Regenerative Architecture

| *Context and Place* |

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Thesis Paper

Thesis Abstract

Architecture is not outside of the laws of nature, yet architects design to do just that; defy the natural cycles and systems of nature. Nature should be seen as the model for everything that can be designed and constructed. Nature has had around 3.8 billion years to perfect itself and its processes. Everything in nature is well adjusted to its context and its through nature's understanding of it's context that it has allowed itself to survive and thrive. Architecture should do the same. Architecture can thrive when it is actively engages the natural environment and addresses the human interaction needed to activate that environment. The natural environment is an equal partner in architecture.

Current standard conventions for addressing this issue are extremely superficial and only scratch the surface. "An open floor plan" and "plentiful windows and curtain walls," among other things, is the way the current convention for connecting the built environment to its natural surroundings functions. This connection is not just about what you can and cannot see or how far removed you feel from development; this connection should be seen as fully immersing yourself into what nature is and what it has to offer, the processes and codes in which nature operates, and how nature sustains itself, now and in the future. This thesis seeks to bring these concepts into the realm of architecture, and by doing so, it will create a better and healthier lifestyle and help people understand and respond to their own context in a new and more fulfilling way.

Introduction / Personal Experience

As a child, my interest for nature and the outdoors was ignited early. The day my sister and I would get out of school for the summer, it seemed my parents would already have several family camping trips planned. These trips were always based somewhere in Michigan, which gave me the opportunity to fully understand what the state's natural landscape had to offer. Michigan summers give many Detroit-area residents the opportunity to travel north on extended weekend trips to get away from the city and spend some time relaxing at the lake house or favorite vacation spot and taking advantage of what the great outdoors have to offer. As a family, our interests were not rooted in one particular place; our interests were based in traveling around and experiencing everything that natural Michigan was. As these trips progressed, I began picking up the hobby of fishing. This hobby was perhaps the best thing that ever happened to me and my interest in nature. I saw fishing as a way to begin to peel back the layers of mystery that exist within the natural landscape. Fishing became the original setting for my inquisition of nature and I began to ask myself questions like “What makes nature work this way?” or “Why does this happen in nature?” As my family grew older, we each had our own responsibilities and weekly routines that made organizing a camping trip near impossible. But my interest in fishing did not stop there. I began using internet mapping sources in combination with writings describing ideal conditions for certain types of wildlife and fish to discover my own ideal fishing settings. These fishing holes were commonly distanced from areas in which human intervention had placed strain or blight upon the natural systems, affecting the chance for successful fishing. As a result, many fishing holes required a long trek through wooded and swampy areas in order to reach a location suitable for my needs. The sense of solitude and exclusivity that these places provided me was something that fueled my natural spirit even further, and I soon picked up the hobby of backpacking. Senior year spring break of high school, two of my good friends and I took a trip to Great Smoky Mountain National Park in Tennessee. During this trip, we camped at one location and traveled around to other areas of the park to fish and day-hike. Even though I knew better, this place made me feel special, like I was the only person to ever explore and experience this setting. In a way, however, this was true; I was in fact the only person to have experienced the park in the very particular and unique way in which I did. I grew intrigued with the idea of going to places in which I felt I was the only person to ever have been there and saw backpacking as a vehicle for achieving this. Backpacking put me at the mercy of the elements and helped me to develop a deep understanding and respect for nature. I learned from natural design and began making things like shelters from natural materials which the earth had given up, eating plants and foods with nutritional value particular to whatever region I was in, and even learned how to predict where and when I might be able to spot fauna given the geographic and floral conditions of the context.

Issues With Standard Conventions

Through my experiences, I have learned to adapt with nature rather than defy it. I have learned that a connection with nature is far more complex and less understood than what we perceive as architects. As designers, we love to think that a more transparent building envelope helps to bring the natural surrounding into interior spaces. The idea is that if we can see the natural surrounding within constructed space, then that constructed space becomes closer and more connected with it. While this may, to a degree, be accurate, it only scratches the surface about what a connection to nature truly is. When constructed space starts to actively engage and flirt with tendencies of the natural world, an architecture that is more responsive to and understanding of nature begins to arise.

All systems on earth (plant, animal, and shelter, among others) rely on natural processes to survive and thrive. Not one plant, animal, or shelter is apart from or without nature. This concept can be explored by asking, “What is a tree without its context?” The substance that physically composes a tree is the fibrous material of the roots, trunk, branches, stems, and leaves. But what are any of those things without their context? Roots take hold in soil or on rocks and anchor the tree. The trunk transports water and nutrients collected through the roots. Branches extend away from the trunk to put leaves and fruit in a position to absorb energy from the sun. Leaves and fruit fall to the ground, giving away nutrients and allowing the tree to reproduce. Take away any part of the trees context and the tree becomes something entirely different; a stick. It is through the tree's deep understanding of and adaptation to its environment that it is able to exist.

All environments can be classified under one of the many biomes found on earth. Plants and animals indigenous to each biome are well suited and adapted to the conditions their environments hand them. For the most part, architecture seems not to follow the guidelines and instructions that the context gives them. It is fair to say that a vast majority of any built environment could be picked up and relocated to another environment and function in the same manner as it once did in its old environment. William McDonough and Michael Braungart, environmental enthusiasts concerned with many aspects of environmentalism within the design community, recognize this problem and state that we need “to become native to each place.” Every environment has its own unique set of conditions that architecture does not account for. Modern architecture forgets its real place, relying on nonrenewable and unsustainable sources of energy, as well as technological advances in machinery and building to make the design work in any place.

The concept of sustainability and environmentally friendly design bring about a common belief, or perhaps a common stigma that taking an environmental approach means using less of the things we rely on and trust. This feeling brings about a sense of regression and that environmental friendliness is suggesting we return to an earlier time with less amenities and services at our disposal. While this would be an approach that could

potentially alleviate some of our problems, it is not likely that very many people, if any, would agree to returning to a more primitive state of civilization. We have the technology and intelligence to allow our societies to advance and stabilize while still protecting, even helping the natural landscape. Rather than regressing, we should use this knowledge and all of the tools at our disposal to develop an architecture that will be more successful in considering how to respond to context and nature.

Advantages of a Natural Approach

Advantages to be had with a more contextual and connected-to-nature design approach range from material things to social and cultural relationships. Advantages also materialize at all different scales, from advantages as a nation to advantages in one single suburban residence. Karlson Hargroves and Michael Harrison Smith, authors of the book titled *The Natural Advantage of Nations*, discuss how concentrating design and business efforts on sustainable practices can positively affect the environment and economy simultaneously. Hargroves and Smith state that, “since environmental amenity is a superior good, the demand for pollution control is likely to increase and there is, therefore, a considerable advantage to an economy to have the technical and production capacity to produce low-polluting goods of pollution control technology.” Across the globe, economies are seeing a concentration on goods and services that make attempts to limit pollution and to help protect the environment. Hargroves and Smith recognize this not like a fashion trend similar to a teenager who desires the newest popular pair of tennis shoes that in a few months will be out of style, but rather a trend that will be the basis for establishing business and design practices for all in the future to come. A large majority of the resources we rely on in modern society are finite; these resources will not sustain the world forever. There will be considerable advantages to anyone who recognizes the necessity for environmental goods and services. Hargroves and Smith define social progress in regards to environmentalism and sustainability at two different scales:

Sustainable Genuine Progress = progress that genuinely sustains and improves economic, social and environmental well-being with no major trade-offs, locally and globally, now and in the future.

Natural Advantage of Nations = the multiple advantages a nation can achieve through a whole-of-society approach to the pursuit of sustainable genuine process.

Architects and designers alike could begin to focus their efforts on achieving sustainable genuine progress. Economic, social, and environmental factors drive every aspect of progress. Ignoring any one of these factors will breed only unsuccessful designs, now and in the future. The key aspect designers need to remember when setting sustainable genuine progress as the end goal is there cannot be any major trade-offs. Economic and social factors cannot be strengthened while weakening environmental factors. Economic and environmental factors cannot be strengthened while weakening social factors, and so on. All three of

these factors need to be equally considered and equally designed for. While this thesis concentrates largely on efforts to connect architecture to nature, it cannot come at the cost of lessening valuable relationships between people or large monetary losses.

Designs that connect architecture to nature redirect the source in which constructed space receives economic support. Nature produces a surplus of all the materials it needs to maintain itself. The leaves and fruit that fall from a tree partially fuel the tree, but they also fuel other plants and animals. The tree also relies on other plants and animals for some fuels and sometimes for processes of reproduction. The tree is just one piece of an economically mutualistic system. The tree can survive on its own, but in order to thrive and reproduce, it must have help from outside sources within the same economically mutualistic system. Architecture should function in the same manner and look to nature to be that outside source in which it receives help.

Architectural Natural Selection

If you think of nature as a single object, consider that nature has had around 3.8 billion years to perfect itself and its connections. Nature has established the most efficient ways to fuel and maintain itself, as well as develop new ways of doing things. Animals and plants in nature must interact with one another in order to develop an understanding that will provide solutions as to how to adapt and grow in the environment they are handed. Charles Darwin's theory of natural selection discusses this contextual phenomenon. In Nature, organisms of the same species have a level of variance that allows for organisms with a particular variance to survive. Two of the same species of animal may be able to run at different speeds, allowing one to escape predators more easily than the other. The faster animal, over a longer period of time, will be more likely to survive. Small genetic variations may account for these differences and these genetic differences can be passed on to offspring when the animal reproduces. These genetic differences may be so small in size that they may seem negligible in making a difference over the life span of the entire species. This is similar to how one may feel that their vote in a presidential election cannot make a difference in the end result of an election. Over time, these differences will compile and they will pose a measurable and significant change. Animals with stronger traits will have a greater chance for survival and they will pass these traits along to their offspring, while animals with weaker traits will begin to disappear, leaving only the strong traits available in the genetic pool of nature.

Traits that make an organism distinct are separated into the categories of genotypes and phenotypes. The difference between these two categories provides the key understanding element that will bring architecture and nature closer together. An organism's genotype is said to simply be its entire genetic make up; its genetic organizational pattern carrying the organism's hereditary information. The phenotype is categorized as the physical composition of an organism's genes; the observed

visual end result. Organisms with the same genotype (human identical twins) have the same genetic organizational pattern, yet they may not express the same physical observed end result. Phenotypes often carry traits such as morphology, behavior, and development, which differ even in the case of human identical twins. Imagine two identical piles of bricks and the required materials needed to make mortar for the bricks. One pile is built using conventions for masonry assembly in which there is the standard amount of mortar between each brick. The other pile, using the same materials, is built using either an excessive or insufficient amount of mortar between each brick. The standard wall's genetic make-up is very different from that of the incorrectly constructed wall. The two walls will also behave and develop very differently. These changes are changes in the genotype of that brick wall that will have a measurable and significant impression on the phenotype of the wall.

In nature, changes to genetic information in organisms requires a natural and drawn-out process in which organisms react to stimuli in their environments and over time they adapt to fit those environments. This process cannot be halted or accelerated at the will of any one organism. Architecture, however, can. Unlike organisms in nature, designers have the ability to alter the genotype of the architecture they create. Architects have the power to decide how their designs will function, what they will be constructed of, how they will respond to their context, and even who will use their designs. The phenotypes of architecture are constantly changing and developing. New products join the market everyday, offering architects and developers new and improved ways of accomplishing the same end goal. It is not through the consideration of new materials and products that architects will find the solution to missing connection between architecture and nature, but rather in the very way in which architecture is conceived, its underlying principles and ideas; architecture's genotype.

The genetic organizational patterns found in current conventions of architectural design must adapt to allow a more fluent and active role of nature within constructed space. Nature must play an active role in the survival of architecture, and architecture must play an active role in the survival of nature. Human beings and the things we construct are not outside of the laws of nature. We must grow smarter with our designs and integrate into and become part of nature. We are all part of the Darwin's theory of natural selection. If you consider that over time, human beings have grown in intelligence and that we now have an extensive amount of knowledge about what we are and are not able to construct, we have indeed adapted to fit into this world. However, adaptation and natural selection are not linear; they do not have an end. The process is cyclical and it will always continue to adapt and grow. Architecture is now at the point where the next level of adaptation will be to integrate more fully with nature and be more connected with what nature has to offer. The world is facing an energy crisis. Many of the sources of energy we rely on today are in jeopardy of being completely exhausted. New designs that connect to nature will be

able to adapt and learn how to accomplish the same goals given different inputs. These designs have stronger traits that over time, will drown out and suffocate traits of older, less efficient designs.

Power in Numbers

Fiona Wain states, "'How can we encourage the whole of society to be involved? How can we encourage this shift so as to create increased markets for environmentally sound products?' One avenue is public procurement." Wain, an environmental enthusiast and CEO of Environmental Business Australia, suggests that perhaps public procurement may be one avenue to achieve goals of environmental sustainability. When people come together they can achieve great things. The same can be true with environmental issues. When people come together they feel a sense of empowerment and that as a group, not just a collection of individuals, they can achieve goals that might otherwise seem out of reach. Like individual votes in a presidential election, one vote seems to make less of a difference than the sum of all similar votes. The goal of connecting architecture to nature is one in which a collective group ideology will be necessary. As a group, people will feel a stronger sense of making a difference and we will see a noticeable change. Group engagement will be a key component in the success of an architecture more connected with nature.

An Unforgiving Nature

Nature has a way of dictating architecture. Designers and architects need to be responsive to the climate region and environment their designs will be used in as to avoid significant damage from natural disasters. Designers can only design to accommodate the powers of natural disasters as much as physically possible given restrictions in material strength and structural stability. Eventually, every structure will encounter a natural force that is stronger than what can be anticipated. Natural disasters are forces that cannot be fully predicted or be entirely accounted for in design. Architects can, however, take into account all aspects of the threats an environment can pose on constructed space and plan to deal with those threats in the most appropriate manner possible.

The position of who is in power between man and nature is evident in architecture exposed to extreme natural forces. It should be evident that nature has the ultimate judgment on whether or not the architecture is able to survive when certain forces are in play. While it may be true that the best way to avoid damage from natural forces would be to avoid construction in any area with strong natural forces, this is not an option. Extreme heat or cold, rain, snow, ice, flooding, and powerful winds are natural, inescapable forces found in nearly every environment on earth. Coastal architecture is designed to accommodate the threats of flooding and hurricane/tsunami damage, while architecture of the United State great plains accommodates the threats tornadoes may pose. Architecture found in the pacific northwest United States must take into consideration how the very damp and wet climate will impact moisture and mold production in the

building envelopes. The question then should not be how to avoid coming in contact with any of these abrasive forces, but rather how to design to accommodate these forces in the most appropriate manner possible.

Regenerative Architecture as the Vehicle

Regenerative architecture may be the most appropriate vehicle to achieving an architecture that is more connected and responsive to nature. Regenerative architecture can be defined as all of the following:

1. The rejection of a linear input-output model;
2. a responsible model to build our environments in order to promote a thorough and meaningful relationship between people and place;
3. a model to actively heal and serve the environment;
4. a model matching technology to need; and,
5. a model that lets nature do the work.

This type of architecture works hand-in-hand with nature to blur the lines that separate architecture from nature. It invites the natural environment into constructed space where it uses natural processes to aid the design and aid the processes associated with the design. Regenerative architecture can help to restore such things as food, water, energy, cultural richness, sense of community, and social interactions. It allows for the architecture to adapt to and evolve with the environment much like organisms in the natural world would.

The regenerative model rejects standard systems that have a constant waste stream. Many of the systems designed today do not realize the potential that a waste stream can have. In nature, waste from one organism or system is almost always used as fuel for another organism or system. In the case of the tree, fallen leaves, fruit, and branches provide some sort of energy source for other plants and animals. Some of it may be composted, returning its nutrients to the soil and some of it may be taken by an animal to use as food or even as a source of shelter. The energy flows in nature never end in one particular place; they go on to provide energy somewhere else. Waste from architecture can be taken to provide fuel for nature, and vice versa. Regenerative architecture connects the energy flows of nature to those of architecture.

Conclusion

Nature should be seen as the model for architecture. Nature is an extremely efficient, self-reliant, regenerative system that has a so much to teach the profession of architecture. The systems, organisms, and processes found in the natural world hold the key that will show designers how to develop more resilient solutions to the problems we face today. Everything in the natural world is contextual to the point that without its context, it would not survive. Context is essential to the understanding of how to survive and adapt for future survival. Architecture can be viewed as any one organism within Charles Darwin's natural selection theory; if it does not find more efficient ways to accomplish its goals and tasks, it will be left to be overtaken

by another more dominant organism. Architecture must adapt. That adaptation will come through the integration of regenerative design in the realm of architecture. Regenerative architecture will keep constructed space functioning in the proper manner while also helping the environment to thrive. Regenerative architecture will bring people together so that they can live in harmony with nature, not against it. As Henry David Thoreau famously put it, “in wilderness is the preservation of the world.”

Site Analysis

City Selection

Site selection was initially rooted in personal interest. Cities were selected based upon a subjective mental ranking system as places most condusive to future career opportunities and personally motivated self-interests.

Cities considered:

Ann Arbor, MI
Atlanta, GA
Austin, TX
Boston-Cambridge, MA
Boulder, CO
Chicago, IL
Denver, CO
Eugene, OR
Huntsville, AL
Lexington, KY
Madison, WI
Minneapolis, MN
Portland, OR
San Francisco, CA
Seattle, WA
Syracuse, NY
Tulsa, OK

Selection Criteria

Upon further consideration and analysis, these cities were narrowed down to a final group of eight. The final group would then be subjected to a more objective set of critieria. This second round of criteria analysis would allow for a more stable and, at the time, more relevant way to decide upon a final location for the project.

Criteria considered:

MSA population	[http://www.kiplinger.com/tools/bestcities_sort/index.php?sortby=name&sortorder=ASC]
Daytime population change	[www.city-data.com]
Cost of living	[http://www.kiplinger.com/tools/bestcities_sort/index.php?sortby=name&sortorder=ASC]
Income growth	[http://www.kiplinger.com/tools/bestcities_sort/index.php?sortby=name&sortorder=ASC]
Average employee wages	[http://www.bls.gov/oes/current/oes_42660.htm]
Percentage of workforce in creative jobs	[http://www.kiplinger.com/tools/bestcities_sort/index.php?sortby=name&sortorder=ASC]
Education levels	[www.city-data.com]
City, county, and state unemployment	[http://www.bls.gov/web/metro/laummtrk.htm]
Universities in proximity	[www.city-data.com]
Real GDP statistics	[http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=2]
Green/sustainable factors and policies	[various sources]

	Austin	Boston/ Cambridge	Boulder	Denver	Eugene	Portland	San Francisco	Seattle
MSA population:	1,705,075	4,588,680	303,482	2,554,474	351,109	2,241,913	4,317,853	3,407,848
Daily Workforce Immigration:	+16%	+42%	+37%	+26%	+14%	+21%	+21%	+26%
Economic Efficiency:	$57,755 per capita UP	$62,395 per capita UP	$57,755 per capita FLAT	$56,706 per capita FLAT	$29,488 per capita DOWN	$54,481 per capita UP	$68,008 per capita DOWN	$60,589 per capita UP
Educational Institutions:	Great	Best	Great	Good	Great	Fair	Good	Good
Unemployment:								
Cost of Living Index:	93	100	100	106	108	111	164	120
Public Transportation:	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Fair
Creative in Workforce:	34.40%	41.21%	44.41%	37.55%	31.13%	34.15%	39.39%	37.68%

While this analysis proved useful as a way to objectively choose a site based upon concrete and undisputable facts, it was not entirely necessary for this thesis. There is a level of fact and truth based analysis to every thesis, and there is also a level of opinion and subjectivity. Opinion and subjectivity allow for a thesis to retain a certain level of interest and richness and help it not to go stale, much as a thesis with all fact and no opinion would do. The way this information was ultimately used was to provide the base for another final level of subjective personal opinion to narrow the choices down to one city.

Of the many criteria applied to each city, one of the most influential criteria considered was the percentage of creative persons in the workforce. This stat brought to light which of the cities would potentially be more open minded to new concepts and ideas and which city might respond to and adopt this thesis' proposal the best.

The most important objective criteria considered was the level and number of collegiate institutions in and around the city. The college culture and atmosphere is one that generally best utilizes public and civic functions and easily adapts to new programs of architecture.

Boulder, Colorado

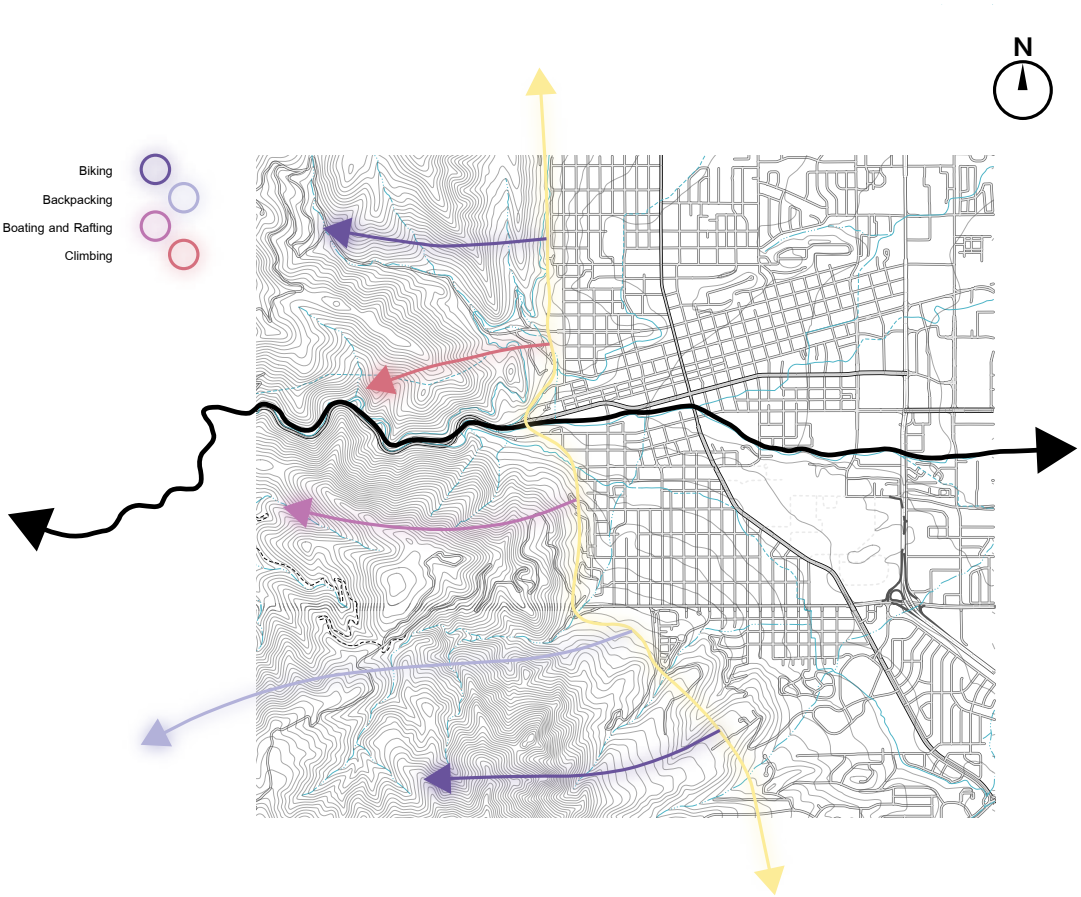
Boulder posted the best results for both the objective statistical criteria and the subjective personal criteria. The city has a large percentage of the workforce in the creative sector, which would make this a place in which a new or adapted program type could be fully utilized.

Boulder has a very progressive attitude towards nature and the outdoors, and always looks to preserve them. A reported 90% of residents recycle and separate their trash. This is a very large number, and it shows the dedication of the city as a whole to preserving and protecting the natural world.

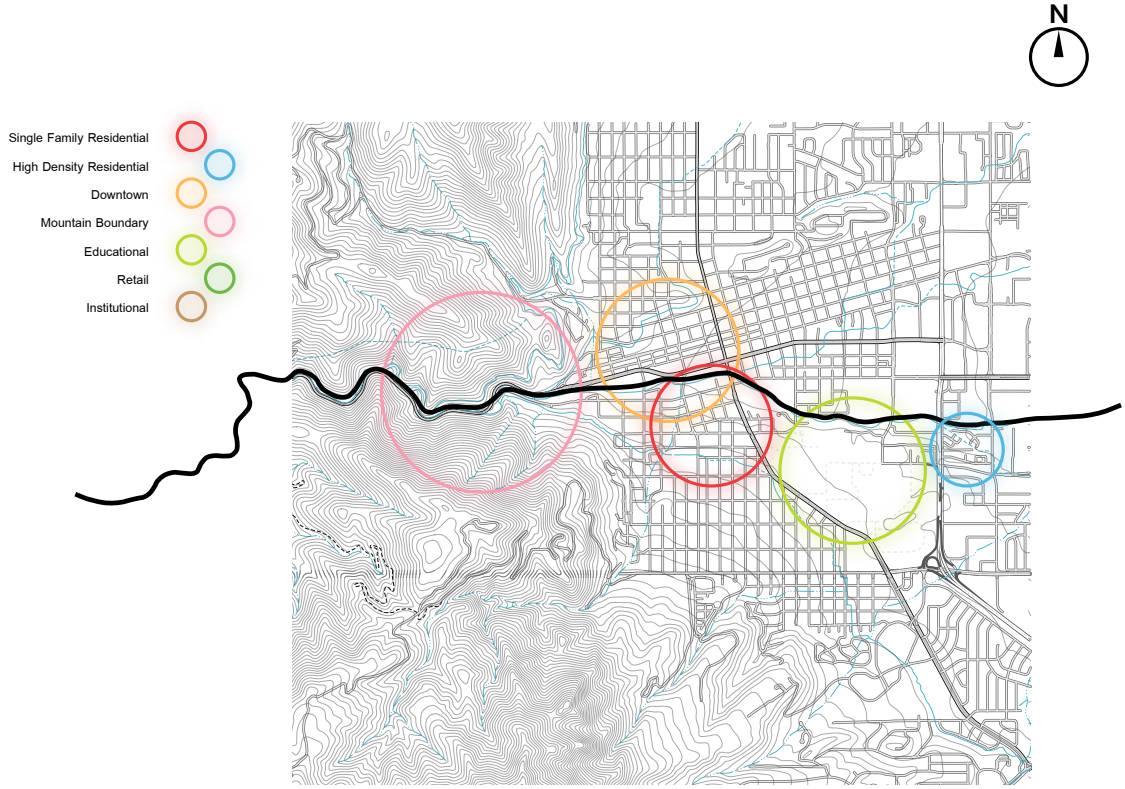
The city also has an elevation restriction on utility meters. Above a certain elevation, the city will no longer install utility meters on new construction. This is an attempt that has proven very successful in limiting the amount of environmental destruction of the high mountain elevations.

The city is very welcoming. With a population of just under 100,000 people, Boulder offers that small mountain town feeling, but has all of the amenities of a large urban city. There are small shops located in the downtown district, as well as the large “big-box” stores outside of the downtown area. Although these large chain stores are close to all residents of the city, many of the residents would prefer to shop and eat at the smaller “mom and pop” establishments in the city. There is a strong sense and feeling of community in this city, and residents are always working toward strengthening this feeling. This city is also a college town; the University of Colorado is at the core of the city, and is largely responsible for many of the businesses and services provided. Students use public transportation frequently. Boulder is one of the most walkable cities in America and is regularly ranked among the top bicycle friendly cities as well.


GO BUFFS!
COLORADO



Boulder has consistently been ranked as the #1 healthiest and most active cities in the United States by several different sources. The city is at the foothills of the Rocky Mountains, which allows for every resident to stay connected to outdoor sports and activities. This opportunity is almost always taken advantage of, and Boulder residents regularly enjoy these outdoor sports and activities all year long. The city is among the sunniest cities in the United States, according to many different sources, which affords its residents a general feeling of motivation and desire to get outdoors and see what the scenery has to offer. A large percentage of the population enjoys winter sports activities, like snowboarding and skiing, as well as summer sports like fishing, biking, boating, climbing and backpacking.



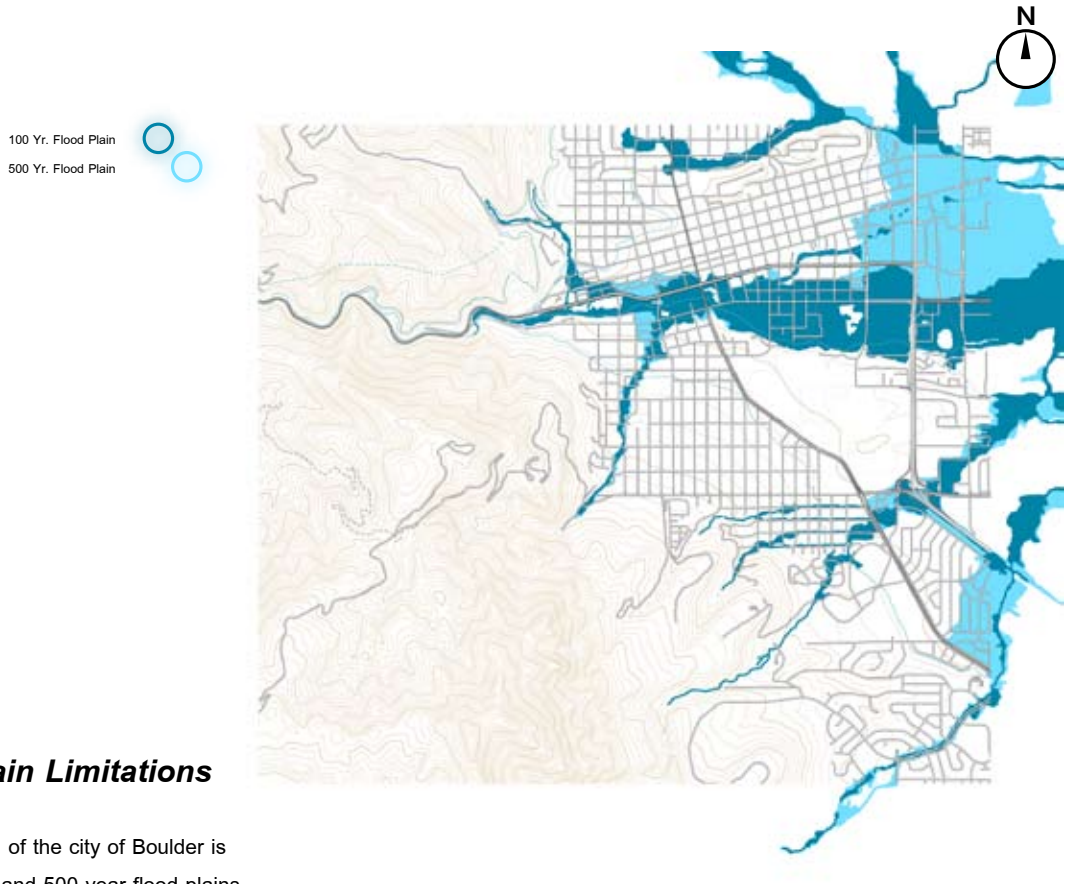
The main artery that links all of these outdoor sports and activities is the Boulder Creek pathway. This pathway runs along Boulder Creek. At times the path is directly adjacent to the creek and other times the pathway is located a short distance away from the creek. The pathway is enjoyed by the vast majority of the city residents. This pedestrian "highway" allows for people located in all of the different areas of the city to be brought together and provided the opportunity to enjoy the same outdoor amenities. This pathway is perhaps the single most important pathway within the city of Boulder. Although the city is built on nature and the scenic landscape, ultimately it still is a city, and pathways like these allow for residents to take time away from that city and enjoy the natural landscape.

19th Street looking south
toward Green Mountain.
(1894 100-Year Flood)

17th Street looking east
(1894 100-Year Flood)

19th Street looking east
(1894 100-Year Flood)

18th Street looking south-east
(1894 100-Year Flood)



Flood Plain Limitations

A large portion of the city of Boulder is under the 100 and 500 year flood plains. This presents an interesting and problematic condition for all design and construction within these areas. In some cases, construction is not permitted and in some areas construction is allowed under very specific and stringent rules.

This thesis is not focused on the full effects and issues of the floodplain. Design challenges are taken into consideration during the process; however, the full responsibility of these water issues will be left to the client or owner of the project, as they will fully determine what precautions must be taken and what the limitations to construction are. These decisions will have an effect on what ultimately will be constructed on the site.

University of Colorado

The University of Colorado at Boulder is the nucleus campus of the University of Colorado. This public research institution has an enrollment close to 30,000 students. This campus is set in the heart of Boulder, at the foothills of the Rocky Mountains.

This university is constantly at the top of collegiate rankings, for many different reasons. CU, as many of its students call it, is a leading research institution for astronomy and other sciences. Many machines and tools used in the study of astronomy and aerospace have come out of or come through the university.

This university is also one with a reputation for fun. It is commonly ranked as one of the most fun party schools in the country. This is an interesting mixture of rankings to have, as it shows how these students are able to perform well with academics, but also make time for life's pleasures and enjoyments.

The architecture for the main core of campus is very homogenous. All of the buildings are done in what is referred to as "Tuscan vernacular revival" style. This style was developed by architect Charles Klauder. He developed this style for the whole university in response to the college Gothic style so many universities were displaying. This Tuscan style took advantage of local sandstone for the walls of buildings, red clay tiles for the roof, and Indiana limestone for the buildings' trim. This rugged style allows the campus to blend aesthetically with its surroundings; these materials fit well within a western style university. After a meeting held with Paul Leef, CU's Campus Architect and Director of Planning, Design, and Construction, it was clear that this style is required of new construction within the core of the established campus, but further away from that core, style and aesthetic preference is left to be decided by the designer.

Meeting with Paul Leef

To have extensive first-hand research of the city and the university, a road trip was taken to the city of Boulder. Prior to the trip, a meeting with the Campus Architect and Director of Planning, Design, and Construction, Paul Leef, was scheduled. This was an informative meeting to get more information from Paul about the university, the campus and its architecture, and the city of Boulder.

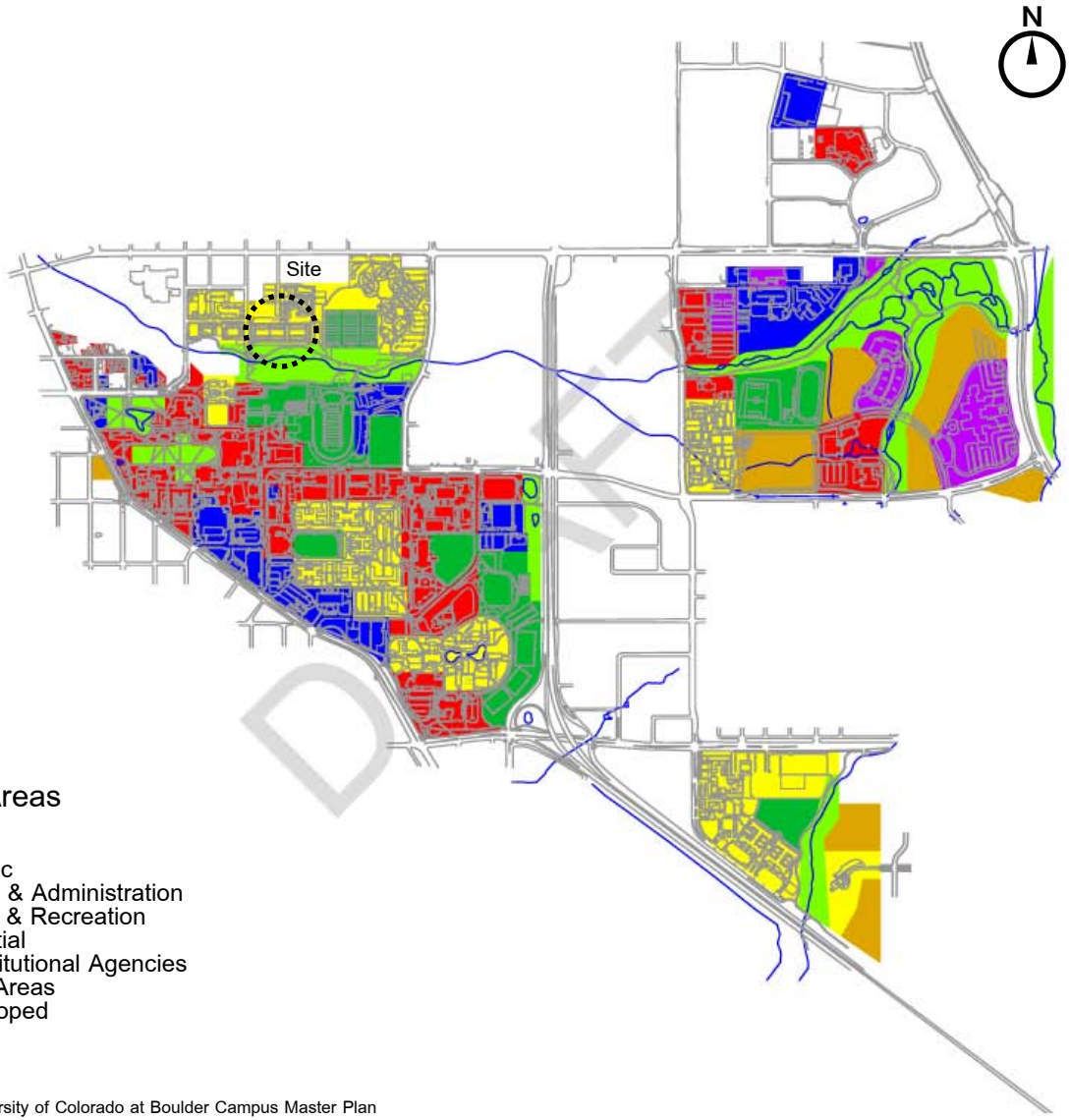
The university has very high expectations for all new construction on campus. The buildings must all meet LEED™ Gold+ (the + is extra criteria apart from the LEED™ system that the university requires). The university is very concerned with the entire life cycle of its buildings, and carefully takes into consideration what a building's program and use might be like today, as well as 10 years from today. This particular campus is very receptive and able to adapt easily to new programs.

Of the many things discussed, the issue of family and graduate housing was stressed. Paul provided information as to where these units are and an approximate number of how many of each of these units there are. One area that began to show promise is the area called North of Boulder Creek. This area is the main location for these family and graduate residences. The building stock has grown to a condition which the university claims is beyond repair. The vast majority of these buildings have major issues with asbestos, insulation, and structural integrity. Even with extensive renovation, these buildings could not attain the level of efficiency, LEED™ Gold +, for which the university requires. This area became of particular interest to this thesis, and was ultimately the deciding factor in determining a location and program for the project. The site chosen is the Athens Court apartments, located at 19th Street and Athens Street, south of Arapahoe Ave.

Programmatic Conclusion

At the conclusion of this meeting, both a project site and program were selected. Although there are several interesting design challenges one might consider to be difficult, the North of Boulder Creek area has great potential, and should be taken advantage of and exploited.

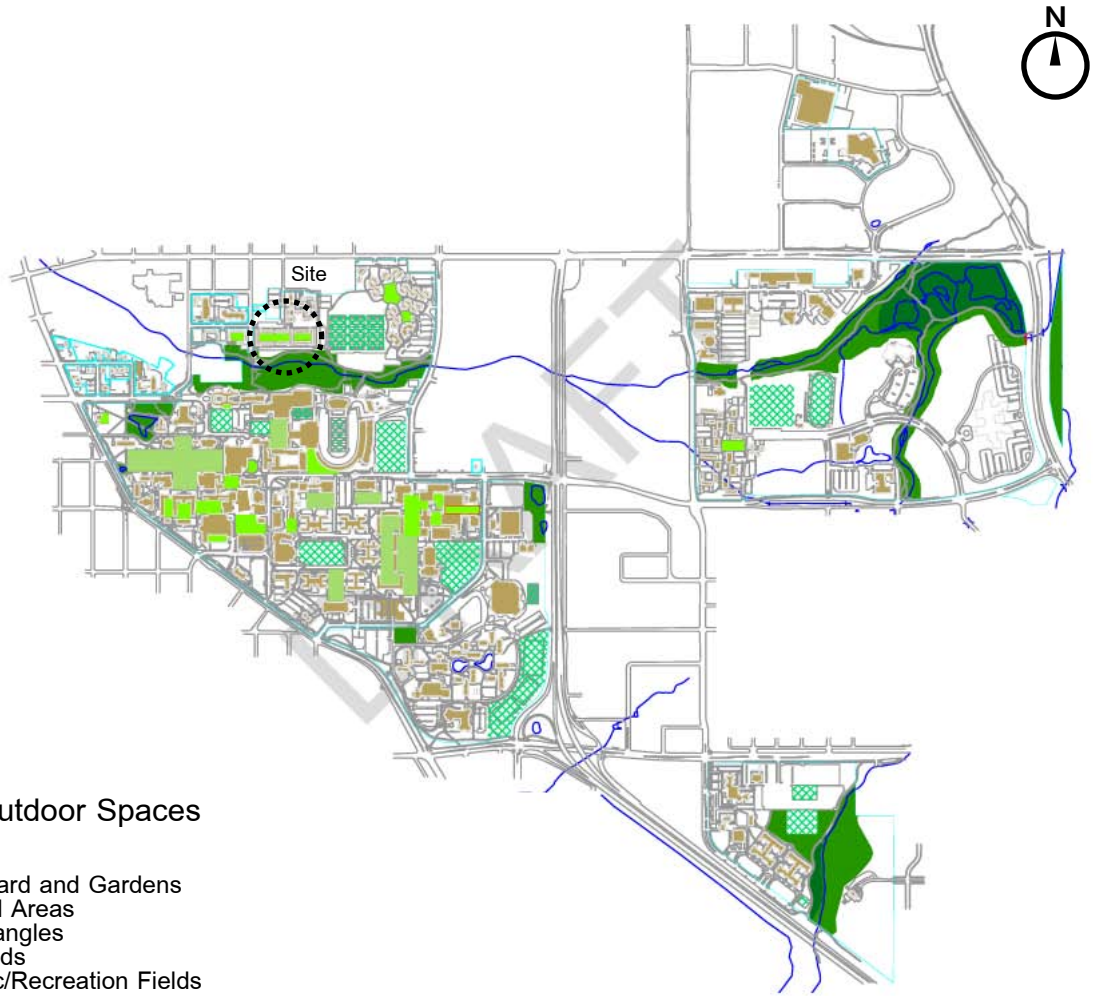
Paul regularly stressed the importance of and value to which family and graduate housing brings to the university; a family and graduate student housing community will be the program for this project. This program is one that will be open to additional program, if deemed necessary during the process.



Land Use Areas

- Academic
- Services & Administration
- Athletics & Recreation
- Residential
- Non-Institutional Agencies
- Natural Areas
- Undeveloped

Maps from the University of Colorado at Boulder Campus Master Plan
*Property of the University of Colorado



Existing Outdoor Spaces

- Courtyard and Gardens
- Natural Areas
- Quadrangles
- Wetlands
- Athletic/Recreation Fields

Maps from the University of Colorado at Boulder Campus Master Plan
*Property of the University of Colorado


FARRAND FIELD

Project Site - Athens Court Apartments

The urgency of this site became apparent after the meeting with Paul Leef. This site has the potential to become the central hub for family and graduate housing as this area becomes reconstructed in the years to come.

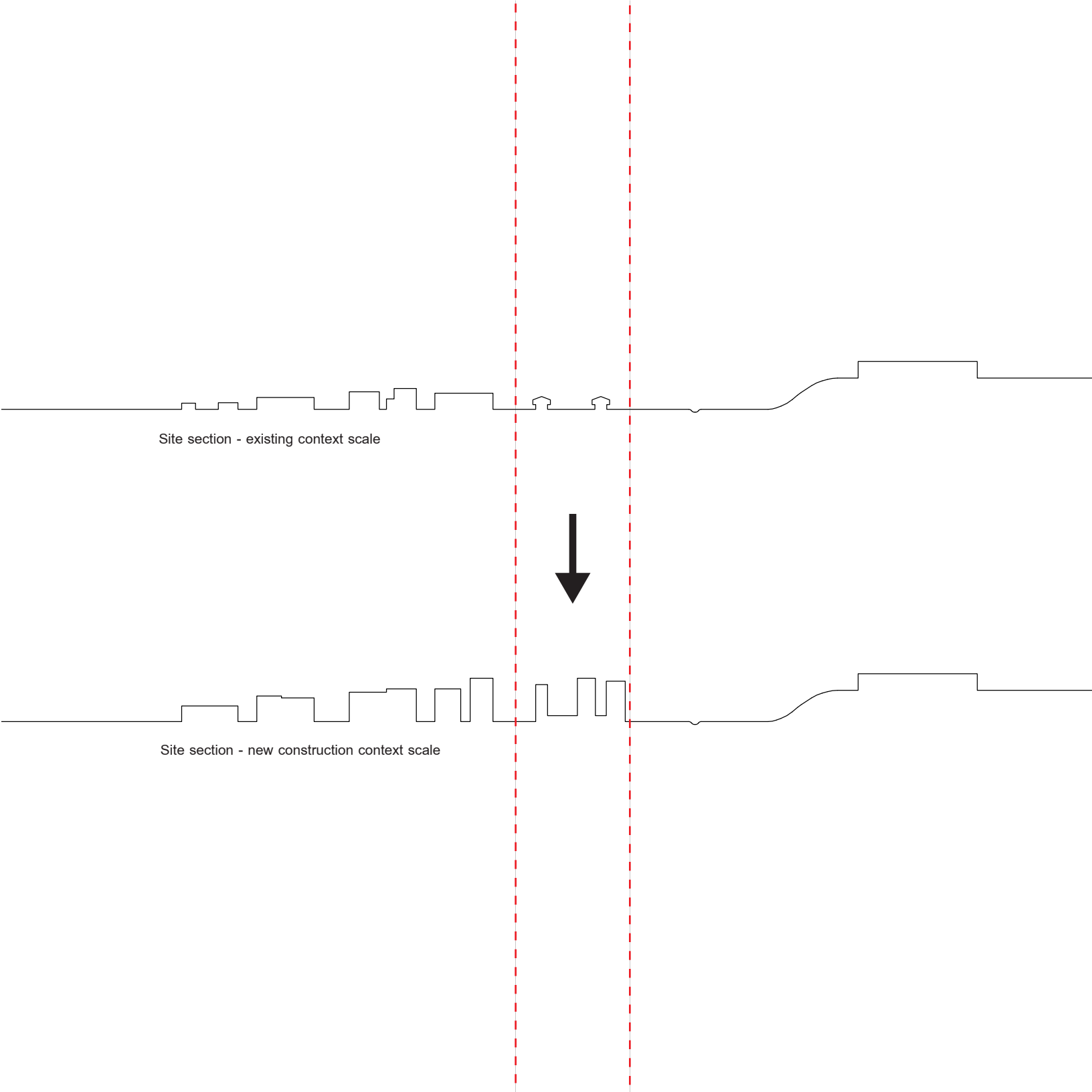
In its present state, there are 116 apartments on site:

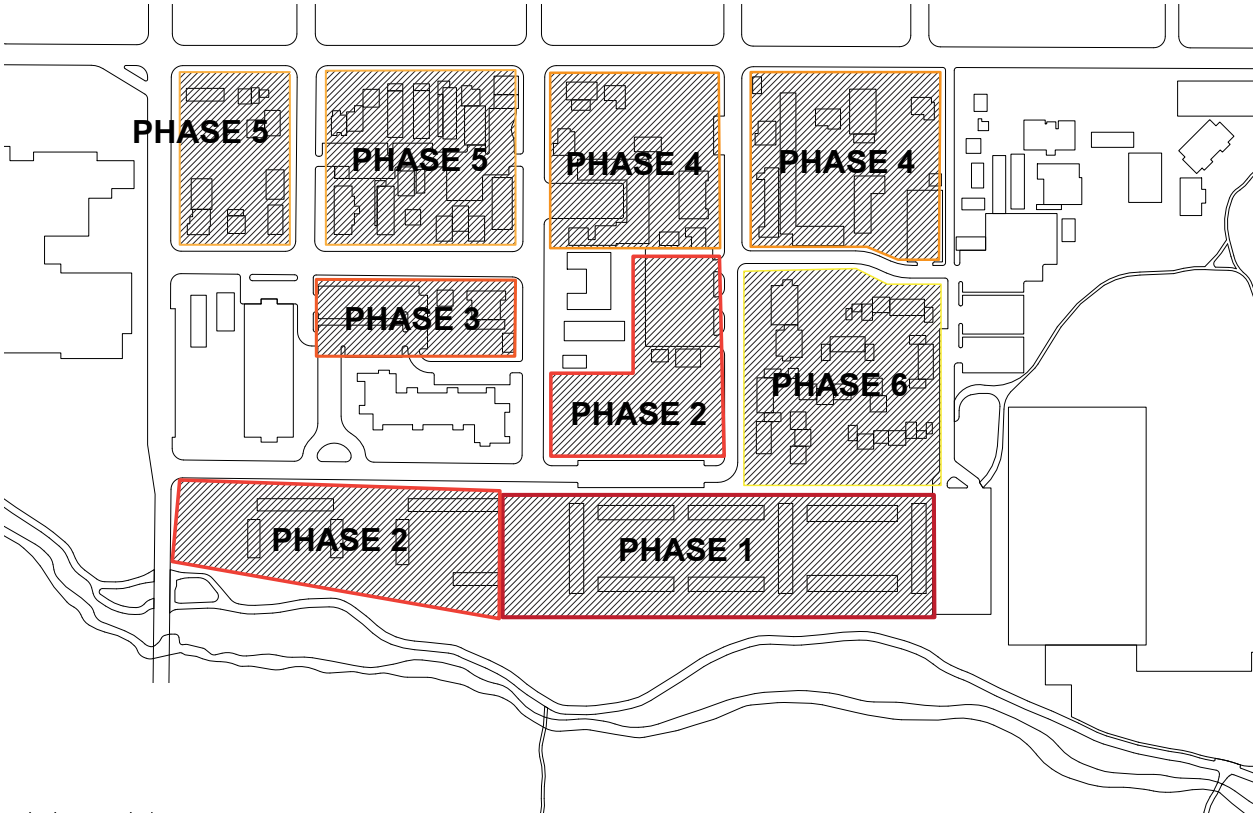
48 Studio Apartments
36 1-Bedroom Apartments
32 2-Bedroom Apartments

These buildings cover an area of approximately 97,650 square feet, giving each an area of about 842 square feet each. At the ground level, this number is within a reasonable density needed to achieve a high density community. There is, however, an inadequate number of apartments on site, if the site is to follow the wishes of a much higher density community as discussed by Paul Leef and in the campus master plan.

In order for this site to obtain a much higher density and be able to support more apartments, the scale of the new construction will need to expand vertically.

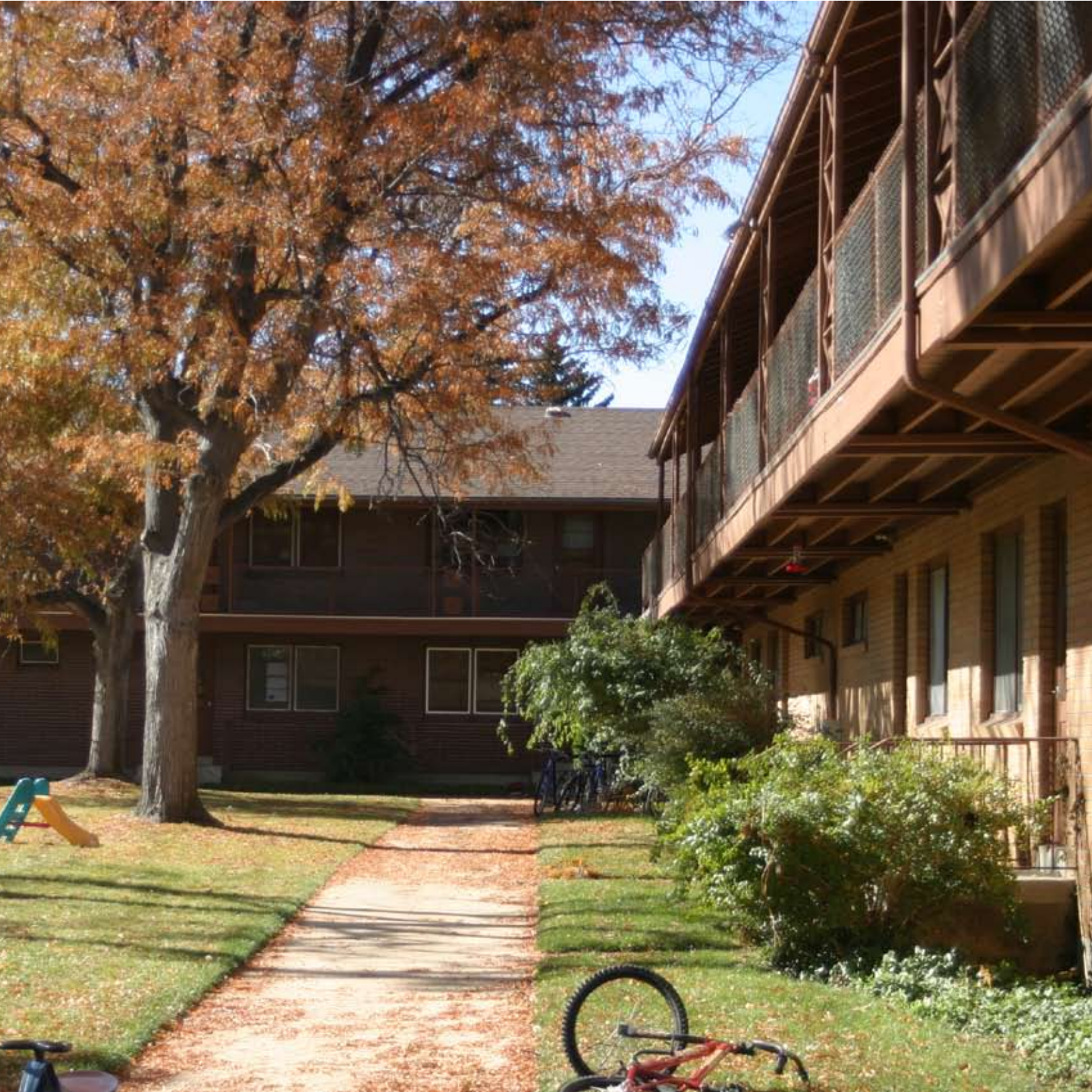
This conclusion raises the question of whether or not the vertical expansion of new construction will be appropriate to the surrounding context. Currently, the building with the largest vertical height in the surrounding context measures approximately 40 feet, compared to the approximate 22 feet of the current Athens Court apartments on site. While this may not seem like a significant difference, new construction will include an increased variety of programs on site, as well as a strategy for the mitigation of the floodplain the site is within. The factors considered, new construction height will be much greater.

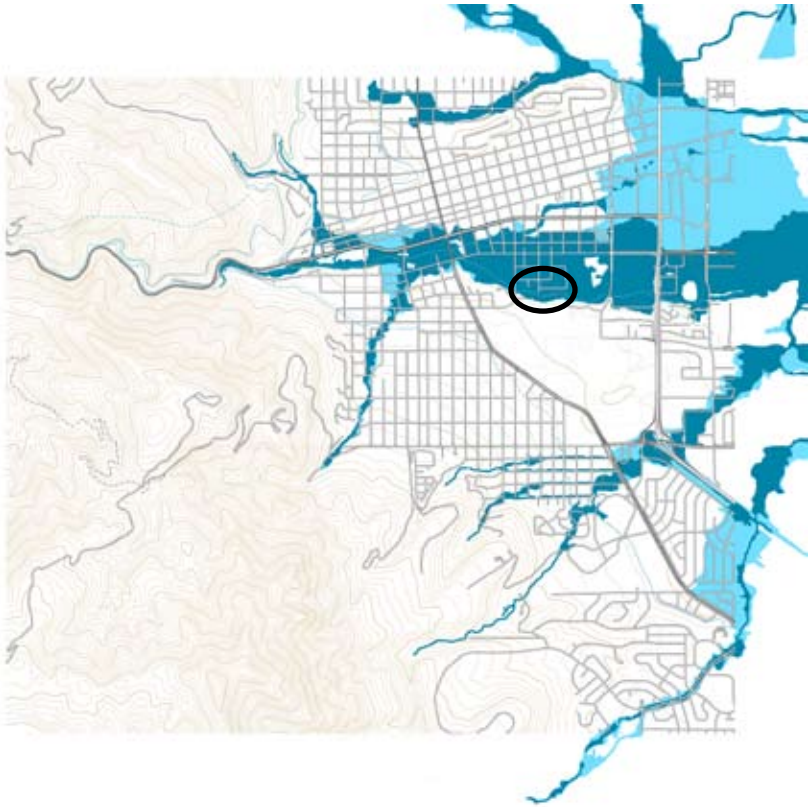

Site section - existing context scale
Site section - new construction context scale



15-Year high density plan for the North of Boulder Creek area. Sites will be phased out to allow the maximum amount of residents to remain in their apartments during construction.

*The images that succeed display the Athens Court apartments and context.





Project Site - Floodplain Mitigation

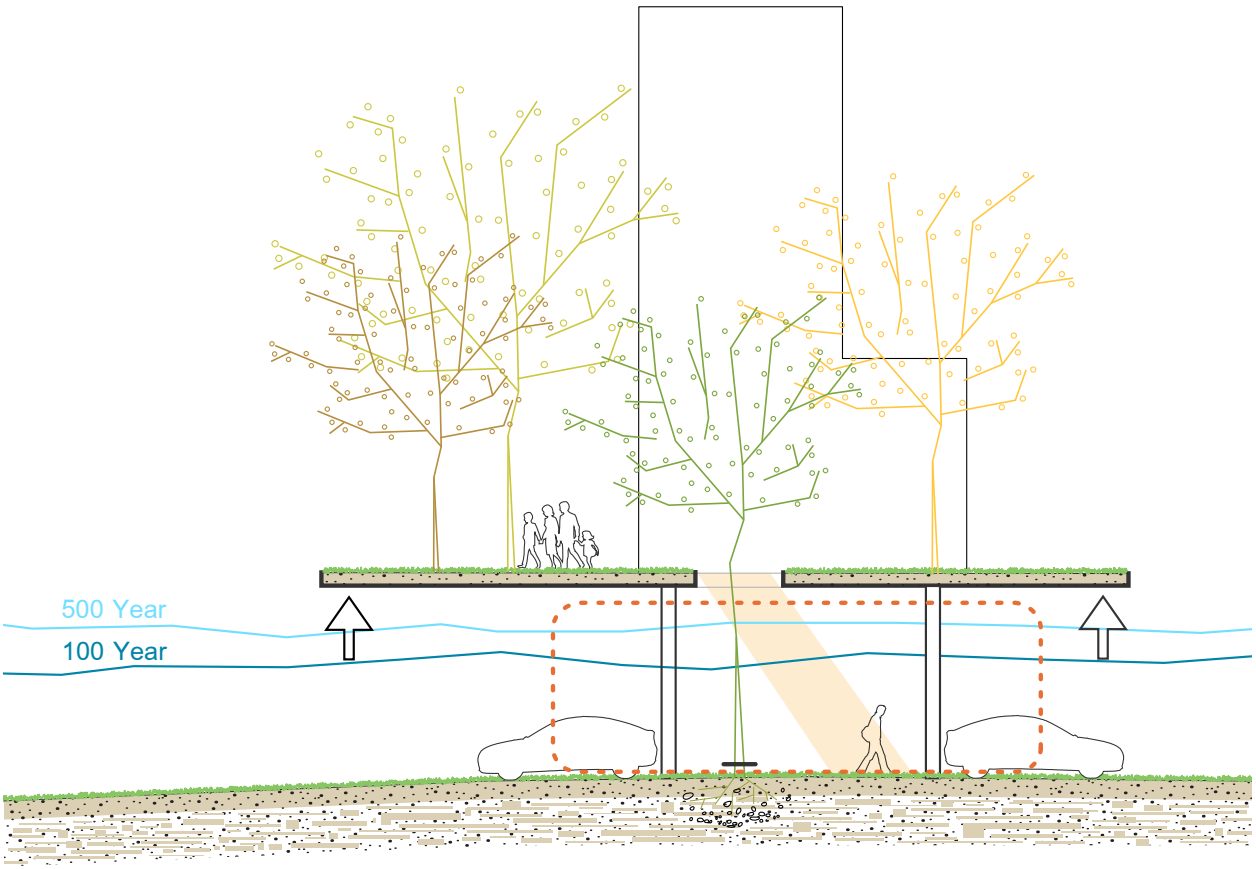
The project site, and nearly all of the area designated as family and graduate housing, is located with both the 100 and 500 year floodplain. A large majority of the city, with the exception of most of campus is also within this floodplain.

Boulder is at the base of the Rocky Mountain foothills, which makes the general attitude about flooding more relaxed. Flooding in this region is inevitable; due to snow melt and rain showers, foothill regions across the globe regularly experience high water levels and flooding. This attitude allows for construction to still occur in these areas.

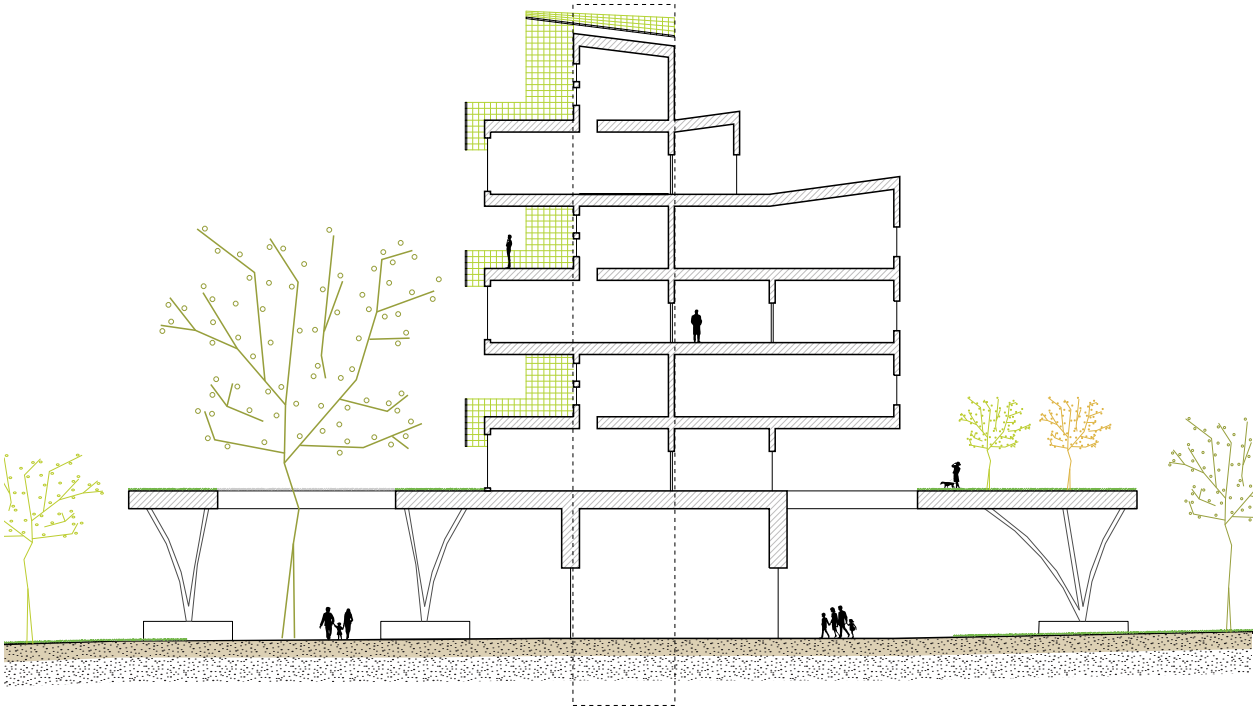
The attitude is similar to that of southern coastal lands; hurricanes are inevitable in these regions, but new construction is not prohibited. Construction must take into account these natural forces and do its best to dampen the effects and mitigate damage as much as possible.

The sensitive and very personal program of the project makes this flood mitigation one of particular importance. The things most irreplaceable are personal possessions people collect throughout their lives. Once these things are destroyed, they are gone forever.

The size of the floodplain means that the area underwater is relatively flat, and the amount of water composing the flood water is very large. These factors make it particularly difficult to implement any successful ground surface treatment or retention basin that would adequately control the water. For these reasons, the simple act of lifting the new construction up off the ground to an elevation that is not affected by any flood is the most appropriate solution. The ramifications of this solution, as previously mentioned, are the responsibility of the university. This is a study of an overall possible schematic design, rather than a detailed summary of factual information.



Initial schematic diagram for the possible design challenges elevating the new construction ground plane above flood waters poses.



Initial concept elevating the new construction to a height which allows for comfortable circulation beneath the new established ground plane.

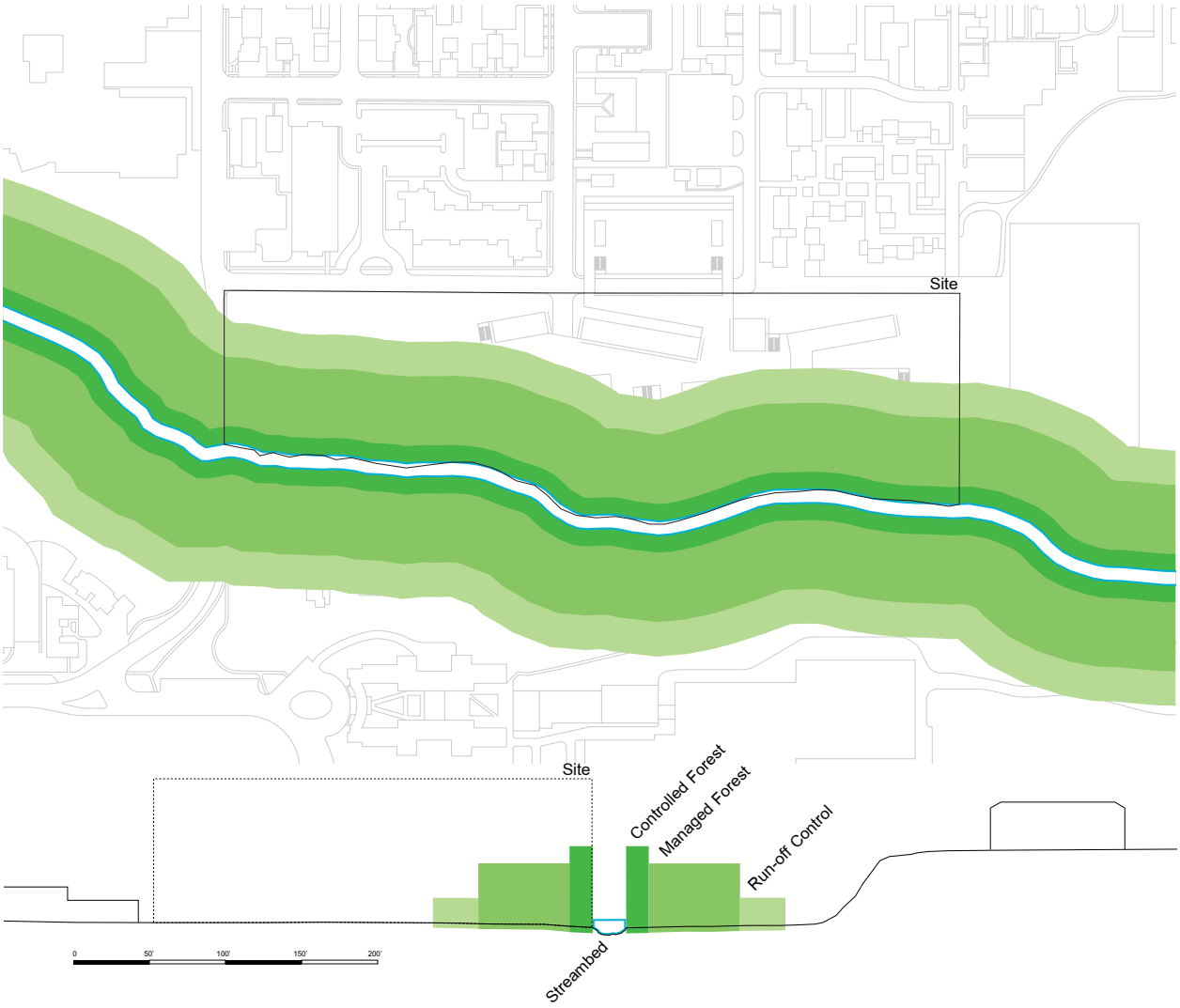
Project Site - Riparian Zones

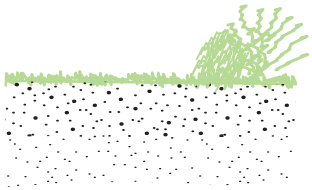
All rivers and bodies of water around surrounded by riparian zones. These zones act as natural buffer interface between the water and dry land.

These zones are very important to all earth's biomes. Riparian zones help to control water run-off, as well as erosion, and they support a diverse array of wildlife species.

In general terms, these zones are organized and defined as being a specific distance away from the water's edge.

The following graphics define different areas that compose riparian zones, where these riparian zones are located, in plan and section, and offer definitions to define the types of surface treatments suitable for each area.


Site
Site
Controlled Forest
Managed Forest
Run-off Control
Streambed
0
50'
100'
150'
200'



Run-off Control

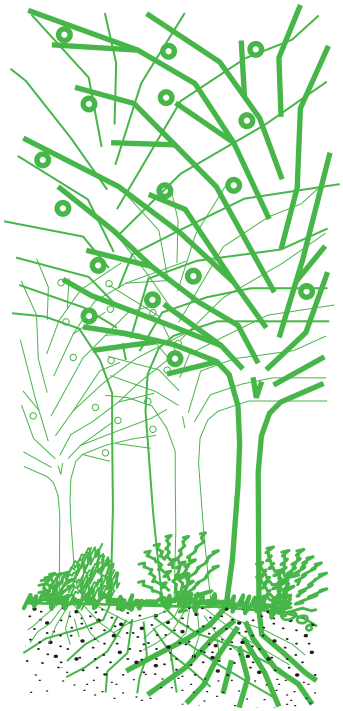
This area concentrates the flows of several water run-offs and allows surface water to connect with ground water. Nutrients are able to be dispersed in this zone.

Landscapes and construction that do not interrupt with the collection and infiltration of surface water are allowed in most circumstances.

Managed Forest

Trees and vegetation help to filter out nutrients and sediments from run-off water. This area is essential for its processes of filtration and deposition of valuable minerals and nutrients.

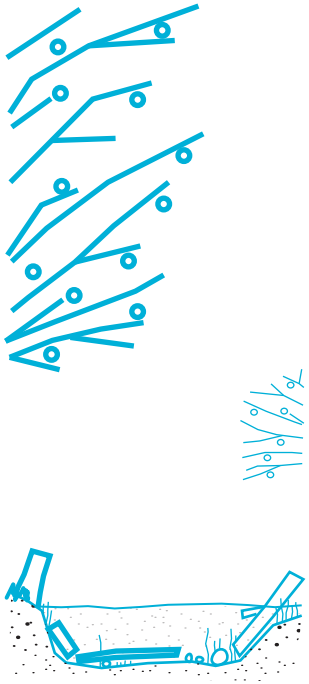
Removal of trees and other vegetation is generally necessary to allow for healthy future growth of this zone.



Controlled Forest

Old and mature trees help to provide shade for the streambed and the shade cools the water, which is vital to the habit of many fish and animals.

Removal of trees and other vegetation is generally prohibitted. Development of this area is prohbitied.



Streambed

Vegetation and material fallen from the controlled forest area provide food and shelter for plants and wildlife to live. This area collects debris from other upstream riparian zones.

Development of this zone is strictly prohibited.

Program Analysis - Student Housing

Among the many issues discussed with Paul Leef during the informational meeting, the long-term retention of the student body in on-campus housing was of particular interest to this thesis. The University of Colorado at Boulder, and arguably every college institution across the country, experience a migration of upper-class students to off-campus housing; students arrive at the university and live on-campus for the start of their college career, and then look to off-campus housing after the first year or two. The allure off-campus housing provides is something unmatched by college housing. After freshmen year, more and more students are finding off-campus housing irresistable, and college institutions are losing out on extremely valuable revenue. To summarize, college housing seems to have an expiration date.

This realization poses the question, “What are universities doing wrong with their housing model that promotes an off-campus migration of students?” Design questions arise and begin to seek answers as to how architects and designers can solve this problem.

Looking to precedent, one program type that has begun to reverse the effects of student housing migration is that of Residential Academic Programs, or RAPs in short. The RAP model combines student housing, educational programs such as classrooms and lecture halls, faculty offices, and sometimes faculty housing. The diversification of program in RAPs has helped to retain students in these housing units. However, even RAPs are not successful enough in keeping students in on-campus housing.

Program Analysis - Michigan State University RAP Survey Results

To gain a better understanding of RAPs and how they work, a survey was sent to several students at Mchigan State University to analyze the experiences they had with their RAP.

The survey started with a general agenda, hoping to find answers to certain questions. Some of the responses from the students prompted corresponding follow-up questions.

Students were questions about the regular schedule of the program, the effects the program had on the individual, whether or not the program type is efficient, as well as the spatial organization and architectural implications the program provided.

Analyzing the responses, six key words were identified. These key words are issues present in the MSU program, and are general to the effect that they are present in most on-campus housing.

Isolation ❶

❷ **Monotony**

Sociability ❸

❹ **Identity**

Pressure ❺

❻ **Inefficiency**


STIGA

Precedent Study

DOX - Student housing residence hall
Location: Bordeaux, France
Architect: K architectures

The following images, plans, and diagrams are property of K Architectures


30

This project is a high density housing complex located in the bustling city of Bordeaux, France.

One of the most fascinating design elements of this project are the exterior staircases. These stairs act as more than just circulation routes; the act as sculptural focal points as well. The design of these stairs allow for other architectural elements like facades and ground treatments to be relatively simple. These stairs are a good example of how utilitarian space can interface with public space and add to the aesthetic quality of the space.

This project also responds well to the urban condition. The project is located in an urban setting, and it does not forget what the implications of that setting are. The long strip along the southwest side addresses the public realm at ground level. This area acts as a buffer and provides an urban entrance that responds to its context in a different way than the green soft-scape garden areas along the southeast edge of the project.

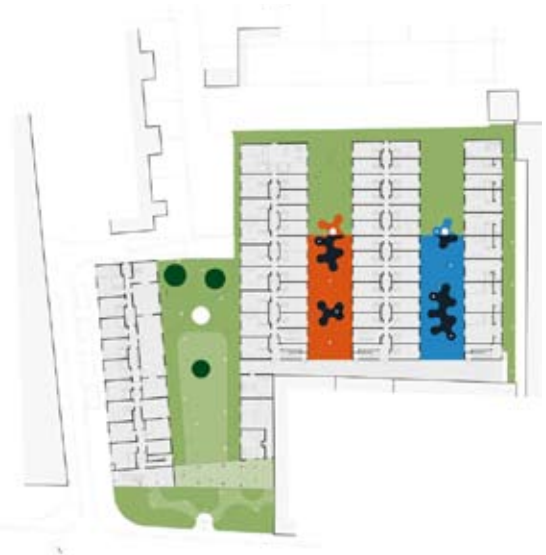
Precedent Study

Student housing residence hall
Location: Paris, France
Architect: ECDM architectes

The following images, plans, and diagrams are property of ECDM architectes

This project is a medium density housing complex located in an intermediate environment between an urban and suburban context. The project is located in Paris, France.

The most interesting element of this project is the use of color. Color is used in this project to provide a sense of identity and location to its residents, as well as anyone passing by on the streets or in cars. The different programmatic needs are aided by the distinction of color. The exterior common spaces are also identified by color. The use of color helps residents to identify with their particular apartment, and not feel as though they are simply a number in a hat, waiting to be drawn.



Precedent Study

Siedlung Halen Housing Project
Location: Bern, Switzerland
Architect: Atelier 5

The following images, plans, and diagrams are property of Atelier 5

This project is a high density “post-war” experimental worker housing project located just out of Bern, Switzerland.

The most interesting element of this project is how the architects were able create the sense of community as well as individuality in such a high density homogenous complex. This community heavily emphasizes nature and its ability to soften the hard concrete character of the apartment buildings. Nature is what binds the community together while also individualizing it. Throughout the complex, there are natural areas that are private, and natural areas that are communal. When this housing complex was still operational, it was reported that these natural areas were very successful in achieving the functions the architect aimed for.

This community also successfully diversified its program; the design does not include only apartments, but it also includes community and public space such as meeting rooms, stores and retail space, activity rooms, and space to practice musical instruments.


Private outdoor space


Connection to nature


Connection to light


Pedestrian walks


Private homes


Children as focus

Precedent Study

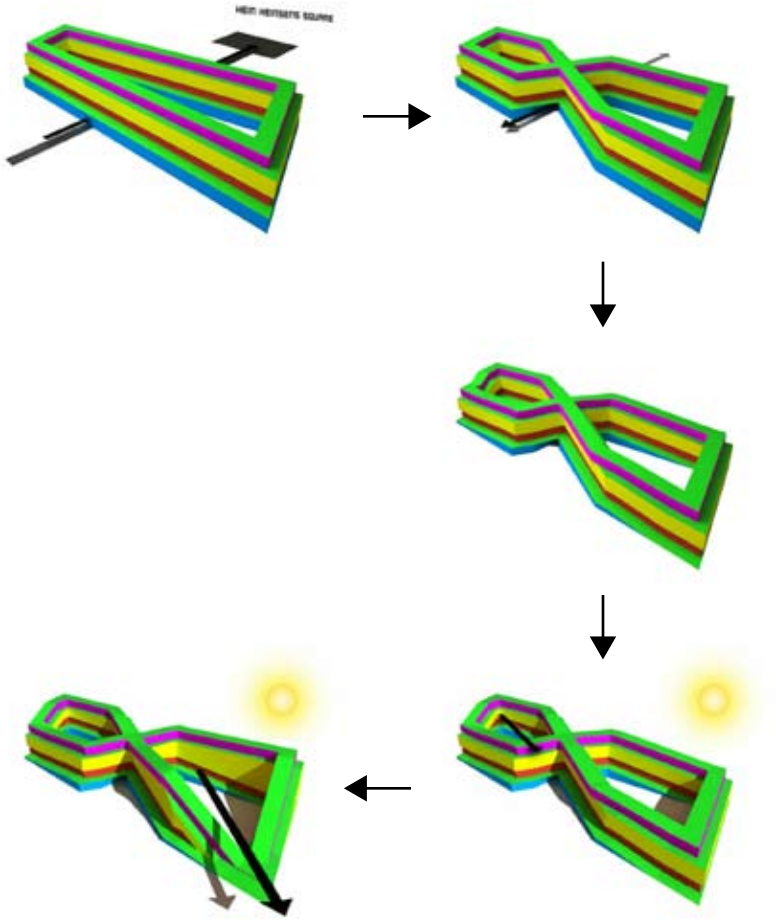
8 | 8Tallet - Housing project
Location: Copenhagen, Denmark
Architect: Bjarke Ingels Group

The following images, plans, and diagrams are property of Bjarke Ingels Group


café

This project is a high density housing project located in Copenhagen, Denmark.

The most interesting element of this project is the way the form of the building is derived. Like all of the firm's projects, the building was formed due to adjacent site and context conditions. By doing this, the building and its program are able to respond to surrounding conditions in the best possible way. Every decision is calculated and is based off of one of these site conditions. The form is initially treated as somewhat of a box, and then pushed and pulled and manipulated until the form is appropriate and responsive to its context. The decisions are logical, which theoretically would provide the simplest of building forms. This building becomes more than just logical; its form becomes a carefully measured sculptural work of art.



Schematic Design

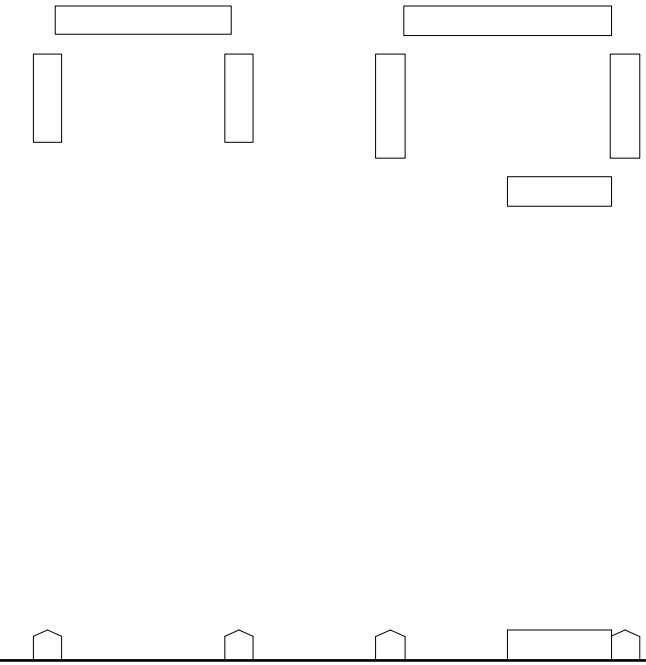
Design Concept - Regenerative Architecture

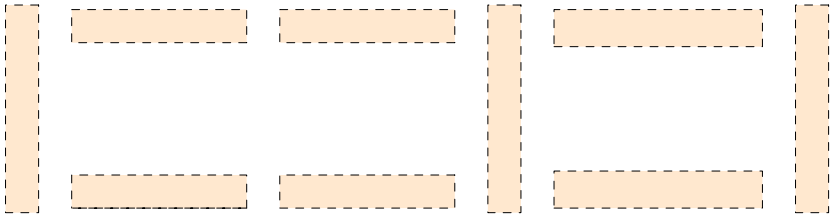
Regenerative architecture is a strategy that can take advantage of existing buildings and infrastructure. The Athens Court apartments have much potential for the application of this concept. The conditions of these buildings are catergorized as beyond repair, but that only considers all of the building and infrastructural systems as codependent systems; individual materials and systems could still be useful independently. These reusable materials have the ability to regenerate the existing program into a much more successful and engaging architecture.

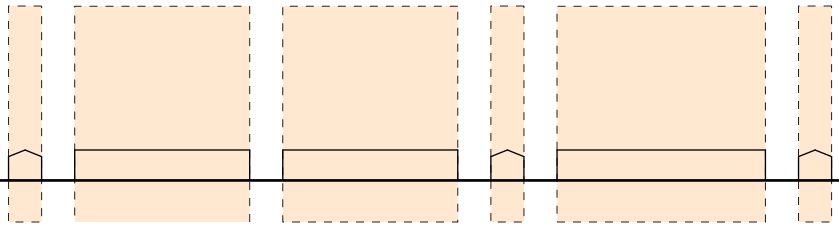
The existing buildings and materials will be regenerated into something new and much more successful, but this does not mean that the new construction will completely cover over and forget about what the site and its program was before. Regenerative architecture plays off of what previously was, highlights it, and then seeks to make it better.

When considering the existing Athens Court buildings, the materials maintaining the most aesthetic and structural integrity are the concrete foundations and the exterior brick. Although most of the interior materials have come in contact with asbestos and as a result have been rendered useless, the exterior brick and concrete foundations remain exceptions to asbestos exposure. Exterior bricks are highly reusable and will be adopted just about anywhere within the new construction.

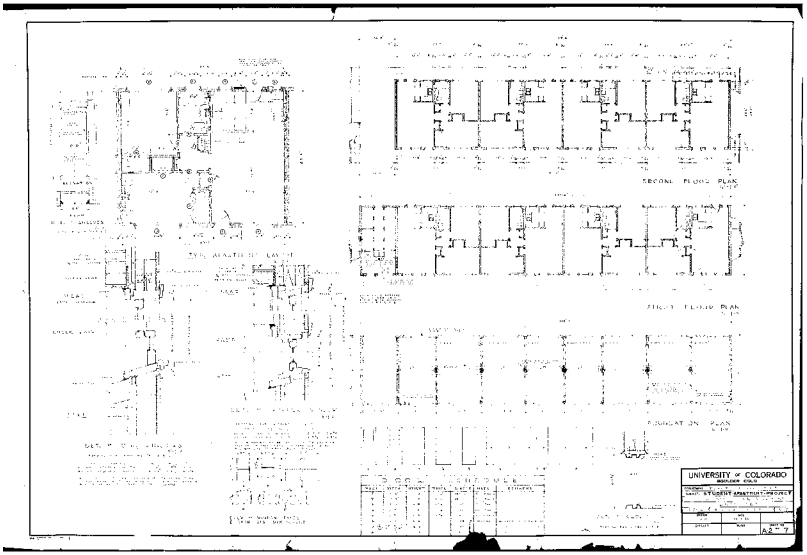
The existing concrete footings will be the heart and soul of Athens Court regenerative architecture. New construction will rise above the existing footprints of the foundations and become the source for organization and circulation. These foundations will be the face of regenerative architecture on this site; they will show what once was, and how it has been regenerated into a similar but new program, what is now.

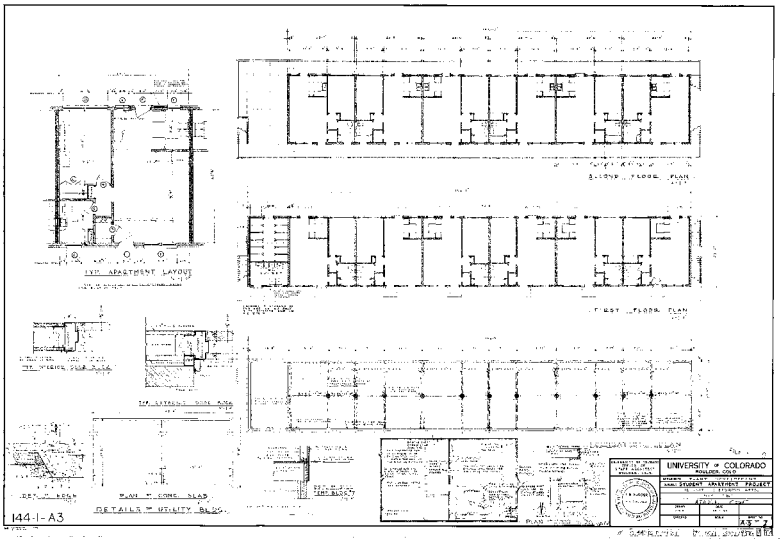






Existing footprint area. This will be the organizational form for the new construction. This form is derived from the existing Athens Court apartment foundations.





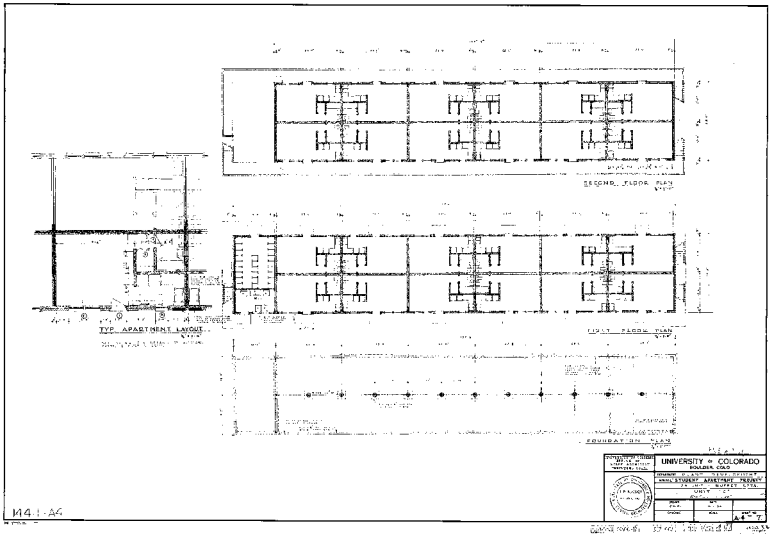
Plans for the existing Athens Court apartments.

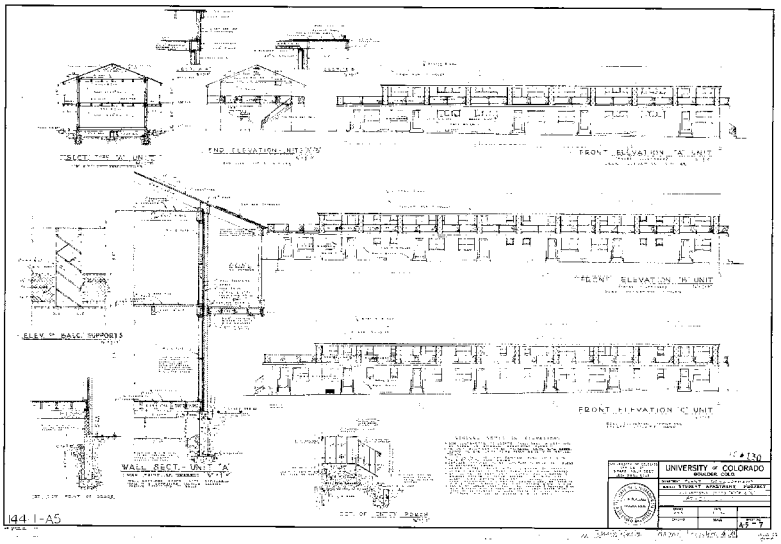
On this page:

Plans for buildings A & B

On the following page:

Plans for building C and elevations


TYP. APARTMENT LAYOUT
SECOND FLOOR PLAN
FOUNDATION PLAN
UNIVERSITY of COLORADO
BOULDER, COLO.
144 I-A4

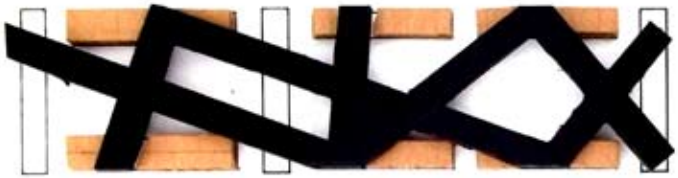

END ELEVATION - UNIT "A"
FRONT ELEVATION "A" UNIT
FRONT ELEVATION "B" UNIT
FRONT ELEVATION "C" UNIT
ELEV. @ BASE SUPPORTS
WALL SECT. UNIT "A"
SECT. OF SLOPED PARAPET
UNIVERSITY of COLORADO
BOULDER, COLO.
144 I-A5

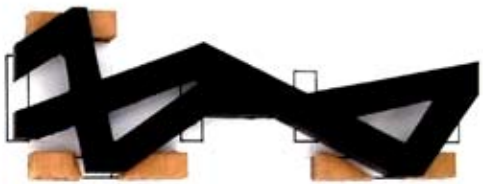
As mentioned previously in Site Analysis, the calculated solution to achieving a much higher density housing complex on this site is going to require a vertical expansion in new construction building height. This new height is going to require a much larger foundation system than that of the current Athens Court foundations. The site's current foundations are shallow trench footings on a relatively small footing. These footings were not sized to support any construction larger than what is already being supported by them, therefore, the new construction will have to have a separate foundation system.

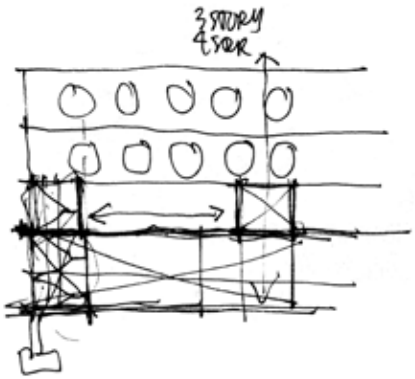
A common challenge and central theme of nearly all new environmentally friendly and green construction is the reduction of the building footprint to minimize the impact the building has on its environment. This concept is something this project will be adopting.

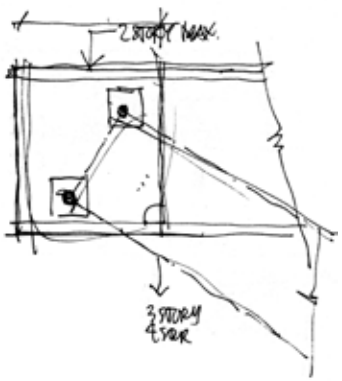
The early study models, pictured to the right on the next page, begin to explore the possibilities of how the new and old construction might interface, and how and where the new structure might puncture down to the ground to its new foundations. These models proved very useful not for their building form, but rather for the location of new structural columns at the ends and middle of the existing buildings. At some points on the model, the existing building form is pulled away to allow a solid visual of the new structure coming to the ground. At other points, the new structure pierces the existing buildings and becomes sculptural elements within the existing buildings.

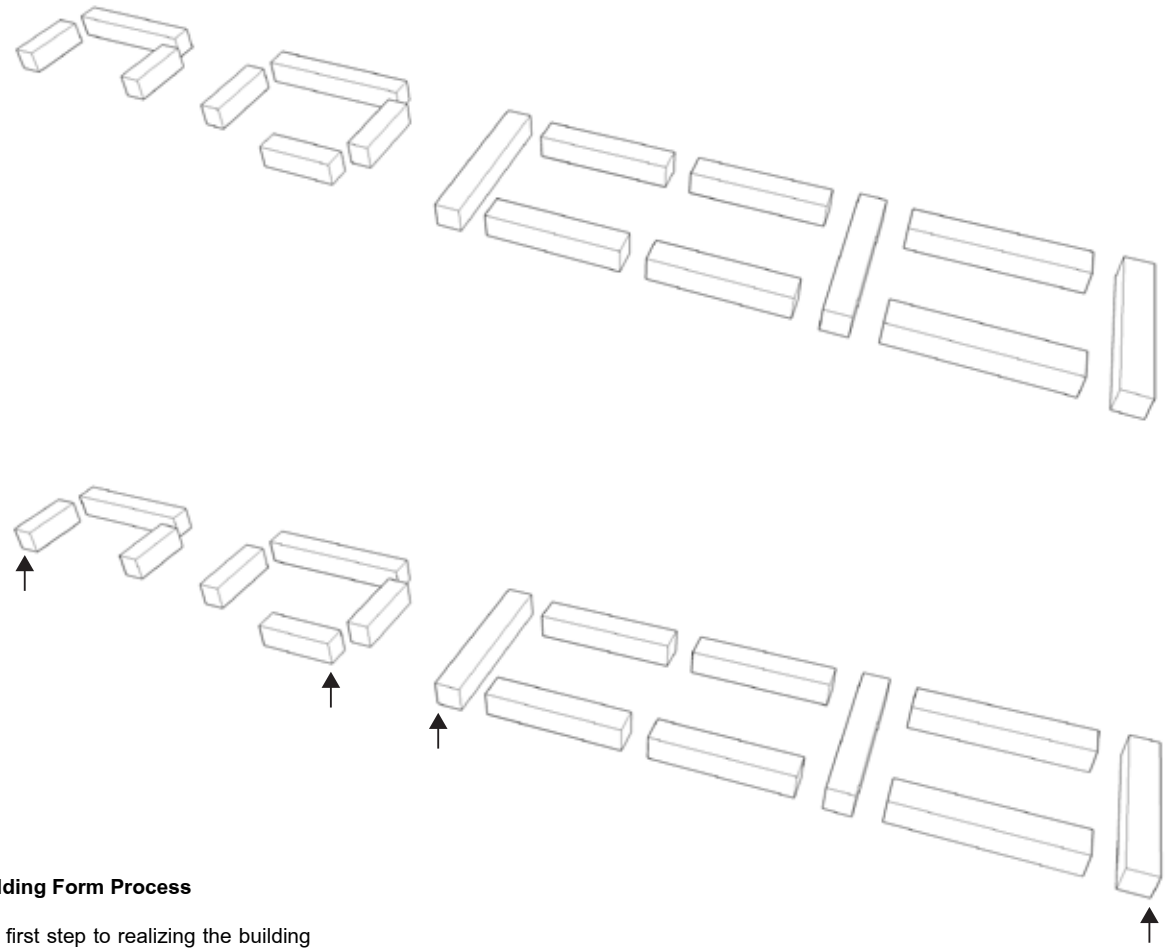
These models made it clear that a separation, but also celebration of the two different structural systems and how they are joined is a necessary component to the final design. This concept is also explained in the adjacent sketches.





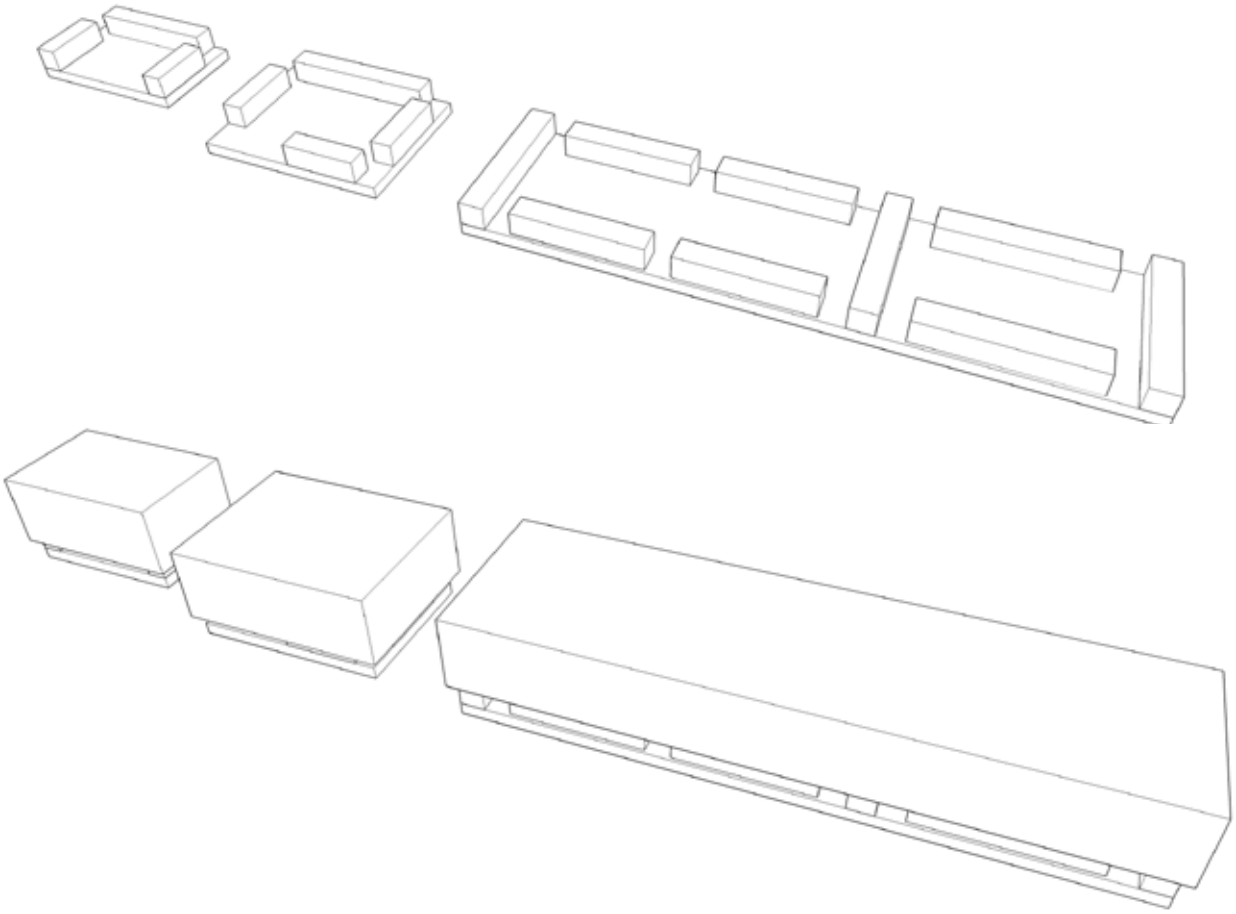

3 STORY
4 STORY


2 STORY MAX.
3 STORY
4 STORY

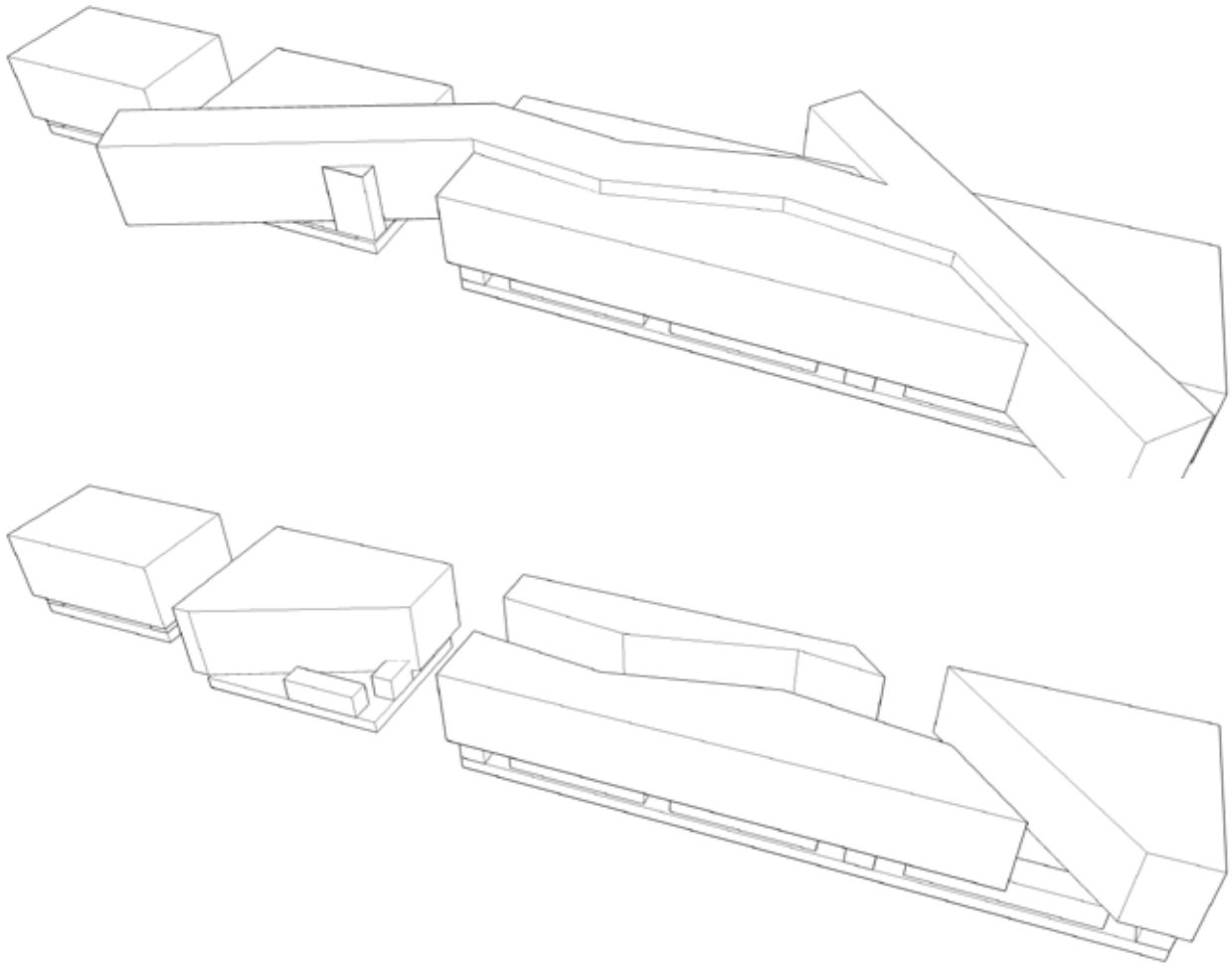


Building Form Process

The first step to realizing the building form was to elevate the reconstructed brick material at the edges of the existing Athens Court building footprints to a height out of harm of flood waters.

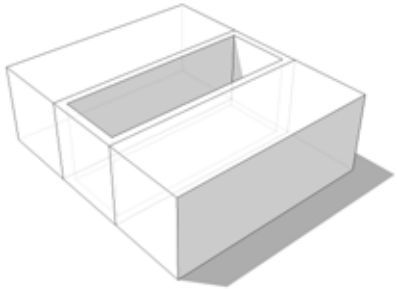


The area under the elevated brick material was then filled with earth. A large volume of space was then extruded up to begin to define the form for the vertically expanded construction.

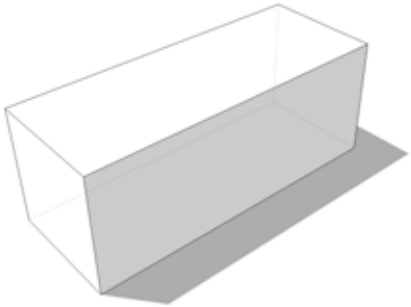


The Boulder Creek Pathway was then brought into the site. It was used as a volume that would cut and carve away at the vertically expanded mass for new construction.

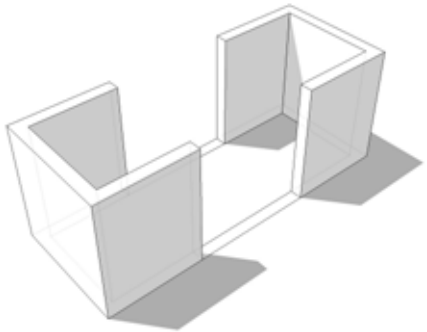
To provide form and organizational arrangement, the exsiting footprints are extruded vertically and transformed in one of the three following ways:



1. Extrusion of space outward.

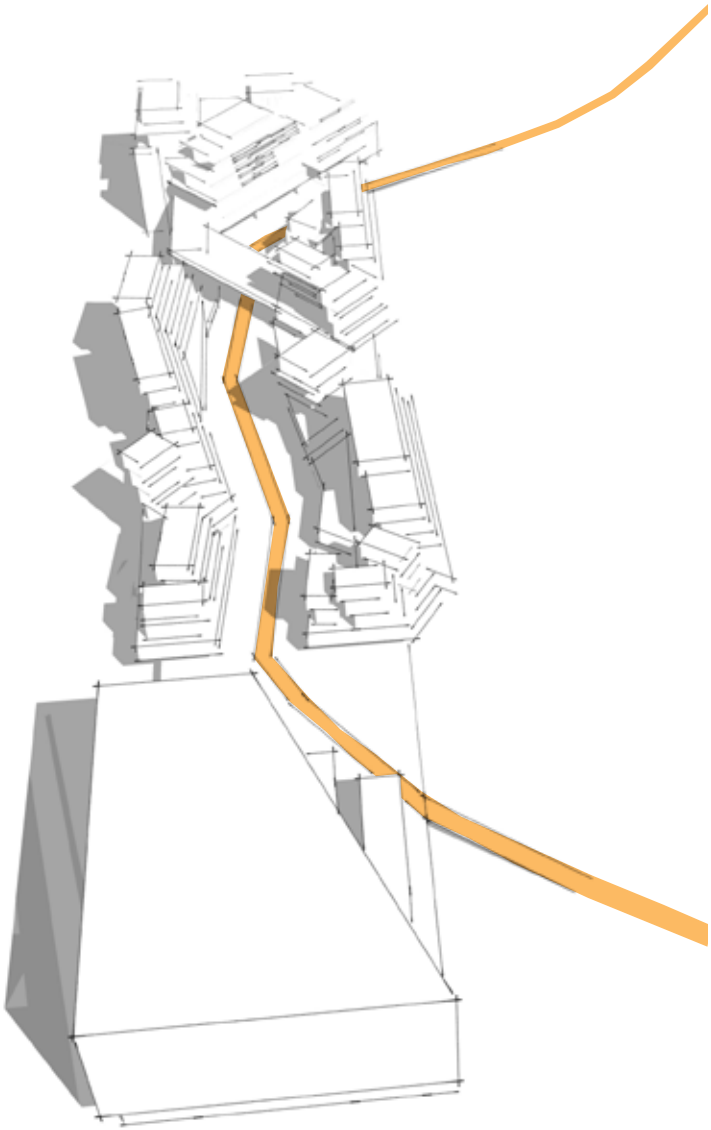


2. Implosion of space inward.



3. Shelling of space inward.

The Boulder Creek Pathway would be the main source for organization of the central pathway area in the project. This area did not have to be just a path; it could be the area that provided excitement and enjoyment for the residents of this community as well as anyone in the general public. This pathway could be strengthened by the diversification of program along its edges. To help better understand what this pathway come potentially become, several precedents were analyzed for applicable design concepts.



Precedent Study

Public Pedestrian Malls and Spaces
Location: various locations
Architect: various designers

The following images, plans, and diagrams are property of respective designers.

Galeries Royales Saint-Hubert
Location: Brussels, Belgium
Architect: Jean-Pierre Cluysenaer

The pedestrian mall is essentially a covered exterior mall. Flanking both sides of this lengthy mall are shops and restaurants. The most interesting element to this project is its success in attracting a very large crowd of pedestrians wishing to travel through. The skylight above allows the space to be flooded with light and seem alive.

La Ramblas
Location: Barcelona, Spain
Architect: n/a

This pedestrian street is among the most widely known and most popular in the world. This street is interesting in its ability to combine program and entertainment with a pedestrian thoroughfare. All along the street are vendors and street performers that draw walkers with no defined destination, just wandering and people-watching.

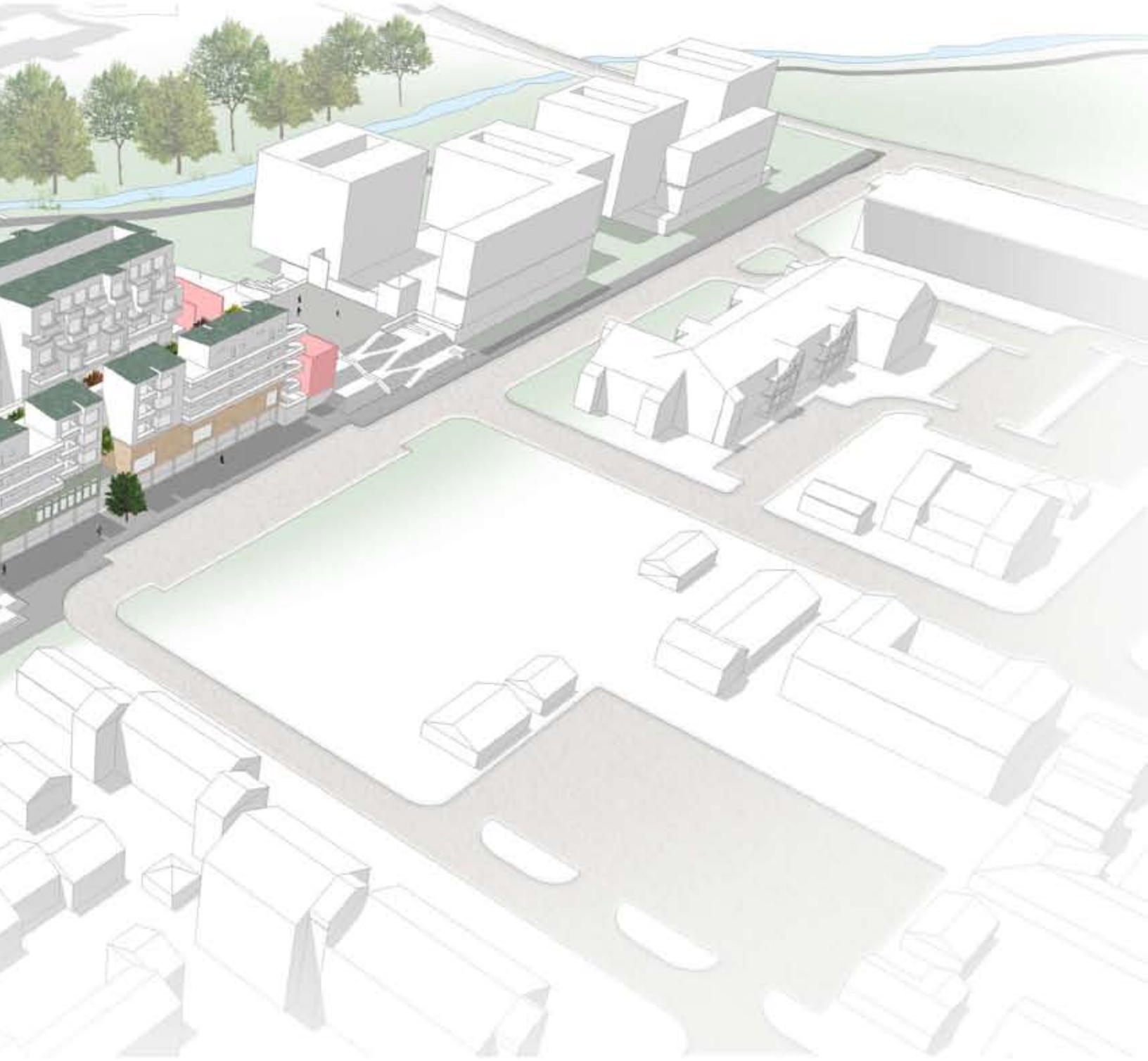
Partidge Creek Mall
Location: Clinton Township, MI
Architect: Hobbs and Black Associates

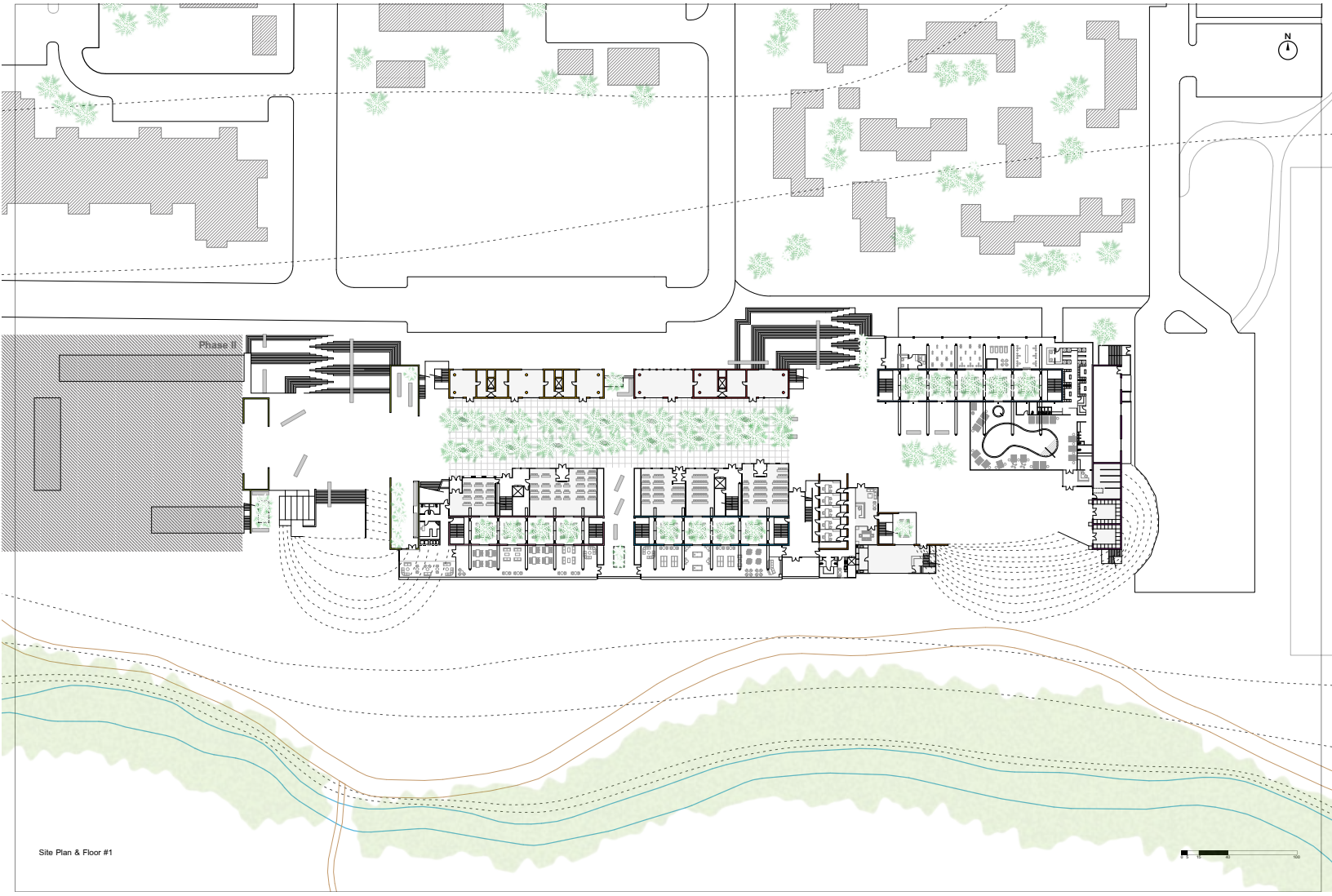
This is a relatively new outdoor open mall located in a suburb north of Detroit, Michigan. Like most suburban “big-box” stores, the area between the store and the street is one large parking lot. This project does an excellent job of hiding this feeling while inside the mall. The use of soft materials and green space, and places for activity help one to forget they are swimming in a parking lot.

Pearl Street Mall
Location: Boulder, CO
Architect: n/a

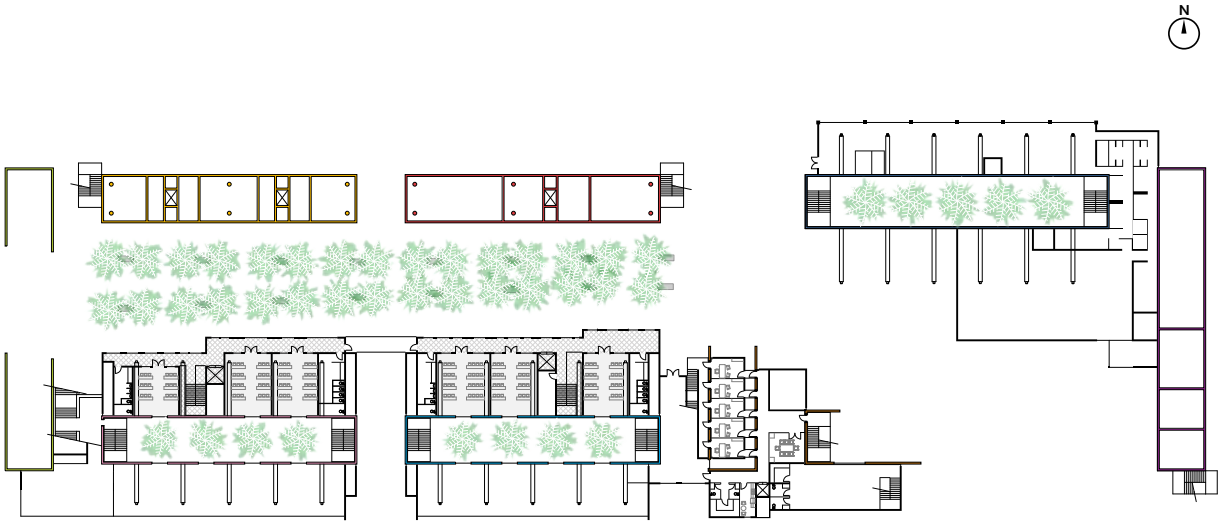
This is one of the most successful remaining pedestrian malls in the nation. Completely cut off from vehicular traffic, the mall is a place pedestrians come to shop, eat, drink, walk, and watch other pedestrians. What makes this mall so successful is the separation of different circulations throughout the mall. One can travel down the middle in the greenery, or at the edges next to stores.

Final Design

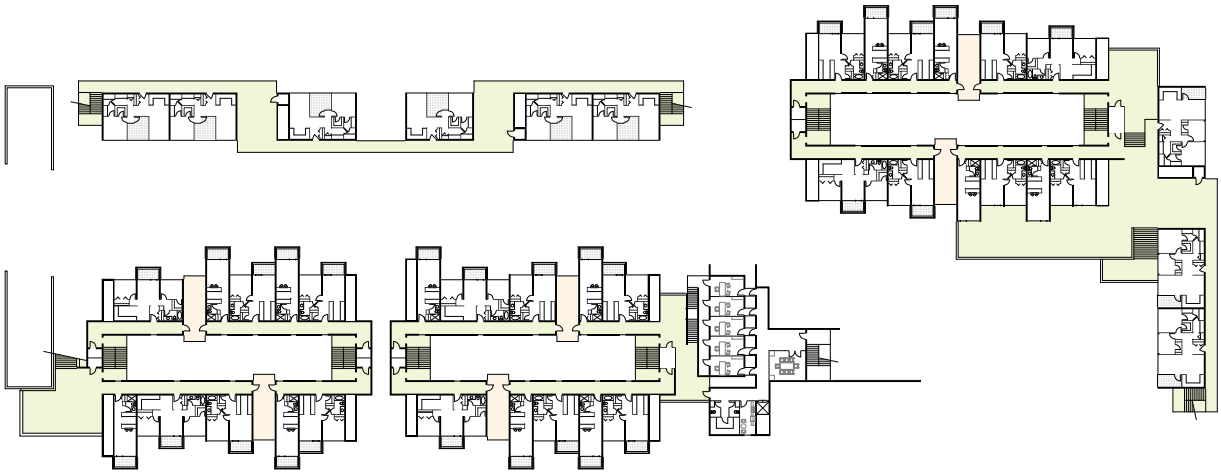




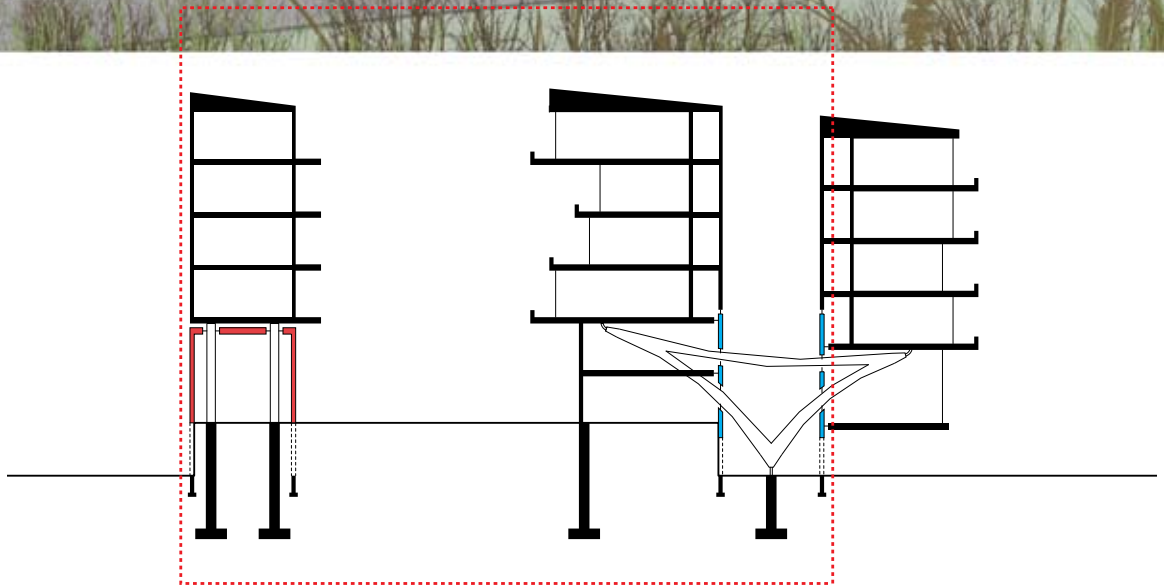
Site Plan & Floor #1

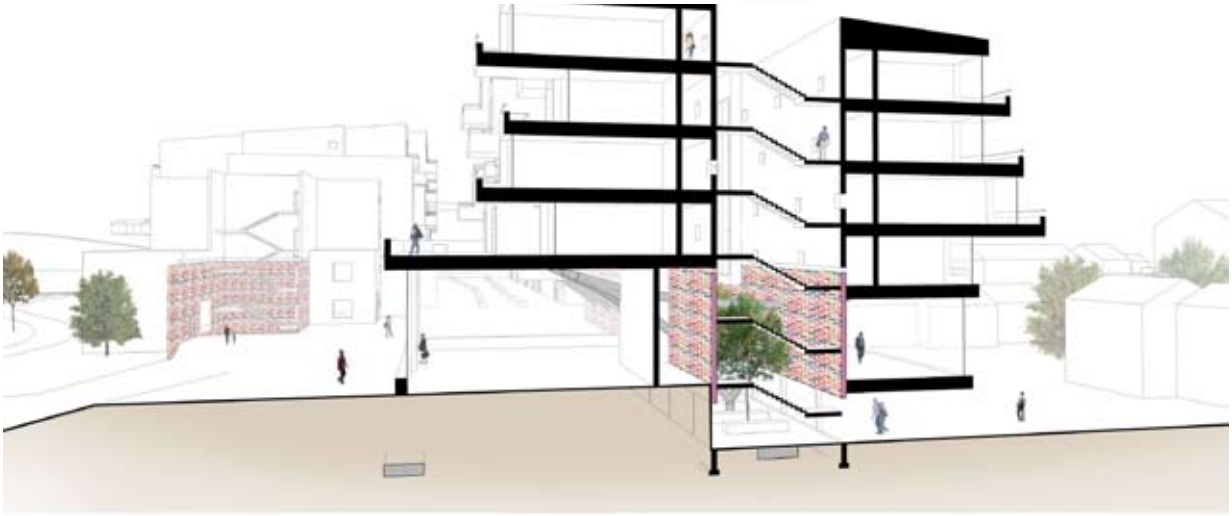


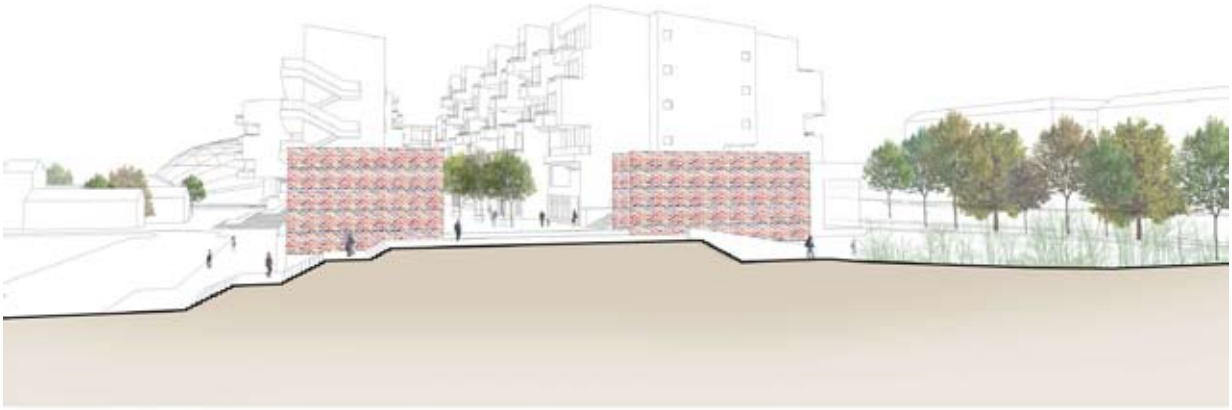
Floor #1.5 & 2

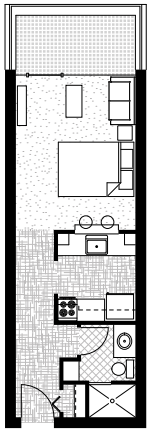


Floor #2.5 & 3







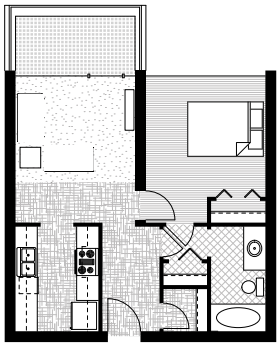


Studio Unit

11' x 31'-6"
5'-6" balcony
2-seat counter bar
Shower unit

358 sq. ft.

48 Total Units

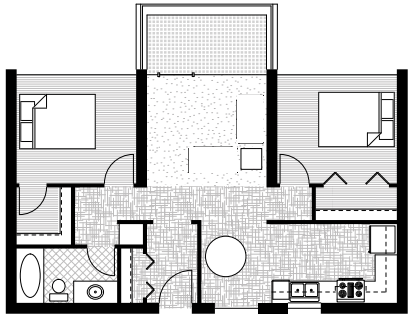


1-Bedroom Standard Unit

23' x 23'-6"
5'-6" balcony
Large kitchen
Tub bathroom

541 sq. ft.

24 Total Units

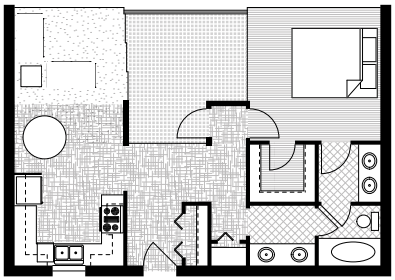


2-Bedroom Standard Unit

21' x 35'-0"
5'-6" balcony
Dining area
Tub bathroom

735 sq. ft.

56 Total Units

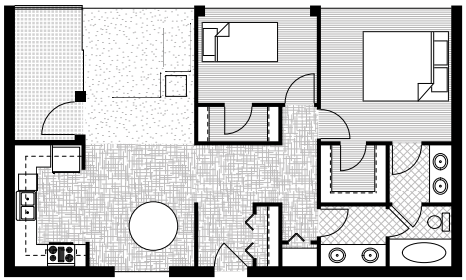


1-Bedroom Deluxe Unit

23'-9" x 33'-8"
117 sq. ft. patio
Dining area
Semi-private bathroom

800 sq. ft.

18 Total Units



2-Bedroom Deluxe Unit

24'-8" x 34'-0"
72 sq. ft. patio
Dining area
Semi-private bathroom

871 sq. ft.

9 Total Units