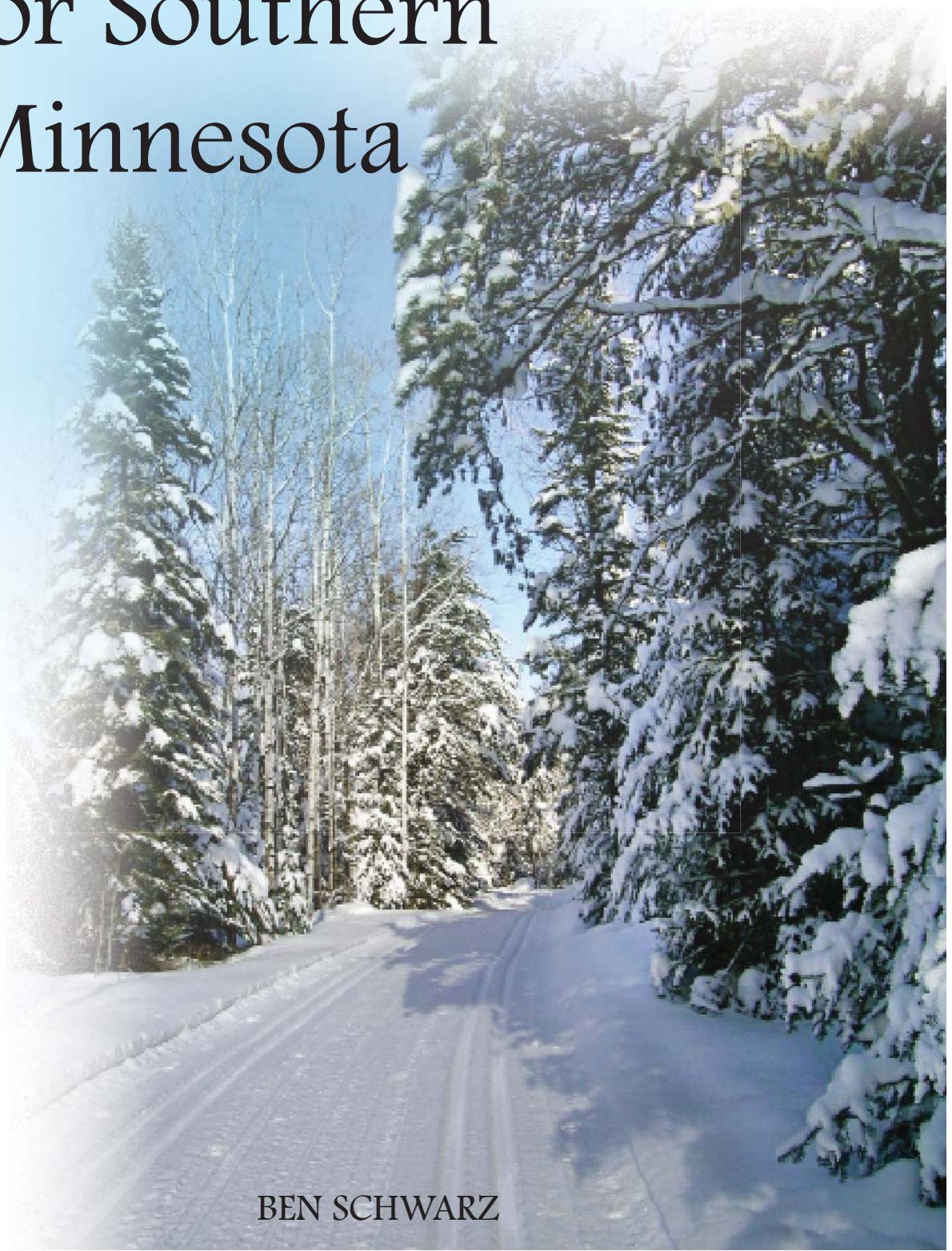


# A Sustainable Living Solution for Southern Minnesota



BEN SCHWARZ

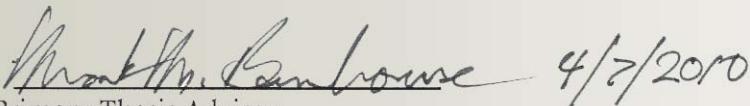
# A SUSTAINABLE LIVING SOLUTION FOR SOUTHERN MINNESOTA

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

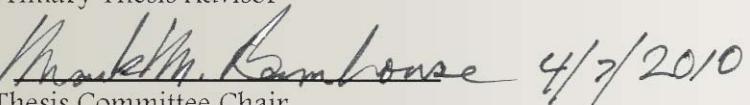
By:

Ben C. Schwarz

In Partial Fulfillment of the Requirements  
for the Degree of  
Master of Architecture

 4/7/2010

Primary Thesis Advisor

 4/7/2010

Thesis Committee Chair

April 2010  
Fargo, North Dakota

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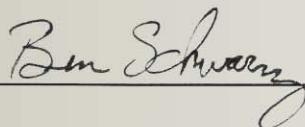
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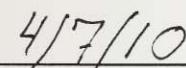
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# Abstract:

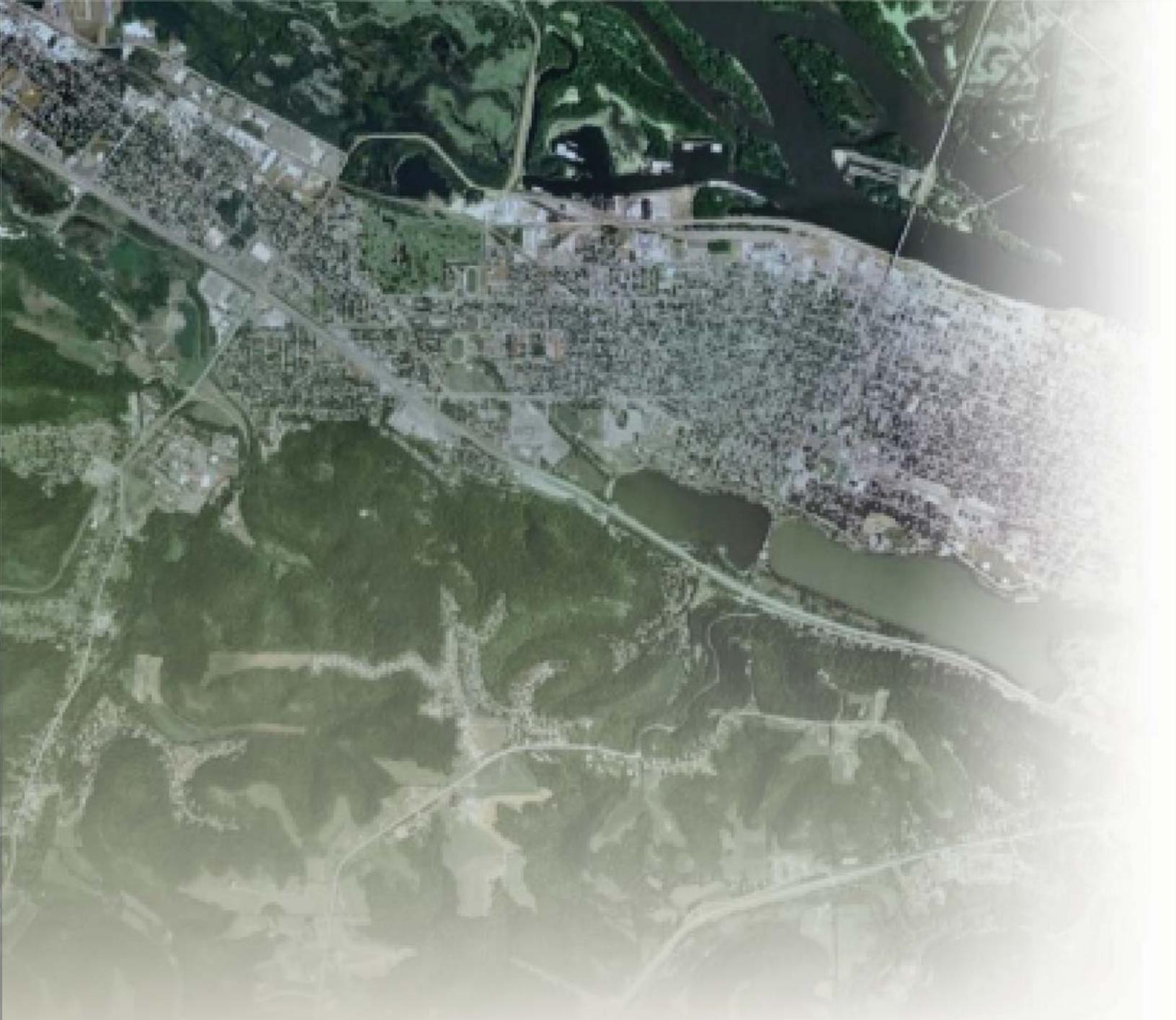
This thesis discusses the possibility and feasibility of designing sustainably in harsh climatological extremes. It more specifically covers the typology of single family residential dwellings, better known as townhomes. It is proposed through the theoretical premise/unifying idea that the definition of sustainable architecture and all areas of sustainable design for that matter, do change in terms of technical application from region to region, and climate to climate; keeping in mind that the underlying concepts and general goals remain the same. The justification behind this thesis is that without a sustainable approach to design and building, our ecosystem and eventually the human race will suffer the ill effects of poorly thought-out and inefficient solutions to problems. It is only through proper research and careful consideration that we can more responsibly use our natural resources, in turn creating and maintaining a healthier environment for ourselves and future generations.

The townhomes being designed are intended for middle-class families ranging between two and five members. The development will consist of twenty single family units. These townhomes would likely be privately owned and operated by a small team of employees under the direction of a landlord. All units within the complex will include a master bedroom and bathroom, a modest guest room, closet and additional storage space, a kitchen and dining area, a great room, private laundry facilities, and based on unit size, additional bedrooms and bathrooms. Square footages per unit will range from 1900 square feet in two person units up to 3150 square feet in five person units. The site for the project is located on along the south facing bluff along county road 43 in Winona, MN. The main goal of this project is to create a sustainable living solution for first time home buyers/renters in a geographic region harboring harsh climatological extremes. This design is not to be completed lavishly, rather through modest yet inventive sustainable techniques, thereby remaining affordable for the bulk of middle class citizens.

Prior to design, extensive research and case studies will be conducted covering the areas of site and typology, as well as historical matters concerning sustainable design. The bulk of the research will be done through a mixed method of both qualitative and quantitative means.

# Problem Statement:

Is designing sustainably a possibility in any location?



# Statement of Intent

# Statement of Intent:

Project Typology:

Multi-Family Townhomes

Theoretical Premise/Unifying Idea:

Claim:

The definition of sustainable architecture and all areas of sustainable design, for that matter, do change in terms of technical application from region to region, and climate to climate; however, the underlying concepts and general goals remain the same.

The actor supporting the claim is sustainable architecture.

The action is the change in application.

The object being acted upon is the region in which the design is taking place.

Supporting Premises:

Sustainable architecture is related to the claim in that it is practiced in many different regions and climates.

Change in application of sustainable design techniques will be directly related to change in region and climate.

The basic goals and underlying principals of sustainable design remain the same regardless of region or climate change.

Conclusion:

Sustainable design is no longer a question of possibility, but rather a question of what research and testing need to be done in order to make a design function as sustainably as possible in the said environment.

Project Justification:

Without a sustainable approach to design and building, our ecosystem and eventually the human race will suffer the ill effects of poorly thought-out and inefficient solutions to problems. It is only through proper research and careful thought that we can more responsibly use our natural resources, in turn creating and maintaining a healthier environment for ourselves and future generations.



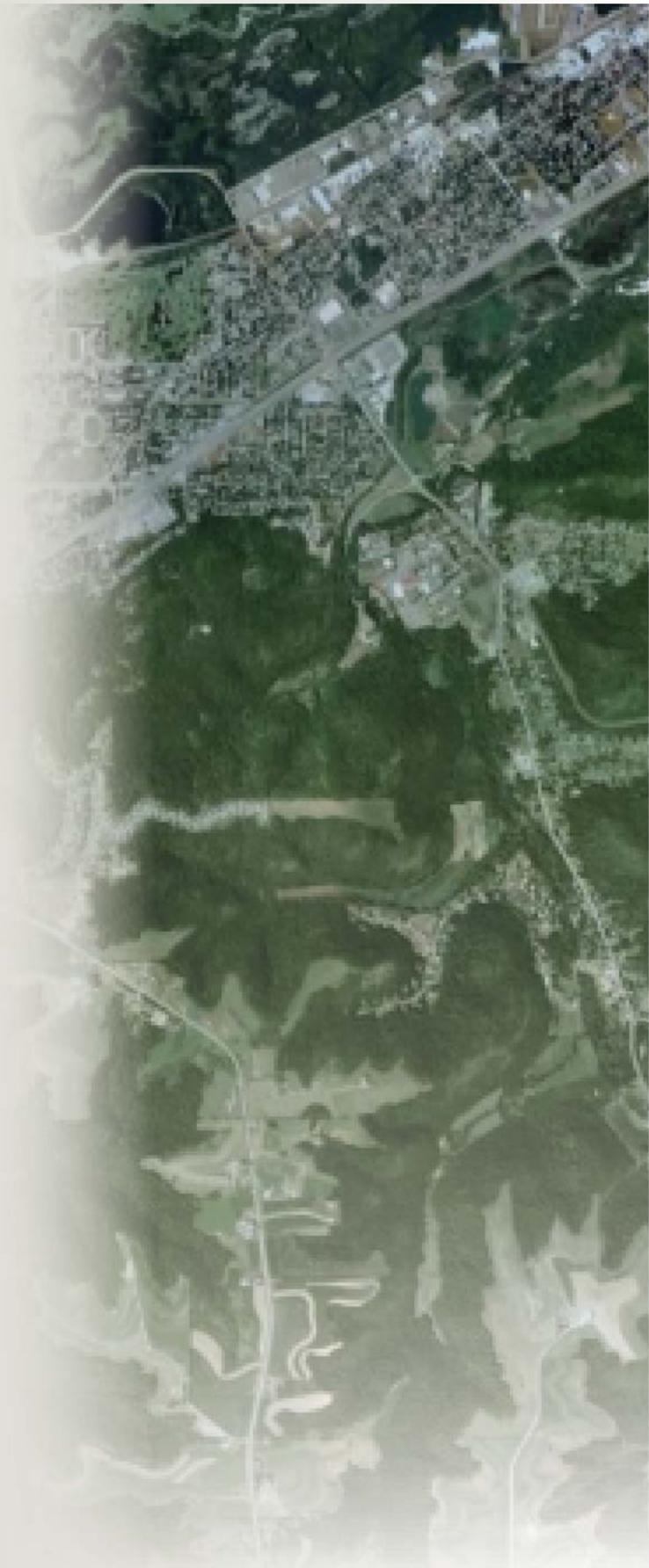
# The Proposal

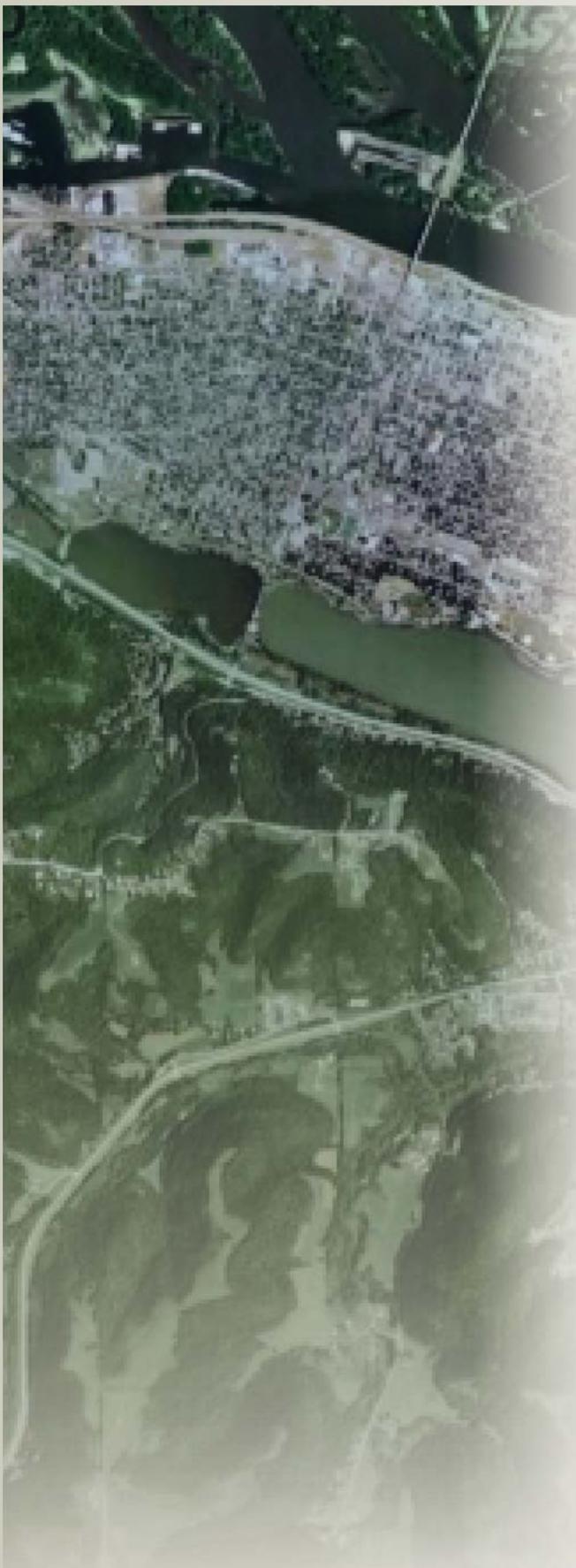
# Narrative

One common problem or concern virtually every designer will face practicing in the 21st century will be how to design sustainably. Although this issue is applicable to all areas of design, the area which this thesis focuses on is the specific typology of multi-family residential dwellings, better known as townhomes. So how exactly does one go about designing sustainably? And is it possible to do so with equal levels of success in harsh, unforgiving climates?

My research will investigate technical applications of sustainable design elements that differ between regions and climates to find the underlying concepts and general goals that remain the same. Without a sustainable approach to design, regardless of the climate at hand, our ecosystem, natural resources, and in turn, the human race will all suffer the consequences of our poorly thought-out solutions to design problems. It is therefore our duty and paramount responsibility to conduct all necessary research and design experiments in the hopes of designing with maximum levels of sustainability.

Prior to design, extensive research and case studies will be conducted covering the areas of site and typology, as well as historical matters concerning sustainable design. The bulk of the research will be done through a mixed method of both qualitative and quantitative means.





## Narrative

There is only one real actor regarding the problem at hand, and that actor is sustainable design. Sustainable design is very interesting as a subject of study for a number of reasons, some of which include, the ever increasing value and importance of its understanding in today's world, and its seemingly ever-flexible means of adaptability to varying situations and regions. It is through this research that I will find out to what extent sustainable practices are applicable and adaptable in climatically harsh environments such as Winona, MN.

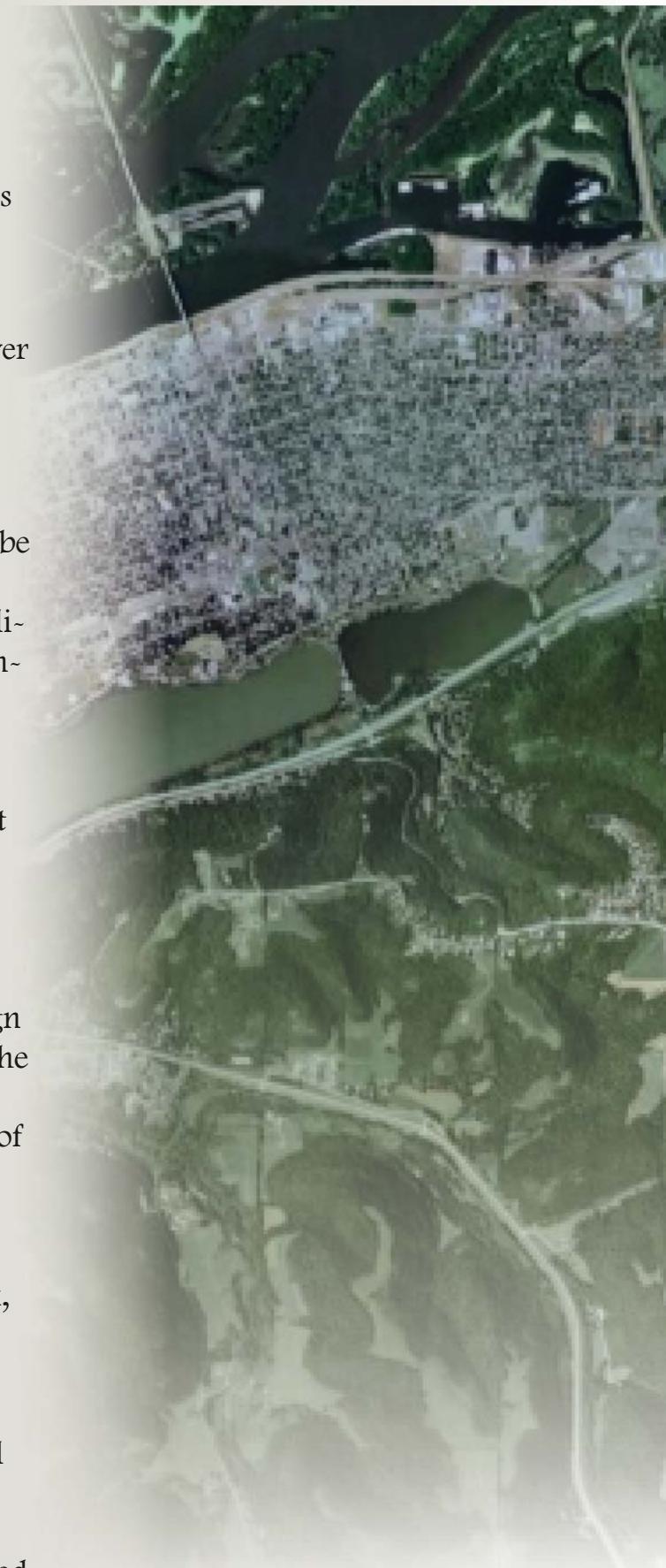
It is made clear through the changes in technical application just how vast the differences and effective techniques concerning sustainable design are. What may work as a solution in one location may be completely unusable in another and visa versa. Once designers become familiar and accustomed to proper and accepted sustainable design techniques for a given region, it is important that they not only use and follow those known methods but also that they keep an open mind to continuously improve upon and expand those methods. The issue of sustainable design is one that is virtually unanimously seen as positive, and is actively being improved upon on a daily basis.

# Narrative

The effects of sustainable design often-times are not immediately visible. Effects of sustainable design usually take some time to show themselves more clearly. These effects can be seen on a smaller scale such as through energy savings over time, or on a much larger scale such as fewer smog forming emissions from power plants.

The most important, and first issue to be considered when thinking of sustainable design, is the region and climate in which you are designing. Without having knowledge of the specific regional and site conditions there is no point in attempting to design sustainably. Factors such as, but not limited to, temperature range, humidity, wind, geographic qualities, and other numerous ecological conditions all play integral roles in determining how to go about the design in the most effective manner. It is of the utmost importance for the designer to understand and document to the best of his or her ability the patterns and conditions observed on a given site, as many of these observed elements that make up the site are in a constant flux, acting independently of one another.

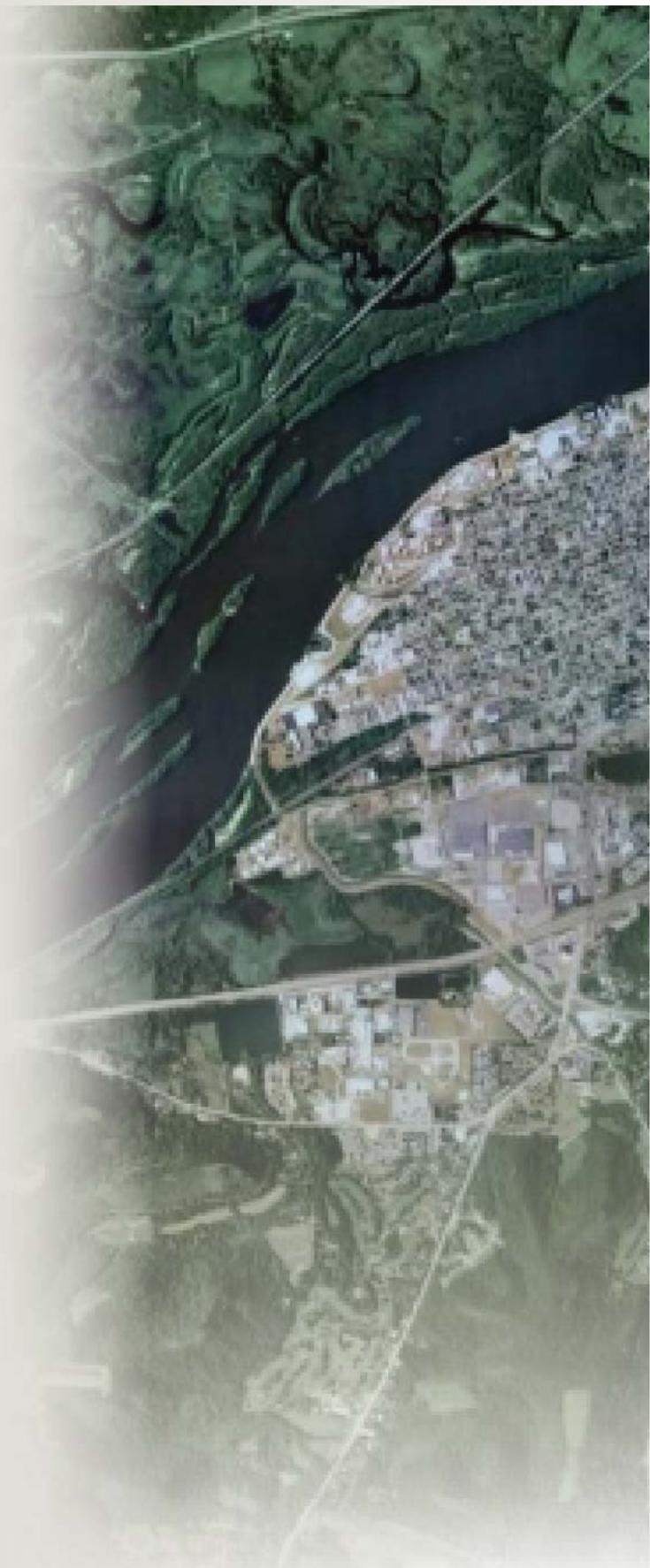
In conclusion, it will be shown that sustainable design is a possibility in all regions and climates throughout the world. But how effective are existing methods, and how must they be adapted and altered to work more effectively in harsh climates? It is the purpose of this research to help better understand and answer those questions.



# User Description

The townhomes being designed are intended for middle class families ranging between two and five members. The development will serve twenty individual families. There is no set peak usage, rather there is only a peak time period for inhabitance; this will naturally be between the hours of 10PM and 10AM. There will be on-site indoor parking accomodating all families within the development.

These townhomes would likely be privately owned and operated by a small team of employees under the direction of a condominium association.



## Major Project Elements

The townhome complex will consist of twenty separate units varying in size to accommodate families between two and five members. Each unit will include a master bedroom and bathroom, a kitchen and dining area, a small guest room/auxiliary space, closet/storage space, a great room, private laundry facilities, garage space, and based on intended unit size, additional bedrooms and bathrooms. Other areas to be considered are three season porches and a community exercise area.





## Site Information

The site chosen for study is located in the upper midwest portion of the United States, more specifically, in southeast Minnesota in the city of Winona. It was chosen largely because of its vast temperature ranges and seasonal extremes.

Within the city of Winona, the site chosen is located on the south facing side of the bluffs that border the city to the south. This was done for several reasons, the major one being that taking advantage of natural southern sunlight over the winter months is very important in conserving energy. Another reason is that it is located in a semi-private area of the city, giving residents superior views and scenery.

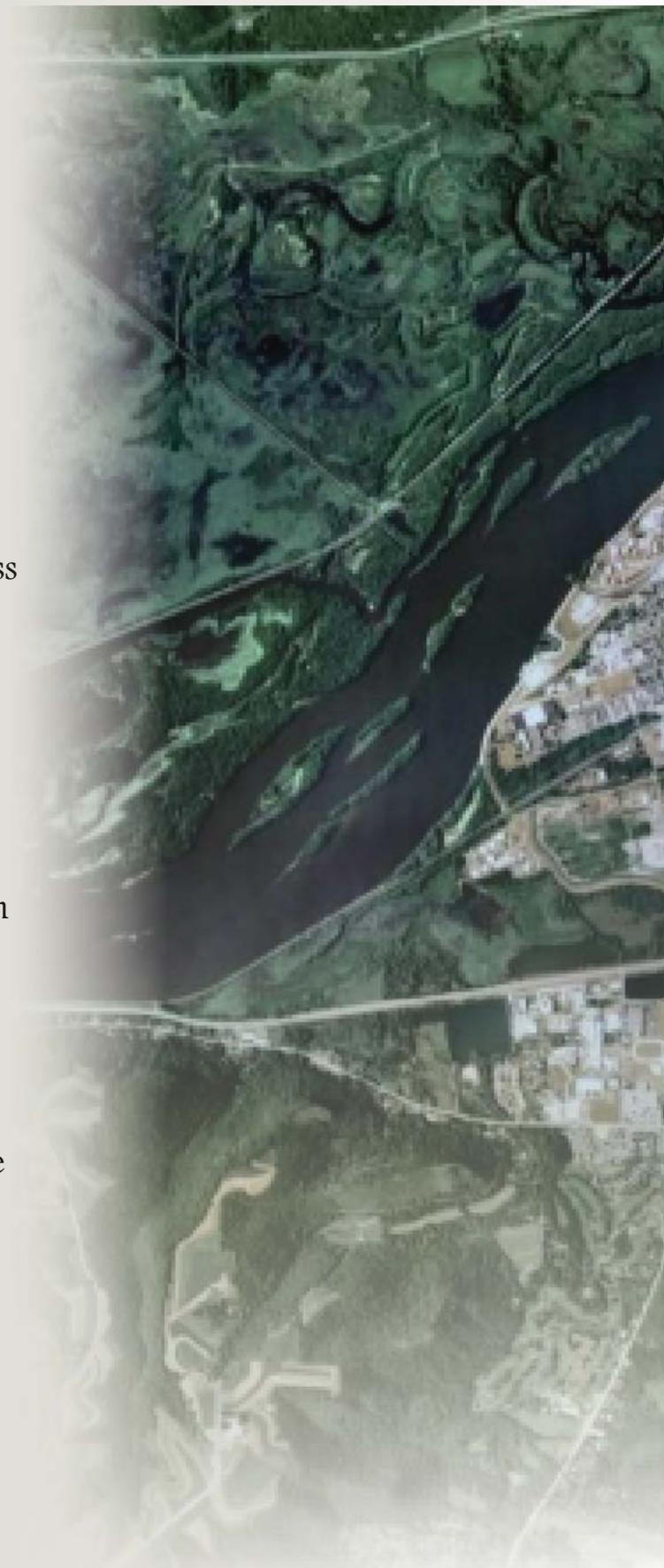
The site is more specifically located approximately two miles from the city, along US county road 43. There are currently no other buildings or structures within the site's immediate vicinity. The most striking natural landmark within the sites vicinity is Sugar Loaf Mountain, approximately two miles to the east.

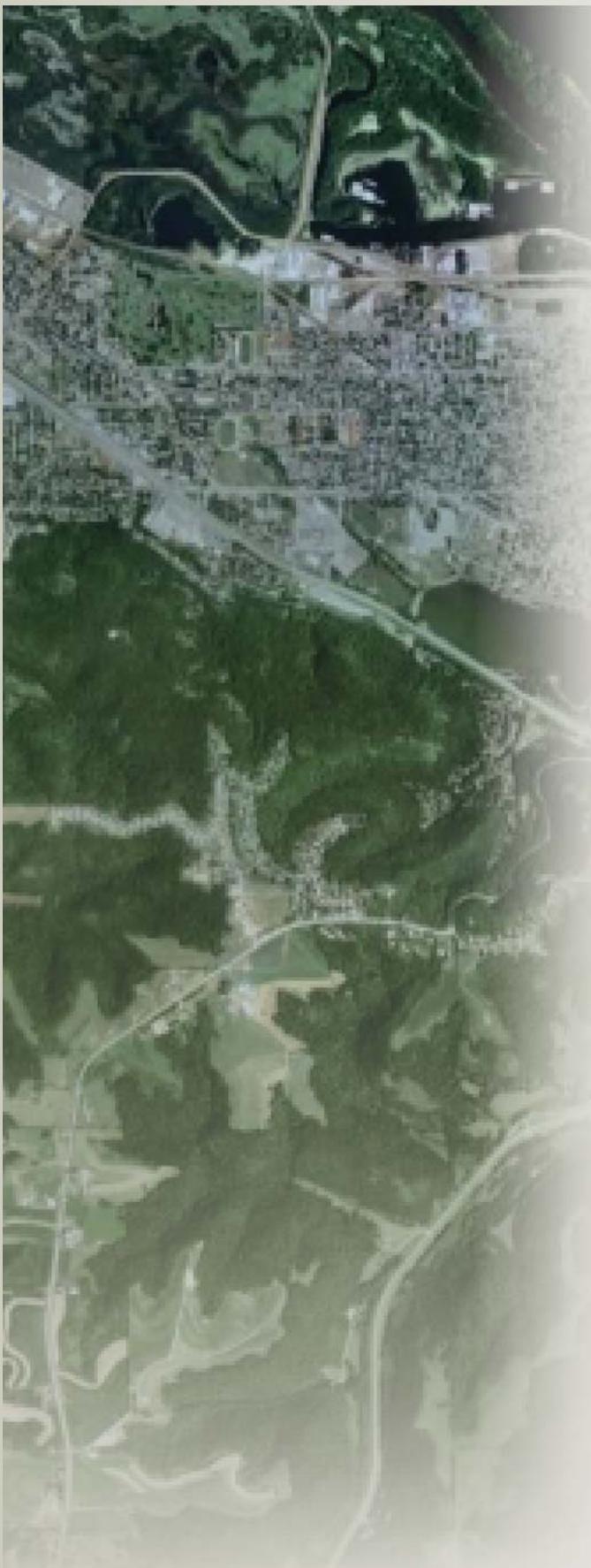
# Project Emphasis

The main goals of this project include creating a sustainable living solution for first time home buyers/renters in a geographic region harboring harsh climatological extremes. This design is not to be completed lavishly, rather through modest yet inventive sustainable techniques, thereby remaining affordable for the bulk of middle class citizens.

More specific goals include using little to no non-renewable energy off of the city power grid through the Development of a self sustaining means of power year round. This will likely be achieved through a combination of methods.

A final major point of emphasis will be to create as little waste and negative impact on the site as possible during the construction of the building.





## A Plan for Proceeding

Prior to design, extensive research and case studies will be conducted covering the areas of site and typology, as well as historical matters concerning sustainable design. The bulk of the research will be done through a mixed method of both qualitative and quantitative means.

# Previous Studio Experience

Second Year, Fall 2005: Stephen Wischer  
Tea House  
Moorhead, MN

Second Year, Spring 2006: Vince Hatlen  
Public Library  
West Fargo, ND

Center For Interdisciplinary Investigation  
Fargo, ND

Third Year, Fall 2006: Bakr Aly Ahmed  
Fargo Skyway  
Fargo, ND

Third Year, Spring 2007: Mike Christianson  
Museum Addition  
Amadabad, India

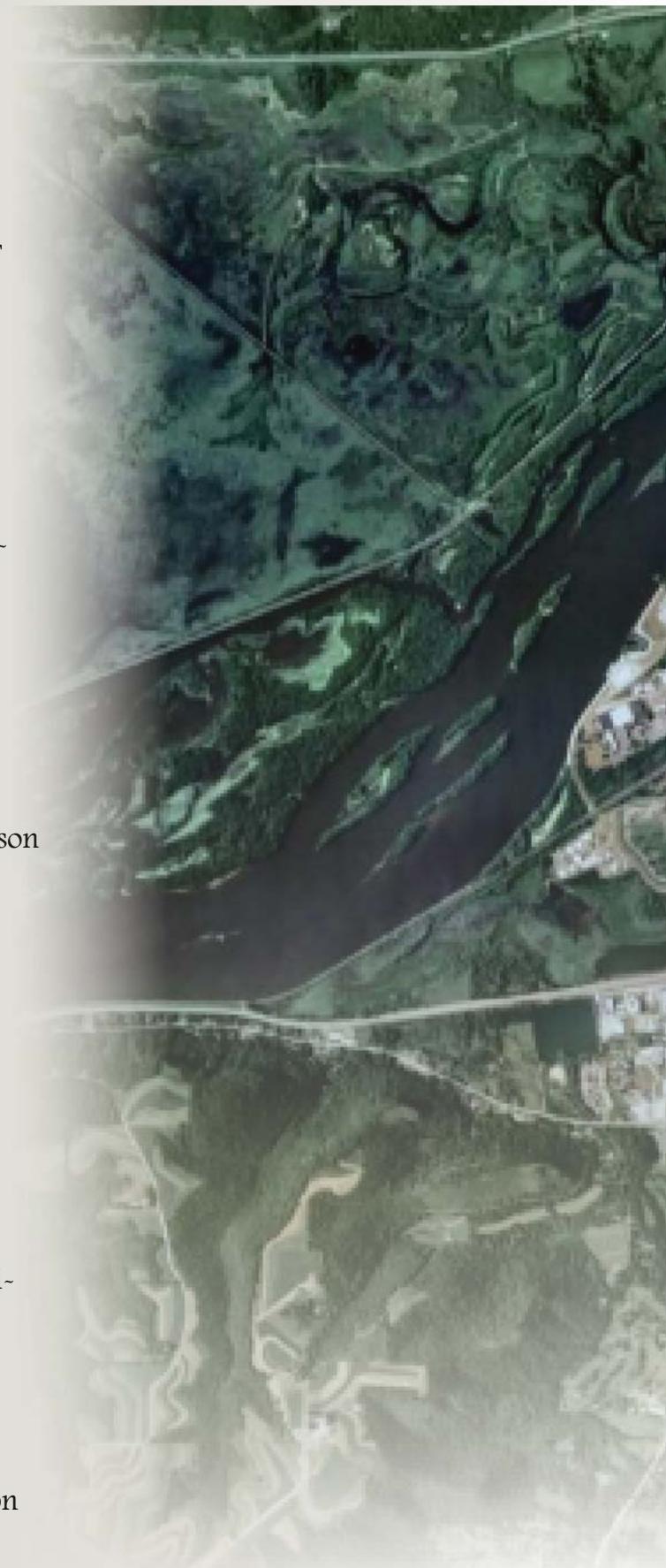
Fourth Year, Fall 2007: Regin Schwaen  
Winnipeg Master plan  
Winnipeg, Canada

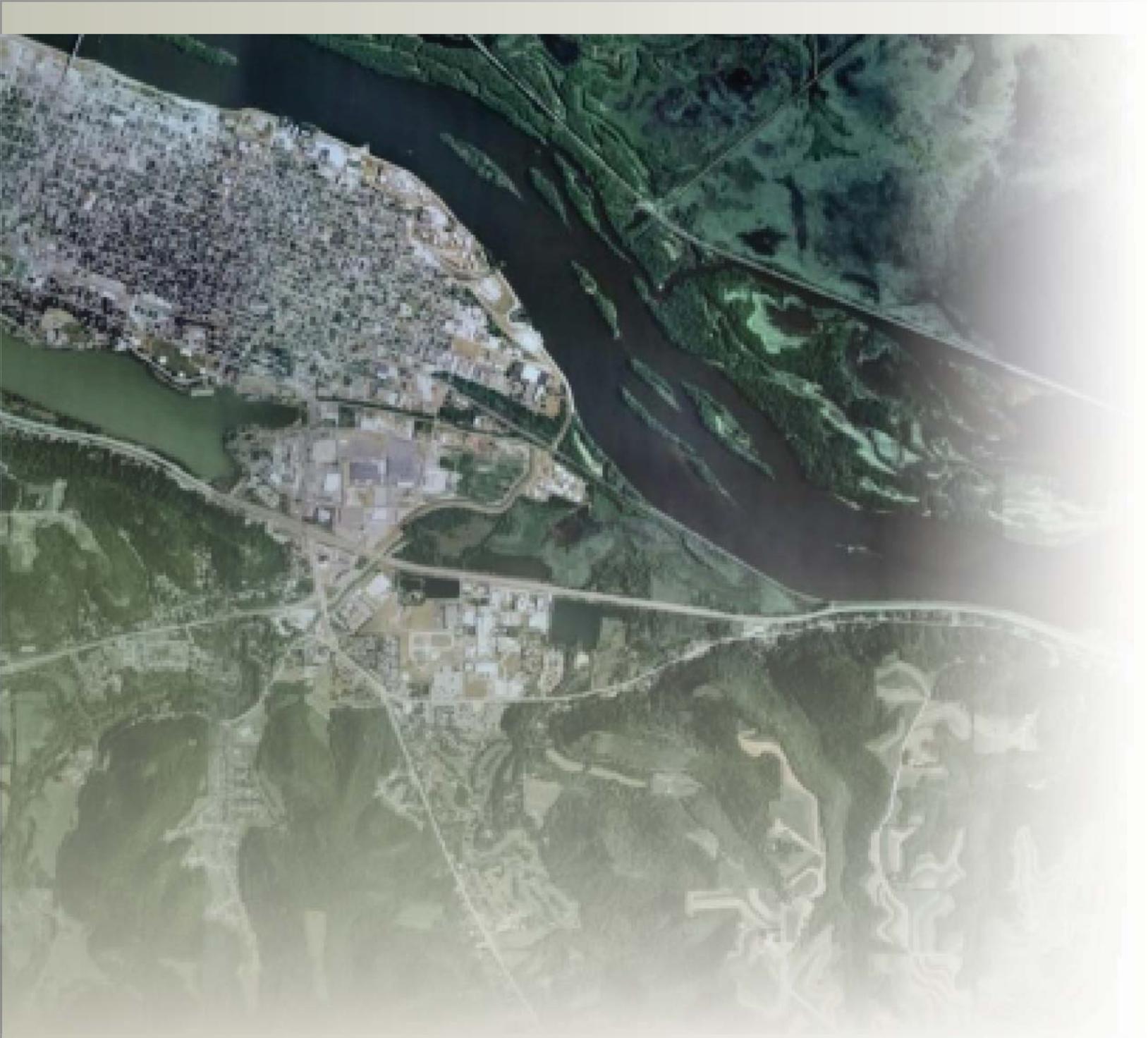
Fourth Year, Spring 2008: Frank Kratky  
High-rise Design  
San Francisco, CA

Marvin Windows Design Competition  
Bismarck, ND

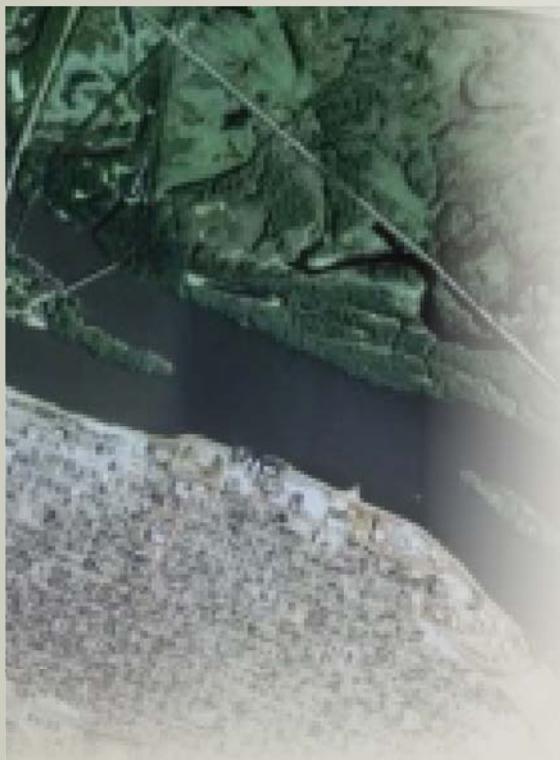
Fifth Year, Fall 2009: Mark Barnhouse

Water Resource Experiment Station  
Linton, ND





# The Program



## Research of The Theoretical Premise/Unifying Idea:

I began my research for this theoretical premise/unifying idea by looking over the Hannover Principles, a set of nine principles developed by William McDonough and Michael Braungart in 1992, pertaining to sustainability and the built environment.

These principals among the first of their kind still hold quite true by today's standards and merit mentioning as they relate directly to my project goals.

### The Hannover Principles:

1. Insist on rights of humanity and nature to coexist 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 viability of natural systems and their right to coexist.
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 state 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 as 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 processes and human activity.

# Research of The Theoretical Premise/Unifying Idea:

The Hannover Principles bring about and hint at many, if not all of the key issues concerning sustainability and the built environment today.

Principals 2 and 7 state and show that humans and all elements of their design are dependant upon the Earth and its natural resources. Based on these principals it becomes evident that we must begin to rely more heavily on readily reusable resources, and use finite ones much more sparingly.

Principals 4, 5, 6, and 9 are also extremely relevant in today's world. As a whole I think most developed countries are at least beginning to realize their mistakes and are taking responsibility by experimenting with new sustainable techniques and processes for energy production and use. No matter what is done there will always be a select group of people with little regard for either themselves or future generations; however, I believe it is the nature of the bulk of mankind to always strive for the improvement and betterment of everything and anything we do or make. Being raised and living in a world of competition helps along if not forcing this principal upon us all.

Lastly, a truly sustainable design is only so if it satisfies not only environmental and ecological concerns, but also satisfying our need for a pleasant habitable space in which people want to spend their time.

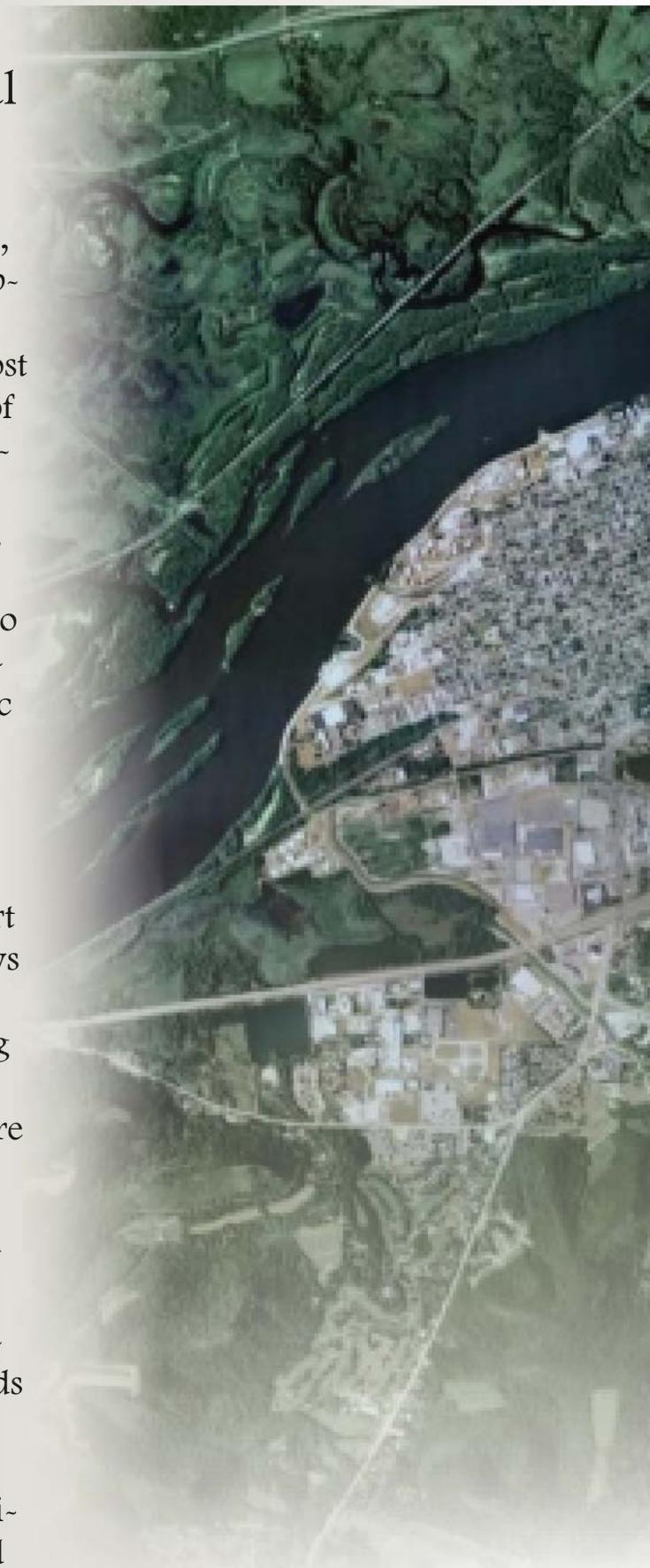


## Research of The Theoretical Premise/Unifying Idea:

My view of the sustainable movement, when speaking in broad terms, is probably close to that of much of the public's at this point. That is, we know most of our past methods as well as many of our current methods for design, building, transportation, heating, cooling etcetera are in need of some revisions.

I think we still have quite a long way to go, however, as a whole I feel the public is much more educated on the topic of sustainability in general than they were even 10 years ago. More specifically, I see the sustainable movement as an ever-evolving and ever adapting one; one that will always remain a part of our designs as architects, and always remain a concern in the minds of inventors and specialty scientists looking to design new items and improve on existing items. That is simply the nature of man, to strive for improvement.

In terms of sustainable design directly relating to architecture and the built environment, I don't really see us shying away from any one of the hundreds of implemented sustainable building techniques. There are in fact just so many of them, many with differing climatological applications, that it would be virtually impossible to track their individual frequency of use.

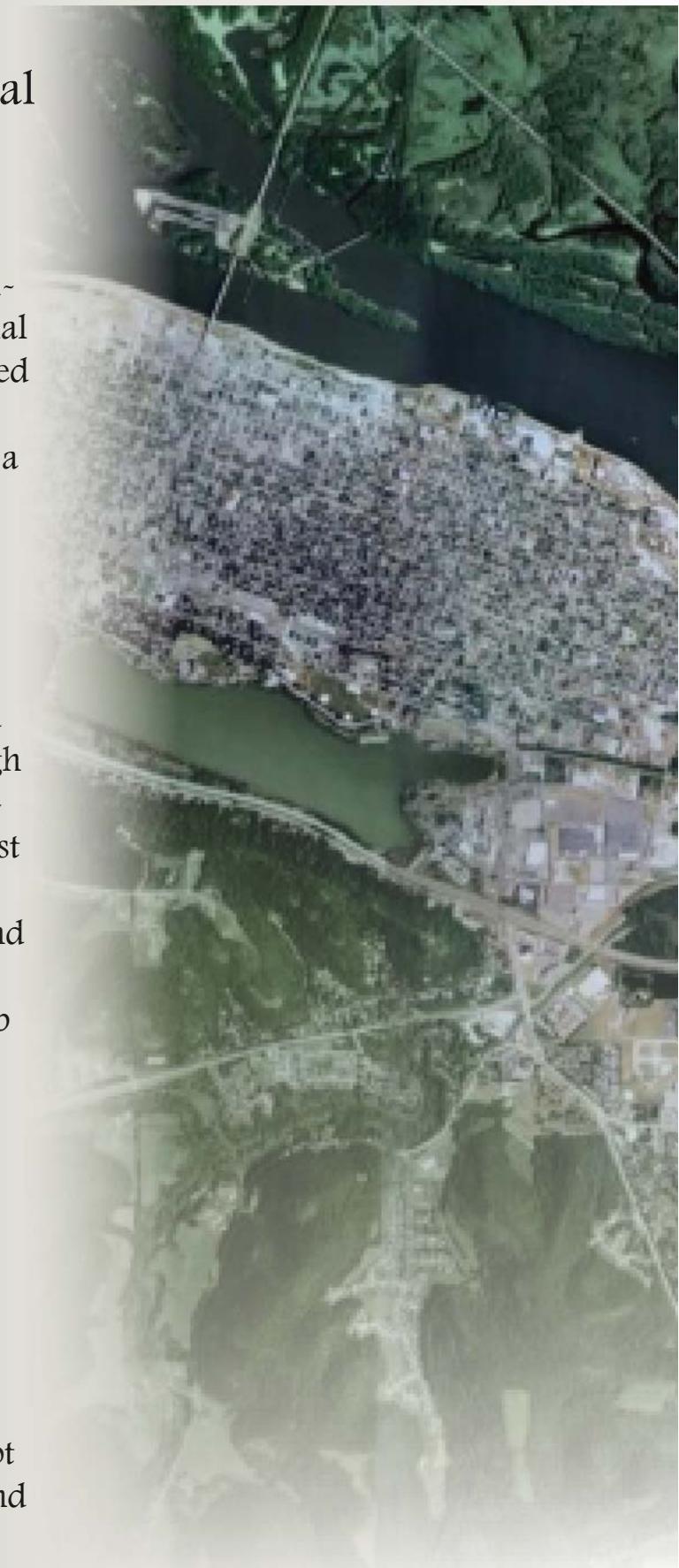


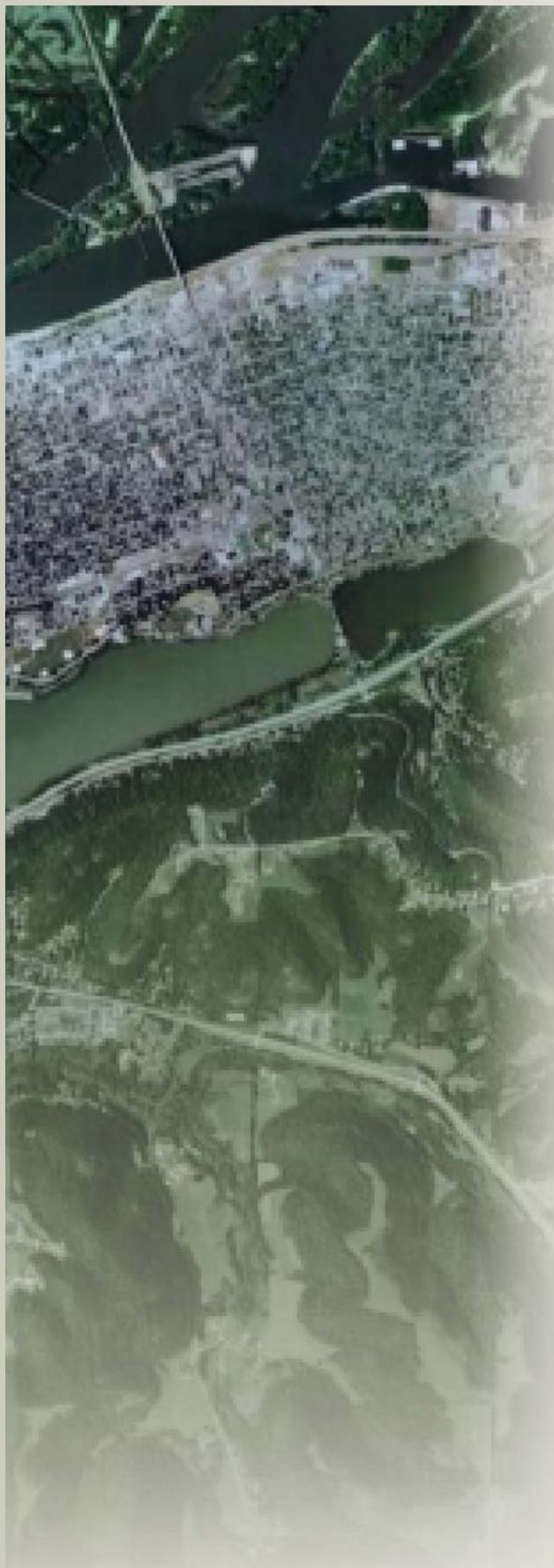
## Research of The Theoretical Premise/Unifying Idea:

A valuable technique that may be hinting at a decline is the use of conventional solar panels on a residential scale. Many newer designs have opted to use the technology of Photovoltaics, due to the fact that is in general a more compact and reliable technology.

One other big natural resource that is not used frequently enough is the process of rainwater harvesting and reuse. Many climates provide enough seasonal rainfall to render this technology effective. Excessive design cost should not be a problem if a simple collection and reuse of rainwater and other grey-water is the system to be employed. Having enough capital up front to install a full collection and filtration system is advantageous in that in wet locations it will pay for itself in savings fairly fast.

The bottom line is that I believe the sustainable movement has officially arrived and is here to stay. To me, the inclusion of sustainable properties within a design is a necessity, not just to satisfy possible future laws and ordinances, but to make the design whole and honest.





## Research of The Theoretical Premise/Unifying Idea:

Sustainable design in its most general terms means nothing more than: with responsible design and appropriate natural resource management in mind, the planet and our natural environment will be there to support us and future generations longer. This is an idea that most just can't get by without feeling they need to do their part; the above mentioned along with other currently visible destructive effects show how real of a concern this is to the masses.

To me, doing your part to preserve the planet and its limited resources is not merely the right thing to do, it's your responsibility to yourself and others.

Designing sustainably should never be thought of as a hindrance or a setback, rather it is the opposite in many instances. Implementations of sun shading devices, water filtration systems, and green or planted roofs are expressions of the architect relaying how he or she solved an environmental issue concerning the built environment.

Other simple sustainable design choices I feel enrich a design include earth integration and plan orientation of the building. These two techniques alone show the occupants and passersby that the placement and direction of the building has meaning.

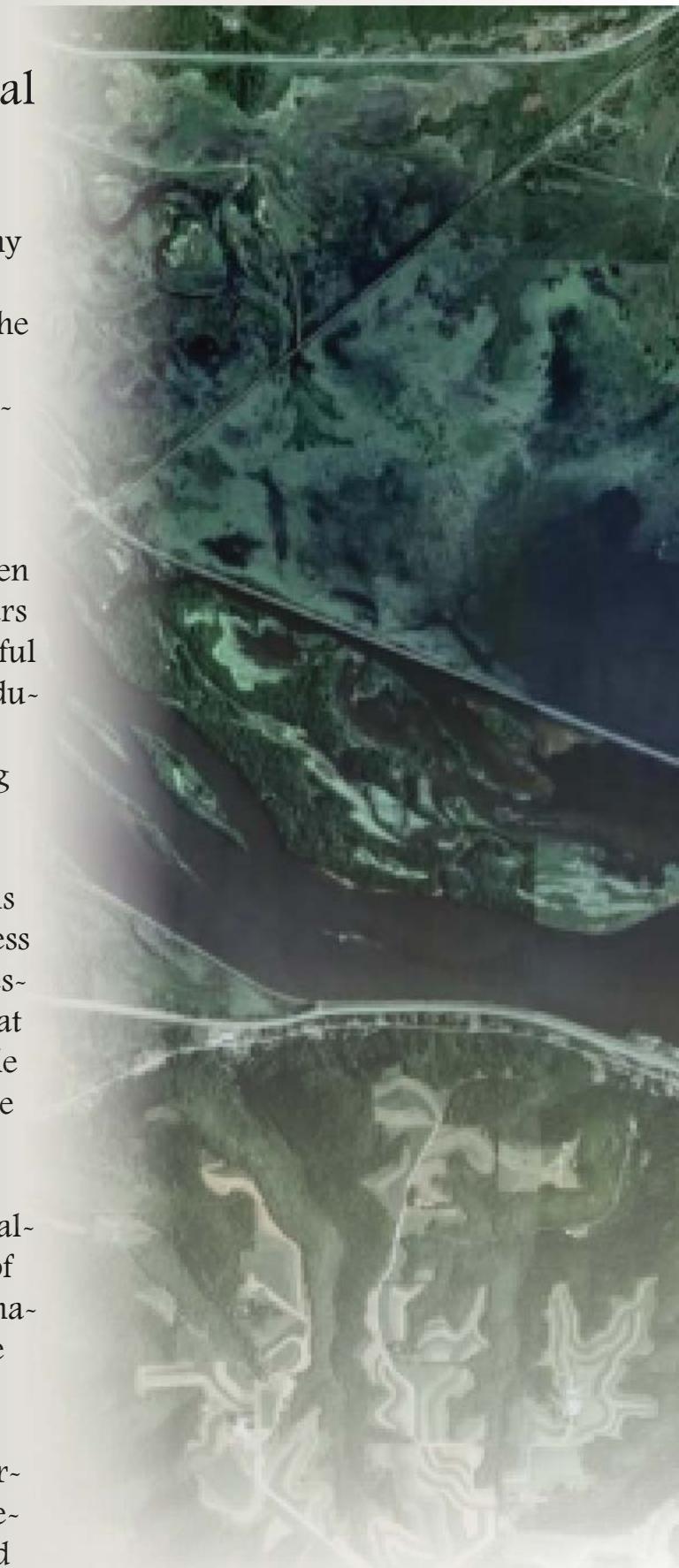
## Research of The Theoretical Premise/Unifying Idea:

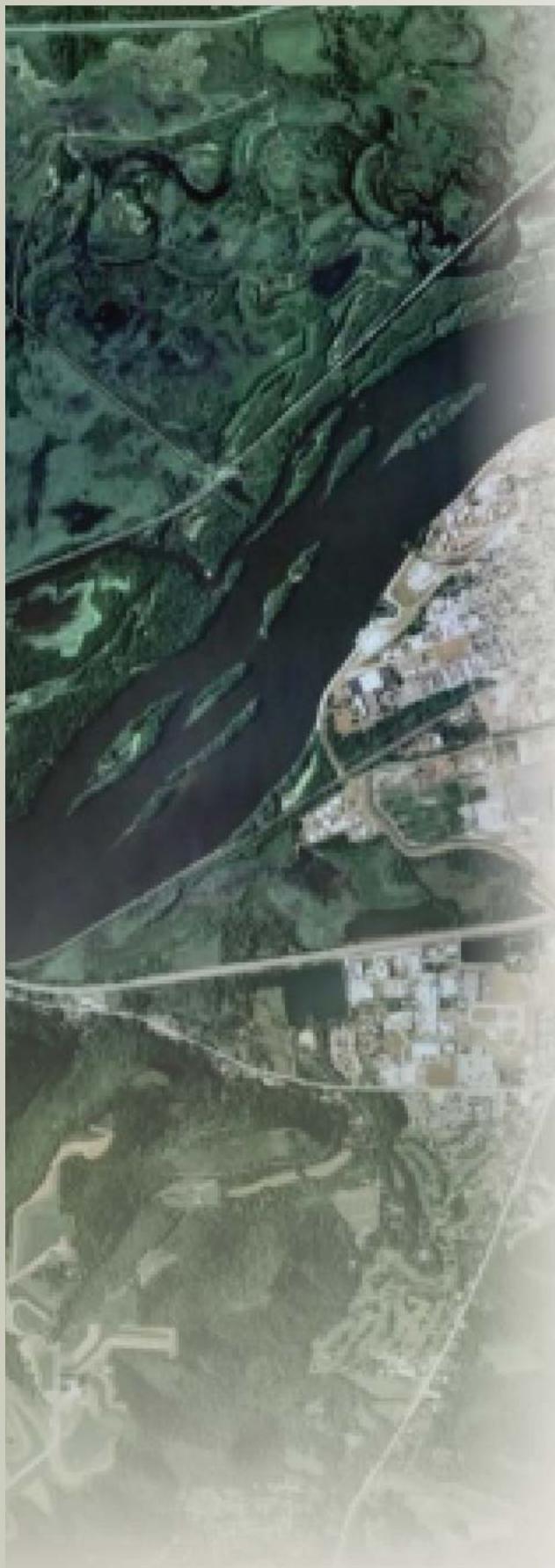
This in turn makes them curious. Many of them ask and find out the reasons behind the decisions, thus spreading the knowledge of sustainable technology down to others not in the field of engineering or architecture.

Some things we as Architects got right the first time around and have forgotten the importance of over the last 50 years or so is the issue of durability and useful building life cycles. I see this very gradually moving back in the right direction with the improvement of building materials and enhanced construction methods, however, today the question still has to be asked: How sustainable is a building if its estimated lifespan is less than 50 years? The answer to this question comes through an analysis of what percentage of the building is recyclable and reusable in the construction of the building taking its place.

Finding and maintaining the proper balance between sustainability in terms of clean materials, recyclable/reusable materials, and durable materials is where we are headed.

When investigating and trying to determine which methods of sustainable design are best for a project, the first and most important factor to consider is the climate in which the building is being designed.



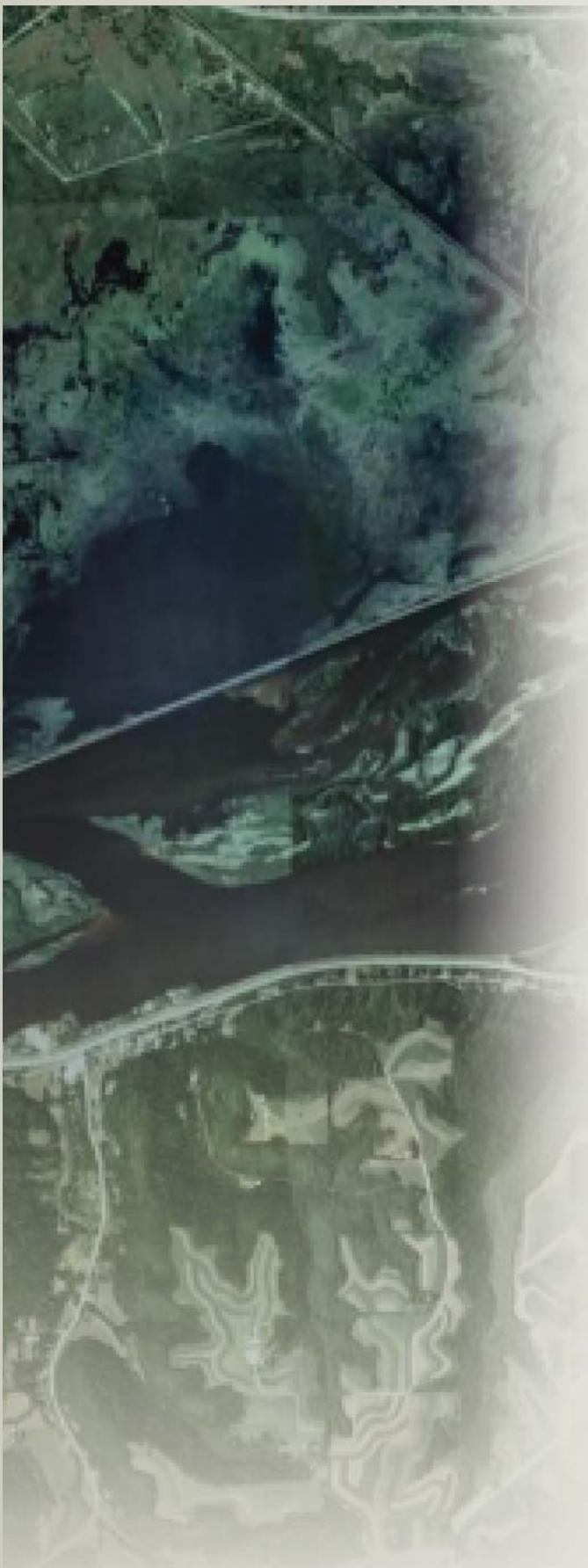


## Research of The Theoretical Premise/Unifying Idea:

In the case of this design, the site, located in South East Minnesota, poses several unique environmental challenges that are less harsh or nonexistent in other areas of the United States. Some of the largest challenges to overcome include: large seasonal temperature variances (~40 degrees during the Winter to over 100 degrees during the Summer.), large standing snow loads on roofs and other exterior portions of buildings, high humidity and dew points, and strong local valley winds.

After looking at all the major challenges with the given site concerning sustainability, the largest area of energy concern will be a direct result of how passively the issues of heating and cooling of the building is resolved.

Several passive sustainable techniques that will be employed within the design include use of curtain and trome walls along South facing glazing to maximize solar gain over the Winter months; implementation of proper sun shading devices to diffuse hot summer sun; and forms of Earth Sheltering and planted roofs to help naturally insulate the building, keeping it cooler longer in the summer and warmer long in the Winter. All these items along with properly placed openings and wind catching devices will greatly increase the building's ability to passively heat and cool itself.



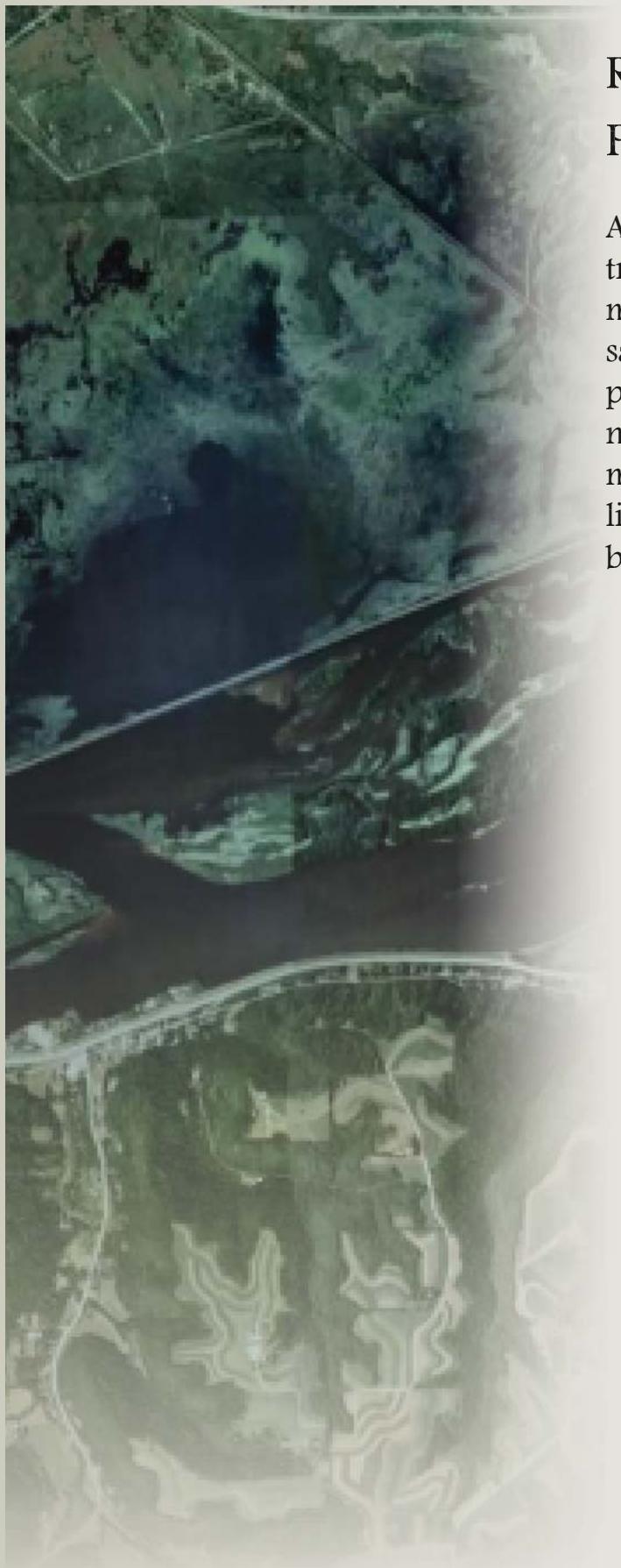
## Research of The Theoretical Premise/Unifying Idea:

Other limited energy consuming methods of sustainably heating and cooling the buildings include the use of Earth cooling/heating tubes.

Obviously not all required actions within a building can be performed passively; the solution to this is to develop and employ methods of effectively harnessing and deploying renewable clean sources of energy. Like all other areas, there are many methods of harnessing many types of renewable energy; however some are more effective than others in a given region.

Several methods of energy renewable energy collection that will be used for this project include use of solar panels for immediate energy needs, photovoltaic panels and cells for seasonal thermal storage and other future energy needs, and implementation of limited wind power as an auxiliary source of pollutant free power.

Other important sustainable techniques that will be employed within the design are a means for rainwater collection, treatment, and harvesting, as well as a self-contained waste management system. These techniques will also be positively influenced by the use of green and planted roofs and built in filtration systems.



## Research of The Theoretical Premise/Unifying Idea:

Another important issue is that of electricity, and how to responsibly use and manage it. Artificial lighting is necessary to some degree in all inhabited places. To minimize the energy and cost necessary for artificial lighting, all permanent interior and exterior artificial light sources shall use either CFL or LED based bulbs.

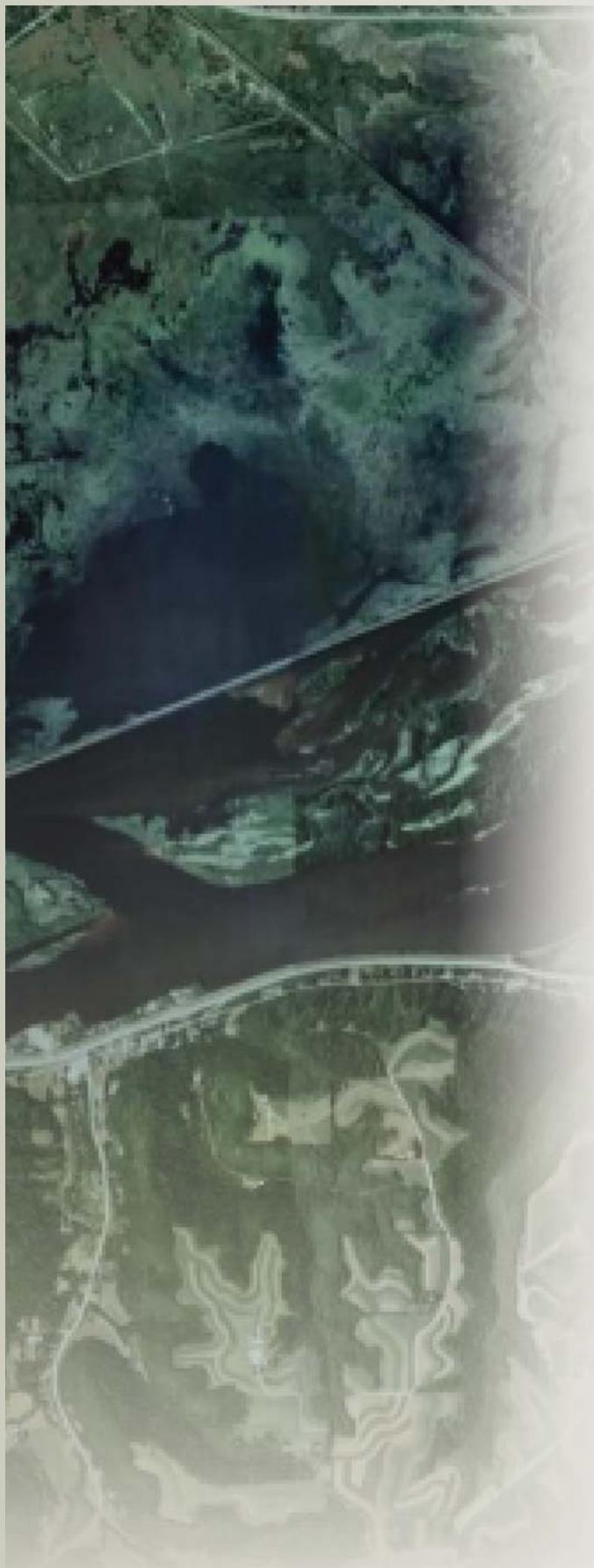


## Summary of The Theoretical Premise/Unifying Idea:

In summary, it has been claimed that although sustainable design practices may change with relation to the geographic area in which they are practiced, the underlying goals and deep seeded concepts remain the same. Through this research it has been proven that sustainable design practices have no climatological bounds and therefore can be practiced anywhere that is geographically possible to reach.

The other big question that is answered through the research is to what degree can these sustainable practices be effective in harsh climatological extremes. It is a common misconception that it is much harder if not impossible task to design a building in a harsh climate that achieves the same levels of sustainability as one designed in a more favorable forgiving climate.

It's not a great deal harder to design as sustainably in harsh climates, it just requires different ways of thinking, taking an inventory of and analyzing how to go about making use of the resources and elements you have available.



## Summary of The Theoretical Premise/Unifying Idea:

A truly sustainable design covers far more than the employment of passive and clean active systems of energy systems within a design; its the more delicate, less publicly admired details such as paint, adhesive, and furniture selection that make up for a huge part of a healthy sustainable building. Without good ventilation and superior indoor air quality, an outwardly energy efficient sustainable building serves no useful purpose.

To sum up this idea, for an Architect to truly create sustainable architecture in any location, it is of the utmost importance to always keep in mind the full scope of varying ideas and techniques that together define sustainability in its most basic form.

# Case Study: Gish Family Apartments

## San Jose, CA

Completed in 2007 and located just south of the Bayshore Freeway, The Gish Family Apartments are a low income housing solution with a focus on many sustainable design elements. Despite the location and obvious climatological differences, The Gish Family Apartments showcase that designing sustainably need not equate to designing expensively. The numerous design elements that make up The Gish Family Apartments will all be discussed in detail later on throughout the study.

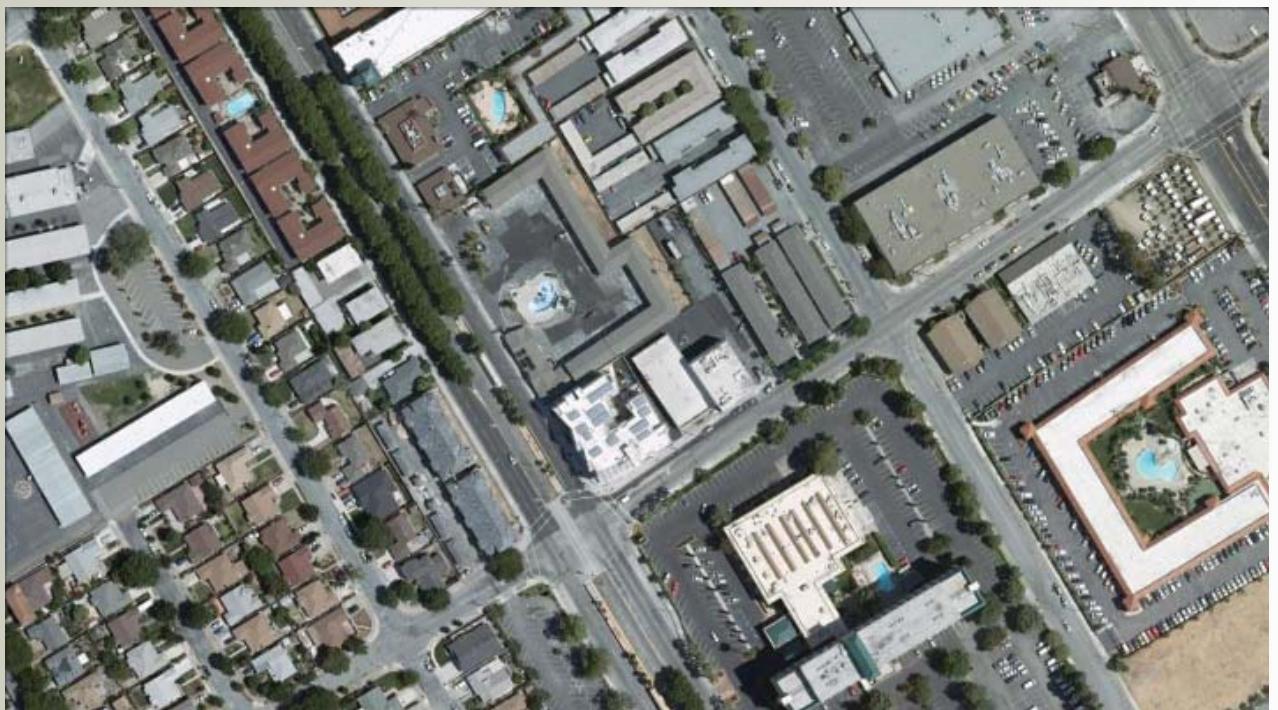


Figure 2 Aerial view of The Gish Family Apartments (2009) Source: Google Earth, Copyright Google.

# Case Study: Gish Family Apartments

## San Jose, CA



Figure 3 Typical floor plan of Gish Family Apartments. San Jose, CA (2007)  
Source: Green Source Magazine, Copyright Bernard Andre.

Typical residential layout showing areas of circulation and areas of usable space.

As seen through the graphical study, the main artery for circulation composes roughly 25% of the total available floor space and the private circulation space accounts for an additional 10% of that space, leaving 65% of each floor to usable living and work space.

# Case Study: Gish Family Apartments

## San Jose, CA



Typical residential layout showing areas divided as visually distinct masses.

Through breaking the Gish Family Apartment building up into a series of geometrically similar shapes it becomes apparent which portions of the building appear repetitive and which portions appear unique. As seen above, the two main facades of the building are made up of what is seen as repetitive and dominant, a series of trapezoidal shapes comprising the bulk of the dwelling units. The cluster of rectangles appear as if they are being sheltered or compressed into one or two definitive pieces, making this the geometrically unique portion of the building.

# Case Study: Gish Family Apartments

## San Jose, CA

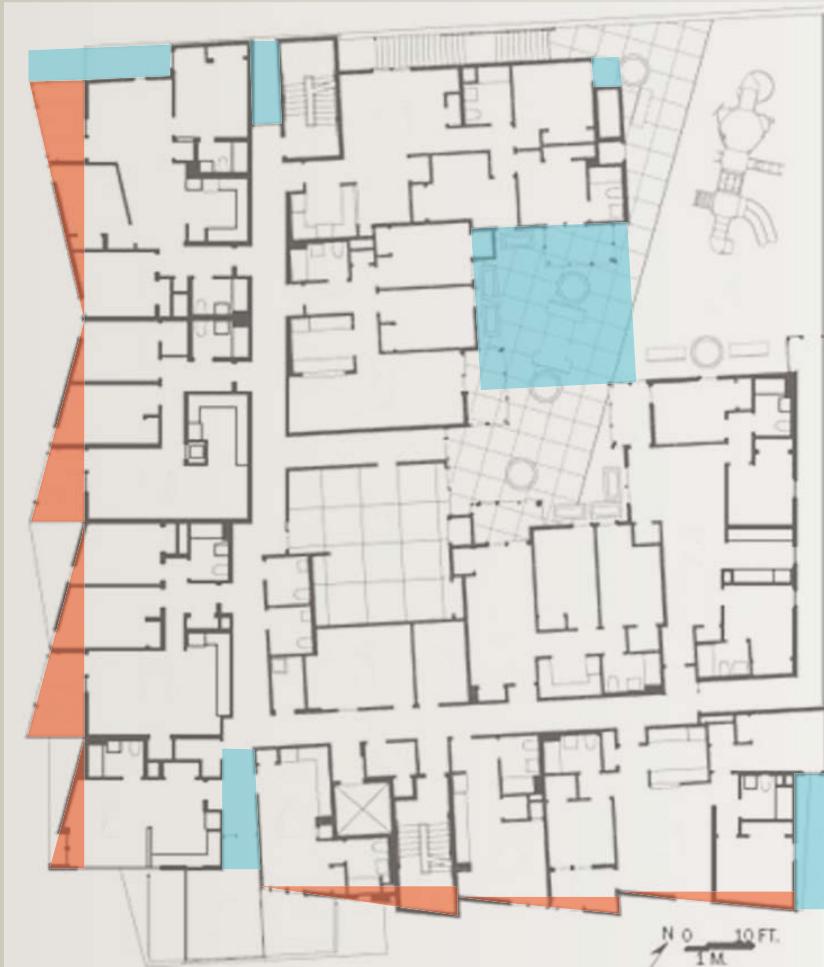


Figure 3

Highlighted portions of building and space implied through void.

Two things become apparent when studying the Gish Family Apartment building in terms of additive and subtractive building elements; one being, the building is quite evenly balanced, the other being that despite the additive fin-like balcony's bold appearance in plan view, the building overall is fairly reserved. It also becomes apparent that even subtle additive and subtractive elements are an integral piece to any facade of interest.

# Case Study: Gish Family Apartments

## San Jose, CA

Spacial Configuration of a typical three Bedroom Unit:

1 = Private Balcony

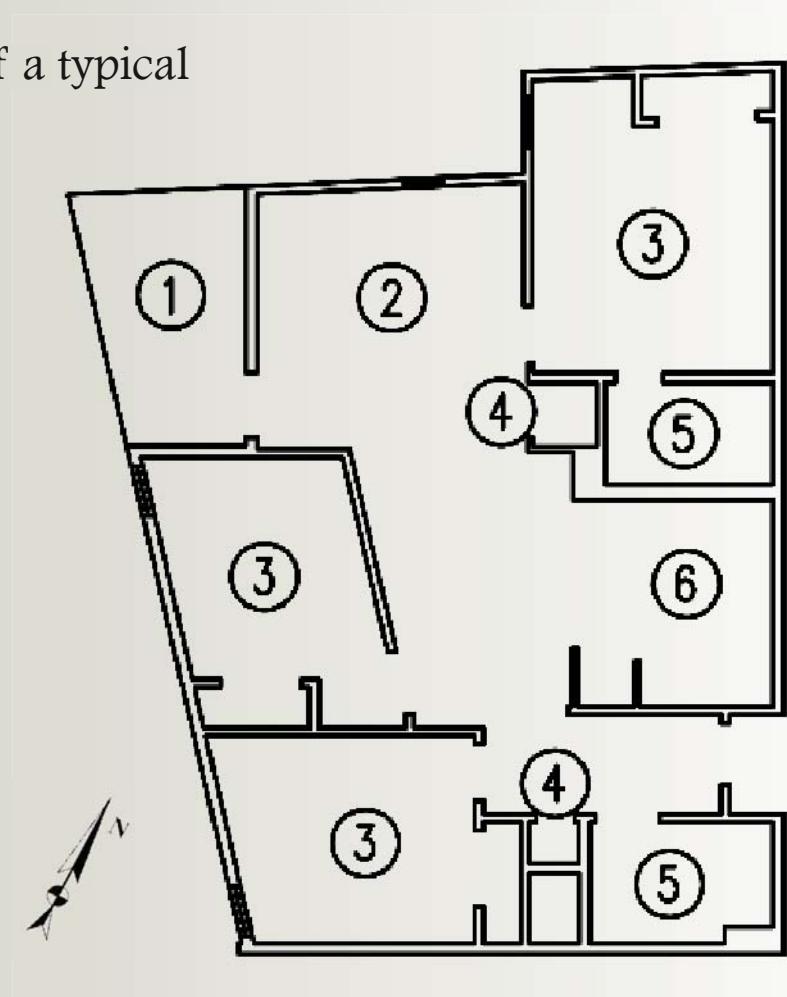
2 = Family Living Space

3 = Bedroom and Closet Space

4 = Closet/Storage Space

5 = Bathroom

6 = Kitchen



Spatially, The Gish Family Apartments are laid out quite simply and without excess space. A typical three bedroom unit averages 1030 square feet of living space; quite small for a family of three. However it must be kept in mind that these apartments are intended as a low income housing solution. All three of the bedrooms are more than adequate in size, averaging over 200 square feet, not including the closet space. Areas where space was heavily condensed include bathrooms, auxiliary storage space, and a modestly sized kitchen. A 300 square foot family living area and 150 square foot outdoor balcony make up the majority of community space within the apartment.

In terms of spacial configuration concerning room use, all of the units are laid out to maximize natural day lighting and ventilation in the bedroom and family spaces by placing them along the outer walls. The specialized and less occupied areas are all nested along the inner edges of main living spaces. Due to limited square footage, closed corridor space restricted solely to circulation was kept to a minimum.

# Case Study: Gish Family Apartments

## San Jose, CA



Figure 4 Birdseye view of Gish Family Apartments. San Jose, CA (2007) Source: Green Source Magazine, Copyright Bernard Andre.

The Gish Family Apartment Building is a four story 72,000 square foot low income family apartment building in San Jose, CA housing 35 apartments ranging in size from individual studios up to 3 bedroom units. The building is mixed use, with many of its on-site services occupying the ground floor. Among these services is a convenience store, youth extra curricular activity area, laundry area, computer lab, community room, and outdoor courtyard.

Visible in the above photograph are several sustainable building and design techniques, as well as a sustainable site consideration. Clearly visible is a 12 piece photovoltaic solar collection system. Building studies have shown that the system yields over 40,000kWh per year, saving the building nearly 100,000 pounds of CO<sub>2</sub> emissions annually, 35% for a minimally compliant building of its size and function. Also seen near the top left of the photograph is an existing light rail system for which residents are given free passes for unlimited usage (Boehland 2009).

# Case Study: Gish Family Apartments

## San Jose, CA



Figures 5 & 6 Eastern perspective and view from 3rd story window of Gish Family Apartments. San Jose, CA (2007) Source: Green Source Magazine, Copyright Bernard Andre.

In both the perspective view looking East and in the image below several other notable sustainable qualities are visible; boldly topping the building is a large sun shading device servicing the Southern curtain wall from the midday sun. Also seen above are smaller sun shading trellises along the West wall covering the individual balconies. Also contributing to the sense of place along the sidewalk without creating a need for additional water usage are



# Case Study: Gish Family Apartments

## San Jose, CA

Sustainable measures taken throughout various areas of the design broken down by category:

**Site Design:** Reduction in total amount of land used was reduced by over 50% due to an underground parking lot for all residents. Cool-Roof technology provided by Firestone TPO helps to eliminate a local heat island effect.

**Water Use:** A sub-surface irrigation system and use of drought tolerant plants help to reduce the amount of potable water necessary. These items along with the implementation of dual-flush toilets and low-flow faucets and showers amount to a 62% reduction in potable water required.

**Energy Use:** A 45.2kW rooftop photovoltaic system provides the building with roughly 20% of its electrical needs, saving in grid energy costs and CO<sub>2</sub> emissions. Adding to energy savings are the use of all EnergyStar rated major appliances, including refrigerators, freezers, washers, and dryers.

**Building Materials and Components:** Aiding in the passive cooling of the building are fully operable windows and 2x6 walls for added insulation space. Made from wheat and rice straw, rapidly renewable Greencor Agfiber doors are used throughout the building, thereby minimizing the need for slower growing lumber. All community, computer room, and housing furniture and carpeting contain no harmful chemicals or adhesives that may become volatile over time. Formaldehyde free MDF and particle board were also used in the construction of the building. More than 20% of the items listed above were all manufactured within 500 miles of the site, saving on shipping and fuel emissions to the site. More than 90% of the construction waste was also recycled. With an exterior comprised of solar-reflective metal, concrete, and stucco, The Gish Family Apartments were designed and built to satisfy the needs of both sustainability and durability.

# Case Study: Dockside Green: Townhomes at Dockside Wharf Victoria, BC



Figure 7 Elevation drawing of buildings at Dockside Green Victoria, BC (2008) Source: Green Source Magazine, Copyright Enrico Dagostini.

Dockside Green is a recent mixed-use 15 acre development bordering the harbor in Victoria, BC. The development is comprised of 4 main building types including an 8 story mixed-use tower, 2 story town houses, a 5 story mixed-use tower, and a series of 3 story town houses. With 26 buildings in total, Dockside Green is Victoria's largest development ever; housing over 2,500 residents. The development overall received a record setting LEED Platinum certification, accumulating 63 criterion points. The portion of the development the case study will focus in on is the series of 3 story town houses seen in the bottom right of the image above.

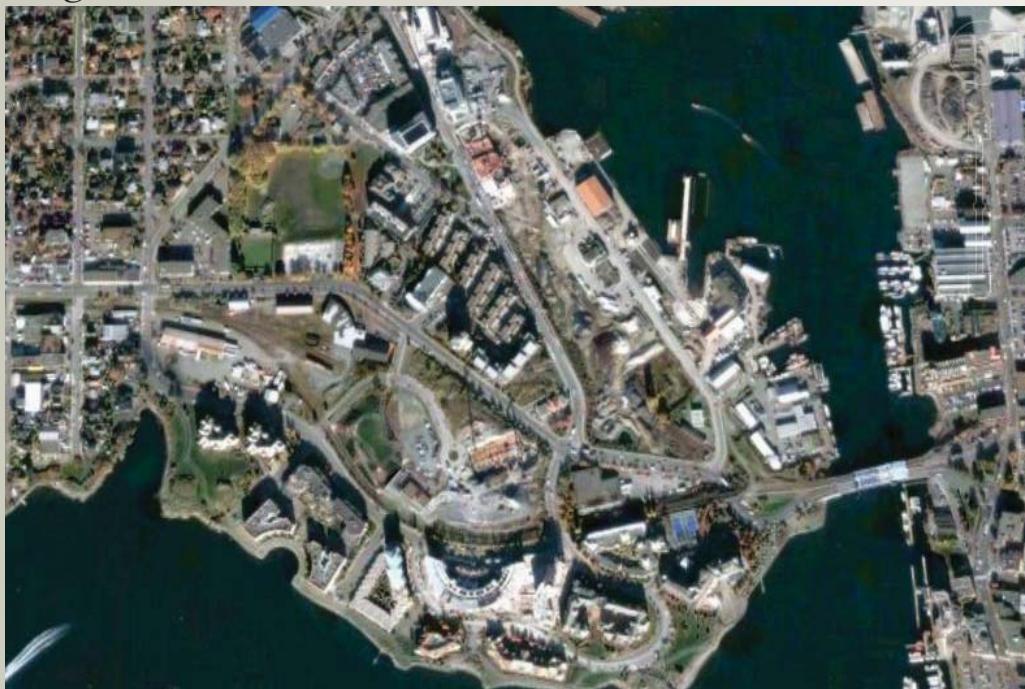


Figure 8 Aerial view of Dockside Green Victoria, BC (2009) Source: Google Earth, Copyright Google.

# Case Study: Dockside Green: Townhomes at Dockside Wharf Victoria, BC



Ground Level  
Floor Plan



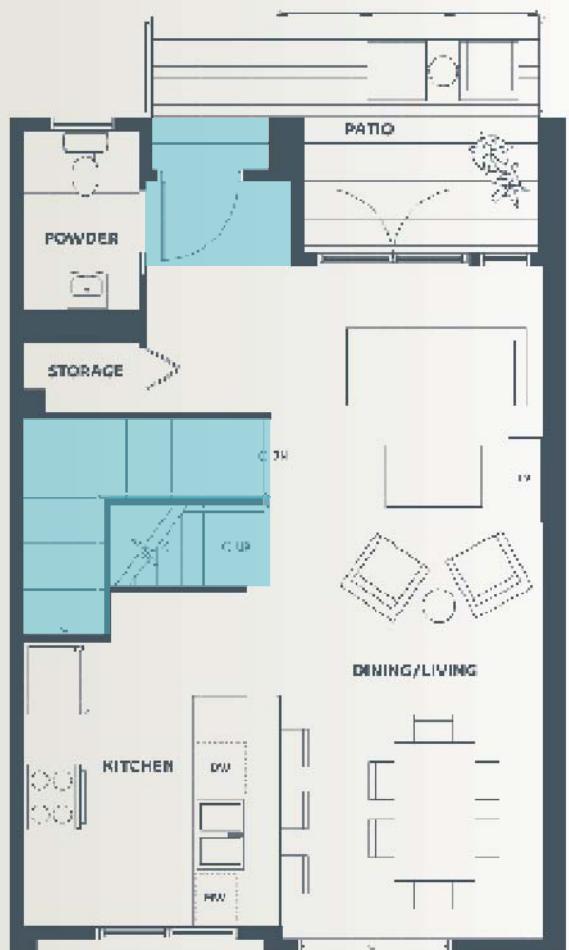
= Circulation  
Space



= Usable space

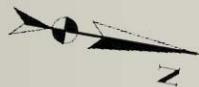
Figures 9 & 10 Floor plans of townhomes at Dockside Wharf Victoria, BC (2008) Source: <http://docksidegreen.com>, Copyright <http://docksidegreen.com>

Main Level  
Floor Plan



The Townhomes at Dockside Wharf are designed with three stacked floors and a roof deck, with all 7 units in the building lined up next to each other.

The areas of each floor plan that are restricted to only circulatory use are quite compact and limited to one or two areas per level. This equates to more livable space without increasing the overall size of the building. Livable square footage varies by level and ranges from 230 square feet on the ground level up to 660 square feet on the second level for a rough total of 1500 square feet per unit.



# Case Study: Dockside Green: Townhomes at Dockside Wharf Victoria, BC



Second Level  
Floor Plan



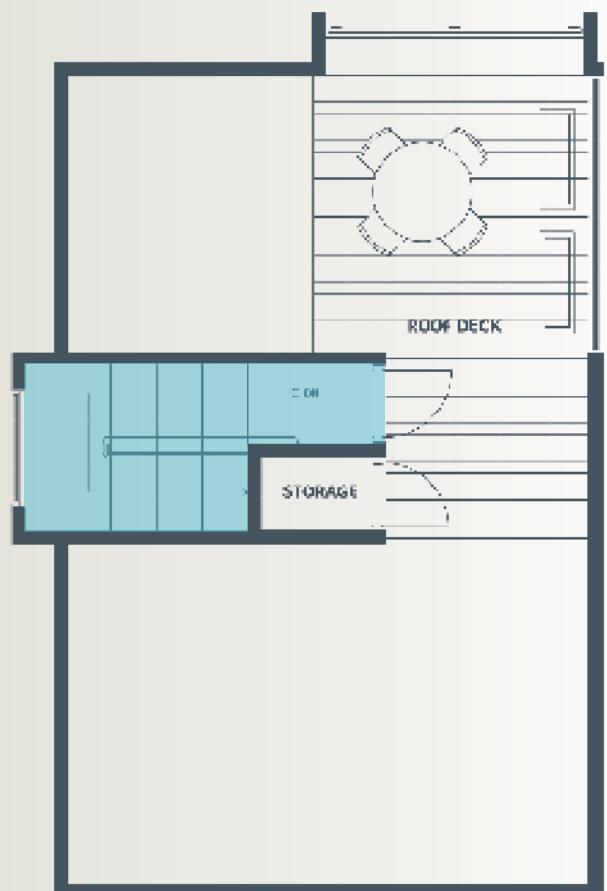
= Circulation  
Space



= Usable space

Figures 11 & 12 Floor plans of townhomes at Dockside Wharf Victoria, BC (2008) Source: <http://docksidegreen.com>, Copyright <http://docksidegreen.com>

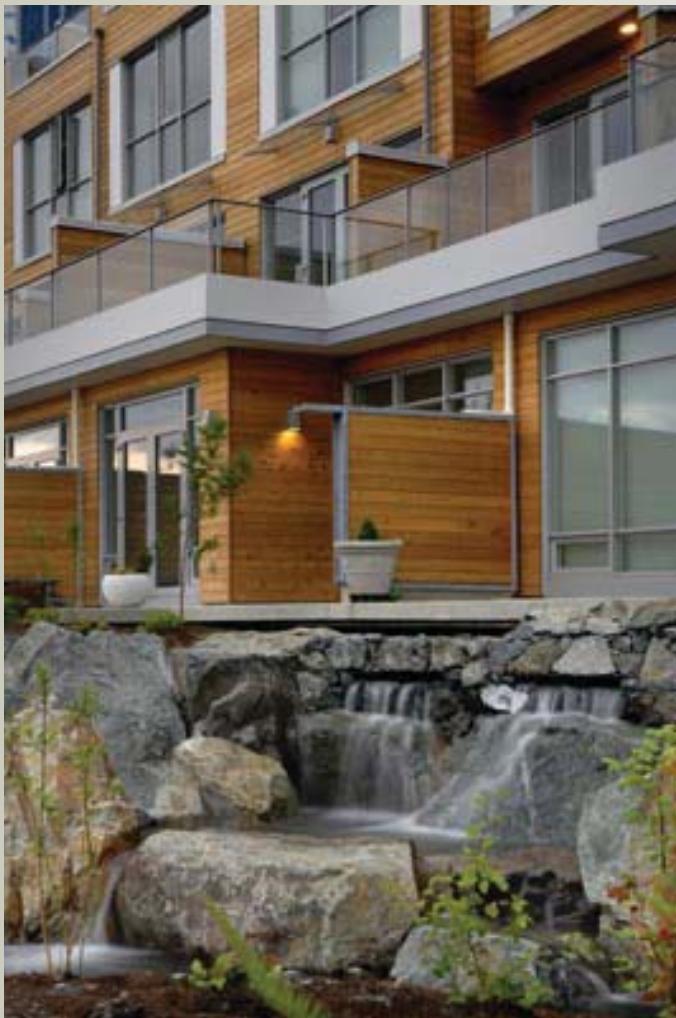
Roof Level  
Floor Plan



Spacial configuration of the townhomes separates family use and private spaces by level. The bedrooms are located on the second floor all with their own access to natural day lighting and ventilation. Each unit also includes two separate outdoor 150-200 square foot deck spaces; one directly off of the west wall of the main floor, the other on the roof of the building.



# Case Study: Dockside Green: Townhomes at Dockside Wharf Victoria, BC

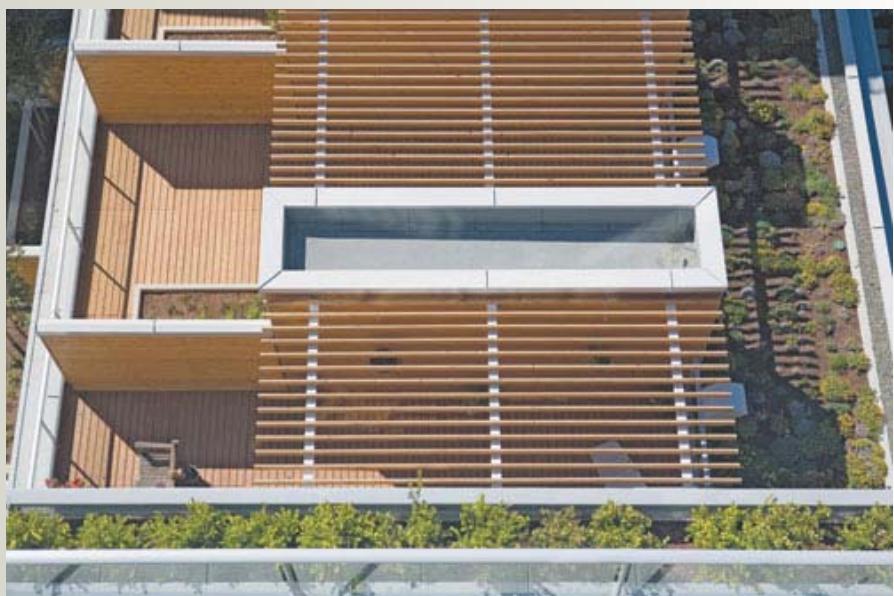


Figures 13 & 14 Western perspective and aerial view of a roof at Dockside Green Victoria, BC (2008) Source: Green Source Magazine, Copyright Enrico Dagostini.

Overhead trellises and harvested wood decking make up for roughly one third of the rooftop of each unit. The remaining portion is covered by a green roof system.

The photograph to the left captures the west side of the series of townhomes, showcasing a portion of the creek and pond system that wind throughout the development.

Convenient site location of the Townhomes at Dockside Wharf plays a big role in their level of efficiency; a number of everyday services and areas for interacting with the outdoor world are within a very close proximity. Some features and conveniences include, direct access to the waterfront and abutting piers, trail connection following a landscaped creek and pond system, community amphitheater, park/play areas, and a car-sharing and localized mini-transit system (Hart 2009).



# Case Study: Dockside Green: Townhomes at Dockside Wharf Victoria, BC

Sustainable measures taken throughout various areas of the design broken down by category:

**Site Design:** Even though there is ample space on the site, townhomes were chosen to be built as multi-story buildings to maximize resident capacity without greatly reducing a family's overall living space. Buildings and their corresponding interior spaces were also oriented to take maximum advantage of solar gain during the winter months.

**Water Use:** The combination of dual flush toilets, low flow showers and faucets, and an on-site sewage treatment and rainwater collection system amount to an estimated 60% reduction in water usage which equates to a savings of 70 million gallons of potable water per year.

**Energy Use:** Passive modes of energy reduction include the implementation of sun shading devices on southern and western facades, and the use of a thermally insulated Low-E glazing system. Heat recovery ventilators are employed to help pre-warm incoming air. A biomass gasification system fueled by local wood waste provides all of the heat and hot water used on the development. Other sources of energy savings include Energy Star rated appliances and motion activated LED and fluorescent lighting systems. All of the above energy saving techniques and appliances amount to a 50% more energy efficient building.

**Building Materials and Components:** Sustainable building material for the structure and shell of the townhomes include concrete floor slabs mixed with 40% fly ash and engineered wood from Triton Logging, a company local to the city of Victoria. The engineered wood is all harvested from flooded hydro-reservoirs, providing a virtually unlimited source of lumber. The portions of the roofs not covered by deck space are green roofs with membranes provided by Soprema. Low and no VOC paints, sealants, and adhesives provided by Cloverdale Paints account for superior indoor air quality.

# Case Study: Ehrlich Residence Santa Monica, CA



Figure 15 Site and ground floor plan of the Ehrlich residence, Santa Monica, CA (2004). Source: Green Source Magazine, Copyright Benny Chan.

## Ground Floor Plan and Site:

1 = Entry Vestibule	5 = Dining Room	9 = Mechanical/Storage
2 = Stair	6 = Kitchen	10 = Garage
3 = Office	7 = Bathroom	11 = Koi Pond
4 = Living Room	8 = Laundry	12 = Terrace

The Ehrlich Residence is a sustainable single family residence located in Santa Monica, CA. The three bedroom two story residence has approximately 3,800 square feet of floor space. Completed in 2004, the total project cost was roughly \$1.1 million dollars. This study will give insight on what sustainable techniques are used, and how they may differ when up front cost is less of a factor for a single owner.

# Case Study: Ehrlich Residence Santa Monica, CA



Figure 16 Second floor and roof plans of the Ehrlich residence, Santa Monica, CA (2004). Source: Green Source Magazine, Copyright Benny Chan.

## Second Floor and roof Plan:

13 = Stair atrium

17 = Master Closet

14 = Hallway

18 = Master Bathroom

15 = Bedroom

19 = Bathroom

16 = Master Bedroom

20 = Photovoltaic Panels

# Case Study: Ehrlich Residence Santa Monica, CA

Building Section looking West:

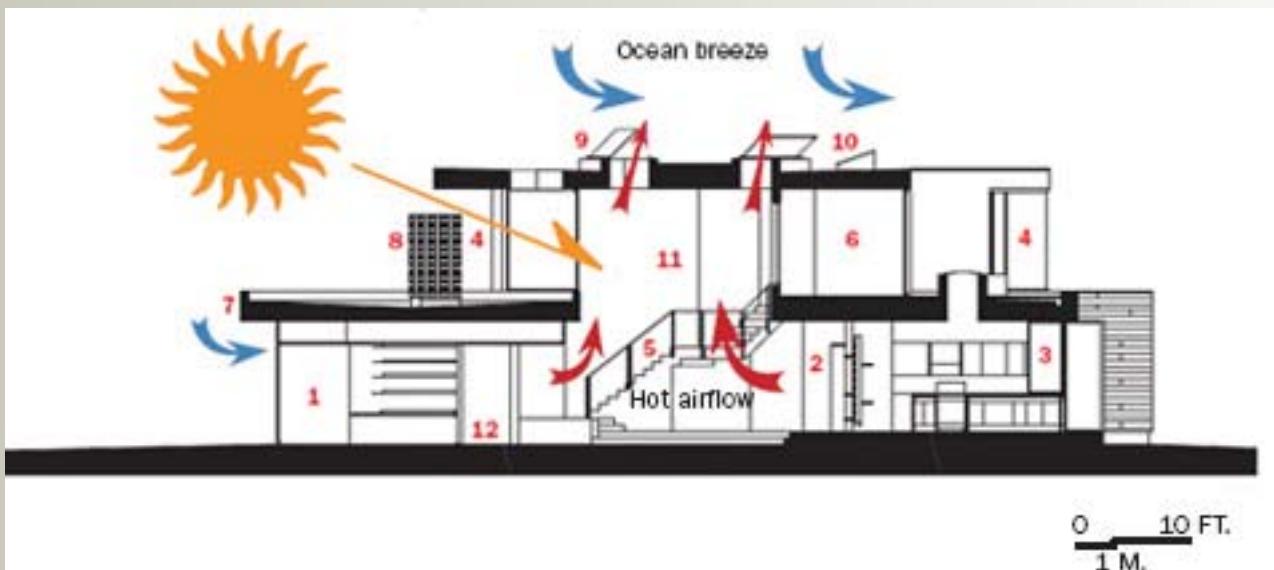


Figure 17 Section cut through the Ehrlich residence, Santa Monica, CA (2004). Source: Green Source Magazine, Copyright Benny Chan.

## Ground Floor Plan and Site:

1 = Office	5 = Open Stair/Atrium	9 = Motorized Skylight
2 = Dining Room	6 = Master Bedroom	10 = Photovoltaic Panel
3 = Kitchen	7 = Southern Sun Shade	11 = Atrium
4 = Terrace	8 = Sunscreen	12 = Radiant Heating in Concrete Slab

As made evident in the section above, the Ehrlich residence employs a number of both passive and active sustainable systems for energy collection. The sun shading devices along the south side of the house protect it from the hot summer sun while still allowing for filtered natural lighting to reach the inner areas of the building. The open stair, atrium, and motorized skylight at the center of the building are an efficient means for venting off excess heat during the day. The roof mounted Photovoltaic panels provide between 60 and 70 percent of all energy for the home. A radiant heating system helps to keep the concrete floors room temperature overnight and during the cooler months of the year.

Several sustainable techniques and products applied but not evidenced here include, a grey water recycling system beneath the koi pond, and the use of low-E glazing and FSC certified Jatoba and Mangaris woods for flooring and partitioning purposes respectively (Chen 2009).

# Case Study: Ehrlich Residence Santa Monica, CA

## Sun Study:

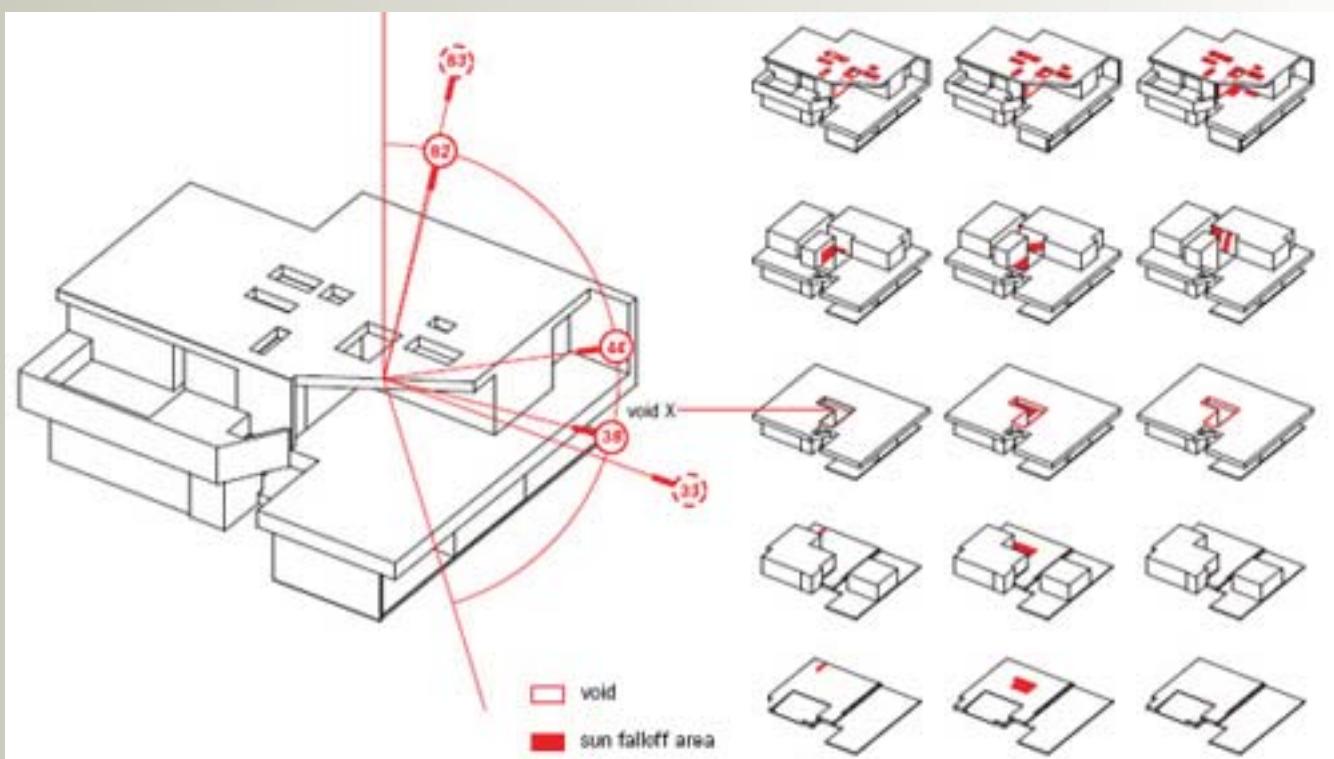


Figure 18 Sun study on the Ehrlich residence, Santa Monica, CA (2004).  
Source: Green Source Magazine, Copyright Benny Chan.

38

44

82

This sun study completed by the Architect, John Friedman shows a series of skylights and how far sunlight penetrates into different levels of the building at different times of the year. 38, 44, and 82 represent the declination of the sun at noon during the Winter Solstice, January 15th, and the Summer Solstice respectively. The diagrams on the right half of the image shows the building broken down by layer displaying where the natural light is cast at the varying times of the year.

# Case Study: Ehrlich Residence Santa Monica, CA



Figure 19 Koi pond at the Ehrlich residence, Santa Monica, CA (2004). Source: Green Source Magazine, Copyright Benny Chan.

Looking North West, is a photograph of the “L” shaped Koi pond that hugs the outer half of the living room. The pond acts as a passive air conditioner during the day, cooling off the hot air blowing towards the house that radiates from the gardens beyond.

A view of the open staircase and atrium above show the massive quantities of natural light that reach the inner areas of the house. Seen in the lower right hand corner are shadows being cast from the multiple variously sized skylights above.



Figure 20 Atrium at the Ehrlich residence, Santa Monica, CA (2004). Source: Green Source Magazine, Copyright Benny Chan.

# Case Study: Schollmeier/Meyer Residence Winona, MN



Figure 21 Southern view of Schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.

The Schollmeier/Meyer residence is a single family home remodeling project located along the south facing bluffs along highway 43 in Winona, MN. The original home was constructed in 1965, utilizing commonplace building practices and techniques of the time. The house is comprised of roughly 2200 square feet of floor space between the first and second floors. An unfinished basement adds an additional 1000 square feet of space.

Though this case study it will become evident that designing sustainably within an existing structure can be achieved through both the additions of new features as well as modifications of existing ones.

# Case Study: Schollmeier/Meyer Residence Winona, MN

The Schollmeier/Meyer residence remodeling is currently a work in progress. All of the preliminary floor plan changes as well as many of the added sustainable features, which will be discussed later, were set in place by the current owners with the help of other specialists in their respective fields.

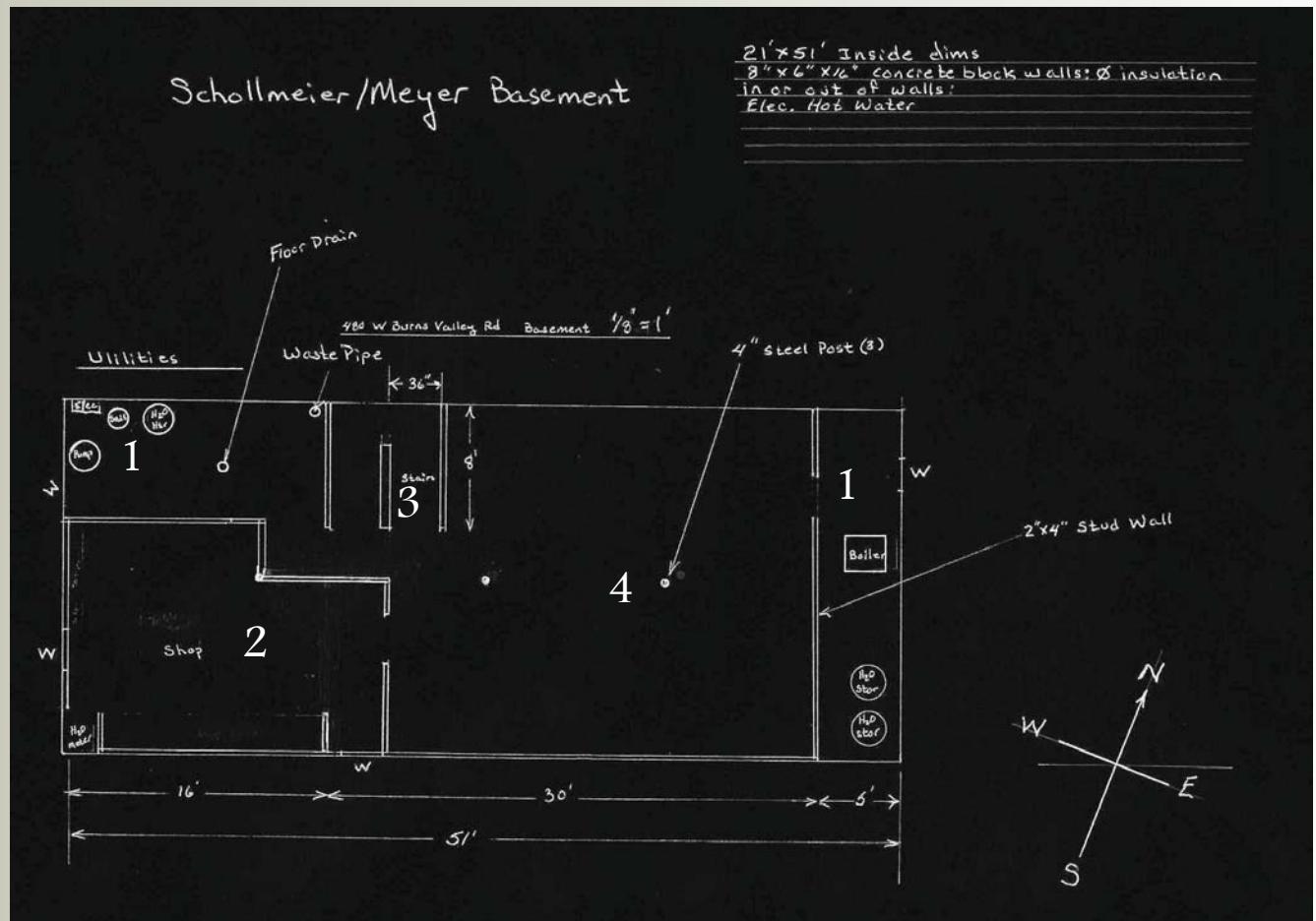


Figure 22 Basement floor plan of Schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.

## Basement Plan:

- 1 = Utilities/Mechanical Space
  - 2 = Workshop
  - 3 = Stairs
  - 4 = Undeveloped Space

# Case Study: Schollmeier/Meyer Residence Winona, MN

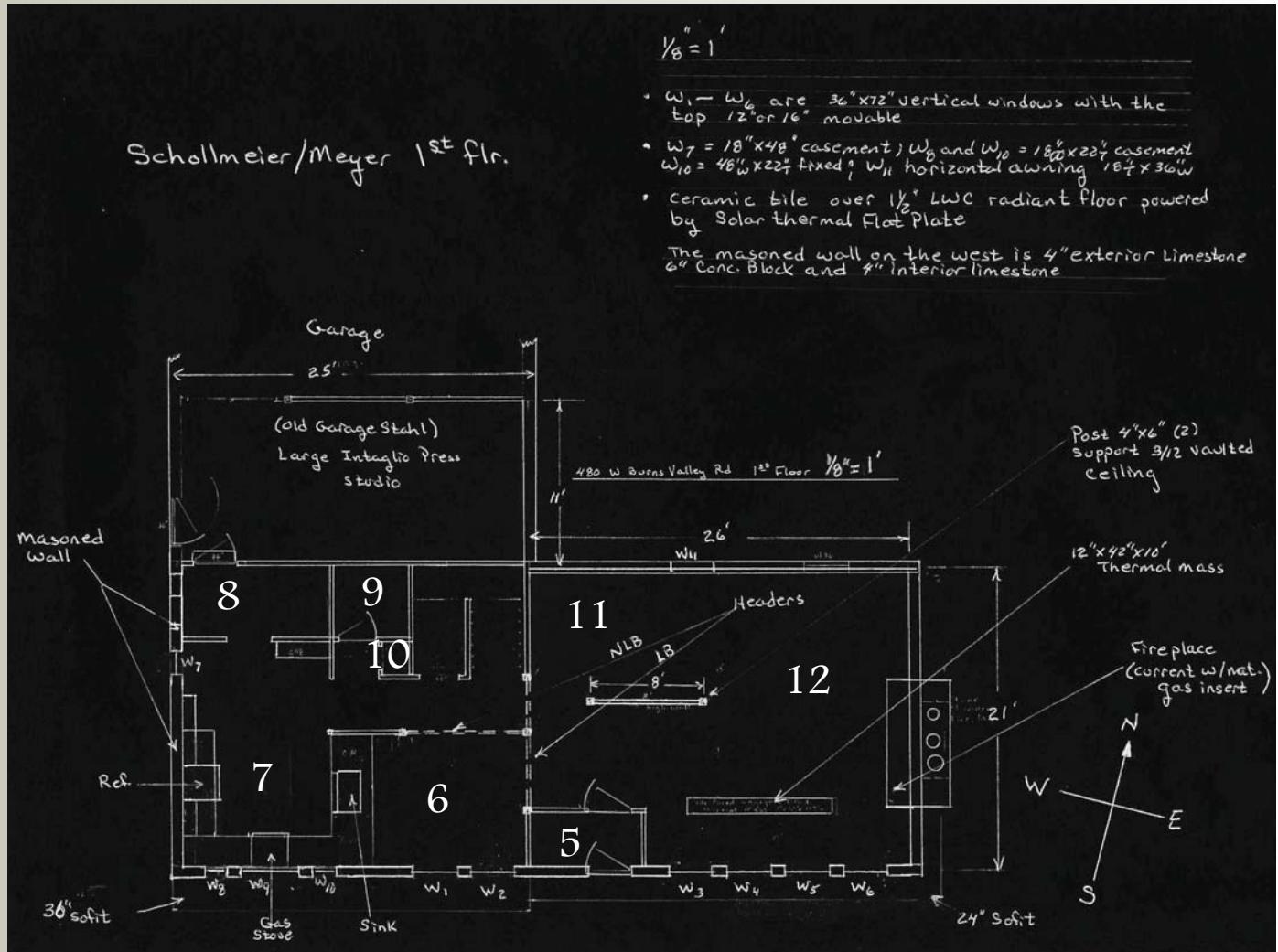


Figure 23 First floor plan of Schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.

## First Floor Plan:

5 = Entry Vestibule  
 6 = Dining Room  
 7 = Kitchen  
 8 = Laundry Room

9 = Bathroom  
 10 = Closet  
 11 = Library  
 12 = Living Room

# Case Study: Schollmeier/Meyer Residence Winona, MN

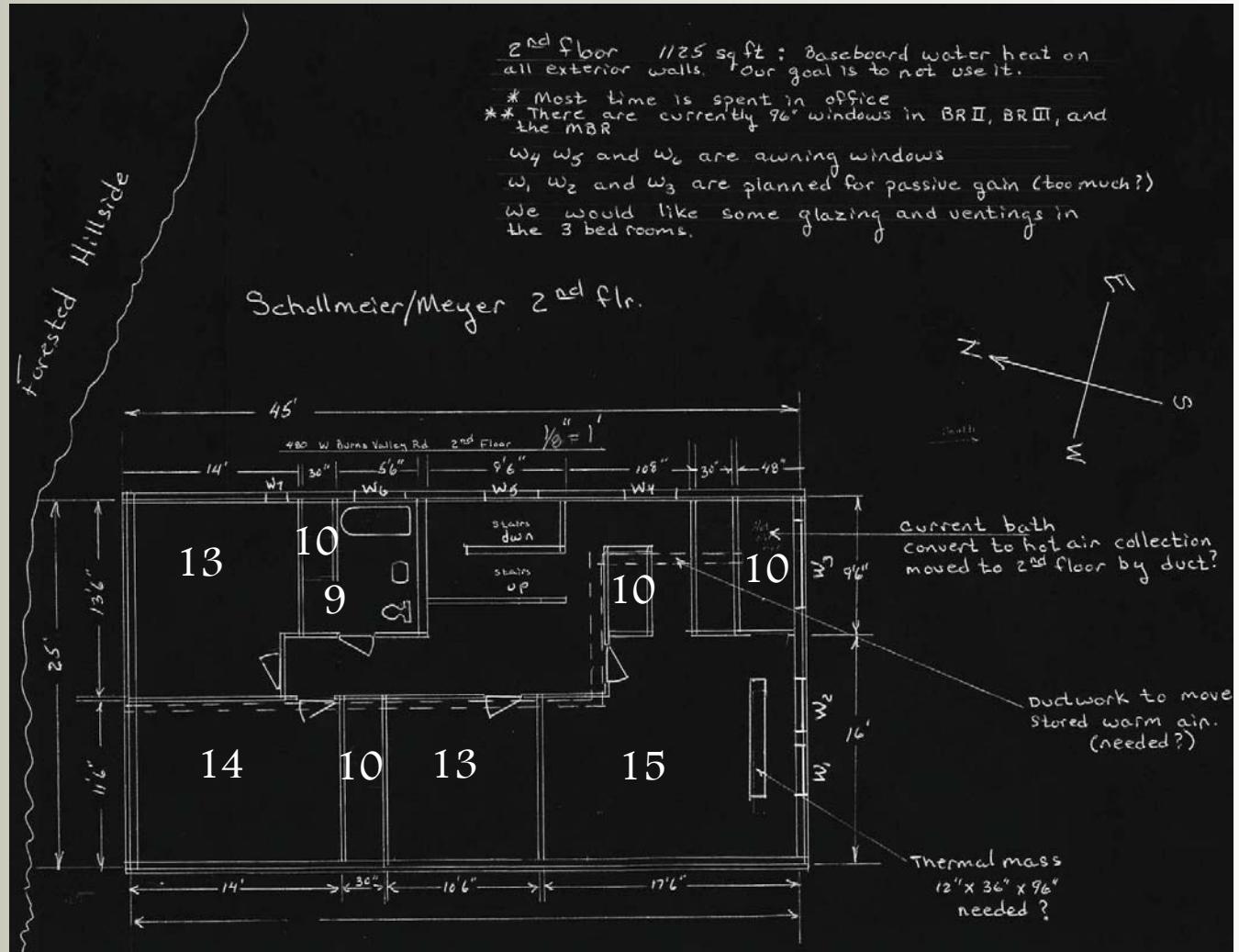


Figure 24 Second floor plan of Schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.

## Second Floor Plan:

13 = Bedroom

14 = Master Bedroom

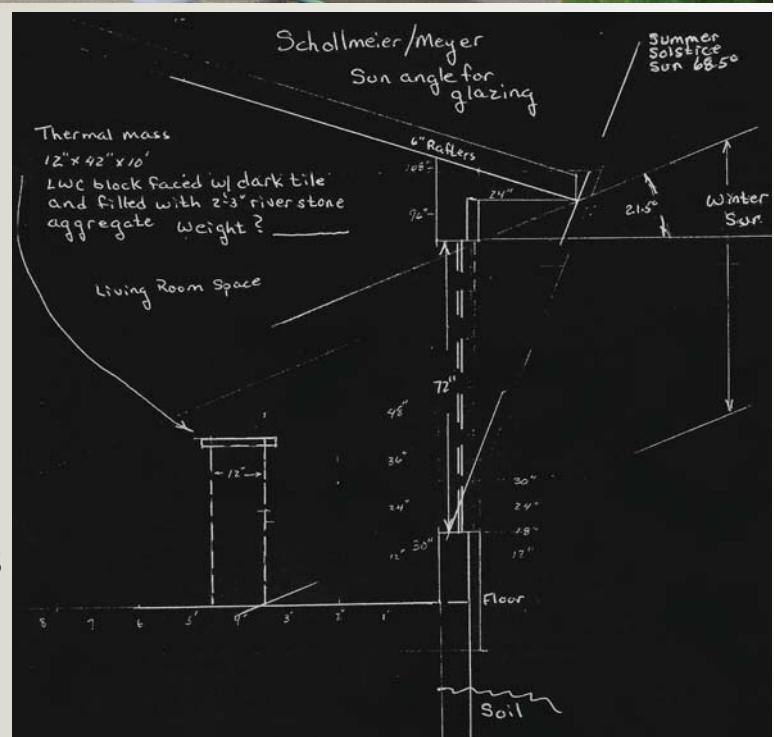
15 = Office

# Case Study: Schollmeier/Meyer Residence Winona, MN



Figures 25 & 26 Southwest view of Schollmeier/Meyer residence, Winona, MN (2009) Sun angle study for schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.

Prior to final sizing of new windows, sun angle studies were conducted at various times of the year with respect to existing overhangs in an attempt to achieve maximum solar gain during the winter and minimum penetration in the summer. Also seen above is the application of rigid 3 inch XPS insulation was added to further increase the homes overall “R” value.



# Case Study: Schollmeier/Meyer Residence Winona, MN

Increasing an existing structure's heat retention ("R") value can be achieved through the application of simple sustainable concepts such as minimizing the amount of existing north facing glass and maximizing, or at least increasing the amount of south facing glass.

This simple and effective technique is used throughout the Schollmeier/Meyer remodeling.



Figures 27 & 28 First floor interior remodeling of Schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.



# Case Study: Schollmeier/Meyer Residence Winona, MN

Another sustainable design technique that is applicable to existing structures is hydronic radiant in-floor heating. In new construction in-floor radiant heating systems are commonly positioned within the freshly poured concrete building pad, using the pad as a large thermal mass to help radiate the heat throughout the building. However, in existing structures a different technique is often used consisting of a plywood base sheet over the existing concrete, followed by the laying of the radiant heating tubes, followed by a 1.5 to 2 inch thick layer of Gypcrete acting as part of the thermal mass. After the Gypcrete is set a variety of floor finishes can be applied over the top. A dark heavy material, such as tile, is often most desirable to further increase the floor's thermal mass and heat absorption values.



Figures 29 & 30 First floor interior remodeling of Schollmeier/Meyer residence, Winona, MN (2009) Source: Paul Schollmeier, Copyright Paul Schollmeier.



# Case Study: Schollmeier/Meyer Residence Winona, MN

The schollmeier/Meyer residence strives to spend and depend on city grid power as little as possible. A 2.8Kw/Hr. photovoltaic tracking array provides the majority of the homes electrical needs.

Hot water and space heating of the home is made available through a series of solar collection panels that are tied into two 120 gallon solar storage hot water tanks, operating through a closed loop continuously circulating propylene glycol.

On partly sunny to sunny days the PV tracker provides enough power to satisfy the homes electrical needs, often with a surplus of unused energy that is sold to the local power company. However during some adverse weather conditions such as heavy cloud cover or snow covering the tracker, an inadequate amount of energy is produced and the difference is then provided through the city grid.



Figures 31 & 32 Rear and front views of Photovoltaic tracker and solar panels at Schollmeier/Meyer residence, Winona, MN (2009). Source: Paul Schollmeier, Copyright Paul Schollmeier.



# Case Study: Schollmeier/Meyer Residence

## Winona, MN

Sustainable measures taken throughout various areas of the design broken down by category:

**Water Use:** The implementation of low flow showers and faucets, and an EnergyStar rated washer and dryer amount to an estimated 40% reduction in water usage.

**Energy Use:** Passive modes of energy reduction include the implementation of sun shading through existing overhangs corresponding sun studies and inclusion of a thermally insulated Low-E glazing system. All of the homes down lighting is provided by long life low wattage CFL bulbs. All major kitchen appliances are EnergyStar rated. Additionally all electronic devices are connected to their source of power through power strips which may be turned off when not in use to eliminate phantom power usage. A hydronic radiant in-floor heating system was installed, greatly decreasing the need for space heating throughout the ground floor. A photovoltaic tracking array and series of solar collection panels provide the majority of the home's electrical, hot water, and space heating needs throughout the year.

**Building Materials and Components:** All materials included in the schollmeier/Meyer remodeling were obtained from local sources.(300 miles or less) Rigid XPS non-porus insulation was applied around the building's exterior, providing superior insulation values and a vapor free barrier. No VOC sealants and adhesives were used in the fabrication of the new kitchen cabinetry accounting for superior indoor air quality.

# Summary of Case Studies:

Each of the four case studies covered had their share of both similarities and differences concerning issues ranging from location and climate to project size and budget to methods and levels of sustainable measures taken. Several similarities and differences from each of the above listed categories will now be discussed.

The Gish Family Apartments and the Ehrlich residence were both quite similar climatologically, both being located within the state of California. However, these two projects differed greatly in size and the user's available budget, one being a mixed-use residential building intended for low income families, and the other a single family home of a fairly wealthy family. Despite these differences, many of the passive sustainable techniques employed were similar. Notably, both took advantage of building and spacial orientation to achieve maximum levels of filtered natural day lighting. They both implemented the extensive use of roof mounted photovoltaics for renewable on-site energy collection.

Two areas where the Ehrlich residence was lacking in terms of sustainability compared to the Gish Family Apartments, the Townhomes at Dockside Wharf, and the Schollmeier/Meyer residence were the absence of energy efficient artificial lighting techniques and installation of low volume water fixtures..

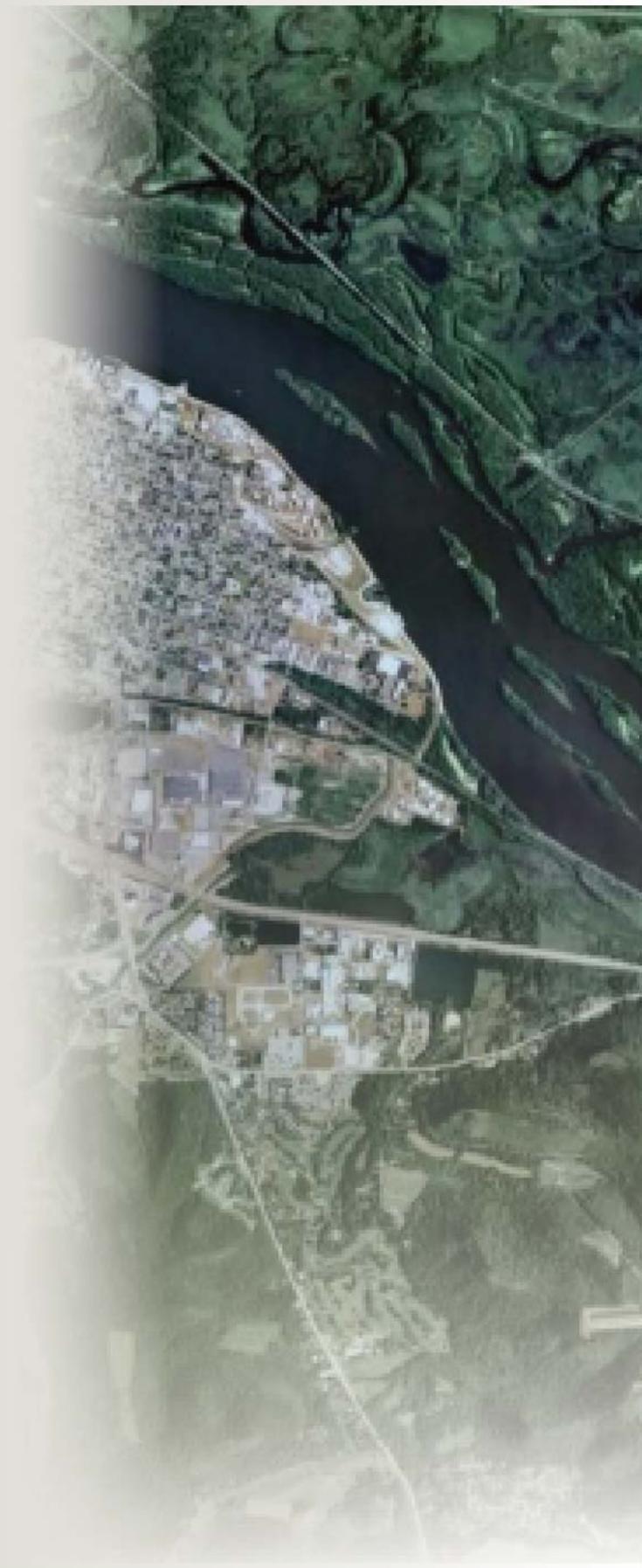


## Summary of Case Studies:

The Townhomes at Dockside Wharf, located in British Columbia and Scholmeier/Meyer residence, located in Winona, MN, vary to a large degree climatically from both the Gish Family Apartments and the Ehrlich Residence. Due to this climatic difference certain sustainable techniques also differed between the townhomes and the other two studies. The largest difference was in the amount of southern glazing used. Buildings in a cooler northern climate implement a large amount of southern glazing to maximize solar gain over the Winter months, whereas in more temperate southern climates, southern glazing is more limited and heavily sun shaded, intended for the penetration of filtered natural light only.

Major similarities between the Townhomes at Dockside Wharf and the Gish Family Apartments were found in how they went about reducing the building's energy and water needs. Both buildings included all Energy Star rated appliances, and both include dual flush toilets and low flow showers and sinks.

Throughout the similarities and differences discovered within these four case studies it is evident that location and thereby climate do change the validity and practicality of certain sustainable techniques. However, supporting my claim in the theoretical premise/unifying idea, the goals and underlying concepts remain unchanged.

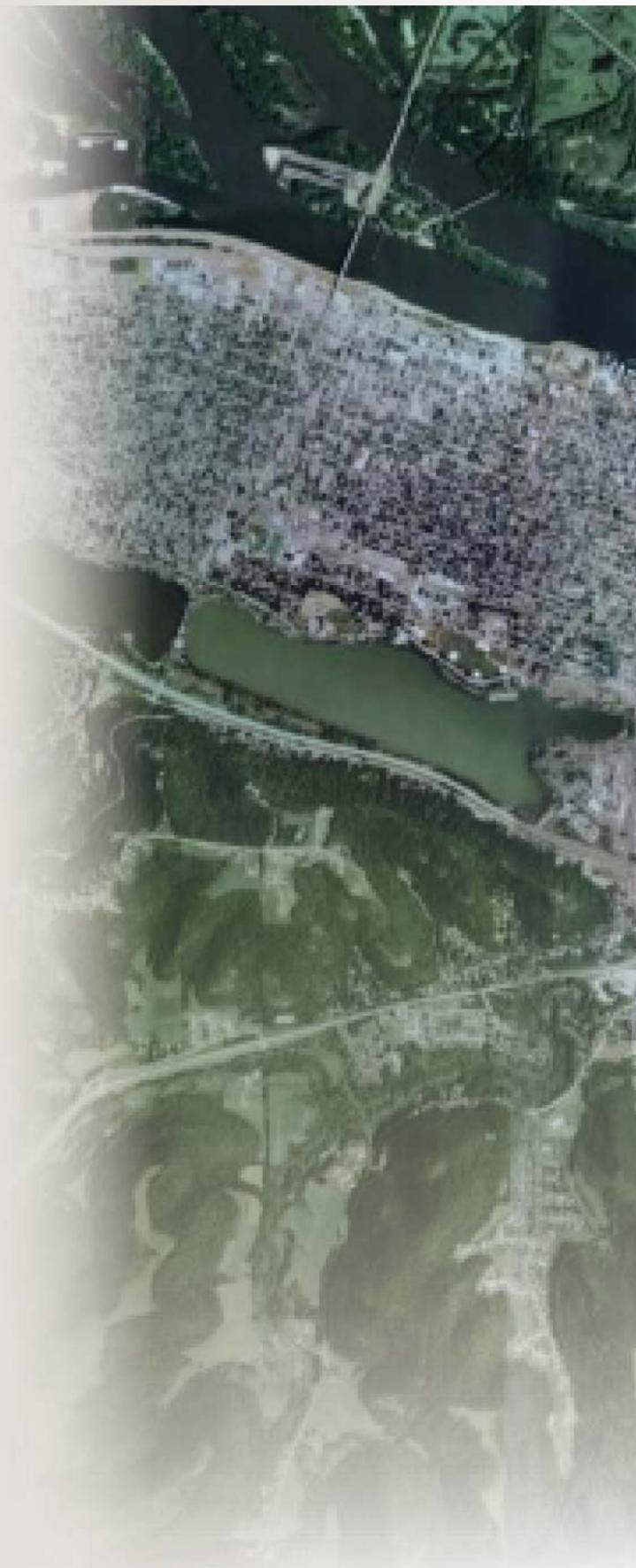


# Historical Context of Sustainable Design:

Before delving into the history of sustainable thinking and design it must first be made clear what exactly thinking and designing sustainably means.

The terms “sustainable design” and “green architecture” are among the most skewed and misconceived in the architectural profession today. Before defining the term sustainable design, the term sustainability must first be given a common understood definition. The dictionary defines something sustainable as something that is able to be maintained over time. This implies that sustainability can not necessarily be achieved through the use of environmentally friendly products alone. Brundtland Commission defines sustainability as: “meeting the needs of the present without compromising the needs of the future.” This definition is applicable to design and all other aspects of society including, agriculture, transportation, industry, and politics.

In his book: *The Philosophy of Sustainable Design*, Jason F. McLennan defines sustainable design as, “the philosophical basis of a growing movement of individuals and organizations that literally seeks to redefine how buildings are defined, built, and operated to be more responsible to the environment and responsive to people.”

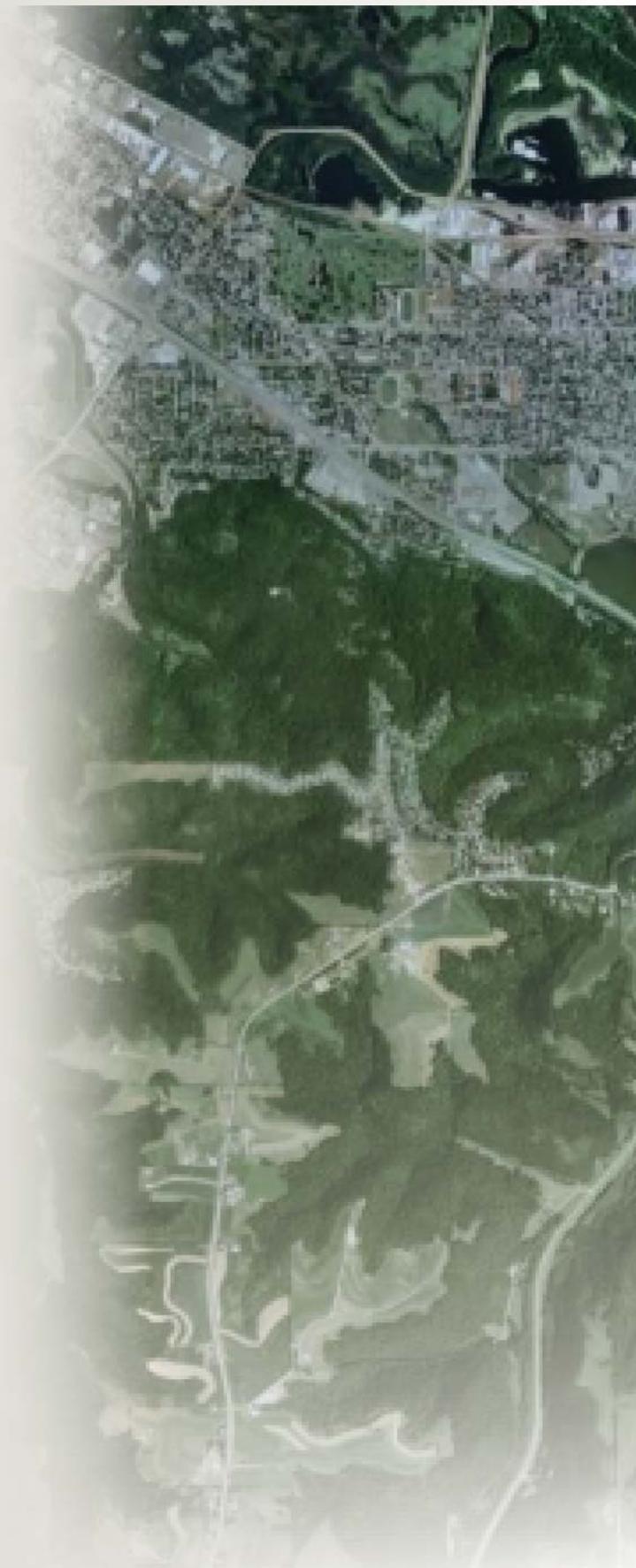


# Historical Context of Sustainable Design:

From McLennan's definition it is important to note that sustainable design is a philosophy, not a stylistic endeavor that is aesthetically distinguishable. Due to sustainable design's philosophical nature, its principals have no boundaries, and it can therefore be applied to any building type of any scale.

More simply stated, the philosophy asks: "what is the most we can do on a given project to enhance the quality of the built environment while minimizing or eliminating the impact to the natural environment?" Under this definition, quality encompasses not only the implementation of better buildings as a whole, but also better products and better project sites.

Traditional questions commonly asked when designing a building included queries concerning its cost effectiveness, level of expediency regarding construction, functional effectiveness, and aesthetical appearance. Keeping in mind that none of the above questions are bad to ask, a series of questions pertaining to issues of sustainability must also be asked. They include questions such as: "is it responsible?, What effects might this have on the environment?, and What effects might this have on human health?" A successful sustainable design must ask and resolve both traditional and sustainable questions pertaining to design.



# Historical Context of Sustainable Design:

Lastly, a definitive element within the definition of sustainable design that is often overlooked or forgotten, is the level of responsibility and respect one must have for the natural world and human life. Those who act and design sustainably are effectively acting as stewards, protecting our environment and resources. As Jason F. McLennan states, “sustainable design should be thought of as a verb, not a noun, meaning that the act or process of sustainable design must clearly be separated from the product.”

Now that a definition for sustainable design has been established, a clearer history of the sustainable design movement can be portrayed.

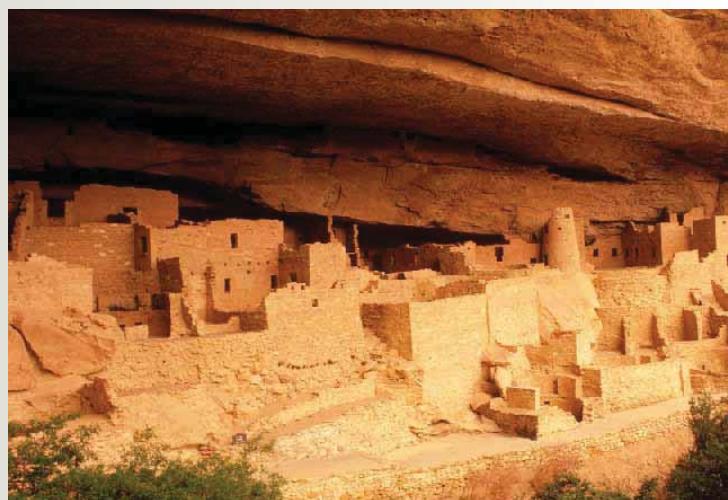
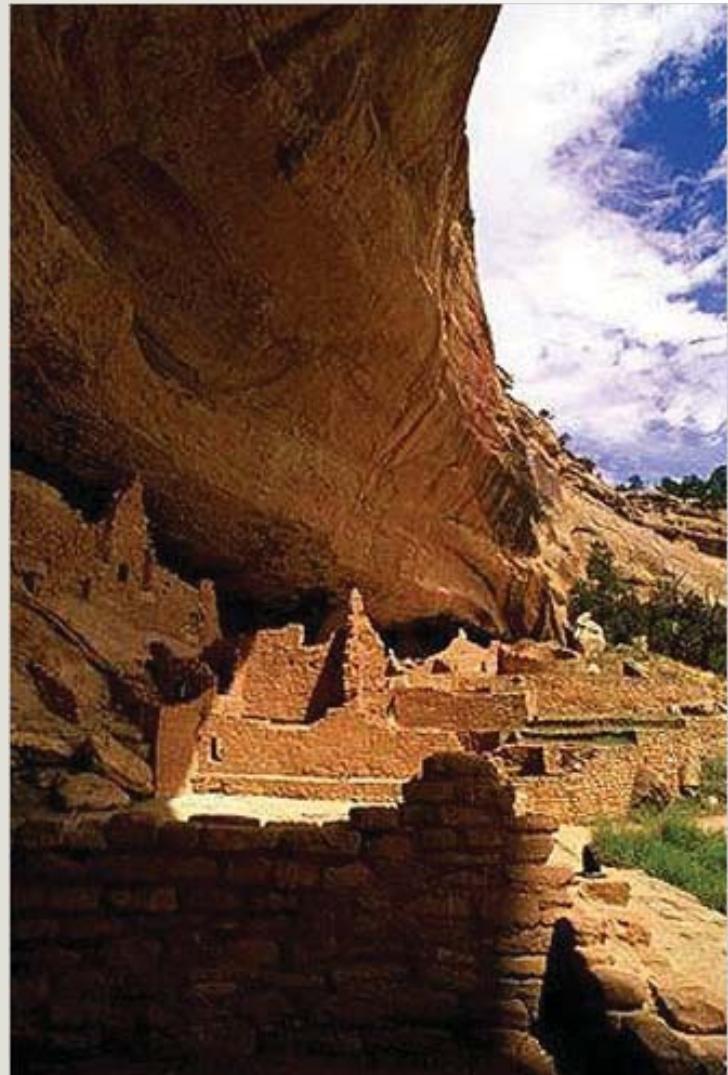
The question, one that literally has no one correct answer is, when and where do the origins of sustainable design lie? As implied, you can never get a complete truth to a question such as this, as it depends heavily on a person's perspective and point of view regarding what constitutes an official beginning. McLennan among others have broken down the history of sustainable thinking and design into four separate beginnings including, a biological, an indigenous, an industrial, and a modern beginning (McLennan 2004). For the purposes of this research I will begin with the indigenous roots of sustainable design.



# Historical Context of Sustainable Design:

The indigenous beginning of our sustainable design techniques are rooted in our innate need for shelter and comfort based on the climatic conditions.

The Anasazi Indians are a good example of a group of people who examined and studied what their environment had to offer and acted accordingly. The Anasazi were a cave dwelling people, and were so for a reason. The Anasazi knew the environment in which they lived could be quite arid, so in response they chose to build their dwellings on the underside of massive cave openings, creating a large natural sun shading device that allowed for protection from the midday sun, and allowing for low-angle light penetration during the Winter. Another technique used was the implementation of massive stone walls to create an effective thermal barrier, keeping the interiors cooler in the Summer and warmer in the Winter. It must be kept in mind, while the Anasazi used the materials they had locally available to them to the best of their ability, they built as they did not with the environment on their minds but rather survival and comfort.



Figures 33 & 34 Views of Mesa Verde, CO (2008). Source: <http://www.latinamericanstudies.org/>, Copyright Unknown.

# Historical Context of Sustainable Design:

Other ancient cultures such as the Anasazi Indians also evidenced that they clearly understood basic principles of heating and cooling to achieve comfort. However many of these cultures did so with little if any regard for the environment. Despite a lack of understanding or regard for environmental effects, widespread visible effects remained hidden for the most part until the onset of the industrial age.

By the latter part of the 19th century the industrial revolution had already taken a stronghold over how people lived and thought. Most people began to settle in more heavily populated towns and cities, as opposed to a rural lifestyle, due to the explosion of employment opportunities available at factories and mills.

During this time period sustainable design details are rarely seen. Despite this, there were several inventions and techniques used. One technique that survived up until the widespread availability of the incandescent light bulb was the narrow plan layout of buildings in hopes of maximizing daylight penetration. The invention of the elevator may not outwardly seem as though it enhanced measures of sustainability, however the elevator along with the introduction of high strength steel allowed for buildings to grow taller than they ever were before, in turn requiring less area for site development.



Figure 35 Typical narrow floor plan layout of pre war buildings Unknown location (2004). Source: The Philosophy of Sustainable Design, Copyright Jason F. McLennan

# Historical Context of Sustainable Design:

This rush of new technology blinded us, as many times people used the newest technology or method simply for the sake of saying they had the latest, even if there was a cheaper and more functional solution. Basic solutions to heating and cooling were totally abandoned as we no longer needed them due to the invention of the air conditioner and advanced controls in heating.

By the middle of the 20th century widespread air pollution from coal powered factories and automobiles had gotten bad enough to get the attention of the masses. Efforts to clean up the air were put into effect and by the late 1950's most major cities had converted the bulk of their factories to the use of oil for energy needs. This measure along with the adoption of new city zoning plans cleaned up the air considerably. However this is where the efforts ceased until the 1970's.

The 1970's are considered by many to be the start of a sustainable way of thinking in terms of energy usage in buildings. The volume of people whom investigated and pursued this way of design was few and far between, and of those who did attempt to design sustainable energy saving buildings did so with limited success.

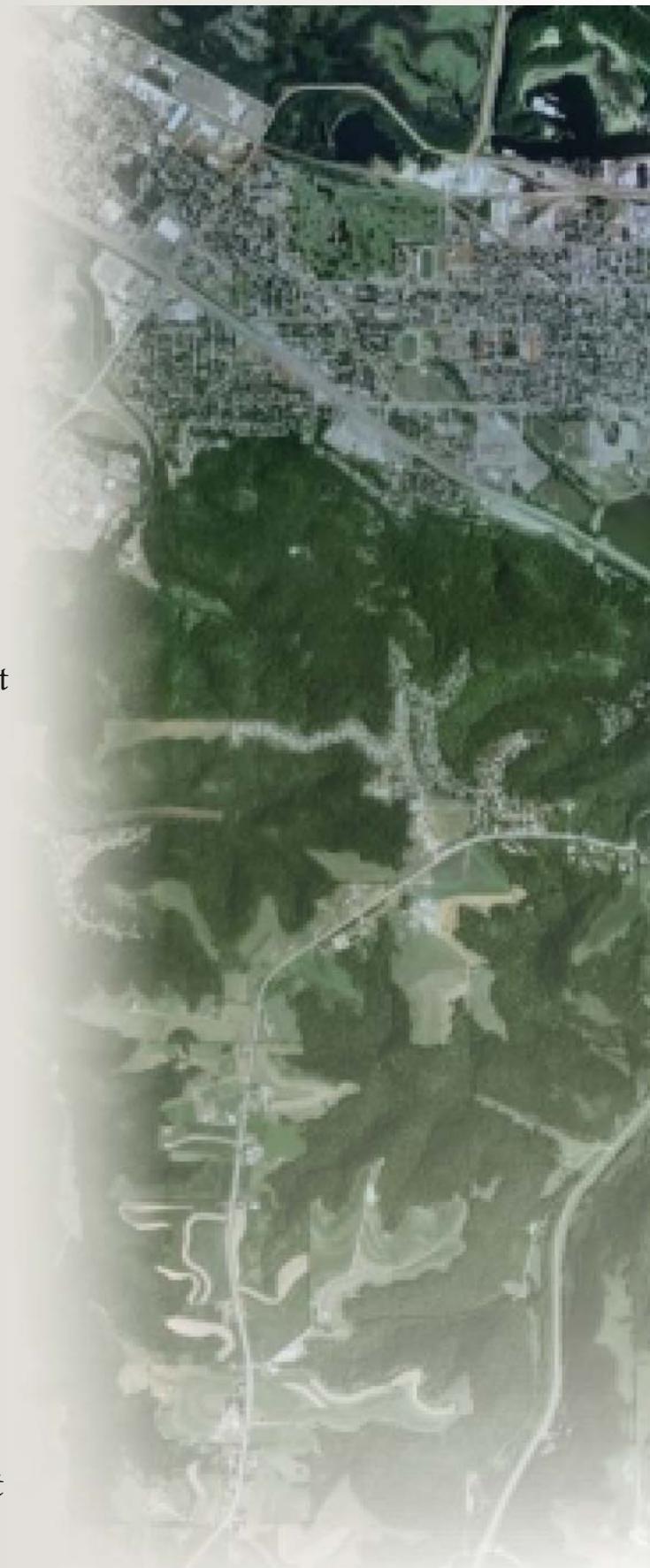


# Historical Context of Sustainable Design:

They succeeded in creating buildings that used less energy, however they neglected to include what are now major areas of sustainable design development such as indoor air quality and natural ventilation. The use of paints, building finishes, and furnishings that over time produced harmful chemical off-gassing added to the problem of poor air circulation, thereby oftentimes creating what became known as sick building syndrome. It became clear to these Architects that many more issues aside from energy consumption had to be taken into consideration.

During the 1980's little tangible progress was made, however a small group of key people and ideas were well underway.

The 1990's was the decade in which the bulk of research groups, sustainable design awareness groups and publications regarding the topic took place. The sustainable design movement gained more world wide attention in 1992 when leaders in the field met at the first Rio Earth Summit in Rio de Janeiro. It was also during this year that one of the first journals concerning sustainable design exclusively went into publication.



# Historical Context of Sustainable Design:

One of the biggest proponents of the sustainable movement came in 1993 with the formation of the United States Green Building Council (USGBC).

With only 8 members and a budget of \$30,000 in 1993, the USGBC inevitably made a huge impact on both the public's and professional's way of thinking, due to the fact that by 2001 their group had grown exponentially in size, comprised of over 2,000 members with an operating budget in the millions.

Spawning from the USGBC is the other leading proponent in sustainable design today, Leadership in Energy and Environmental Design (LEED). LEED provides an incentive to designing sustainably, awarding qualifying buildings different levels of achievement based on their energy, water, and material usage as well as the building's indoor air quality and site quality.

since 2000 up through the present date the sustainable movement has continued to gain supporters at an ever-increasing rate, much in part due to the development of supportive and vocal organizations such as the USGBC, LEED, and the AIA. Many people are beginning to realize that sustainable design is the right choice. Many times its even more cost effective up front, and if not, the return on investment pays for any excess initial cost in a short amount of time. Jason F. McLennan states in his book that "this decade will likely be known as the decade green became mainstream."

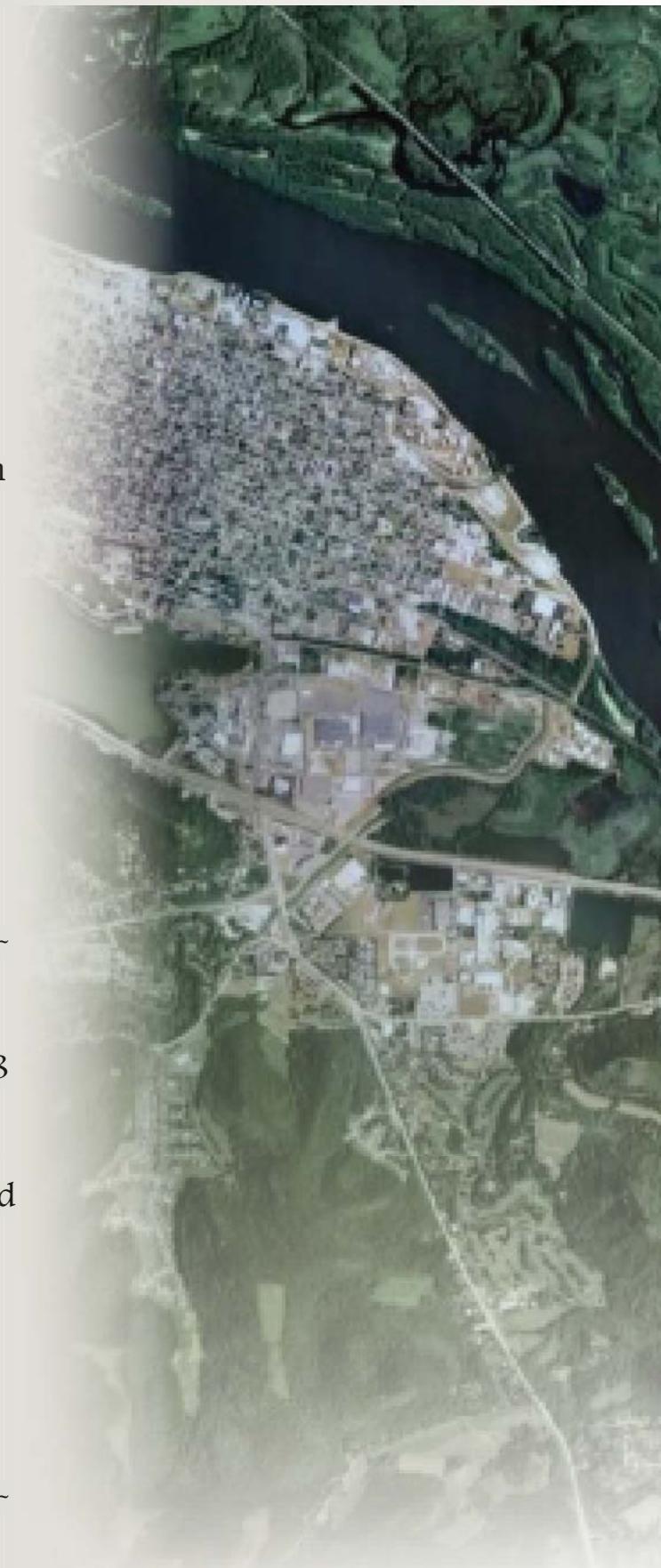


# Historical Context of Sustainable Design:

Now that both a definition and history of sustainable design have been established I will explain how my project relates to projects of similar typology concerning issues of sustainability in a middle class suburban society today.

As evidenced throughout the case studies in the typological research, areas to be considered when designing sustainably can vary greatly in numbers and complexity depending on location, climate, and up front budget available. For a development of my intended magnitude (Twenty townhomes) I am assuming the hypothetical owner(s) of the development would have an amount of available capital ranging anywhere between \$8 and \$10 million dollars.

The development will employ any and all regionally beneficial methods of sustainable design pending a limited budget. As the site is remote in terms of immediately adjoining neighborhoods, the development will stand alone as its own clearly distinguishable entity, while respecting the natural topography and vegetation on the site.



## Historical Context of Sustainable Design:

As stated in the project emphasis, the goal is not to design lavishly and create an “exclusive gated community stigma,” but rather an affordable living environment offering vast natural views and ample outdoor space. The development is to be an inviting place for its residents, guests, and curious members of the city alike.



## Goals of the Project:

As mentioned in the project emphasis, the basic broad goals of this project include creating a sustainable living solution for first time home buyers/ renters in a geographic region harboring harsh climatological extremes. This design is not to be completed lavishly, rather through modest yet inventive sustainable techniques, thereby remaining affordable for the bulk of middle class citizens.

More specific goals include using little to no non-renewable energy off of the city power grid through the development of a self sustaining means of power year round. It will also be important to ensure superior indoor air quality and adequate air circulation. Developing an on site water collection and recycling system will also be implemented, aiding in the amount of reliance placed on city water. Additionally, product research and corresponding manufacturer plant locations will be taken into consideration to reduce the amount of materials imported from distances greater than 500 miles from the site. A final portion of my overall project goals include creating as little waste and negative impact on the site as possible during the construction of the building.



# Goals of the Project:

A Combination of methods used in the generation of clean on site energy will be employed to reduce the amount of energy taken of the city grid; they will include a biomass gasification system, using local wood waste and excess biomass produced by the residents as fuel and a roof mounted photovoltaic system.

Use of electricity will be minimized through the use of motion activated LED down lighting in corridors and other circulation areas, and low energy CFL bulbs will be required for ambient lighting. These lighting techniques combined with the installation of all Energy Star rated appliances will greatly reduce the total amount of electricity need per family.

Total water usage will be reduced through the installation of dual flush toilets and low flow sinks and showers.

Indoor air quality will be electronically monitored for any harmful chemicals that may be present at all times. Indoor air quality will be of superior quality due to responsible design finishing and furnishing choices. All paints, finishes, and adhesives will contain zero VOC's, and all furniture will be comprised of materials that eliminate or keep off gassing to a minimum.



## Goals of the Project:

All usable construction waste will be either recycled and reused after construction is complete or used in the on site biomass gasifier.

A final, yet ever-important goal of this project is to increase the general public's knowledge of sustainable design techniques in terms of how they are employed, how they work, and how to distinguish them.



## Site Analysis:

Before beginning a detailed analysis of the site for the townhome development, a brief narrative covering the history of Winona will be portrayed to give a better understanding and feel for the site as it relates to its immediate surroundings and region.

The Mississippi river and surrounding tree covered bluffs played key roles both economically as well as aesthetically in the site location of what was to be the city of Winona. It was due to these tree rich bluffs, fertile ground, and active accessible waterway that the present day site for the city was chosen. The Mississippi, which ran right along the city, initially served as a means of transportation of both old growth timber and other goods to be used and processed by the city before being shipped further down river to other settlements.

Winona's real history began in October of 1851 when a steamboat captain, Orrin Smith dropped off two settlers named, Erwin H. Johnson and Caleb Nash along the banks of what is now present day Winona. The steamship captain wanted credit for the settlement so he proceeded to name the settlement: Montezuma and have maps drawn up showcasing his name as a founder.

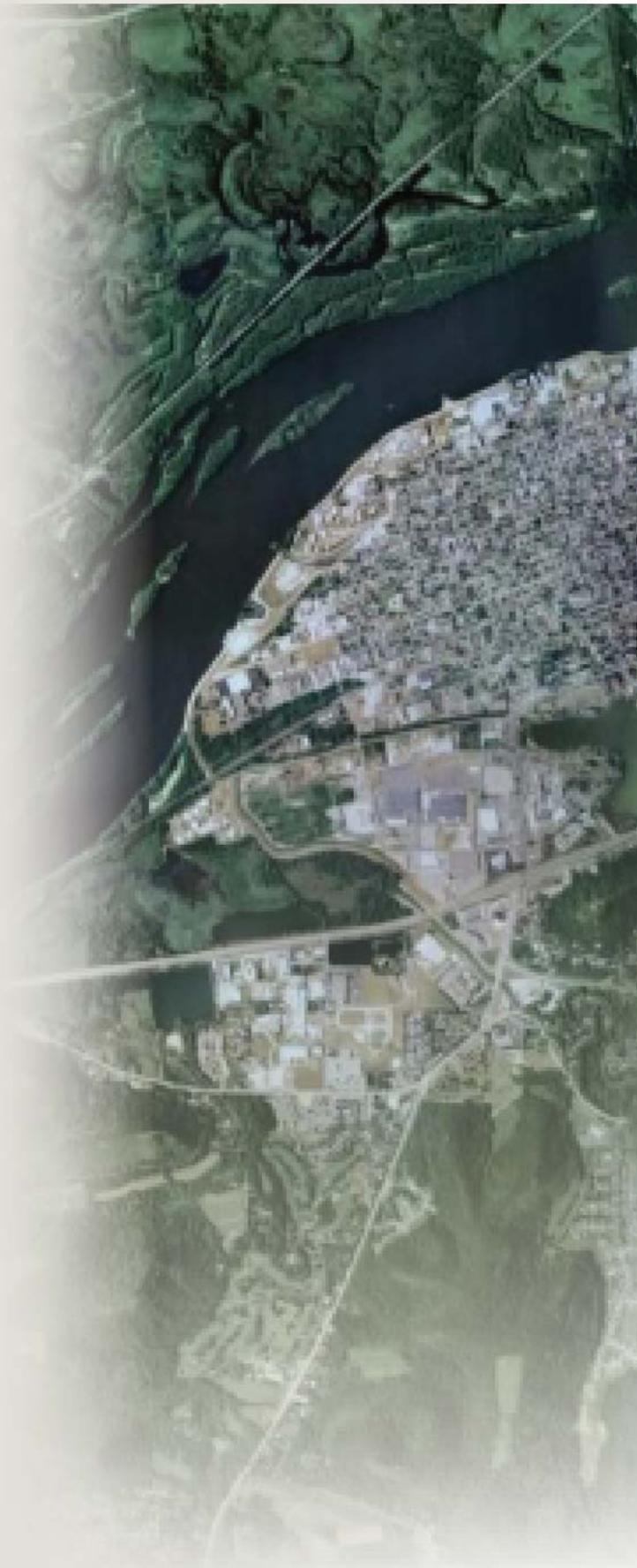


## Site Analysis:

However, many original settlers did not like the name which he chose for the settlement; and through monetary donation, convinced the map maker to change the name of the settlement to Wenonah, in recognition of the Indian Princess Wenonah that belonged to the local Wabasha tribe. In a hurry to reprint the maps, the map maker misspelled Wenonah as Winona and the misspelling was never corrected, accounting for the discrepancy in the two names today.

As stated, Winona began as a major hub for timber milling and wheat shipping in the United States, growing rapidly during its first few years. The first major sawmills, owned by the newly formed Laird & Norton Company, were erected in 1855 followed shortly after by the erection of the first Bay State Milling grain towers.

On March 6th, 1857 the charter for the city of Winona was approved. From the early 1850's up through the turn of the twentieth century Winona's timber milling and wheat production thrived to say the least, resulting in more millionaires per capita than in any other city in the United States at the time.



## Site Analysis:

During the midst of Winona's economic explosion, some foresaw that the logging industry would be coming to an end in the not so distant future, and in turn developed an array of small businesses and textile factories to provide and ship goods to others while maintaining a steady more reliable source of income as the logging industry began to slow down.

Several notable companies that were formed around this time period and are still in operation today include: J.R. Watkins Company, which provides a great variety of spices and home medicines to locations worldwide today; Bay State Milling Company, which is one of the largest producers of flour in the United States; Union Fibre Company, a long running insulation manufacturer; and Peerless Chain Company, which produces a variety of industrial, marine, and general purpose chain, cordage, and wire ropes (Whipple 1913).

Winona is currently in stable economic condition, harboring many diverse businesses both new and old and receives a steady secondary source of economic support from the three colleges that are located there.

Winona is an aesthetically pleasing medium sized (30,000 people) river-town housing more than five miles of open green park space, displaying many original unique architectural structures from its beginnings, as well as a variety of others as the decades passed leading up to the present.



## Site Analysis:

As mentioned previously, the site for my project is in Winona county within the city of Winona, MN. The images shown on this page and the following page outline in red, the approximate site boundaries. The site is oriented on a scarcely wooded portion of the south facing bluff. The slope in the area varies between 15 to 50%. The site offers grand open views of neighboring bluffs and forest in the distance. Also visible is a small existing neighborhood, consisting of approximately 20 single family homes. Aside from that neighborhood, no other existing grid work exists on or immediately around the site; it is quite undeveloped and virtually unchanged by the presence of man.

A number of intermittent rainwater streams are also available for water harvesting on the site and could easily be diverted into a retention pond for storage and future use.

As far as wind is concerned, the site is virtually protected from the straight line winds that come predominantly out of the North West during the coldest months of the Winter. In the months May through September the winds predominant range varies to some degree, but is generally coming from the South. The town-homes will be able to take full advantage of breezes blowing off the bluff tops in the distance to the south.



Figure 36 Aerial photograph of the region my project is in. Winona, MN (2009). Source: Google Earth, Copyright Google.

## Site Analysis:

As far as the quality of the soils are concerned, they appear to be quite rocky and stable, holding their shape without signs of erosion at a 50% slope. The lower lying areas where rainwater runoff is channeled consist of a combination of plastic organic clays and clayey gravel.



Figure 37 View of slope on site. Winona, MN (2009).  
Source: Ben Schwarz, Copyright Ben Schwarz

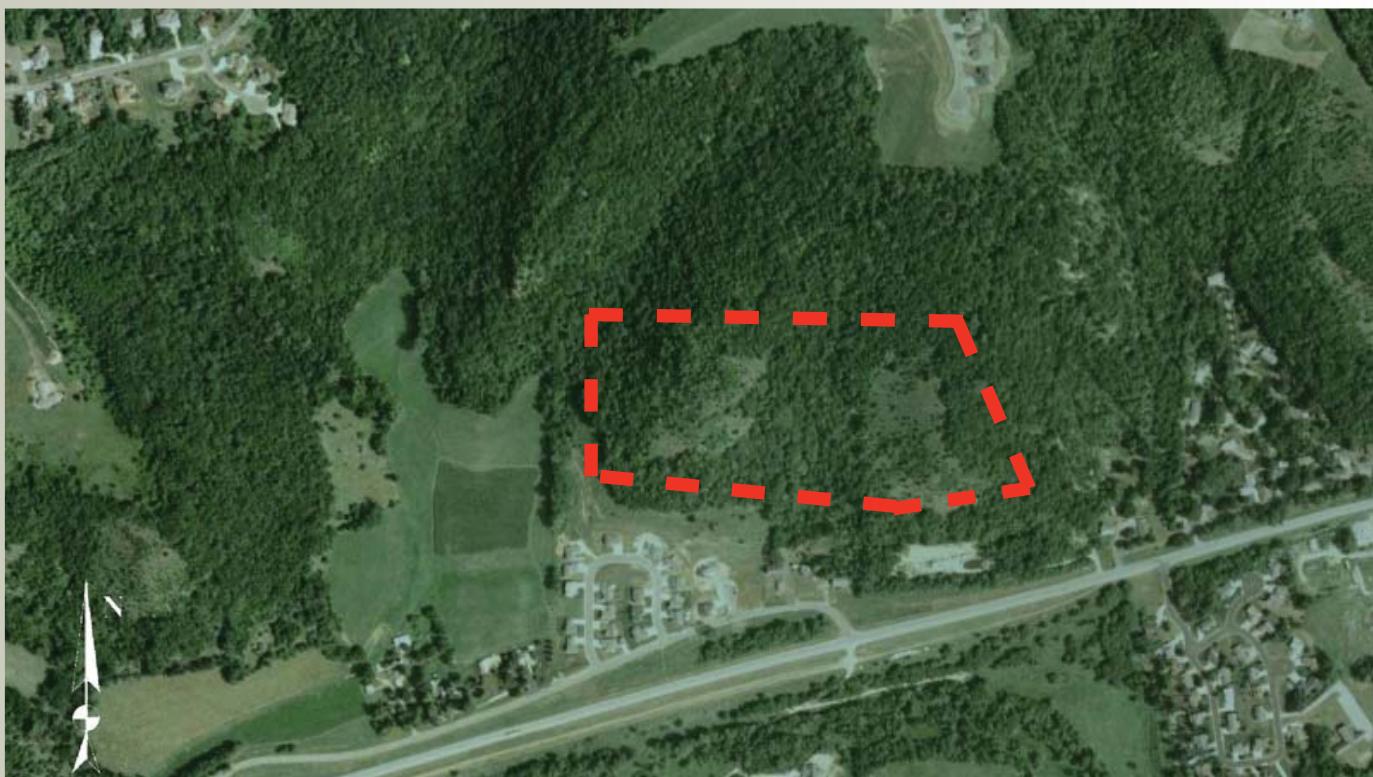
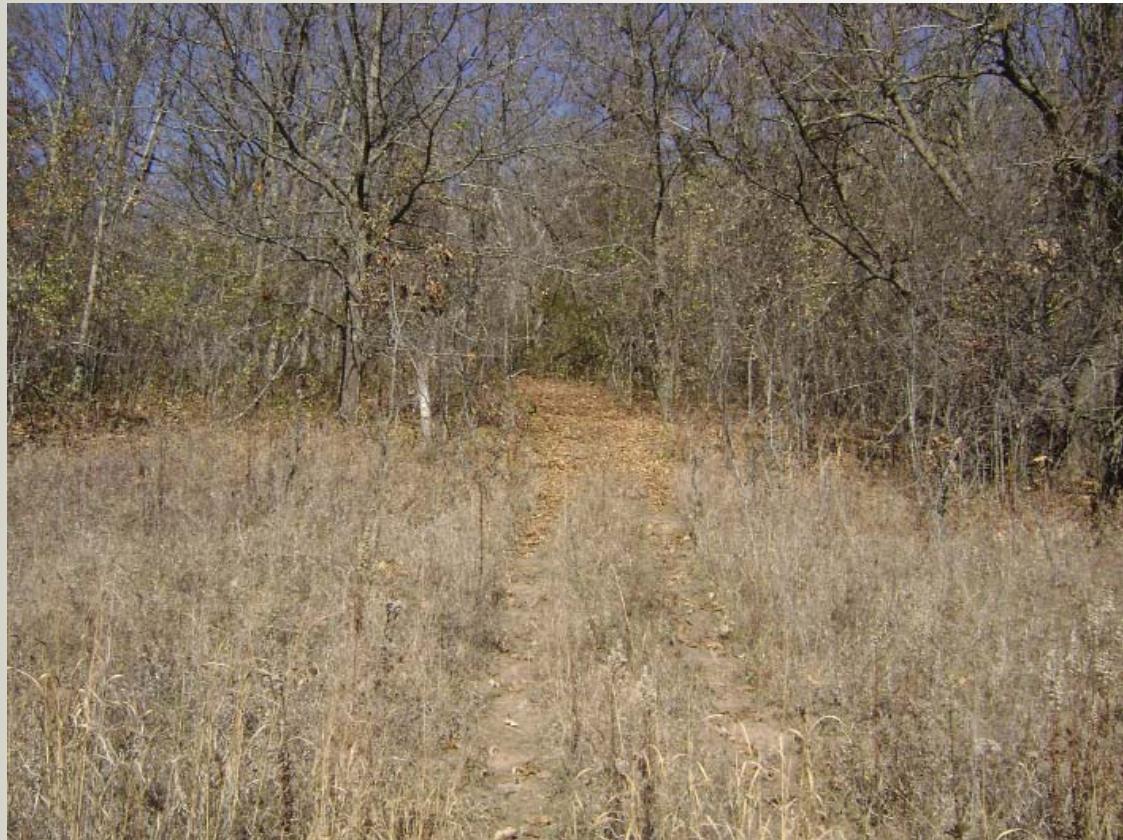


Figure 38 Aerial photograph of the region my project is in. Winona, MN (2009).  
Source: Google Earth, Copyright Google.

## Site Analysis:



Figures 39 & 40 Views of site from various points. Winona, MN (2009). Source: Ben Schwarz,  
Copyright Ben Schwarz

## Site Analysis:



Figures 41 & 42 Views of site from various points. Winona, MN (2009). Source: Ben Schwarz,  
Copyright Ben Schwarz

# Site Analysis:

## Regional Climate Data:

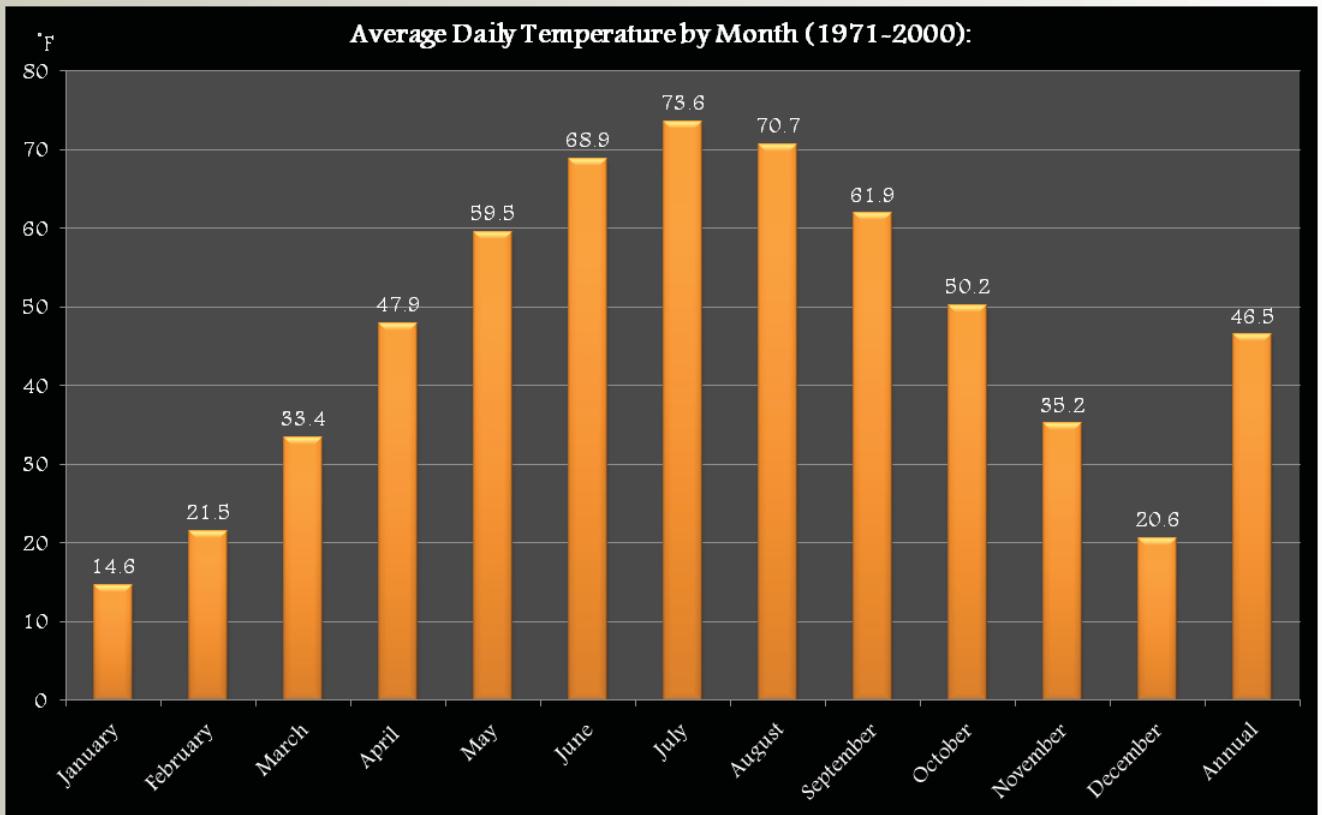
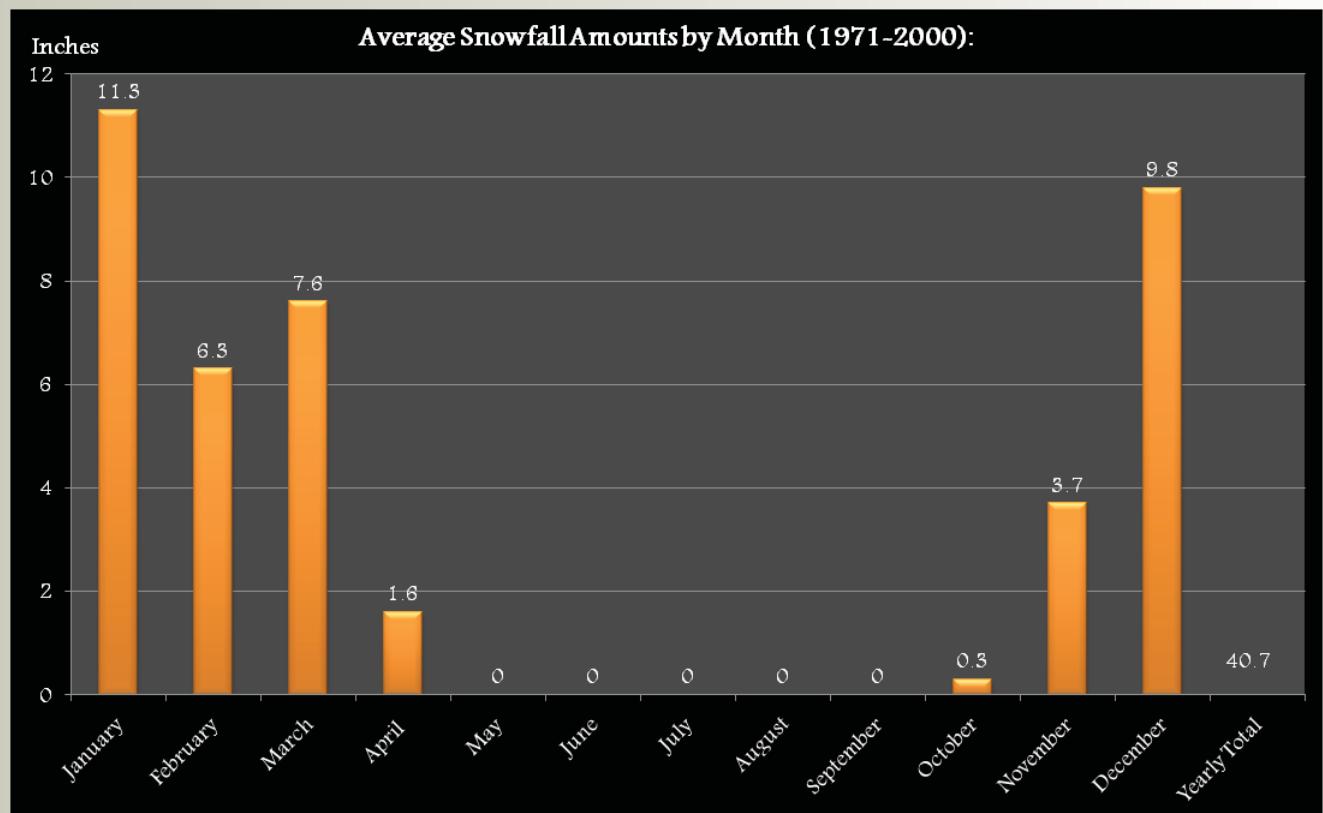
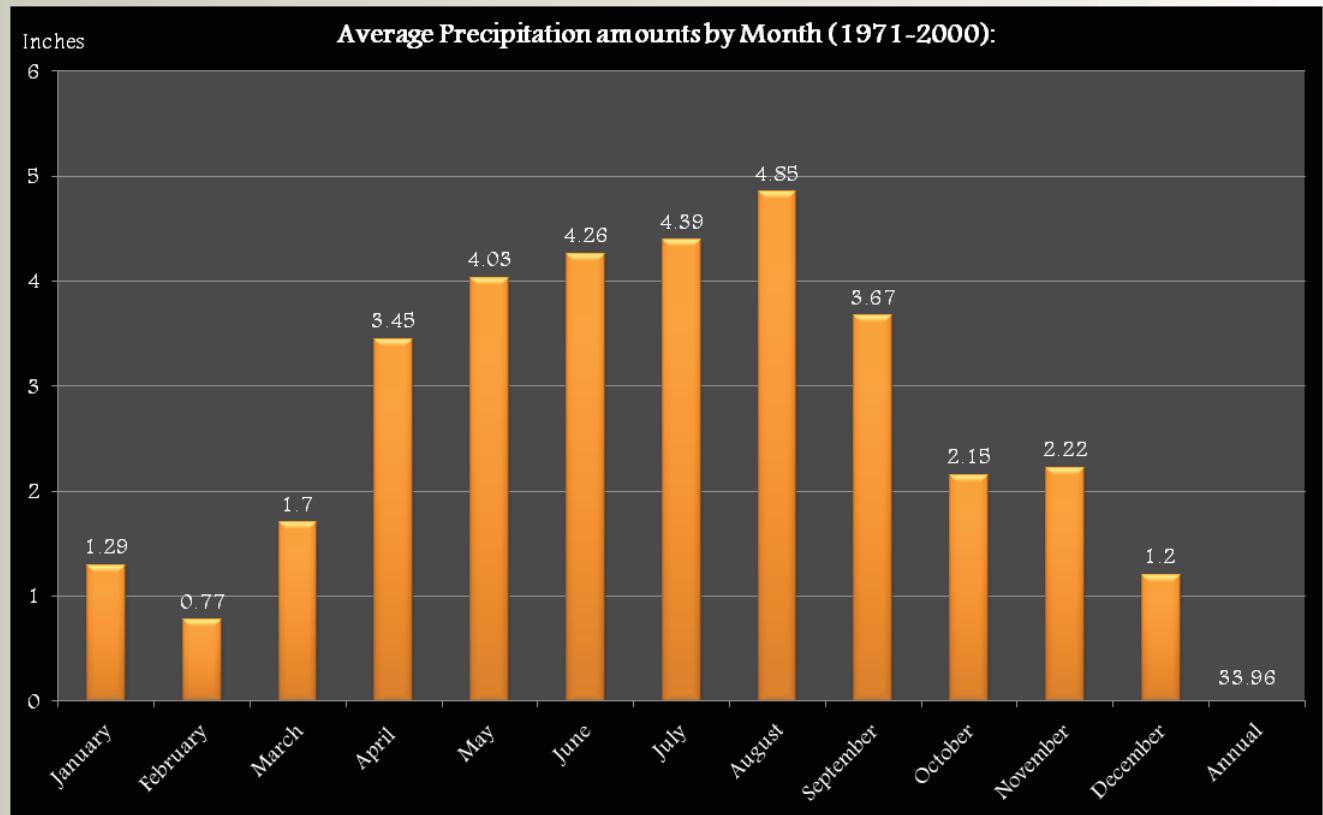


Figure 43 Climatological data chart. Winona, MN (2009). Source: Ben Schwarz, Copyright Ben Schwarz

After looking over the historical climate data charts over the next few pages, two factors become quite evident concerning the climatological trends, one being that Winona is a very moist climate year round, equating to high dew points and levels of humidity throughout the summer; the other being that Winona has nearly 10 times the amount of heating degree days than it does cooling degree days, pointing towards the reasonable assumption that developing effective methods of sustainably heating homes in this climate is much more important than the contrary.

# Site Analysis:

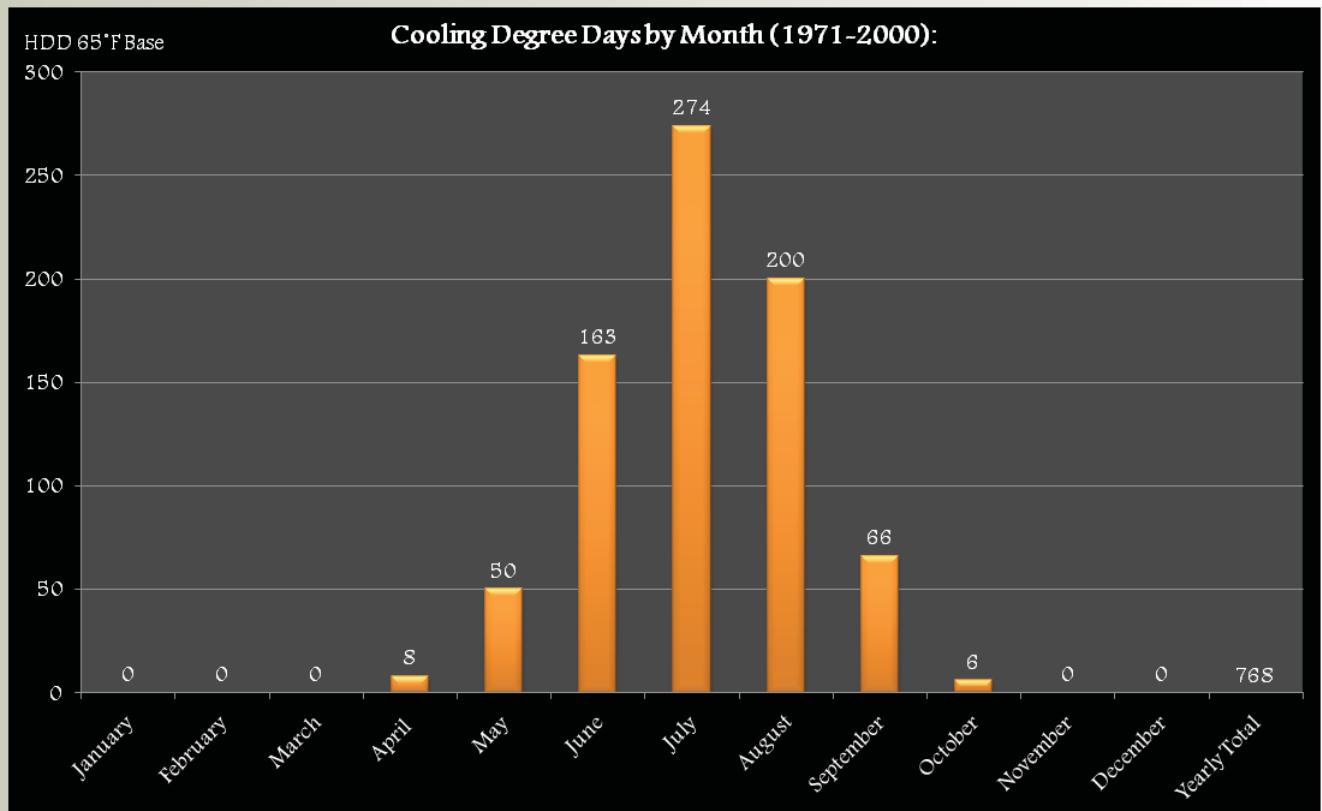
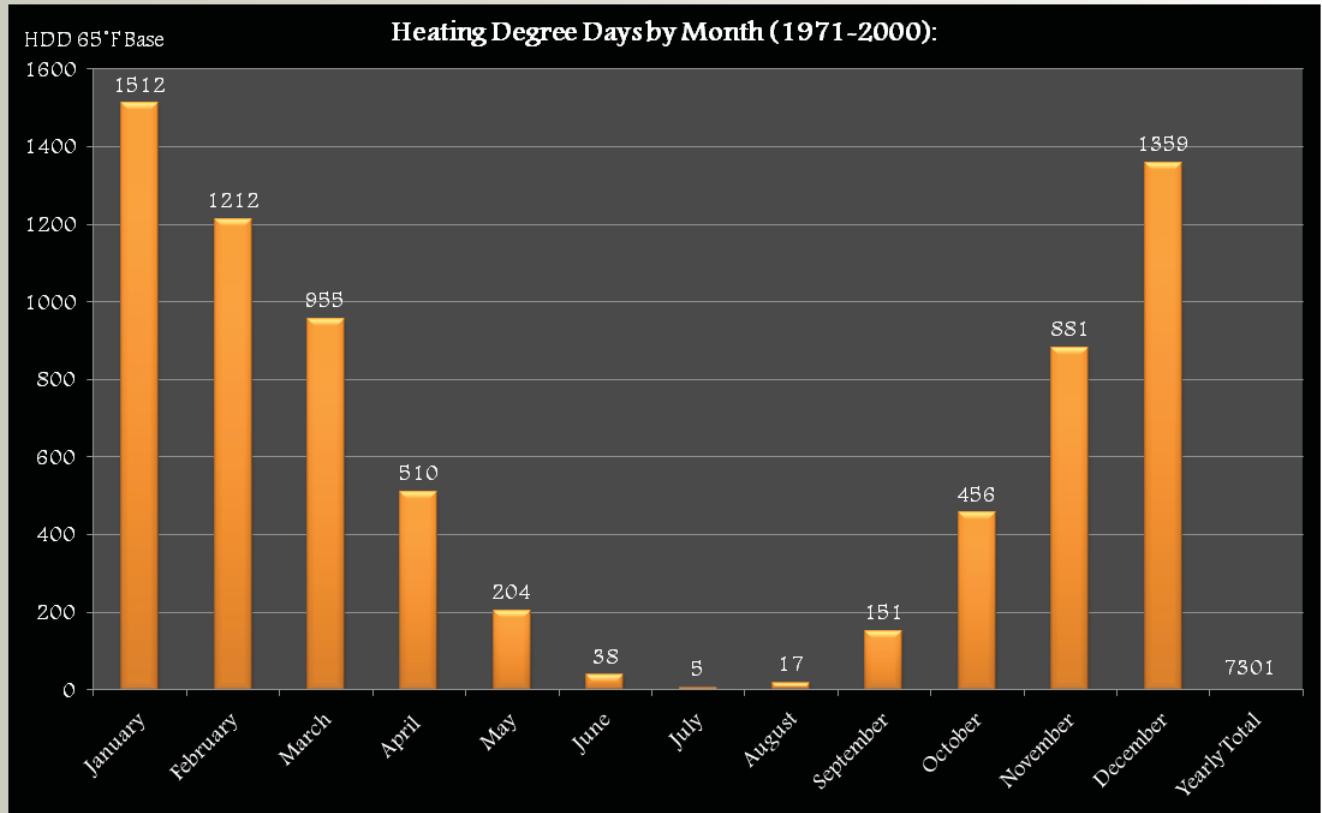
## Regional Climate Data:



Figures 44 & 45 Climatological data charts. Winona, MN (2009). Source: Ben Schwarz, Copyright Ben Schwarz

# Site Analysis:

## Regional Climate Data:



Figures 46 & 47 Climatological data charts. Winona, MN (2009). Source: Ben Schwarz, Copyright Ben Schwarz

# Programmatic Requirements:

Required Spaces and their corresponding spacial and organizational requirements:

Circulation Space: Varies by designed townhome occupant capacity. Spaces solely dedicated to circulation shall be kept to a minimum and shall be restricted to as few separate areas as possible.

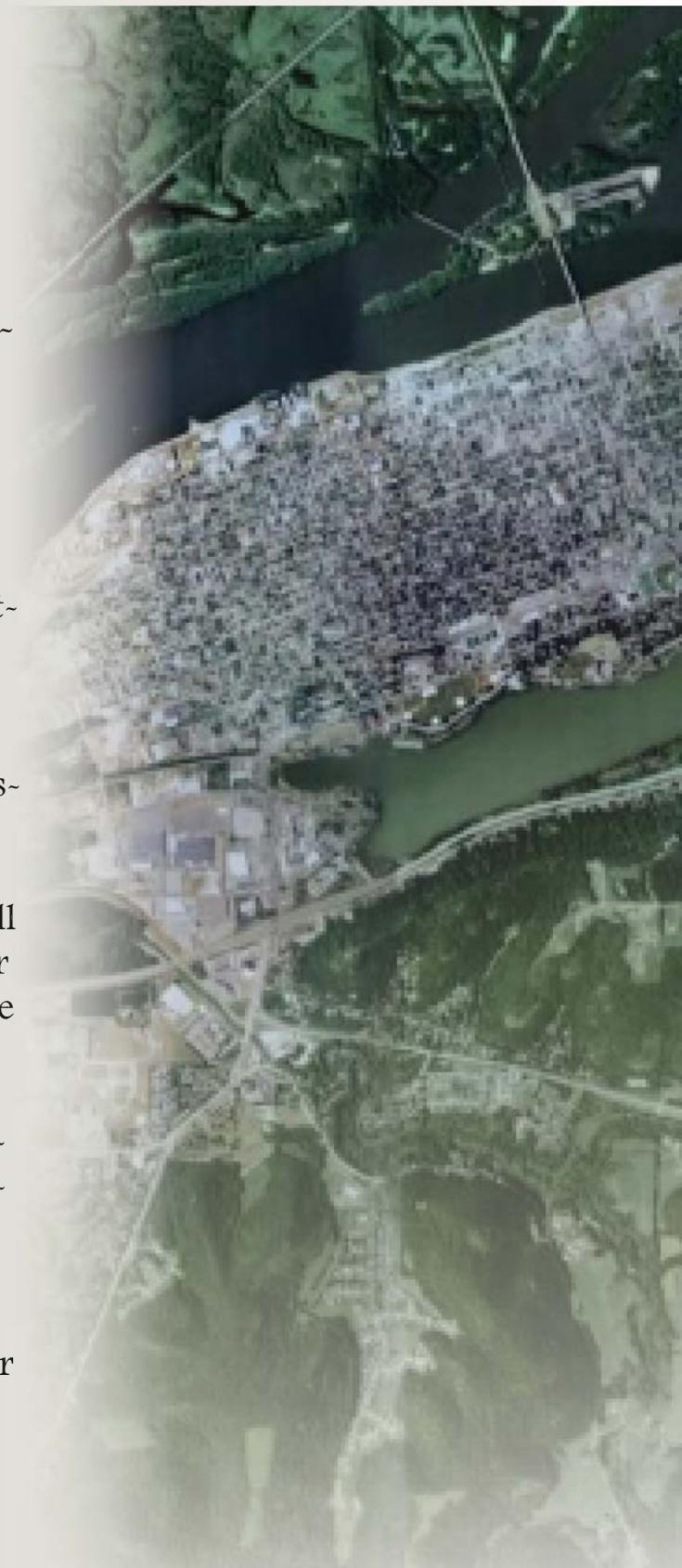
Closets/Storage Areas: 25~85 square feet per closet. Located as deemed necessary.

Family Room: 300~400 square feet. Will be located centrally on the ground floor with at least one wall allowing adequate access to natural light.

Small Den: 100~125 square feet. Located on the ground floor in close proximity to the work office.

Work Office/Utility Room: 100~125 square feet. Located on the ground floor in close proximity to the den. At least one wall must allow for natural light penetration.

Dining Room: 175~225 square feet. Located on the ground floor in close proximity to both the kitchen and family room.



# Programmatic Requirements:

Required Spaces and their corresponding spacial and organizational requirements:

Kitchen: 125-175 square feet. Located on the ground floor in close proximity to the dining room. Must also allow for adequate natural ventilation

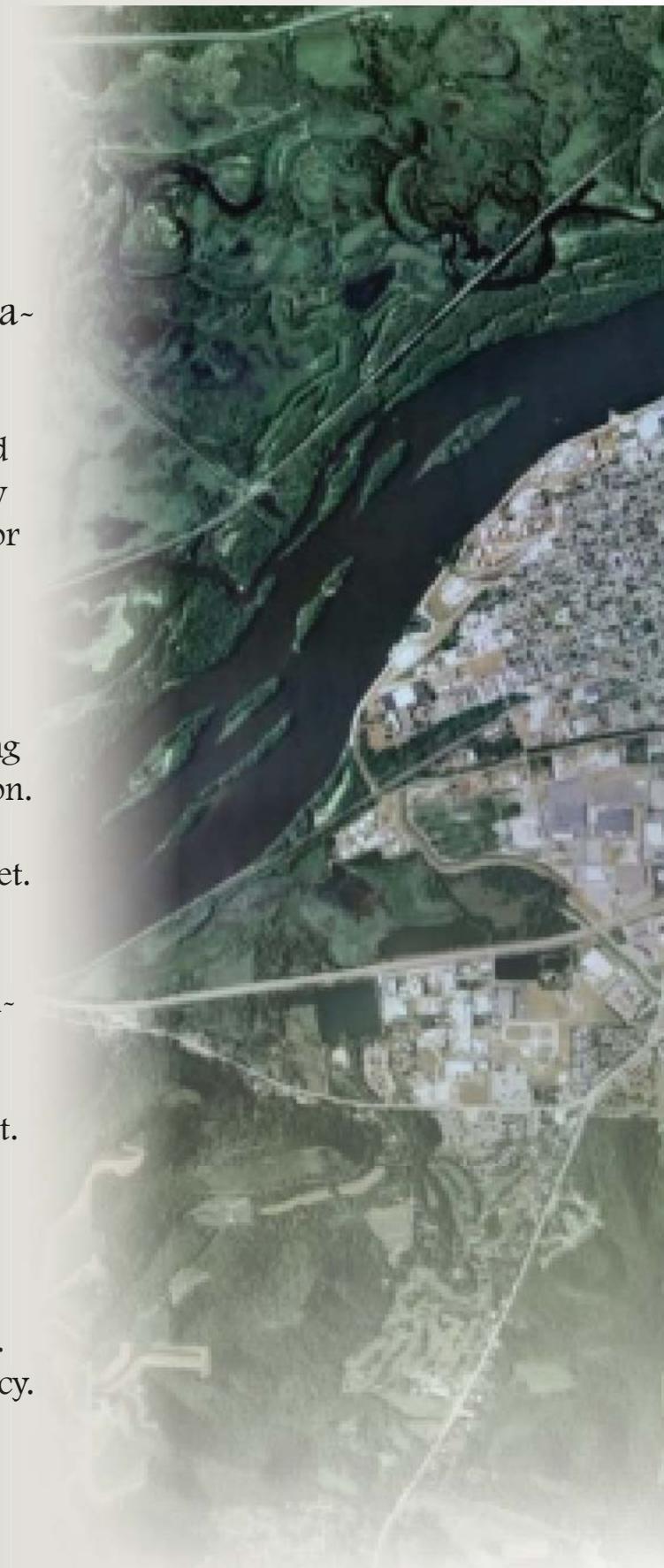
Laundry Room: 75-100 square feet. Located on the ground floor far from the family room, den, office and dining room with adequate natural ventilation.

Average Bedroom: 150-175 square feet. Located on the second floor with adequate natural lighting, fresh air and views and in close proximity to a bathroom.

Master Bedroom: 225-250 square feet. Located on the second floor with adequate natural lighting, fresh air and views.

Average Bathroom: 50-75 square feet. Multiple units depending on occupancy. A minimum of one bathroom on the ground floor and two on the second floor including the master bathroom.

Master Bathroom: 100-125 square feet. One will be located within each master bedroom on the second floor.



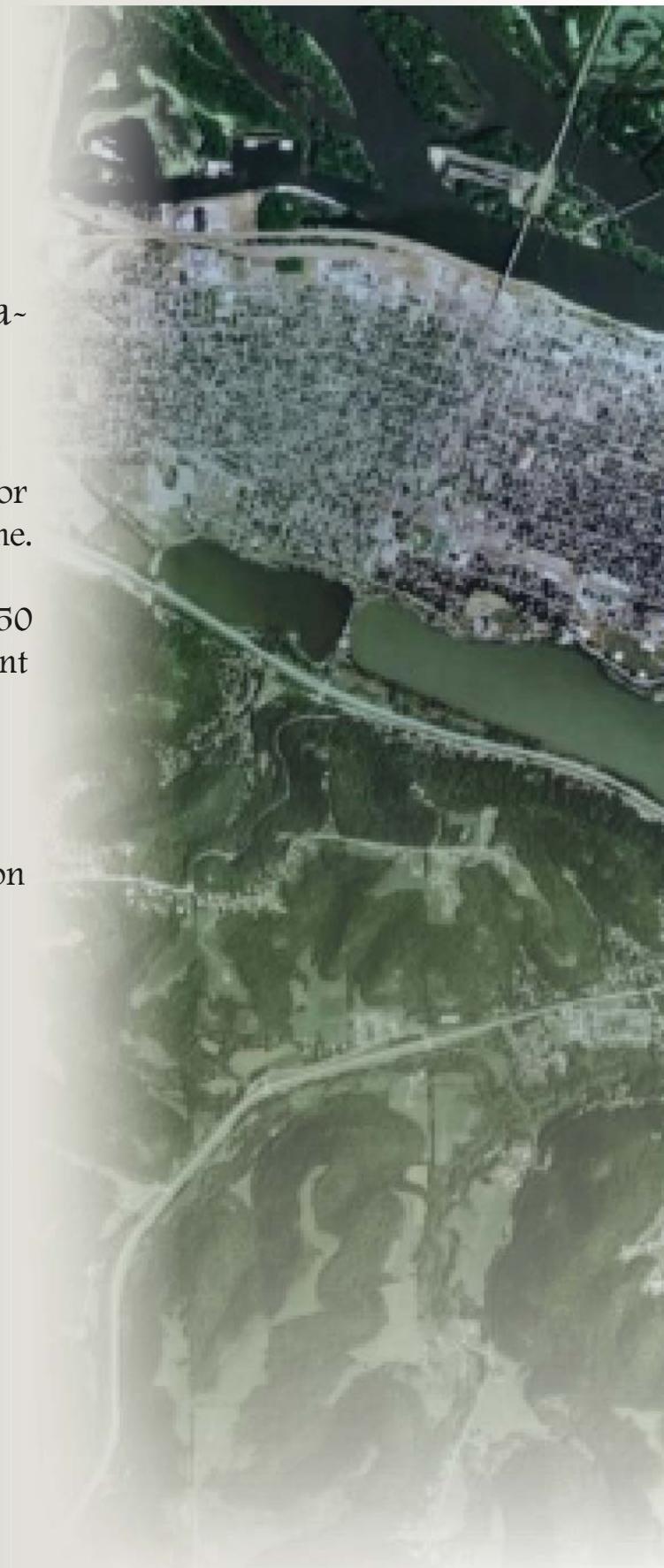
## Programmatic Requirements:

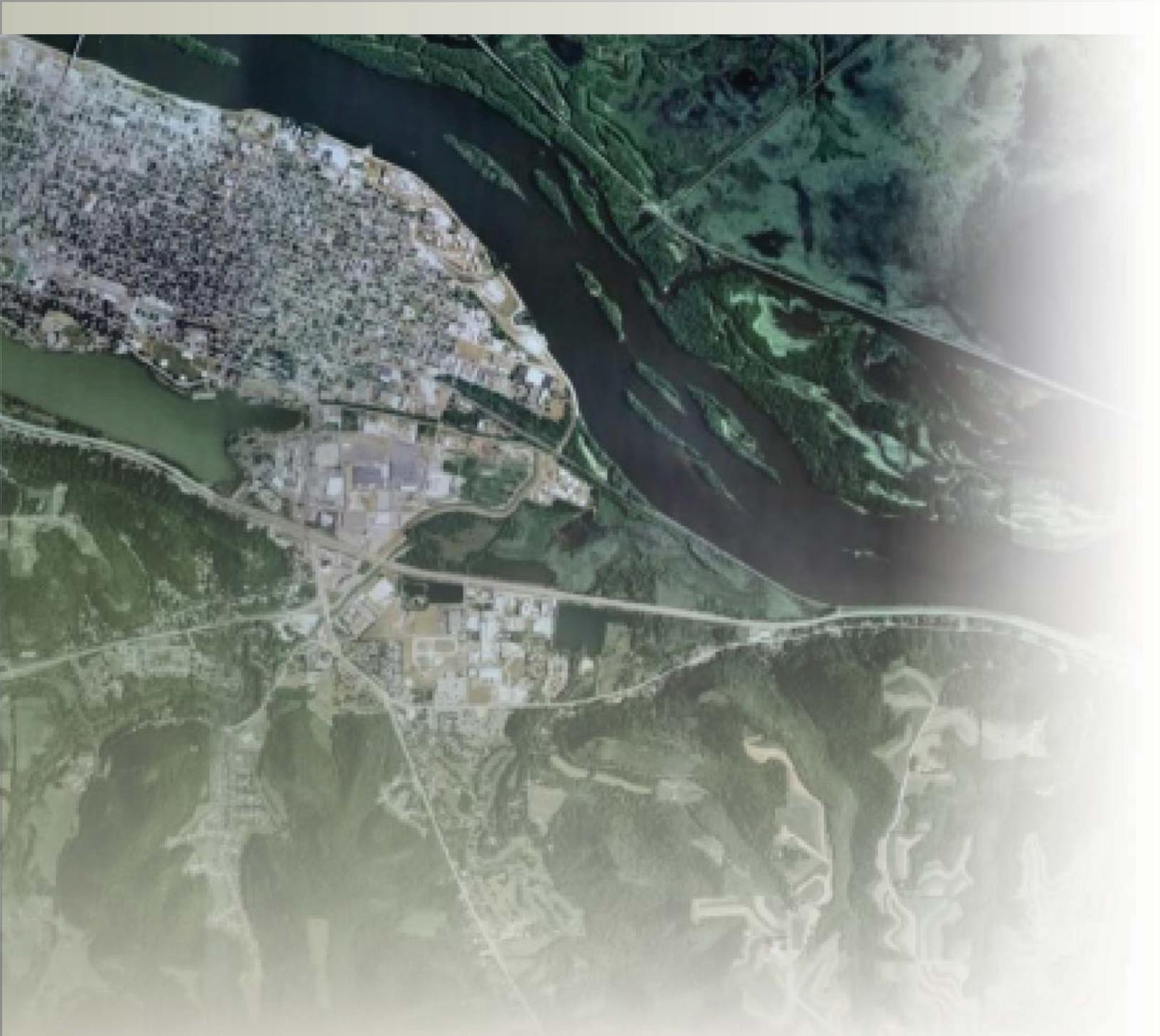
Required Spaces and their corresponding spacial and organizational requirements:

Three Season Porch or Deck: 175~200 square feet. Located on the ground floor off the southern side of each townhome.

Mechanical Space/Workroom: 100~150 square feet. Located in a small basement area that will serve a dual purpose as a severe weather shelter for the occupants.

Office: 100~125 square feet. Located on the ground floor in close proximity to the family room and/or den.



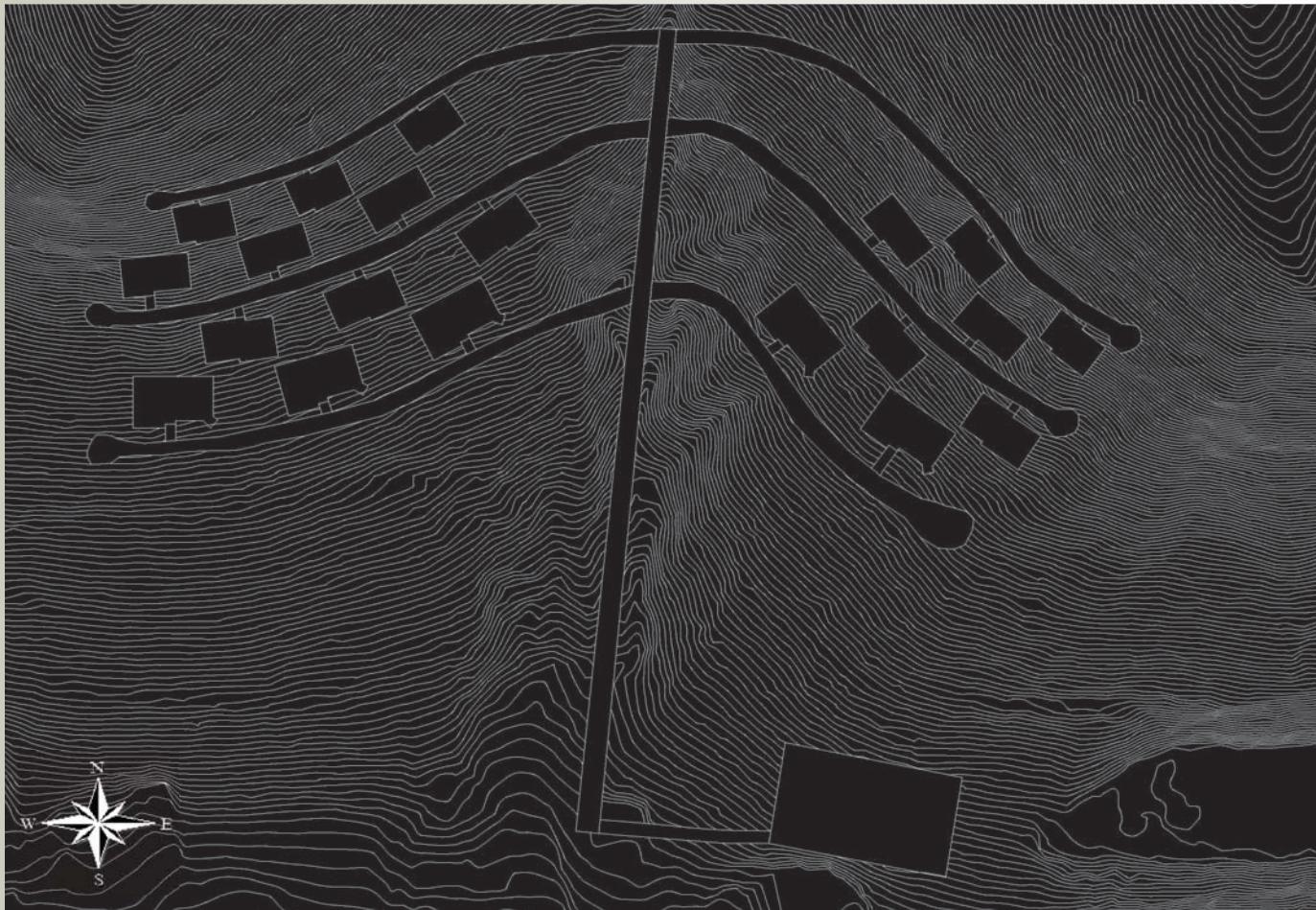


A high-angle aerial photograph of a river valley. The river, with its dark, winding channels, cuts through the landscape. On the left bank, there is a large industrial complex with numerous buildings and parking lots. The surrounding land is a mix of green fields and brown, possibly arid or semi-arid areas. The overall scene suggests a blend of natural and human-made environments.

# Design Documentation

# Design Documentation:

## Building Organization and Site transportation:



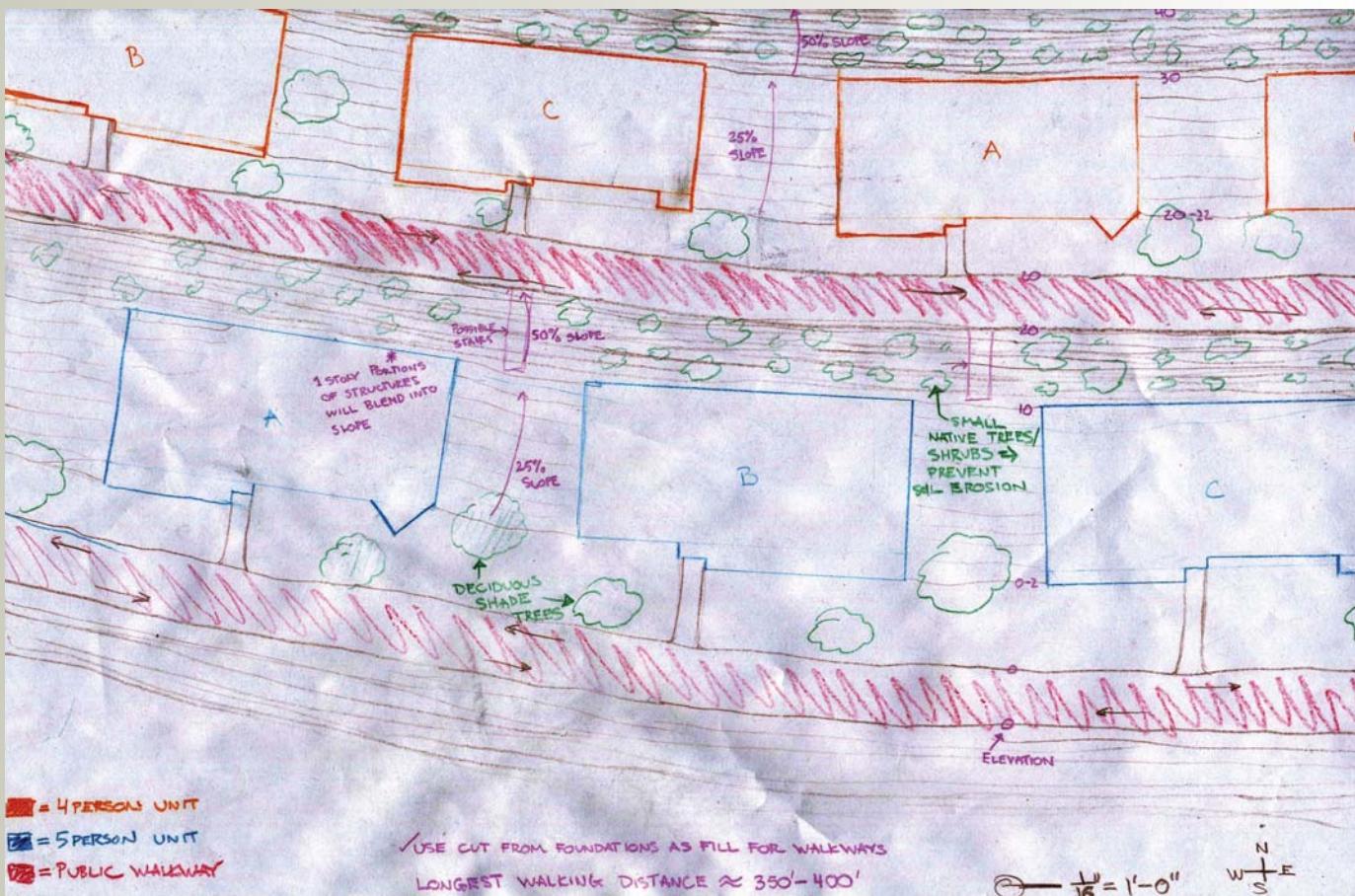
The slope on site averages between 40% and 50%. Because of the severity of site slope, a permanent vertical means of transportation will be necessary regardless of building configuration and organization.

### Solution:

A community parking facility will be available at the base of the site off of the main road. Next to this facility will be an inclined elevator system that will run between the two main housing clusters, stopping at every other row of houses progressing up the slope. This facility will also house the series of solar collection panels and photovoltaic trackers that will be the development's main source of power.

# Design Documentation:

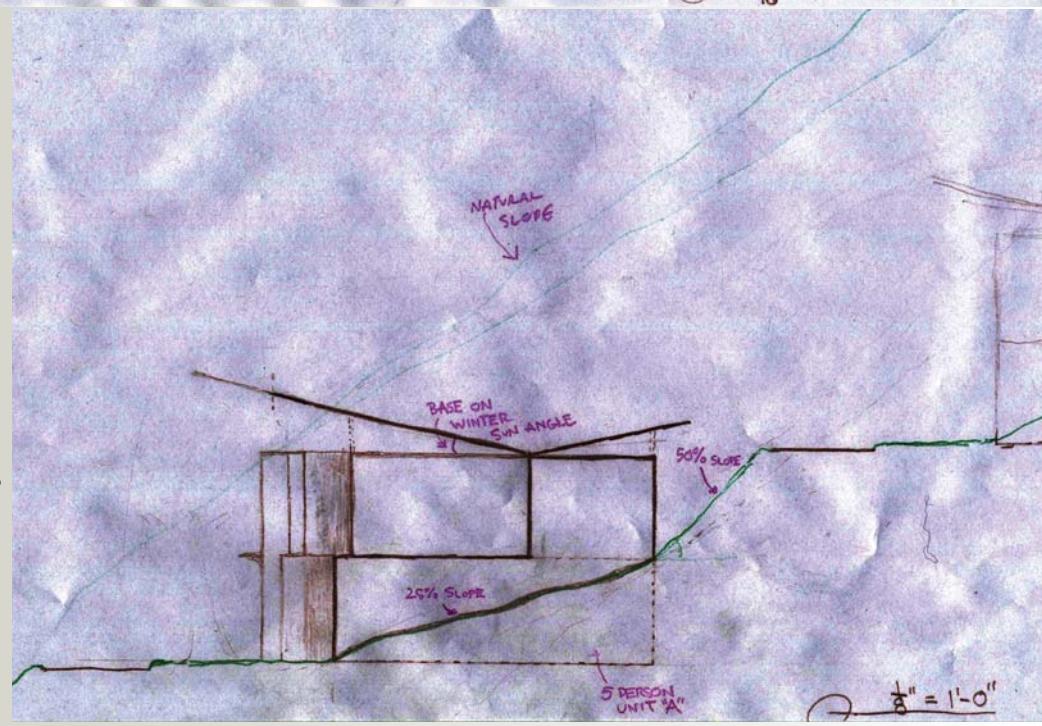
Building Organization and Site transportation:  
Housing and walkway layout



First attempts at a housing and walkway layout in plan and section.

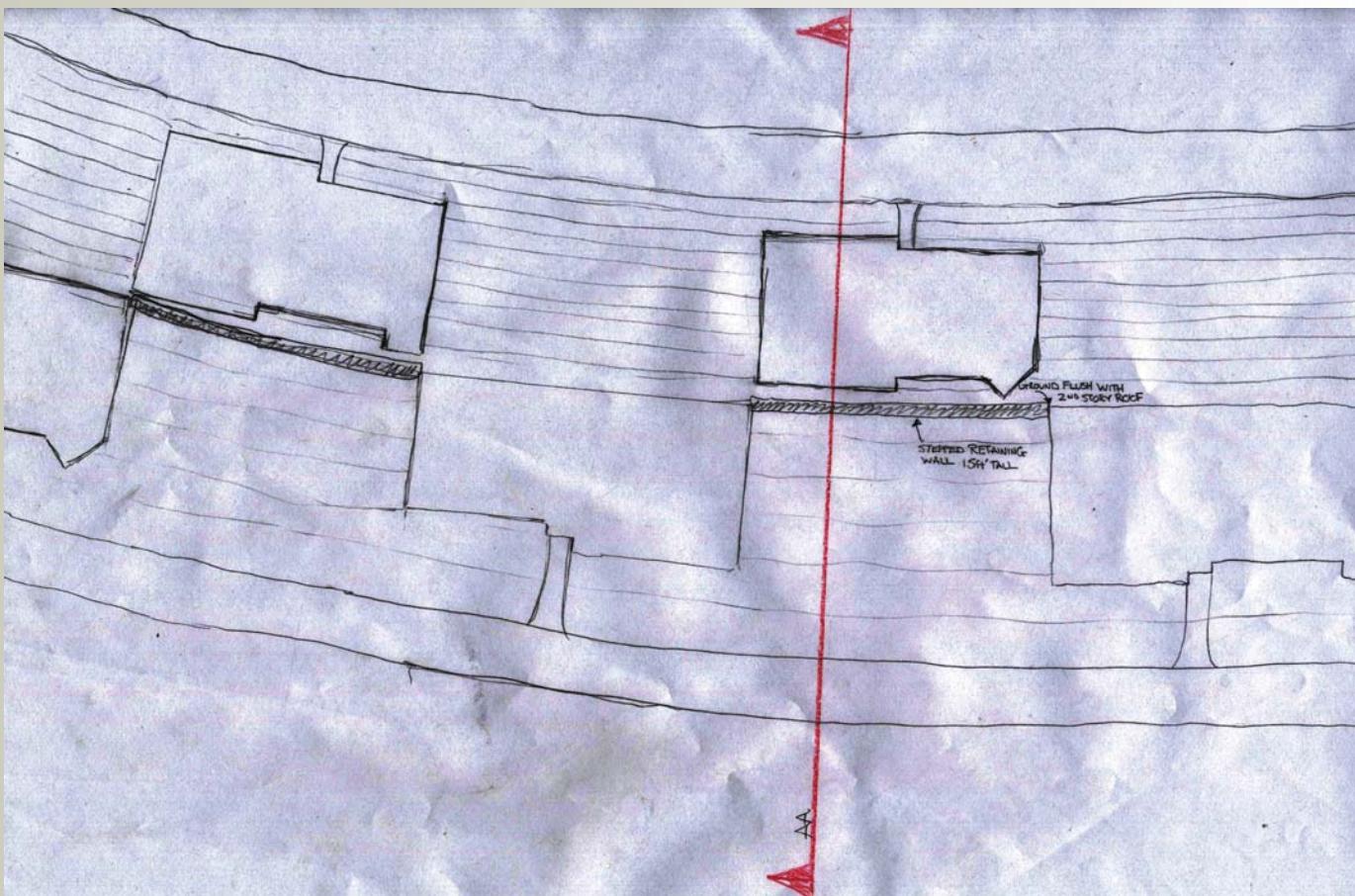
Problematic Issues:

1. Blocked views to the south.
2. Extreme amounts of soil removal and relocation.
3. Little accessible yard space.

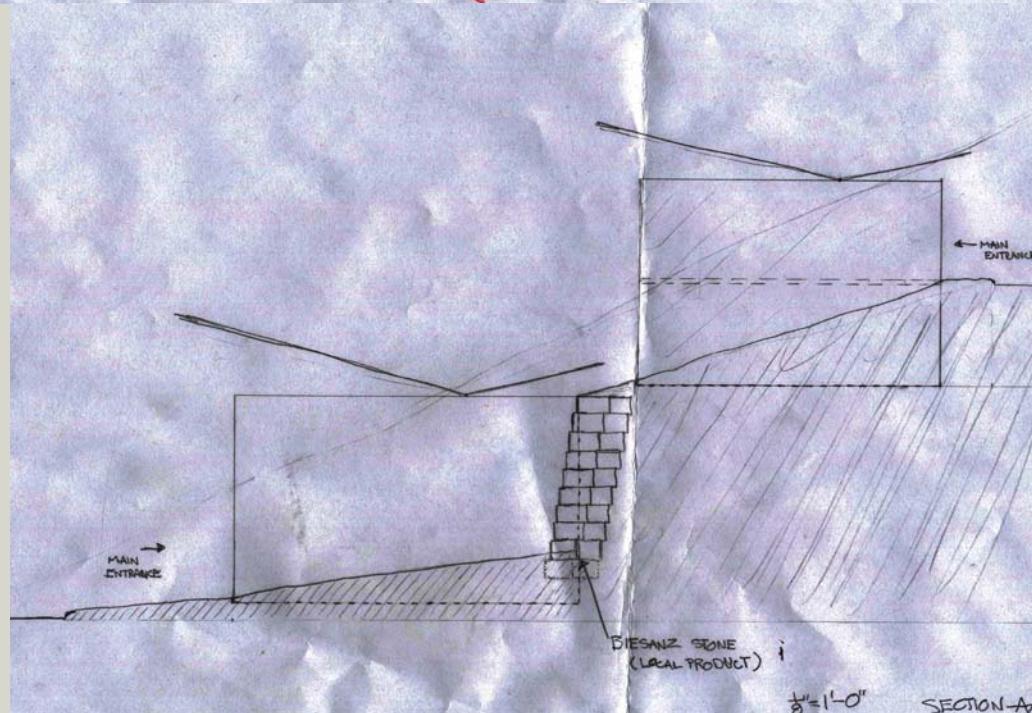


# Design Documentation:

Building Organization and Site transportation:  
Housing and walkway layout



The final solution solved all prior problematic issues noted in the first attempt.

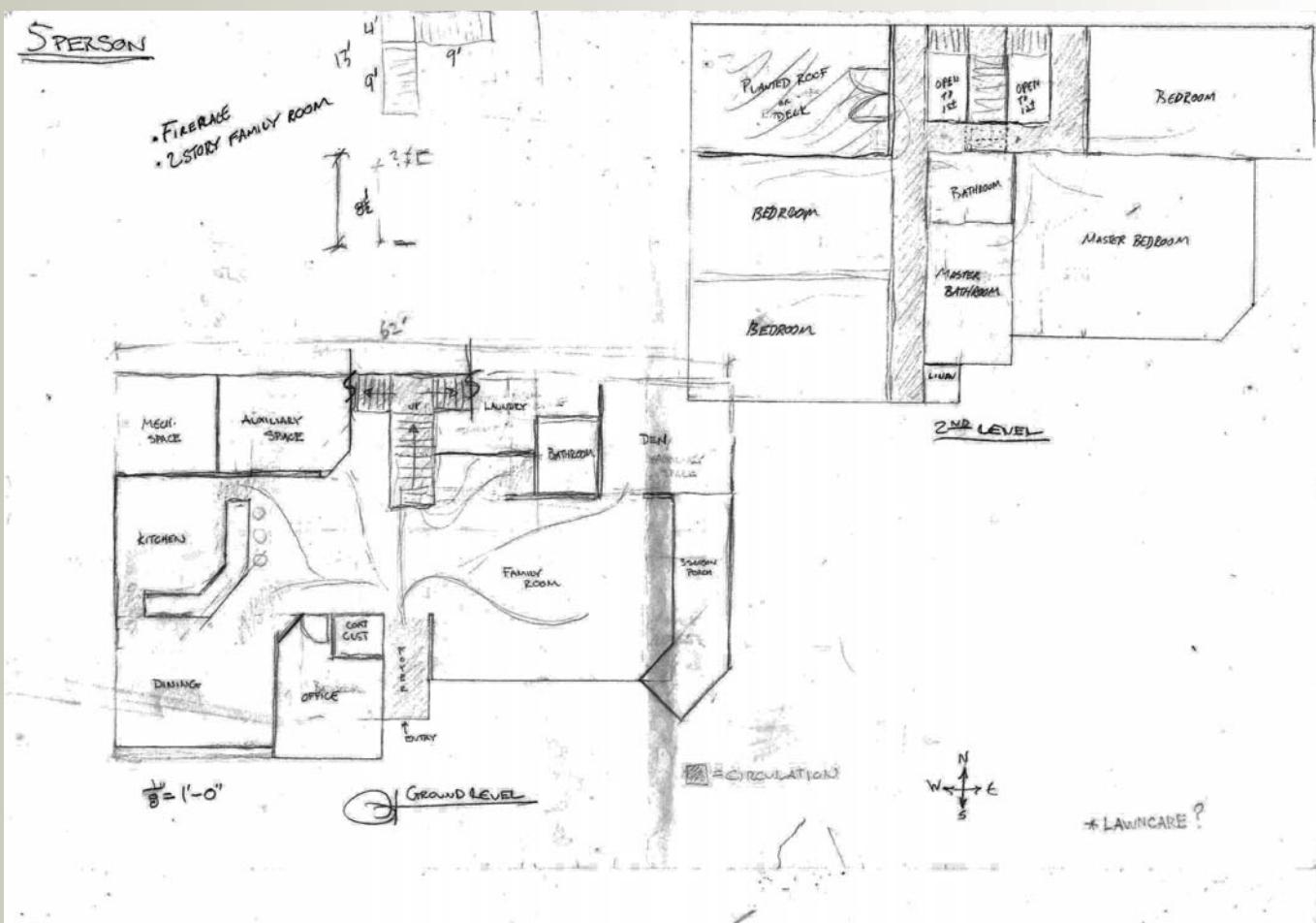


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SECTION A  
89

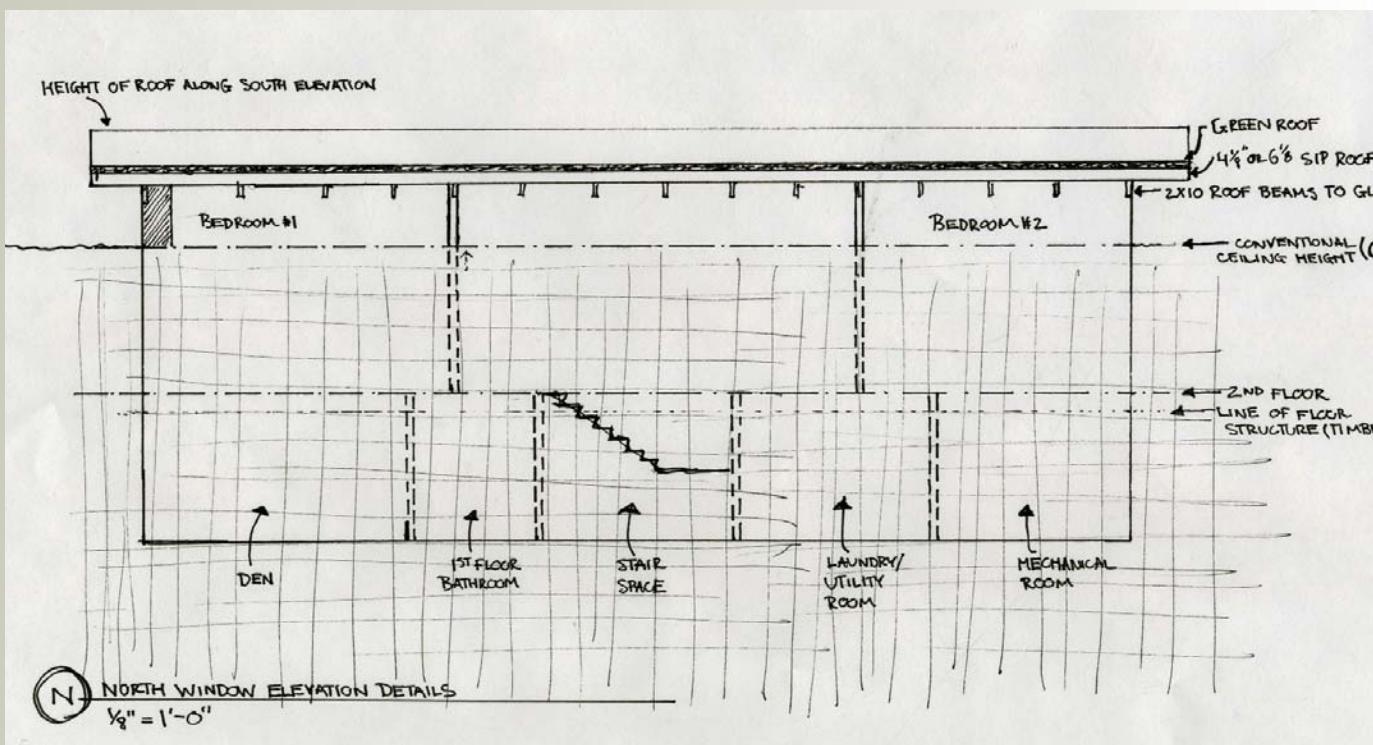
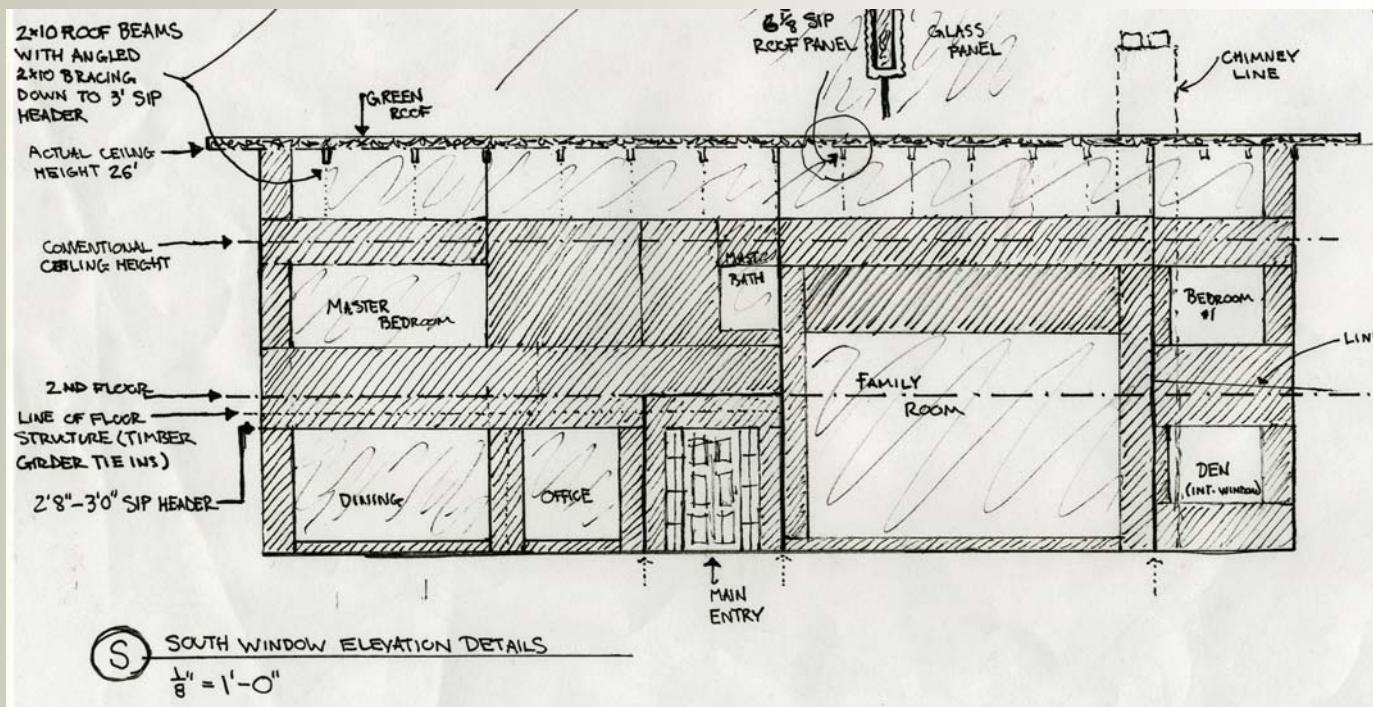
# Design Documentation:

Floor plan and elevation development:  
Five person unit



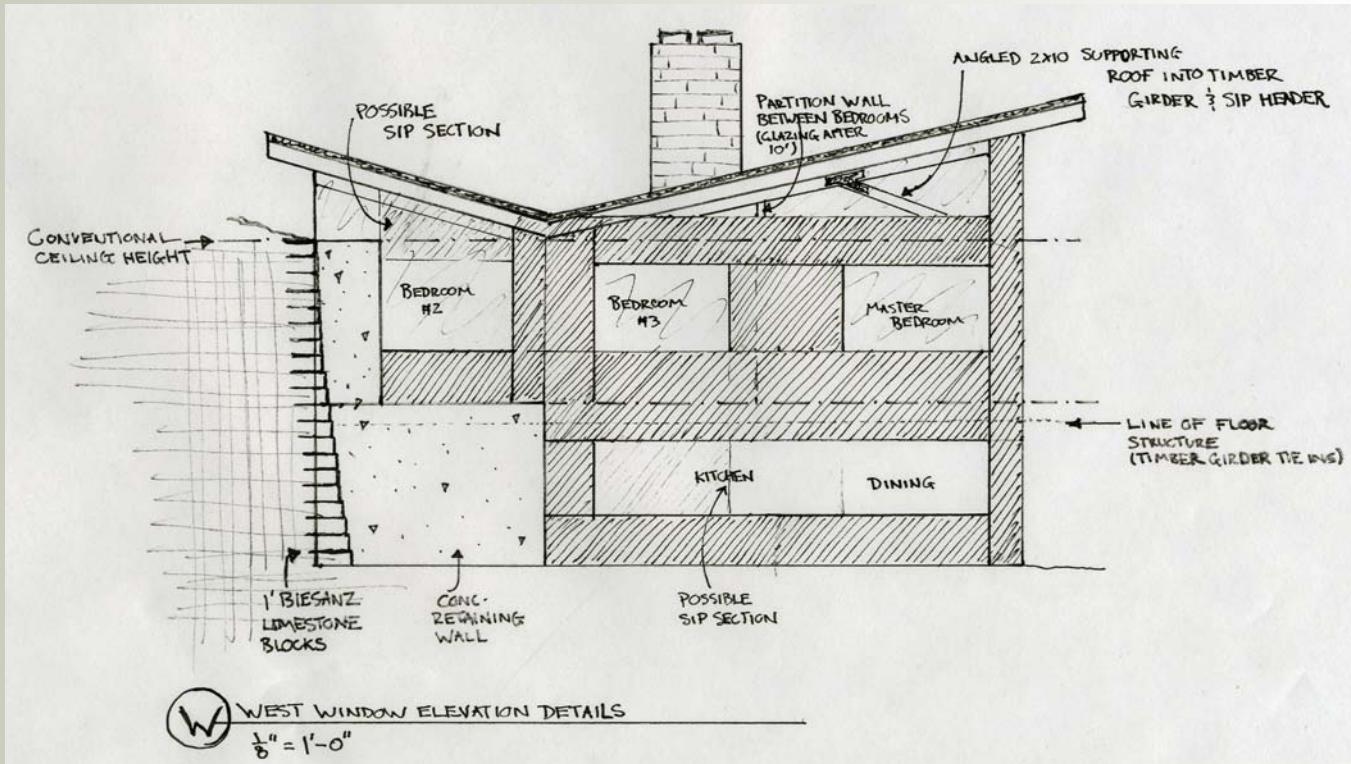
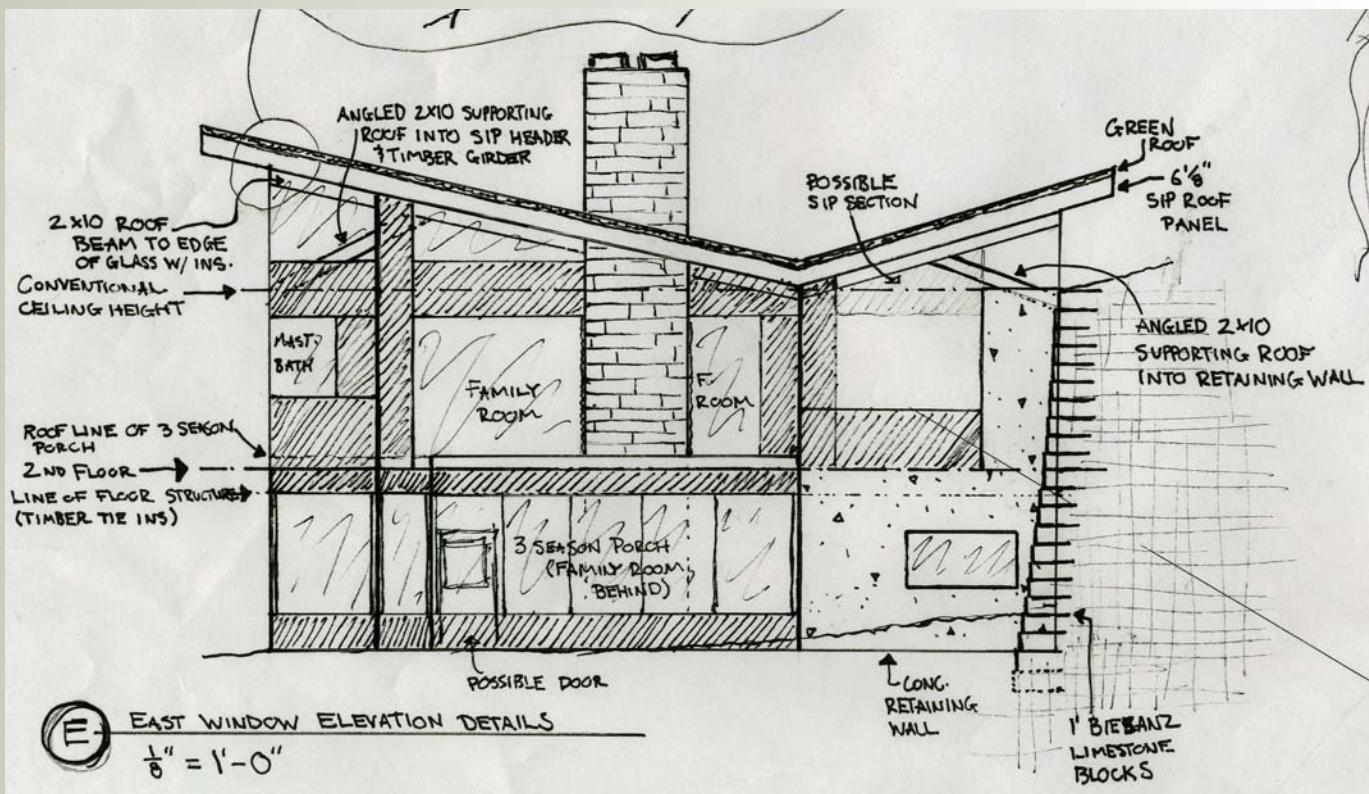
# Design Documentation:

Floor plan and elevation development:  
Five person unit



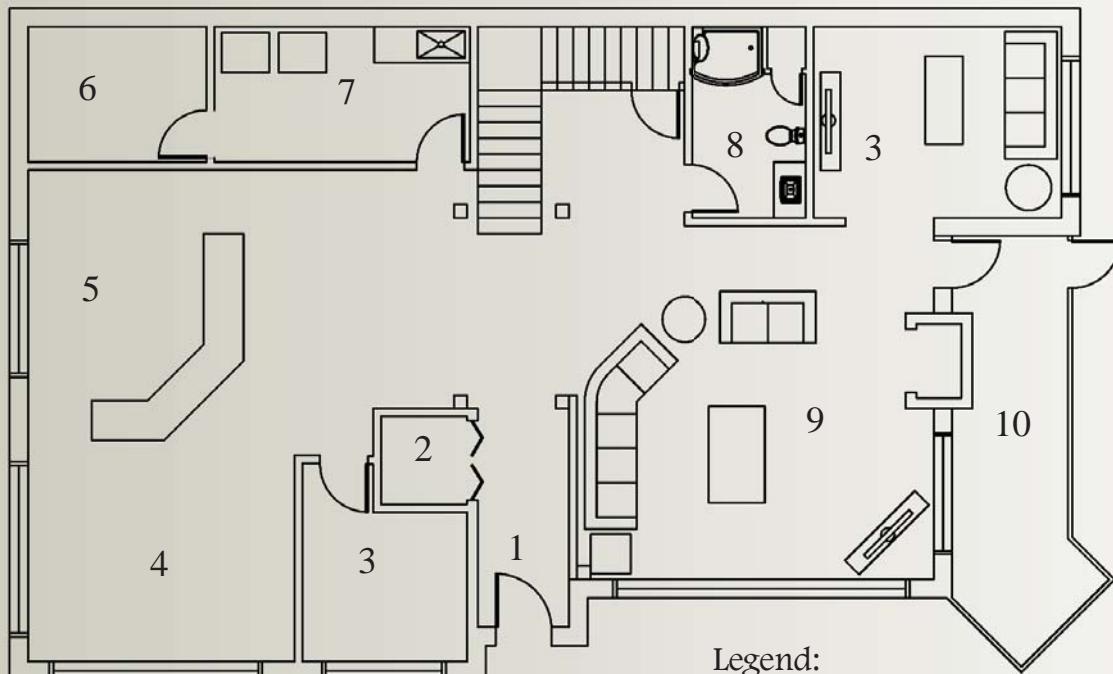
# Design Documentation:

Floor plan and elevation development:  
Five person unit



# Design Documentation:

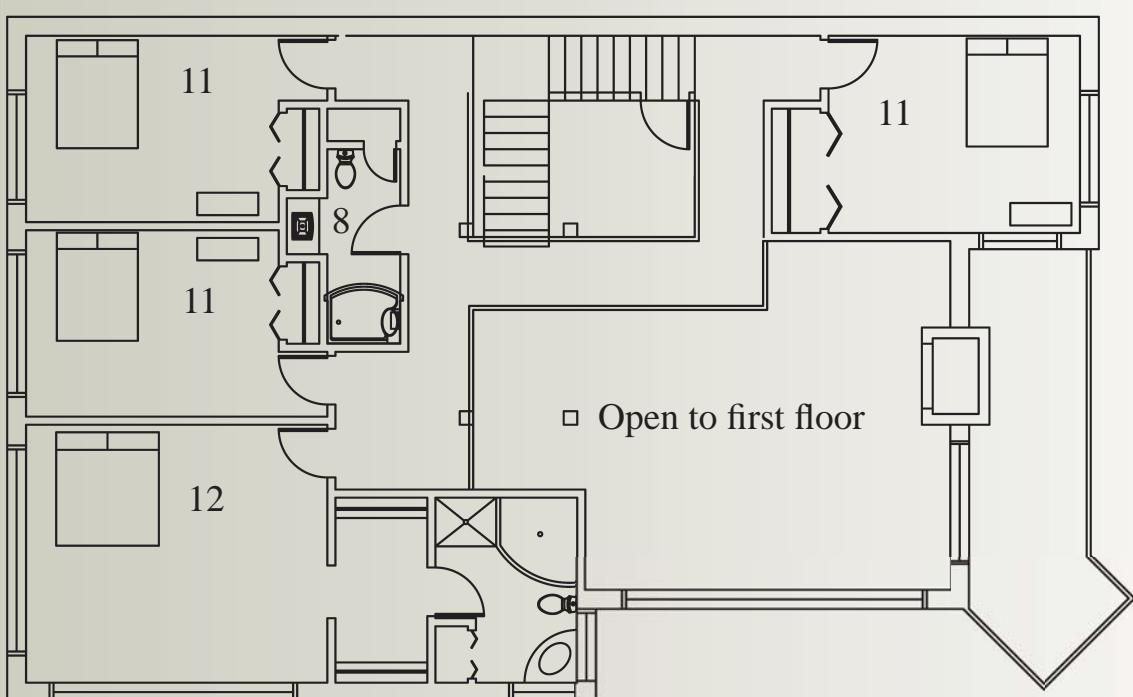
Final floor plans: Five person unit



First Floor:

Legend:

- 1: Main entry
- 2: Closet
- 3: Office/Den
- 4: Dining room
- 5: Kitchen
- 6: Mechanical
- 7: Laundry room
- 8: Bathroom
- 9: Family room
- 10: 3 Season porch
- 11: Bedroom
- 12: Master bedroom suite

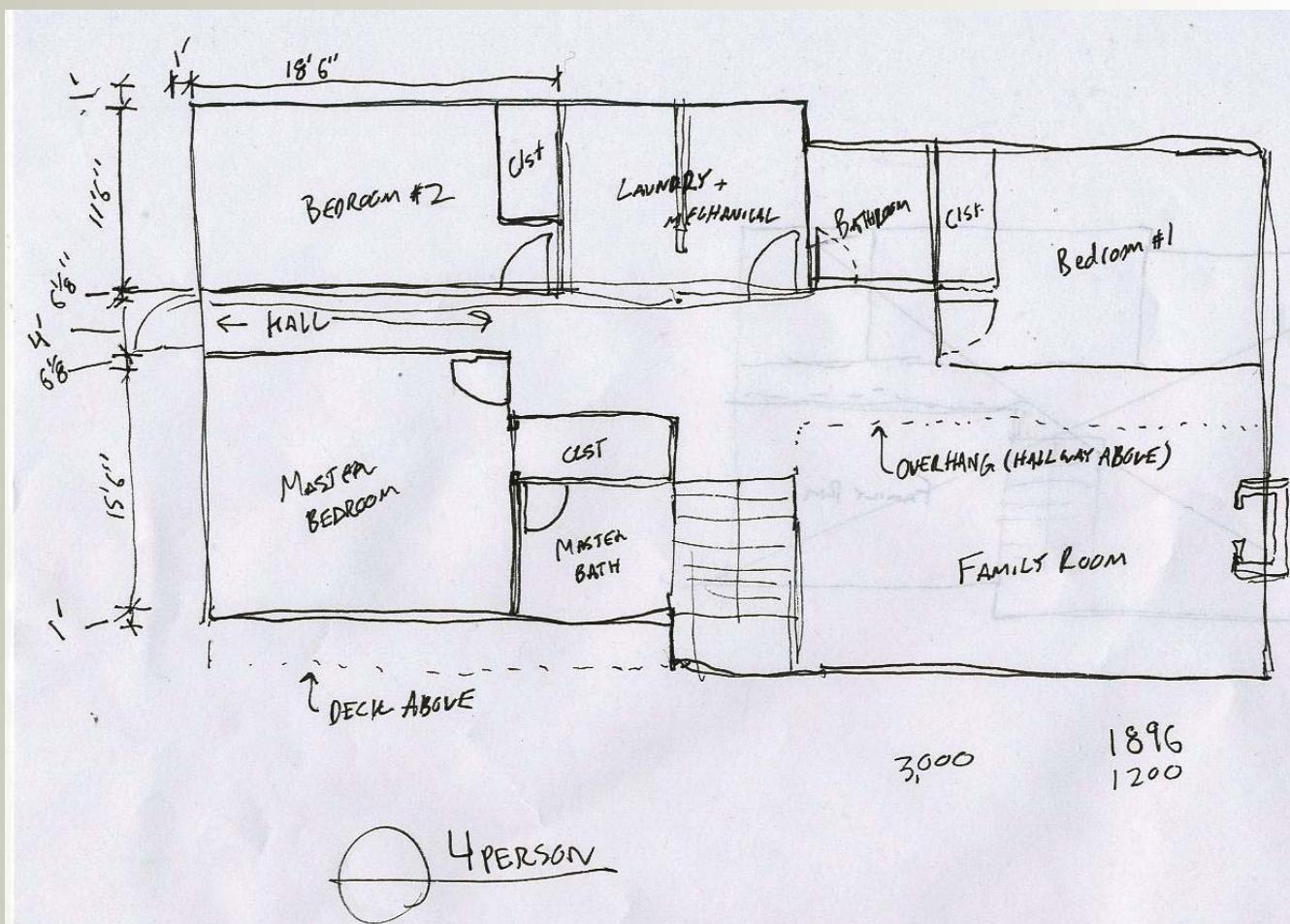


Second Floor:

Scale: 5' 15' 35'

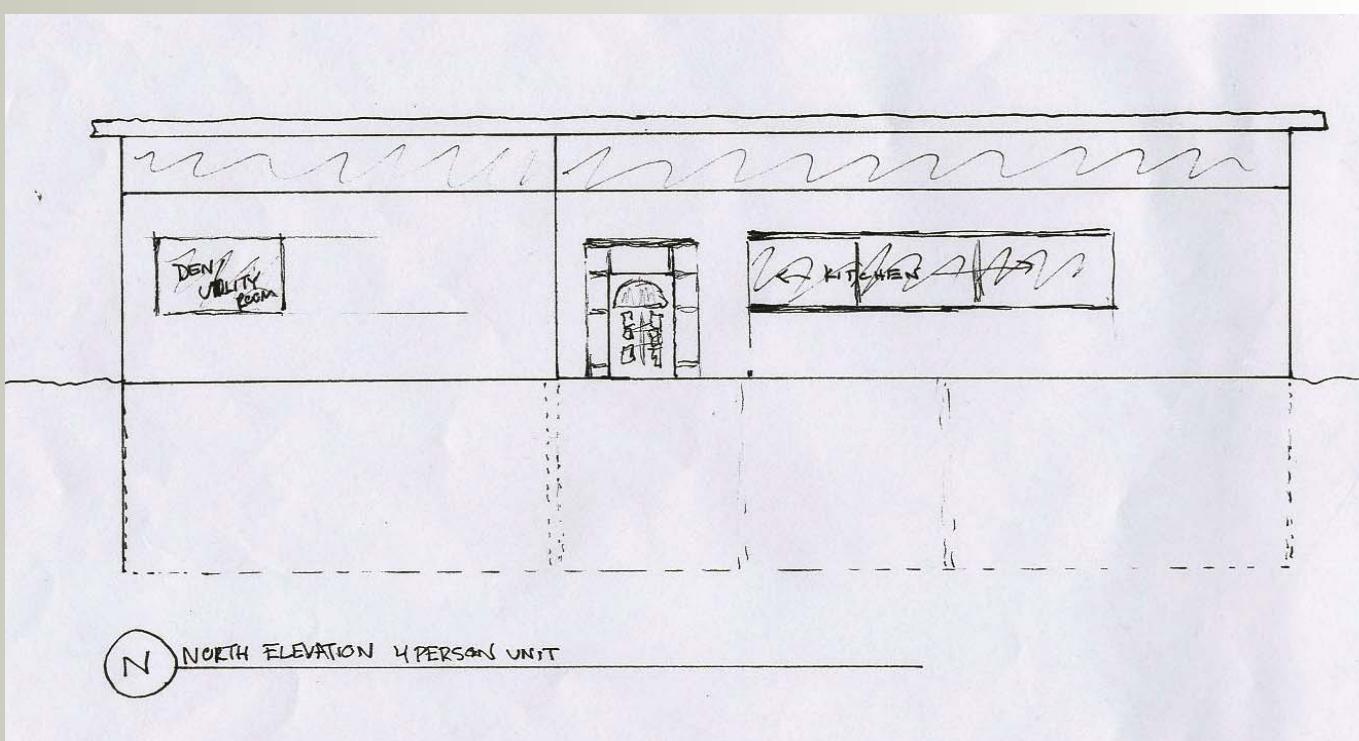
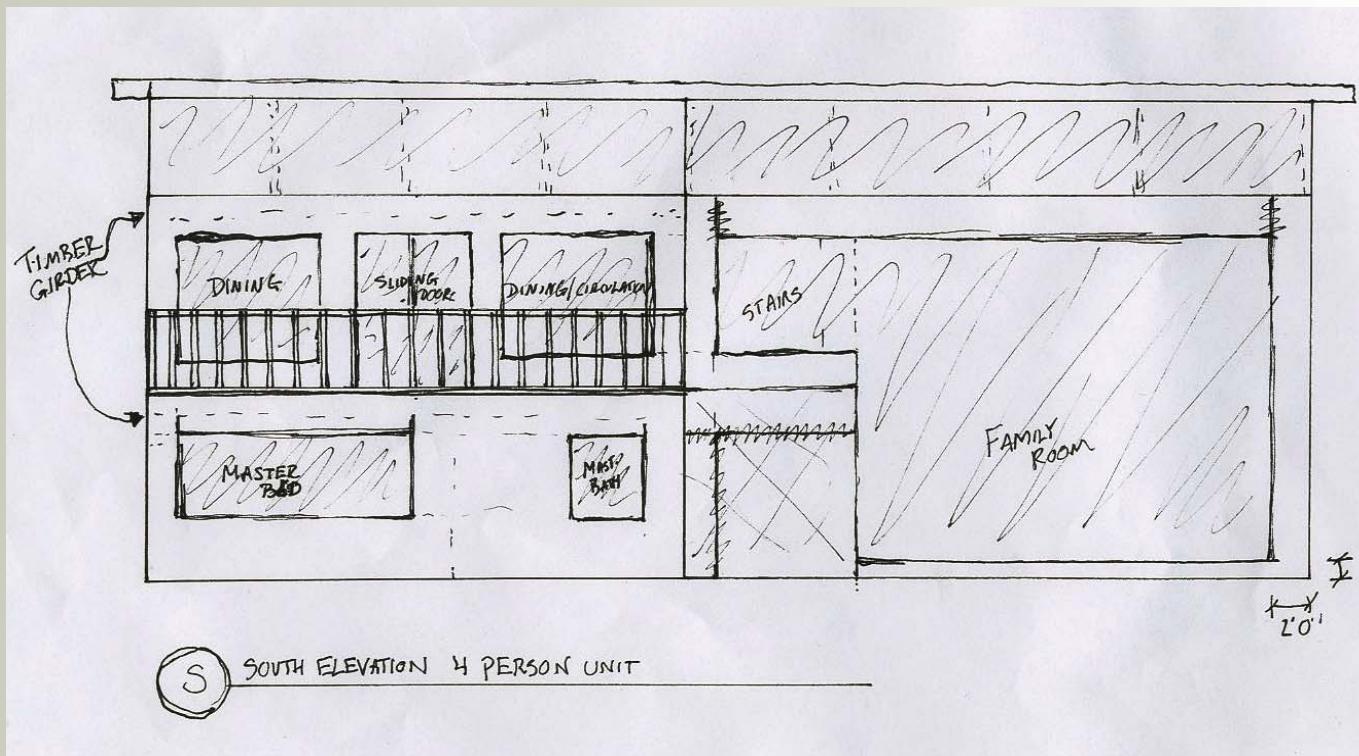
# Design Documentation:

Floor plan and elevation development:  
Four person unit



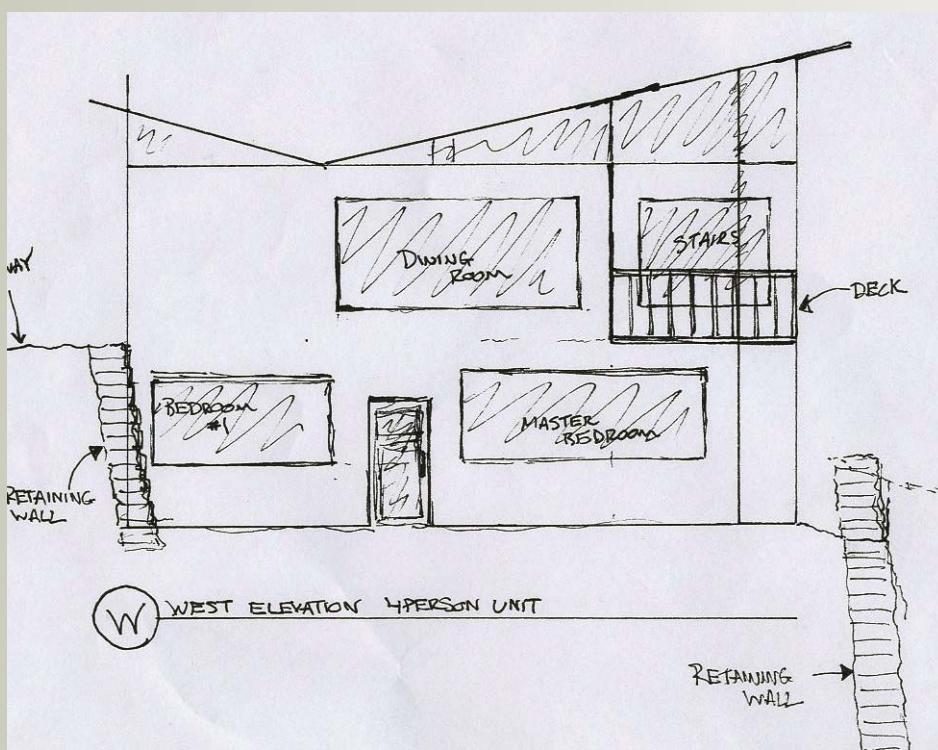
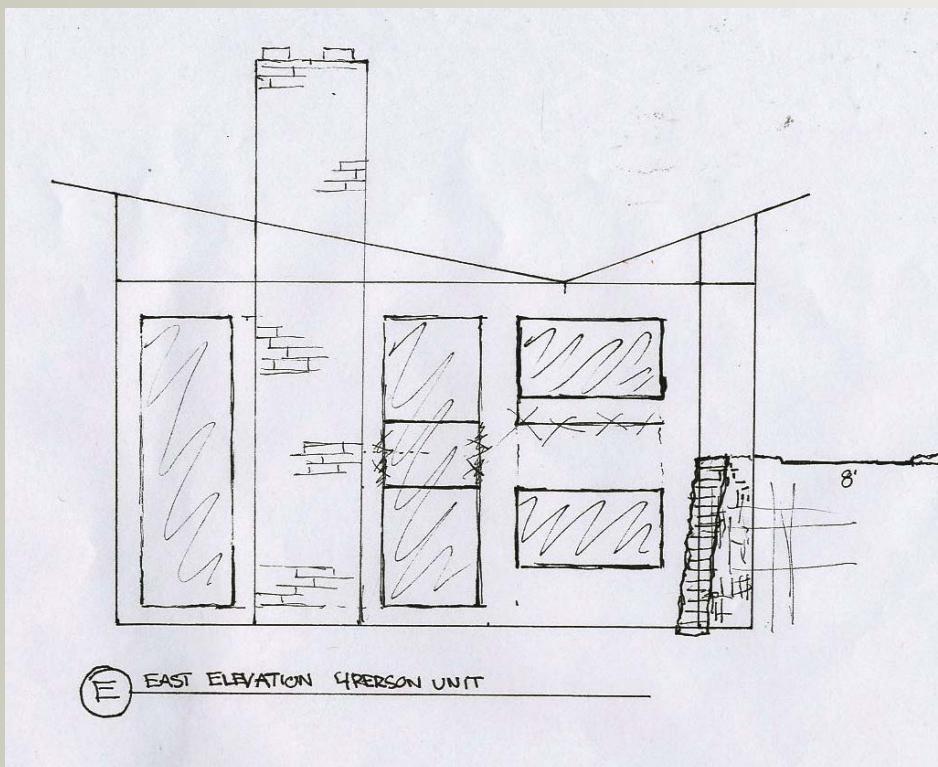
# Design Documentation:

Floor plan and elevation development:  
Four person unit



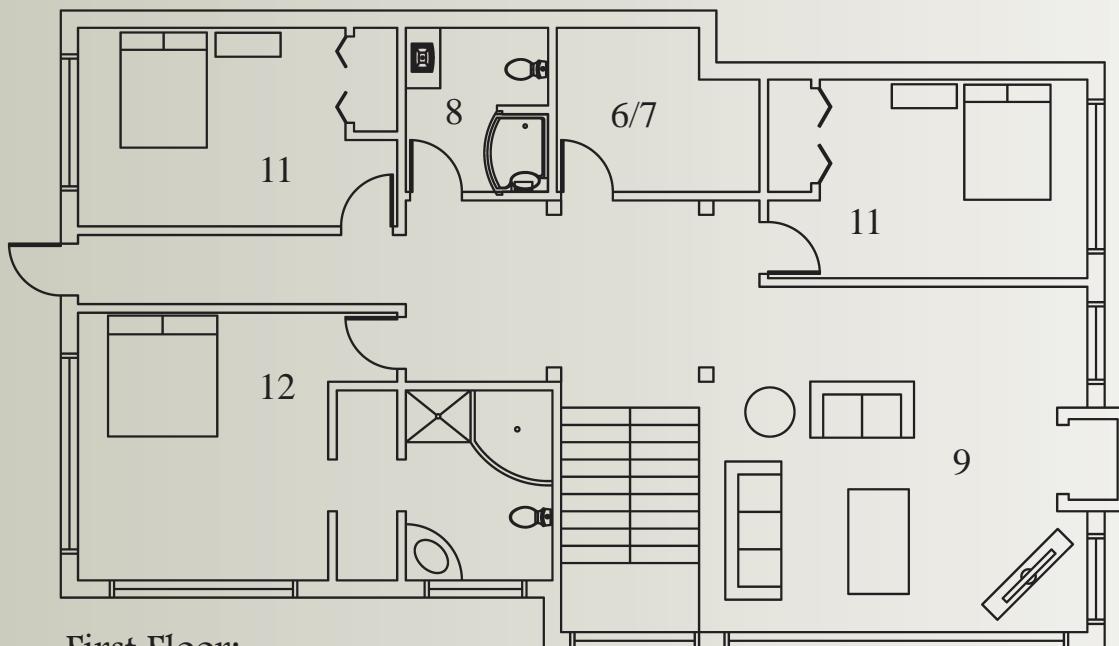
# Design Documentation:

Floor plan and elevation development:  
Four person unit



# Design Documentation:

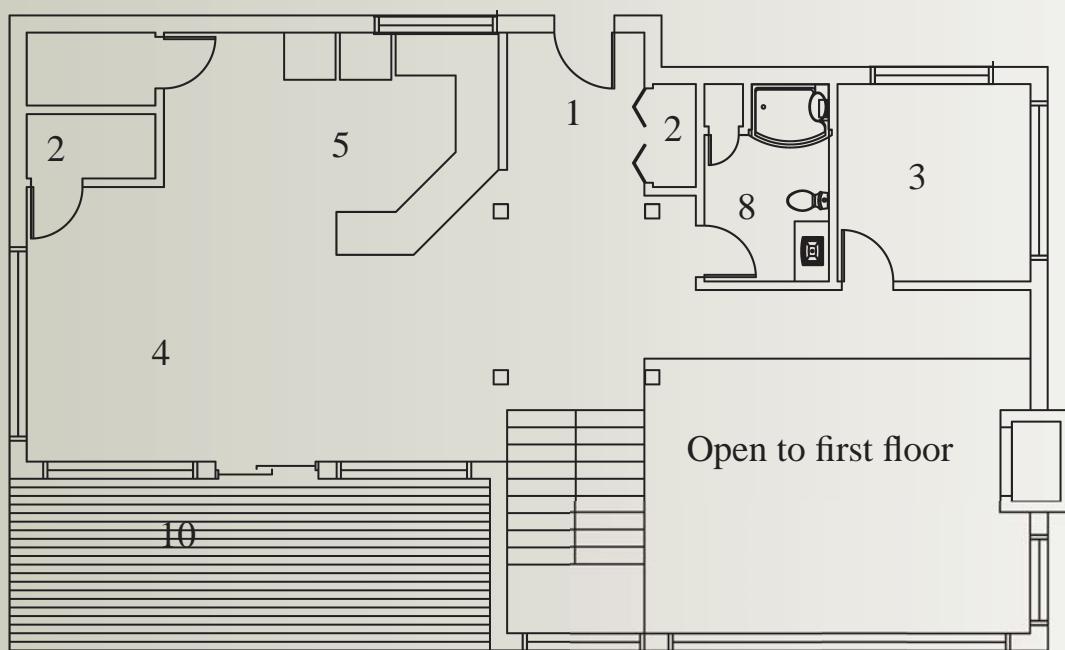
Final floor plans: Four person unit



First Floor:

## Legend:

- |                |                          |
|----------------|--------------------------|
| 1: Main entry  | 7: Laundry room          |
| 2: Closet      | 8: Bathroom              |
| 3: Office/Den  | 9: Family room           |
| 4: Dining room | 10: Deck                 |
| 5: Kitchen     | 11: Bedroom              |
| 6: Mechanical  | 12: Master bedroom suite |

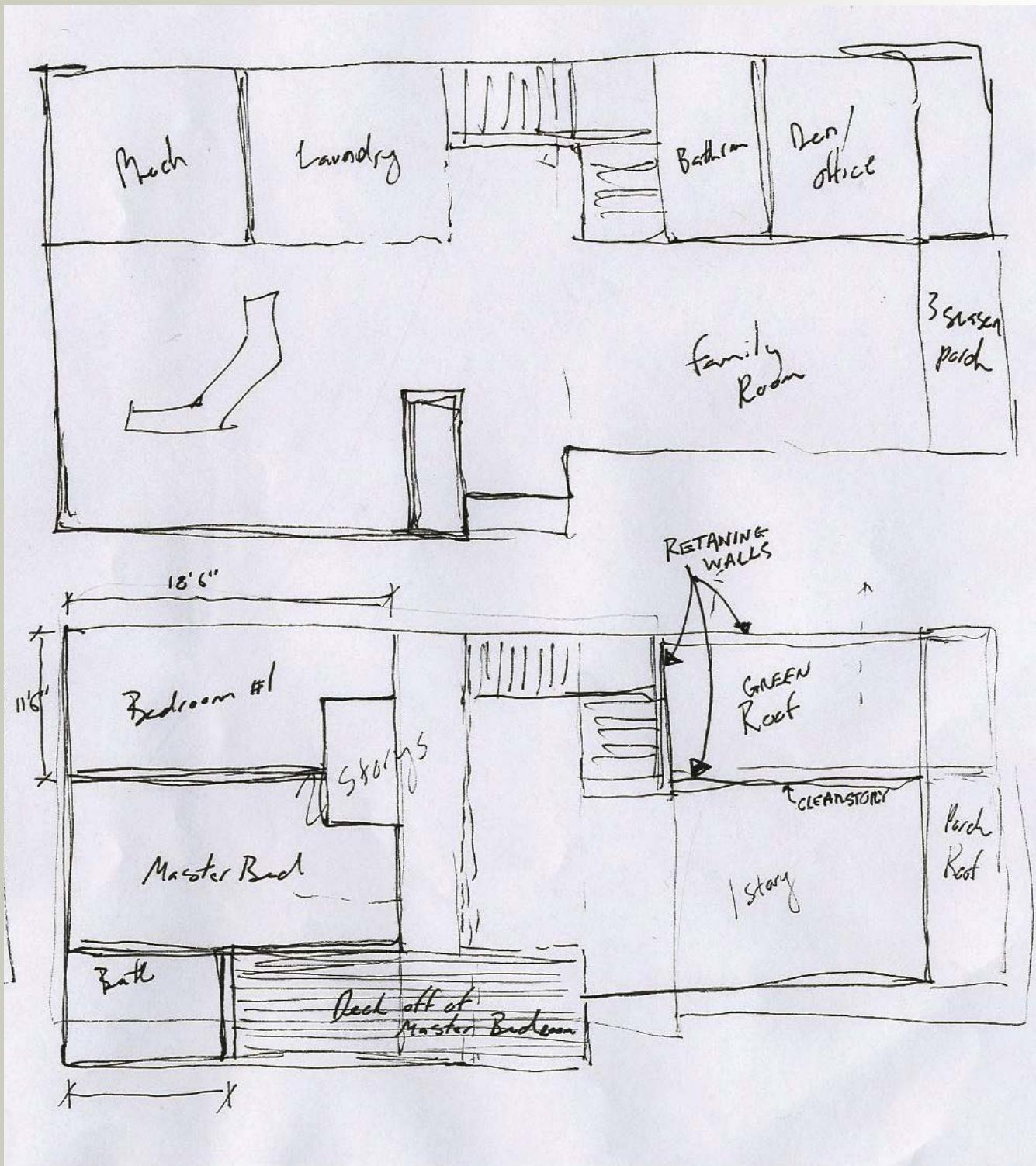


Second Floor:

Scale: 5' 15' 35'

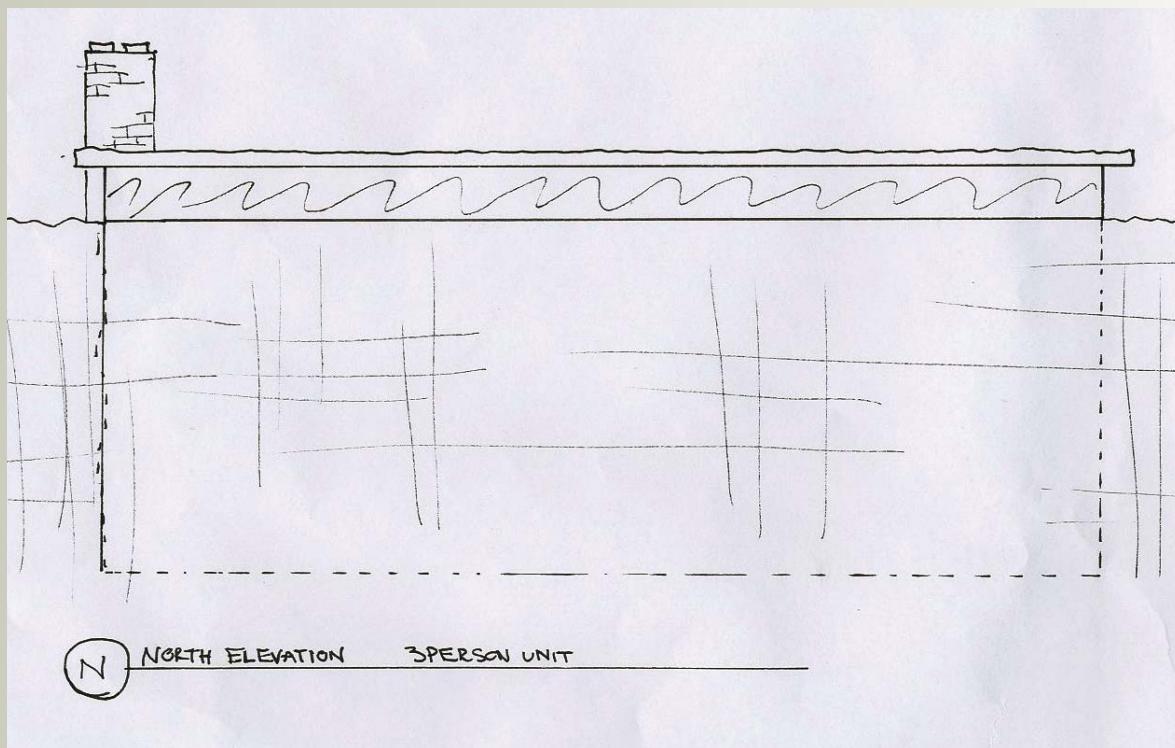
# Design Documentation:

Floor plan and elevation development:  
Three person unit



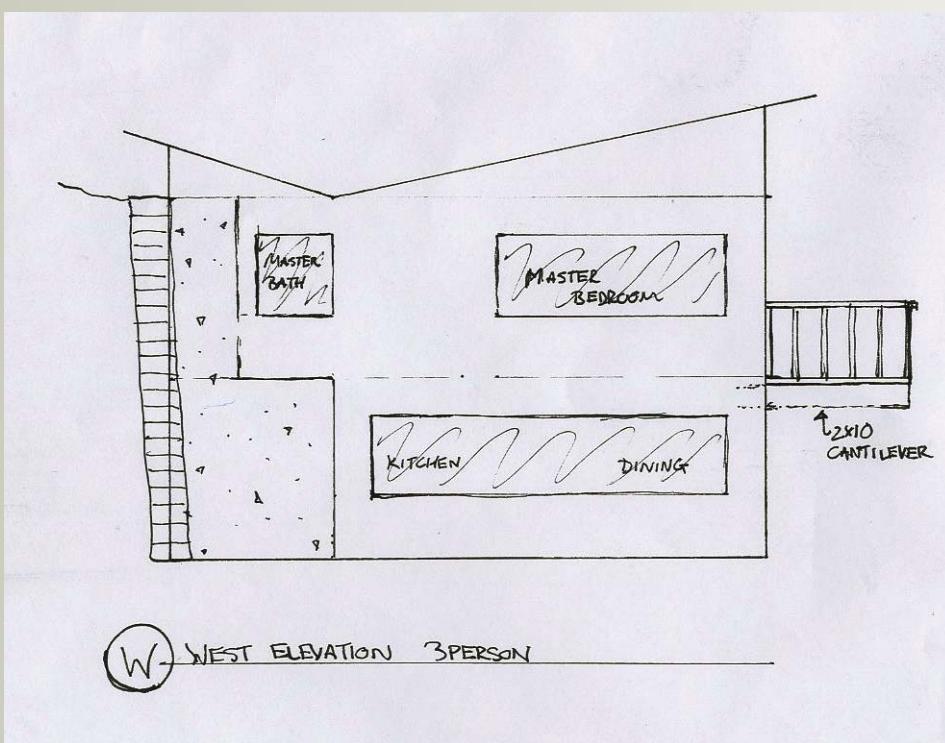
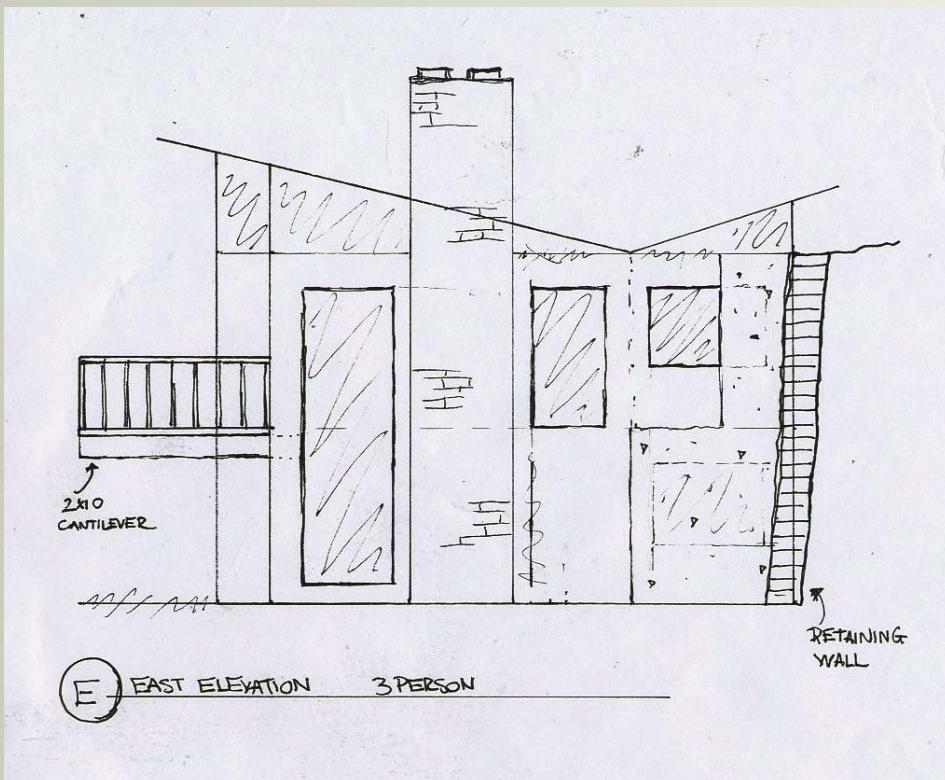
# Design Documentation:

Floor plan and elevation development:  
Three person unit



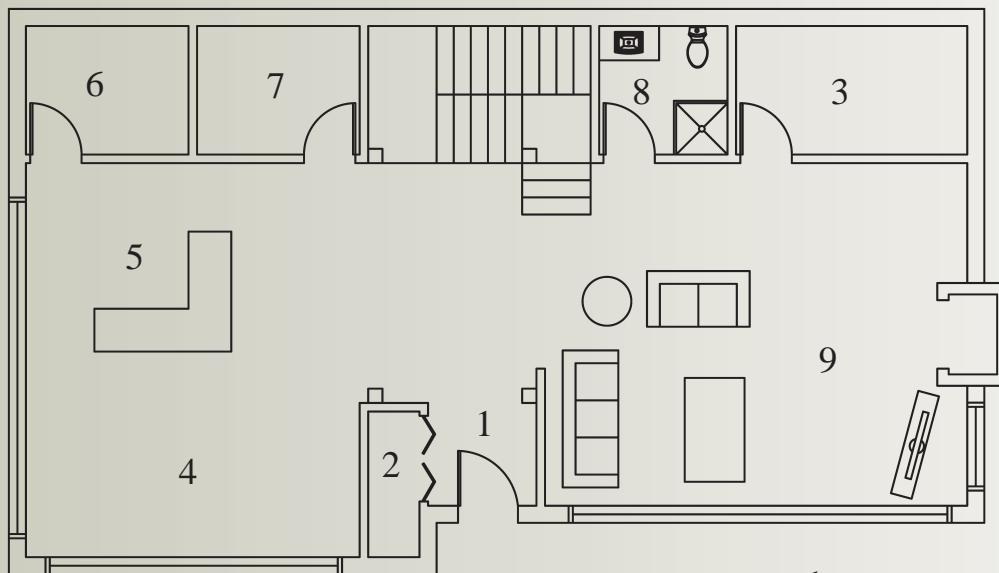
# Design Documentation:

Floor plan and elevation development:  
Three person unit



# Design Documentation:

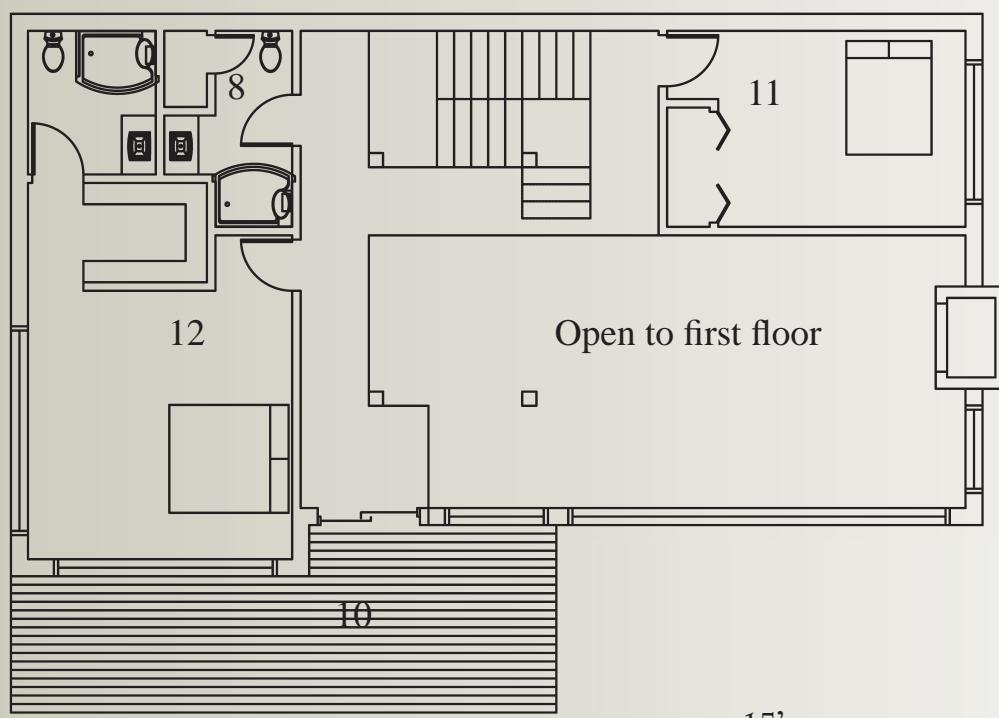
Final floor plans: Three person unit



First Floor:

Legend:

- 1: Main entry
- 2: Closet
- 3: Office/Den
- 4: Dining room
- 5: Kitchen
- 6: Mechanical
- 7: Laundry room
- 8: Bathroom
- 9: Family room
- 10: 3 Season porch
- 11: Bedroom
- 12: Master bedroom suite

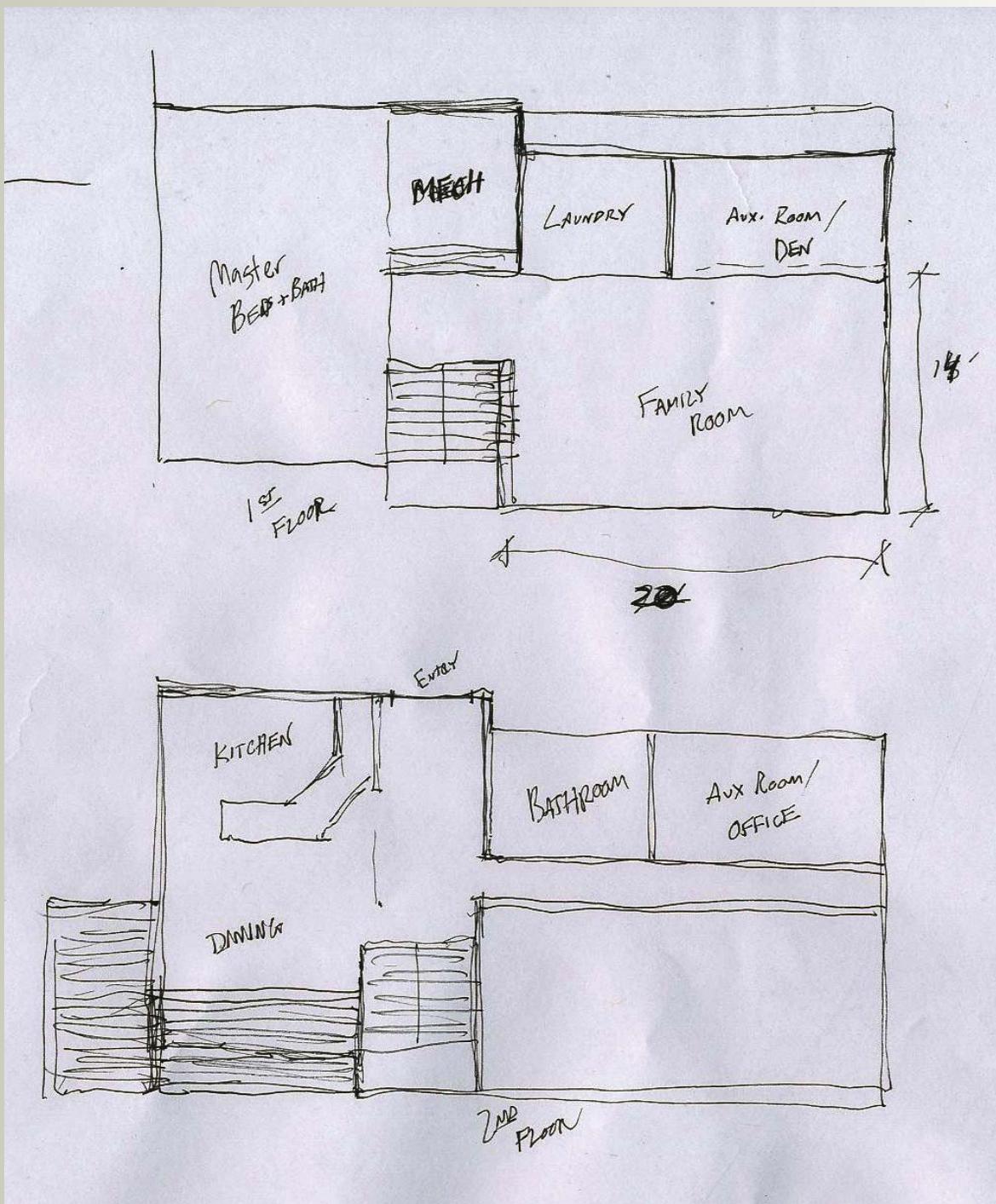


Second Floor:

Scale: 5' 15' 35'

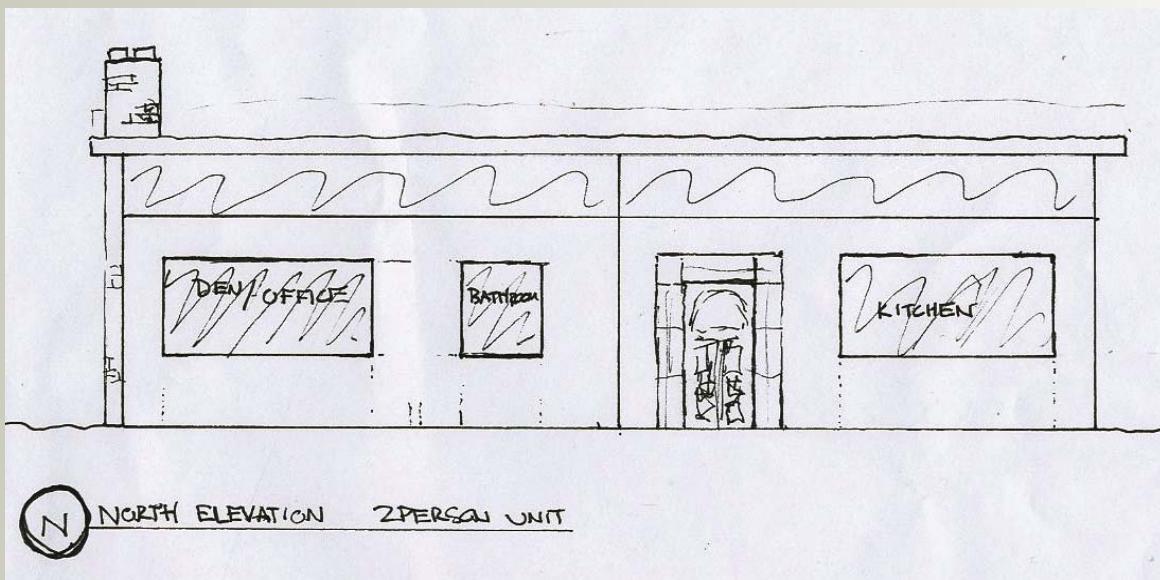
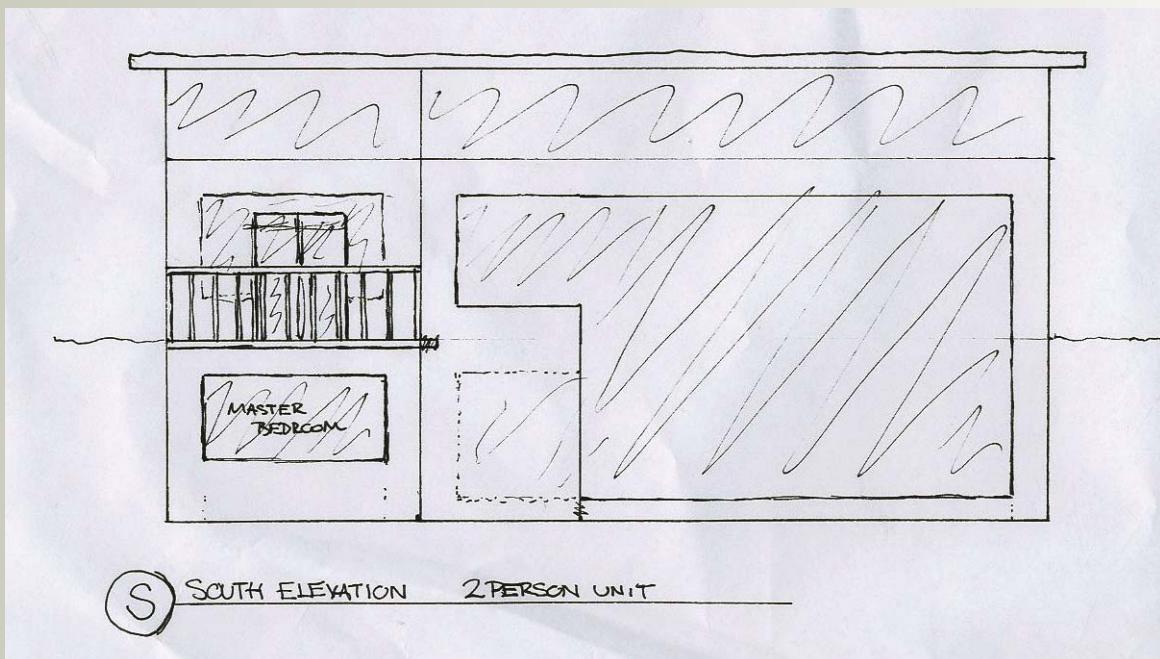
# Design Documentation:

Floor plan and elevation development:  
Two person unit



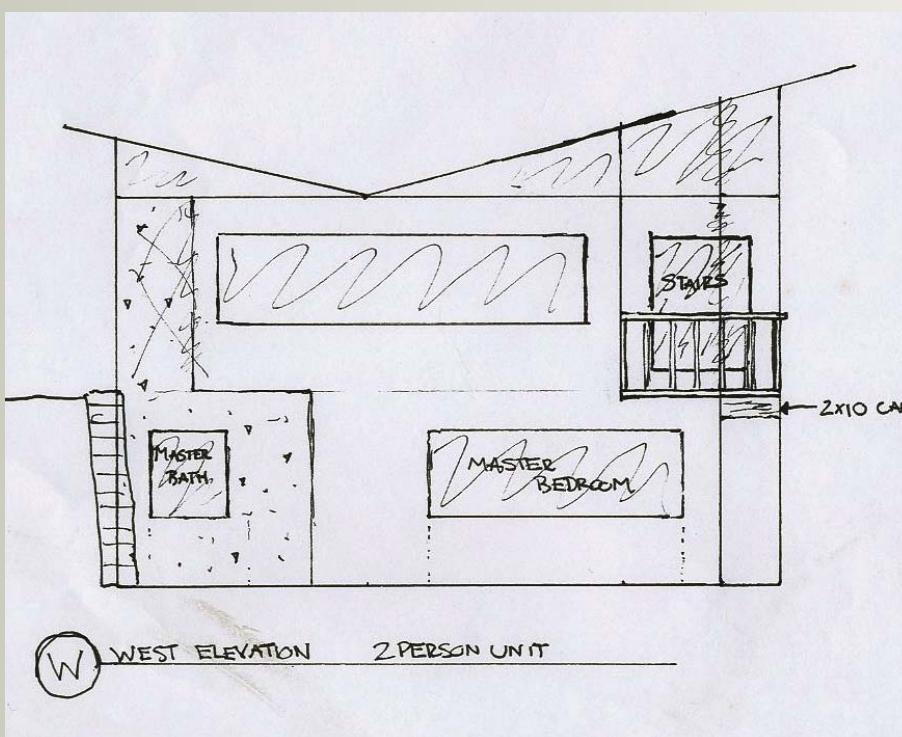
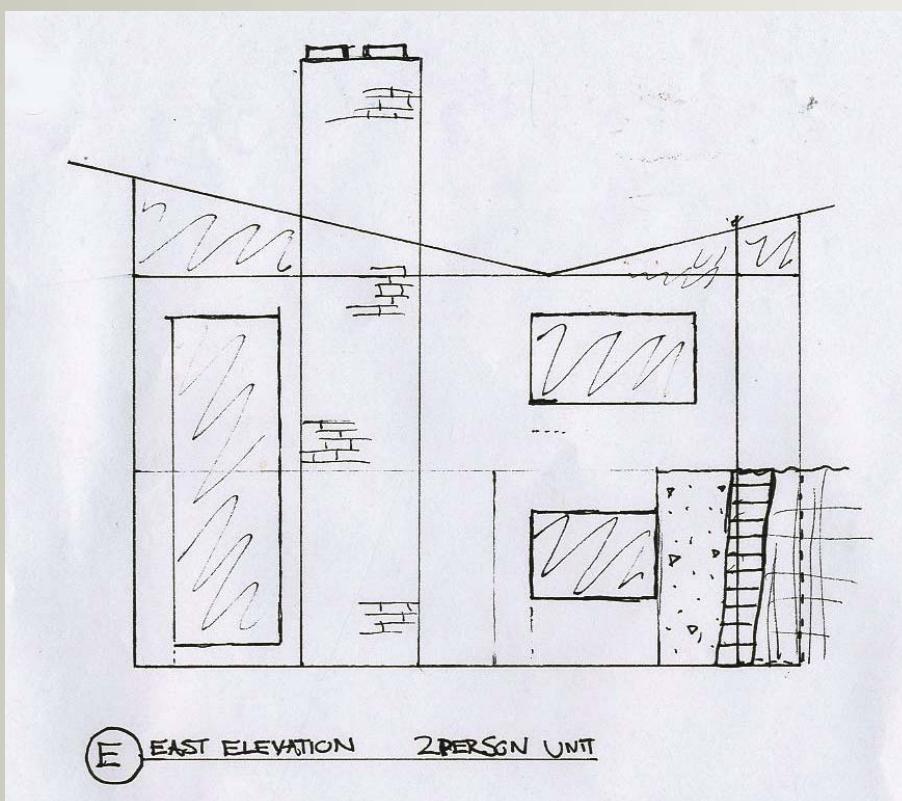
# Design Documentation:

Floor plan and elevation development:  
Two person unit



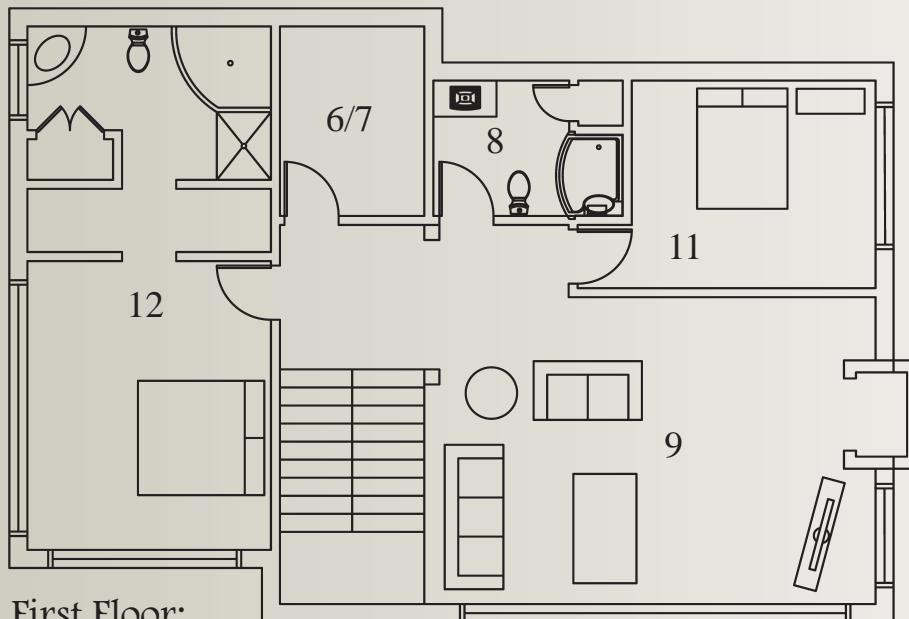
# Design Documentation:

Floor plan and elevation development:  
Two person unit



# Design Documentation:

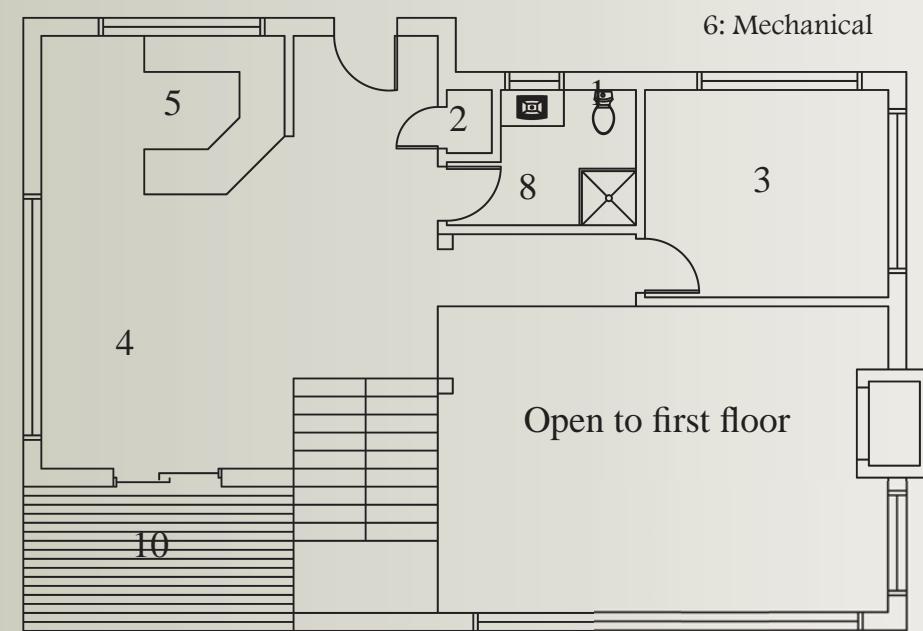
Final floor plans: Two person unit



First Floor:

## Legend:

- 1: Main entry
- 2: Closet
- 3: Office/Den
- 4: Dining room
- 5: Kitchen
- 6: Mechanical
- 7: Laundry room
- 8: Bathroom
- 9: Family room
- 10: Deck
- 11: Bedroom
- 12: Master bedroom suite

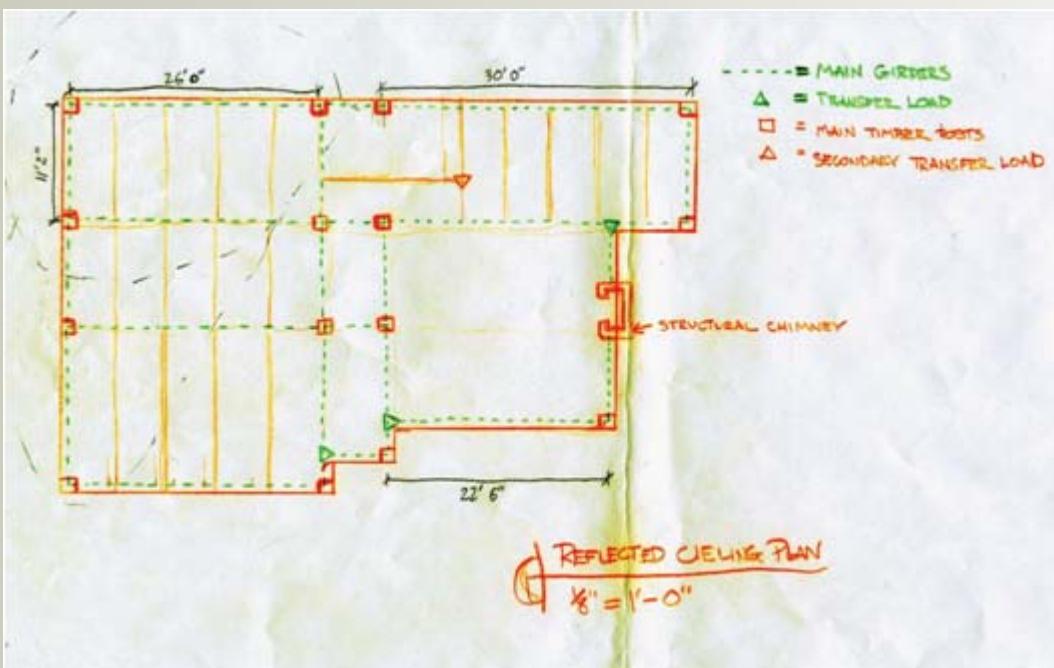


Second Floor:

Scale: 15'  
5' 35'

# Design Documentation:

Structural and detail development:  
Main structural system

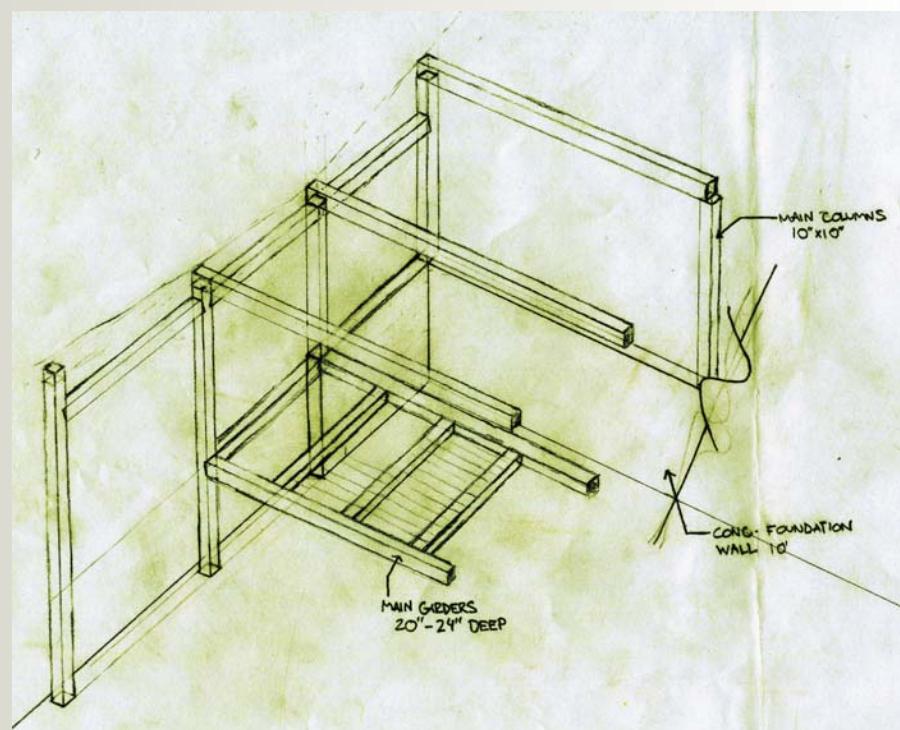


First attempts at a structural system:

Timber post and beam construction with no load bearing exterior walls along the East, South, and West, with a concrete retaining wall along the North

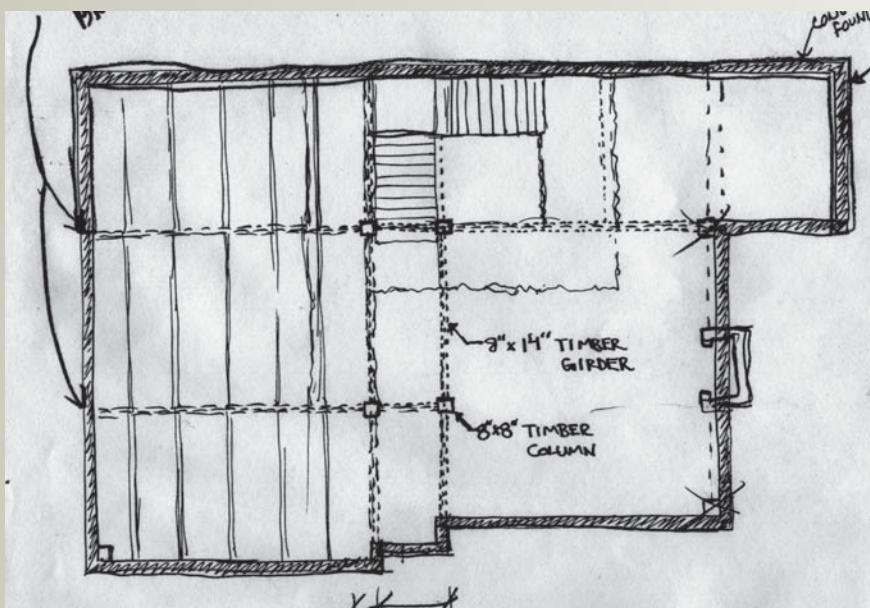
Problematic Issues:

1. Exterior stud walls produce significant thermal bridges at each stud, resulting in "R" values no greater than 16
2. High initial cost of large amounts of solid sawn timbers.



# Design Documentation:

Structural and detail development:  
Main structural system



Final solution for a structural system:

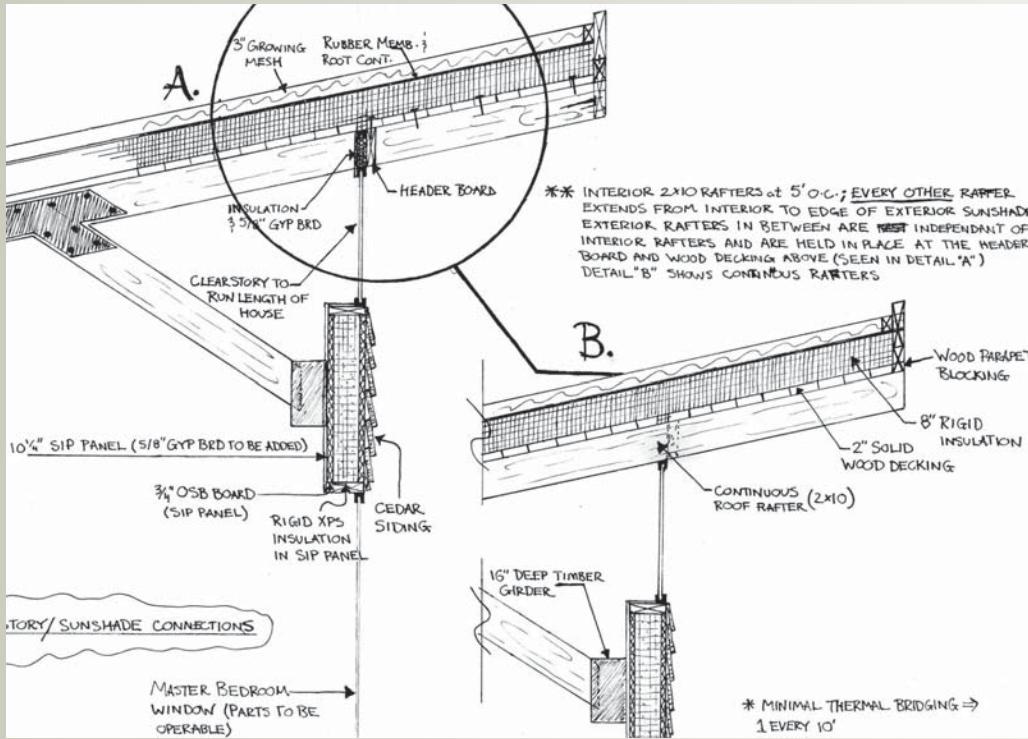
A combination of traditional timber post and beam construction throughout the interior with load bearing structural insulating panels (SIPs) covering the exterior along the East, South, and West, with a concrete retaining wall along the North

This system solved both the issue of low "R" values; previously 16, now 48, as well as the issue of high up-front building cost; cutting the number of necessary posts in each home from 15 down to 4.



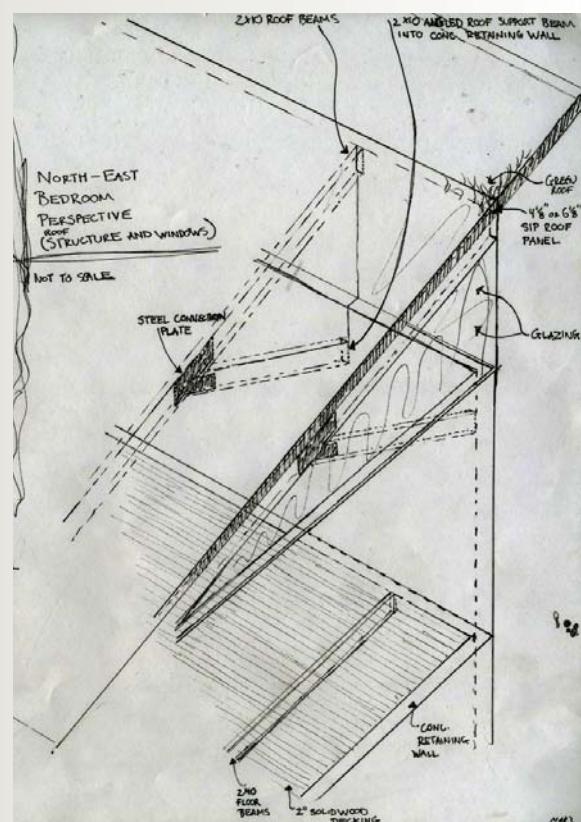
# Design Documentation:

Structural and detail development:  
North and south clearstories



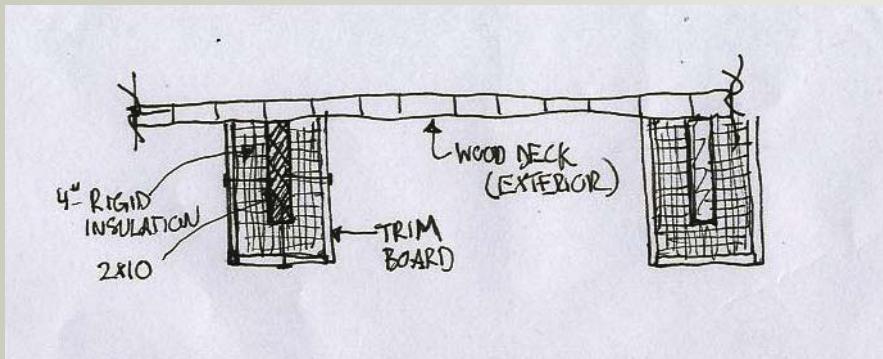
Development of the North and south clearstories required special care, both in terms of exterior aesthetic qualities, as well as minimization of thermal bridging.

To create a continuous clearstory running the entire length of the structure, the roof load created by the overhang had to be carried back down through the building's walls via angled 2x10 roof rafters. These angled rafters then transferred the load down into a 16 inch deep timber girder which would in turn rest on the exterior SIP panels.



# Design Documentation:

Structural and detail development:  
North and south clearstories

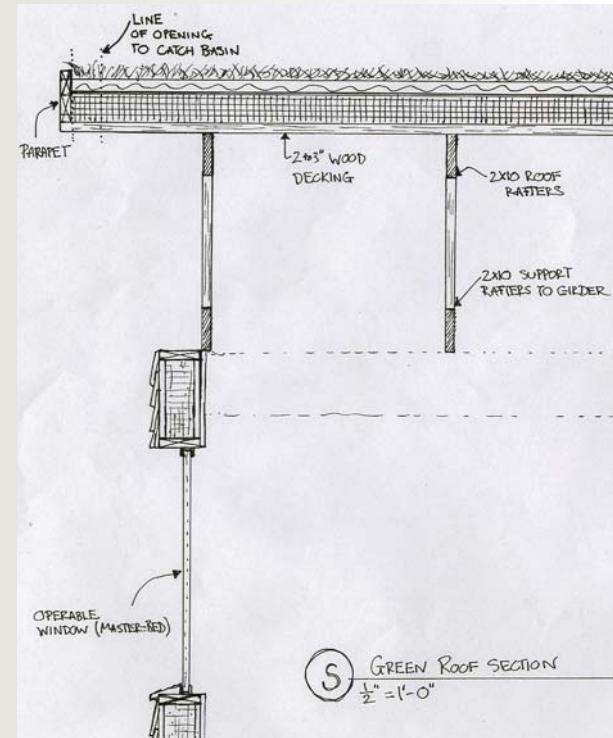


To minimize thermal bridging, each main 2x10 roof rafter was wrapped in 4 inches of rigid soy based extruded polystyrene (XPS) insulation, followed by application of exterior trim boards.

# Design Documentation:

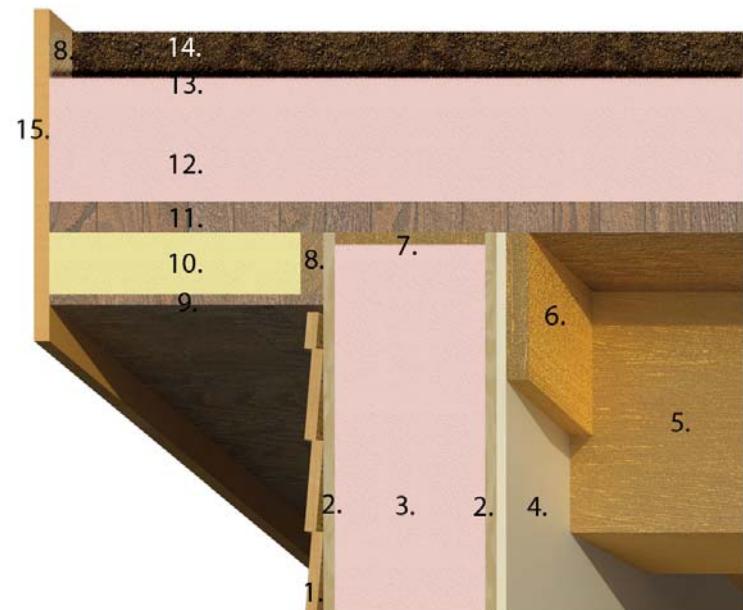
Structural and detail development:  
East and west overhangs

In development of the East and west green roof overhangs similar measures to minimize thermal bridging were taken. All components of the green roof and exterior walls can be seen in the transverse section cut below.



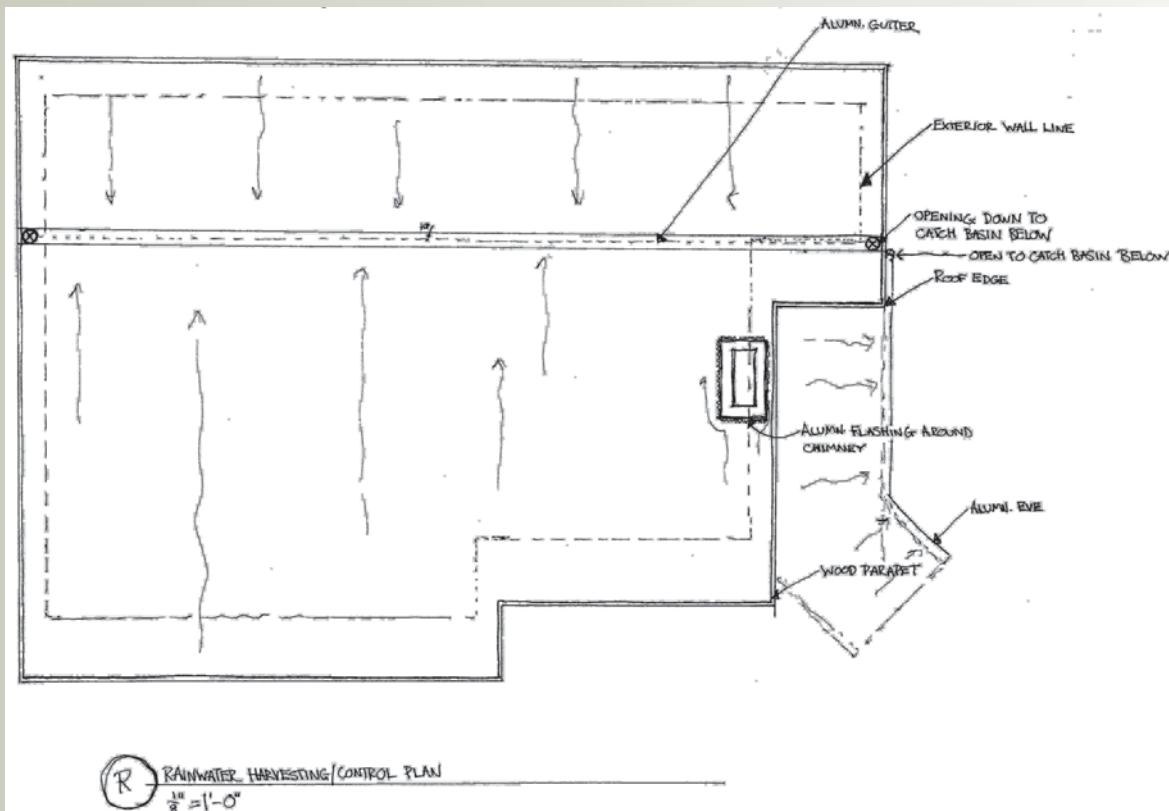
## E: Greenroof overhang assembly:

- 1: 6" cedar lap siding
- 2: 3/4" plywood
- 3: 8 3/4" rigid XPS insulation
- 4: 5/8" gypsum board
- 5: 16" timber girder
- 6: 2"x10" roof rafter
- 7: 2"x10" SIP wall brace
- 8: 2"x4" exterior trim board support
- 9: 3/4" trim board
- 10: 3 1/2" soy based EPS insulation
- 11: 2" solid wood decking
- 12: 8" rigid XPS insulation
- 13: 8 mil. roof membrane and root control layers
- 14: 3" growing medium and mesh
- 15: Trim board



# Design Documentation:

Structural and detail development:  
Rain harvesting and control

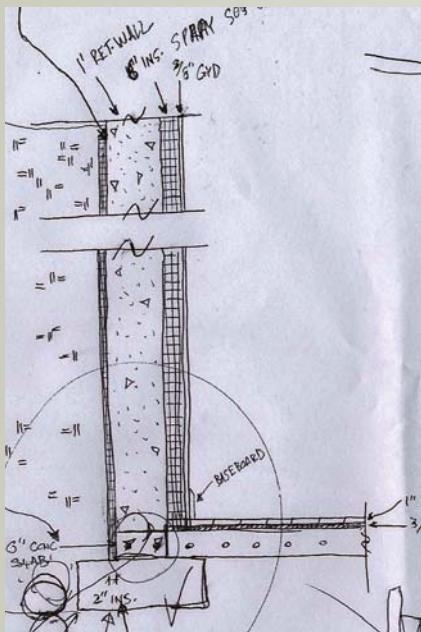


The rainwater harvesting and control system consists of a copper rain gutter, with a central high point, which all the roof water drains into. The water is then drained off the the east and west sides of the house where it is then scuppered down into rainwater collection tanks. These tanks are connected to a water filtration system which the collected water will pass through before it is reused throughout the house.



# Design Documentation:

Structural and detail development:  
Foundation wall and floor slab

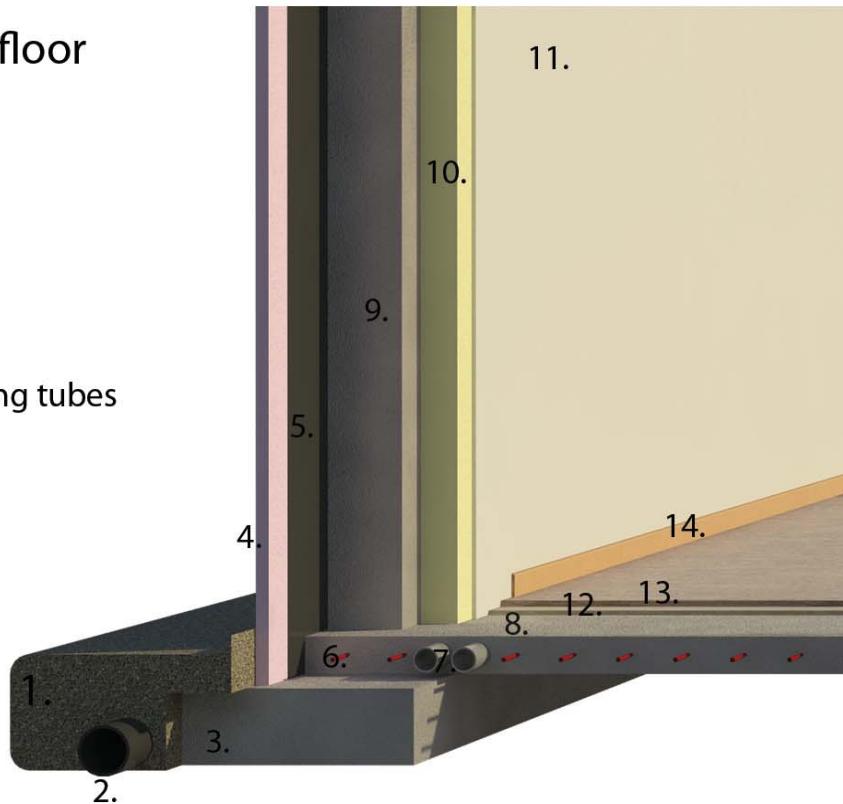


In development of the foundation wall and concrete floor slab, keeping heat in and moisture out were the two main concerns. All final wall and slab components can be seen in the detail section below.

Also visible is the hydronic radiant in-floor heating and cooling system. Space heating for the house is provided by a system of hot and cold water radiators

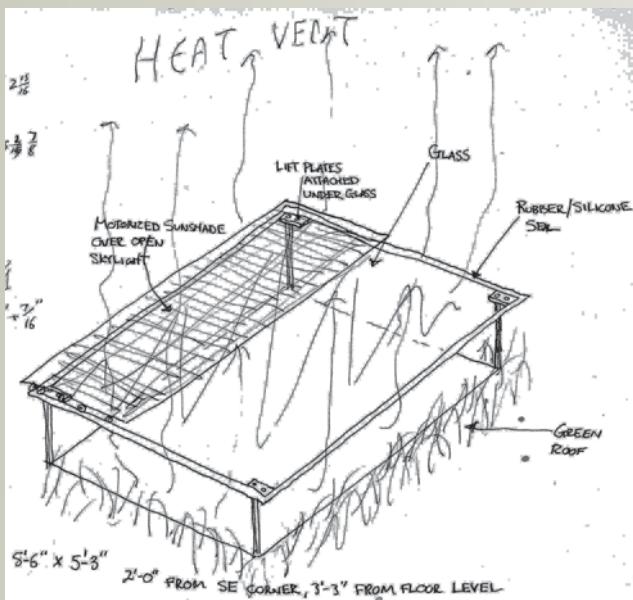
## A: Foundation wall and floor slab components:

- 1: Pea gravel
- 2: Tile drain
- 3: 1'-0" x 3'-0" concrete stem wall
- 4: 2" rigid XPS insulation
- 5: 8 mil. sheet waterproofing
- 6: Hydronic radiant in-floor heating tubes
- 7: In-floor plumbing
- 8: 6" flyash concrete building pad
- 9: 1'-0" concrete retaining wall
- 10: 6" soy based EPS insulation
- 11: 5/8" gypsum board
- 12: 3/4" plywood
- 13: 1" hardwood flooring
- 14: 4" hardwood baseboards



# Design Documentation:

## Structural and detail development: Operable skylight

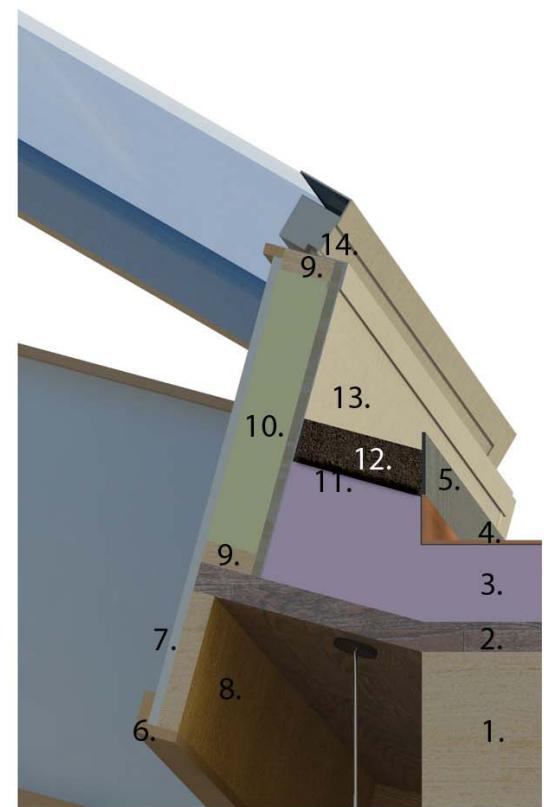


Operable skylights along the northern portions of the units serve dual purposes in that they not only provide a source of filtered natural light, but they also act as a passive form of interior climate control by venting out hot air as it rises in the home.

Other operable tilt and turn windows and clearstory sections throughout the units act in a similar manner.

### C: Operable skylight and greenroof gutter assembly:

- 1: 16" timber girder
- 2: 2" solid wood decking
- 3: 8" rigid XPS insulation
- 4: 1/8" copper drain gutter
- 5: 1/8" polyurthane debris filter
- 6: 3/4" trim board
- 7: 5/8" gypsum board
- 8: 2"x10" skylight framing
- 9: 2"x4" cripple wall
- 10: 3 1/2" soy based EPS insulation
- 11: 8 mil roof membrane and root control layers
- 12: 3" growing medium and mesh
- 13: Exterior skylight aluminum flashing
- 14: Operable skylight coil mechanism



# Design Documentation:

Preliminary sun studies:  
January 21st



9 A.M.

A series of sun studies were conducted, testing various roof overhang pitches and lengths to determine which combination would produce the largest amount of solar gain during the winter months and the greatest amount of protection during the summer.

The combination that was most advantageous was a 5'-0" overhang at a 25° angle to horizontal.



12 P.M.



3 P.M.

# Design Documentation:

Preliminary sun studies:  
March 21st



9 A.M.



12 P.M.



3 P.M.

# Design Documentation:

Preliminary sun studies:  
June 21st



7 A.M.



9 A.M.



12 P.M.



3 P.M.



5 P.M.

# Design Documentation:

Preliminary sun studies:  
September 21st



9 A.M.



12 P.M.



3 P.M.

# Design Documentation:

Final drawings: Sectional perspectives  
Transverse



# Design Documentation:

Final drawings: Sectional perspectives  
Longitudinal



# Design Documentation:

Final Drawings: Exterior perspectives  
Southeast view showing inclined elevator



# Design Documentation:

Final Drawings: Exterior perspectives  
Southeast view



# Design Documentation:

Final Drawings: Interior perspectives  
Entry view looking North.



# Design Documentation:

Final Drawings: Interior perspectives

View looking south at the kitchen and dining room.



# Design Documentation:

Final Drawings: Interior perspectives  
View looking southeast into the family room.



# Design Documentation:

Final Drawings: Interior perspectives

View from family room looking northwest at open staircase and second floor corridor.



# Design Documentation:

Final Drawings: Interior perspectives  
View from den looking south through family room.



# Design Documentation:

Final Drawings: Interior perspectives  
View from stairway landing looking south.



# Design Documentation:

Final Drawings: Interior perspectives

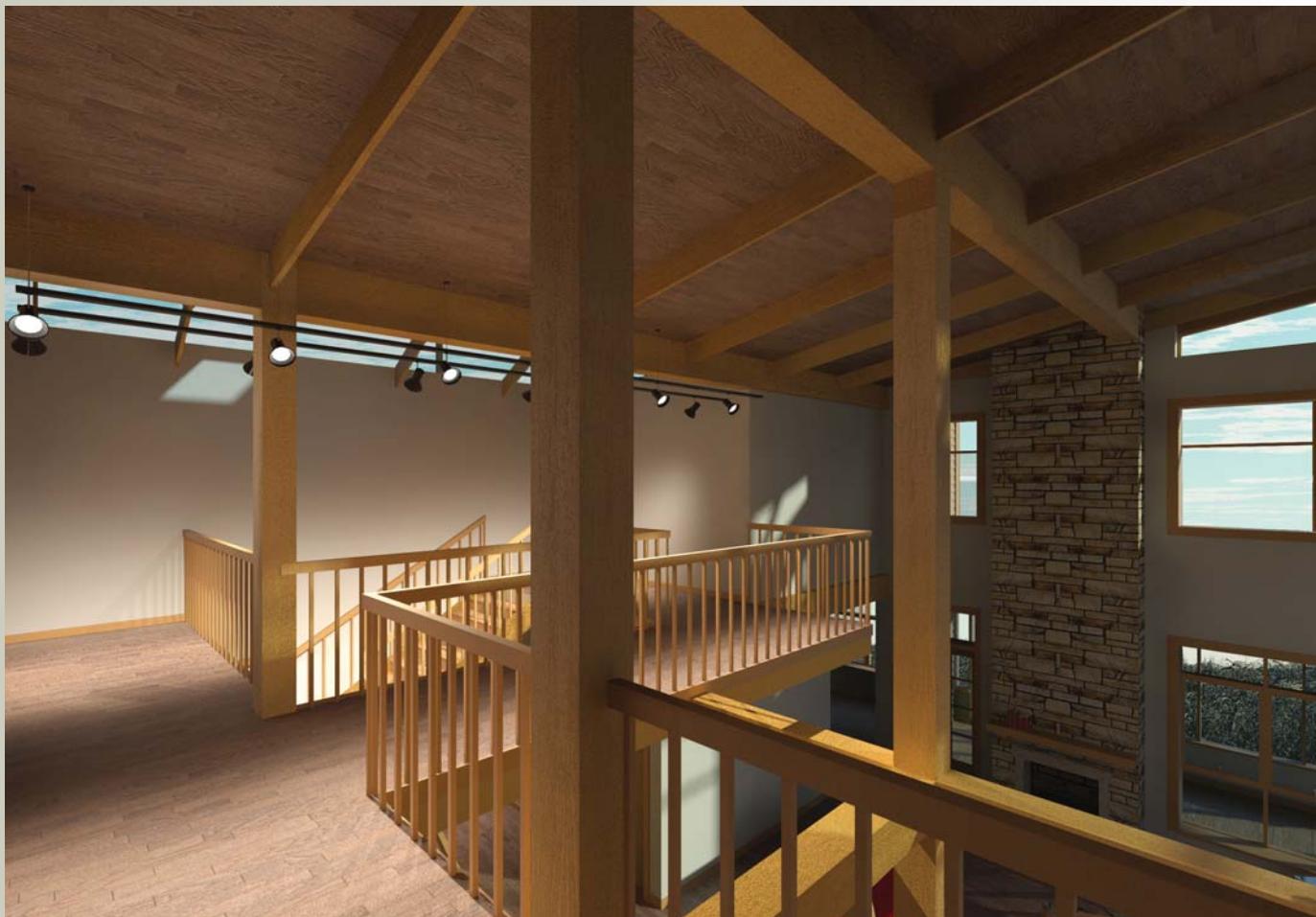
View from top of stairs looking southwest at bedroom and bathroom doors.



# Design Documentation:

Final Drawings: Interior perspectives

View from second floor corridor looking over family room.



# Reference List

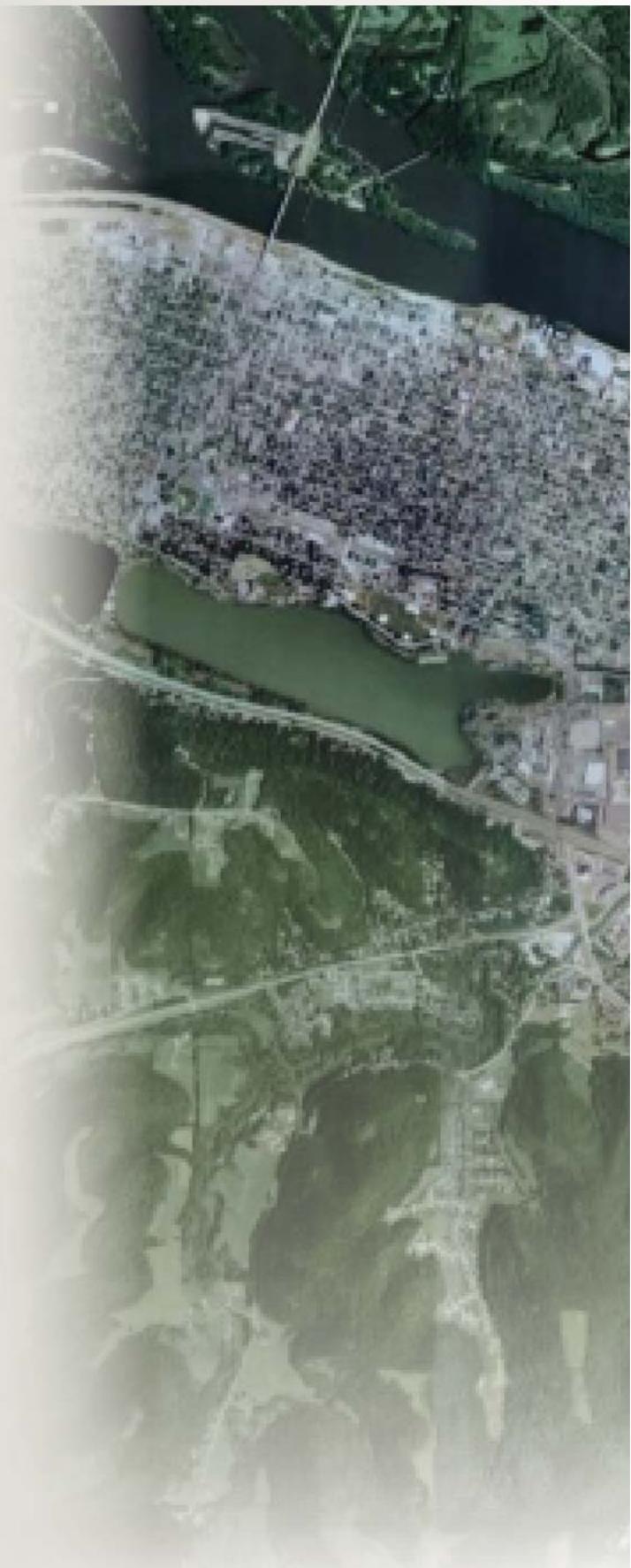
- Boehland, J. (2009). Certified Frugality: A development group provides stylish and sustainable low-income housing amidst the Silicon Valley housing boom. *Green Source Magazine, 1-09*. Retrieved from [http://greensource.construction.com/projects/2009/01\\_GishFamilyApartments.asp](http://greensource.construction.com/projects/2009/01_GishFamilyApartments.asp)
- Braungart, M., & McDonough W. (2003). New Perspectives From Principles to Practices Creating a sustaining architecture for the 21st century, using the enduring laws of nature. *Green@Work Magazine, 5-03*. Retrieved from <http://www.greenatworkmag.com/gwsubaccess/03mayjun/perspect.html>
- Chen, A., (2009). Back to the Garden: John Friedman Alice Kimm Architects skillfully satisfied their client's sustainability mandate. *Green Source Magazine, 1-09*. Retrieved from [http://greensource.construction.com/projects/2009/01\\_EhrlichResidence.asp](http://greensource.construction.com/projects/2009/01_EhrlichResidence.asp)
- Clark R. H., & Pause M. (2005). Precedents In Architecture: Analytic Diagrams, Formative Ideas, and Partis. Hoboken, New Jersey: John Wiley & Sons.
- Department of Energy's Building Technology Program, High Performance Buildings. (2009). *Gish Family Apartments*. Retrieved from <http://www.buildinggreen.com/hpb/overview.cfm?projectId=1140>
- Farmer, T. (2009). *Dockside Green's Synergy Named to AIA/COTE Top 10*. Retrieved from <http://www.inhabitat.com/2009/05/04/dockside-green-synergy-aiacote/>
- Hart, S. (2009). A Platinum Setting: This 15-acre, mixed-use, harbor-front development in Victoria, B.C., will set records for sustainability at the neighborhood scale. *Green Source Magazine, 1-09*. Retrieved from [http://greensource.construction.com/projects/2009/01\\_DocksideGreen.asp](http://greensource.construction.com/projects/2009/01_DocksideGreen.asp)
- Johnson, G., (2008, April 8). Vanished: A Pueblo Mystery. *The New York Times* Retrieved from [http://www.nytimes.com/2008/04/08/science/08anasazi.html?\\_r=1&scp=1&sq=Vanished:%20A%20Pueblo%20Mystery&st=cse](http://www.nytimes.com/2008/04/08/science/08anasazi.html?_r=1&scp=1&sq=Vanished:%20A%20Pueblo%20Mystery&st=cse)

## Reference List

- McLennan, J. F., (2004). *The Philosophy of Sustainable Design: The Future of Architecture*. Canada: Ecotone Publishing.
- National Weather Service Forecast Office, LaCrosse, WI. *Winona, MN Historical Climate Data*. Retrieved from <http://www.weather.gov/climate/xmacis.php?wfo=arx>
- United States Department of Agriculture Soil Conservation Service. *Soil Survey of Winona County, Minnesota*. Retrieved from [http://soildatamart.nrcs.usda.gov/manuscripts/MN169/0/Winona\\_MN.pdf](http://soildatamart.nrcs.usda.gov/manuscripts/MN169/0/Winona_MN.pdf)
- Whipple, J. W., (1913). *History of Winona County, Minnesota*. Chicago Ill: H.C. Cooper Jr. and Company.
- Wind Logics. *Community Winds of Winona County: Mount Vernon Township Wind Resource Analysis*. Retrieved from [http://www.co.winona.mn.us/school1000179/images/files/wind\\_logics\\_report.pdf](http://www.co.winona.mn.us/school1000179/images/files/wind_logics_report.pdf)
- Winona County, Department of Planning and Zoning. (2009) Topographic data set for Winona county, Winona, MN.

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A quote about NDSU:

You've been Thunderstruck!

A special thank you to all those who contributed their time and resources:

Mark Barnhouse  
Chris Meyer  
Nick Meyers  
Paul Schollmeier  
Rod Schwarz  
Gayle Schwarz  
Samantha Schwarz  
LouAnne Schwarz