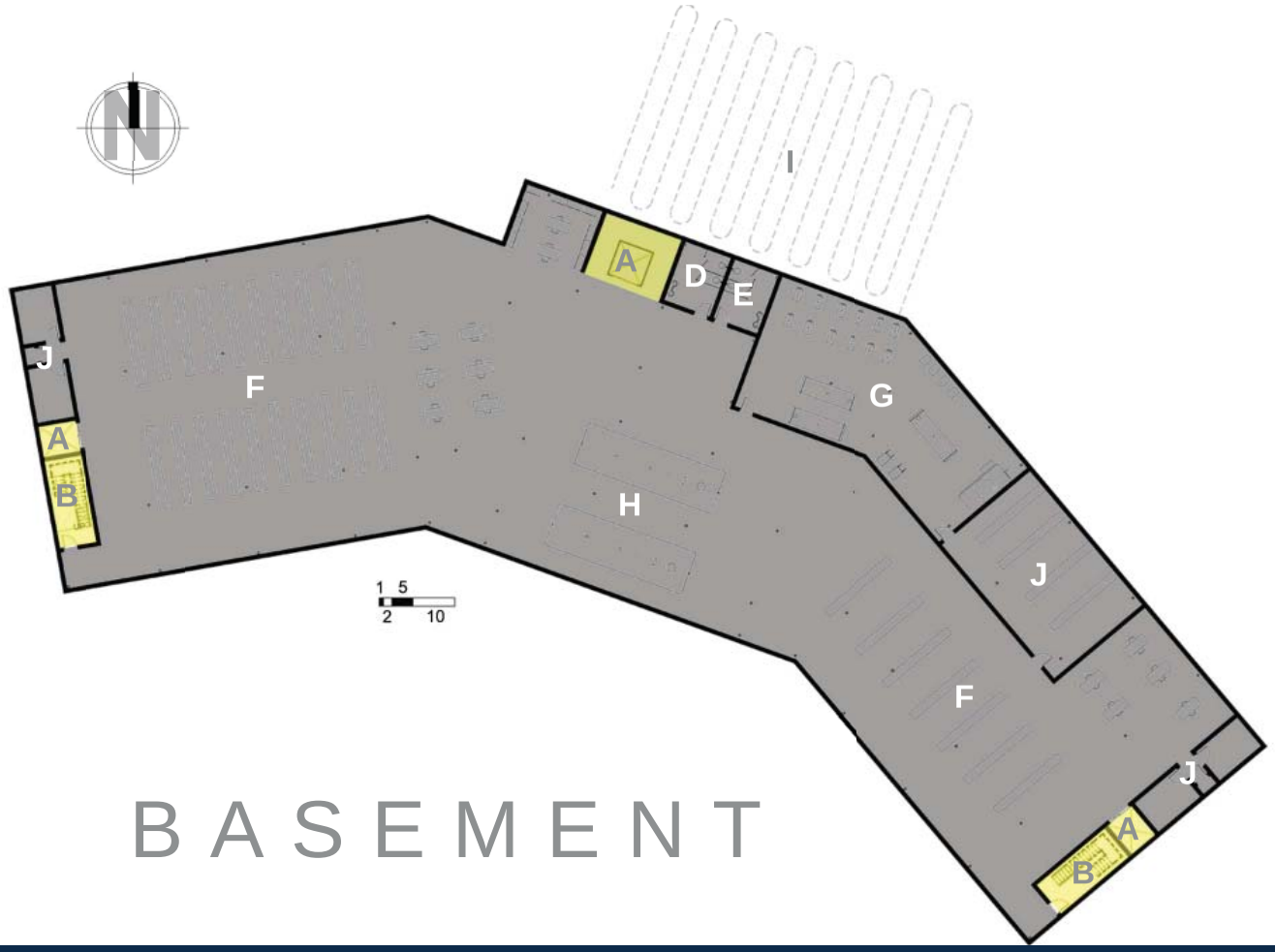
CIRCULATION

PRIVATE

SUPPORT

A- ELEVATOR
B- STAIRS
C- VESTIBULE
D- MEN'S RESTROOM
E- WOMEN'S RESTROOM
F- LONG-TERM STORAGE
G- MECHANICAL
H- WATER STORAGE
I- GEOTHERMAL WELL FIELD
J- HAZARDOUS MATERIALS
K- PUBLIC CORRIDOR
L- PUBLIC ATRIUM / EXHIBITION
M- CLASSROOM
N- TEACHING LAB
O- CAFETERIA
P- CONFERENCE ROOM
Q- DIRECTOR'S OFFICE
R- ADMIN. OFFICE
S- GRADUATE STUDENTS
T- RESEARCHER OFFICE
U- GARAGE
V- PLANT LAB
W- GREENHOUSE
X- FISH LAB
Y- AQUARIUM
Z- SHORT-TERM STORAGE
AA- OVERNIGHT RESEARCH

Figure 203.1



BASEMENT

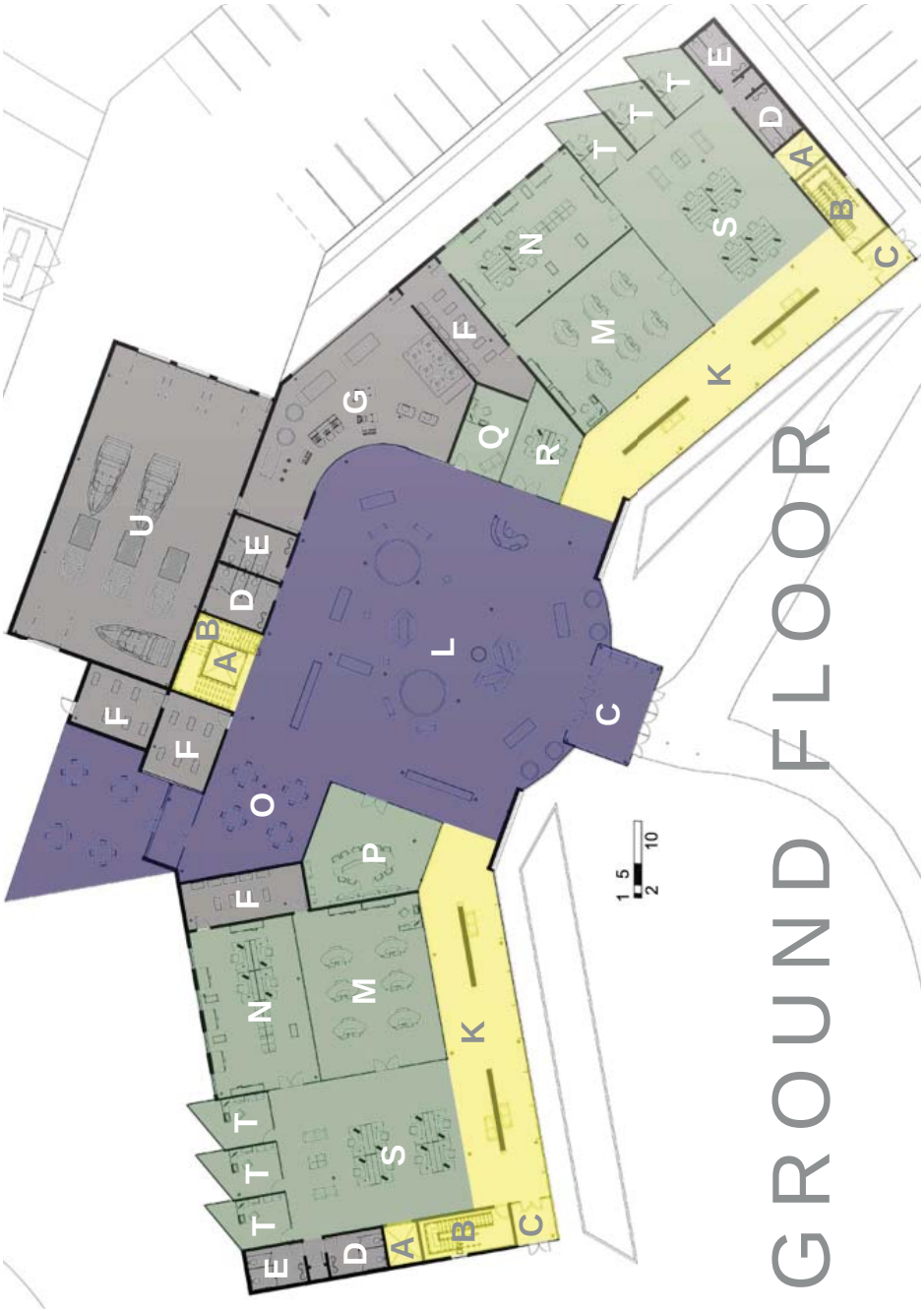


Figure 204.1

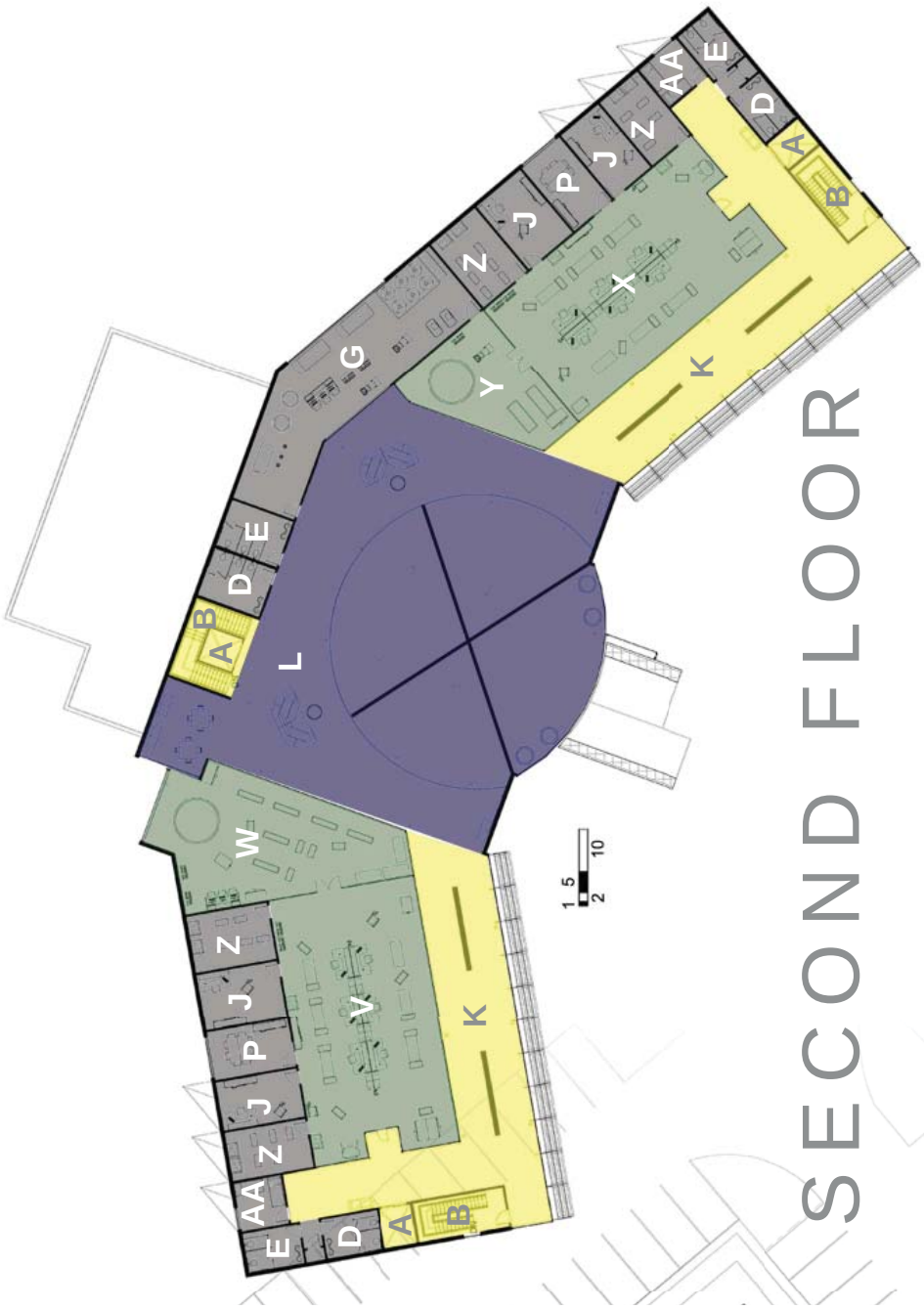
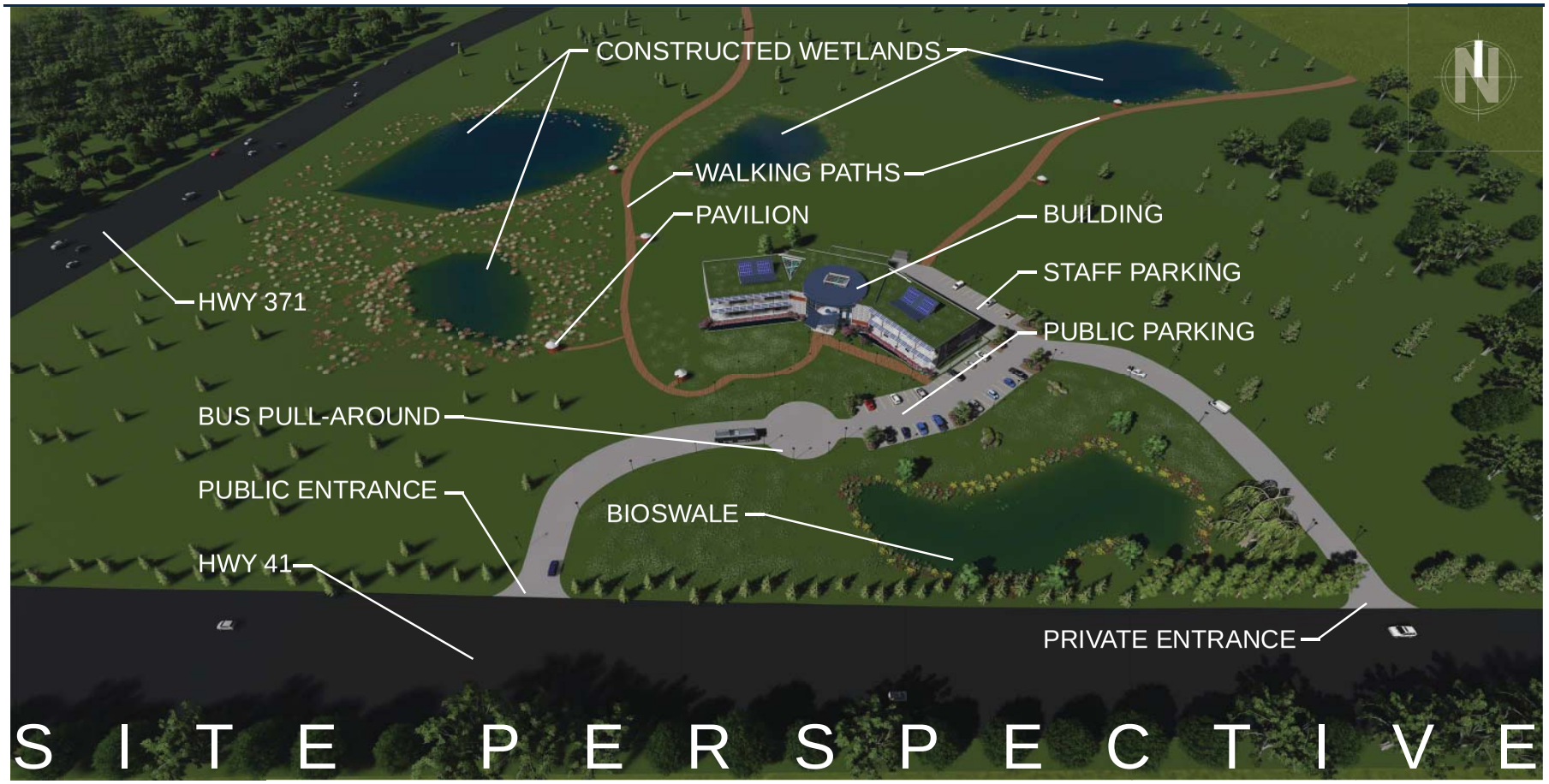

SECOND FLOOR
A
B
D
E
G
Z
J
P
J
Z
AA
E
D
A
B
X
Y
K
L
W
V
K
A
B
D
E
AA
Z
J
P
J
Z
1.5
2
10

Figure 205.1

Figure 206.1


CONSTRUCTED WETLANDS
WALKING PATHS
PAVILION
BUILDING
STAFF PARKING
PUBLIC PARKING
HWY 371
BUS PULL-AROUND
PUBLIC ENTRANCE
BIOSWALE
HWY 41
PRIVATE ENTRANCE
N
SITE PERSPECTIVE

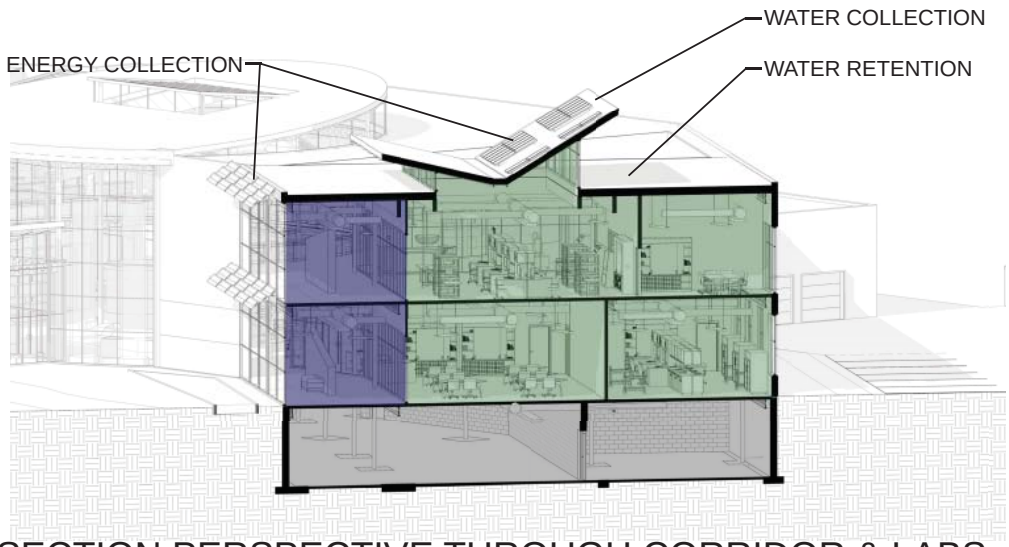
SECTION STUDIES

KEY

PUBLIC

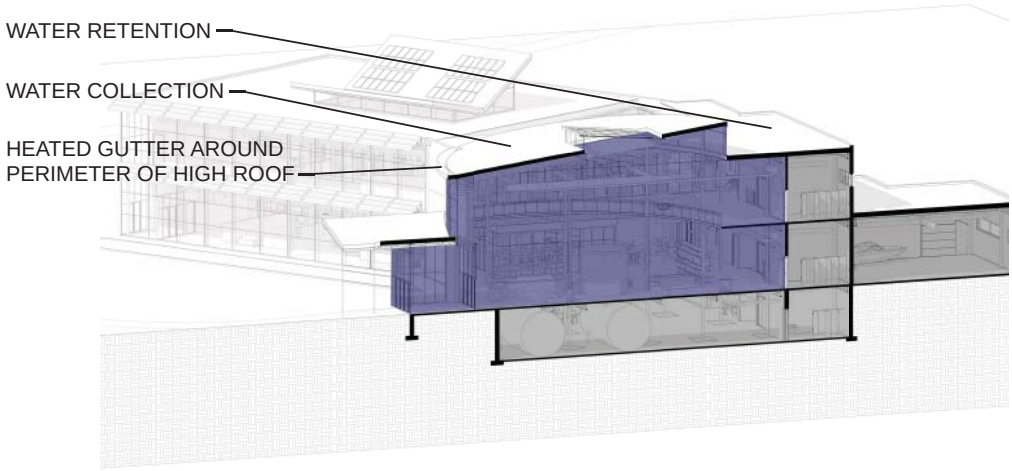
PRIVATE

SUPPORT



SECTION PERSPECTIVE THROUGH CORRIDOR & LABS

Figure 207.1



SECTION PERSPECTIVE THROUGH ATRIUM & GARAGE

Figure 207.2

PASSIVE STRATEGIES

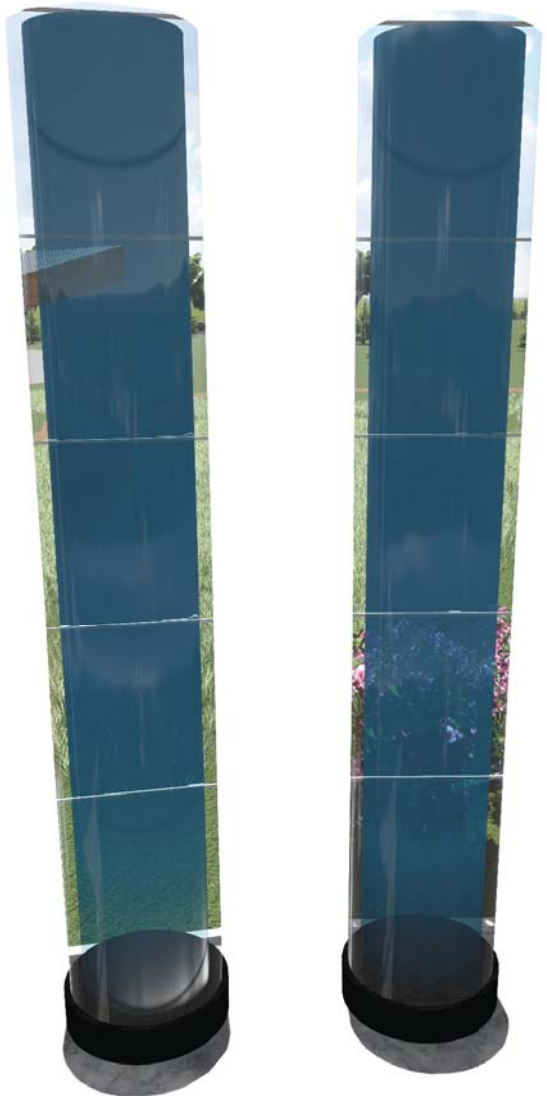


Figure 208.1

WATER TROMBE WALL

WATER IS KEPT AND CIRCULATED IN LARGE TANKS ALONG THE SOUTHERN WALL OF THE ATRIUM. THIS WATER IS HEATED UP BY SUNLIGHT ENTERING THROUGH THE CURTAIN WALL. DURING THE SUMMER MONTHS THE WATER WALLS ACT AS A BUFFER ZONE ABSORBING HEAT BEFORE IT REACHES THE INTERIOR OF THE BUILDING AND ALSO FILTERING HARSH SUNLIGHT. DURING HEATING PERIODS, THE WATER WALLS SLOWLY RELEASE HEAT BACK INTO THE SPACE KEEPING THE BUILDING THERMALLY REGULATED.

Figure 209.1

TROMBE WALL

TRADITIONAL TROMBE WALLS ARE PLACED ALONG THE SOUTH-FACING CORRIDORS. THERE THEY ABSORB SUNLIGHT AND SLOWLY HEAT UP DURING THE HOTTEST PARTS OF THE DAY. THEN THEY SLOWLY RELEASE HEAT DURING THE COLDEST PARTS OF THE DAY TO HELP THERMALLY REGULATE THE BUILDING. THE TROMBE WALL IS SET BACK FROM THE CURTAIN WALL SO THAT VISITORS MAY WALK ON BOTH SIDES OF THE WALL AND FEEL THE DIFFERENCE IN HEAT BETWEEN ITS SUN-FACING AND BACK SURFACES.

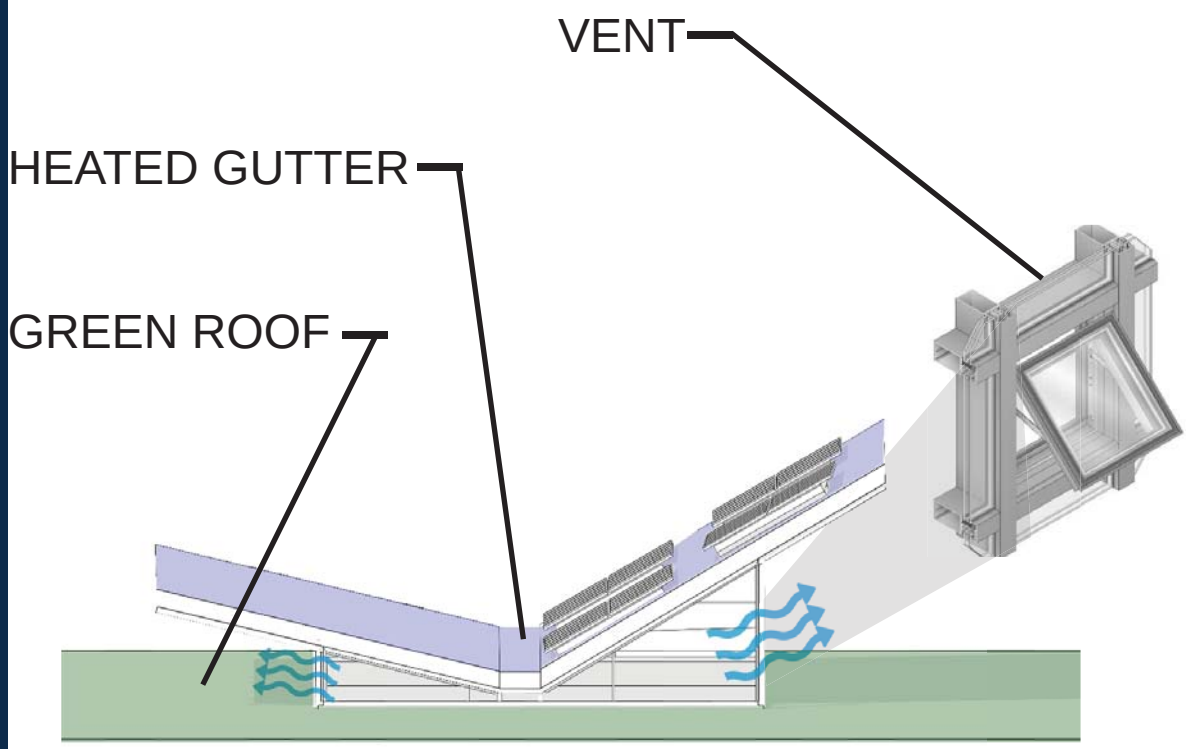


Figure 210.1

WATER COLLECTION & VENTING

THE BUTTERFLY ROOFS ABOVE THE LAB SPACES ACT PASSIVELY IN THREE WAYS. THE ANGLE AND MATERIAL OF THE ROOF CATCHES RAINWATER AND DIRECTS IT INTO A HEATED GUTTER SYSTEM. FROM THERE THE WATER IS TRANSPORTED TO THE BASEMENT CISTERNS THAT FILTER AND RE-USE THE GRAY WATER. PV PANELS ARE PLACE ON THE SOUTH SIDE OF THE ROOF AT AN OPTIMUM ANGLE FOR SUN EXPOSURE. CLERESTORY WINDOWS LINE THE ROOF WITH THE HIGHER SIDE ON THE NORTH TO ALLOW MORE INDIRECT LIGHT INTO THE LABS. BOTH SIDES OF THE CLERESTORIES HAVE MECHANICALLY OPERATED VENTS THAT CAN BE OPENED TO NATURALLY ALLOW AIR TO FLOW THROUGH AND OUT OF THE LABS. THESE CAN ALSO BE USED TO HELP EVACUATE HARMFUL EXHAUST FROM THE LABS IN THE EVENT OF AN EMERGENCY.

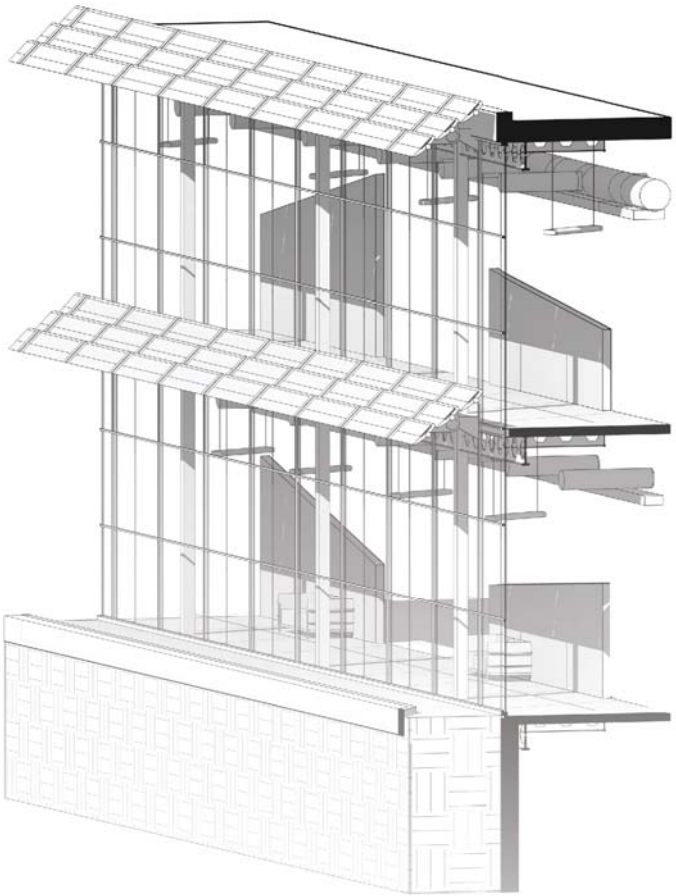


Figure 211.1

PHOTOVOLTAIC PANELS & SUN SHADES

THE SOUTH FACADES OF THE BUILDING ARE LINED WITH LARGE EXPANSES OF TRIPLE-INSULATED GLAZING. THIS CREATES A PROBLEM WITH CONTROLLING LIGHT AND HEAT COMING INTO THE BUILDING. TO REMEDY THIS, SHADING SYSTEMS ARE ATTACHED TO THE EXTERIOR OF THE BUILDING. WHEN THE SUN IS AT ITS HIGHEST POINT AND GENERALLY AT ITS HOTTEST, THE INTERIOR SPACES ARE SHADED AND KEPT COOL. THE SHADING SYSTEM IS COVERED IN PV PANELS THAT ARE PLACED AT THE OPTIMUM ANGLE TO CAPTURE SUNLIGHT AND CONVERT IT TO USABLE ENERGY.

ACTIVE STRATEGIES

Figure 212.1

CISTERN

TWO 20,000 GALLON CAPACITY WATER TANKS RESIDE IN THE BASEMENT WHERE THEY RETAIN GRAY WATER FROM VARIOUS POINTS IN THE BUILDING. SOME OF THIS WATER IS FILTERED MECHANICALLY AND RE-USED THROUGHOUT THE BUILDING IN APPLICATIONS SUCH AS THE WATER TROMBE WALLS AND THE VARIOUS AQUARIUM TANKS. OVERFLOW FROM THESE TANKS IS PUMPED OUT INTO THE CONSTRUCTED WETLANDS TO BE FILTERED BY NATURAL MEANS AND REPLACED INTO UNDERGROUND AQUIFERS. ANY WATER THE TOUCHES THE ROOF OF THE BUILDING WHETHER IN THE GREEN ROOF SYSTEM OR DRAINED OFF THE STANDING SEAM METAL ROOFING IS RETAINED SO THAT IT ENTERS BACK INTO THE WATER SUPPLY SLOWLY AND DOES NOT OVERLOAD A STORM SEWER SYSTEM.

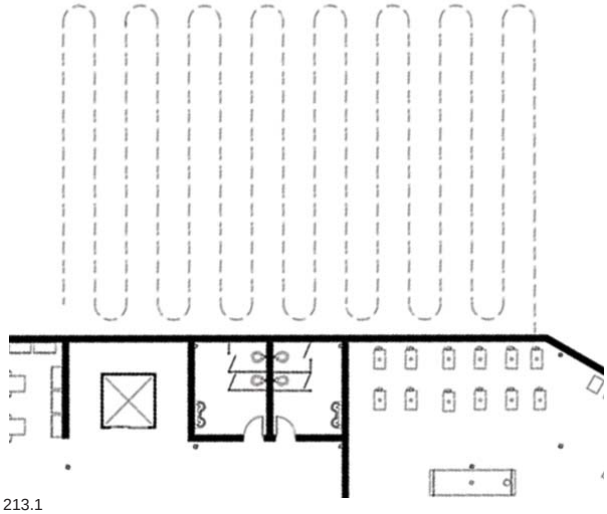


Figure 213.1

GEOTHERMAL WELLS

A SERIES OF 12 LARGE HEAT PUMPS ARE LOCATED IN THE BASEMENT MECHANICAL ROOM. THESE PUMPS CIRCULATED A WATER AND ANTI-FREEZE MIXTURE THROUGH A SERIES OF UNDERGROUND WELLS LOCATED APPROXIMATELY 20 FEET BELOW GRADE. AT THIS ELEVATION THE GROUND STAYS AT A STEADY TEMPERATURE OF ABOUT 50 DEGREES FAHRENHEIT AND IS FAR ENOUGH BELOW GROUND THAT THE PIPES WILL NOT BE DAMAGED BY THE HEAVY MACHINERY IN THE GARAGE ABOVE. THE WATER TRAVELS THROUGH THE PIPING UNDERGROUND WHERE IT REACHES THE STEADY TEMPERATURE AND IS THEN CIRCULATED THROUGHOUT THE BUILDING WHERE DEPENDING ON THE TIME OF YEAR, IT EITHER COOLS OR HEATS. THEN THE WATER IS RETURNED THROUGH THE CYCLE UNDERGROUND WHERE IT WILL REPEAT THE PROCESS. THIS SYSTEM USES A NON-COMBUSTION PROCESS THAT REQUIRES LESS ENERGY THAN A TRADITIONAL BOILER SYSTEM AND

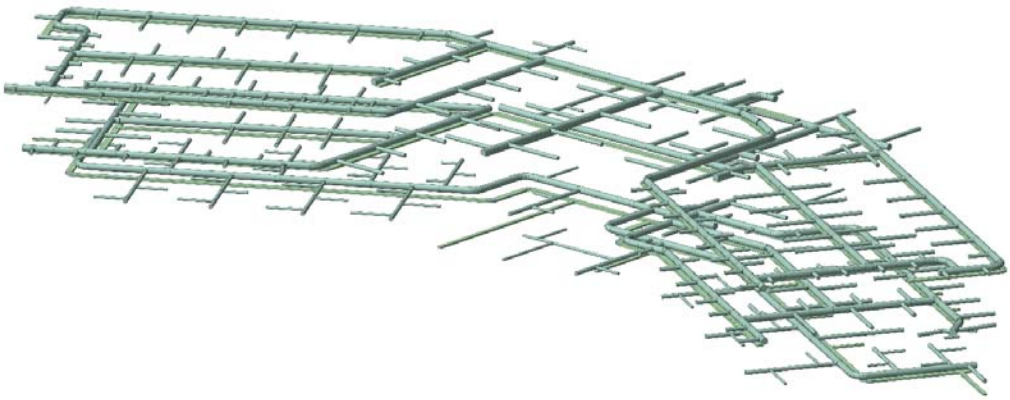
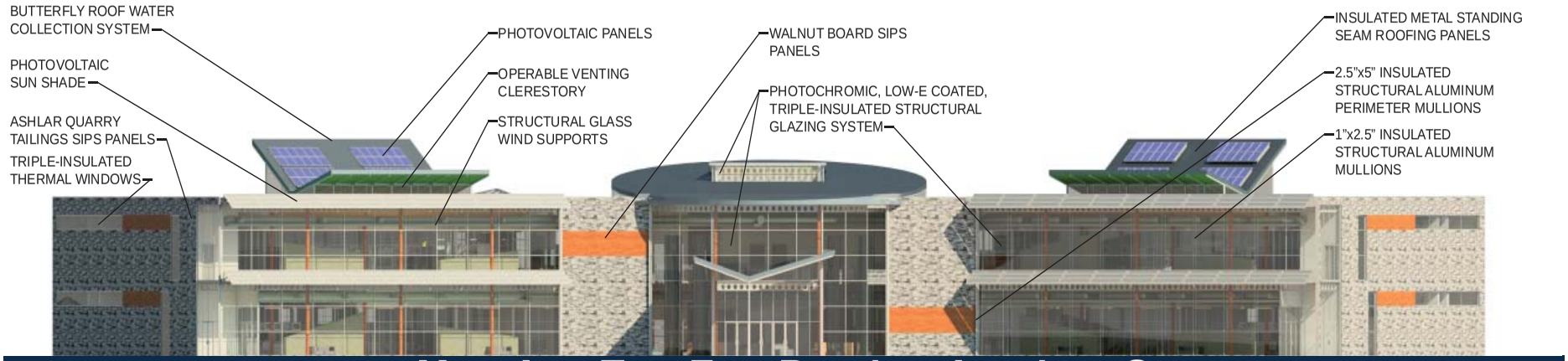


Figure 214.1

HVAC DUCT SYSTEM

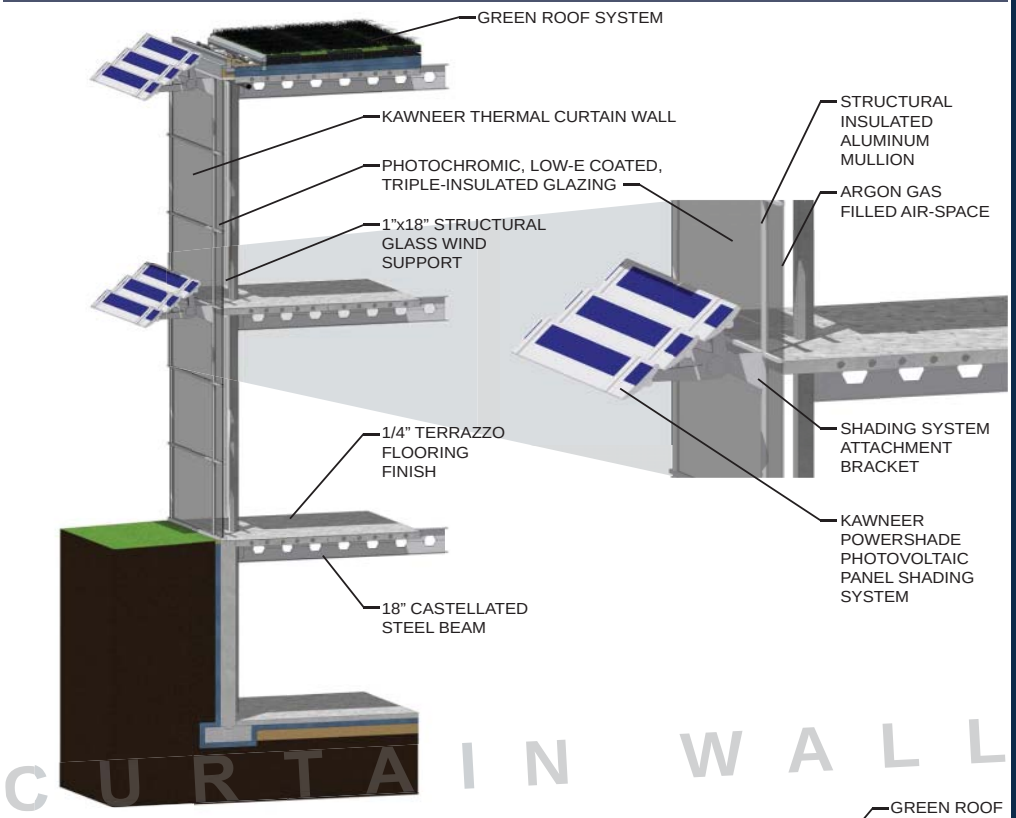
AIR IS MECHANICALLY CIRCULATED THROUGHOUT THE BUILDING TO PROVIDE CLEAN, FRESH AIR TO THE INHABITANTS. SEPARATE DUCT SYSTEMS PUSH CLEAN AIR OUT INTO EACH SPACE AND A SEPARATE SYSTEM DRAWS USED DIRTY AIR BACK TO THE MECHANICAL ROOM WHERE IS DEPOSITED OUTDOORS. EACH FLOOR HAS ITS OWN MECHANICAL ROOM AND COMPLETELY SEPARATE HVAC SYSTEM SO THAT THE MORE PUBLIC SPACES ON THE FIRST FLOOR ARE ISOLATED FROM THE MORE PRIVATE SPACES ON THE SECOND FLOOR. IN THIS CASE, IF A HAZARDOUS GAS WAS CREATED IN ONE OF THE LABS, THE HVAC SYSTEM WOULD ONLY CIRCULATE THAT AIR THROUGH-OUT THAT SPACE, WHICH COULD BE EVACUATED AND ISOLATED. THE OTHER FLOORS WOULD NOT BE IN DANGER OF HAZARDOUS GASES BEING CIRCULATED FROM OTHER FLOORS.

IT IS UNREALISTIC TO EXPECT A SCIENTIFIC RESEARCH BUILDING TO RELY ON COMPLETELY PASSIVE STRATEGIES AND NOT MECHANICALLY OPERATED SYSTEMS BECAUSE OF THE CRITICAL NATURE AND PRECISION NEEDED WHEN PERFORMING SCIENTIFIC EXPERIMENTS. HOWEVER, PASSIVE STRATEGIES WERE EMPLOYED WHEN POSSIBLE TO HELP LIMIT THE IMPACT AWAKING WATERS HAS ON ITS LANDSCAPE AND SURROUNDING UTILITIES. THE PASSIVE STRATEGIES HELP TO OFFSET THE ENERGY USED BY THE BUILDING MECHANICALLY. WHILE THE BUILDING MAY NOT BE NET-ZERO IT WILL BE CLOSE AND WILL HELP TO SHOW THAT THERE ARE MANY THINGS WE CAN DO THAT DO NOT REQUIRE THE USE OF FOSSIL FUELS.

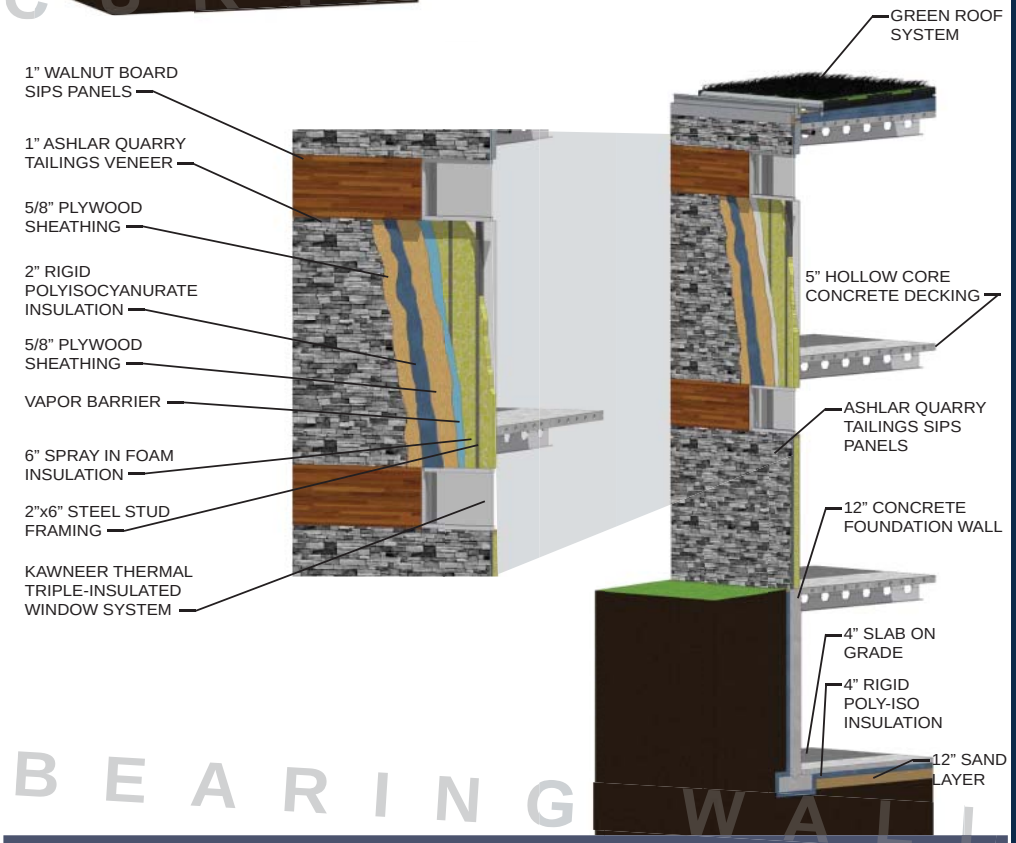


M A T E R I A L S

Figure 216.1

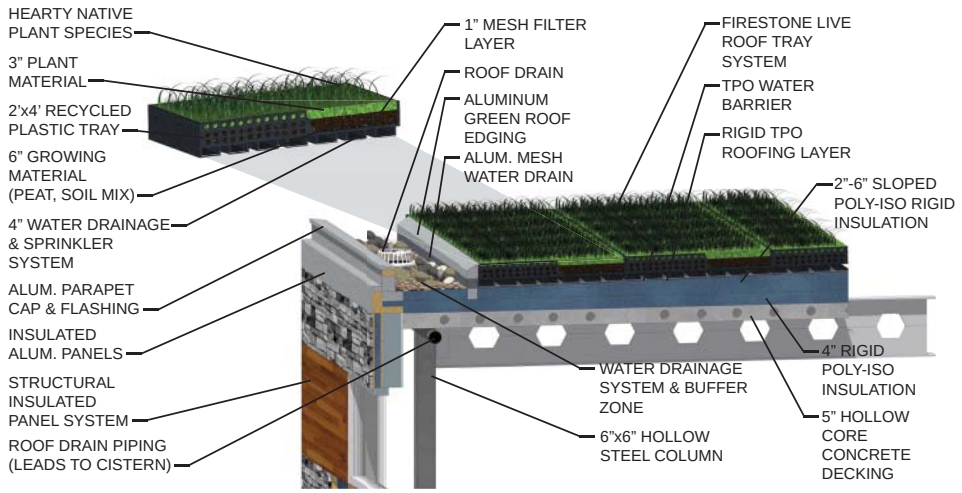


C U R T A I N W A L L



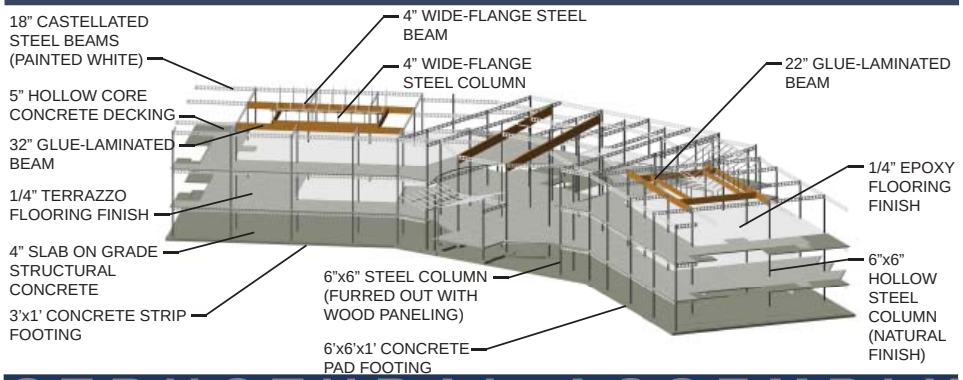
B E A R I N G W A L L

Figure 216.1



GREEN ROOF ASSEMBLY

RETENTION



STRUCTURAL ASSEMBLY

BALANCE

Figure 218.1

HVAC LAYOUT
TRIBUTARIES

Figure 219.1

R E N D E R S

SECOND FLOOR LOOKING INTO ATRIUM

Figure 220.1

ATRIUM AND RECEPTION SPACE

Figure 221.1

Figure 222.1

MECHANICAL ROOM EXHIBIT

Figure 223.1

Figure 224.1

SECOND FLOOR GREENHOUSE

BUILDING ENTRY

Figure 225.1

Figure 226.1

PARKING BIOSWALE

CLASSROOM

Figure 227.1

Figure 228.1

CONFERENCE ROOM

SOUTH-FACING CORRIDOR

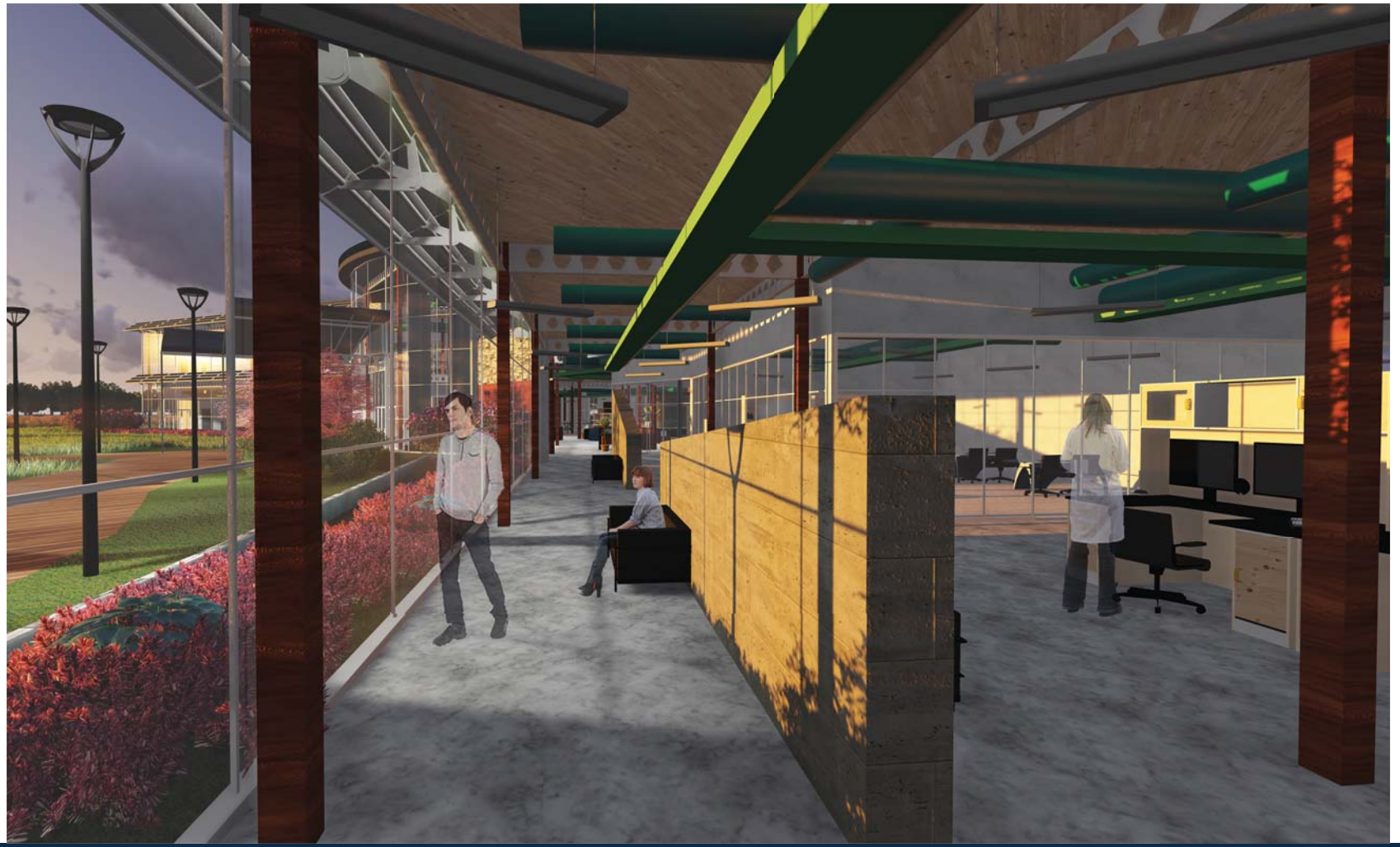


Figure 229.1

Figure 230.1

EXTERIOR PATHWAY

EXTERIOR FROM BUS PULL-AROUND

Figure 231.1

Figure 232.1

EXTERIOR PATHWAY

BUILDING ENTRY

Figure 233.1

Figure 234.1

EXTERIOR IN WITNER

EXTERIOR PATH FROM PARKING TO BUILDING ENTRY

Figure 235.1

Figure 236.1

EDUCATIONAL PAVILIONS

GRADUATE STUDENT CUBICLES AND RESEARCH SPACES

Figure 237.1

Figure 238.1

GREENHOUSE INTERIOR

GREENHOUSE INTERIOR

Figure 239.1

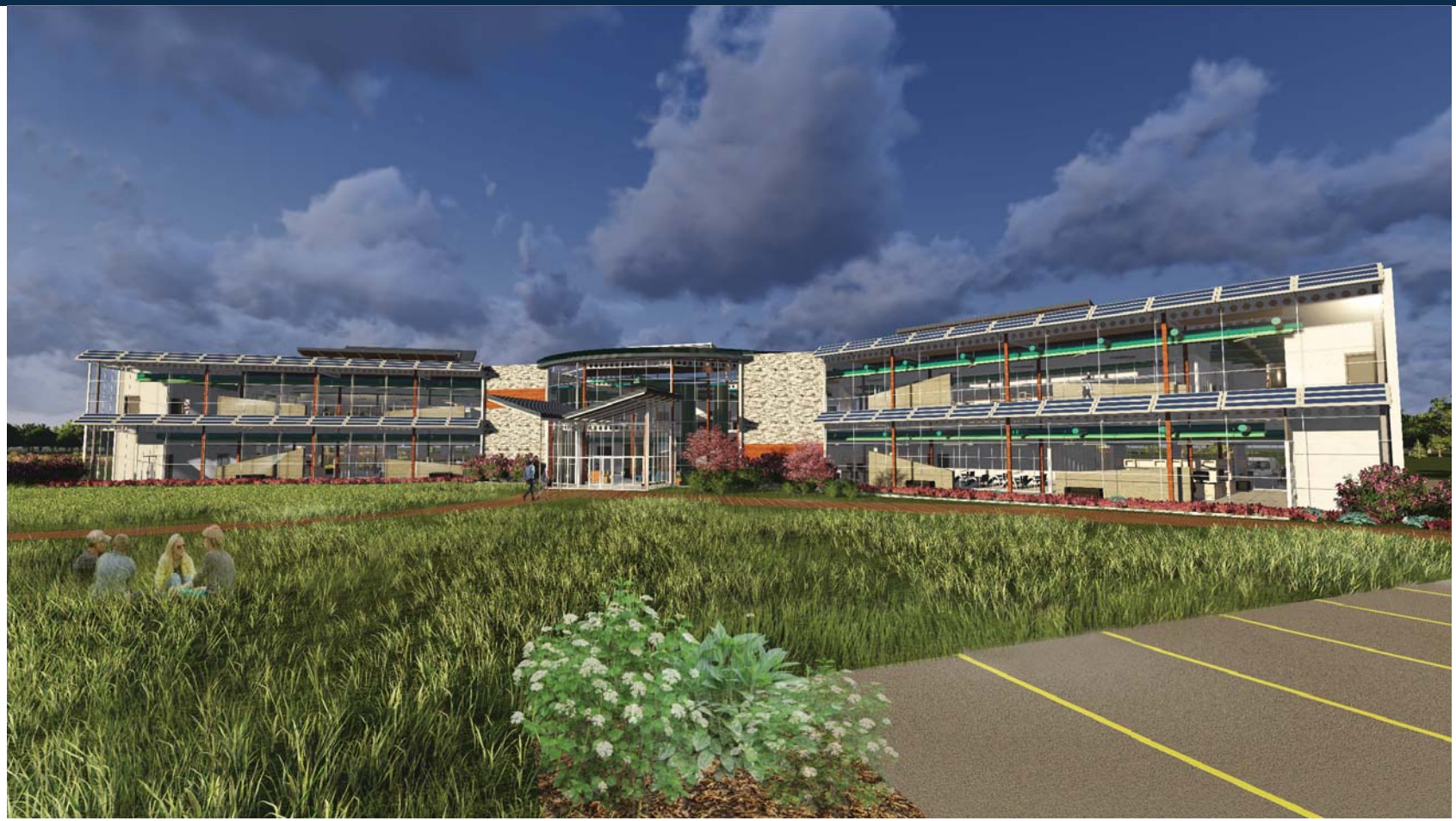
Figure 240.1

GREENHOUSE LAB INTERIOR

GREENHOUSE LAB INTERIOR

Figure 241.1

Figure 242.1



BUIDING EXTERIOR FROM PARKING

RESEARCHER OFFICE

Figure 243.1

Figure 244.1

SECOND FLOOR FISH LAB

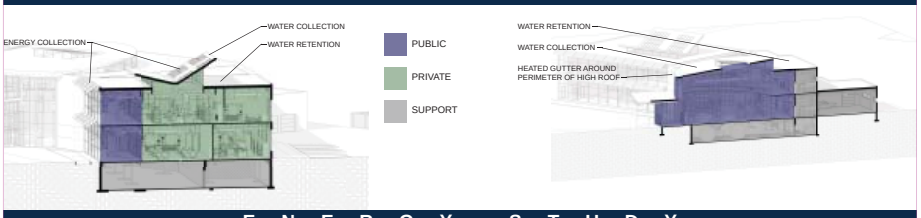
SITE PERSPECTIVE

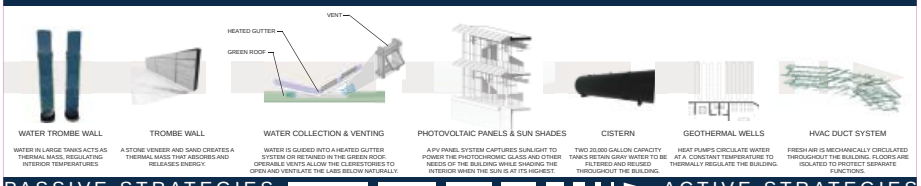
Figure 245.1

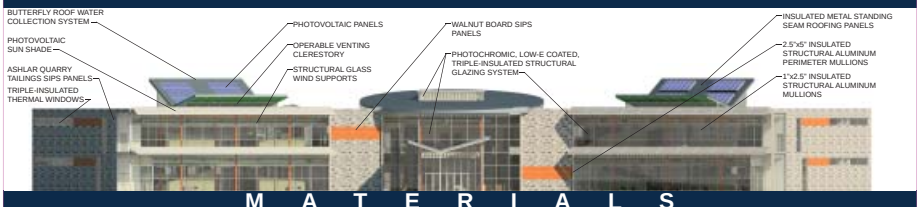
B O A R D S

"WE NEVER KNOW THE WORTH OF WATER UNTIL THE WELL IS DRY"
-THOMAS FULLER HISTORIAN

MUCH LIKE AN ECOSYSTEM IN NATURE, A BUILDING MUST BE A SUM OF ITS PARTS. AWAKING WATERS DRAWS INSPIRATIONS FROM THE PASSIVE QUALITIES OF A WETLAND, THE ACTIVE QUALITIES OF A RIVER, AND THE SYSTEMS REQUIRED IN A FUNCTIONAL BUILDING DESIGN. BY DOING SO, THE CENTER PROVIDES STATE-OF-THE-ART RESEARCH FACILITIES AND INVITES THE PUBLIC IN TO LEARN ABOUT NATURE WHILE LIMITING THE BUILDING'S IMPACT ON THE LANDSCAPE.



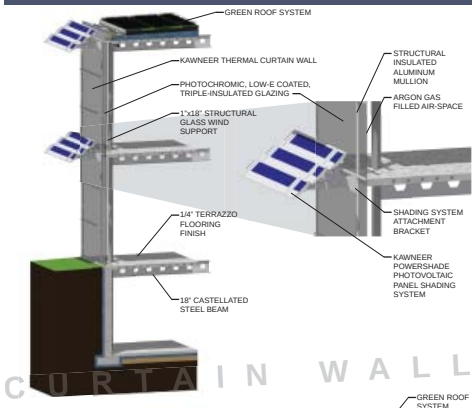




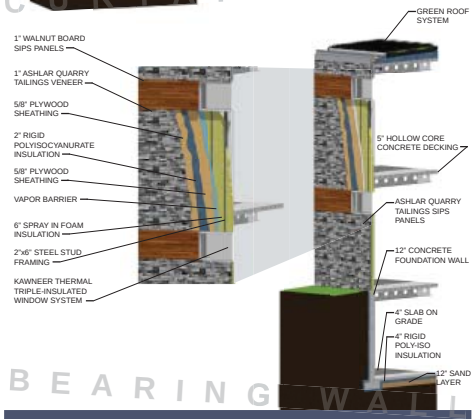
AWAKING WATERS CHARLOTTE HAUGH ARCH 772 PROFESSOR STEVE MARTENS 4-21-16

Figure 246.1

S Y S T E M S

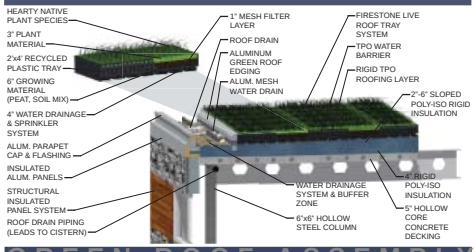


C U R T A I N W A L L



B E A R I N G W A L L

E N E R G Y

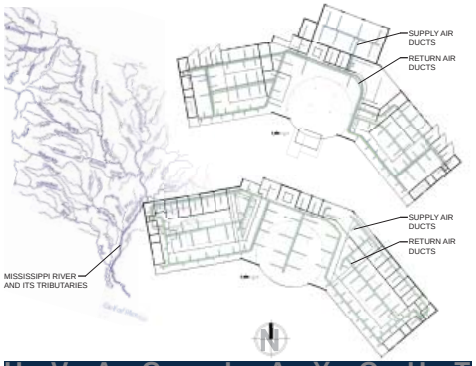


G R E E N R O O F A S S E M B L Y

R E T E N T I O N

S T R U C T U R A L A S S E M B L Y

B A L A N C E



H V A C L A Y O U T

T R I B U T A R I E S

P E R S P E C T I V E S

PUBLIC CIRCULATION CORRIDOR
PUBLIC AND PRIVATE USERS CROSS PATHS IN SPACIOUS, SOUTH-FACING CORRIDORS

EXHIBITION
LARGE DISPLAYS AND AQUARIUMS EDUCATE THE PUBLIC ABOUT MINNESOTA WATER ECOSYSTEMS AND THEIR INHABITANTS

LABORATORY
SPACIOUS AND FLEXIBLE, LABORATORIES PROVIDE A PLACE FOR RESEARCH AND ARE TRANSPARENT TO THE PUBLIC

ENTRY PATH
WOODEN PATHWAYS LEAD FROM THE PARKING LOT TO THE BUILDING AND OUT TO THE PRAIRIE PLOTS AND CONSTRUCTED WETLANDS

ATRIUM
WITH CLERESTORIES AROUND THE PERIMETER, A LARGE SKYLIGHT IN THE CENTER, AND A SOUTH-FACING CURTAIN WALL, THE DOUBLE-HEIGHT ATRIUM IS AN INVITING GATHERING PLACE

GREENHOUSE
A TEMPERATURE AND SUNLIGHT CONTROLLED GREENHOUSE PROVIDES YEAR-ROUND RESEARCH AND EDUCATES THE PUBLIC ABOUT INVASIVE PLANTS

Figure 247.1

A P P E N D I X

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STUDIO EXPERIENCE

2ND YEAR:

FALL 2012- Professor- Daryl Booker

PROJECTS: The first project we worked on with Booker was the Tea House. This was meant as an introductory to spacial arrangements and also the exploration of metaphors in design. The project also focused heavily on the site which was located on the Red River in Fargo.
The second project in this studio was the Boat House located along the Mississippi River in Minneapolis, MN. This focused more on flood awareness and the programming of spaces.

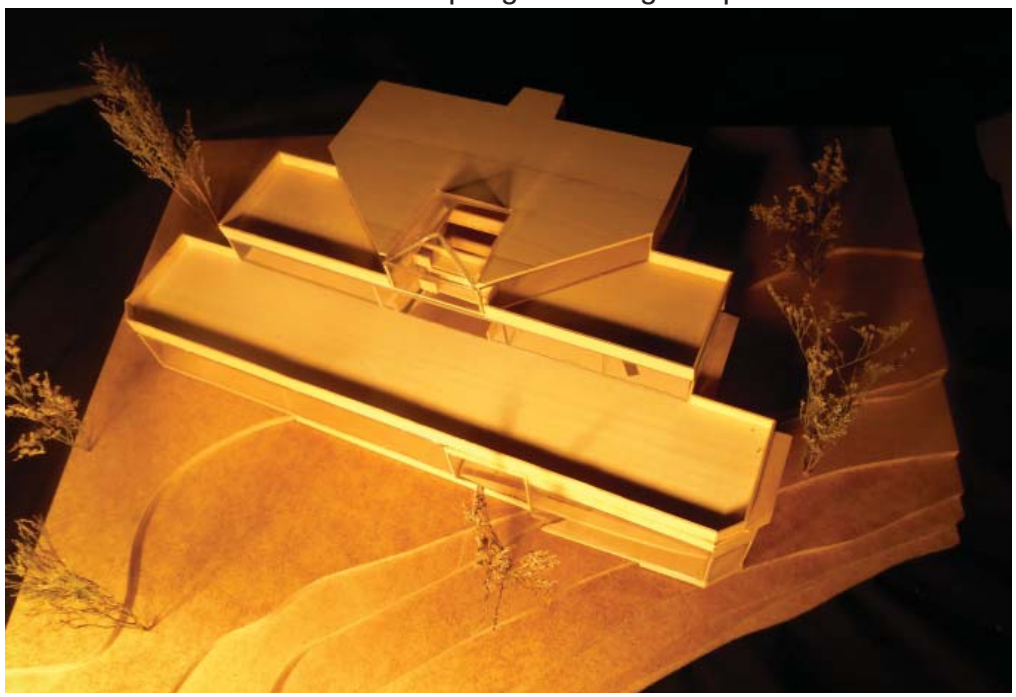

Figure 252.1

SPRING 2013- Professor- Rhet Fiskness

PROJECTS: In Spring of 2nd year the first project we worked on was a dance studio located as urban infill in downtown Fargo. We were each given a type of dance to embody in our design, mine being tap dance. The project focused on the beginnings of structure and detailing.
Following the dance studio was the culinary school which allowed students to pick where their site would be and form groups. My culinary school was in Dubai and focused on sustainable practices of design.

3RD YEAR:

FALL 2013- Professor- Milt Yergens

PROJECTS: Starting out the third year was the Healdsburg Guitar Center located in Healdsburg, CA. This design was meant to be a place for the Healdsburg Guitar Festival to take place and at other times be a place to showcase the making of sting instruments. This project complimented those in second year and took our structural exploration further.
After the guitar center came the Portland Center for Writers. This project was an urban infill site in Portland Maine. I chose to use the writings of Stephen King as design inspiration and created a building that would cater to the mind of a mystery novelist.

SPRING 2014- Professor- David Crutchfield

PROJECTS: The first project of this studio focused on the use of Steel as a structural building material. It was meant to be the new headquarters of Mid America Steel and was located on the current site of the Mid America Steel plant in Fargo. The project was to be used as a visitor's center where the public could learn more about how steel is made and public events could be held. To close out the third year was a project that complimented our trip to Chicago. It was to be a youth art center to bring art back into the youth of the Chicago south-side youth. This project focused on using concrete as a structural material.

Figure 253.1

4TH YEAR

FALL 2014- Professor- Don Faulkner

PROJECTS: This studio is seen as our senior capstone for the undergraduate degree in architecture from NDSU. We start out with a trip to San Francisco to locate our site for a high rise design. Done in teams of two, each team creates a high rise residential and mixed use design along with a project book that profiles the process of the design. My partner, Joe Miller, and I focused on using a hexagonal structure broken down into its simplest form of triangles. We also focused on shielding the building from the sun so as to limit its draw on the grid.

SPRING 2014- Professor- Steve Martens

PROJECTS: The spring semester focused on historic preservation. I chose the Woodrow Wilson School in Fargo and turned it into the Woodrow Wilson Animal Center. The center encompassed a shelter for dogs and cats, an animal hospital, and therapy dog training grounds. We were challenged with finding ways of preserving what the building was but also making it usable again and relevant in today's society.

Figure 254.1


Figure 254.2

5TH YEAR

FALL 2015- Professor-Mark Barnhouse

PROJECTS: This project is a Wetlands Research Center in Ulen, MN. It will serve as lab space and administration for the wetlands program at NDSU. The main basis of the design is water harvesting and feeding into man-made wetlands and natural wetlands.

Figure 255.1

SPRING 2016- Professor- Steve Martens

PROJECTS: Awaking Waters was a year-long thesis design project which came into completion in the spring of 2016. This semester was meant to apply our previous research into a design recommendation for a building.

Figure 256.1

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"MY YEARS AT NDSU WERE THE MOST SCARY, EXCITING, TUMULTUOUS, AND EXHILARATING TIMES AS OF YET IN MY LIFE, AND I AM ALL THE BETTER BECAUSE OF THEM."