Urban Floodplain Design:

Utilizing the Regenerative Disturbance of Flooding to Create Form and Habitat Within the Urban Landscape

Urban Floodplain Design: Utilizing the Regenerative Disturbance of Flooding to Create Form and Habitat Within the Urban Landscape

Clay Craft . MLA Thesis . 2010
Auburn University
College of Architecture Design and Construction
School of Architecture
Master of Landscape Architecture
Submitted May 14th, 2010

Dedication

I would like to dedicate this book to my family. Without the constant love and support from all of you I would have never made it to where I am today and I would certainly not be the person that I have become. You mean more to me than you will ever know.

Acknowledgements

First and foremost I would like to thank my thesis professor, Rod Barnett. You have changed the way I view Landscape Architecture and design in general. You allowed me to delve beyond the surface of design and see practice as a process, as opposed to a final product. I have thoroughly enjoyed working with you over the past year and it has truly been a blessing to have studied underneath you.

I would also like to thank my thesis committee member, Jocelyn Zanzot. Thank you for always encouraging me not perceive everything at face value. You always encouraged me to take an objective look at every move I made and that really helped me to push through many challenging aspects of the research project.

Last, but certainly not least, I would like to thank my thesis committee member, Professor Charlene LeBleu. You were always there to provide me with a real world perspective into my research project which helped to keep me and my project grounded throughout the process.

I would also like to thank the rest of the faculty of the College of Architecture, Design and Construction for helping to guide me through this process over the previous three years.

Permissions

City of Birmingham GIS Department
Dr. Mable Anderson of The Village Creek Society

Table of Contents

Key words:

Landscape Disturbance

Colonization

Succession

Initial Conditions

Regeneration

Resilience

Research Question: How can the regenerative effects of flooding be utilized to create form and habitat within the urban landscape?

Abstract

Village Creek watered the industrial machine that became Birmingham, AL. Once seen as the lifeblood of the city, attitudes towards Village Creek have deteriorated due to a century of poor development decisions. By creating an ecological corridor along Village Creek, its natural floodplain can be recovered. Through subtle design interventions the regenerative process of the annual flooding can be embraced to give form and create habitat within the landscape. The large scale goal of the research is to promote dispersal and connectivity of an assemblage of species along Village Creek while also providing social and cultural connections for Village Creek floodplain residents.

The project focuses on the flood plain of Village Creek in Ensley where numerous homes have been removed due to annual flooding damage. The situation currently is a large tract of once residential land that now stands as ambiguous terrain between downtown Ensley and Village Creek. The research methodology is to establish conditions that enable the landscape to respond to the regenerative power of the flooding events of Village Creek. To do this, initial conditions will be set to engage the geomorphological processes of deposition and erosion allowing them to organize and give form to the landscape.

These geomorphological processes will be engaged by creating deposition structures from asphalt on the site and placing fluvial rods on the stream bank. Setting up these conditions will engage the natural processes that already occur in the hydraulic landscape. This strategy of engaging disturbance-colonization-succession implemented over time along the entire length of Village Creek will lead to the reintroduction of a riparian corridor along the waterway. This will promote the development of wildlife habitat and improvement of water quality of the stream. It will also give the residents along Village Creek an open space for social interaction and recreation.

This graphic was submitted to the Auburn University Graduate Scholars Forum research project competition as brief snapshot of the design research project

Introduction

The situation selected for research inquiry is the Village Creek floodplain of Birmingham, AL. Village Creek provided early Birmingham with the water needed to produce steel and it also served as the city's drinking water for some time. A century of poor development decisions has left many homes and structures in the floodplain of Village Creek, which has resulted in millions of dollars in property loss in the Birmingham area. Since the 1980s Birmingham, along with the federal government, has been working to relocate families from the floodplain of Village Creek. These acquisition projects have left several large tracts of open space which have provisions implemented that no structures can be built on them. The next step in the process is to decide what to do with these sites after they have been designated as open space by the city. The design research project will investigate one particular site in Moro Park-Ensley and show how the ecological model of disturbance-colonization-succession can be utilized to generate form and habitat within this hydraulic urban landscape. By returning a riparian zone to Village Creek, the creek will be able to regain its natural floodplain, wildlife will be able to re-inhabit the area and residents will be provided a space for social interaction and recreation.

Chapter 1:
Historical Context
Birmingham, AL

Fig. 1

Birmingham, Alabama was founded just after the American Civil War as an industrial enterprise. It borrowed its name from one of the major industrial cities in the UK and quickly became the industrial center of the south. The enormous amount of growth the city experienced around the turn of the 20th century gave it the nickname "The Magic City" and its enormous steel production earned the city the name "The Pittsburgh of the South." Birmingham's population in 1880 was around 3,000. By 1900 the city had boomed to over 38,000 and by 1921 just 50 years after the city's inception the population had soared to 178,000 (Bagget, 2006).

Right is the earliest known photograph of Birmingham taken in 1873 just two years after Birmingham was founded. Before development began in what became Birmingham the Jones Valley was described as "One vast garden as far as the eye could see and **Village Creek** was one beautiful clear running stream found gushing out everywhere" (White, 1985: P. 3). The land that Birmingham was founded on was forest and agricultural fields planted in cotton, corn, wheat, rye, potatoes and turnips (White, 1985).


Fig. 2


Fig. 3

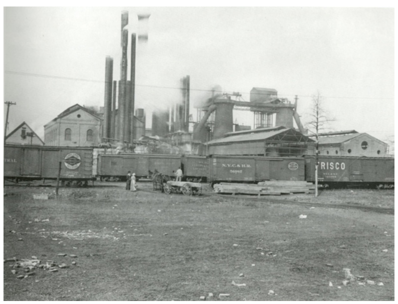


Fig. 4

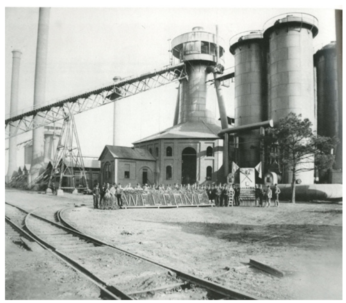
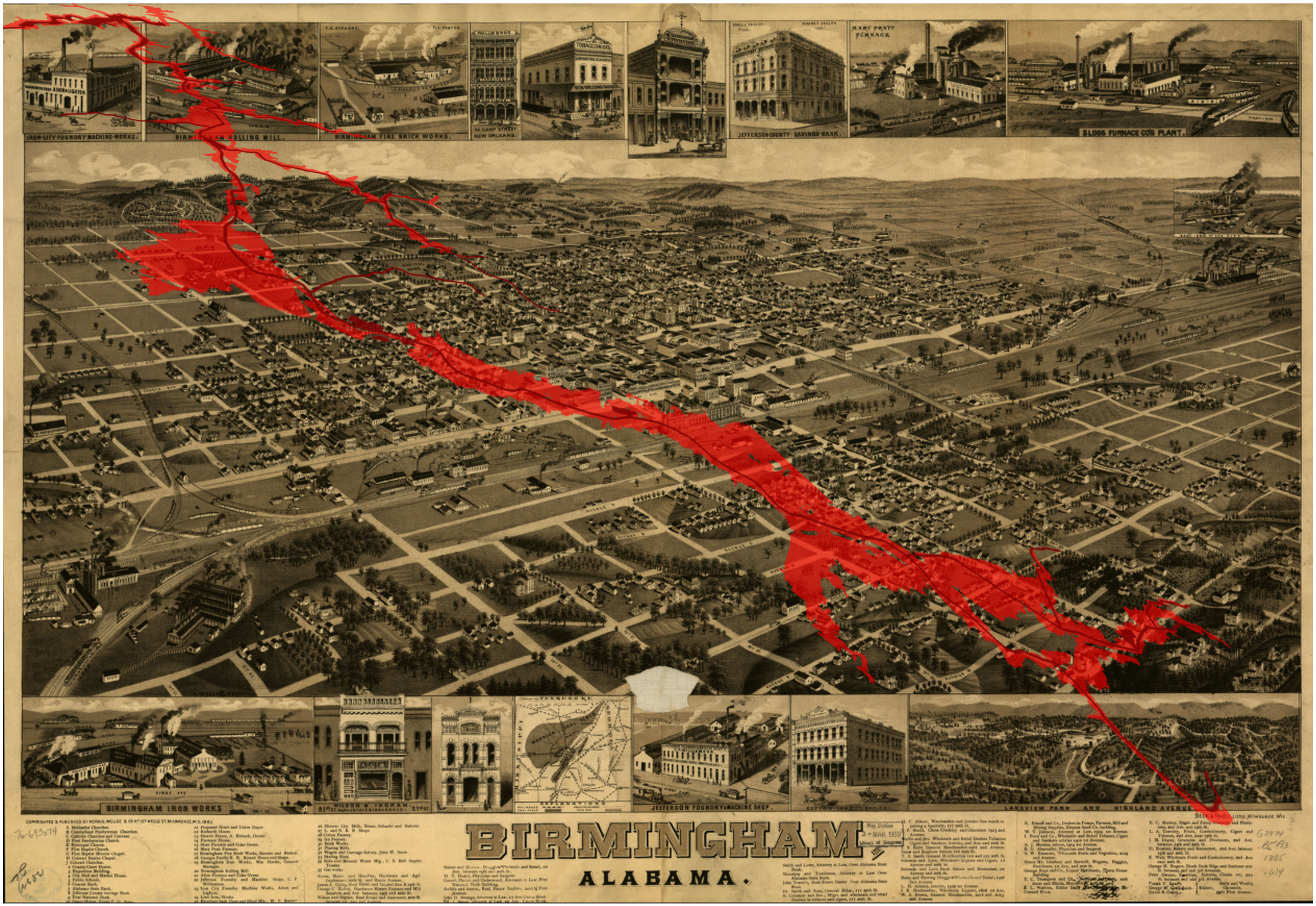


Fig. 5


Fig. 6

Village Creek was the lifeblood that allowed Birmingham to become an industrial power of the south

"Village Creek in many ways, made Birmingham's industrial miracle possible. A century of industrial concentration and expansion, however, changed the role the creek played in Birmingham's mills. Industrial growth also changed the character of the creek and the attitudes of the residents of the communities that line its banks. Once a valued asset, Village Creek was, by the end of Birmingham's centennial year, widely regarded as a nuisance." (White: P. 14)



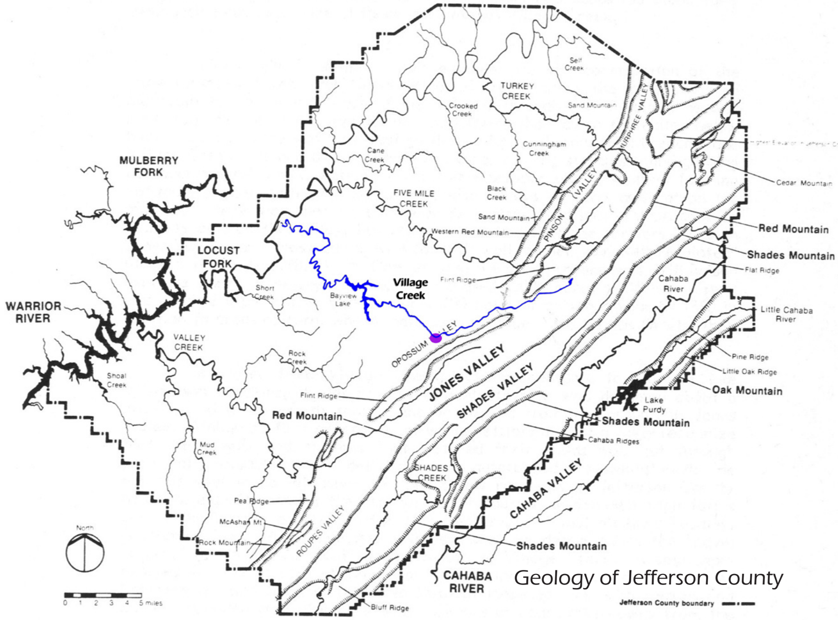


Fig. 7

Village Creek is a spring-fed tributary of the Black-Warrior River in Alabama. It flows 44 miles East to West across the floor of the Jones and Opossum Valley through Birmingham Alabama. The headwaters are in Roebuck and it flows 7 miles through Birmingham city limits. The creek is fed by run off and a spring that developed in the limestone that underlies most of Jefferson County. It was dammed at Bayview to create Bayview Lake. The creek drains over 100 square miles of Jefferson County.

Birmingham owes much of its early industrial success directly to Village Creek. The city was established in 1871 by John T. Milner at the intersection of two railroads in a cotton field at the center of the Jones Valley. The initial attraction of site was the large deposits of iron ore, coal and limestone that existed in such close proximity which were the raw goods needed to produce steel. The site also had rich alluvial soils that had been deposited by the four major creeks that traversed the valley. Birmingham attracted prospectors from all over looking to cash in on the industrial promise of the city granted by the unique geological formations of the valley. Birmingham's industrial boom at the turn of the 20th century earned it nicknames such as "The Pittsburgh of the South" and "The Magic City." If not for the water source of Village Creek Birmingham would have never seen its industrial potential fulfilled.

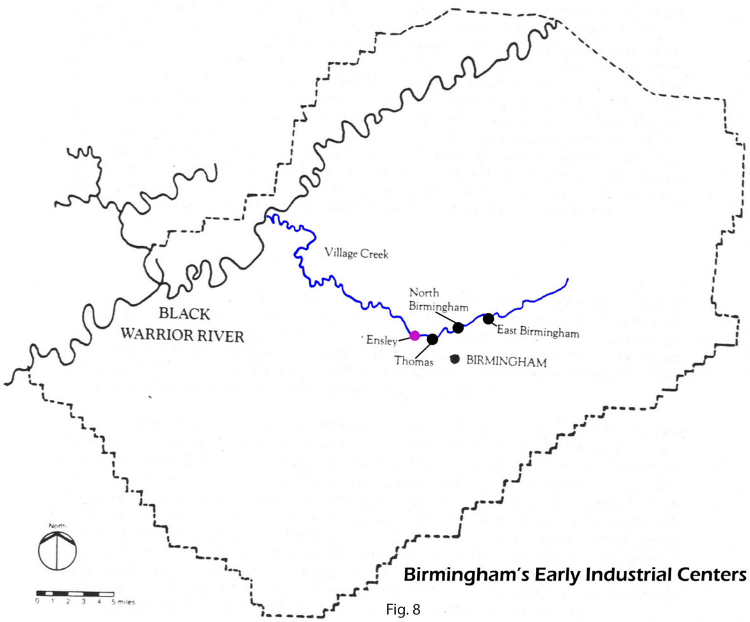
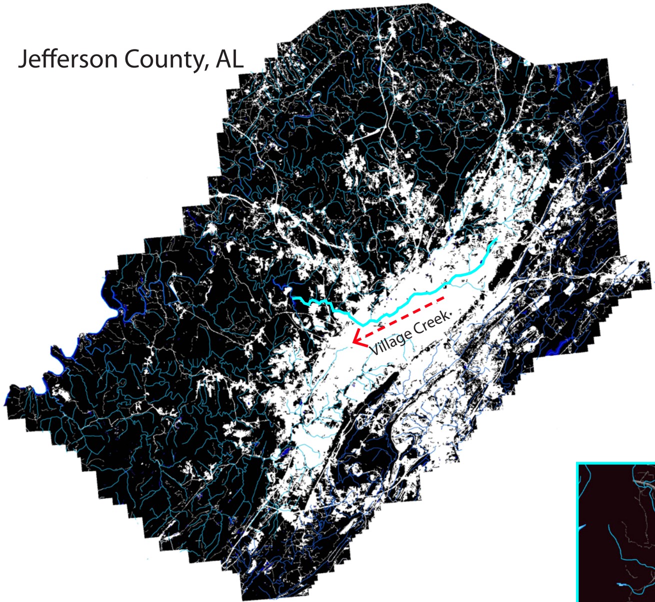


Fig. 8

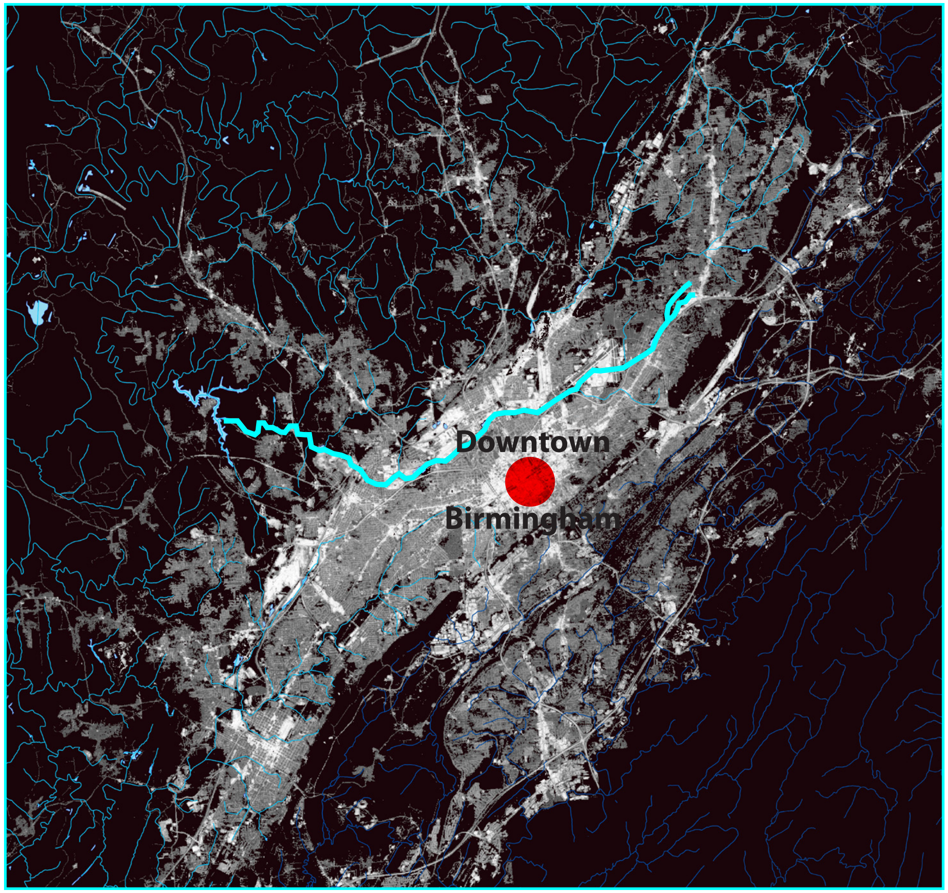
The creek was the early source of drinking water for Birmingham and all of Birmingham's industrial centers cropped up along the creek because huge quantities of water were needed at each stage of iron production. The Tennessee Coal and Iron Company estimated that by 1910 they were using 400 million gallons of water per day to cool their blast furnaces in Birmingham. Village Creek, which was once viewed as an amenity by early Birmingham, became simply as a tool for industrial growth at the turn of the century (White, 1985).

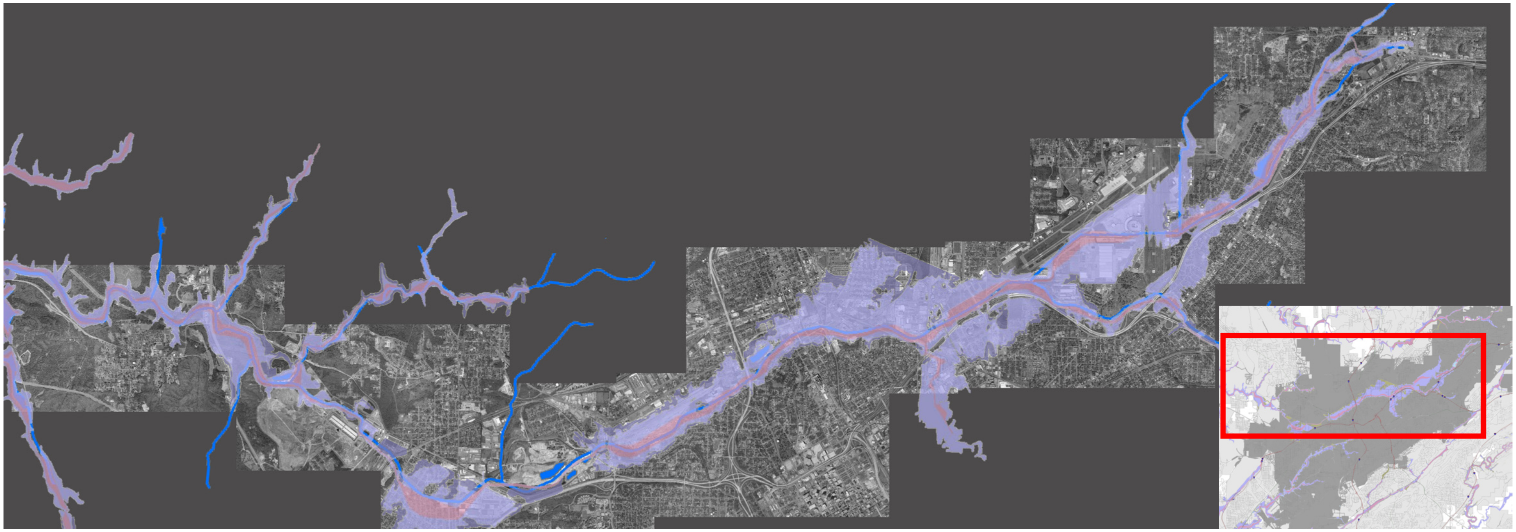
Jefferson County, AL



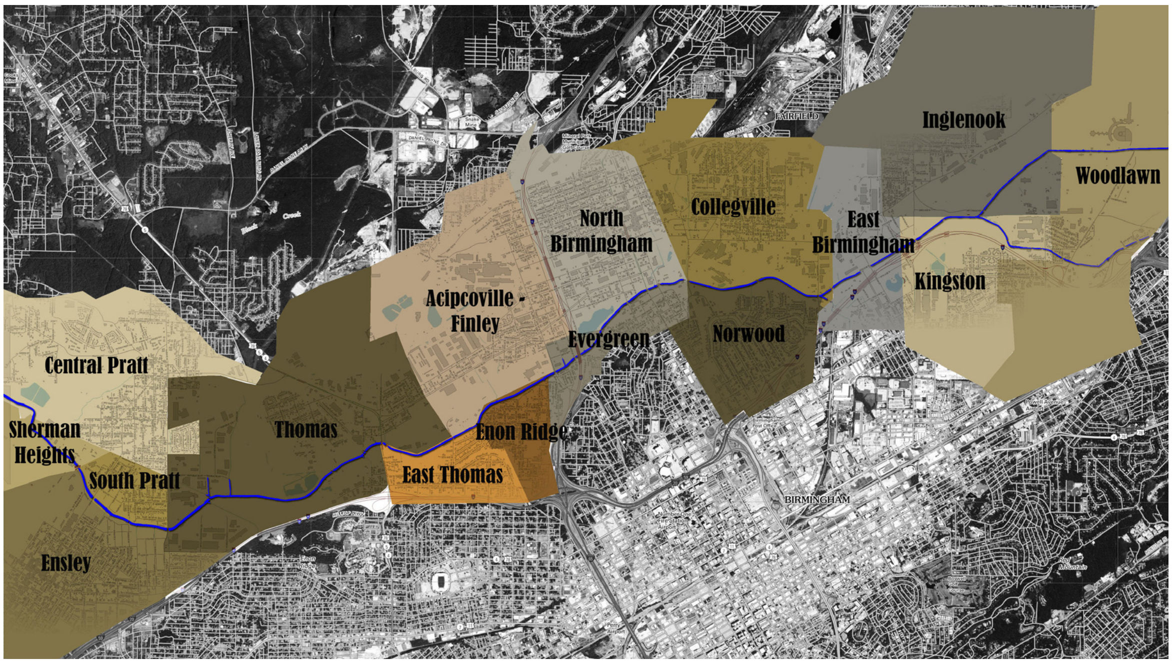
Left is a map of Jefferson County Alabama showing the undeveloped land (black) and the developed land (white) with the streams. Village Creek is highlighted where it runs through Birmingham city limits. As can be seen development has pushed all the way up against Village Creek and its riparian corridor no longer exists. Only small patches of ecosystem occur along the creek today. The implementation of an ecological corridor along the creek would re-establish its riparian zone and serve to bridge the eco-patches that currently exist along its length.

The map (right) shows the impervious surface (grey) in Birmingham. Village Creek runs adjacent to industrial sites, residential neighborhoods, commercial areas, schools, churches, an airport, a gravel quarry and several rail yards. Run-off from these sites is not filtered before entering into the creek. Polluted run-off combined with source point dumping from industrial sites and sewage outlets has left Village Creek extremely impaired.





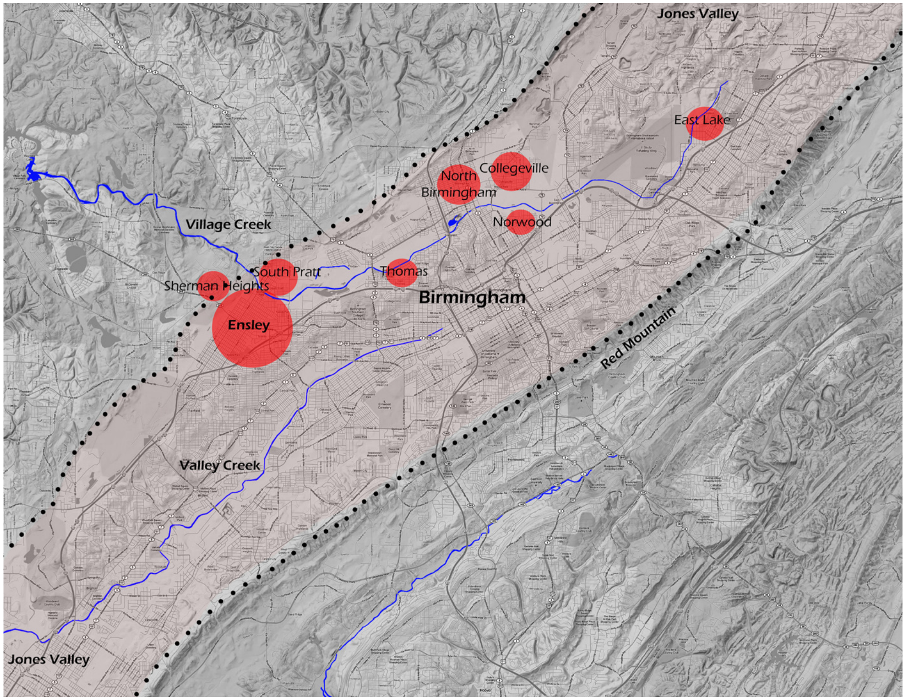
Above is the floodplain of Village Creek through Birmingham. Village Creek's floodplain constitutes 53% of Birmingham's flood hazard area (Acquisition, 2010).

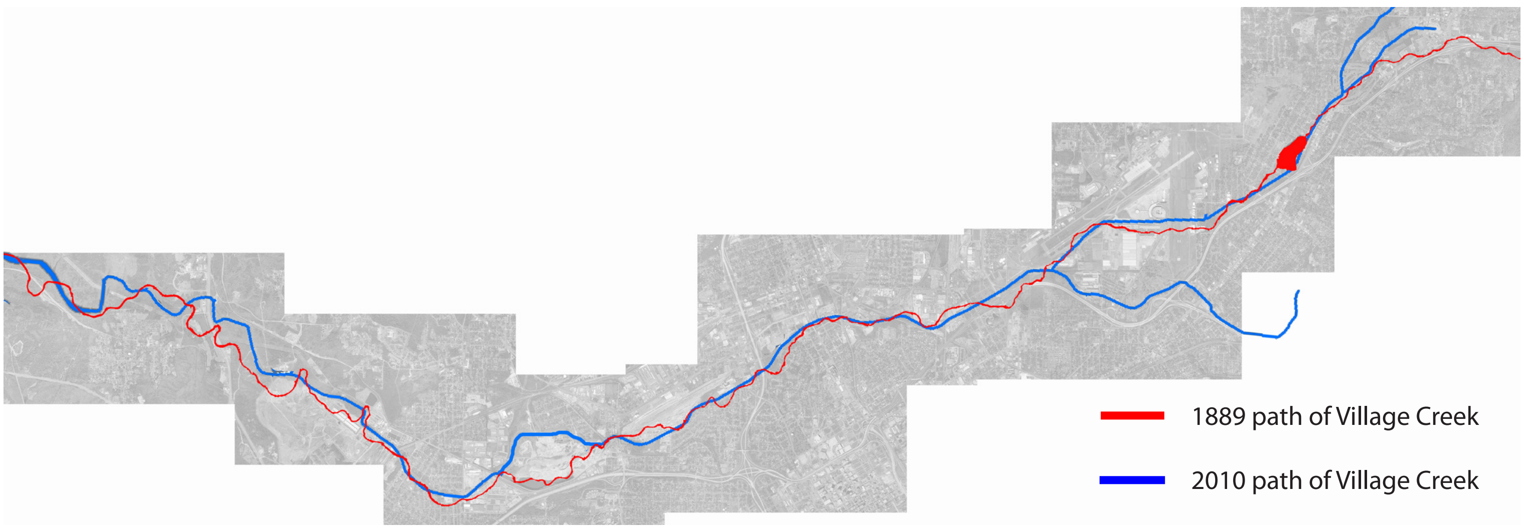


The map (left) shows all of the residential communities that are adjacent to Village Creek in Birmingham. These areas were not developed residentially for the first 50 years of Birmingham's existence. The boom of the 1920's put pressure on builders to develop the low meadow lands along Village Creek. Many of these residential communities started as industrial mill villages.

Highlighted to the right are the main residential communities that lie in Village Creek's floodplain and are subject to frequent flooding. Traditionally the heaviest flood areas along the creek have been Ensley, North Birmingham and East Lake.

Village Creek still generally adheres to its ancient course, but it flows through a vastly different landscape than was found by the first white settlers who moved into Jones Valley. Efforts to control and straighten the creek increased the frequency and intensity of flooding of the creek. As shown below most of the sinuosity of the creek has been removed and replaced by culverts and gabion walls. Engineering structures combined with increased deverlopment has led to 80+ years of flood problems for Village Creek floodplain residents.





The Olmsted Vision for Birmingham

"Village Creek is the storm-water drainage channel for Jones Valley below Huffman and for Opossum Valley from Tarrant City to Ensley. Its fall is very slight, so that it floods easily; and this situation is being constantly aggravated by the encroachments of slag dumps and various constructions and industrial developments.

Birmingham must face the problem of building a large and expensive covered sewer or of developing an open channel treatment with adequate flood sections and with storage basins to handle extreme flood conditions. The city is facing a more or less serious drainage problem along these two creeks because in order to prevent these floods or at least to reduce them enough to eliminate the serious damage the flood channels needs to be greatly enlarged. The city recognizes this and the problem is likely to be tackled sometime before very long. However, it will mean some millions of dollars and expense and as the damage heretofore has not been very serious I expect the city will be slow in the undertaking it.

At present there are scattered along the creek considerable areas of generally flat meadow land, sometimes open, sometimes tree covered; and all of them subject presumably to occasional flooding. They are, therefore, not usable for commercial or industrial purposes without filling; and their market value is relatively low. On the other hand, they are particularly well adapted for many park uses- playfields and gold courses at a minimal cost, long park drives and bridle paths can be easily built, and lakes and other water features can be secured without undue cost and in a manner to serve the needs both of recreation and of storm drainage. An occasional flooding of park meadows would do little harm. Such a developer would permit an open-channel solution of the drainage problem; thus realizing, we believe, a considerable economy for the city" (Birmingham Historical Society, 2006: P. 28)

Olmsted Brothers, A Park System for Birmingham, 1925.

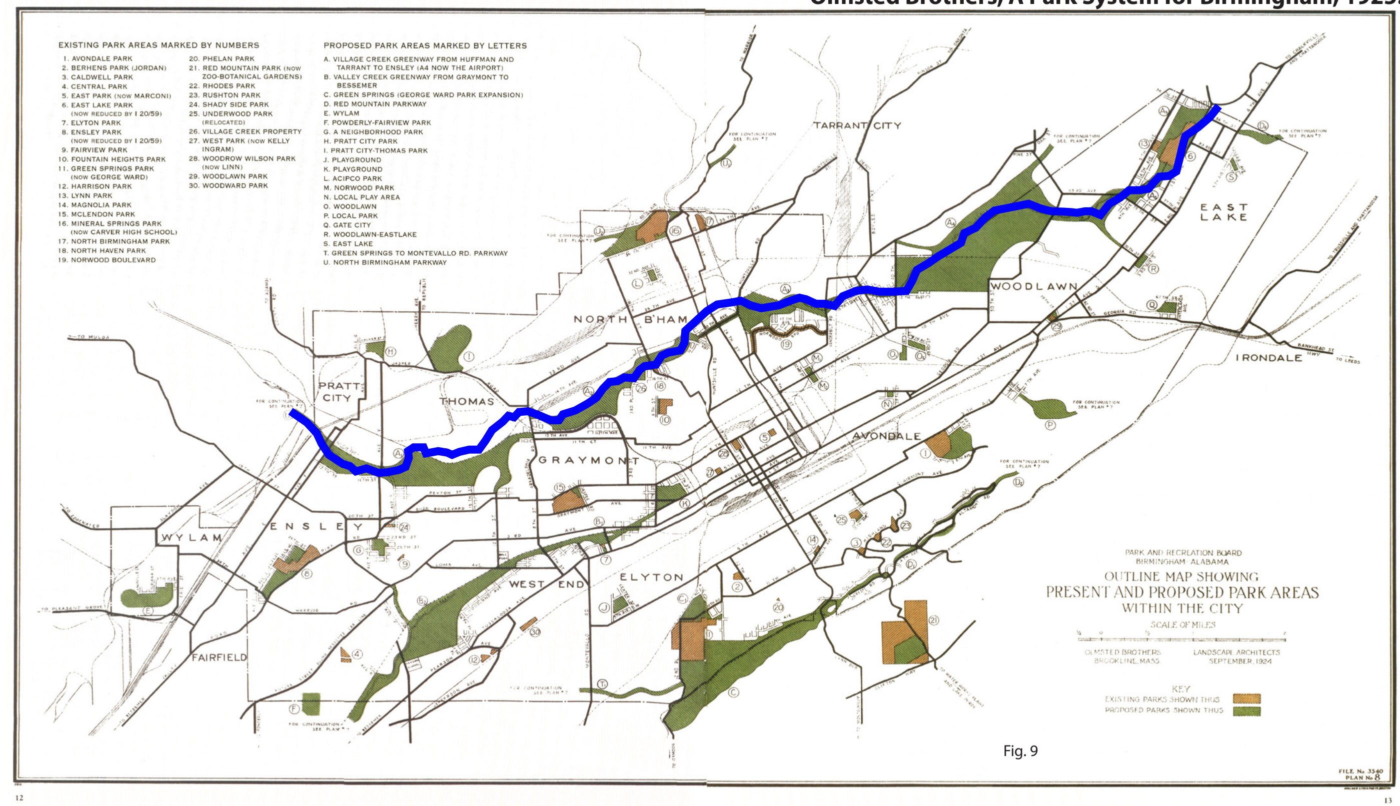


Fig. 9

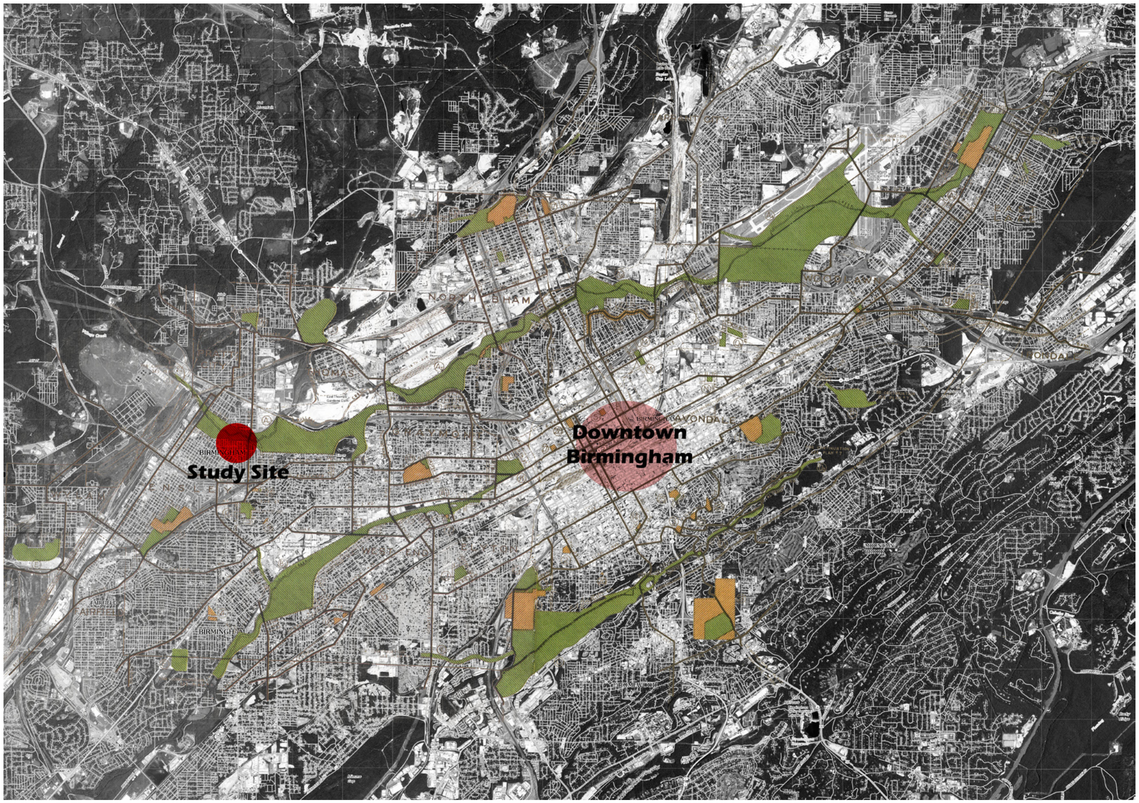
So What Happened?

"**Birmingham officials did not act on this Olmsted advice. By 1928, three years after the publication of the park plan, hundreds of houses had bee constructed in Village Creek's floodplain in Ensley and East Birmingham.** Rapid development of the East Lake reaches did not occur until after World War II, but when it came residents faced the increased flooding the firm predicted would result from additional concentrations of industrial, commercial and residential building along the creek and its tributaries.

One vast meadow became the site of the Birmingham Airport in 1931. The construction of large shopping complexes in Roebuck area, expansion of the airport and industrial plants continued introduction of asphalt surfaces created further along creek banks.

By the 1960's, culverts and dikes were used to divert flood waters and other engineered solutions failed to calm Village Creek, and its floods became more damaging to residents of the creek neighborhoods and properties.

After what some victims call Village Creek's worst flood in 1979, City of Birmingham Mayor Richard Arrington Jr.., together with U.S. army Corps of Engineers and other local and federal officials, considered flood-control measures other than channelization. The Corps agreed it could not stop the adverse affects of water, so it bought out the residents and acquired the flooded-out property" (Birmingham Historical Society, 2006: P. 29)



Left shows what Birmingham would look like today if the Olmsted plan would have been implemented. Greenways along Village and Valley Creeks would have prevented eighty years of flood damage in Birmingham. We have through trial and error that flood risk reduction is much more sustainable than flood control. Luckily for Birmingham there has been a recent push to partly realize the Olmsted Vision albeit retroactively. Once we realize that we can live with floods and not fight against them we can stop developing in flood plains and let the natural process of creek and river flooding occur without interrupting its cycle.

Chapter 2:
Investigation 1: **Ecological Framework and Assemblages**

Original Research Question:

"How can an urban ecological corridor along Village Creek in Birmingham, AL provide dispersal and connectivity to an assemblage of species while at the same time providing social and cultural connections for the neighborhoods adjacent to the creek?"

Original Abstract:

Village Creek was the lifeblood of early Birmingham and now due to development and poor placement of early settlements the creek is now looked at as a nuisance by the city and those who live within its floodplain. The creation of an urban ecological corridor would serve to reclaim the nearly nonexistent riparian corridor and return Village Creek's floodplain to its original state. The corridor's ecological features and function would cater to a selected assemblage of species that would be indicators of ecological health of the corridor and it would provide opportunities for dispersal and connectivity of these species. This corridor along Village Creek would provide economic, ecological and social benefits to the city of Birmingham and its residents. The redefinition of the relationship of Village Creek to the city that it helped to build is vital to the future of Birmingham.

Species Assemblages

The original theoretical framework for the project was based around assemblages, and particularly species assemblages. The intent was to create an ecological corridor along Village Creek that was designed for flora and fauna first and foremost but would also function to provide residents with leisure space. The original research question was, "How can an urban ecological corridor along Village Creek in Birmingham, AL provide dispersal and connectivity to an assemblage of species while at the same time providing social and cultural connections for the neighborhoods adjacent to the creek?" No case studies were found where an urban riparian zone had been reconstructed with a particular species, or an assemblage of species in mind, and the research was to show how this could happen.

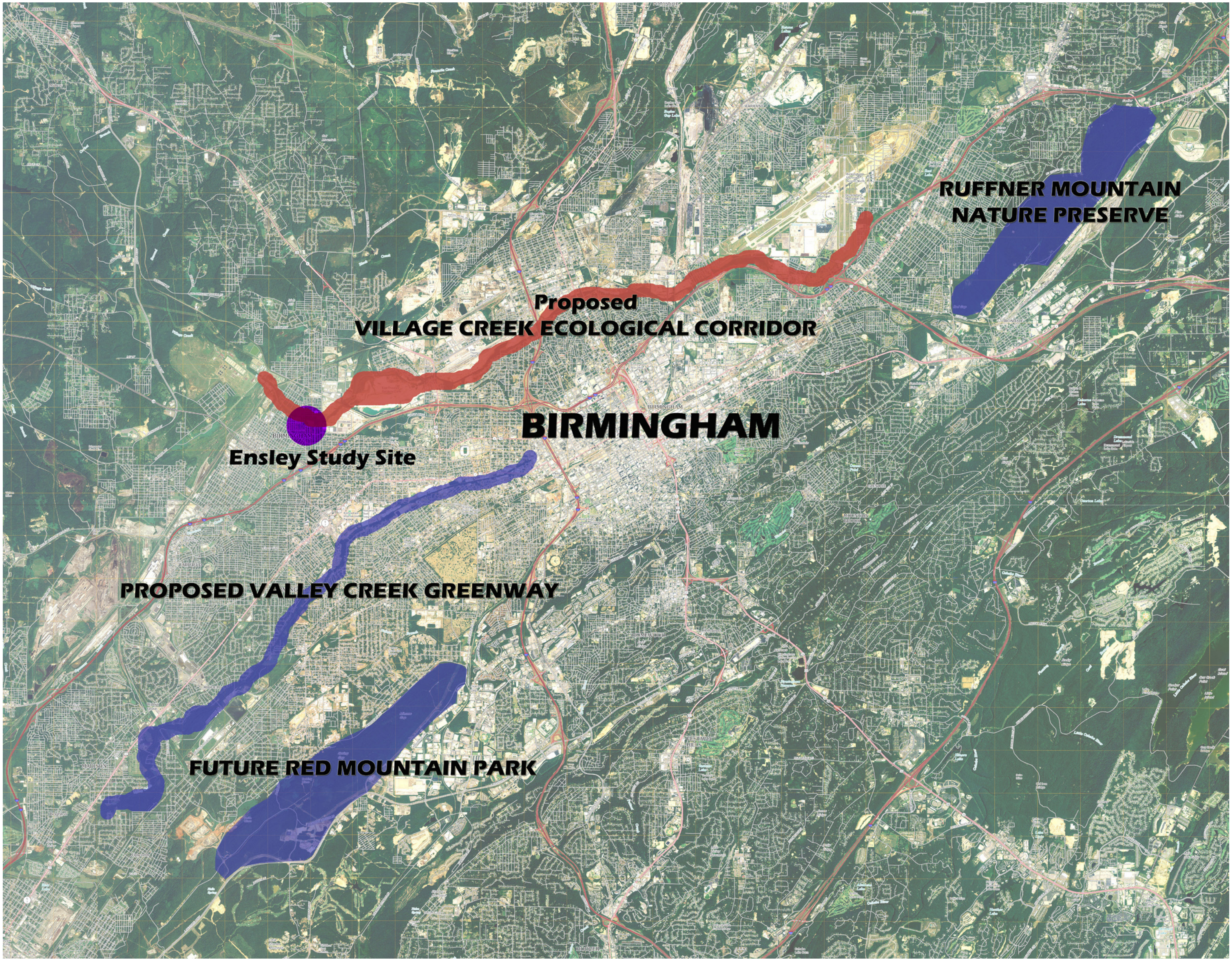
All plants and animals generally associate themselves with particular environmental conditions. All of the plants and animals that associate themselves with these environmental factors form to make a biotic community, or an assemblage. These plants, animals, insects etc. interact on some level with each other and any change in environmental conditions affects the entire assemblage. Key aspects of assemblages are the type of species, as well as the number of species they contain and how the structural characteristics of their habitats alter in time and space relative to their specific biotopes (Barnett, 2008). Understanding the specific needs of certain species allows the designer to create habitat or enhance existing habitat to create ecological niches for the particular species or species assemblages. The assemblage is a relationship of nested conditions, not just the physical condition of a situation.

In designing this corridor, the intent was to select an assemblage of species that were adapted to the local and would thrive in the edge conditions of an urban riparian corridor. Based on the particular needs of these species, habitat would be created or enhanced to meet of their needs. Nesting, resting, shelter, food, mating and dispersal areas would all be accounted for. The problem that was identified with common "ecological corridors" was that they are created for people first and biota second. The alternative to this approach would be to create the corridor strictly for biota and then weave human interaction in delicately as to minimally disturb the biota on site.

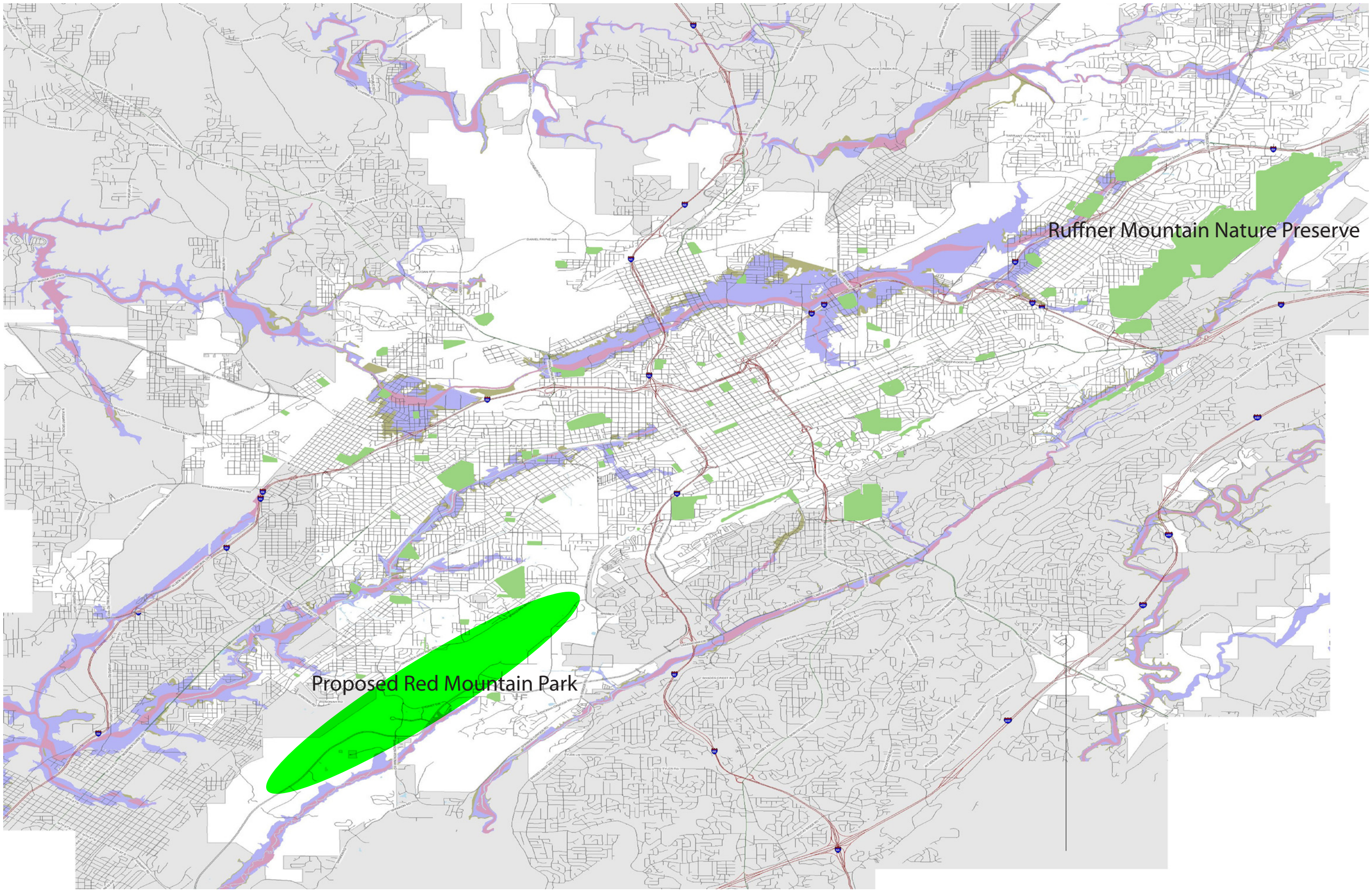
While this approach would have made a fine research project the critique was that the idea was a little farfetched as a redevelopment project and would be more feasible in the planning stages of an urban area. This methodology helped shape the current theoretical framework that the research is based off and provided an ecology first approach to the project. The research methodology of species assemblages could easily be paired with the theory of the ecological model of disturbance-colonization-succession to create riparian corridors in urban areas. This chapter of the report documents the research done to provide the framework for the ecological corridor in which to show design implementation of the project on a site scale.

The map (right) shows the large urban parks that either exist, such as Ruffner Mountain Nature Preserve and others that are either proposed by the city or in the research. The city has plans to break ground soon on a 1000+ acre park which will be Red Mountain Park. Birmingham also has proposals for greenways along Village and Valley Creeks. These large urban green spaces could provide the framework for a future series of ecological corridors that could create an ecological network through Birmingham. Ruffner Mountain Nature Preserve is one of the largest urban nature preserves in the United States. When these parks are completed, combined with the Birmingham Railroad Reservation Park, Birmingham with have more green space per capita than any other city in America.

Birmingham's large existing and proposed parks

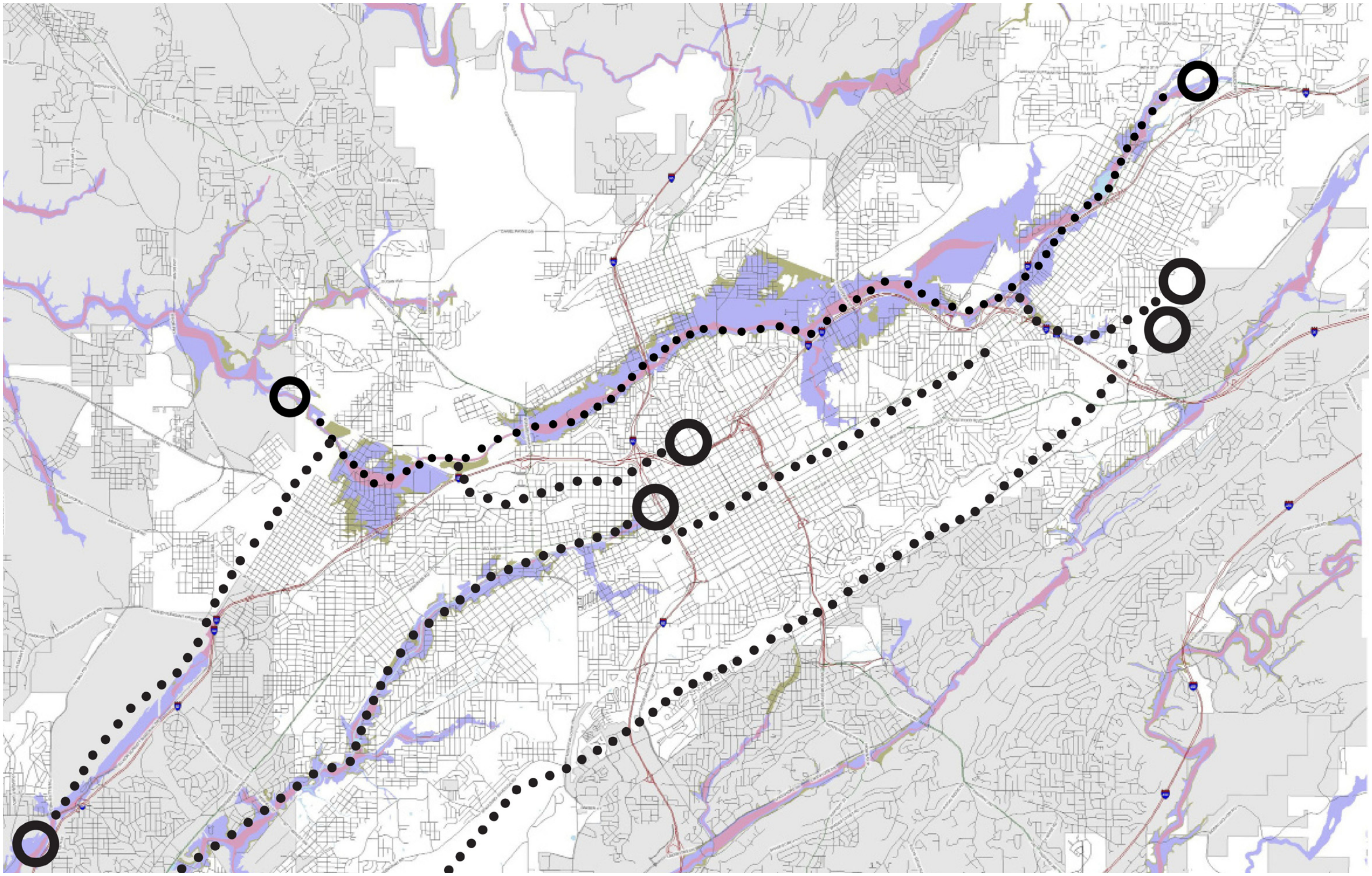


Birmingham parks



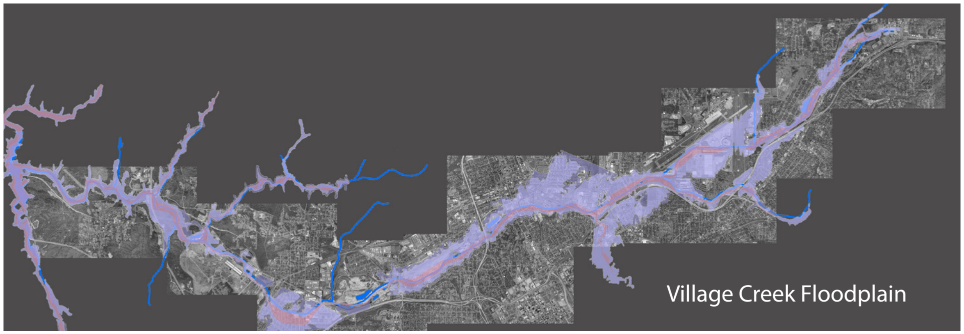
Above are the existing parks that currently exist in Birmingham with the addition of the proposed Red Mountain Park

Potential connections of park spaces

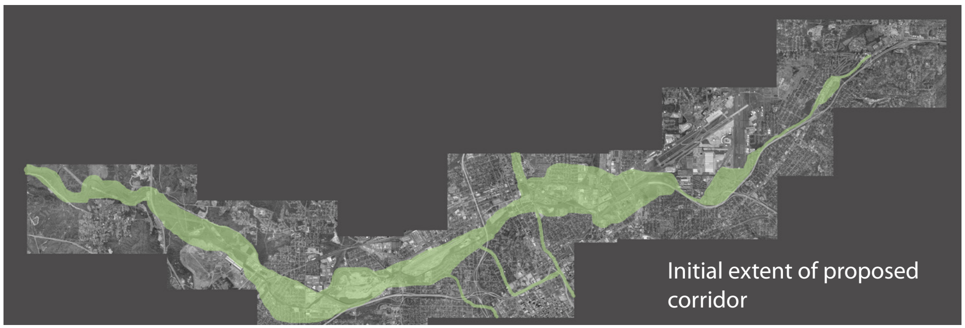


The potential connections of a large ecological network spanning across Birmingham that connects urban parks to provide connectivity and dispersal routes for species while also providing walkable green spaces for residents to use for leisure and connectivity.

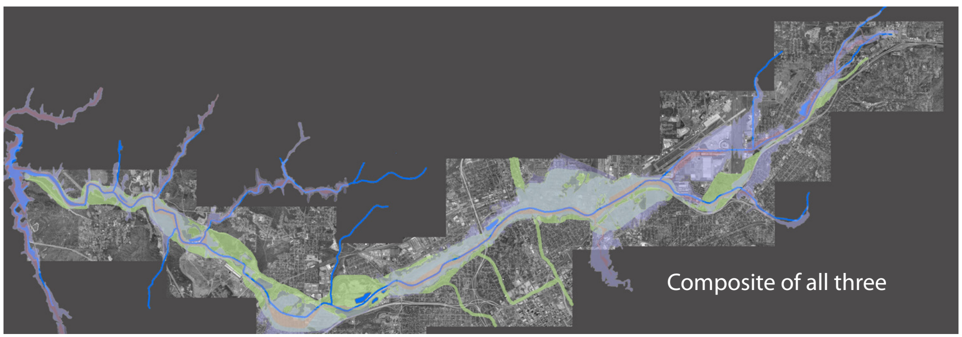
Village Creek



Village Creek Floodplain



Initial extent of proposed corridor

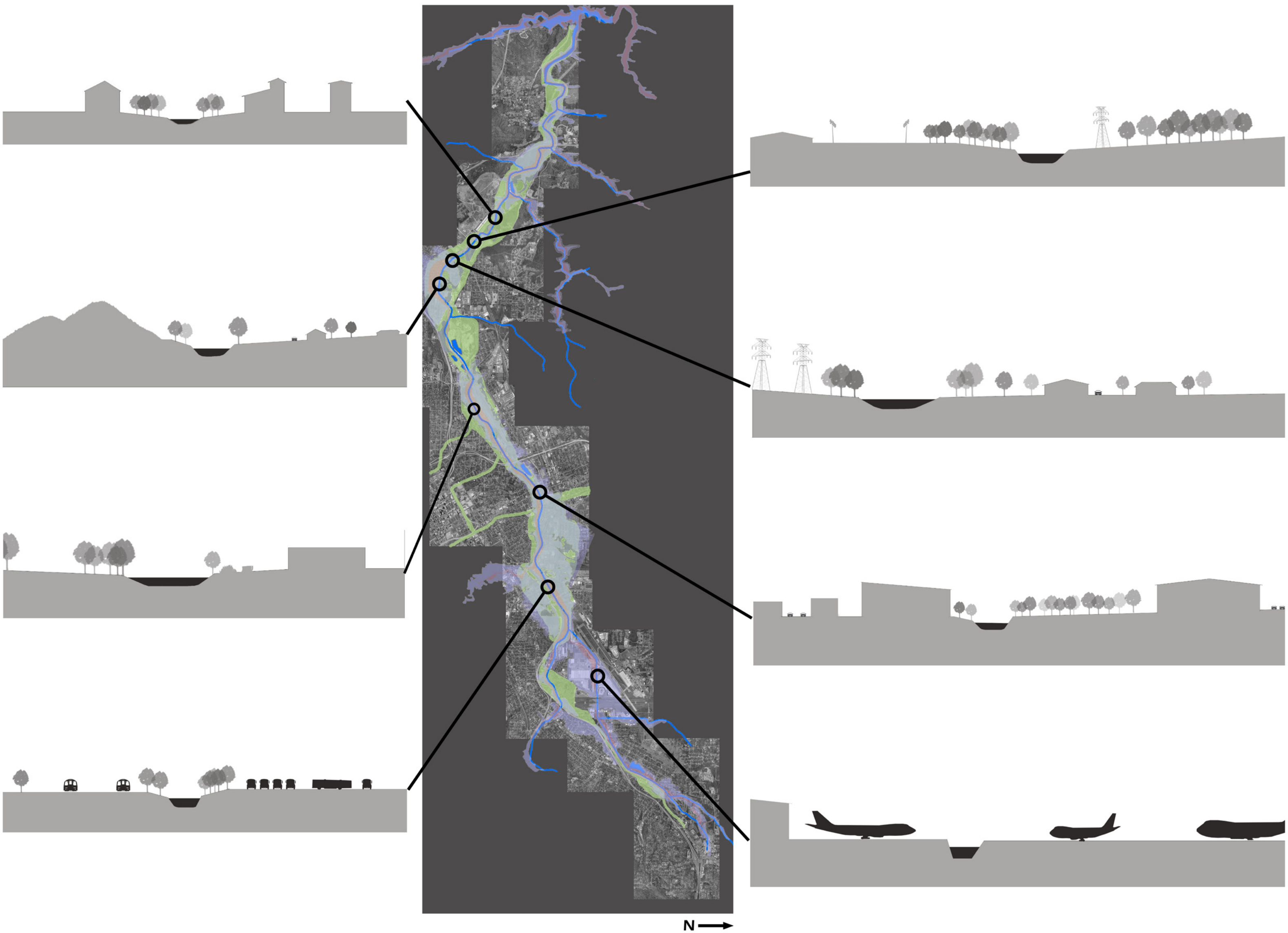


Composite of all three

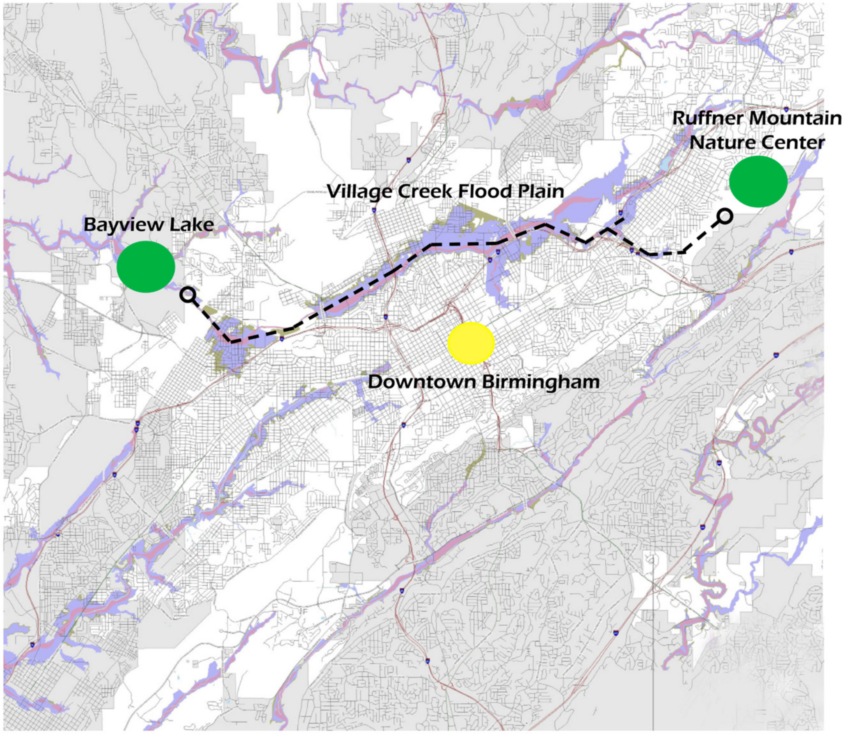
Due to the time constraints of a thesis the research needed to focus on one particular connection of of the ecological network. The research landed on the 7 mile stretch of Village Creek through Birmingham's city limits. Village Creek was selected due to it's historical significance and the flooding damage it has caused in Birmingham. The original idea was that an ecological corridor along Village Creek would be a huge benefit to Birmingham as it would alleviate all of the dangers of the creek flooding. The first design of the corridor generally adhered to the 100 year floodplain of the creek and required the removal of many industrial site and the relocation of some residential properties.

Right are eight sections show the diverse adjacencies along creek. The creek's 7 mile course through Birmingham passes through an airport, a gravel quarry, a school, several parks, junk yards, many industrial sites, past an electrical substation and through many residential neighborhoods. All of these developed areas along the creek are affected almost annually by floods.

Village Creek Sections

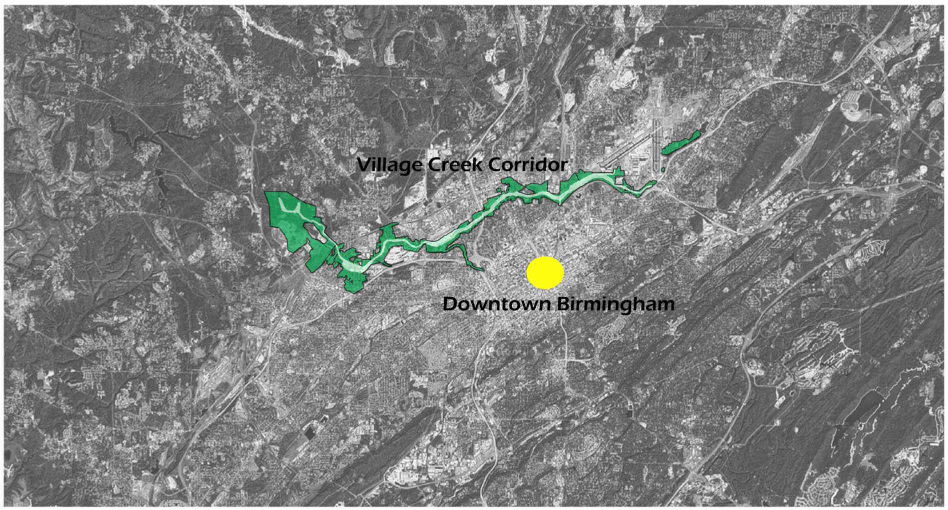


Village Creek Flood Plain In Context



Birmingham, AL GIS Floodplain Map

The research identified Ruffner Mountain and the Bayview Lake area significant ecological source habitat areas. Source and sink habitat areas depend on their ability to maintain a species for an extended period of time. A sink area usually is limited by size and resources and cannot sustain a particular species for an extended duration. A source habitat has the physical size and the necessary resources needed to provide for all the needs of a particular species and can maintain populations of that species without risk of extinction (Jongman, 2004).



Proposed Corridor Along Village Creek

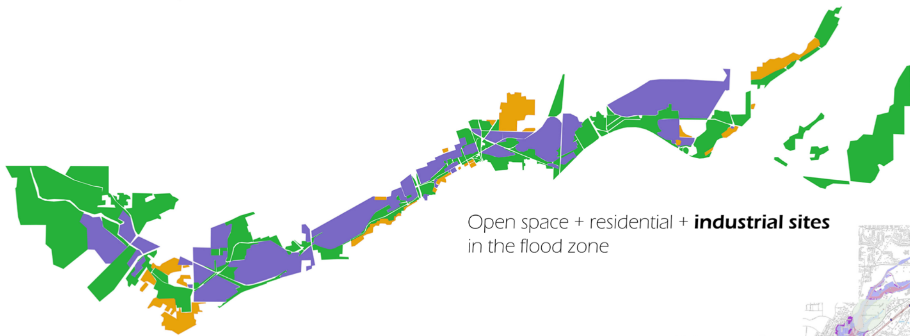
The eco-corridor would span between the two source habitat areas providing habitat to some species, connectivity and dispersal for others and refuge for upland species.

Village Creek Adjacent Land Use

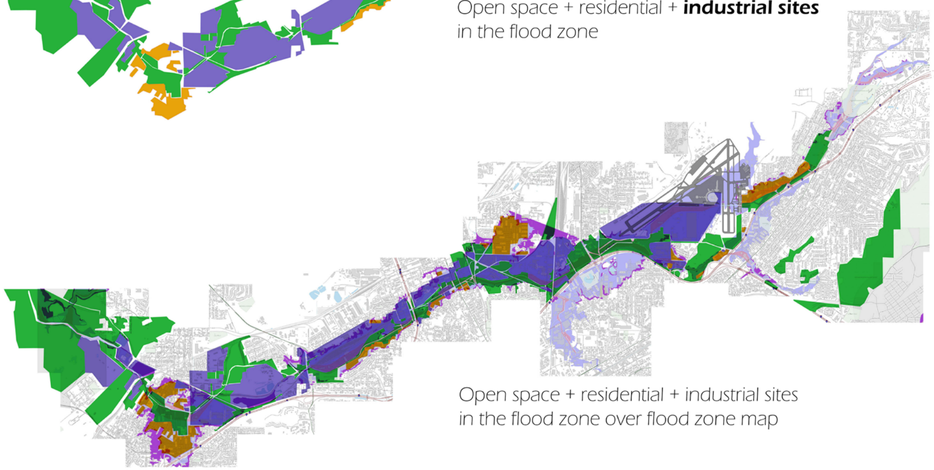
The maps (right) show the generalized land use adjacent to the creek. The green represents the open space adjacent to the creek. The orange represents the residential neighborhoods that lie in the 100 year flood plain and the purple represents the industrial sites that fall within the 100 year flood plain.

Open space adjacent to the creek

Open space + **residentia**l in the flood zone



Open space + residential + **industrial sites** in the flood zone



Open space + residential + industrial sites in the flood zone over flood zone map

The corridor design will be based on spatially explicit relationships between species traits and ecosystem patterns. To design this corridor a framework needed to be laid out on how it would be created. The land for the corridor would have to be acquired and created in phases since the total extent of the project is so large. The images (right) show a refined phase plan as opposed to the first corridor plan that would have incorporated all of the land within the 100 year floodplain.

The first phase of the new plan would to acquire all of the land within the immediate floodway of Village Creek. The floodway is defined as the main channel of the creek and the adjacent land to the creek that is most susceptible to flooding and experiences heavy currents during floods. The second phase of this plan would be to acquire all of the open space adjacent to the creek. The third phase would be to acquire land in the residential neighborhoods that are within the 100 year floodplain and are historically susceptible to flooding. The final phase of this plan is to secure portions of industrial sites adjacent to the creek that have been identified as either easily reclaimable due to lack of permanent infrastructure or under utilized. The plan would be set on a 100 year time frame to acquire the space for the corridor and developed in phases to provide different stages of succession to increase biodiversity (Perlman, 2005). Although this plan for a phased corridor was a refinement from the original corridor plan, the corridor went through another stage of refinement before it was finalized.

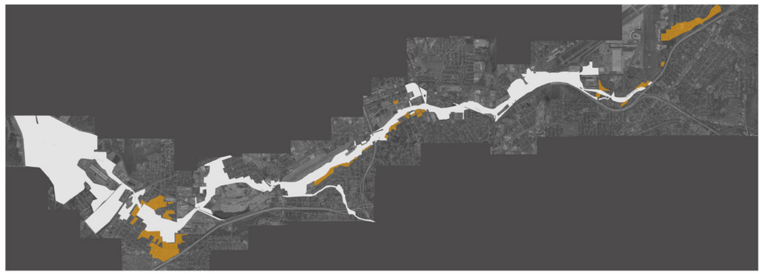
Village Creek Sequential Layer Corridor Study

Floodway

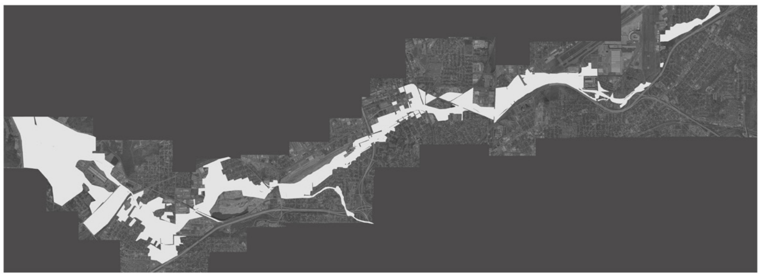
Floodway + Open Space

Floodway + Open Space

Floodway + Open Space + Residential



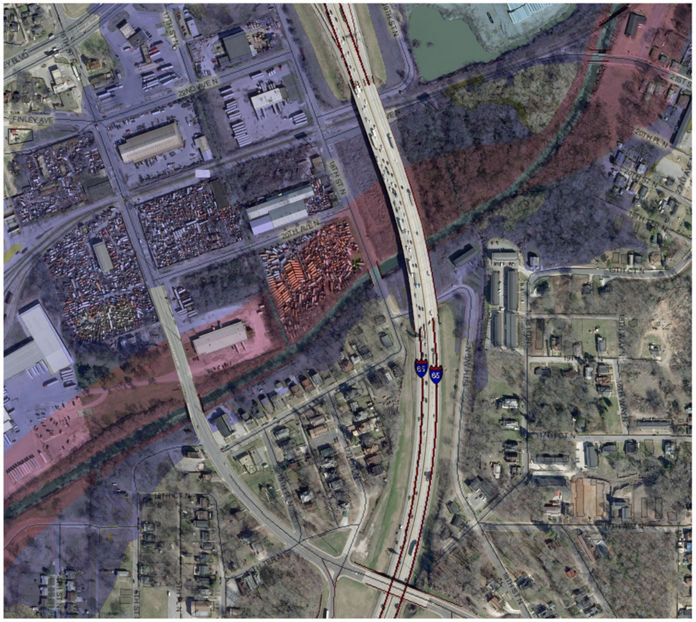
Floodway + Open Space + Residential



Floodway + Open Space + Residential + Industrial Sites

Floodway + Open Space + Residential + Industrial Sites

Village Creek Focus Site Concept Plan



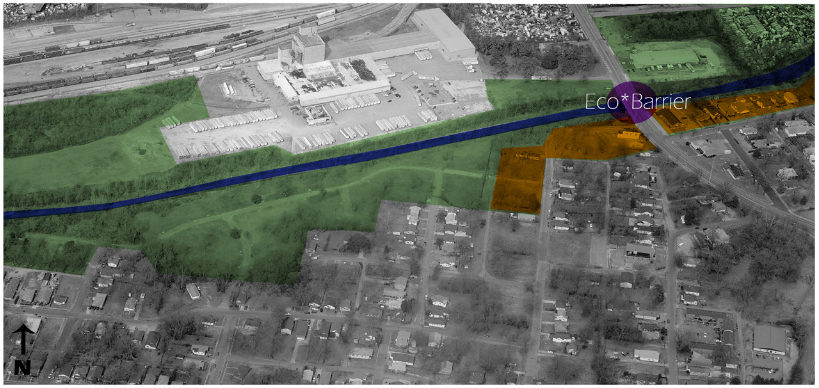
Flood plain *through the site. The purple is the floodway and the blue is the 100 year flood plain*

Phased corridor through the site. **Phase 1** is green (floodway & open space).**Phase 2** is orange (residential). **Phase 3** is purple (industrial).

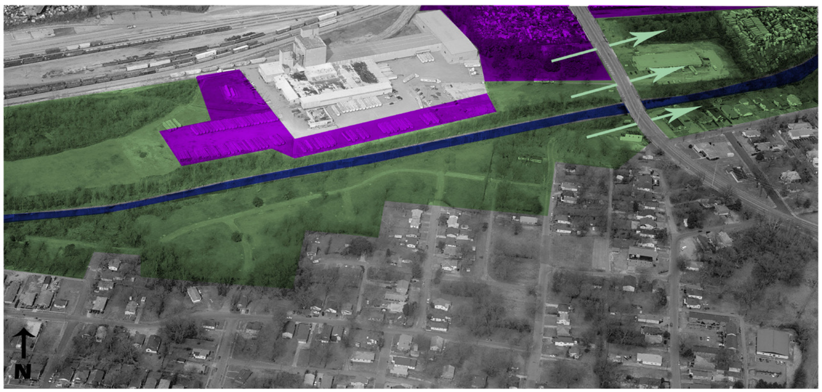
The site chosen to show the implementation of this three phased corridor implementation was an industrial and residential site along Village Creek near I-65 in the Enon Ridge area. The situation posed many hurdles dealing with the infrastructure that existed on the site. The idea that the corridor would one day be an uninterrupted continuous corridor posed a design challenge specifically in regard to the roads. The options were to either remove the roads, raise the road and go under it or build land bridges over the roads. On this site, one under utilized road was removed and one road was proposed to be lifted to an overpass. The corridor would pass under the overpass that existed on the site at I-65. This situation allowed the phased process of the corridor implementation to be applied to a real site with real design issues and challenges.

Village Creek Focus Site Corridor Options

Phase 1 Existing open space and floodway zone for corridor

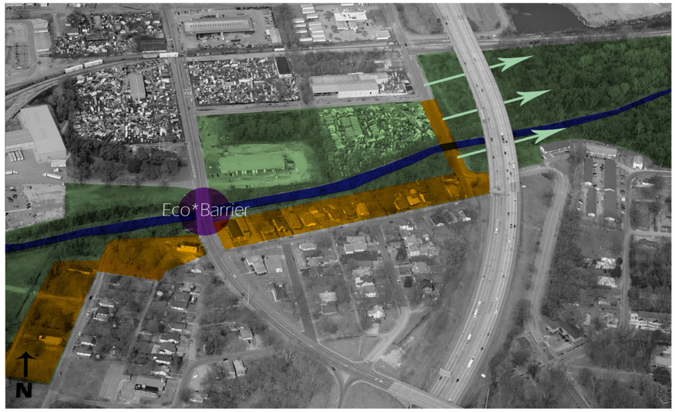


Phase 2 Phase 1 + flood risk residential properties for corridor

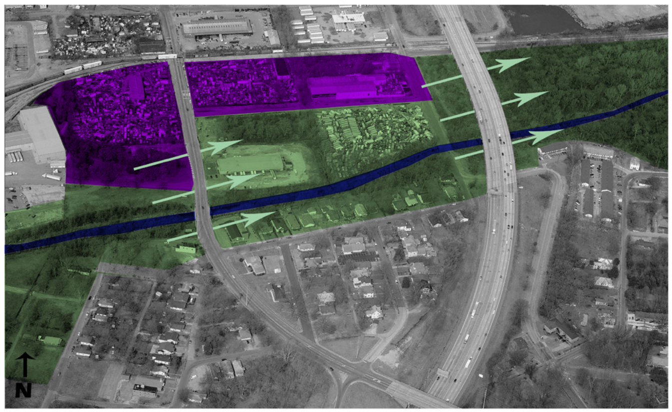


Phase 3 Phase 2 + selected industrial light sites for corridor

Phase 1 Existing open space and floodway zone for corridor

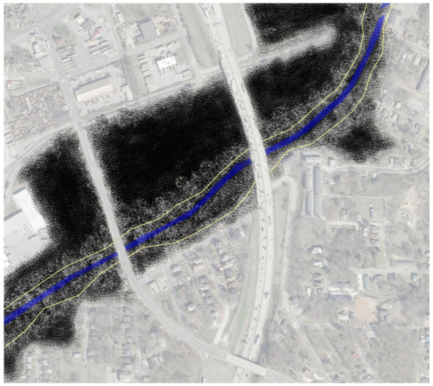


Phase 2 Phase 1 + flood prone residential properties for corridor



Phase 3 Phase 2 + selected light industrial sites for corridor

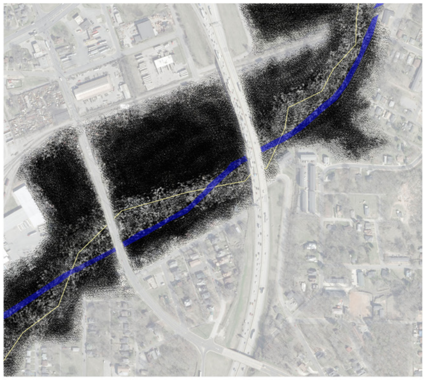
Potential Effect of Human Disturbance on Wildlife Habitat



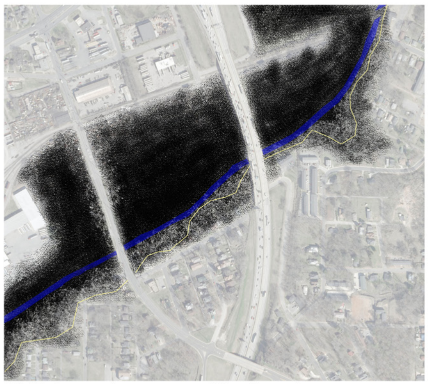
#1: Two paths along creek (High Disturbance)

#2: Two paths interweaving corridor (High Disturbance)

#3: One path dissecting the corridor (Medium Disturbance)



#4: One path criss crossing the creek (Medium Disturbance)



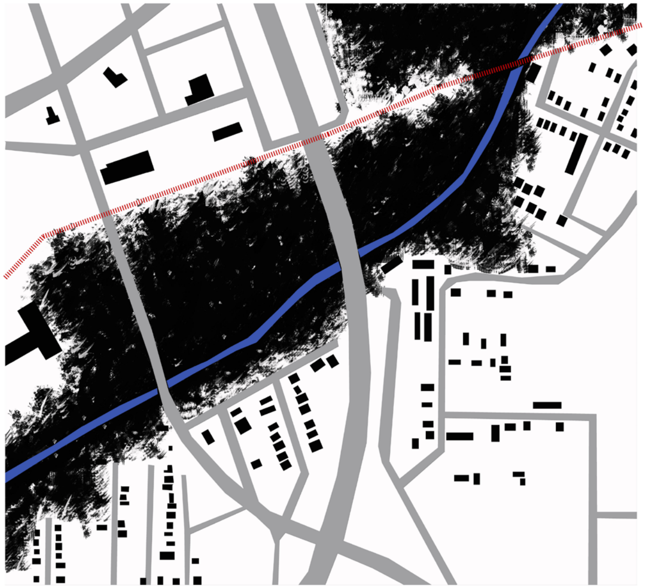
#5: Path running on one side of creek (Low Disturbance)

#6: Two paths on perimeter of corridor (Least Disturbance)

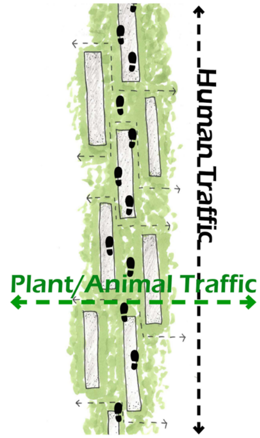
This series of images shows the testing of pedestrian trails through the corridor. The goal was to establish an average flushing distance for a range of species and factor that into placement of the trail. The corridor needed to function first for wildlife and secondly for humans. By testing the trail placement in different areas of the corridor the path of least disturbance could be established and would dictate exactly where the paths needed to run through the corridor.

Ecotonal Edges - Human Assemblages merged with Wildlife Assemblages

This graphic shows representation of the ecotonal edge that humans and wildlife generally share. Human habitat exists and wildlife habitats exist, but for the most case these habitats are usually shared by the two but most often dominated by humans. The original goal of this project was to create the corridor that was dominated by wildlife, by designing the corridor specifically for an assemblage of species. The edge conditions that exist in situations like this were the most challenging to deal with. By creating an urban ecological corridor for an assemblage of species with as little human disturbance as possible, the lofty goal was to this to be a wildlife and vegetation corridor only with humans limited to the perimeter of its boundaries.

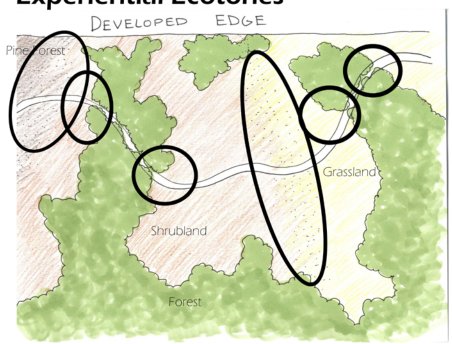


Above is a conceptual look at the potential of an ecological corridor. The focus of the corridor is the edge conditions. Edge conditions don't just occur between the corridor and the matrix surrounding the corridor. Edge conditons also occor within the ecological communities that make up the biotopic features of the corridor.



The pathway that runs through the corridor will be broken up to let biotic processes permeate through the path

Experiential Ecotones



Ecotones are not just where two ecological communities meet to form richer and more diverse habitats. Ecotones can also be experiential places where abiotic and biotic forces meet to create distinct and diverse spaces. In this plan the the experience of the landscpa is moving in and out of the different biotopes and experiencing the change between them.

Mutualism occurs between humans and wildlife. In my model there is diversification where the two niches interact, but also space for each community to seperate.

"**Assemblage** is a relationship of conditions.

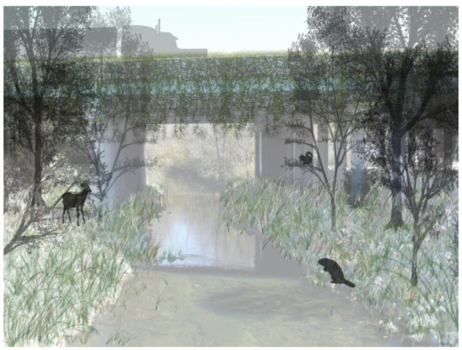
Not just the physical condition." - Rod Barnett

Ecological patches inserted into the urban fabric

The main issue is how to allow humans to move through the corridor without disturbing wildlife to the point where the disperse out of the corridor. The typical way to create an ecological corridor or greenway is to put a path along a creek and plant some trees. This technique does preserve some of the plants and animals on the site, but true ecological corridors should function for wildlife first and people second. During the research not one case study was found where habitat was created and set aside for wildlife only. National parks and nature preserves are set aside for wildlife but then walking and riding trails are placed all through them and encourage people to traverse the habitat. Scientists have studied the disturbance effects of previously though minimally invasive activities such as hiking and bird watching and have found these activities to be very disturbing to local species assemblages.

The goal is for human and wildlife to interact to a certain degree but have places that remain wildlife habitat only with no disturbance from humans. This would allow more species to inhabit and use the corridor. By creating ecological niches for species that were screened from human disturbance the corridor could start to function as a true ecological corridor. By slowly breaking up development and infrastructure pockets of ecology could be phased into the urban fabric which would eventually lead to the formation of the riparian corridor



Riparian zone sections

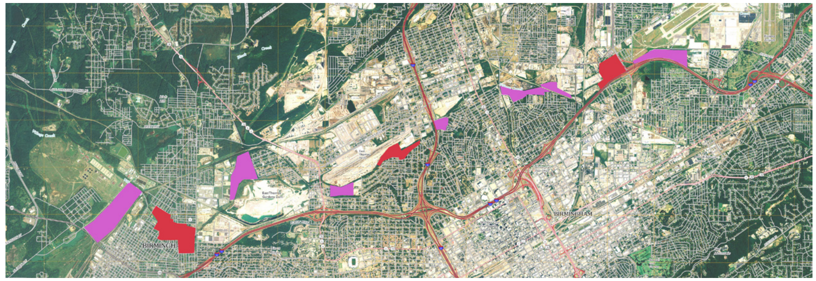
Ecotonal edges are created by a range of assemblages that make up corridors and ecosystems in general. Within the Village Creek site there are industrial-human assemblages, human-wildlife assemblages, and wildlife-creek assemblages among others. These assemblages unfold and diversify based upon biotic and abiotic changes. These assemblages cannot be planned or controlled, but the goal was to set up the eclogical framework for initial condtions to be established to maximize opportunites for wildlife habitat in the given space and reduce human distrubance as much as possible.

Ecological framework for corridor development

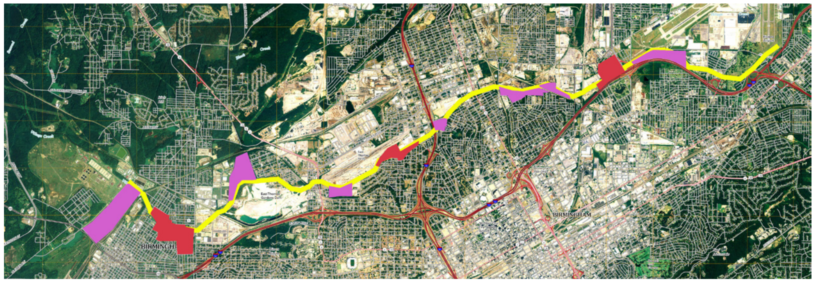
Although the research shifted focus away from designing for assemblages, the research allowed a framework for a phased corridor to be implemented along Village Creek. The first phase of the corridor will encompass the flood acquisition sites along the creek (red). Phase two will be the acquisition of as much of the undeveloped open space adjacent to the creek as possible (pink). Phase three will be to designate and acquire a 100' buffer on both sides of the creek (yellow). Phase five entails acquisition of all of the land that lies within the immediate floodway of the creek (blue). The final phase will be to acquire the land that the Wade Sand and Gravel Co.. currently exists on. The quarry has a finite life, so eventually the land will be available to be acquired into the corridor. This phased plan allows the corridor to be implemented over a long period of time. Creating the corridor in this manner creates ecosystem patches that exist and function on their own, but the idea is that these patches will be eventually connected by the continuous corridor.

Phase 1: Flood acquisition sites

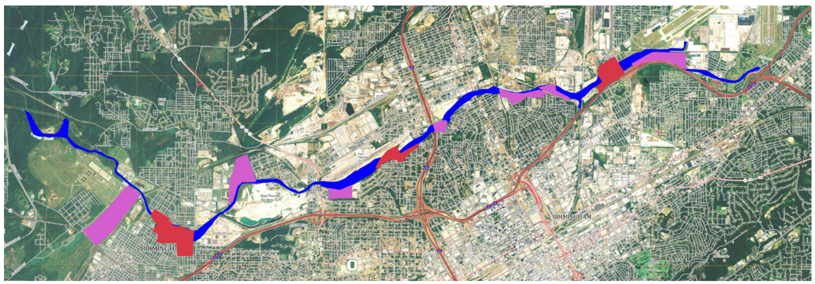
Phase 2: Existing undeveloped space



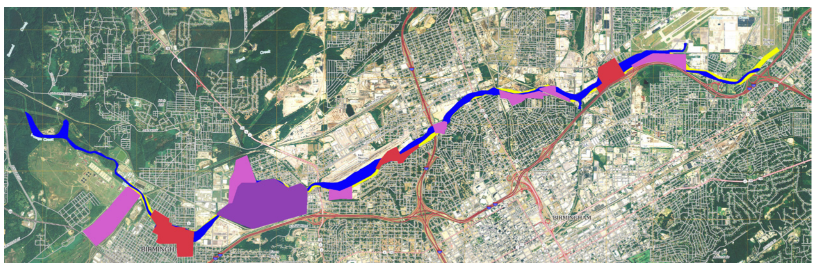
Phase 3: Acquire a 100′ buffer along creek



Phase 4: Acquire land in floodway



Phase 5: Acquire gravel quarry after it expires



Chapter 3: **Ensley, AL** Industrial Prosperity In a Floodplain Town

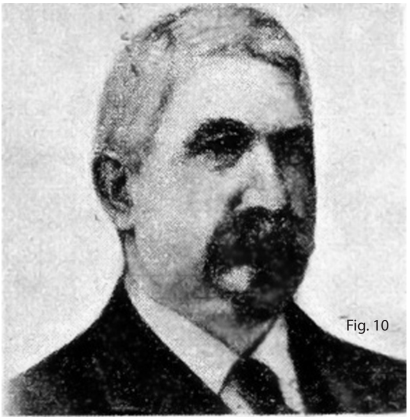
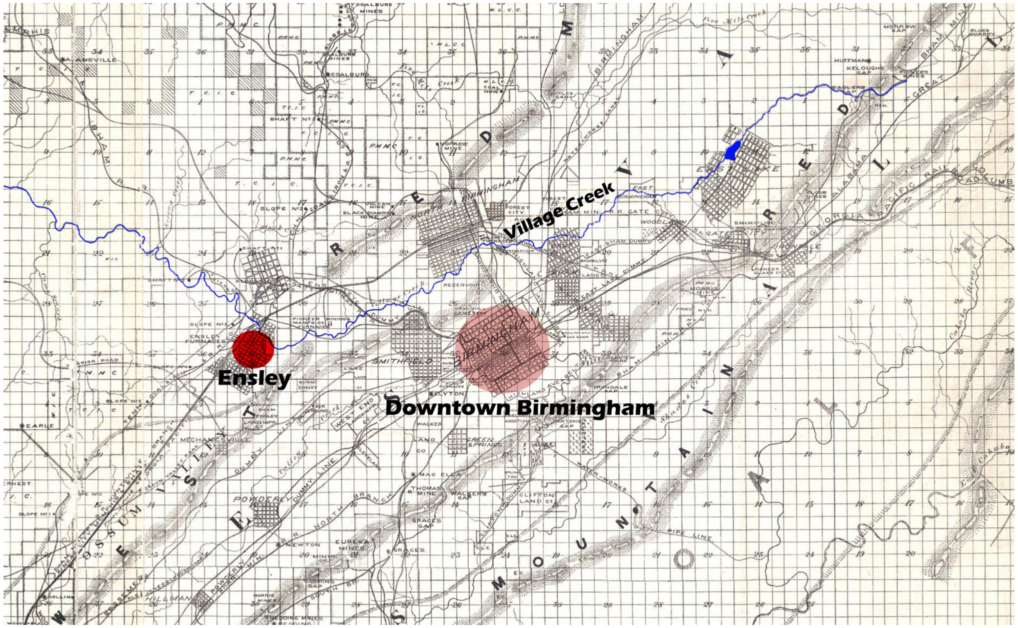


Fig. 10

Enoch Ensley was a wealthy entrepreneur from Memphis, TN who started buying up tracts of land in Jefferson County in the 1880's. One particular site he discovered and purchased was the site of his future town, Ensley which he named after himself. The site was flat, adjacent to Village Creek and was situated at the edge of the ultra productive Pratt Coal seam. Ensley had a vision for his city to be the greatest industrial city in the world some day. In 1887 Ensley began construction on four large blast furnaces that when they were completed in 1889 was the largest battery of furnaces in the world (White).



Ensley formed a land company that helped to build Ensley Works Mill and the villages the cropped up around it. 4,000 acres adjacent to the mill were surveyed out to become the city of Ensley. Ensley Works was operated by the Tennessee Coal and Iron & Railroad Company (TCI) and covered 750 acres. The mill operated from 1888-1978 and saw peak production from 1888 through the 1920's (Birmingham Historical Society, 1993).

Above is an 1889 map of Birmingham showing how Ensley developed in relation to Birmingham. Ensley was one of the four main centers in the Birmingham area, which includes Thomas, North Birmingham and East Birmingham.


Fig. 11

Birmingham’s turn of the century boom was actually due mainly to TCI starting to cast steel in 1899 at its Ensley Works Mill (Bagget, 2006). In 1904 TCI added two more blast furnaces to Ensley’s battery and began production of brick, lumber, cement and finished metal which garnished Ensley much attention nationally (White, 1995). In 1907 TCI nearly went bankrupt but it was rescued by the United States Steel Company, a move that saved the city of Birmingham but also insured it would never grow larger than its industrial brother to the north, Pittsburgh, PA (Bagget, 2005).


Fig. 12

Photograph of main business street in Ensley taken in the 1890’s.

The population of Ensley at the turn of the century was fewer than 600. By 1907 Ensley Works had a male labor force of over 14,000 and by 1910 when Ensley was annexed into Birmingham, Ensley’s estimated population was around 25,000 (White, 1995).


Fig. 13

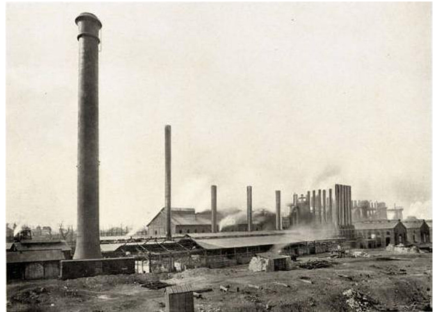


Fig. 14


Fig. 15


Fig. 16


Fig. 17

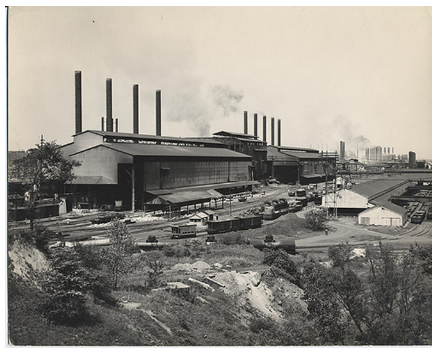
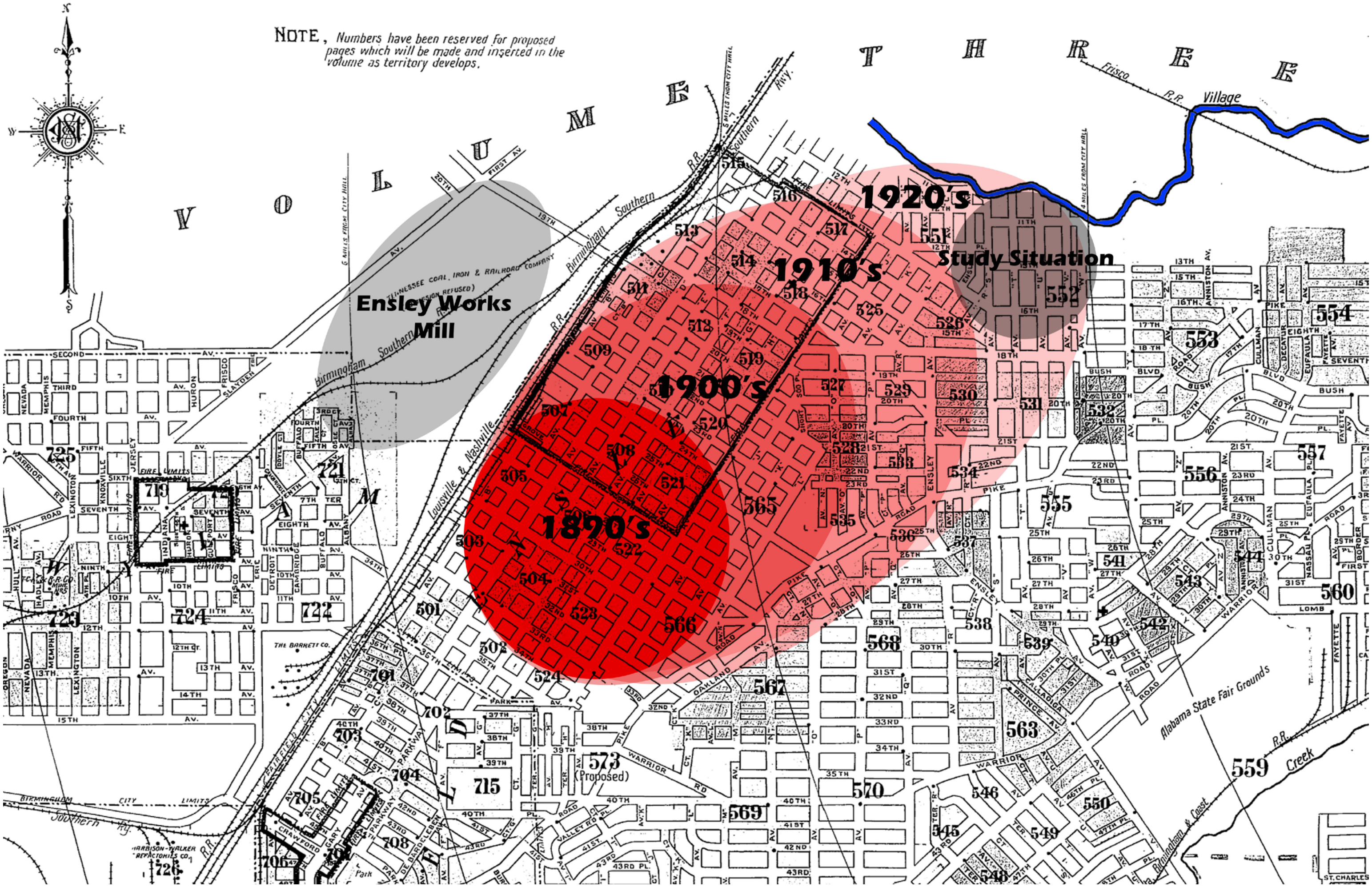


Fig. 18

When Ensley Works was constructed the Ensley Land Company had built close to 200 dwellings to handle the first wave of workers to live next to the mill. The industrial boom of the turn of the century brought thousands of additional workers to the city and housing was in very limited supply. Ensley Land Company began vigorous production of housing to suit the needs of their workers. These mill villages first cropped up next to Ensley Works along 19th street and slowly worked their way north towards Village Creek.

By the 1920's Ensley was a bustling city. A street car line connecting Ensley with downtown Birmingham and Ensley offered lavish commercial shopping areas that competed with Downtown Birmingham's retail market. The tremendous growth that Ensley experienced in the 1920's forced developers to build homes in the low lying areas adjacent to Village Creek. These homes were mostly sold to African American families who were employed by the mill and had no idea of the flood dangers associated with their new homes. Between 1924 and 1928 significant development occurred along Avenues W., V., U., S., L. and K. which is now the area of Moro Park-Ensley (White, 1985).

Residential development of Ensley



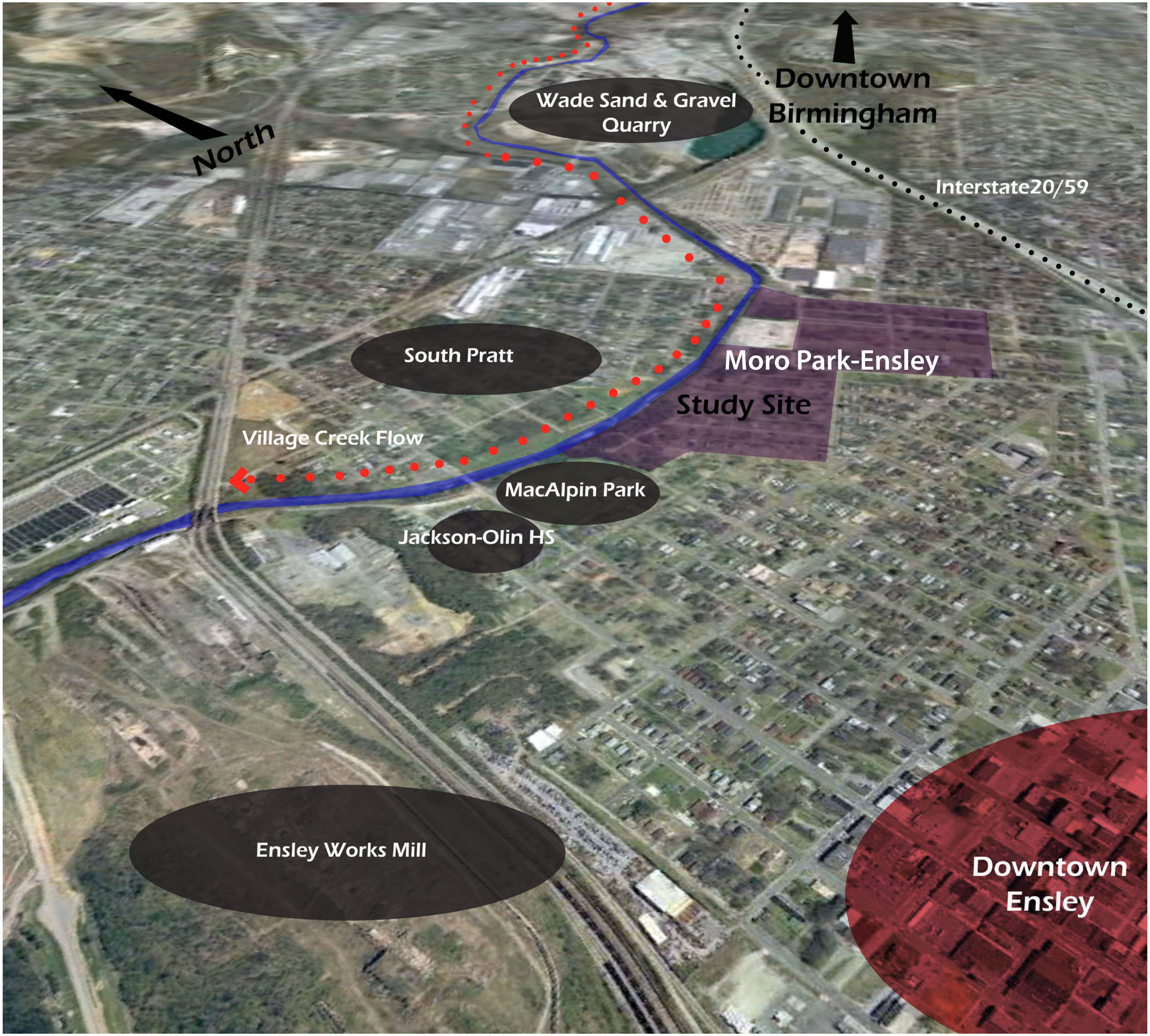
The Sanborn map above shows how development in Ensley occurred. The first homes were built adjacent to Ensley Works Mill. As development pressure increased residential areas were developed further and further north until they reached the banks of Village Creek. The area that is now know as Moro Park-Ensley (represented as the grey circle on the map) was developed between 1924 and 1928. These homes were sold to residents who had no knowledge of the flood dangers that would invade their neighborhood for the next 80 years.

Ensley Works Mill closed in 1978, by which time much of the industrial production in the United States had moved to overseas markets. Ensley never regained the flair it had from the 1920's -1940's. It's population and economic base has been in a decline ever since. Much of present day Ensley is in a condition of deterioration.

The design research is focused on Ensley and a particular neighborhood of the city. The situation chosen to investigate is in the once residential neighborhood of Moro Park-Ensley (highlighted in the purple box on the map). Moro Park was a residential neighborhood built in the 1920's in the floodplain of Village Creek, and in 1996 FEMA and the United State Army Corps of Engineer's (USACE) spent 7.6 million dollars to remove 135 homes from the floodplain (Acquisition, 2000). Today Moro Park is devoid of any homes, but the infrastructure such as the roads, sidewalks and drainage systems are still in place.

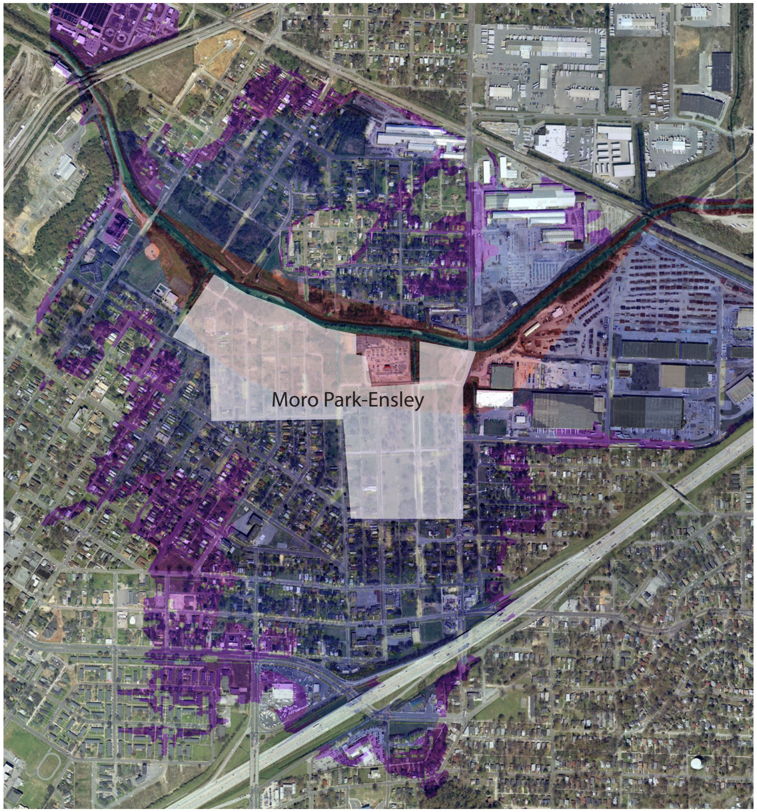
Ensley is located just north of Interstate 20/59 and just south of Village Creek. It is bordered by South Pratt neighborhood to the north just across the creek and an industrial site to the east. To the west lies MacAplin Park and the newly constructed Jackson-Olin High school. Just beyond the industrial site to the east is the Wade Sand and Gravel Quarry. Downtown Ensley is located south of Moro Park, and to the west across the rail line remnants of Ensley Works Mill still stand today. Moro Park is devoid any building infrastructure other than a few homes and a church. An Alabama Power substation is on the northern edge of the study site adjacent to the creek. Moro Park-Ensley was purchased by the city of Birmingham from the USACE with covenants put in place to make sure the land was remained as open space and used for flood control (Birmingham Historical Society, 2006).

The question that is being asked is that now that this land has been set aside, what should the city actually do with it. Jefferson County is in the middle of an unprecedented debt crisis of 3.2 billion dollars owed. If Birmingham goes bankrupt it will be the largest municipal bankruptcy in United States history. The solution to the question of what to do with the open space is la series of low cost, discreet design interventions. These will allow the space to remain open while acting as an amenity to the public and helping to contain the flood waters of Village Creek.


North
Wade Sand & Gravel Quarry
Downtown Birmingham
Interstate20/59
South Pratt
Moro Park-Ensley
Study Site
Village Creek Flow
MacAlpin Park
Jackson-Olin HS
Ensley Works Mill
Downtown Ensley

Village Creek floodplain in Ensley

Below the extent of Moro Park-Ensley is highlighted. A large portion of this neighborhood was constructed in the immediate floodway of Village Creek which can have several feet of water flowing over its surface during a flood event often more than once per year.



Much of Ensley still lies in Village Creek's floodplain today. In the 1920's when most of the homes were built in the floodplain, flooding occurred but the frequency and severity were nothing compared to what residents experienced years later. As development increased in Birmingham the impervious surface in Birmingham increased and more and more run-off relied on Village Creek to carry it away from the city. This, combined with the building of the Birmingham Airport and many large shopping centers in the Roebuck area in the 1930s only worsened the flooding. The 1940s is when residents of Moro Park remember the beginning of the "bad flooding" (White).

In the 1930's the city spent tremendous amounts of money to clear the creek banks and widen the channel, but outside the city limits the county failed to widen the channel downstream and this only worsened flooding as floodwaters backed up heavily upstream. In the 1940s and 50s the creek was put in culverts and straightened in efforts to relieve flooding pressure upstream in highly developed areas to the low land areas downstream that were less heavily developed. Village Creek has a very slight fall as it travels from east to west, but it is particularly flat where it runs through Ensley. Ensley was already a natural location for floodwaters to back up and overflow the creek banks but the disruption to the natural flow upstream compounded this problem in Ensley. In 1951 a flood on March 28 forced 3,000 residents from their homes in Ensley as a deadly flood swept through the city. Ironically the city was trying to practice flood control but the solutions adopted only worsened the flood problems for many Village Creek neighborhoods (White).

Right is the floodplain of Village Creek in Ensley. The red is the floodway. Blue is the 100 year flood plain and the purple is the 500 year flood plain. As can be seen, much of Ensley is subject to flooding of the creek.

As time went on flooding in Ensley gradually became worse. The Birmingham News profiled Village Creek in the 1970's as a "monster" (White: P. 13). The creek that gave life to Birmingham was now viewed as a nuisance. Once fond memories of a time when residents would swim, bathe and fish in Village Creek had been washed away by years of continuous flooding. Measures to control the creek combined with 70 years of development in Birmingham put too much strain on Village Creek and the only place the flood waters were able to flow were into the homes that now populated the floodplain. By the 1970s it was estimated that flooding along the creek brought about $2.4 million worth of property loss annually. In 1979 the largest recorded flood to that point hit Ensley. The creek reached a final crest of 14 feet, which is 4 feet above flood stage. Many residents escaped before the flood waters came, but many others had to be rescued by boat, but 400-500 homes in Ensley were severely damaged (White). The 1979 flood was the final straw for the city, and something had to be done.

At a 1981 Birmingham community meeting, distraught Village Creek residents met with Birmingham officials to express their dismay. Birmingham councilwoman Nina Miglionico expressed her feelings in the meeting that day, **"she sympathized with anyone who 'lived with all of the human misery that results from having a creek of this magnitude running through the middle of Birmingham.' As one can tell, long gone is the love and appreciation once held for Village Creek the life blood of city that it helped built. It is simply looked at as a nuisance and an inconvenience running through the city. Residents 'did not welcome the creek's occasional flooding as an event that replenished depleted soils. Instead they feared the floods because they damaged property, depressed the value of their houses and drowned their children. They no longer described the creek as a place to catch turtles, a fish or swim. They now warned their children that the creek was a repository for industrial filth. Most residents only knew the creek as a source of trouble.'"** (White: P. 13)

Federally Declared Flood Events of Village Creek

1977	September	
1983	December	**Triggered USCOE $29.6 million acquisition project**
1995	October	**Triggered FEMA-HMGP $5million acquisition project**
1996	January	
1996	March	**Triggered FEMA-HMGP $7.6million acquisition project**
1997	January	
1998	January	
1998	May	
1998	August	
1999	January	**Triggered FEMA-HMGP $7.0million acquisition project**
2000	March	**Triggered "Losses Avoided in Birmingham, Alabama" Analysis**

(Acquisition, 2000: p 3)

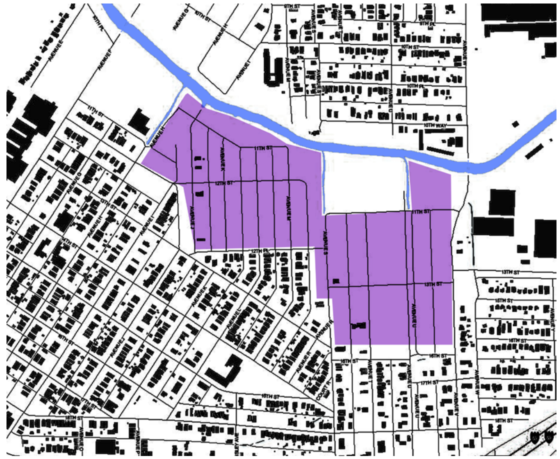
The 1979 flood of 14′ got the ball rolling on an action plan to help the residents of Village Creek but it was the next major flood in 1983 of 13.9′, that triggered immediate action by the Federal Government and the city. In 1986 Congress passed the Water Resources Development Act which authorized $29.6 million for the Village Creek hazard area. Birmingham also contributed $7.4 million to the cause and they were able to purchase and remove 642 properties in the floodplain (Acquisition, 2000). Nine years later in 1995 a major flood triggered a FEMA-Hazard Mitigation Grant Program acquisition project which gave $5 million dollars to remove additional floodplain properties (Acquisition, 2010).

Moro Park-Ensley was set to be included in the original floodplain property acquisition project, but residents put up fierce opposition. In 1996 two major floods hit the Ensley area and residents finally had put up with all of the suffering they could handle. That year Dr. Mable Anderson, who is the founder of the Village Creek Society, organized efforts to help the citizens of Moro Park where she grew up. Another FEMA-HMGP grant was the result of her actions and 135 homes were removed from the neighborhood at a cost of an additional $7.6 million dollars (Acquisition). In 1999 another FEMA-HMGP acquisition project took place in the Village Creek floodplain. In all, the acquisition project spanned 20 years with a joint effort of the city, state and the Federal Government that cost $37.5 million to remove 735 structures from the floodplain of Village Creek. It was the largest flood acquisition project ever implemented (Acquisition, 2010).

Fig. 20

Moro Park-Ensley

Fig. 21



Above is a figure ground map of Moro Park-Ensley before the 1996 acquisition project. The brown box outlines the extent of the acquisition project where 135 homes were removed.

Right is the current figure ground of Moro Park. As can be seen, the homes have been removed and only the streets remain of the once residential neighborhood. The bottom map shows Village Creek's floodplain in Ensley. Most of the Moro Park site lies within the floodway (red).

Left are photographs that show flood levels and rescue efforts by boat in Ensley

Today, Moro Park-Ensley is a 75 acre open space between Ensley and Village Creek. The infrastructure of the former residential neighborhood still exits sans the houses. The situation is sparsely populated by various trees, with the most common tree being *Carya illinoinensis*, or the common Pecan tree. A foot bridge which crosses Village Creek on the site and it has been recently restored to good condition. The situation sees a large amount of foot traffic due mainly to this footbridge where people pass to and from Ensley and South Pratt.

This site has flooded over 25 times since 1977.
The following are some historical crest levels:

(1) 14.80 ft on 12/03/1983
(2) 14.28 ft on 02/06/2004
(3) 14.00 ft on 04/13/1979
(4) 13.96 ft on 03/11/2000
(5) 13.90 ft on 05/19/1983
(6) 13.79 ft on 01/26/1979
(7) 13.72 ft on 01/26/1996
(8) 13.68 ft on 05/08/2003
(9) 13.58 ft on 09/16/2004
(10) 13.26 ft on 09/07/1977

(Advanced, 2010)

Current Situation of Moro Park-Ensley









The National Weather Service describes flood impacts of Village Creek in Ensley as follows:

"**Major Flood Stage:** 16.0′ SERIOUS RESIDENTIAL FLOODING OCCURS IN THE ENSLEY AREA. PERSONS IN LOW-LYING AREAS NEAR THE CREEK SHOULD MOVE TO HIGHER GROUND AT ONCE.

Moderate Flood Stage: 13.0′ RESIDENTIAL FLOODING OCCURS IN THE ENSLEY AREA AND EVACUATIONS WILL LIKELY BE NECESSARY. PERSONS IN LOW LYING AREAS NEAR THE CREEK SHOULD MOVE TO HIGHER GROUND.

12.5′ RESIDENTIAL FLOODING BEGINS AND EVACUATIONS MAY BECOME NECESSARY. PERSONS IN LOW-LYING AREAS NEAR THE CREEK SHOULD MOVE TO HIGHER GROUND.

11.5′ AVENUE W. AND OTHER LOCAL STREETS IN THE AREA BECOME IMPASSABLE.

Flood Stage: 10.0′ FLOODING OF LOW LYING AREAS BEGINS"
(Advanced, 2010).

Bird's Eye View of Situation

Village Creek Society

The Village Creek Human and Environmental Justice Society (VCS) started in 1980 as a non profit coalition by Dr. Mable Anderson, who grew up in the Ensley area. VCS was started to help residents who were suffering due to floodplain living conditions. Today the society focuses on creek restoration projects and water quality issues. VCS was approved as the first "Creek keeper" in the nation by the International Water Keeper Alliance. They have numerous current initiatives that are shown below and to the right, such as installation of gabion walls along the creek to stabilize the banks,removal of 12 support column bridge and a sewer pipe that crosses the creek at the Ave. F. bridge (Village, 2010).

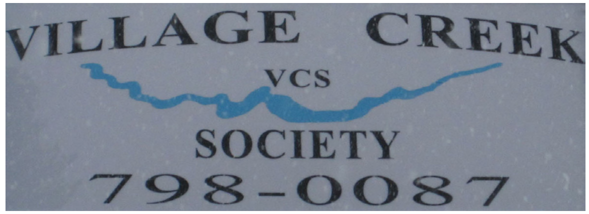


Fig. 22

(Left) is VCS's master plan for the Moro Park-Ensley situation. The plan includes a trail, skating, mini-golf, and outdoor classroom, an outdoor conference room, a historic museum, a performance area, rose gardens, a pecan grove and a picnic area with pavilions. The plan also incorporates gabion walls to support the creek banks through the site in an effort to tame the flooding of Village Creek.

Current Initiatives of the Village Creek Society

#1. Replace the 1920's bridge that has 2 lanes/2 side sidewalks between Ave. F Bridge and Ave W in Ensley with 12 intermediate concrete support piers with a new concrete bridge with no intermediate support piers with 2 lanes/2 sidewalks. The concrete support piers have caused 80 years of flooding between Ave F and Ave W where approximately 135 homes and one church have been removed by FEMA funds ten years ago.

Estimated Cost: $1.5 Million Dollars

#2: Relocate 3ft. diameter sewer pipe, now 5ft. above Creek at Ave. F to under the creek.

Estimated Cost: $ 4.8 Million Dollars

#3. Construct gabion walls on both side of Village Creek between Ave. F and Ave W bridges (3,400') to eliminate bank erosion, stream-line the creek to stabilize flow and provide a permanent feature with landscaping for a learning recreation park of approximately 75 acres.

Estimated Cost: $2.0 Million Dollars

Total Estimated Cost to Reduce Flooding Along Village Creek in Ensley: $8.3 Million Dollars

Existing Gabion Walls along Village Creek through Birmingham Airport

Existing Gabion Walls along Valley Creek in Birmingham

Below are photos of current stream banks repair efforts along Village Creek. The city spends a tremendous of amount of money annually to build Village Creek's banks back up after they slump from erosion.

Chapter 4:
Theoretical Framework and Design Interventions

Disturbance - Colonization - Succession



Disturbance - Colonization - Succession

When natural or human disturbance occurs natural processes will respond. When this disturbance is taken into account in design, conditions can be establishedto respond to this disturbance and the natural processes that already occurring in the situation.

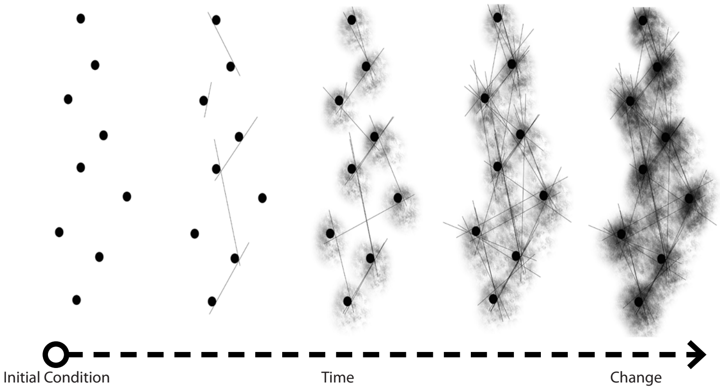
Fig. 23

Fig. 24

Left is an abandoned rail car that has been left on the former site of Ensley Works Steel mill. Landscape resilience is displayed here as adventitious biota reclaims the site and buries the rail car in vegetation.

The theoretical framework for this project is based on the ecological model of disturbance-colonization-succession. The situation in which I am working is a floodplain which is dynamic and ever-changing by nature, so to master plan the site with a final form would be inappropriate. By understanding the natural processes occurring in the situation, calculated design interventions can be set up to respond to and reveal these processes. Setting up the initial conditions to respond to disturbance is a steering process in which the final form cannot be fully realized until after the fact. The setting up of the condition is the design. The natural processes are already occurring on the site, they are just being affected by the designer. (Raxworthy, 2006)

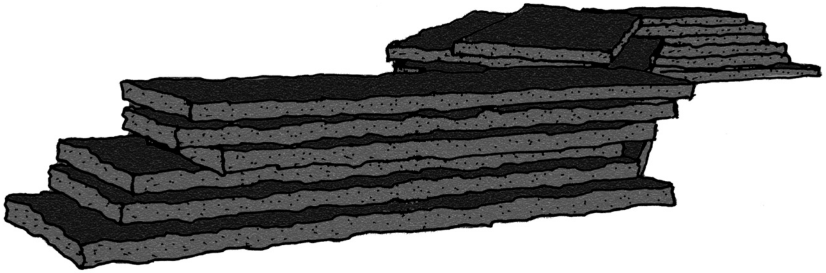
Dutch Landscape Architect Roel van Gerwen uses an analogy of "the stick in the sand" to describe this design methodology, *"To build a sand castle one could form the sand into the shape of a castle. However as soon as the sand castle is built it begins to erode through the action of wind and water. An alternative approach would be to correctly locate a stick in the sand which would then over time, catch sand. The result will not be exactly the same as forming the sand castle, but may be quite close. It would also involve significantly less labor"* (Raxworthy: P. 6. 2006)



The design research focuses on establishing initial conditions on the site to engage the natural flooding processes of deposition and erosion that are already occurring on the site and letting those processes shape the final form of the land. The processes are already occurring on the site, they are just being affected by the designer. The establishment of the initial conditions is the actual design.

(Right) Colonization and Succession is an ongoing natural process that is all around us. This abandoned railroad track lies just off the banks of Village Creek and gives us a glimpse of the remnant landscape and the ecological process of succession already occurring on the site.

Primary design interventions

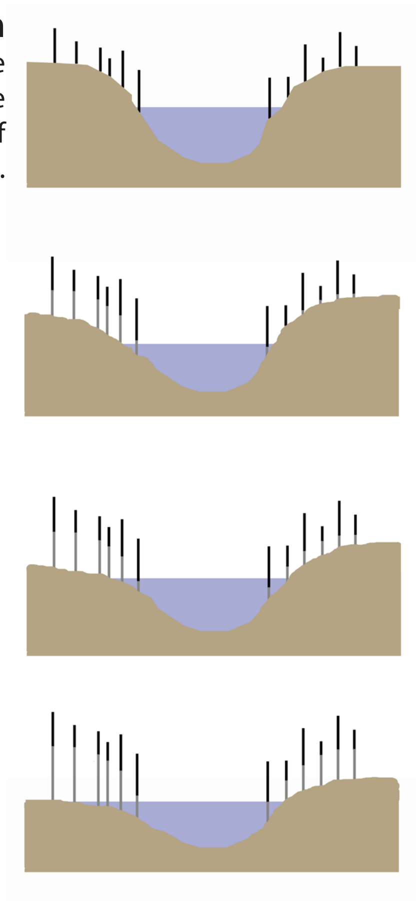


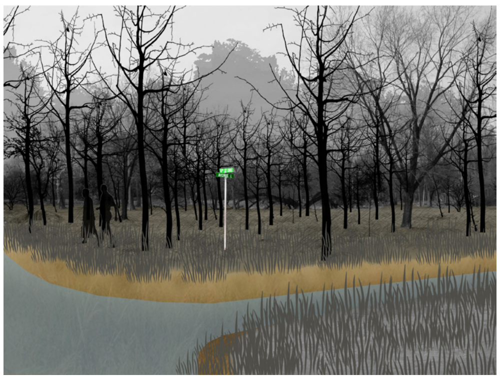
Deposition

Sediment deposition structures will be set in the floodway to collect sediment, litter and woody debris (deposition). Over time and after many flood events fluvial landforms will begin to emerge on and around these structures. Thus revealing the geomorphological process of flooding.

Erosion

Fluvial rods or piles inserted into the creek banks will serve to reveal both the process of erosion and of deposition. The rods , depending on the configuration, will either stabilize the creek banks or reveal the eroding level of the creek bank.

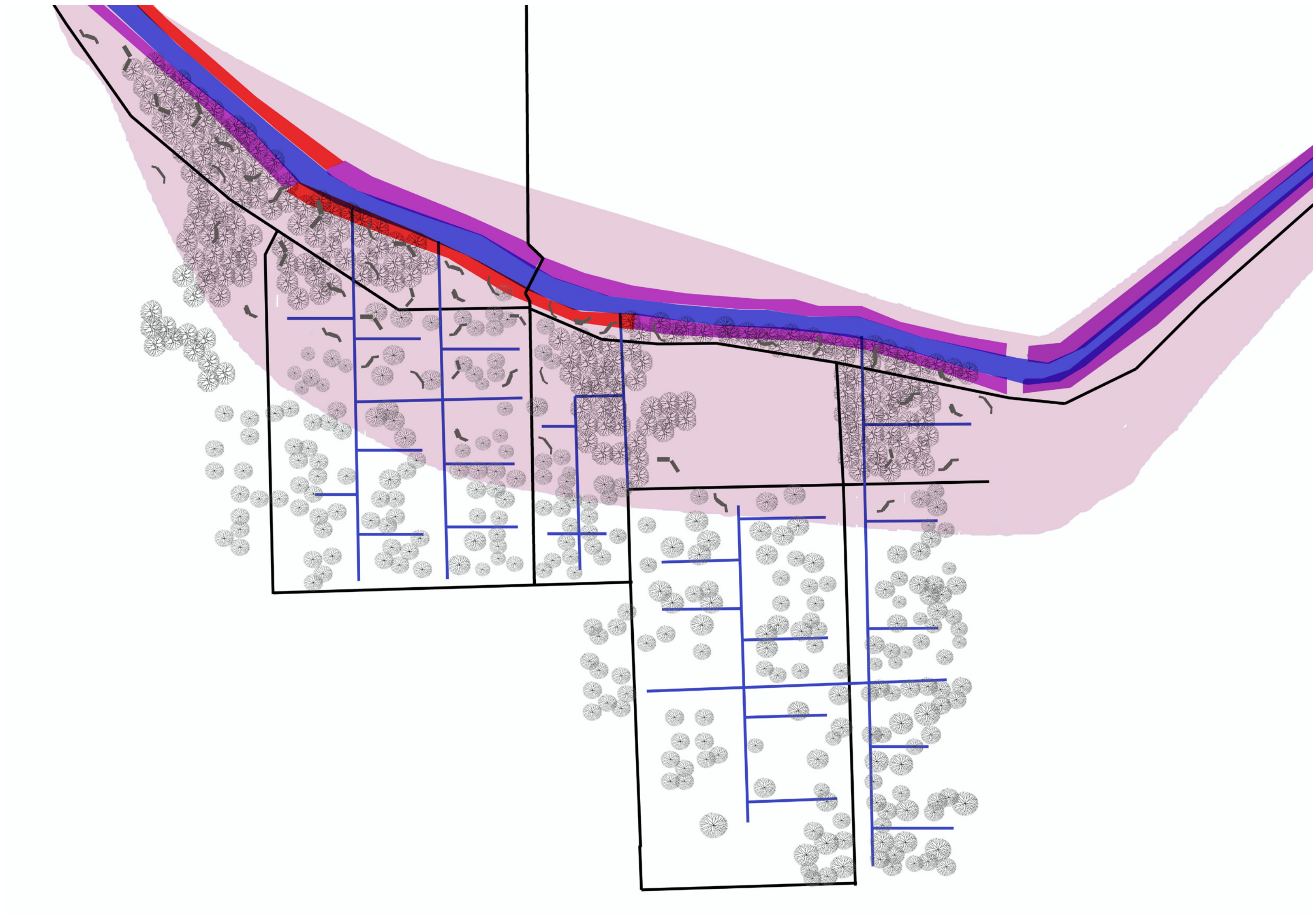




Flood Detention Channels

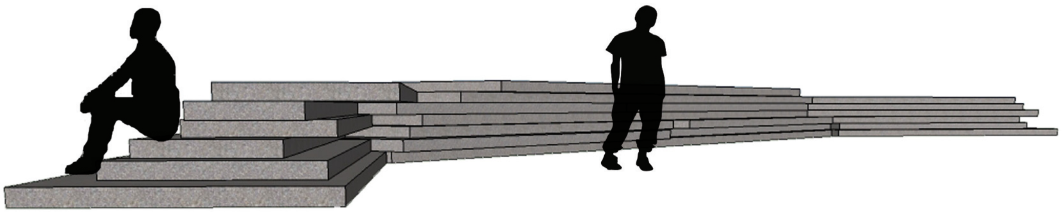
Flood relief channels will be dug on site in the footprint of the existing residential roads that currently remain on site. The channels will serve to filter stormwater into the creek during normal rain events, act as flood retention areas during heavy storm events and then act to dissipate flood waters during overbank flood events of Village Creek.

Flood geomorphology response interventions established on Moro Park-Ensley situation



The deconstruction and superuse of asphalt on the situation

In 1996 when 135 homes were moved from Moro-Park Ensley, the main infrastructure that was left behind were the asphalt roads that once served the community. Today they stand as remnants of a landscape that once was. Since they no longer serve a purpose, part of the proposal is the removal and reuse of the asphalt roads. Some of the roads will be partially removed only leaving behind a small walking path for pedestrian movement across site. Other roads will be completely removed and in their place flood relief channels will be dug. The asphalt will be used and stored on site. Its reuse potential is boundless. Asphalt will be used to create the sediment deposition walls, spread in crushed aggregate to form walking paths, to aid in remediation of creek banks and also stored in slabs for potential future flood water diversion on site if necessary. Reuse of materials that are on site will greatly aid in cost reduction. By not having to dispose of the asphalt and not having to bring in new materials for sediment walls and walking paths, the cost of removing the roads will almost be offset. The entire design of this site will mostly rely on materials indigenous to the site.



Asphalt slabs are stacked and bound to create deposition structures and seating in the floodway.

The perspective (right) shows an asphalt road partially removed to leave a pedestrian path on the site.

The asphalt roads will be broken up into slabs that will be stacked and bound to create the sediment deposition structures. There are approximately 317,200 square feet of roads that are currently on the site of Moro Park-Ensley. At an estimated $2.50 per square foot, road removal and reduction will cost a $793,000. Funds for other projects along Village Creek to control flooding, could be used to fund the road removal and implementation of the research project along the floodplain.

Fig. 25

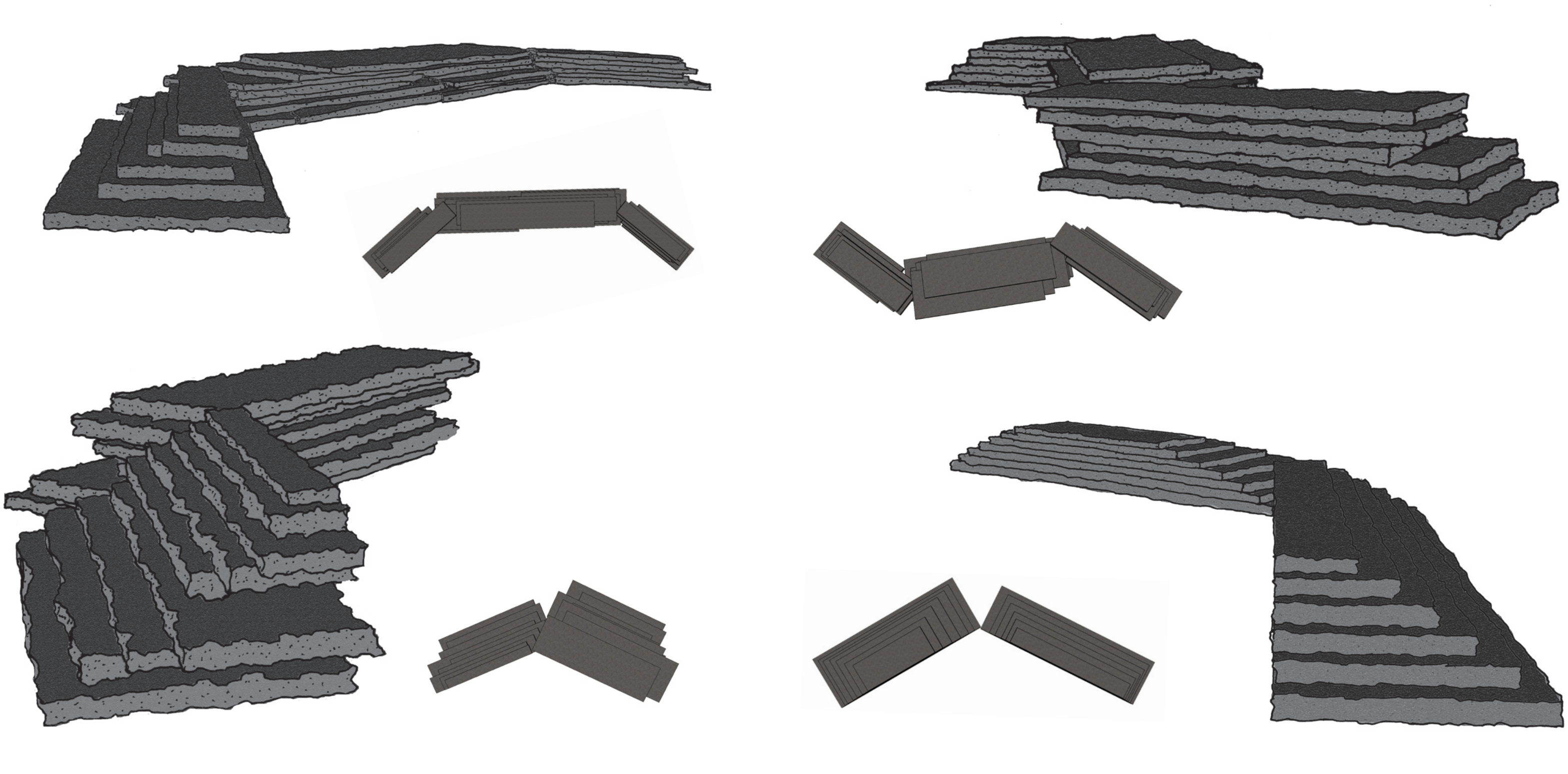
Fig. 26

Fig. 27

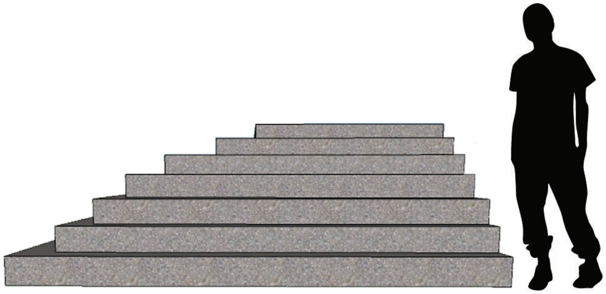
Fig. 28

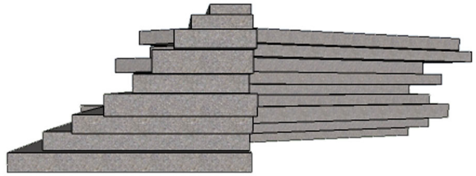
Deposition structures formed from reused asphalt

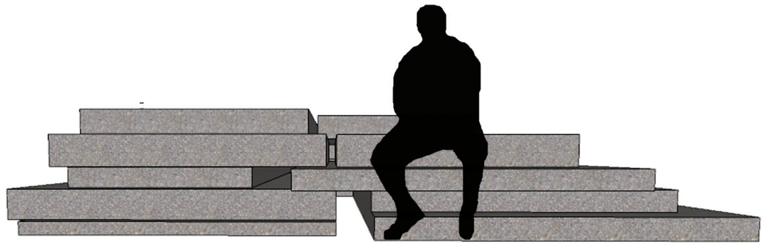
The roads will be demolished and cut into large pieces to form the asphalt slabs that will be used to create the deposition walls. The slabs will be stacked, bound and placed along the floodway in order to collect deposition and reveal gemorphological process of fluvial landscapes. My hypothesis is that these structures will act to slow the velocity of flood waters in the floodplain therefore depositing entrained sediments and debris. After each flood event sediment will be deposited and afterwards adventitious biota will colonize the sediment and grow (succession). This plant material will act to stabilize the sediment and give it some permanence. The deposition along with the vegetation will only act to increase the amounts of deposition after subsequent flood events. Over time fluvial landforms will begin to emerge around these structures as flood disturbance events occur and layers of deposition are left and adventitious biota colonizes the sediment.

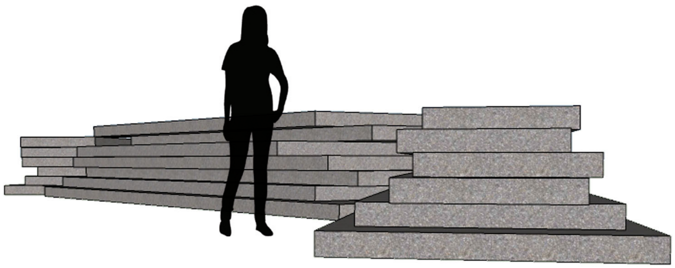


Deposition Structures Function Secondarily as Seating

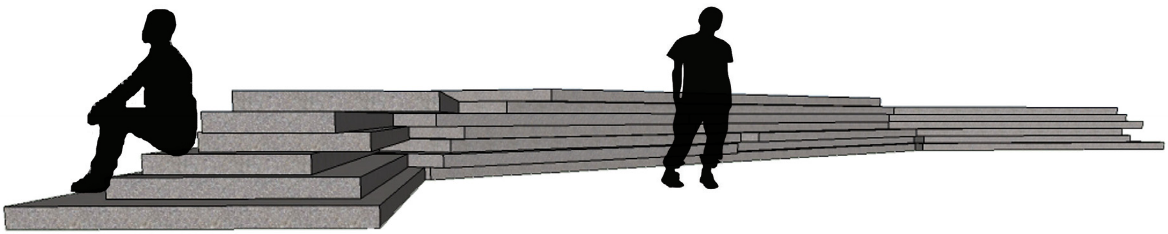








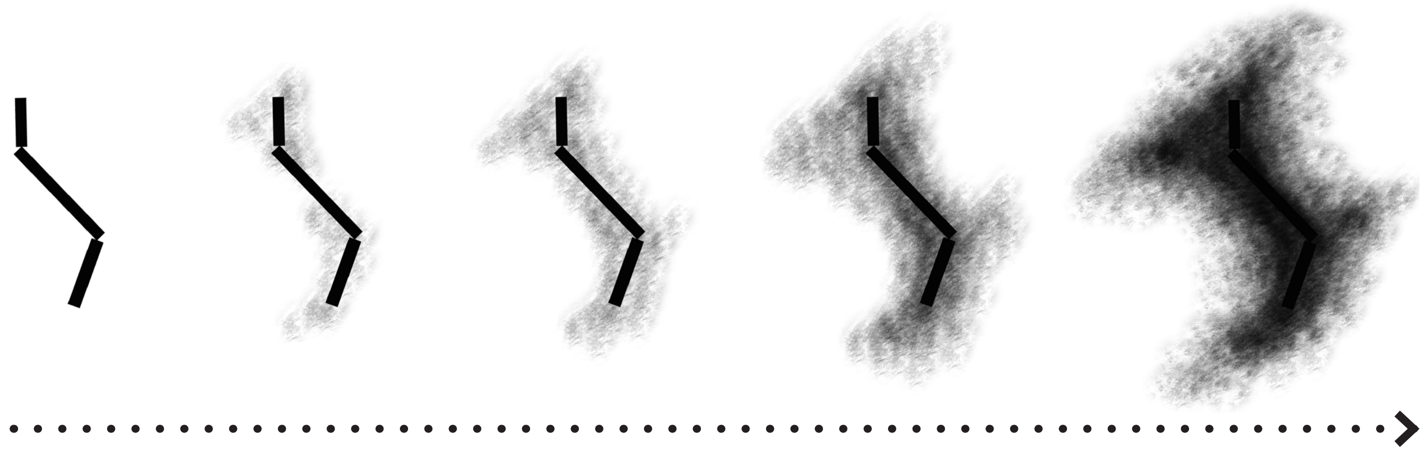
The deposition structures function during flood events to collect deposition, but in normal conditions will serve as seating and to form micro-habitats. The structures will be placed in the floodway along paths so to be accessible and observable by residents recreating or passing through the site.

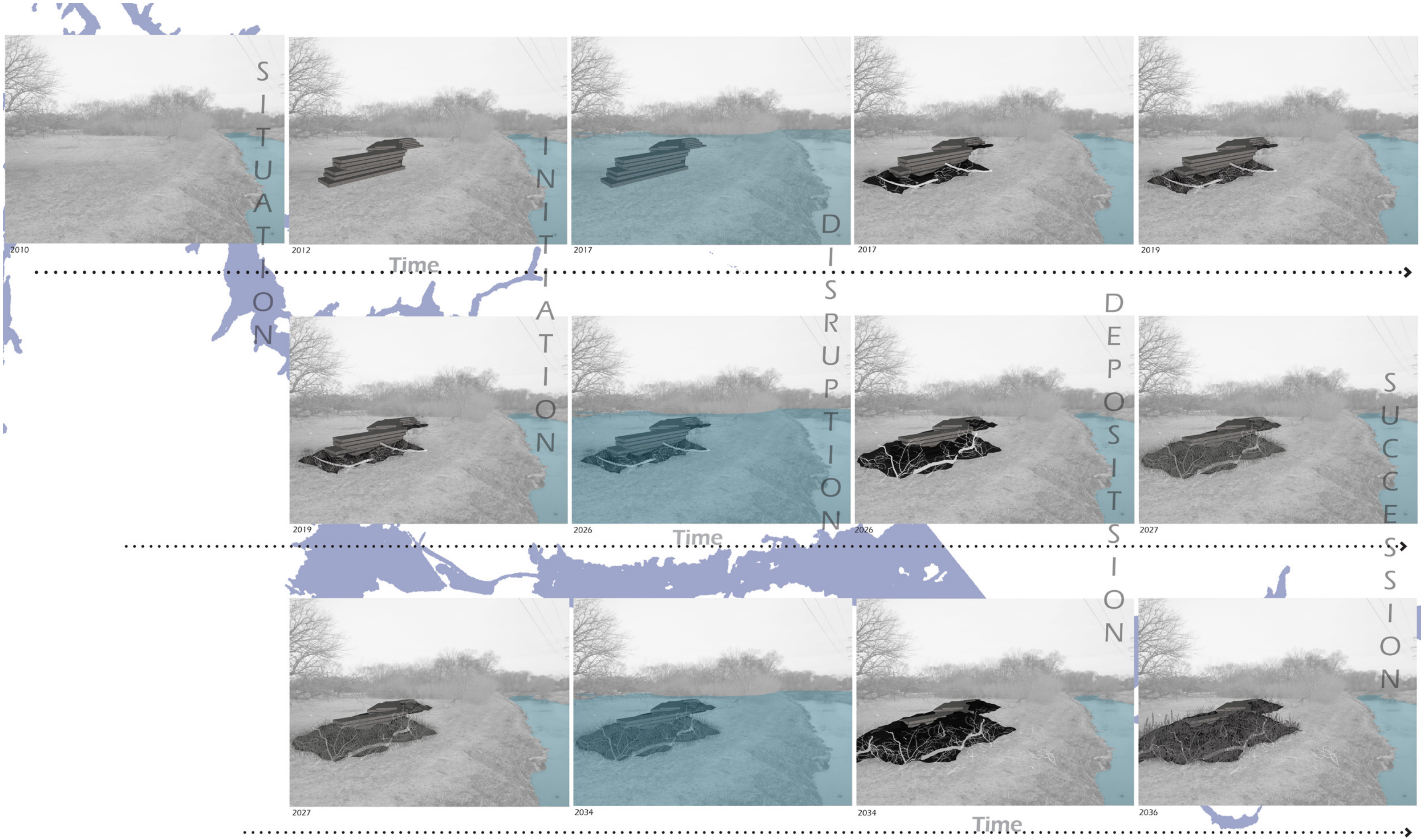


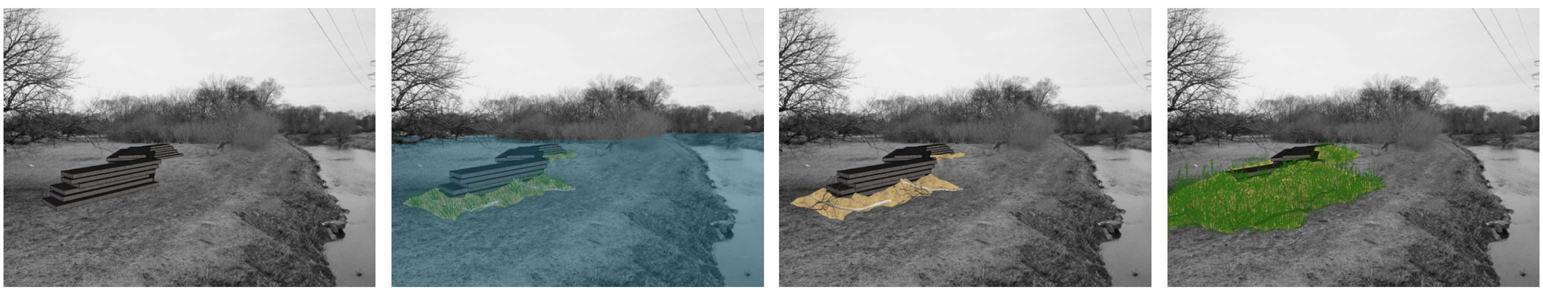
Deposition structure disturbance-colonization-succession sequence

By utilizing the regenerative process of flooding, the goal is for the flooding events of Village Creek to be seen as a positive event rather than a destructive event. The idea is that if the geomorphological processes of flooding can be revealed and highlighted then they can be understood. With understanding comes acceptance and with acceptance stewardship towards the creek will be returned. Floods are naturally replenishing events. They bring new soils to floodplains and they also deposit plant seeds and material. These organizing qualities of floodplains are what the research project is trying to embrace. The human disturbance of efforts to control the creek are juxtaposed to the disturbance that the creek naturally endures. Both types of disturbance alter the creek and floodplain in unique ways, but designing with this disturbance in mind, landscapes can be created to allow this disturbance to happen without disrupting the social or infrastructure systems that functioning simultaneously on the site.

By establishing initial conditions for the floods create form and habitat within the landscape, the goal to change local attitudes towards the flooding of Village Creek. Instead of seeing the floods as a destructive and damaging event users of this terrain may eventually come to view flooding as a necessary and natural process that is used to regenerate and replenish the floodplain landscape.

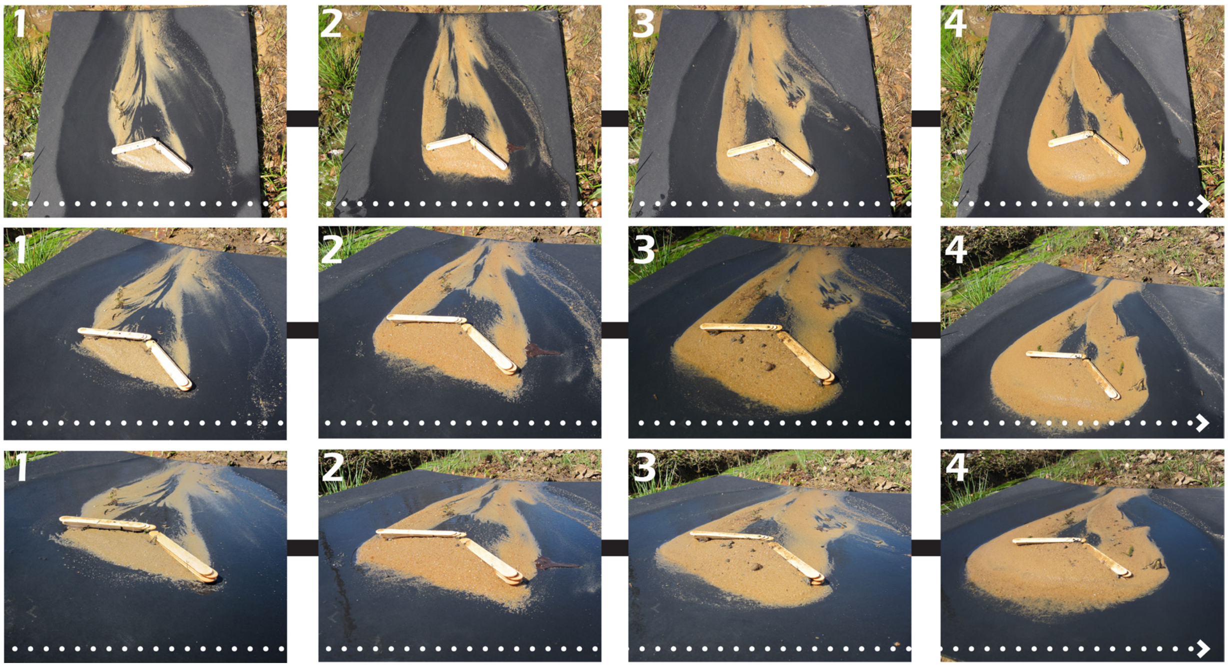



SITUATION
INITIATION
DISRUPTION
DEPOSITION
SUCCESSION
2010
2012
2017
2017
2019
Time
2019
2026
2026
2027
Time
2027
2034
2034
2036
Time

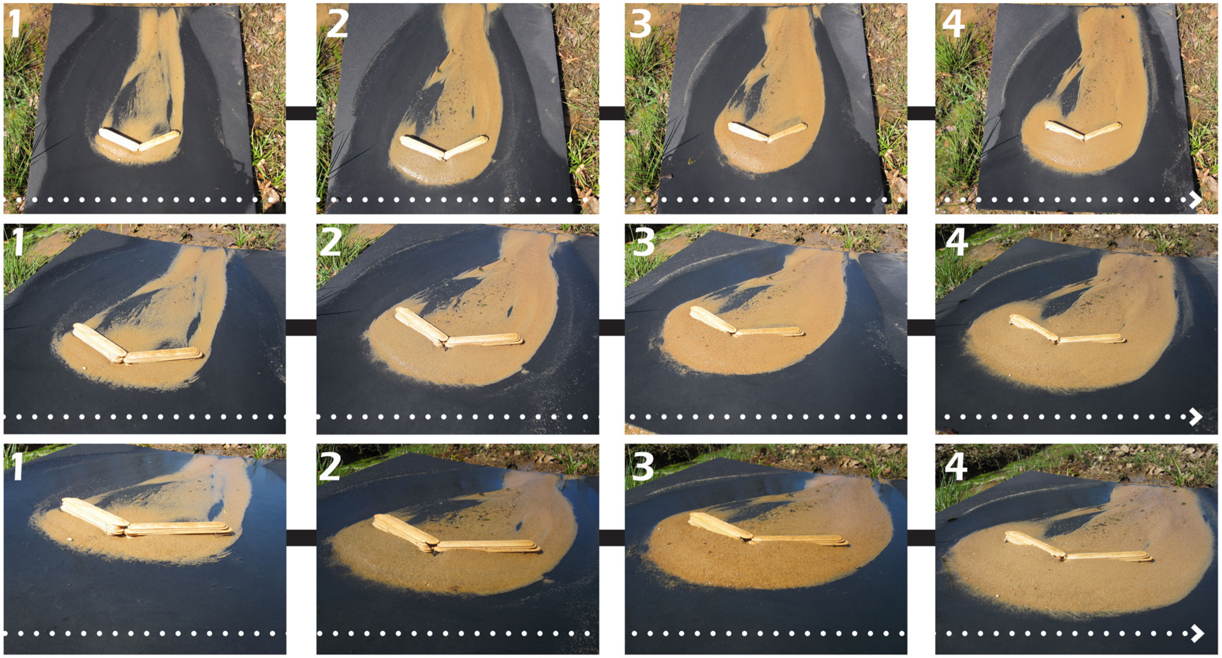


Deposition structure modeling

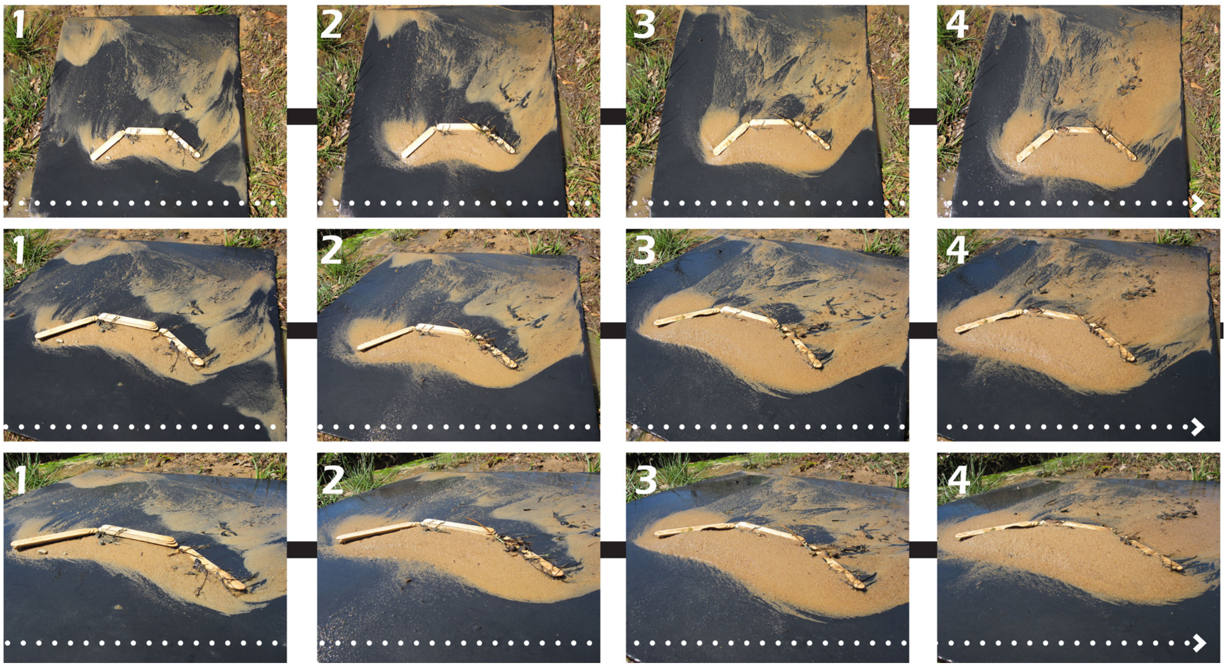
Test 1: *Single Face Sediment Wall*



Test 3: Double Face V-Shaped Sediment Wall ("V" Facing Away From Flow)



Test 2: Double Face V-Shaped Sediment Wall ("V"Facing Flow)



Test 4: Triple Face Sediment Wall

This series of models was used to determine how sediment would form deposition around deposition structures. Four basic shapes of the structures were tested to investigate how sediment would react to the shapes when it was entrained by water. For each shape four flood events were simulated. The tests were performed using the same amount of sand and water for each simulated flood event.

From these tests information was revealed on how the fluvial landforms might appear after years of flood events. These models aided in the decision making process of how to construct the deposition structures and how to orient them along the floodway.

Pathways emerge from road removal

An alternative approach to having to construct new pathways on the site, is to partially remove 50% or more of the road to allow the framework of the once residential roads to organize the new pedestrian circulation system on the site. The street signs would be retained to serve as remnants of the former neighborhood of Moro Park-Ensley.

The images profile two sequences of different areas of the path. The upper sequence shows the situation of the road in 2010 and then 20 years later in 2030 after the road has been removed and colonization and succession of vegetation has taken place on the site. The 2050 image shows the pathway after it has succumbed to natural processes on the site and years of deposition have covered up the pathway residents eventually stopped using. On top of the layers of deposition vegetation has colonized and the adjacent terrain has reclaimed the pathway.

2010

2010

2012

2030

2050

The lower sequence profiles a separate section of pathway along the site. The 2010 situation shows the current road in place. By 2012 the road has been reduced to a pathway and some vegetation has colonized the adjacent area. By 2016 some native grasses have been planted to line the pathway and the adjacent vegetation has continued to succeed. By 2022 the vegetation has grown substantially and the native grasses that were present in 2016 have been crowded out by more resilient vegetation.

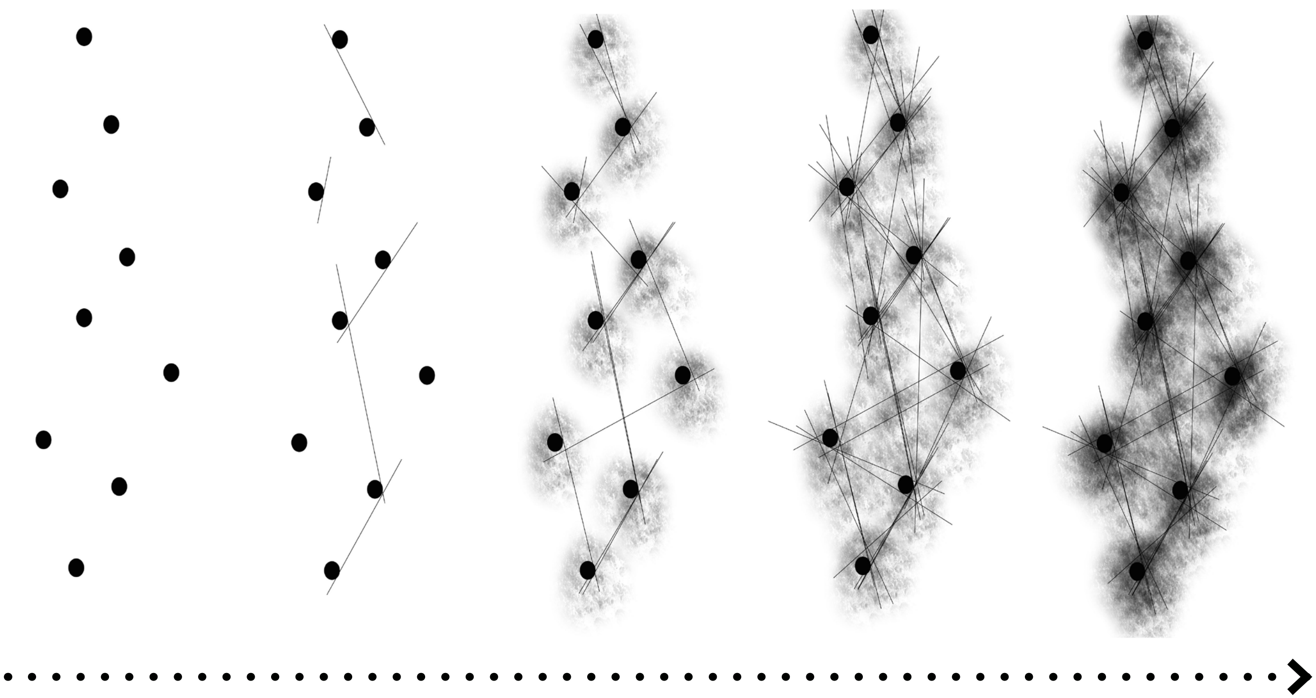
2016

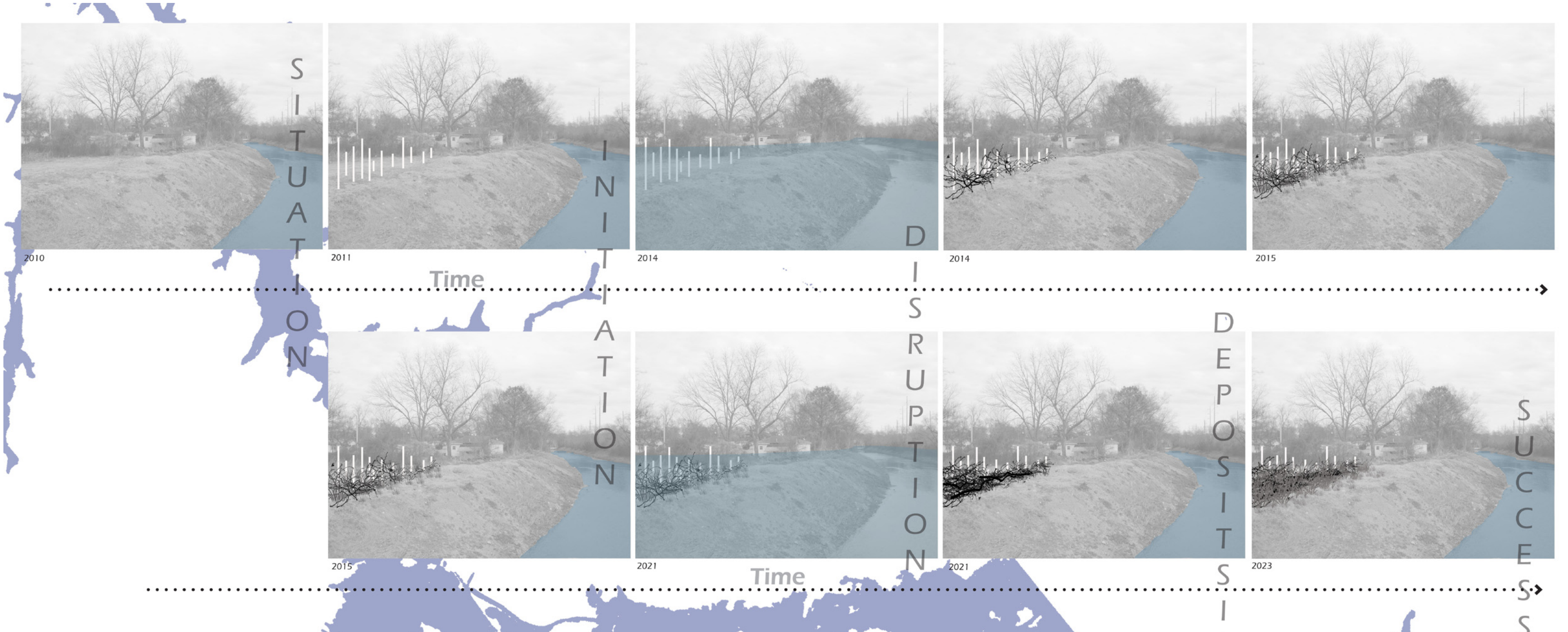
2022

Fluvial rod disturbance-colonization-succession sequence

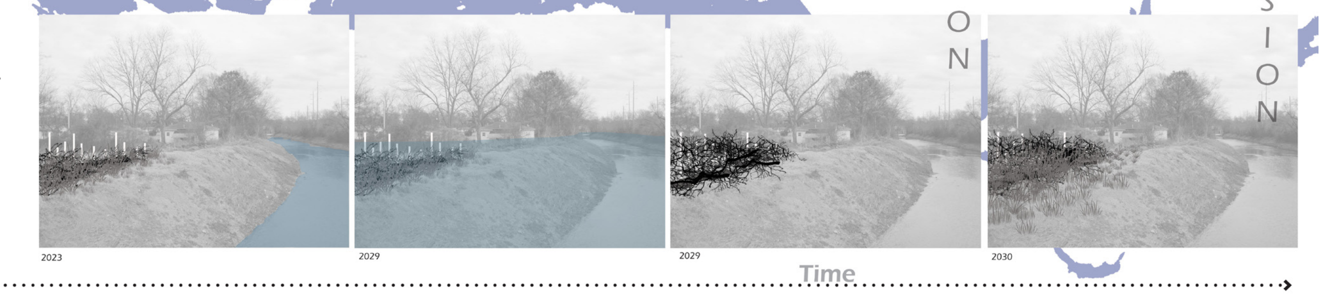
Fluvial rods, or poles will be set along the stream banks to not only stabilize the banks by encouraging natural deposition processes, but they also reveal the process of erosion. The rods will mimic the natural effect that tree trunks have on a flood banks by working to encourage deposition of sediments entrained in either stream flow or run-off flow. Deposition will build up around these rods and will build the banks up. In addition, adventitious vegetation will colonize the piles due to the new soils being deposited. The rods paired along with the new vegetation will act to stabilize the stream banks and provide the situation with an ecological and economical sustainable alternative to gabion walls or the processes of having to constantly build the creeks banks back up.

The other process the rods will reveal is erosion. The rods either encourage deposition or reveal erosion due to their placement and configuration along the stream banks. When placed in lines that are tightly formed the rods induce deposition. When the rods are scattered loosely along the stream banks they will allow the process of erosion to be revealed. When the rods are initially set they are painted white at grade. As erosion occurs the unpainted subsurface portion of the rods will be revealed. This will act to reveal the natural process of erosion and will also act as an indicator to the amount of erosion that is occurring on the banks.

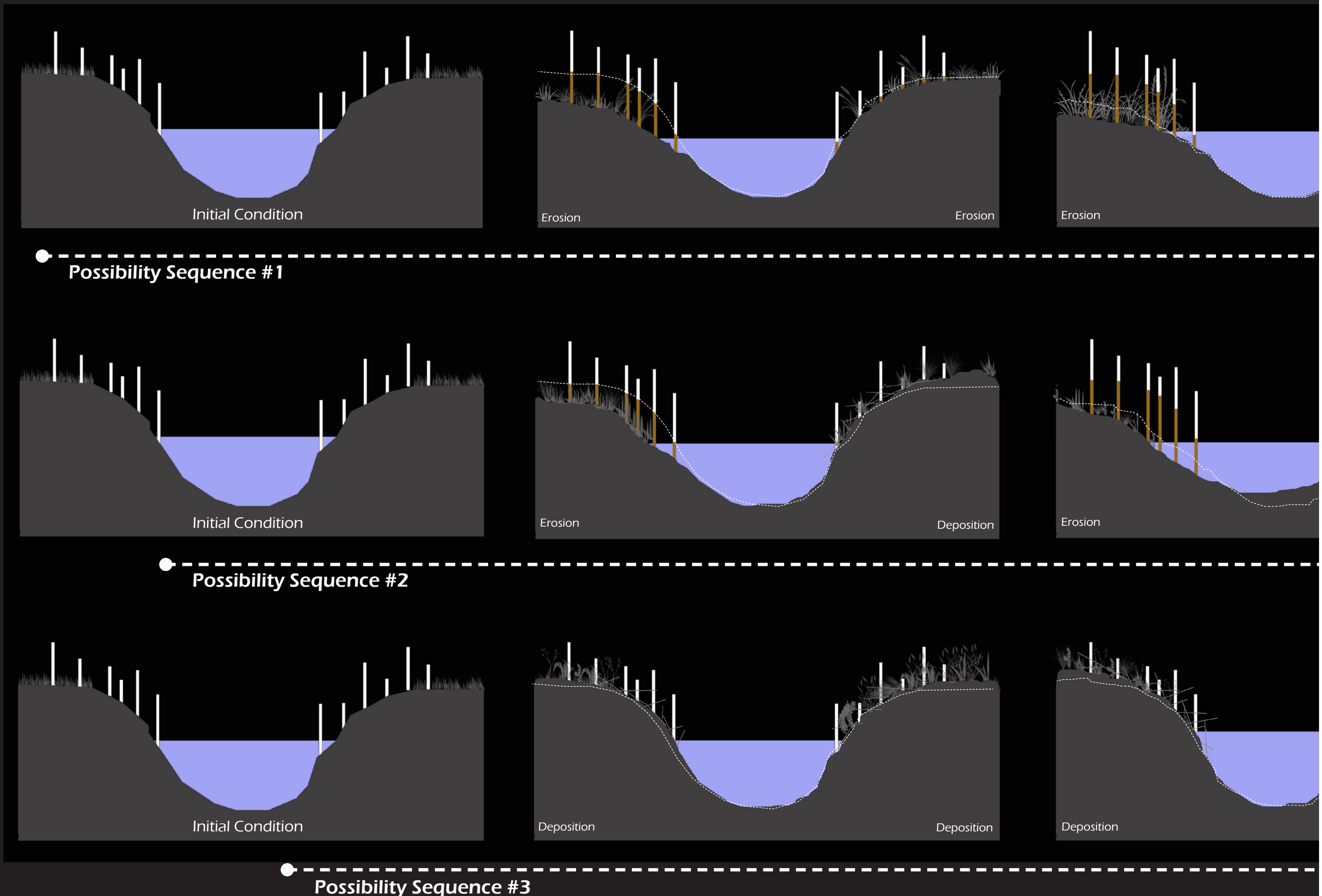


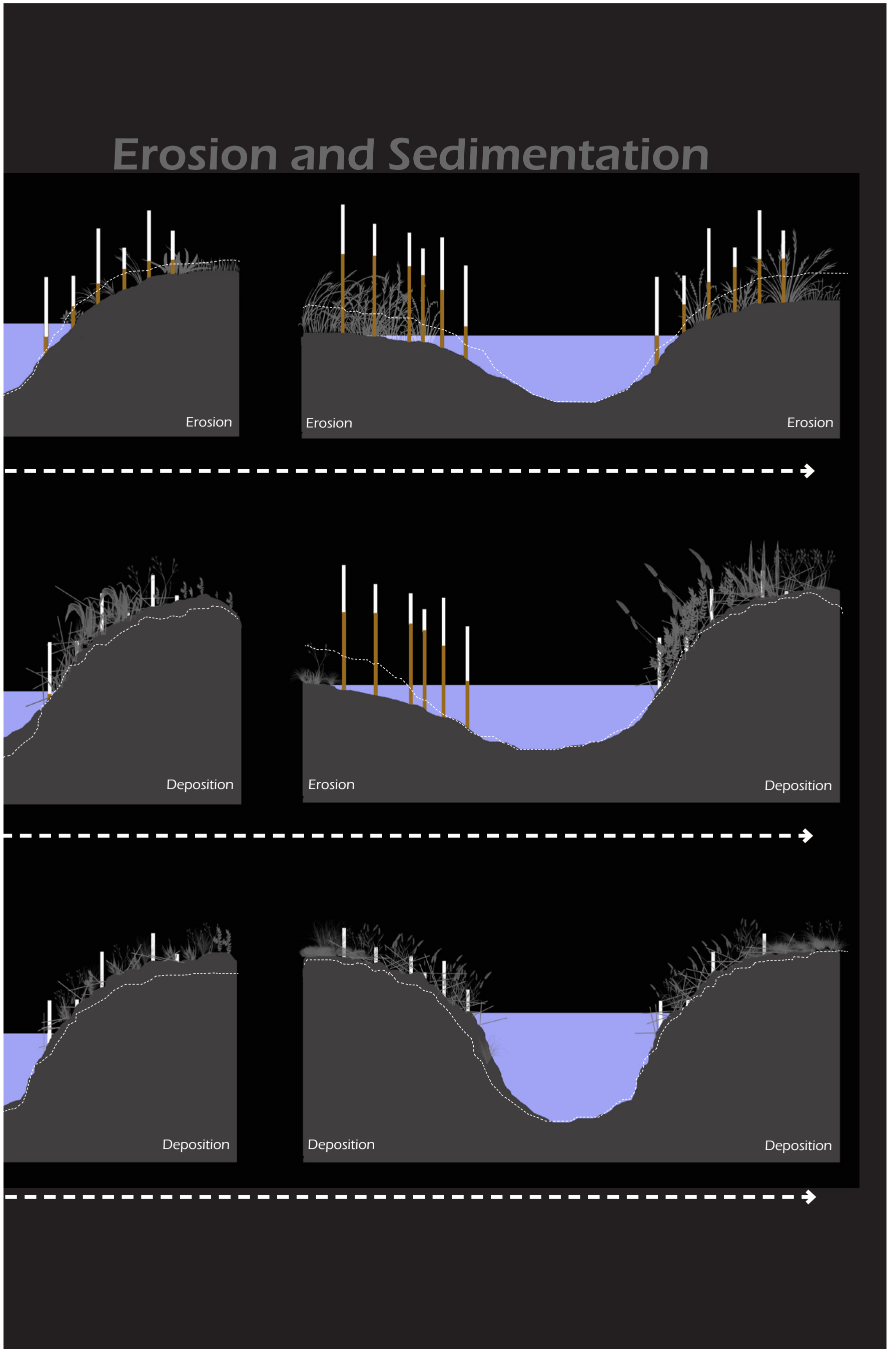


This sequence shows four flood events and how deposition of sediment, woody debris and litter could accrue around the fluvial rods over time.



Revealing the Geomorphological Processes of Flooding





The following sequences shows three different scenarios or possibilities for the rods. In each sequence on the left side of the bank the rods are in a loose configuration to show the erosion process. The right side of the bank is set in a tight configuration of rows.

Sequence #1 shows the possibility that the rods may not stabilize the banks and erosion occurs on both sides of the banks.

Sequence #2 shows what would happen if the intervention invoked the response that was intended. The left side of the banks erodes and reveals the lower portions of the rods and deposition occurs on the right side of the bank, therefore stabilizing it.

Sequence #3 shows the possibility that both configurations of the rods could actually promote deposition. In this scenario deposition occurs on both banks reducing the width of the stream channel and causing it to incise.

Fluvial rods reveal the natural proccesses of deposition and erosion

This image shows the initial condition of the fluvial rods. The near side of the bank has been set in a loose configuration to reveal the erosion process. The far side of the bank has been set with rods placed in rows with tight spacing. The rods are painted white from the surface level up in order to reveal the erosion process.

2011

This image shows the same location 10 years after the initial condition was established. As can be seen, erosion has occurred on the near bank and the unpainted portions of the rods have been revealed. On the far bank deposition has occurred and the rods appear to be shorter than they were in 2011 because sediment has begun to bury them. Vegetation has also colonized the stream banks which further aids in the stabilization of the banks.

2021

In Australia a form of "soft engineering" has been used to stabilize stream banks for the Werrington Creek Restoration Project. The project uses environmentally sensitive wooden piles to take advantage of the natural sediment deposition process that will help stop and even reverse the process of erosion. The piles are placed in tight configurations of lines on the outside of creek bends where erosion usually occurs. The tight configuration ensures a maximum amount of deposition without interrupting the flow of the creek. This wooden pile system is a sustainable way to stabilize creek banks because it mimics the effects of tree trunks in the stream bank. On top of encouraging deposition the piles also intensify rehabilitation of the creek bank vegetation which will also aid in stabilization of the banks. The wooden pile system is a sustainable alternative to typical engineering solutions that allows and encourages natural process of the creek to occur. The piles are also easily removable, or moveable if the situation called for it (Werrington, 2010).

WOODEN PILES

CASE STUDY

Werrington Creek Restoration Project, Australia

Fig. 29

Wooden “piles” are used to stabilize the creek banks

Fig. 30

Fig. 31

Faschine is a bank stabilization process that is being used in European countries in stream bank restoration projects. A faschine is constructed from a bundle of sticks that are bound in circular bundles that are held in place by vertical stakes driven into the banks. These bundles utilize the natural process of deposition to help further stabilize the banks and encourage vegetation. This is another low cost and ecologically sustainable alternative to hard engineering structures used in creek stabilization.

FASCHINE

CASE STUDY

Lahnung is another stabilization process being used in European countries. Lahnung is mainly used for coastal reclamation projects, but the its principles can be easily applied to creek restoration. The lahnung are placed in shallow waters and as the tides come in and out sediment is deposited and removed, but deposition occurs at a higher rate than erosion due to the design. Over time the sediment piles up around these structures and land forms around them. Eventually land claims the space that was once ocean. Lahnung is usually constructed of wooden piles set in rows with bundles of sticks lashed between them. The same results can be achieved with only wooden piles (as seen in the top photo) but at a slower deposition rate.

Fig. 32

Fig. 33

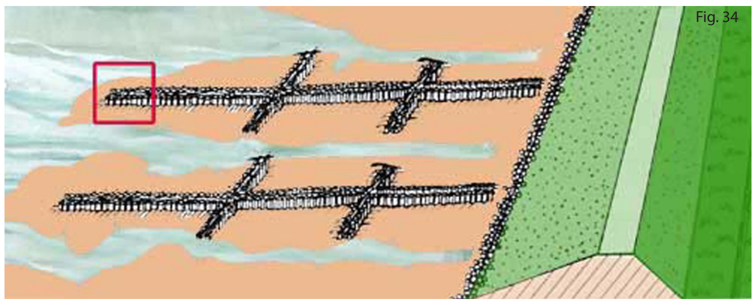
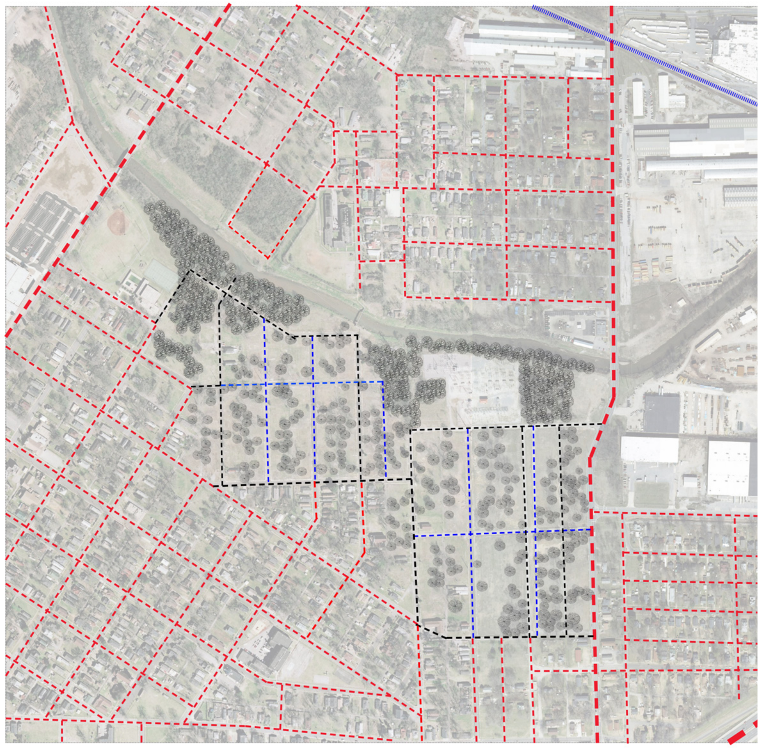


Fig. 34

LAHNUNG

The red dashed lines are the roads at Moro Park-Ensley that are currently utilized by the community and the yellow lines show the under utilized roads that will be removed.



This diagram shows where flood relief channels will be dug on site and where roads will be reduced to paths. The blue dashed lines show where the road will be removed and flood channels dug in their footprint. The black dashed line shows where the road will be reduced to a pedestrian pathway.

Site circulation diagrams

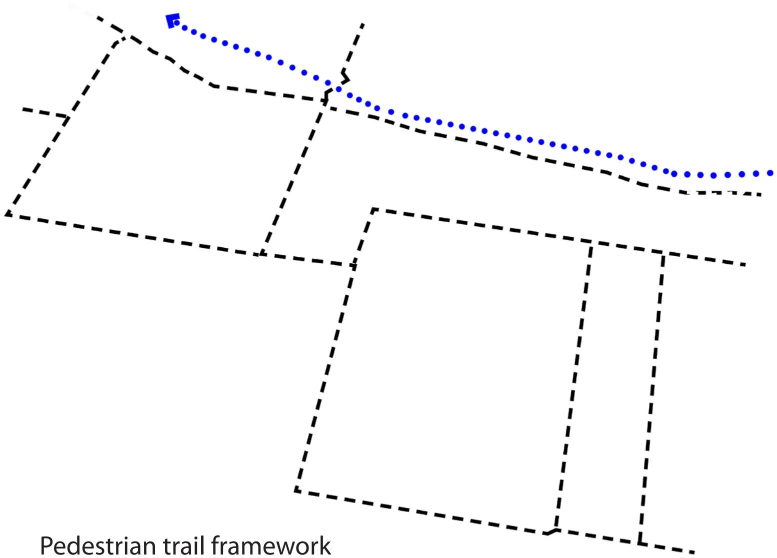
This diagram shows the routes (purple dotted line) of residents as they have moved through and the across the site as witnessed by the researcher.

This diagram shows all three data sets overlaid. The yellow circles are where observed pedestrian routes have intersected the proposed flood channels.

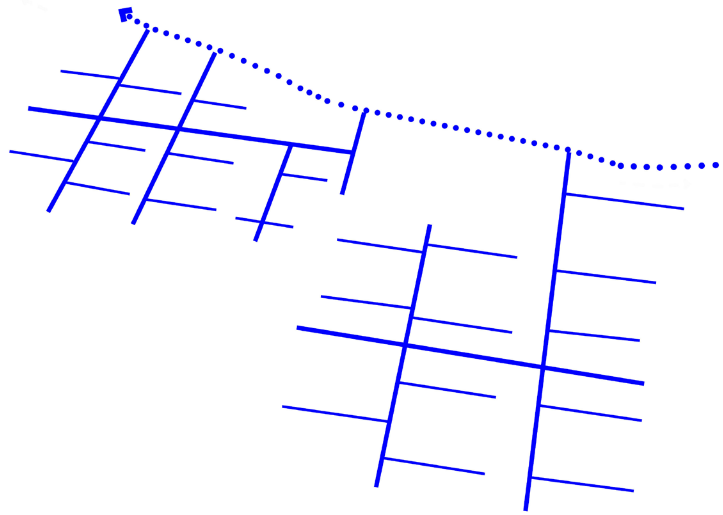
Pedestrian trail and flood channel implementation

These bird's eye diagrams show the pedestrian trails and the flood channels implemented on the site. The black dotted lines are where the residential roads will be reduced by half to leave the pedestrian trail. The solid blue lines in the bird's eye to the right are where the flood relief channels will be dug on the site.

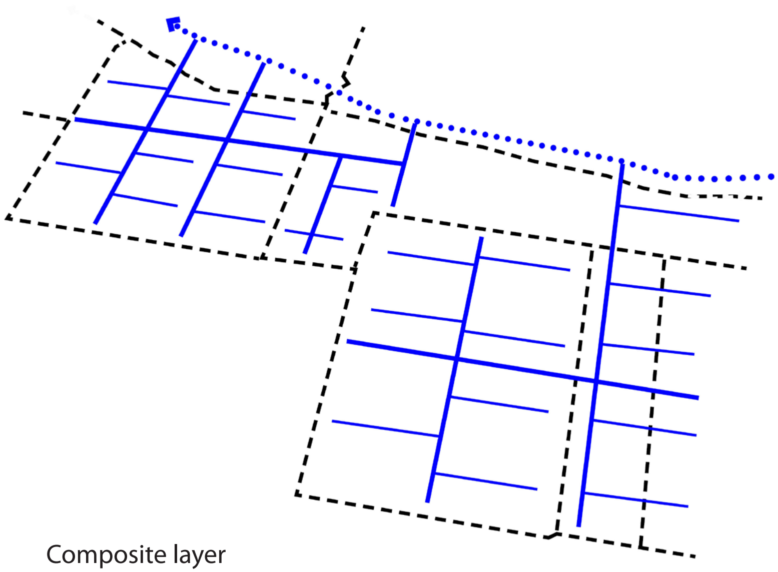
By using the existing framework of the once residential neighborhood to organize this new hydraulic landscape, the idea is that a remnant landscape will be created of the former neighborhood. This remnant landscape will serve as a reminder that flood risk reduction should be practiced instead of flood control. Residential development should no longer occur in urban floodplains. Urban floodplains can serve as valuable amenities to cities if they are protected from development and allowed to function for flood storage without risk of damage to infrastructure.



Pedestrian trail framework



Flood channel framework

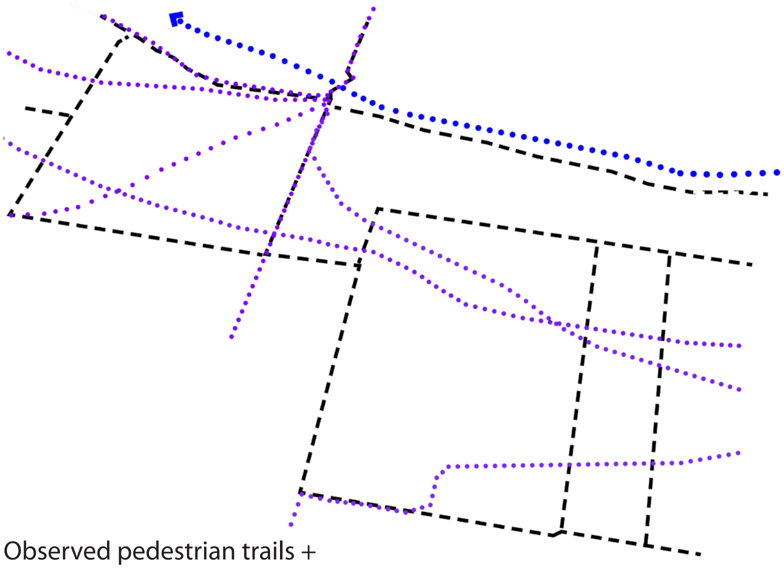


Composite layer

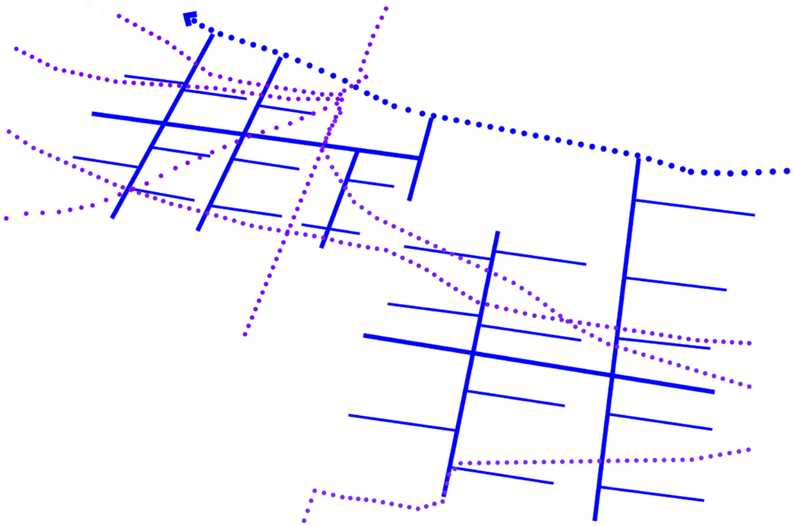
Self-organizing pedestrian trail and succession on site

The bottom left bird's eye shows the paths (purple dotted line) that the researcher witnessed pedestrians using to move across the site. This suggests that the site might possibly be used for circulation in a different manner than the researcher had intended. By allowing opportunities for the site to be self organized by the people who actually use the landscape, the site programming becomes as dynamic as the floodplain that it lies in. After a length of time the site would be evaluated. If pedestrians were still using the cut throughs as opposed to using the defined pedestrian paths, the cut throughs could then be defined. To do this crushed aggregate from the removed asphalt could be laid down to define these pathways that have already been established by the landscape users.

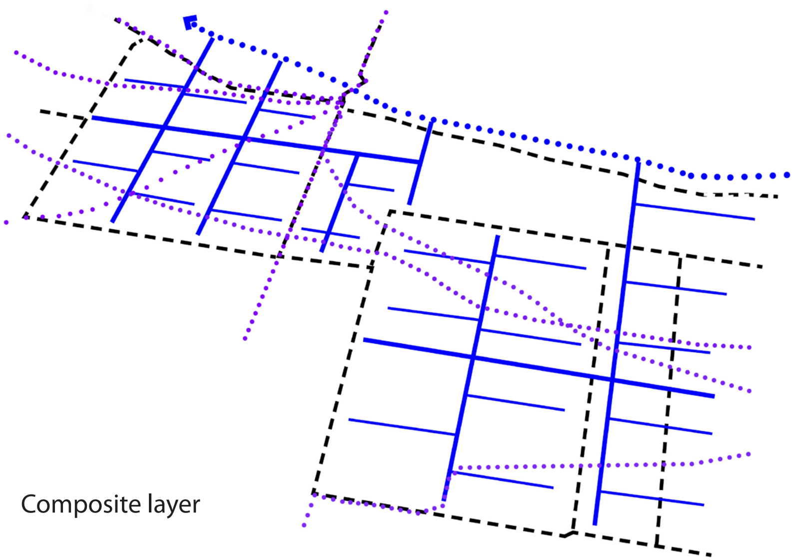
The bird's eye to the right projects what the site could look like after many years of colonization and succession on the site. The goal is for the site to one day become an ecosystem patch that aids in the connectivity of the ecological corridor along Village Creek. The Moro Park-Ensley site could function as an ecological stepping stone for species in the future.



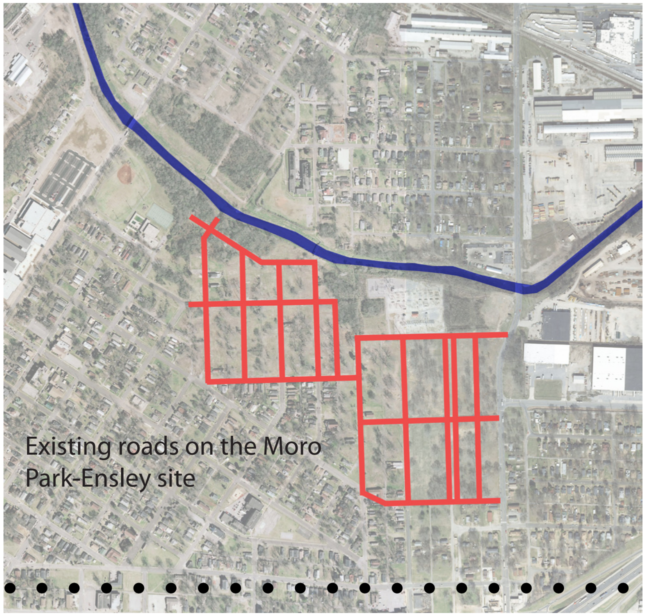
Observed pedestrian trails +
established pedestrian trails

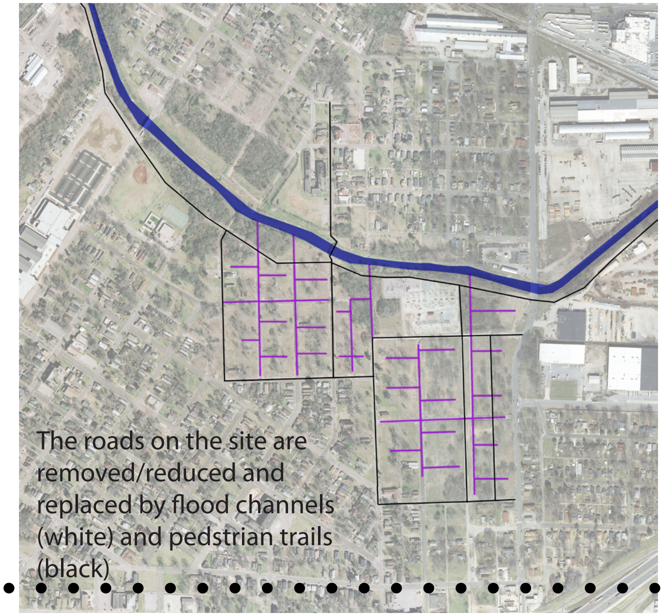


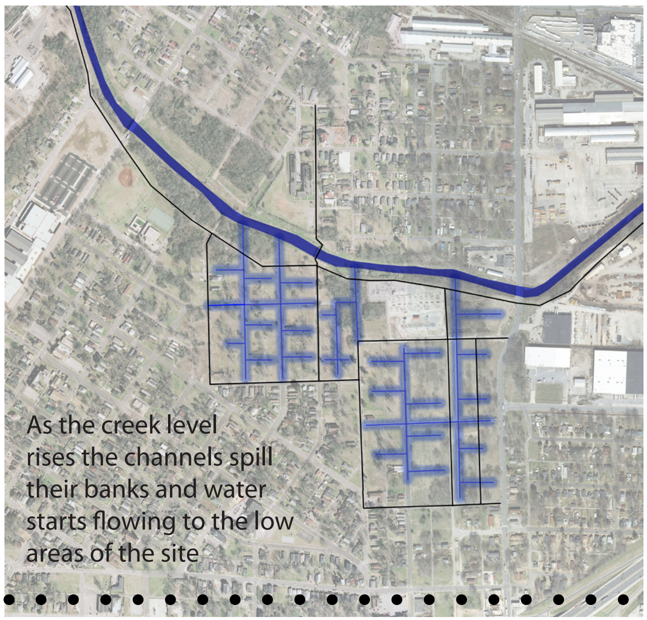
Observed pedestrian trails +
flood channels

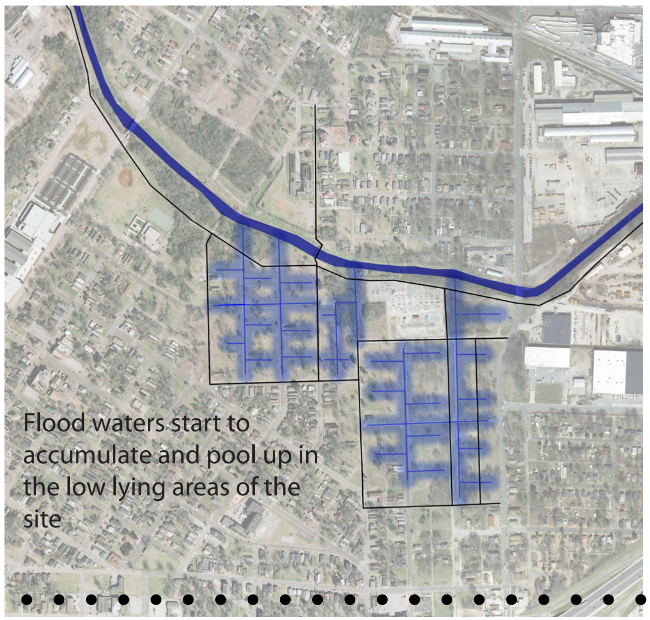


Composite layer

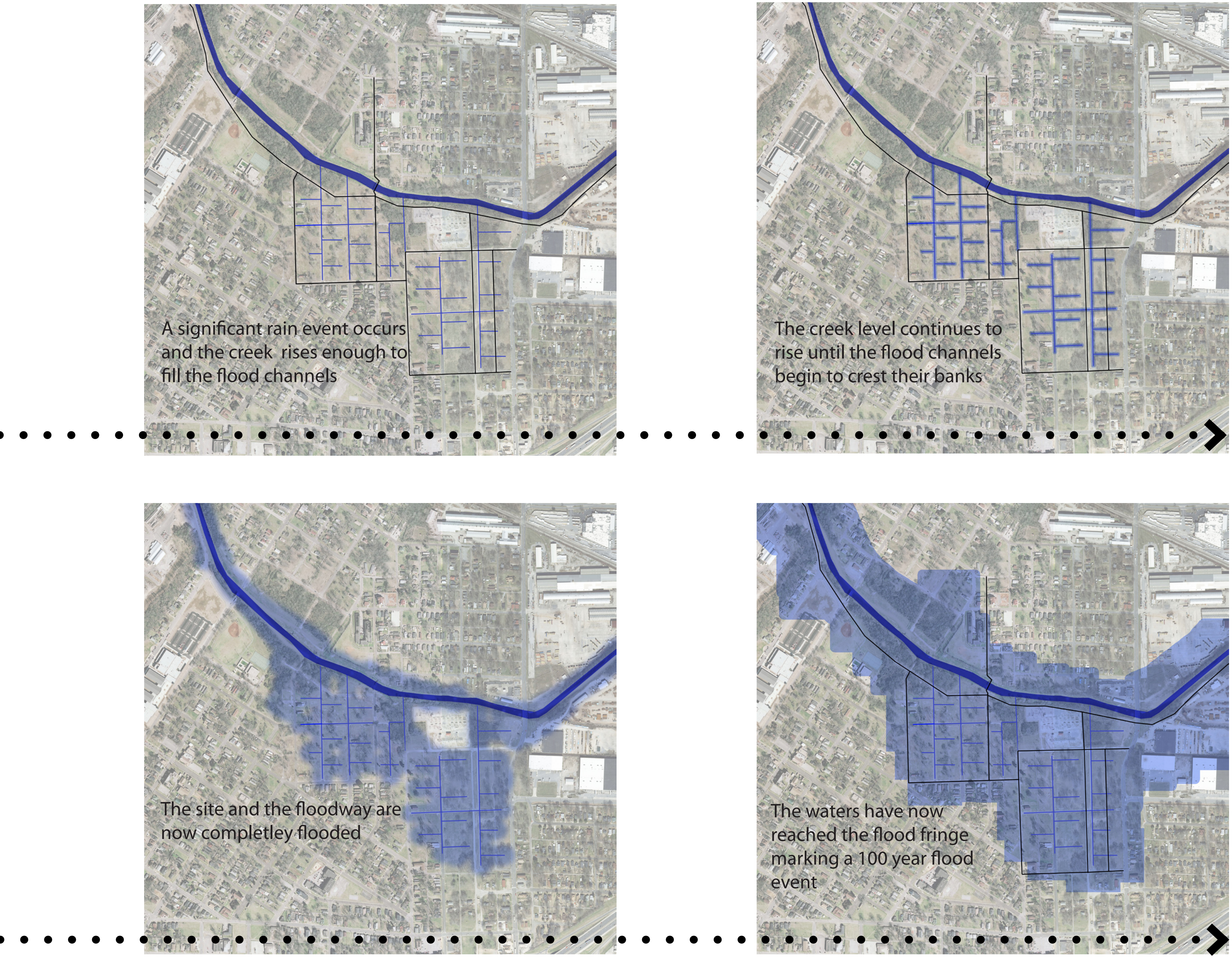

Existing roads on the Moro Park-Ensley site


The roads on the site are removed/reduced and replaced by flood channels (white) and pedstrian trails (black)


As the creek level rises the channels spill their banks and water starts flowing to the low areas of the site


Flood waters start to accumulate and pool up in the low lying areas of the site

Projected flood sequence on site

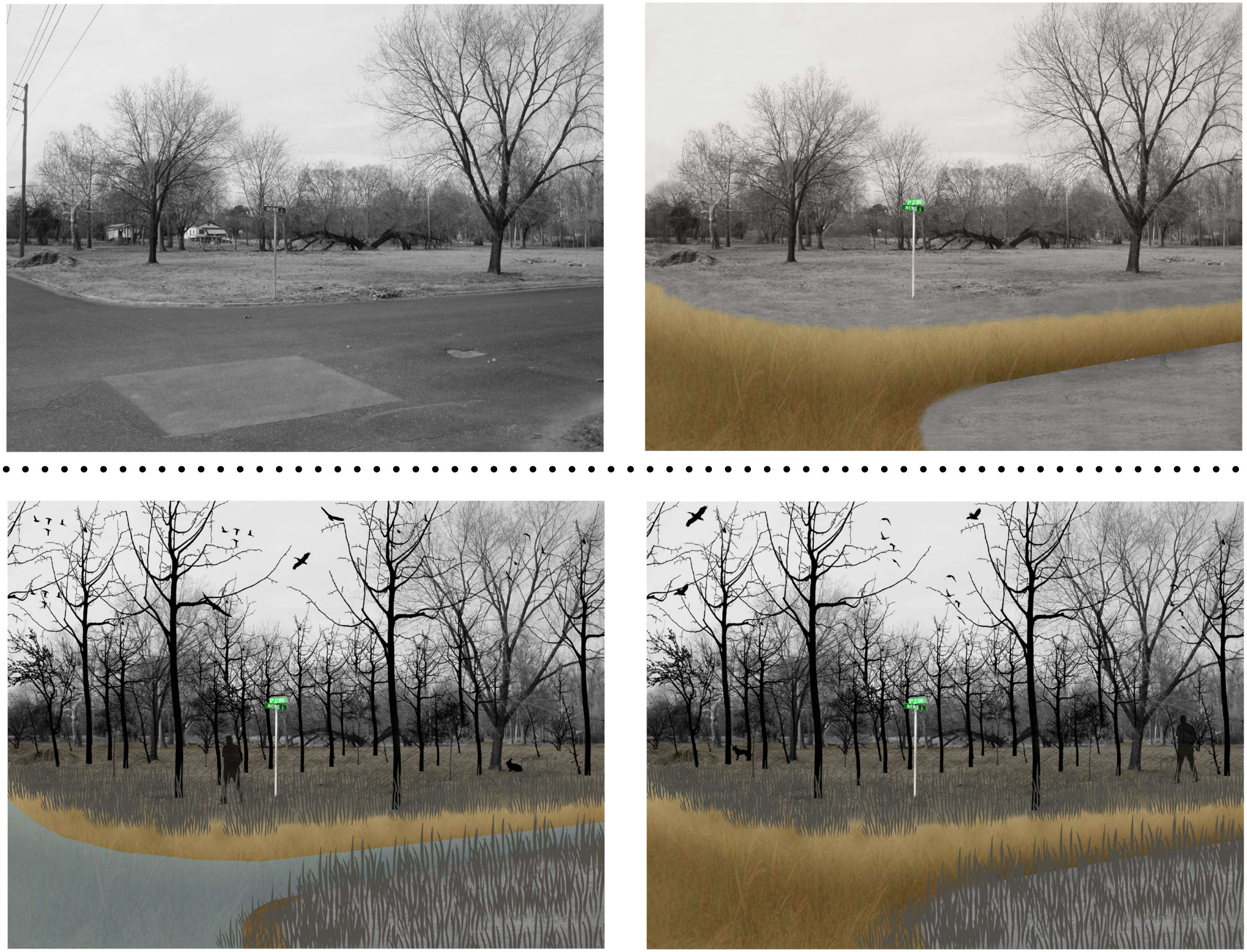


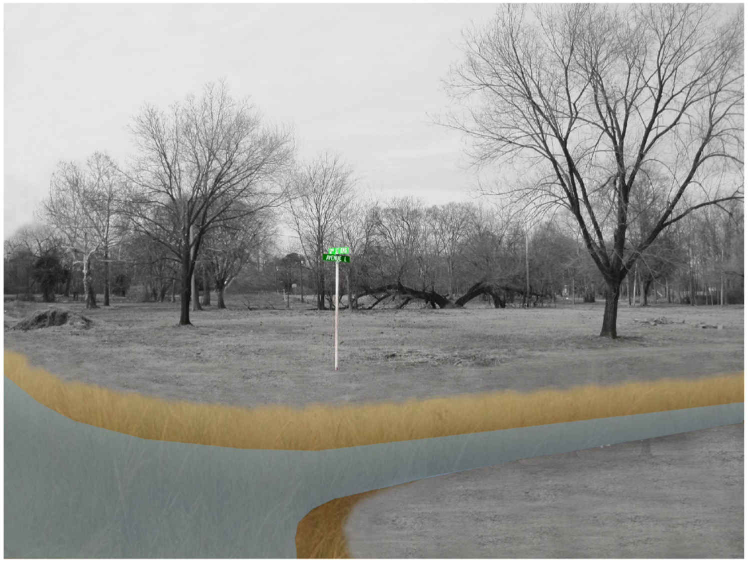
The flood water holding capacity of the site needed to be increased. Instead of creating a large detention area, the flood relief channels would act as linear detention areas. This increased the flood capacity of the site, which will help relieve flooding pressure on the entire length of the creek, and it provides remnant cues of the former residential site. The idea is that if the flood detention channels could be dug on the acquisition sites that they would add up to create a large storm water holding areas that would greatly reduce risk of damage to infrastructure during flood events.

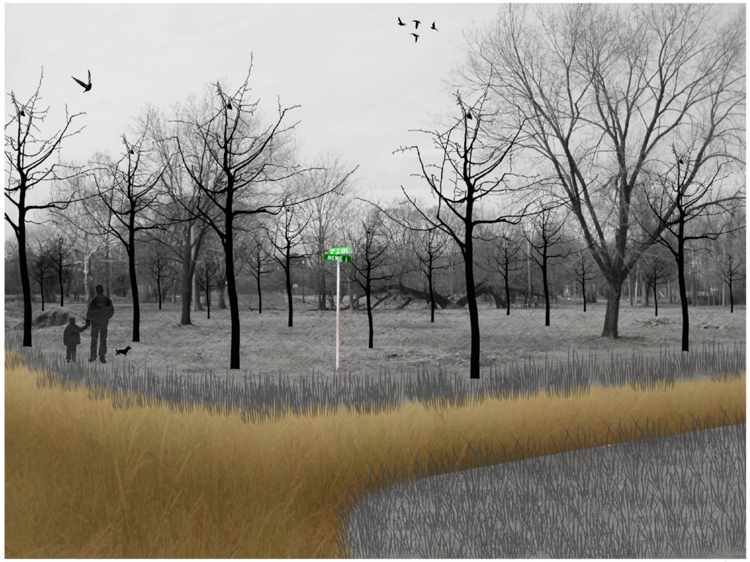
Flood channel perspectives

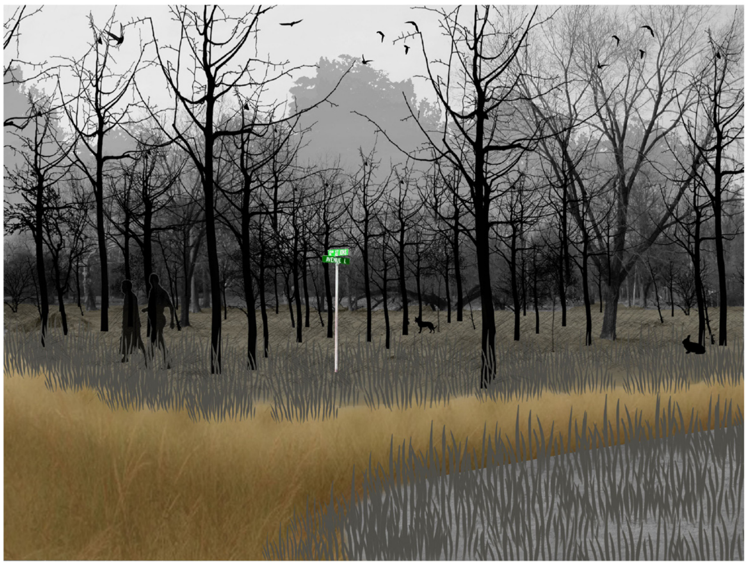
Much like the other design interventions, the flood channels are not exempt from the processes of flooding. Over the years as flood water infiltrate the channels and retreat sediments and debris will be deposited. Over time the flood channels will filled up and be returned to their former grade level, but by the time hopefully development along the creek will have been pushed back far enough by the city that the extra flood detention areas won't be needed.

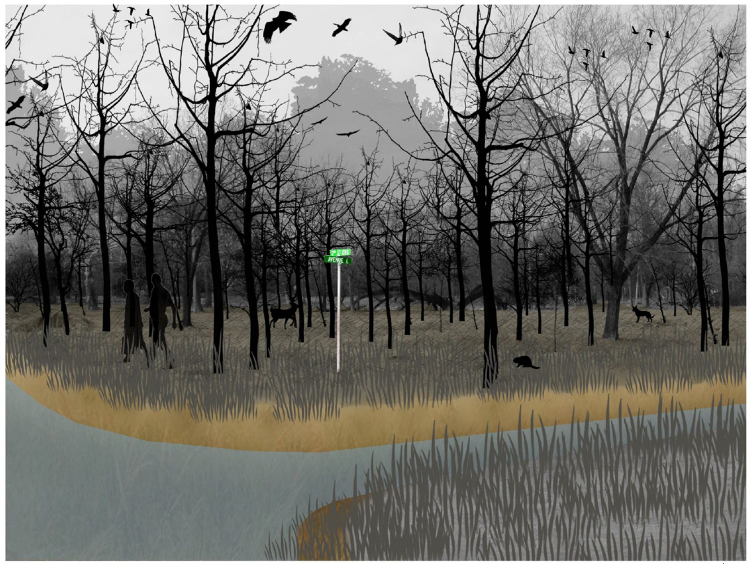
Flood relief channel sequence perspectives







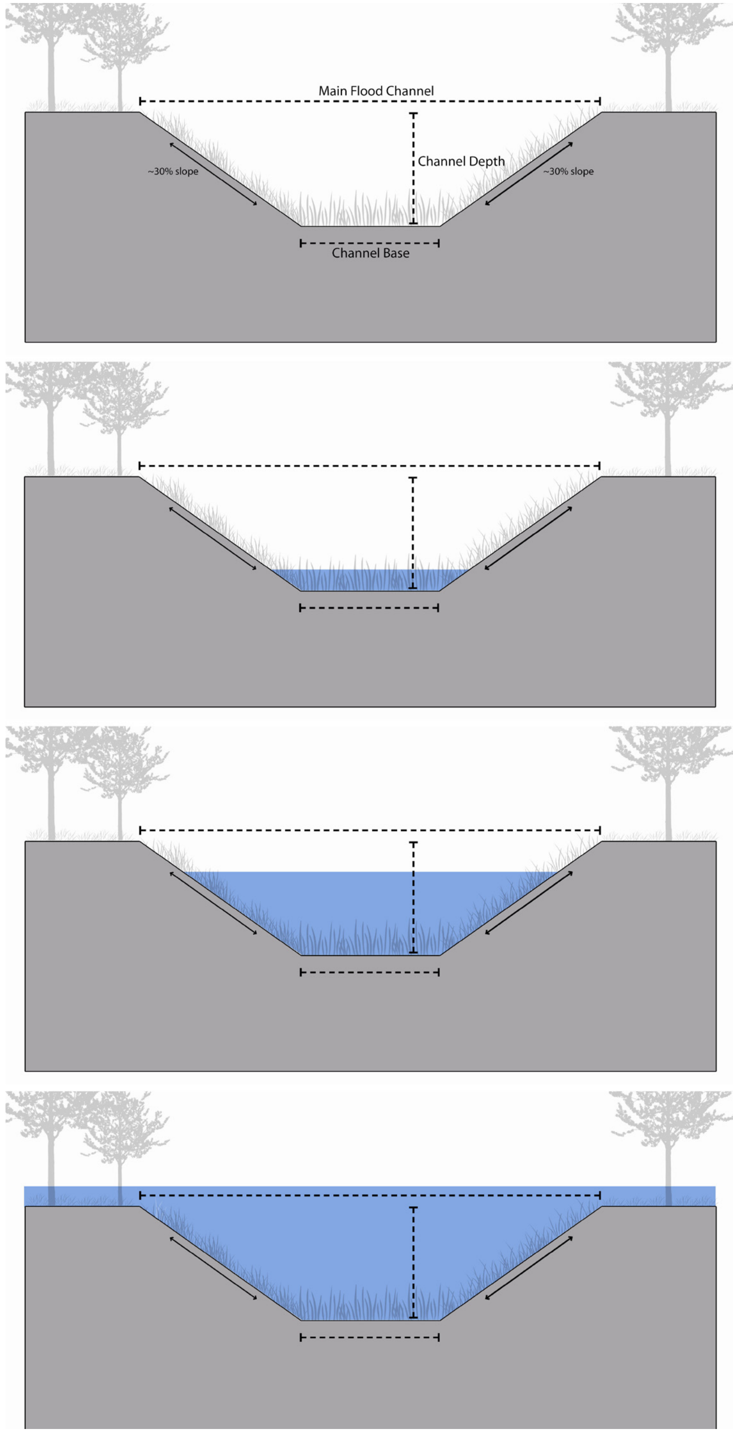




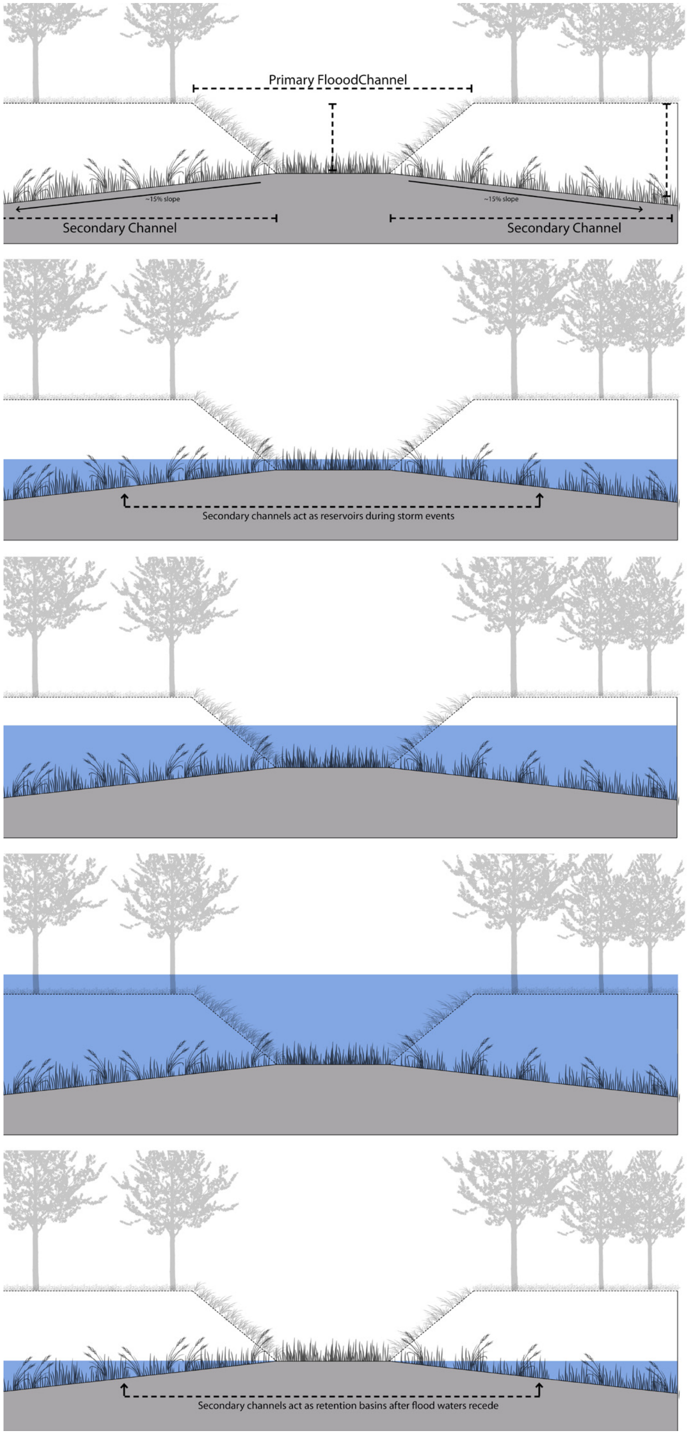
Primary flood channel

Two types of flood detention channels will be implemented on the site. The first type of channel, a primary flood channel, is shown to the right. These channels will be dug in the footprint of the former roads and will be the widest of the flood channels. These channels make up the majority of the additional flood detention capacity of the site and they will range from 20-28' wide depending on the road and from 3-7' depending on the grade. The channel flood will be dug at a level grade so it does not influence flow of water into or out of the channels.

The images to the right show a cross section cut through a primary flood channel and that channel during a sequence of a flood event. The flood channels will be naturalized and any vegetation that colonizes them will be allowed to grow in the channels. These channels could function as microhabitats depending on the amount of rainfall and frequency of flood events.



Secondary flood channel



The second type of flood channels dug on the site will be secondary flood channels. These secondary flood channels will be dug protruding out from the primary channels and increase the flood storage capacity of the site. These channels are much narrower than the primary channels and their grade is cut sloping away from the primary channels. Grading the channels in this manner will allow them to hold storm water after the flood waters have receded and will act as temporary habitats for species.

The image to the left show a cross section cut through a secondary habitat during a sequence of a flood event. The flood channels will be vegetated with what ever plant species colonizes them. The last image in the sequence shows the flood waters being retained after the flood waters have receded from the primary channels.

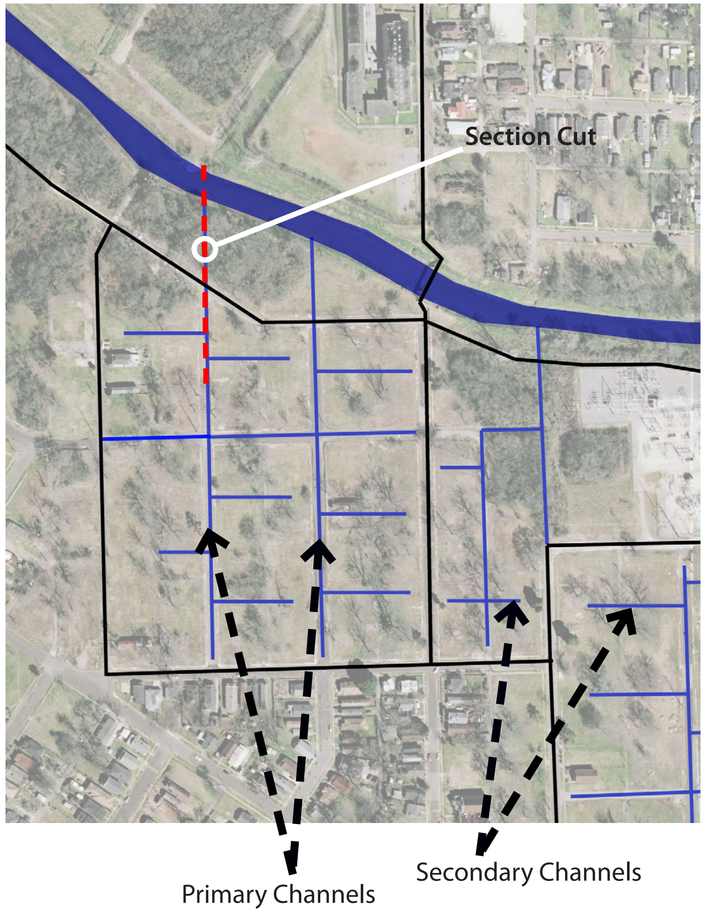
Flood channel storm event sequence

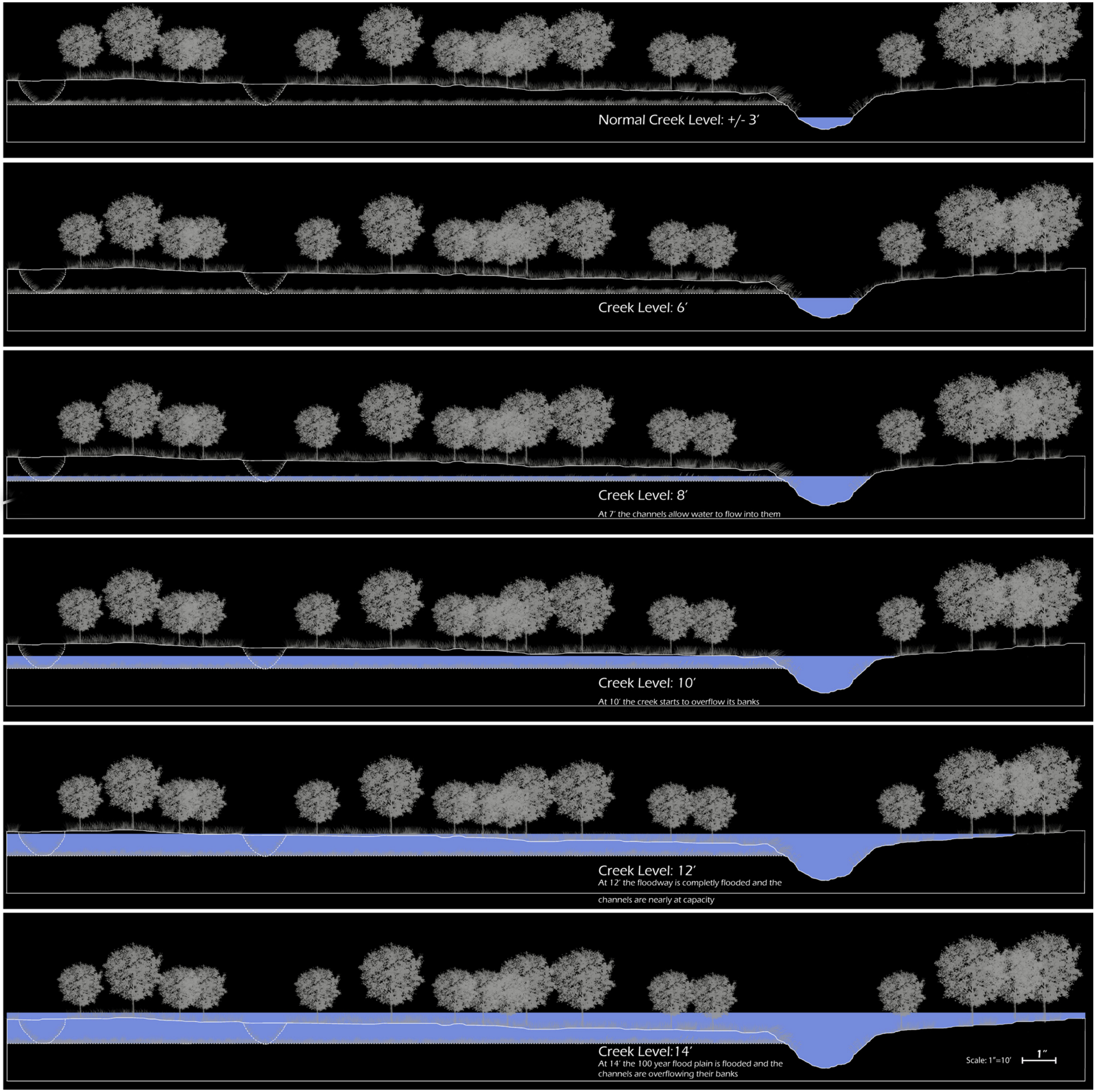
The image to the right shows a flood channel functioning during a storm event. Village Creek's normal flow level is usually between 1-3' as shown in the first graphic. During a storm event, Village Creek can rise up to 3' per hour (Acquisition, 2010). The second section shows the creek level around 6'. The flood channels will be cut into the bank on the site so that when the creek level hits the 7' mark water starts infiltrating the flood relief channels.

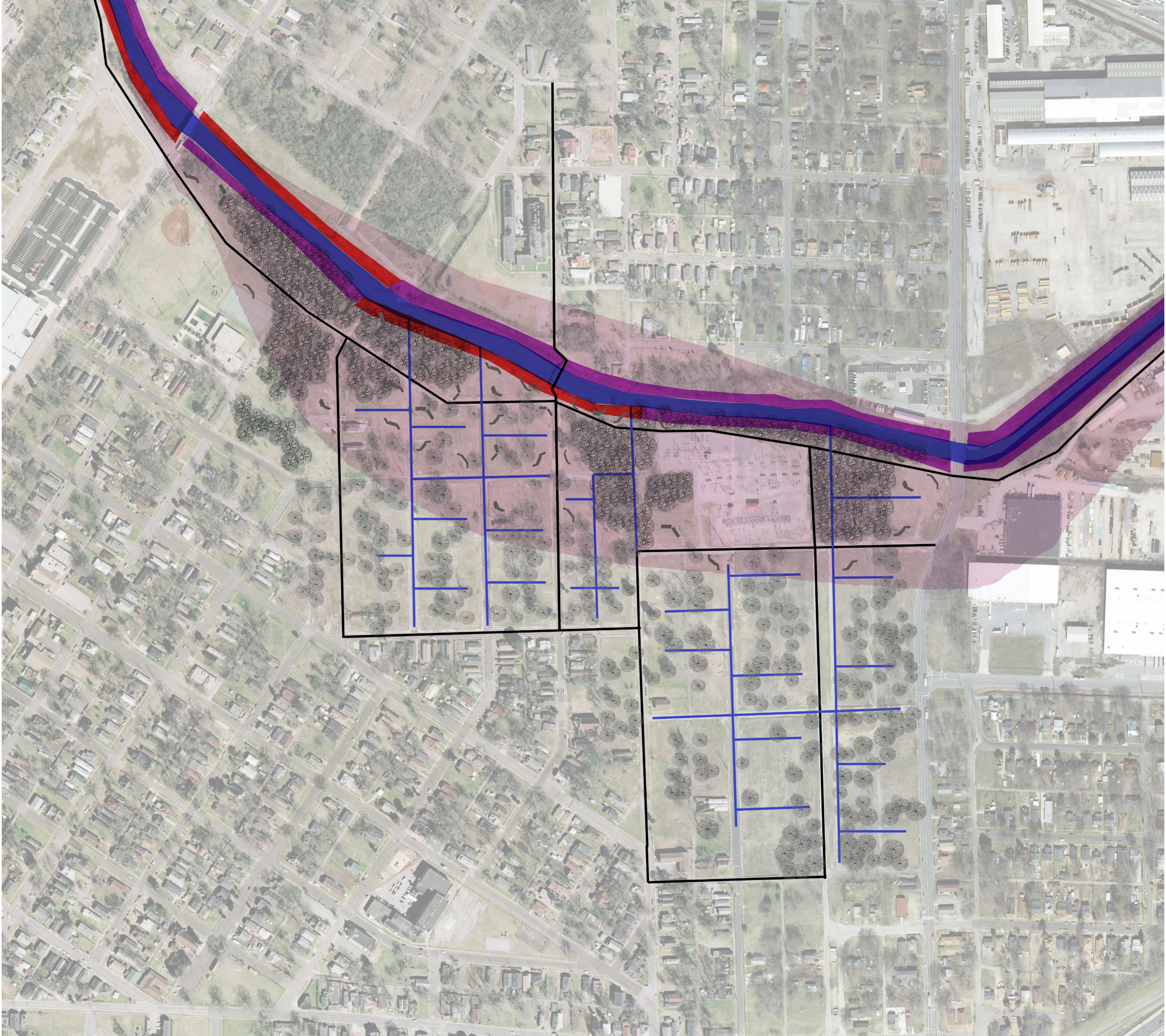
The next section shows the water level around 8' and water is flowing into the detention channel. At Moro Park, overbank flow of the creek starts at 10'. In the final graphic the water is at the 14' mark which almost bests the historical mark of 14.80' that the creek reached on December 3rd, 1983 (Advanced, 2010). The 16' flood mark is what NOAA considers the major flood stage of the creek. At this mark significant flood damage would occur across the entire city of Ensley (Advanced, 2010).

The incorporation of these flood channels along the length of the creek paired with a reduction of development in the floodplain will hopefully lead to a reduced flood risk to residential and commercial properties adjacent to the floodplain.

Section Key

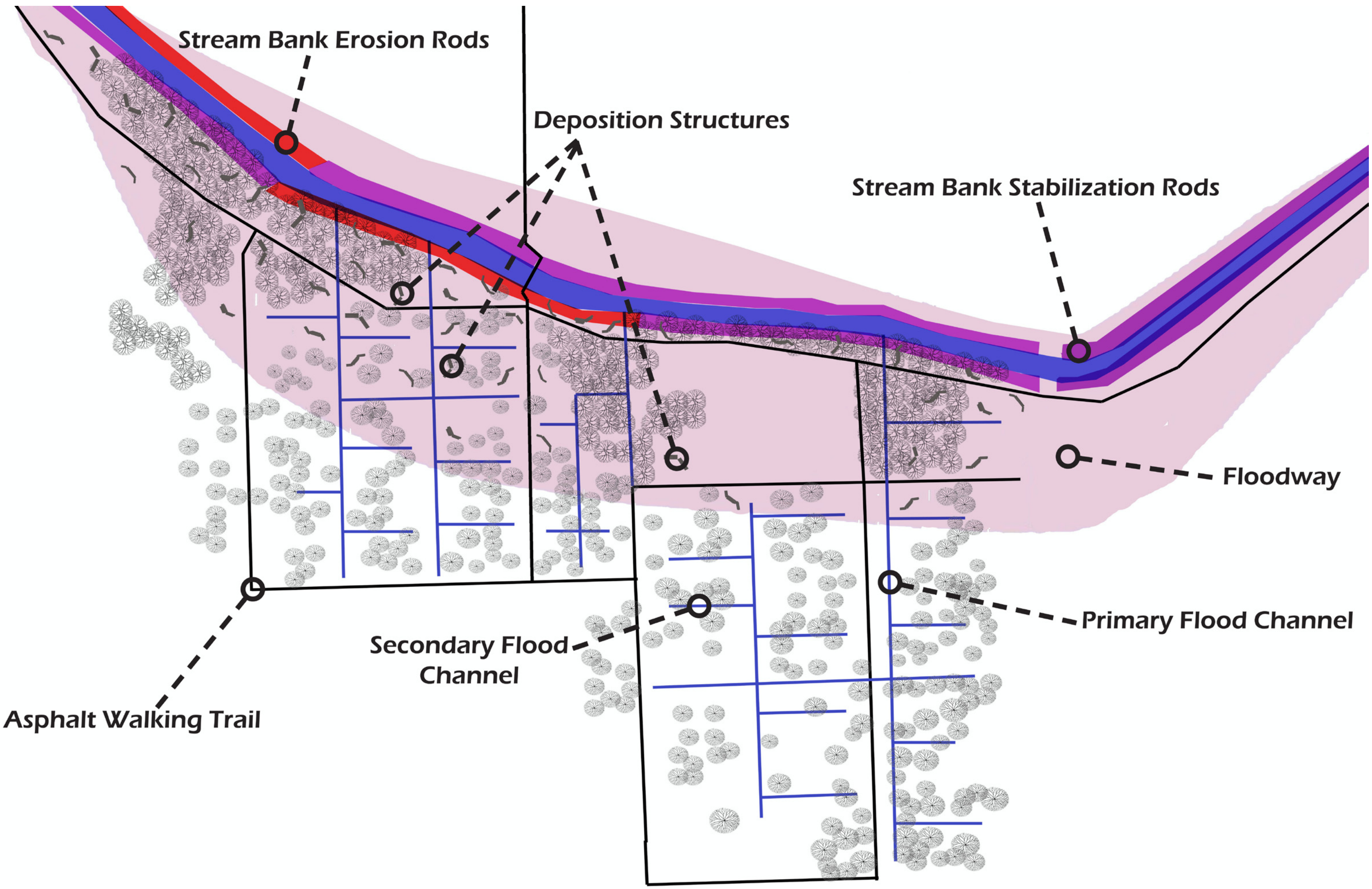



Normal Creek Level: +/- 3'
Creek Level: 6'
Creek Level: 8'
At 7' the channels allow water to flow into them
Creek Level: 10'
At 10' the creek starts to overflow its banks
Creek Level: 12'
At 12' the floodway is completly flooded and the
channels are nearly at capacity
Creek Level:14'
At 14' the 100 year flood plain is flooded and the
channels are overflowing their banks
Scale: 1"=10'
1"



Initial conditions implmentation

This diagram shows generally where all of the design interventions will be established. The purple box along the creek bank shows the areas where the stream banks need to be stabilized by using fluvial to protect residential and industrial sites or schools. The red boxes along the creek show where the stream banks don't need to be stabilized therefore the loose configuration of fluvial rods would be implemented here. The pink outline shows the extent of the floodway. All along the floodway the deposition structures will be placed. The pedestrian trails are shown as black lines and the flood detention channels are shown as blue lines. This diagram shows the implementation of a strategy, not a master plan. The initial condition is shown, but it is subject to much change and evaluation. This general strategy can be easily implemented along the whole stretch of Village Creek and even other urban flood plains.



Possibilities for future social programming on the site

“Most open space that is planned in modern Western cities- parks, plazas, shopping malls, arcades- is decidedly not public: its purpose is to control and direct social interaction, to police it rather than to provide a stage on which various publics can come together in all their often contentious differences and spark a conflagration of public, political and social interaction. In fact, much contemporary open space design stands opposed to public space” (Czernick. P. 103. 2001).

Although the site is initially unprogrammed, the dynamic nature of the site allows for it to be easily programmed for social or civic needs in the future. For an example of this the Village Creek master plan for Moro Park-Ensley was overlaid with the initial conditions diagram to reveal that many of the programs proposed by VCS could easily be incorporated into the site without disturbing the hydraulic processes of the site. Using the site in this manner would reduce the habitat capacity of site due to the constant disturbance, but this example is just to show the open ended possibilities of the site.

The site is designed in a fashion that easily allows for the site to be programmed or altered in the future if needed. The design interventions are low cost and easily moveable which allows the site to be as dynamic as the floodplain that it resides in. The initial conditions of the site are set to engage the hydrological and ecological processes on the site and to transform the existing open space into public space.

The space provides a stage for **social interaction** and **recreation** while performing the important duty of **flood risk reduction** by engagement of natural processes on site.

Conclusion

The situation that the research has investigated is the Village Creek floodplain of Birmingham, AL. Village Creek provided early Birmingham with the water needed to produce steel and it also served as the city's drinking water for some time. A century of poor development decisions left many homes and structures in the floodplain of Village Creek which resulted in millions of dollars in property loss in the Birmingham area. Since the 1980's Birmingham, along with the Federal government has been working to relocate families from the floodplain of Village Creek. These acquisition projects left large tracts of open space which have provisions built in that no structures can be built on them. The next step in the process is to decide what to do with these sites after they have been designated as open space by the city. The design research project investigated one particular site in Moro Park-Ensley and revealed how the ecological model of disturbance-colonization-succession can be utilized by establishing initial conditions to generate form and habitat within this hydraulic urban landscape. By returning a riparian zone to Village Creek, the creek will be able to regain its natural floodplain, wildlife will be able to re-inhabit the area and residents will be provided a space for social interaction and recreation.

This research project challenges the typical method of landscape architectural project delivery. This design methodology is an alternative to the master planning of a site. Typically when a master plan is drawn and implemented it immediately begins to degrade. When designing with initial conditions decay and degradation are accounted for and are not only welcomed, but they also contribute to the form making process. Landscape degradation leads to opportunities for another whole series of events to occur. Designing with initial conditions requires the designer to stay with the project well after the initial conditions have been established. This method allows the designer to make periodic evaluations and adjustments of conditions based on natural responses to the interventions. This project also expands the typical scope of work of a landscape architecture project as it takes into account maintenance practices into the design.

Much like a gardener prunes a tree to achieve a particular final form; when designing with this methodology the landscape architect would make adjustments to conditions to achieve a desired form. The gardener has to know the biological functions of the tree in order to know how his actions will affect its final form. In the same way, the architect needs to understand the ecological processes that are occurring on the site so he will have a general idea of how the landscape will respond to the conditions that he establishes. Pruning a tree for a form has no less formal quality or precision than a well executed steel drawing (Raxworthy, 2006). When working with initial conditions you are working with ranges and possibilities. The designer can never know the exact final form of a design, but based on knowledge of natural processes a final form or a range of forms can be predicted. This way of practicing prioritizes the demonstrable change in landscape and its elements over the final form of the end product (Raxworthy, 2006).

By using an ecological model as a machine without idealizing it, the model can be utilized to generate form in the landscape (Raxworthy, 2006). This methodology is currently being used in European landscape designs. In order to implement this type of project in the United States a very particular client and situation would be needed. This research project is an example of a situation where this design method would be appropriate and hopefully accepted. The client for this project is the City of Birmingham which is facing an economic crisis, so the low cost aspect of this project would be very appealing to them. The other aspect of this situation is that it's a series of large open spaces that are currently unused by the city, so it provides a design solution to these ambiguous open spaces. To introduce this design methodology a site would ideally need to be public space in areas where aesthetically naturalized landscapes are already generally accepted, such as riparian zones.

The proposal offers a low cost and dynamic solution for the question what to do with these flood acquisition properties that responds to the economic, ecological and social needs of the city. By implementing this phased corridor along Village Creek, the creek will be allowed to flood naturally with no risk of flood damage to neighboring residents. A riparian zone will allow opportunities for connectivity and dispersal for species as well as providing habitat for edge adapted species and refuge for upland species. The corridor will also provide neighboring residents with public space for social interaction and recreation. By establishing initial conditions based on natural responses from ecological processes, the site can be created at a much lower price than if it was master planned because much less labor is involved and most of the materials used are indigenous to the site. This project has demonstrated how then natural processes of flooding can be utilized to create form and habitat within the urban floodplain of Village Creek in Birmingham, AL.

References:

"Acquisition, Evaluation and Evaluation". Earthquake Engineering Research Institute. 1/23/2010 <http://www.eeri.org/mitigation/files/resources-for-success/00008.pdf>.

"Advanced Hydrologic Prediction Service: Village Creek at Avenue W.". National Weather Service. 3/11/2010 <http://ahps.srh.noaa.gov/ahps2/hydrograph.php?wfo=bmx&gage=ensa1>.

Amidon, James. Michael Van Valkenburgh Associates: Allegheny Riverfront Park. New York: Princeton Architectural Press, 2005.

Bagget, James L. Historic Photos of Birmingham. Nashville: Turner Publishing Co., 2006.
Barnett, Rod. "A Disturbance Ecology Model for Pacific Urbanism". <http://www.rodbarnett.co.nz/pub/news/a-disturbance-ecology-model-for-/files/A_Disturbance_Ecology_Model_for_Pacific_Urbanism.pdf>. 2005.

Barnett, Rod. "A Ten Point Guide to Initial Conditions 2009". <http://www.rodbarnett.co.nz/pub/news/a-ten-point-guide-to-initial-con/files/Ten_Point_ Guide_to_Initial_Conditions.pdf>. 2009

Barnett, Rod. "Under the Radar: Combining animal habitat enhancement with creative landscape design in the formation of new urban places". <http://www.rodbarnett.co.nz/pub/news/under-the-radar-combining animal/files/Under_the_Radar.pdf>. 2008.

Birmingham Historical Society .The Birmingham District: A survey of cultural resources. Birmingham Historical Society, 1993.

Birmingham Historical Society. The Olmsted Vision Parks for Birmingham. Birmingham: Birmingham Historical Society, 2006.

Czerniak, Julia. Case: Downsview Park Toronto. New York: Harvard Design School, 2001.

Jongman, Ron and Pungetti, Gloria. Ecological Networks and Greenways: Concept, Design, Implementation. Cambridge University Press, 2004.

Lindmayer, David B., and Fischer Joen. An Ecological and Conservation Synthesis. Washingon: Island Press, 2006.

Malanson, George P.. Riparian Landscapes. Melbourne: Cambridge Press, 1993.

Perlman, Dan L., and Milder Jeffrey C.. Practical Ecology: For Planners Developers and Citizens. Washingon: Island Press, 2005.

Raxworthy, Julian. "Transgressing Edges and Doing Time". 3/04/2010 <http://www.stichtingtijd.nl/pdf/Raxworthy-Bienale-Paper-last.pdf>. 2006

"Village Creek Society." Village Creek Human and Environmental Justice Society. 2/16/2010 <http://www.villagecreeksociety.org/>.

Waldheim, Charles. "Park=City? The Downsview Park Design Competition". Landscape Architecture Magazine. March, 2001: 81-99.

"Werrington Creek Restoration Project". Perinth City Council. 2/26/2010 <http://www.penrithcity.nsw.gov.au/index.asp?id=4019>.

White, Marjorie L. Village Creek: An Architectural and Historical Resources Survey of Ensley, East Birmingham and East Lake. Three Village Creek Neighborhoods of Birmingham. The Birmingham Historical Society, 1985.

List of Illustrations

Fig. 18: http://pic15.picturetrail.com/VOL615/3680850/8848385/214434393.jpg

Fig. 19: http://upload.wikimedia.org/wikipedia/en/thumb/4/42/Tencoal.jpg/300px-Tencoal.jpg

Fig. 20: Photos courtesy of Dr. Mable Anderson of The Village Creek Society

Fig. 21: Figure ground courtesy of Dr. Mable Anderson of The Village Creek Society

Fig. 22: Moro Park-Ensley master plan courtesy of Dr. Mable Anderson of The Village Creek Society

Fig. 23: http://www.alabamarailpics.com/files/Ensleyswitch.jpg

Fig. 24: http://farm3.static.flickr.com/2109/2145097484_25d4d64da8.jpg

Fig. 25: http://upload.wikimedia.org/wikipedia/commons/6/6a/Jackhammer_On_An_Excavator_End.jpg

Fig. 26: http://www.bernardoconcrete.com/blog/wp-content/uploads/2008/11/172.jpg

Fig. 27: http://mikeshaulandtractor.com/graphics/photos/asphalt_1.jpg

Fig. 28: http://www.beyondtoday.org/videos/2008july31asphalt.jpg

Fig. 29: http://www.penrithcity.nsw.gov.au/index.asp?id=4019

Fig. 30: http://upload.wikimedia.org/wikipedia/commons/e/ef/Templin_channel.jpg

Fig. 31: http://upload.wikimedia.org/wikipedia/commons/thumb/9/9e/F%C3%B6sse_Kanal.jpg/180px-F%C3%B6sse_Kanal.jpg

Fig. 32: http://upload.wikimedia.org/wikipedia/commons/thumb/9/9e/F%C3%B6sse_Kanal.jpg/180px-F%C3%B6sse_Kanal.jpg

Fig. 33: http://oshuenibach.educanet2.ch/klasse.egger/.ws_gen/15/Lahnung%20Flut.jpg

Fig. 34: http://www.deutsches-sielhafenmuseum.de/kids/bilder_deich/lahnung_1.jpg