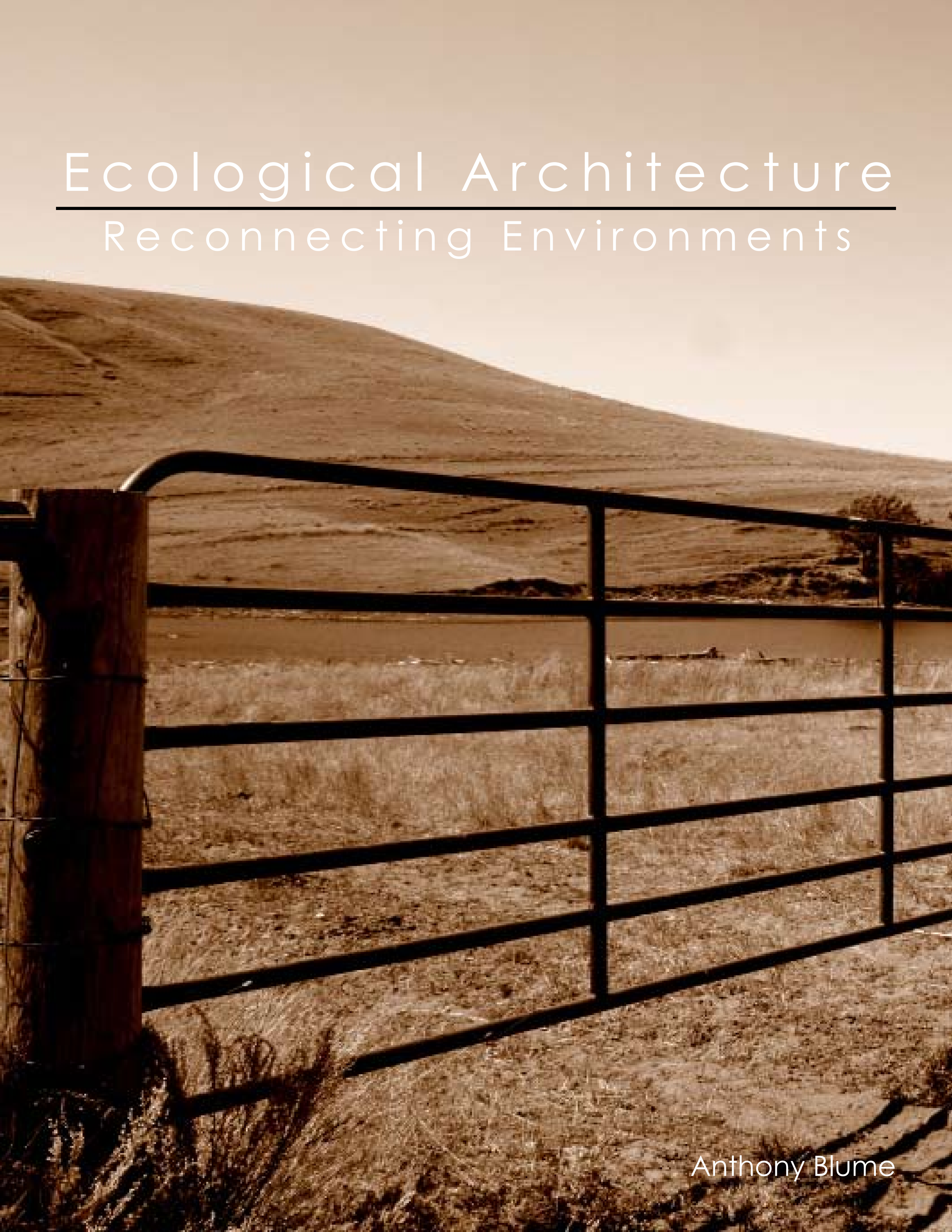
Ecological Architecture

Reconnecting Environments



Anthony Blume

Ecological Architecture: Reconnecting Environments

A Design Thesis Submitted to the
Department of Architecture and Landscape Architecture
of North Dakota State University

By

Anthony Blume

In Partial of the Requirements
for the Degree of Masters of
Architecture

Primary Thesis Advisor

Thesis Committee Chair 05/11/11

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Abstract

The typology for this facility derived from the problem concerning the separation of environments. The design will incorporate an Ecological Education and Research Center for Sustainable Development (EERCSD) within the context of the rural-urban fringe. Designing multi-purpose spaces is vital to programmatically accommodate to Fargo's changing seasons. The EERCSD will begin to evaporate the dividing boundaries of the built and natural environment by employing ecological design as a foundation for the design process. Providing a place to educate the public while experiencing both the natural and built environments can lead to a better understanding of the areas ecology.

key terms: rural-urban interface, environment, ecology

Problem Statement

How can architecture lend itself to the reconnection of environments?

STATEMENT OF INTENT

TYPOLOGY

An Ecological Education and Research Center for Sustainable Developemnt will offer the public insight into environmentally sensitive approaches to urbanization. This facility will conduct research pertaining to Fargo's ecology and educate the building industry, the city of Fargo, and the general public on the results, creating a broad education base concerning construction practices and the destruction of the native habitat.

THE CLAIM

Due to urbanization, the landscape that comprises our ecosystem has become separated; therefore, architecture must unify these environments it once divided.

PREMISES

Architecture has encroached upon the landscape, destroying characteristics of the ecosystem and creating unfavorable boundaries dividing environments.

In reaction to the separation of environments, architecture must mend the divorced relationship between our ecosystem's characteristics.

Environments are dynamic entities of our natural landscape, and when an architectural gesture is created within the environment's context, characteristics are changed and the pristine quality may be lost.

THEORETICAL PREMISE/ UNIFYING IDEA

The rural-urban interface is a dynamic and transforming area at the edge of large cities. Urban sprawl has leached into the native landscape, destroying habitats and threatening species. Architecture must create an urban gradient between the two environments in question, dissolving the abrupt termination of the urban environment at the rural-urban interface.

PROJECT JUSTIFICATION

As metropolitan areas expand and suburbia encroaches into outlying landscape, boundaries are modified and change occurs, forcing an alteration in environmental character. Architecture can have detrimental impacts upon our landscape thus separating the built and natural environments. Architecture must address this problem of divided environments and design in an ecologically-sensitive manner.

THE PROPOSAL

The Narrative

During the past century cities across the United States have endured periods of growth due to the rural populous migrating to urban centers in search of a better quality of life. The phenomenon known as "urban sprawl" came about in reaction to these periods of rapid growth. Urban sprawl has expanded communities providing affordable, single family housing, but in doing so has destroyed parts of the native landscape. Environments are defined by their characteristics, such as vegatation, animals, and wetlands and when those characteristics are transformed, or altogether removed in order to accommodate a growing population, environments become disconnected from one another. Architectural forms define city limits, strengthening the separation of environments, and encroach upon the undeveloped landscape. Architecture must design in an ecologicallly-sensitive manner with the intention to reconnect these divided environments.

User/Client Description

The EERCSD will be designed for, and operated by, the city of Fargo, North Dakota. This facility will prompt its visitors to become involved in the preservation and revitalization of Fargo's native environment, especially at the rural-urban interface.

The accommodating proximities to the local public and private schools of Davies High School, Bennett Elementary Achool, and Shanley High School will allow the schools science programs to partner with the education center and provide the studens with advanced tutorial facilities. This will provide the adolesents of Fargo and Moorhead to gain advanced involvement in the environmental issues threatening the region's habitats. The local institutions of higher education: North Dakota State University, Minnesota State University in Moorhead, Concordia College, and Minnesota State Community and Technical College will use the center to study regional ecology with the intention of preparing students for occupations in related¬ fields.

The Department of Natural Resources (DNR) will also call the center home. Occupying a small portion of the facility, the department will conduct business and provide services for the surrounding communities. Sufficient space will be planned for the storage of vehicles and supplies in preparation for environmental disasters, such as annual flooding.

MAJOR **PROJECT** ELEMENTS

Department of Natural Resources

A small area will contain the offices and garage space for North Dakota's Department of Natural Resources. The public will have access to the offices to obtain permits and assistance for any nature in related situations. Garage space for one vehicle and two all-terrain vehicles along with two snowmobiles will be in close proximity to the offices. The garage will also house a watercraft and rescue equipment in preparation for annual spring flooding.

Ecological Education Center

The EERCSD is the focal point of the facility and will initiate the education of Fargo's history and ecology. Gallery space, interactive exhibits, both indoor and out, a presentation room, and smaller conference rooms are all spaces which will provide the facility with the tools necessary to produce a healthy learning environment.

Workshop

The large workshop will offer adequate space for large equipment repairs and full in scale scientific studies. This space will be a multi-purpose space that will adapt to the community's needs.

Store

A store will be incorporated into the EERCSD and provide additional income to the facility. The store will act as a gift shop for visitors to purchase artifacts of regional significance.

Parking

On-site parking will be accessible for all users of the facility. Included in the parking lot will be sufficient space for buses and over-sized vehicles. A separate, private, parking lot will be included for the daily workers, scientists, and technicians. Handicap parking will be offered in close proximity to the building.

Outdoor Space

Outdoor space will be designed for educational use. The recreational trail system in and around the site will be tied into the overall landscape of the facility, and allow pedestrian access at all times of the year. Designing the outdoor space to mesh with the indoor environment will blend the two competing spaces into one coherent, comfortable space. An amphitheater will offer appropriate seating for outdoor presentations and seminars.

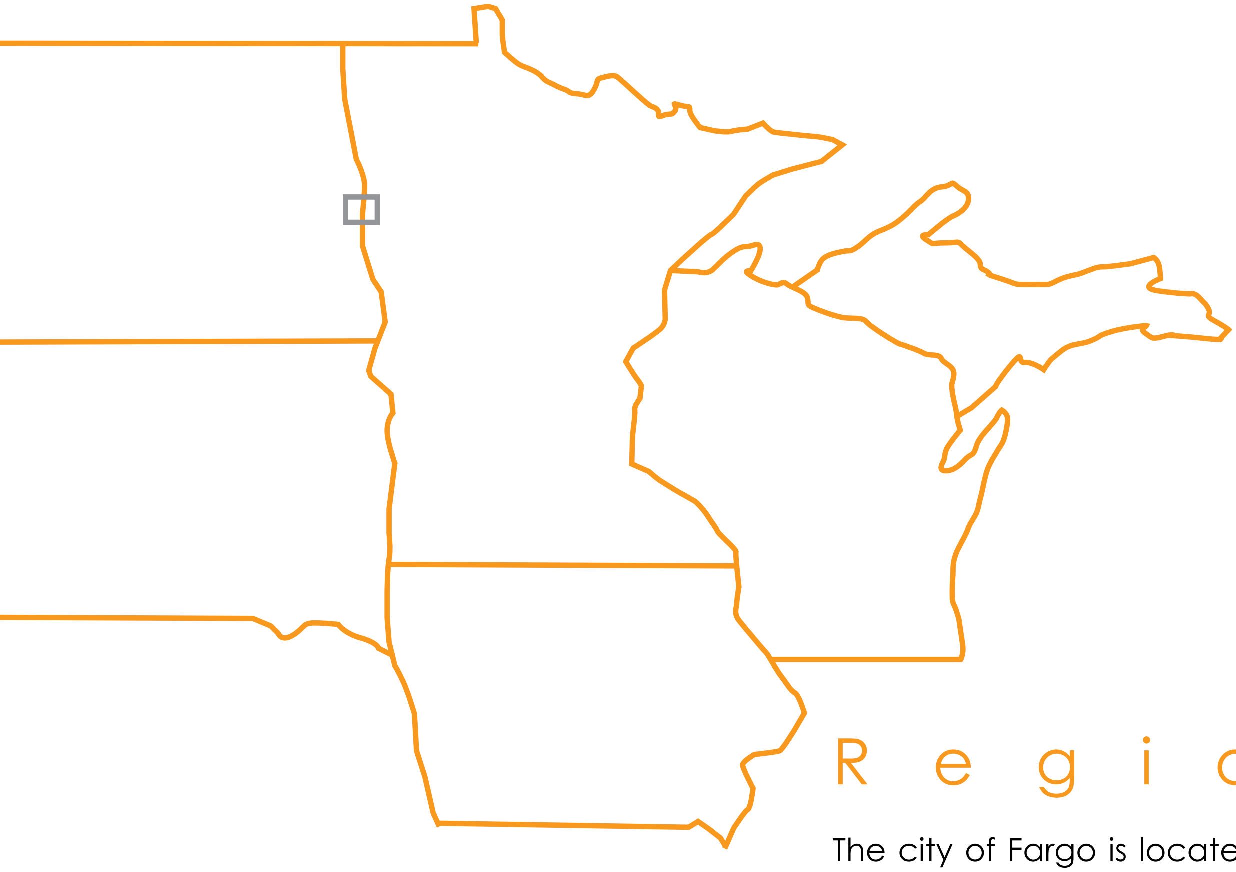
Laboratory

A large lab will supply scientists, engineers, and technicians with the space needed to conduct environmental experimentations. The lab will be an area where a group of people come together to explore new ways to integrate architecture into the ecology and vice versa. Experts from the scientific and engineering professions will provide the facility with the knowledge needed to produce useful results for the building industry. Soil, water, and air quality samples will be handled on a daily basis so there must be substantial storage space within close proximity to the labs.

SITE **INFORMATION**

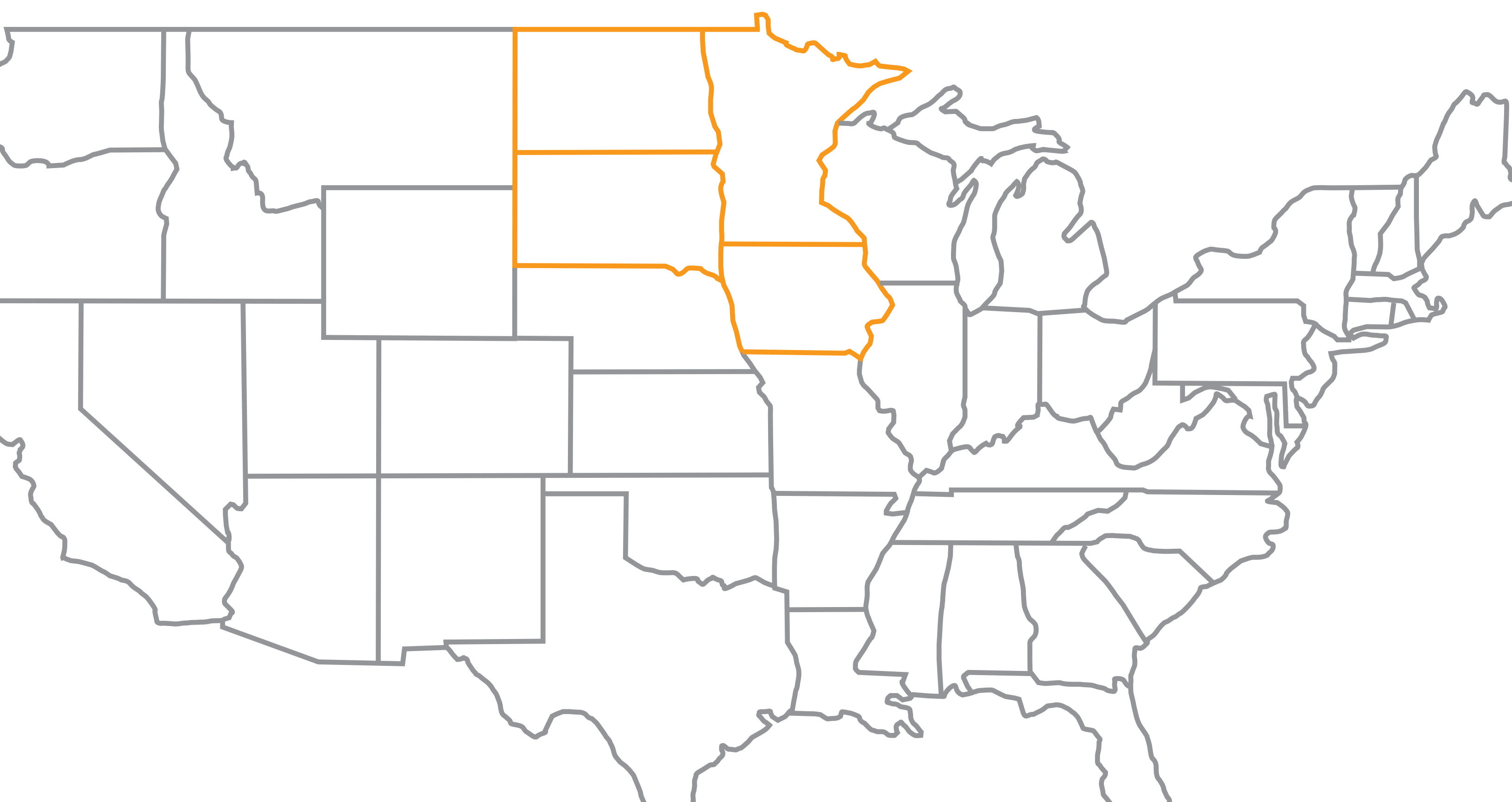
Fargo, North Dakota is located within the fertile farmlands of the Red River Valley. Having the largest population in North Dakota, Fargo is the major economic, commercial, transformational, and industrial hub of the state. The city is a central node, within the context of the United States, for transcontinental shipping. Fargo not only has two major interstates, I-29 and I-94, intersecting at its nucleus, but it also has the Hector International Airport and the Northern Pacific Railroad to export and import goods into and out of the city. These modes of transportation play a large role in the shipping of Fargo's agricultural products throughout the country.

fig. 1.10



R e g i o n a l

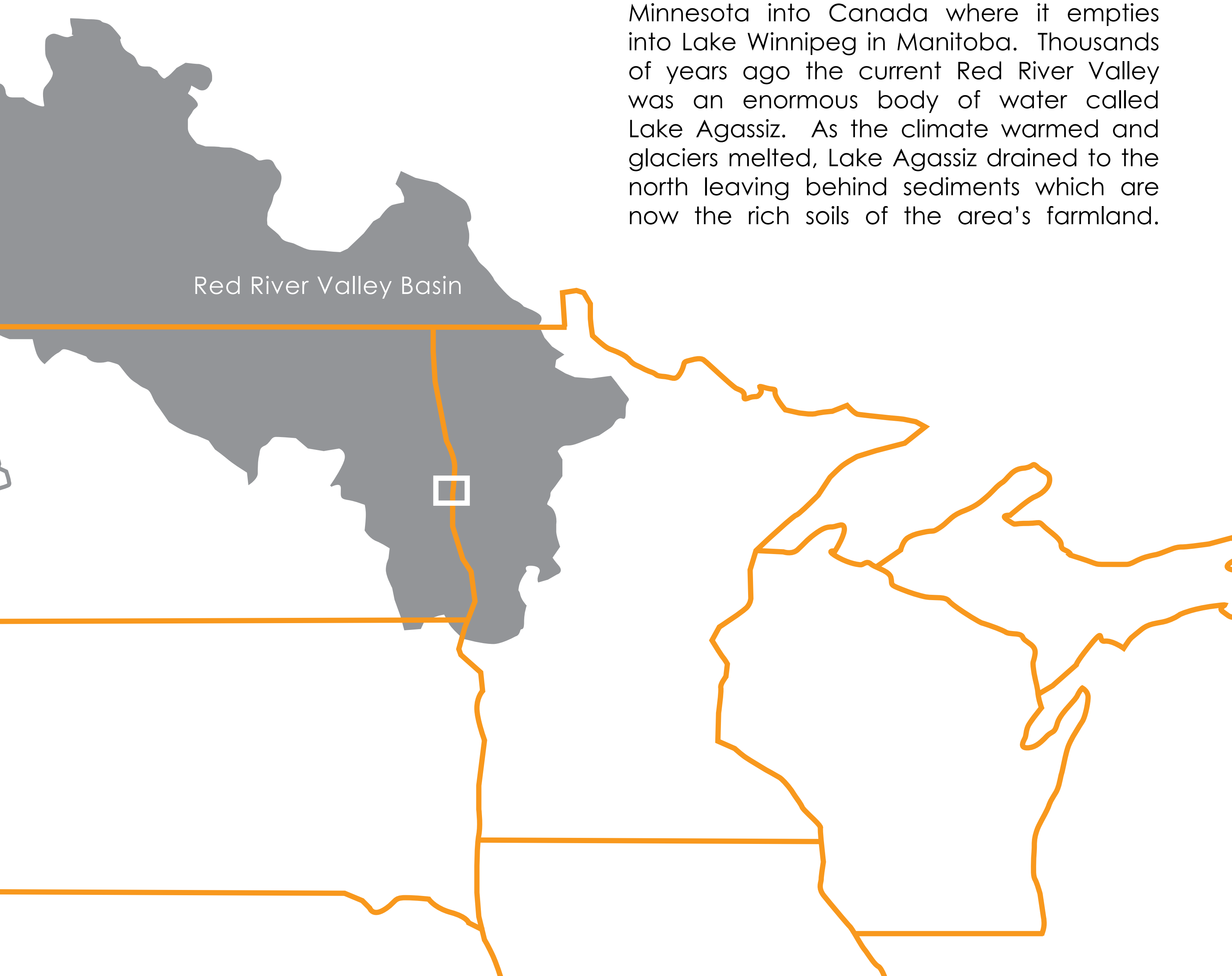
The city of Fargo is located on the border of North Dakota and Minnesota. Surrounded by cropland, the city is deeply rooted in the region's agricultural history. Because of Fargo's agricultural fertility, farming is a large contributor to the region's economy.



Red River Valley

An ecological facility cannot be built in Fargo without knowing the history of the area's dominant ecological element, the Red River.

The Red River Valley Basin is known for its rich, fertile farmland and the problematic annual flooding of the Red River. Separating the cities of Fargo, North Dakota and Moorhead, Minnesota, the Red River establishes the North Dakota / Minnesota border. The Red River of the North lies within the Red River Valley Basin. Uniquely flowing from south to north, the river begins in Breckenridge, Minnesota by combining the Bois de Sioux and the Otter Tail Rivers and meanders 190 miles through the plains of North Dakota and Minnesota into Canada where it empties into Lake Winnipeg in Manitoba. Thousands of years ago the current Red River Valley was an enormous body of water called Lake Agassiz. As the climate warmed and glaciers melted, Lake Agassiz drained to the north leaving behind sediments which are now the rich soils of the area's farmland.



M a c r o

The proposed site is located on the southern edge of Fargo. Located within the city's rural-urban interface, the site will most likely be consumed by the rapid growth of the city. Approximately a ten minute drive north-east will bring you to downtown Fargo, the city's center. Standing at the site one can experience both the rural farmland and urban, single family housing. This makes for an excellent location to house the EERCSD, to study the effects the urban environment imposes on the rural landscape.

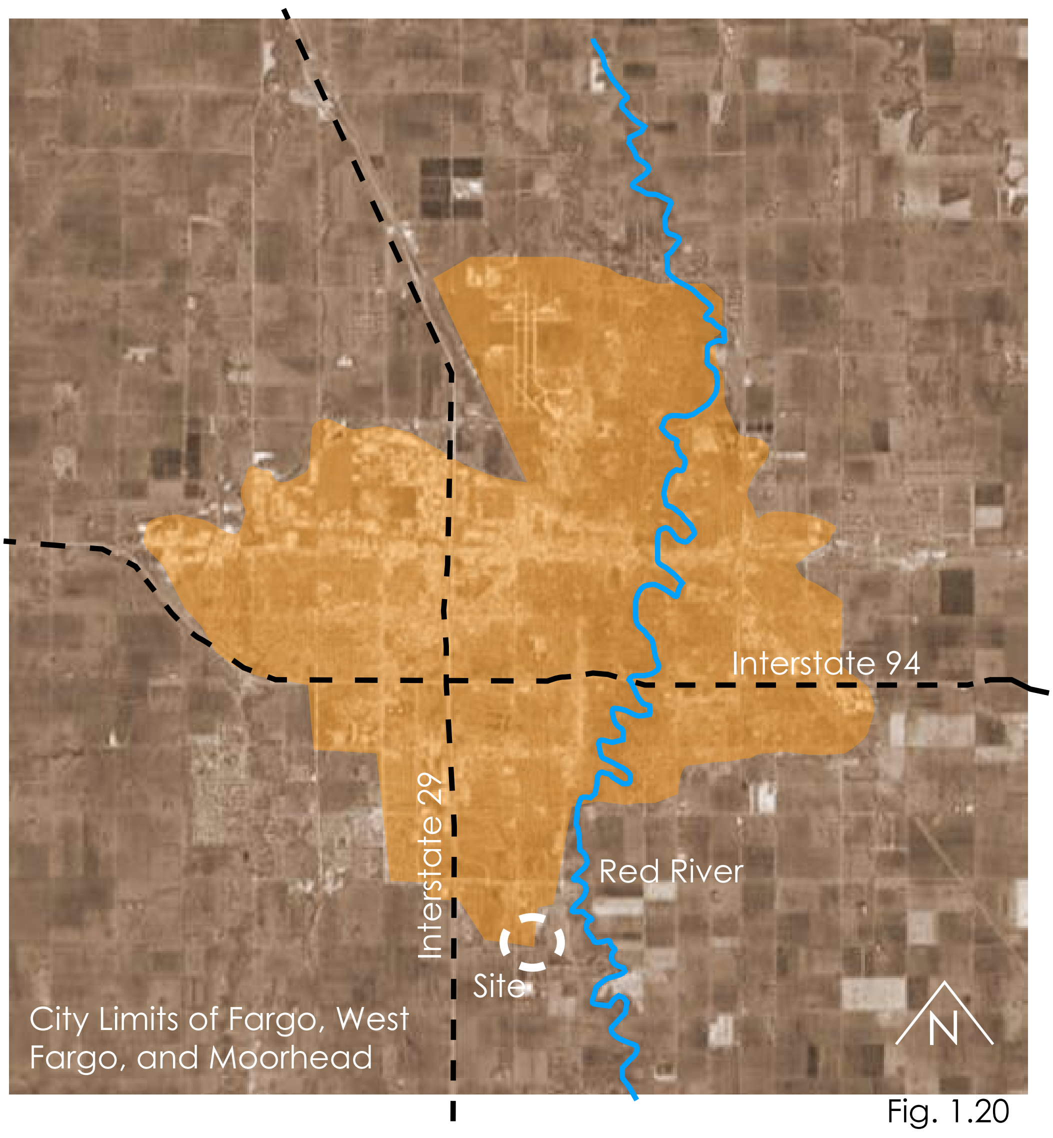


Fig. 1.20

M i c r o

The chosen site lies at 46°47’24.15” north latitude and 96°48’41.34” west longitude. The site is accessed by traveling south on either University Drive South or 25th Ave. South. The proposed site is .40 miles west of University Drive on 64th Ave South, and is the exact same distance east of 25th Ave. South. Due to the undeveloped rural landscape, admittance from the south is currently non-existent. Evidence of urban growth surrounds the site with Fargo presently installing utilities for future developments. After witnessing the installation of these utilities I knew this had to be the site as it lies within the rural-urban fringe.

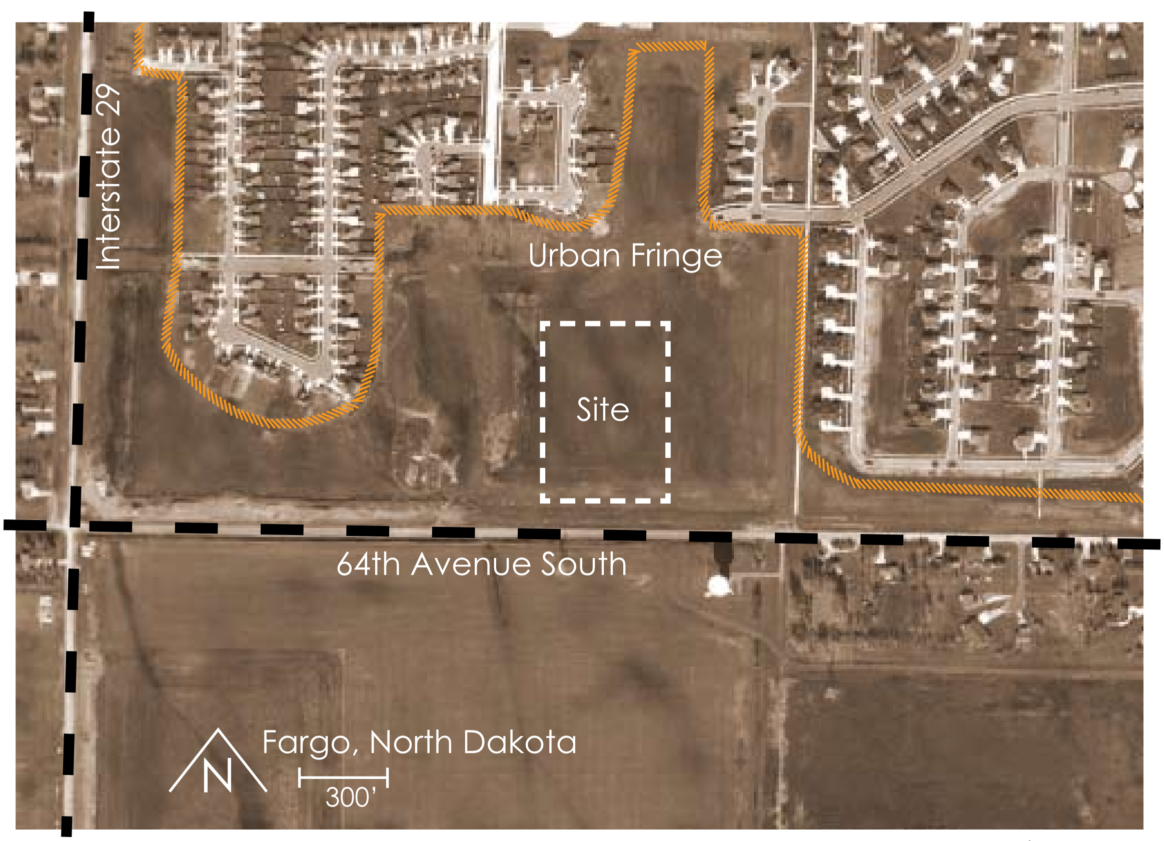


Fig. 1.21

PROJECT **EMPHASIS**

This project emphasis will be on how architecture engages our ecology and attempts to distinguish the boundaries of environments. Studying the history of how civilization has encroached upon the natural landscape will be the catalyst for my analysis. An importance will be given to how the built form created an unpleasant threshold at the city's edge and by what means boundaries begin to dissolve with the application of site sensitive, adaptive, ecological architecture.

PLAN FOR PROCEEDING

Research Direction

Site Analysis

An extensive examination of the site will be conducted. Areas of study within the site analysis will be:

History of Site
Soil Condition
Vegetation and Wildlife
Wind
Precipitation

Project Typology

Case studies will be conducted studying typologies relating to Ecology and Cultural Education Centers. Considering projects that have integrated themselves within a site in a particular manner will be of importance for all case studies. Examining facilities in different climates and locations will provide insight into a universal style of programming and spatial configuration. This area of study will include Programming Requirements, informing what the possible programmatic elements will be for the facility.

Theoretical Premise / Unifying Idea

I will assess why and how cities creep into the surrounding environments and how urban centers have dealt with the population growth at certain periods in time. Researching the effects urban sprawl has on a native habitat will be pertinent to the typology of this facility. An examination into how Fargo's city limits have transformed may offer a circumstantial result on how Fargo may one day encompass all the land surrounding the EERCSD's site. I will also investigate the perception of how space can affect the memory and how one may perceive boundaries.

History

History will be the catalyst of all areas of research. Examining the past, present, and future of the site will provide a suitable understanding and context to the project. History is the tool used to determine what are successful practices and what aren't.

Design Methodology

A mixture of qualitative and quantitative research methods will provide the necessary data to support the Theoretical Premise/ Unifying Idea throughout the research and design process. Collecting data in a qualitative and quantitative fashion will drive this project in the proper direction.

The qualitative research approach will be conducive to asking questions which pertain to the subject of ecological architecture and then, to gathering data to support a conclusion. The quantitative method will stabilize the research and overall project, providing numerical data to support ideas and execute decision-making.

Integrating data throughout the project will provide the proper information to understand all aspects of the project. Presenting the data in a simple, understandable, and coherent manner will enrich all aspects of the project.

Design Documentation

Documentation throughout the research process and design will be conducted in appropriate ways. Digital documentation of site visits, parti modeling, and conceptual sketching will give a simple and accessible way for those wanting to examine the work done throughout this thesis. Collecting and organizing the documentation on a weekly basis will supply the project with a comprehensive, systematic result in the end. Collecting the documentation on a weekly basis will also treat all pieces of the project as an important asset.

PREVIOUS **STUDIO** WORK

2nd Year

Fall 2006
Professor: Stephen Wischer

+ Tea House
+ Row House
+ House for Twins

Spring 2007
Professor: Mike Christenson

+ Eladio De Este Residence
+ Community Courtyard

3rd Year

Fall 2007
Professor: Steve Martens

+ Fox Research Center
+ Mason's Guild

Spring 2008
Professor: Ronald Ramsay

+ Shaker Community Auditorium
+ Chicago Mid-Rise Housing

4th Year

Fall 2009
Professor: Darryl Booker

+ Transbay Terminal Highrise

Spring 2010
Professor: Mike Christenson,
David Crutchfield

+ Urban Design:Median Redesign

5th Year

Fall 2010
Professor: Mark Barnhouse

+ Water Research Facility

Theoretical Premise/Unifying Idea

R e s e a r c h

From the countryside urbanity may be perceived as stagnant, too far away and complex to conceptualize the hustle and bustle of "city life." Looking out from a tenth story office building the countryside may be perceived as endless. Sim Van der Ryn wrote in his book, Design for Life, "Virtually everything we perceive as fixed is actually in a state of flow and change" (Van der Ryn, pg. 151). The urban and rural environments are so vastly different that in some instances they may be perceived as disconnected. What is intriguing about these dual forces is where they begin to intermingle, the rural-urban fringe. Seen as a stage, the rural-urban boundary becomes the common ground where these two environments begin to dance. In order to comprehensively understand how these opposing environments engage one another ,this research will focus on the topics of urban sprawl, urban gradient, fragmentation of the landscape, and the perception of the rural-urban interface. Concluding this research will be ideas of how this study can integrate architecture and the natural environment in a way to soften the edges of the rural-urban fringe.

Cities are now being forced to expand their limits in order to combat the issue of over-crowding and affordable housing. In order to integrate architecture within the landscape and preserve nature for future generations there must be an understanding of the forces we as a civilization have imposed upon our environments. The rural-urban periphery is a complex belt of land and in some instances can be extremely hard to identify. In the following section dedicated to case studies, I explore the rural-urban interface of Phoenix, Arizona and find it is unfortunately easily distinguishable.

Native habitats provide architecture with sites, resources, and materials only to become the potential victims of urban sprawl. Urban congestion has caused many families and businesses to flee urbanity for suburbia in search of cleaner air, quieter neighborhoods, and sufficient living, working, and playing space. It was inevitable; in order for cities to grow the surrounding land had to be developed to accommodate society's needs. In order to preserve native habitats for future generations, architecture must sensitively integrate itself into the ecology creating a harmonious gradient between the built and natural environments.

Cities are centralized entities within our society, alluring people because of well-established governmental, educational, commercial, transportation, or entertainment purposes. These urbanized nodes have been spatially tested by society developing a density uncomfortable for some inhabitants. City planners along with developers and architects have combated "urban density" with "urban sprawl." Urban sprawl is defined by the *American Heritage Dictionary* as "the gradual spreading of urban dwellings, businesses, and industry to the relatively unexploited land adjoining the urban area" ("Urban Sprawl," pg.1). Using the native landscape as a "blank canvas," developers construct neighborhoods, educational institutions, and commercial enterprises at the city's edge to combat urban density. Leaking urbanity into the natural landscape via the urban corridors, cities have readjusted the urban belt thus destroying native species in the undeveloped landscape. I agree with what David Orr writes in his book *The Nature of design: ecology, culture, and human intention*, "ecological design is the careful meshing of human purposes with the larger patterns and flows of the natural world and the study of those patterns and flows to inform human actions" (David, pg. 20). Employing this approach to the occurrence of urban sprawl may integrate the rural-urban environments.

Urban sprawl not only transitions city limits and boundaries, it also eliminates native plant species, relocates animal species, and removes rich topsoil from native habitats. Native plant and animal species are critical to the character of environments, being key elements in identifying regions of the ecosystem. Once lost to clear cutting during initial site development the intrinsic vegetation and forestry of a site may take years or even decades to fully regenerate. In his work, *Urbanization, Biodiversity, and Conservation*, Michael McKinney states that "urbanization endangers more species in the continental United States than another human activity" (McKinney, pg.883). Christopher Lepczyk also alludes to the environmental dangers of urban sprawl in the article, "Spatiotemporal dynamics of housing growth hotspots in the North Central U.S. from 1940 to 2000", saying "ecologically, housing growth, both in the form of suburban and rural sprawl, has been identified as on the major threats to ecosystems, due to its effects on water quality, land use, forest management, wildlife populations, biodiversity, endangered species, and habitat loss" (Christopher, pg.941). The repercussions of urbanization, in some cases, have become detrimental to the ecology and many government agencies have passed laws to make sure future generations have natural, native, undeveloped environments.

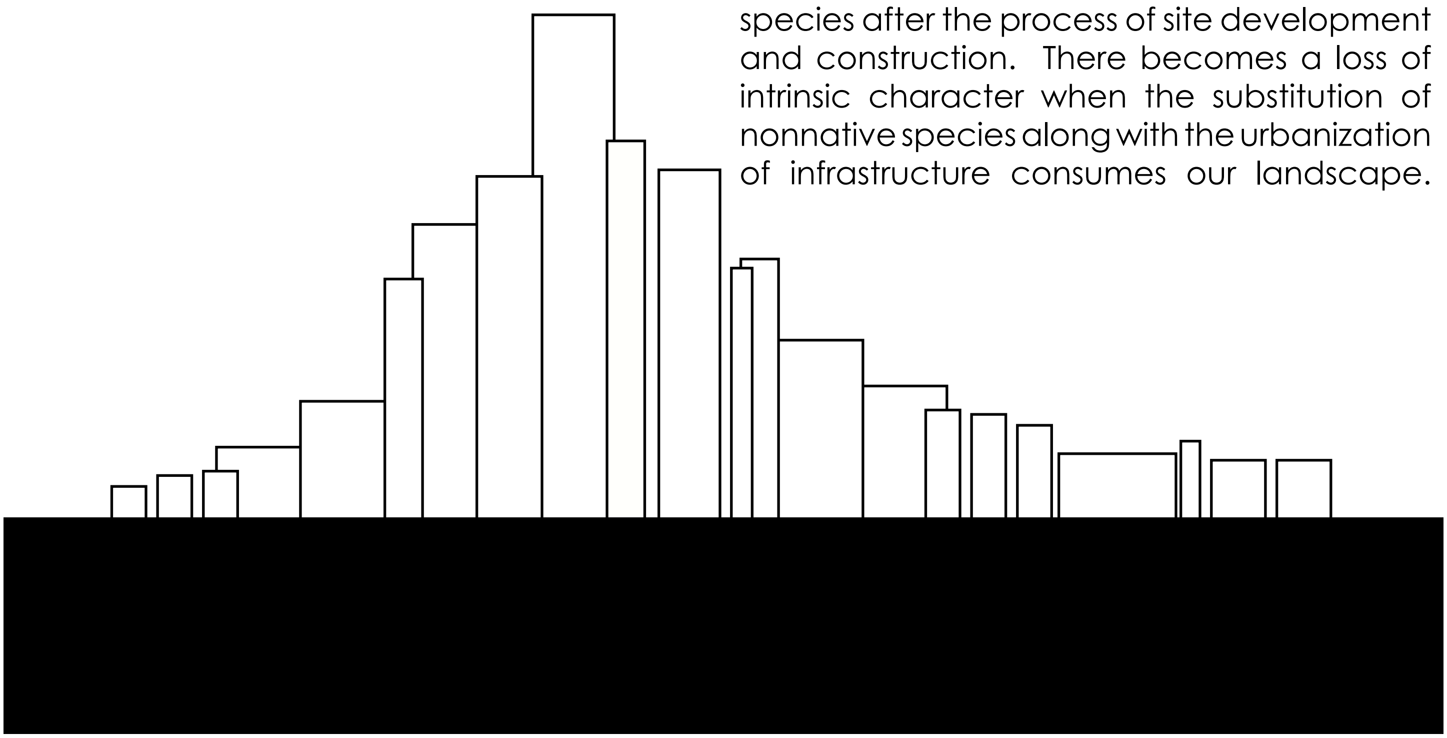
In reaction to urbanization the term "Wildland-Urban Interface" (WUI) was created and defined as "the area where houses meet or intermingle with undeveloped wildland vegetation" (Randeloff, pg.799). To be more specific, in the article titled "Land-Use Dynamics beyond the American Urban Fringe, David Theobald suggests that the urban-rural interface is the "area within 5-50 miles of a city that has scattered, low-density development and fewer than 500 people per square mile" (Theobald, pg.545).

The numeric values Theobald assigns to the WUI are somewhat arbitrary because of the growth rate of urban environments and complexities to the WUI.

McKinney also writes about the WUI in his article "Urbanization, Biodiversity, and Conservation," and says "the pervasiveness of the WUI highlights the value of protected areas, and the need to quickly identify and secure priority sites for conservation in the face of strong development pressure in rural areas" (McKinney, 2002). Even with the assistance of high definition satellite imagery it can be difficult and sometimes impossible to definitively locate the WUI. With the advancements in technology and machinery the construction process is being completed faster than ever before, making it quicker and easier to assemble buildings, transform native landscapes and relocate the WUI. As in Fargo, North Dakota, the WUI is such an abrupt terminated gesture that it leaves no protection to the outermost buildings of a city.

Through the research of urban sprawl I have developed my own theory relating to the rural-urban interface. My theory of why the WUI has such strict and abrupt edges, especially in Fargo, dates back to the origin of land surveying. In response to what Thomas Jefferson believed to be a difficult and confusing surveying system he implemented his own system of mapping the United States landscape, now referred to as the Jefferson Grid. Jefferson's grid divided plots of land into 1-square-mile increments with each square composed of 640 acres. The Jeffersonian Grid was used in the planning of Fargo, and as you will see in the following section of case studies, the city of Phoenix is the same way, along with many other American cities and the surrounding country side. Due to the dominantly rigid rectilinear shape of the Jeffersonian Grid the WUI around Fargo creates sudden, awkward edges where the built form terminates and the rural farmland begins. The rigid nature of Jefferson's gridded system becomes exaggerated in agricultural parts of the country due to contrasting colors and textures. Architecture has created boundaries dividing urban and rural environments, and it now must create a gradient to transition from one environment to another.

Imagining a city as a staircase, the urban core where the tall skyscrapers and office buildings are commonly located is the highest step. Traveling away from the city center to the suburbs and eventually to the native landscape, you visually encounter the stepping-down effect of a city as buildings physically descend in height. Figure 5.5 helps demonstrates this. Architecture must establish a gradient through a city using architectural form assisted by native vegetation. I believe a gradient in this manner may dissolve the abrupt edge felt at the city limits and provide a much more acceptable experience as one travels through a city. This urban gradient isn't only experienced by the heights of buildings but also the use of native plant species throughout the urban environment. The application of native plant and vegetation is paramount to obtain the original characteristics of a natural habitat. McKinney says in his article, "nonnative plant species become proportionately more common towards the urban core, going from less than a few percent in rural areas to over 50 percent at the urban core" (McKinney, pg.888). Introducing nonnative plant species will greatly affect the insect and small animal populations but may also welcome nonnative animal species to the area. Nonnative species are more likely to replace native species after the process of site development and construction. There becomes a loss of intrinsic character when the substitution of nonnative species along with the urbanization of infrastructure consumes our landscape.



The initial perception, or first impression of a city can come from different modes of transportation, at different paces, during different times of the day and year, and from varying elevations. Alberto Perez-Gomez writes about the perception of a city in his book *Questions of Perception*, syaing "the old condition of linear perspective with its vanishing points and horizon line, disappear behind us as modern urban life presents multiple horizons, hovering horizons, and multiple vanishing points" (Perez-Gomez,2006 pg. 48). The most common initial perception of a city is from a vehicle traveling along a predetermined path at a governed speed. As you approach city limits a threshold, a rural-urban interface, will likely be experienced as the vehicle transitions from the rural to urban environment. The perception of a city is always fragmented. Because of the scale of cities, the experience of the entire urban environment is perceived through individual snapshots stored and arranged in the memory in a way that can be retrieved in order to fully understand the city as a whole.

Boundaries are frequently associated with lines, indicating limits or borders and are generally understood through maps. Lines on a map define plots of land and edges of territories. These lines relate to geographical coordinates represented by locations within the physical landscape. Boundary lines illustrated on a map are not physically present in nature but they can be perceived by natural land formations such as rivers, lakes, and mountains. The Red River resembles the North Dakota/ Minnesota state line, providing citizens with a perceptible understanding of where the state's border is located. The Minnesota River does the same thing in southeast Minnesota, indicating the Minnesota/Wisconsin border. Even though these elements in our landscape separate states and countries, they don't necessarily separate the characteristics of environments and experiential qualities.

Boundaries have been created by our given landscape, destroyed by architecture, and re-created by the built form. Rivers, lakes, mountains, or even a slight depression can be recognized as an entity of our landscape that divides plots of land and creates an area of separation without a change in perceivable characteristics.

This means that you could drive across a bridge that spans the Red River and without prior knowledge or proper signage you may not even know you had entered another state therefore, the line indicating a different state doesn't indicate a different environment. Natural land forms that create boundaries seldom divide environments' character qualities. Man-made elements also divide the landscape. Roads, buildings, utilities, and neighborhoods are built forms that fragment sections of land and disconnect habitats. The fragmentation of environments is a serious problem concerning the habitats of local animal and plant species. Dividing the land by means of roadways and utilities alters soil composition by changing drainage patterns. Drainage is also affected by the introduction of concrete and non-porous pavements. Restricting rainwater to access the native soils can cause overland flooding due to the amount of non-pervious horizontal surfaces eventually leading to the extinction of vegetation and plant life. Man-made environments commonly fragment rural areas, dividing organic characteristics of pristine environments. Areas of fragmentation occur away from city limits and are connected by the exact element that begins fragmentation, transportation arteries.

Eco, the root of ecology, is derived from the Greek word "oikos" meaning house. The native landscape surrounding Fargo is the community's ecology; hence, it's our house. While the city is dispersing into the farmland surrounding Fargo, the house in which we live is becoming dismantled. The environmental impacts of urban sprawl may be solved by the application of ecological design. Sim Van der Ryn defines ecological design in his book, *Ecological Design*, as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes" (Van der Ryn, 1996 pg.x). Ecological design solves many environmental problems by the simple employment of passive architectural systems integrated into the built form. Rainwater harvesting, site orientation, site integration, the use of solar gain, and seasonal winds are all methods used to reduse the environmental impact architecture has on the landscape. With urban sprawl reaching out into the landscape, architecture must begin to re-think the city's ecological footprint and preserve as much native landscape as possible for the future. Ecological design can educate the public while blurring the boundaries of the built and natural environment.

CASE STUDIES

Aldo Leopold Legacy Center

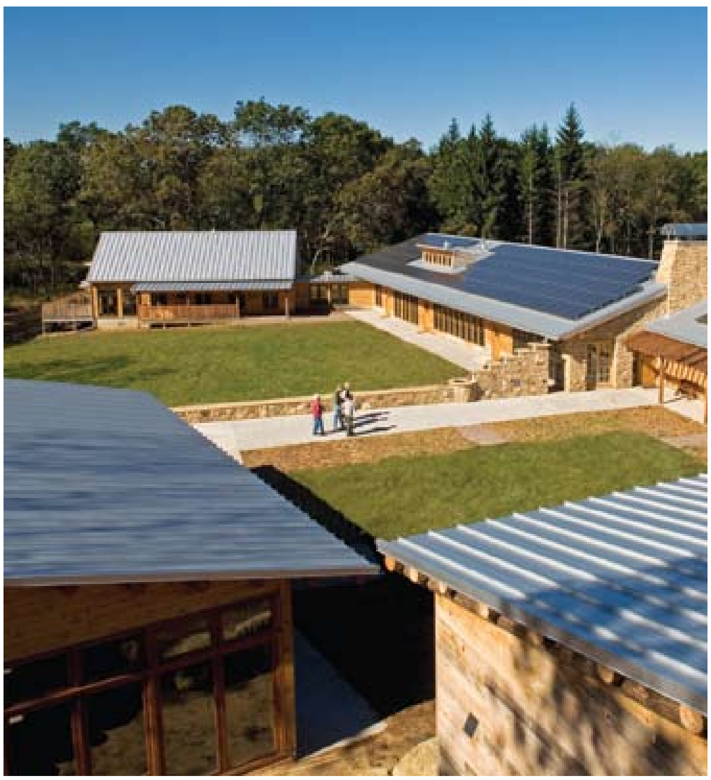


Fig. 1.30

The Aldo Leopold Legacy Center was designed by Kubala Washatko Architects. The 12,000 square foot complex is located in Baraboo, Wisconsin.

The Leopold Center is a unique center because of its very obvious decision by the architect to design it as a group of buildings and not one single structure housing all the parts of architecture. An intensively environmental approach to all aspects of the project is brought out in the design of even the smallest details. Working as an integrated living machine within its surrounding ecology, the Legacy Center evolves ecological design to a whole new level. The facility balances the sense of nature and built form with its interior and exterior use of local materials. The Legacy Center is a real environmental achievement throughout every level of design, from the orientation on the site, to the building's footprint, and locally harvested materials; this facility fully encompasses all aspects of the local environment.

Existing Programmatic Elements:

Auditorium
Workshop
Gallery Space
Staff Area
Offices
Central Courtyard

Site Analysis

Because of the stance the Legacy Center takes on ecological importance it is appropriate to examine the relationship of the natural and built environments. What struck me as an interesting idea by the architects, and this can be seen in the site plan, is how the building is tucked back into a wooded area. Acting as a hand, the wooded environment wraps itself around the complex, protecting it from the sometimes harsh Wisconsin climate. To the immediate south of the Leopold Center lies a pond, offering a healthy environment for wetland species. The site is relatively flat with gentle sloping contours toward the pond. Parking is to the northeast of the facility, forcing visitors to engage the site's ecology. Pedestrian walking paths weave through the wooded areas, again forcing the public to mesh with the native environment.

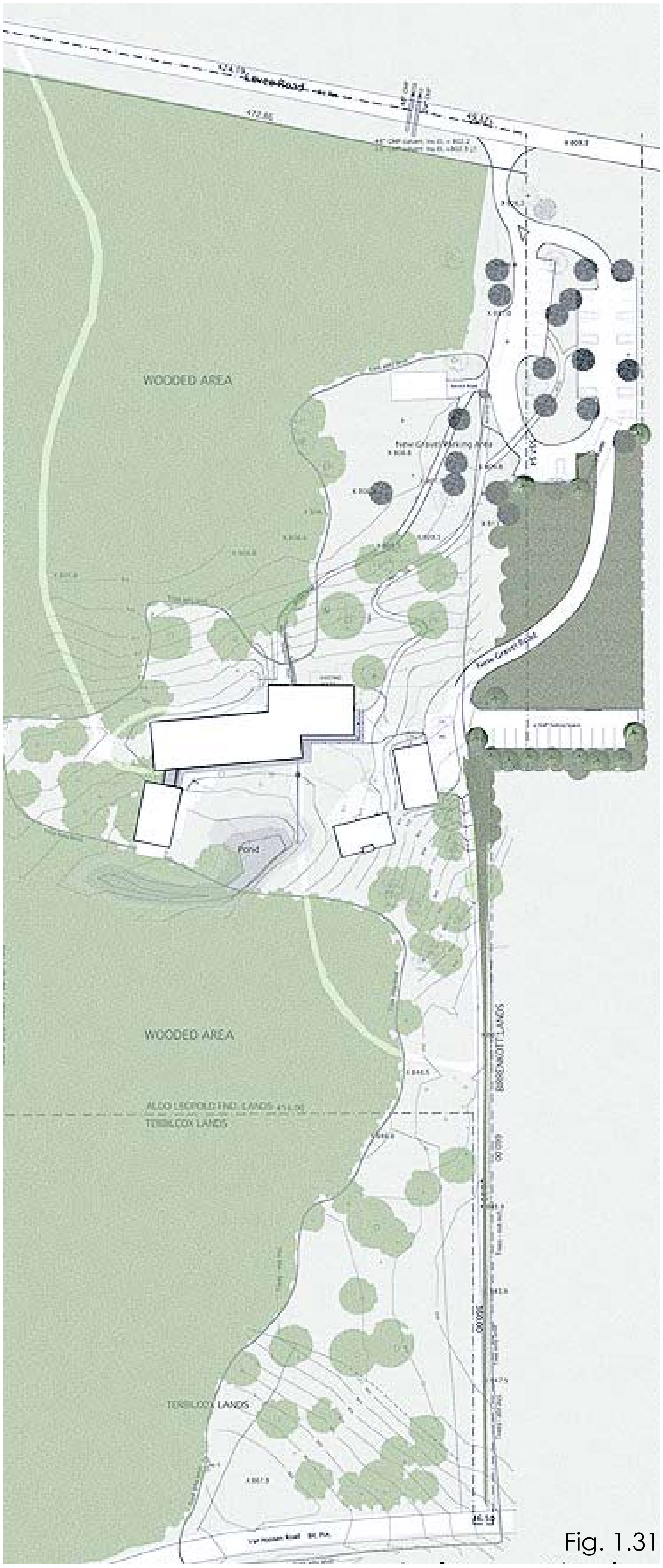


Fig. 1.31

G e o m e t r y

The Legacy Center is an example of how mass can design void. The built-form of this facility creates a protected environment defining the courtyards. The Legacy Center is comprised of five primary spaces, three of which are entirely separate from one-another, shown in the diagram below. In the analysis of Legacy Center's building arrangement, I used a layering method to show the five built spaces and how they created the "L's." These five spaces, in plan, create three "L" shapes further creating two separate exterior courtyards. The two larger "L's," colored red, are generally south-facing, essentially creating a "horse shoe" containing the courtyards.

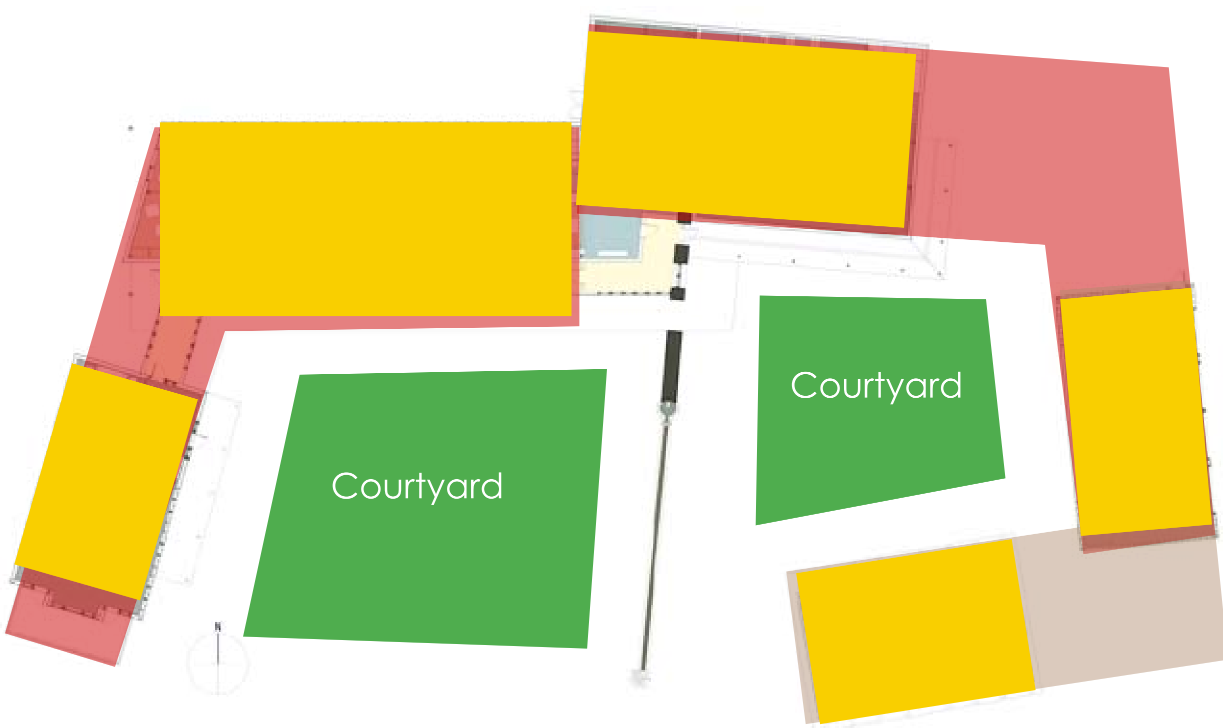


Fig. 1.32

Structure

The super structure of the Aldo Leopold Legacy Center is constructed from large, cylindrical, site-harvested timbers assembled in the traditional post-and-beam system. An ecologically sensitive and structurally responsible decision was made by the architect when it came to the primary structural system. Small dimensional logs, measuring 6 to 8 inches in diameter, were kept to their native round state as they were used for the posts, beams, and trusses throughout all buildings of the complex. In deciding to use the logs in their native condition, the sapwood, being the strongest part of the logs, was preserved, maintaining the structural integrity of the logs. The structure of the post-and-beam system is exposed to interior spaces, expressing the raw character of the site-harvested timber. Heavy stone foundation walls provide additional structure where needed. Locally harvested lumber was not only used throughout the entire structural system but aesthetically as well, providing interior spaces with the mixture of warm wood, and cold, stone materials.

Natural Light

The design of the Legacy Center has taken full advantage of the sun. It is clear by simply looking at the buildings of the complex that the use of solar gain contributed a substantial role to the overall design. Daylighting plays an integral role in the passive systems of the Legacy Center. The Legacy Center benefits from bringing in natural light with the reduction of needing to use artificial luminaries, there by cutting down on the electricity consumed. The larger building of the complex faces due south, providing the building with the maximum amount of natural light. The implementation of clerestory windows brings indirect daylight into the buildings, eliminating the glare of direct daylighting and additionally reducing the need for artificial illumination.

Circulation Space

The circulation space throughout the complex is located on the south facing side. This space acts as a thermal flux zone becoming a thermostat for interior spaces.

Hierarchy

There is a sense of hierarchy as a person enters the grounds of the Leopold Center. From the south a long retaining wall grows up from grade. The wall becomes one with a rainwater collection cistern, and then further builds itself up to the stacked stone chimney. Creating a linear progression into the main entrance of the facility, the stacked stone wall wraps itself around the door. The natural locally-harvested stone used in the construction of the wall creates a hierarchy between materials. Contrasting with the background of oak and ash boards cladding the exterior of the main building of the center, the stone offers a rigid texture to the façade.

E n v i r o n m e n t a l l y

Environmentally, this case study is pertinent at almost every level of my thesis, from site orientation to materials chosen and spatial configuration. The buildings were orientated in a way which would be ecologically sensitive to its surroundings. Keeping the footprint of the Leopold Center as small as possible allows the remainder of the site to be restored to its native state. Prairie, savanna, and wetlands surrounding the buildings deliver an ecologically sensitive environment between the buildings and outlying wooded area.

S o c i a l l y

The Leopold Center has strong social ties to the community of Baraboo. As a common space within the community, the public come to the facility to socialize and become educated on the environmental issues we as humans face in today's world. Both private and public events are held here, providing the community with a healthy environment to hold gatherings. The open floor plan and multi-use spaces leaves no restrictions to the community on what activities can be held within the facility.

E c o n o m i c a l l y

Economically, the Leopold Center offers itself to the surrounding energy companies as an energy provider. The buildings at the Legacy Center use 70% less energy than a typical building its same size (aldoleopold.com). The Leopold Center generates all of its own energy and even provides the grid with additional energy. With its net-zero energy budget the Leopold Center produces the entire amount of energy it needs on an annual basis.

Urban Ecology Center in Milwaukee


Fig. 1.33

The most obvious reason for studying this piece of architecture is because of its typology, an ecology center, and its relationship to the urban context in which it is located. Most ecology centers are set within a natural environment but this center has transformed a once-tarnished, urban land into a rehabilitated Ecological Education Center. Designed by Kubala Washatko Architects, the Urban Ecology Center doesn't limit itself to the client's programmatic needs. Not only is it a tool for educating the city's youth, it also facilitates expert research, provides the community with an environmental appreciation, and is an example of sustainable architecture. Relating in a similar fashion to my site, the center acts as a melting pot for the urban environment on its front side and the natural environment of the Riverside Park at its rear.

Existing Programmatic Elements:

Observation Tower
Conference Room
Class Room
Multi-Use Area
Rain Garden
Pond

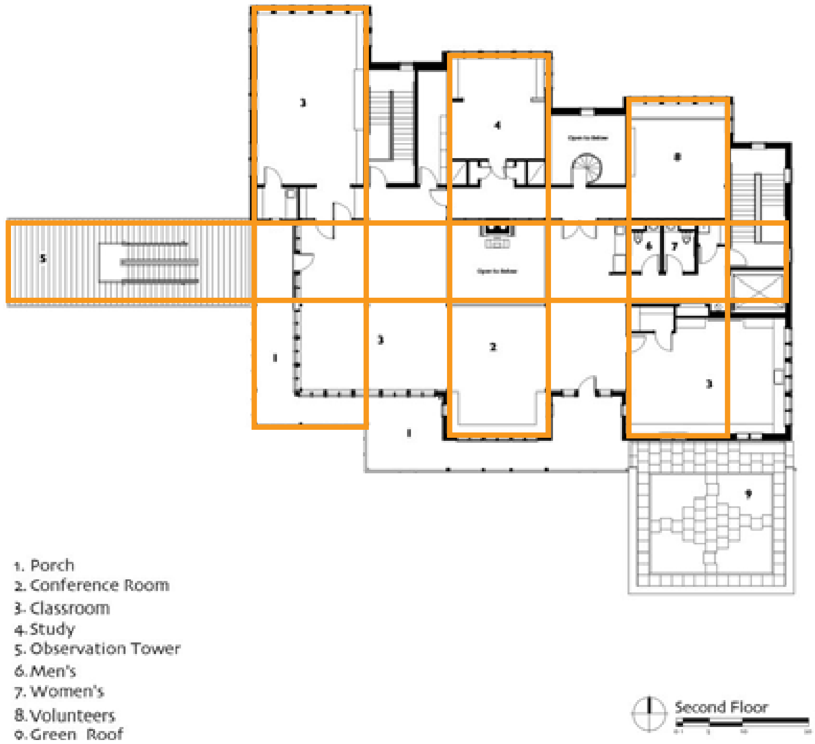


Fig. 1.34

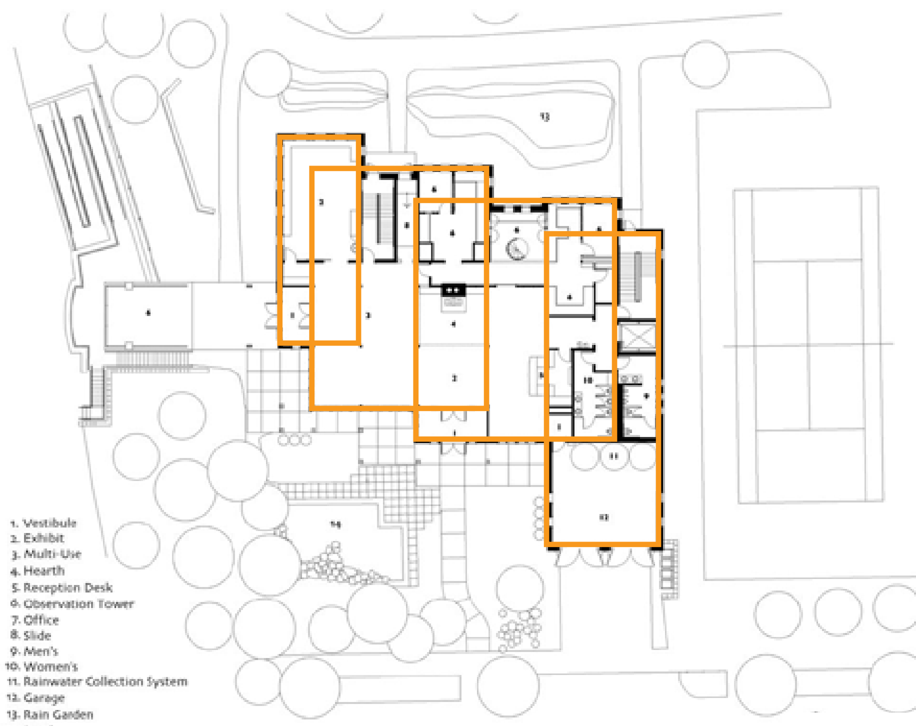


Fig. 1.35

Spatial Relationships

Figure 1.36 on the following page illustrates one of two spatial arrangements I examined for the case study. The Urban Ecology Center's interior spaces are organized in a rectilinear arrangement. In plan, the spaces are comprised of slender rectangles in the north/south cardinal directions. The three north/south spaces are stepped back from one another, creating a form that can be recognized inside and out. The three spaces are intersected by a long space running from the far-east side of the building to the observation tower acting as a bookend on the extreme west side. The intersecting relationship of spaces demonstrates how one might move throughout the spaces, using the intersecting rectangle as an element provoking the sense of pulling from one space to another.

Figure 1.37 at the bottom of the following page is the plan of the first floor, showing how the interior spaces relate to oneanother. Looking at both drawings, the conclusion can be made that the spaces in plan either interconnect or share area with another space; this provides the building with more multi-purpose spaces. The grid which is seen on the south side of the building begins to suggest a rhythm to the layout of the spaces and a scale to the building.

Examining both drawings, one can conclude that there are similarities in the proportioning of spaces throughout the entirety of the building. The proportioning of spaces relates adjacent spaces and, in my opinion, makes the transition of spaces less abrupt and more predictable.

I took the proportioning of the facility's spaces a step further as I was curious to know if the spatial relationship of the floor plan stayed true in elevation. Because of the level of detail of figure 1.36, I am unclear about an exact conclusion that can be drawn between the two illustrations. The imposition of figure 1.36 onto figure 1.37 begins to hint at scale of the spaces.

Fig. 1.36

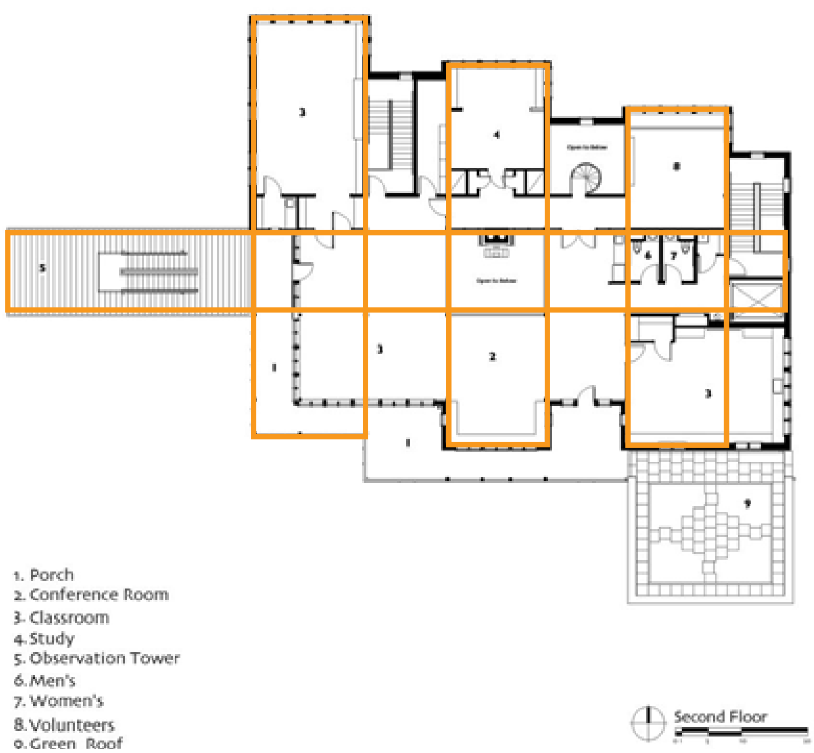


Fig. 1.37

Urban Sprawl in **Phoenix**

The city of Phoenix, Arizona is located in the southwest region of the United States. The state of Arizona was the 48th territory to enter the union and was established on February 12, 1912. Being the fifth-largest city in the United States, Phoenix had a population of 6,500,180 in 2008.

Discovered in 1870, the city of Phoenix began as an agricultural community. Still holding true today, Phoenix has a surprising amount of farmland surrounding its city limits. Phoenix's irrigated cropland can be seen from satellite images and is usually in a concentric shape due to the revolution of irrigation spreaders. After originally discovered, the settlement was incorporated into present-day Phoenix. The city has experienced an extensive growth since its discovery. Expanding dramatically in size from 1970 to the present, Phoenix went from a population of 584,303 in 1970 to 1,499,576 in 2006, more than doubling its population in three decades. The substantial growth in population has effectively brought about growth in the land area of the city. In 1970, Phoenix covered 247.9 square miles and by 2006 the city had leached out into the landscape and covered 516 square miles. The city has doubled in almost every aspect, from traffic-controlled intersections, to miles of streets, and municipal parks (Phoenix growth, 2000).

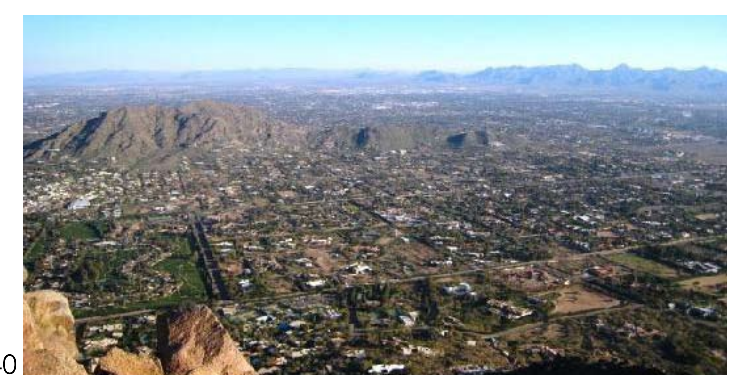


Fig. 1.40

Change in **Boundaries** due to **Urban Sprawl**

1881 . 1920 . 1930

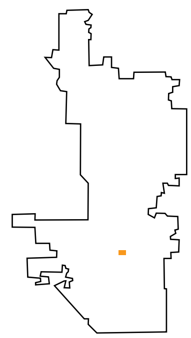


Fig. 1.41

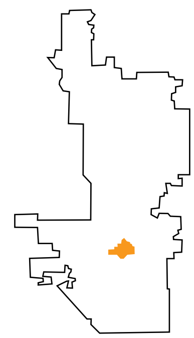


Fig. 1.42

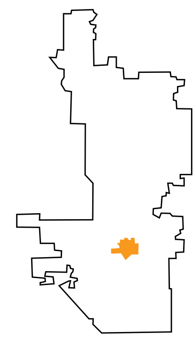


Fig. 1.43

1940 . 1950 . 1960

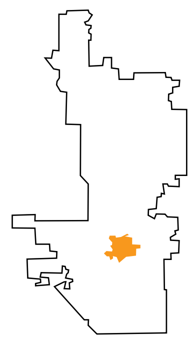


Fig. 1.44

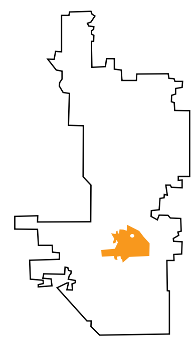


Fig. 1.45

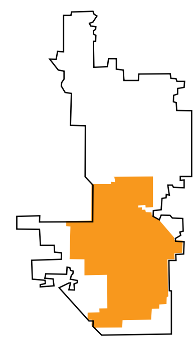


Fig. 1.46

1970 . 1980 . 1990

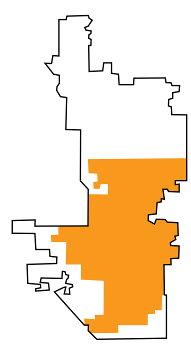


Fig. 1.47

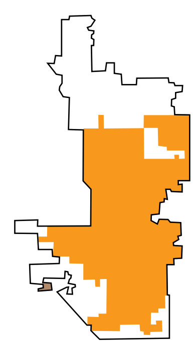


Fig. 1.48

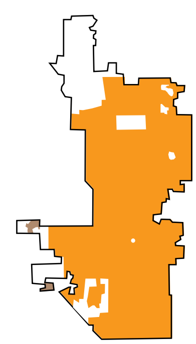


Fig. 1.49

2000 . 2005

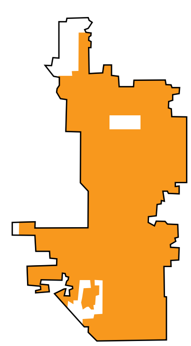


Fig. 1.50

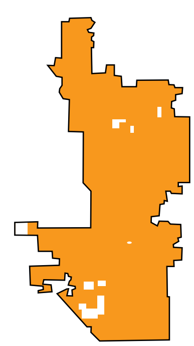


Fig. 1.51

fig. x

Mountains

Areas of Leapfrogging Urban Sprawl

Urban Environment

Major Roadways

As one form of urban sprawl, the act of leapfrogging occurs when a neighborhood is developed away from the city limits, effectively leaving undeveloped land between it and the city's edge. An easy way to imagine "leapfrogging" is to perceive the disconnected neighborhood as an island. Phoenix has experienced its own leapfrogging effect in reaction to its rapid urban growth. Even though this counterproductive act of urban growth is evident in figure x, I believe another factor should be evaluated concerning the growth of Phoenix. The landforms surrounding the city have a great deal to do with where and how the urban sprawl takes place. Seen in the picture below, the city of Phoenix is surrounded by steep mountains and rugged terrain, so in order for Phoenix to grow in land area it must find buildable land away from the city's edge.

Figure 1.70 on the following page is of a four-mile by four-mile square piece of land at Phoenix's eastern edge. This may be the clearest representation I have found demonstrating the abrupt manner of the rural-urban interface. The dense urban infill of the city of Phoenix strictly terminates at arbitrary points within the landscape. This case study, more specifically figure 1.70, is evidence of the theory I develop in the Theoretical Premise / Unifying Idea research. The theory states that the abrupt transition created at city edges is due to the application of the rigid, rectilinear Jeffersonian Grid.

Fig. 1.60

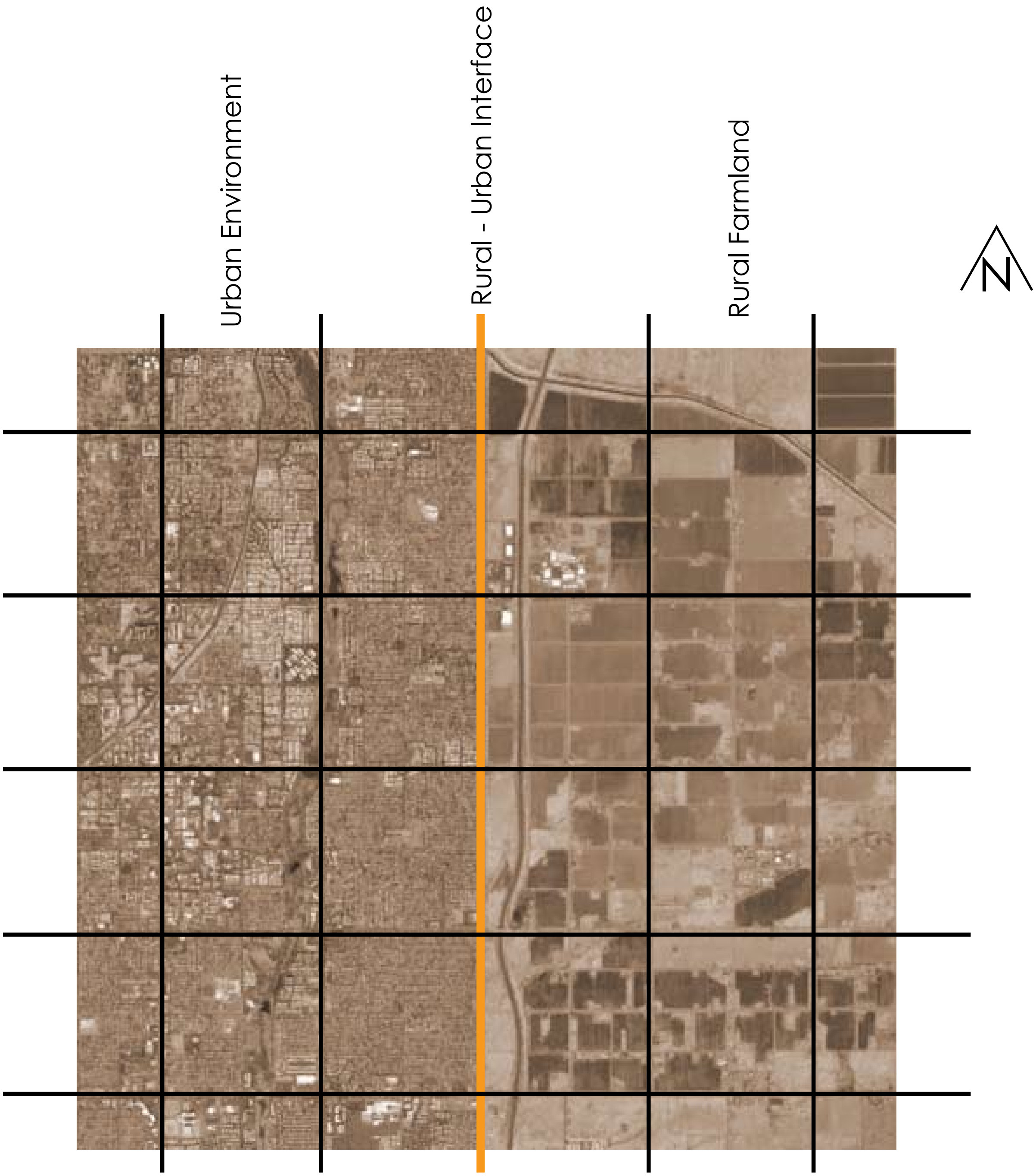


fig. 1.70

Figure 1.71 below is of a piece of land on the southwest side of Phoenix. Demonstrating the fragmentation of land at or near the city's edge, this study illustrates how defined the rural-urban interface sometimes is. Phoenix is an excellent example of fragmentation because of the direct contrast and proximity of the urban environment to the rural farmland. High resolution images clarity what might be misunderstood about the rural-urban interface.

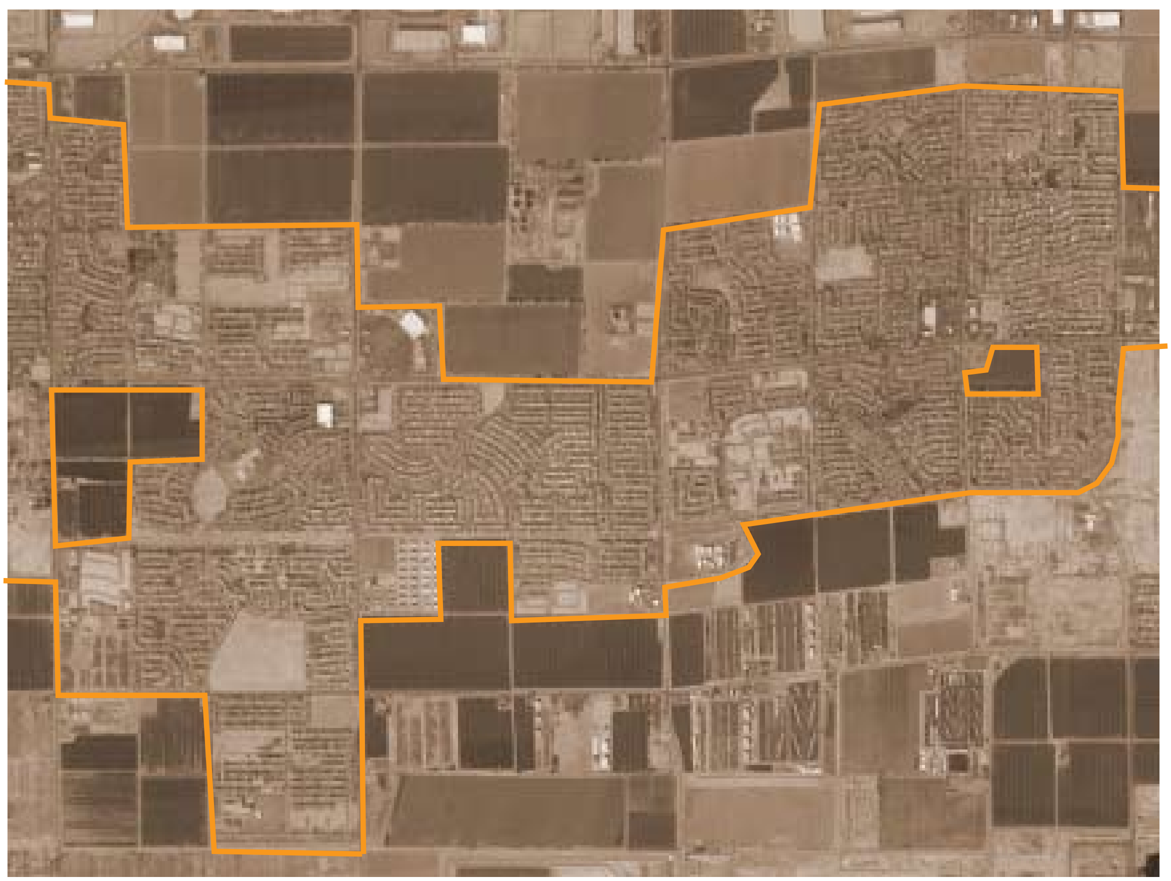


fig. 1.71

Conclusion

The case studies assessed: Aldo Leopold Legacy Center in Baraboo, Wisconsin, the Urban Ecology Center in Milwaukee, Wisconsin, and an urban sprawl study of Phoenix, Arizona all deal with the topics of ecological design or urban sprawl. I approached this set of case studies with an attitude of diversity. Even though the first two case studies concerning ecological education centers are located in Wisconsin, I believe that both environments are completely disconnected in experiential qualities. I believe these case studies were all pertinent to my area of research and the ideas obtained during this process will be carried through to the final product of an ecological education center in Fargo, North Dakota.

These three case studies of the ecological education centers and urban sprawl have provided this thesis with the background needed to move forward in a confident manner. Interior studies of the educational centers lead to an understanding of the spatial relationships and the sizes of spaces need for a facility of this typology. The education centers examined gave contextto what an ecological center can be. The Legacy Center is a complex of buildings arranged on the site in a conservative fashion, while the Urban Ecology Center being a multi-level facility within the tight confines of an urban core. Ecology is an exhaustively complex subject, these two facilities seemed to simplify the field of ecology into an understandable experience for the public. Because of the importance of ecology in this study and the integration of the built and natural forms, a site analysis was conducted for both education centers.

The third case study was closely linked to the Theoretical Premises / Unifying Idea research. I believe the illustration of my theory on the rural-urban interface with connections to the Jeffersonian Grid will be an affective relationship in explaining my developed theory. Phoenix is a unique city in the way it has grown so rapidly but has adapted to the surrounding uninhabitable landscape. Phoenix also has many clear, understandable examples of urbanized phenomena: fragmentation, rural-urban interface, and leapfrogging. The study of Phoenix is also a great example of how a small settlement can turn into a world-class urban environment.

Using the case studies as a reference and a tool for continuing, I will proceed with complete studies of environmental and architecture character throughout my own site and design process. The examination of ecological design and urban sprawl at both micro and macro levels will allow me to understand the full scale of urban sprawl.

HISTORICAL CONTEXT

The state of North Dakota began with the land. The Red River Valley as we know it today was transformed over thousands of years by continuous glacial shifts. As glacial lakes carved and gouged away the geography, Lake Agassiz formed the Red River Valley. According to Elwyn Robinson, in the book *History of North Dakota,* the Red River Valley lies somewhere between 800 and 1000 feet below sea level and slopes gradually north (Robinson, 1966) which is why the river flows to Canada.

The eastern half of North Dakota was settled rather quickly due to the construction of the railroad. North Dakota relied heavily on the introduction of the railroad into the state because of the booming agricultural economy of the early-1800s. The railway system the Northern Pacific installed was a major cause for rapid settlement throughout parts of North Dakota. As the populations of settlements across the territory grew so too did the population of foreign-born people. As Robinson points out, by 1890 foreign-born people comprised 43 percent of the population with the majority of the 43 percent being either from Norway or Canada (Robinson, 1966). During the "boom" years of the early 1800s land was quickly sold to people coming to the area.

The boom years peaked in the mid-1880s, and the area began to see a turn in the population. With the years of prosperity over and populations leveling off, the territory surprisingly still saw an increase in settlement.

fig. 1.80

Another boom time came at the hands of the oil industry. On April1, 1951, the first discovery of oil was made just south of Williston. Oil companies from across the United States had come to North Dakota in search of this black gold and it took 35 years of experimental drilling before an oil company found what everyone had been looking for. As many as 150 oil companies occupied land near Williston in search of oil and, as noted by Robinson, by the late 1960s there had been approximately $650,000,000 invested in the oil fields of North Dakota (Robinson, 1966).

From the 1920s to the 1950s, there was a transition in life style. By 1960, 35 percent of people lived in urban centers. With advancements in technology, the telephone and car began connecting people at distances which had never been experienced.

fig. 1.81

Urban sprawl began with national sprawl, or exploration of the frontier, as surveyors traveled west along with the development of the railroad system. Following the American Revolution in 1776, cities began springing up across the American landscape. Cities were used as centralized points within the landscape to bring products which would then be shipped to Europe and other countries in exchange for finished goods. According to the National Research Council, "more than 95 percent of the population lived in rural areas" (Costs of sprawl, 2002 pg.28), and this was because the majority of the population was self-sufficient, producing its own food. In 1790 the population of the union was around four million and by 1840 the population had grown to 17 million After another 50 years the population had exploded to 63 million. It was a time of tremendous growth for the country and its expanding cities. Prior to the Industrial Revolution, cities began a transformation in identity from exportation hubs to livable urban cores. As said in the report "Cost of Sprawl," "the nation's early patterns of growth had been one of spatial dispersal into undeveloped lands, it now began to shift towards one of growth established in urban areas" (Costs of sprawl, 2002 pg.31). With the industrialization of factories and mills, people moved to developed cities during the Industrial Revolution, to find employment. The cities of Philadelphia, Boston, Baltimore, and Charleston were subject to densely packed housing with cramped corridors for vehicular and pedestrian circulation. Housing in these cities was typically narrow row housing built up to the sidewalk's edge, allowing for no front yard. Because of the location of jobs and living essentials at the city's core it was inconceivable to live at the city's edge.

A desire for better living conditions soon took precendent over proximity to the workplace and a transition in city density occurred from the 1950s to the 1970s. Inhabitants of the inner-city sought refuge in the suburbs, due to the growing urban issues of high crime rates, poor air and sanitation issues, and decrepit housing. Seeking clean air and spacious single family housing, those who could afford to move and travel to the city's edge did so in order to find better living conditions. A large factor in the growth of suburbia was the federal subsidies by the government for returning World War II veterans to obtain inexpensive mortgages on new housing (Costs of sprawl, 2002). Because of the evolution and affordability of the automobile, the public quickly gained access to rural land surrounding cities and began expanding outward from the city centers at an increased pace. With the introduction of zoning into the planning of cities, officials were able to restrict the building of commercial facilities and limit areas to the construction of residential housing. Even though the residents were moving to the outlying suburbs, the inhabitants of suburbia were still directly dependent on the urban core for most activities, including employment and entertainment. The 60s and 70s brought an increased desire by the public to remove themselves from the urban centers. As noted in the Transportation Research Board, the cities of St. Louis, Buffalo, and Detroit lost between 35 and 47 percent of their populations between the years of 1950 and 1980 (Costs of sprawl, 2002). As the National Environmental Policy Act was being passed in 1969, the public began to question the environmental consequences of urban sprawl. Currently, the focus has shifted to the traditional neighborhood development, transport-oriented development, sustainable development, New Urbanism, and smart growth as concepts that encourage the balancing of city growth with the preservation of resources (Costs of sprawl, 2002).

When someone is asked to define the Midwest character he/she will most likely respond by saying, farming. The Midwest region of the United States is closely associated with the helpful, hard-working farmers who cared for one another and have spent their entire lives enduring the struggles of agriculture. The Midwest has never been, with the exception of Chicago, described as an area of sprawling urban metropolis. Instead of being dominated by subways and skyscrapers of business suites ,the Midwest region has eighteen-wheel semis, grain elevators, and dirty jeans. The tradition of rolling up your sleeves and working hard is, I believe, a trait that this region of the United States is extremely proud of.

Agriculture and the rural landscape have seen a substantial decline in population as high school graduates permanently move to urban centers in search of a college education and lucrative occupation. As Linda Lobao and Katherine Meyer write in their article, "The Great Agricultural Transition: Crisis, Change, and Social Consequences of Twentieth Century U.S. Farming," "in the early 1900s, more than one of every three Americans lived on farms, a number greater than that at any other point in our country's history" (Lobao & Meyer, 2001 pg.103). This research examines the mechanization of agriculture and its influences on rural lifestyles and the decline of cropland.

Mechanization has not only brought about a decline in the population of rural communities because of a lack of jobs but also a dramatic evolution in farming. Beginning in the early 1900s, mechanization has transformed agriculture from small self-sufficient family farms to large commercialized rural entities. Lobao and Meyer said the time following World War II ushered in the most rapid transformation, brought about by the New Deal interventions and diffusion of new technologies (Lobao & Meyer, 2001). As shown in the following table, figure 6.2, the value of farmland and buildings along with average farm size has increased by a factor of four over the past century while the number of farms has greatly diminished. During the past century,

TABLE 1 Structural changes in U.S. farming in the twentieth century[a]

Year	Farm[b] numbers (1,000)	Farm population[c] as % of total	Land in farms (100,000 acres)	Average farm size (acres)	Gross sales per farm (constant $1982)	Value of land & buildings per farm (constant $1982)	Family or unpaid workers/ hired workers
1900	5,737	—	839	146	—	—	—
1910	6,361	34.7	879	138	10,817	63,651	3.00
1920	6,447	30.0	956	148	10,341	54,060	2.96
1930	6,288	24.8	987	157	10,141	51,408	2.92
1940	6,096	23.1	1,061	174	10,577	40,769	3.10
1950	5,648	15.2	1,202	213	21,084	57,322	3.26
1960	3,955	8.7	1,171	296	27,831	111,974	2.74
1970	2,944	4.7	1,098	373	40,849	173,810	2.85
1980	2,428	2.7	1,036	427	67,167	366,861	1.84
1985	2,327	2.2	1,016	437	55,655	266,528	1.84
1990	2,146	1.9	987	460	59,122	242,880	2.24
1995	2,196	1.8	963	438	52,681	244,404	2.26
1999	2,191	—	956	436	55,238	255,496	2.27

[a]Figures from 1900–1985 and their sources are reported in Lobao (1990: Table 2.1). Figures for 1990–1997 are updated from comparable recent sources: farm numbers, average farm size, and value of land and buildings, USDA, Economic Research, Service, *Agricultural Outlook*; land in farms, gross sales per farm, and unpaid workers per farm (reported as family workers through 1970), USDA, National Agricultural Statistics Service.

[b]The definition of a farm was most recently changed in 1993 to include several new categories of commodities, slightly inflating the number of small farms.

[c]The farm population was not estimated by the Bureau of the Census prior to 1910. The figure for 1995 is from the most recent (1992) estimate and is reported by USDA, National Agricultural Statistics Service.

fig. 1.82

significant technological advancements have been made to farming equipment, driving up the initial cost of machinery and repairs. This alone has shut down family farms, forcing people in the rural communities to find jobs in larger urbanized communities. As government and political policies were introduced into farming, Midwest agriculture grew into a global giant supplying the country with exported crops. Lobaos goes on to write about the governmental impacts on agriculture, saying that "large farms reap greater governmental benefits, small and moderate-size farms also draw from various commodity, insurance, environmental, and disaster relief programs" (Lobao & Meyer, 2001 pg.112). Driven by the global markets, farming still remains a risky occupation because of the frequent fluctuation in stocks and crop prices. The United States government has provided financial aid to farmers acting as a safely net in response to natural disasters.

The Red River Valley Basin is known for its rich, fertile farmland and the problematic annual flooding of the Red River. Being the dominant natural feature slicing through the landscape, the Red River of the North is the result of the prehistoric glacial Lake Agassiz. Uniquely flowing to the north, the river begins at Breckenridge, Minnesota with the combining of the Bois de Sioux and the Otter Tail rivers. Meandering 190 miles through the plains of North Dakota and Minnesota, the Red River enters Canada where it continues north and empties into Lake Winnipeg in Manitoba.

The EERCSD will be located on the southern edge of Fargo and will evaluate the condition of the natural environment as the city sprawls into the surrounding landscape. The primary objective of the EERCSD is to assess the changes imposed on the native landscape by the built environment and then educate the public based on the facility's results. Research of the historical context of the Red River Valley Basin and its ecology and geology will offer insight onto how the native landscape is affected by architecture and how architecture is affected by the area's geology and ecology.

Thousands of years ago the current Red River Valley was an enormous body of water called Lake Agassiz. The drainage of Lake Agassiz 9,200 years ago left behind sediments which are now the rich soils of the area's cropland. Dating just over 9,000 years, the Red River Valley is the youngest major land surface in the continental United States. The soils that provide ideal nutrition for cropland also cause extreme engineering problems for the building industry. Clay and silty-clays are the key ingredients in the Red River Valley soils. Large sediment loads are transmitted into the flow of the Red River from the drainage of the area's cropland. The farmland surrounding Fargo is extremely flat, so it has become common practice for farmers to dig ditches into their plots of land in order to efficiently remove surface water. This critical decision to ditch the farmland may transform the geological composition and greatly affect Fargo's ecological environment.

RESEARCH RESULTS

Resulting from the Theoretical Premise / Unifying Idea research was an inclusive understanding of what the building blocks for this thesis is. The opening topic of my research revealed the metropolitan problem of urban sprawl. This section of study concluded as follows: the issue of urban sprawl as an unpredictable, uncontrollable phenomenon has lead to the transformation in land-use, destroying native environments and disconnecting itself from the urban core.

The scrutiny of urban sprawl was followed by the evaluation of the "Wildland-Urban Interface" more commonly referred to as the rural-urban fringe. Research was conducted on this dynamic piece of land that surrounds most major cities. Being the location at which this thesis projects site is located, this topic of research was tremendously important findings. Not only were exact definitions noted in the finds but also specific distances in which the WUI is typically located. This information gave insight to what should be expected as I continue to study my chosen site location within the rural-urban fringe of south Fargo.

A developed theory of my own was recorded during this research. The theory pertained to the reason there is such an abrupt change from the urban to rural environments. This theory will continue to be studied as I make site visits and draw a final conclusion based on evidence found first-hand.

Following my theory on the strict nature of the rural-urban interface was a section of research focused on urban density. I referred to urban density as urban gradient because of the rhythm I look to create between the rural and urban environments. I concluded with a theory that cities reflect a staircase, stepping down in structures high in size as they approach the urban-rural periphery.

I did a brief amount of research examining the sensitivity of site development concluding that an aggressive approach to site development can be financially better for the contractor and developer, but the native plant and animal species living on the site can be destroyed, as can the rich top soil.

The perception of environments and boundaries brought about the research of memorization of place due to sensory perception. Research showed that some senses dominate over others when it comes to the memory of place. I also theorized about initial perception as one arrives to a city, transitioning from one neighboring environment to another. I also researched the idea of "boundary" and theorized about how boundaries are learned by the general public. The conclusions drawn from this area of study will again aid in site visits as I engage the urban and rural environments.

Another brief study was conducted on ecological design and how it can help blur the edges of boundaries while integrating the built and natural environments. Ecological design also takes a substantial stand on land preservation and environmental conservation, which are both affected by the base problem of urban sprawl.

PROJECT GOALS

The Theoretical Premise / Unifying Idea will be carried out in all aspects of the project from initial research to final design. Returning back to the Theoretical Premise / Unifying Idea will keep the project headed in its intended direction and final product.

Extreme importance will be given to the integration of the project typology within its ecological surroundings. Straddling the urban-rural boundary, proper significance will be given to both environments.

Allowing the Theoretical Premise / Unifying Idea to evolve and adapt to the research and studies is paramount throughout the project. Allowing the criticism from others to affect the project's direction may be a healthy approach to the final product.

Producing a superior quality publication will allow future individuals to reference this material and provide them with useful information pertaining to the Theoretical Premise / Unifying Idea.

Organization and keeping a set schedule with personal deadlines will sustain the development of the thesis.

The final product will be complete, creative, and fun throughout all aspects of the thesis book, final graphical and verbal presentation, and physical model.

Attention to detail will provide a comprehensive understanding of the thesis.

As the typology demands from me, I must incorporate previous education experience from multiple fields of science. This thesis will stand as a complete accumulation of my studies while attending North Dakota State University.

This thesis will set itself apart from previous collegiate work and be used as a critical piece in demonstrating the full range of my architectural skills and launch my professional design career.

SITE ANALYSIS

I can remember back to when I was a young child and my first experience of a bounded environment. As I began the enormous process of learning to ride a bike my parents evoked strict rules for my bipedal voyages. My parents defined an imaginary boundary encompassing a two city block radius from the house. I could go no further than those blocks because at that point in time I wasn't familiar with the rest of the small farming community's environment. As I became better at riding my bike the training wheels came off and I was suddenly encouraged to break through the imaginary boundary.

Even though I could read street signs I understood the bounding limits my parents set forth because of environmental characteristics. I was not able to go any further than the white house on the corner and was to never go past the ditch running alongside one narrow street. This environment became so familiar to me that I began feeling disconnected from the remaining neighborhood blocks. As I grew older and my small red Huffy turned into a 10-speed mountain bike, trust in my responsibility grew in my parents and only at that point was I able to venture further than the confining two block radius.

We engage bounded environments every second of every day, whether it is a wall, ditch, or even an imaginary line governed by an outside force, we tend to stay within the boundaries in fear of the unknown.

This site analysis and overall thesis is about breaking down bounding elements so we can experience other environments. When I say break, I don't physically mean going and smashing a wall or jumping over a fence. I mean in experiential terms, we as a society must take down these dividing lines in order to blur environments into one harmonious experience.

Architecture divides interior from exterior space, and that I'm not worried about I'm concerned with a larger scale, the urban and rural environments. I want to understand how we experience these environments without ever being completely able the experience the whole all at the same time. Experiencing large environments comes in bits and pieces, over an extended period of time, at varying speeds, from different perspectives and yet we are somehow able to pull it all together and fully comprehend the entirety.

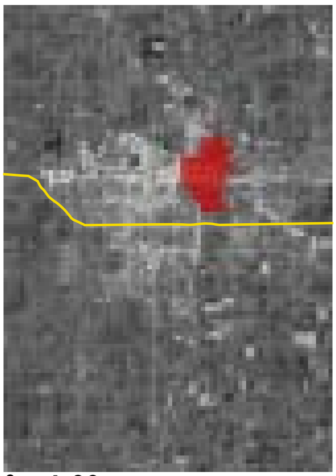


fig. 1.90
1940

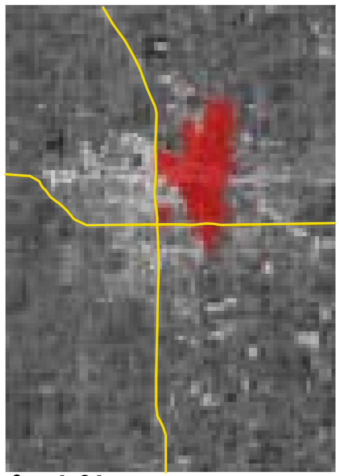


fig. 1.91
1960

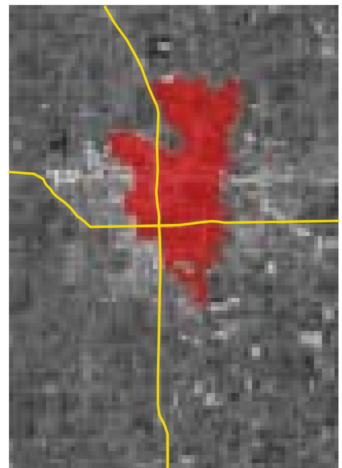


fig. 1.92
1980

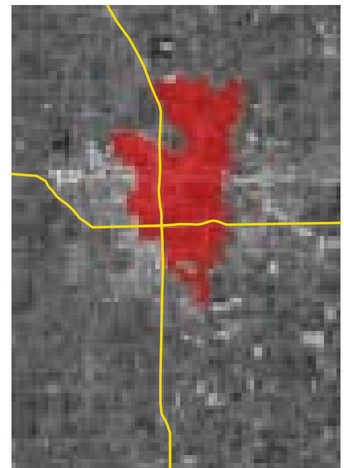


fig. 1.93
2000

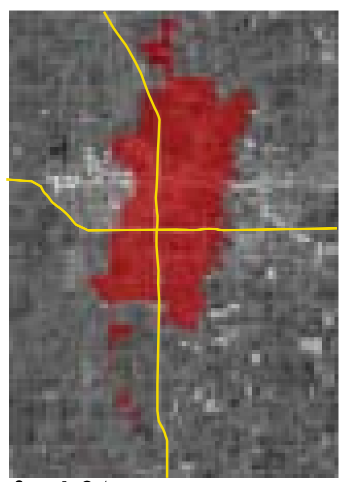


fig. 1.94
2007

City Growth

Arranged to the left are figures 1.90 -1.94, they illustrate how the city of Fargo has increased in size during a 67-year period. These drawings show how the city substantially grew north of Interstate 94 and east of Interstate 29. The area east of I-29 and north of I-94 contains the city's oldest neighborhoods and also is where the downtown district of Fargo is located. With growth restricted on the east side due to the Red River and Fargo's sister-city, Moorhead, Minnesota, Fargo has had to expand north and south. Fargo also has a neighbor to the west, West Fargo, so there are no expandable areas east or west of the city. Some critics believe that Fargo will someday completely surround West Fargo, making it an enclave within the city of Fargo.

Wind & Water

The site is subject to strong winds from all directions. The flat farmland to the south has no wind breaks in the form of tree lines or built structure, allowing winds to build from the south, southwest, and southeast. To the north is single-family housing, also providing little to no barrier from the cold Midwest winter clippers. As the city sprawls to the south and surrounds the site, vegetation and built forms will provide sufficient wind breaks.

Even though Fargo is subject to annual overland flooding as the spring thaw fills the Red River, the ecological education center is far enough away from the source so this annual occurrence will not affect the site. Site development and proper grading will drain rainwater away from the building.

Light Quality and Temperature

Because of the site's location in relation to the city of Fargo and its surroundings, the site will get direct natural daylight at all times throughout the day. Very few shadows will affect the site from surrounding residential housing because of the distance between the neighborhood dwelling and site and vice-versa. The only time the shadows may creep onto the site is in early morning or late afternoon when the sun is at its lowest angles. Because of the growth of Fargo, daylight will change and considerations will need to be made for future daylighting issues.

Existing Structures

Davies High School
Bennett Elementary School
Shanley High School
Residential

The site is almost entirely surrounded by single-family housing. The location of the site offers itself to the expansion of the city and its inhabitants, and is not as concerned with what currently exists but what may be built in the future. Traveling into the city center, one will experience a wider mix in building typology as well as building size and scale. Experiencing a change in urban density and infill also has a substantial gradient from the cities edge to downtown Fargo.

Soils and Geological Characteristics

The Red River Valley is the result of the enormous Lake Agassiz, which covered the area 12,000 years ago. What is now the Red River Valley Basin was once the floor of glacial Lake Agassiz. As the climate warmed thousands of years ago, glaciers melted, emptying Lake Agassiz and creating some of America's most fertile farming land.

The soils and sediments found 30 meters beneath Fargo have predominantly weak engineering characteristics. Left as remnants from Lake Agassiz the soils in the Fargo area are mostly fine-grained sediments, clay which was derived from churned up shales (Schwertz NDSU). The clays found throughout Fargo react extremely poorly to moisture, expanding and contracting as they absorb and remove water, making for poor engineering characteristics.

Views and Vistas

The site lies on the southern edge of Fargo offering views to both the natural and built environments. With farmland spreading for miles, and the newly built Davies High School off in the distance, the site provides panoramic views to the south. Looking east or west from the site one can understand the edge which the built environment creates with the rural farmland. Views north are greatly obstructed by low-rise housing, with the city's arteries creating vast corridors of linear perception.

Pedestrian Circulation

There is currently a pedestrian path running in the north/south direction on the east side of the site. The path is connected to additional paths throughout the adjacent neighborhoods. Additional pedestrian circulation will be considered during site development. Possible pedestrian circulation may connect the Ecology Center with Davies High School to the south.

Utilities

Due to the rapid development of Fargo's southern edge, utilities for the site are currently limited but are being installed. Utilities being installed are mostly subterranean with a major electircal line located just south of 64th Ave South.

Topographical Issues

The site is extremely flat along with the surrounding neighborhoods and farmland. Because the majority of the site has a slope of less than 1%, proper drainage during site development will need to be considered. The ecological importance of building integration will play a major role in the topographical issues throughout the site.

B a s e M a p

This base map relates to the six photographs on the following pages. The images taken around the site demonstrate how the built and natural environments relate to one another at the southernmost edge of Fargo. The numbers at each view on this base map correspond to their appropriate image.

fig. 1.95

1 - Looking east on 64th Ave South fig. 2.10

2 - Looking northeast from the intersection of 64th Ave South and 25th Street. fig. 2.11

3 - Looking west on 64th Ave South fig. 2.12

4 - Looking northwest on 63rd Ave South fig. 2.13

5 - Looking southwest on 62nd Ave South fig. 2.14

6 - Looking South towards Davies High School on 64th Ave South fig. 2.15

Average Monthly Temperature

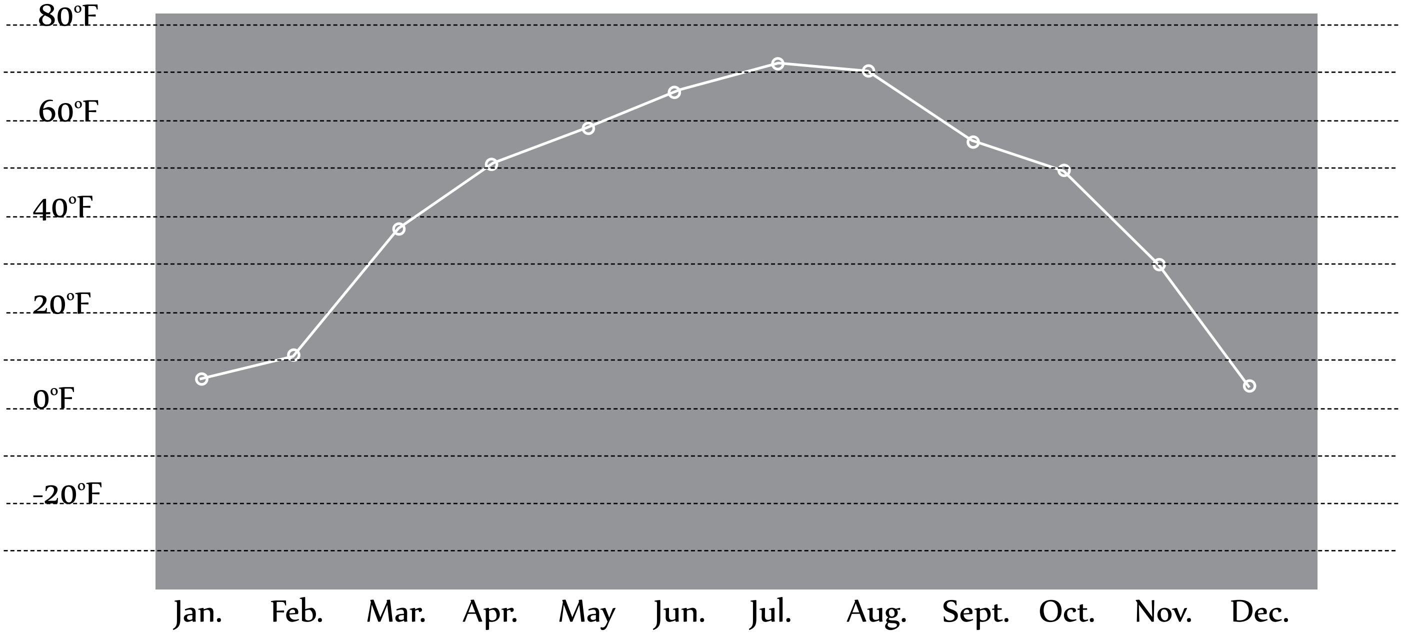


fig. 2.20

Percentage of Possible Sunshine

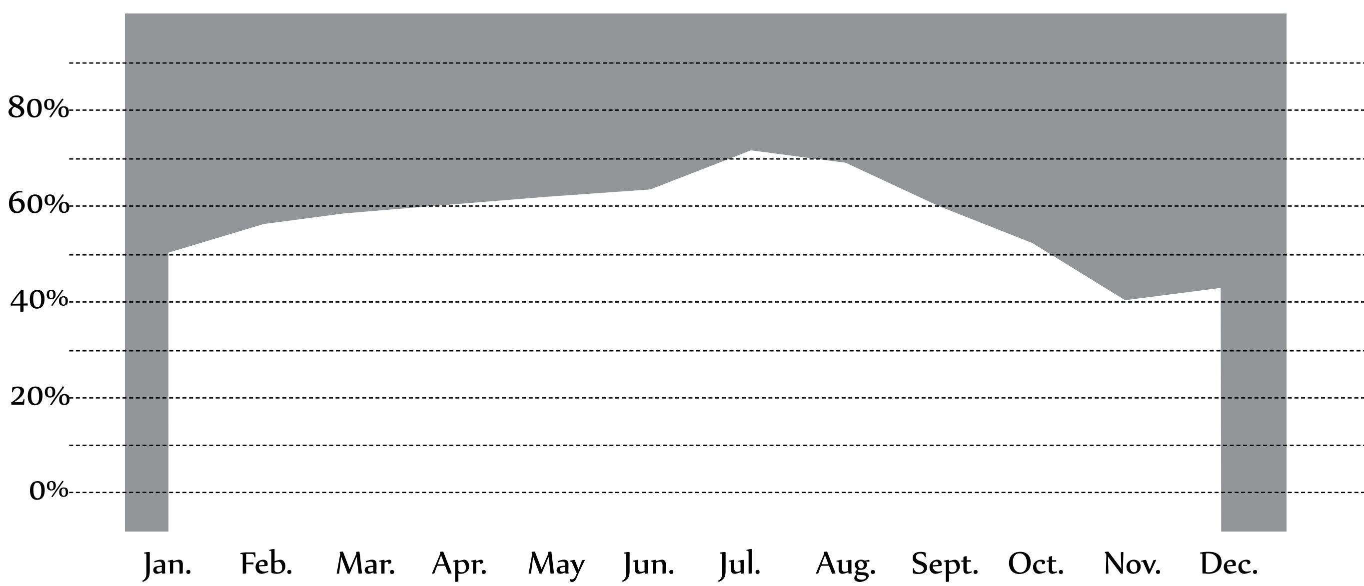


fig. 2.21

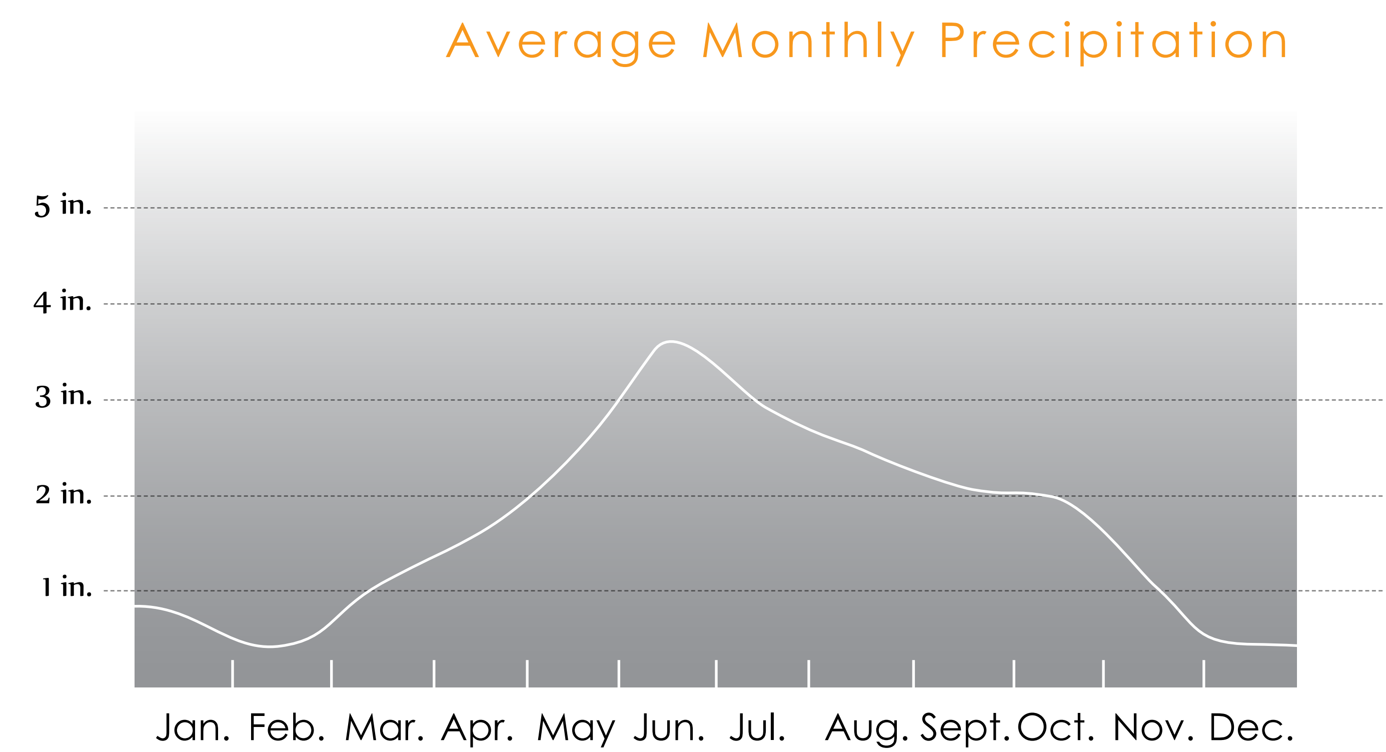


fig. 2.22

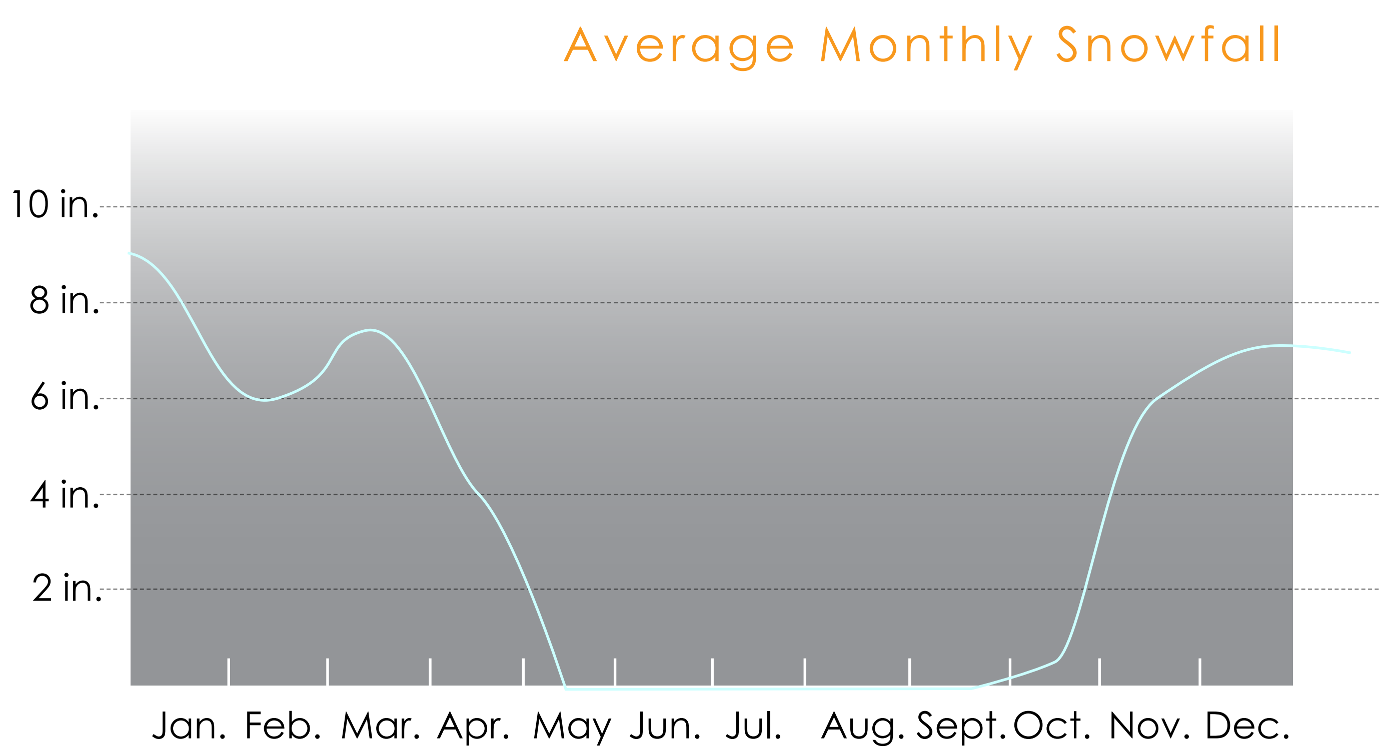
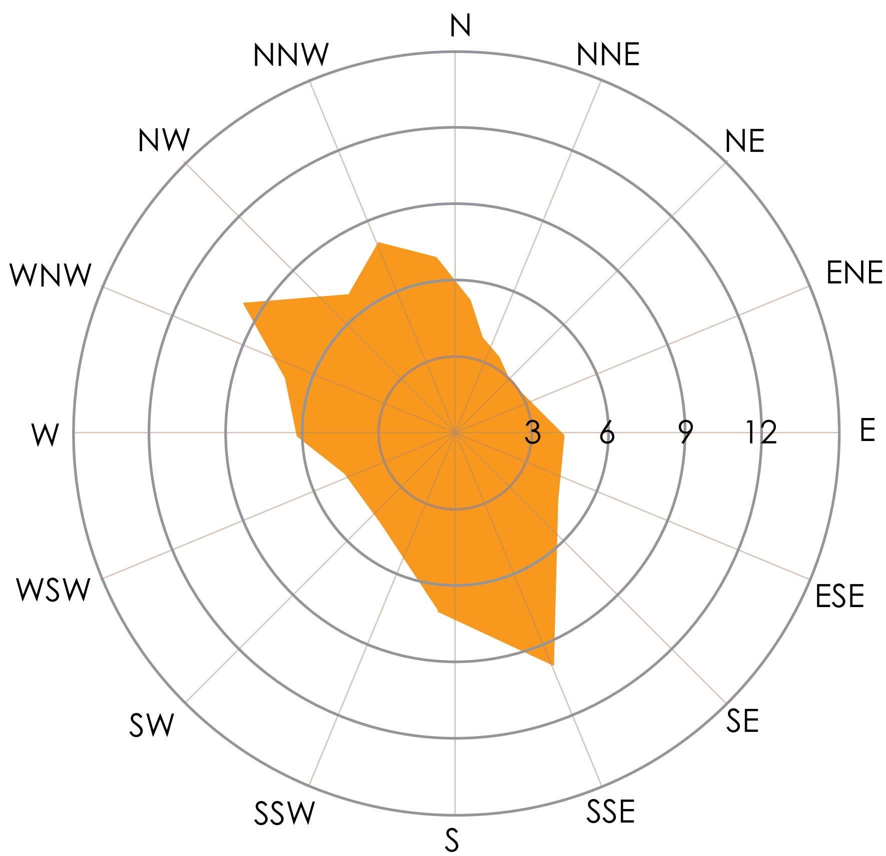


fig. 2.23

Wind Direction Distribution (%)

fig. 2.24



Soils and Geological Characteristics of the Region

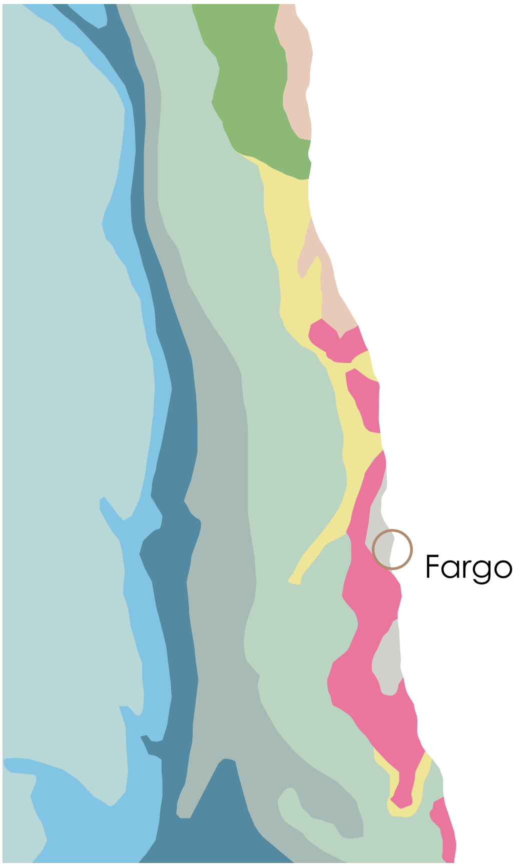


fig. 2.25

- Precambrian Rocks
- Jurassic Rocks
- Ordvician Rocks
- Inyan Kara Formation
- Belle Fourche, Mowry, Newcastle, and Skull Creek Formations
- Greenhorn Formation
- Carlile Formation
- Niobrara Formation
- Pierre Formation

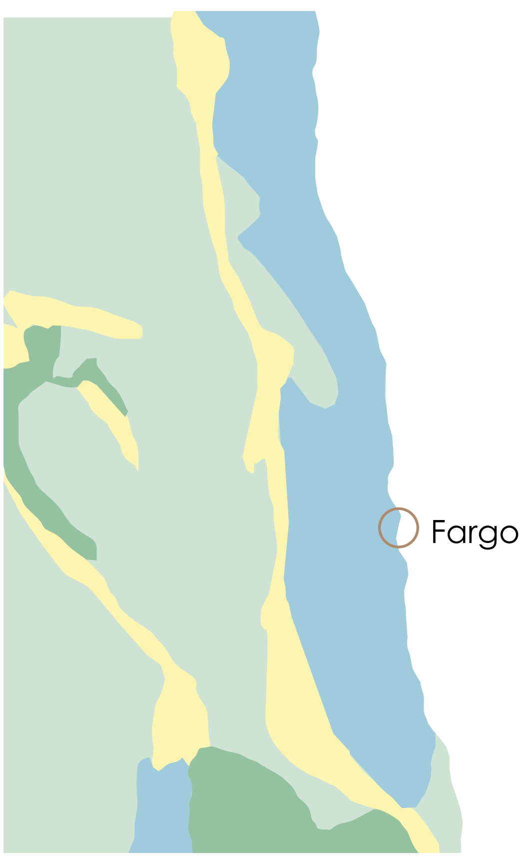


fig. 2.26

- Lake Sediment (silt and clay)
- River and Beach Sediment (sand and gravel)
- Glacial Sediment (till) Hilly Sand
- Glacial sediment (till) Rolling Land

This site is currently a quiet area in terms of the amount of daily traffic. Currently, 64th Avenue South is not directly connected to Interstate 29; therefore, 25th Street South and University Avenue South are the major arteries connecting 64th Avenue South with the rest of Fargo. Primary access to the site will be via vehicular traffic.

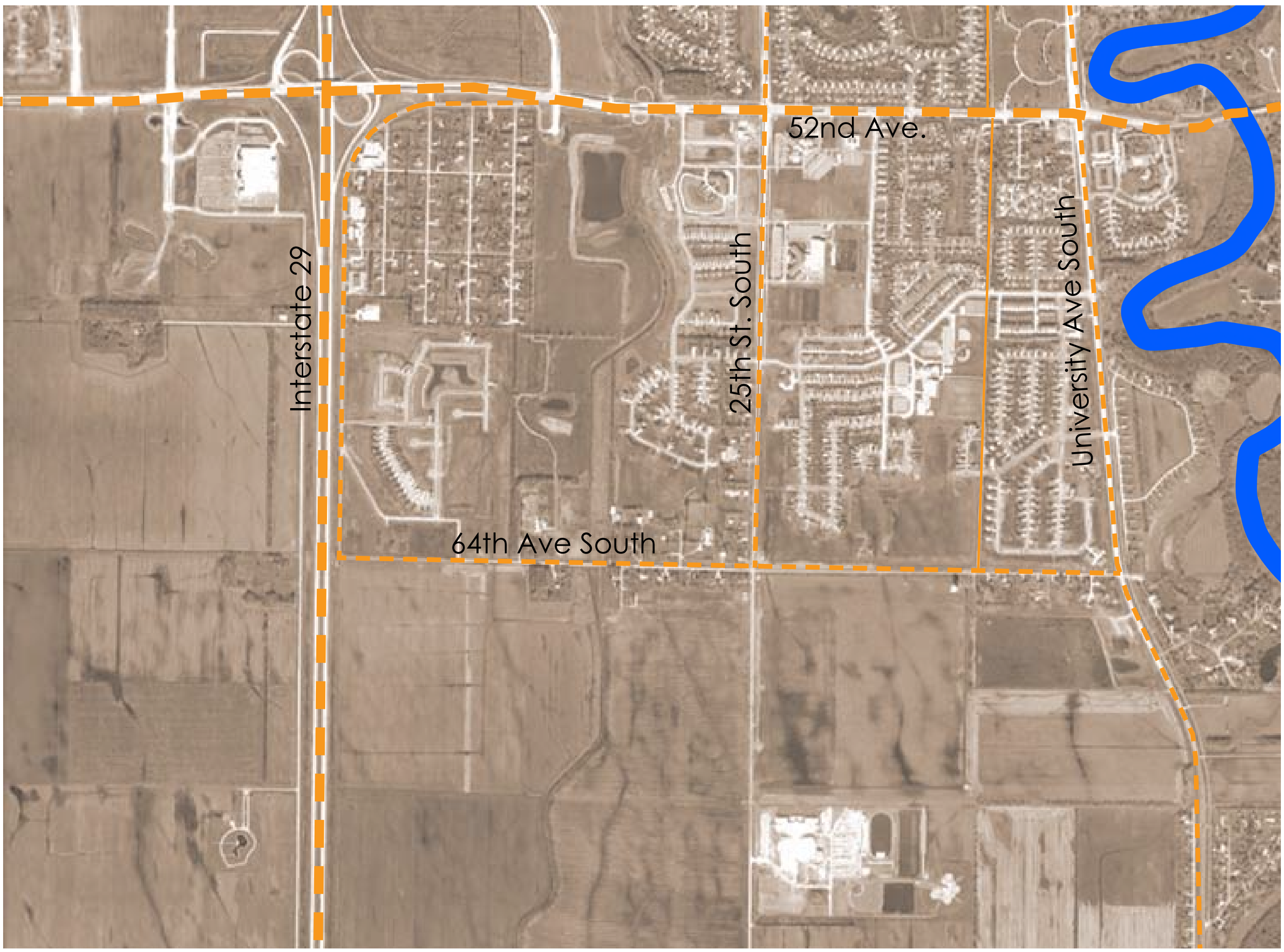


fig. 2.3

PROGRAMMATIC REQUIREMENTS

Entry and Lobby - 1000sf

Receptionist - 100sf

Offices
Ten total - 100sf each

Conference Rooms - 200sf each

Large Meeting Room - 800sf

Classroom - 800sf

2- Bathrooms - 300sf each

Laboratories - 1000sf each

Gallery / Exhibition -6500sf

Breakroom - 800sf

Storage - 300sf

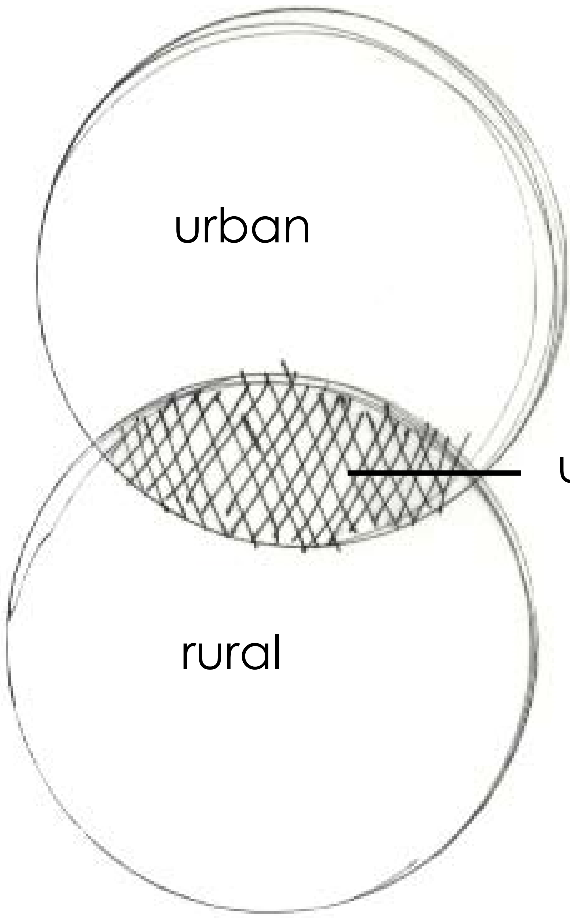
Mechanical - 1500sf

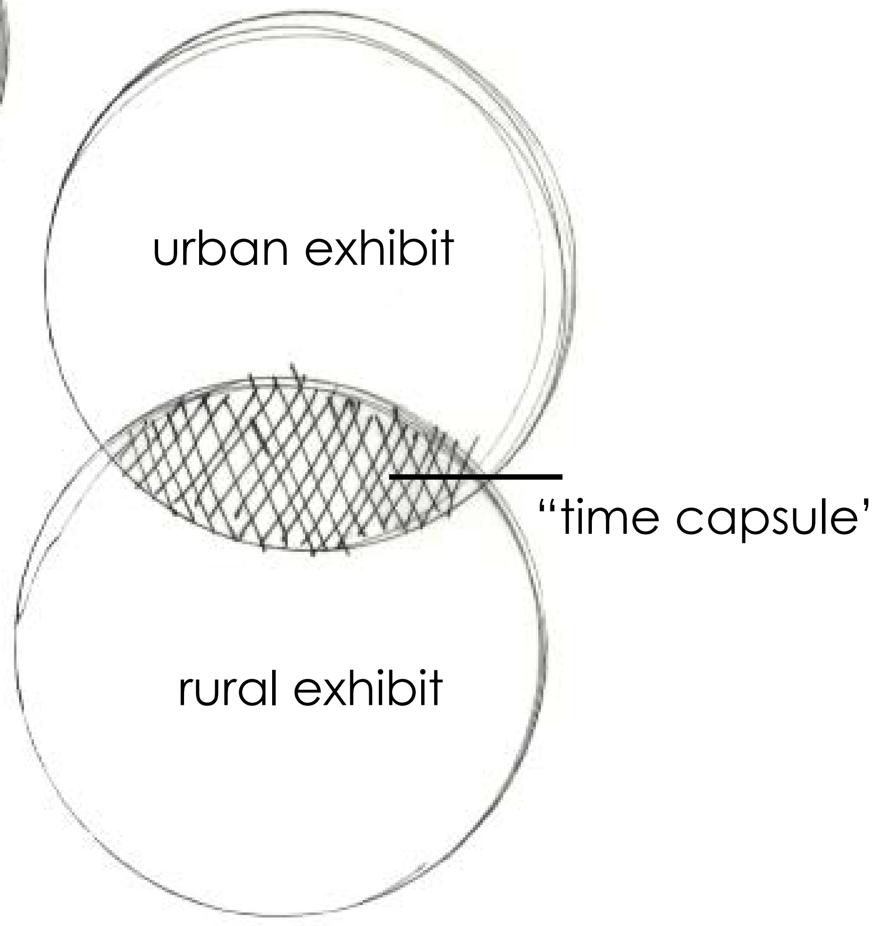
Total - 16,000 s.f.

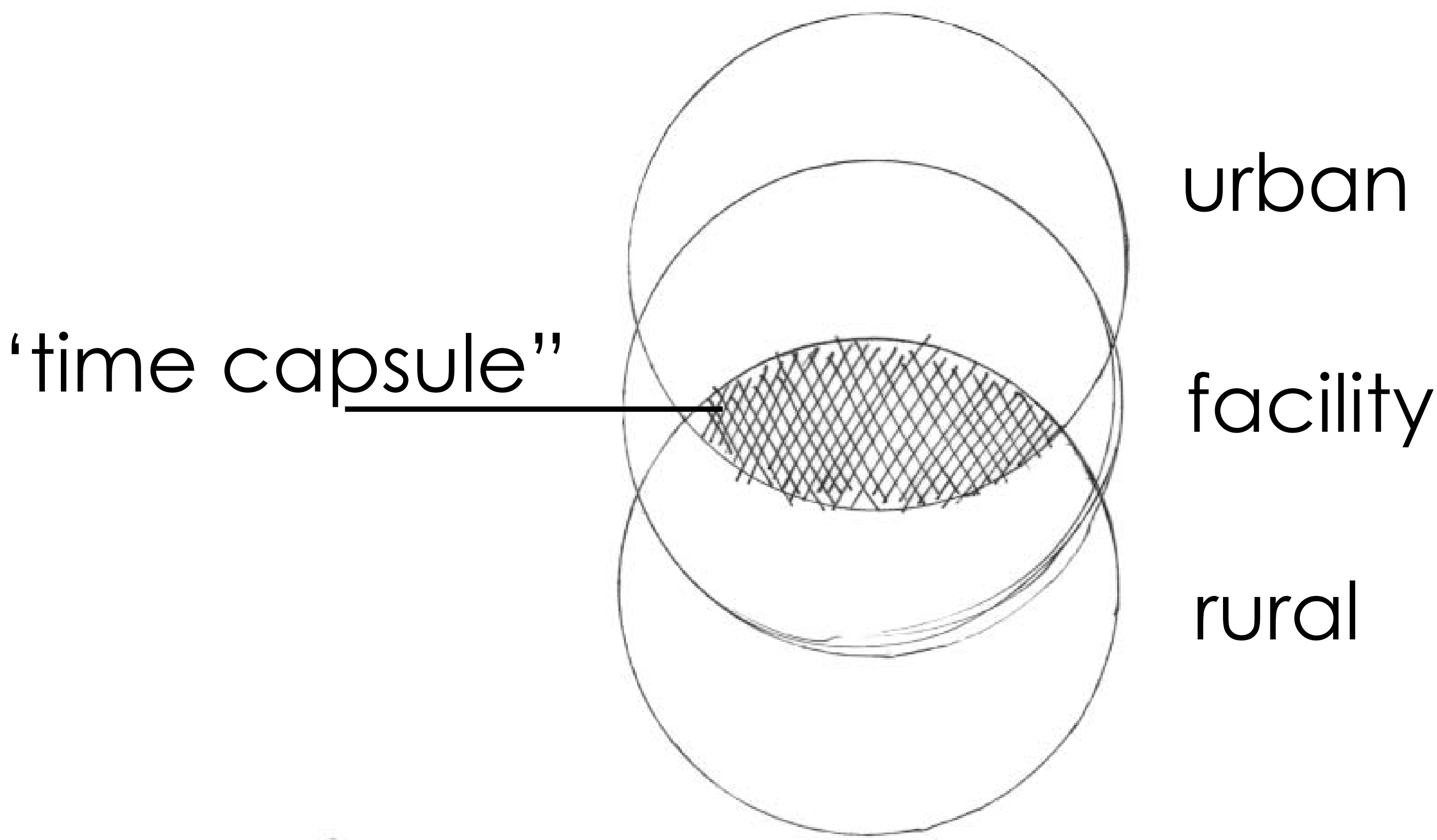
DESIGN DOCUMENTATION

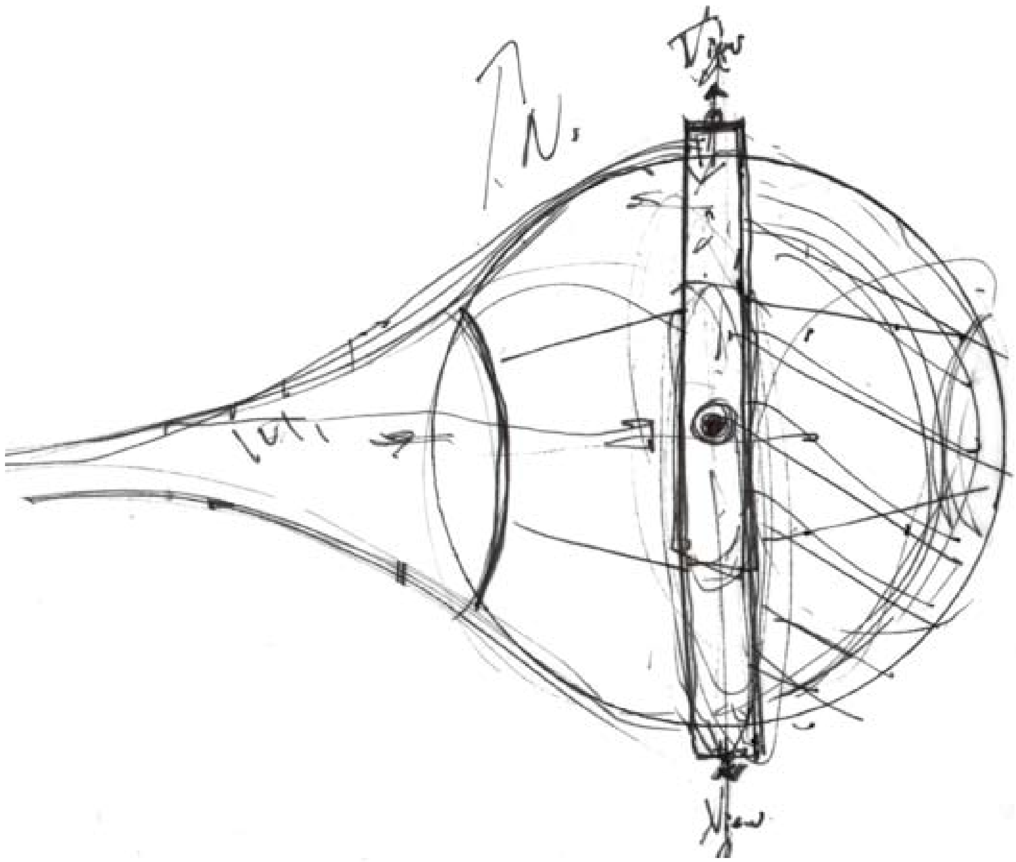
DESIGN PROCESS

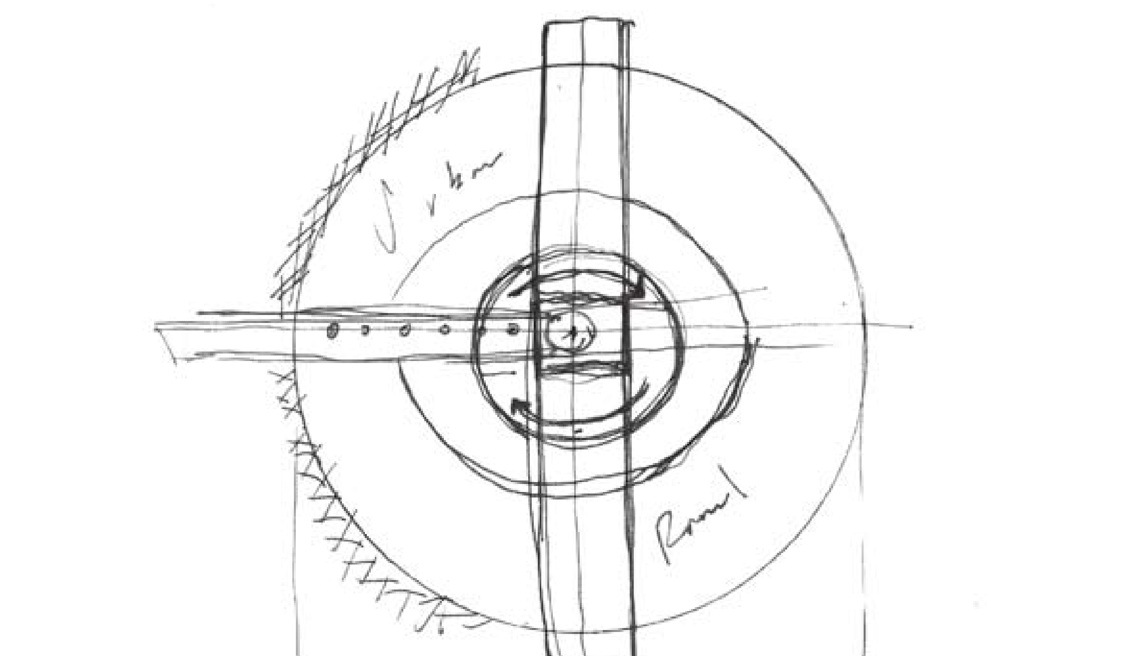
These concept drawings were the catalyst for the spatial layout. The interior spatial configuration of the Environmental Education and Research Center relates to the exterior environments. Placing each of the exhibit spaces towards their respected environments created a blending area at the center of the facility.



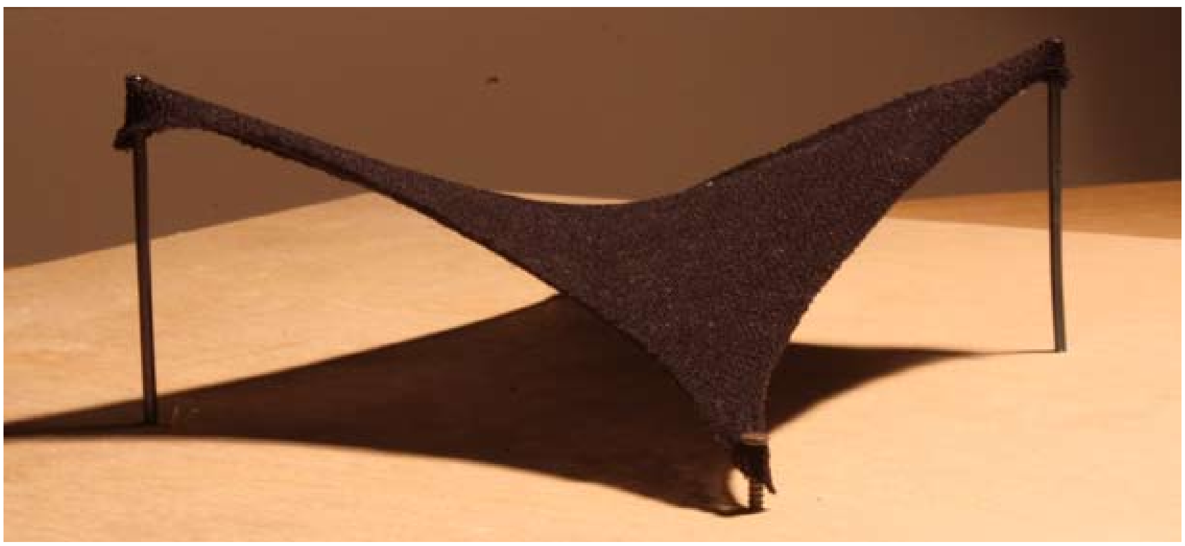


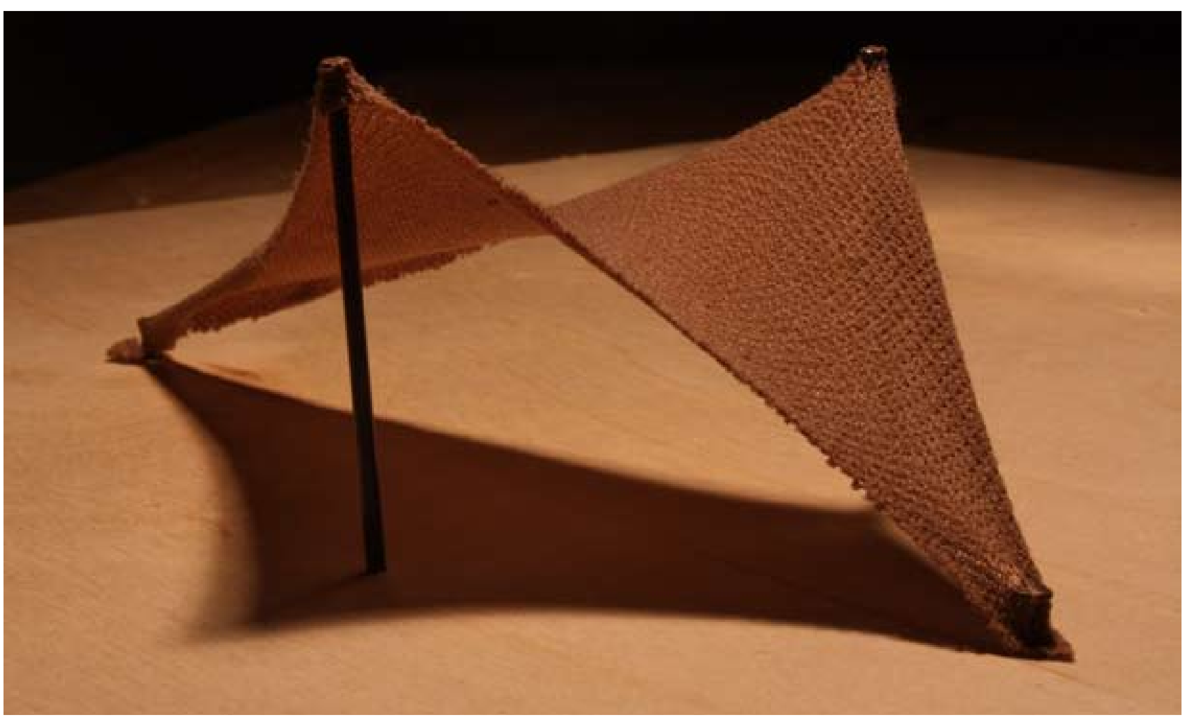

urban
'time capsule"
facility
rural

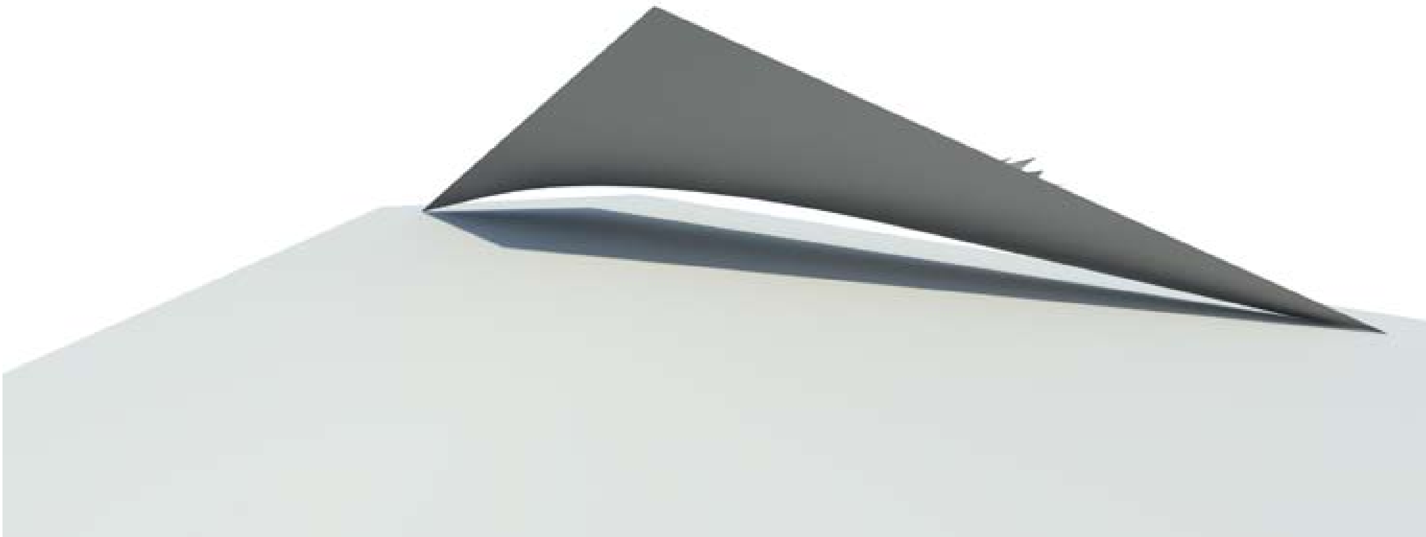

View
View

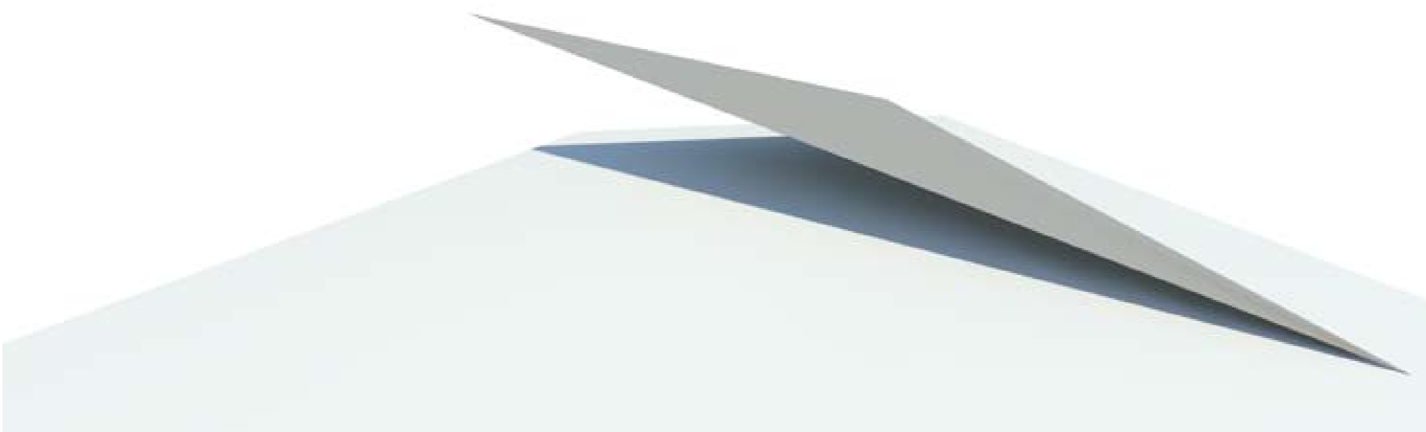

Urban
Rural
8'

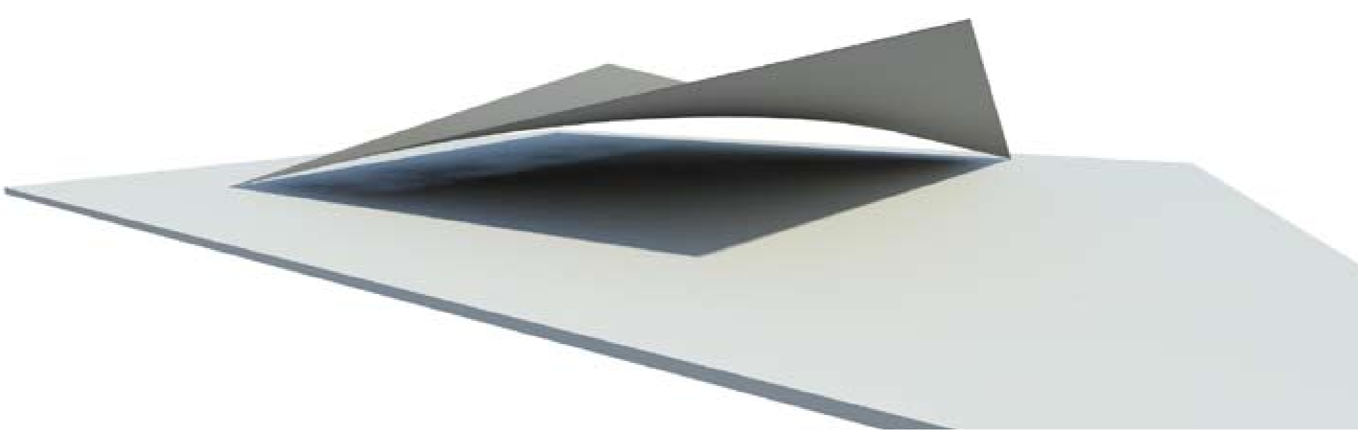
The majority of the semester was consumed by digitally and physically modeling shapes and figures which related to tensile stuctures that I had been studying. Even though the final design didn't involve any tensile structure the overall shape of the Environmental Education and Research Center derived itself from these modeling studies.

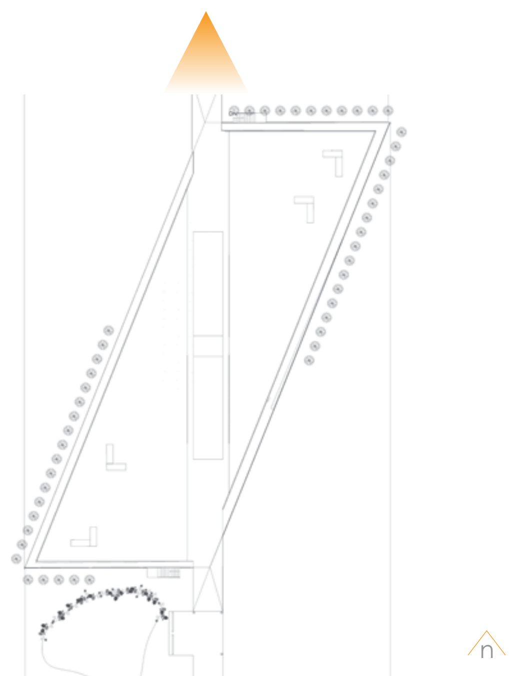




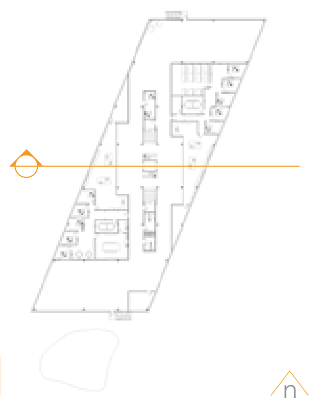








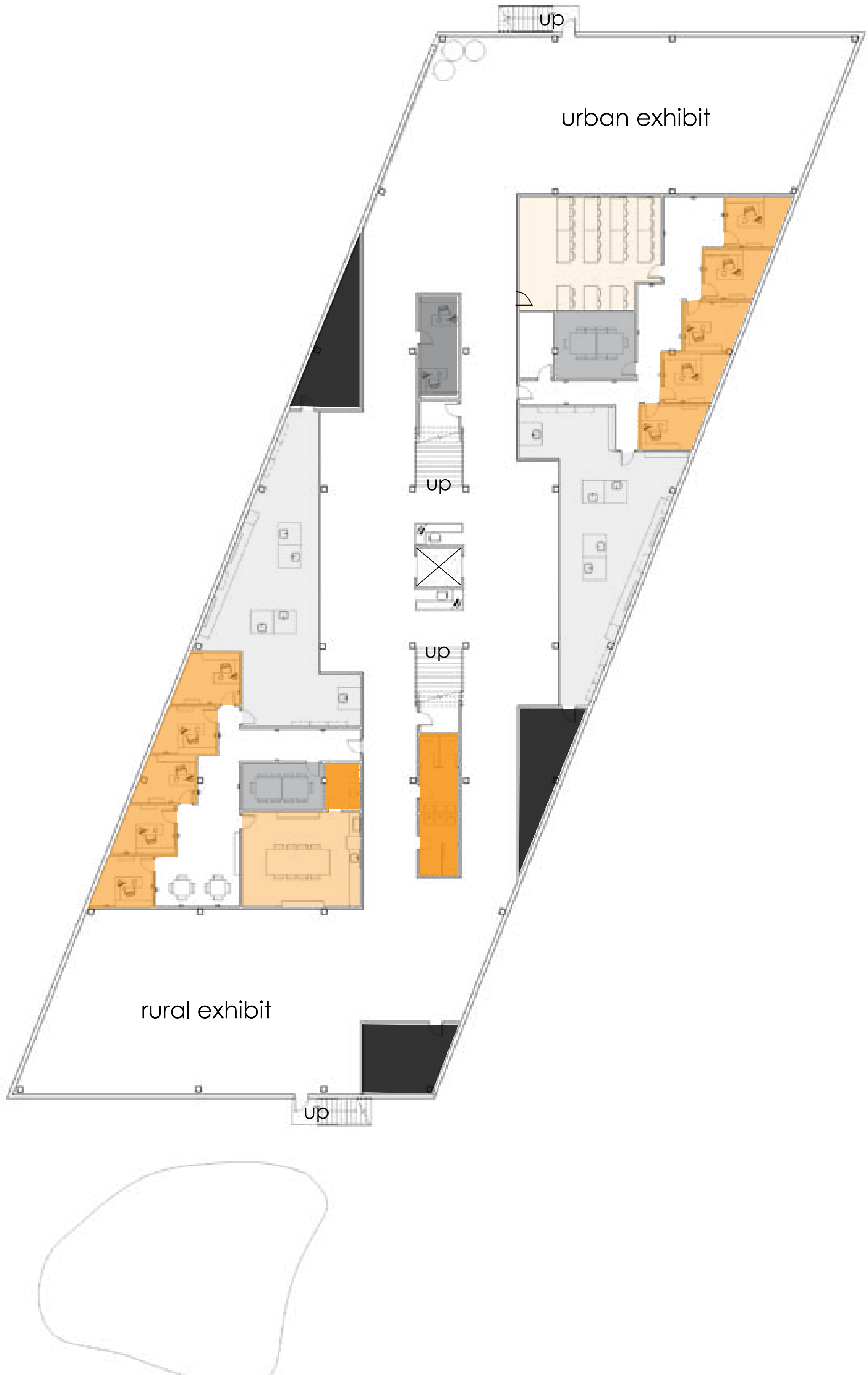
greenway



transverse section

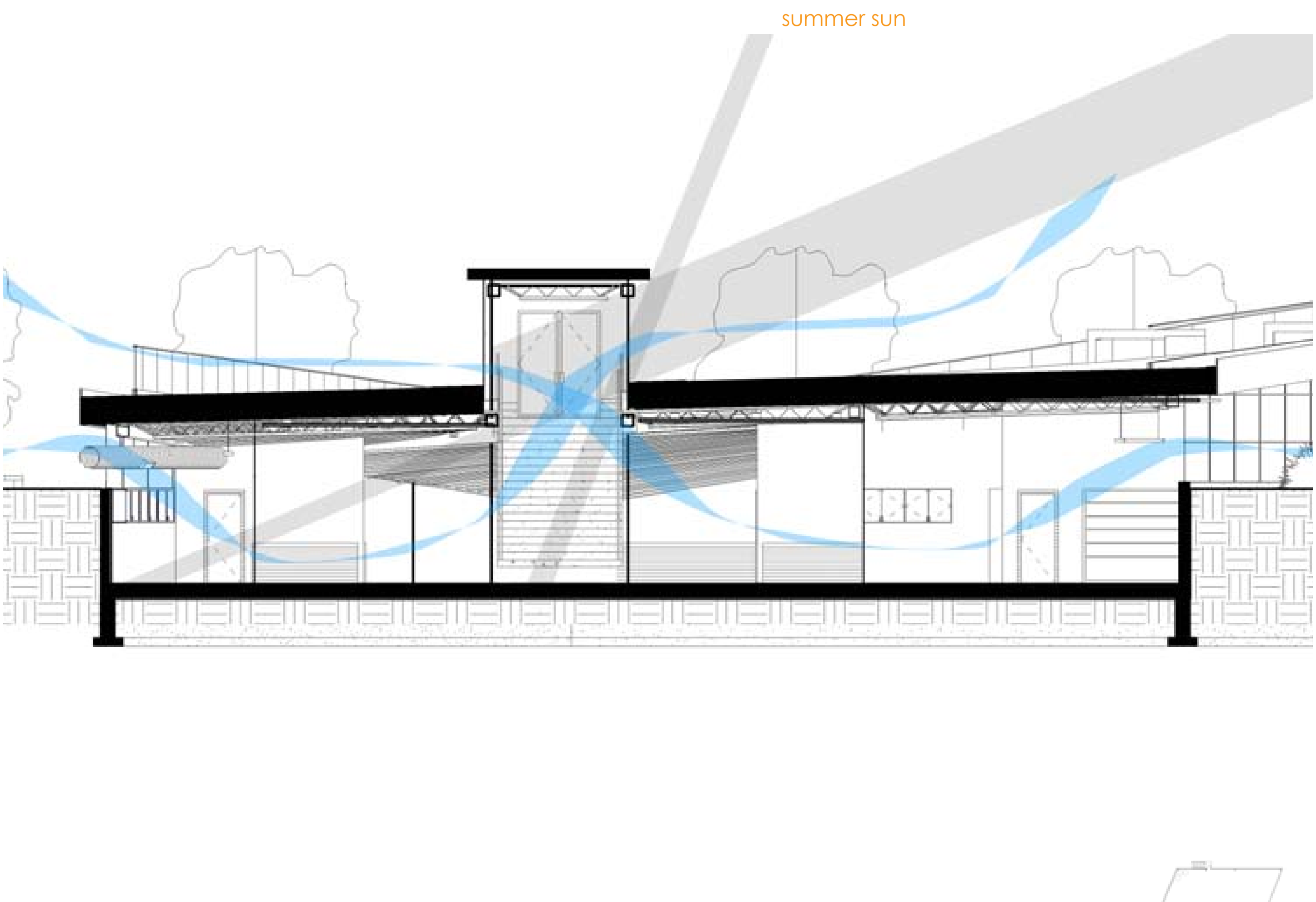
rural exhibit

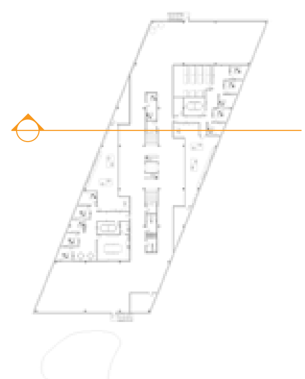
classroom
breakroom
offices
toilets
laboratories
conference rooms
DNR office
mechanical rooms



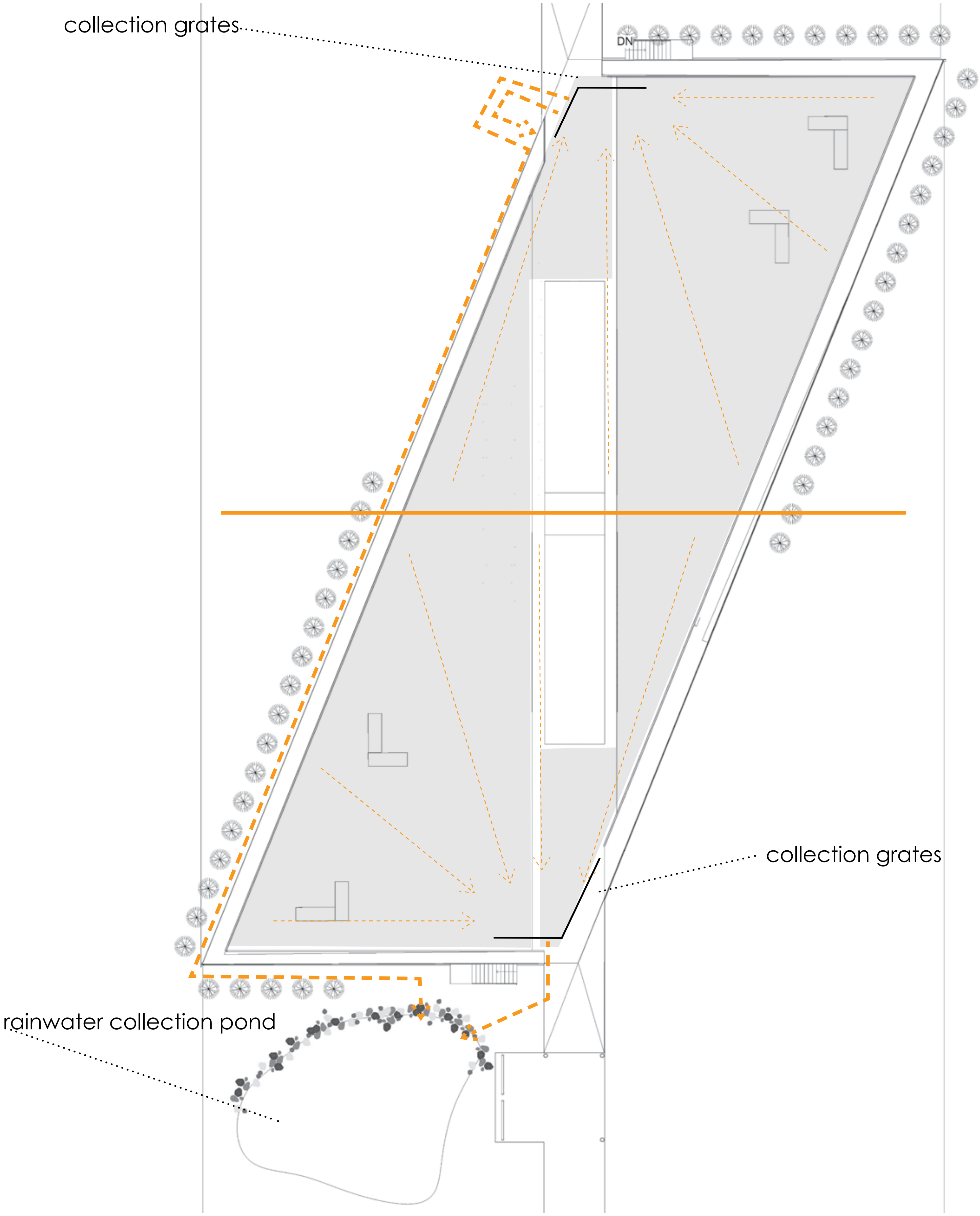
floor plan

laboratory





cross section



rainwater collection system

PRESENTATION DISPLAY BOARDS

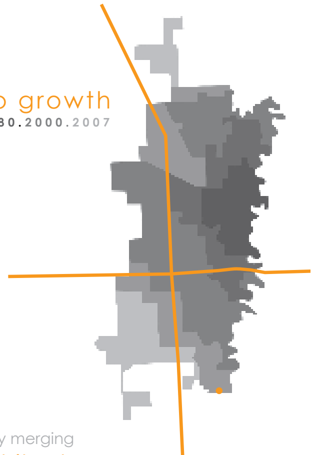
the passage

an environmental education & research center for sustainable development

anthony blume.david crutchfield revit 2011.photoshop.indesign

fargo growth

1940.1960.1980.2000.2007

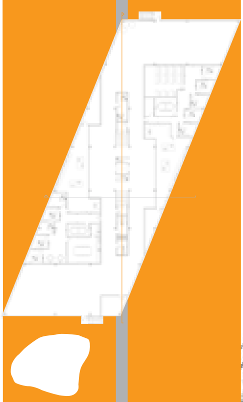


reconnecting environments by merging nature and architecture while restoring native habitats

"deliberately designed and protected corridors provide a crucial kind of connectivity in an otherwise fragmented landscape"

- sim van der ryn . stuart cowan

- floor plan



exhibit

community linking nature

sustainable development laboratory

rainwater retention pond

south elevation

west elevation

design is the mediator between culture and nature

- sim van der ryn

- passage perspective

longitudinal section perspective

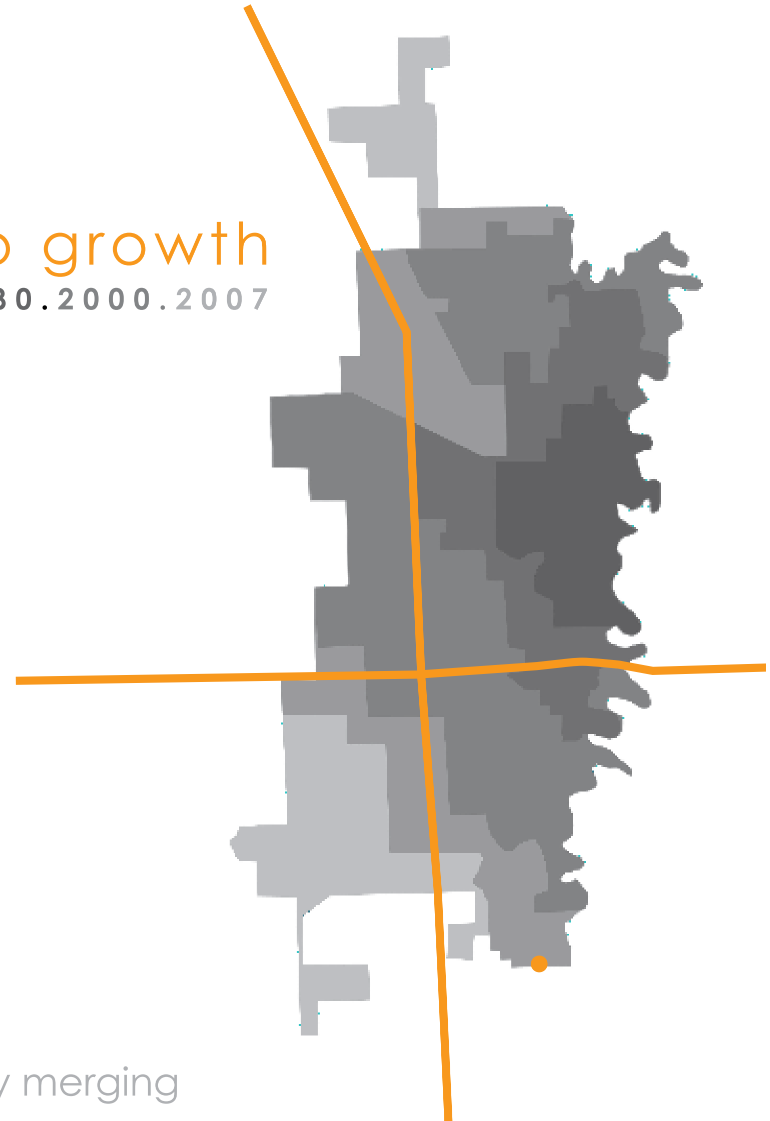
ecological design is the adaptation to and integration with nature's processes in a way that respects the health of the place

- sim van der ryn . stuart cowan

green roof plaza

fargo growth

1940.1960.1980.2000.2007



reconnecting
environments by merging
nature and architecture while
restoring native habitats

"deliberately designed and protected corridors provide a crucial kind of connectivity in an otherwise fragmented landscape"

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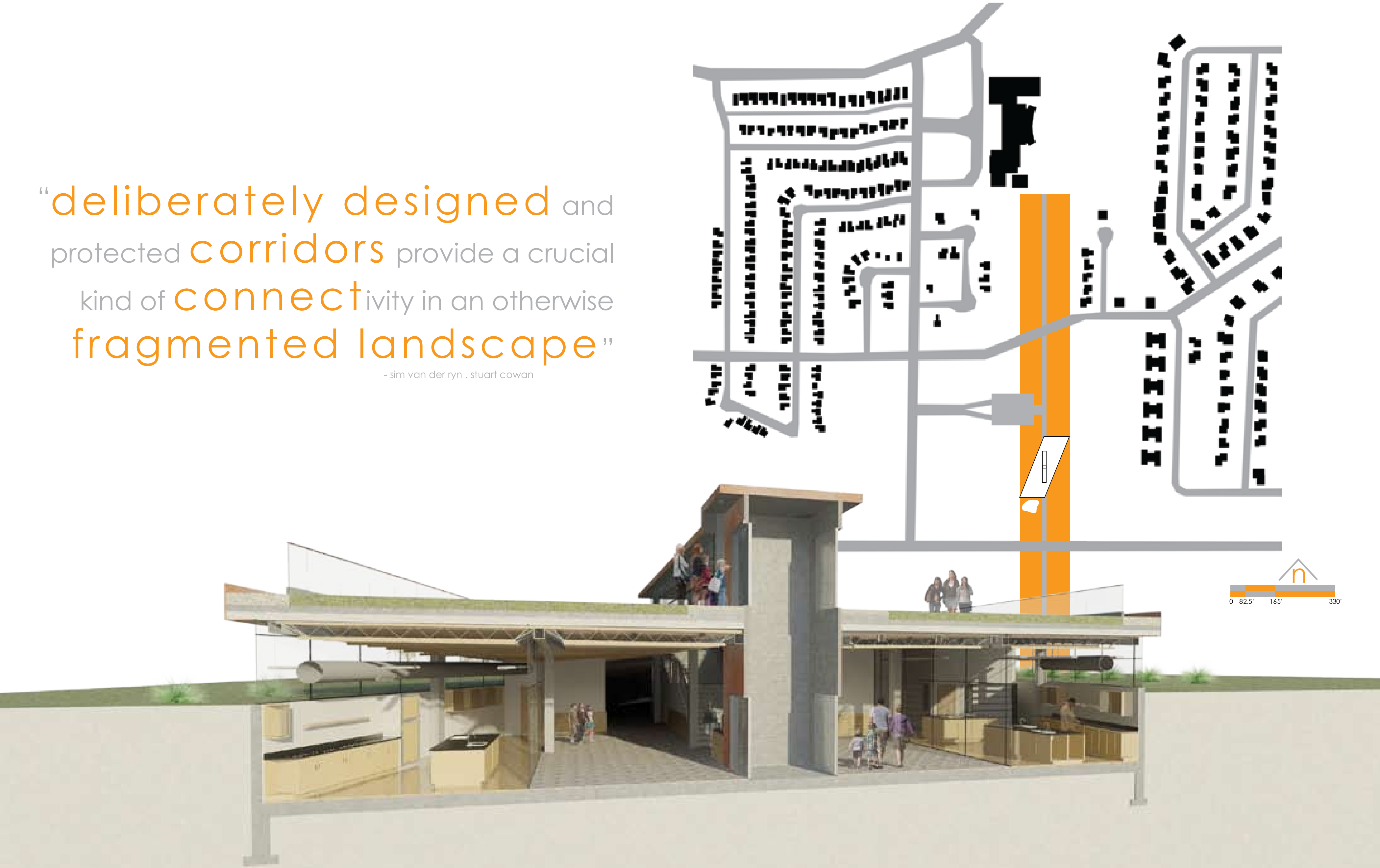
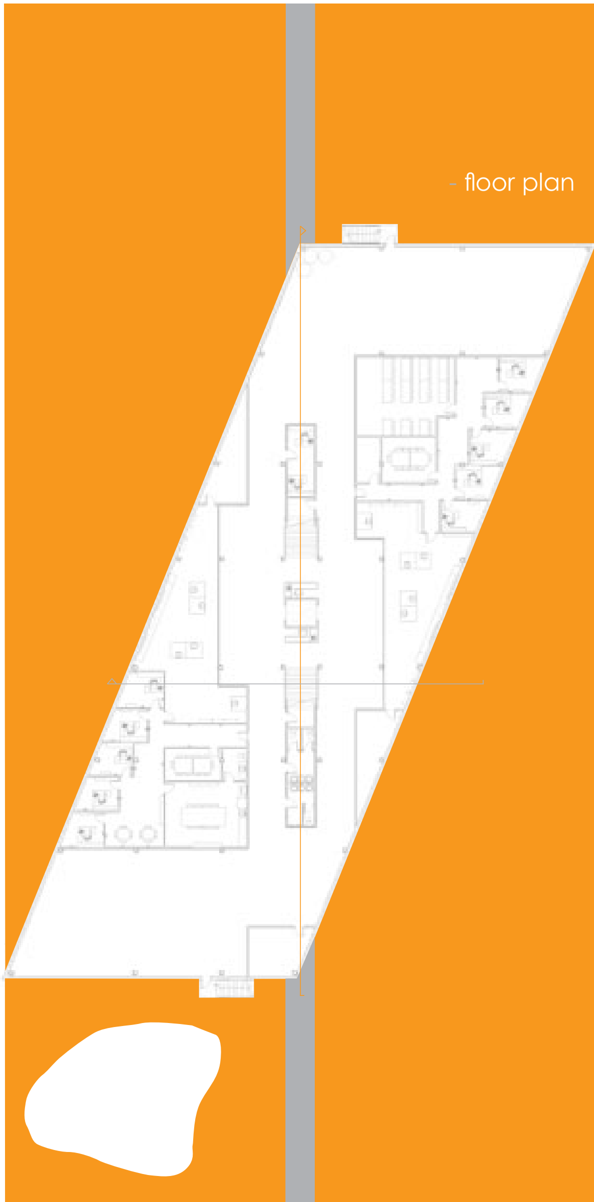


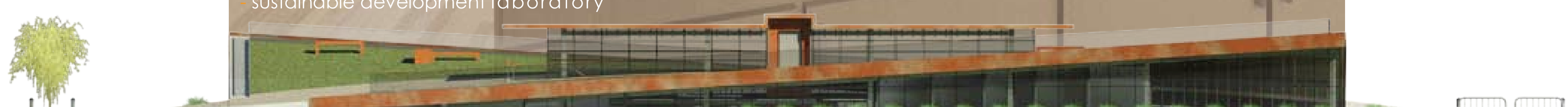

- floor plan


- exhibit

community linking nature


- south elevation

- rainwater retention pond



west elevation

design
is the **mediator** between
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- passage perspective

- longitudinal section perspective

ecological design is the **adaptation to** and **integration with** nature's processes in a way that respects the health of the **place**

- sim van der ryn . stuart cowan

- green roof plaza

R E F E R E N C E S

Text

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Van der Ryn, Sim. (1996). *Ecological Design*. Washington, DC:Island Press.

Images

Authors Photography:

Cover Page, Figure 2.10 – 2.15,

GoogleEarth:

Figure 1.20, 1.21, 1.70, 1.71, 1.90-1.94, 1.95, 2.3

Figure 1.10 – City of Fargo. http://www.cityoffargo.com/CityInfo/FargoHistory/

Figure 1.30 – 1.32 – ArchitectureWeek

http://www.architectureweek.com/2007/1003/design_1-2.html

Figure. 1.33 – 1.37 – ArchitectureWeek

http://www.architectureweek.com/2010/0519/environment_5-2.html

Figure 1.40 – Trip Advisor

http://www.tripadvisor.com/LocationPhotos-g31310-w2-Phoenix_Arizona.html#17557144

Figure 1.41 – 1.51 – Phoenix Growth

http://phoenix.gov/budget/bud05pro.pdf

Figure 1.60 – Phoenix Downtown Panorama

http://www.squidoo.com/Phoenix-Property-Management

Figure 1.80 – Red River

http://gsc.nrcan.gc.ca/floods/redriver/images/view1.jpg

Figure 1.81 – Fargo, North Dakota

http://www.fargo-history.com/transportation/steamboats2b.htm

Figure 1.82 – Structural Changes in the U.S. Farming in the Twentieth Century. http://www.jstor.org.proxy.library.ndsu.edu/stable/2678616?seq=6&Search=yes&list=hide&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dfarming%2Bin%2Bthe%2Bmidwest%26wc%3Don%26acc%3Don&prevSearch=&item=6&ttl=3147&returnArticleService=showFullText&resultsServiceName=null.

Figure 2.24 – Wind Direction Distribution

http://www.windfinder.com/windstats/windstatistic_fargo_airport.htm

Figure 2.25 – North Dakota Geological Map

http://0.tqn.com/d/geology/1/0/V/Z/1/NDgeomap.jpg

Figure 2.26 – Surface Geology of North Dakota

http://www.ndsu.edu/nd_geology/nd_maps/nd_map4.jpg

Personal Information

Anthony Blume

Address:
1810 42nd St. South
Fargo, ND 58103

Phone Number:
612.616.4924

Email:
anthony.blume@ndsu.edu

Home Town:
Herman, MN

"I would like my architecture to inspire people to use their own resources, to move into the future."

Tadao Ando