SEEDS TO GROW

By Jesse Riley

A community led greenway

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

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Bachelors of Landscape Architecture

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Thesis Committee Chair

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ABSTRACT

Abstract

Project-based learning can positively influence community in the normally reactionary design of a riparian greenway. This thesis examines how a greenway system can affect a community by allowing its residents to play an integral role in its development and implementation. Exploring the relationship between flooding and community will provide insight into ways for the two to coexist. An ecological corridor designed for both social and ecological sustainability can provide flood protection, education, community pride, and enhance the wellbeing of the community for future generations. By taking a proactive approach these goals can be obtained and planned appropriately.

KEYWORDS: ecological corridor, landscape ecology, Nature Deficit Disorder, flood protection, community, project based learning, sustainable parks, green way

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How can a Greenway educate a community through the natural occurrence of flooding?

Statement of Intent

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Ecological corridor:

The designation of a continuous geographic greenway links ecosystems, either spatially or functionally; such a link restores or conserves the connection between habitats fragmented by natural systems or human development.

CLAIM

A designed greenway can help a community celebrate the natural occurrence of flooding by allowing its members opportunity to play an integral role in the process of its development and implementation.

The actors in this claim are the landscape architects, city planners, elementary through high school students, educators, public works departments, and citizens of the community.

Design a greenway that provides an opportunity to educate the future residents of the area as well as provide an ecological buffer along its riparian flood plain.

The riparian flood plain and low-lying areas of communities negatively affected by flooding are the object of the intervention.

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A greenway in flood-prone areas can turn an event that was once feared as well as destructive into a chance to improve the lives of a community's residents.

The natural occurrence of flooding affects a community both socially and economically. Designers and communities must welcome the natural actions of a river by planning and designing for all of its natural cycles. During times of normal river flow a river has several opportunities to provide recreational activities for anglers, kayakers, and nature lovers. Moderate to severe flooding can harm populations economically in terms of protection and loss as well as socially by creating a climate of fear and uncertainty.

By designing an ecological corridor that welcomes the natural cycles and actions of a river, the community will develop a sense of pride and ownership in its greenway and its future.

The riparian flood plain and low lying areas of flood prone rivers becomes the physical area where the community as a whole provides input, creation, and implementation of a beneficial amenity.

The linkage for environmental components to travel through the river corridor to other networks has been fragmented due to development. This indistinguishable development also prevents residents from maintaining a close interactional relationship with the river.

CONCLUSION

The design for improvements in communities adjacent to flood prone rivers will bring together a community to create an identifying amenity. This will benefit the environment and teach the members of that community how to be better stewards of the land as well as how to secure their property.

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It is important for a community to be engaged with most aspects of its natural systems. If a community plays a major part in the creation of a greenway then it will develop a sense ownership and pride. This positively affects the residence, ecological systems, and community.

Proposal

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The city of Moorhead, as of 2011, has been forced to contend with catastrophic flooding. To do battle with the Red River's natural seasonal cycles requires vast economic resources on the local, state, and federal level.

I have been a contractor for close to 20 years. During times of record flooding I have felt compelled to untether my resources and battle the forces of nature. I did not know it then but those sleepless nights, victories, tragic losses, friends made, and teamwork provided me with the confidence to overcome any challenge.

Natural disasters have a way of altering the lives and character of a community.
A community full of dedicated, civic minded, and resourceful citizens seems to be growing weary of the seasonal confrontations with their beloved amenity. There is evidence of this in the increasing number of residents adding their properties to a request for buyout list. The increased presence of the local school populations as volunteers could also signify a community's lack of stamina in what is becoming a drawn out fight.

How can a close-knit community and an environmental system live healthy and harmoniously? Do we have an opportunity to educate the school-age children? How can the residence of Moorhead help plan and implement an amenity that celebrates the Red River and the ecological systems that accompany it?

This program will provide all residence of the City of Moorhead a chance to celebrate the Red River and all it has to offer. By respecting boundaries, these important elements (community and river) can coexist and be a benefit to one another.

USER/ CLIENT DESCRIPTION

Client/Owner
The client/owner for this redevelopment project will be the city of Moorhead. The city will assume responsibility for the redesign of the Red River corridor.

Users
Community members
Residents of the community will use this site during all four seasons. This group is the one that will be both affected and benefit the most. It is for this group's self-assurance as well as their properties physical protection that makes this program important.

Students
Local students will use this green way as a place to study ecology by using hands on methods as well as classes conducted in natural settings. Moorhead State University, Concordia College, Moorhead High School, Moorhead Middle School, and Moorhead's elementary schools are all located within a few miles of the site.

Riparian species both plant and animal
Riparian species will use the site as a place to grow and flourish like nature intended. The plant species that are important to the natural systems of the greenway will aid in the reestablishment of biotic systems that disappeared due to over development and fragmented systems.

Communities that are affected by flooding
This program and design can serve as a guide to other communities that are hydrologic cycle and flows of river systems in competition with man and development. With other areas implementing a design that celebrates nature and its natural characteristics entire watersheds can learn to better manage some of its most sensitive areas

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Major Project elements

Community Involved Ecological Education
The impact the community will have on the planning and implementation of the design is a crucial part of the program. In order for residents to be culturally engaged with their amenity, their assistance and input is crucial. With several schools located within close range of this site, it becomes an opportunity to teach future stewards, decision makers, and residents the importance of ecological systems, community pride, and environmental craft.

Moorhead parks system
Much of the site's current use is by the Moorhead parks Department. A more unified ecological corridor would connect these areas and begin to include them into the planed greenway. Much of these current parks can maintain their use, but adjustments to buffer zones and sensitive areas will be made.

Red River and Adjacent Lands
This site is located in Moorhead, MN, along the Red River of the North. Its elevations are among the lowest in the community. Hosted within this site are a variety of land uses, mainly classified as residential, commercial, municipal, agriculture, and light industrial.

MAJOR PROJECT ELEMENTS

Existing neighborhoods and developments: Blue Stem Performing Arts Center to down town Moorhead

The site's southernmost boundary is the Blue Stem Performing Arts Center. From this point it rolls north along the Red River 4 miles to the Hjemkomst Center. The site also extends east of the river to prevent crowding of competing species. This will allow the river space to swell without threatening the city of Moorhead's physical property and its citizens' psychological well-being.

Community Health

With the establishment of a greenway that allows the Red River greater area to expand during flooding without damaging personal property, the residents can begin to look at the river as an important part of the area's natural system. With the greenway and riverfront parks being a gathering space, educational opportunity, and buffer zone, the residents can celebrate the existence of such an identifying and powerful amenity.

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Regionally this site located on the western side of the state of Minnesota within the Red River Eco Region. Agriculture is the dominant land cover at approximately 81 percent of the eco region, while grassland/shrub land is approximately 7.3 percent, forest approximately 5.5 percent, wetland approximately 4.7 percent, and the remaining land cover classes combined at approximately 1.6 percent of the eco region.

Moorhead Area

Site Context

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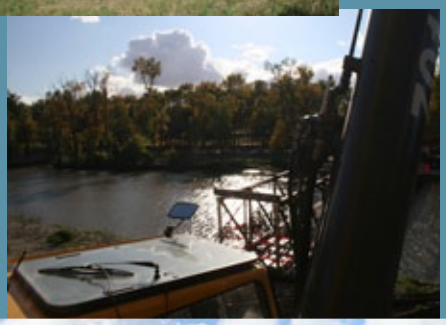
Moorhead is a city located in the state of Minnesota in the Midwest region, and the largest city in Northwest Minnesota. The population was 38,065 at the 2010 Census. Elevations are within the lowest of its basin laterally.

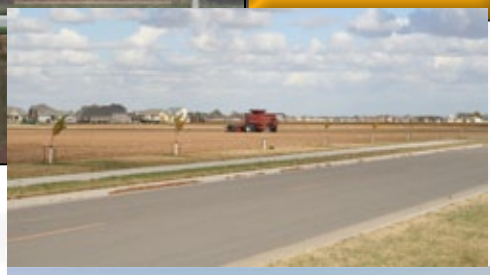


The Red River divides Moorhead, Minnesota and Fargo, North Dakota. On either side of the river there lies a riparian buffer diminished and fractured by development. On the Moorhead side of the river there are several parks, residential neighborhoods, some commercial and light industrial land uses.

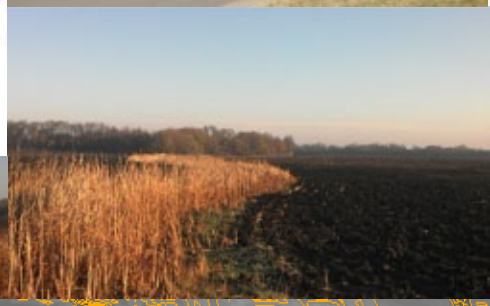
Greenway Site

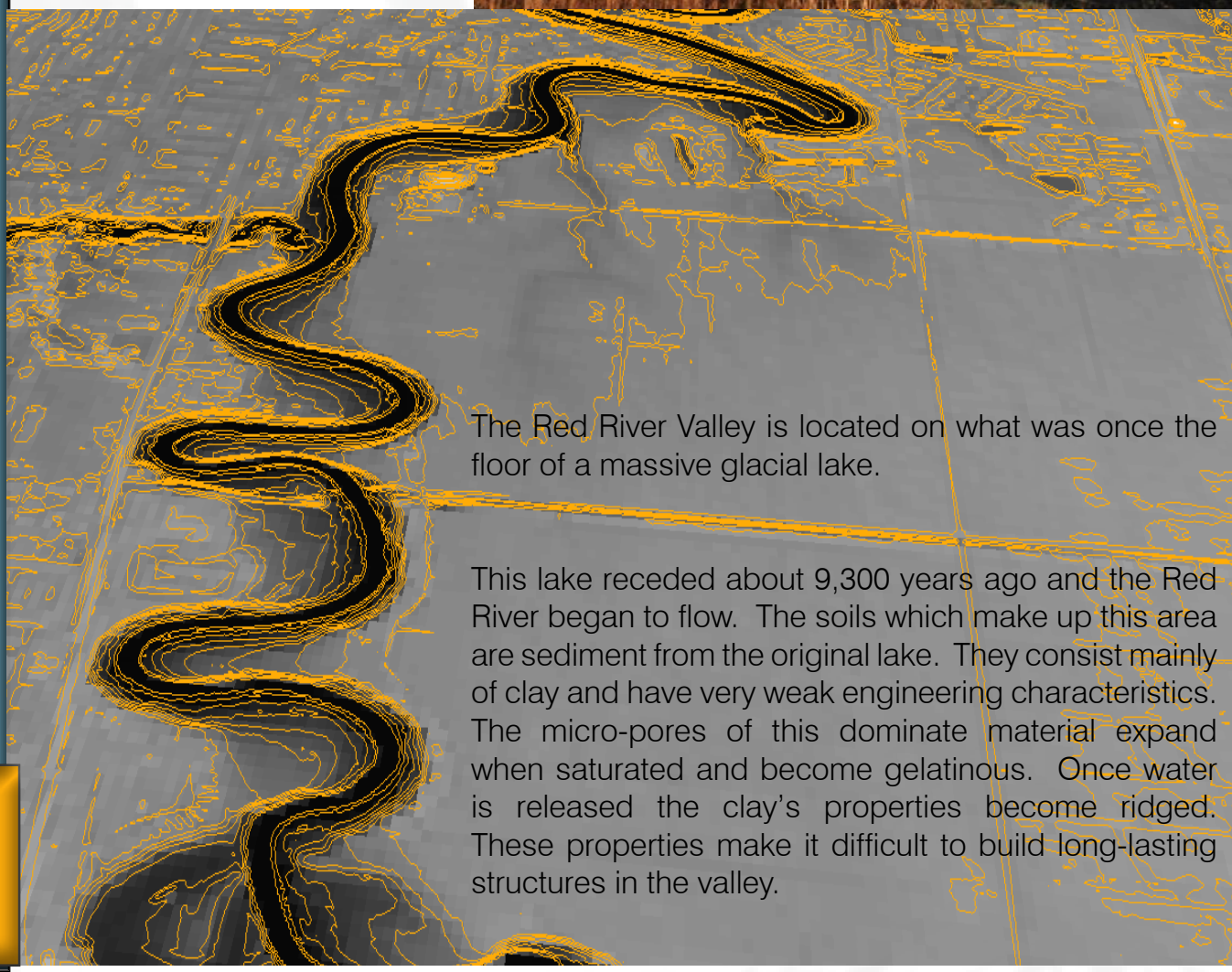
Moorhead, Minnesota

SITE INFORMATION



Blue Stem Performing Arts Center





The Red River Valley is located on what was once the floor of a massive glacial lake.

This lake receded about 9,300 years ago and the Red River began to flow. The soils which make up this area are sediment from the original lake. They consist mainly of clay and have very weak engineering characteristics. The micro-pores of this dominate material expand when saturated and become gelatinous. Once water is released the clay's properties become ridged. These properties make it difficult to build long-lasting structures in the valley.

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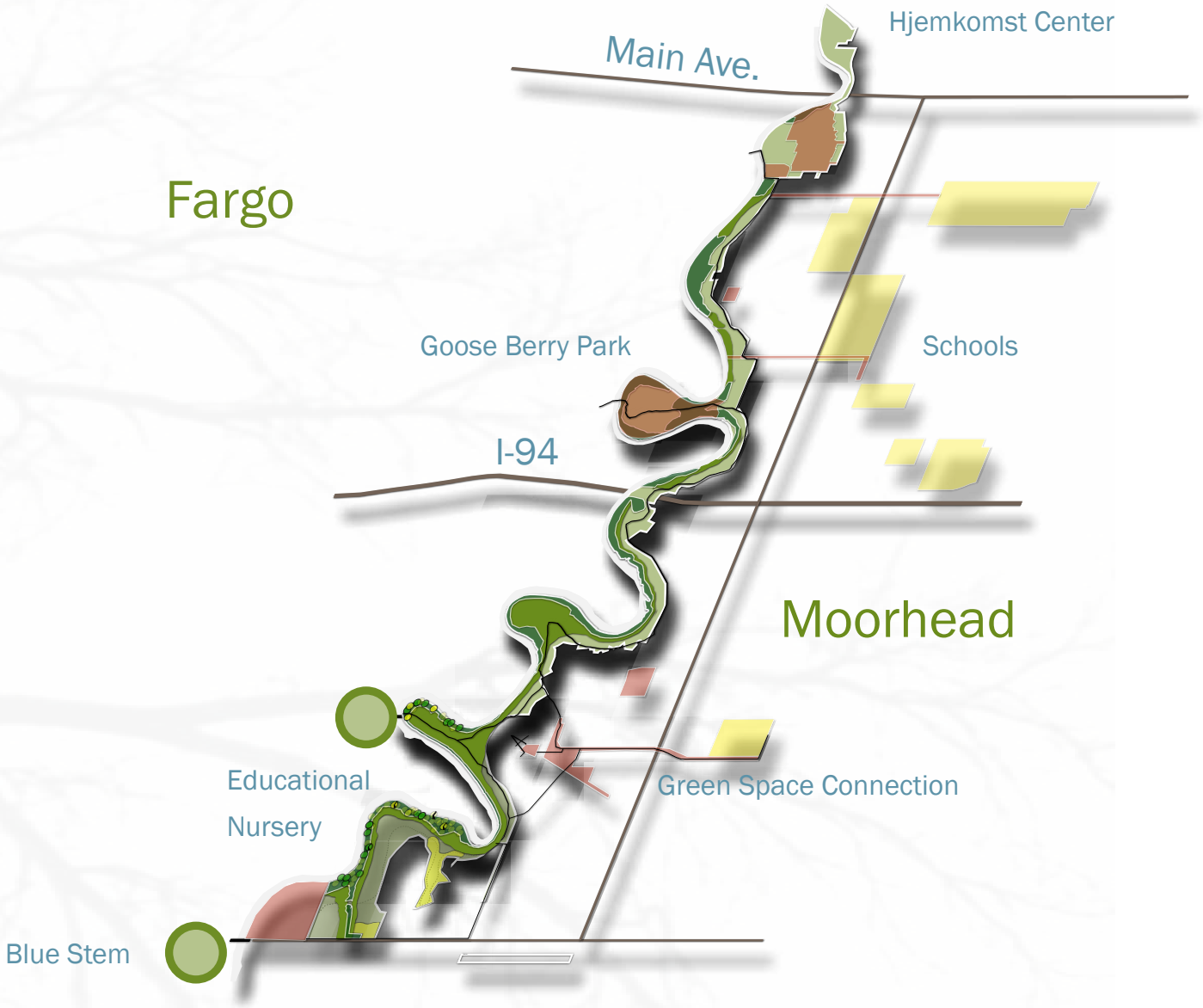

SITE NARRATIVE

On a moderately warm autumn afternoon I began my much anticipated site exploration. I am a resident of the city in which my site is located so I often pass through these stretches of land without much consideration. For me, my site began from its southern most borders at the Bluestem Performing Arts Center, flowing north along the Red River to Johnson Park in North Moorhead, MN. The giant arches of the stage seemed to grow out of the burnt yellow corn fields days away from harvest. At first glance I was astonished at the lack of people in the vicinity of the Bluestem Performing Arts Center. Closer investigation led me to the actual amphitheater which is a source of pride in community.

My next stop along the river corridor was about a mile north of Blue Stem where I discovered a hive of construction activity directly related to river and the resident's desire for protection. A flood gate valve was being installed and several pieces of machinery where operating, a stark contrast to the silent tranquility of my last stop. I spoke to the general contractor on site who gave me a brief summation as too much of the recent flood mitigation efforts. It became apparent that much of my site was becoming a blank canvas which provided liberty and space for design and development.

After passing a large open space that had been occupied by flood prone structures I was reassured that my ability to perform a site intervention was facilitated by recent buy outs. A large clay berm with the browning evidence of the recent hydro-seeding was all that separated the road I was traveling from newly created open space void of structures. These large ribbons of land could now hold areas where nature would thrive unhindered and serve as defining amenity to the city. This made me smile.

My final stop on this day of exploration would be Johnson Park on the northern edge of Moorhead Proper. Before I could reach this destination I ventured upon what will undoubtedly be my greatest challenge to the implementation a seamless ecological corridor. The area of downtown Moorhead near the Memorial Bridge has little green space between the river and a large retaining

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wall. This road is frequently inundated with water during times of flooding making it one of first to close. With this band being positioned in the most populated and hectic location of the greenway I feel the need for a natural connection great. From that day forth I find myself contemplating the various solutions to that particular location. Upon arrival to the northern most borders of my site I was amazed to find significantly more users than in the Blue Stem Area. On one of the last days of this year's Indian summer dog walkers, hikers and Frisbee players populated this space. Deeper assessment of Johnson Park allowed the time to let go and connect to nature. After leaving the parking lot and traveling down a meandering path all views of the surrounding city are lost, giving way to a grand open space. This space is truly a gem and I'm guessing few are privileged to be aware of its existence.

The river corridor in Moorhead is a fantastic site which holds several opportunities to celebrate nature and become a cherished amenity amongst the community.

PROJECT EMPHASIS

The main goal of this project is to explore and reveal the ability of a community to coexist with a natural system and celebrate their symbiotic relationship. Moorhead is a community that has dealt with severe flooding in its past. The community's resolve is strong yet the current development strategies have proven inadequate. The site along the Red River and properties adjacent to it provide several opportunities to create a greenway.

This project will examine how a community can have a sense of pride and ownership in an amenity that changes its community's identity. A natural greenway will provide destinations for users and habitat for wild life. If successful the formation of an ecological corridor will give the river room to flood when necessary providing security to residents and space for natural systems to exist.

Now is the appropriate time to discover more sustainable options.

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I will be investigating the following areas during this thesis project: the theoretical premise/ unifying idea, project typology, historical context, site analysis, case studies, and programmatic requirements. I will gather quantitative data collected from books, journals, archives, and government documents, and gis information. Qualitative information will be gathered from studying the site first hand and conducting interviews of current land owners.

All research and design for this project will be compiled and documented digitally. The design process will be documented with sketches, photos, video, graphics, drawings, interviews and research findings.

At the conclusion of the project, the final product will be presented through a digital presentation. All of the research, text, interviews, surveys, video, and graphics will be documented in the NDSU digital repository.

DESIGN METHODOLOGY

The methods I will employ a Mixed Method Model and follow a Concurrent Transformative Strategy which includes a synthesis of quantitative and qualitative analysis. I will analyze information and demonstrate the information through text and graphics. The research I gather will be guided by the theoretical premise that flood prone areas can turn an event that was once feared as well as destructive into a chance to improve the lives of community's residents. The research will be guided by this theoretical premise. The quantitative data I gather will include statistical and scientific data through local and archival searches. The qualitative data will be gathered by analyzing and observing the sites directly, through archival searches, and one-on-one discussions.

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All research and design I gather for this project will be compiled and documented digitally. I will document the design process with sketches, photos, graphics, drawings, interviews and research findings.

At the conclusion of the project, the final product will be presented through a digital presentation. All of the research, text, and graphics will be documented in a bound hardcopy book as well as a digital file available at NDSU's Library Archive for future viewing.

PREVIOUS STUDIO EXPERIENCE

Second Year
FALL 1999: MATT THORGENSON
Edward Hopper Project
Study of Quality and Space
Emotions in a Box
Emotions through abstraction
Fargo Theater Site Design
Site inventory/analysis
Design of an existing site

SPRING 2000: JOSH WALTERS
Elementary School Design
Inventory/analysis and Grading
Golf Course Design
Idea of Site Drainage & Layout
Cranberry Island
Trail System Design

THIRD YEAR
FALL 2000: DENNIS COLLITON
N.D. Capitol Design
Site Revitalization
5 min. Sketch Problem
Design Concept 5 min.
Scenic Corridor
Site Enhancement

SPRING 2001: TIM KENNEDY
Figure/Ground Study
Development of Urban Space
Moorhead Living Development
Urban Design
Site grading and Drainage

FOURTH YEAR
FALL 2001: JOSH WALTERS
Urban Sprawl & Design
Collaboration w/Architects
Masterplanning
Downtown Development
Flood Proofing and Design

SPRING 2002: DAVID MYERS
Land Reclamation
Interpretive Center
Runoff Control and Grading
Complete Design Package
Programming
Charrette w/Bill Johnson
1997 Flood Memorial
Crushed Stone Competition

FIFTH YEAR
FALL 2011: DOMINIC FISCHER
Environmental Planning Red River Basin

Program Document

THEORETICAL PREMISE

Project based learning and constructionism

What skills do learners need to become productive, well-balanced adults as well as actively engaged in their environment? According to Newell, learners who participate in projects develop skills necessary to create a life of possibilities for the learner. Learning is not just academic but dispositional (Newell, 2003). Dispositional learning addresses important aspects of community involvement and character development.

Project-based learning provides students the opportunity to problem solve as well as hone skills which are used throughout a productive adults' life. During the time it takes to bring a project from the idea phase to completion, a learner must use several life skills. Newell uses the example of horses in his book, but a community greenway could also fit his model. The first step taken is brainstorming where a learner meets with an advisor who points out all of the possible areas (reading-writing-math-science-history-etc.) such a project could cover. For example, if students were to develop their own projects in connection with the community's celebrated greenway, they could show their ability to read complex information, understand natural systems, and interpret perspectives. In writing, they could write a technical manual or draw a diagram of how a tree develops from a seed into a forest, or an academic piece in the form of a historical paper on river cycles and their impacts. Mathematics and science are easily introduced into such construction-based projects. Math can be addressed by calculating volume of water flow and well as topographical cut-and-fill projections. The science implications are endless, covering biology, chemistry, sociology, physics, and psychology at every grade level. The history of this Greenway is very important to this region and the character of its people. Once a project is completed the learners would be expected to present their findings to the public as well as their peers.

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It is important to note that students who develop the goals and criteria for their projects become more invested in their studies. When one sets out on a path of research they must be accountable for all aspects ranging from time management to production. If a final project is presented using Power Point or another computer application learners are required to learn these programs, thus furthering their education and self-enrichment skills.

This constructivist school of thought applies to my premise of improving the lives of the community's members, proving the notion where as a student works on a project, such as the Seeds To Grow, they can develop skills that help them to be more self-reliant as well as educated stewards of the land, and authentically involved in their community.

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Children and nature

n the past, kids played outside and had a real connection to nature. Hide and seek, climbing a tree, fishing, and exploring are all undertakings which provide one with an ability to create a bond with nature. These days children are more likely to spend time with parents in a car on the way to a field to play sports or doing homework. While these activities do have value, they remove our younger citizens from the natural environment and thus a chance to form a lifelong understanding and respect for our ecological connection.
Parents' drives and expectations are rooted in the beliefs that they must make productive members of society at any cost. If opportunities are squandered at this early age they may be lost forever. Parks can be constructed relying on imagination. Between Ages 5 and 12 are the most critical years of development, according to Niban and Trimbal (2002). This is when ecological education should be introduced.

Children have lost a connection to nature and a free spirited childhood. When given the chance, kids can turn things that occur naturally into objects of play. The owner of "Natural Playgrounds" has concluded thru studies and sampling of over 5,000 school age children that:

> Kids are easily bored by equipment because it can't hold their attention for long periods. The thrill of going up and down a ladder, or sliding down a pole, or walking across a wobbly bridge, or even climbing on a net dies out after a few times, and that's when kids use the equipment in ways for which it wasn't intended. That's when they get hurt. The answer, King says, is not to give them more equipment, but to give them play opportunities that hold interest.
> A nature path is a perfect example. Along the path can be hundreds of little things that can be touched, observed, charted, or used. Natural things grow and change, so there is always something new to see, and as the seasons change, even boulders take on a new look surrounded by fall colors or covered by snow. In northern winters, a small hill becomes a sliding area, and in the summer, a place for kids to roll down. There's just so much more to do, and so many more ways to have different kinds of fun and to learn something along the way! It's this variety of opportunity that is the essence of natural playground design. (King, 2006)

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According to King, a natural playground is all about helping kids and adults interact with and learn from nature and the natural environment while they're having fun. "It's really very simple," says King. "Equipment is the focus in manufactured playgrounds; nature is the focus in natural playgrounds. In terms of what the kids prefer, nature wins every time" (King, 2006). This is why Nature plays such an important role in children's growth and development.

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The location for these parks, which would be mostly made available to children should be in accessible areas such as school grounds, community centers, neighborhoods, and public lands near schools. Redefining green space as ecological connections provides children with more opportunity and time spent amongst nature. If we build greater spaces for our children to coexist with nature then we as a community succeed addressing cultural issues of our own.

Greenway-ecological corridor

For years greenways have been used as a tool in planned landscapes. They are generally defined as an area that lacks built features. There are several types serving several needs. Greenways can serve as a connection linking people to other areas in a city. This linkage also benefits users by improving the environmental systems that take place within them. Greenways provide a buffer from elements of the landscape that can be detrimental to inhabitants such as rivers which are subject to flooding. Implementations of greenways have been proven to benefit social, economic and environmental conditions.

In Mecklenburgs county's report the authors further define greenways' benefits:

A multi-purpose greenway can address and resolve many community issues that affect the future environmental and economic health of the County. Greenways have been implemented by other communities to control flooding, improve water quality, protect wetlands, conserve habitat for wildlife, and buffer adjacent land uses. Greenways typically incorporate varying types and intensity of human use, including trails for recreation and alternative transportation, and passive and active park facilities, including open play fields. Greenways have also been shown to increase the value of adjacent private properties as an amenity to residential and commercial development. (Haden-Stanziale ,1999)

This research reiterates the positive aspects of incorporating an ecological corridor into a flood mitigation solution. The physical amenities of a green way congregated with these benefits are all reasons a greenway would be successful in Moorhead, Minnesota and other communities dealing with flooding.

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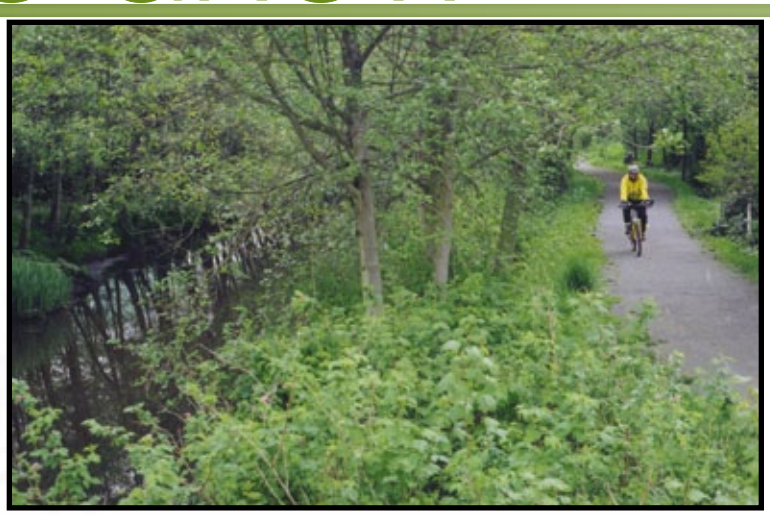
Greenways



Providing an ecological corridor is beneficial to the environment. Wildlife such as birds, fish, and land based animals thrive in greenways because they provide connections to habitat and that suits their needs. During the planning phase it is important to identify keystone species, specific habitats as well as areas to be protected. Greenways adjacent to water benefit its quality by providing buffer strips, wetlands, and greater area for soil and plants to remove toxins. Plants species thrive in these systems because they are not threatened by development and typically use corridors along rivers and streams as means of conveyance and propagation.

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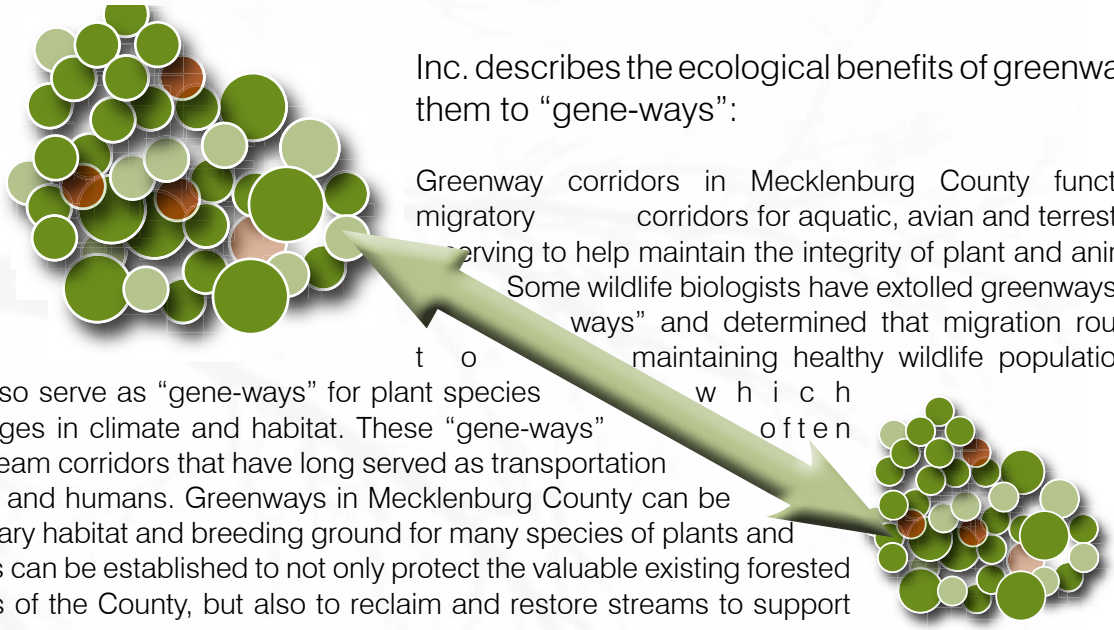

Greenway Inc. describes the ecological benefits of greenways by equating them to "gene-ways":

Ecological corridors in Mecklenburg County function as primary migratory corridors for aquatic, avian and terrestrial wildlife, serving to help maintain the integrity of plant and animal gene pools. Some wildlife biologists have extolled greenways as future "gene-ways" and determined that migration routes are essential to maintaining healthy wildlife populations. Greenways can also serve as "gene-ways" for plant species which migrate with changes in climate and habitat. These "gene-ways" often follow river and stream corridors that have long served as transportation routes for animals and humans. Greenways in Mecklenburg County can be targeted as a primary habitat and breeding ground for many species of plants and animals. Programs can be established to not only protect the valuable existing forested and wetland areas of the County, but also to reclaim and restore streams to support higher quality habitat.(Haden-Stanziale ,1999)

Economic benefits of greenways

There was a time in the Fargo-Moorhead area that the tax revenues generated from the tax on expensive homes or other buildings along the river were a boon in the coffers of the city. This is no longer the case. Poorly planned expansion along the river has cost the sister cities, state, and federal government hundreds of millions in protecting and now buying out low-lying property. According to Rails to Trails Conservancy:

ecological benefits of greenways can help communities mitigate costs associated with the control of water and air pollution and flood management. Dedicated trail and greenway corridors can also play a valuable role in preserving linear space for future infrastructure needs. Greenways can increase perceived quality of life in a community, and consequently attract new businesses (rails to trails.org 2009).

Properties adjacent to greenways bolster values and re-sale. Many business and home owners desire properties that are close to greenways and areas with natural amenities. In a 2002 survey of recent home buyers sponsored by the National Association of Realtors and the National Association of Home Builders, trails ranked as the second most important community amenity out of a list of 8 choices (Consumer's Survey on Smart Choices for Home Buyers, National Association of Realtors and National Association of Home Builders, April 2002).

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Greenways

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By creating a greenway in an area that once had a negative impact on that community, those residents can begin to celebrate the natural occurrences within that area. This idea is reinforced by "Rails to Trails" in its publication addressing trails and greenways Clearinghouse, 2009. The author's state:

Through recognition of the cultural, historical, and natural assets of places, trails and greenways can enhance a sense of community identity. By incorporating recreation, education and interaction into a single-user experience, trail and greenway systems bring a community to a level greater than the sum of its parts. (Rails to Trails, 2009)

THEORETICAL PREMISE

Connections are an integral part of green space whether it is for human or ecological use. By creating a network with connections to the land and its inhabitants, ecological processes as well as human connections are strengthened. This creates a positive experience in an area which was once associated with negative emotion.

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Community

Communities find that trails and greenways provide the tools to turn geographic resources into community trademarks that become focal points of civic pride and key attractions of new residents and businesses. For years the community of Moorhead, Minnesota has expended scarce economic resources to procure specialized equipment and hire contractors to protect property. The cost savings in public services is a crucial economic factor pertaining to this community.

Those that are integrating the combination of social, economic and environmental components of their communities are developing a more vibrant economy and sense of community, and a more engaged populous.(National Trails Training Partnership, 1999)

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In the reading Defining the Sustainable Park: A Fifth Model for Urban Parks, Galen Cranz and[25] Michael Boland take the reader through the history of the American Park. They begin by explaining how parks were born as a remedy to cities, which citizens perceived as stressful, dangerous and unhealthy places to live. Through more modern theories and education the sustainable city is now believed to be a possibility. Instead of seeing cities as stressful, dangerous and unhealthy places, we now strive to make cities more ecologically balanced and sustainable. Parks are a pivotal method of achieving this desired outcome.

A Park Typology- A classic study of urban parks (Cranz 1982) described four types: the Pleasure Ground (1850-1900), the Reform Park (1900-1930), the Recreation Facility (1930-1965), and the Open Space System (1965-present). This typology includes both the shifting social purposes that parks served and the corresponding variations in designed form. The four types of park typologies are further defined as:

THEORETICAL PREMISE

The Pleasure Ground: was typically large and located on the edge of the city. Mental appreciation of the landscape was important, but these parks were actively programmed and sports were popular so they were not merely passive.


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Reform Park: with special play equipment children, these parks were small and symmetrical, with no illusion of country or nature. Their principle architectural innovation was a field house, envisioned a club house for the working class. Reform parks were developed out of the to reduce class conflict, to reinforce the family unit, to socialize immigrants to the American way of life, to stop the spread of disease, and to educate new citizens.

Recreation Facility: The major innovations to this form of park were the stadium, parking lot and asphalt ball courts-hence the term recreational facility.

A generation later a derelict response against the perceived sterility of the recreation facility emerged.


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Open Space System: All parks came to be conceived as part of a network of disparate open spaces linked together hence the term Open Space System. (Cranz & Bolland, 2004)


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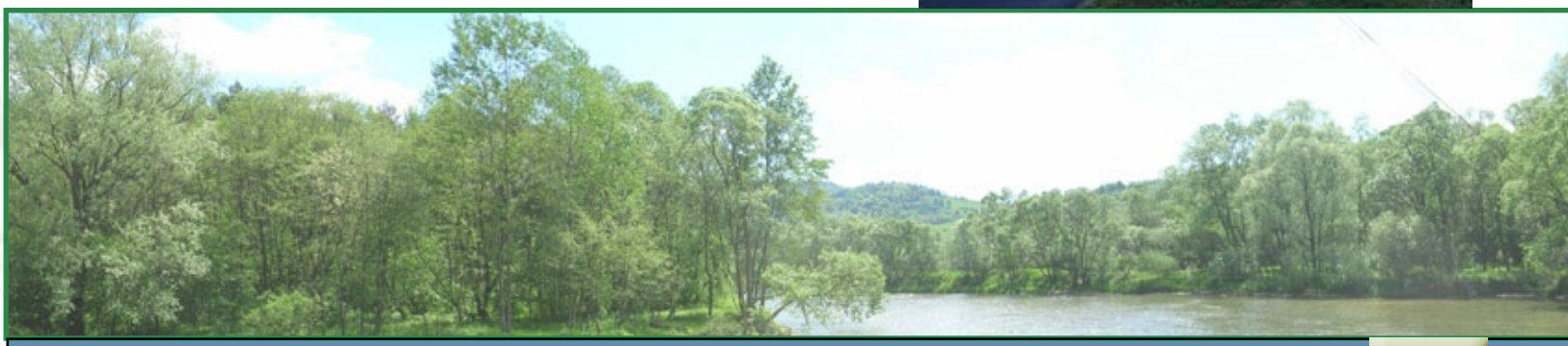
It became apparent to the authors that park models tend to dominate for 30-50 years. Therefore one can conclude that these models are generational. Each generation has its own set of programmatic requirements as well as frustrations in previous park models. Given our current generations attention to ecological fitness and sustainable development Cranz and Bolland concluded that the fifth model, the park model for our generation, would focus on solving ecological problems.

The fifth model for urban parks would need to be designed with sustainability in mind. There are several definitions for sustainability so the definition that will be used in this instance will be the commonly cited Brundtland definition of sustainability as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" emphasizes that aspect of sustainability having to do justice within and between generations (Thompson, 2000, 12-32). Many designers don't want to be constrained by one general definition of sustainability. Cranz and Bolland developed



THEORETICAL PREMISE

a loose working definition of sustainable parks as a compromise between being too broad and too specific. This was done order to remain sensitive to the range of innovations which may surface the future. Their working definition of sustainable urban parks read as follows: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"To start, we knew that Sustainable Parks would have to have traits generally thought to increase the ecological performance of parks. To warrant being recognized as a distinctive model, we expected that at least some of these traits would not be found in any of the other four prior park types. These new characteristics included the use of native plants, restoration of streams or other natural systems, wildlife habitat, integration of appropriate technologies or infrastructure, recycling, and sustainable construction and maintenance practices. This working definition started out emphasizing the ecological value of parks, but we knew it would also include social values. After all, sustainability is ultimately a social concept rather than a technical of biological one because humans are responsible for the ecological crisis today. (Cranz and Bolland, 2004)

In the past societal characterizations of recreation and its desire to achieve a hiatus from its cities held the most influence upon park design. It is the use of this definition that introduces the significance of social values with regards to the ecological merit of the user.


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the previous traditional models. First, sustainable parks attempt to become self-sufficient with regards to material resources. Second, they can play a role in solving larger urban problems outside their boundaries when they are integrated with the surrounding urban fabric. Third, new aesthetic forms emerge for parks and other urban landscapes.

Principle 1 Resource self-sufficiency

In the past parks have not been self-sufficient and required large degrees of maintenance. Instead of sustainability traditional parks have required large amounts of fertilizer, labor, water, pesticides and non-native ornamental plant material. Often leaving the site were negatively impacting environmental factors such as lawn clippings, contaminated run off and garbage. With recent economic conditions requiring municipalities to cut funding within their budgets the high cost of maintenance for the traditional park model is difficult sustain. High maintenance parks which lose funding tend to fall into a state of disrepair. By increasing a parks ability to reduce the need for resources it becomes more self-sufficient. The strategy of environmental autonomy should be interlaced into every aspect of park design, construction and management.


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Principle 2 An integrated part of the larger urban system

When parks are designed to be introduced into a sustainably planned city they begin to function as an integral part of the larger ecological strategy. There are four categories in which a sustainable park can further the objectives of a larger urban system. The four problems that are best solved within an urban framework are those dealing with infrastructure, reclamation, health and social well-being. A sustainable park can go a long way to treat a city's waste water and storm water. Properly executed the treatment of waste water and storm water can create wild life


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habitat, scenic views and recreational activities. The de-industrialization of American cities has left many areas in a state of urban decay and architectural blighted. These areas provide excellent opportunities for communities to reclaim, remediate, and cherish spaces once deemed unsightly. The third urban problem that sustainable parks address is health. Urban parks have been shown to improve physical and psychological health. The fourth problem dealing with societies need for well-being is addressed by eliminating citizen's alienation from nature and natural processes. Reconnecting members of a community to nature will provide a connection to the environment which has been lacking.

Principle 3 new modes of aesthetic expression

In the past rigid forms, static images of landscape and manufactured design amenities played a dominating role American parks. Cranz and Bolland explain the changes in aesthetic approaches by stating the following:


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New types of aesthetic expression are emerging in Sustainable Parks. The form of the park itself and its relationship to the city, its style, and its management practices have moved in a more ecological direction, developing an evolutionary aesthetic, a new spatial relationship to the city, and a new role for designers. This new type may serve as a model for other urban landscapes, private gardens, and ultimately, the city itself. (Cranz and Bolland, 2004)


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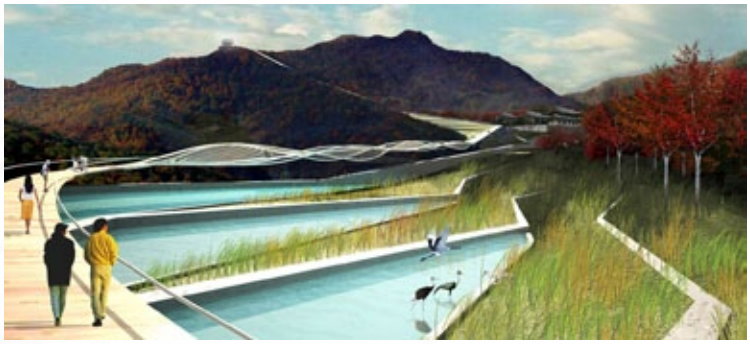
SEEDS TO GROW

Parks were once designed without forethought to context and position within overall environmental systems. The fifth model for urban parks takes into account the greater role a park has within its city and environment.

33



It is important for parks departments as well as municipalities to begin designing park systems pro actively in hopes of creating a synergetic relationship to its surrounding city. The first steps that can be taken are to turn existing parks into low maintenance environmental areas capable of sustaining themselves. Once existing park systems have been brought into line with environmentally sound practices, future parks can be created to fit into the existing ecological matrix. With community involvement and implementation citizens become engaged and educated in sustainable practices. These are concepts that when implemented properly produce parks that bring the ecology of our cities and relationship to our surroundings closer to a sustainable balance.

THEORETICAL PREMISE

Summary of Theoretical Premises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The research looks into three topics of relevance: greenways as ecological corridors, Educational benefits of nature, and sustainable parks. Green ways that serve as ecological corridors have three aspects which are beneficial to the communities for which they are designed. The way green ways benefit communities socially, economically, and ecologically is examined in detail. Educational benefits of nature are discussed as a means to connect children with nature as well as provide citizens with the opportunity to learn about their environment. The ages of discovery are important in the development of an environmentally conscience person as well as the learners proximity to the study area. Sustainable park design can solve many of the community's problems. By designing space that provides storm water management and waste water treatment one can create space containing scenic views with possibilities of recreation. Parks that strive to connect users to nature foster a greater knowledge and respect for nature and its processes. The various researches into these premises serve as a foundation of future design. Not only for the community of Moorhead, MN but for communities that struggle to coexist with natures unpredictable cycles.

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SEEDS TO GROW

Greenways

There are several benefits that greenways offer. Socially they include a connection to nature by providing areas to meander, stroll and educate. When a greenway provides a community with flood protection it creates a sense of security and emotional wellbeing that is felt by its users. Greenways advance the opportunities to connect people to other neighborhoods and communities thus strengthening a social bond between those members. Trails and areas of activity make it possible for users to carry out an active and more healthy lifestyle. Trails are a communities front porch; everyone is welcome.(Nelson, 2007) The benefits greenways systems provide to communities economically vary upon the greenways use. The economic benefits manifest themselves in the form of higher tax revenue for adjacent properties. Businesses as well as home owners have a strong desire to be located within close proximity of a greenway. Increased tourist dollars, amenity rentals, and vendors all contribute to the economic success of a community with a greenway. In the cases of flooding the economic drawbacks include areas involved with flood mitigation, flood protection, and disaster repair. During times of high water lost wages and decline in business productivity can negatively affect a cities bottom line. Greenways are a more affordable solution than large scale engineering projects. Providing an ecological corridor is beneficial to the environment. Wildlife such as birds, fish, and land based animals thrive in greenways because they provide connections to habitat that suits their needs. Greenways have also been called gene-ways because they protect migratory patterns of animals and connections to various species habitats. Ecological greenways as a whole provide numerous benefits to the space they occupy as well as its inhabitants human, animal and vegetative.

THEORETICAL PREMISE

Educational benefits of nature

Children have lost their connection to nature and that has negative consequences for our culture. There used to be a strong connection between nature and forms of play. Whether it is hide and seek outdoors, climbing a tree, fishing or just taking a walk through the woods, interaction with nature at an early age provides a foundation for life ecological respect. reason for this nature deficit disorder is in two basic forms. first factor competing children's attention manifests itself in the increased amounts media in the manner of television shows, games, and internet. next factor limiting exposure to nature is parent's expectations of their children to compete in sports and become honor roll students. More than ever kids have their time structured and find less time to get outside and explore the world. When given the chance children have an uncanny and imaginative way of turning items in nature into objects of play. By making nature accessible to children we are helping them to form those important bonds to ecology early.

Project based learning is a constructivist theory which helps learners to develop strong skills on their journey to becoming well balanced adults. Learning is not just academic but dispositional. Dispositional learning addresses important aspects of community involvement and character development. Throughout

the progression of a project several life skills are refined by a learner's ability to complete their tasks associated with their projects. A project in ecology for example would require skills in reading, writing, science, math, software use, as well as presentation. This form of education leaves a learner more invested in their education and the topics they explore.

Sustainable Parks

Throughout the history of our great country the park movement has meet the need of several generations for different reasons. The first parks where produced as a remedy to cities, which citizens perceived as stressful, dangerous and unhealthy places to live. As our country expanded and our perceptions about the outdoors and recreation changed so did our green spaces. The park typology evolved from Pleasure Grounds in the late 19th century where open space and a pastoral escape from the city was desired to the reform parks in the early 20th century where special play equipment was introduced and locations where chosen on left over undesirable plots of city land. The reform parks where intended to reduce class conflict, to reinforce the family unit, to socialize immigrants to the American way of life, to stop the spread of disease, and to educate new citizens. The third park movement to influence Americans was the Recreation Facility which was prevalent from 1930 to 1965 . The major innovations to this form of park were the stadium, parking lot and asphalt ball courts-hence the term recreational facility. These parks often served limited uses and characteristically exposed a sense of sterility. In 1965 until recent the open space park has been popular. This park system strived to link a series of individual parks together creating an emerald chain if you will to unify green spaces to one another. The open space parks provided psychological relief, free-formed play equipment and water features for viewing. All of these parks responded to social standards of the times and fit cultural expectations for those periods.

THEORETICAL PREMISE

Evolving over the years out of social conscience, financial necessity, and cultural behavior a fifth model for urban parks was born. This model emphasized the importance of sustainability and environmental harmony. There are three major principles in which sustainable parks differ from that of the previous traditional models. The first being, sustainable parks attempt to become self-sufficient with regards to material resources. Second, they can play a role in solving larger urban problems outside their boundaries when they are integrated with the surrounding urban fabric. Third, new aesthetic forms emerge for parks and other urban landscapes.

SEEDS TO GROW

It is with the facts garnered in this research that I will base my design for an ecological corridor in Moorhead. The green way will have areas that benefit the community culturally, economically, as well as ecologically. By designing a green way pro actively I can assure the project is locally sustainable and provides several educational possibilities.

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The following case studies all show the ability to allow users a closer interaction with a river. These excellent designs create mixed use greenways while further connecting there sites to a greater ecological network.

Title of Project: Grand Forks, Greenway
Location: Grand Forks, ND
Date designed/planned: 1998 approved by city council 2001
Size: 2200 acres
Cost: Initial construction of the Greenway was funded with federal, state, and local dollars. In Grand Forks the ongoing operations and maintenance are funded through a monthly fee to every residence and business owner.
Landscape Architect: Greenway Inc. North, Carolina
Client: Grand Forks and East Grand Forks
Managed by: Melanie Parvey-Biby, Environmental Compliance/Greenway Mgr.

The Grand Forks Greenway is project located along the red river in both Grand Forks, ND and East Grand Forks, MN. It consists of approximately 2,200 acres of natural space located between flood protection system and the banks of the Red and Red Lake Rivers. It was placed in areas that held residential development and commercial space. After the great flood of 1997 the Army Core of Engineers suggested the two cities develop a greenway to reduce the effects of future flood damage. The city has embraced its new amenity and uses the site for recreation and civic gatherings.

The Grand Forks greenway has several features including: 2 golf courses (1-18hole and 1-9 hole), four boat ramps, campground, disc golf wildlife viewing areas, playgrounds, basketball courts, tennis courts, historical interpretive pieces, softball fields, sand volleyball, horseshoe pits, and wildflower gardens and trails. The reason for the sites creation, flooding, is also one of the major factors that affect its use through times of major flooding and high water. Due to its lower elevations and proximity to the river some activities and features of the greenway are forced to close during high water.

SEEDS TO GROW

The towns of Grand Forks and East Grand Forks experienced catastrophic flooding in 1997. To ensure the success and revival of the cities they chose a project that was constructed as a greenway in a larger scale flood prevention program.

The Grand Forks Greenway was born out of necessity as well as opportunity. With several properties damaged or destroyed the land was available in areas that would have been hard to acquire. The United States Army Corps of Engineers developed the initial plan for the greenway in association with Greenways, Incorporated, a North Carolina-based firm. In 1998 the City of Grand Forks commissioned Greenways, Incorporated to build upon the original vision for the Greenway and develop a comprehensive Greenway Plan. A series of public meetings were held with residents from both communities to define a working concept for the purpose, function and composition of the greenway. The result offered a document known as the Greenway Plan. A portion of the Greenway Plan was approved by the Grand Forks City Council in September 2001.

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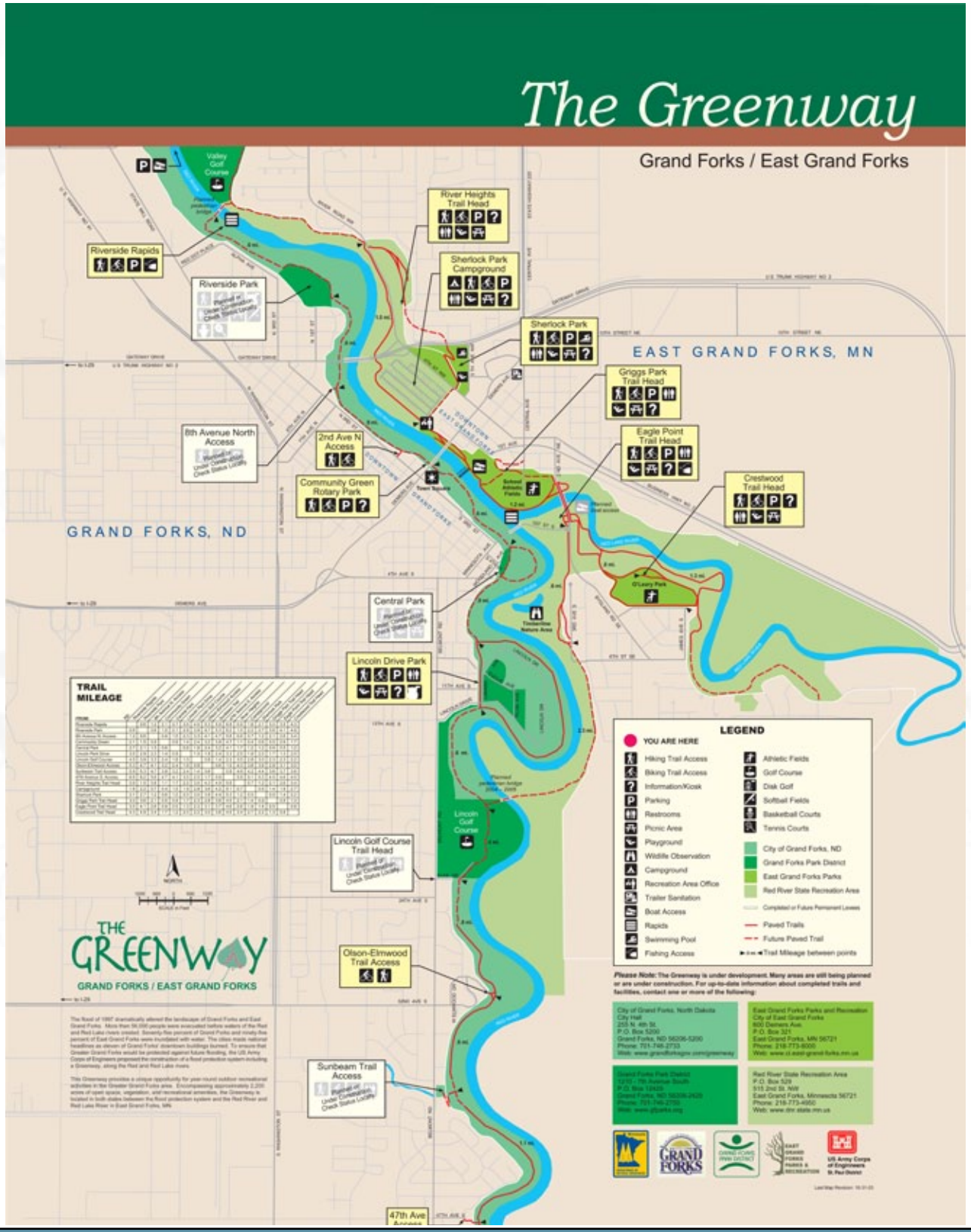
The role Greenway Incorporated took in the development of the Grand Forks Greenway was to work with an embattled community to design an amenity which would help protect property and provide recreational opportunities for its members. The landscape architects worked with several local, state, and federal agencies on the project. They aesthetically enhanced the flood prevention solutions designed by the civil engineers.

The major project elements of the green way are permanent flood protection, storm water storage areas, over 20 miles of new multipurpose trails, trail system connecting the communities, several winter recreational opportunities, high quality spaces/facilities for community events, golf courses, a campground and a commercial zone for businesses.
The green way is now maintained by each of the city's public works departments. All activities, locations, and amenities are overseen by Melanie Parvey-Biby, Environmental Compliance/Greenway Manager.

The significance of the greenway between the two cities is the fact that it symbolizes a community that would not die. After the catastrophic flooding of 1997 the cities decided against great odds to rebuild. This greenway is a monument to their perseverance.

Information uptained from : Melanie Parvey-Biby, Environmental Compliance/Greenway Mgr.
: http://www.grandforksgov.com/greenway

SEEDS TO GROW



Title of Project: Allegheny Riverfront Park
Location: Pittsburgh, Pennsylvania
Date designed/planned: March 1995
Size: 177,000 square feet of park space
Cost: 22 million including moving of roads for project
Landscape Architect: MVVA
Client: Pittsburgh Cultural Trust

Between Ninth Street Pier and Fort Duquesne Bridge Pittsburgh, PA .Two active park promenades running alongside the Allegheny River, one upland, the other at river level

The Allegheny Riverfront Park site contains 3 bridges. At the time of planning four lanes of traffic existed on the lower tier of the park. The original site was loud, dirty, and largely emblematic of city blight. There was no native soil to be salvaged; it was in fact constructed on coal slag deposited behind a 25-foot flood wall. A large sewer line ran directly beneath the site. Water levels on site fluctuate 20 or so feet, subjecting it to catastrophic ice jams and flooding.

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In 1911 Frederick Law Olmstead, Jr. planned a park system for this river edge but soon it became just a series of highways. The original site of the project was a 6 lane highway where the upper level park was to sit. A sliver of concrete in between a four lane highway and the Alleghany river on the lower level was the park site. This site has also been known to flood as it did during the planning and design process in 1998. The project was put off 1 year due to this problem.

The Pittsburgh Cultural Trust was creating a new and revitalized area in downtown Pittsburgh. They decided a park would be a great addition to the area, and the riverside was the only spot available that would suit this purpose.

SEEDS TO GROW

Landscape Architect Michael Van Valkenburgh and his firm MVVA played a major role in the redesign of the highway area near the park in order to create the park areas. MVVA hired artist Ann Hamilton to add additional color and texture to the park. The Landscape Architect was also pulled into traffic engineering problems as they worked with the state highway, and county.

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The elements in the riverfront park are two levels of walkways, the lower level is a more natural space with native planting that regenerate after flooding, and the upper is a more urban park using materials from Pennsylvania. The designers created a cantilevered walkway to bring more area to this park. There are two ramps leading to the lower level of the park. The concrete was textured with native grasses and paving areas used bluestone.
Ethan Carr has reviewed The ARP and discussed the merits of this project by comparing it to Boston's Big Dig. He viewed it as a chance to improve on a space by making minor changes and alterations to the site not great changes and completely recreating a new land form. Erik de Jong felt that Michel Van Valkenburgh mixed construction, materials, and art in a positive way. Both critics where pleased with the Alleghany Riverfront Park solution.

There were many limitations to this project. The site of the project had limited amount of soil and surface space. This surface face exacerbated problems such as ADA requirements and ramp placements. With space being a premium a cantilevered walkway was installed for bike and pedestrian use. Another limitation that was overcome was the fact that there were two governing bodies in charge of the site. The state entity governed the riverfront, while the city of Pittsburgh governed the upper level of the park.

TYPOLOGICAL RESEARCH

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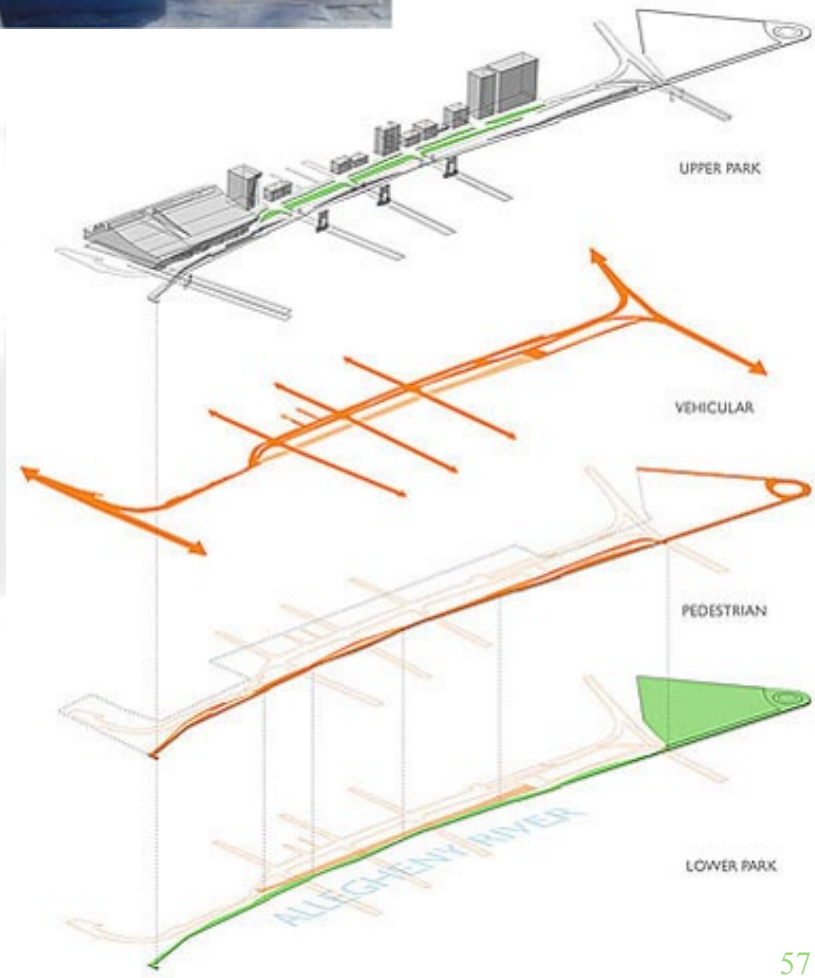

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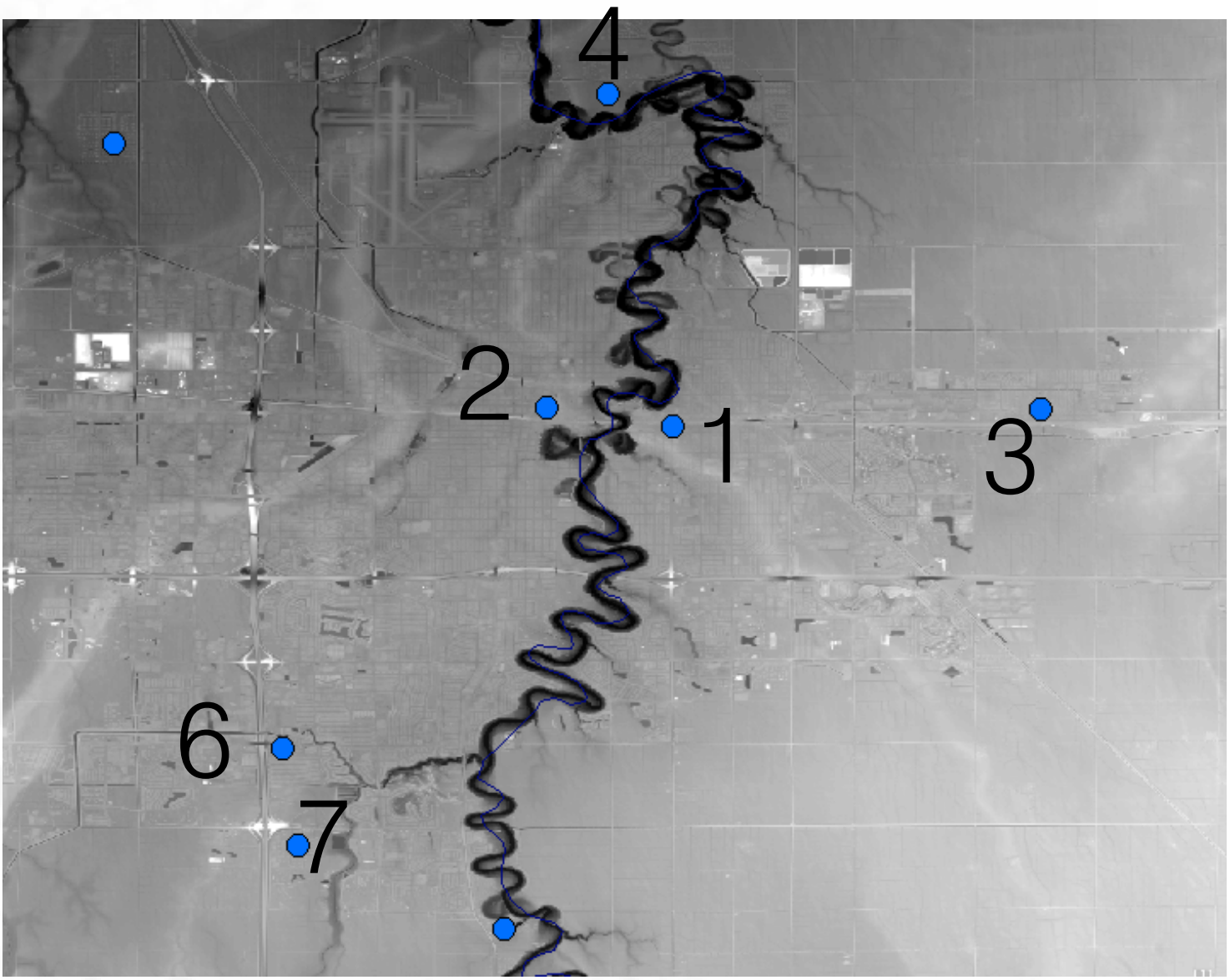
Master Plan

SEEDS TO GROW



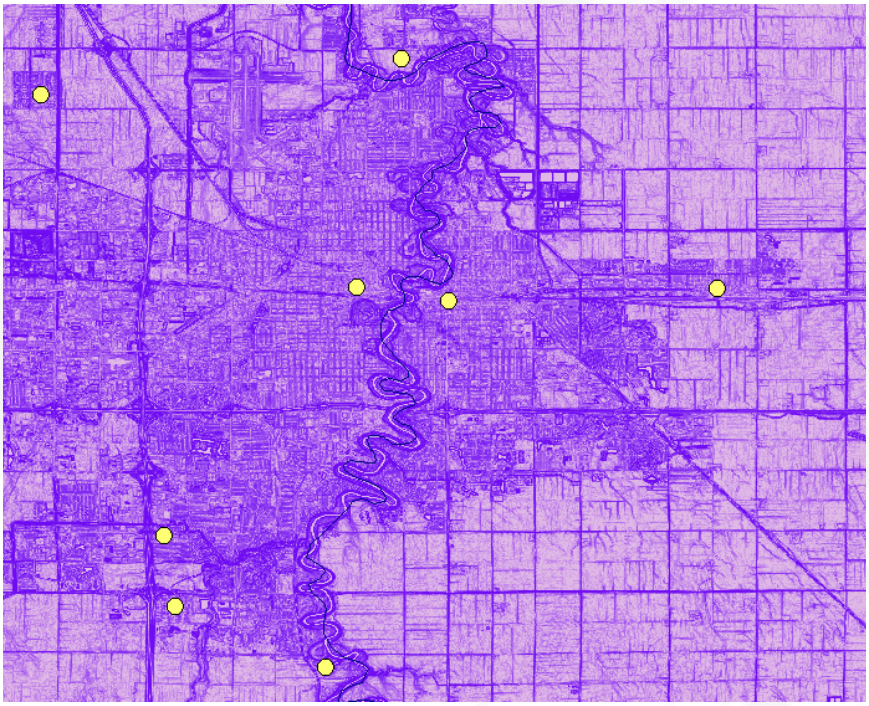
SITE ANALYSIS

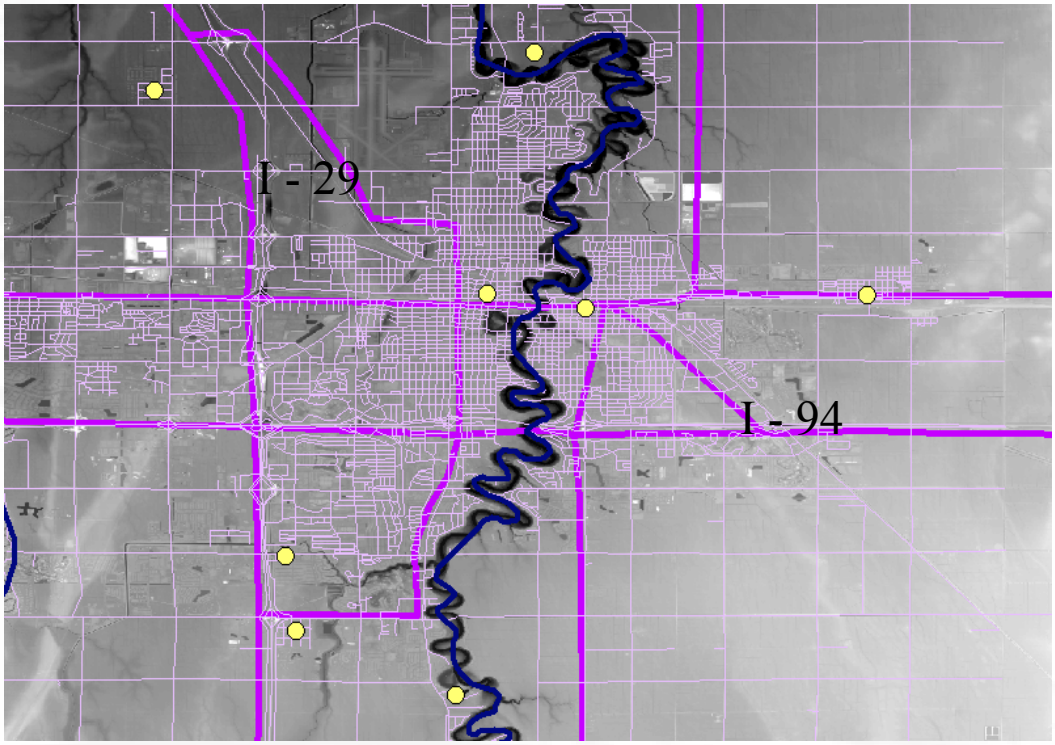
Slope analysis

Less than 10%

10 - 20 %

Greater Than 20%



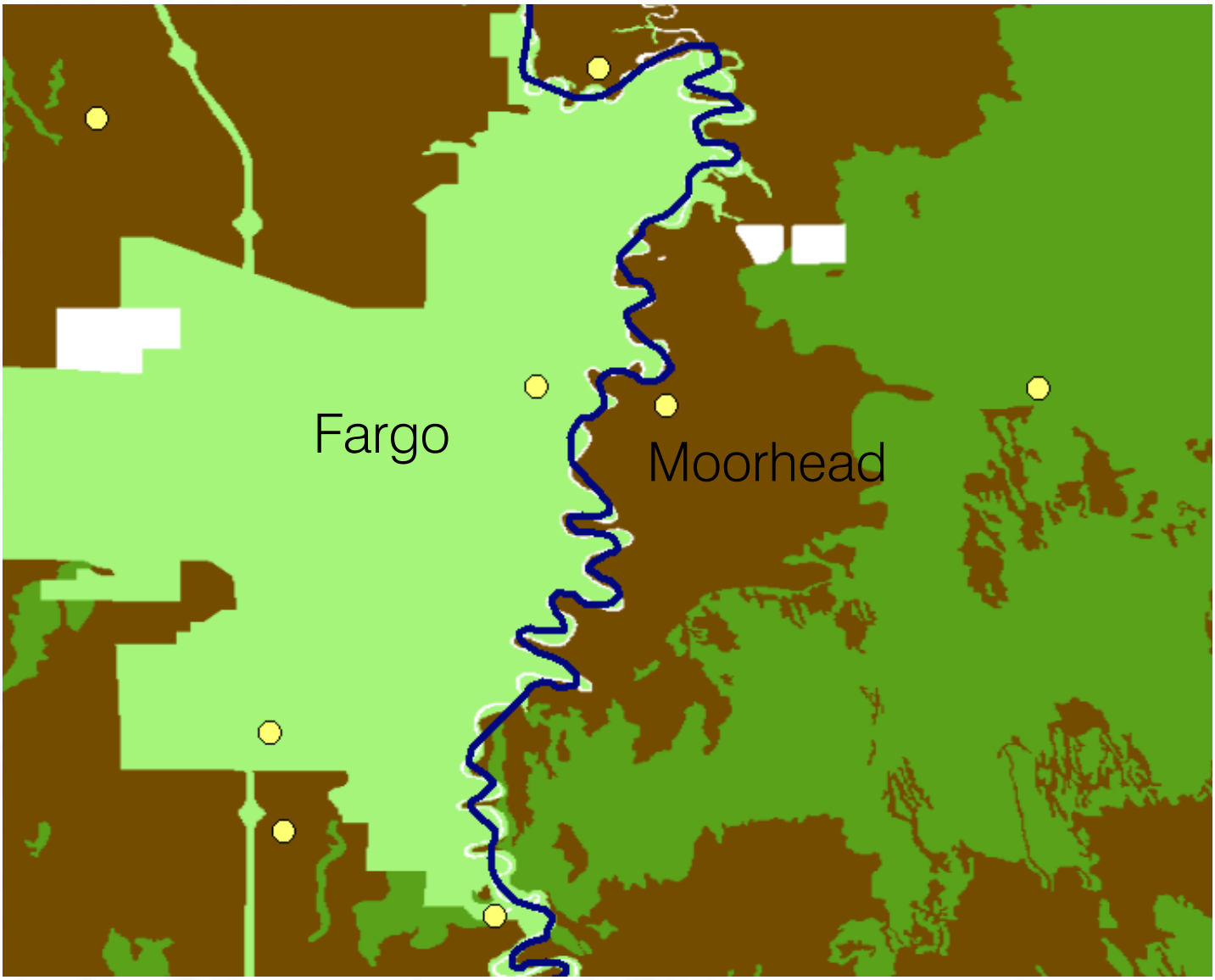


Roads and Highways

Soils Analysis

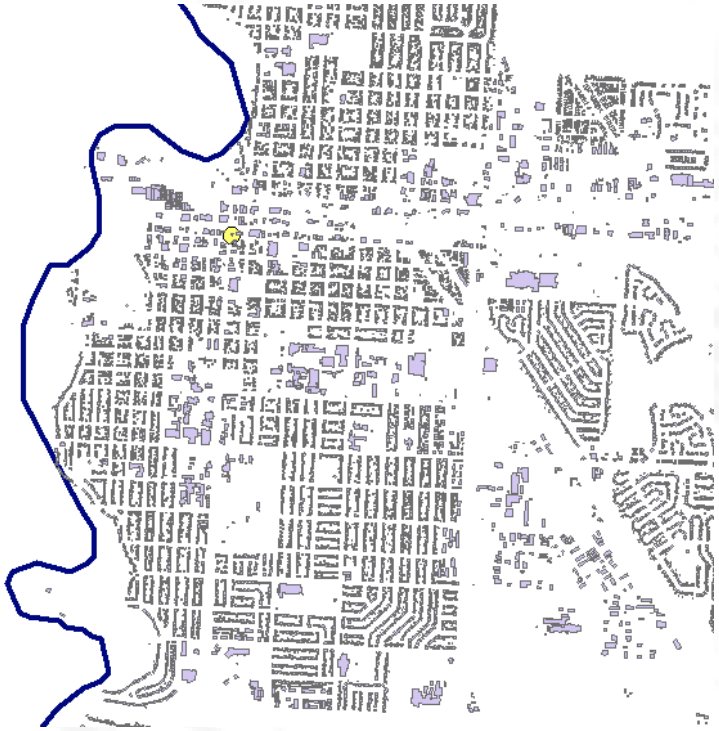
- Entisols
- Ryan Silty Clays
- Colvin Sitly Clay
- Dumps and Pits

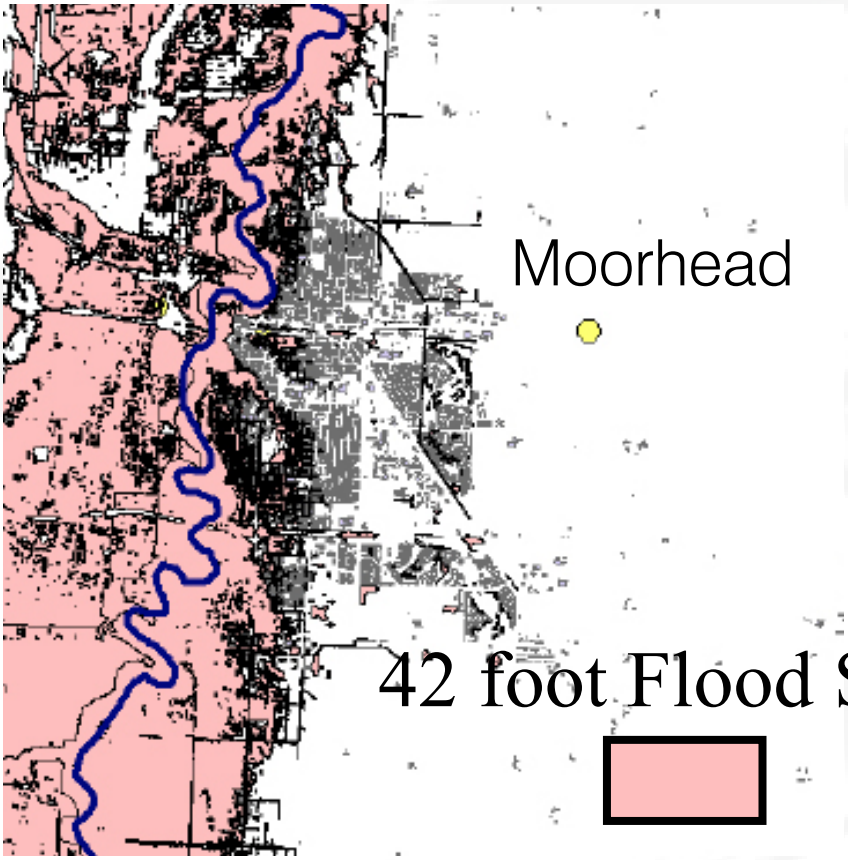
SEEDS TO GROW



SITE ANALYSIS

Building Footprints





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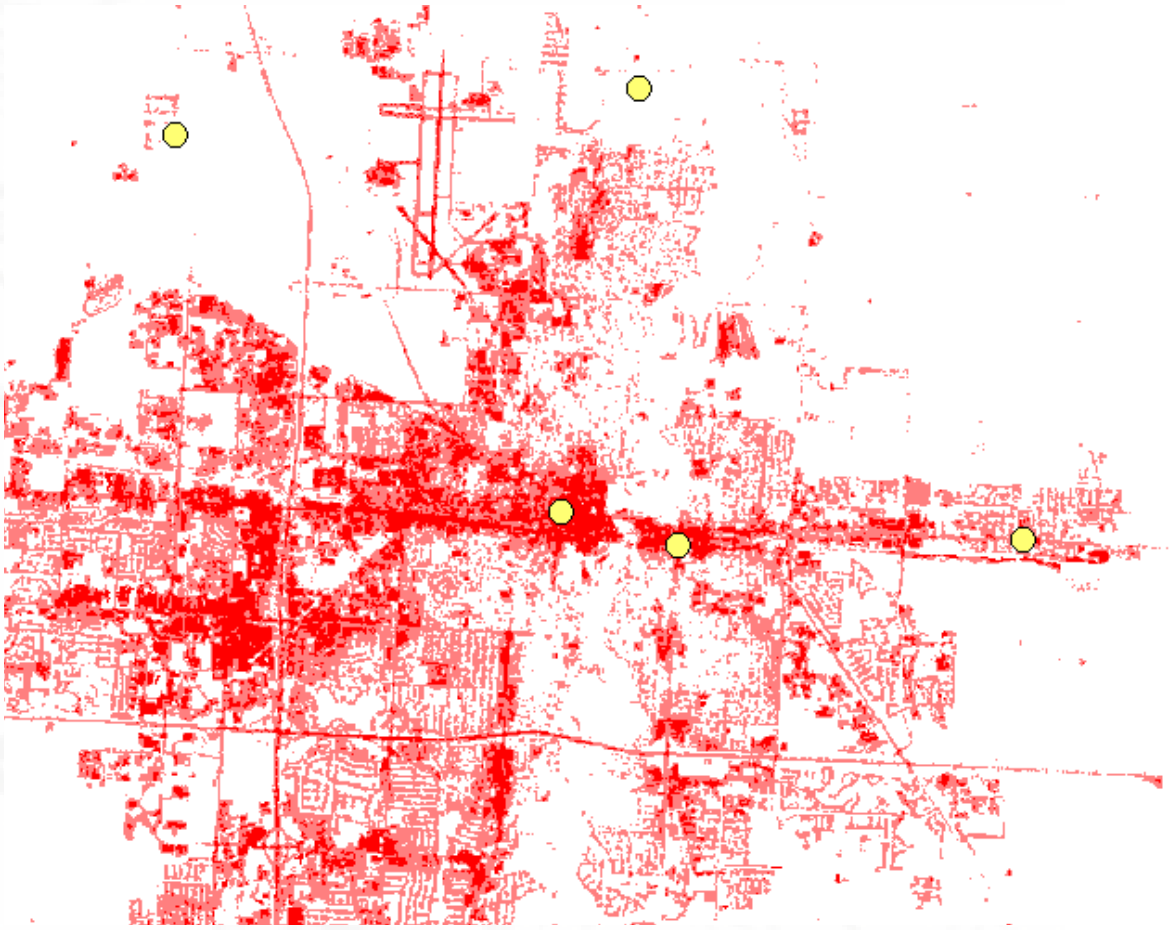
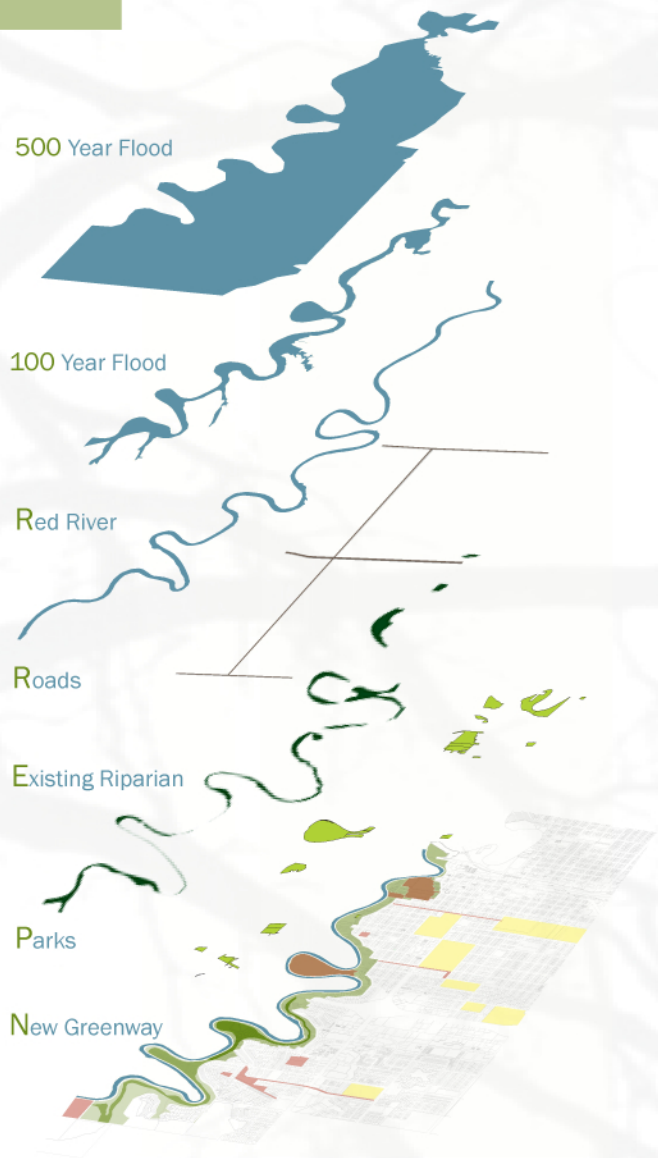


Impermeable Surface

SITE ANALYSIS

Inventory



SEEDS TO GROW

Riparian Buffer

Strip of vegetation (trees, shrubs, grasses, etc.) that grows along the edges of a bank or a waterway.

Its major role is to **Filter** and **Store** sediment, nutrients, pesticides, and metals from upland surface and groundwater through infiltration, uptake, and transformation.

PROGRAMMATIC REQUIREMENTS

Flood Protection

Permanent Flood Protection
Water and Environment

Restore Riparian Areas

Year-Round Recreational
Opportunities promote Health

Remove Flood Prone Structures

Public Art Arts
and Culture
Gathering Spaces With Arts
and Culture

Strengthen Circulation To Parks and Fargo

City-Wide Trail Loop

SEEDS TO GROW

Ecological Corridor
- Bird Sanctuary
- Walking Paths
- Buffer Reestablishment
- Erosion control

River Walk
- Flood Kiosk
- Biking Path
- Walking Path
- River Observation Platform
- Signage

Educational Center
- Plant Nursery
- Visitor Center
- Compost Site
- Community Garden
- Natural Playground

APPENDIX

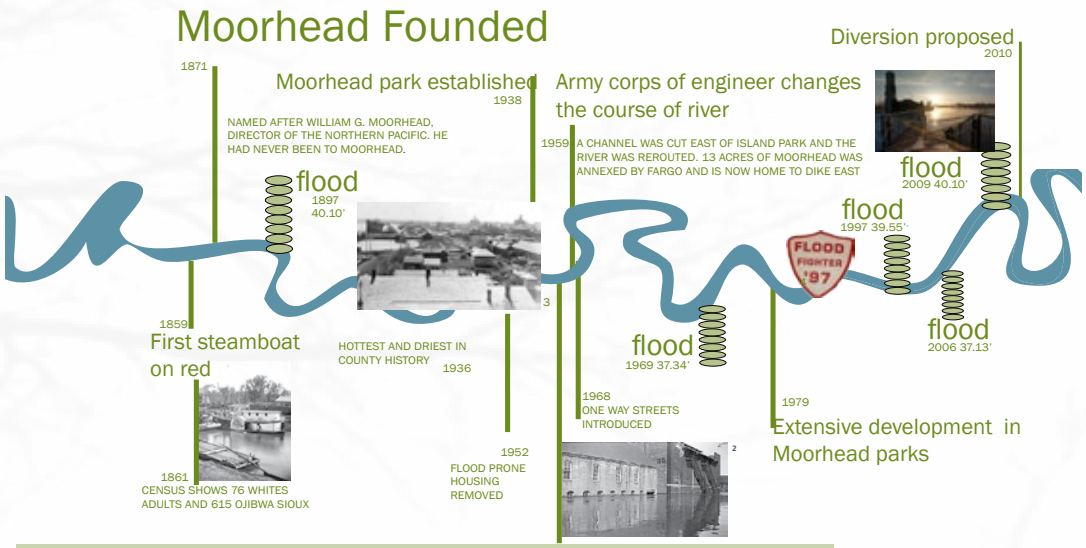
Seeds To Grow

How can a Greenway educate a community through the natural occurrence of flooding?

A Community Led Greenway

SEEDS TO GROW

Seeds To Grow

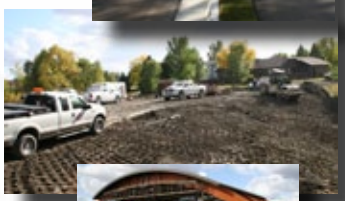


History

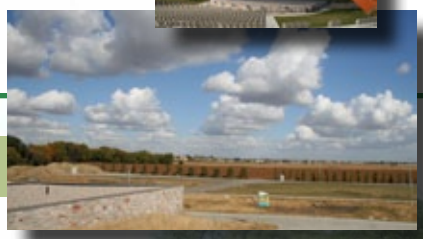
Seeds To Grow

Woodlawn park

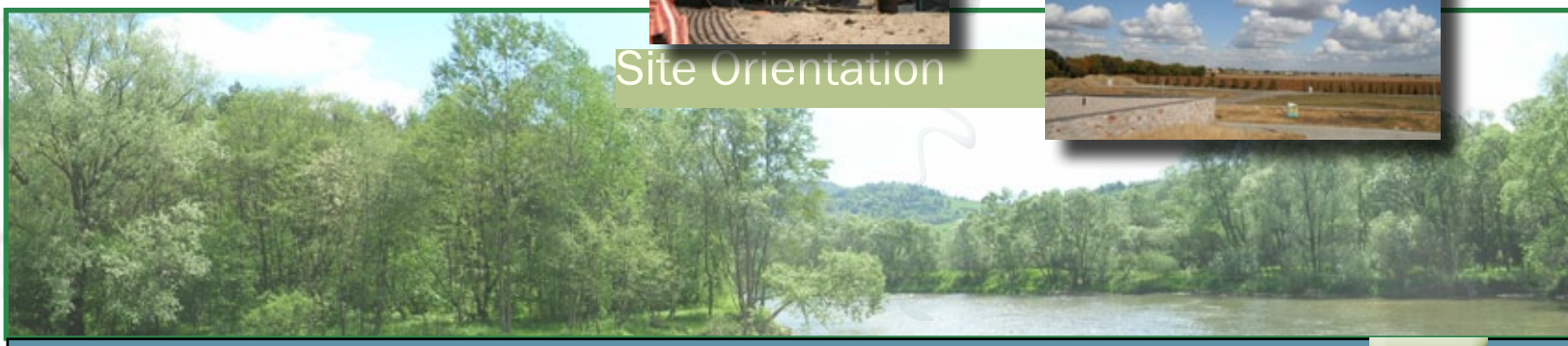
Extensive Engineering and Buyouts



Bluestem Amphitheater

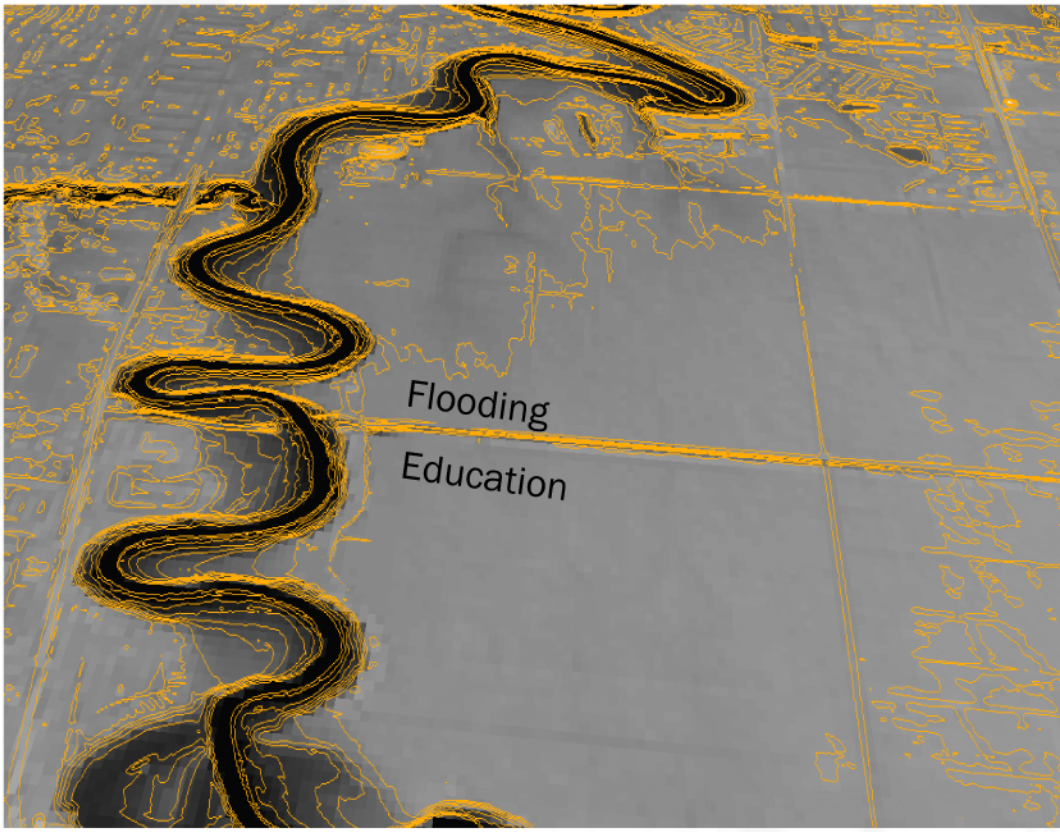


Site Orientation



APPENDIX

Seeds To Grow



SEEDS TO GROW

Seeds To Grow

Physical

lack of walkway connectivity to parks

lack of spatial enclosure

lack of a continuous path along the river

various micro climates could be utilized for multi seasonal activities

positive views should be capitalized on

the river corridor provides an excellent opportunity to strengthen circulation

Cultural

views to the river blocked by structures

lack of pedestrian connections to fargo

site accessibility limited due to private ownership

opportunities for sensory impact should utilized

site should be used as an interpretive area for students and residents of community

Biological

degraded riparian corridor

lack of native species along river

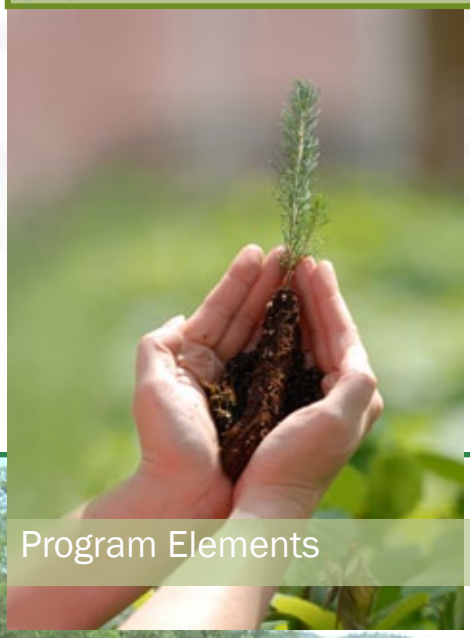
uninterrupted storm water flowing to river

riparian areas should be restored

creation of migratory routes would be beneficial to animal connectivity to ecosystems outside of immediate area

Constraints | Opportunities

Seeds To Grow



Flood Protection

Permanent Flood Protection
Water and Environment

Restore Riparian Areas

Year-Round Recreational
Opportunities promote Health

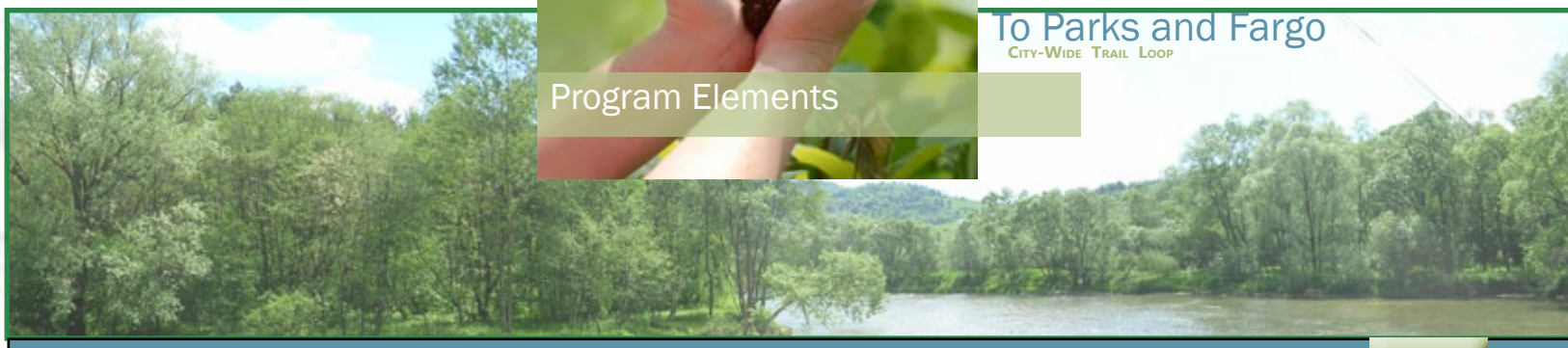
Remove Flood Prone Structures

Public Art Arts
and Culture
Gathering Spaces With Arts
and Culture

Strengthen Circulation To Parks and Fargo

City-Wide Trail Loop

Program Elements

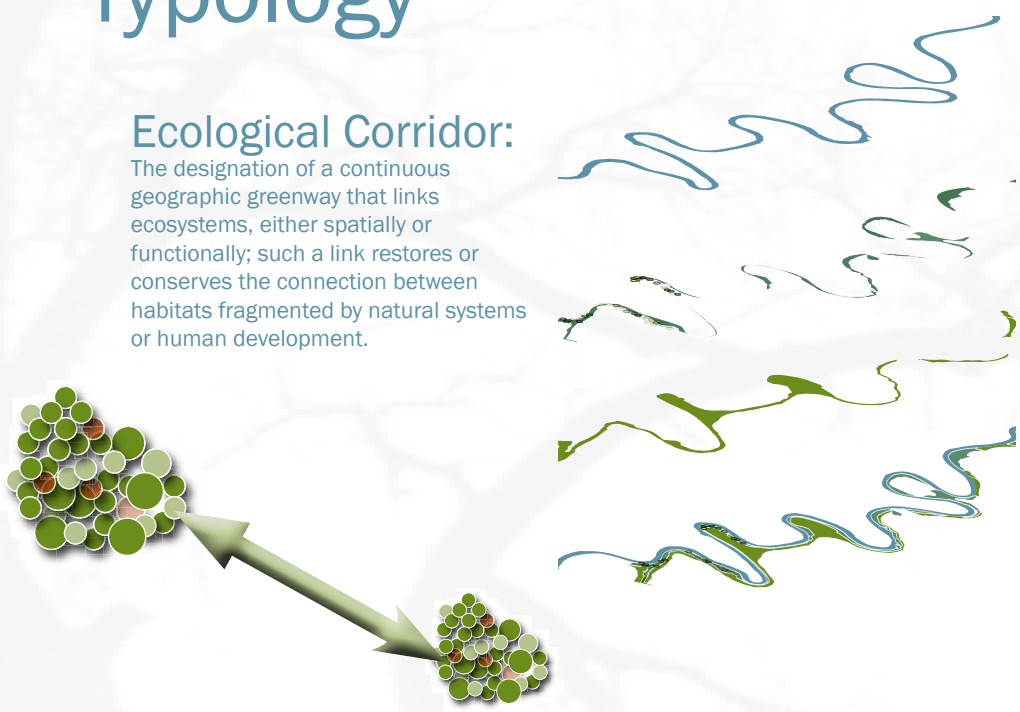


APPENDIX

Typology

Ecological Corridor:

The designation of a continuous geographic greenway that links ecosystems, either spatially or functionally; such a link restores or conserves the connection between habitats fragmented by natural systems or human development.



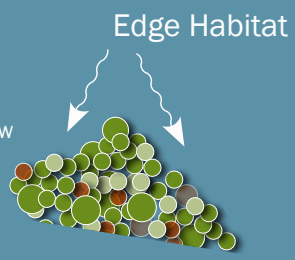
Seeds To Grow

Patch:

In order to repair riparian degradation, due to development, a network of ecological patches will be introduced. Patches are relatively homogeneous areas that differ from their surroundings.

Edge:

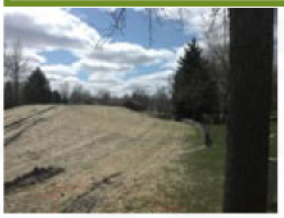
The linear form of the Red River presents the opportunity to create an abundance of edge eco-zones. Edge systems in the environment differs significantly from the interior of the patch. Whether a boundary is curvilinear or straight influences the flow of nutrients, water, energy, or species along it.



Mosaic

SEEDS TO GROW

Seeds To Grow

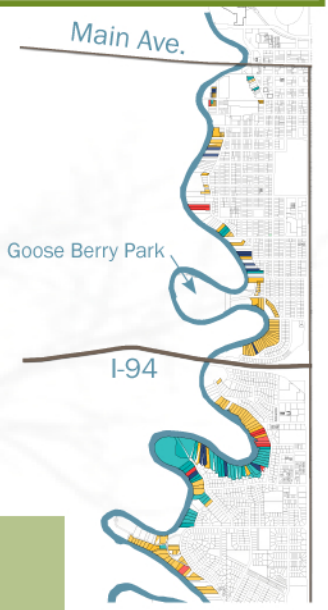


No Response

Accepted or pending

Completed Property Buyouts

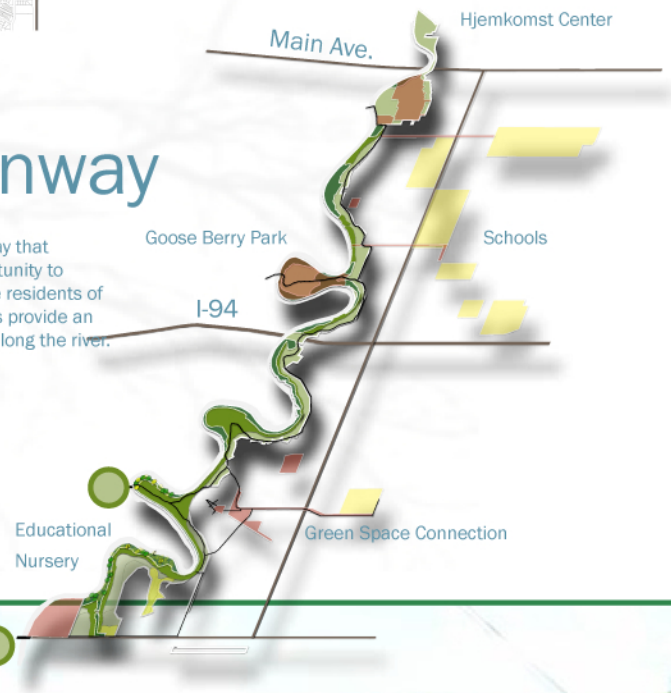
No



Remove Flood Prone Structures

New Greenway

Design a greenway that provides an opportunity to educate the future residents of the area as well as provide an ecological buffer along the river.



APPENDIX

Existing Riparian + Strengthened

Species Mobility

Riparian Species

Zone One | Rivers Edge
Black Willow
Cotton Wood
River-30'

Zone Two | Water Tolerant
Oak
Silver Maple
30'- 120'

Zone Three | Habitat Establishment
Poplar
River Birch
Hickory
Hackberry
American Elm
Black Walnut
Hazelnut
120'- 300'

Restore Riparian Areas

Seeds To Grow

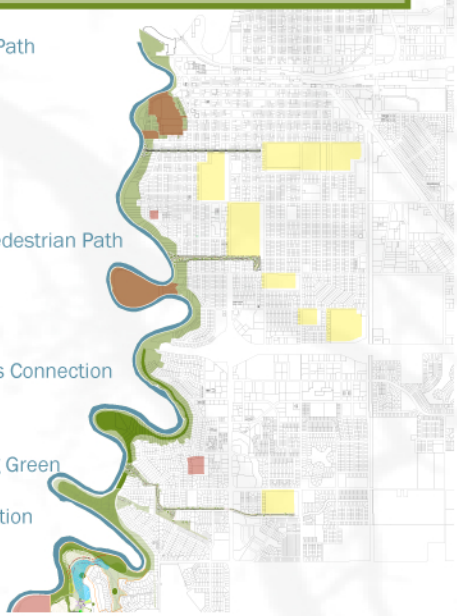
Strengthen Circulation To Parks

MSU Pedestrian Path

MSU Pedestrian Path

Hopkins Connection

Existing Green Space Connection



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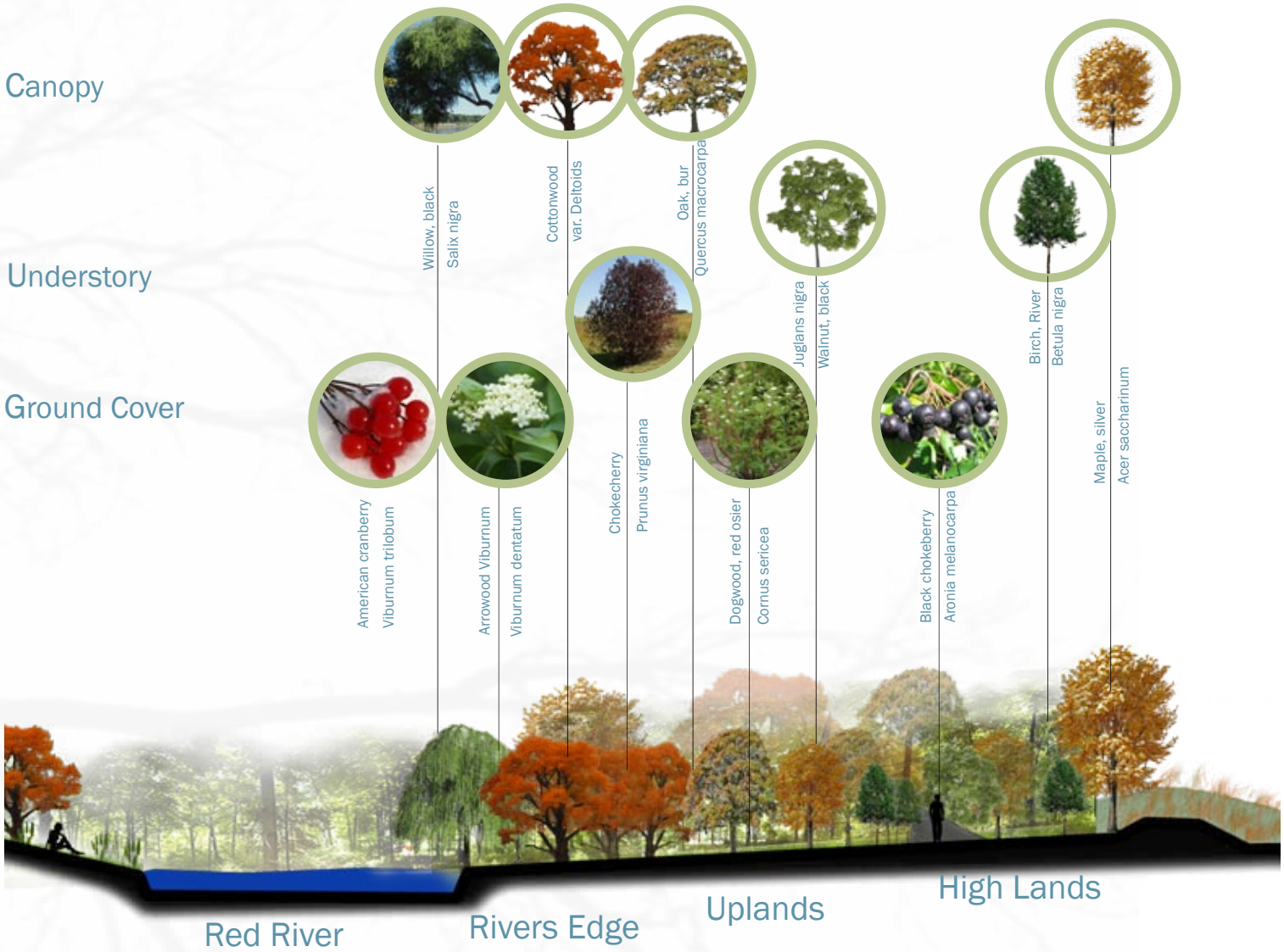


APPENDIX

Seeds To Grow

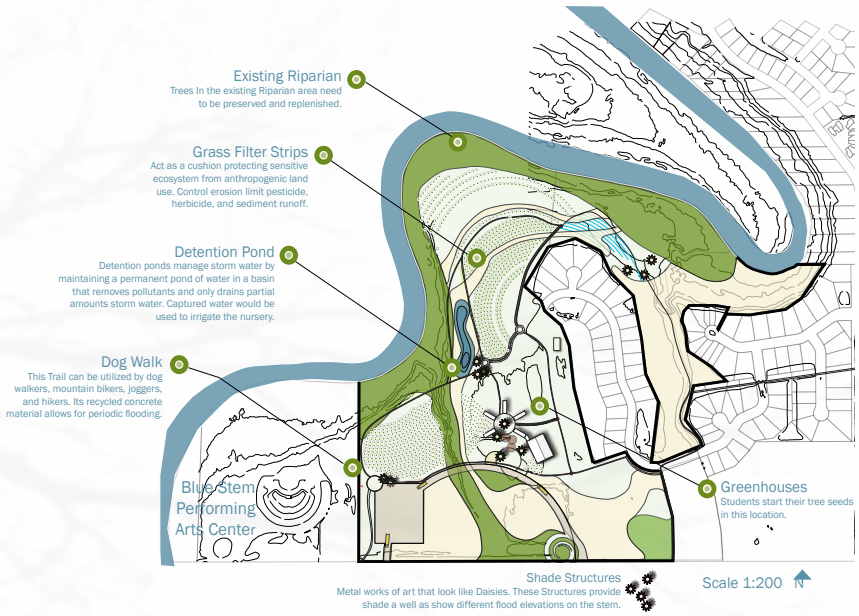
Seeds To Grow

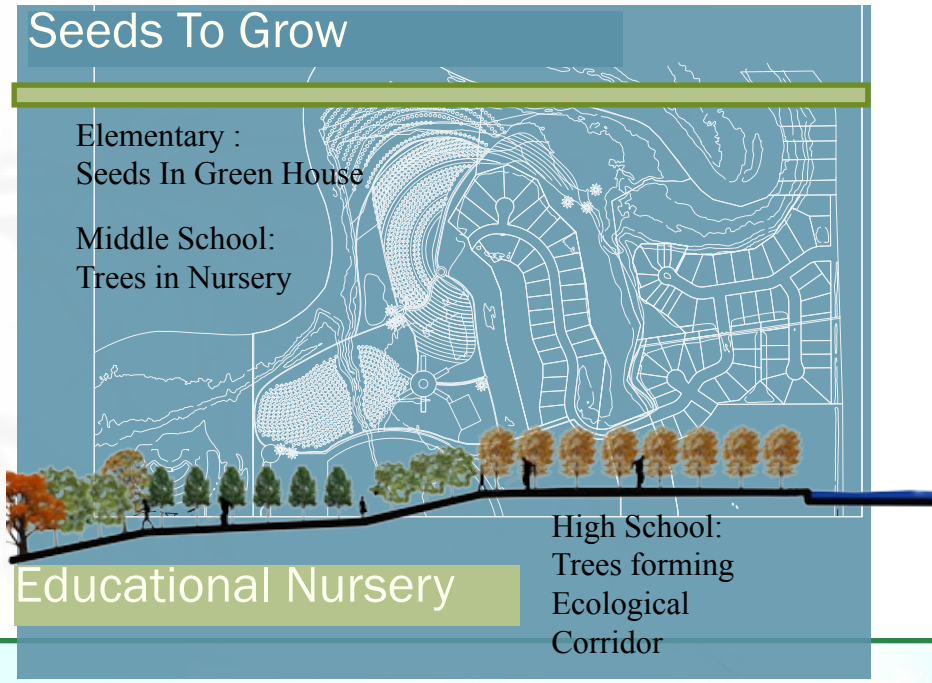
Between Ages 5 and 12 are the most critical years of development according to Niban and Trimbal (2002).

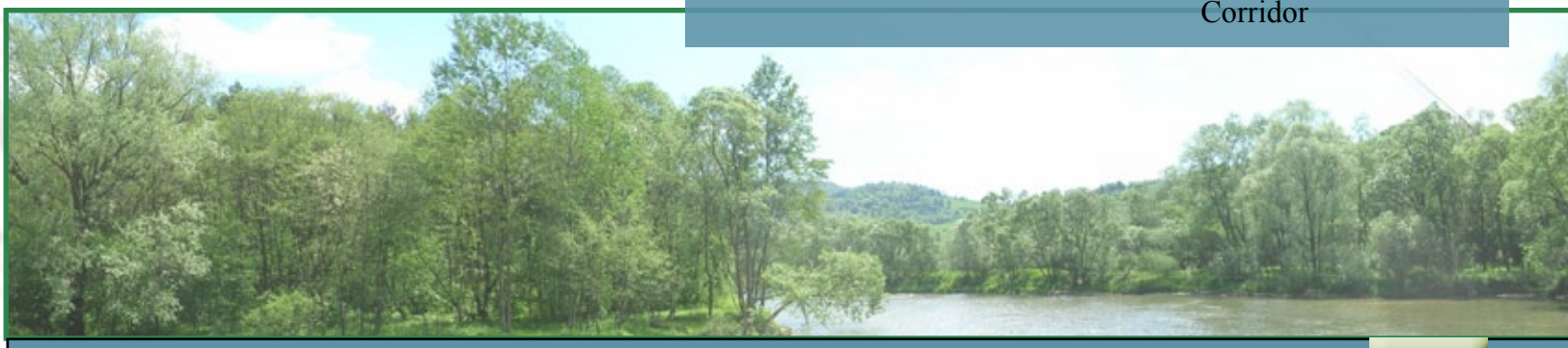
Children have lost a connection to nature and a free spirited childhood

Nature Deficit Disorder

SEEDS TO GROW





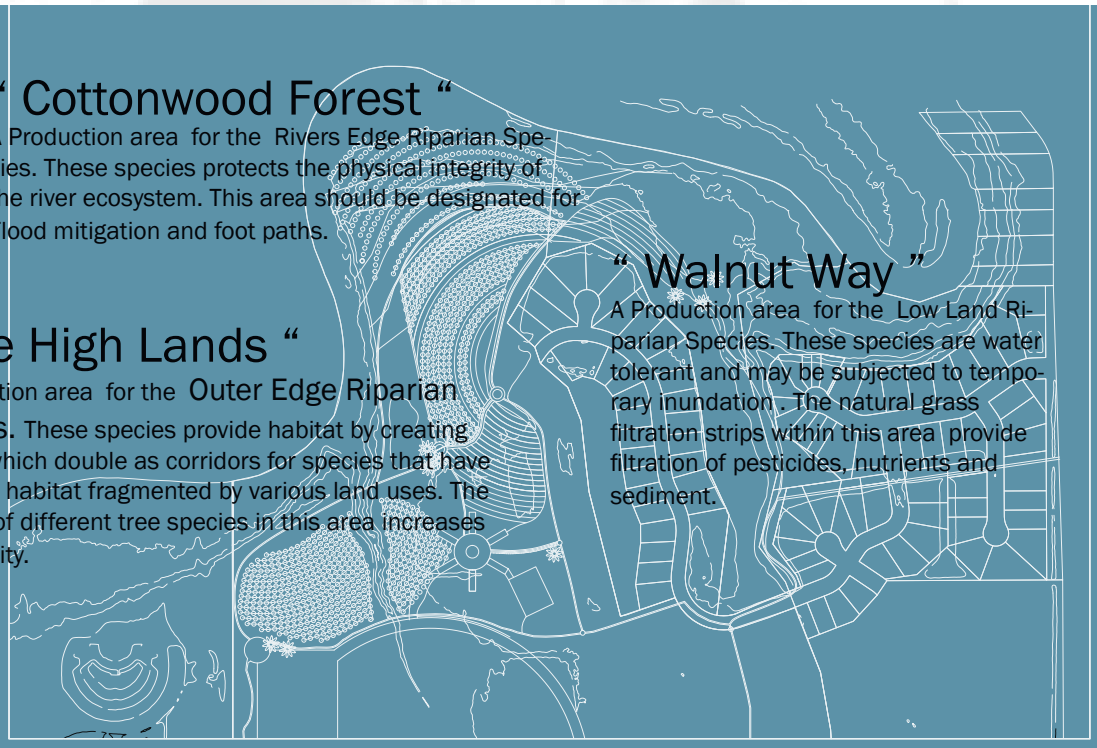


APPENDIX

Seeds To Grow

Detention Basin

Educational Nursery



" Cottonwood Forest "

A Production area for the Rivers Edge Riparian Species. These species protects the physical integrity of the river ecosystem. This area should be designated for Flood mitigation and foot paths.

" Walnut Way "

A Production area for the Low Land Riparian Species. These species are water tolerant and may be subjected to temporary inundation . The natural grass filtration strips within this area provide filtration of pesticides, nutrients and sediment.

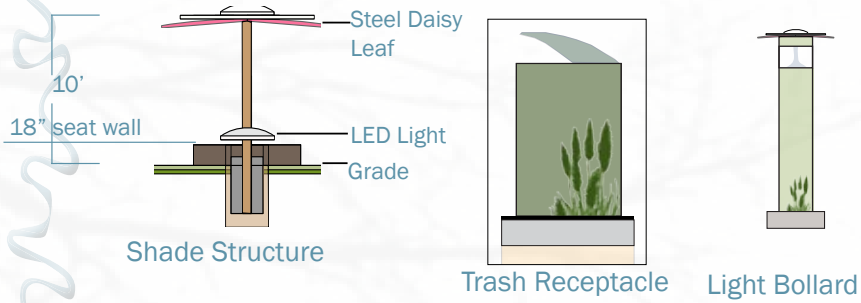
" The High Lands "

A Production area for the Outer Edge Riparian Species. These species provide habitat by creating buffers which double as corridors for species that have had their habitat fragmented by various land uses. The number of different tree species in this area increases biodiversity.

SEEDS TO GROW

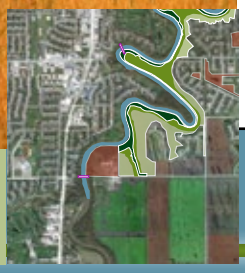
Seeds To Grow

Locally grown trees



Materials

Seeds To Grow



Connections

APPENDIX

Seeds To Grow

Political

PERMANENT FLOOD PROTECTION WATER AND ENVIRONMENT

Buy Outs | Levees

Environmental

Greenway | Trails | Bridges

CITY WIDE TRAIL

Cultural

Sculpture | Bluestem

YEAR-ROUND RECREATION

PUBLIC ART ARTS AND CULTURE

Festivals | Sledding | Community

Priorities

SEEDS TO GROW

Phases

☑ Buy outs

Levees

1 Buffer zone/Nursery
5 Years

Project Base Learning

Greenway | Bridge

2 Public Arts and Culture
10 Years

Sculpture | Gathering Spaces

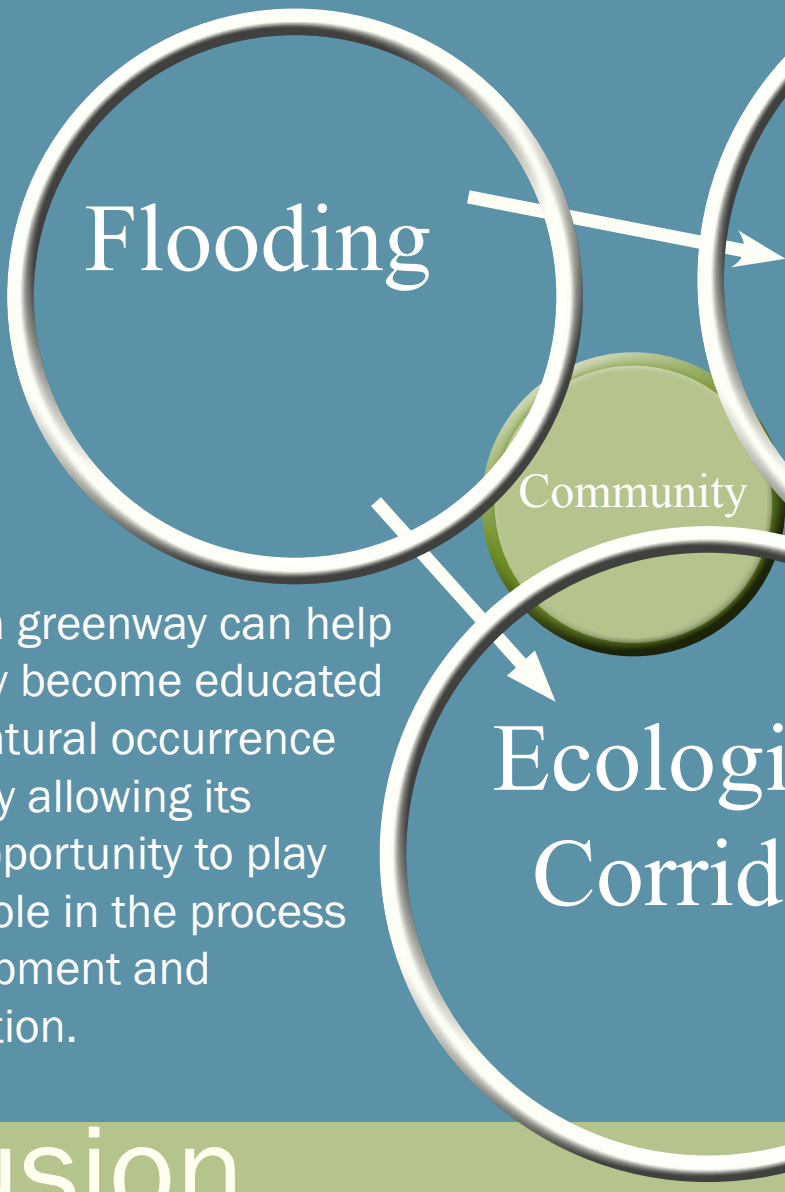
3 Connections
15 Years

Trails | Paths |

4 Native and Valued Amenity
Future

APPENDIX

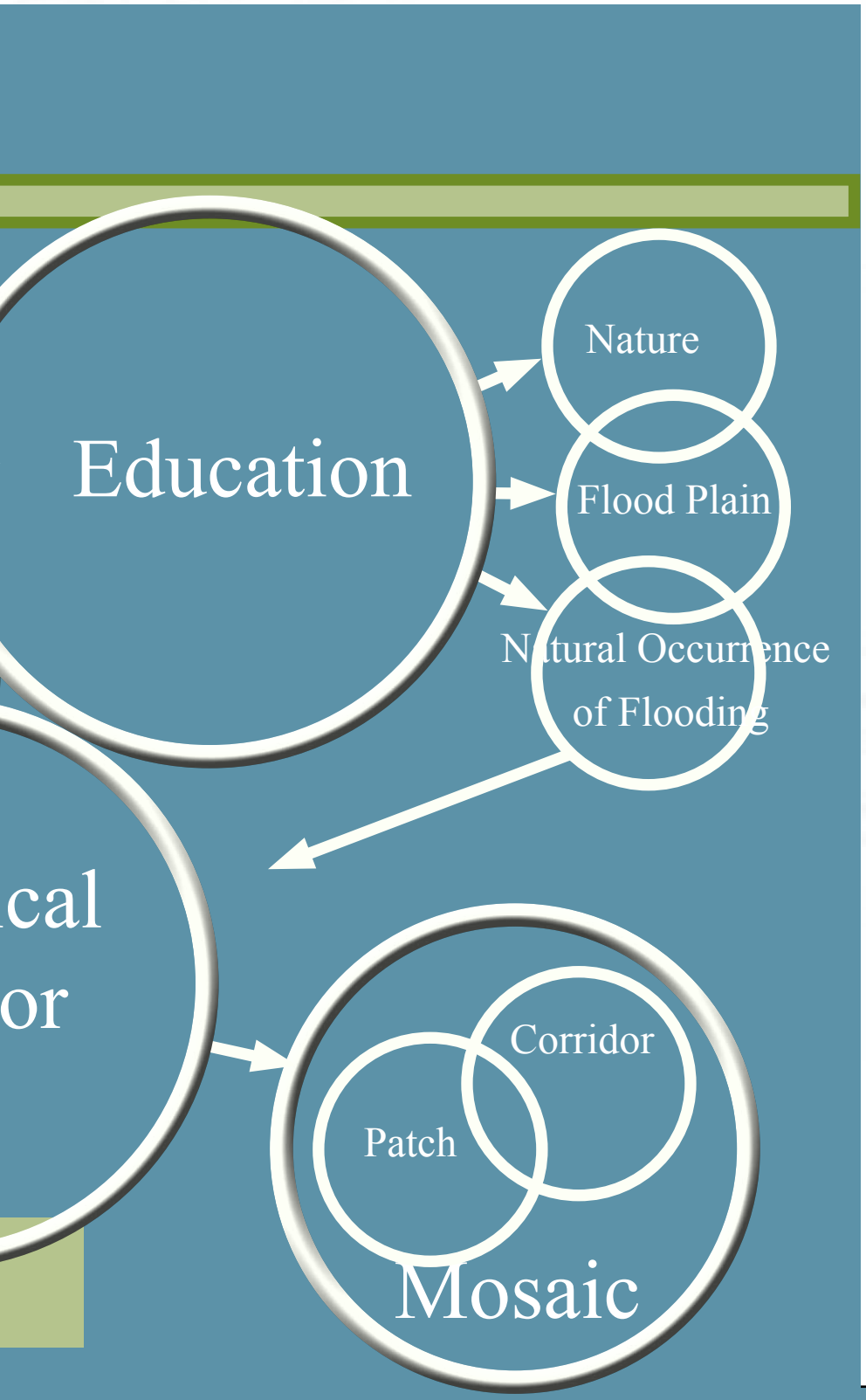
Seeds To Grow



Designing a greenway can help a community become educated about the natural occurrence of flooding by allowing its members opportunity to play an integral role in the process of its development and implementation.

Conclusion

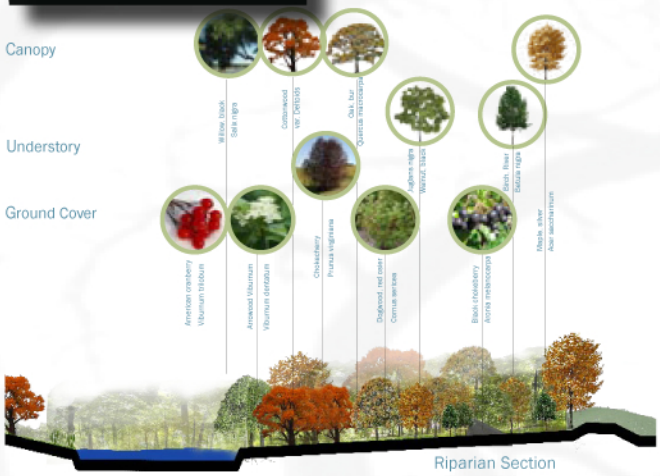
SEEDS TO GROW



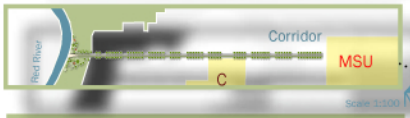
APPENDIX

ECOLOGICAL GREENWAY CONNECTIONS

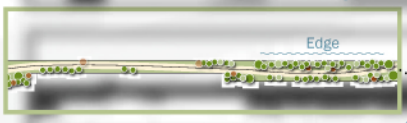
Pedestrian connection to river from MSU and Concordia



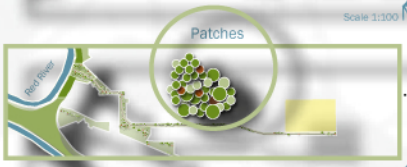
Pedestrian connection to the greenway links the two largest Universities in the city to the ecological corridor. 7th Ave South in Moorhead will be transformed into a one-way street leading cars away from the river, while allowing for a larger bike and pedestrian connections.



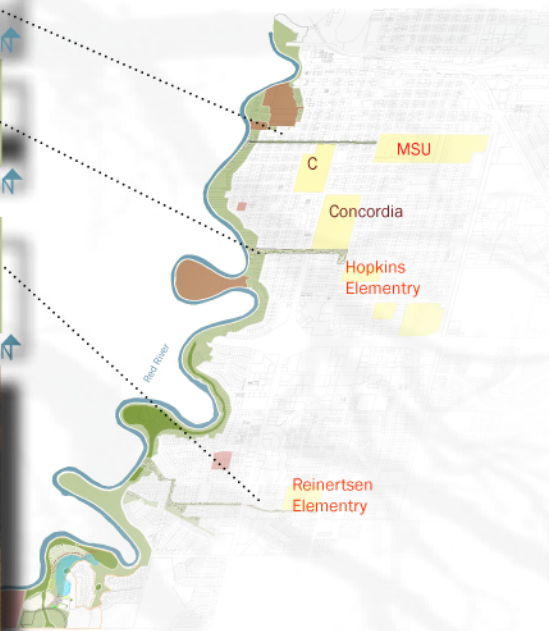
The linear form of this connection increases habitat for wildlife which exists on the edge of an environment. This new form differs from an interior patch. The walk will instill thoughtful experiences about nature at a critical age of development.



Utilizing green space, a trail to the river provides pedestrian access to the greenway. The use of massed riparian adapted vegetation provides a series of ecological stepping stones to the corridor.



New Greenway



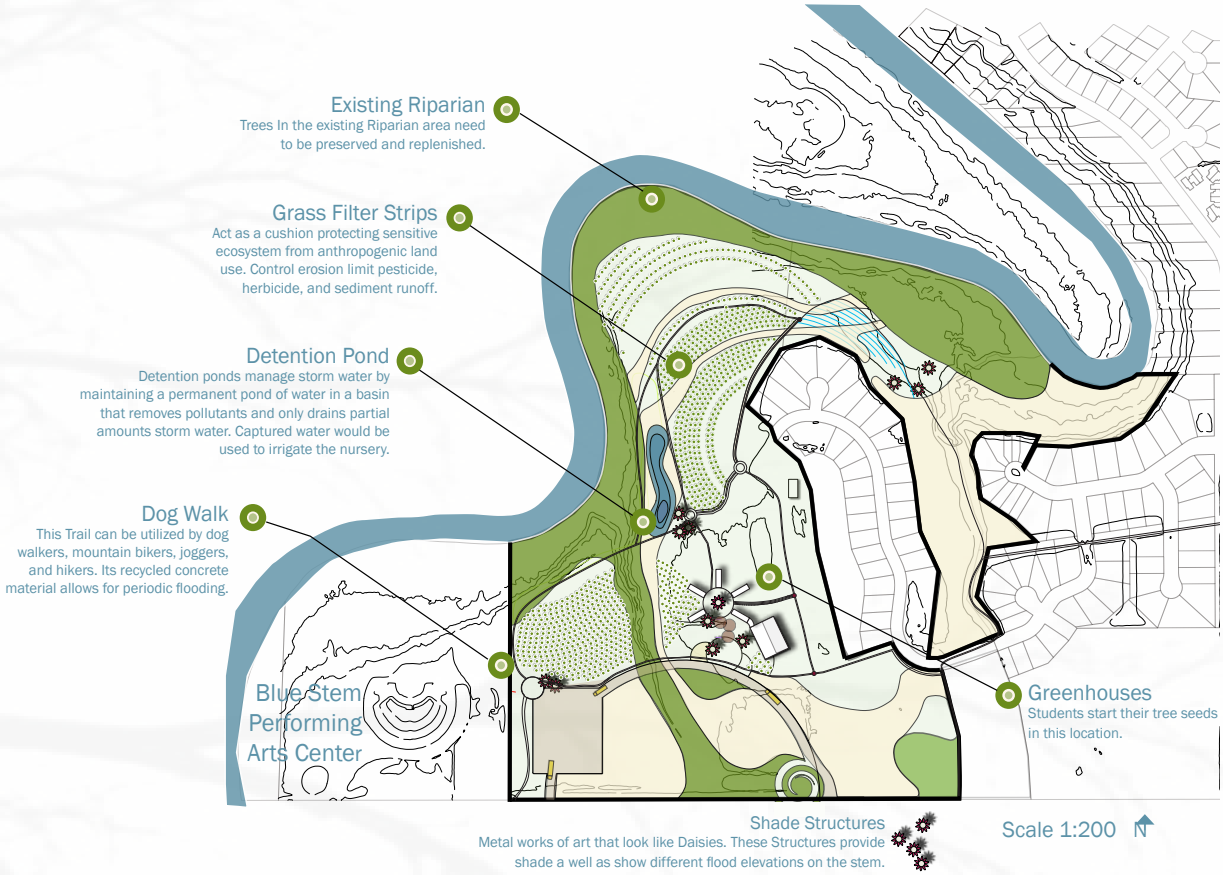
Connection To Fargo

Programs Used Illustrator | Photoshop | Sketch up | Google earth pro

Auto Cad | In design | Esri

ArcMap

SEEDS TO GROW



APPENDIX

The modern world has been subjected to flooding just like those of the past. The flooding now seems to have greater impact on mankind due to increased population levels and development. The Water Damage Team of North Carolina has compiled a list of the ten most deadly floods in recent history. They are as follows.

1. Huang He (Yellow) River, China 1931 Death Toll: 1,000,000 to 3,700,000
The Huang He river is prone to flooding due to the surrounding low plains. A high silt content in the river (which also gives the river its name, "yellow") causes the river to gain volume, helping it to rise above the plains. Death tolls are often high because there are so many people in the surrounding area and no real way to escape.

2. Huang He (Yellow) River, China 1887 Death Toll: 900,000 to 2,000,000
For years, farmers living along the yellow river were building dikes to protect their land from the rising waters. During a bad 2 day storm, the waters rose too rapidly for them to contain, and their dikes were overpowered and lands flooded. At the time, it was one of the worst natural disasters ever recorded, and still is among the worst.

3. Huang He (Yellow) River, China 1938 Death Toll: 500,000 - 900,000
In 1938, Nationalist Chinese troops actually broke the levees themselves hoping to turn back advancing Japanese troops. Although it did work to some extent, the death toll was very high.

4. Huang He (Yellow) River, China 1642 Death Toll: 300,000
Chinese rebels along the city of Kaifeng and destroyed the dikes. The area lost roughly half of its residents, making it the 2nd largest loss of human life at the time. The city was abandoned after the flood until 1662.

5. Ru River, Banqiao Dam, China 1975 Death Toll: 230,000
Heavy rain caused by a typhoon caused the collapse of the Banquia Dam along with several others. The water accumulated was more than a years worth of normal rainfall.

SEEDS TO GROW

6. Yangtze River, China 1931 Death Toll: 145,000
The Yangtze River is the longest river in Asia, and the third longest in the world. Unfortunately, it has such a tendency to flood they've had over 1,000 floods. The river is so large it receives water from both Northern and Southern flanks, contributing largely to its flooding.

7. The Netherlands and England 1099 Death Toll: 100,000
100,000 were killed when high tides and storms flooded the Thames and the Netherlands.

8. The Netherlands 1287 Death Toll: 50,000
The polder was flooded due to the failure of a seawall on the Zuider Zee, a complicated dam system protecting the surrounding areas.

9. The Neva River, Russia 1824 Death Toll: 10,000
Before the flood, there had been a very cold winter. Ice backed up the river for days, and water backed up behind the ice. When the natural ice dam broke, water flooded everywhere uniting canals and streets alike.

10. The Netherlands 1421 Death Toll: 10,000
Although the Zuider Zee had prevented many floods in the past, it would fail to stop some of the stronger storms. In 1421 another failure of a seawall on the Zuider Zee caused the flood (Water Damage Team.

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NDSU is enduring.

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