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Integrating Infrastructures: Redefining Ecological + Man-made Systems, Bio-remediation Facility, Woonsocket, Rhode Island

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INTEGRATING INFRASTRUCTURES : REDEFINING ECOLOGICAL + MAN-MADE SYSTEMS

: BIO-REMEDIATION FACILITY
WOONSOCKET, RHODE ISLAND

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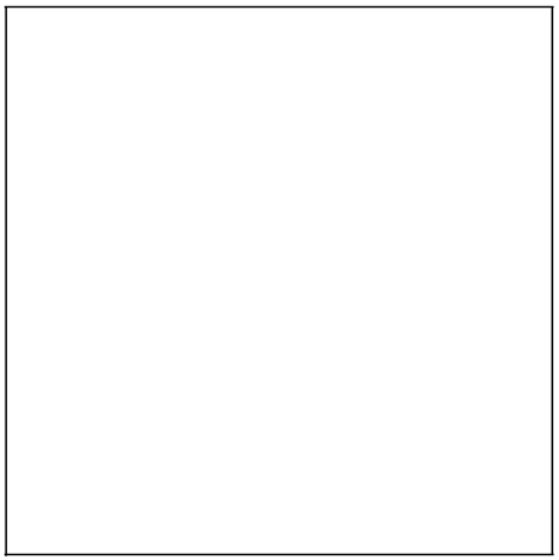

I would like to acknowledge my professors who challeneged my ideas and helped push my theories: Professor Hasan-Uddin Khan, Professor Derek Bradford, Professor Edgar Adams, & Professor Ulker Copur.

I would also like to thank Professor Patrick Charles for his innate understanding of the science in architecture.

ABSTRACT

Many post-industrial cities across the United States are struggling to provide for the current demands of its people and health of its natural enviornment. The downfall of industry required a redefinition of the infrastructures that supported it. This project reintegrates lost infrastructures in order to revive and reconnect them to one another and to the people of the city. New uses of structures and spaces in the city will challenge and redefine how people use their surroundings.

A city is a mesh of systems working together to provide a functioning place to live, work and enjoy life for its inhabitants. This brings opportunity to the areas of infrastructure, opening them up to the public and bringing education to these multi-functioning spaces for many diverse people.

Post-industrial cities contain many areas of neglect and pollution from decades of vast production and industry. Bioremediation is an organic process that uses plants to clean metals and other harmful pollutants in the soil, air and water. As a system, bioremediation can be used throughout a city to create a larger ecological infrastructure that cleanses urban conditions, while bringing life and nature into deeper layers in the city.

The bioremediation training facility consists of a series of educational buildings including laboratories, libraries, an auditorium, classrooms, greenhouses and garden social spaces for students to learn about ecological systems. The facility runs adjacent to a series of old built infrastructures, like the Blackstone River Dam, drawing a parrallel to how people use these systems with the function of the ecological ones within the building. The parrallels between these two types of systems will bring new definitions to one's environmental conditions in the city.

The site is therefore a provided example of how to construct spaces for nature and man to co-exist in an urban condition. The site consists of a series of constructed wetlands, living machines and social spaces where the living, working and recreational environments are confronted with working natural systems. Nature is carried from the ground floor throughout numerous gathering spaces in the educational facility and housing units.

The site proposes a city within a city concept, providing housing, education, retail and park space within the extended urban block. The complex relationships between the buildings and spaces between the buildings provide a comprehension to the built and natural systems presented on site within a dense built environment. The highly functioning series of infrastructures can be noticed and understood as a definite integration of man, nature and technology.

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** All illustrations in document are by the author.
Titled images in document are cited in appendix II.

PROBLEM

INFRASTRUCTURE: SYSTEMS OF LIFE

Infrastructures are the tools that allow multiple populations of living organisms to function together in a working system. Infrastructures have many forms and scales. They consist of the systematic circulation of air we breath, the modes of transportation that move us through space, the collection and deposit of water and waste, the transformation of energy into usable sources, the insulation of structures we inhabit; every apsect of the systems we use everyday are part of a larger source of infrastructure. Each infrastructure has its sources of energy and sources that filter.

These are just examples of infrastructures built by man.

Too often, the largest network of systems functioning in our world today is misinterpretted: the networks in nature. Nature consists of structural cycles, similar to our man-made systems, that rely on one another for life on earth to exist. We too rely on these ecological systems to provide clean water to drink, clean air to breath and food to eat. But little do we realize, we have been destroying these natural infrastructural systems as we continue to modernize our civilized world. Our instinctive understanding of ecological infrastructures has deminished along with our functional understanding of our own man-made systems. This has resulted in destruction of ecological infrastructures and mis-use of our own cities.

In order for these systems to be able to properly function together, they need to be monitored and maintained as one larger functioning whole. Over time, man has lost the comprehension of how these systems work, no matter, how they must work together. Our reliance on the systems and our desires for technological advances have grown, resulting in new advances in technology that take on most of our responsibilities we have for human survival.

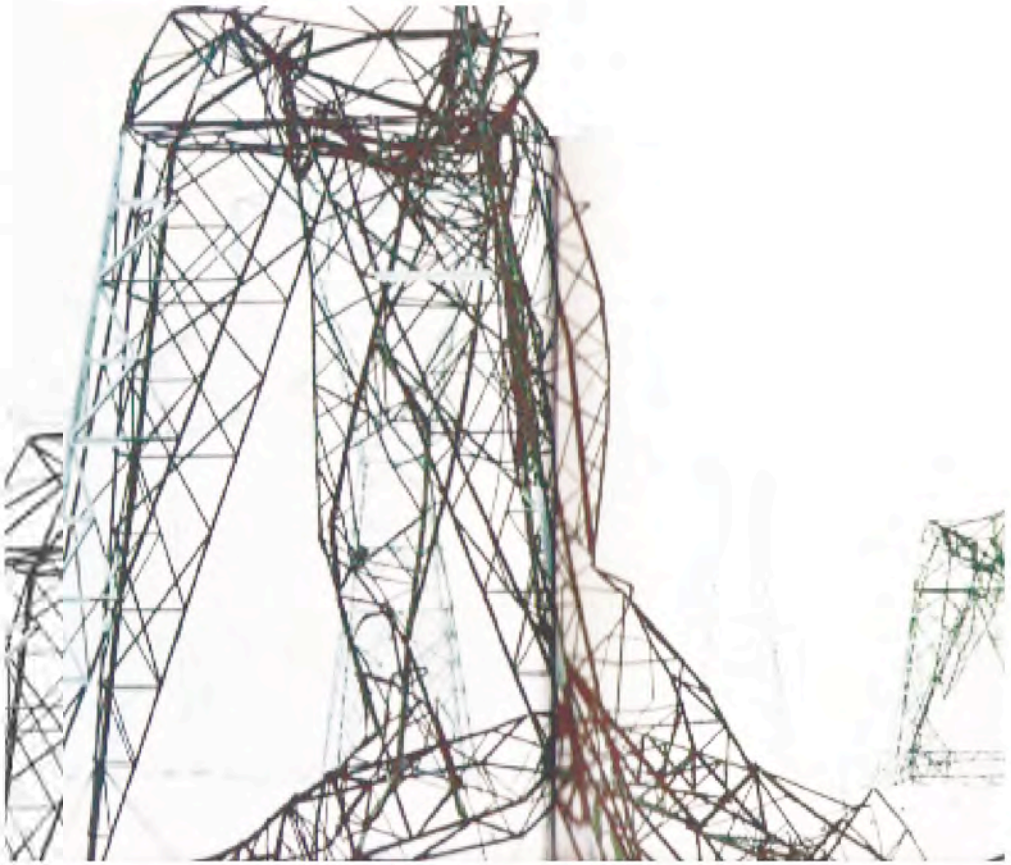


Image 1

PROBLEM

LOSS OF PLACE

What use to be instinctive is now techinically bypassed.

The boom of the industrial revolution stripped societies of many subconsious relationships to functions of natural and built infrastructure. People became self-absorbed, making convenience and independence overrule the well-being of social structure and surrounding environment. This moved people farther away from the connections with the places and systems they use everyday.

For instance: distance. One who travels from New York to Los Angeles by airplane, only understands this distance as a 6 hours flight. These places are interpreted based on this skewed understanding of the 3,000 miles that separates these places, not to mention the thousands of civilized places in between these two major destinations that are overlooked. The image to the right shows a skewed image of North America in terms of the amount of time it takes to fly from New York to Los Angeles. This diagrams how our intuitive sense of distance and place is deteriorating due to our misunderstanding and daily reliance on the many systems we use.

We associate places with symbols and things we discover due what we do at these places, instead of the systems that withhold them and our role within these systems. When our actions only consist of traveling or using technology that remove ourselves from these places, the physicallity and presence of place no longer speak to us.

Image 2

Image 3

Image 4

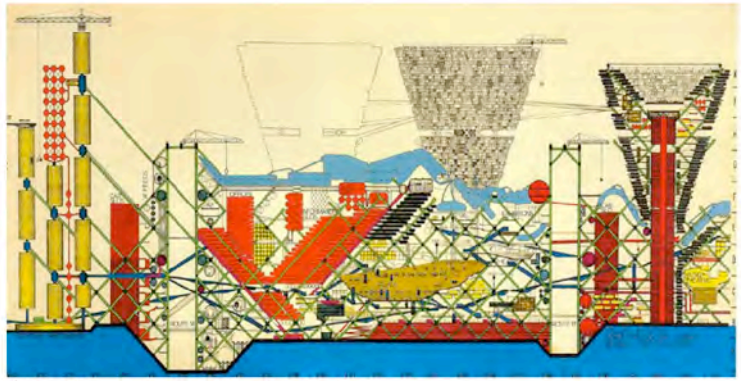


Image 5

PLUG-IN CITY : New York, NY

Rooted into a massive piece of bedrock, New York City has many integrated sources of infrastructure. Reservoirs, subways, railroads, sewer systems, aqueducts, drainage shafts, bridges, and powerplants are all parts of the system on which the city functions. The buildings, therefore act as vertical plugins to the horizontally stretched series of pipes, drudges and steel. The bedrock locks in the foundation of the building, and the building is plugged into the larger grid.

The problem with this system, is that people are not aware of how this densely populated island can provide so many functioning parts. All is hidden beneath the ground, after the bedrock is laboringly blasted away, leaving room for more tunnels and bypassing systems. Of course, these sytems all require access for maintainence.

It has been discovered that within the multi-level labyrinths below the busseling city are a population of 'Mole People' who inhabit these infrastructures. The the early 1990's, there were an estimated 5,000 people living beneath the streets of New York, mostly in subway and railroad tunnels.[1] And why not? Besides the minimal sun exposure, ventilation and light, it is comparable to a skyscraper.

It is all a matter of how people decide to use their city and their systems.

Image 6

Kaplan, Don, «Notes From the Underground,» New York Post. March 2009 [1]

PROBLEM

Image 7

Image 8

Image 9

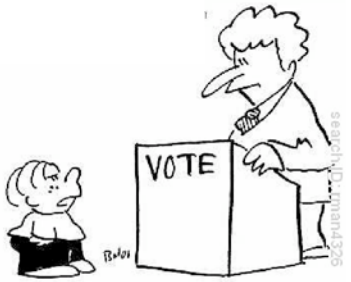
COMPREHENSION OF SYSTEMS

Most of the time we live within these systems, unaware of our reliance on them, what holds them together, and what keeps them processing.

Like life, each system is cyclacle with a beginnging and an end. In ecological systems, a metamorphical cycle uses surrounding sources as receivers of energy. At the end of ones life, its energy does not die, but it transforms itself into fuel or food for another source to use. Each system relies on another source, in one way or another, for its survival. We fail to take this concept of a recycling energy and waste into consideration when building our man-made infrastructural systems.

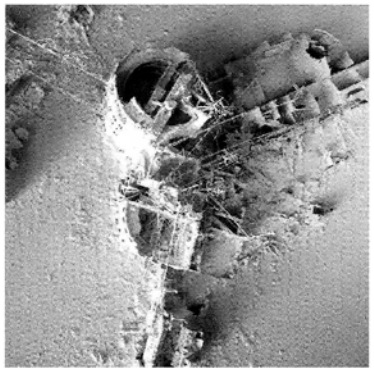
Since our systems do not imply a cyclacle way of life, people do not comprehend their logic. Their initial use, power and reliance on other systems goes unnoticed. It is only when our infrastructures fail us that we notice our reliance on them and how much power they hold over us. It is only through comprehension of our systems' processes that we can begin to create environments where both built and ecological infrastructures can co-exist.

This will result in more people using infrastructure more efficiently and progressively. Efficient usage of these system is important; for often times these systems contribute to the identity of the city. When the infrastructure is not fully comprehended, neither is the full-scale image of the city.



"This 'infrastructure' stuff you keep talking about — does it have anything do do with *vegetables?*"

Image 10



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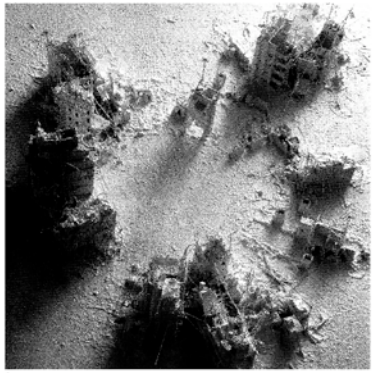


Image 12

"Often our perception of the city is not sustained, but rather partial, fragementary, mixed with other [metaphysical] concerns. Nearly ever sense is in operation, and the image is the composite of them all."
~Kevin Lynch, Image of the City

Image 13

IDENTITY : decaying cities

In a city, people mostly recognize systems for their power of failure. In most infrastructural systems, there is a natural rise and fall or an in-put and an outcome process. But what happens when a system is bypassed by time and no longer needed? The reminence, or what was left behind, remains in a state of decay.

During the industrial revolution, the hype of production overruled the health of the ecological infrastructures. Land and nature were not looked upon as systems of life needed in a city, but rather something to use and discard upon afterwards. Much polution and damage was done to river, land and air. It was not until after the revolution when mills workers were replaced by technology and production was shipped overseas that industrial cities' economic security deminished. At that point, the ecological damage was already done and started to become a problem. Mills were left empty and too massive and costly to destroy. The physical environment was left unaddressed and in a state of decay.

Meanwhile, new ways to make a living meant new demands for the city.
The image of the city was brought forward with technology, rather than rehabilitation of its decay.

Image 14

There are deep stories, dialogues that have become interwoven, embedded, in place over time. Every place has ongoing stories, recognized, concealed, and lost.

PROBLEMS _ & PROPOSITIONS

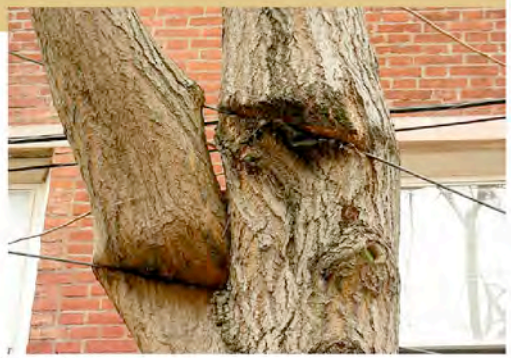


Image 15

ECOLOGY vs. TECHNOLOGY

The decay of old industrial sites still lingers in our cities today. Many of the old mill grounds and dump sites remain intoxicated and are called brownfields. The toxins are so pure, that they make the soil poison of any living systems. The saturated soil can then pollute the groundwater below and make the purifcation process of the water into drinking water very costly.

Other sources of decay come from one of the most abused technological inventions: the automobile. After the industrial revolution, the automobile inflicted the 'Malling of America' wave, where people no longer used the city for its local amentities. Mini-malls were created along highways, and the car became the number one investment a family could make. With more cars came more roads and highways. The more roads, the less amount of pervious surfaces there are to fitler rainwater runoff that collects all the pollutants from roads. According to the Wood's Hole Research Center study in 2008, the current estimate for paved surfaces in the United States is about 41,000 square miles, an area the size of Ohio. [2]

Between the amount of paved surfacing, polluted brownfields, air emissions, and toxic products we use on a daily basis, the ecological systems have no chance for survival in compeition with our man-made infrastructures.

http://www.whrc.org/programs/landcover.htm [2]

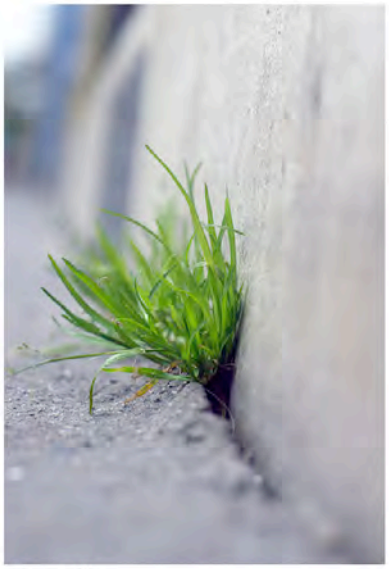


Image 16

Image 17

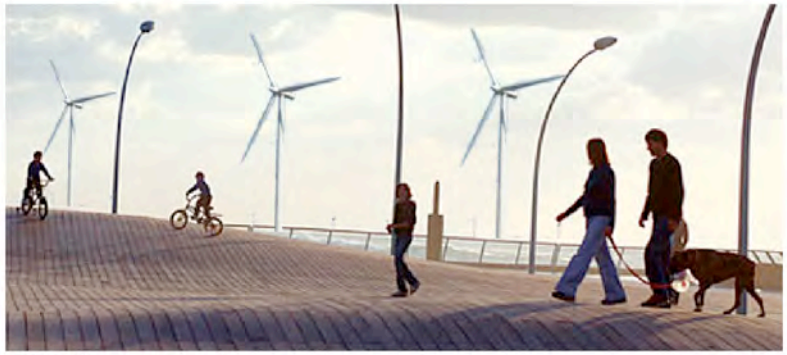


Image 18

Image 19

RE-INTERPRETING INFRASTRUCTURE

Most households pay their electric, gas and water bills without completely understanding where all these resources come from. People need to redfine and understand what their infrastructures are. This includes how, why, and when they use them, how efficiently these systems work, along and together. Most importantly, we need to understand how these systems affect one another's health, security and function.

SYSTEMS THAT COEXIST

Man-made infrastructures need to function like nature: in a cycle. Making waste into usable energy for another source is how ecological cycles work in order for many systems to coexist in one dense space.

In order for a city to function as such, it must reclaim its existing, failed infrastructures and create a new use for them. They must be looked upon as a whole regenerating system, rather than outdated, failed infrastructures.

Image 20

Image 21

Image 22

WOONSOCKET, RHODE ISLAND

Woonsocket is a place of many failing systems.
In the 19th century, Woonsocket was one of the leading textile mill industries in the United States. This made it a prime location for immigrants to settle and start a new life for their families. It was a place of hope, productivity and opportunity.

Regionally, Woonsocket was connected to Boston, Worcester Providence and New York City through the industrial railways. The map to the right shows the many stops along the rail lines, with Woonsocket highlighted in blue. The Blackstone River runs through the city of Woonsocket, allowing a hub of industrial mills to build along the river for power. The river starts in Worcester, also powering much of its industry, through Woonsocket, Providence and down to Naragansett Bay, where it is discharged into the Atlantic Ocean.

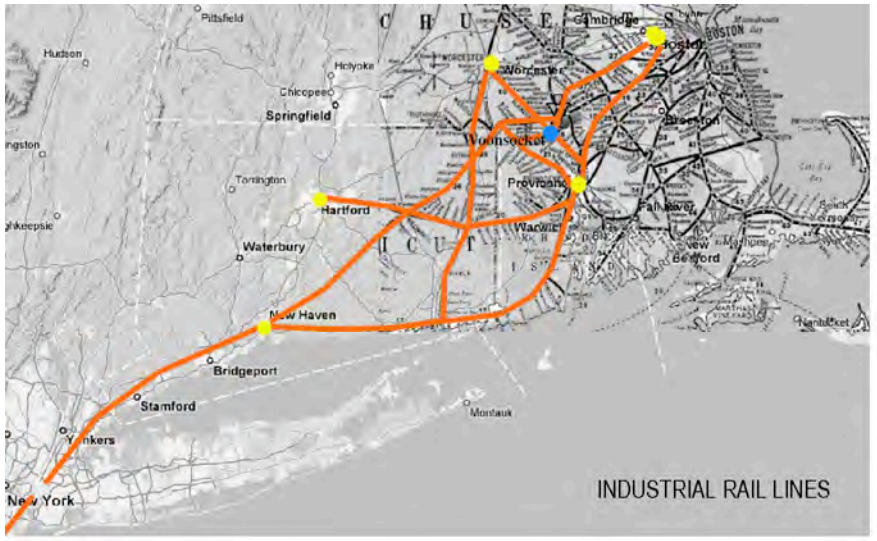


Image 23

Image 24

Woonsocket was full of commerce with the production of mainly rubber and textiles. Everyone worked and lived in the city, creating an environment where business was plentiful, cultures were merging, and religion brought people together. The map to the right is of Woonsocket's main quarters in 1892. Many mill buildings are located along the numerous elevation changes in the river. Along the main industrial hub, located in the bottom turn of the river, the river was channeled inland towards main street so it could be used again and again by many different mills for power.

The Boston, New York and Worcester rail lines interseted just north of the city center, with two railways stations that opened in 1863. There was also a trolley that ran through the city and into adjacent Rhode Island towns at the beginning of the 20th century. By 1906, there were trolley routes on all main roads in Woonsocket, averaging about 70 miles of trolley routes radiating from the city.[3] Woonsocket was supposed to be the next Manhattan, and its infrastructure was the key to that scale of success.

[3] Bellerose, Robert. *Images of America: Woonsocket Revisited*. Arcadia Publishing, Britain,2004:

MAIN STREET

MAIN ST DEPOT

POST-INDUSTRIAL WOONSOCKET : Fall of Infrastructure

Woonsocket was hit hard by the fall of the industrial revolution. Blue-collared workers lost their jobs, so they had to travel outside the city center, some to neighboring towns, for work. The automobile became the gateway out of the city center, allowing for a suburban lifestyle. It was the new infrastructure to freedom, while all other types of transportation and economic stability fell with its rise.

Decentralization:
Today, decades after the fall of industry, the suburban sprawl has pushed people farther from Main Street, or any sort of center, towards the highways. The decentralization cost local businessmen to lose their customers to larger chains. The town attempted to bring people back to Main Street by making multiple free parking lots down the strip, but they remain scarcely used. Instead, automobiles use a street just south of Main Street, for it has a faster speed limit and wider lanes. It allows drivers to cross town to the highway, without going down Main street.

Transportation:
Both the rail systems remain unused with both stations closed. A new infrastructure of state buses make frequent stops throughout the city, but the length of trips and overcrowding makes them inefficient. Currently, more than 80% of the people in Woonsocket drive alone to work, 14% carpoll, 1% take the bus, 3% walk and 1% work at home. [4] People spend the majority of their days in traffic, working outside of the city, removing additional economic stability from the downtown.

ILLUSTRATION 1 : DOWNTOWN CAR ROUTES

< MAIN STREET >

[4] RI Census Bureau, http://www.planning.ri.gov/census/ri2000htm

MARKET SQUARE PARKING LOT

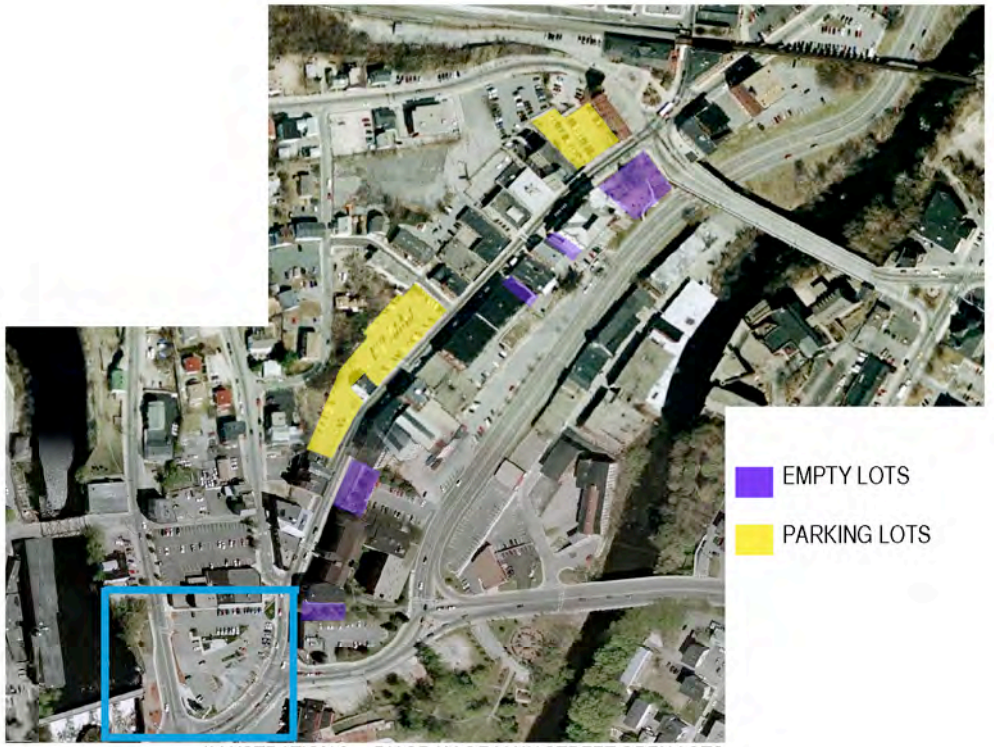
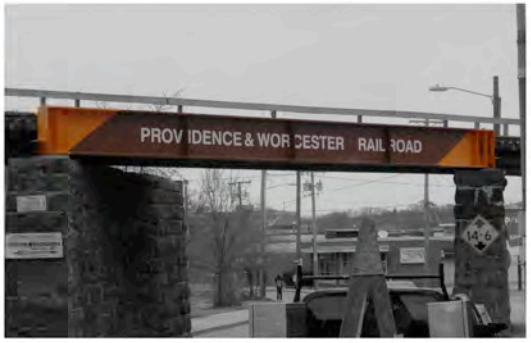


ILLUSTRATION 2 : DIAGRAM OF MAIN STREET OPEN LOTS

Population Loss:
Few industrial buildings have been put to reuse. Those buildings who have are reused as retail or office space. The remaining sit with half eroded facades covered in graphitti. Market Square, the old industrial hub, seen to the right boxed in blue, now consists of empty paved parking lots a the end of Main Street. A demographics study of Rhode Island communities shows that there will be a 6 % population drop by 2030 in Woonsocket.[5] Shrinking post-industrial cities need to provide new ammenities for higher density neighborhoods. The inhabitants of Woonsocket need to be able to managably economically provide for their families while having a sense of environmental, cultural and social stability.

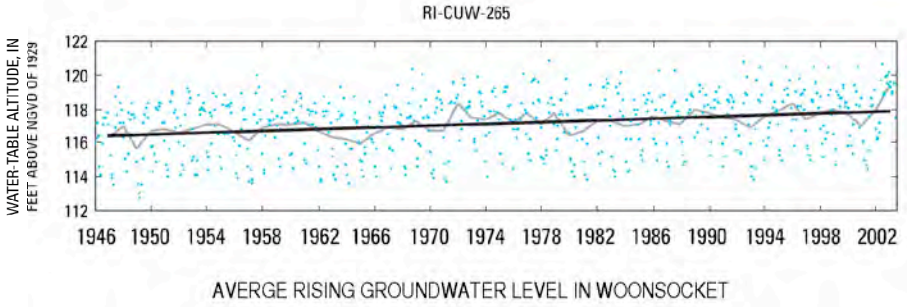
[5] RI Statewide Planning Program, "*Woonsocket, RI Commuter Rail Feasibility Study,*" 2000



EFFECTS ON WATER

Years of high industrial production has left Woonsocket's land full of many scars that remain unaltered. Concentrated amounts of toxins have been dumped and spilled throughout these industrial zones. As a result of the pollution, the ground water is constantly contaminated by the high purity of these pollutants. Each year, the groundwater rises, causing more water the be contaminated. This creates an even larger problem for inhabitants in the Blackstone River Basin, polluting drinking water and threatening the health of many ecological systems.

The make-up of the land in the Blackstone River Basin changes from area to area, affecting the rate at which liquids passes through different areas of land. These transmissivity levels are a main part of the ground's infrastructure, allowing moisture to move and recyle itself into a ground water source. These levels also give reference to the rate ain which these pollutants will soak into the ground on a rainy day. If the transmissivity levels are low, than the water is more likely to runoff the surfaces to a place of open water or where the transmissivity levels are higher. In these circumstances, pollutants on paved surfaces are in great risk of running off into the nearby river, rather than being filtered through the ground.



AVERGE RISING GROUNDWATER LEVEL IN WOONSOCKET

Image 25

COMPOSITION : Blackstone River Basin

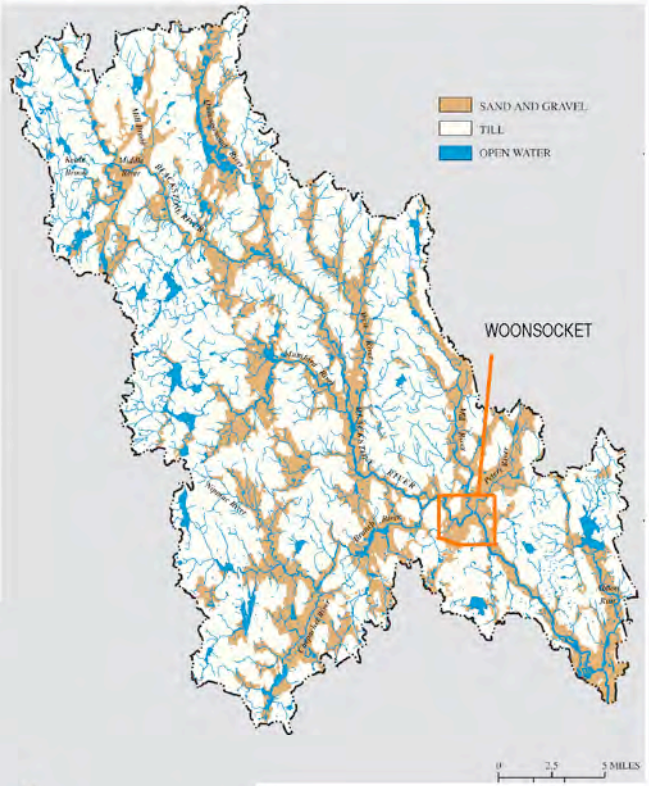
Woonsocket's largest, most reliant piece of infrastructure is the Blackstone River. Without it, the city would not exist, for the immigrants who settled there would not have jobs in mills that used to river to power its production. According to stream-flow gage recordings from1929-2004, the blackstone river discharges an average of 755 cubic feet per second at its location in Woonsocket, with a drainage area of 416 square miles with 109 dams in that drainage area.[6]

Between Worcester and the mouth of the basin, the Blackstone River slopes at about an average of 7 feet per mile. This drop in elevation allowed many of the mills to use the movement of the water for power. There are approximately 125 dams in the river whose elevation drops greater than 6 feet.[7] This creates many flat water conditions for the rest of the river. Most of the Blackstone river basin consists of sand gravel and till. In map to the upper right, the brown represents sand and gravel while the white represented areas made up of till, with the Woonsocket region boxed in orange.

The map on the bottom right declares how little wetlands there are in the Woonsocket area. Wetlands are a prime aspect of the hydrology of the basin, for they reduce peak flows, increase evaporation losses and help filter contaminated runoff water that may enter the river and streams. Many of the existing wetlands in the Blackstone River basin are discontinuous areas bordering stream channels.

Image 26

SURFICIAL GEOLOGY >
OF THE BLACKSTONE RIVER BASIN



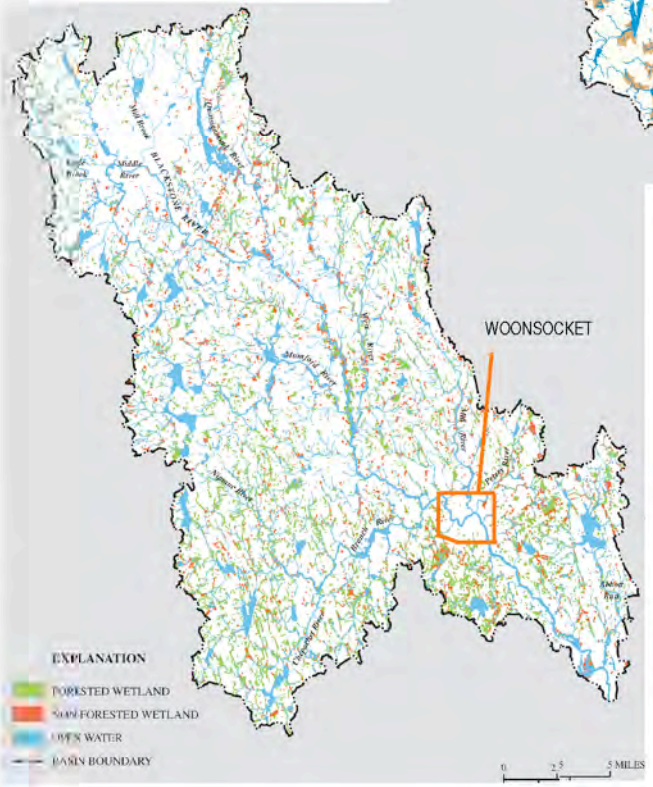


Image 27

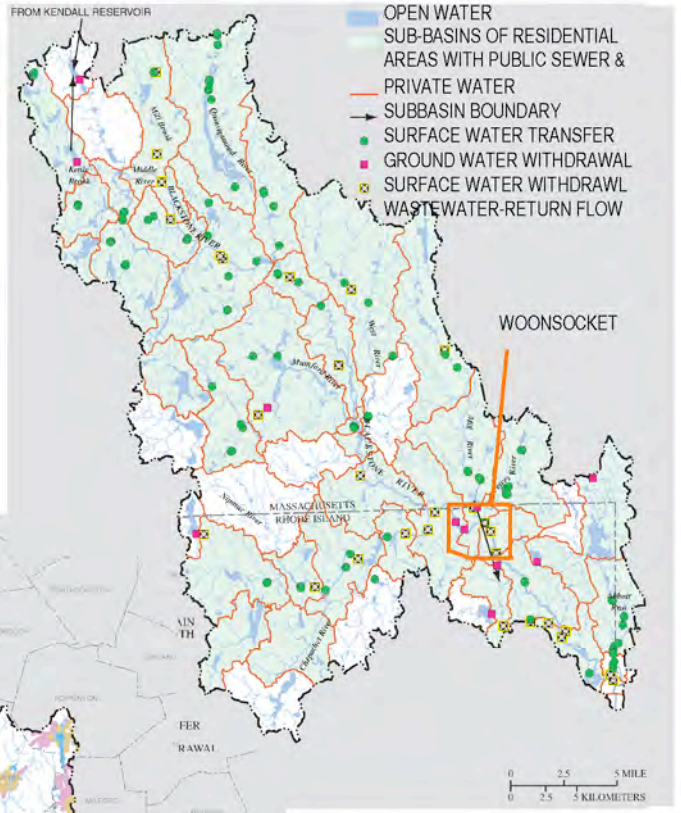
< WETLANDS IN
THE BLACKSTONE RIVER BASIN

[6] Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007

[7] Ibid, pg9

Image 28

LOCATIONS OF WATER WITHDRAWLS, TRANSFERS, & WASTEWATER RETURNS IN THE BLACKSTONE RIVER BASIN. >



USES

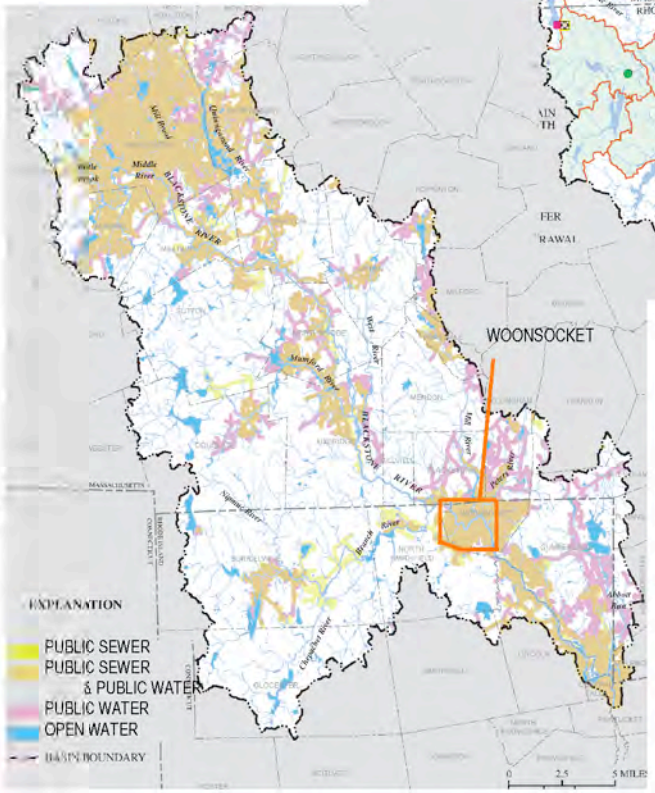
Woonsocket uses surface water as the sole source of water, due to its many impervious surfaces. The map to the lower right shows the summary of water use by the towns in the Blackstone River basin. Woonsocket uses the basin for all of its public water supply and public sewer systems, with return flow into the basin.[8] This means that Woonsocket uses the water from the river over again, then returns some of it for future use by towns further south.

The Blackstone River Basin receives wastewater-return flows from 10 municipal wastewater treatment facilities. The map to the upper right shows the locations of the waste water-return flow along with the groundwater withdrawl and surface water withdrawl from the river. In the lower Blackstone River Basin, 68% of the total wastewater disposal for 1995–1999 was municipal wastewater disposed at treatment-facility outfalls. The amount of return flow from wastewater treatment facilities, including both commercial and industrial facilities, averages about 54 million gallons per day, according to information gathered for 1997–2001.[9]

This declares the amount of water used and returned to the Blackstone river on a daily basis. Woonsocket, along with the many other civilizations along the river, is largely dependent on the health and stability of the Blackstone River for their future survival.

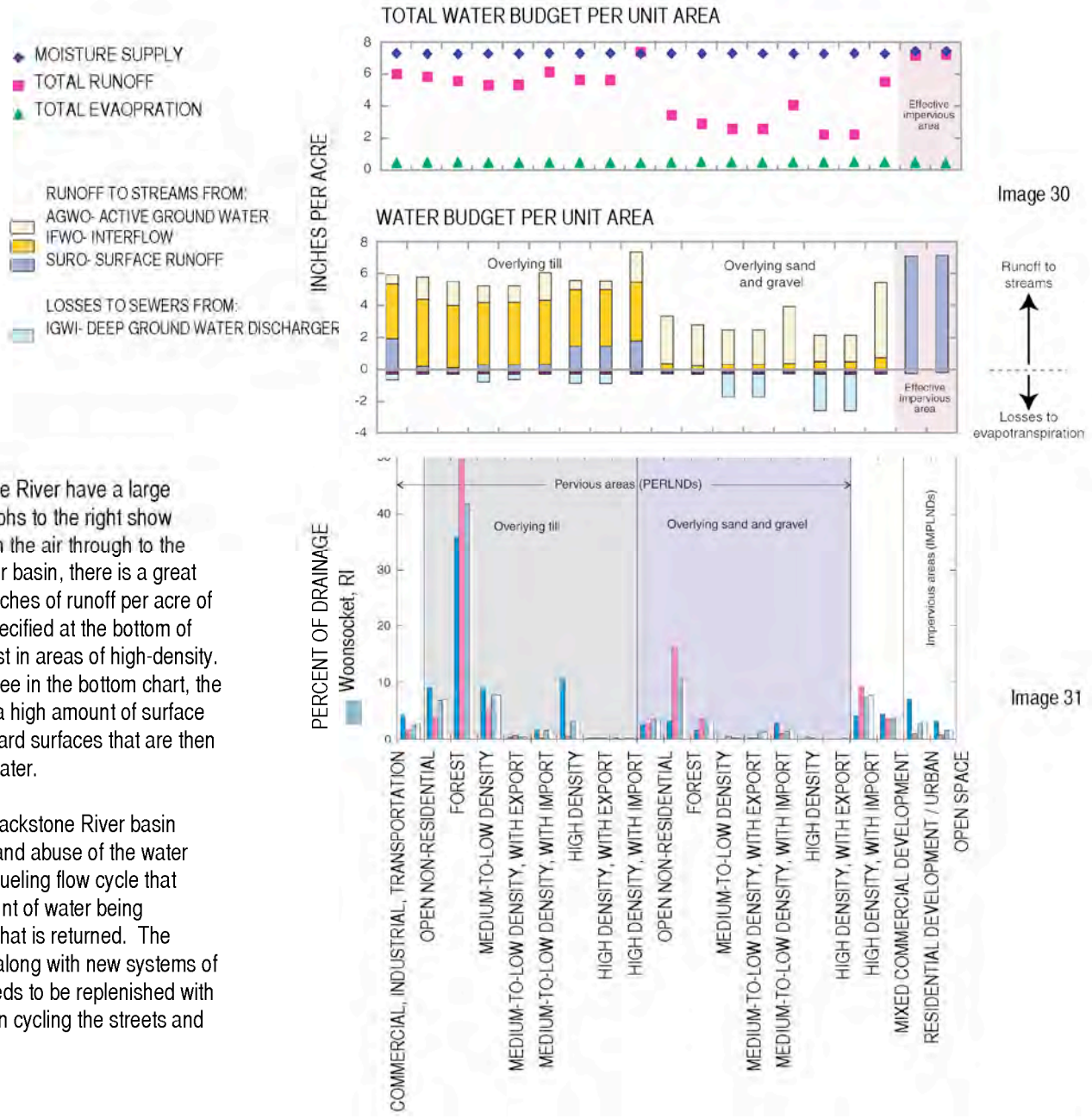
Image 29

< WATER USE IN THE BLACKSTONE RIVER BASIN



[8] Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007, pg6

[9] Ibid, pg14



FUNCTION AND EFFECTS

Our constructed environment and uses of the Blackstone River have a large impact on the function and quality of the water. The graphs to the right show the river as a working system of water that is cycled from the air through to the ground. Due to the amount of paved surfaces in the river basin, there is a great amount of runoff. The top graphs show the amount of inches of runoff per acre of land in developments of different densities, which are specified at the bottom of the graphs. The larger amounts of runoff to streams exist in areas of high-density. The amount of water that is evaoprated is minimal. As see in the bottom chart, the impervious areas allow minimal drainage. This creates a high amount of surface water flow, which becomes polluted from toxins on the hard surfaces that are then carried to streams, the river, and inevitably, the groundwater.

The combination of withdrawls and return-flows to the Blackstone River basin causes the river to remain in a stressful state. The use and abuse of the water used, returned, and surface run-off together creates a grueling flow cycle that barely makes the river sustainably functional. The amount of water being withdrawn succeeds the amount of used polluted water that is returned. The amount of water the public uses needs to be regulated, along with new systems of rainwater collection and recycling. The groundwater needs to be replenished with water that is clean, rather than runoff water that has been cycling the streets and sewers.

OVERALL WATER SYSTEM

The Blackstone River basin is experiencing rapid population and commercial growth, resulting in higher stresses on the water systems. In a natural hydrological system, there is the natural systems at work, and the man-made system created due to humans needs. The diagram to the right shows how a natural hydrological system works with its numerous inflows and outflows. These inflows and outlfows, defined more specifically as precipitation, evaporation, runoff, and subsurface flow, all respond and affect the quality and level of the groundwater. Proper drainage is necessary for a hydrological system to be healthy and keep high water levels. Inevitably, surface materials will affect how the water is drained and what is contaminating the water before it reaches the subsurface flow. Due to demanding human needs, there is a high percent of impervious surfaces which causes more stormwater runoff carrying higher pollutants to the river and groundwater.

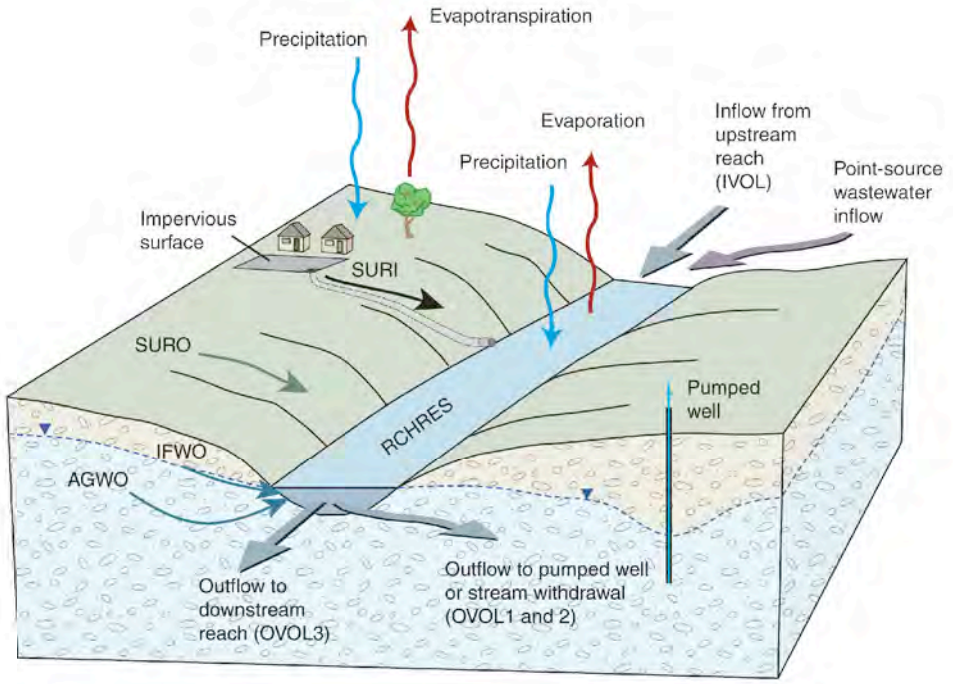


Image 32

^ INFLOWS AND OUTFLOWS OF A HYDROLOGICAL SYSTEM

SURI- SURFACE RUNOFF FROM IMPERVIOUS SURFACES

SURO- SURFACE RUNOFF FROM PERVIOUS AREAS

IFWO- SUBSURFACE FLOW THAT RESPONDS QUICKLY TO RAIN

AGWO- ACTIVE GROUND WATER FLOW

RCHRES- RESERVOIR SEGMENT

Image 33

< WOONSOCKET WATERSHEDS & RESERVOIRS

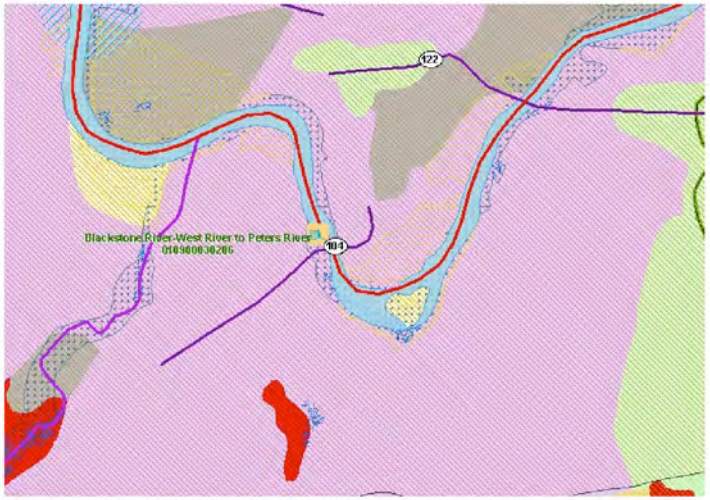


Image 34

The numerous public uses of the Blackstone River basin require large water withdrawls which continue to increase over time. In order for the hydrological system to continuously function and remain a high water quality, it is necessary to evaluate the public uses for the water and the condition in which it is being returned to the ground water after each use. If the amount of withdrawls are decreased, so will the number of returns. The larger infrastructural system takes a toll due to the large amounts of water inhabitants use, the minimal number of small scale water re-use, and the poor condition the water is in when it is discharged back into the system. The man-made systems currently used need to be evaluated for they directly affect the health and evolution of the natural systems that are heavily relied upon for survival.

Image 35

^ HIGH GROUND-WATER AREAS

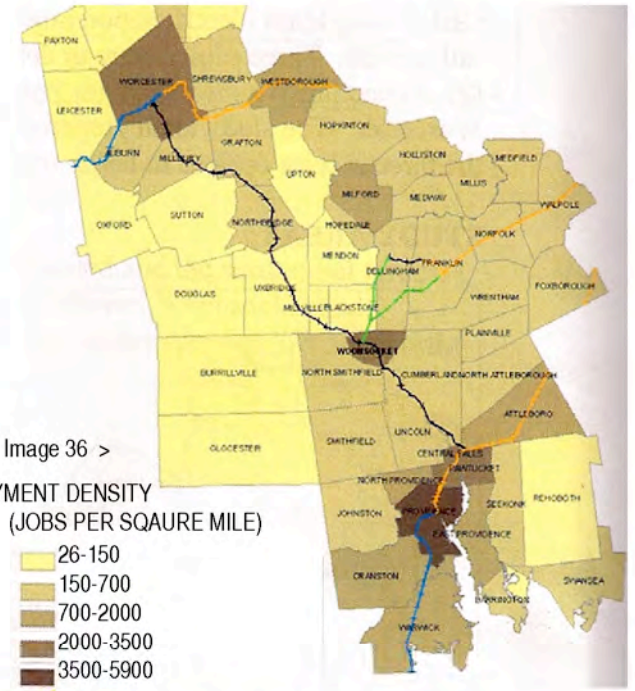


Image 36 >

REGENERATING OLD INFRASTRUCTURE : Bridging the Gaps

For the city to effectively grow it needs a technical support from the people and their technological and economical needs.

The old Providence-Worcester railroad has been inactive for over fifty years. A Woonsocket Commuter Rail Feasibility Study has been done to see whether it is geographically and economically feasible to reactivate the railway and use it as a commuter rail system. *Image 36* shows the surrounding counties of the two railroads. The different shades of yellows represent the amount of jobs each county has per sqaure mile. The railroad lines are shaded in different colors. The black paths represents the freight only rail lines, the blue paths are intercity passenger raillines, the yellow paths are local passenger rail lines and the green paths represent abandoned rails.

By reactivating these rails as commuter rails, the employment density in areas along the path could heighten. The economic and cultural health of these areas could vastly improve and create a larger, more diverse region of counties.

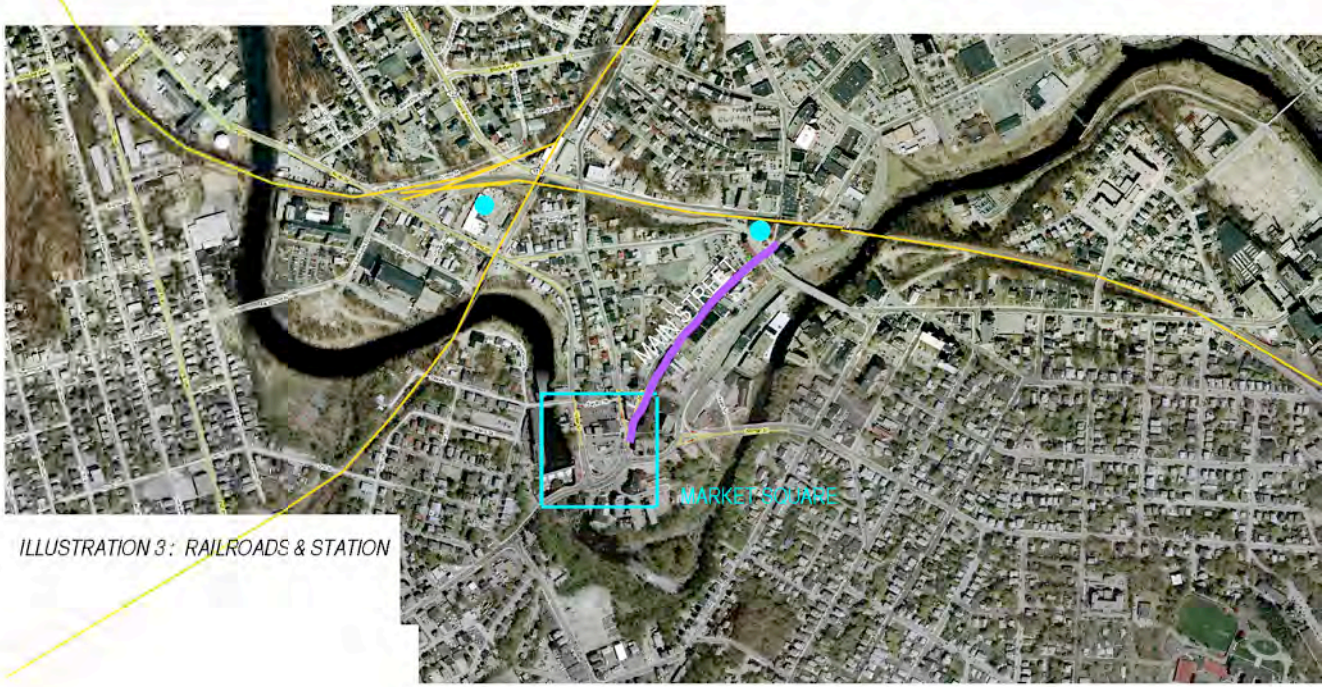


ILLUSTRATION 3 : RAILROADS & STATION

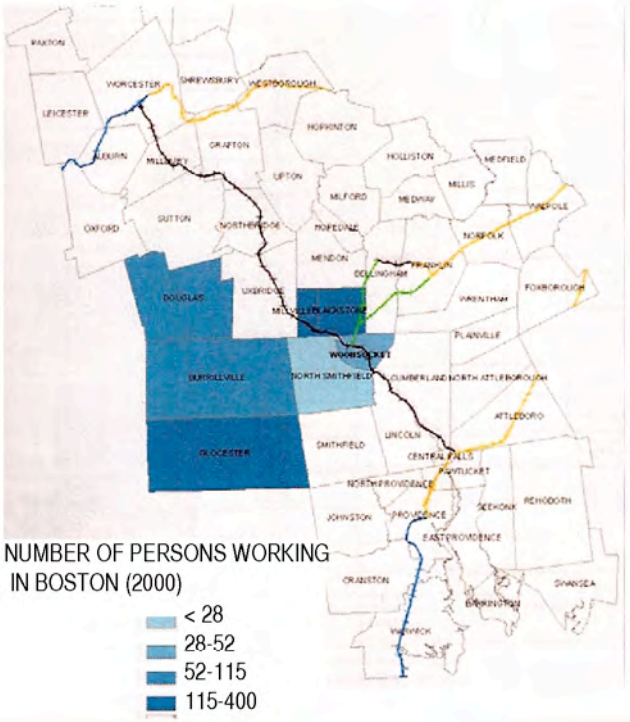


Image 37

In Woonsocket, there are two locations of old railway stations. They are highlighted in blue on the map to the left, and the yellow lines symbolize the old railways that run through the city. Their remanence are seen throughout the downtown, as seen in the image above. The amount of commuters to surrounding cities as it stands is very few. The map to the upper right shows the current number of people in surrounding counties who work in Boston. In Woonsocket, as of 2000, there were under 50 people who work in Boston. If the commuter rails were reopened, it would drastically change the status of economic opportunity in Woonsocket.

URBAN CONTEXT _ CURRENT URBAN CONDITIONS

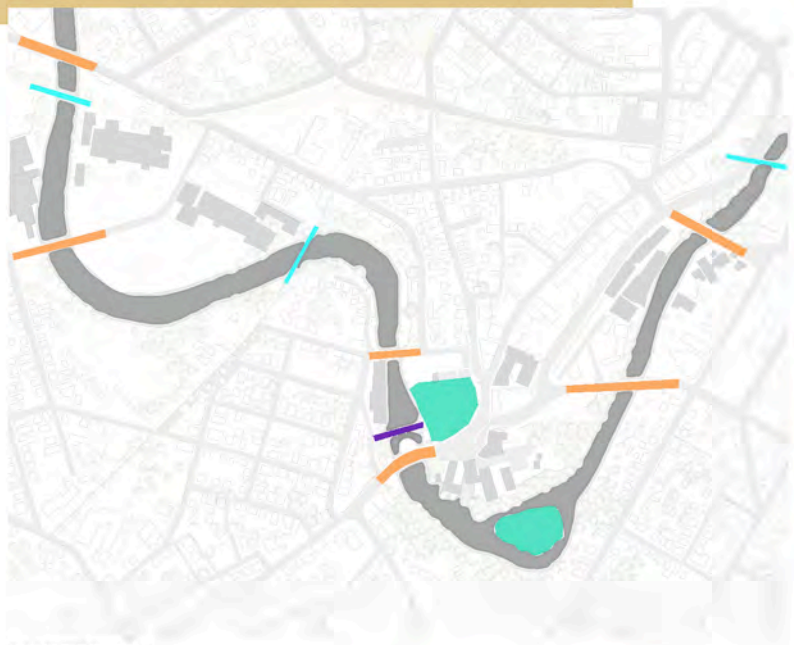


ILLUSTRATION 4

BRIDGING & ISOLATED ELEMENTS ^

river dam
railroad bridges
automotive bridges
isolated urban block

ILLUSTRATION 5

AUTOMOTIVE TRANSPORTATION ^

Woonosocket's current relationship to the Blackstone River remains disengaged. The roads, buildings, and adjacent urban spaces remain diconnected to the river's health and functioning needs. The river is crossed by many automotive bridges, railway bridges, elevation changes and dams. The curviung form of the river creates two isolated areas around the south main street hub that are separated from the bend of South Main Street and the remaining mill buildings. The Blackstone River Dam flows through a series of grade changes that create unique urban spaces full of movement.

The main mode of transportation through and around Woonsocket is the automobile. There is also a series of public bus routes that carries inhabitants through, in or out of the city. Although the roads connect people to places through travel; they also disengage people with their surroundings through the harsh separation it creates between urban blocks.

ILLUSTRATION 6

BUILDING DENSITY ^ schools churches

ILLUSTRATION 7

TREE & PARKS ^

Woonsocket has a moderate building density which defines it as urban. This environment requires many people to use the same infrastructures, while withstanding the natural conditions of the environment before the urban density was established.

Various types of infrastructure link, divide, bypass, and connect the many neighborhoods. Some of these conditions result in divisions instead of interactions between the different urban conditions. This friction between the various forms of infrastructure puts stress on the natural systems within the urban conditions.

LANGUAGE OF LANDSCAPE_EAST TO WEST

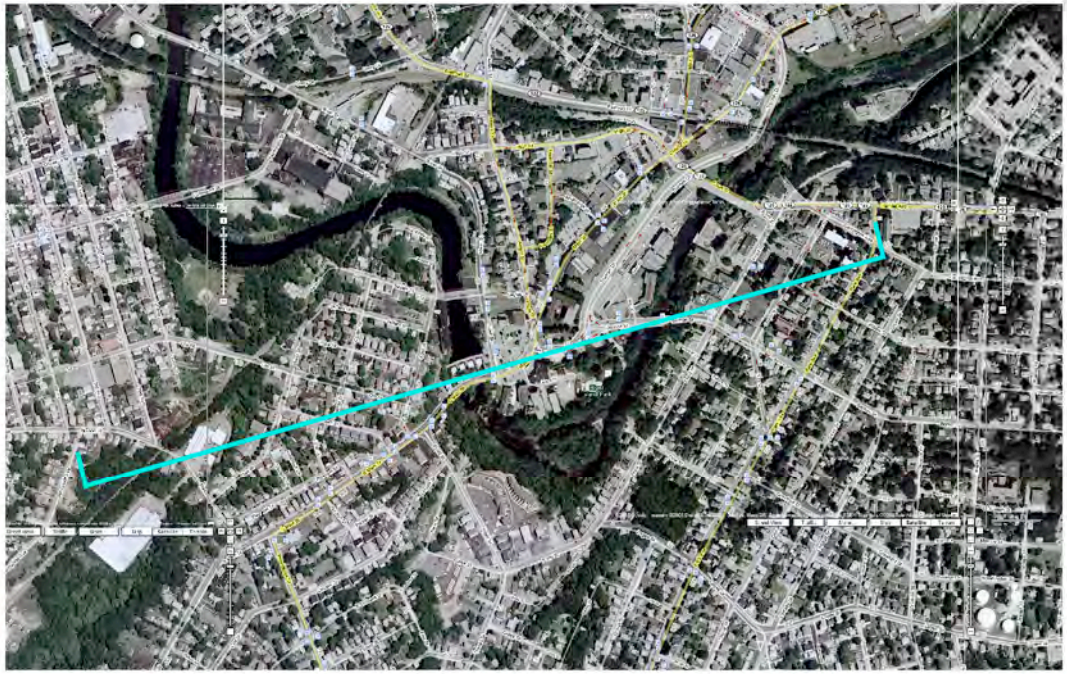
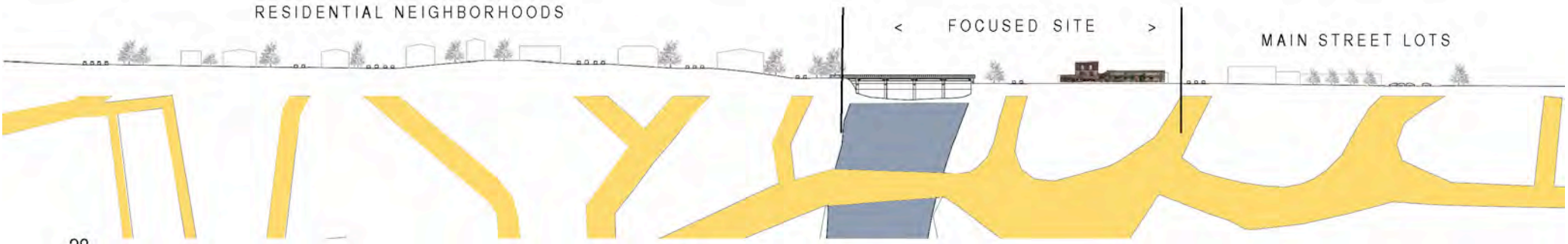


ILLUSTRATION 8: DOWNTWON WOONSOCKET

READING THE LANDSCAPE

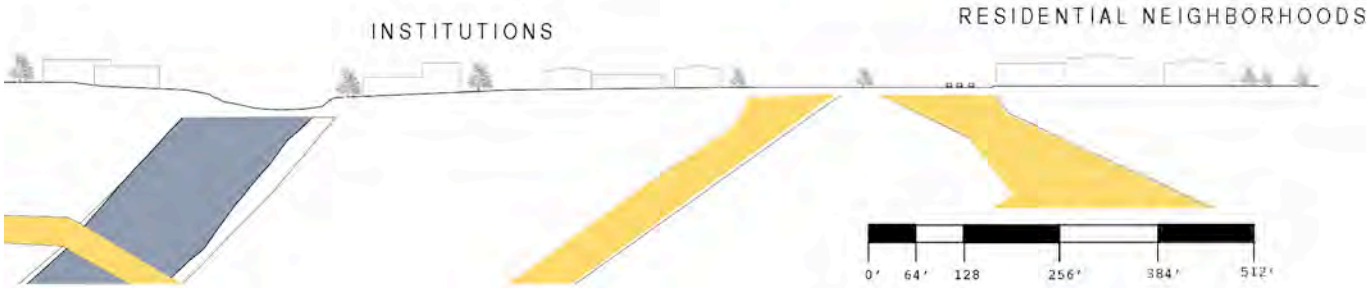
" A place is particular, a tapestry of woven contexts: enduring and ephemeral, local and global, related and unrelated, now and then, past and future. Landscape context is a fabric whose strands are narratives of landscape elements and features, both the persistent and the fleeting."
-Anne Whiston Spirn, Language of Landscape, pg 160



< MARKET SQUARE >

The landscape across Woonsocket tells the story of its past and its capabilities. The sloping of the land from east to west funnels all points to the river. The outer residential neighborhoods create a supportive buffer to its relivence. They remain on the high points, with the inner city instituional and industrial buildings remain along the river on the lower points. The land is so strongly comprehended by the physical path and dominance of the winding Blackstone River.

The residential hills to the west of the focused site, Market Square, slope dramtically down towards the river, while Market Square slopes to the east towards the river behind Main Street. Main Street is made up of a series of tiered lots that slope towards Market Square. Across the river to the east, the land starts inclining again, starting with institutional buildings and then expansive residential neighborhoods.



LANGUAGE OF LANDSCAPE_ NORTH TO SOUTH

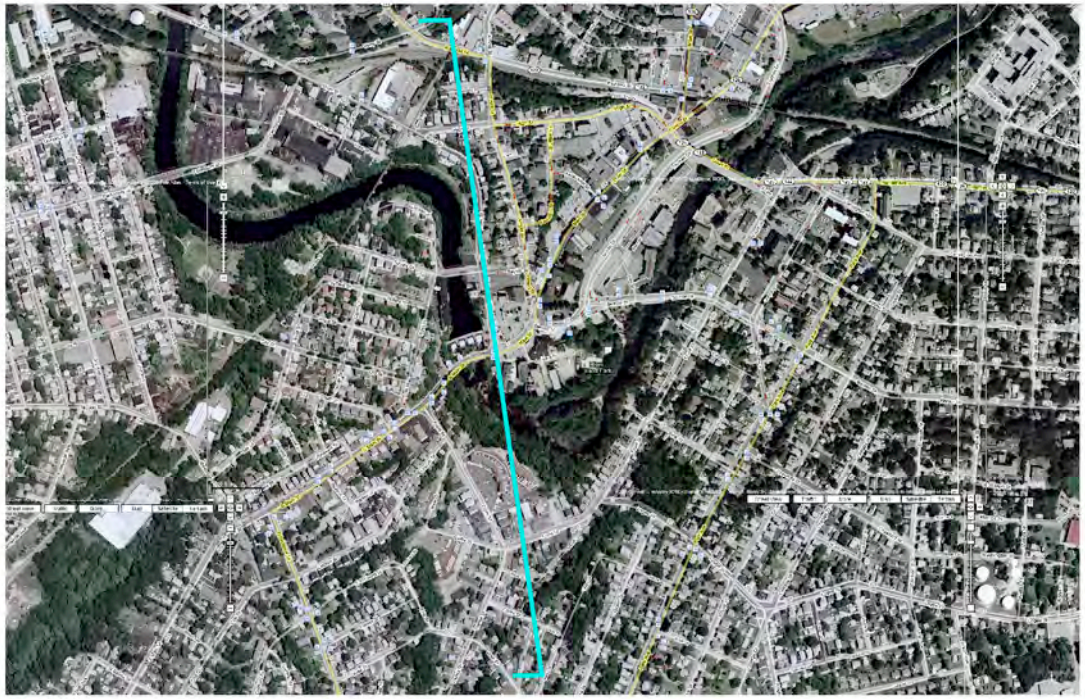
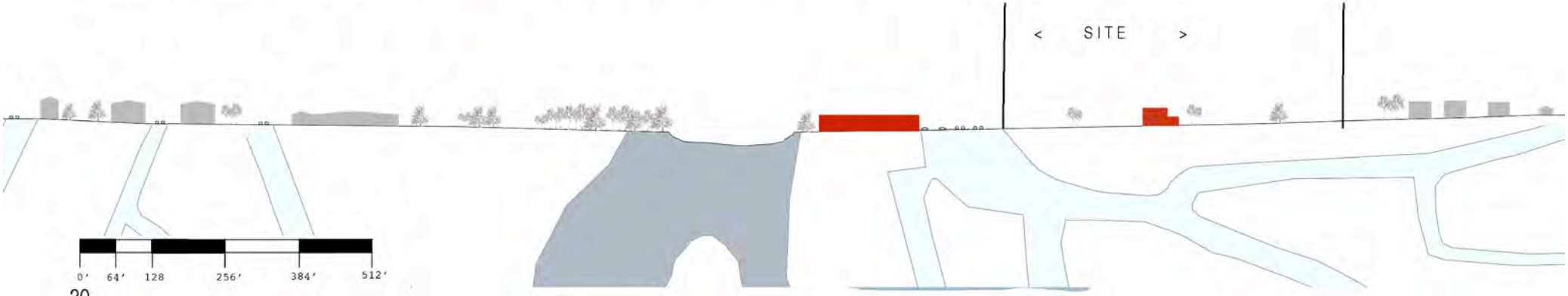


ILLUSTRATION 9: DOWNTWON WOONSOCKET

FEELING THE LANDSCAPE

"To speak in context [of landscape] is to distinguish deep and lasting contexts from those that are superficial and fleeting; it is to respond to the rhythms and histories of each and to project those contexts into the future."
-Anne Whiston Spirn, (p167)



< MARKET SQUARE PANORAMA >

The land becomes part of the historical development of the city. It holds metaphors of living, coexisting, and change within. Sadly, the city seems to orient its movement based on the layout of the main roads and highways. From north to south, the land funnels towards Market Square, with the residential areas on the high points.

In Market Sqaure, the site gradually drops 8 feet from north to south. To the north is a series of elongated residential blocks that run and turn with the river, north to south. To the south of the site, behind old existing mills, is an isolated piece of land surrounded by water. The Blackstone River also creates areas of isolation along its banks that are physically attached. On the other side of the river to the south is a green space that buffers new apartment buildings and the intersection of two residential grids. SUN

< FOCUSED SITE >

FOCUSED SITE >

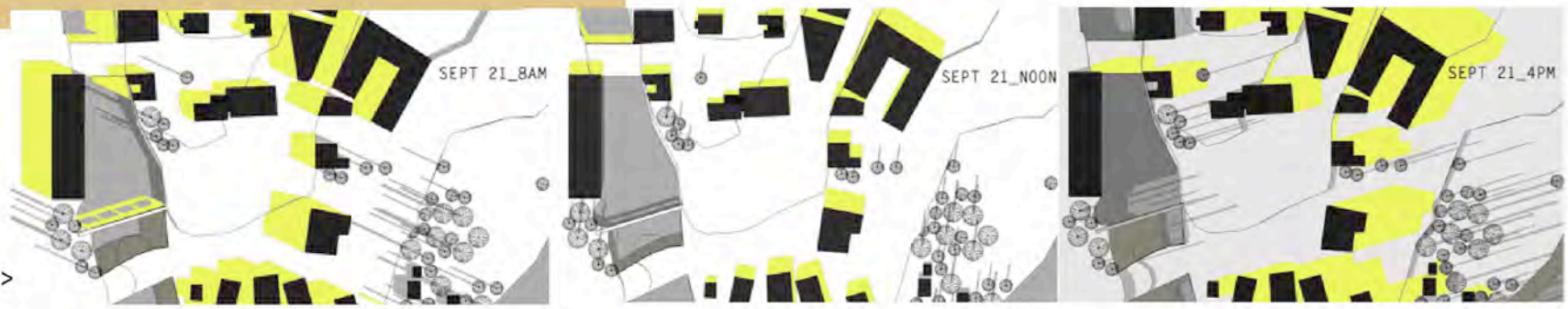


ILLUSTRATION 9 : SUN SHADOWS ON SITE

Due to the south facing slope of Market Square, it receives full sun exposure the majority of the day for most of the year. In the winter, the site receives the least amount of sun. At 8am in December, the site is 90% shaded. By noon, the grounds are fully exposed, but by 4pm the sun has set. Annually, the great amount of light the site receives brings forth many opportunities for building.

To the right is a sun path diagram showing the angle of the sun for each hour at different times of year. The blue curve shows the sun's angles throughout the day on December 31st. The green curve shows the suns angles throughout the day on June 21st.

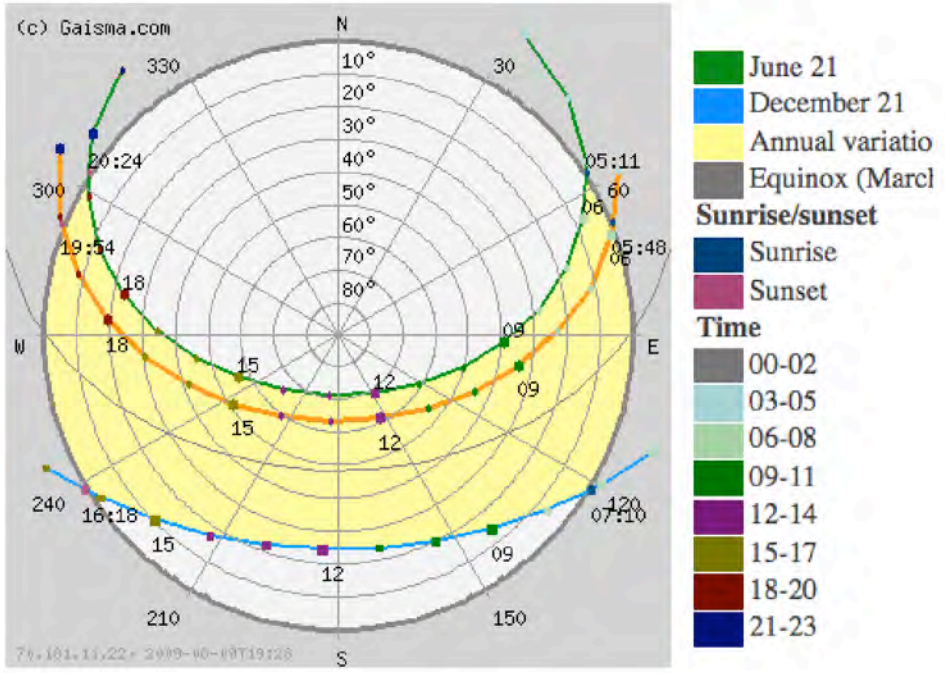
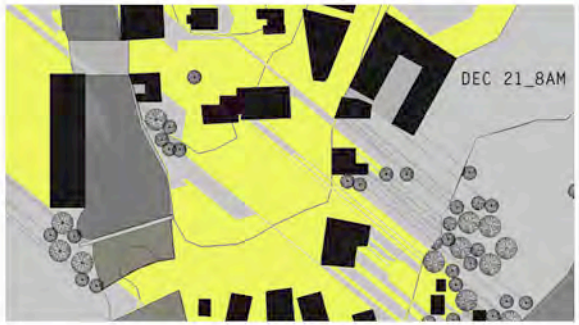
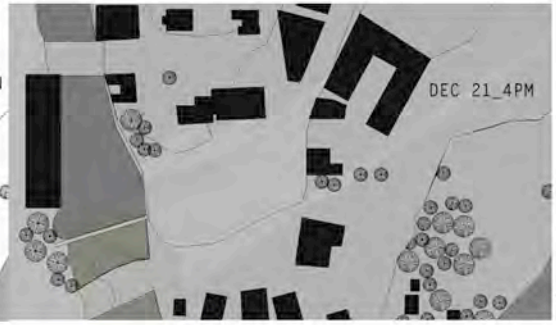


Image 38





< FOCUSED SITE

WIND

The wind rose to the right shows the average wind directions and speeds in Providence, Rhode Island from April 1st to October 30th. The diagram shows that the strongest winds come from the south, making the position and slope of Market Square prime for natural ventilation.

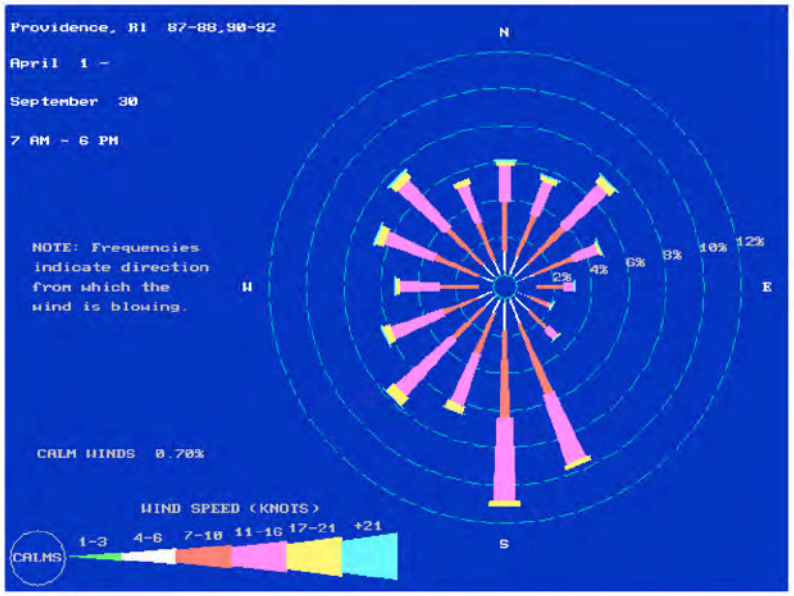
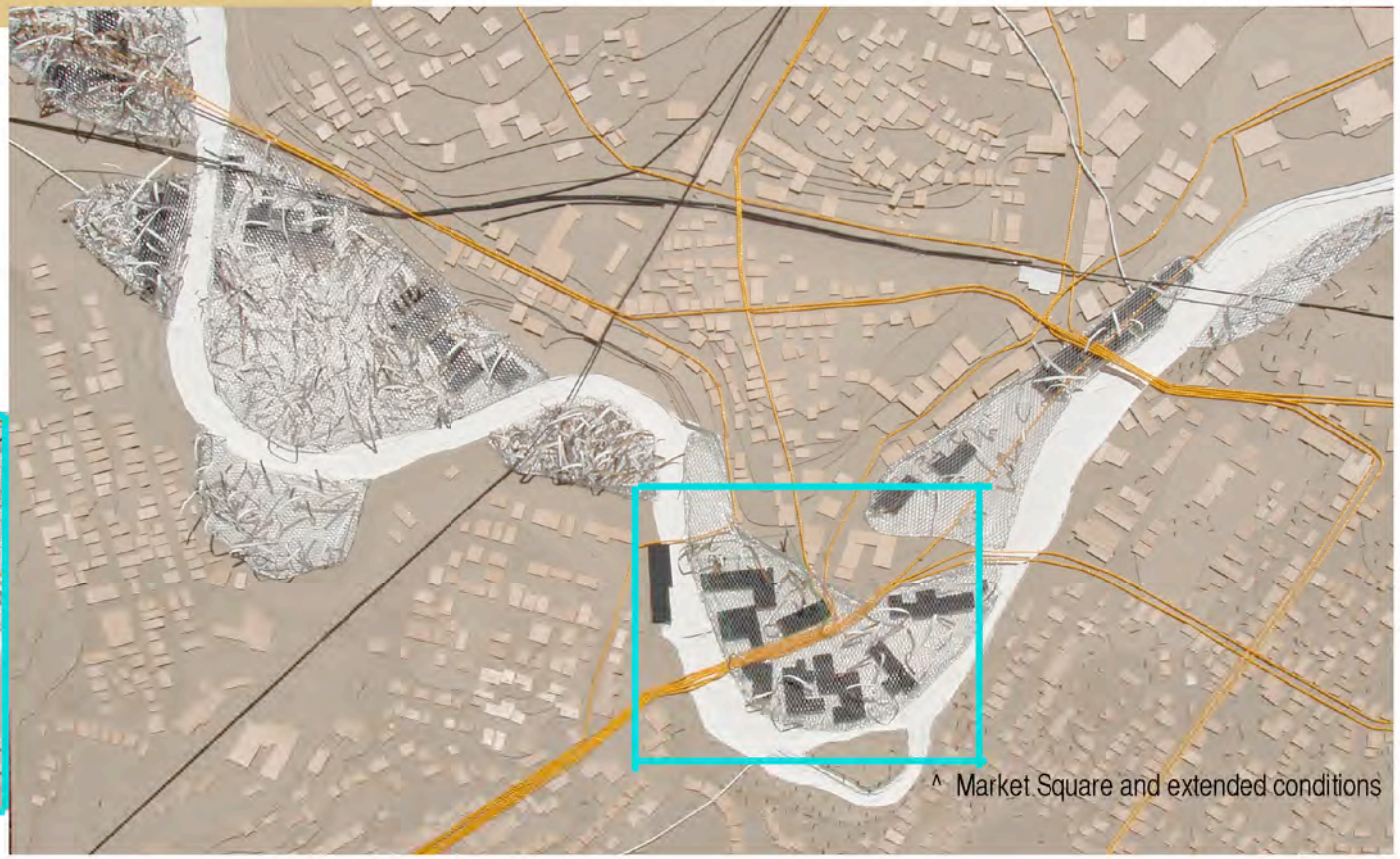


Image 39

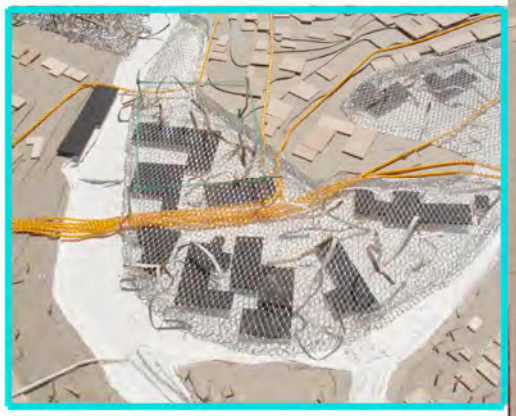
LANGUAGE OF LANDSCAPE _ CURRENT CONDITIONS

Woonsocket, RI



^ Market Square and extended conditions

ECOLOGICAL & TECHNICAL INFRASTRUCTURES



Traces of past infrastructural systems remain in the context of Woonsocket today. Some are used and others remain vacant. Above, is a diagrammatic urban model showing Woonsocket's many existing systems, both functioning and non-functioning. The gold paths represent the most common automotive routes taken through the city. Many of the residential neighborhoods are defined by these routes. The black paths resemble the old rail lines, which stopped being used several decades ago.

The areas of land modeled in mesh along the Blastone River are polluted brownfields. The screens resemble the land as a sponge, containing the substances of Industrial production. Threads are woven through the land, signifying the rate at which water and nutrients pass through the soil and into the ground water at that location. White strings cascading fown the contours are the main rainwater runoff routes to the river. The building footprints show the layout of Woonsocket as it is today. The black building footprints resemble the old mills that once polluted these landscapes. Many of these infrastructural systems come together at the industrial hub along South Main Street in Market Square, as seen boxed in blue.

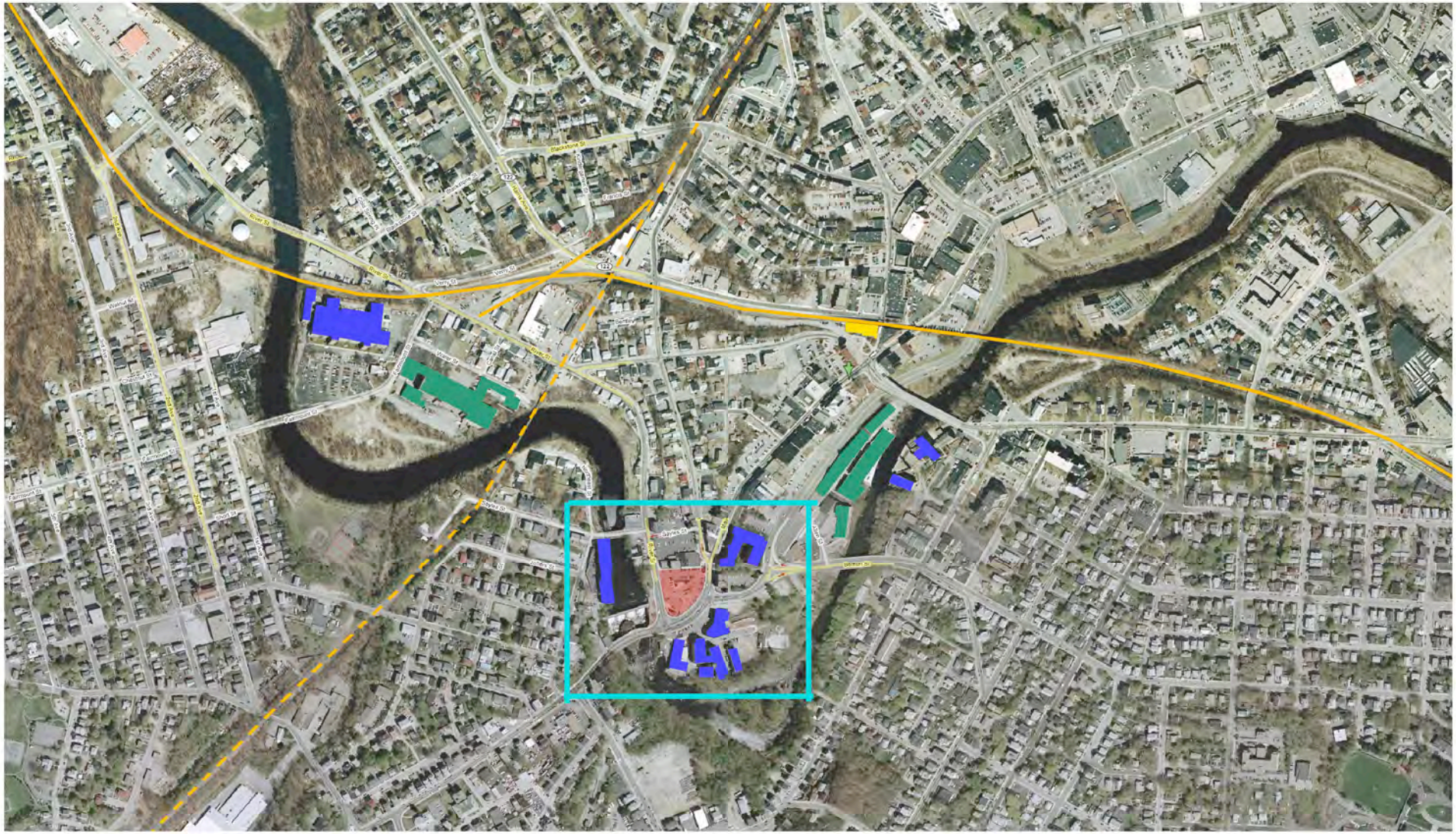


ILLUSTRATION 9 : ARIEL VIEW OF WOONSOCKET, HIGHLIGHTING CURRENT STATE OF INDUSTRIA INFRATRUCTURES

FOCUSED SITE_THE INFRASTRUCTURAL HUB

Blackstone River Dam

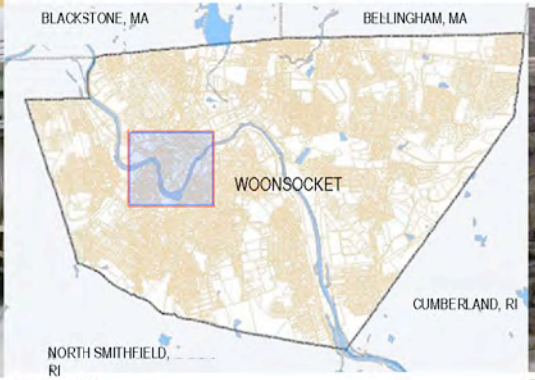


Image 40

Blackstone River Dam Automotive Bridge

MARKET SQUARE

Market Square is rich with contrasting infrastructural systems. Their coexistence creates the potential for high stimulation, which ironically remains underutilized and discontinuous in its current condition.

The Blackstone River dam is located to the left of the site, where the river falls approximately 12 feet. The groundwater level is approximately 10 feet below the surface. Most of the site is paved, except for a trip of trees and grass along the river front to the west of the site. The square stands on the edge of three main intersecting roads: Main Street, Bernon Street, and Arnold Street. Market Square, once the main industrial hub of the city, has become a central node of the many surrounding infrastructures.

"Infrastructures ensure the functioning of the city, and sometimes explain its origin," -El-Khoury [10]

ILLUSTRATION 10 : SITE: EXTENDED CITY BLOCK FROM MAIN ST. TO BLACKSTONE RIVER

[10] Robbins, Edward and El-Khoury, Rodolphe. Shaping the City in Design. New York: .2003 Routledge

Image 41
WOONOSCKET FALLS VILLAGE
1825

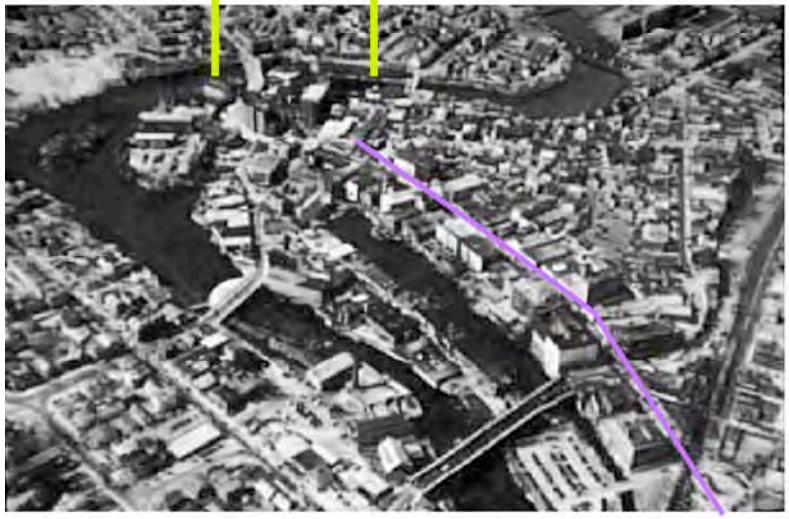
Image 42
WOONOSCKET FALLS -
MARKET SQUARE
1930

Image 43
WOONSOCKET VILLAGE-
TRENCHES & CANALS
1938

Image 44
WOONSOCKET VILLAGE-
TRENCHES & CANALS
1938

Market Square was the initial development of the original Woonsocket Falls Village back in 1825. During this time, the Blackstone River had a small canal that went through the village, providing necessary water and currents to the people. By 1938, the people of Woonsocket village manipulated the river by creating trenches that further divided the water system. This created more waterfront land for mills to use the water for power. Due to these trenches, the road parralel to Main Street became filled with industry and production. By 1950, Market Square was fully developed into a node of clustered mill buildings along the Blackstone River, located at the end of Main Street.

< MARKET SQAURE >



^ MAIN STREET

Image 45
DOWNTOWN INDUSTRIAL HUB- MILL TRENCHES
1950

FOCUSED SITE_ MARKET SQUARE

DISCONTINUED INFRASTRUCTURES

Few of the mill buildings that made up the industrial hub still stand today. The existing mills radiate out around the south of the site reaching towards the Blackstone River. All restored and reused, these mills are a reminder of the city's past production and cultural values. Comparatively, the mills are proof of how the functions and demands of the city have changed since the industrial years. These structures bring attention to the presence of the infrastructural systems, the workers and technology, that once suported the growth of the city.

Market Square has dramatically changed its physical relationship to all forms of infrastructures. It went from being the infrastructural hub, relying on the water for it's survival, to a paved, isolated urban block surrounded by roads, removing any bold relationships to the river. The mill trenches no longer exist in Market Square or down Main Street; they have been replaced by roads that isolate each urban block containing any continuous green infrastructure.

River Street divides Market Square from the River, creating a narrow strip of green space to the public parallel to the water. The space is very cut off from the water, and directs your attention more towards the automotive activity down the slope. It is a shame this relaionship to the river stands so bleak, for across the river from this space stands one of the only remaining mill buildings that holds its dramatically reliant relationship to the river.

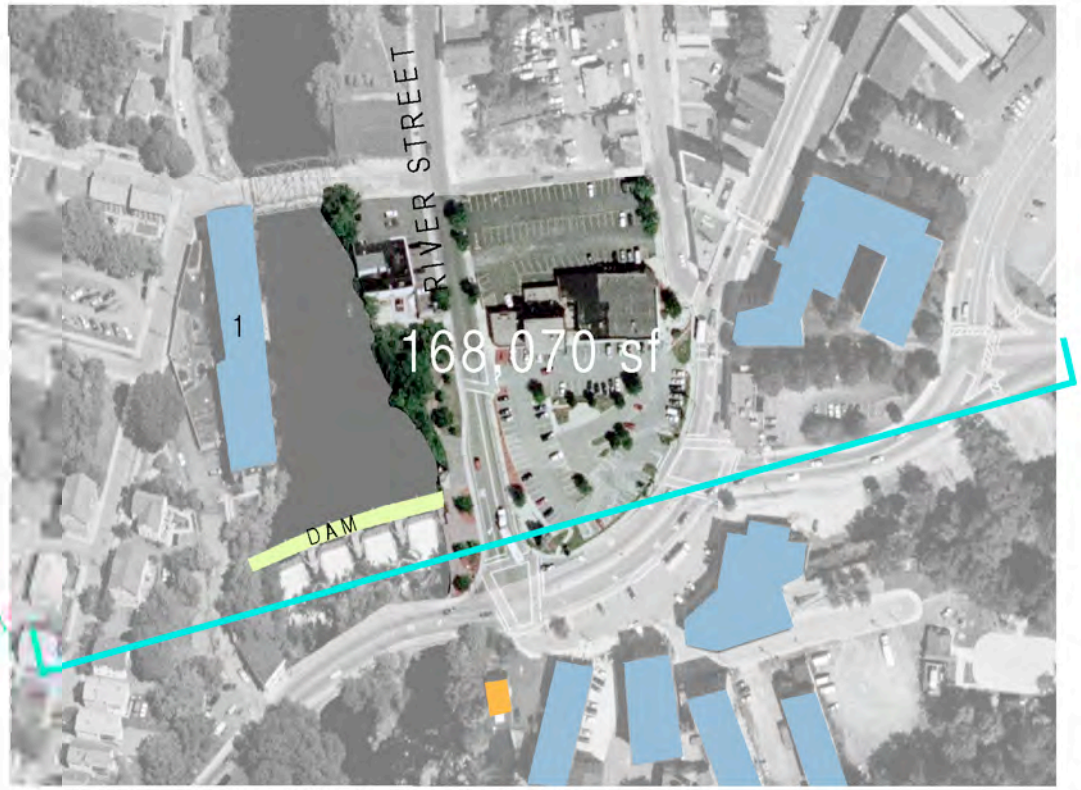


ILLUSTRATION 11: MARKET SQUARE AND SURROUNDING MILLS

Across South Main Street from this public space is a power house, highlighted in orange, that stores power generated from the water's movement over the dam. The electricty produced is used to power the Woonsocket's new water treatment facility, which currently runs below full capacity.

The Blackstone RIver Dam has a maintenance footbridge on top of its support, that leads from the high point of land to the west of the river to the low point at Market Square.

FOCUSED SITE_ EXISTING BUILDINGS

Today, Market Square contains a small strip of buildings at the north end, including a restaurant, a karate school, and massage therapy office. To the north and south of these buildings are parking lots of about 91,000 sf that takes up 54% of the overall site.

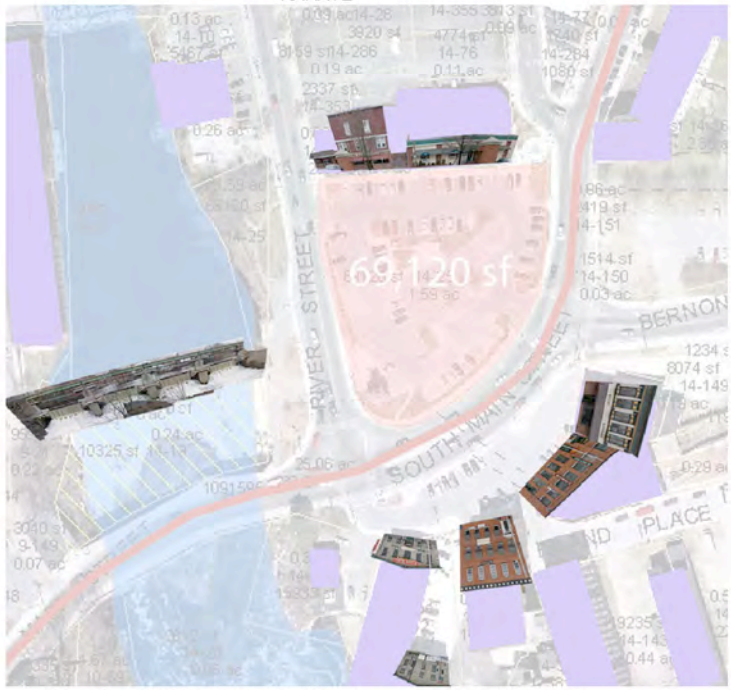
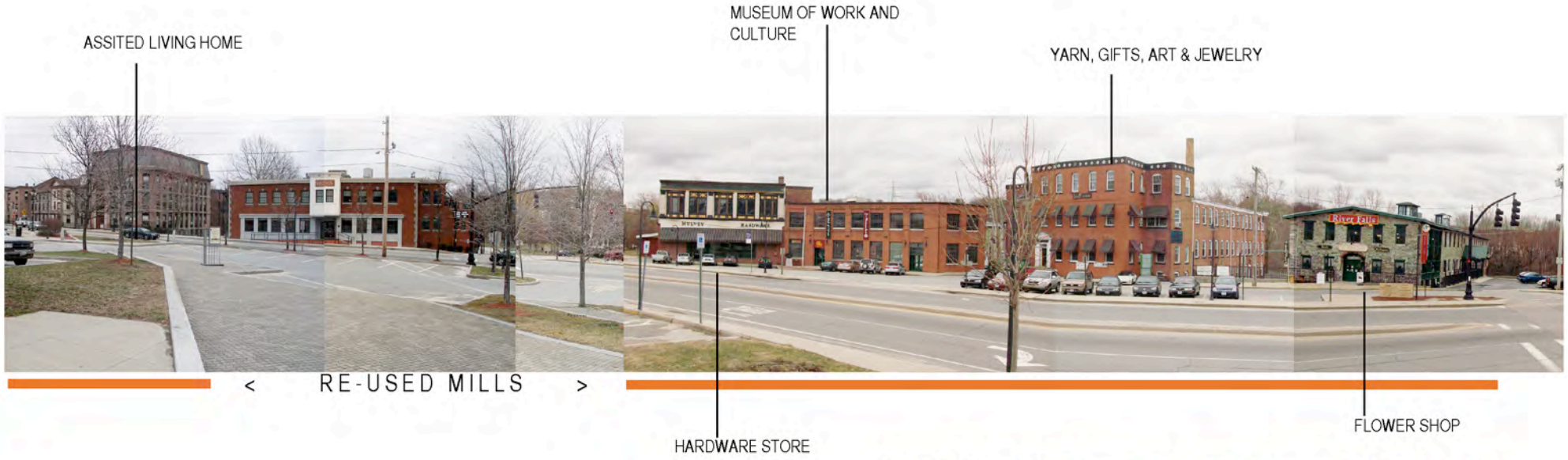


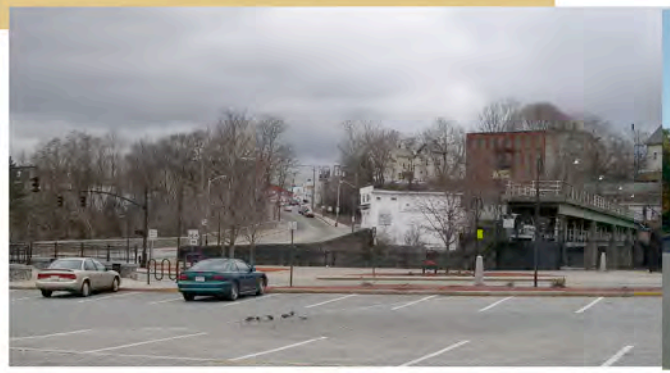
ILLUSTRATION 12: MARKET SQUARE AND SURROUNDING MILLS



To the south of the site are the existing mill buildings that have been rehabiliated and reused for commercial use. There yarn mill is the only still functioning factory. To the west of the yarm mill is a flower shop, and to the east is the Museum of Work and Culture. This historic museum educates the public about the lives and culture of the past mill workers during the industrial revolution. It enlightens people about the families who migrated to Woonsocket for work and to start new lives. It talks about their faith, integrity all the way to the fall of the industrial revolution. It is an important part of Woonsocket that is easily forgotten about. To the east of the museum is a hardware store and across Bernon street is another mill that has been reused as an assisted living home. The identity of these buildings and what they represent is very important to the history and future of Woonsocket.

ILLUSTRATION 13: MARKET SQUARE AND SURROUNDING MILLS

FOCUSED SITE_ BRIDGING & TRANSPORTATION



Although Market Square stands on the south end of Main Street, its pedestrian passage is minimal. It stands at the intersection of two main roads that lead to three different maine routes. To the north, River Road leads to route 122, which leads to the Massachusetts Pike. Bernon Street bridges east across the river to route 126 which eventually connects to 295 south to Providence. South Main Street bridges across the river to the west and meets up with route 146, which is the main route that runs north to south, Worcester to Providence. Along these main roads are bus routes that run from Providence to Woonsocket and inner city routes that run throughout Woonsocket. Although their effiency is poor, these bus routes are highly relied upon for transportation to school and work by those who live in the city.

ILLUSTRATION 13: AUTOMOTIVE ROUTES AROUND SITE

Above are the many bridging elements surrounding the site. They all connect and disconnect from the pieces of land in different ways, which affect their function and their connections to their surroundings. Below is the curve main road at the south of the site that bridges across the river to a higher elevation in the west. The diagram to the left also contains the main pedestrial paths through the site in purple. The paths are mainly used to move past the site, rather than using and performing within the site.

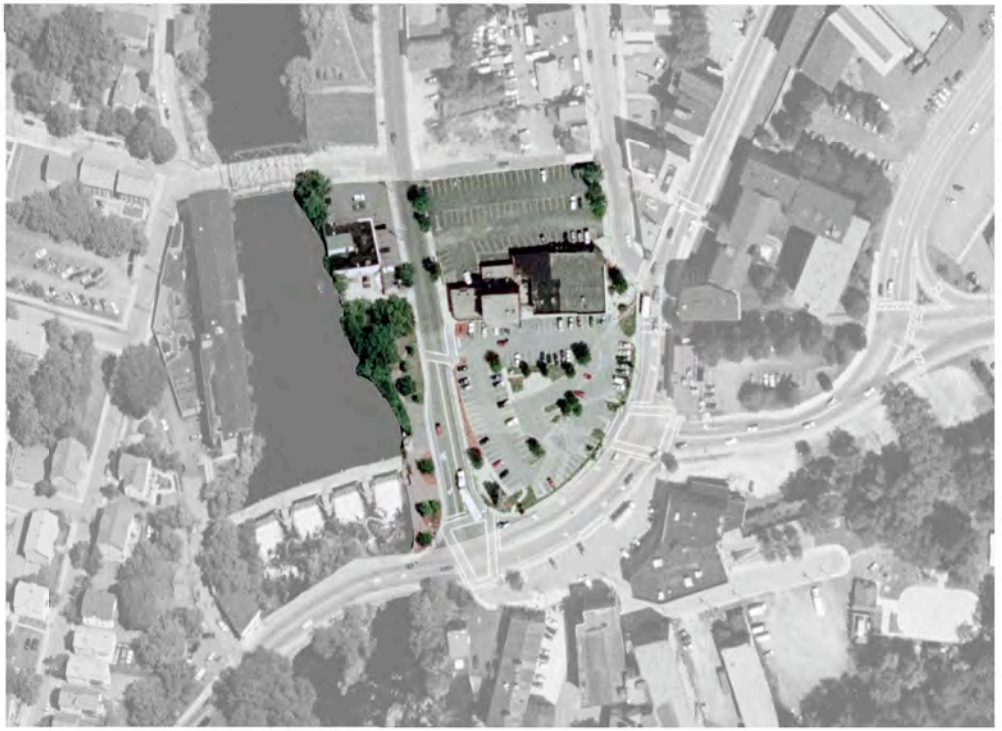
FOCUSED SITE_ IN-BETWEEN URBAN CONDITIONS

PARKING LOT BEHIND MARKET SQUARE ^

LIVE, WORK, PLAY

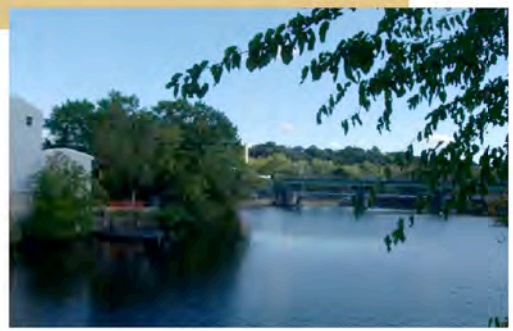
In between every road, every block, every building, every sidewalk are neglected urban spaces that could be put to use. In a city, every square foot needs to be utilized, whether it is for built infrastructure or a natural system. Both of these types of systems are vital to the survival of the city.

The site contains a series of paved spaces that fill the gaps in between buildings, parking spots, and sidewalks. There are random trees that break the continuous concrete and relieve the natural soil. The amount of continuous green space is almost non-existent. The most commons gathering throughout the city streets are the bus stops, but there are no spaces that contain diverse spaces for multiple types of public function and interaction. After all, a city is a dense environment where many people work, live and play.



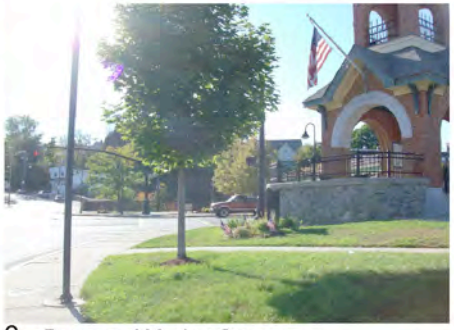
The images to the above far right is the most popular bus stop on Main Street. Behind is it an empty parking lot, and in front of it are empty retail stores for rent. To the right is a picture of Market Square from Main Street. It shows the differentl paving pattern used to separate the lanes. Across the street are random green patches that fill the space between the parking rows. These spaces are similar to the image on the above left, a contaminated brownfield out front of an old mill down the road from Market Square.

FOCUSED SITE_ RECONNECTING EDGE CONDITIONS



1 River Dam from north

2 Narrow Park Strip



3 Bottom of Market Square

FILTER LAYERS

This area of town has been slowly breaking down for the past 60 years. There are many spaces in the city whose function is to filter two adjacent urban conditions, or to transition through a converging piece of the city's infrastructure. These in-between spaces tend to each have their own energy and relation to the specific ground condition. Every piece of land has a cause and affect relationship with its users; and therefore, each space must have proper ecological and material layers that make up the balance in the urban fabric. This balance can be attained through a series of filters in the cities' many edge conditions.

In Market Square, many edge conditions exist due to its peninsular topographic shape. Ineptly, the function of many of these urban conditions have either changed or diminished over time. These conditions directly affect the nodes around them. The diagram to the right points out the numerous nodes who formed at the interface of multiple edge conditions, seen in blue and red. Many of these nodes in Market Square have become voids due to their lack of activity and tension received from surrounding edges. There are also automotive nodes, seen in red, that create public isolation between many urban blocks and different public spaces throughout the cradle of South Main Street.

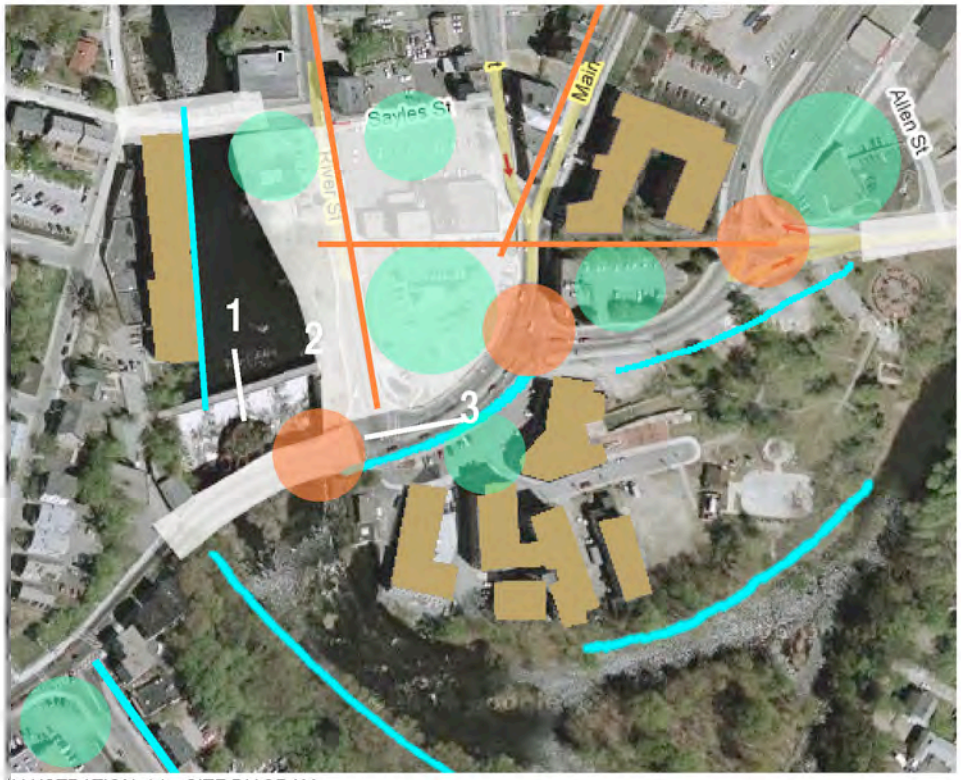
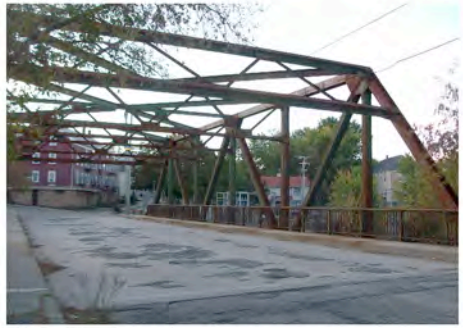


ILLUSTRATION 14: SITE DIAGRAM

4 River Edge North of Park Strip

5 Arnold Street northeast corner of site

6 Sayles Street in north border of site



7 Bridge leading off of Sayes Street

SEPARATING LAYERS

Above are the numerous edge conditions in the extended site. In many cases, the rivers' edge is off limits to the public usually caused by a physical barricade. This creates a very indirect relationship to one's surroundings. Many of these spaces also lack human scale and human function. Even simple resting areas gathering conditions where people could use their city and impulsively create an environment that is healthy.

TRANSITION PATHS

If these edge conditions were treated as transition spaces, it would open them up to public use and understanding the relationship of two colliding systems. Transition paths and spaces are defined by the high energy produced at a site through many activities happening at once. It is vital for urban dwellers to see how many co-functioning systems it contains and how a balance can be maintained to acheieve co-existence and function.

ILLUSTRATION 15:
SITE DIAGRAM

FOCUSED SITE_ HIDDEN INFRASTRUCTURES

Image 46 STORM SEWERS

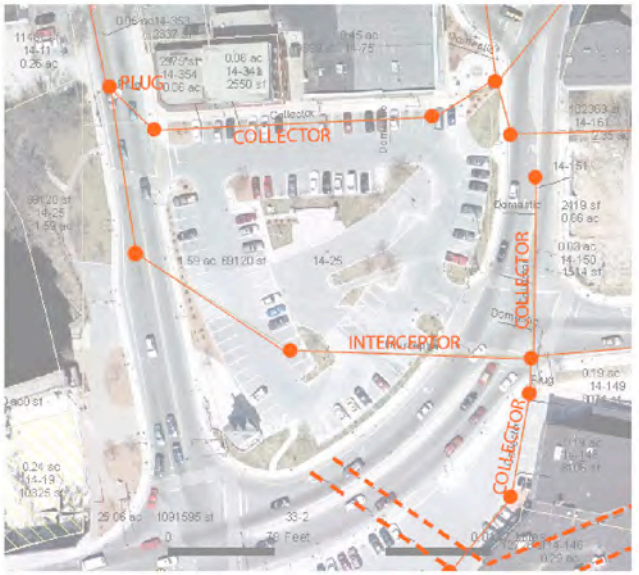


Image 47 SANITARY SEWERS

Market Square contains much activity beneath its paved surfaces. The land was a brownfield for the industrial mills that has been capped off and paved over. Below the surface are a series of drainage sewers and sanitary sewers that are all part of the city's hidden infrastructures. Without these, the city could not properly dispose of its waste or stormwater.

Image 48

Green infrastructure could be applied to the surface treatments within the city to take away the need for so many storm sewers. The water would filter through the ground and become part of the ground water supply. The image above shows the areas with high ground water along the river. These areas are most sensitive to stormwater runoff. The diagram to the right shows these areas and the scars that live below the surface. Ecological systems are needed to relieve the pollution and runoff that continues to pollute these areas below the ground surface.

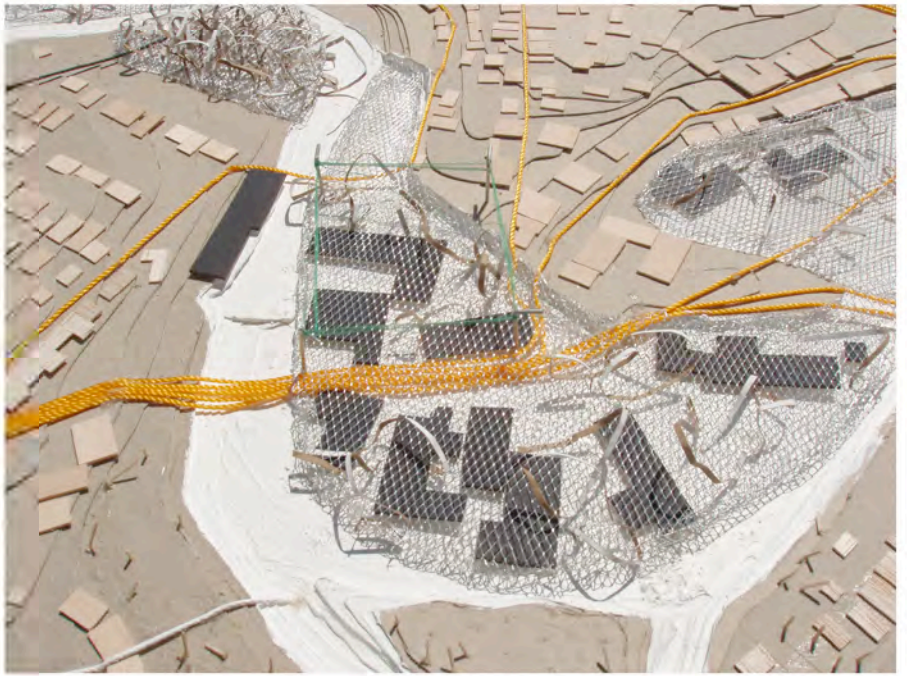
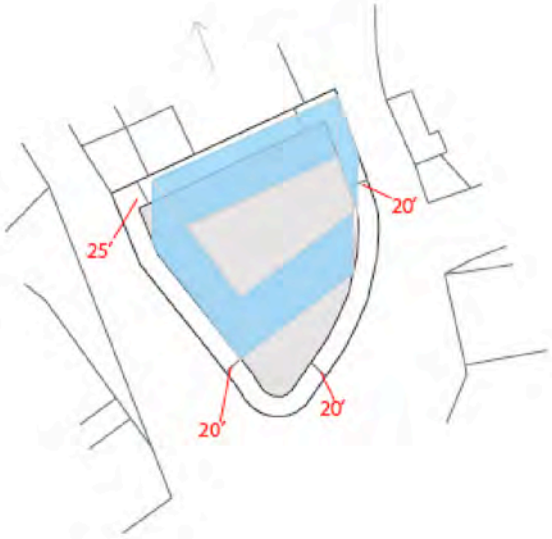


Image 49 Woonsocket Zoning Map



Market Square is zoned as a major commercial district, primarily for the conduct of major retail trade and services to the general public.

This requires that building uses a minimum lot area of 6,000sf, with a maximum Floor Area Ratio of 2.0

Front Setback: All buildings have a set back a minimum of zero feet from the street right-of-way line of which they front.

Side Setback: All buildings shall be set back from each side lot line a minimum of sero feet or 25' when abutting a residential zone.

Rear Setback: All buildings shall be set back from the rear lot line a minimum of 25'

Height/ # of Stories: No building shall exceed 5 stories, or 60', unless each side yard is increased over the minimum setback requirement by 10' for every 1 additional story

Upper Story Residential Uses:
No ground story residential uses shall be permitted; however, dwelling units shall be permitted on all stories above the ground floor.

GREEN SPACE REQUIREMENT

All developments within this overlay district shall include a minimum of 50 sq. ft. of on-site green space for every parking space required under this ordinance, except that in the case of parcels with unreasonable constraints, the design review commission may alter, reduce or waive the green space requirement.

Perimeter Buffers:

Where any portion of a site is adjacent to any non-residential use property, a minimum landscaped buffer of 5' in width shall be established along the line which adjoins such non-residential use property, and said landscaped buffer shall contain landscape treatment which is determined by the design review commission to be an appropriate nature.

Where any portions of a site is adjacent to any street or public-right-of-way, a minimum landscaped buffer of 4' in width shall be established along the lot line which adjoins such street or right-of-way and trees of an appropriate size and type shall be located approximately every 50', with exact tree locations to be determined on a site-by-site basis to avoid interfering with underground utilities and/or curb cuts.

OFF-STREET LOADING

Exception for Main Street Area: Off-street loading shall not be required within the C-1 Urban Commercial District from Market Square to Monument Square.

ILLUSTRATION 16: BUS ROUTES AND SURROUNDINGS DIAGRAM

PARKING

Except in the case of a circular driveway, no off-street parking shall be permitted in that portion of the front yard of any residential property which is bounded by the extension of the side lines of the principal building foundation, excluding any attached garage or carport, from the line of said foundation to the public right-of-way.

Parking areas shall meet the following minimum dimensional requirements affecting the width and length of individual parking space and the width of aisles exclusive of necessary drives and other access ways:

Minimum parking space width ..... 9'
Minimum parking space length.....9'
Minimum aisle widths
(back-up space no less than 9'
wide by following corresponding aisle widths):
90 degree angle .....24'
60 degree angle .....16'
45 degree angle .....12'
30 degree angle .....11'
parallel parking .....12'

OFF-STREET PARKING

Exception for Main Street Area: Off-street parking shall not be required for non-residential establishments located within the C-1 Urban Commercial District and the MU-2 Mixed used Industrial/Commercial District from Market Square nor for non-residential establishments located within the Social Renewal Area, which is bounded intersection of Social Street and Clinton Street to the west.

PARKING SPACE REQUIREMENTS BY USE

Educational Institutions Serving Older Children or Adults, and Similar Establishments: 1 space per 3 students (based on design capacity)

OR 1 space for every 4 seats or places available at maximum legal capacity in any places of assembly located within the institution. The greater of these two numbers will be used for the requirement.

Entertainment Facilities: 1 space is required for every 5seats or individuals for which the facility is designed to accommodate.

PROGRAM_ CONSTRUCTING THE ENVIRONMENT

Creating heathy surrounding infrastructures is important to Woonsocket's future survival. Enforcing public transportation, multi-use public spaces, healthier surrounding ecosystems, and education all take part in regenerating the city's emotional and physical stability. Woonsocket is in need of a rehabilitation to its built and ecological infrastructures in order to regenerate the hope and future of the city. This requires Woonsocket to redefine the downtown in terms of boundaries, function, and role. The built environment needs a positive identity that influences people to understand the systems of the city and how they work together. Transparency, coexistence and order are definitive for such comprehension, but the freedom to travel through such conditions is also important for the individual. Allowing people to explore and experience the different possible conditions of the city freely is necessary for the people to feel a sense of community ownership.

Economic stability is also unavoidably necessary for the rehabilitation of the downtown to occur. Jobs must come back into the city in order for families to stabilize their foundation in their environment. Woonsocket needs an institution that resembles the potential growth of its people and environment. It needs to redefine the use of function of old infrastructures in accordance to today and tomorrow's needs. The many old mill buildings have left large footprints in the land, demanding revival and new life. This metabolism of the old decay into new growth is similar to many processes in nature. Many biological processes are used in many parts of the world to turn our evergrowing waste into another systems food.

Image 50

The United States Government is attempting to turn our cities post-industrial cities around by implimenting green infrastructure into the urban fabric in atttempt to cleanse our natural surroundings. Federal organizations are formed to provide new training programs that create jobs to local cities. These institutions are implified to provide new careers to willing individuals within a few months of training and education. Today, these programs are generated to quickly start a reformation in our physical and economic environments.

Woonsocket needs a to fill the void of the old power-generating Market Square with a facility that benefits the public economically and environmentally. I am proposing a training facility that teaches the public about the health of our environment; our land. Bioremediation is a process which uses ecological systems, such as plants and organisms, to metabolize concentrated amounts of toxins in our water and soil. This process is being more recently used to remove waste from old industrial dump sites, or brownfields. Green infrastructure will bring wildlife back into cities, creating a dense environment where nature and man can coexist, without the many compromises that exist today. Woonsocket can improve the quality its tainted land and groundwater through the planting and preservation of natural ecosystems, while creating more internally balanced environments for its inhabitants.

Image 51

PROGRAM_ BIOREMEDIATION

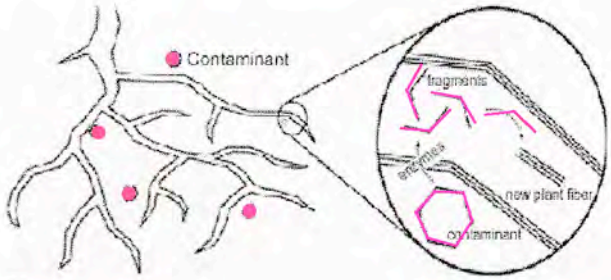


Image 52

Bioremediation is the process when plants metabolize, filter, break down or stabilize its surrounding soil or water from harsh contaminents. There are a series of different types of pants that perform different processes to their immediate surroundings in order to change it to survive. These biologically regenerative processes can also be known as *phytoremediation*.[11]

Rhizosphere biodegradation / Microorganism stimulation is a process where a plant's roots release organic substance, such as fungi and bacteria, to supply nutrients to microorganisms in the soil to DEGRADE the contaminents.

Phyto-stabilization is the where the plant produces a chemical compound to IMMOBILIZE contaminents in the soil or water. This process reduces surface runoff erosion and the fow rate of the ground water.

Phyto-extraction is the process where the plant's roots ABSORB metals and contaminents into its leaves and shoots. The plants are then contaminated and require proper disposal if absorbing toxic substances. *Rhizofiltration* is like phyto-extraction, but it is a hydroponic system grown in water greenhouses. This system is good for groundwater treatment.

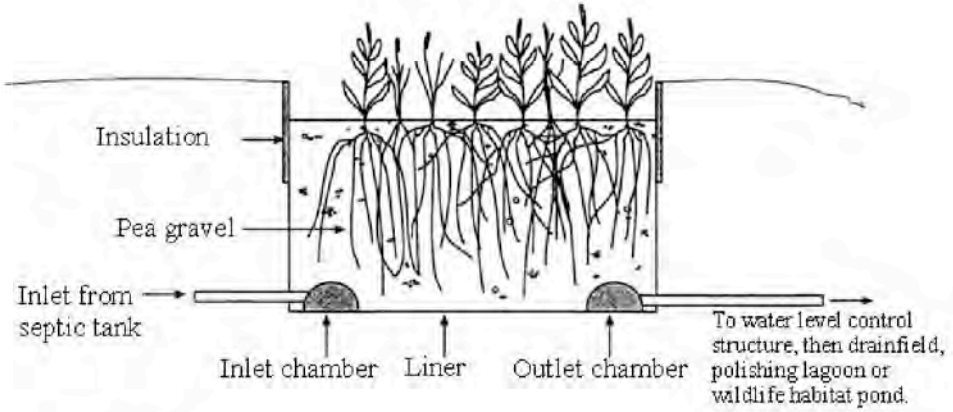


Image 53

[11] EPA's RCRA Waste Disposal, http://www.cpeo.org/techtree/ttdescript/phytrem.htm[11]

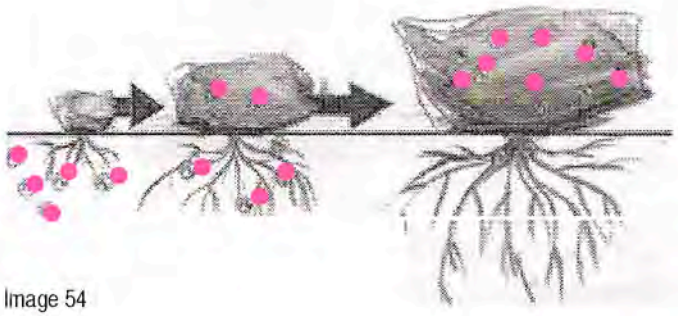


Image 54

Phyto-degradation is the process where pants METABOLIZE contaminents within its own tissue, destroying some, but reducing other complex organic pollutants into more simple molecules to use as food. This biological process is a complex example of how to turn waste into food. [12]

Wetlands are transitional areas between land and water, whose function is to filter and metabolize organic and non-organic matter. This filtrating process found in nature needs to be very systematic when constructed by man, for the process is something that occurs over a period of time. Many constructed wetlands are tiered, using gravity as a system for moving water through a series of plants that will cleanse the water.

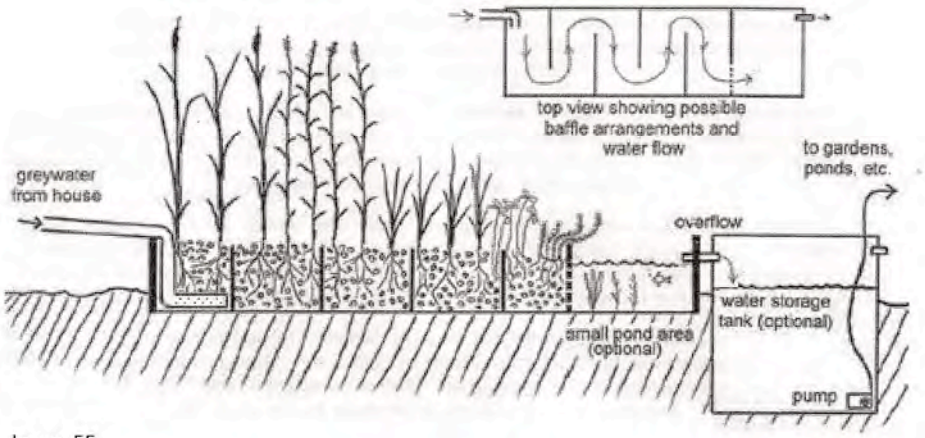


Image 55

United Nations Environment Programme, Phytoremediation: An Environmentally Sound[12]
:Technology for Pollution Prvention, Control and Remediation, visited 9/4/08
http://www.unep.or.jp/ietc/publications/Freshwater/FMS2.asp

PROGRAM_ SQUARE FOOTAGE

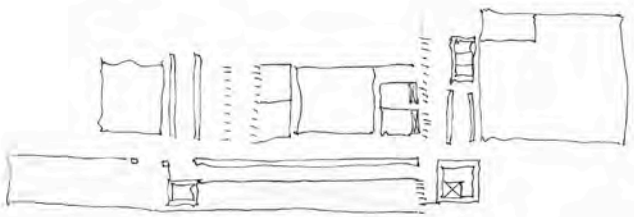
TRAINING FACILITY

Greenhouse			8,240 sf
Community Outreach Center			4,900 sf
Library/ Research Center			4,784 sf
Computer Lab			4,400 sf
Administrative Offices			4,940 sf
Auditorium			1,704 sf
Overflow Outdoor Garden			300 sf
Living Machine			600 sf
Community Rooftop Garden			960 sf
Storage	165 sf	x3	495 sf
Bathrooms	360 sf	x4	1,440 sf
Classrooms	860 sf	x3	2,580 sf
Laboratories	1,525 sf	x3	4,575 sf
Support Space	470 sf	x2	940 sf
Lounge	450 sf	x2	900 sf

Mechanical Rooms	4,000 sf
Loading Dock	1,300 sf
Net Square Footage	**30,838 sf**
Gross Square Footage	**43,173 sf**

TEMPORARY STUDENT/FACULTY HOUSING

Housing Unit Types _			
	1 Bedroom Unit	550 sf x9 units	4,950 sf
	2 Bedroom Doube-Bay Unit	1100 sf x6 units	6,600 sf
	2 Bedroom Double-Height Unit	900 sf x13 units	11,700 sf
Student/Facuty Rooftop Garden			2,880 sf
Rooftop Recreation Area			3,390 sf
Lounge/ Study Room		460 sf x 4	1,840 sf
Mailroom			460 sf
Ground Floor Retail			5,400 sf
Net Square Footage			**37,220 sf**
Gross Square Footage			**52,108 sf**



GROUNDS / SOCIAL & ECOLOGICAL INFRASTRUCTURES

Blackstone River Wetlands	tier 1	42,978 cubic feet
	tier 2	51,000 cubic feet
	tier 3	39,000 cubic feet
	tier 4	53,400 cubic feet
Wastewater Wetlands	tier 1	10,400 cubic feet
	tier 2	8.800 cubic feet
	tier 2	6,000 cubic feet
	Wetlands on-site	**211,578 cubic feet**

Market Square Piazza	8,667 sf
Bus Stop	1,050 sf
Garden Courtyard	2,657 sf
Multi-use Wetland Docks	5,727 sf

PUBLIC AFFORDABLE HOUSING

Affordable Housing Buildings	30,000 sf
	14,796 sf
	10,200 sf
Retail	4,932 sf
	6,000 sf
Net Square Footage	**65,928 sf**
Gross Square Footage	**92,300 sf**
Public Courtyard	3,555 sf

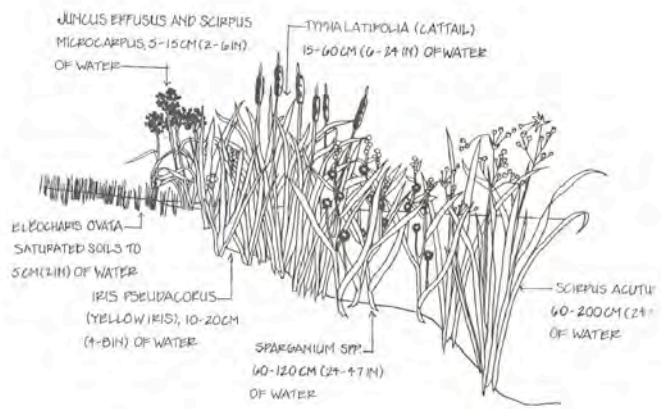


Image 56

There are many different types of plants who metabolize different pollutants, fungi and bacteria at different rates. A natural wetland, or even pond, contains a series of different plants along the edge where land meets the water. Along the Blackstone River, the edge condition becomes very important for this metabolic process. For heavy metal pollutants, cabbage, barley, dandelions, grasses, indian mustard, rapeseed and sunflowers are the best plants to remediate soil and water. Cattails, arrowroot, pondweed, agae, and water lilies are best to remove nitrates, commonly found in agricutural runoff.[13] Each piece of land and microcimate are more suitable for certain plants and animals that continue the cycle of food and waste.

In Woonsocket, RI the Blackstone River discharges 1,620 cubic feet of water per second. It would take 556,111 cubic feet of wetlands to process the 4,160,000 gallons of water in Market Square per year.[14] This could be accomplished through a large series of wetlands that treat 26 gallons of water per square foot per year. Currenty, Market square contains the proper slope to take in water from the top of the river dam and release it below the drop off once it is filtered. This filtration process woud help treat the pollution in the flowing river, as well as the contaiminents in the soil that seep into the groundwater.

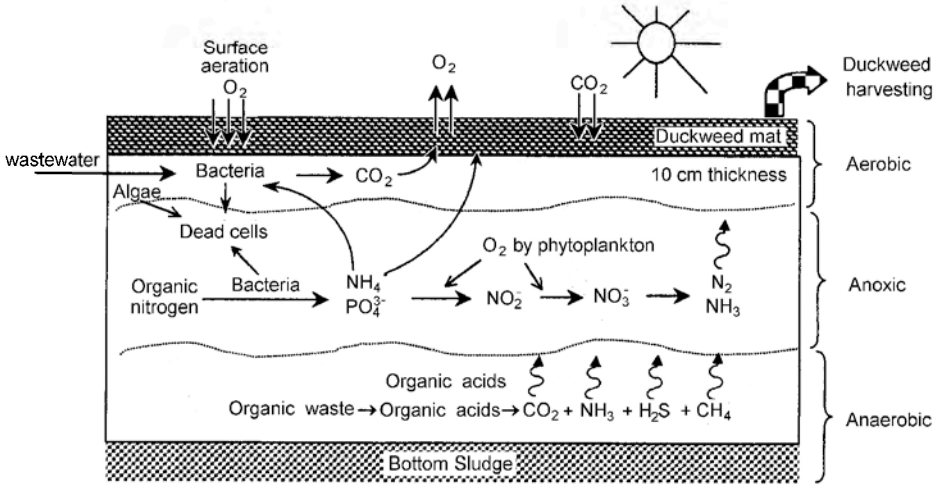
[13] http://ourgardengang.tripod.com/whsuchitup.htm

[14] Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007

Trees are another great stabilizer in groundwater heath and groundwater levels. Hydraulic Control is the process in which trees control the movement of groundwater below the ground's surface as their roots reach down to the groundwater and pump it into their roots. This not only cleanses the water, but controls the groundwater level, keeping it farther away from the polluted surface.

Subsurface wetlands are another way to use wetlands to turn waste into energy. Wastewater can be treated through a series of wetlands whose water remains below the plants surface to control odor. The pants have the same role in metabolizing the human waste by breaking down the organic substances using the sun and plant bacteria. Once the wastewater has been fully processed, the remaining grey-water can be used to flush nearby toilets and for irrigation.

Creating these biological cycles in our landscape help revive what natural cycles existed before man inhabited them. They create a new found relationship between man and natural systems, feeding one another to create a healthy landscape and common language.



Biological Processes in Duckweed-Based Wastewater treatment

Image 57

ARCHITECTURAL INTENTIONS _

Architecture is the medium that provides limiations and connections to people's natural and built environments. In many cases, architecture is the built environment that people inhabit. In other cases, it is a mere guide or path that connects spaces of different functions to the people who use them. Architecture can be both concealing and uniting between people and their environment. In terms of a post-industrial cities, architecture must re-unite people to their environment by abruptly confronting people with the remaining conditions of the environment while suggesting its efficient use and opportunity for enjoyment. This calls for spaces of confinement and reflection, as well as social spaces for cultural improvement and definition.

HERE, THERE, & IN-BETWEEN

Market Square is a strong node in the city where many ecological and built infrastructures visually and physically interact with the site. Architecturally, it is important to take advantage of these relationships to show how these systems work alongside one another, effect one another, ultimately rely on one another for their individual survival. Understanding the city as a series of functioning systems, both built and un-built, is necessary to interpret the role of each building form. The built forms in Market Sqaure must show the public how different systems in the city work and why they are important to the progression of the city. The site should be given back to the people as a tool to explore many vertical and horizontal levels and spaces of the city at all scales. The block should contain spaces for the individual to retreat to, as well as larger gathering spaces for further interaction and social interpretation. Many of these contemplative spaces happen in-between more defined programmatic areas whose function is more evident. These in-between spaces are what hold the truth behind the city and its many engines.

BUILDING ELEMENTS

These spaces in between larger programmatic elements are the infrastructure for the building. This includes the mechanical elements that provide temperate air, water and light to each room, as well as storage and circulatory devices. Anything that provides a source to the people in the buiding can be considered part of its infratructure. In most buidings, these parts are hidden and covered up, but by revealing their paths and function, one starts to understand the building as a functioning machine.

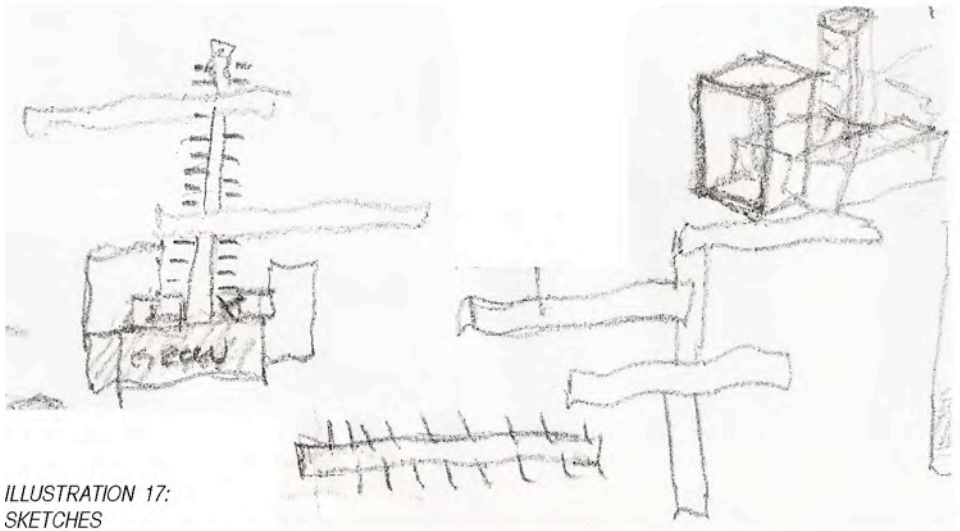


ILLUSTRATION 17: SKETCHES

ILLUSTRATION 18: PROCESS DRAWING

USE

Each building or space needs to be designed accordingly to its environment and use. The training facility must architecturally symbolize the old mill buildings that once existed on the site. The facility will take on the heaviness and rhythm of the factories, with cold materials and a modular structure. The structure of the old mills defined the inner working spaces, and so the training facility's circulation should be in between the spaces of production and social spaces.The training facility must resemble a 'modern mill,' a place of social, economic and ecological progression; and therefore, it must symbolize stability as well as transparency and comprehension. The modern mill will be different than the old factories, for they will be a place for the people; a stepping stone for education and urban comprehension. The new modern training mill will be the hub for which new infrastructural systems, both built and ecological -- coexisting.

Urban comprehension must be taken down in scale and used in examples on the site. The public must be able to explore parts of the grounds and public quarters of the building to see what production is taking place. It is necessary for the public to experience the city through a series of layers vertically and horiztonally to properly comprehend the complexity of the city's reationship to its people. People must understand that their activity and actions hold the energy and engine for change in their environment. This requires a series of public spaces throughout the city's layers of infrastructure, allowing the public to understand certain functions of spaces at all scales.

The system of buildings and open space must always revert back to its inner strength, the people and our environment. This relationship is the drive behind the constructed architecture and its identity. The building is just an empty structure without people to inhabit it. The building should represent the engine and the people and nature are equally its fuel.

The educational spaces symbolize the new type of production in the city. The architecture must enforce public awareness of group indoor activities, while allowing moments of solitude for the individual. One's built environment must symbolize the growth of the whole, the community,as well as growth and freedom of the individual.

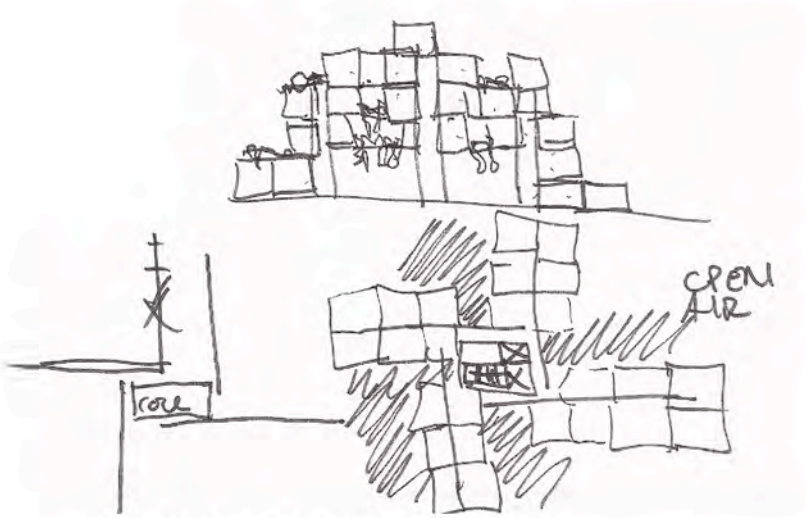
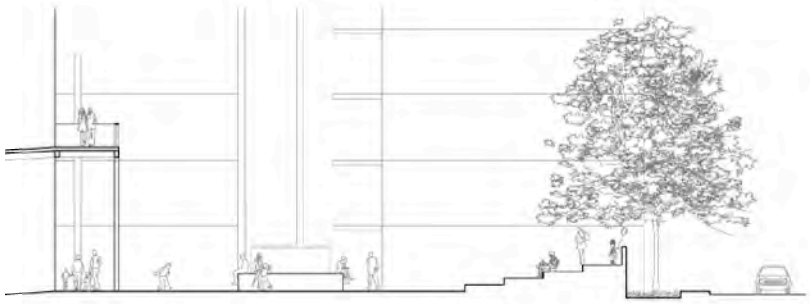


ILLUSTRATION 18: SKETCHES

ILLUSTRATION 19: SKETCHES



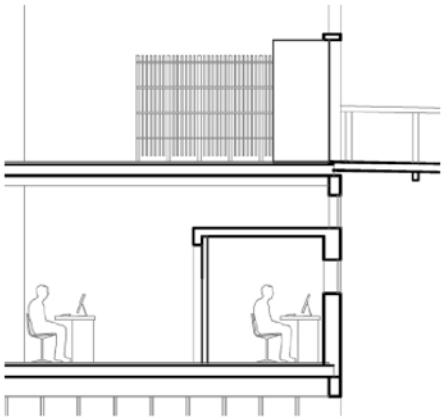
ARCHITECTURAL INTENTIONS_

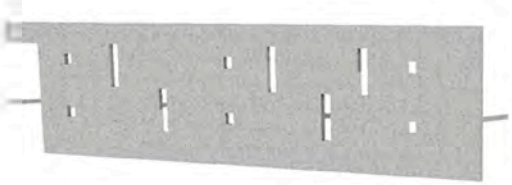
The library is a place where groups can gather to share knowledge, but an individual can also seek a confinement to be alone with oneself. This balance can be obtained through individual working spaces where the ceilings are low, the light is focused and the walls feel insulating and supporting.

The urban complex must contain flexible yet defined areas for all activities of the city. The living quarter must be merely defined as places for just that-- living. The educational facility is a mix of public and private spaces for the individual to explore and educate oneself. There must also be areas for play and recreation. To give an individual all necessary amenities within one's living quarters would prevent them from going out and investing in the city's other businesses and public spaces. Such all inclusive design would construct a selfish community who do not share spaces of similar activities but claim ownership of space. Providing flexible public and private spaces within individual programs is vital.

IDENTITY

Concrete is a very powerful material whose density represents many things. It is a modern buiding material that more obviously feels heavy and stable. Its texture brings down its massive scale and can draw down the attention of a larger module or wall. Prefabraicated concrete uses building modules that are easier for construction as well as providing spaces that can made larger or smaller depending on the need. A module also strengthens the idea of a larger system at work, for modules are only stable once part of a larger structural system. The educational parts of the training facility should be within theses modular concrete systems, while the greenhouses, circulation, and outdoor gathering spaces can be supported by the building cores, creating open spaces to view the surroundings. This allows the educational program to feel structurally rigid, but emotionally free.





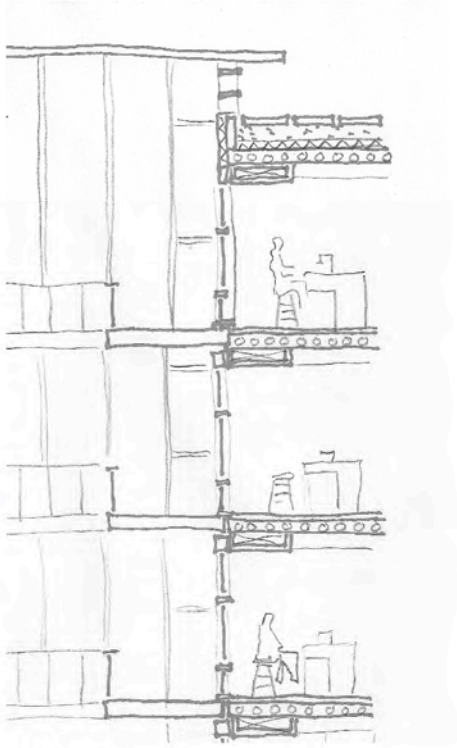
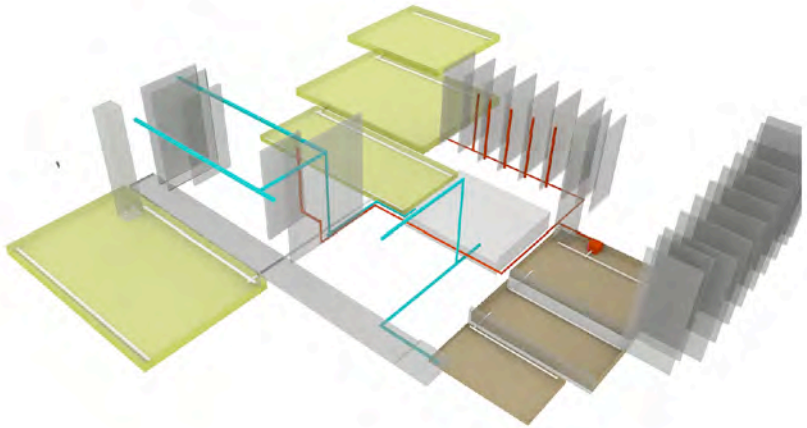


ILLUSTRATION 20: WALL SECTION

The site's system of buildings and open space must always revert back to its inner strength- the people and our environment. This relationship is the drive behind the constructed architecture and its identity. The building is just an empty structure without people to inhabit it. Structure, circulation and program must be aparent and integrated into the natural state of the landscape whenever possible. The building should represent the engine and the people and nature are equally its fuel.

The public gathering spaces must have more than one use. They must be available for the facility to use in demonstrations as well as unrelated public activities. The ground floor retail areas below the housing bring in unrelated people to the site that can use its grounds and explore its layers. The classrooms and laboratories will be removed from oublic access, but the community outreach and grounds will be accessible from many areas of the site. The community outreach and library programs are the central node on the site, centering public education as the drive behind the facility. This program connects with the Museum of Work and Culture across the street that educates the public about the old mill workers' culture and living conditions during the revolution. Public comprehension of new regenerating systems must be highlighted in the museum in the public outreach as well as on the grounds and in the greenhouses.

The grounds must be open for public exploration. The south facing sloped site will be tiered into a series of wetlands that filter both the Blackstone River, as well as the wastewater produced on site. These functional wetlands will be places of recreation as well as education. People will understand the structure needed to prevent human destruction of the ecological systems, as well as the enjoyable conditions these structures create. The river's edge is opened up to the public, allowing a direct connection and conversation with the adjacent mill across the water.



PRECEDENTS _ ONE WITH NATURE

Image 58

Image 59

WEST 8 - Ecological District _ St. Denis, France _ 2008

Living respectfully and equally with nature in dense urban conditions is very attainable. Most housing complexes in a city fail to understand the importance of having enough green space for people to gather and play on. By creating a direct connection, whether visual or physical, with nature allows one to break the harsh boundaries of building blocks and open their living quarters up beyond their heavy load-bearing walls.

Netherlands based urban design firm, West 8, transformed St. Denis' industrial district into a ecological system of green infrastructure with mixed-used buildings and public space. The series of wetlands and waterways transition one from the buildings to the surrounding water.

The housing is also well integrated with its surrounding both at the ground level as well as in upper levels of housing. The image to the right shows the elevated living quarters up beyond the glass retail level and into the tree line. The trees are being used as a filter to give the residents more privacy, as well as bringing life to the upper stories.

Image 60

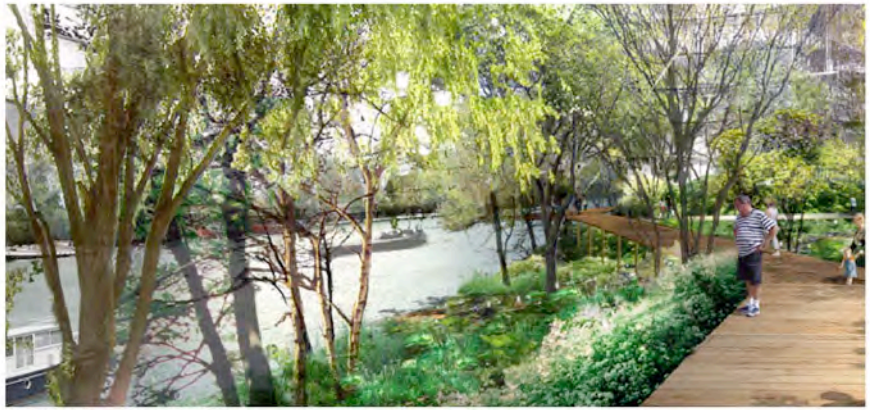


Image 61

Image 62

Image 63

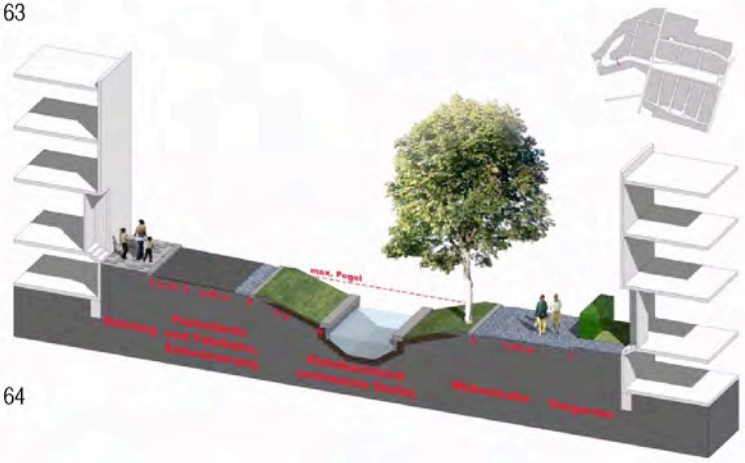


Image 64

West 8 also used green infrastructure, such as wetlands, brush and trees to bring life and cleansing methods into the dense urban blocks. It is necessary for many hard surfaces to exist since the traffic volume is high, but there are intermediate pervious surfaces that smoothly transition one to the grass and waters edge. In between the built blocks are constructed areas for wetlands as well as more naturally constructed wetlands with a strongly defined path, as seen in the image above. The series of wetlands and waterways that move through the urban blocks are used to filter pollutants that runoff the hard surfaces and into the water.

These wetlands and water edge conditions change as each block changes, creating diverse areas for social gathering and relaxation. Creating different conditions also shows the public that each space needs to be designed according to sun exposure, wind and use. The different conditions make for exciting, un-expected areas throughout the district. The green incorporated green infrastructure is as much designed as the buildings themseves, making sure they will survive heavy urban activity.

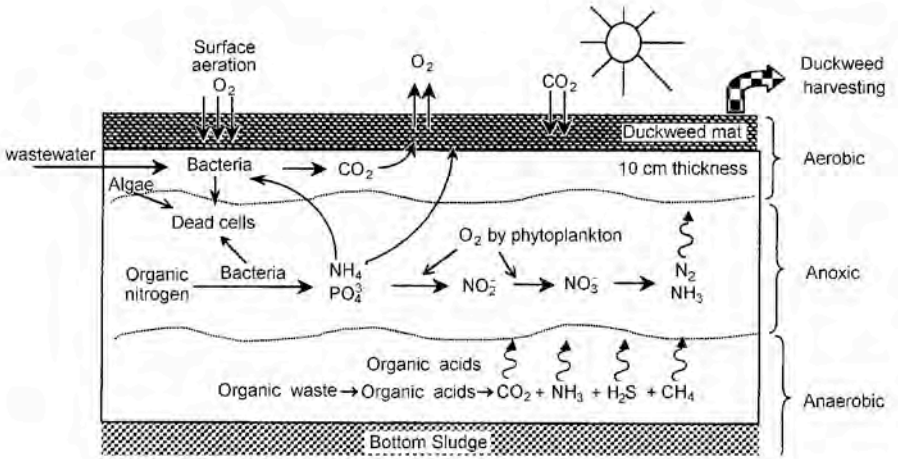


Image 65

CONSTRUCTED WETLANDS_ Janisch & Schulz Consultants_ Shanghai, China

Janisch and Schulz is an environmental consulting company out of Germany who study how to use constructed green infrastructures to remediate polluted cities and sites. They use constructed wetlands and reed bed systems to naturally filter wastewater at the lowest costs possible. [15] To the right, is an image of their project for a housing complex in Shanghai, China where the space in between two city blocks was made into a spread of green plants. This constructed weltand uses a sub-surface water system to filter the wastewater from the housing units. The water is held below a series of layered rock and pebbles to minimize the odor and increase the productivity and filtering of the plant roots. This system offers a wonderful view to the housing units, while efficiently turning their wastewater into re-usable grey water for irrigation and flushing toilets. This housing example shows how even confined urban conditions can be utilized in a productive and ecologically friendly way.

Image 66

[15]Janisch & Schultz http://www.pflanzenklaeranlagen.de/english/index.html

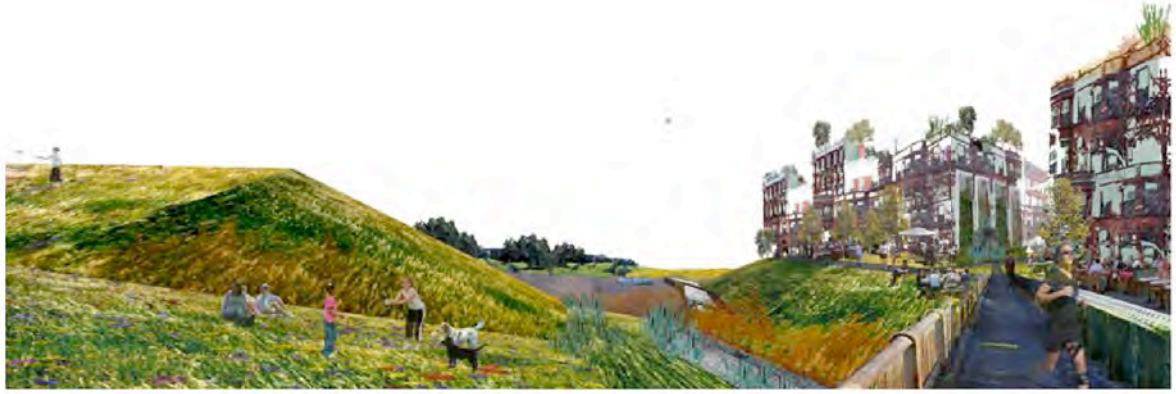


Image 67

Image 68

EDGE AS CENTER_ Envisioning the Post-Industrial Landscape
sponsored by the Boston Society of Architects (BSA)

Edge As Center was an international redevelopment and revival of the Brick Bottom area in between the elevated McGrath highway and the two-acre waste transfer station in Somerville, MA. The competition asked for the developement include mixed-use, sustainable, transit-oriented development with integreated open space for the public. [16]

To the right is an entry by John Baran, Josh Price, David Westmoreland of Ithaca, NY called "Healing the Land." This design incorporated a spine of green infrastructure that includes drainage, a tiered filtration system, tiered green roofs, perenniel forested wetlands, and additonal seasonal wetlands as the main public spaces. [17] The rendered perspective above shows the qualiy of public space that can be attained in such urban conditions through renewal of the land and landscape. Creating different elevations of public space is important to remove onesef from the ground zero level of a city.

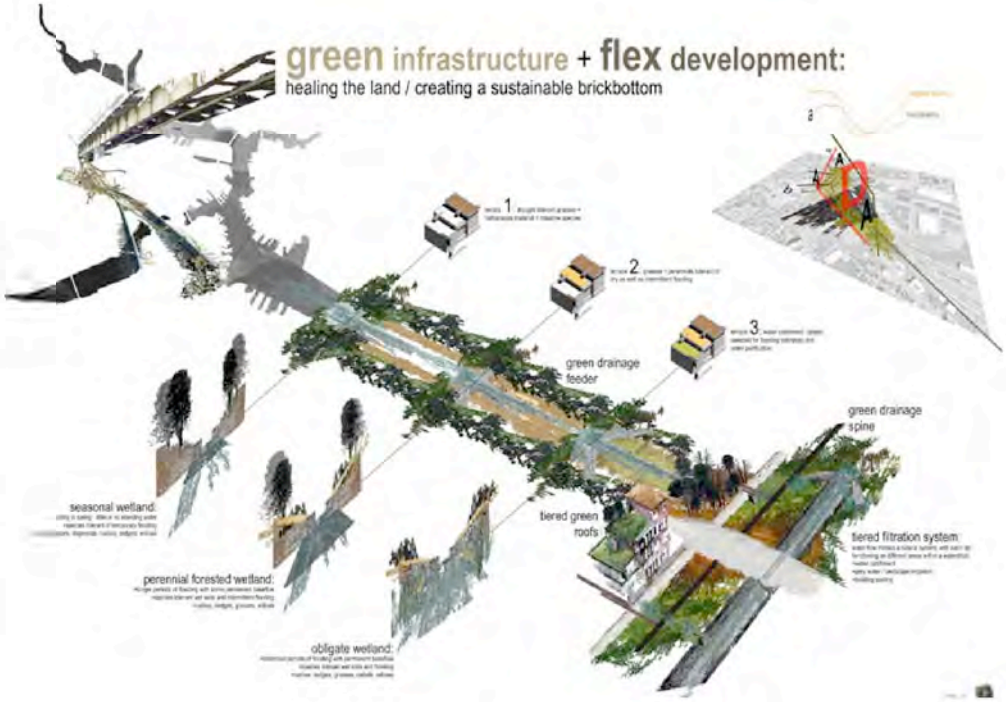


Image 69

Alexandra Lee , http://www.architects.org/shaping_communities/index.cfm?doc_id=175 [16]
www. architects.org/emplibrary/Edge_As_Center_synopsis.pdf [17]

Image 70

Image 71

EDGE AS CENTER _ Incorporating Green, Transportation, Economic & Cultural Infrastructures

The Big Re-Rig was another entry by Emily Abruzzo, Gerald Bodziak, Jonathon Solomon of New York, NY. This innovative team focused on creating a comprehensive plan that the community could understand and relate to. Their plan also brought forward the importance of creating a better future to the local economy by incorporating the public, retail and residential relms. A sustainable local environment was also integreated to reach out to the larger regional network by tranforming the elevated McGrath highway into a pedestrian green space that instigates non-automotive means of transportation. As seen in the rendered perspectives, this long elevated green space also includes cultural elements, like scultpures and other art forms, as well as environmental elements such as wind turbines and green space.

Image 72

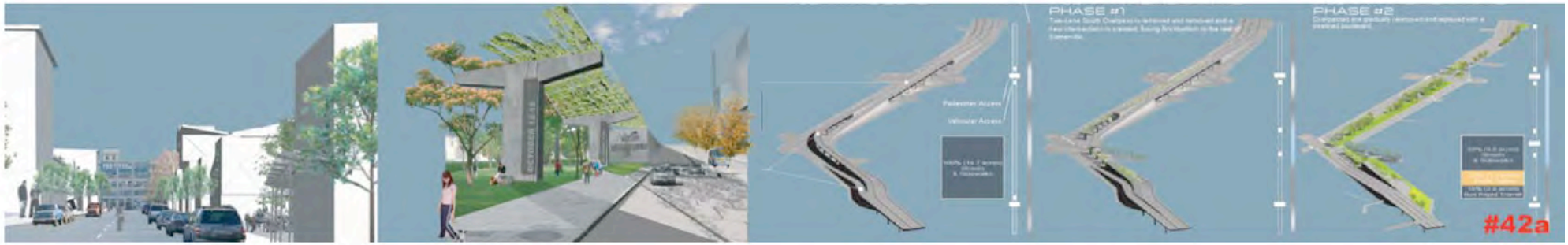


Image 73

Wilson Martin, Tanya Chiranakhon, and Antonio Mederios of Somerville, MA was also a finialist in the competition with their tranist oriented design, "T-omorrow." Their entry included the reincarnation of the McGrath highway with green infrastructure, like many other entries. Thery also focused on creating more pedestrian territory that cars could not over-power or over-come. The designers broke down the existing buildings and programs of the existing site and labeled what elements were considered assertive and momentive. They were searching to input elements that would help generate a local economy and put the area into a self-sustaining drive that would generate jobs and people through local transit, green recreational parks, and mixed-use development.

Overall, all the designs had the correct ideas about how to regenerate a bring hope to an old industrial site. The main componenets include, non-automotive transportation, green infrastructure, on-site energy generation, on-site waste recycling, cutlural components, recreational areas, incorporated living environments, and a generating a local economy.

Image 74

Image 75

Image 76

Image 77

CELEBRATING HISTORY
Alveole 12 _ St. Nazaire, France_ Completed March_2003

Old mills and industrial buildings hold many memories and signs of past acitivity. Most of these activities were for people's survival whether it was mill fabrication or structures of war. These moments in time can be celebrated and respected today with a higher and lighter spirit: through the arts.

The Alveole 12 is a port in St. Nazaire, France that was once a submarine base. This large, heavy concrete structure was built to be indestructable, so why forfeit its use? Concrete is a beautiful material that holds many scars as it ages, but still holds its strength and integrity. Today, three cells of the base have been converted into 3,3000 square meters of event halls and galleries.[18] LIN Architects, Finn Geipel and Giulia Andi, have restored this historic landmark into a cultural destination where the public can finally inhabit the mysterious structure that borders the hovers the water's edge.

The program includes a venue for contemporary music, an international centre for emerging arts, a large open public space, a rooftop gallery enclosed by a dome, and a circulatory 'street' which runs through the building, adjacent to through 14 cells of the structure.

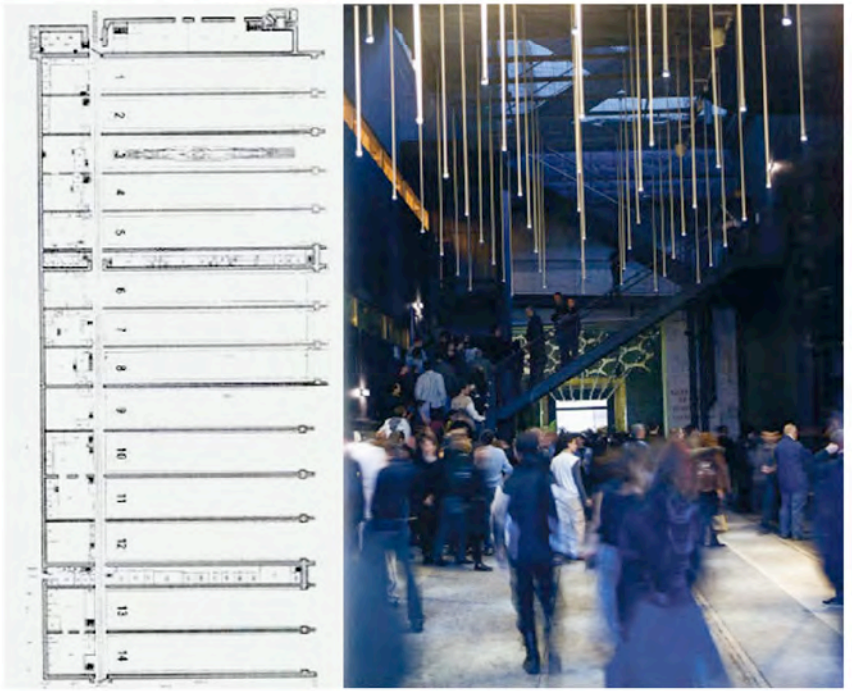


Image 78

[18] 20080125precedents.pdf/www.mcgill.ca/files/urbandesign

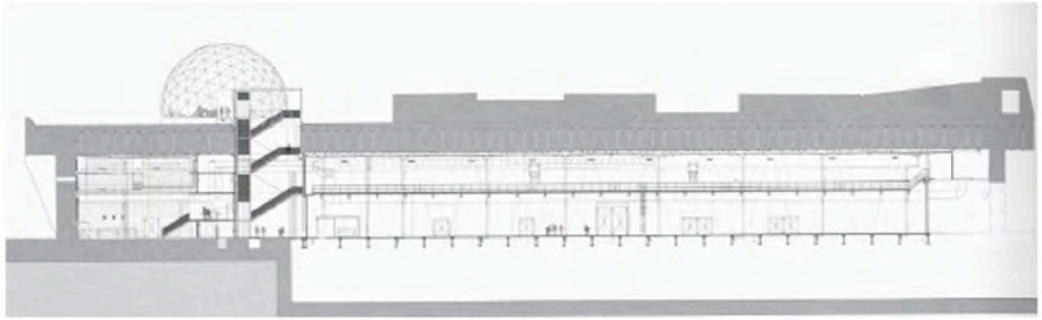


Image 79

Image 80

The LIFE, or the International Centre for the Emerging Arts, is located in one of the long cells whose end gate can be retracted to open up to the harbor view. The large heavy structure is lit with simple, long industrial-looking fiber optic lights that highlight the concrete down the long narrow street. The lights are simple, but very energizing to the adjacent concrete walls. This contrast creates high energy that is tranfered to the people and through the arts within the cell spaces. A different textured concrete path is used in the street to define its territory. Colored lights are used to create different moods and effects in different programs, defining the street as a path to discovery.

Within the cells, the concrete is kept exposed with minimally added structure for the lofted areas, as seen in the above section. The main circulation stair leads all the way up to the rootop where there is the enclosed glass adome for additional gathering and gallery space.

The minimal design needed for the reuse of the base keeps its old identity with a new modern use. The concrete and lighting are the essential architectural elements, while the rest of its identity is created through the people and the activities within.

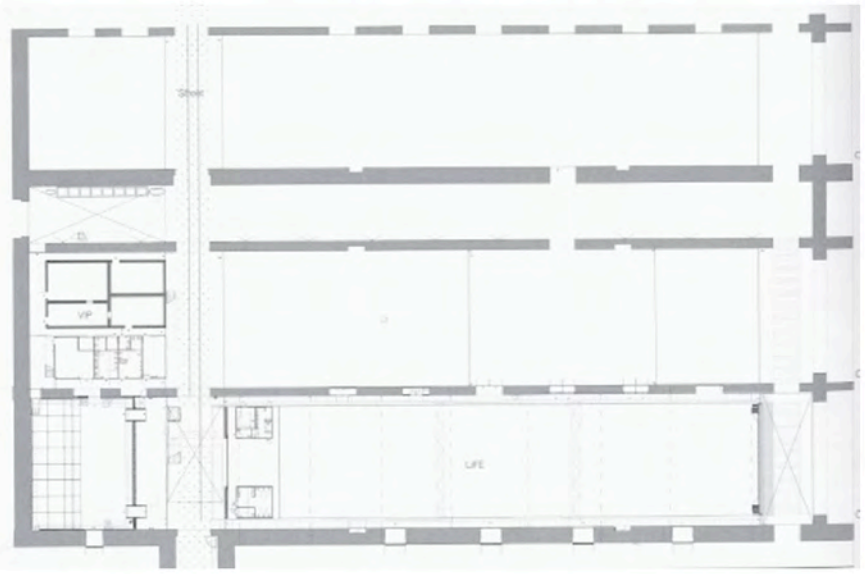


Image 81

Image 82

Image 83

Gigon & Guyer Architects_ Kalkriese Archeological Museum Park_
Landscape Architects_ Zulauf, Seippel & Schweingruber
Kalkriese, Germany_ 2002

At this historic battle site, the architects attempt to use the landscape to tell the story of what happened. The landscape design, using weather core-ten steel, marks the lines of battle from 9 A.D., insisting that the land is haunted, scarred and will forever hold these memories. The various heighted walls are a series of interrupt the natural agricultural landscape, evoking our understanding of the contemporary consequences of war. The walls are rhythmic and cold, but their relationship to the ground is where the true relationship lies.

At this site, in the Battle of Varus, the Romans were trying to expand into Germany, but they were ambushed by Teuton fighters from behind a sod and sand earthmound at the edge of the dense oak forest. To mark this ambush, vertical iron poles are placed rigidly along the forest's edge, while fallen steel plates mark the failure of the Roman ranks. The steel sheet pilings lead to a series of sculpted landscape, like an excavation pit and a sandy landscape and pond, representing the Roman side. The steel plated walls leads one through the landscape to a series of walled pavilions that are also covered with the weather core-ten steel panels, representing the marks in time in the land, while providing view to the surrounding language of the landscape.

Image 84

Image 85

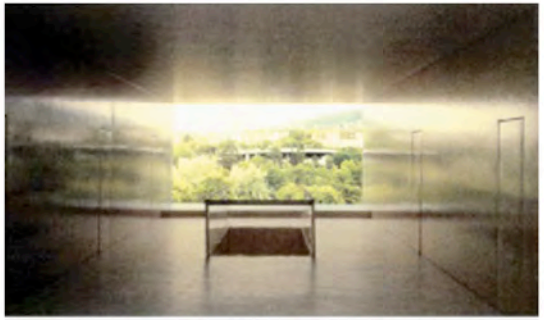


Image 86

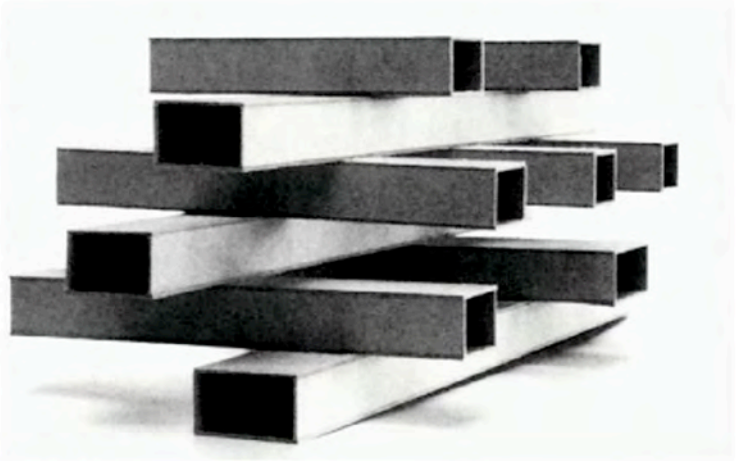


Image 87

Christian Kerez_ Vocational & Art School_ Zurich, Switzerland

One's path through a landscape and building are very important in representing a certain perspective of the landscape and place. In Kerez's Vocational and Art school in Zurich, his bases his project off an abstract circulation model, as seen in the upper right image. The circulation interconnects paths along the educational programs, while framing strong views to the surrounding buildings and landscape. This design allows the students to internally focus on their adjacent classmates and classrooms, while reconnecting with the outside world. The long white circulation bars represent the vertical circulation interwoven within the voids of the horizontal circulation in between the education program spaces.

Reconnecting students with the outside conditions in an educational facitlity helps refocus the individual on the task at hand, while grounding them in their own surroundings. The focused view and drastic light sources provide an escape to the outside world.

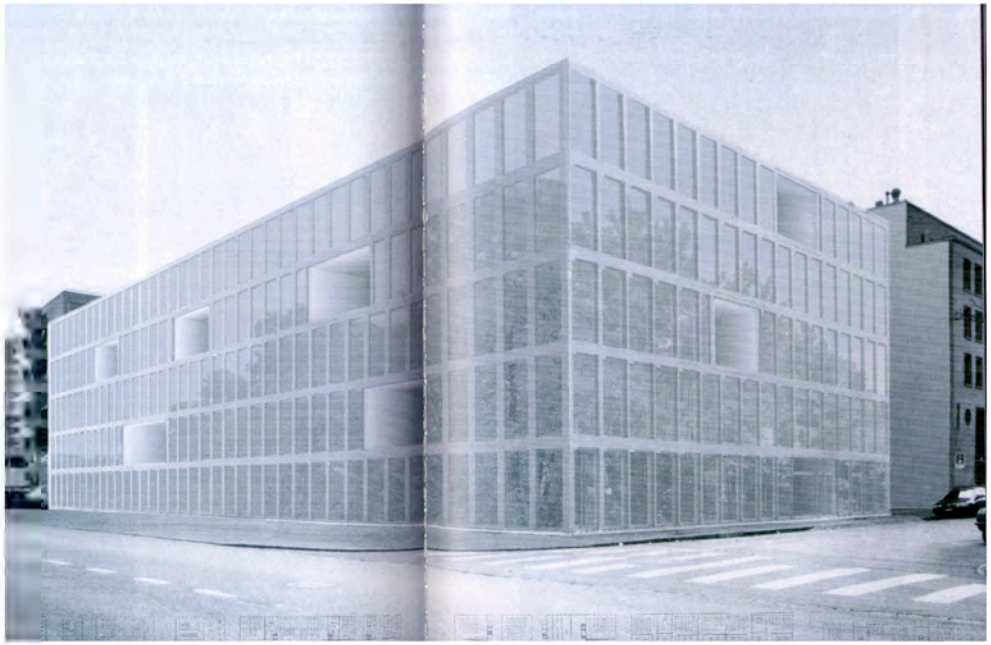
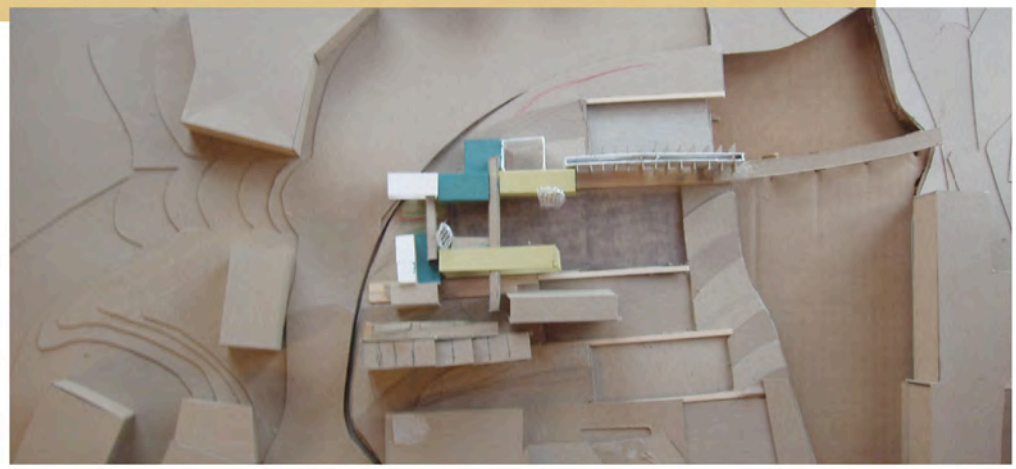
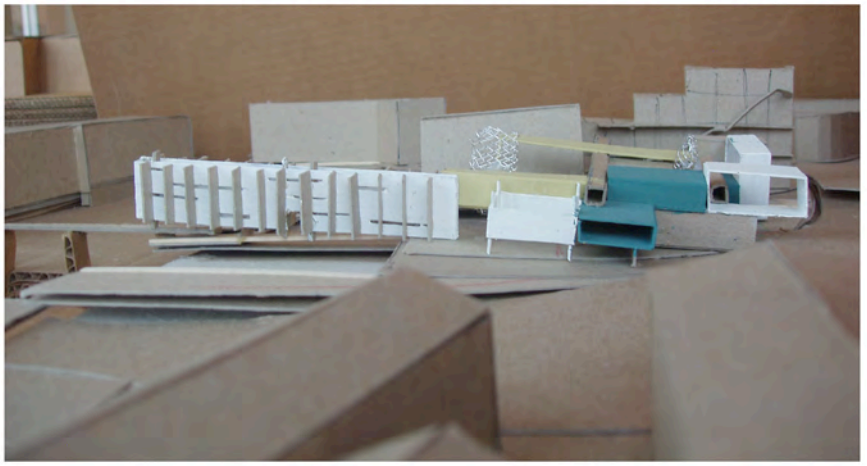


Image 88





The lead of the linear dam is incorporated into an elevated street with individual workshop spaces for students. The grow houses and laboratories rotate off one another, cornering the intersection and creating a courtyard to have a garden bordering the bus turn-off. The housing units run up the slope to the north, giving it sunlight and relief from the training facility. The wetlands are step down the slope along the water, shearing foundations with housing units. The growth of program shares vertical circulation along with many permeable garden spaces throughout the buildings rooftops and courtyards.

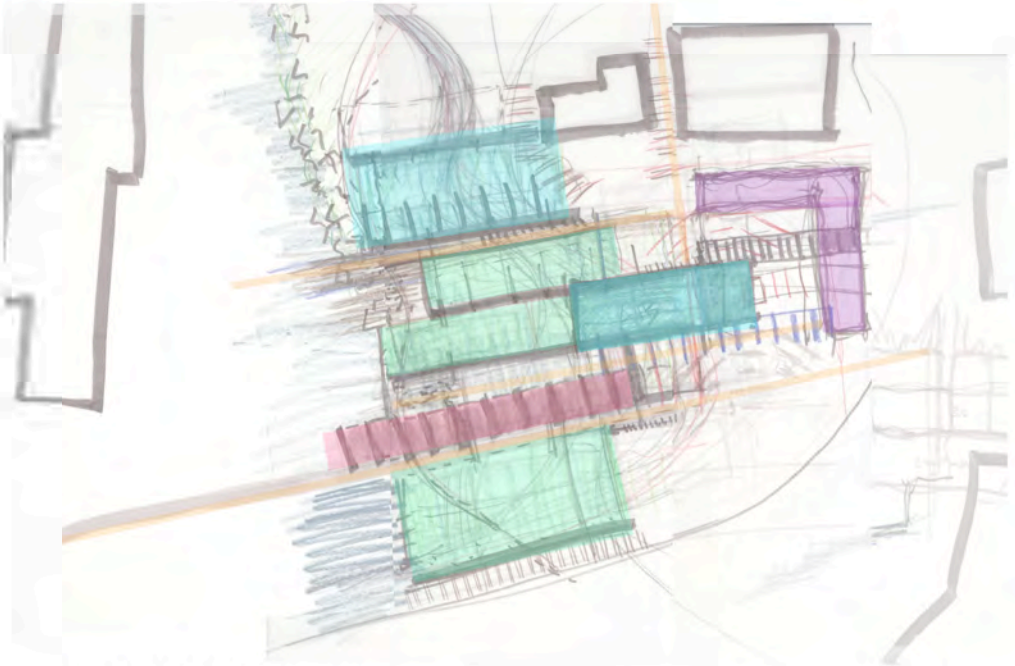
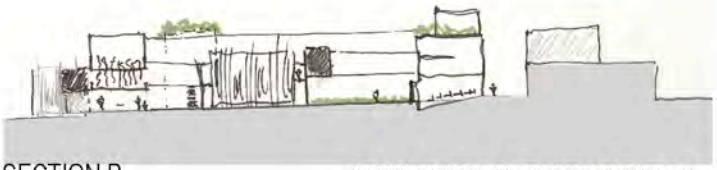


ILLUSTRATION 20: PROCESS SKETCH



SECTION B

ILLUSTRATION 21: PROCESS SKETCH

SECTION A

ILLUSTRATION 22: PROCESS SKETCH

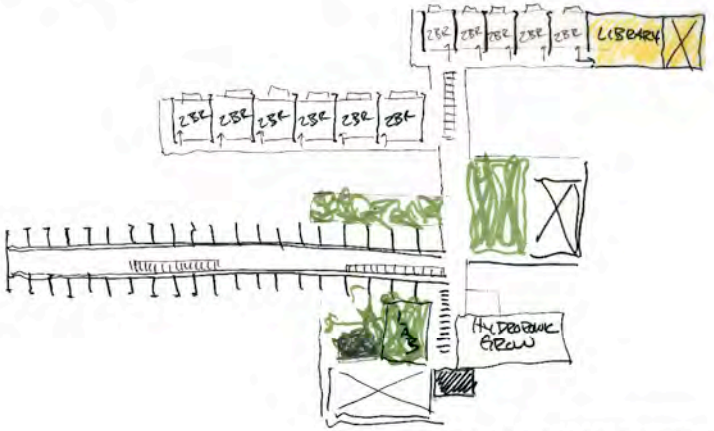


ILLUSTRATION 23: PROCESS SKETCH

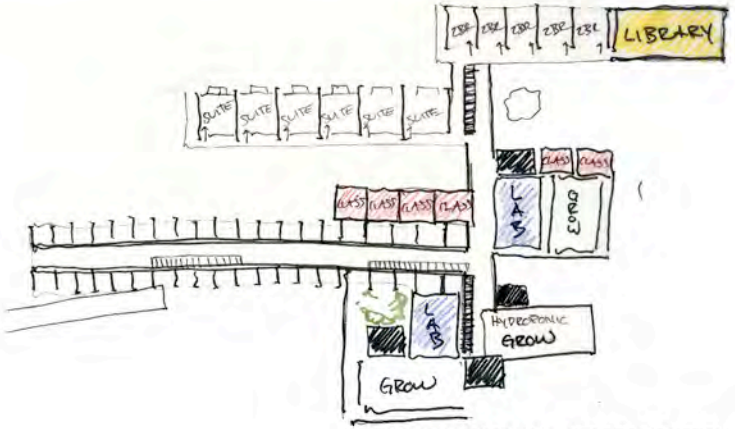
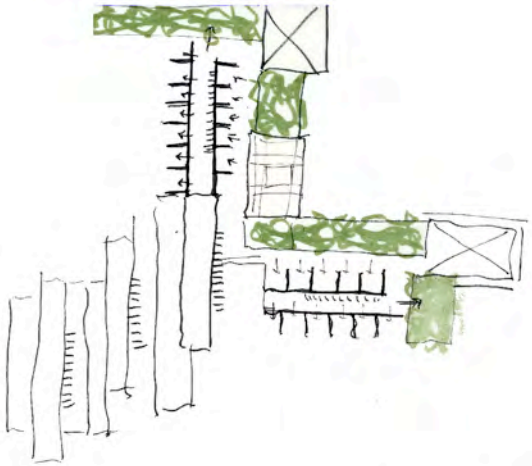


ILLUSTRATION 24: PROCESS SKETCH

ILLUSTRATION 25: PROCESS SKETCH

The long linear buildings to the far north are the mixed-income housing with ground floor retail in one building. The angled facade frames a view of the massive mill structure across the river with an adjacent stepping river wetland. Both these processing landscapes sit side by side, across a flowing river about to take its fall.

The housing units structure sits alongside the dam bridge, using its transiency as an escape to the inhabiting people. The prviate workspaces sit alongside the pedestrian street, creating a front row view of working people. This road leads either down to the street or up the laboratories that border the classrooms and grow houses looking over the courtyard. The housing and facility has their own courtyards, both leading to the wetland along the river.



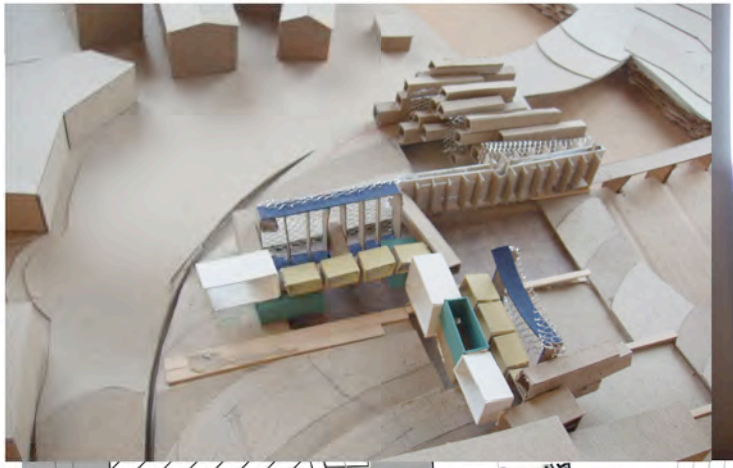


ILLUSTRATION 26: PROCESS SKETCH

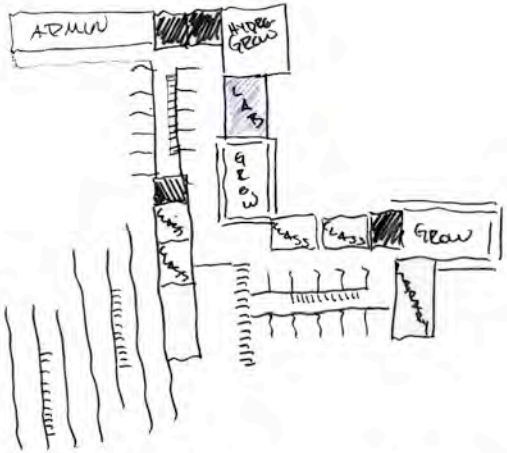
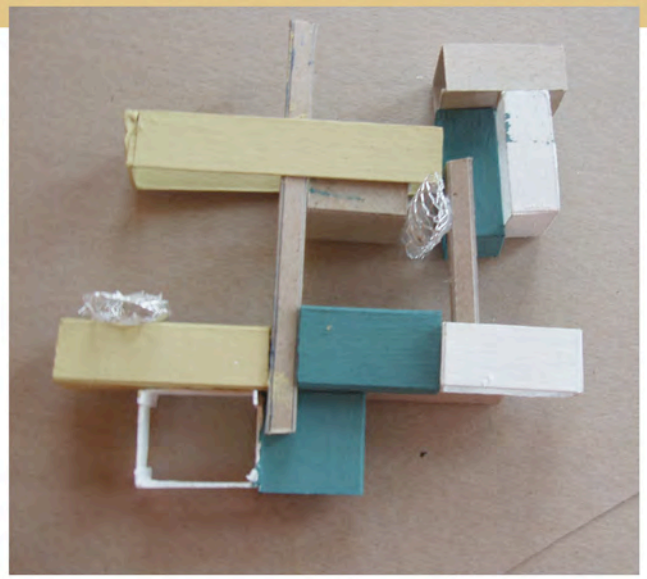


ILLUSTRATION 27: PROCESS SKETCH

PROCESS _ INCORPORATING INFRASTRUCTURES



This model explores the possibility of extending the outdoor wetlands between the educational spaces and other greenhouses. These green spaces can also be apart of circulation spaces, creating more pleasant pervious spaces in the building zone and within the immediate outdoors.

Presented abruptly in the main intersection is a raised growing space, with a double story picture window grow space along Main Street. This designed privatizes the penetreation through the building and onto the site. The northern corner library and workspaces try to open at the top of the site.

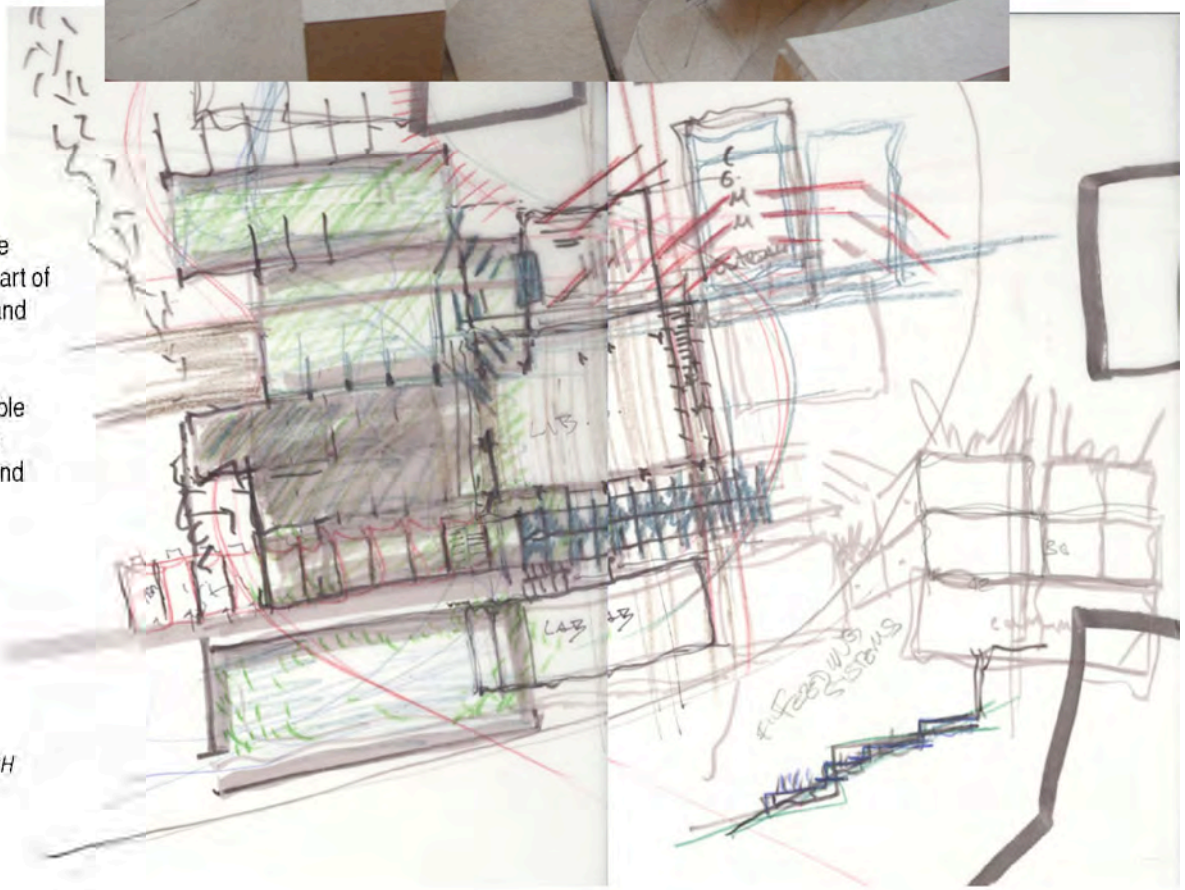
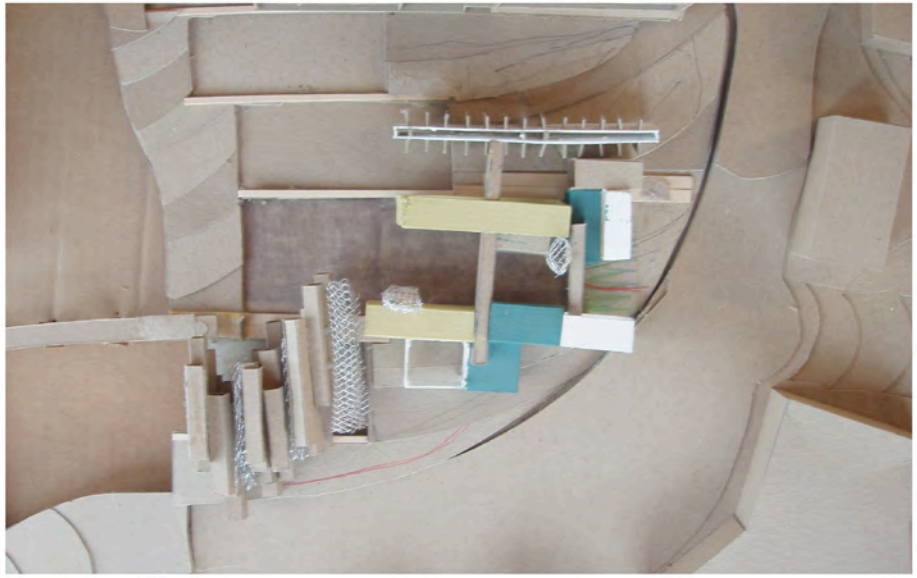
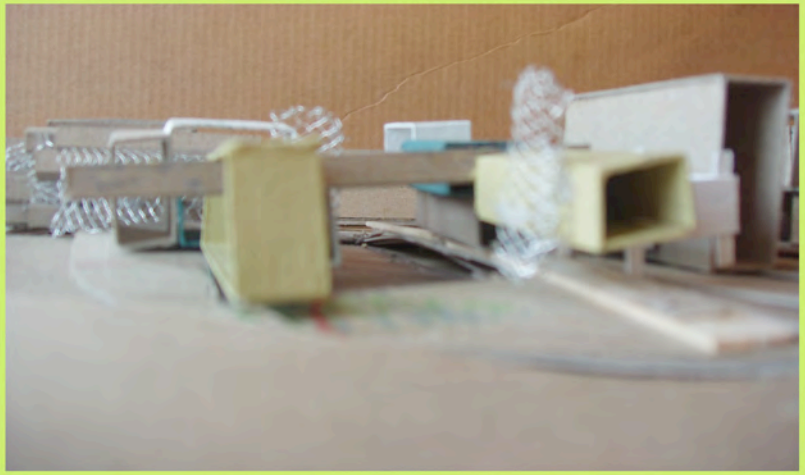


ILLUSTRATION 28: PROCESS SKETCH

These explore the reverse order of the streefront courtyard spaces. Here, the grow spaces and laboratories are put in the back, facing the river, and the classrooms are brought to the urban condition.





PROCESS_ WORKING STRUCTURE, NODES & MOVEMENT

Here is the workings of the chosen design, with the private housing developments in the north of the site (seen in red). The housing buildings are conencted through elevated walkways, for they share public garden spaces and private community gardens. The main cubic hub building is the library center with a rooftop community agricultural garden.

The section to the bottom shows the elevation of the elevated housing, standing on a wetland wall, as well as the west elevation of the classroom and greenhouse spaces. The section through the dam shows the change in elevation and nearby bridging elements.

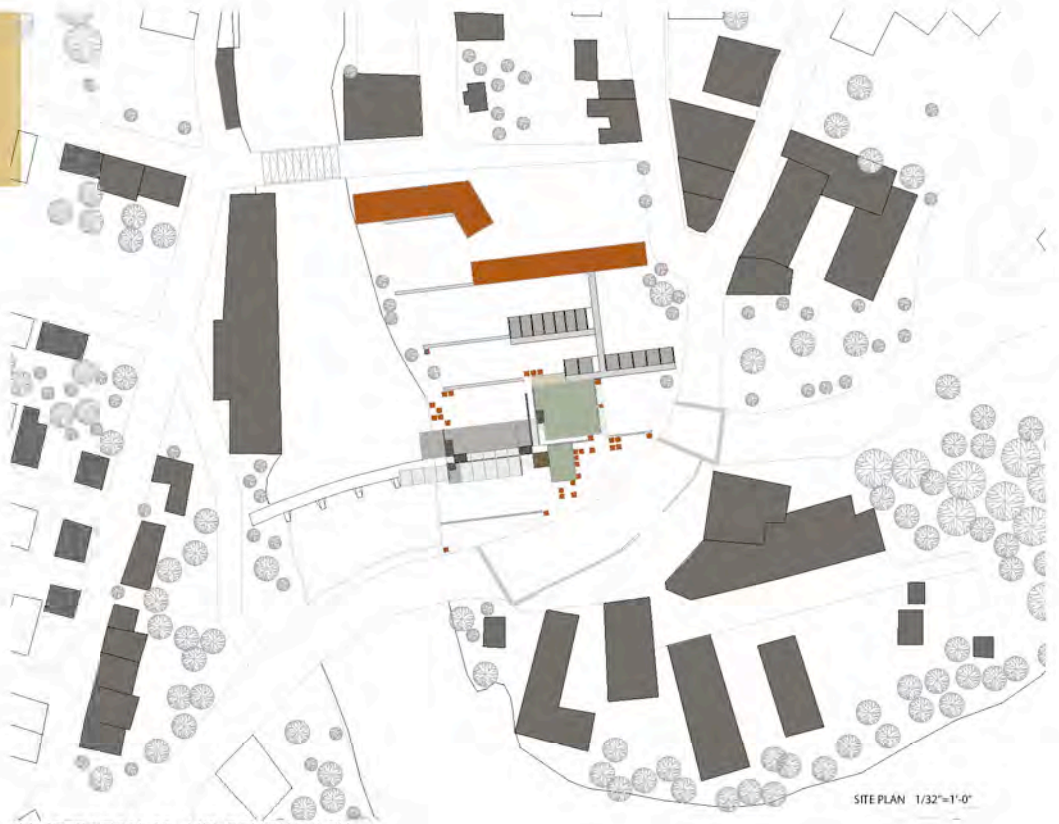
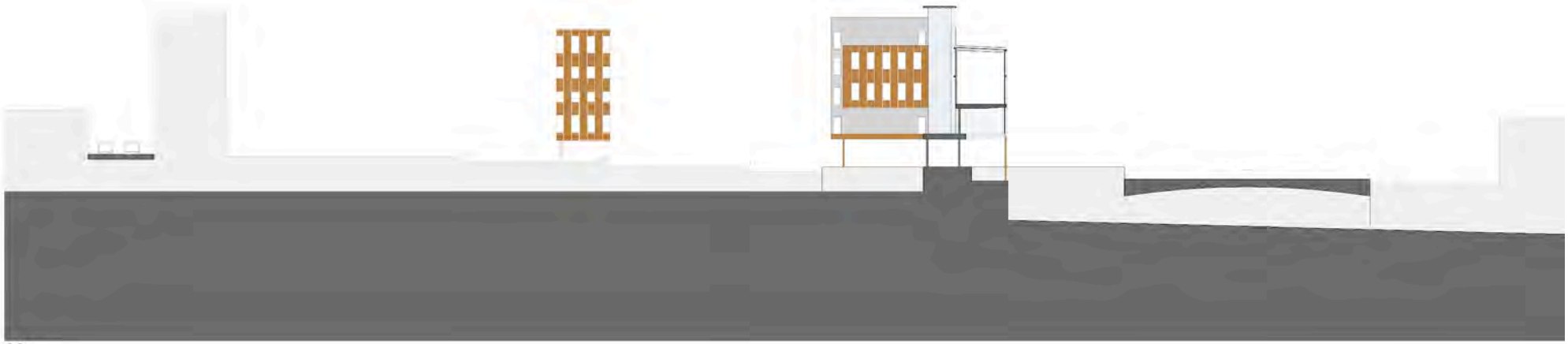


ILLUSTRATION 29: MID-REVIEW PLAN



The linear south facing building is made up of many programmatic elements, including classrooms, labs, grow houses, an auditorium and support spaces. The presence of these spaces and their connection to the people outside the building is important. The comprehension of activty in the building must be revealed to the public through exploration of the public spaces created to teach us more about ourselves and nature.

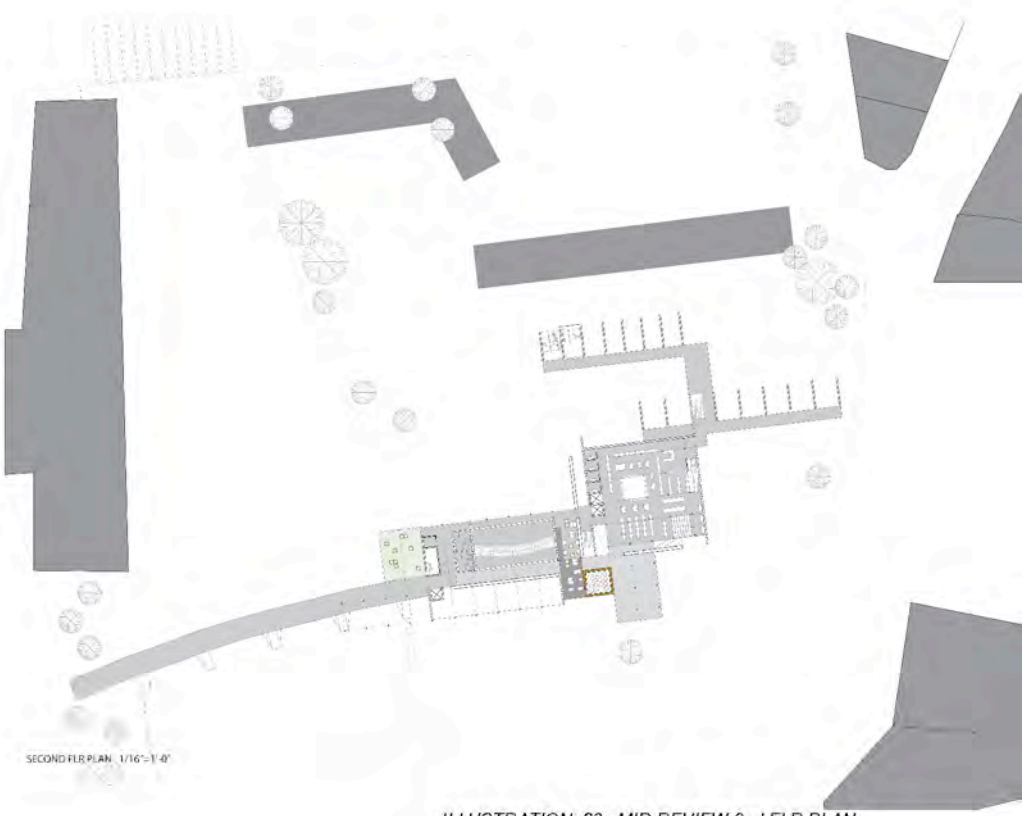
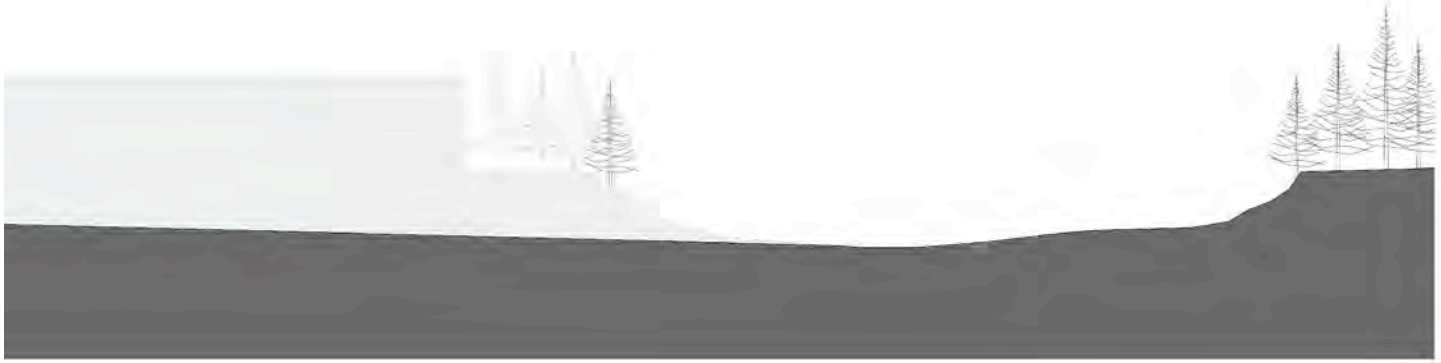
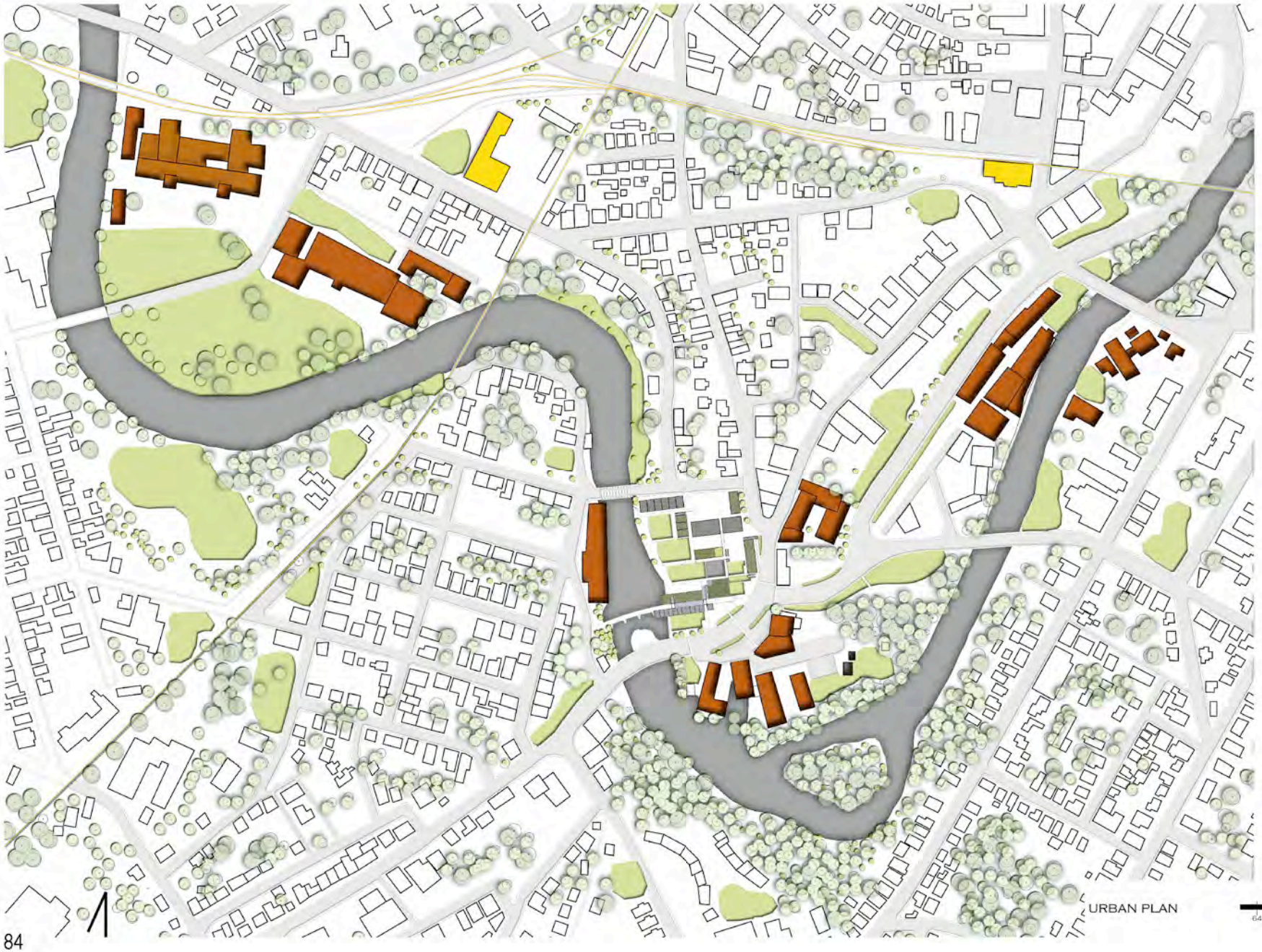


ILLUSTRATION 30: MID-REVIEW 2nd FLR PLAN




URBAN PLAN
64' 128' 256' 384'

URBAN RENEWAL _ INCORPORATING INFRASTRUCTURES

Woonoscket needs a reconnection to its natural surroundings, as well as a new introduction to the variety of built infrastructures that support the city. Both are strongly relied upon by inhabitants, whether this dependency is concious or not. Technologically speaking, the bus system is the only current means of transportation to and from the city unless driving an individual car. The system is not efficient. The reuse of the old railroads as commuter lines along with a light rail system will both relieve bus system as well as regenerate use of the downtown.

The light rail system will focus its destinations based on local schools and institutions that provide education and work for the community. This will decrease the buses' capacity, making it more efficient, as well as making it easier for children and city workers to transport to school and work in the city. The range will connect areas and resources in the downtown with neighborhoods just outside of walking distance and terminate that the commuter railways. These rail systems could be powered using solar panels, cutting costs, increasing the long-term use of the system, and creating a system that coexists well with nature.

The safety of many ecological systems in the city needs enforcement. Creating small ecosystems can bring enjoyable leisure spaces to the city, while bringing an awareness of their survival and use to the general public. Establishing safe natural environments for people to live and share throughout the dowtown is vital to its survival and growth. Providing protection to these nautral environments is necessary for humans and nature to co-exist. By nature, humans overstep boundaries and overtake other systems in his enviornment, making it necessary to architecturally build stabilizing boundaries that provide man with space in nature without erosion or destruction.

Wetlands help break the boundary between the land and water, while protecting its flowing structure. Wetlands mediate water flow as well as provide plants and organisms that clean it. A series of smaller wetlands and parks, as seen in the left image, will create ecosystems that contribute to the health of the larger system, while absorbing runoff and providing food and shelter for animals.

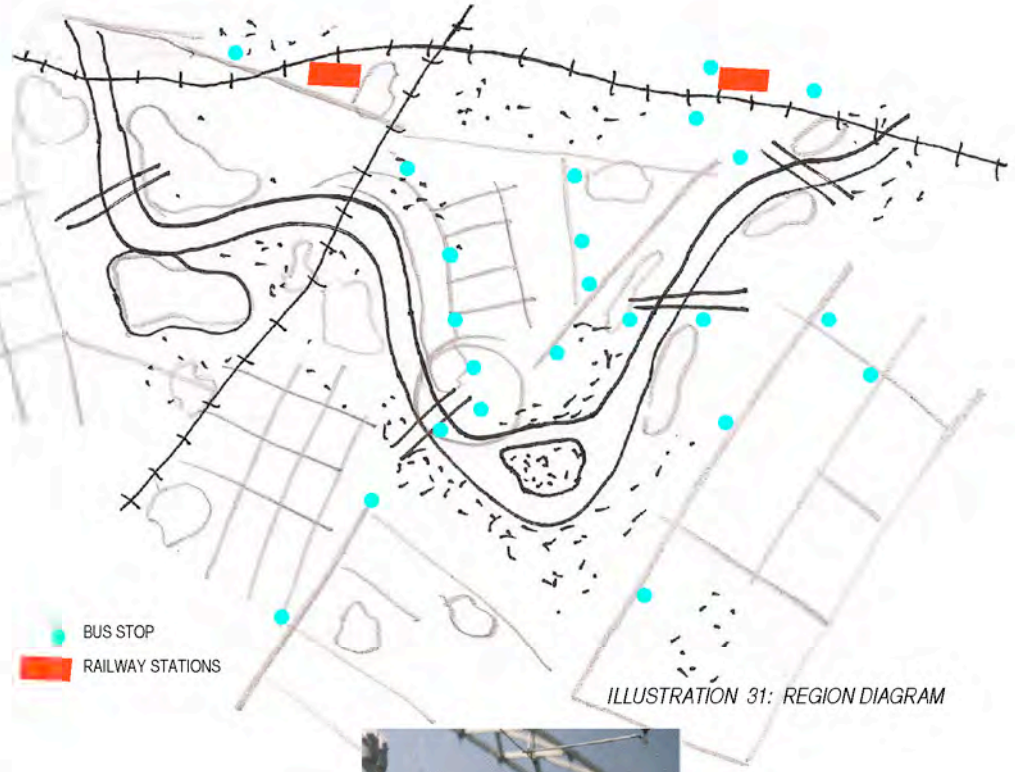


ILLUSTRATION 31: REGION DIAGRAM

Image 89

URBAN RENEWAL _ INCORPORATING INFRASTRUCTURES

ILLUSTRATION 32: REGION DIAGRAM

A network of wetlands, swales and green grounds are being connected throughout the city to regenerate wildlife and to clean the land and water. In bend of the river, the series of green strips have been contructed to preserve the rivers edge and filter the groundwater.

In Market Square, the end of River Street has been replaced by a series of constructed wetlands that step down the hill. These open grounds influence more pedestrian acitvity and promote healthy land and water. These wetlands connect with the park across the street and to the east of the old mill buildings. To the north, are more wetlands that continue the wet grounds along the rivers edge and next to a recreational pedestrian path.

The building blocks in the northern border of Market Square are mixed-income housing that are bordered by personal and public gardens, the wetlands, and a public piazza. The inhbaitants may also share the raised pubic gardens on top of the two-story commercial building. These housing units are joined to the training facility and short-term housing units by an elevated walkways that explores the various public-private layers of the site.

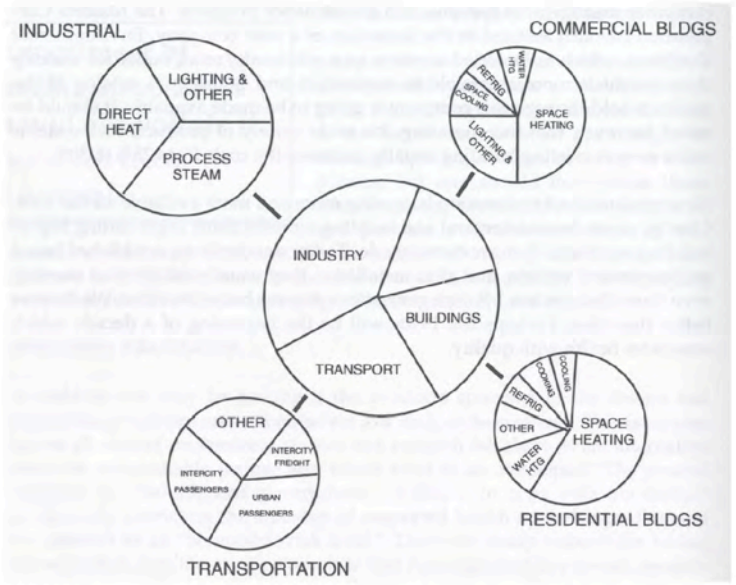


Image 90

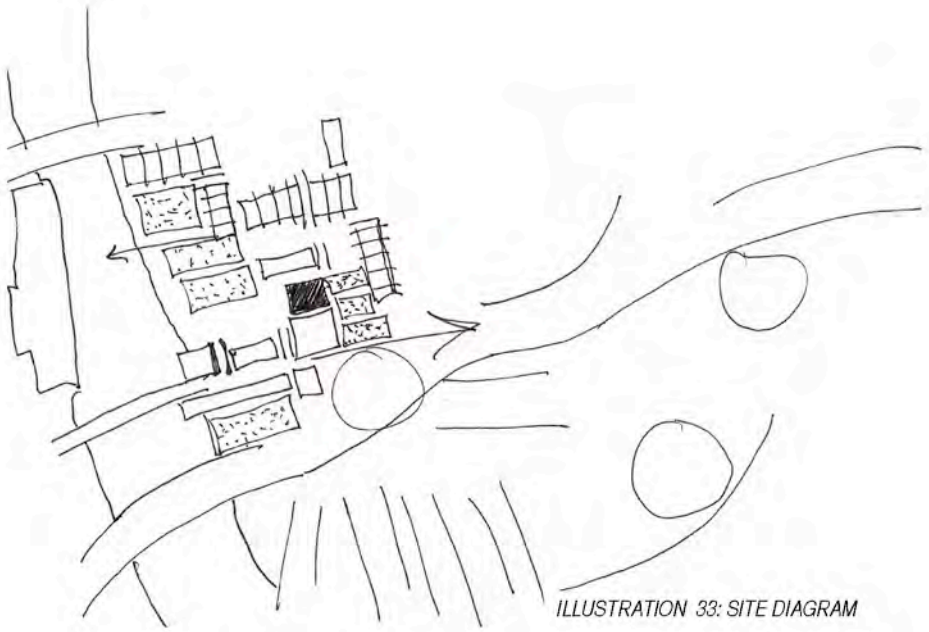


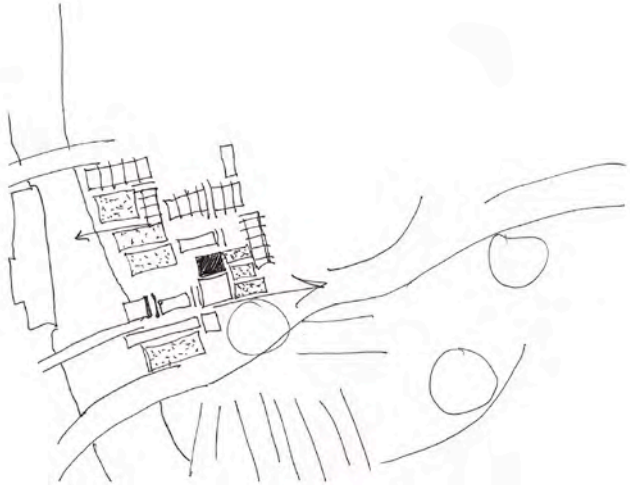
ILLUSTRATION 33: SITE DIAGRAM

High-density mixed-use development allows opportunities for energy conservation as well as shared facilities, water sources, and waste removal. When analyzing what contributes to the energy use in a city, users can be divided into industry, buildings, and transporation. The chart to the right shows that that heating, lighting, and transporation are the main energy uses in the country. Architecture can be applied to make these energy uses efficient and shared with muliple types of users and function.

The builing types and site are designed so in time, the facility and land will be continually used as place for creation and process. The building is suited for many insitutional uses, as well as manufacturing and commercial use. With these uses, there will always be a connected demand for adjacent short-terming housing.

The slightly larger, affordable housing blocks on site allow the local public of Woonsocket to live in the downtown with adjacent amenities, such as public tranportation, wetland park, pedestrian accessibility to adjacent neighborhoods, commercial buildings and public recreation in one urban block.

SITE _ GROUND FLOOR PLAN



The newly constructed landscape of Market Square provides the urban dweller, commuter or worker with new ways of using urban space. The river's edge has been given back to the people and back to nature. The urban block is still defined by the mixed-use density of the buildings, with ground floor retail and upper level housing. The main building is the training facility which faces the southern bend of South Main Street, facing the old mills that stagger with the curving road.

All of these buildings make use of their rooftops, bringing gardens and green space to not only the grounds, but a new social layer of the building. The numerous balconies and upper floor open spaces are used as private 'backyard' spaces for students and faculty. The public needs accessibles areas on different ground layers, leaving some private garden platforms to retreat to. There must be rewards and areas of release for both the public and private users of the city.

The ground story of the training facility is open for public passage onto the grounds. The concrete columns mark the ground where their load is carried onto their foundation. Their rhythm connects those people exporing the grounds, with the spatial rhythms experienced by those in the building. The center aisle of columns lie on a raised concrete foundation that continues off the linear obstruction of the dam. This link draws movement and rhythm from the dam supports to the column supports, off the platform and into the intersection towards the turning river. The gesture completes the path of the water, as well as the path of the people.

The south-facing long linear building terminates at a light cube that contains a community outreach facility, a library, offices and a garden. The community outreach informs the public of the facility and its studies, as well as recruit the public. This building is the generator of the site; where the energy is concentrated. The pre-fab concrete building is surrounded by wetlands, a pond and hard paths that lead the public deeper into the grounds. This hub is connected to the surrounding housing buildings by upper floor ramps and gardens.

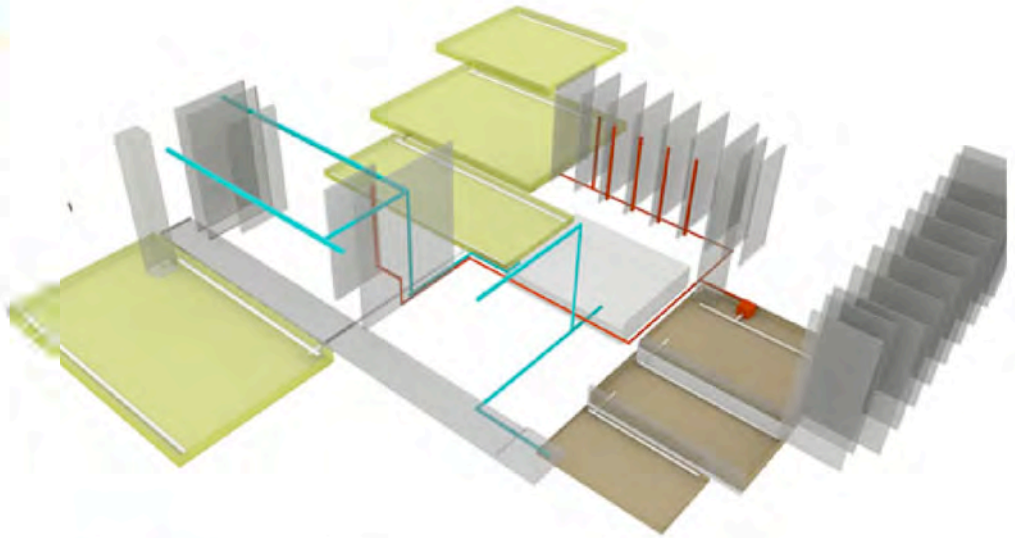
GROUND FLR PLAN

PROPOSAL _ CONSTRUCTION OF LAND

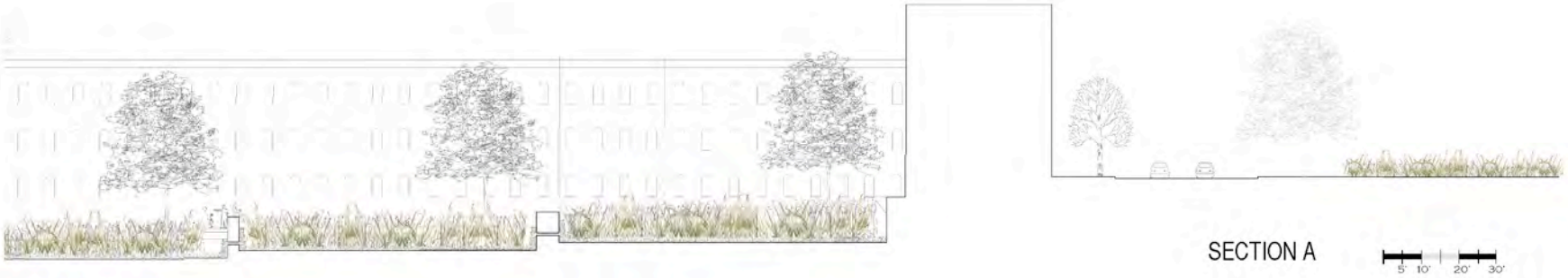
The newly structured landscape in Market Square is quite relative to the past uses of the land when the mills constructed the land to harvest the energy from the water current. The landscape is constructed into a series of wetlands that hold the water for numerous days before it is released to a lower tier. The foundations for the wetlands are used to support pedestrian docks that run overhang the wetlands and run parrallel to the walls. The scale of the wetlands and walls are big enough to provide numerous people with activities, but create a controlled space.

After the third tier, the water passes beneath the training facility and released in its final streetfront wetland. This wetland has a series of docks and sitting areas to invite the public into this new realm. This wetland sits adjacent to the river falls, where most of the water is released back into the flowing river.

A subsurface wastewater wetland sits between the street front housing building and the community center. The wetland's water is kept below the gravel and soil level and into an overflow pond which sits in front of the short-term housing. This pond is where rainwater is collected from all the buildings' rooftops and stored for later use. Once the wastewater is filtrated from the wetland, it is pumped into this pool and used for irrgation and toilet flushing in complex of buildings.



The rendering to the right shows the view from the top of the hill by the mixed-income housing developments. From here, one can see the classrooms and laboratories of the training facility that hang above the open ground floor. Each wetland path leads into the courtyards in between the different housing buildings.



SECTION A

5' 10' 20' 30'

PROPOSAL _ DIVERSE SITE RELATIONSHIPS

The many in-between spaces created on the site give the pedestrian the power to chose their path in order to expore the diverse site.

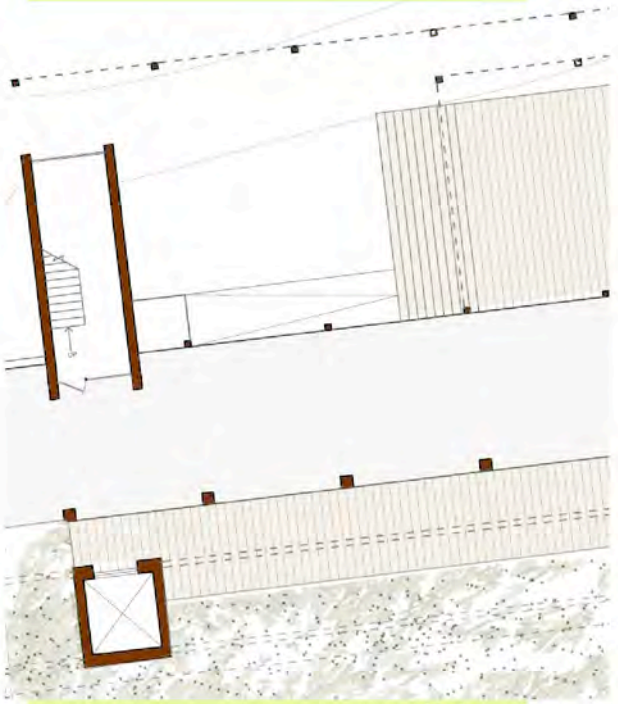
The corner public node contains a tall service structure that defines this as a place of production. Stairs on either side allow further progression onto the site. A bus pull-off provides public transportation to the site with diverse covered waiting places. The multiple ground treatments imply different functions with places to play and confront the adjacent wetland and bio-swale.

1 >

An active node where man and nature can co-exist along the busy bend of Main Street.

2 <

Where the sidewalk meets the river, there is a break in the concrete bearing wall, allowing pedestrians to descend down stairs and enter a realm beneath the earth, overhanging the flushing river. Here, one can experience the release valve of the filtered water from the site back into the river.

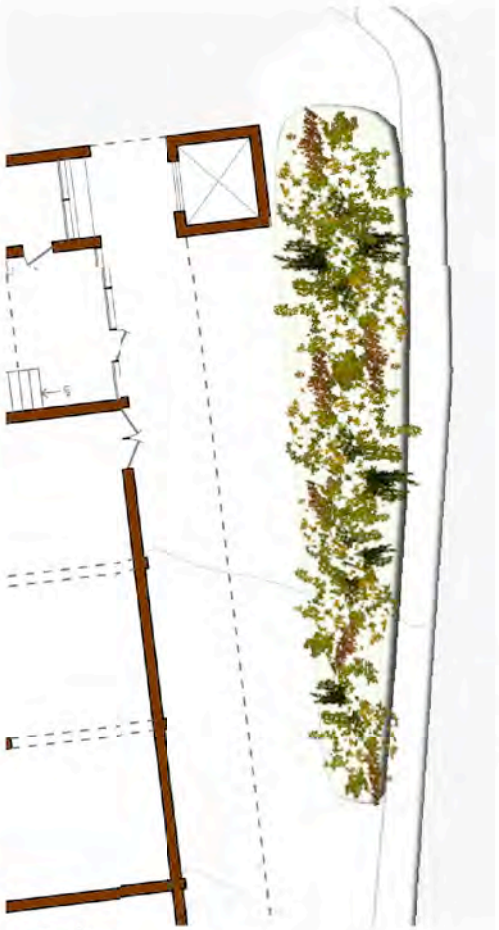


3 ^

One can ascend past the threshold of the long elevated greenhouse by a number of ramps or stairs to a long strip of concrete foundation that stores runoff water from the site. At this moment, one is beneath the building, neither inside nor outside. From here, one can either retreat backwards towards the constructed landscape, continue along the concrete strip to a series of constructed paths or enter the building up egress stairs. This space is comforting in that there are several levels to experience both the wetlands and the city on while being protected from the elements.

Coming from north Main Street, pedestrians can ascend through the urban block edge and into this free flowing urban landscape. In between both residential blocks, this space contains a hard surfaced dock, soft grass, overlooking balconies and ramps to the main community outreach building. This space is protected from direct contact to the busy city by various freely green spaces and structured wastewater wetlands.

4

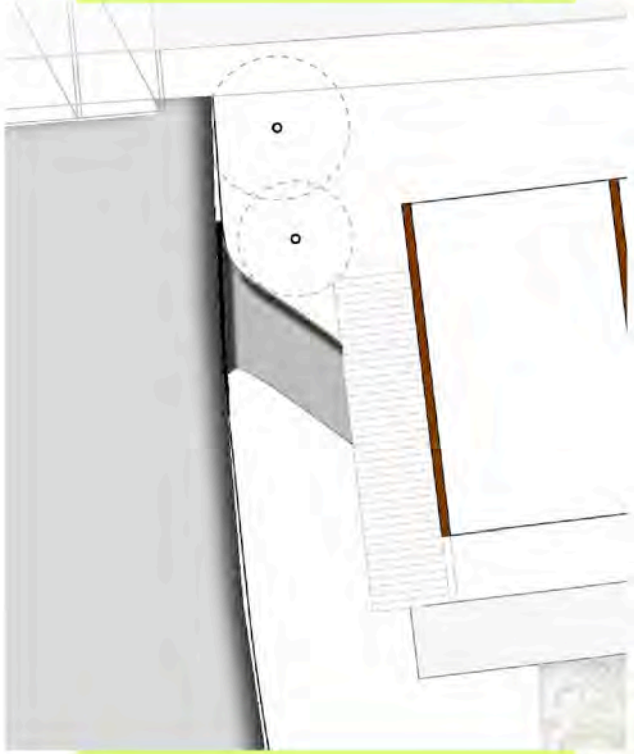


5 ^

The sloping South Main Street is a very busy street, requiring much filtration of the runoff from car pollution. At the Northeast bend of the site, along the main commercial ground floor, is a covered walkway that brings the public alongside the building and between the bio-swale along the sidewalk. Pedestrian continue forward through the circulation core where they can further penetrate the site's diverse spaces.

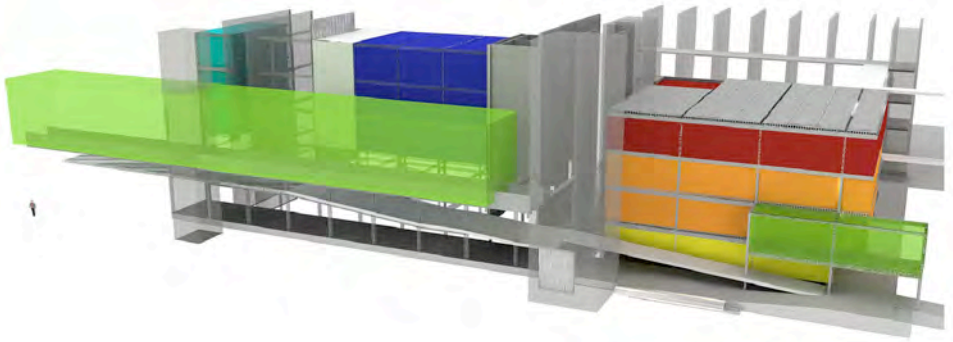
The generator for the site is where the water is brought in from the river and into the wetlands. To get here, one must have ascended up the site through the wetlands and finally to this point of intake. A mechanically operable valve controls when the water is moved into the site. It is at a point in the site that is narrow and converses with the adjacent bridge and mill structure. These elements all share a language with nature and the water, making the handling of water delicate.

6



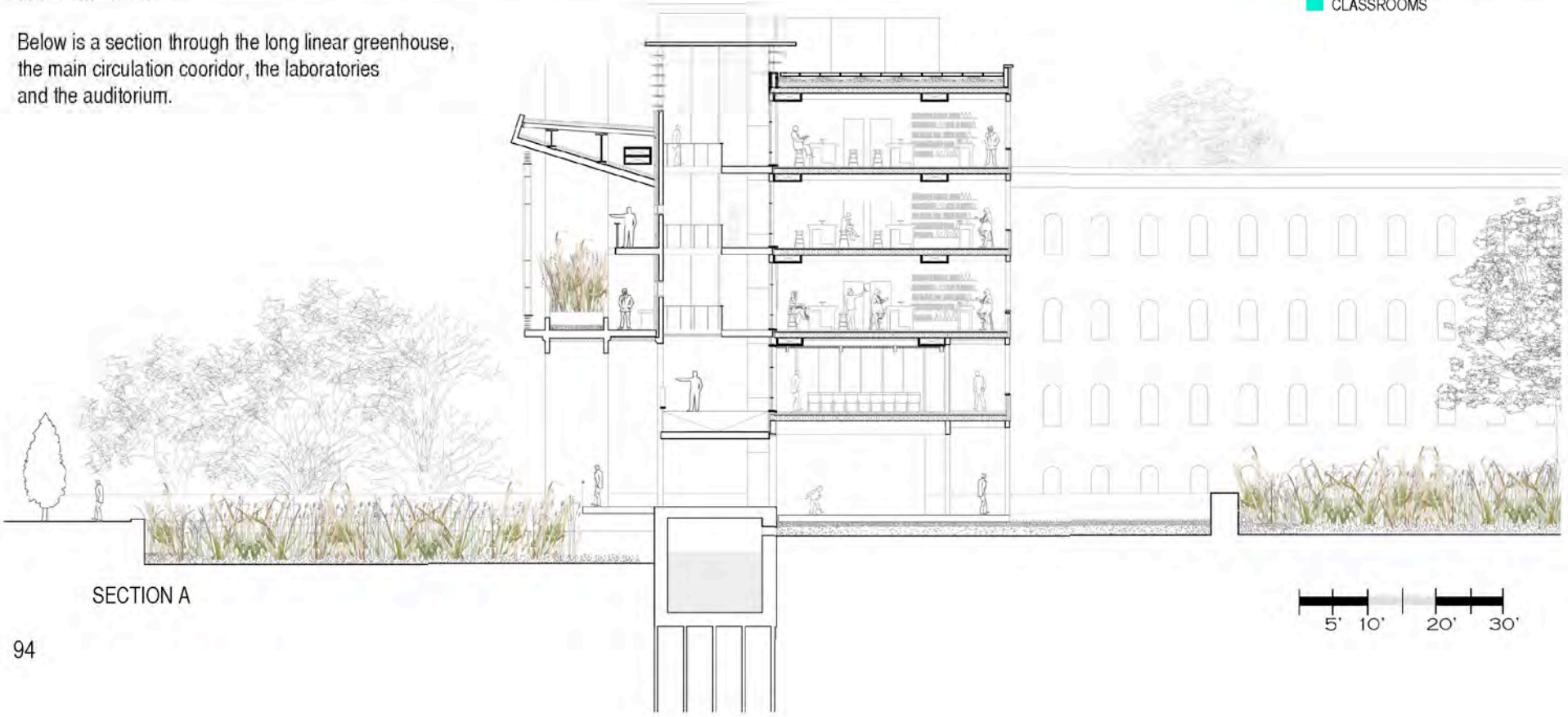
PROPOSAL _ PROGRAM RELATION

The educational building consists of two zones. The section through the building below is the first educational zone, containing a long-suspended greenhouse, classrooms, laboratories, support spaces and an auditorium. One can see the easy access to the grounds through underneath the auditorium. The cubical building is the second zone, containing the community outreach program on the ground foor, with the library and administrative offices above. To continue the linearity of the greenhouse and circulation path, the living machine is structure in front of the cube, providing covering to the pedestrians below at the main public entrance, while providing heat and an example of an urban set biological system in an upper floor. Both zones are separated by an infrastructural spine that provides restrooms, veritcal circulation, and ventilation shafts to the two zones.



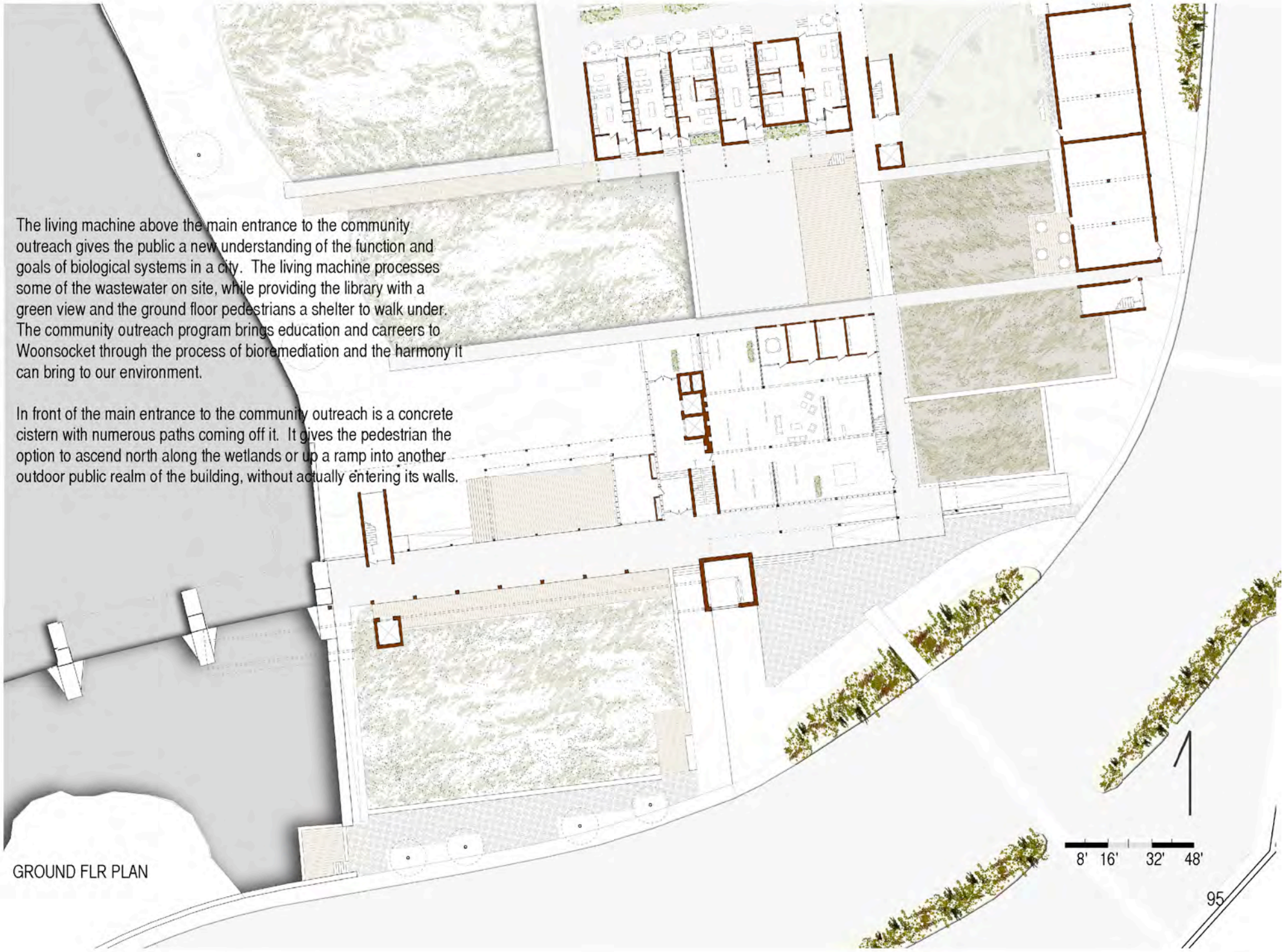
LABORATORIES
GREENHOUSES
ADMINISTRATION
LIBRARY
COMMUNITY OUTREACH
CLASSROOMS

Below is a section through the long linear greenhouse, the main circulation cooridor, the laboratories and the auditorium.



SECTION A

5' 10' 20' 30'

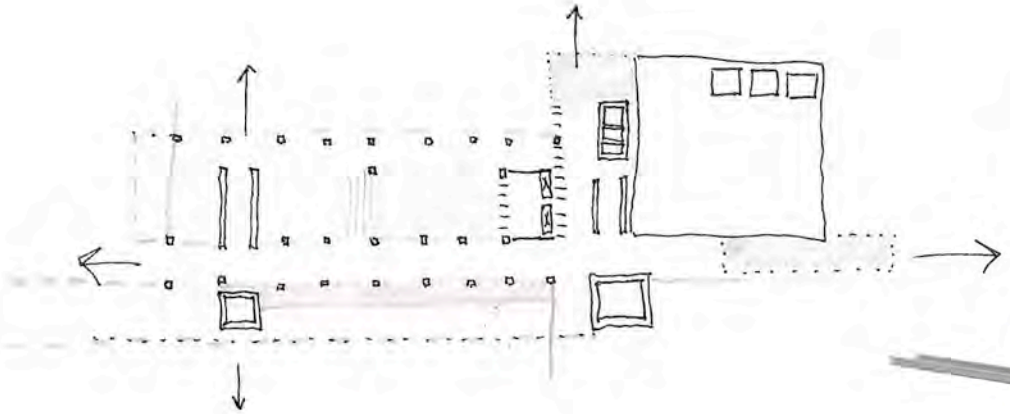


The living machine above the main entrance to the community outreach gives the public a new understanding of the function and goals of biological systems in a city. The living machine processes some of the wastewater on site, while providing the library with a green view and the ground floor pedestrians a shelter to walk under. The community outreach program brings education and carreers to Woonsocket through the process of bioremediation and the harmony it can bring to our environment.

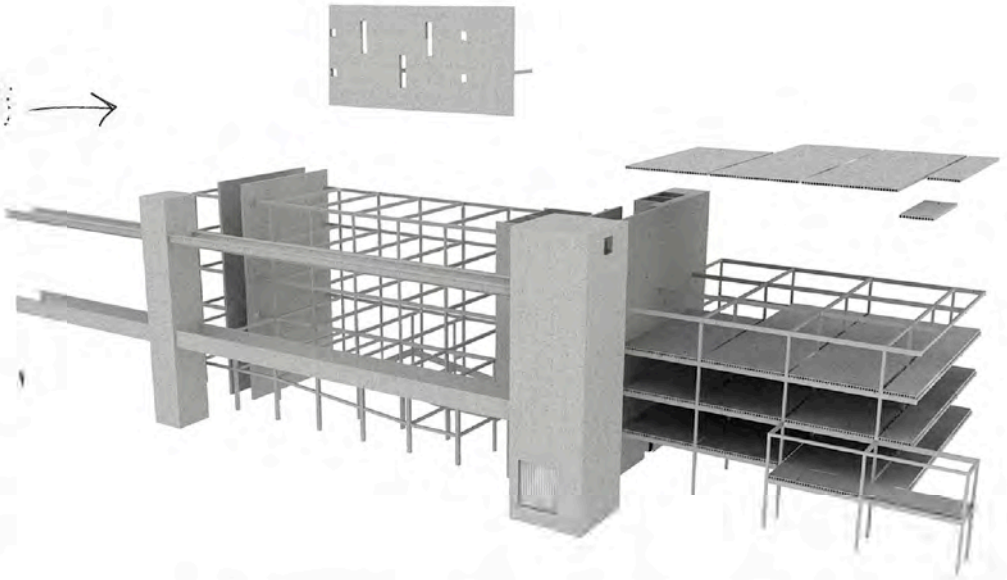
In front of the main entrance to the community outreach is a concrete cistern with numerous paths coming off it. It gives the pedestrian the option to ascend north along the wetlands or up a ramp into another outdoor public realm of the building, without actually entering its walls.

GROUND FLR PLAN

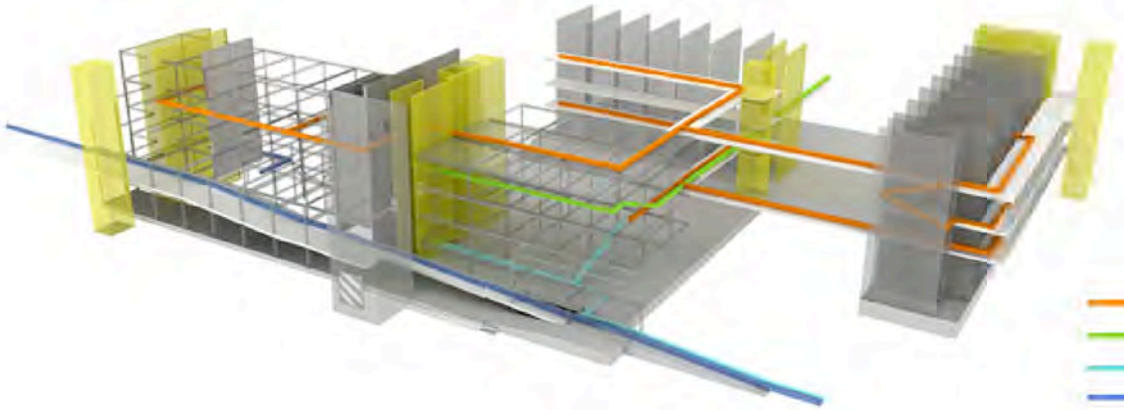
8' 16' 32' 48'



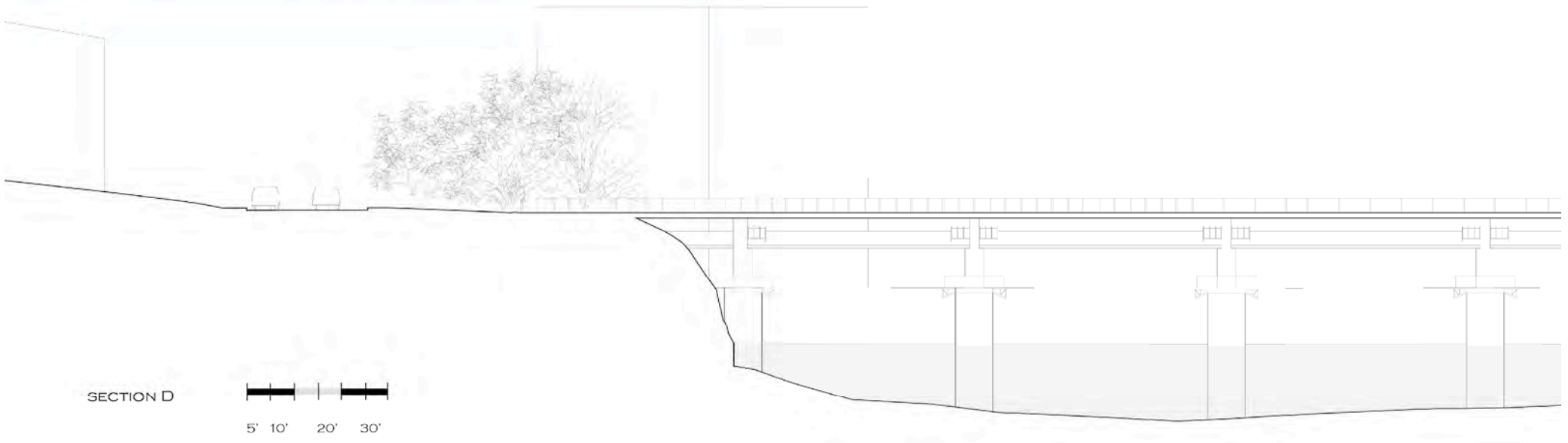
The diagram above expresses the linearity of the main cirucation spine with the numerous infrastructural spines in the building pronounced by vertical elevator shafts. Each spine declares adifferent zone of the building, influencing a gesture into another part of the building or site. As seen in the circuation diagram below, the public may pass behind the two south facing towers and up a ramp to the level of the dam. The dam bridgeway is converted to a pedestrian walkway that brings pedestrians from the neighborhood across the river onto the site. The ramp runs along the auditorium space where education and recreational films can be played.



The structural diagram above shows the dominance of the vertical towers and infrastructural spines in the building. The community outreach is made of prefabricated concrete columns and girders with prefabricated concrete floors. The modularity of the building allows for opening and continuation of vertical spaces. The elevator towers suspend two 5' deep parrallel beams that support the floor and roof of the extended greenhouse. The long length of the beams allows them to overhang out onto the river, creating a drastic relationship between the land and the water.



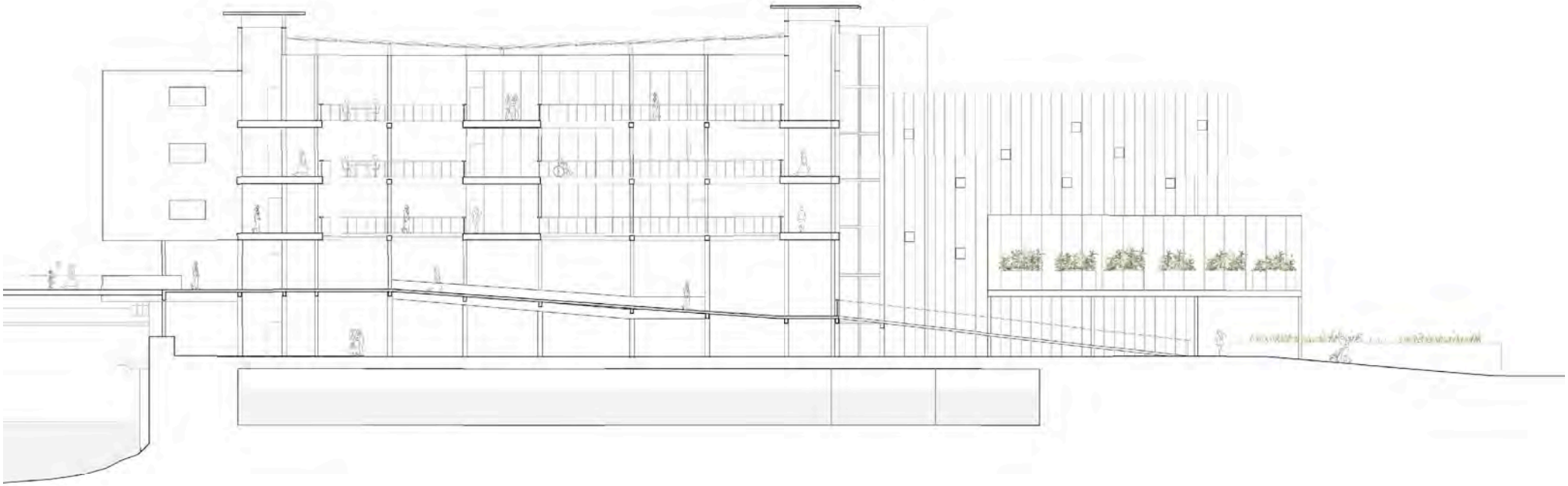
RESIDENT CIRCULATION
COMMUTER CIRCULATION
PUBLIC CIRCULATION
PUBLIC THROUGH CIRCULATION



SECTION D

5' 10' 20' 30'

From the main intersection adjacent to the site, pedestrians may ascend up the ramp onto the concrete cistern, where they can continue up more ramps to a place that is protected by the building, but open to the fresh air. The ramp is directly below the main circulation cooridor of the education facility with glass on the bottom, so pedestrians can look up into the building and students and faculty can look down and out at the passers by. This relation subconciously brings a transparency to the public about the studies within the building, while providing an escape to those within.



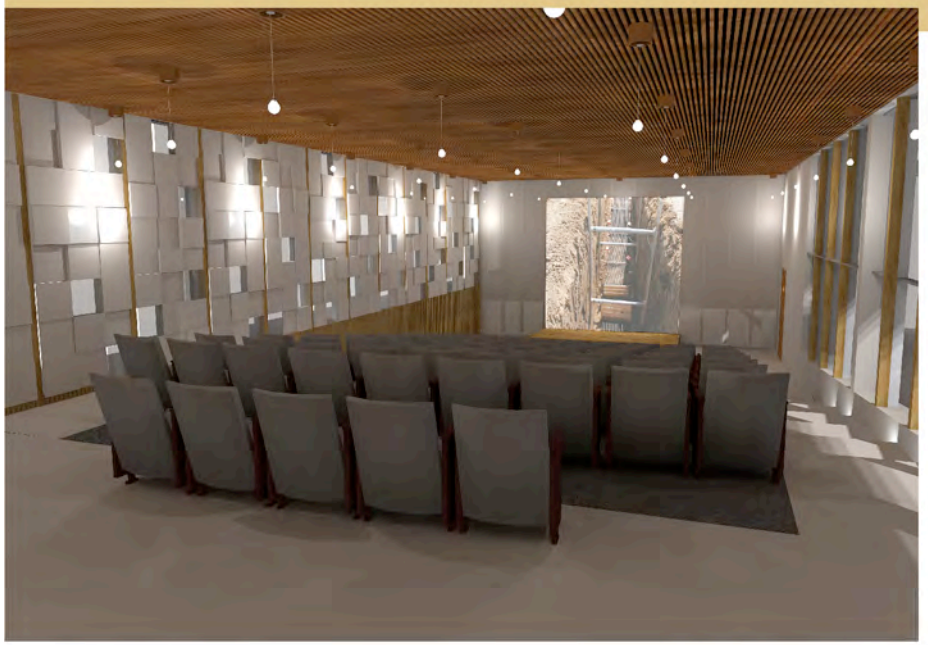
PROPOSAL _ SECOND FLOOR PLAN

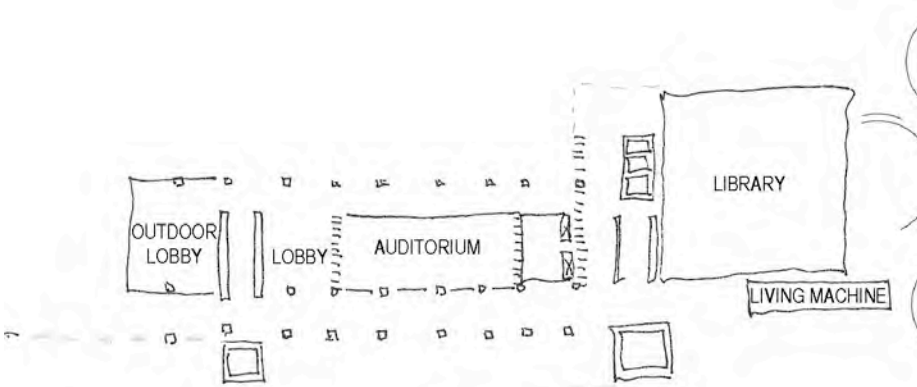
View from West, across River pedestrian bridge

From the exterior ramp, pedestrians have a great view and comprehension of the structure holding up the suspended greenhouse. It will become evident that the two towers are withtaking the forces and are functional axes for the building. Once on the ramp, pedestrians cannot see within the greenhouse until ascending up to the bridge or descending into the corner piazza. Both these positions are great for viewing the facility as a functioning system of education, growth, recreation and social structure.

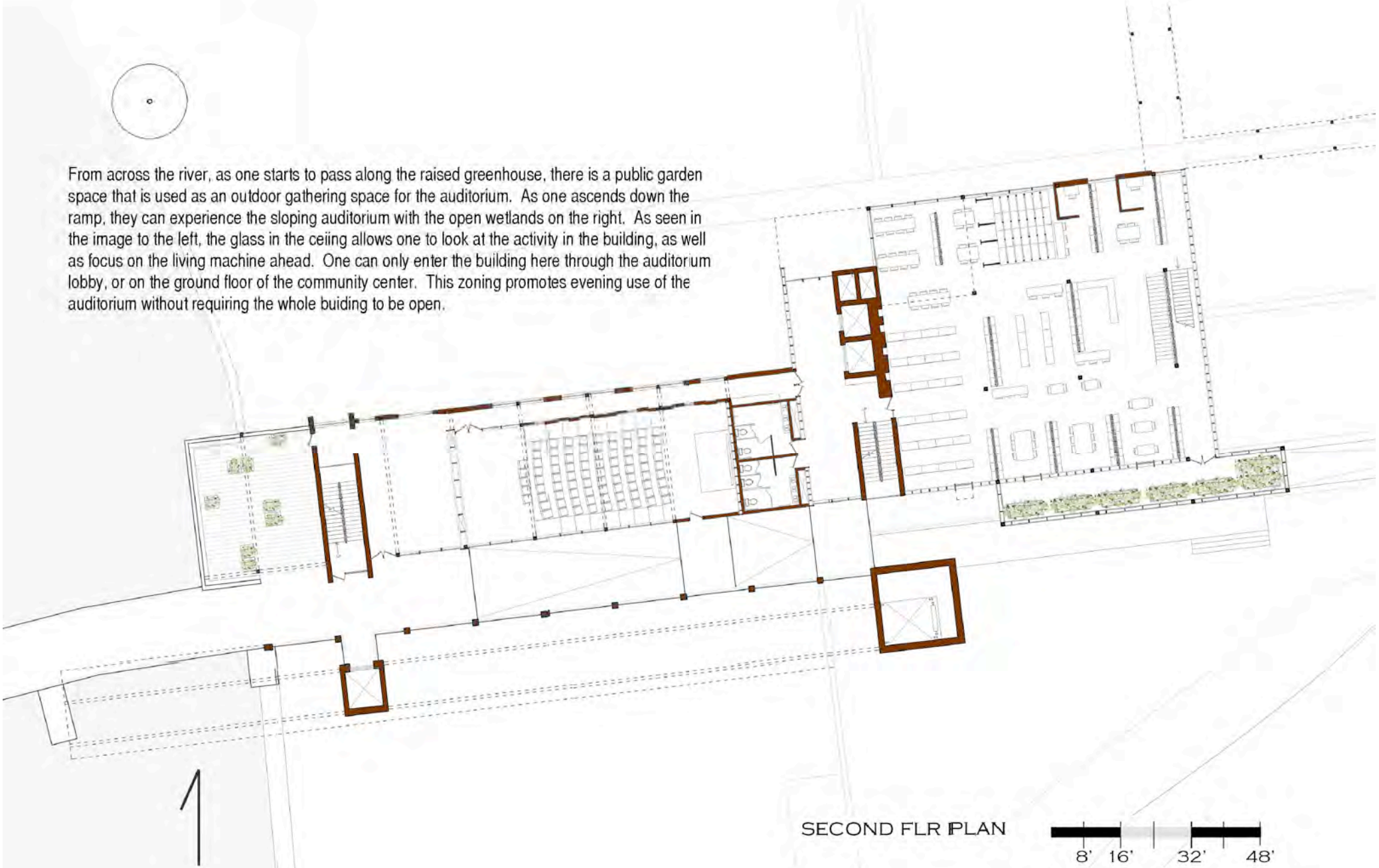

SECOND FLOOR PLAN
8' 16' 32' 48'

PROPOSAL _ SECOND FLOOR PLAN





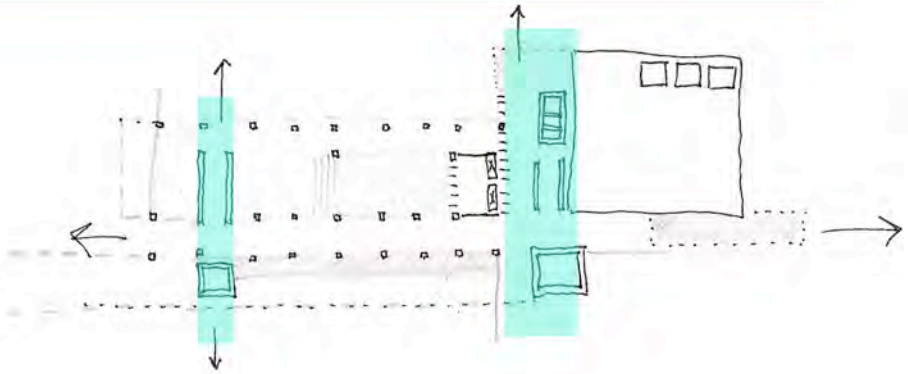
From across the river, as one starts to pass along the raised greenhouse, there is a public garden space that is used as an outdoor gathering space for the auditorium. As one ascends down the ramp, they can experience the sloping auditorium with the open wetlands on the right. As seen in the image to the left, the glass in the ceiing allows one to look at the activity in the building, as well as focus on the living machine ahead. One can only enter the building here through the auditorium lobby, or on the ground floor of the community center. This zoning promotes evening use of the auditorium without requiring the whole buiding to be open.

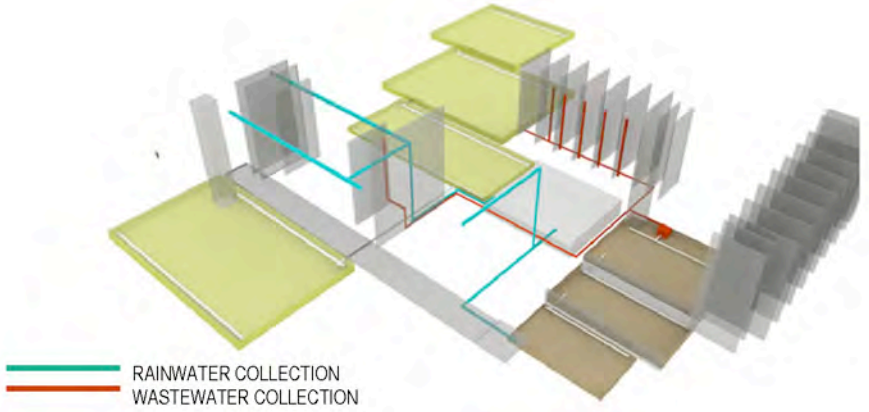


SECOND FLR PLAN

8' 16' 32' 48'

PROPOSAL _ FILTERING BUILDING LAYERS



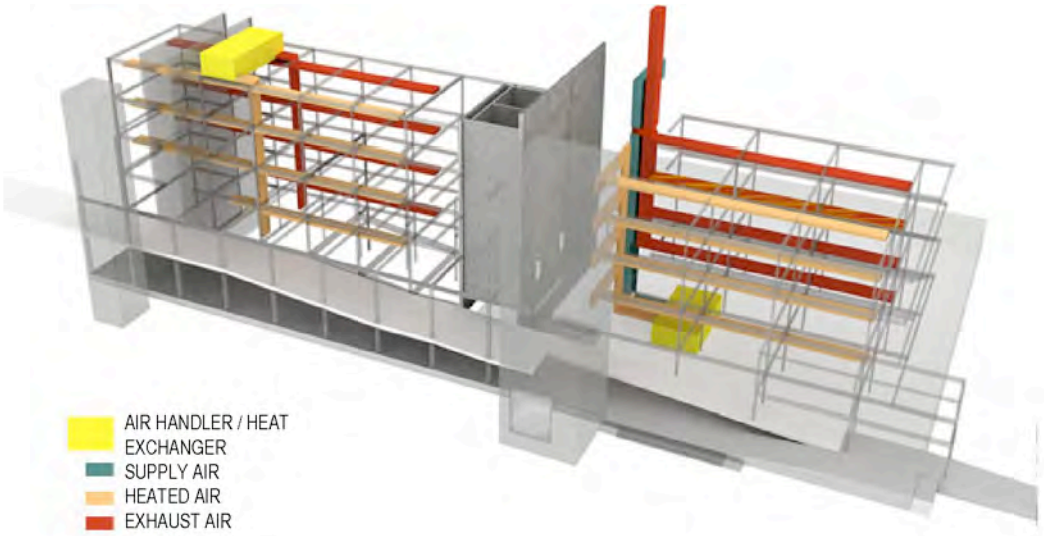


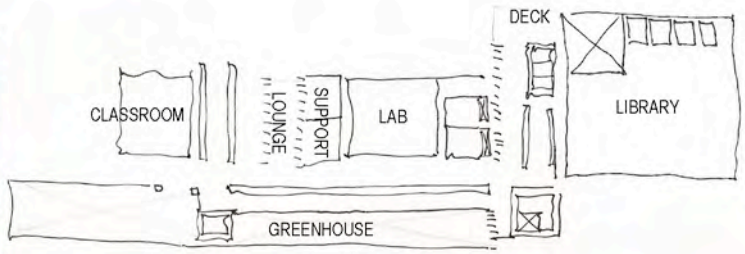
Within the building's core zones are a series of filtering walls that imply an active function within the vertical wall. The main two core zones are indicated in the diagram above between the main programmatic spaces. This is where the major activities for the building happen, and thus where the most energy is created. Both zones are off the axis of vertical core shafts with circulation within.

These thin shafts are moments of release, where one can be reconnected with the outside surroundings and activity. The egress stairs contain a filtering wall that one circulates around when going up or down the stairs. The wall is made of horizontal wood panels that filter the light from the glass ceiling above. The light coming from the top brings release to the space as the wood warms the concrete walls.

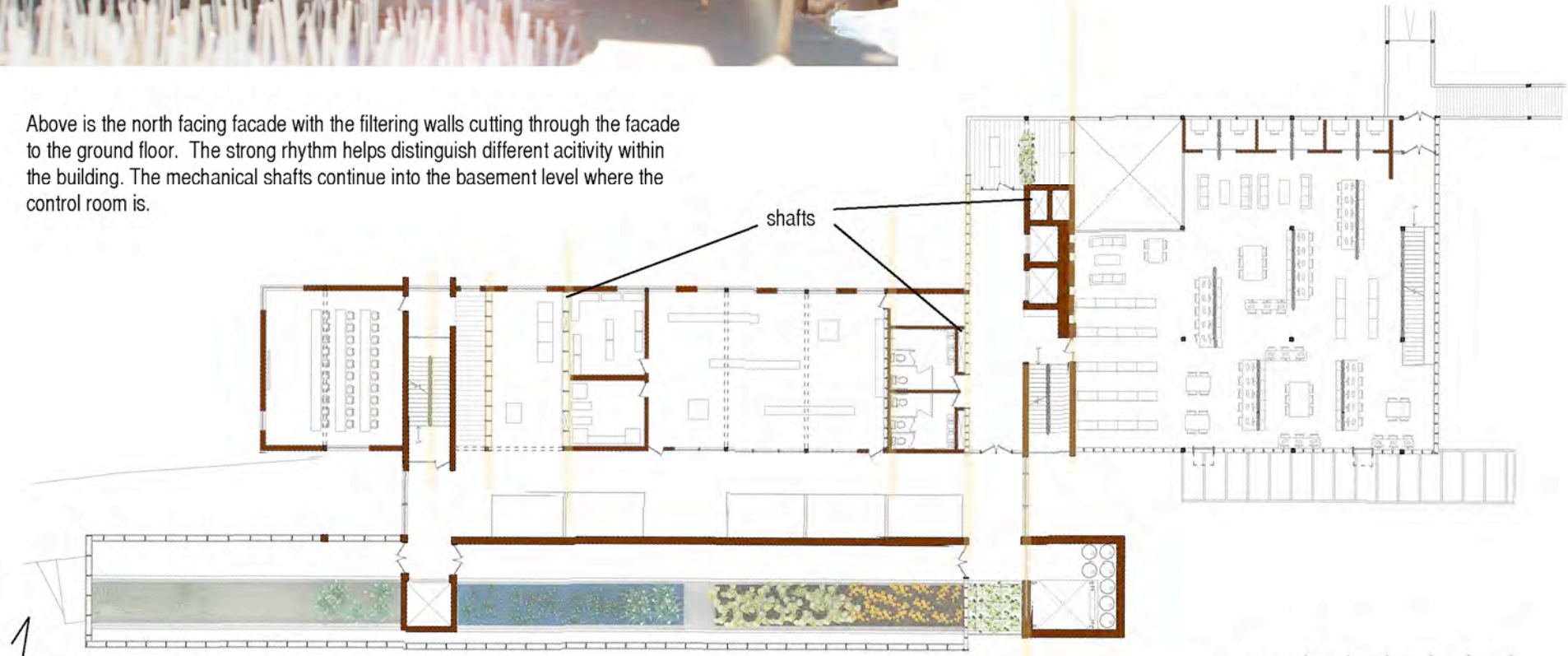
Adjacent to many of these solid concrete structures are lighter, transulent walls. These walls are hollow and contain much of the necessary plumbing, and ventilation shafts within them. They are translucent, showing the activity happening within the walls, revealing their purpose within the functioning building.

There are smaller scale walls throughout the education spaces that have structured voids within for putting things in. A wall is a hollow structure who can have more than one function. In the library, the larger concrete wall belonging to the elevator shaft is thick and massive, but has relief holes throughout its material.





Above is the north facing facade with the filtering walls cutting through the facade to the ground floor. The strong rhythm helps distinguish different acitivity within the building. The mechanical shafts continue into the basement level where the control room is.

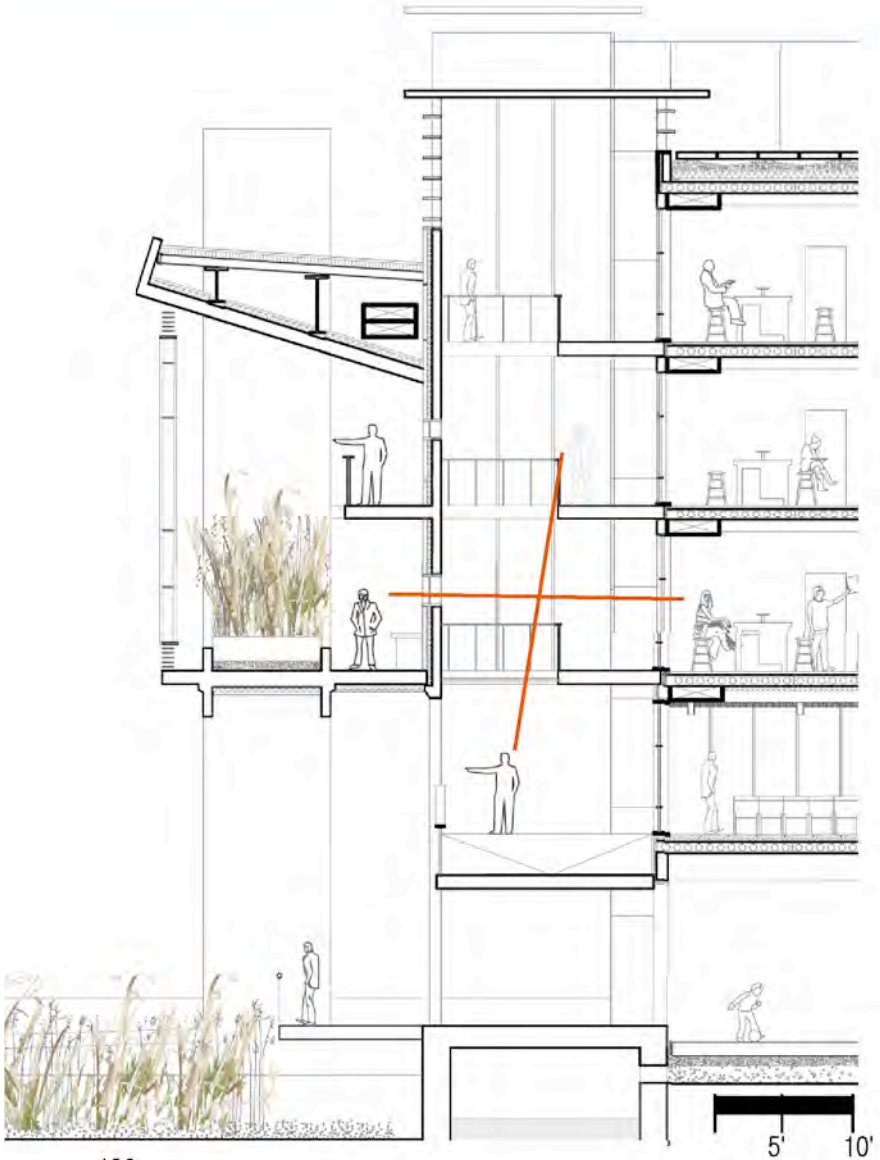


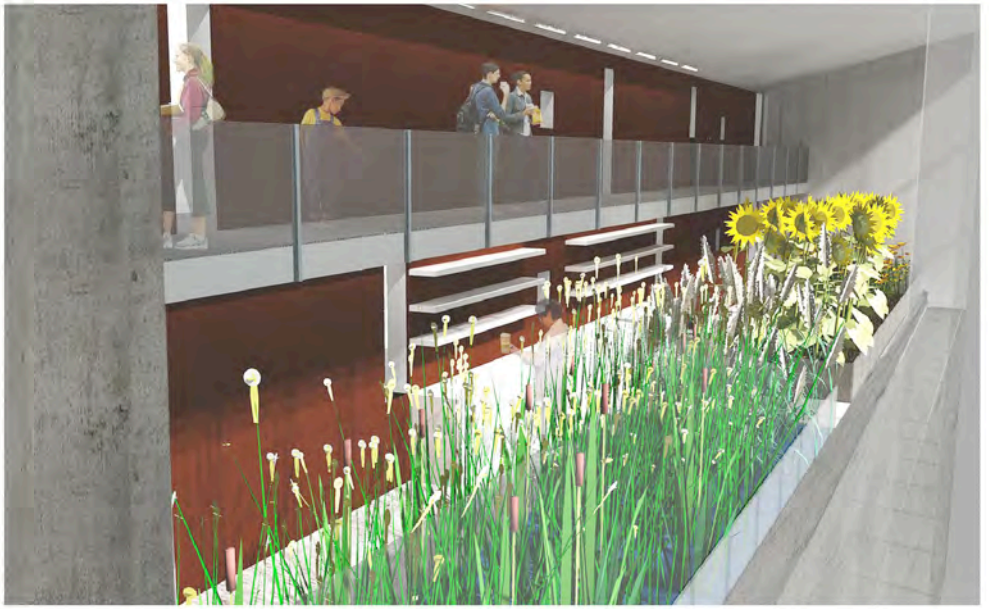
1

THIRD FLOOR PLAN

8' 16' 32' 48'

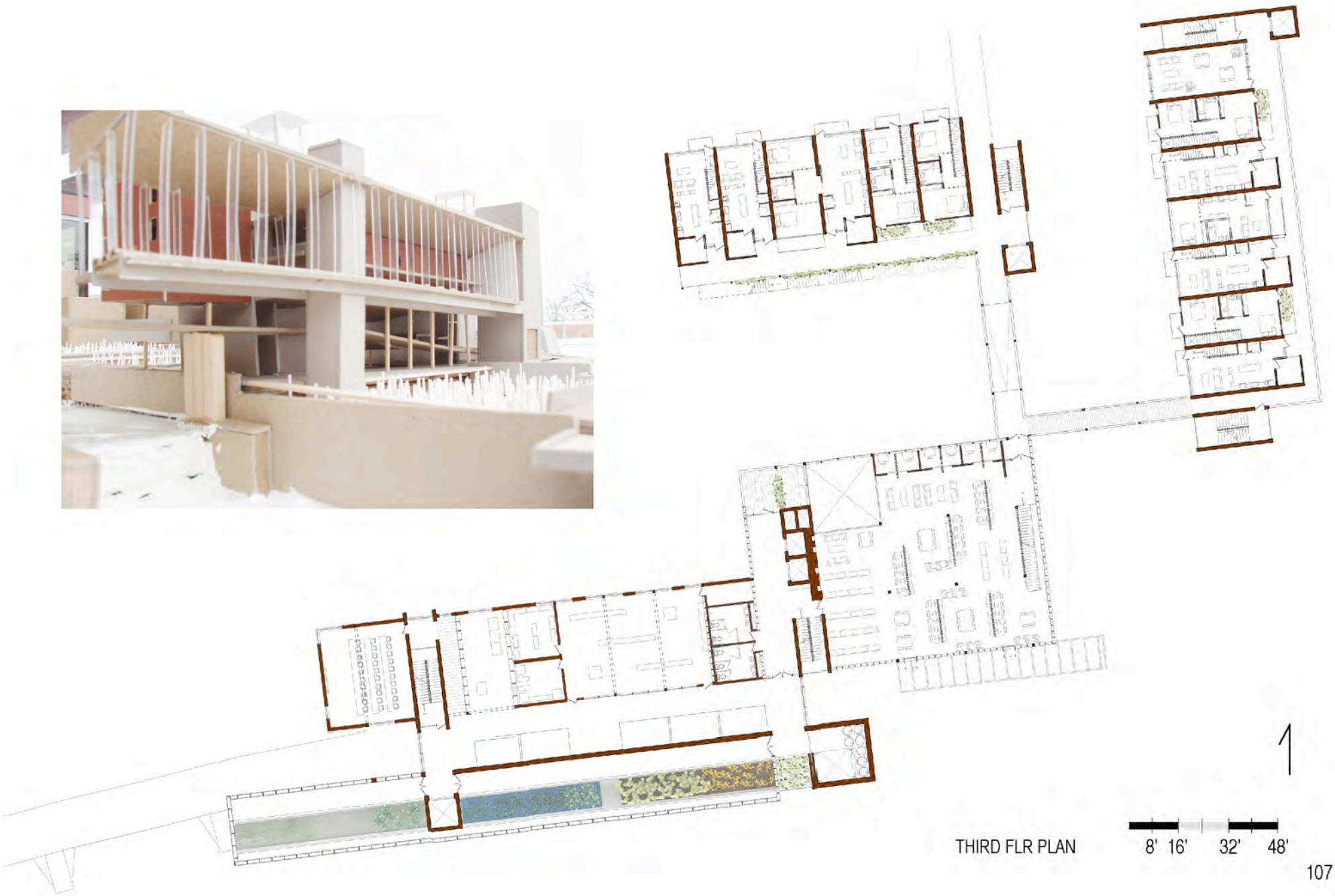
PROPOSAL _ VISUAL CORRIDOR





The main circulation corridor is ventilated through two vertical chimneys at each end. The corridor walkway is pulled away from the large concrete wall that changes into columns at the ground and second story levels. The massive wall is symbolic of the massive exterior masonry walls of mill buildings. The small box windows piercing certain spots, revealing the life of the plants beyond. At the bottom of the corridor is a glass floor, allowing outside visibility onto the exterior pedestrian ramp. The laboratories on the north side of the building receive light through the gass walls facing the sunlight corridor with some operable windows for cross-ventilation.

There is a narrow walkway along the upper floor of the greenhouse, allowing on-lookers and more lecture space. The image in the above right shows the visual connection with those on the upper walkways of the greenhouse with pedestrians outside in the public wetland space.

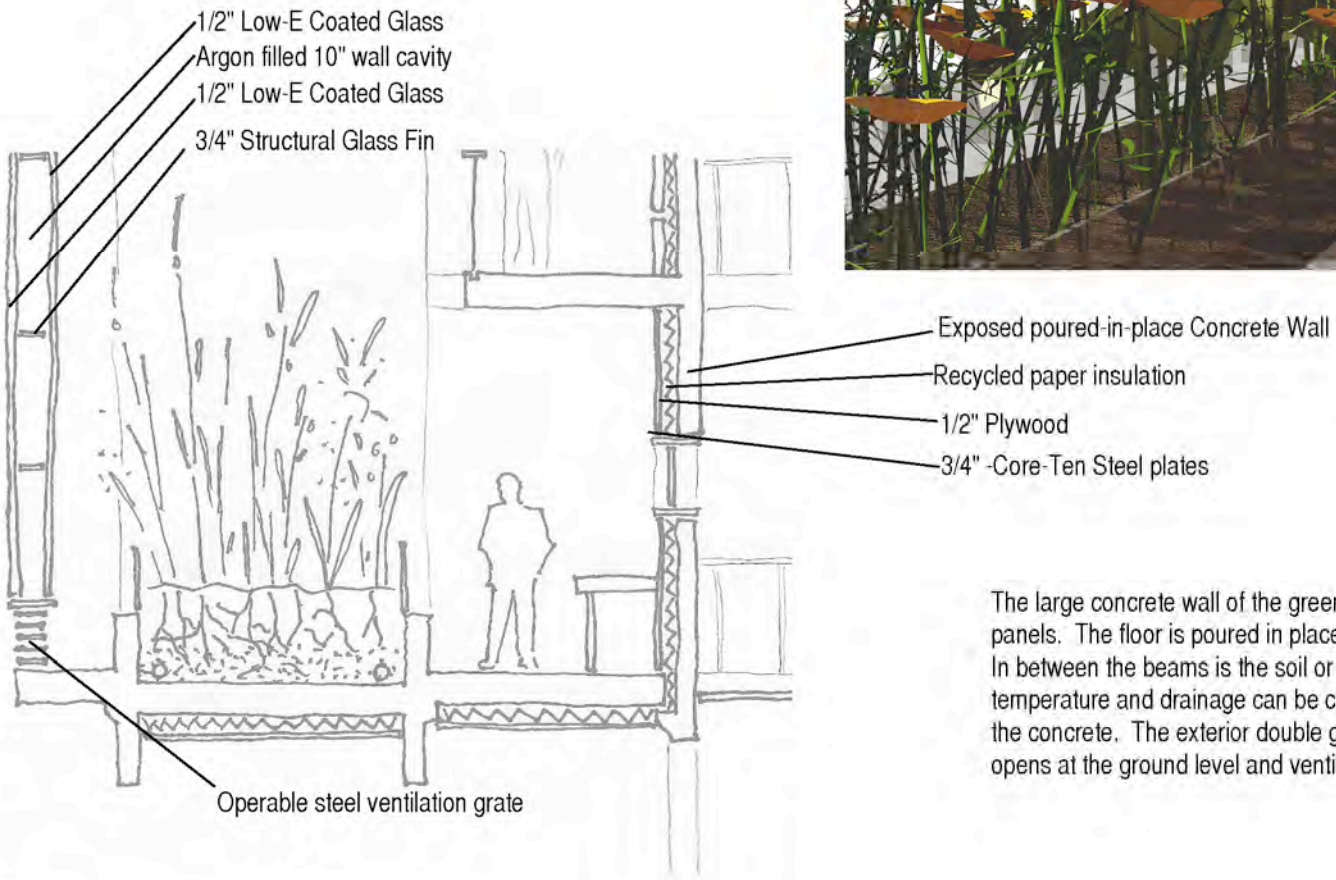


1

THIRD FLR PLAN

8' 16' 32' 48'

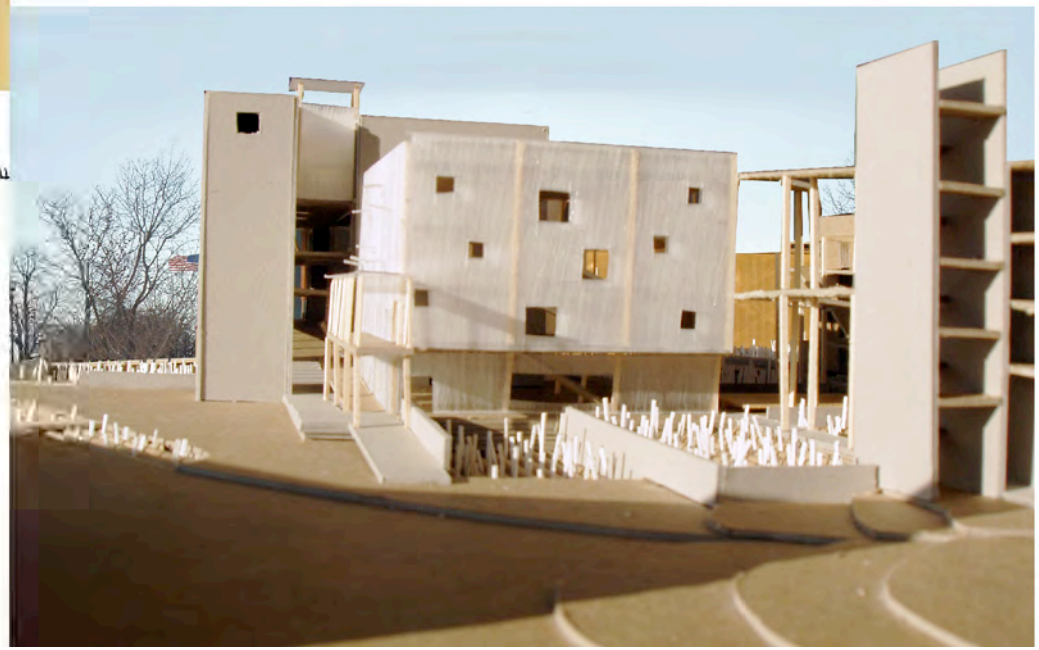
PROPOSAL _ GREENHOUSE DETAIL



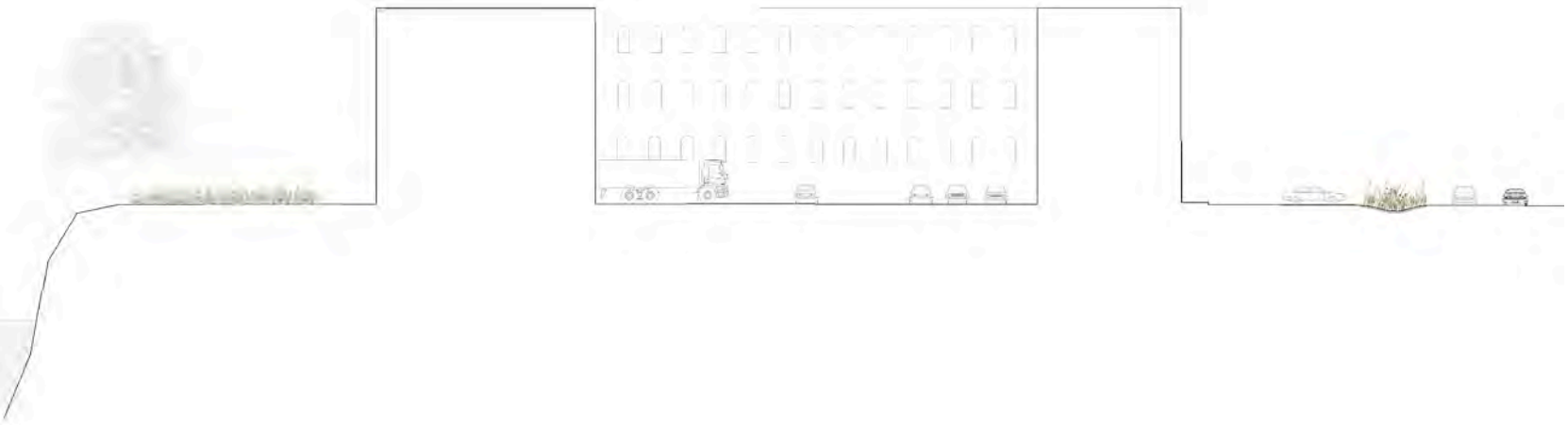
The large concrete wall of the greenhouse is covered with core-ten steel panels. The floor is poured in place concrete with 5 foot parallel floor beams. In between the beams is the soil or water for the plantlife. From hear, the temperature and drainage can be control by a radiant heating system in the concrete. The exterior double glass facade has a ventilation grate that opens at the ground level and ventilates out at the top.

FOURTH FLOOR PLAN

PROPOSAL _ SECTIONS



The large concrete tower in front of Market Square is a large outsourcing tool that retrieves, delivers and stores all goods shipped to and from the facility. The void between the cube promotes the through passage. Once in between the two buildings, one feels the weight on the concrete, but the release of the open space around it. Adjacent to the cube is an overflow storage pond that lies in front of the housing building. The screen of green vines filters the sun into the housing entry corridors, whie brining life and privacy to their living quarters. Behind the housing is a small hard surfaced courtyard with individual backyard spaces for the units as well as one larger shared pedestrian space. The back wall of the adjacent lower story retail building is solid stone, giving the space privacy as well as providing a functional recreational wall.



SECTION B

5' 10' 20' 30'

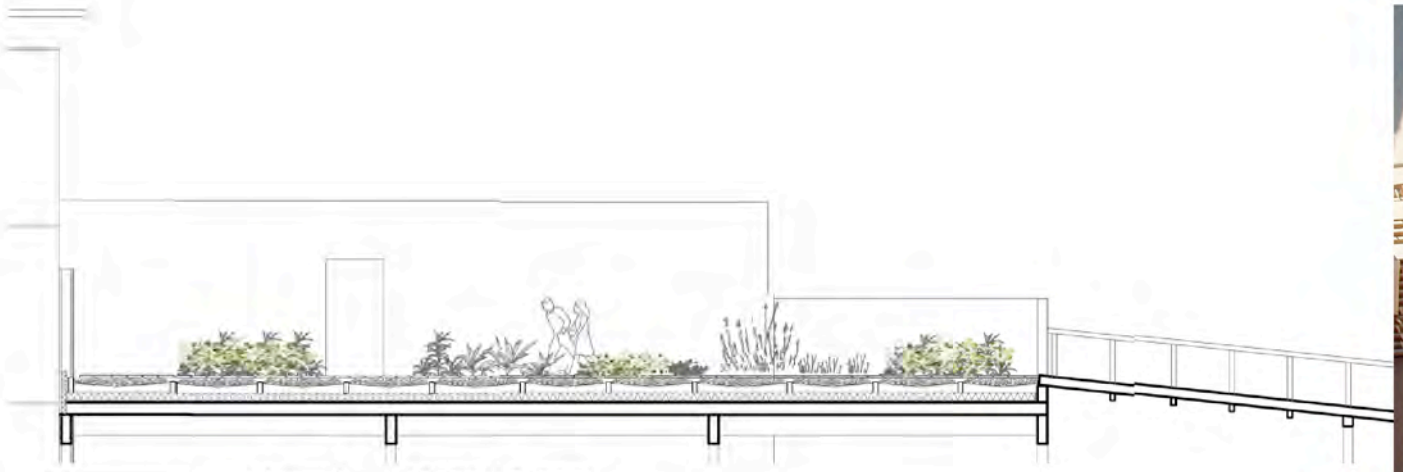
There are many different possible environments in which nature and man may coexist. This system of sources brings nature into different layers of urban spaces and generates life and healthy environments, while bringing to light our dependency on these life systems and relations.

SECTION B

5' 10' 20' 30'

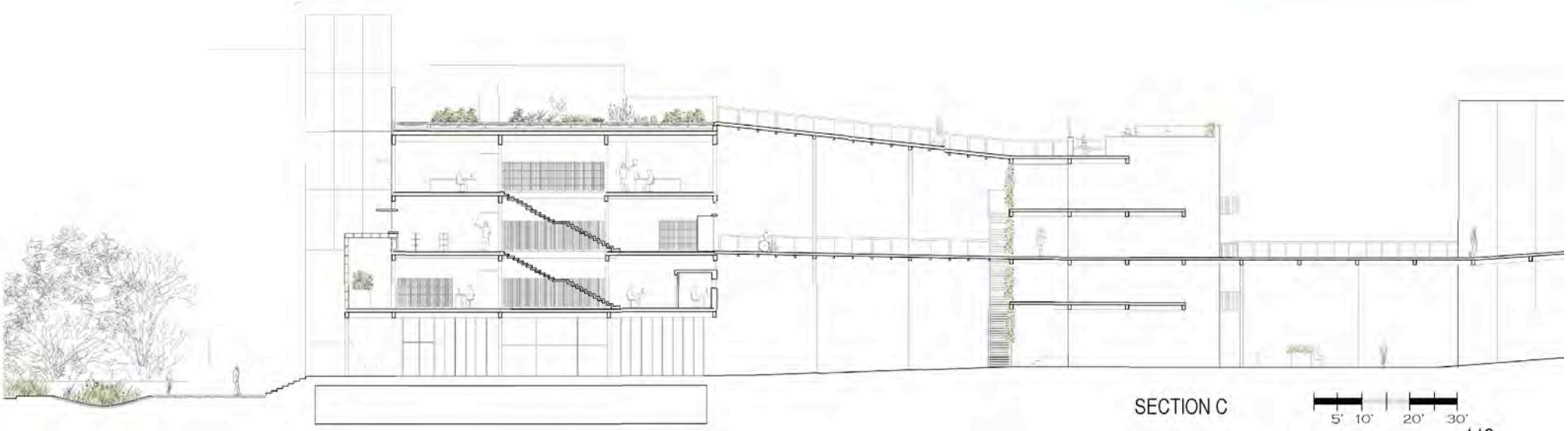
The roof of the community outreach building is a community garden where students and faculty sustain themselves and their families while going to school and training for future careers. The rooftops of both housing buildings are shared garden spaces with numerous individual garden areas for the tennants. The upper floors have a network of private green spaces and healthy living environments to recreate the ground conditions throughout the urban block.

FIFTH FLOOR PLAN



5' 10' 20'

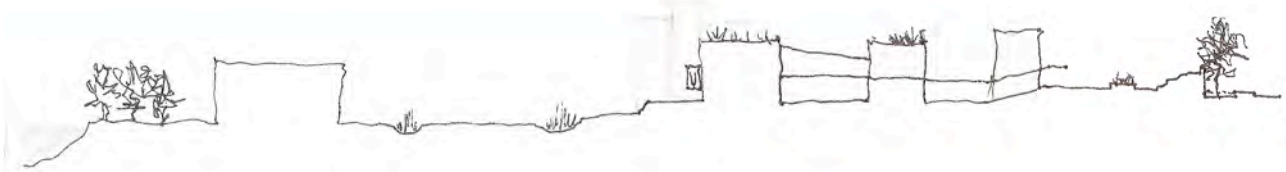
SECTION C DETAIL



SECTION C

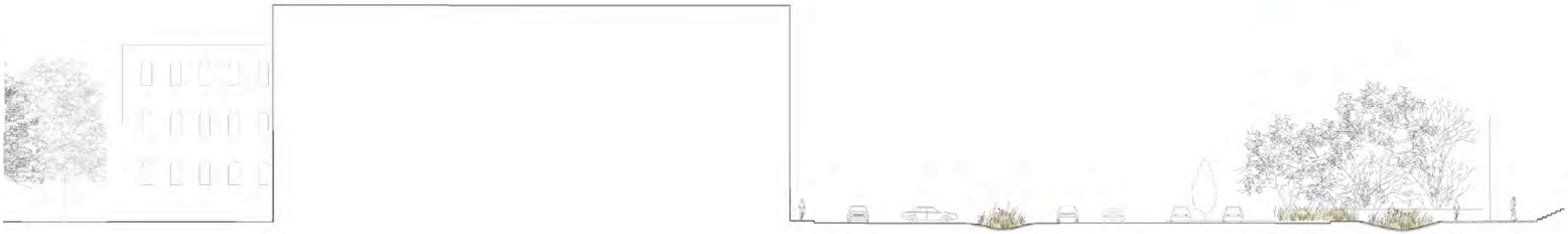
5' 10' 20' 30'

PROPOSAL _ SECTIONS

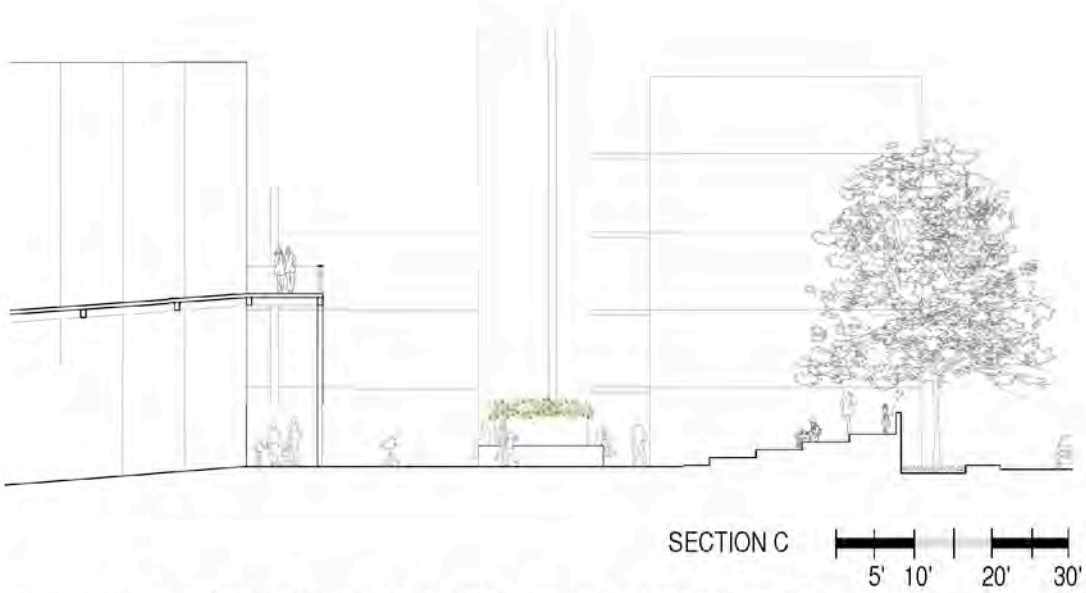


The main intersection approach to the site shows the network of systems present on the site. The network of pedestrian paths throughout the site lead to the egress that leads to the undergound parking below the mixed-income housing.

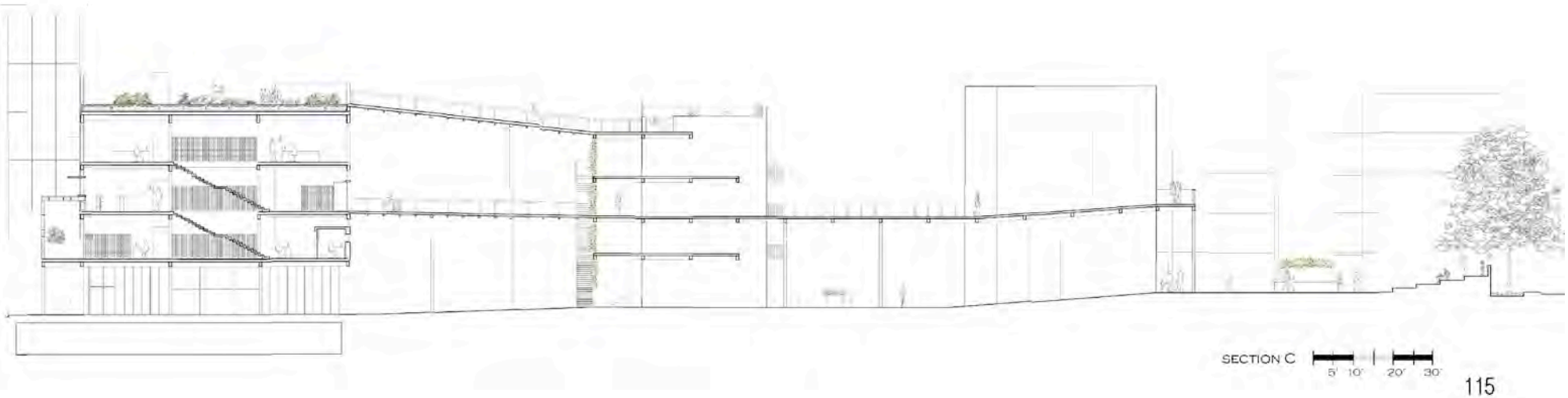
Corner view of the Market Sc



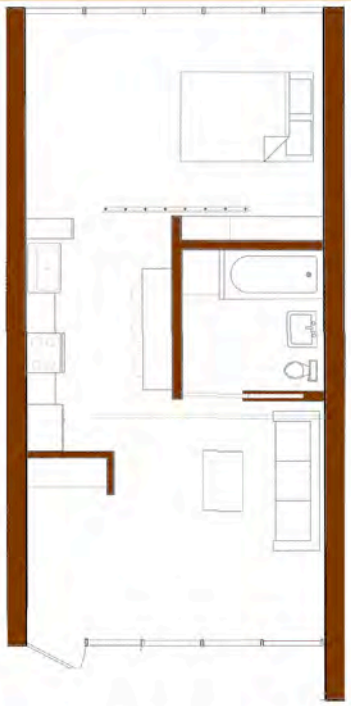
The entrance ramp to start ascending up into the building's different levels is at the corner of Main Street. A covered walkway penetrates beneath the library and alongside the seating next the the wetland.



^ The north end of the site contains a hard-scaped courtyard with a center seating arrangement and outdoor auditorium seating. This busy plaza can also be viewed above the two-story retail building from the public rooftop garden. This community garden provides art gallery space and planting space to the public.

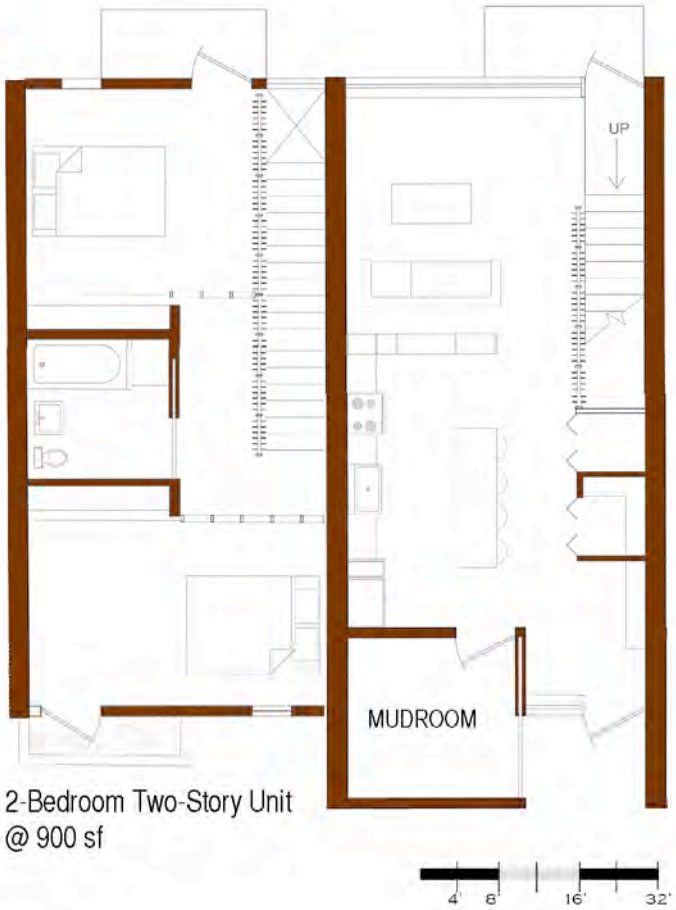


PROPOSAL _ HOUSING TYPES

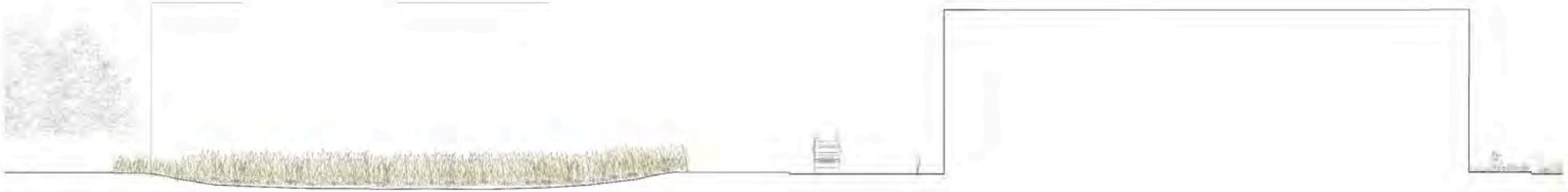


1-Bedroom @ 550 sf

2-Bedroom Double-Bay Unit
@ 1100 sf

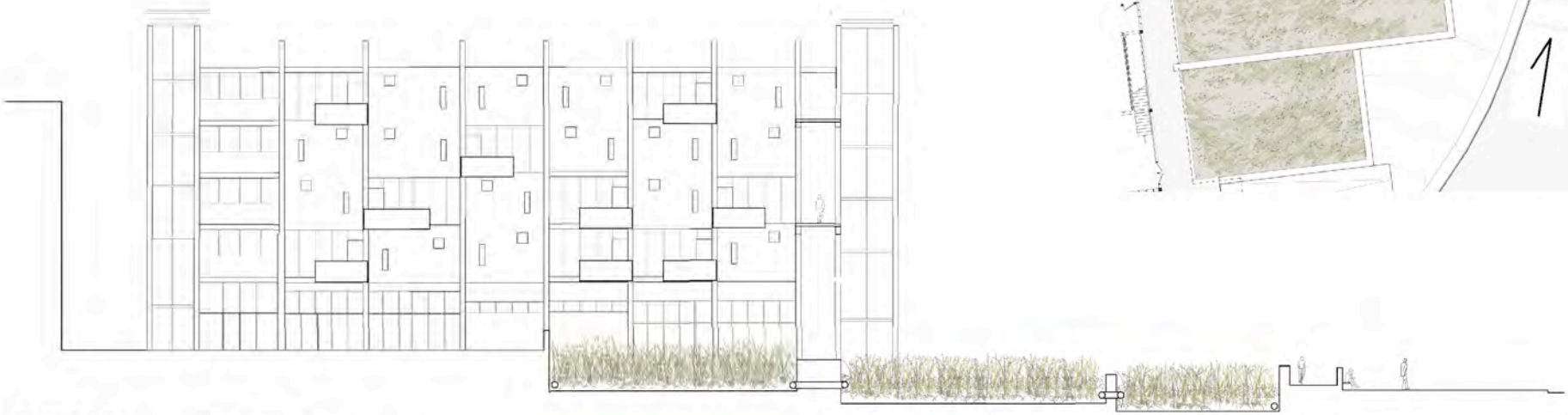


2-Bedroom Two-Story Unit
@ 900 sf



The Main Street short-term housing building is a concrete modular building that provides the students with enough space to bring their small families into while they tend the facility. All two-bedroom units have their own storage garage space in the front, creating a buffer to the corridor. The single bedroom unit takes up one module, while the two-bedroom units take up two cells. The ground two stories are retail spaces, with one cell as a lobby and mail room for the units. The exterior corridors overhang the sidwalk, protecting pedestrains below from the rain. The bio-swale stands between the covered sidwalk and the roadside walkway, collecting runoff water from the sloping street.

Behind the roadside building is wastewater wetland, with central walkways going through it. The wetlands provide a buffer from the more private backyard to the secondary housing building. The wetland provides a green backyard to the upper housing units. The units could access the main building through raised walkways on the third and fifth floors.



SECTION F

5' 10' 20' 30'

SECTION E

5' 10' 20' 30'

5' 10' 20'

PROPOSAL _ HOUSING

HOUSING GROUND FLR PLAN

The off-street short-term housing building is set within the urban block, perpendicular to the other housing. This housing sits on line of axis off one of the wetland foundation walls. The surrounding land acts like a dock, a platform on the water's edge. There is a light steel structure on the ouside of the exterior cooridor for vines that will shield the building's south facade from sun. The raised potters provide a clear ground story, while giving southern shade and nature to the housing units. This simple existence of nature brings birds, insects and life to the upper floors of the urban housing units.

HOUSING FOURTH FLR PLAN

HOUSING FRONT ELEVATION

DIGITAL RENDERINGS _

VIEW DOWN RIVER DAM RAMP

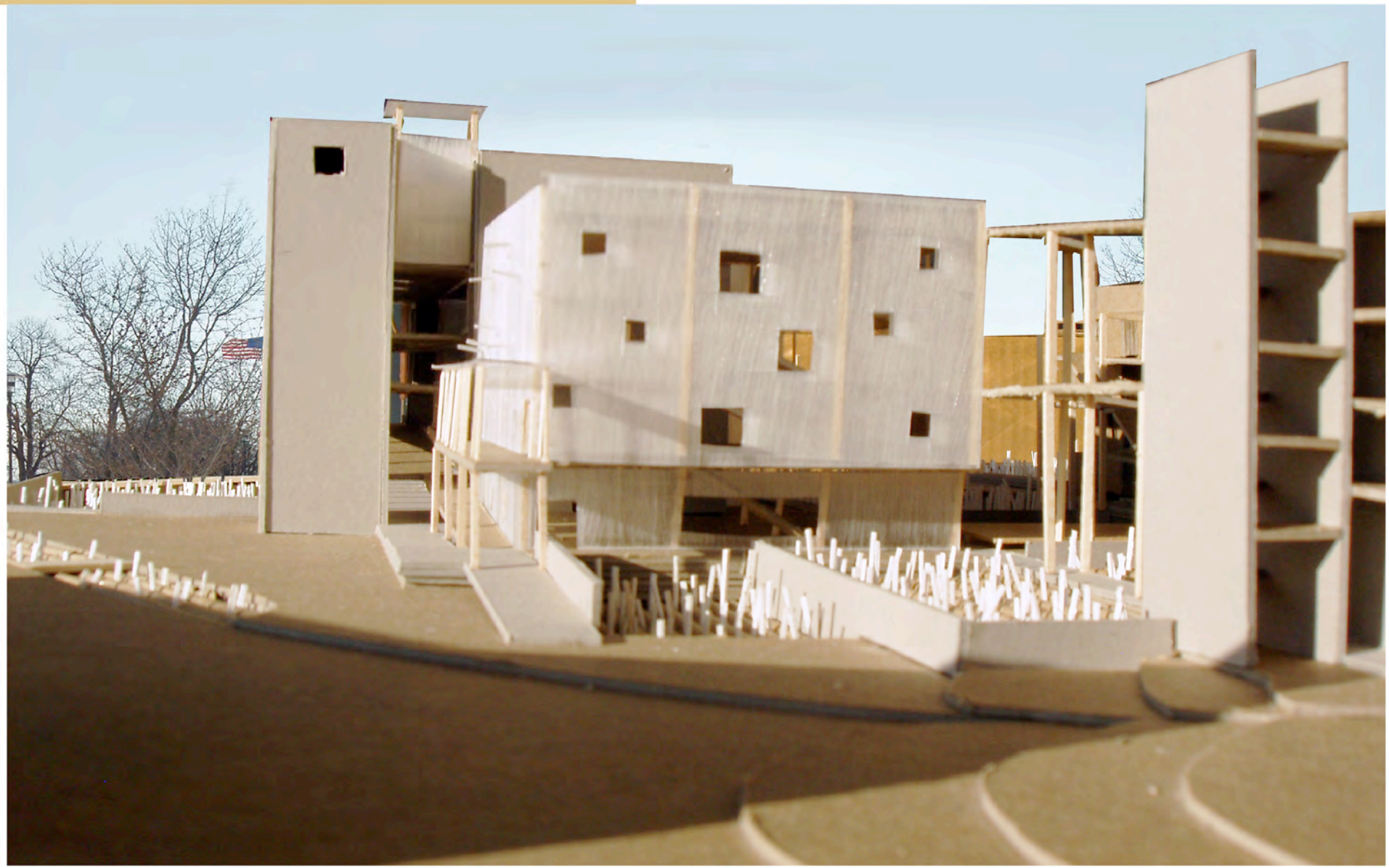
DIGITAL RENDERINGS _

INSIDE SUSPENDED GREENHOUSE

MODEL IMAGES _

VIEW FROM NORTH LOOKING DOWN WETLANDS TO THE TRAINING FACILITY

MODEL IMAGES _



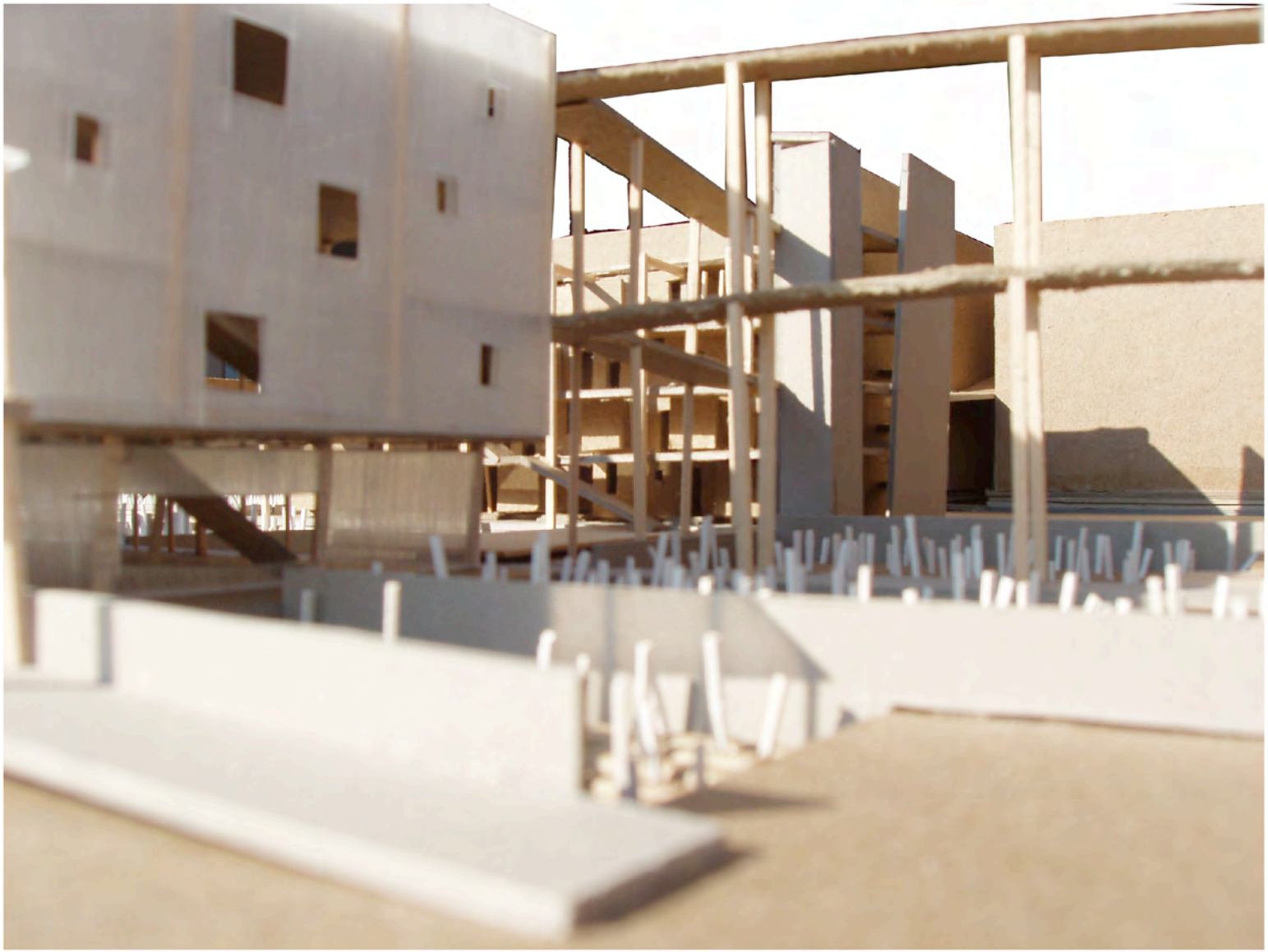
VIEW AROUND BEND OF SOUTH MAIN STREET

MODEL IMAGES _

SOUTH MAIN STREET FACADES

COMMUNITY OUTREACH

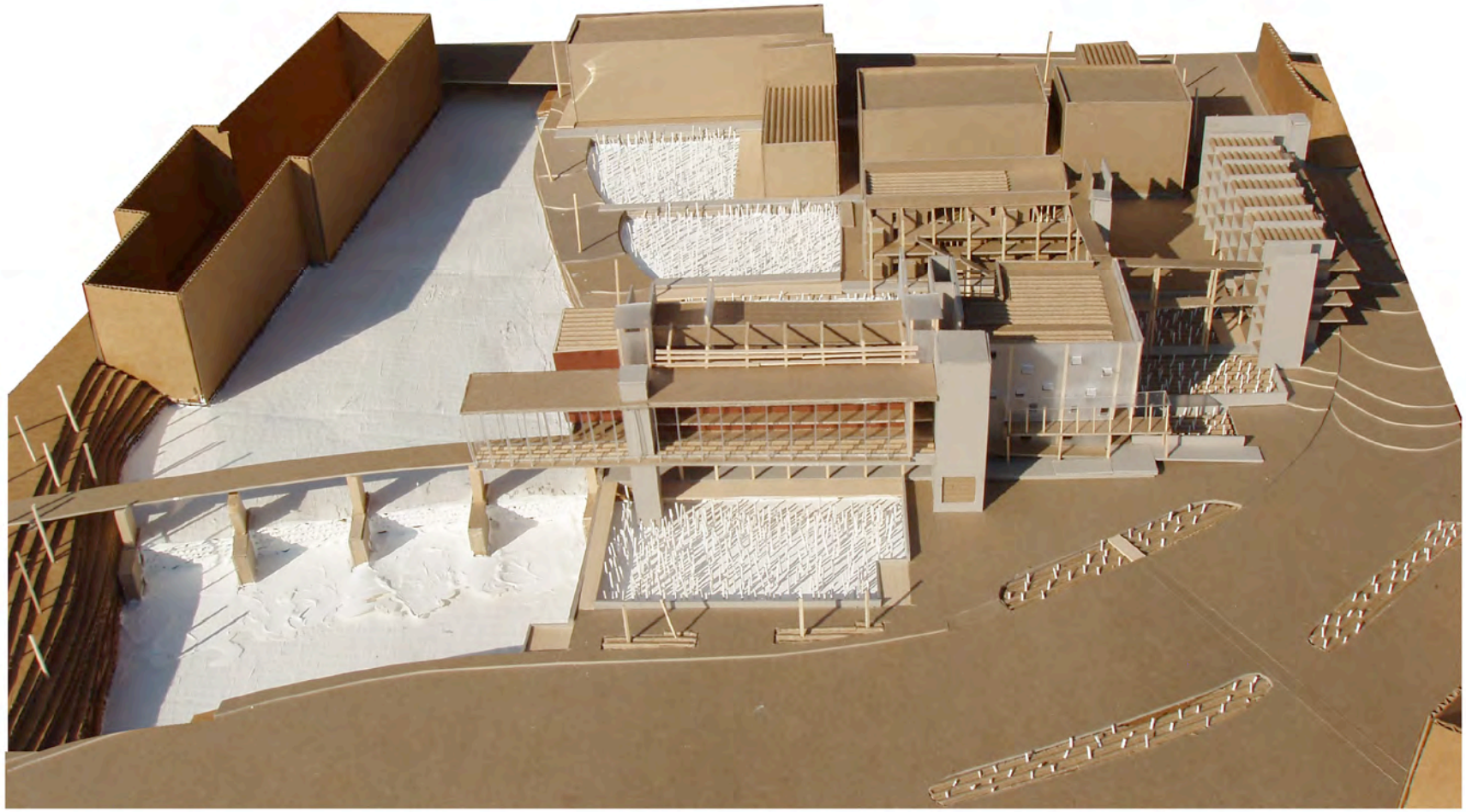
SHORT-TERM HOUSING



RAMP ENTRY FROM CORNER MAIN STREET PLAZA

CLOSING _ COEXISTING INFRASTRUCTURES

As a system, the growing block in Woonsocket's urban layers symbolizes the future of the city. The buildings and land bring back the memories of past destruction and revive them in public ways that bring a new identity to the downtown. The regrowth of the city ultimately depends on the use of the land and environment. Generating a city that can withold change and create new interfaces with its surroundings will bring harmonious conditions to the downtown. The urban block provides the people with amenities it needs, but it also holds conditions that subconciously root us back to our existence, our reinterpretation of all that is created by man and nature.



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APPENDIX I _ IMAGE SOURCES

IMAGE 1 : Failing Infrastructure
Bokov, Anya and Martin, Alice. *"Edge As Center: Envisioning the Post-Industrial Landscape,"* Mayor's Office of Strategic Planning& Community Development. Sommerville, 2006. Visited 9/30/08. http://www.architects.org/emplibrary/Edge_As_Center_synopsis.pdf

IMAGE 2 : Distance and Time
Mau, Bruce. *Massive Change*. New York, NY: Phaidon, 2004, pg 7.

IMAGE 3 : Underground Diaphram with Steel Lining
New York Public Library: Digital Gallery, http://digitalgallery.nypl.org/nypldigital/dgkeysearchresult.cfm?parent_id=137165&word=

IMAGE 4 : Catskill Aqueduct
New York Public Library: Digital Gallery, http://digitalgallery.nypl.org/nypldigital/dgkeysearchresult.cfm?parent_id=137169&word=

IMAGE 5 : Peter Cook's Plub-In-City Diagram
Cook, Peter. T*he City, Seen as a Garden of Ideas*. New York: Monacelli Press, 2003

IMAGE 6 : Waterproofing Subway Tunnels
New York Public Library: Digital Gallery, http://digitalgallery.nypl.org/nypldigital/dgkeysearchresult.cfm?parent_id=137169&word=

IMAGE 7 : Failed Road Infrastructure
http://terraverde.files.wordpress.com/2009/02/minnbridgecollapse.jpg

IMAGE 8 : Electrical Infrastructure
Mau, Bruce. *Massive Change*. New York, NY: Phaidon, 2004.

IMAGE 9 : Beach Pollution
http://tcal.net/wp-content/uploads/2007/01/4.jpg

IMAGE 10 : Infratructure Cartoon
www.cardstock.com

IMAGE 11 : Decay & Growth
Cook, Peter. T*he City, Seen as a Garden of Ideas*. New York: Monacelli Press, 2003

IMAGE 12 : Decay & Growth
Cook, Peter. T*he City, Seen as a Garden of Ideas*. New York: Monacelli Press, 2003

IMAGE 13 : Decaying Mill Structure
Littlefield, David. *Architectural Voices: Listeneing to Old Buildings*. Hoboken, NJ: 2007

IMAGE 14: Old Mill Wheel
Littlefield, David. *Architectural Voices: Listeneing to Old Buildings*. Hoboken, NJ: 2007

IMAGE 15 : Tree Overtaking Technology
http://farm3.static.flickr.com/2155/2106296953_7a855a9d40.g?v=0

IMAGE 16 : Green Frass Grows
http://farm3.static.flickr.com/2240/2385275808_ba79d8b57a.jpg

IMAGE 17 : Industrial Waste Barrels
http://farm4.static.flickr.com/3195/3109476639_51e4acbb33_m.jpg

IMAGE 18 : Public Space & Infrastructures
Made by me in Photoshop

IMAGE 19 : Woonsocket Railroads
Picture taken by me along Railroads on Main Street

IMAGE 20 : Welcome to Woonsocket
Bellerose, Robert, *Images of America: Woonsocket Revisted.* Arcadia Publishing, Great Britain: 2004. pg 4

IMAGE 21 : Company of Taft Pierce Company
Bellerose, Robert, *Images of America: Woonsocket Revisted.* Arcadia Publishing, Great Britain: 2004. pg113

IMAGE 22 : Main Street Woonsocket, 1910
Bellerose, Robert, *Images of America: Woonsocket Revisted.* Arcadia Publishing, Great Britain: 2004. pg 43

IMAGE 23 : Google Map of New England Photoshopped to Highlight Railway paths

IMAGE 24 : Blackstone River Industrial Map
Photo Taken of Map Posted in Market Square

IMAGE 25 : Rising Groundwater Level in Woonsocket
Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007

IMAGE 26 : Surficial Geology of Blackstone River Basin
Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg 7

IMAGE 27 : Wetlands in Blackstone River Basin
Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg 10

IMAGE 28 : Locations, Withdrawls, Returns	Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg21
IMAGE 29 : Water-Use in Blackstone River Basin	Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg14
IMAGE 30 : Water Budget Charts	Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg58
IMAGE 31 : Surface Drainage Chart	Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg33
IMAGE 32 : Hydrological System Chart	Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg16
IMAGE 33 : Woonsocket Watersheds	Barbaro, Jeffrey R. and Zarriello, Phillip J. *"A Precipitation-Runoff Model for the Blackstone River Basin, MA and RI,"* U.S. Geological Survey, Reston, Virginia: 2007. pg10
IMAGE 34 : Groundwater Classifications	GIS Woonsocket, RI Map, http://ceo.fando.com/Woonsocket/find.aspx?service=Woonsocket
IMAGE 35 : Highground Water Level Areas	GIS Woonsocket, RI Map, http://ceo.fando.com/Woonsocket/find.aspx?service=Woonsocket
IMAGE 36 : Employment Density Map	Rhode Island Statewide Planning Program, *"City of Woonsocket, RI Commuter Rail Feasibility Study,"* 2000, pg 14.
IMAGE 37 : Persons Working in Boston 2000	Rhode Island Statewide Planning Program, *"City of Woonsocket, RI Commuter Rail Feasibility Study,"* 2000, pg 19.
IMAGE 38 : Sun Path Chart	http://www.gaisma.com/en/location/providence-rhode-island.html
IMAGE 39 : Providence Wind Rose	http://home.pes.com/windroses
IMAGE 40 : Woonsocket, RI	GIS Woonsocket, RI Map, http://ceo.fando.com/Woonsocket/find.aspx?service=Woonsocket
IMAGE 41 : Woonsocket Falls, 1825	Woonsocket Harris Public Library, http://www.quickpix.com/Woonsocket.htm
IMAGE 42: Woonsocket Falls, 1930	Woonsocket Harris Public Library, http://www.quickpix.com/Woonsocket.htm
IMAGE 43: Woonsocket Village, 1938	Woonsocket Harris Public Library, http://www.quickpix.com/Woonsocket.htm
IMAGE 44 : Woonsocket Village, 1938	Woonsocket Harris Public Library, http://www.quickpix.com/Woonsocket.htm
IMAGE 45 : Downtown Industrial Hub, 1950	Woonsocket Harris Public Library, http://www.quickpix.com/Woonsocket.htm
IMAGE 46 : Storm Sewers	GIS Woonsocket, RI Map, http://ceo.fando.com/Woonsocket/find.aspx?service=Woonsocket
IMAGE 47 : Sanitary Sewers	GIS Woonsocket, RI Map, http://ceo.fando.com/Woonsocket/find.aspx?service=Woonsocket
IMAGE 48 : Groundwater Levels	GIS Woonsocket, RI Map, http://ceo.fando.com/Woonsocket/find.aspx?service=Woonsocket
IMAGE 49 : Woonsocket Zoning Map	Department of Planning and Development, Woonsocket Planning Board. *"City of Woonsocket RI Zoning Ordinance,"* Updated January 23, 2002.
IMAGE 50 : West 8, Waterfront Public Docks	West 8 Architects and Urban PLanners, www.west8.nl/js/image.php?i=945
IMAGE 51 : West 8, Housing and Retail	West 8 Architects and Urban Planners, www.west8.nl/js/image.php?i=947
IMAGE 52 : Phyto-degradation	http://www.unep.or.jp.ietc/publications/Freshwater/FMS2/2.asp
IMAGE 53 : Constructed Wetland Diagram	Melby, Pete and Cathcart, Tom. *Regenerative Design Techniques,* New York: Wiley, 2002, page 303.
IMAGE 54 : Phyto-degradation	http://farm3.static.flickr.com/2254/2054597858 b94bd1000e.jpg?v=0
IMAGE 55 : Constructed Wetland Diagram	http://frogs.org.au/img/450/phytoremediation wetland.jpg
IMAGE 56 : Wetland Edge Drawing	Melby, Pete and Cathcart, Tom. *Regenerative Design Techniques,* NewYork: Wiley, 2002, page 301
IMAGE 57 : Duckweed Wastewater Treatment	Melby, Pete and Cathcart, Tom. *Regenerative Design Techniques,* New York: Wiley, 2002, page 306.
IMAGE 58 : West 8 Ecological District, Urban Model	www.west8.nl/js/image.php?i=940
IMAGE 59 : West 8 Ecological District, Site Plan	www.west8.nl/js/image.php?i=942

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IMAGE 61 : West 8, Waterfront Public Walkways	www.west8.nl/js/image.php?i=945
IMAGE 62 : West 8, Housing and Retail	www.west8.nl/js/image.php?i=947
IMAGE 63 : West 8, Building and Site Section	www.west8.nl/js/image.php?i=940
IMAGE 64 : West 8, River, Landscape 3D Model	www.west8.nl/js/image.php?i=949
IMAGE 65 : Wetland Metabolizing Process	Melby, Pete and Cathcart, Tom. *Regenerative Design Techniques,* New York: Wiley, 2002, page 306.
IMAGE 66 : Wastewater Wetland in Shanghai Housing	www.pflanzenklaeranlagen.de/english/constructerd-wetlands.html
IMAGE 67 : Flex Development_ Rendering	Edge As Center, http://www.architects.org/emplibrary/55_board1.jpg
IMAGE 68 : Flex Development_ Urban Plan	Edge As Cetner, http://www.architects.org/emplibrary/55_board2.jpg
IMAGE 69 : Flex Development_Diagramic Plan	Edge As Center, http://www.architects.org/emplibrary/55_board1.jpg
IMAGE 70 : The Big Re-Rigy_Perspective	Edge As Center, http://www.architects.org/emplibrary/73b_board1.jpg
IMAGE 71 : The Big Re-Rig_Public Space	Edge As Cetner, http://www.architects.org/emplibrary/73b_board1.jpg
IMAGE 72 : The Big Re-Rig_ 3D Massing Model	Edge As Center, http://www.architects.org/emplibrary/73b_board1.jpg
IMAGE 73 : Tomorrow, Street-side Perspective	Edge As Center, http://www.architects.org/emplibrary/42_board2.jpg
IMAGE 74 : Tomorrow, Ariel Perspective Model	Edge As Center, http://www.architects.org/emplibrary/42_board2.jpg
IMAGE 75 : Site Plan, Alveole 14	LIN, Finn Geipel, Giulia Andi. "*Alveole 14: Transformation of a Submarine Base*" A+U: Architecture and Ubranism, n.12, December, 2007, pg 70.
IMAGE 76 : Front Perspective, Alveole 14	LIN, Finn Geipel, Giulia Andi. "*Alveole 14: Transformation of a Submarine Base*" A+U: Architecture and Ubranism, n.12, December, 2007, pg 70.
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IMAGE 78 : Plan & Lobby Perspective	LIN, Finn Geipel, Giulia Andi. "*Alveole 14: Transformation of a Submarine Base*" A+U: Architecture and Ubranism, n.12, December, 2007, pg 73.
IMAGE 79 : Section through Main Cell Space	LIN, Finn Geipel, Giulia Andi. "*Alveole 14: Transformation of a Submarine Base*" A+U: Architecture and Ubranism, n.12, December, 2007, pg 74.
IMAGE 80 : Interior Street	LIN, Finn Geipel, Giulia Andi. "*Alveole 14: Transformation of a Submarine Base*" A+U: Architecture and Ubranism, n.12, December, 2007, pg 74.
IMAGE 81 : Plan	LIN, Finn Geipel, Giulia Andi. "*Alveole 14: Transformation of a Submarine Base*" A+U: Architecture and Ubranism, n.12, December, 2007, pg 75.
IMAGE 82 : Kalkreise Museum, Approach Perspective	http://eng.archinform.net/projekte/9620.htm
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IMAGE 84 : Kalkreise Museum, Site perspective	http://www.pushpullbar.com/forums/germany/-1031kalkriese-kalkriese-archeological-museum-park-gigon-guyer.html
IMAGE 85 : Hallway View 1	Hubertus, Adam. *"Christian Kerez, House with One Wall, Zurich, Switzerland" A+U: Architecture and Urbanism,"* n.9, p14-23, September, 2007
IMAGE 86 : Hallway View	Hubertus, Adam. *"Christian Kerez, House with One Wall, Zurich, Switzerland" A+U: Architecture and Urbanism,"* n.9, p14-23, September, 2007

IMAGE 87 : Circulation Diagram Model — Hubertus, Adam. *"Christian Kerez, House with One Wall, Zurich, Switzerland" A+U: Architecture and Urbanism,"* n.9, p14-23, September, 2007

IMAGE 88 : Exterior Street View — Hubertus, Adam. *"Christian Kerez, House with One Wall, Zurich, Switzerland" A+U: Architecture and Urbanism,"* n.9, p14-23, September, 2007

IMAGE 89 : Oregon Streetcar — Othoman, *Urban Land*, June 2008, pg 91

IMAGE 90 : Urban Energy Diagram — Stenhouse, Douglas Simms, "Energy Conservations Benefits of High Density Mixed-Use Land Development," pg 50.