



**CONSERVATION DESIGN:  
LINKING DEVELOPMENT TO THE LAND**



## ACKNOWLEDGMENTS

I first want to thank my parents for everything they have done for me over the past 24 years. I know it has not always been easy but their constant encouragement and pressure to make me do my best in everything I do made me the person I am today. I also want to thank my committee members, Rod Barnett and Charlene LeBleu, for their continuous support during this process. Without the two of you, I do not think I would have learned anything.

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LINKING DEVELOPMENT TO THE LAND

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## RESEARCH QUESTION

What is the best way to approach development within a portion of an expansive forested area?

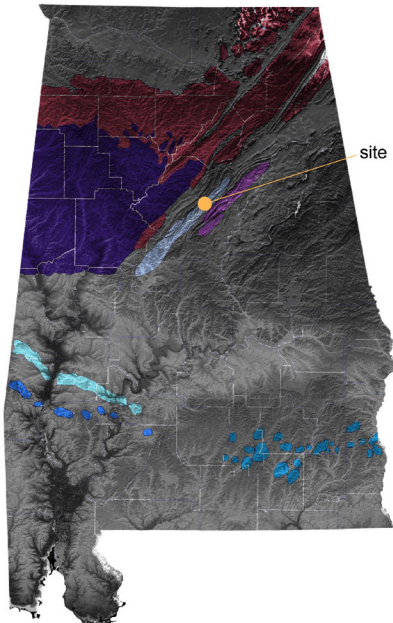
## ABSTRACT

Alabama contains well over 500 abandoned mines across the northern part of the state and while some mining zones continue to degrade the landscape over time, others have been reclaimed naturally and left in an ambiguous state. One of these areas is the Cahaba River watershed, which is internationally known for its biodiversity. In recent times, however, it has come under pressure of development and pollution from nearby tributaries. Specifically, the land between Cahaba Heights and Lake Purdy, currently undeveloped wilderness, is disappearing because of residential development from the north and the constant expansion along Highway 280 from the south.

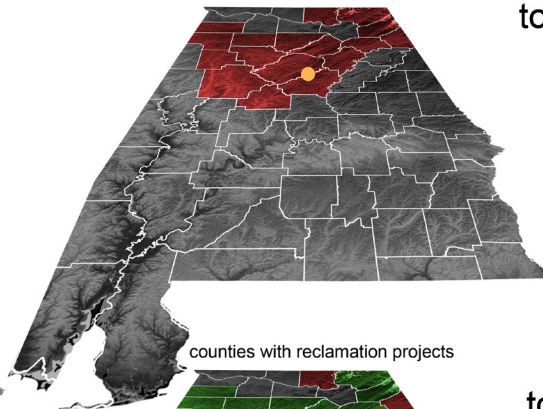
This research investigates how to develop this land in a profitable way for a private developer, but in a productive way for the city using a conservation methodology, initially devised by landscape planner Randall Arendt. The premise is straightforward: a private land developer benefits from the construction of a clustered housing development that works with the land instead of the land working with the development, while the city retains a large portion of the land for public recreation. The resulting landscape not only becomes a quaint neighborhood in the woods, but also creates public amenity in a natural setting.

# Alabama Coal

alabama coal fields

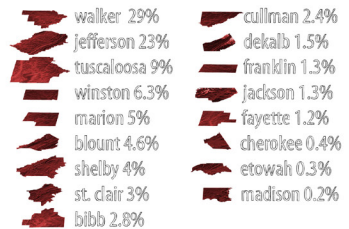


counties with abandoned mines

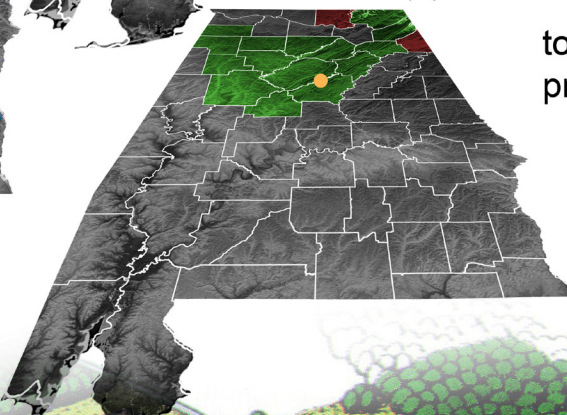


total number of abandoned mines: 886

counties (percentage of total):

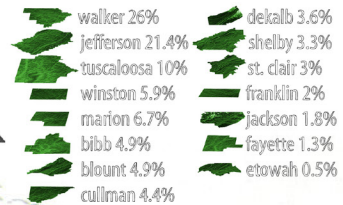


counties with reclamation projects



total number of reclamation projects : 388 (1982-2008)

counties (percentage of total):



CONSERVATION DEVELOPMENT



# INTRODUCTION

Today there are countless abandoned and working mines across the United States - “the western United States alone has more than five hundred thousand abandoned and active mines, covering millions of acres and tens of thousands of square miles” (Berger, 2008). Some of these abandoned mines have been reclaimed either by mining associations or by nature, but most are left in peril and continue to pollute and/or degrade natural resources and local ecologies surrounding them. But there is something we can do. Alan Berger suggests, “that reclamation, as a unique form of landscape production, offers designers a substantial opportunity to expand their intellectual concerns and scholarship in the areas of landscape disturbance, renewal, design and the reoccupation of synthetic space and ecology” (Berger, 2008).

The research investigates Berger’s ideas of a reclamation approach to design in a different way. The idea is to link reclamation with conservation while focusing on improving civic land holdings as well as generating a profit for land developers.

Randall Arendt, a land-use planner and site designer, sees conservation as the best approach to design. He explains that, “communities can employ state-of-the-art zoning and subdivision standards to preserve large, interconnected networks of permanent open space, using protected lands within individual ‘conservation subdivisions’ as basic building blocks in creating this ‘green infrastructure’” (Arendt 1999). Arendt’s strategy is a simple, yet practical approach to the design process where he focuses on conserving the land before creating a neighborhood or new development. The idea is not about getting as many homes as possible on a single piece of land. Instead, Arendt wants to fit the same amount of homes as a traditional development on the land while conserving as much of the land’s natural features and processes as possible.

The proposal that has developed through the research aims to link development with the land. The land refers to all of the characteristics of a particular piece of land, or the cultural landscape, natural processes, and local ecologies. Using Berger’s ideas of reclamation design and Arendt’s scheme of conservation design, the final proposal works with both of these concepts to create a subdivision coupled with a conservation easement. The goal is simple: the city retains ownership of the conservation easement, but it is maintained by a chosen liaison and becomes accessible by the public with a series of interconnected trails. The developer then gets a long-term lease on a small portion of that land to create a subdivision, which is consciously linked to the land and the conservation easement, meaning the landscape continues to evolve as an ecosystem and habitat. Doing this generates new green space for the city and a profit for the developer.

# RATIONALE

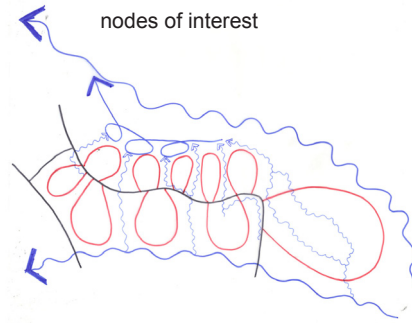
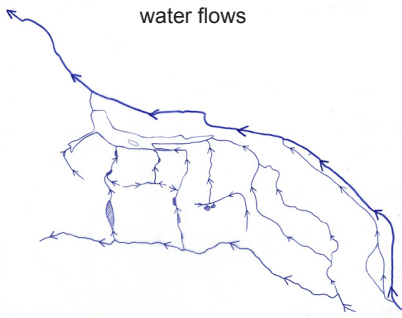
Realizing the mass quantity of abandoned mines in the United States and how traditional neighborhoods are designed and developed, the profession of Landscape Architecture must make a stand. Instead of a tabula rasa approach, Arendt believes we need to preserve what land we have left. By linking the abandoned land with smart, conservation development, not only will abandoned land be salvaged, but beautiful, environmentally sustainable and practical solutions can be realized.

# CASE STUDY: RIVER RUN - BOISE, IDAHO

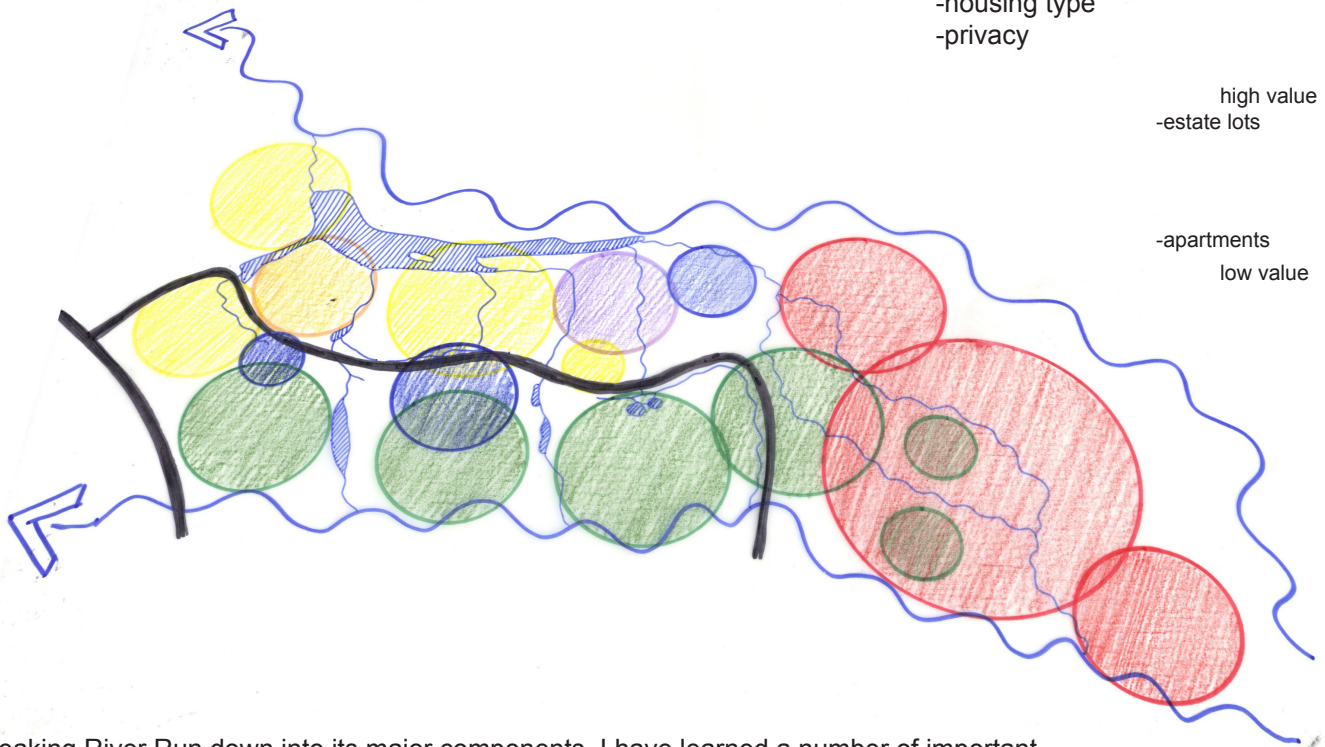


image courtesy of O'Neill Enterprises

In 1977, land developer Peter S. O'Neill realized the potential of "enhancing a property's natural amenities to increase the value of homes" (Leal & Terry 1997). The development, known as River Run, extended over 120 acres in Idaho along the Boise River and contained single-family homes, condominiums, and some custom-built homes all "built to blend into the natural surroundings of the Boise River" (Leal & Terry 1997). Looking beyond development for a profit, O'Neill realized the "growing demand for a natural setting in an urban environment" (Leal & Terry 1997).



property values based on:  
 -water accessibility  
 -distance from major arteriole roads  
 -housing type  
 -privacy



By breaking River Run down into its major components, I have learned a number of important lessons. First, smaller lots and higher density housing can make it more difficult to incorporate surrounding ecologies. Second, there is a need to look beyond the immediate conditions and into the larger context. Third, development can connect and promote ecological processes within the broader networks of terrain conditions.

## CASE STUDY: MT. LAUREL - BIRMINGHAM, AL



image courtesy of Duany Plater-Zyberk & Company

Mt. Laurel serves as a quiet refuge just beyond the leading edge of Birmingham, Alabama. It is a Traditional Neighborhood Development, built around the principles of New Urbanism. “The town of Mt. Laurel was built with a respect for the natural topography and vegetation of the land,” utilizing the idea of minimal disturbance (EBSCO Industries Inc., 2010). The motto for the town quickly became “We leave the trees,” showing a respect for the land and the commitment to “maintain the land’s integrity, beauty and ecological value” (EBSCO Industries Inc., 2010).



image courtesy of Duany Plater-Zyberk & Company

These images are examples of how the homes blend in with the natural setting, leaving as much existing vegetation as possible. Open space and trails are incorporated throughout the development as well, giving children and families communal areas of recreation.



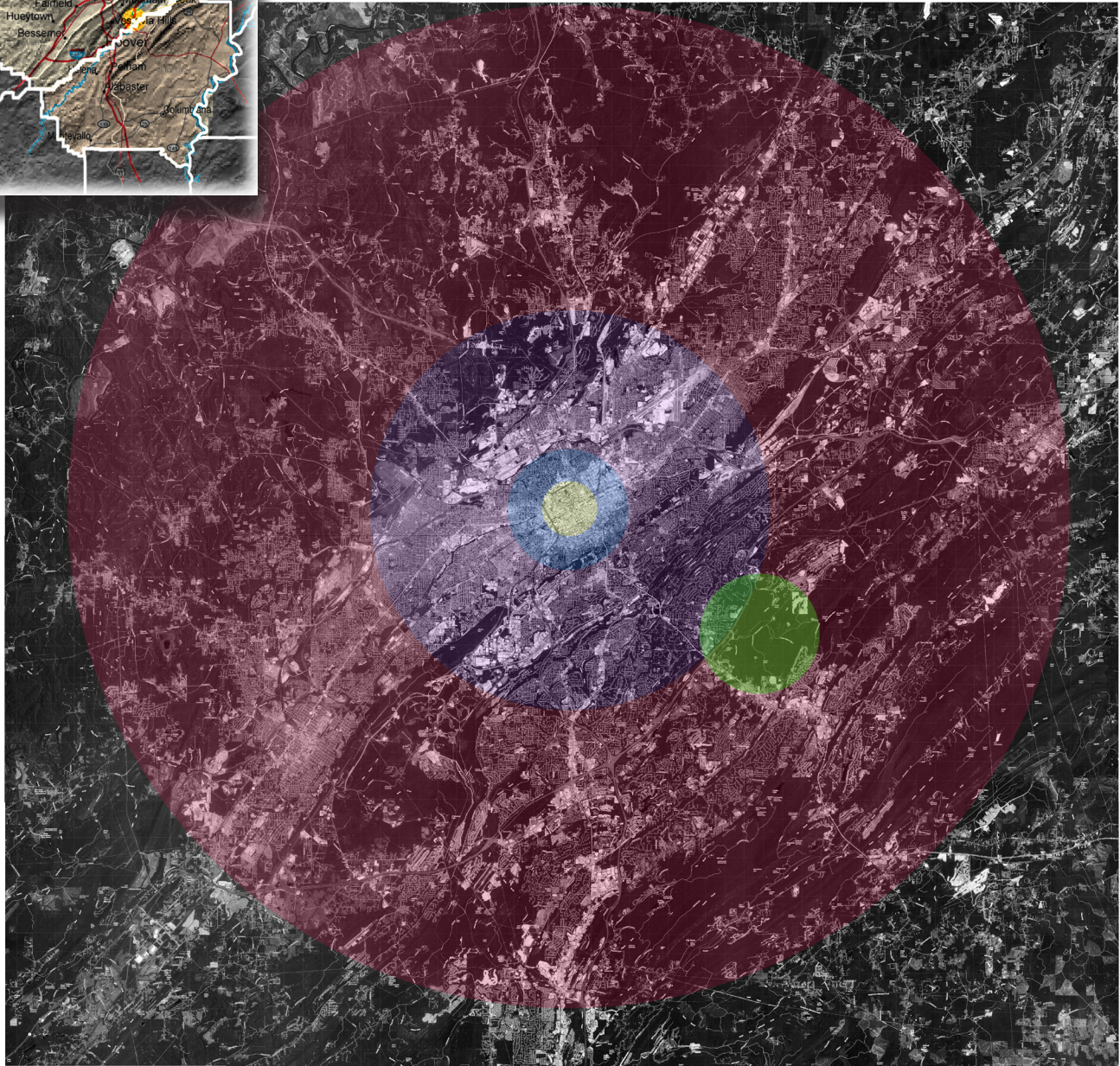
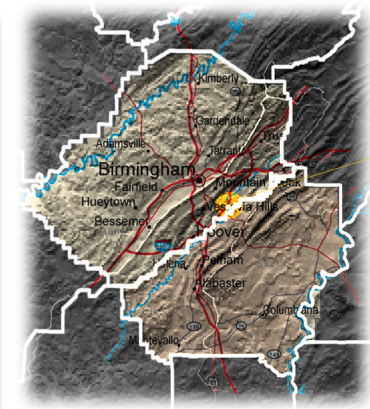
image courtesy of Mt. Laurel & EBSCO Industries Inc.



image courtesy of Mt. Laurel & EBSCO Industries Inc.

“We leave the trees” refers to a development process where the home platforms are outlined in place before any trees are cut down. Only the trees inside of the platform outline are to be cut, leaving homes that reflect their natural surroundings and look as if they have been there for years.

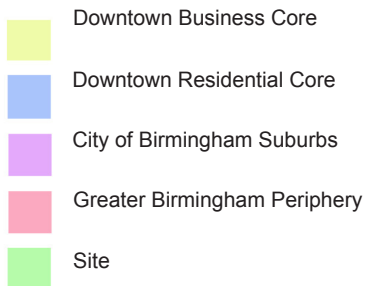
Both ideas of these ideas, maintaining a natural setting and leaving the trees will become a useful tool in the design process.



# CHAPTER 1: SITE CONTEXT + HISTORIES

Birmingham is located in Jefferson County, Alabama's most populated county, and adjacent to Shelby County, which reveals Alabama's rural nature as you move further away from the city. The extended area straddles both counties, but my main area of focus falls within the limits of Jefferson County site.

This map opposite breaks Birmingham down into its four major components: the downtown business and residential cores, the City of Birmingham suburbs, and the Greater Birmingham suburbs. Doing this helped decipher the undeveloped land from the developed as well as pinpointing a location that does not separate itself from the rest of the city.










## THE SITUATION

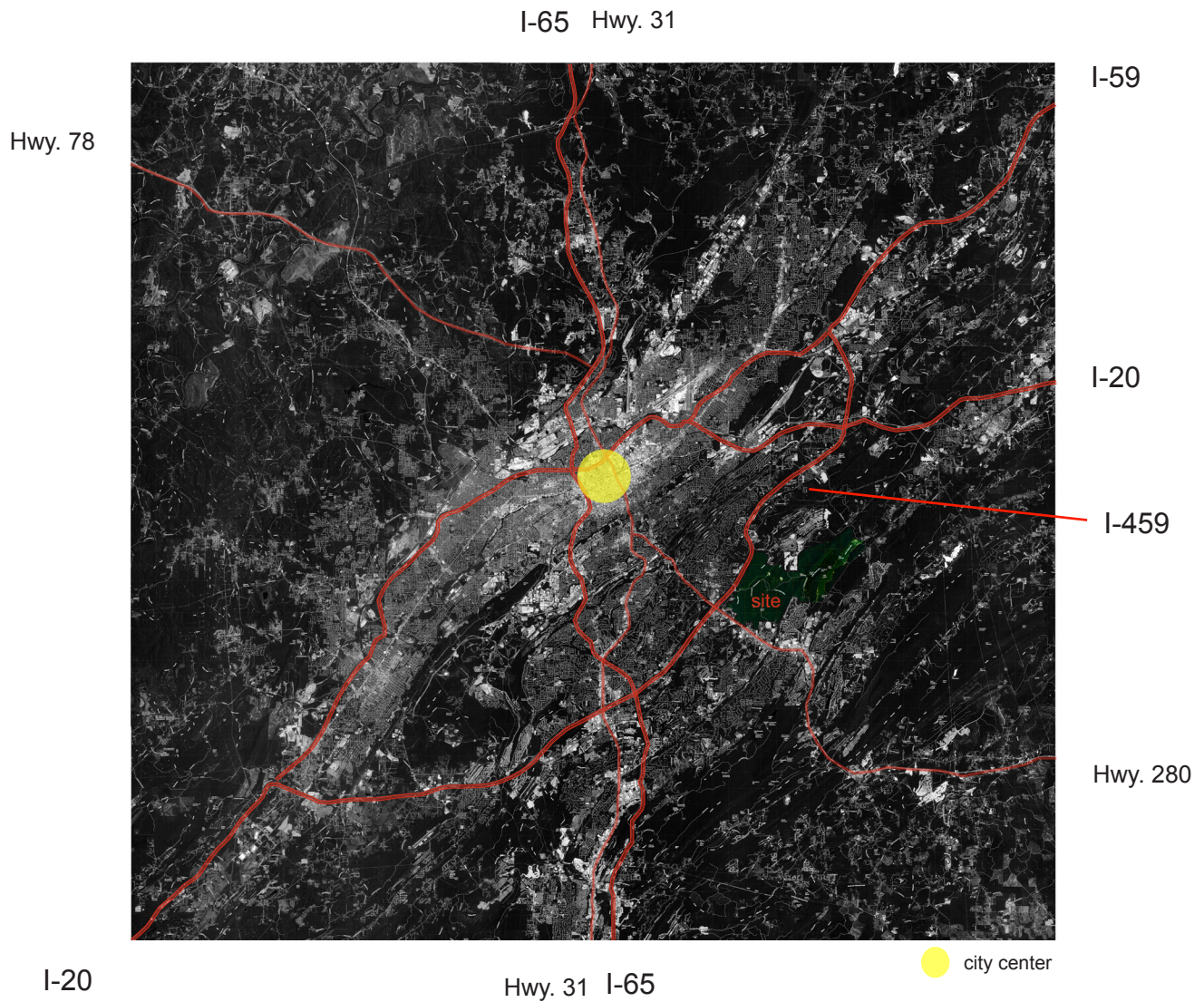
The site is surrounded on three sides by encroaching development, but the pristine forest area in the middle reaches beyond Birmingham and its adjacent suburbs. There are not many forests like this left within the Birmingham Metro area and the opportunity to preserve this land for future generations is now.

Formerly, the site served as a coal mining area for years, but had been cleaned out by underground and strip mining activity by the mid-1970's. Remnants still remain at the location paying homage to its cultural and historical significance to the city of Birmingham, which boomed when Iron Ore and Coal were discovered around the city by about 1900.

Still serving as a significant piece of Birmingham's resources and also located on the site are the Cahaba and Little Cahaba Rivers. The Cahaba River has been named by the Nature Conservancy as one of eight "hotspots of aquatic diversity" in the United States that must be saved. Lake Purdy, to the northeast serves as Birmingham's primary water source while the Cahaba River pump station, just off the southwest corner of the site still serves citizens daily.

-  water bodies + rivers
-  coal mining locations
-  undisturbed forest

# REGIONAL ROADS

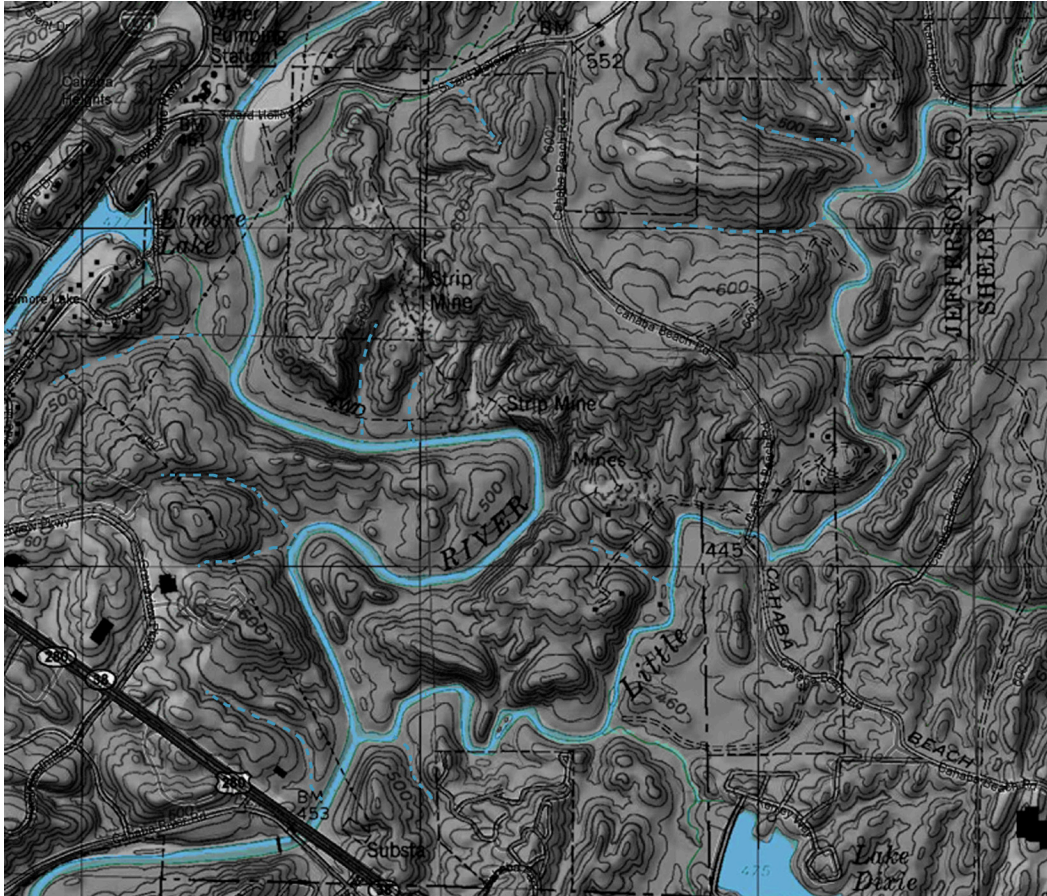


The site is situated along two major roads that travel into and around Birmingham, Interstate 459 and Highway 280. Highway 280 has consistent bumper-to-bumper traffic and speed limits only reach 55 mph, which gives the driver ample time to explore their surroundings. This map shows the sites proximity to all of Birmingham and its immediate connection to two heavily travelled roads.

# LOCAL ROADS

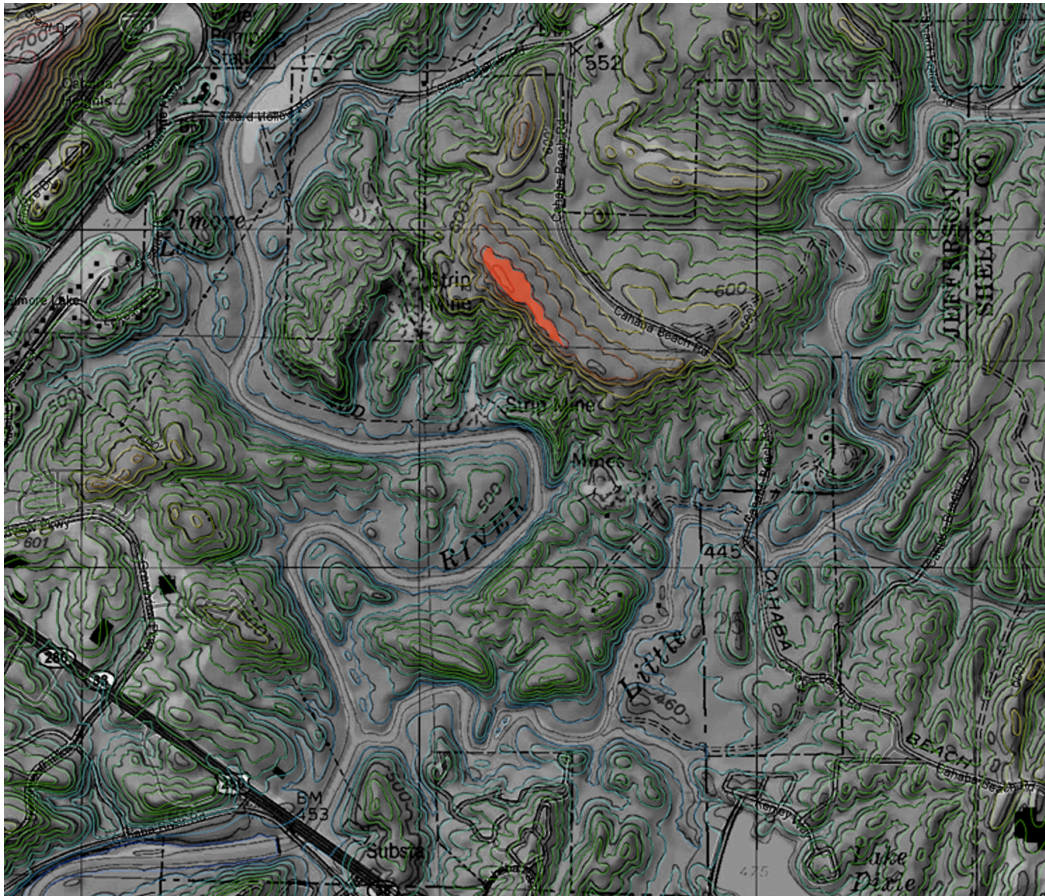


# WATER



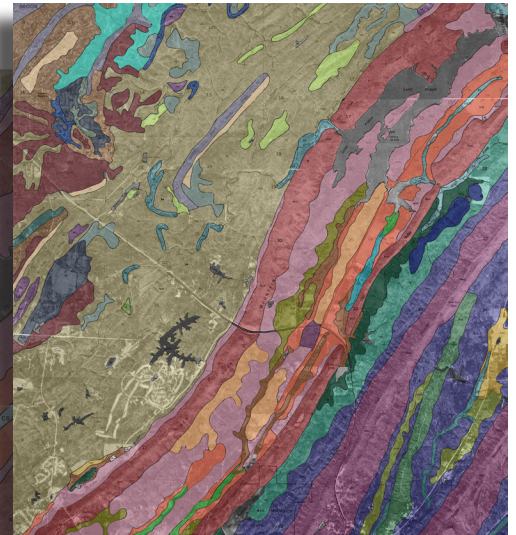
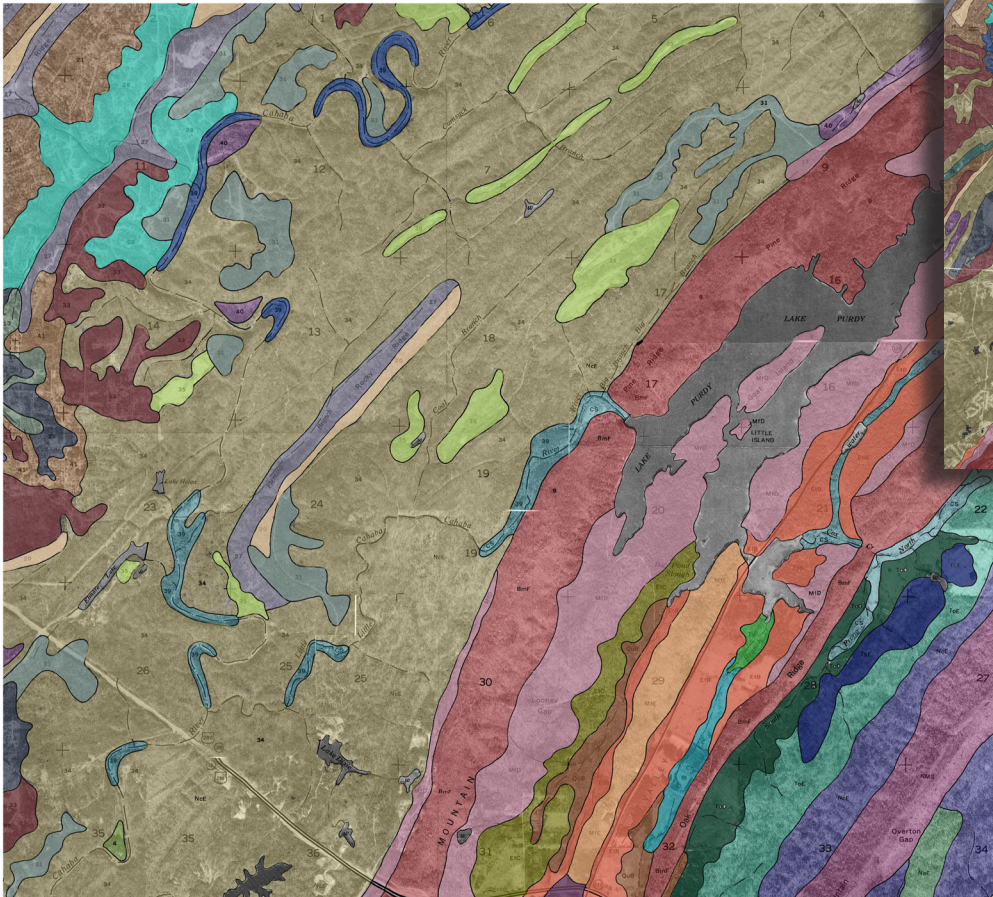
The most valuable amenities within the site are the two rivers. One of the reasons that the Cahaba River is a biologically diverse “hotspot” is that the river contains 131 total fish species, three of which are endangered. Mussels once thrived in this river, but in recent times its numbers have declined. At one time there were 42 mussel species in the river but one is now extinct, eight have been extirpated from the river, and eleven more are either threatened or endangered. All of this led to National Geographic naming the Cahaba River one of six biologically rich areas in the world threatened by “habitat loss, fragmentation, invasion by nonnative species, pollution, and unsustainable exploitation” (National Geographic, 2007). Knowing this heavily influenced the decision to choose this site because allowing this place to be destroyed would be a tragedy not only to Birmingham, but all of the ecologies and processes involved with the river.

# TOPOGRAPHY



Undulating terrain follows the river while a large ridge and subsequent steep hillside tower over the property from the north. Shown are twenty foot contour intervals with the water level sitting around 420 ft. above sea level. The high point on the ridge tops out at 700 ft. above sea level, exemplifying a significant change in elevation from south to north through the site.

# SOIL



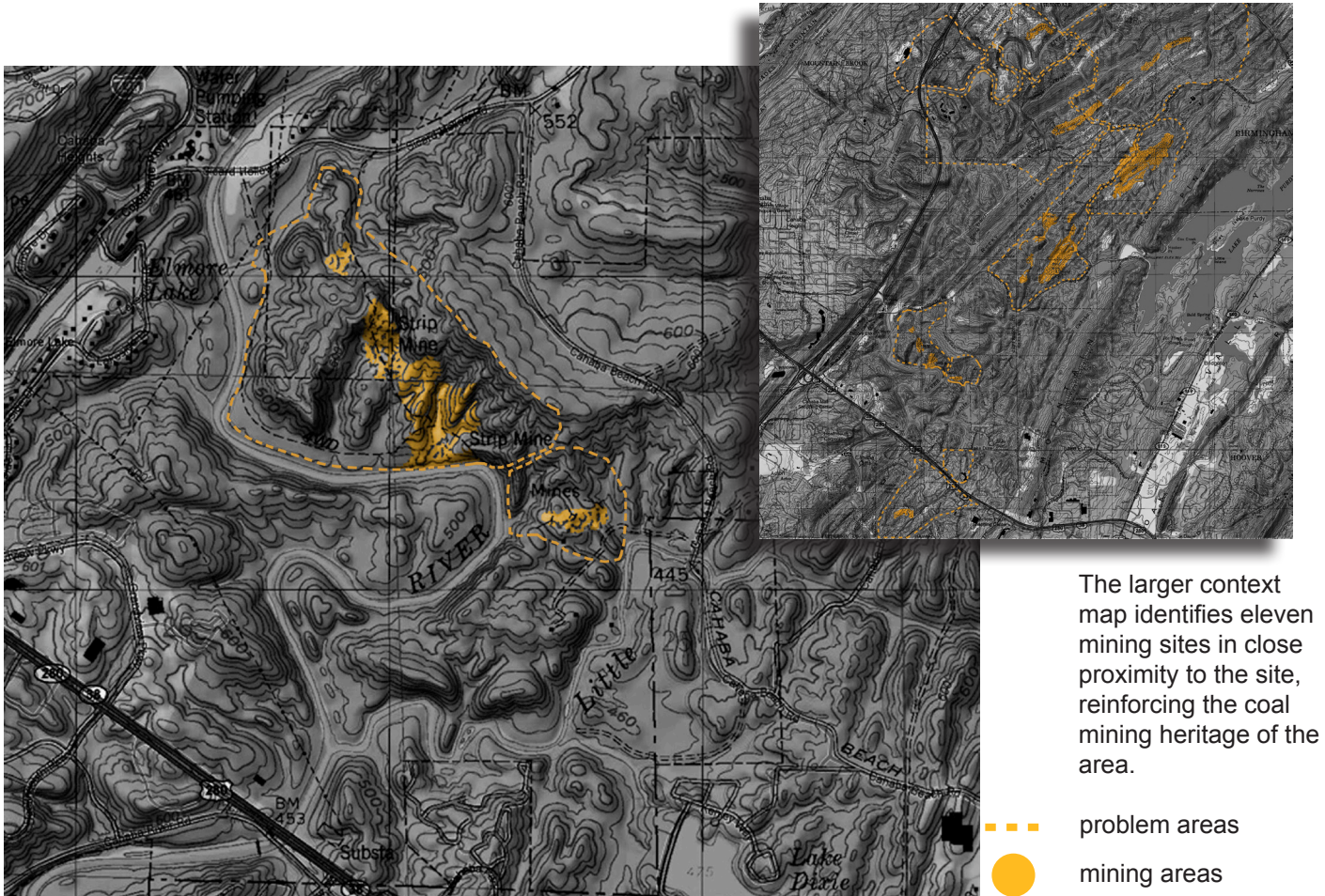
The larger context map begins to show the differentiation in soil to the east and west. Shades Mountain is to the west while New Hope Mountain, Pine Ridge, and eventually Little Oak Mountain form to the east while the area around the Cahaba River remains relatively homogenous.

Differentiation in soil on site is fairly trivial. Although, to the east is New Hope Mountain and Pine Ridge and their obvious multitude of different soils. The bulk of the soil on site falls within the Nauvoo-Montevallo association. This grade of this soil is classified as steep and is considered as fair habitat for woodland animals. Different soils come into play along the rivers and streams that flow through the property, adding a different mix of vegetation and wildlife in lower lying, and more saturated areas.



The site is a heavily wooded area with mostly mature growth, surrounded by development. Some areas contain younger growth than others, typically indicating an area of disturbance, or mining activity, but with above ground mining ending in the mid-1960's these areas have come into their own. This image was taken during winter in order to differentiate between deciduous and evergreen trees, whereas the darker areas represents Loblolly Pine, White Pine, Virginia Pine and Shortleaf Pine, and the lighter areas signify Yellow Poplar, Red Oak, Chestnut Oak, Scarlet Oak, Eastern Red Cedar, Sweetgum, Water Oak, and Birch among a few others.

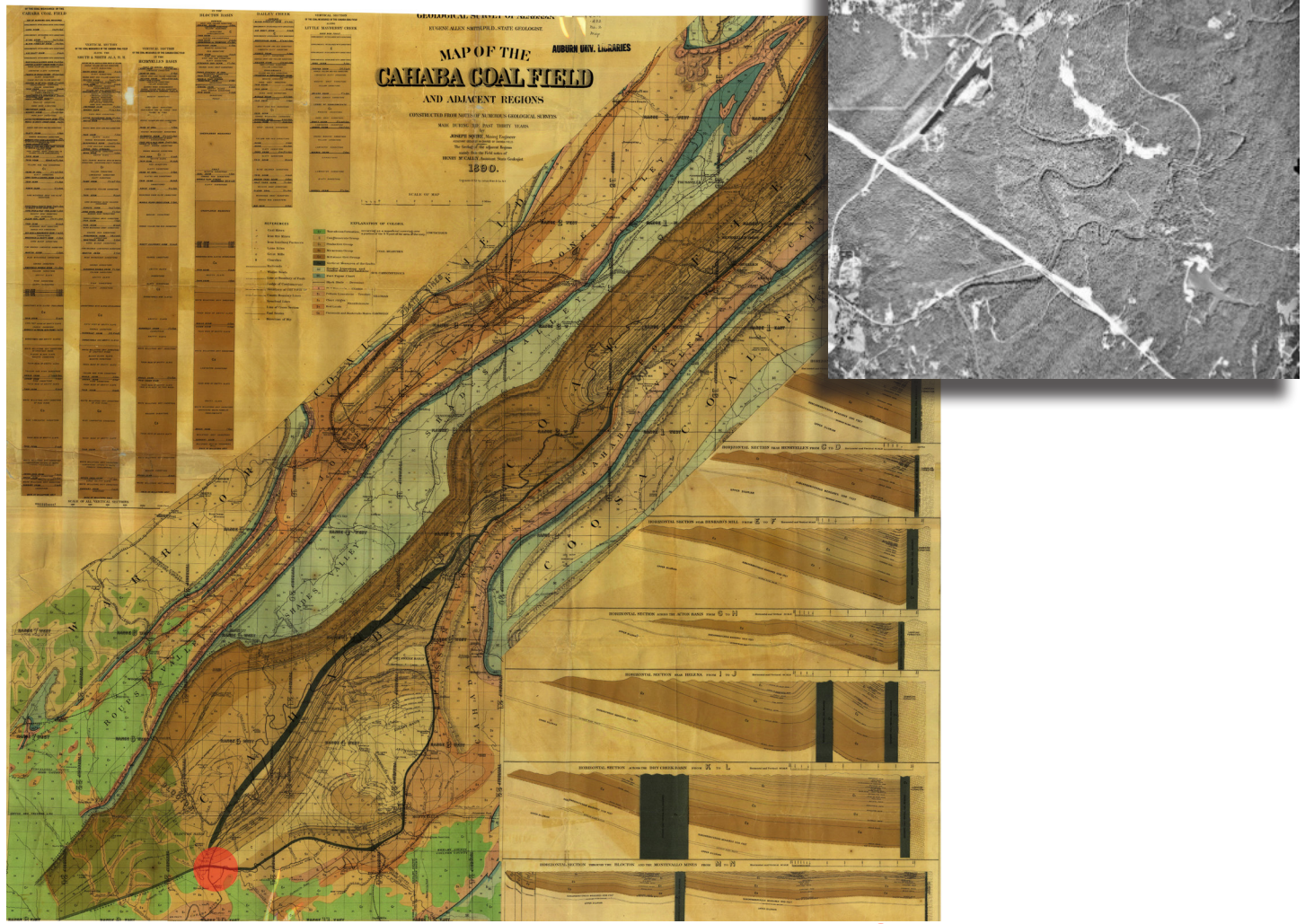
# MINING



Because mining locations and other evidence are prevalent on the site, there is a need to point out what the Alabama Department of Industrial Relations Mining and Reclamation office calls problem areas. These two areas were at one time listed as problem areas because of exposed high walls and exposed mining tunnels, but they have since been reclaimed naturally, meaning the ground is stable and no gases are leaking into the air or the water supply. This map simply identifies areas of the mining heritage on site and helps in trail design through the area.



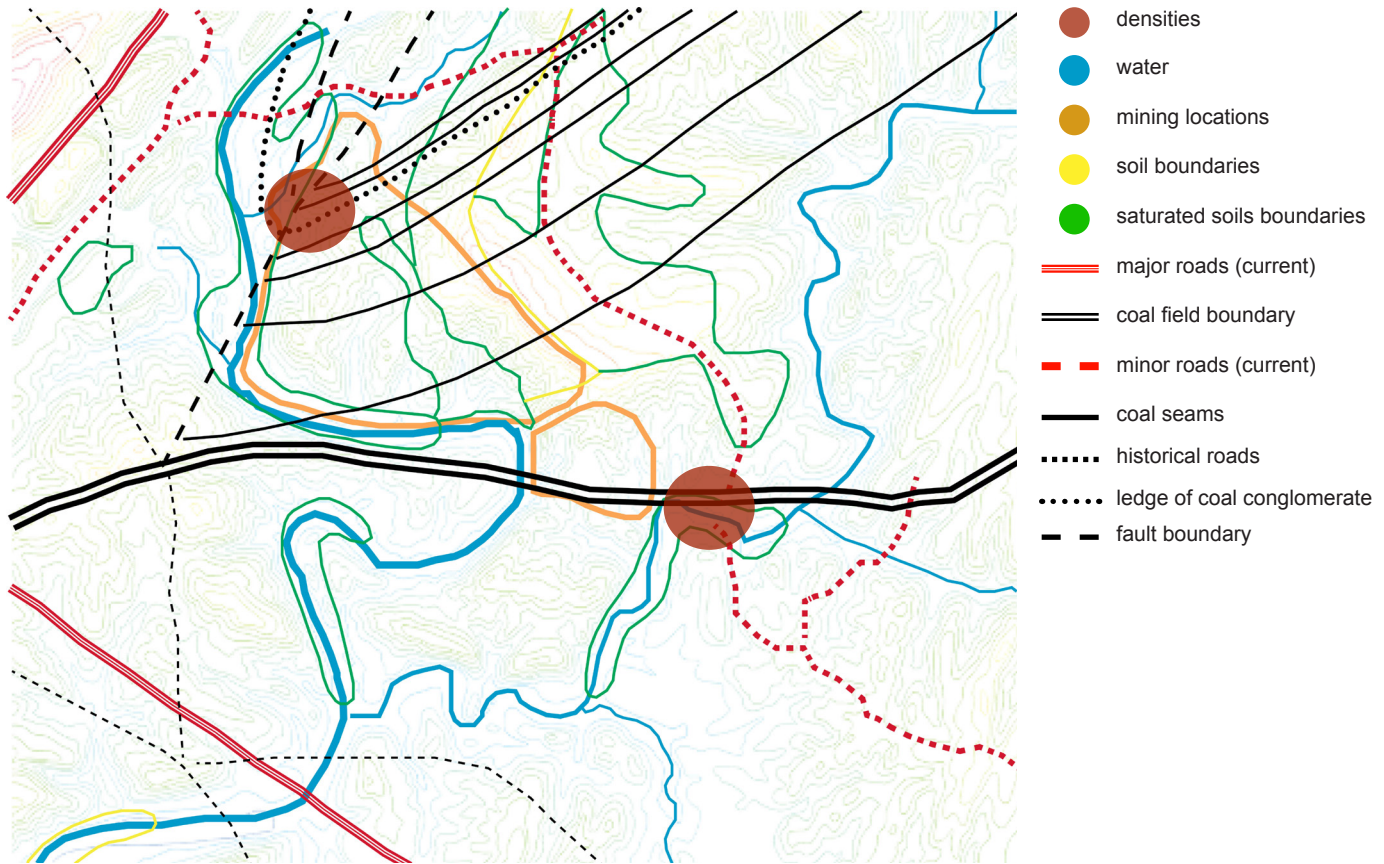
# HISTORIES



● site

The 1967 aerial photograph, top right, confirms above ground coal mining on the site in the clear-cut areas near the center of the photograph. Although I do know that coal mining was taking place here, records prior to the Surface Mining Control and Reclamation Act of 1977, which regulates the environmental effects of coal mining, have been especially difficult to locate. The Map of the Cahaba Coal Field, shows the site sitting just on the edge of the field. It outlines the underground characteristics of the site, namely the coal seams and the sediment layers consisting mainly of different types of sandstone and shale.

# OVERLAY + DENSITIES



The overlay helps to understand the complexity of the site by seeing everything together on one field. By doing this, densities begin to become apparent. Locating two major areas on different portions of the site that contain multiple entities, past and present, create “no-build” zones, or areas that should be left undisturbed. By locating densities and designating them as either poor areas to build or good areas to build has been a useful tool in the creation of the final design.

## CHAPTER 2: INITIAL DESIGN

The design investigation began by looking at the potential of the site for creating a “hybrid landscape,” or a landscape that crossed multiple ideas to create one. Although this study has been useful for analysis and investigation of the site, the design was later redirected to the realization of the conservation design.

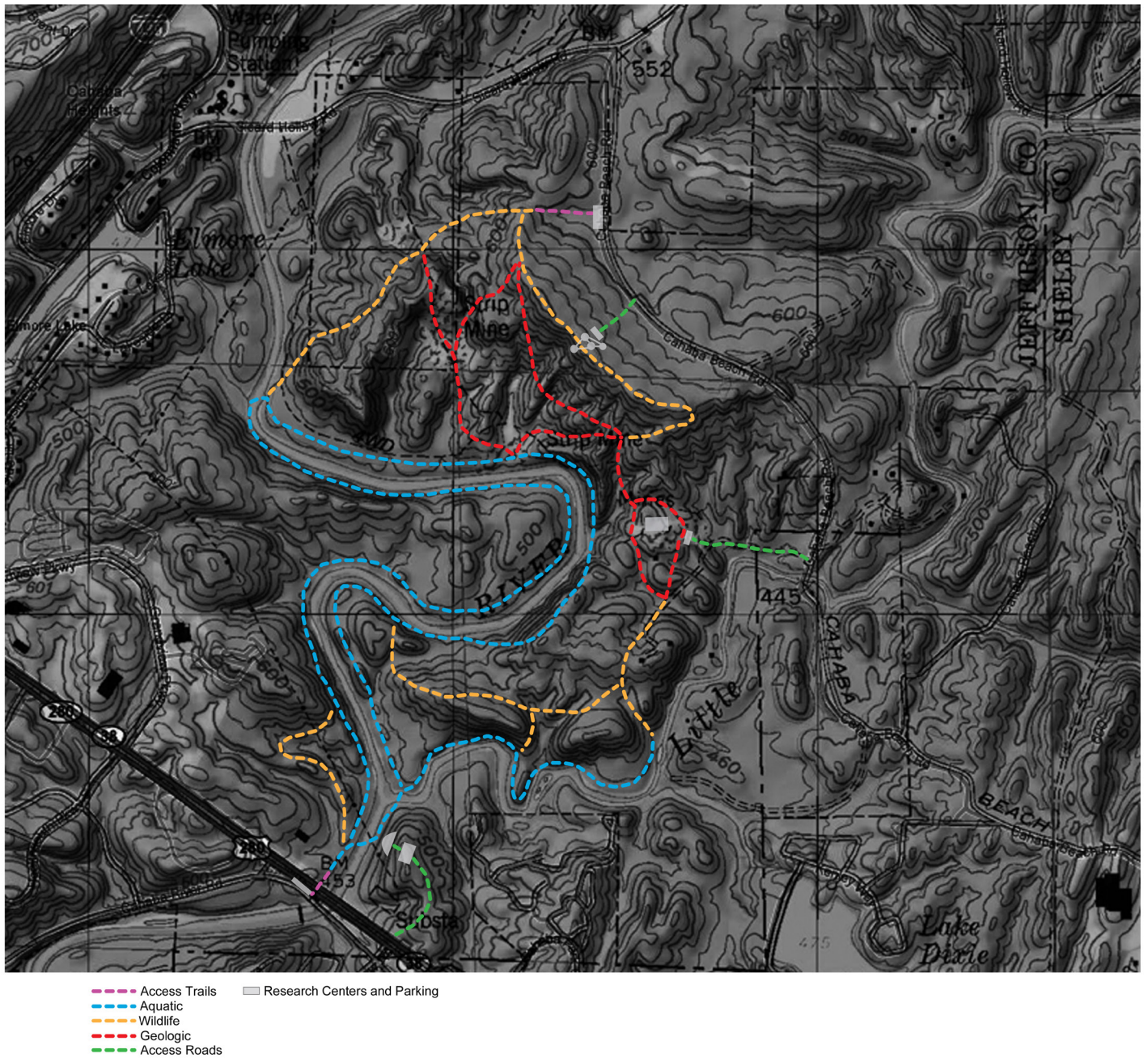
This initial design phase investigates the overall goal of improving civic land holdings and generating a profit for a developer.

The plan is to create a situation, where the public and the private sectors come together, forming a partnership benefitting both parties. In this case, the public sector is made up of Birmingham citizens and visitors, the city government, and the Birmingham Water Works Board, while the private sector consists of local universities and research groups.

The land is obtained from the current owners, the Birmingham Water Works Board, by the universities and research groups using a federally funded grant. After obtaining the land, a trail system designated for public access is implemented on site, allowing visitors and researchers the opportunity to come into contact with one another. The trails system consists of three separate trails, highlighting the assets of the property. The main trail follows the Cahaba River and the Little Cahaba River, crisscrossing the floodplain on trails created by people walking. The idea is not to designate where people can and cannot go, it is to give them the opportunity to explore and find their own way, while still being guided through the site. Countless site visits prove that wildlife is abundant on the site, so a similar trail through the ridges and valleys and away from other visitors makes up the wildlife portion of the trail system. Lastly, the coal mining heritage on the site is highlighted by its own series of trails. Winding through above-ground mining locations, walking past flooded underground mines, and travelling on abandoned mining roads can take the visitor back in time and allow them to paint their own picture of the past.

After the trail system has been established, three separate research centers are set up throughout the property that allow researchers and students to learn hands-on skills in the field. These researchers and students teach people visiting the park what is being studied and give them advice on how to maintain, preserve, and restore local habitat and resources. The centers run hand in hand with the ideas behind the trail system. Three centers, geologic, aquatic, and wildlife, are located accordingly with the trail system. Each center is located in close proximity to the trail, giving researchers and visitors maximum opportunity to come into contact.

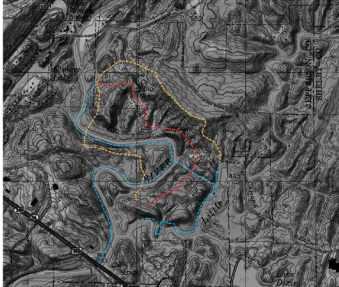
The problem is simple. There would be limited return to the developer and the city would be the only participant reaping the small benefits. The positive aspect of this design is the interconnected trail system. This system will stay in place, but the development possibilities need to change in order to meet the needs of all participating parties.



This image represents the final plan for the initial design. It is broken down into individual parts over the next six pages

- Geologic Trail System
- Aquatic Trail System
- Wildlife Trail System

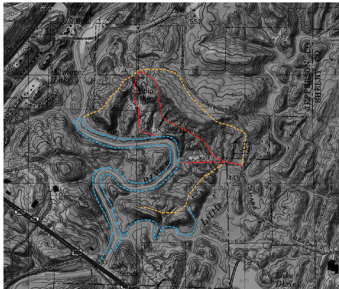
Trail Scheme 1



Trail Scheme 2



Trail Scheme 3



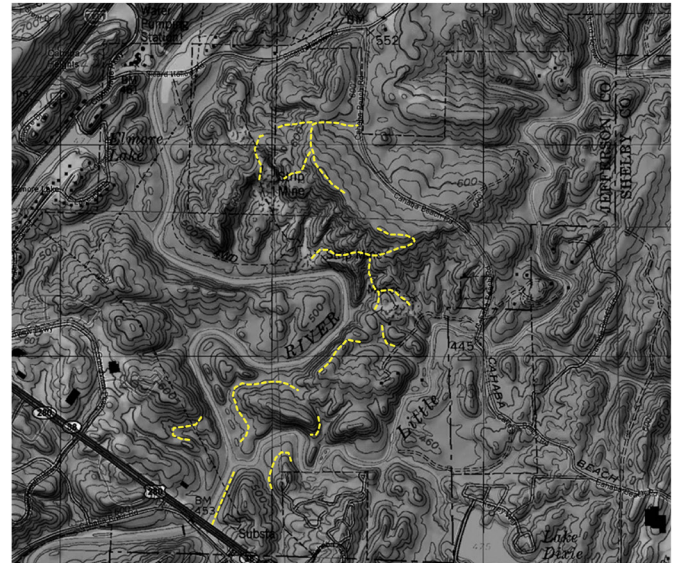
Trail Scheme 4



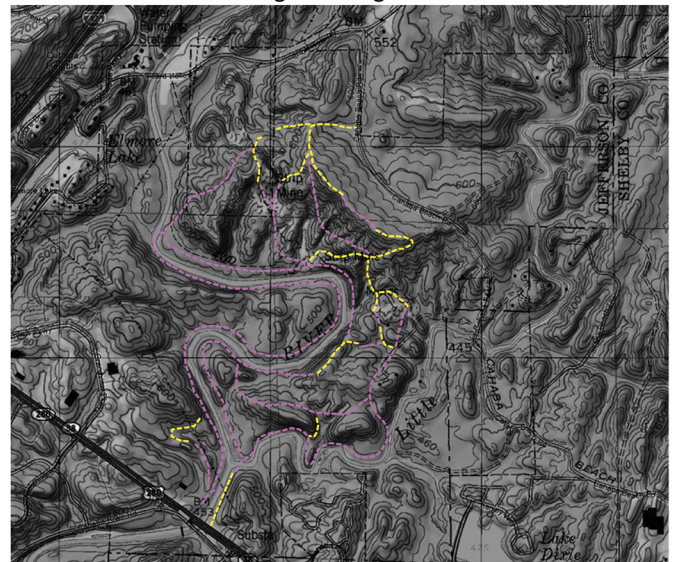
The initial trail design was created using topography and first hand knowledge of the site to generate accessible trails and highlight the chosen qualities of the site. Four schemes were created using the before mentioned criteria and, although similar, there are subtle differences in length, location, and pattern.

These schemes combined and incorporated existing abandoned roadbeds from the mining activity on site. The problem was that the roadbeds led to nowhere and it was a disconnected matrix of roads. So, using the existing roadbeds complimented with original four trail schemes, connections were made in the roadbeds using the best routes from the original schemes. Connecting the roadbed and adding to them now creates a interlocking matrix of three types of trails on the site.

## Existing Roadbeds



## Connecting Existing Roadbeds





Running alongside the Little Cahaba River through the open brush and the quiet wilderness, a visitor comes into contact with a researcher monitoring water quality. Opportunities are abundant along these trails to have encounters with field researchers, allowing the visitor to take something more from the place than a simple walk.



Here, researchers are peeling back leaf litter and years of decay in order to unfold the geologic history of the post-mining era. Visitors enjoy seeing the head wall to the right as it is just another reminder of the strip mining and damage that took place here in the past.



The local Audubon Society teams together with local bird enthusiasts to locate and point out the plethora of birds in the woods. The close proximity to the city allows visitors the chance to get into a woodland setting and experience species that are not commonly found within urbanized areas.

# ONE: AQUATIC RESEARCH CENTER



The Aquatic Center is located just off of Highway 280, in order to draw visitors in as they drive over the river. It can be accessed by foot or through the tunnel entrance that leads to the underground parking garage. The garage was set underground to alleviate any above ground grading, culminating in loss of habitat, and to minimize the introduction of hard surfaces within the natural setting. The Center is surrounded by a curvilinear deck connecting to stairs down to the water. A floating dock is placed in the water for hands-on research for visitors and researchers. It will move up and down during flood stages.

The trail system runs along the Cahaba on both sides, allowing for two different experiences, as well as providing an easy trip for those short on time. It also runs along the north side of the Little Cahaba where it connects with the Geologic Center. Due to its close proximity to the water, visitors may see researchers in the field either in the water or in the pools around the river formed from flooding events. This enables opportunities for sharing information where the visitors can converse with the researchers and learn in a natural setting.



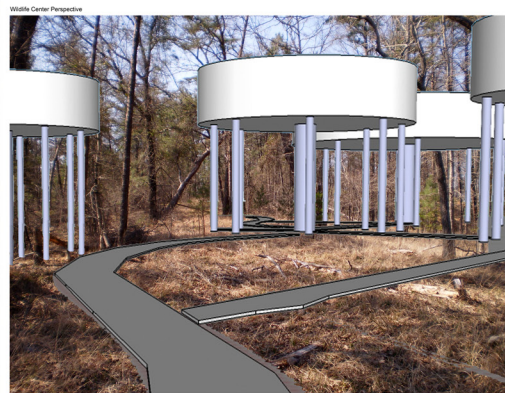
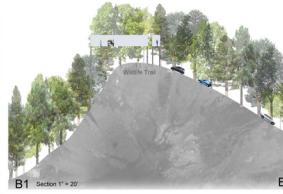
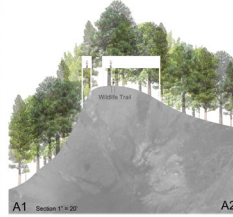
## TWO: GEOLOGIC RESEARCH CENTER



The Geologic Center and surrounding trails highlight the rich geologic history of the site, which was mined for bituminous coal during the early part of the 20th century, until it was eventually mined out in the 1970's. The area was left to be naturally reclaimed, while some existing 40 foot high walls were left intact along with entrances to the underground mines. The underground tunnels have since flooded, leaving a few emerald green water holes.

The center serves as an on-site home base for local researchers, and includes a display area for visitors to get a closer look at what they learn while coming into contact with researchers in the field, or on-site. Structurally, the center is located underground to pay homage to the integrity of the site and the geological nature of the center. Water percolates through the soil above the building but is redirected around the structure with a slight grade in the roof. Existing vegetation is not disrupted. The roof only stops root structure from growing down; when it hits the structure, the roots begin to grow horizontally along the plane of the roof. The platform in front of the structure is a crushed black granite to symbolize coal, and is crossed by concrete paths to allow for two different experiences.

# THREE: WILDLIFE RESEARCH CENTER

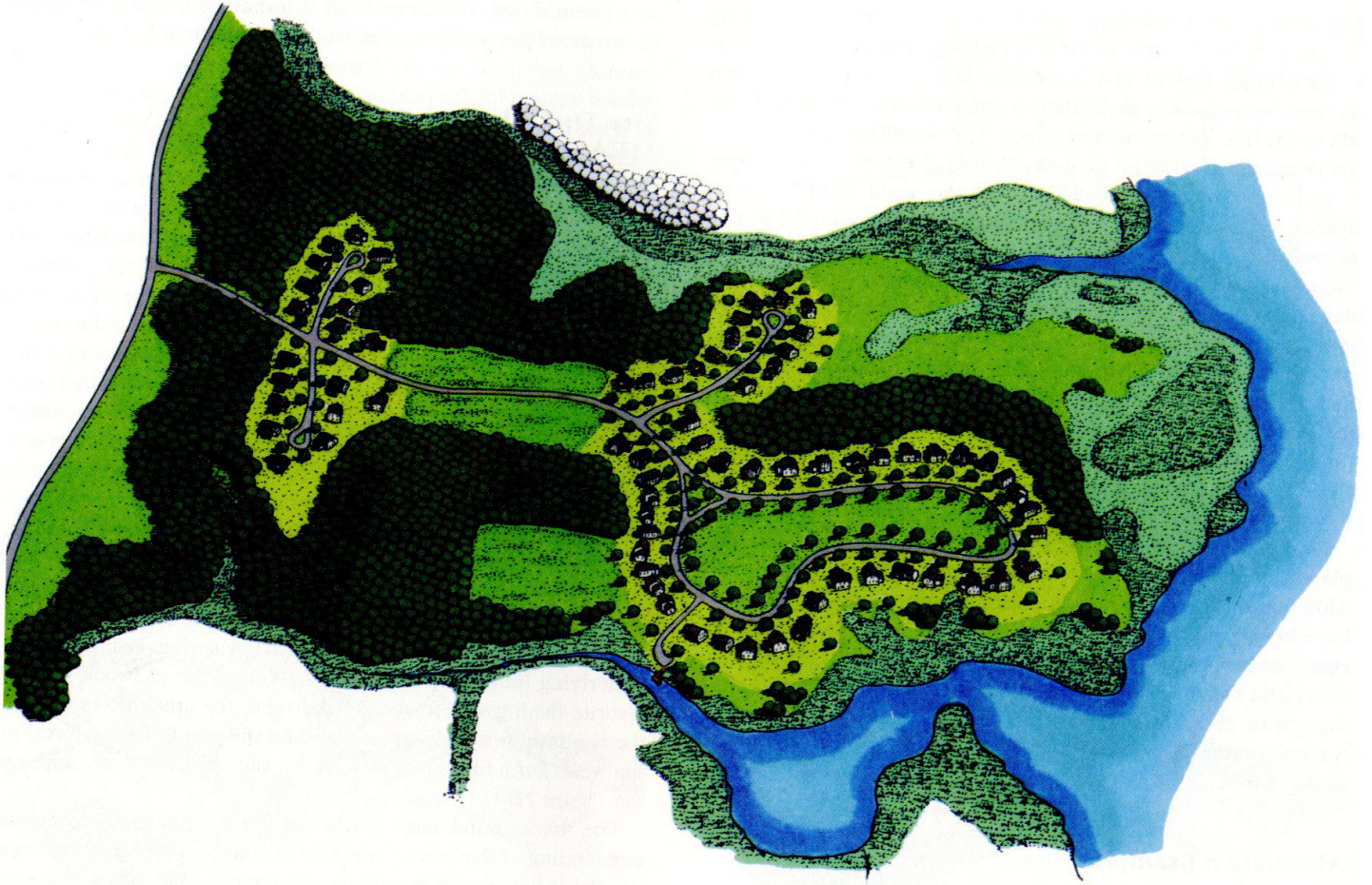


The Wildlife Center and coordinating trails provide for close and far away wildlife encounters. On-site, three major species, deer, turkey, and wild boar, have been identified. The abundance of wildlife in an area so close to commercial and residential development gave impetus to the creation of the wildlife center.

The center is situated atop the highest point on the site, with a sharp ridge to the west which leads to the river, through the geologic research area. Four pods, all with glass windows, contain a wet lab, dry lab, observation and teaching room, and storage. The observatory is located just over the edge of the ridge to provide for the best views of the area, and local wildlife. The pods are elevated as not to disturb the local ecology and habitat of the wildlife, also allowing the visitors a private escape from the trails.

This unique experience of encountering wildlife in a semi-urban setting is not what makes it different from other similar sites. Instead, visitors will see researchers in the field and will be able to ask questions about their current research and what they might see along the trail. This collaborative experience sets the center apart from others.

# CHAPTER 3: RANDALL ARENDT



# ARENDT PROCESS

Research about conservation subdivisions led to the discovery of Randall Arendt, a land use planner, site designer, author, lecturer and proponent of conservation planning. His drive to create more sustainable neighborhoods working with the landscape to conserve it for future generations spraked the final design proposal.

Arendt's Conservation Subdivision design process is quite simple and can be applied to any number of different situations and locales. His design stages include four steps that create a complex approach to the design through a series of different explorations.

## Stages

1. Identify all potential conservation areas
2. Locate the house sites
3. Designing street alignments and trails
4. Drawing lot lines

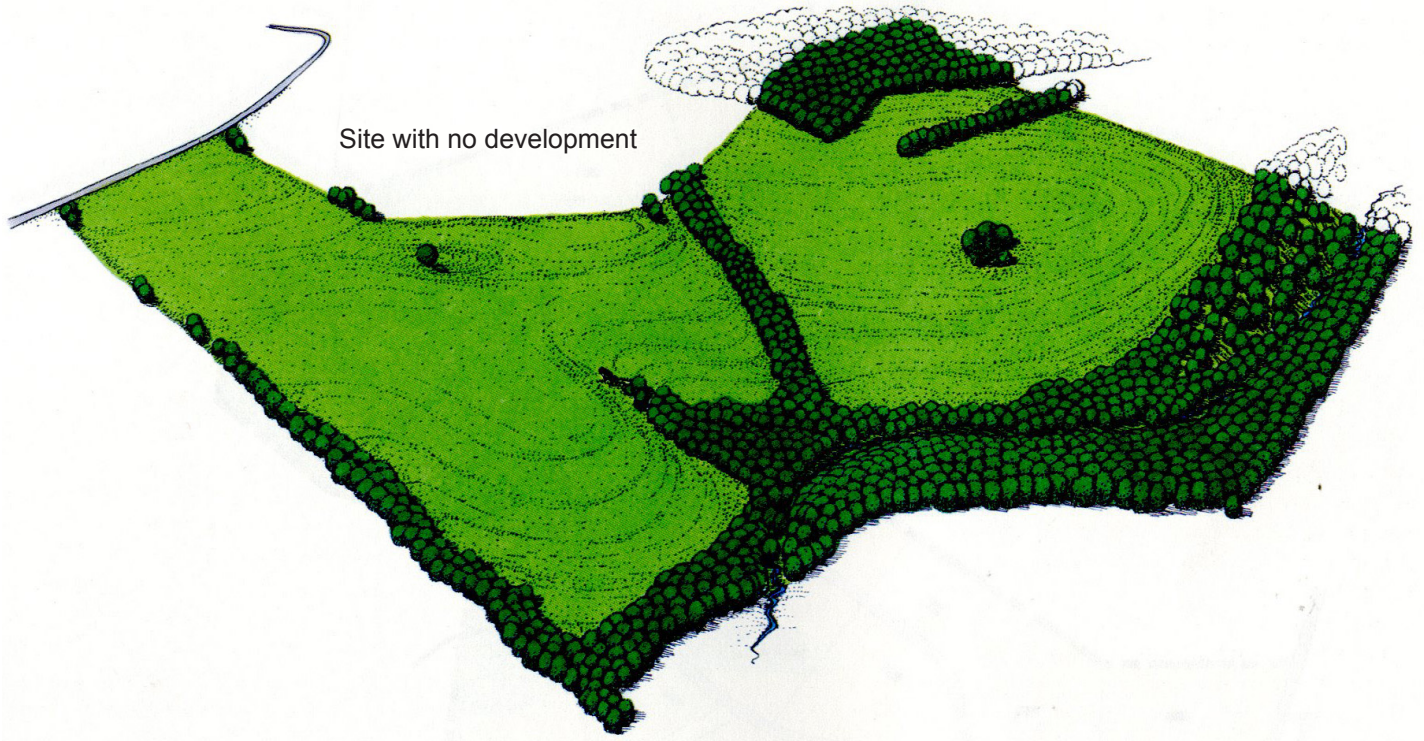
He says "the above sequence of steps may be modified in situations where a more formal, 'neo-traditional,' or village type layout is desired" (Arendt, 1996).

The next four pages illustrate how this process is done, adding a couple of steps along the way to add to the depth of the project.

# ADVANTAGES OF CONSERVATION SUBDIVISIONS

"Conservation subdivision designs offer distinct and measurable economic advantages over conventional layouts in at least five different ways, reflecting various stages or periods in the life of a project" (Arendt, 1996).

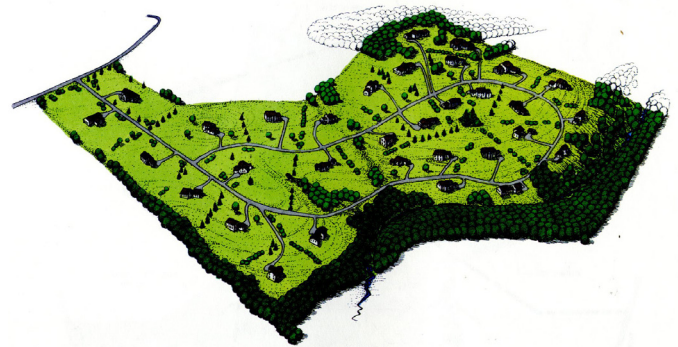
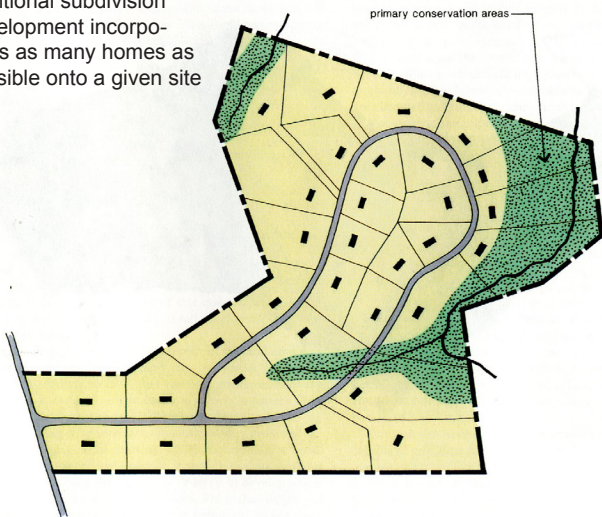
1. **Smoother Review** - The initial start-up process and design phase will take into account sensitive consideration of the townships conservation objectives as well as those of county officials and interested residents. Doing this smooths process, limiting any dispute or confrontation along the way.
2. **Lower Costs** - Conservation design provides opportunity to reduce infrastructure engineering and construction costs by narrowing house lots, streets and utilities can be shortened, meaning less maintenance over time, subdivisions designed with conservation in mind are much cheaper than specialized projects such as golf course communities, etc.
3. **Marketing and Sales Advantage** - The marketing and sales period capitalizes on the amenities preserved within the development, and an environmentally oriented marketing strategy is implemented to highlight the benefits of living in a natural setting.
4. **Value Appreciation** - "Homes in conservation subdivisions tend to appreciate faster than their counterparts in conventional development" (Arendt, 1996). This is also used in the marketing approach to lure buyers to the profitable community.
5. **Reduced Demand for New Parkland** - From the local government perspective, these communities are providing recreational amenities for he city, and over time more and more of this space will be necessary as populations continue to rise. So as each new conservation development meets its needs for recreational amenities some of the pressure is taken off of the local government to take action.



Site with no development

### Site yield plan

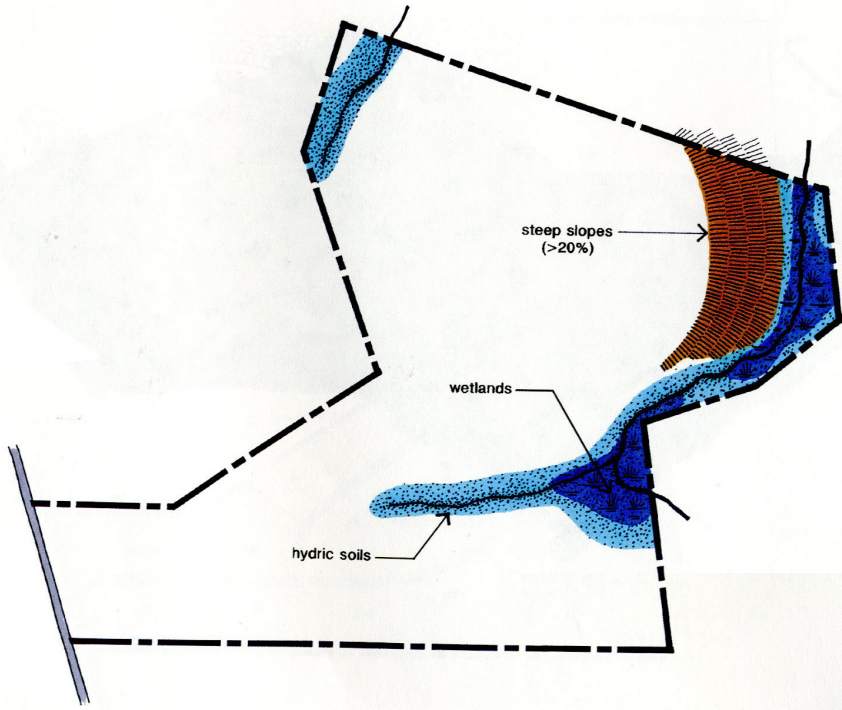
traditional subdivision development incorporates as many homes as possible onto a given site



Site with conventional development

Identify conservation areas

conservation areas can be natural or cultural



Identify potential developable areas

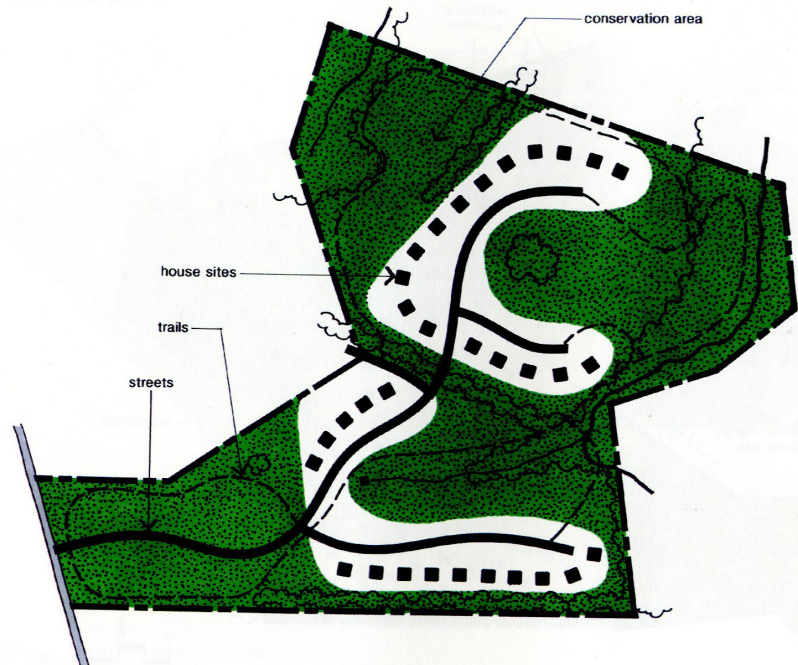




### Locating potential house sites

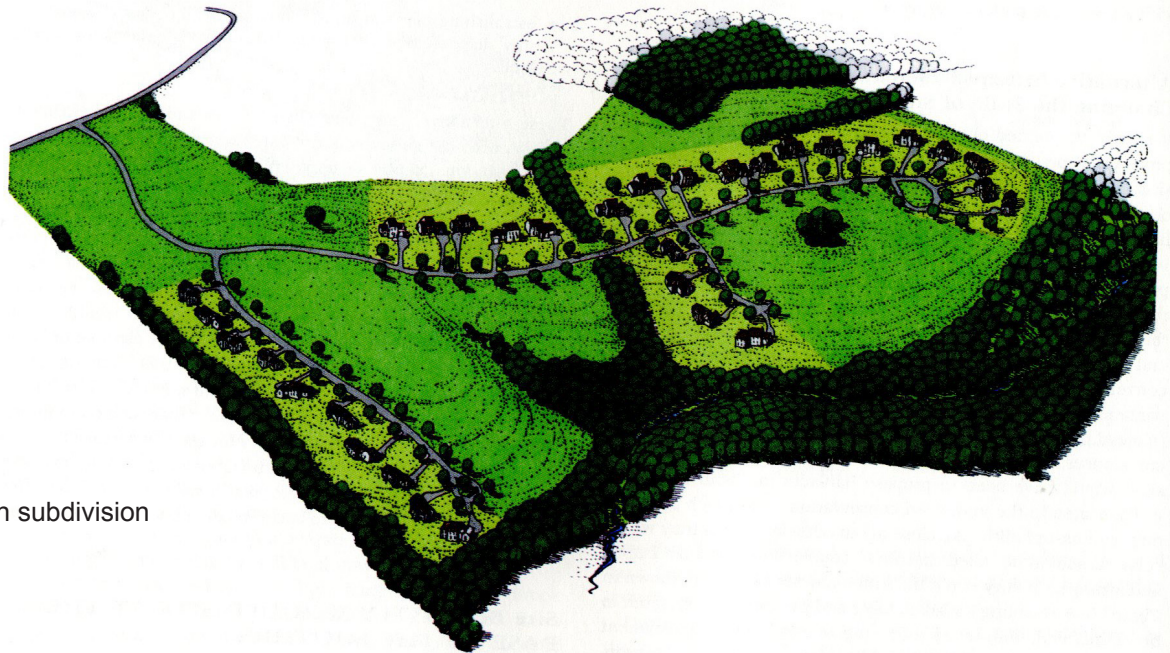
Arendt uses clustered housing to reach a “density neutral” site. This means, that the same amount of homes as a conventional development are built within the site, but their lots are smaller and more land is conserved.

### Design road alignments and trails





Draw in the lot lines



Site with conservation subdivision

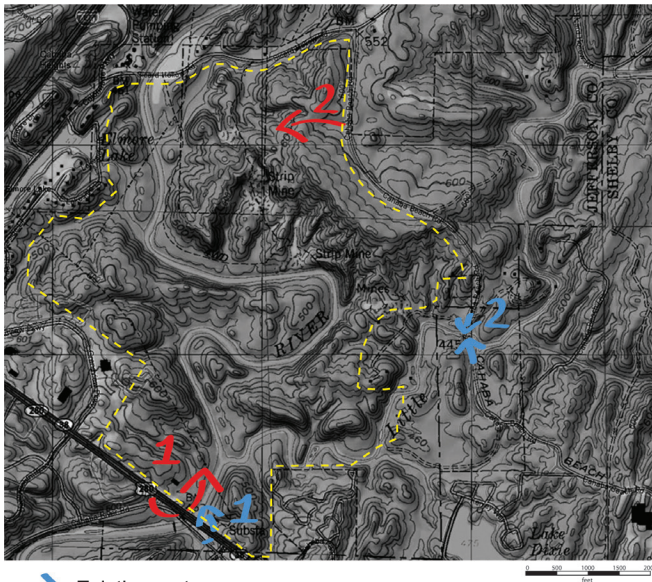


## ADAPTING ARENDT

Arendt's approach is a proven method in the design of conservation subdivisions. The design process for this thesis follows Arendt's process to an extent but the ordering will be slightly different. The process derived from Arendt begins with locating all conservation areas, in this case locating the conservation easement area. Next, the developable areas are located based upon a given set of criteria which is outlined in the next chapter. After locating the developable areas, road layout and home locations are chosen. In contrast to Arendt's process, the next step was to draw the lot lines, before the design of the trails. There is no reason these cannot be reversed, but because of the approach to the design of lots, they were established first.

# CHAPTER 4: SITE INVESTIGATION

# ACCESS



- Existing water access  
 → Existing trail access

1.



2.

1.



2.



## Trail access 1

- Parking between Hwy. 280 and Cahaba River Rd. allows access to the few existing trails along the West side of the Cahaba River.

- Wide access trail goes underneath two bridges, but thins to a single track trail once visitors travel beyond bridges

## Trail access 2

- An old mining entrance leads into the property, but is fairly hidden from the occasional passer-by

- The small roads leads into the property where it connects to an extensive mining road-bed system

## Water access 1

- Car access under Hwy. 280 and Cahaba River Rd. leads to a small parking area and provides a put-in and take-out point for small boats and canoes

- A small roadway continues into the property for 300 feet but blocks automobile access

- Few foot trails run on the East side of the Cahaba and Little Cahaba

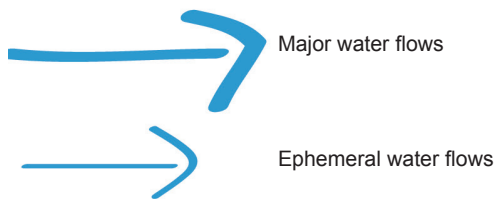
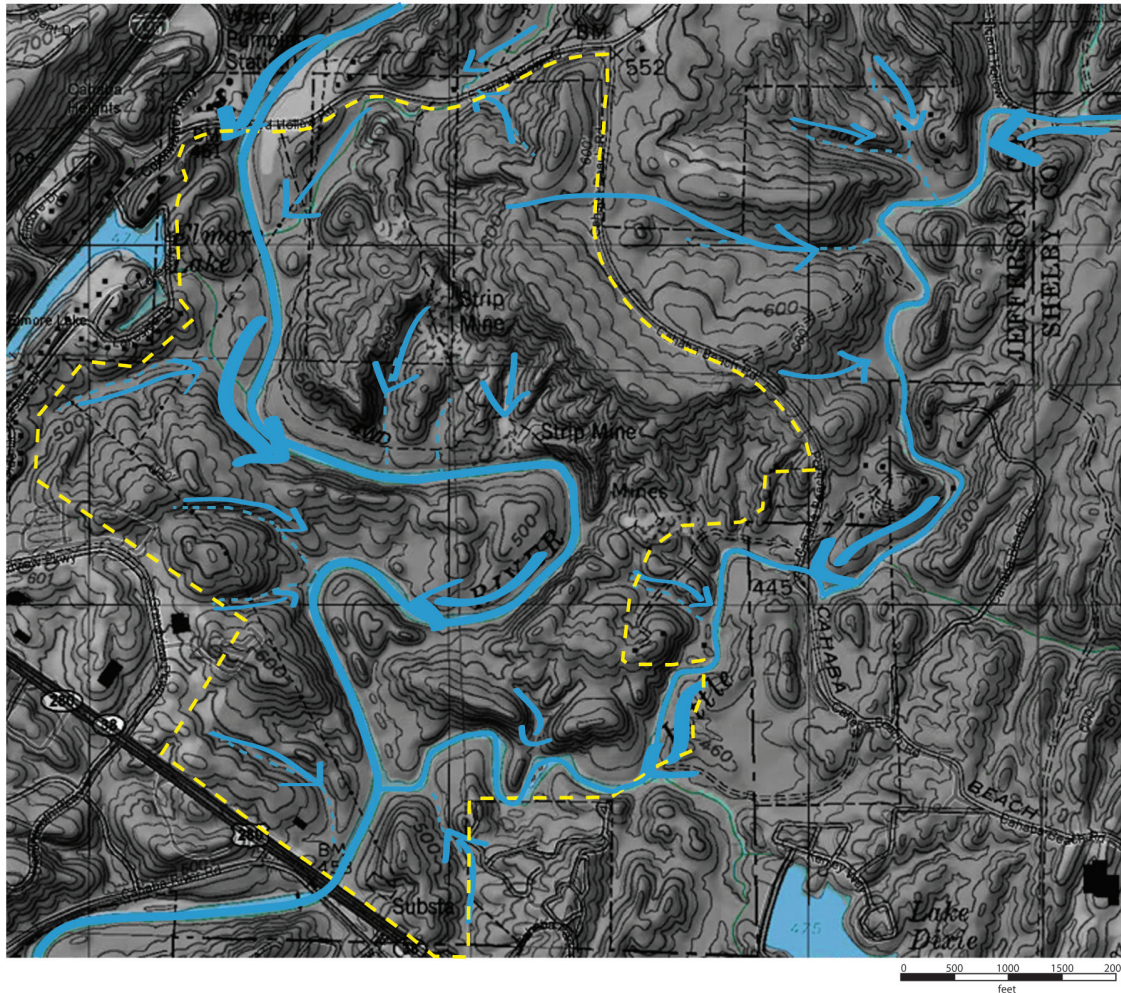
## Water access 2

- Cahaba Beach Rd. extends to an old iron bridge from the North and South that is barricaded, but water access is readily available

- The bridge is a local hang-out, hidden from major roads and accessed via dirt-road from Hwy. 280 (South entrance) and Cahaba Beach Rd. from the North

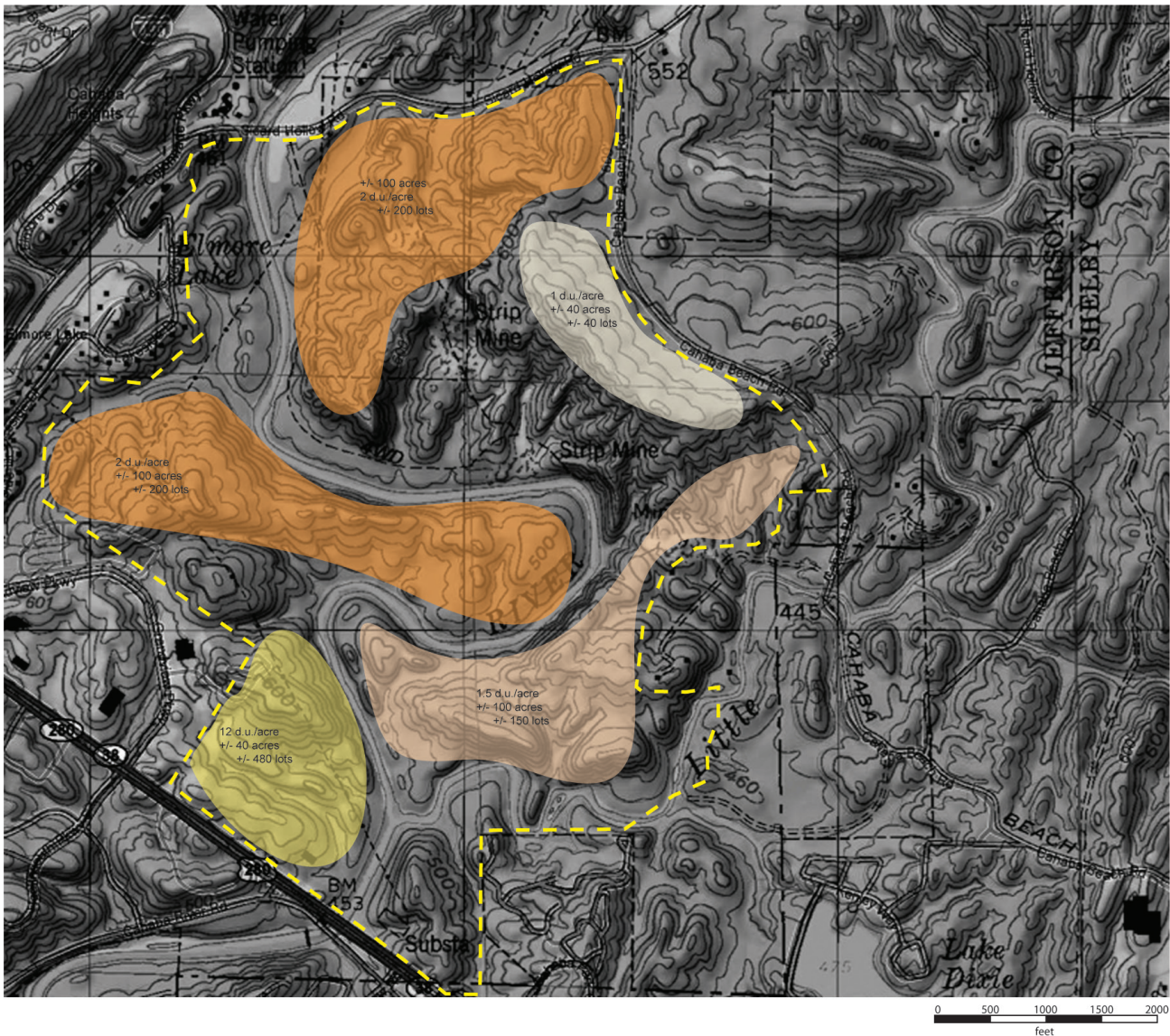
Trail access one remains as the Highway 280 entry point to the trail system and water access one remains as a boat launch area. Trail access two remains a public entry from Cahaba Beach Road, but now runs through the clustered housing development and water access two remains, but because of its location off of the chosen site, it is to be left unchanged.

# WATER



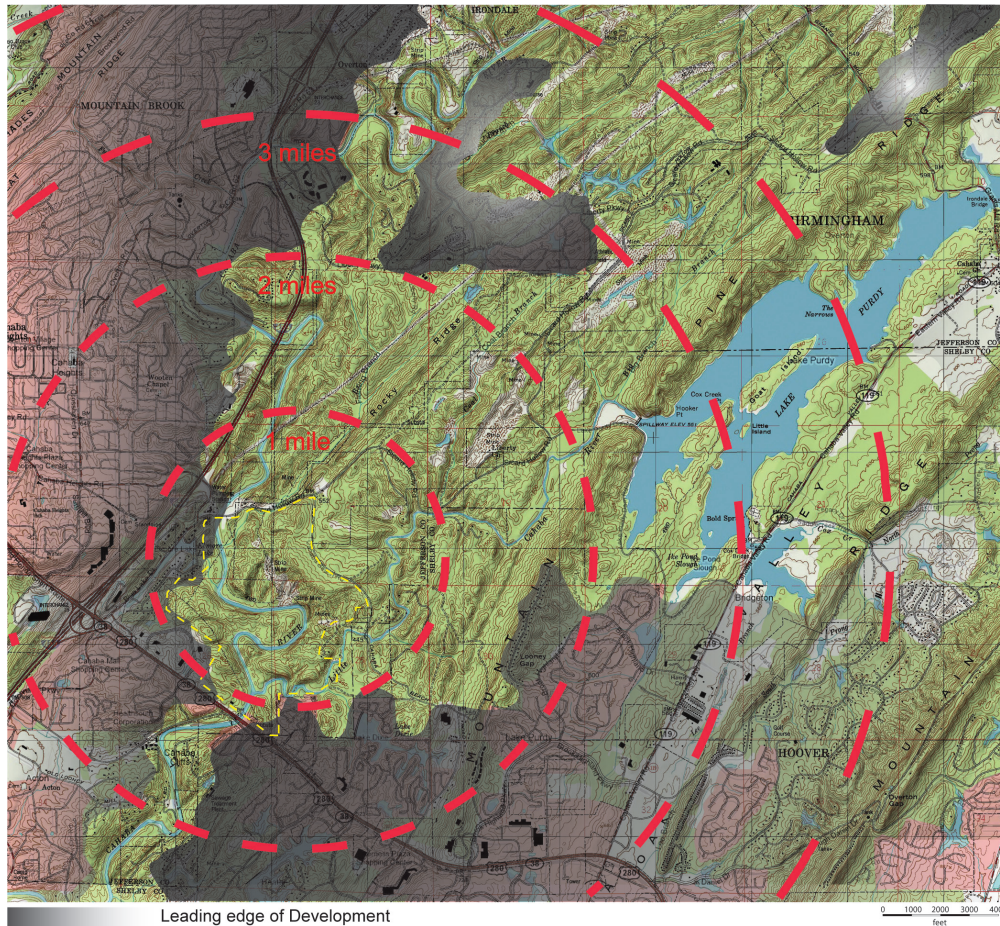
Locating major water flows, the Cahaba River and Little Cahaba River, and the ephemeral flows on the site will help in locating potential developable areas. With the a major goal being to minimize disturbance, the developed areas should try to remain as conscious of all of these flows as possible.

# CARRYING CAPACITY



This diagram illustrates how a traditional developer might approach the site. Almost all of the site would be graded in order to fit the maximum number of units on the buildable portion of the property. In this scenario, a developer could provide as many as 600 individual lots, and would also build apartments along Highway 280.

# PROXIMITIES

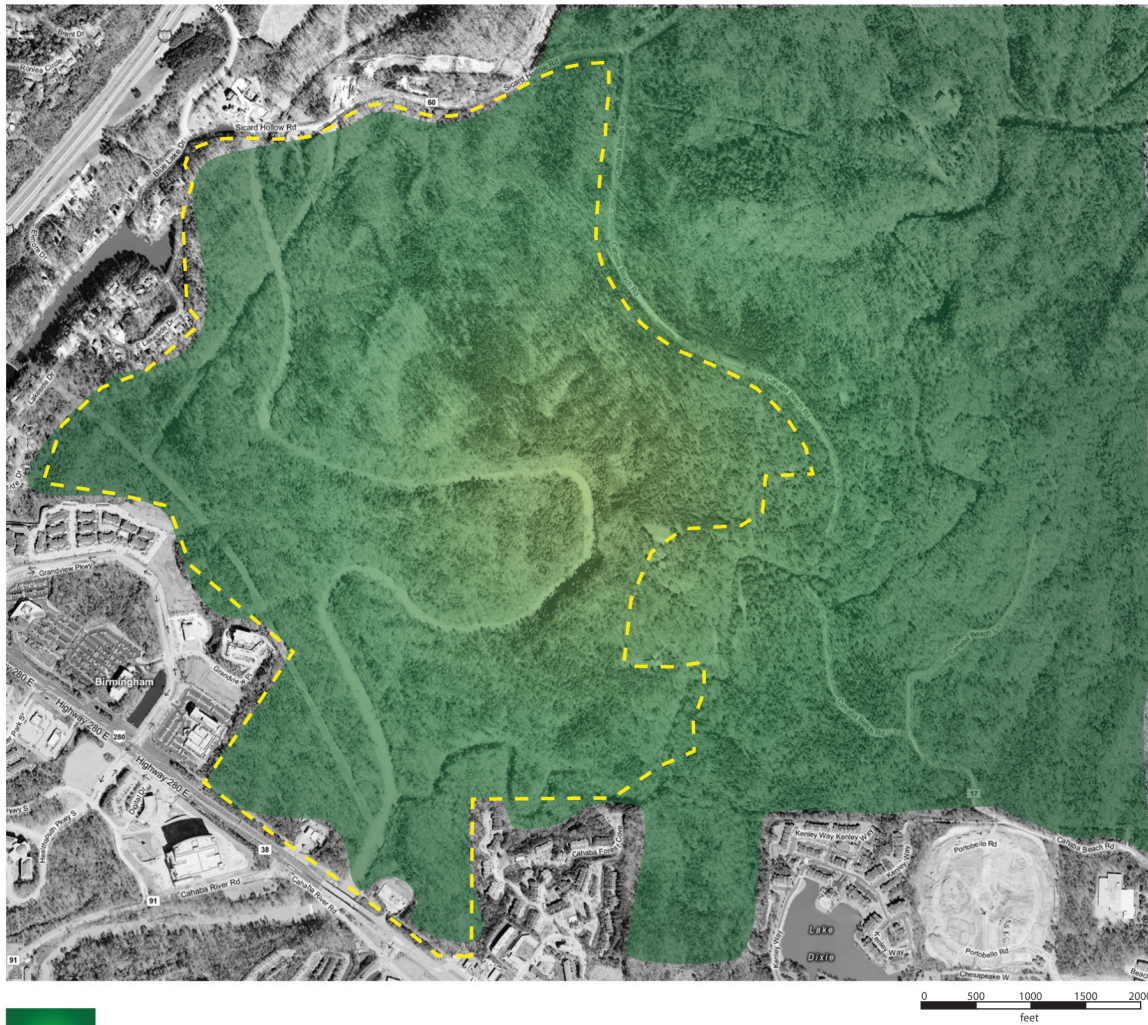


Up to 1 mile: pristine wilderness, Cahaba River, Little Cahaba River, connections to: Sicard Hollow Rd., Cahaba Beach Rd. and Interstate 459

2 miles: extended pristine wilderness to the northeast, Summit shopping center, Colonnade shopping center, Target shopping center, connections to: Cahaba Heights and Highway 280

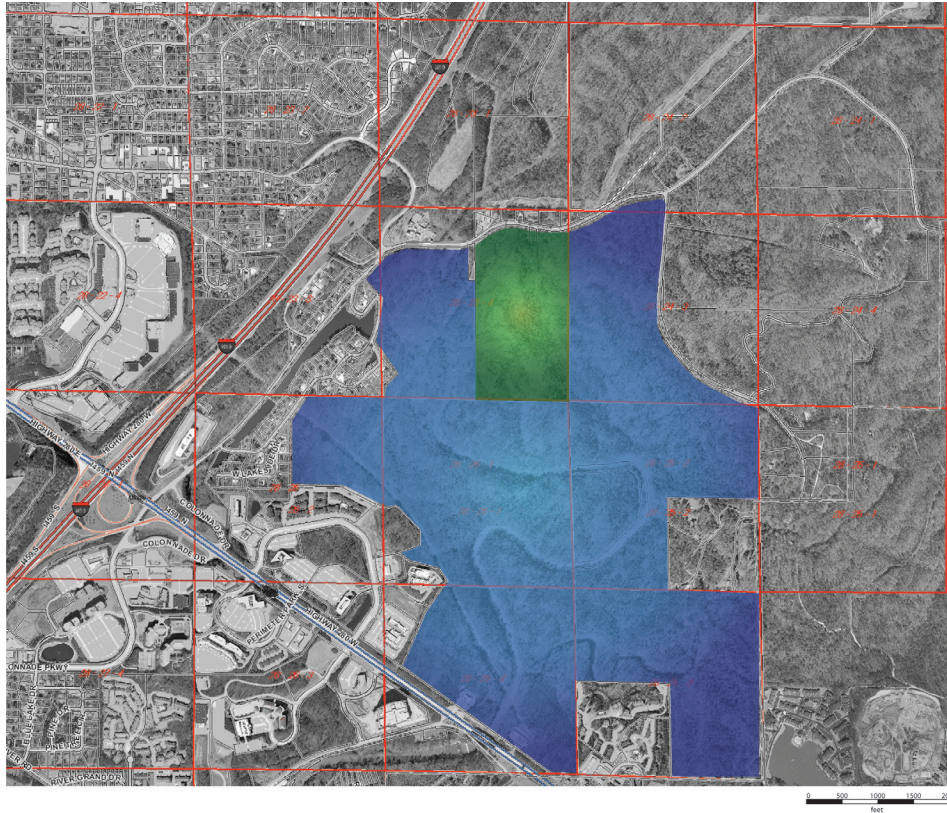
3 miles: extended pristine wilderness to the northeast, Lake Purdy, Liberty Park Elementary School, connections to: Old Overton Country Club, Wal-Mart shopping center, Hoover, Mountain Brook, Liberty Park (Vestavia), Highway 119,

4 miles: connections to: Shoal Creek Country Club, Greystone Country Club



This area is at the southern end of a ten mile strip of woodlands reaching into Birmingham. It gets cut off to the North by Interstate 20, but remains relatively untouched for those 10 miles. The goal is not to break up a beautiful piece of land, instead it is to keep in unified through careful design.

# PROPERTY OWNERSHIP



## Birmingham Water Works Property - 655 acres

This property falls within the Cahaba River/ Lake Purdy Watershed and any development within this area must follow guidelines set forth in the Water Works Board's Watershed Protection Policy



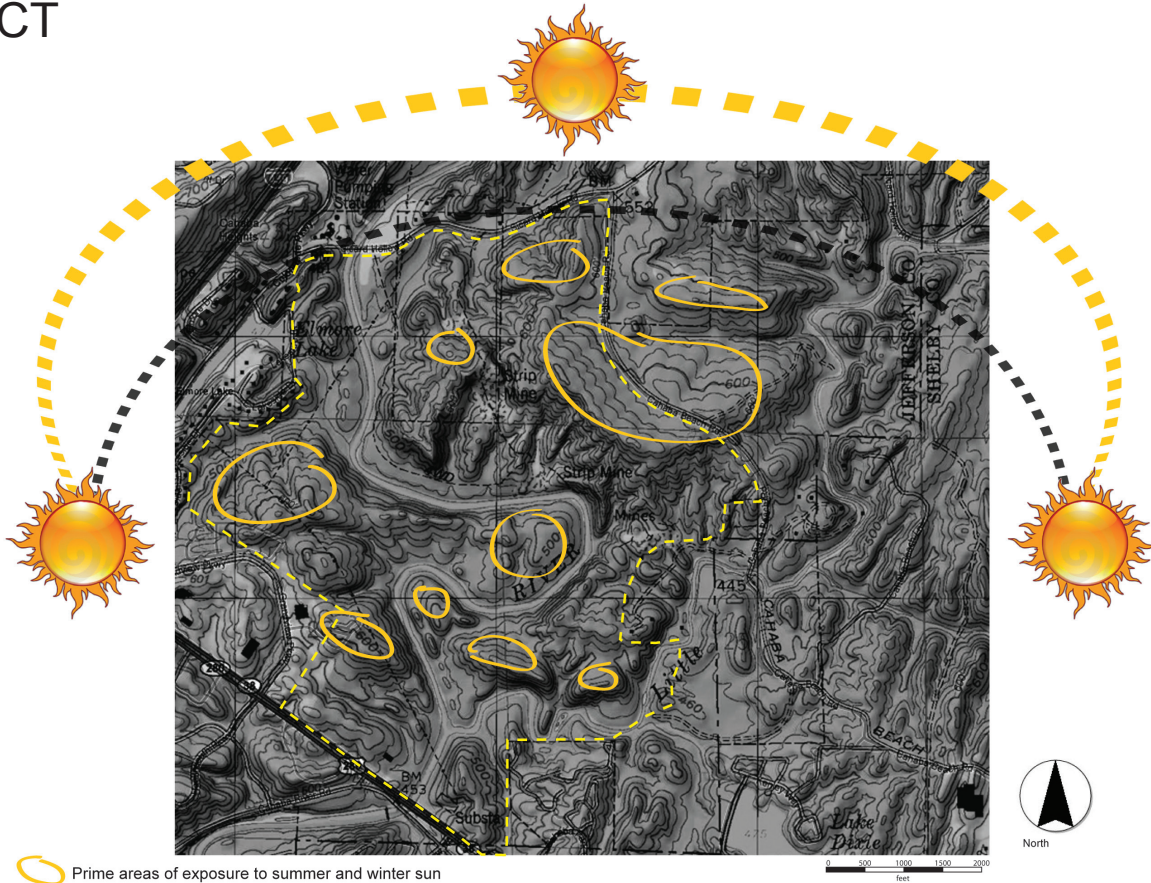
## Fleming Branch LLC - 70 acres

Fleming Branch LLC and the Birmingham Water Works Board are considering entering into a development agreement wherein Fleming Branch LLC could develop seven estate sized lots on an allotted approximately 23 acre area adjacent to Sicard Hollow Rd. The remaining 50 acres would be designated a conservation easement for tax credits, OR the land could be sold to the Water Works Board, giving the Board full ownership of the property. While Fleming Branch LLC would collect profits from the new development, they would have to return some monies to the Water Works Board until the initial investment of \$1,112,500 was met.

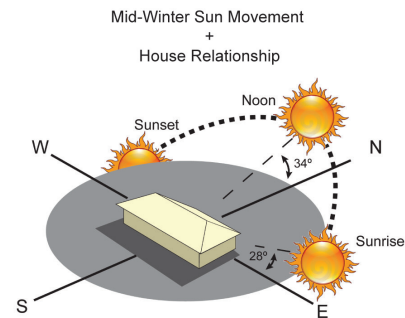
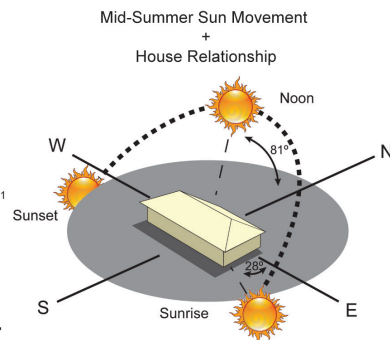
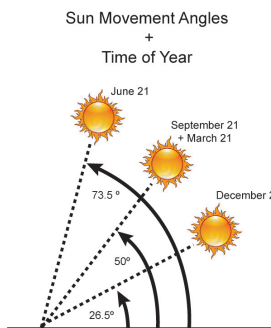
The Fleming Branch research is strictly informational to realize how a development of this type might be approached. Although there is talk about a conservation easement, Fleming Branch LLC has not moved forward with any plans and the final design will disregard their agreement. The property owned by the LLC is to be left untouched and worked around in this project.



# ASPECT

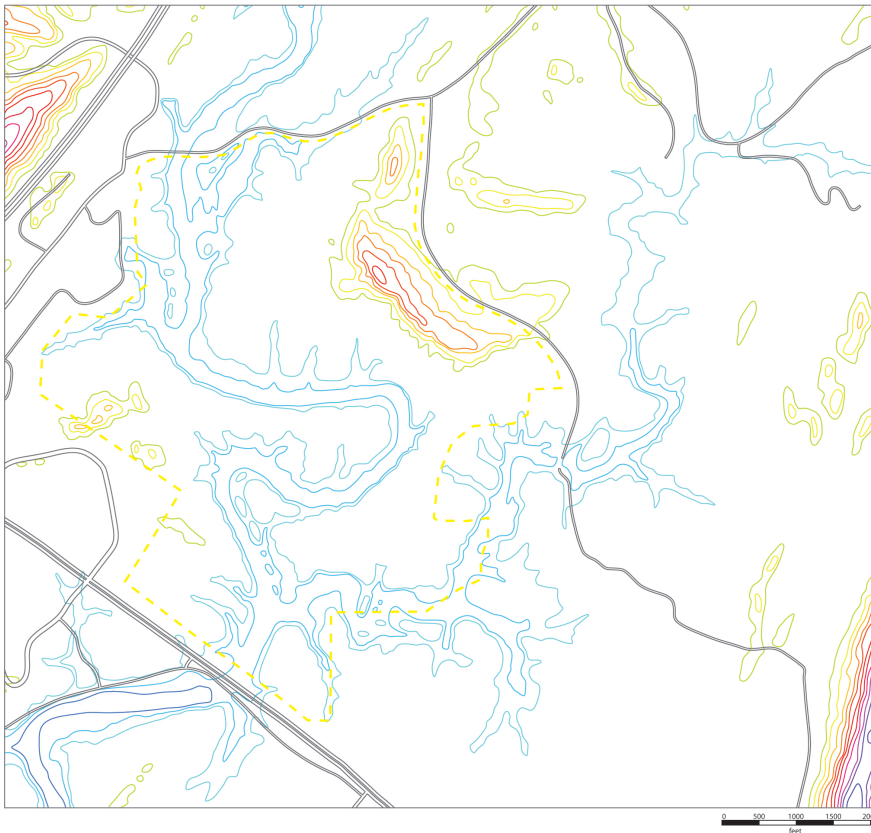
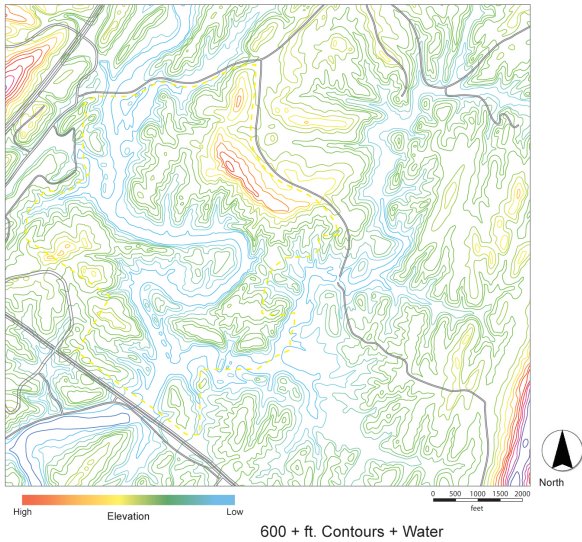


○ Prime areas of exposure to summer and winter sun



The above map shows the prime areas of exposure for sun. The largest area, not blocked by any other terrain, is the ridge adjacent to Cahaba Beach Road, highlighting a major area of interest for development. Another useful tool for the final design is the understanding of home layout. The homes take the most advantage of the sun when they are located on a north-south axis.

# TOPOGRAPHY



- Located in Cahaba River + Lake Purdy Watershed

- Elevation change: 380 ft. total change -- 420 ft. (water level) to 700 ft. (high point on site)

- There is a multitude of high points within the site, but the major peaks are at 600 + ft.

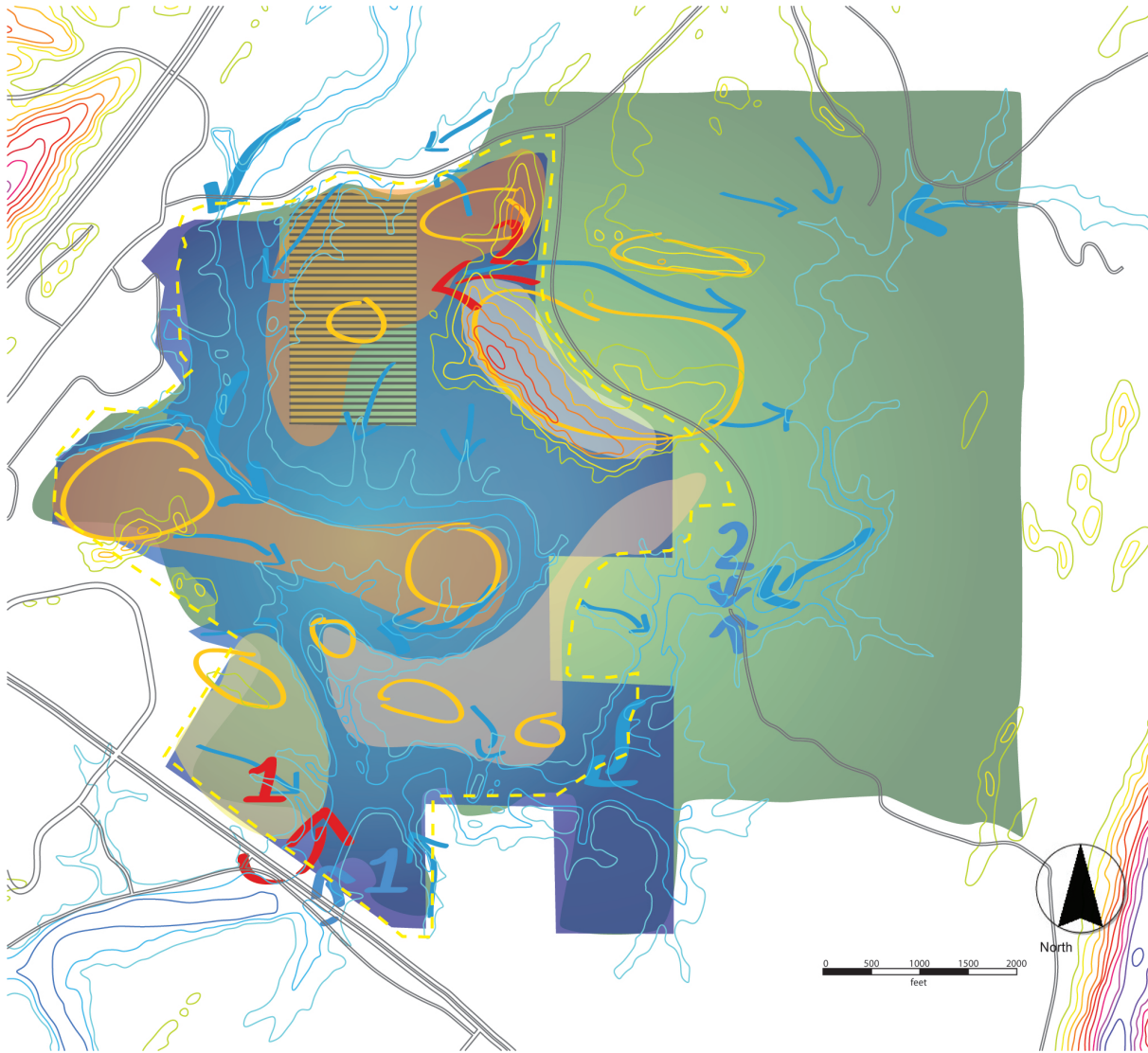
- Areas of higher elevation with north facing slopes will receive full summer and winter sunlight because they will not be blocked by opposing hillshade

- A small ridge runs East - West along Cahaba Beach Rd. comprising the high point of 700 ft. and an easy connection to the road

- A portion of the ridge extends further west to the corner of Sicard Hollow Rd. and Cahaba Beach Rd. reaching 680 ft. and allowing a connection to both existing roadways

Using topography as a guide, the thought is that these high points and ridges will provide for the best available locations for the clustered housing development.

# OVERLAY



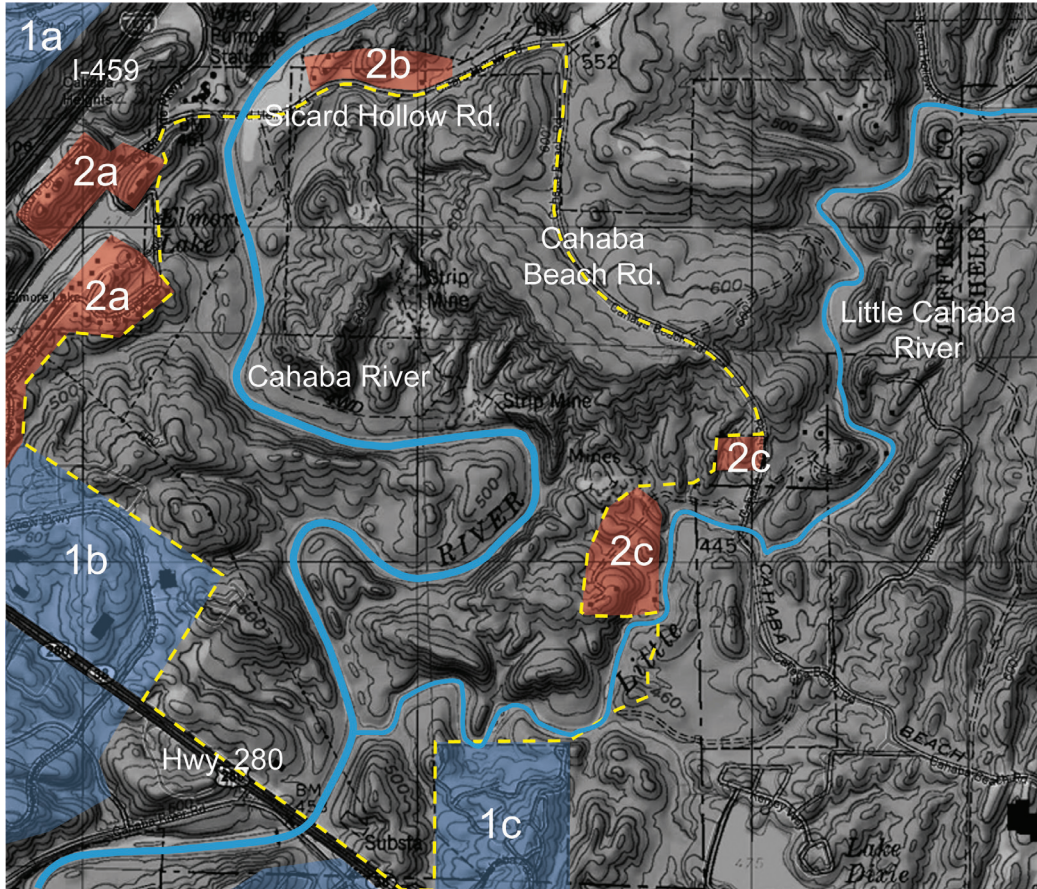
- development sites are chosen based on access, water, carrying capacity, proximity, vegetation, property ownership, aspect, and topography
- densities of these criteria are looked at as areas to be developed
- locating densities and developing in those areas links the development to the surrounding landscape
- maintaining the connection between the developed areas and the wilderness extending to the northeast will be a major area of focus

The overlay begins to show where potential site locations may be. The idea is to focus on those areas that contain multi-properties from the analysis as buildable zones and to move forward with a design of the potential sites.

# CHAPTER 5: DESIGN INVESTIGATIONS

# POTENTIAL DEVELOPABLE AREAS

After analysis of the site, and looking at the overlay of the site conditions, a diagrammatic approach to the design took place. The purpose was to locate potential developable areas in order to move forward with a design. This map sets up the diagrams with initial conditions on site.



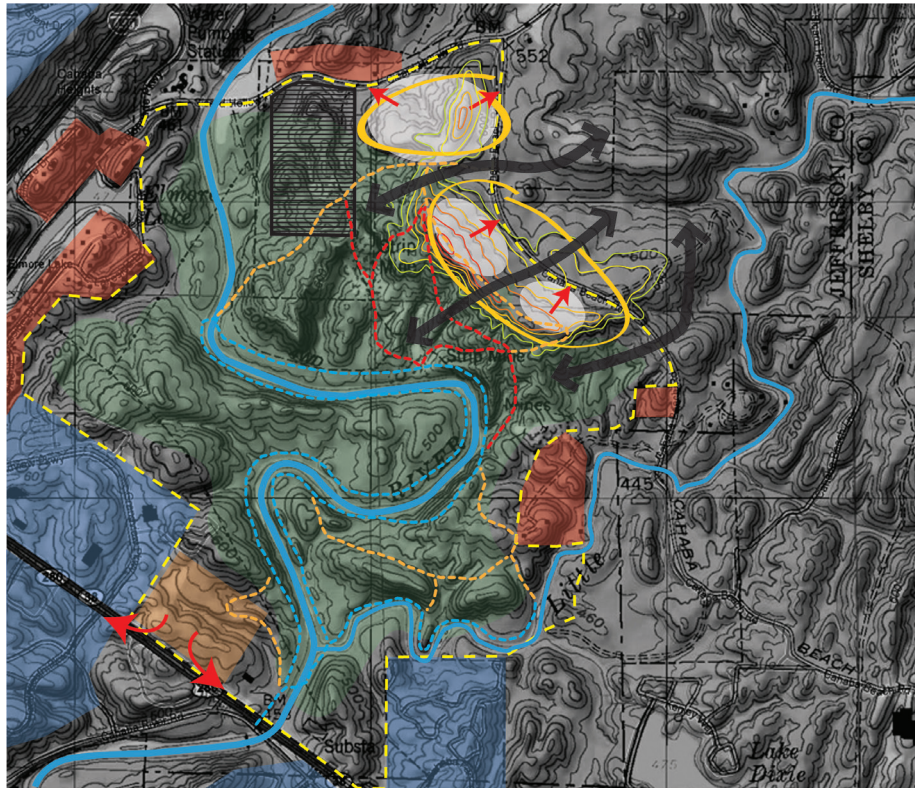
## 1. Existing Commercial + Apartments

- 1a. Summit Shopping Center, Cameron at the Summit Apartment Complex
- 1b. Grandview Center, Colonnade Shopping Center, Grandview Apartments
- 1c. Lake Dixie Apartment Complex

## 2. Existing Single-Home Residential

- 2a. Blue Lake Subdivision
- 2b. 7 homes along Sicard Hollow Rd.
- 2c. 8 homes assessable from Sicard Hollow Rd. and Cahaba Beach Rd.

# DIAGRAM ONE



pro

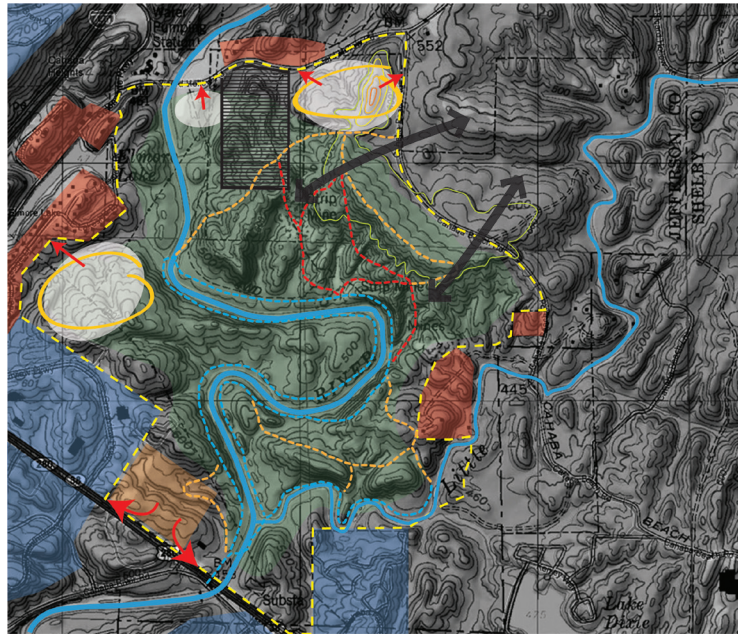
- areas along Sicard Hollow Rd. and Cahaba Beach Rd.
  - receive year round sunlight
  - focused around highest elevations within the site
  - allow connections to be made to both Sicard Hollow and Cahaba Beach Roads
  - within Birmingham Water Works property
  - outside of Flemming Branch LLC property
  - privacy from Hwy. 280 and most surrounding development
  - clustered housing allows for wildlife corridors
  - access to conservation trail system

- commercial area along Hwy. 280
  - easy access to Hwy. 280
  - visibility from road
  - proximity to existing commercial and residential development
  - access to conservation trail system

con

- areas along Sicard Hollow Rd. and Cahaba Beach Rd.
  - funnels wildlife between housing instead of allowing uninterrupted movement
- commercial area along Hwy. 280
  - commercial development may not be the most profitable opportunity, residential apartments are scattered close by

# DIAGRAM TWO



## pro

area along Sicard Hollow Rd. and Cahaba Beach Rd.

- receive year round sunlight
- focused around higher elevation within the site
- allow connections to be made to both Sicard Hollow and Cahaba Beach Roads
- within Birmingham Water Works property
- outside of Flemming Branch LLC property
- privacy from Hwy. 280 and most surrounding development
- single clustered housing allows for one wildlife corridor instead of multiple
- access to conservation trail system

area behind Elmore Lake Subdivision

- receives full year-round sunlight
- grouped closer to existing development allowing for larger single piece of land to be preserved

commercial area along Hwy. 280

- easy access to Hwy. 280
- visibility from road
- proximity to existing commercial and residential development

## con

area along Sicard Hollow Rd. and Cahaba Beach Rd.

- fairly close proximity to existing housing along Sicard Hollow Rd. (>10 homes)

area behind Elmore Lake Subdivision

- no existing access to neighborhood, meaning new road ways would need to be constructed
- closed off the south by commercial development

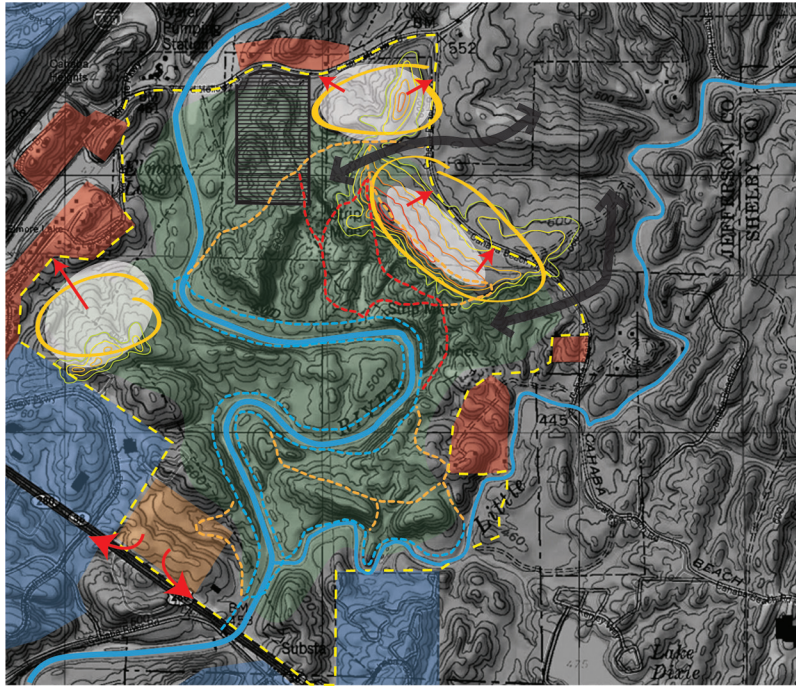
area adjacent to Cahaba River along Sicard Hollow Rd.

- in floodplain
- no buffer from river

commercial area along Hwy. 280

- commercial development may not be the most profitable opportunity, residential apartments are scattered close by

# DIAGRAM THREE



pro

areas along Sicard Hollow Rd. and Cahaba Beach Rd.

- receive year round sunlight
- focused around highest elevations within the site
- allow connections to be made to both Sicard Hollow and Cahaba Beach Roads
- within Birmingham Water Works property
- outside of Flemming Branch LLC property
- privacy from Hwy. 280 and most surrounding development
- clustered housing allows for wildlife corridors
- access to conservation trail system

area behind Elmore Lake Subdivison

- receives full year-round sunlight
- grouped closer to existing development allowing for larger single piece of land to be preserved

commercial area along Hwy. 280

- easy access to Hwy. 280
- visibility from road
- proximity to existing commercial and residential development

con

areas along Sicard Hollow Rd. and Cahaba Beach Rd.

- funnels wildlife between housing instead of allowing uninterrupted movement

area behind Elmore Lake Subdivison

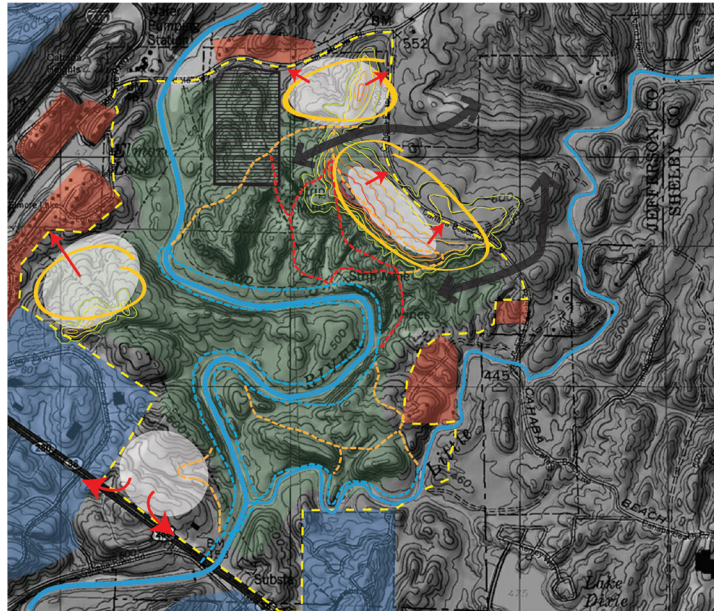
- no existing access to neighborhood, meaning new roadways would need to be constructed
- closed off the south by commercial development

commercial area along Hwy. 280

- commercial development may not be the most profitable opportunity, residential apartments are scattered close by



# DIAGRAM FOUR



## pro

areas along Sicard Hollow Rd. and Cahaba Beach Rd.

- receive year round sunlight
- focused around highest elevations within the site
- allow connections to be made to both Sicard Hollow and Cahaba Beach Roads
- within Birmingham Water Works property
- outside of Flemming Branch LLC property
- privacy from Hwy. 280 and most surrounding development
- clustered housing allows for wildlife corridors
- access to conservation trail system

area behind Elmore Lake Subdivison

- receives full year-round sunlight
- grouped closer to existing development allowing for larger single piece of land to be preserved

residential area along Hwy. 280

- easy access to Hwy. 280
- visibility from road
- proximity to existing commercial and residential development
- allows more housing in a small area, works toward "density neutral" development
- access to conservation trail system

## con

areas along Sicard Hollow Rd. and Cahaba Beach Rd.

- funnels wildlife between housing instead of allowing uninterrupted movement

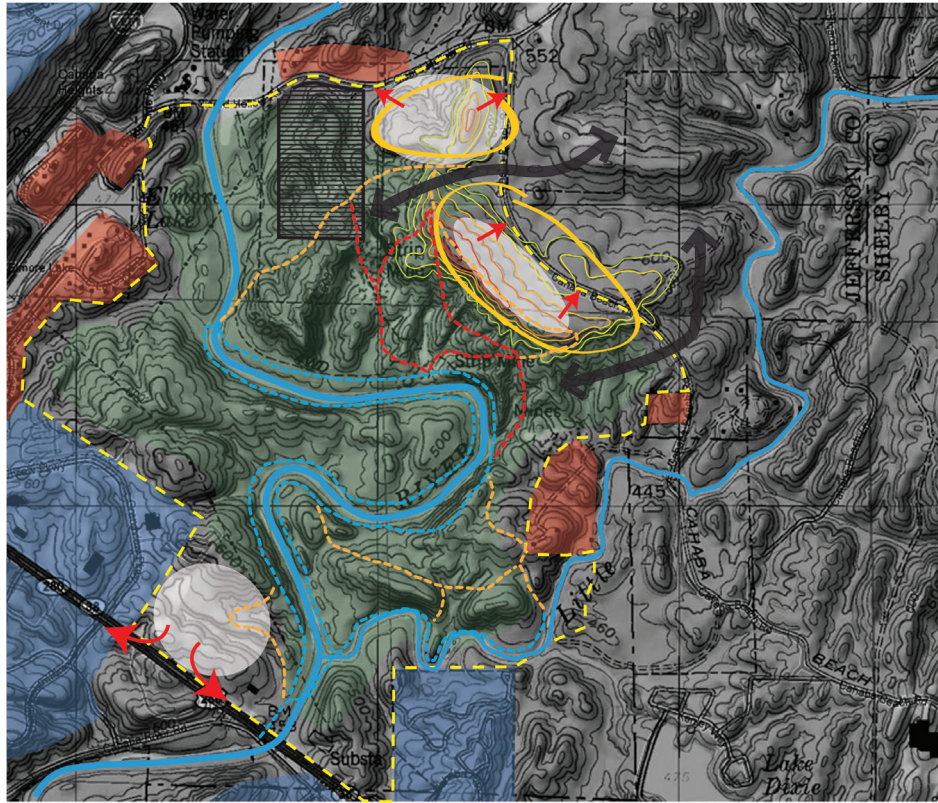
area behind Elmore Lake Subdivison

- no existing acces to neighborhood, meaning new roadways would need to be constructed
- closed off the south by commercial development

residential area along Hwy. 280

- Hwy. 280 is filled with commercial property as well as residential apartments

# DIAGRAM FIVE



pro

areas along Sicard Hollow Rd. and Cahaba Beach Rd.

- receive year round sunlight
- focused around highest elevations within the site
- allow connections to be made to both Sicard Hollow and Cahaba Beach Roads
- within Birmingham Water Works property
- outside of Flemming Branch LLC property
- privacy from Hwy. 280 and most surrounding development
- clustered housing allows for wildlife corridors
- access to conservation trail system

residential area along Hwy. 280

- easy access to Hwy. 280
- visibility from road
- proximity to existing commercial and residential development
- allows more housing in a small area, works toward "density neutral" development
- access to conservation trail system

con

areas along Sicard Hollow Rd. and Cahaba Beach Rd.

- funnels wildlife between housing instead of allowing uninterrupted movement

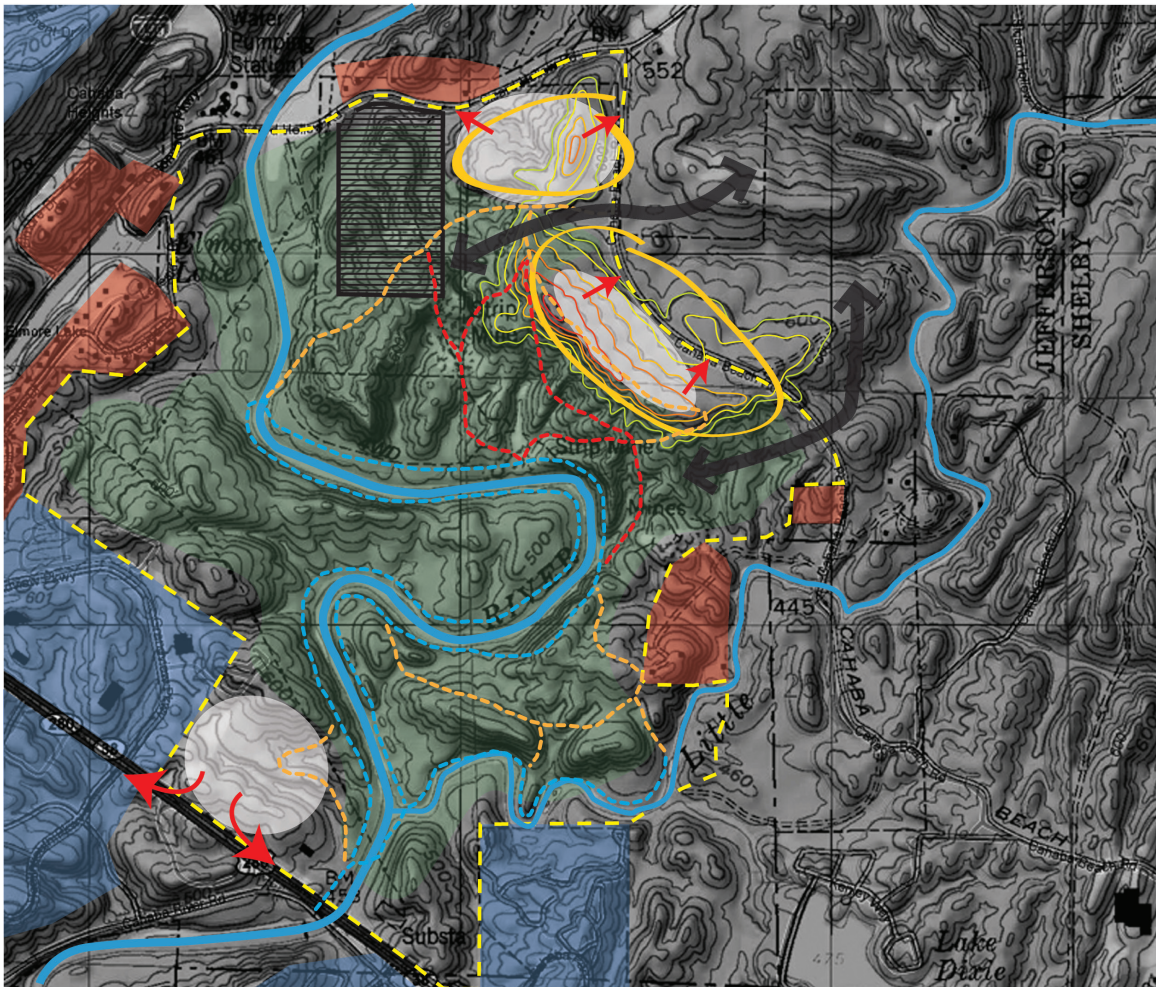
residential area along Hwy. 280

- Hwy. 280 is filled with commercial property as well as residential apartments

# DIAGRAMMING CONCLUSIONS

After studying the pro's and con's of five different scenarios for development, Diagram five becomes the one chosen. Capitalizing on a neighborhood in the woods with a quaint and private setting, the two locations on the ridge were chosen for residential development. Also, along Highway 280 an area has been identified as a valuable piece of terrain for a developer to implement apartment buildings. The current design leaves the apartments off and focuses only on the residential development on the ridge, while the area highlighted in green will serve as a conservation easement around the rivers and coal mining sites.

As the analysis has shown, the locations are prime areas in capturing summer and winter sunlight, they are located atop the highest ridge on the property, although not the highest in the surrounding area, they allow for wildlife movement through the developable areas, and the property can be bought from a single owner.

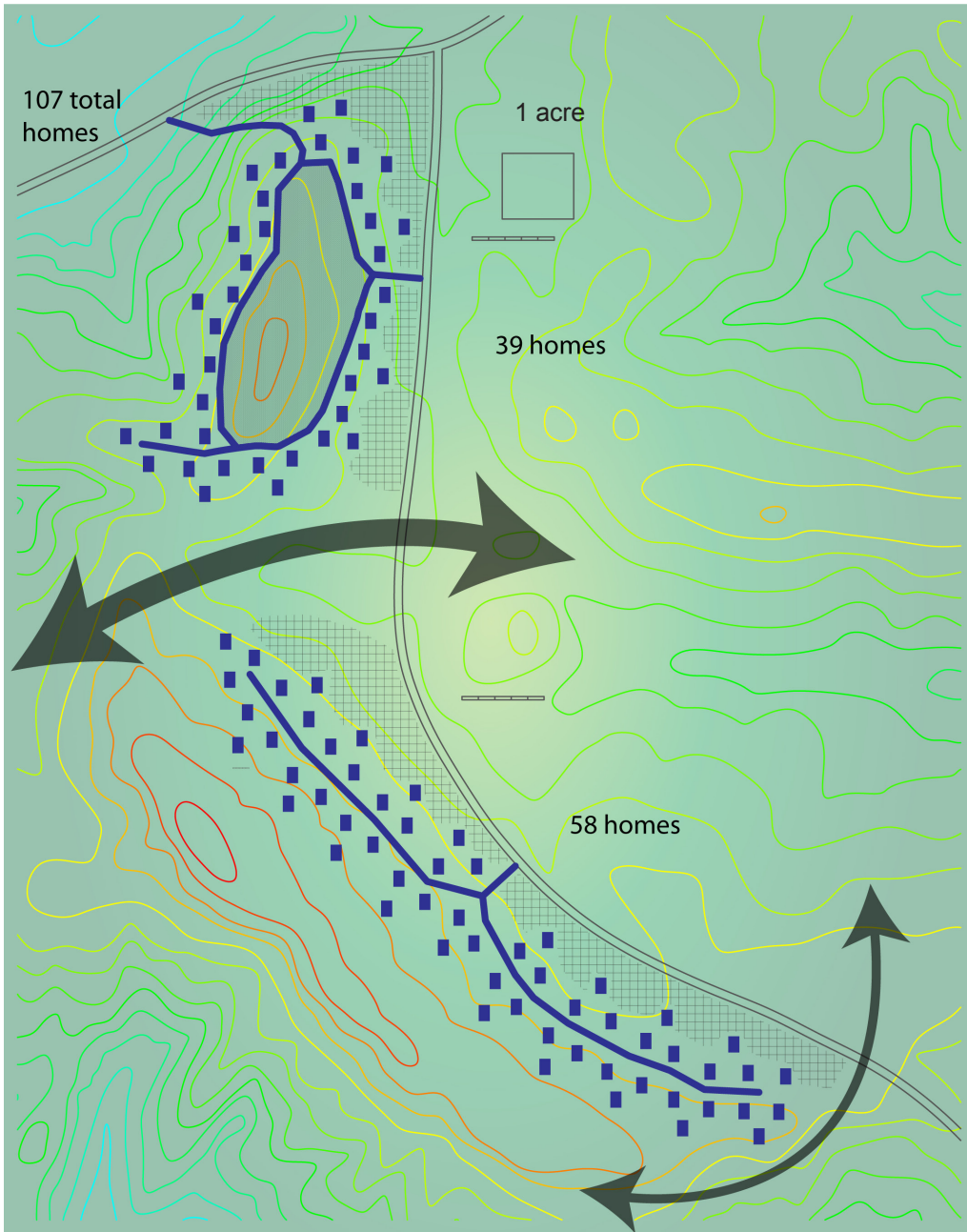


## LOCATING HOMES + ROAD ALIGNMENT

The process now zooms in on the locations chosen for development and the focus shifts towards housing and road layout. Arendt goes about doing this by placing houses first and then coming back with the roads (see pages 36-37). In this plan, the roads were designed at the same time the housing was configured.

All road designs work with the terrain in order to minimize grading costs and to create as little disturbance as possible.

# HOUSING + ROAD LAYOUT 1



pro

- access to both roads
  - enclosed communal open space
  - through access
  - buffer from Cahaba Beach Rd.
- con

- steep grade from Sicard Hollow Rd.
- no wildlife movement through homes

1,092 total feet of roadway

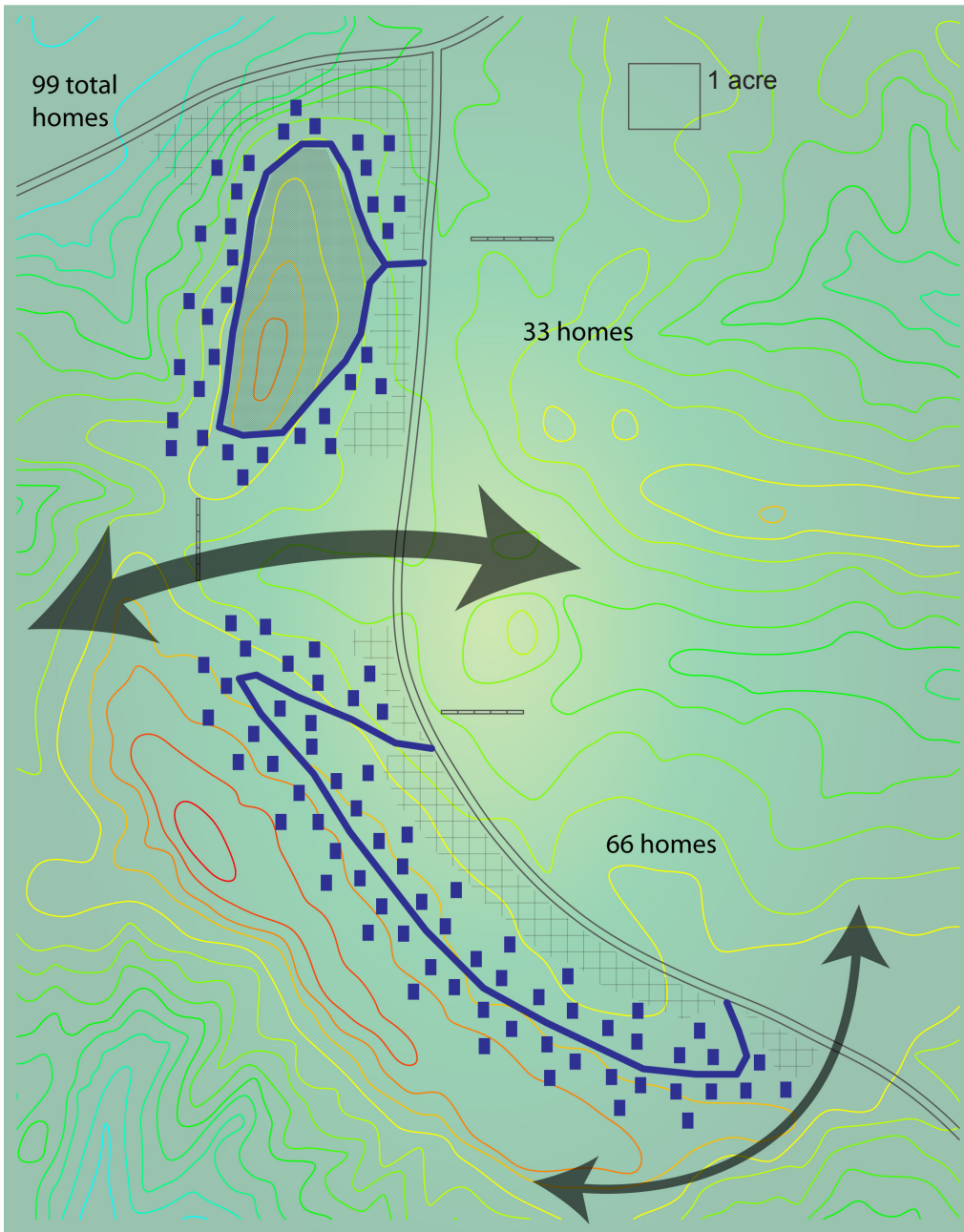
pro

- buffer from Cahaba Beach Rd.

con

- single access point
- no wildlife movement through homes
- no through access

# HOUSING + ROAD LAYOUT 2



pro

- communal area between homes
- possibility for one-way road
- through access

con

- no wildlife movement through homes
- least amount on homes
- no access to Sicard Hollow Rd.

1,067 total feet of roadway

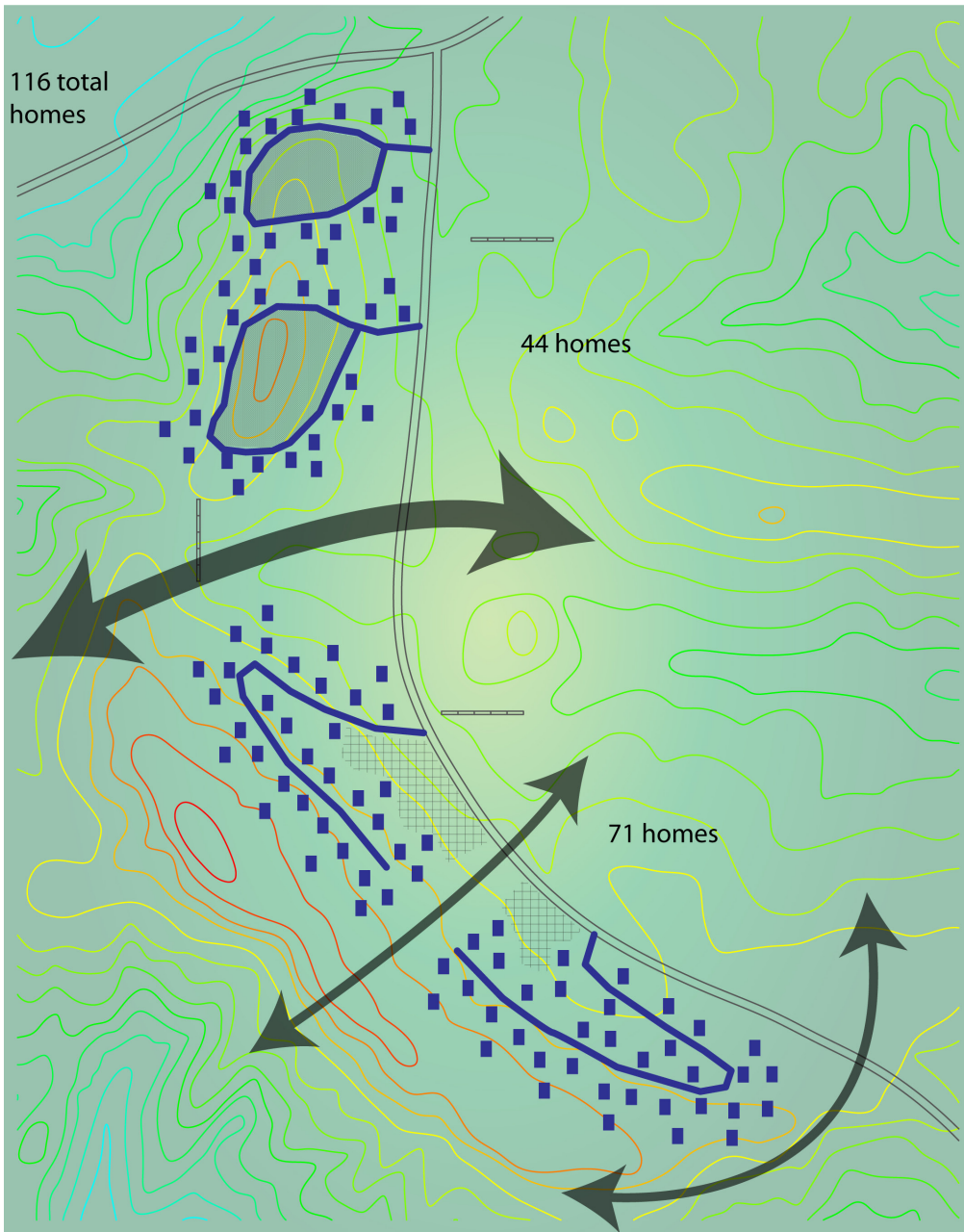
pro

- possibility of one-way road
- second largest plan
- through access
- buffer from Cahaba Beach Rd.

con

- no wildlife movement through homes
- no open/communal space for residents

# HOUSING + ROAD LAYOUT 3



pro

- through access
- communal/open space for residents

con

- no wildlife movement through homes

1,207 total feet of roadway

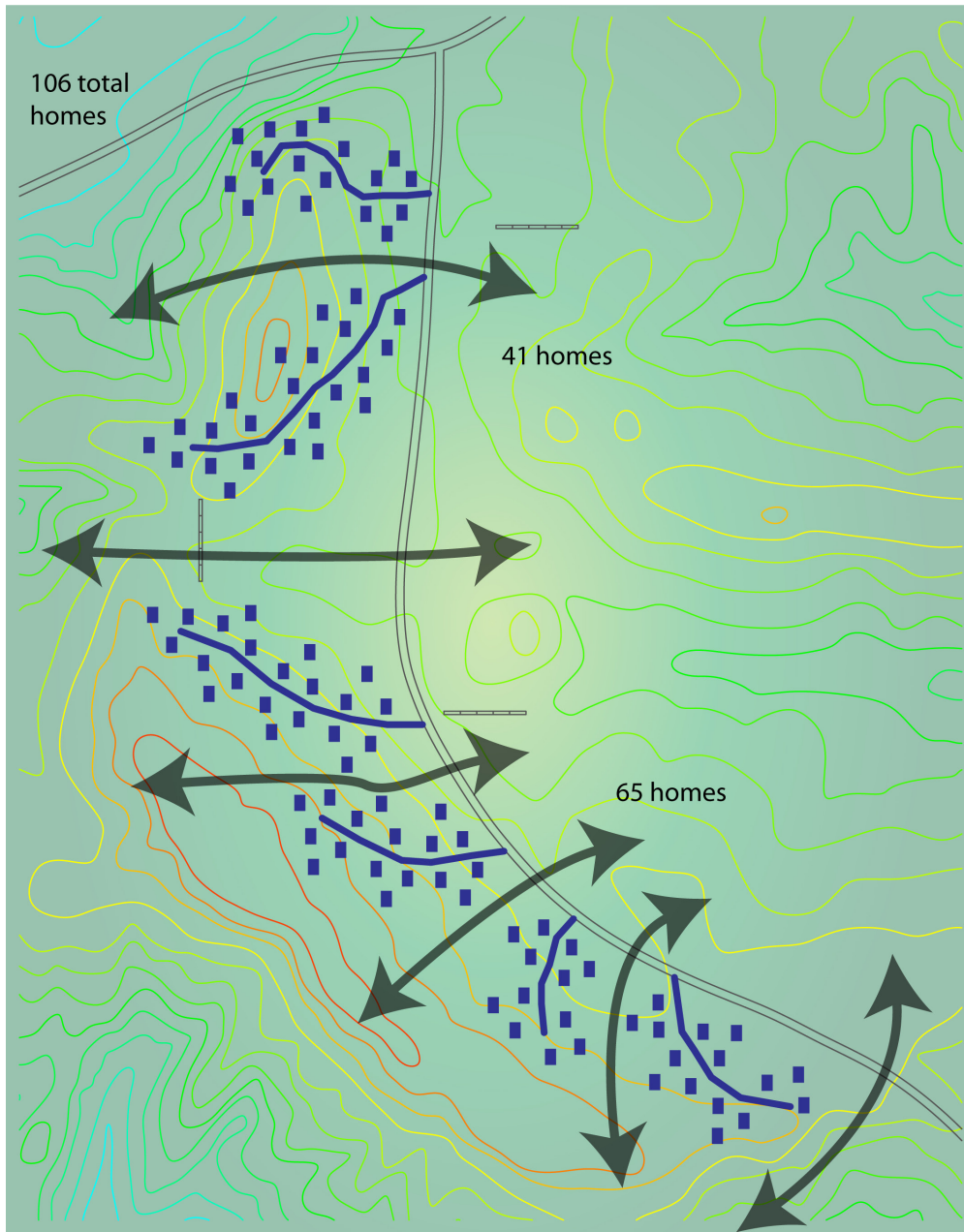
pro

- wildlife movement through homes
- 71 total homes

con

- no through access
- small buffer from Cahaba Beach Rd.

# HOUSING + ROAD LAYOUT 4



pro

- wildlife movement between home
- two separate areas (more privacy)

con

- no designated communal/open space

808 total feet of roadway

pro

- multiple wildlife movement through homes
- four small communities make up the whole (more privacy)
- shorter roads give feel of seclusion (no monotony)

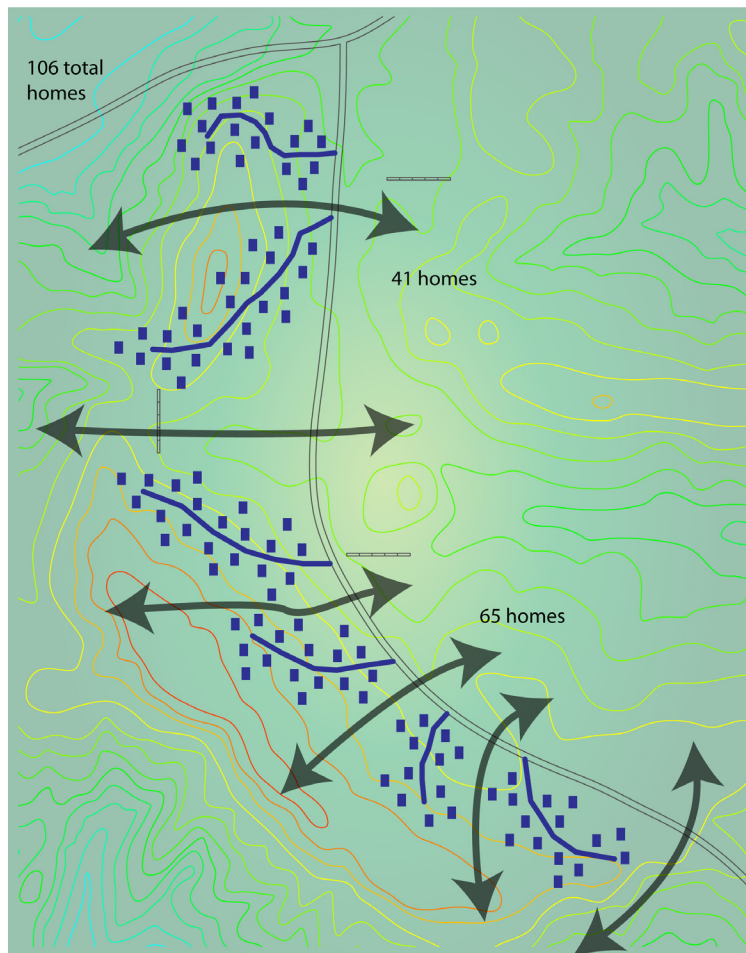
con

- no through access
- no designated communal/open space



# HOUSING + ROAD LAYOUT CONCLUSIONS

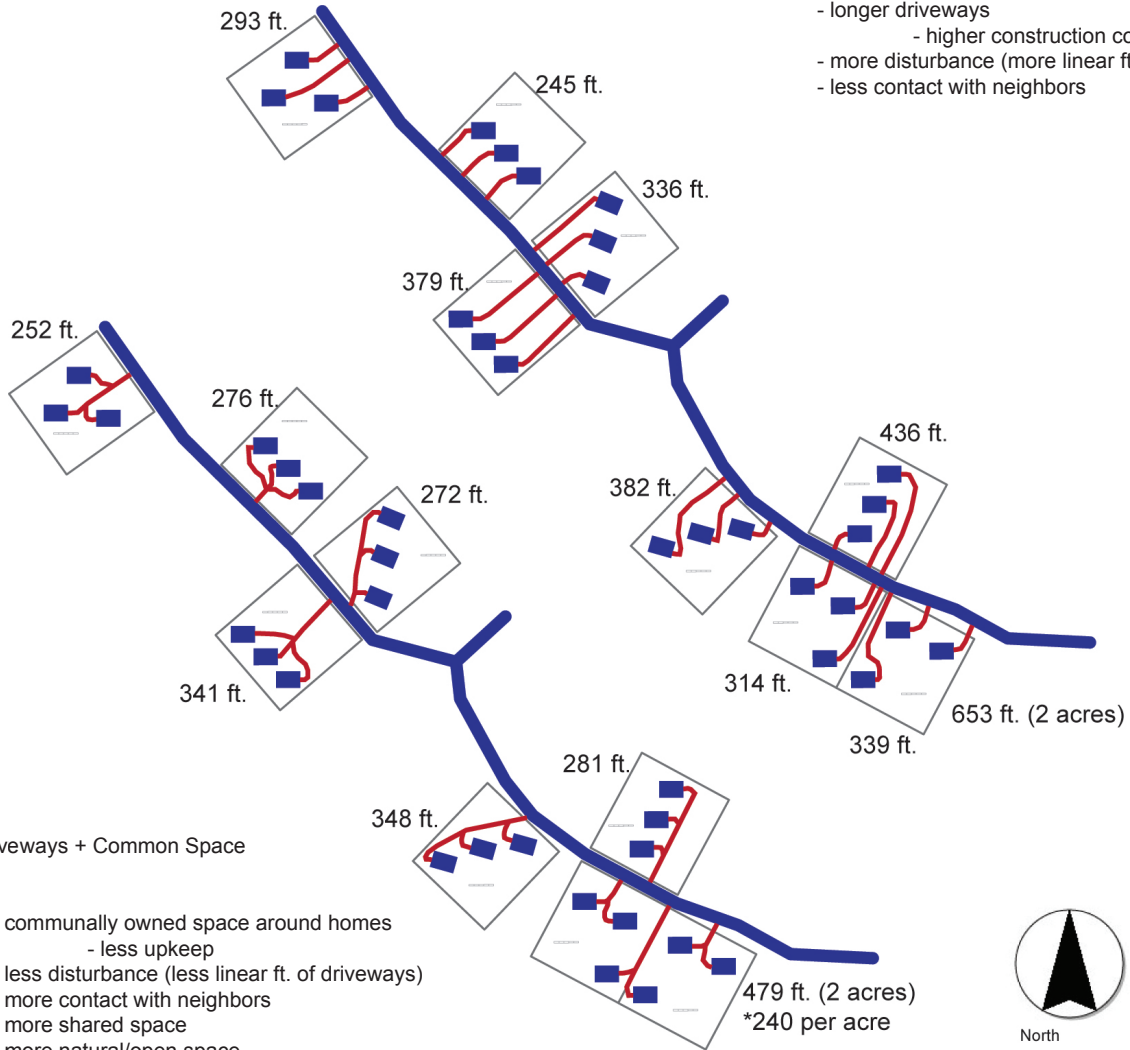
After an analysis of the four housing and road layout schemes, layout four stands out as the choice. The total number of homes is the median for the four different layouts and one hundred and six total homes fits the carrying capacity of the selected portion of land. This layout allows wildlife movement through the home sites, and allows for a meshwork of forest running through the residential neighborhood. With only 808 linear feet of roadway, this design will become the most cost efficient and will contain significantly less roadway than the others. Arendt clusters the housing so that more land can be preserved, and you can still reach the same capacity of homes as a conventional development. The separated roading will provide for a sense of privacy from the other residents and allow the cluster housing to take place in a manner consistent with conserving the land.



## SHARED VS INDIVIDUAL DRIVEWAYS

Using minimal disturbance and development for a profit as two of the main goals in the development process, there is a need to look at driveway structure. Sharing driveways with two, maybe three, homes will cut down on development costs as well as minimize the impact on the land. When talking about minimizing impact, a couple of examples are: leaving as much existing vegetation as possible and reduce all grading to a minimum. The idea was explored using the desired three homes per acre, where the black box around the blue homes and red driveways consists of 43,560 sq. ft. (1 acre).

Total driveway lengths in linear feet



Individual Driveways + Lots

pro:

- easily dividable lot sizes
- individual ownership of land (1/3 acre)

con:

- longer driveways
  - higher construction costs
- more disturbance (more linear ft. of driveway)
- less contact with neighbors

Shared Driveways + Common Space

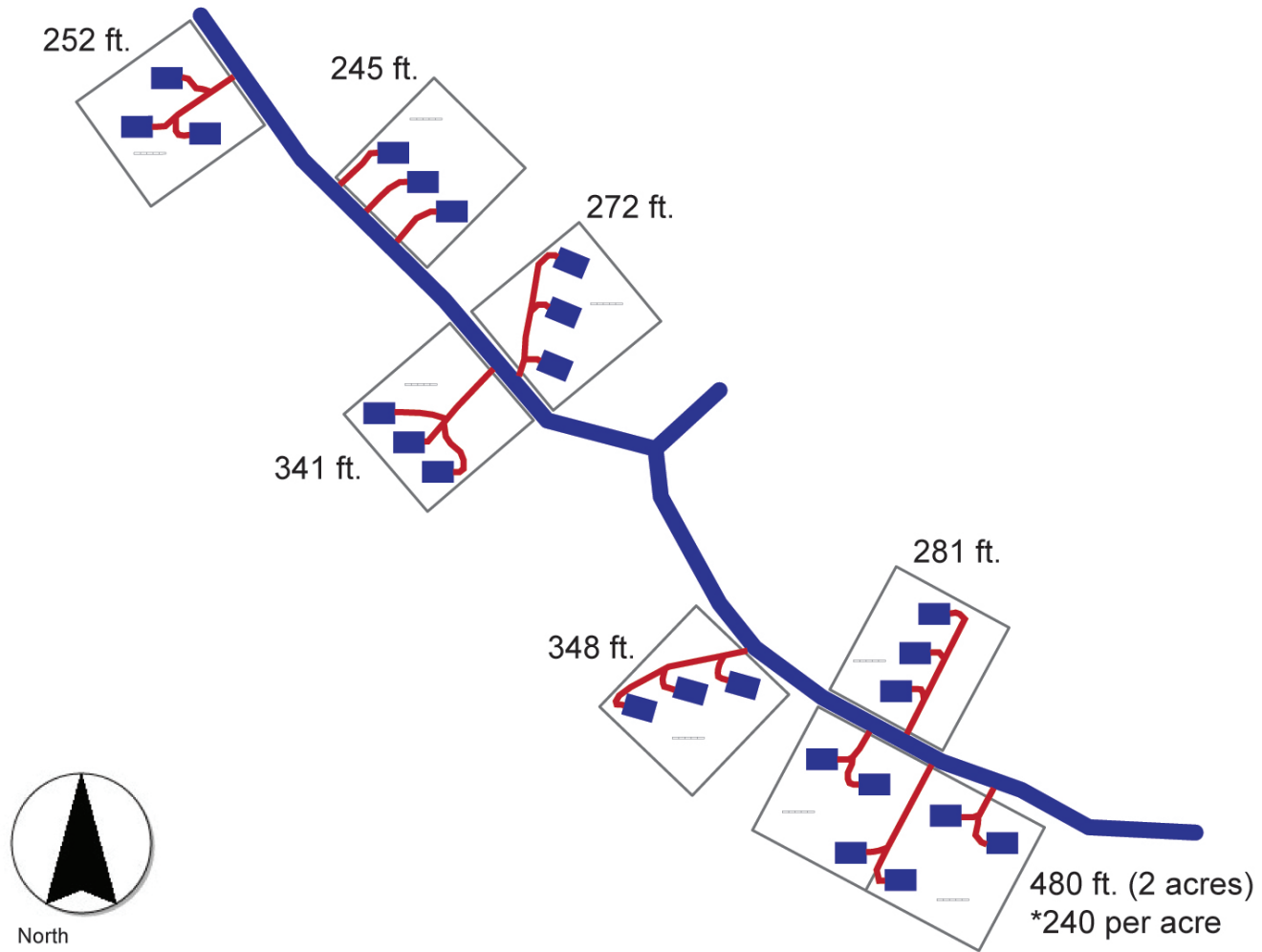
pro:

- communally owned space around homes
  - less upkeep
- less disturbance (less linear ft. of driveways)
- more contact with neighbors
- more shared space
- more natural/open space

con:

- less private area (other than home)





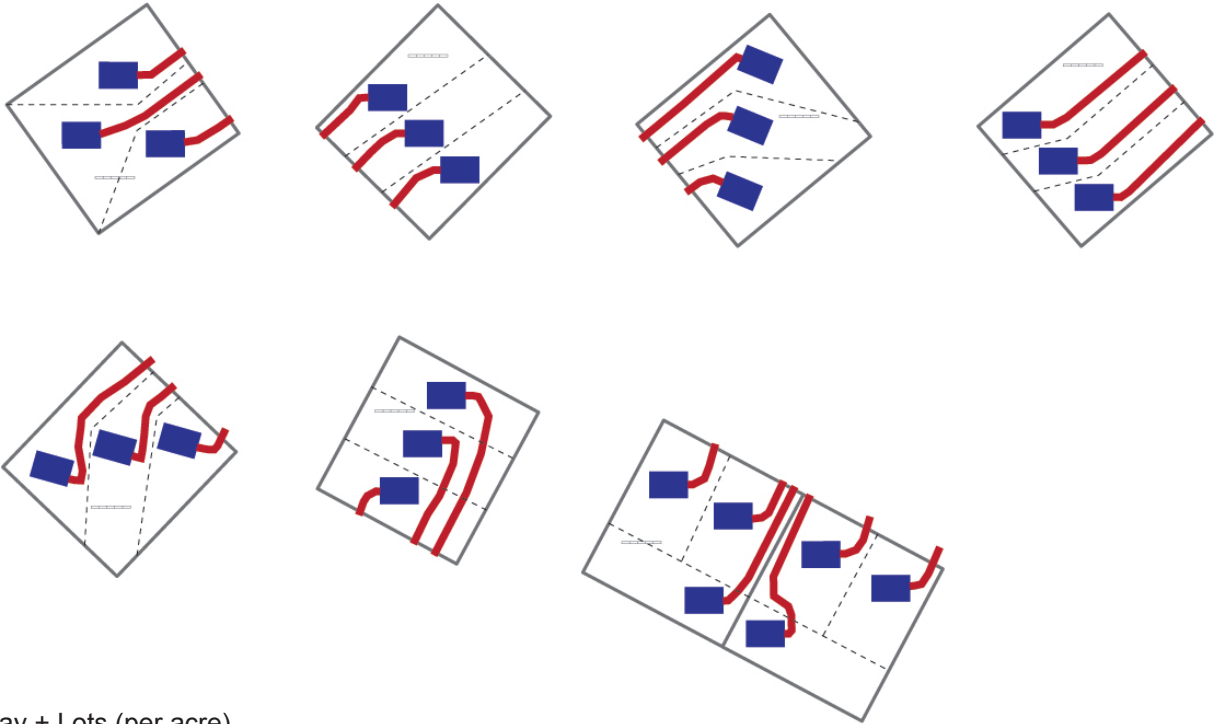
This diagram was derived from the previous, where the shortest driveway lengths were chosen as the best possible scenarios. Using the same housing layout and establishing shared driveways on set and individual driveways on another set, the driveway distances are drastically different. As shown here, the shortest driveway lengths are the ones using shared driveways, with the one exception of individual driveways when the homes are positioned close to the road. These exact examples may not be used in the final design but the idea of using a shared driveway is implemented, lowering cost and minimizing disturbance.

## LOT LAYOUT INVESTIGATION

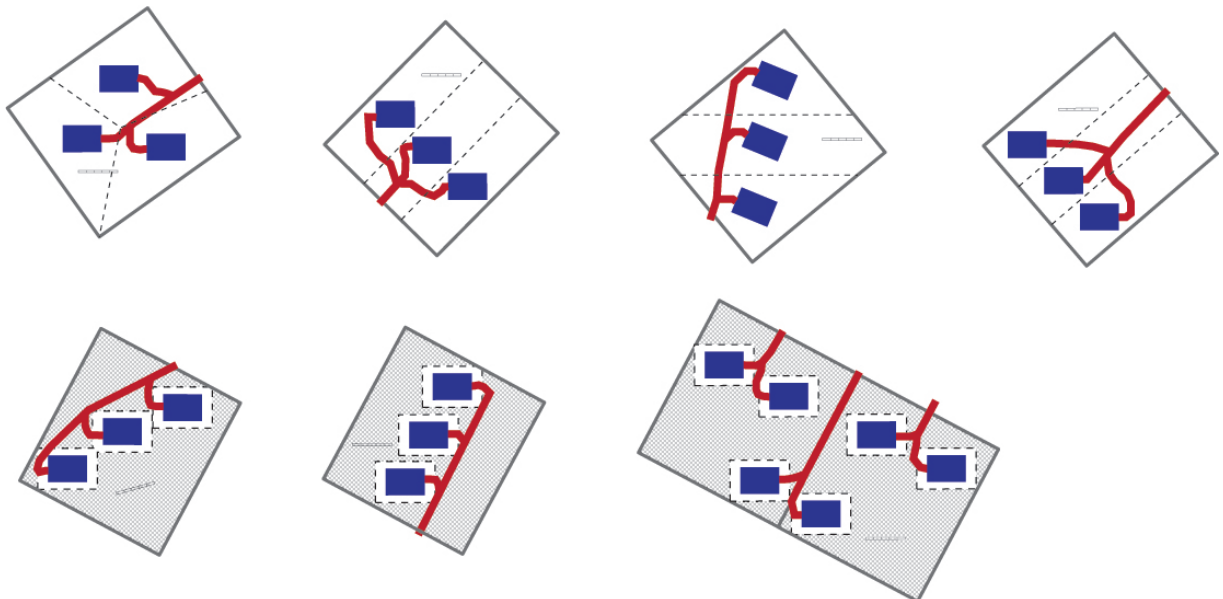
After the driveway investigations, a lot line strategy is developed. The findings are based off of the models used in the driveway investigation but are not limited to either shared or individual. After looking at a multitude of different lot layouts, the findings were quite similar. There were a couple of problems. First, on individual driveways, it is difficult to establish lot lines around homes within the confined area of an acre because different homes would have different lot sizes and many times the lot lines would run through someone else's driveway (property). Secondly, on the shared driveways, the problem of driveways running through someone else's property remains, but they do allow for more equally sized lots within the acre.

The final idea investigates using the homes as the lot lines. The plan is to extend a perimeter thirty feet around each home and leave the remaining area as communal open space. Doing this allows the homeowner to put their own individual touch on the home while holding upkeep to a minimum and allowing for more free space throughout the property.

Individual Driveway + Lots



Shared Driveway + Lots (per acre)



## CHAPTER 6: FINAL DESIGN

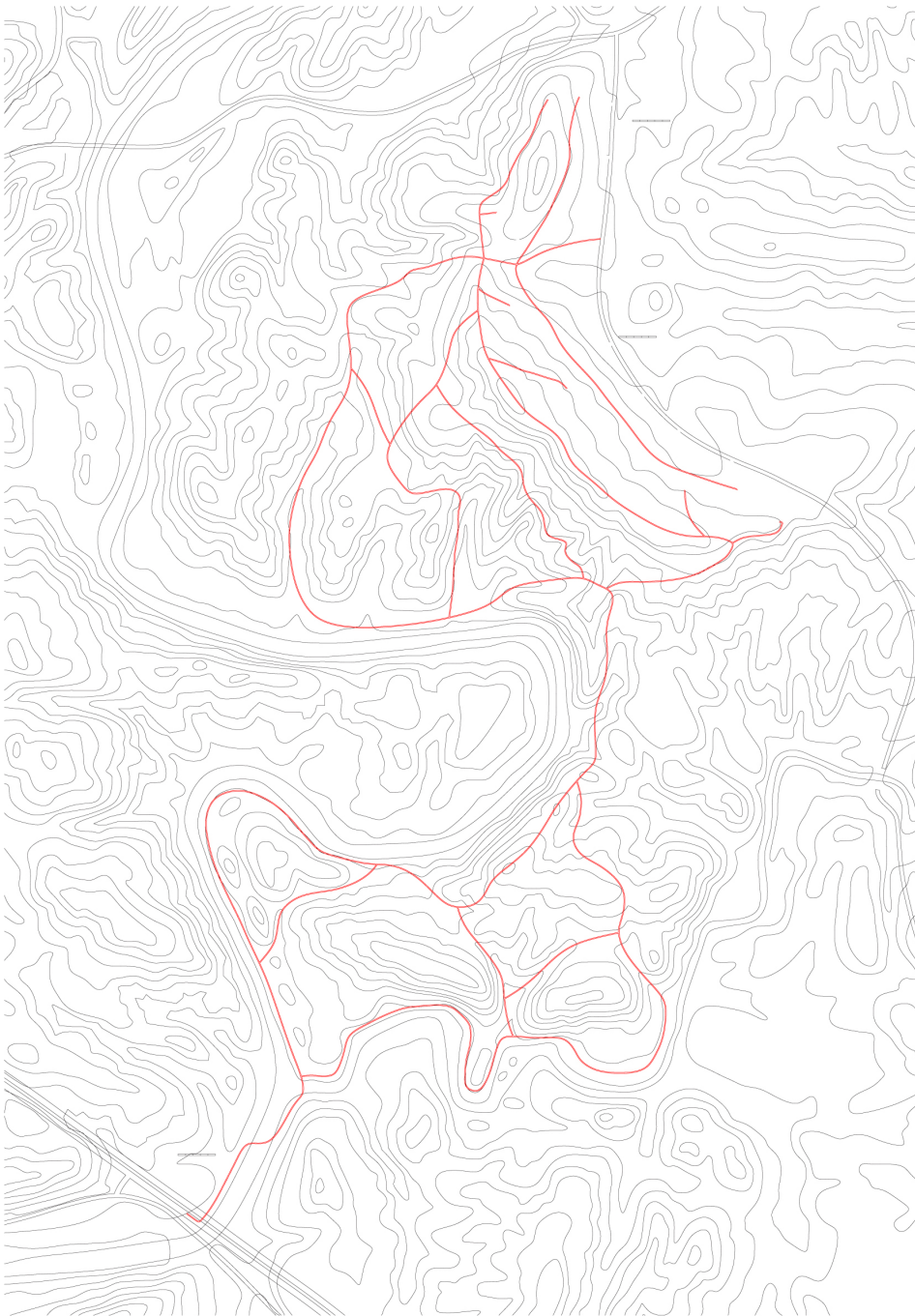
The final design consists of two separate portions that work together to make up the whole. Clustered housing development is located on the highest ridge, while the rest of the site is placed under a conservation easement. The easement is maintained by a neutral member, not the Water Works Board nor the developer. It ensures that the land will never be altered, preserving it for future generations. The design of the easement is quite simple because it consists only of natural trails. Some of these trails already exist and the rest will be created over time as visitors consistently walk the same paths. The clustered housing development also maintains an air of simplicity. Trees will be left in place unless they are in the direct path of the roads, driveways, swales, and home sites, creating a natural and quiet setting for the residents. The main roads are lined on both sides by grass swales, and the shared driveways use local stone to create small bridges that cross over these swales. Each home is built at approximately 1750 square feet on the ground level, with options of another level. Small trails between the homes are created, but they are not designed in order to give the residents freedom of movement throughout the shared property.

## TRAILS

Trail design becomes a significant aspect of the development, and there is a need to separate the public from the private. The public trails meander around the river and the adjacent land, including the coal mining sites and the highest ridge on the property for the best views, making up the conservation easement on Birmingham Water Works property. The private portion focuses more around the home sites, and a trail running horizontally through the entire housing development connects all the clustered housing together. Private may be the wrong word, it would be considered more private because of its close proximity to the homes, but they do not restrict access to residents only.

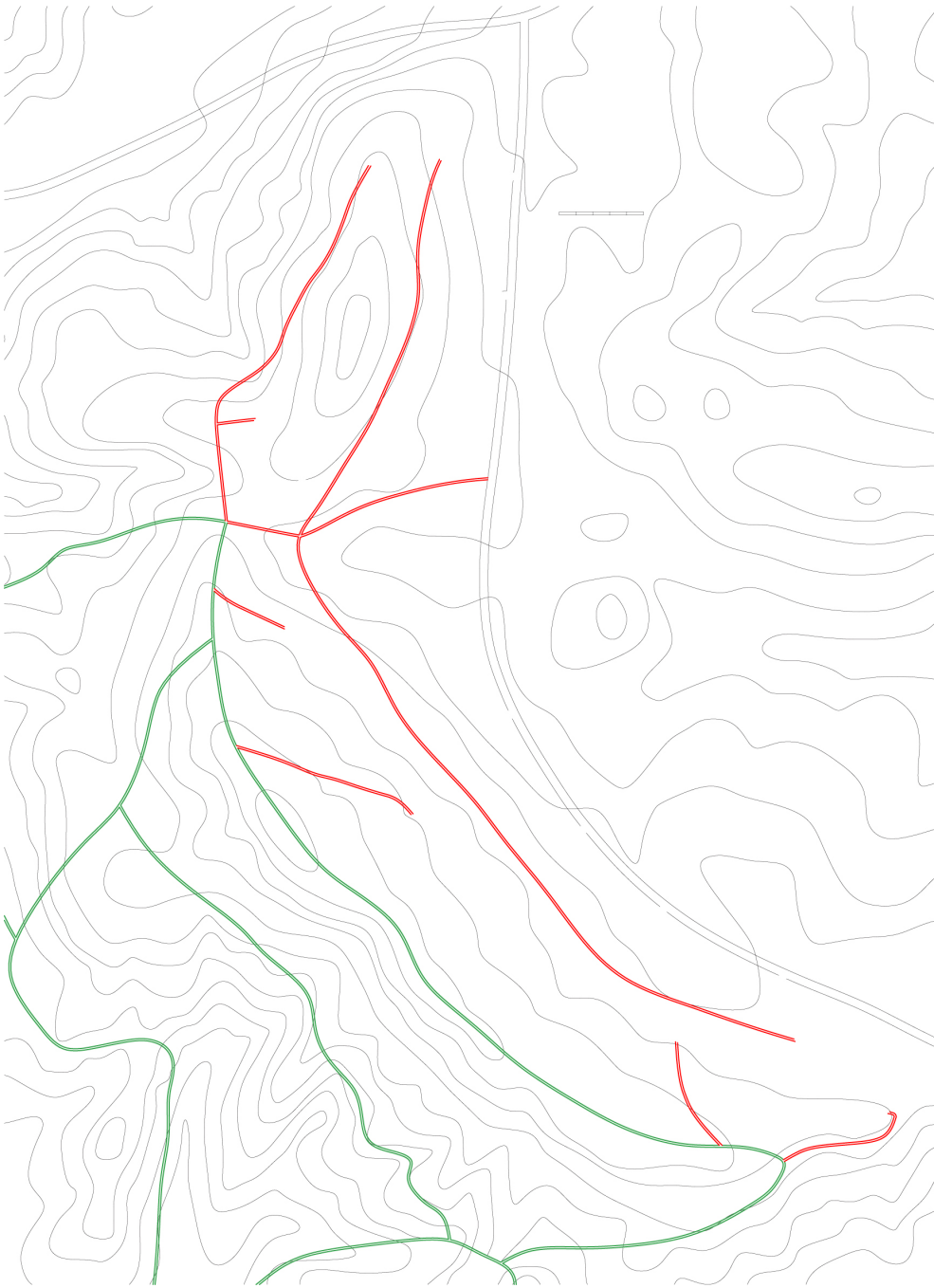


# PUBLIC + PRIVATE TRAILS

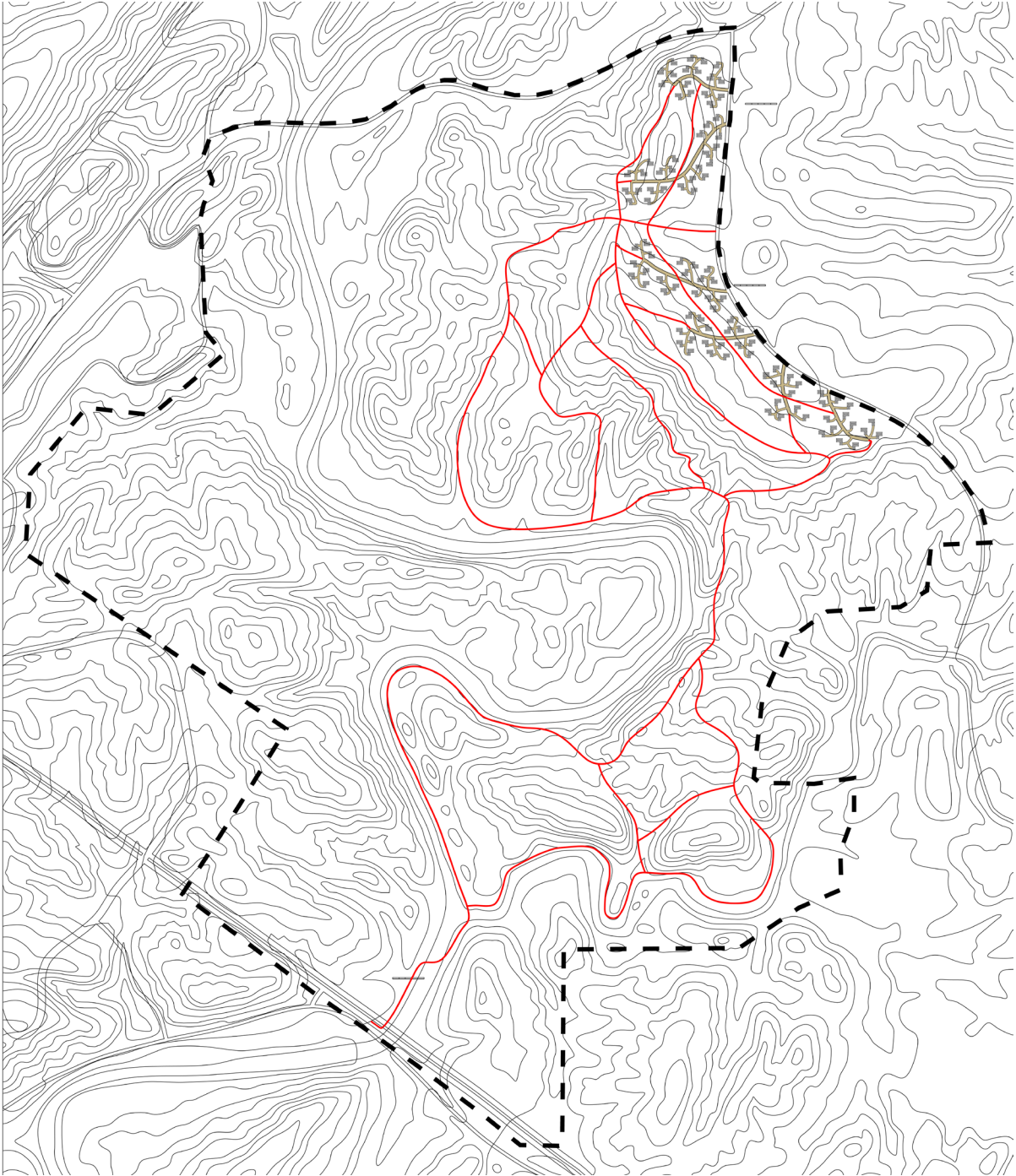


The map shows, with no distinction, a complete view of the trails, public and private. The peninsula in the middle of the site, was left untouched mainly for wildlife, but also because the cost of bridges back and forth over the Cahaba River would be cost prohibitive. Overall, the trails link the entire site together, public and private, and allow residents and visitors their own quiet respite in the woods or a good afternoon jog.

# PRIVATE TRAILS + CONNECTIONS

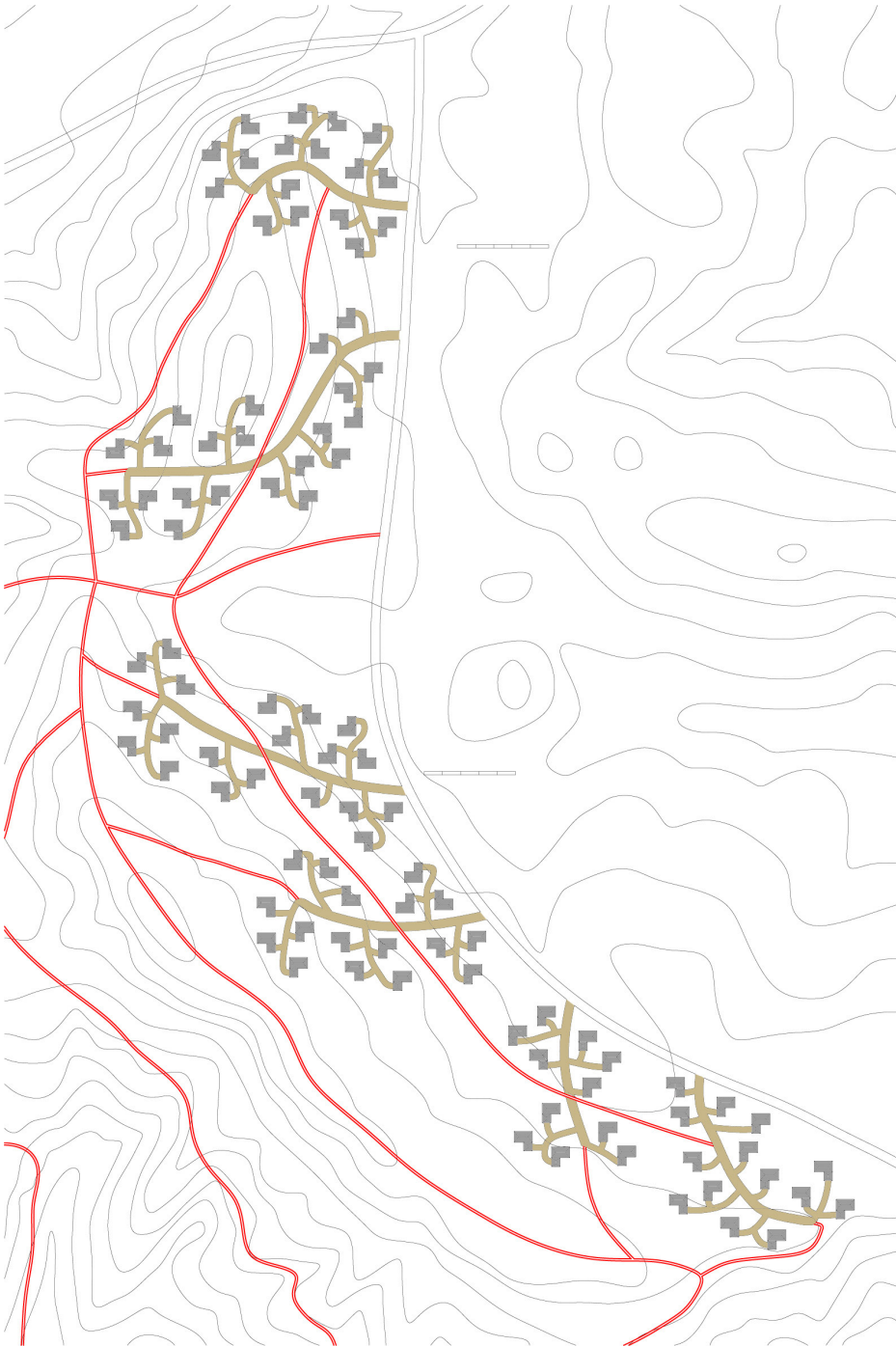


This image shows the separation between the public and private portions of the development. The red lines serve as the private sector trails, as they run through the clustered housing development. The green lines represent the conservation easement trails in the public sector, but are available for use by anyone. There are connections made from the private sector to the public sector, designed to be used for the residents, but parking along Sicard Hollow Road would be open to the public, meaning they access the conservation easement through the housing.



The entire site contains roughly 680 acres, 40 of which are developed as a cluster housing neighborhood.

# HOMES



## Housing Guidelines

- homes are on a north + south axis in order to receive as much winter and summer sun as possible
- all homes are roughly 1750 sq. ft. and are one level, including a two-car garage - second level is prohibited
- property lines will be set 30 feet off of the homes footprint

## Building Guidelines

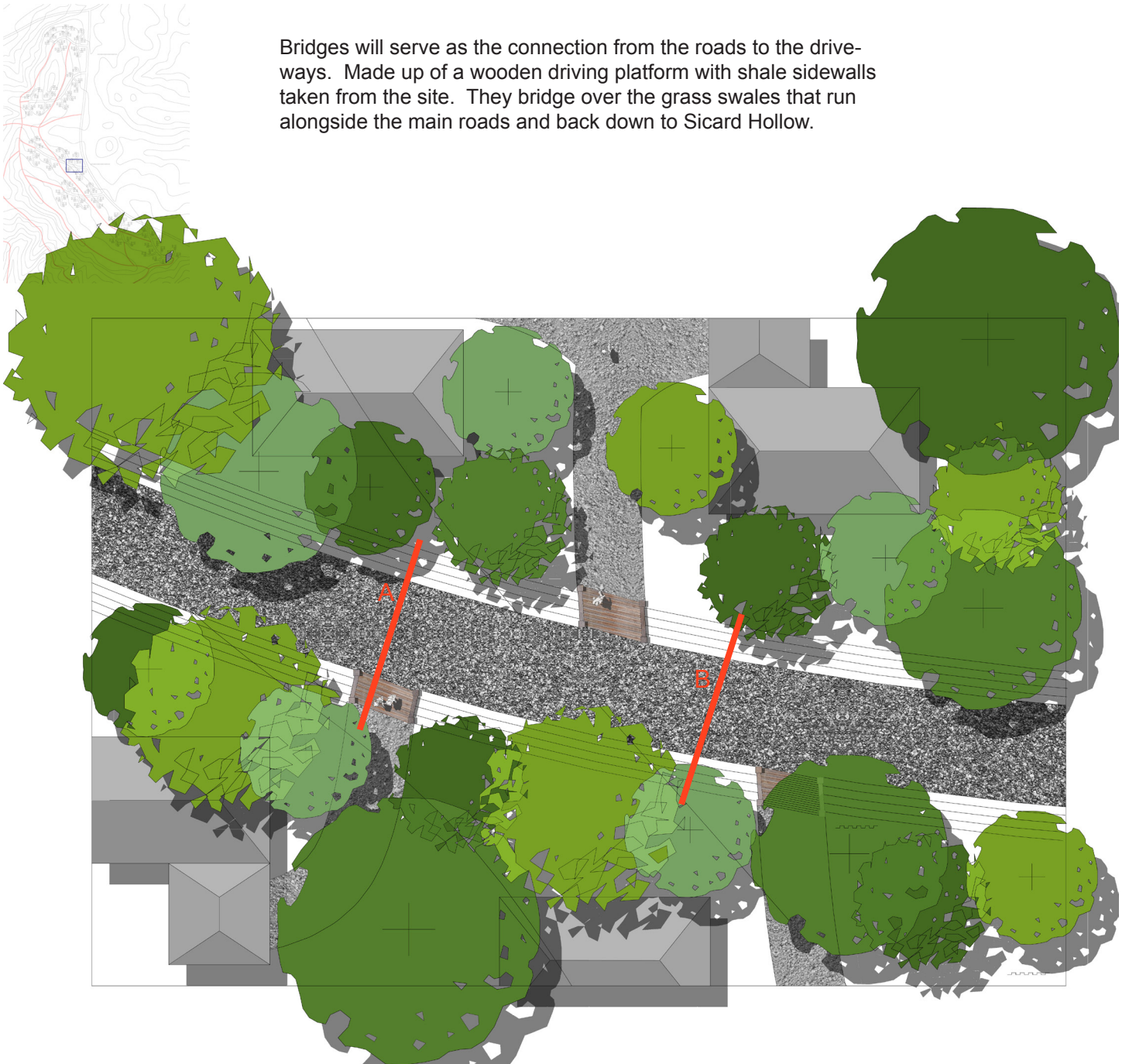
- before any trees are cut down, the building platform is to be outlined, and any existing trees inside that frame will be removed, whereas the rest will remain
- should a home site contain any trees larger than 24 inches in diameter, the home is to be shifted accordingly

The overall goal of selecting home locations is to preserve the natural beauty of the site, retaining as much existing vegetation as possible.

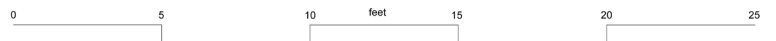
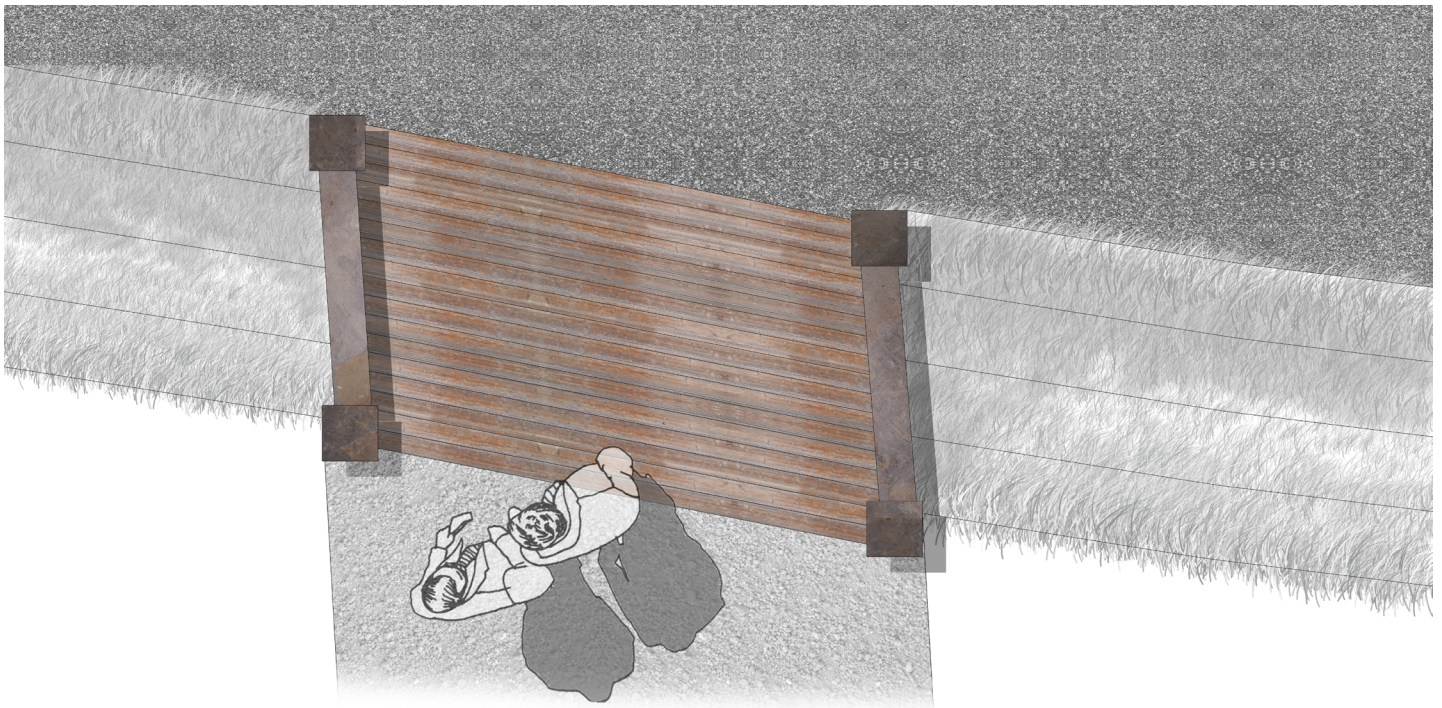
The theme is consistent throughout the clustered housing. A few sections and plans, although taken from certain locations, represent the entire developed area.

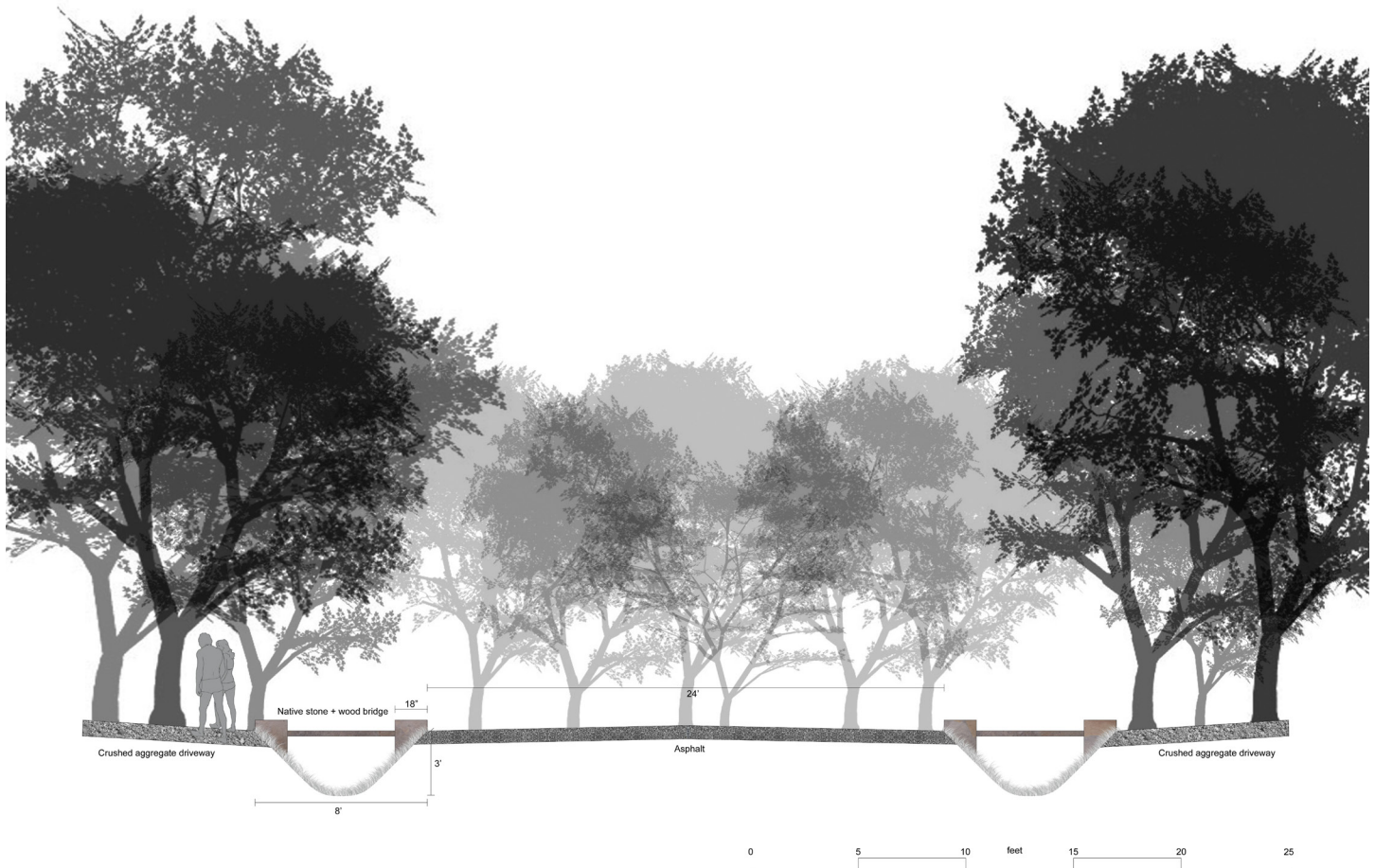
# BRIDGES

Bridges will serve as the connection from the roads to the drive-ways. Made up of a wooden driving platform with shale sidewalls taken from the site. They bridge over the grass swales that run alongside the main roads and back down to Sicard Hollow.



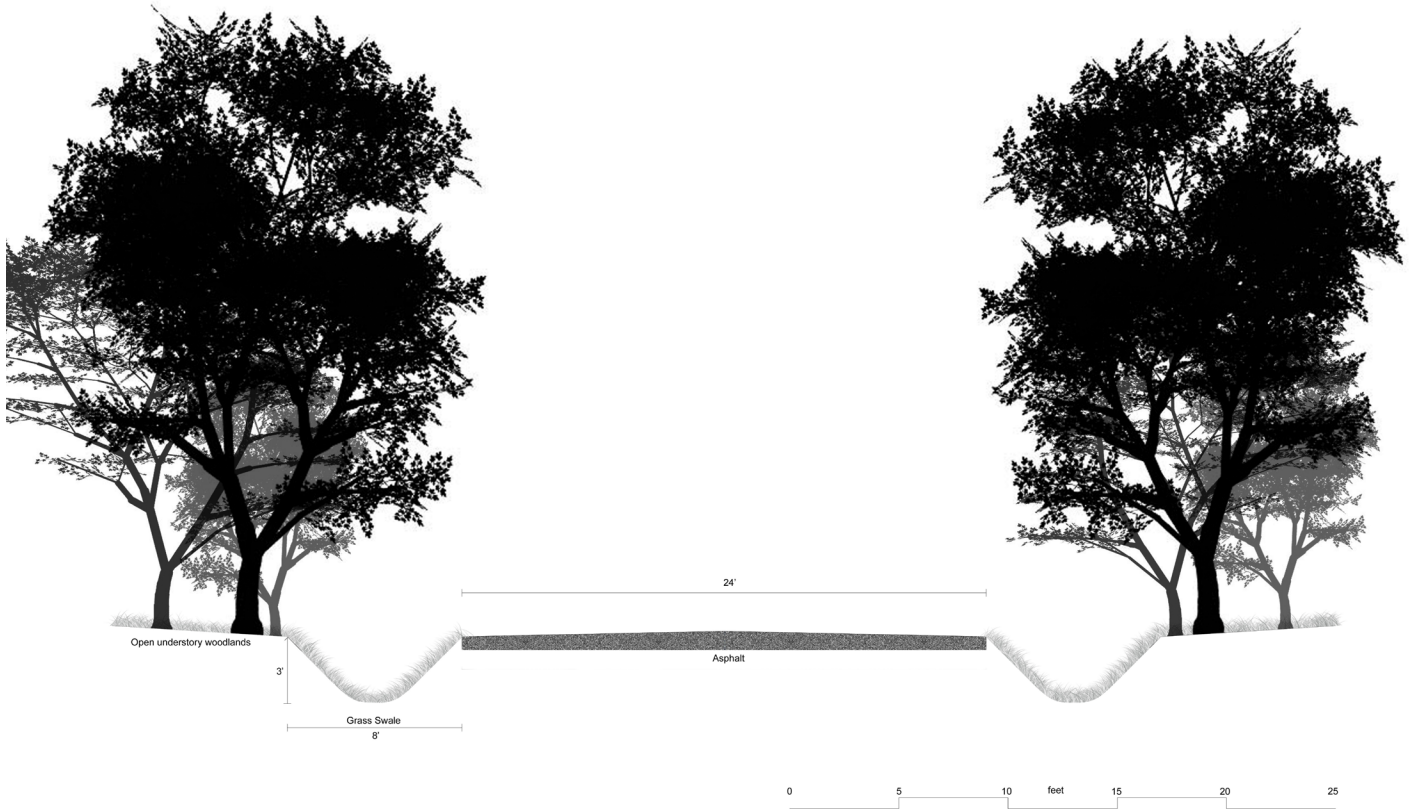
A closer look at the materiality of the bridges and a close-up image of the shale taken from the site.





This section demonstrates the role of the bridge and shows details of their surroundings. The driveways will consist of a crushed aggregate that hardens almost like concrete, but remains pervious to water. The swales will be three feet deep by six feet wide and will contain thick grasses to maintain their shape.

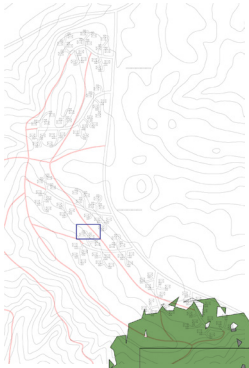
# SECTION B



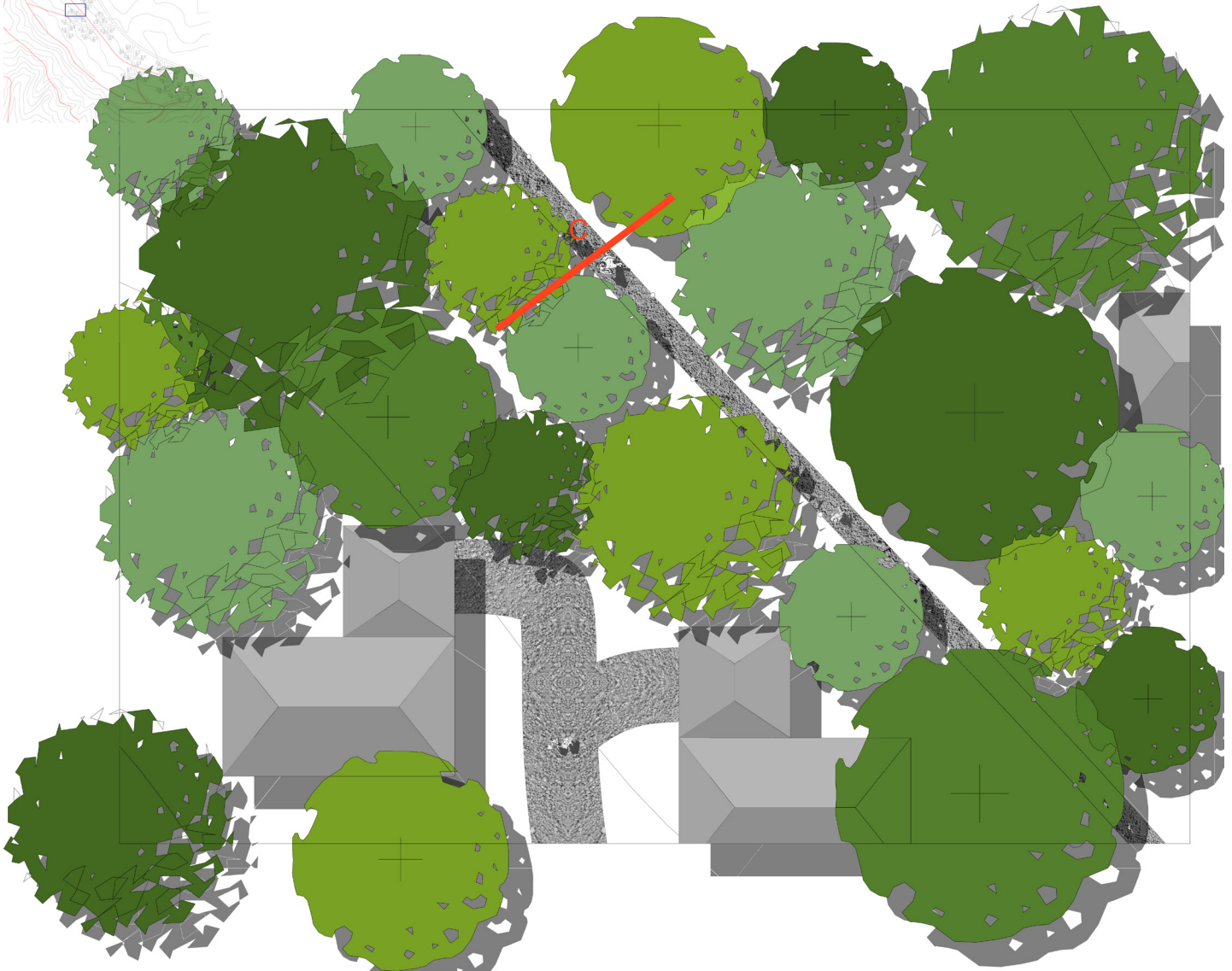
This section detail, shows the roads as twenty-four foot wide asphalt roads lined on both sides with grass swales. The swales will not contain any trees for fear of them breaking up the road, but will nestle close to the edges so that over time they will produce a canopy over the roads.



# TRAILS FOR HOMES



The trails within the housing development are constructed out of a crushed aggregate, smaller than that of the driveway, and will allow walkers, runners, and strollers a comfortable stroll amongst the neighborhood. The aggregate finish distinguishes them from the public trail systems natural pathways.

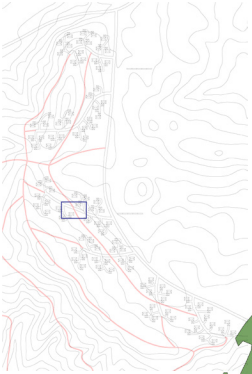


# SECTION C

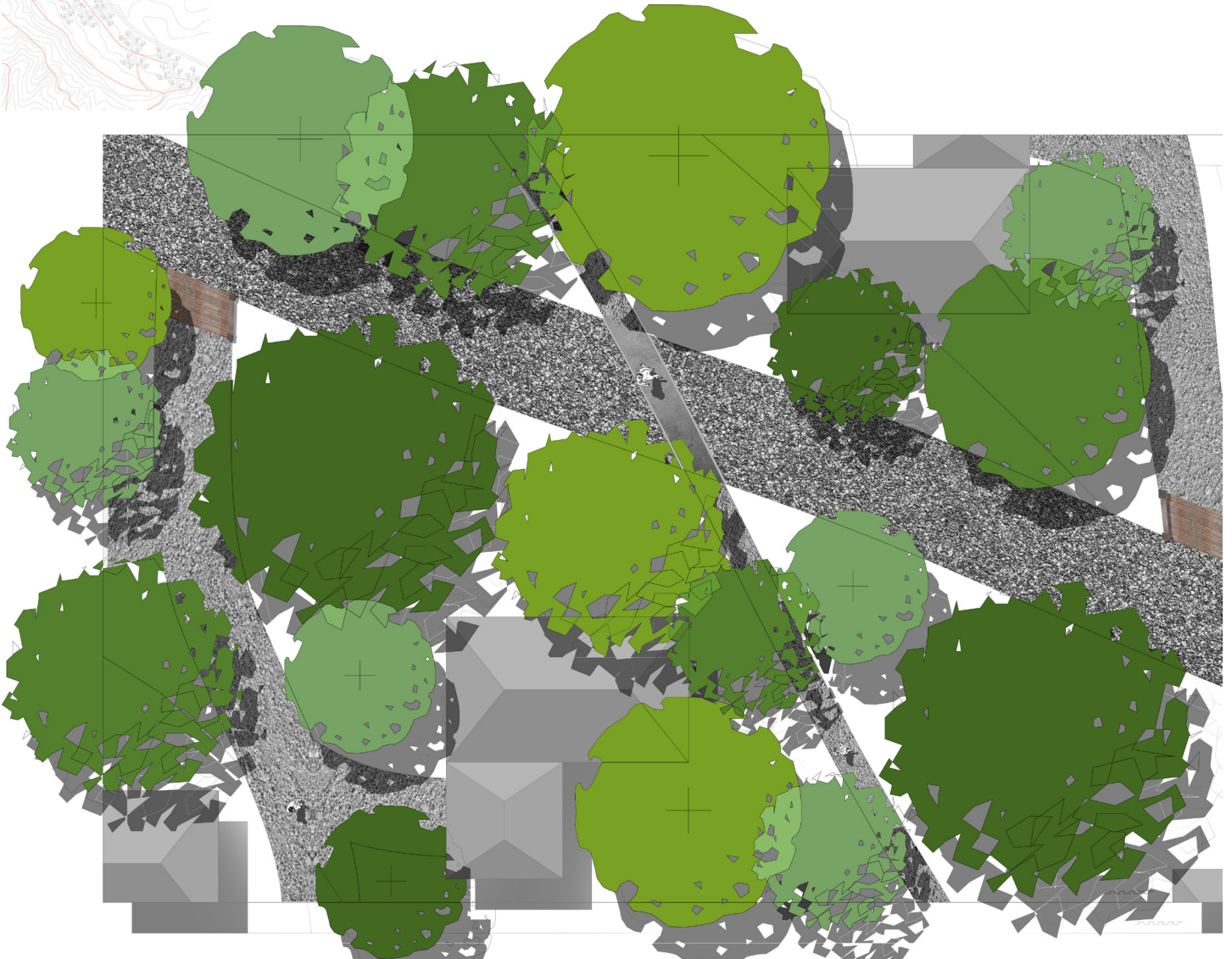


This section demonstrates the nature of the trails around the homes. They are six feet wide and run from one end of the development to the other. This also explains the ground level around the homes. The existing canopy is so thick that only thick grasses grow, leaving an open understory for children to play and adults to enjoy some leisure time in the woods.

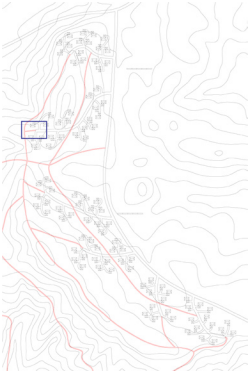
## TRAIL + STREET CROSSING



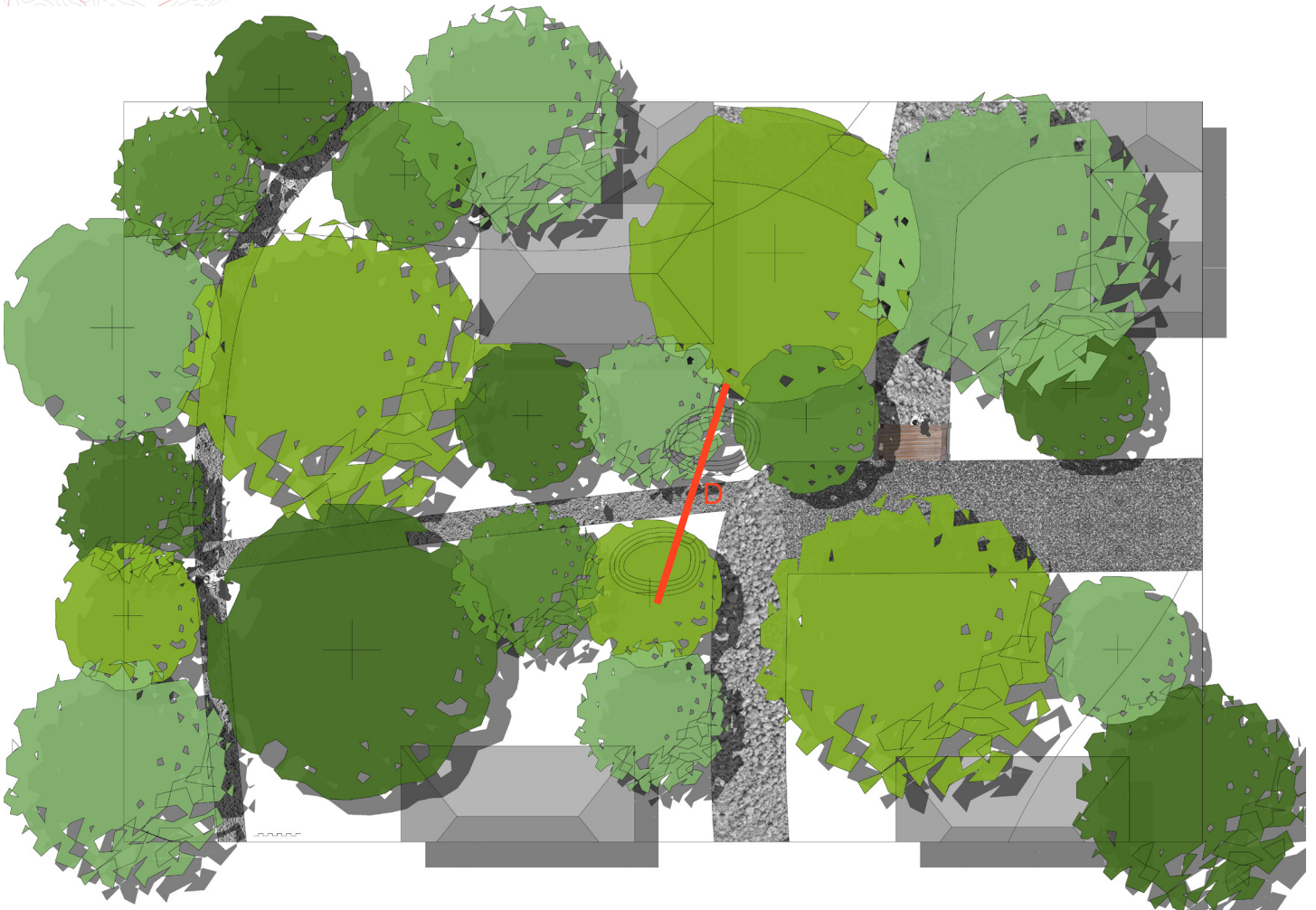
The neighborhood trails cross over the street four times en-route from one end to the other. These crossings are constructed with a flagstone design using the same shale from the site as the bridges. A small concrete barrier on either side will set these crossings apart from the road urging drivers to be cautious.

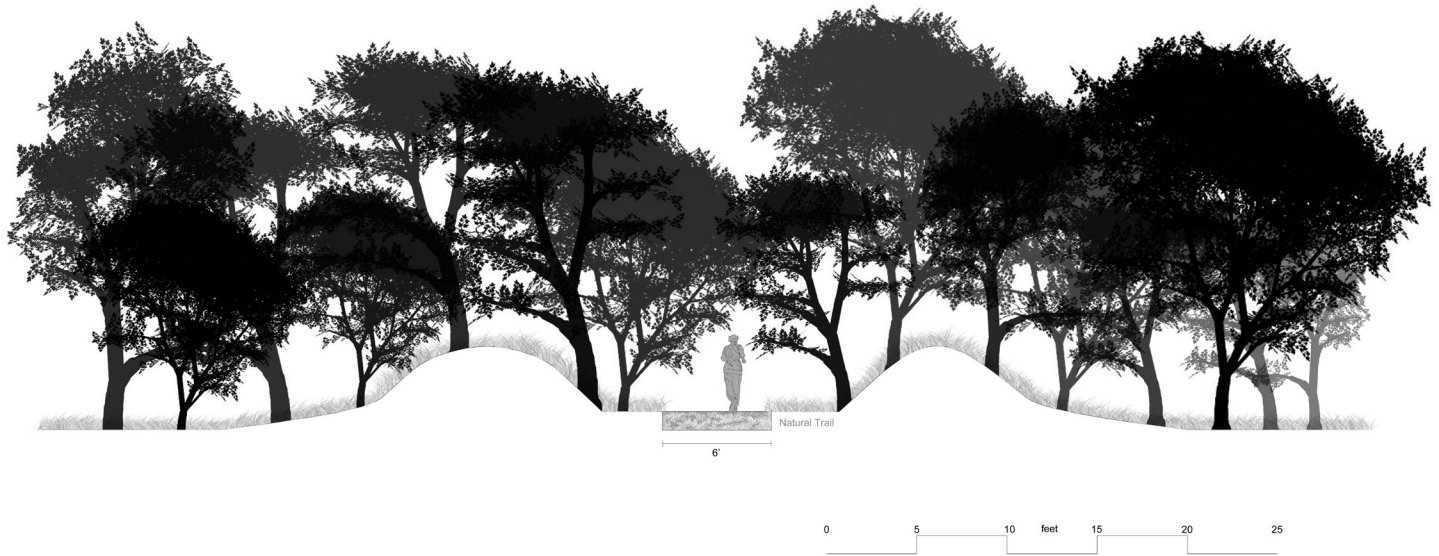


# TRAIL ENTRANCE



The entrance into the larger trail system became an important area of focus as the development plan unfolded. If housing were to be at the end of the street, then the meshwork of forest running through the site would be weakened. With that in mind, the design calls for no housing at the end of the roadways, so that when driving the feel of being in the woods never stops. At the end of the road and the beginning of the trails, two mounds, about five feet tall, lead the way to the rest of the trails. The mound design came from the rubbish piles of rock spread throughout the site that was left behind as mining ran its course on the property.





This section explores the entrance to the trail system at the end of the roadways. The trail differs from the neighborhood trails slightly in that it becomes a natural footpath. Here, the six foot width is maintained until the main trail system is reached, where the trails become subject to us over time. Again, the grass understory is spread throughout the housing development, allowing for communal open space in between all of the homes.

# CONCLUSIONS

## DEVELOPER

### INFRASTRUCTURE COSTS

The Environmental Protection Agency recognizes Low Impact Development (LID) as a way to significantly lower overall capital cost of a project. Their studies have shown that "significant savings were realized due to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping" (EPA, 2007). Because of these techniques, total capital savings range from 15 to 80 percent, but a more credible range is from 15 to 30 percent.

Based on these studies, the conservation subdivision construction costs are significantly less than those of conventional development, just another reason to develop in this way. This research uses these percentages to create a cost analysis for the project, and will use 25 percent as the cost variable. Local developers around Birmingham confirmed that conventional neighborhood construction cost, including everything: grading, sewer, power, run-off infrastructure, etc. would cost approximately \$90,000 per acre. This was derived from \$30,000 per home, and in this case there are three homes per acre. Therefore conventional infrastructure costs on 40 acres of clustered housing development is \$1.2 million, but because of it is an LID its costs are reduced to \$900,000.

### DEVELOPMENT COSTS

Development in this area for a custom home will cost about \$150 per square foot, so if each house is 1750 sq. ft. then the total development cost per home will be \$262,500 ( $\$150 \times 1750$  sq. ft.) and for 101 total homes the cost is \$26,512,500.

### DO THE MATH

The value of the completed home is estimated at \$400,000 based on comparable homes in the area. This means that the residual land value, the difference between finished value and development costs, would be \$137,500 per home ( $\$400,000 - \$262,500$ ) or \$13,887,500 for the entire development. This means that in order to break even, the developer can purchase the land for \$13,887,500.

### WORK IN THE PROFIT

If the cost to develop is \$26,512,500 and the developer wants to make a 30 percent profit then the profit margin would be \$7,953,750 ( $\$26,512,500 \times 30\%$ ). This number is then subtracted from the residual land value in order to create a maximum offer price for the land at \$5,933,750 ( $\$13,887,500 - \$7,953,750$ ) That means, in order to make a 30 percent profit on the development costs, the developer would not pay more than \$5,933,750. Assuming the developer wants to make a 30 percent profit on the land as well that profit is \$1,780,125 ( $\$5,933,750 \times 30\%$ )

### MAX OFFER PRICE

Take the residual land value minus profit on cost, and subtract the estimated profit on land cost to determine maximum land offer price of \$4,153,625 ( $\$5,933,750 - \$1,780,125$ ).

### CHECK THE MATH

$\$4,153,625$  land purchase +  $\$26,512,500$  for development and construction costs ( $\$262,500$  per home  $\times$  101 homes) +  $\$900,000$  infrastructure costs

TOTAL PROJECT COST  $\$31,566,125$

PROJECTED REVENUE FROM SALES  $\$40,400,000$

TOTAL PROFIT  $\$8,833,875$  ( $\$40,400,000 - \$31,566,125$ )

PROFIT MARGIN 28% ( $\$8,833,875 / \$31,566,125$ )

## CIVIC LAND

The civic land holdings are now maintained by a non-profit organization who oversees the land over time. A conservation easement is a "voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place on a piece of property now and in the future, while protecting the property's ecological or open-space values" (The Nature Conservancy). This reduces the maintenance cost to the city and assures no cost in the future, even though the property is accessible by the public. 640 acres of beautiful wilderness in Birmingham, Alabama which were originally private property are now open to the public, creating Birmingham's only open space on a major river, and preserving the "hotspot" which is the Cahaba River.

## REFERENCES

- Arendt, Randall G. *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks*. Washington, D.C.: Island, 1996.
- Arendt, Randall G. *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks*. Washington, D.C.: Island, 1996.
- Berger, Alan. *Designing The Reclaimed Landscape*. London: Taylor & Francis, 2008.
- United States Environmental Protection Agency. "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices". December 2007.  
<http://www.epa.gov/owow/nps/lid/costs07/documents/factsheet-reducingstormwatercosts.pdf>
- The Nature Conservancy. "Conservation Easements." 2010. <http://www.nature.org/aboutus/howwework/conservationmethods/privatelands/conservationeasements/>





# ILLUSTRATIONS

All images are property of the author unless noted below.

pg. 6 (bottom), 33-38 - Arendt, Randall G. Conservation Design for Subdivisions

pg. 8 - O'Neill Enterprises - <http://oeliving.com/>

pg. 10-11 - Duany Plater-Zyberk & Company - <http://www.dpz.com/projects.aspx>

pg. 11 - Mt. Laurel & EBSCO Industries Inc. - <http://www.mtlaurel.com/community>

pg. 23 - Aerial Photography of Alabama - <http://alabamamaps.ua.edu/aerials/Counties/Jefferson/index.html>

pg. 23 - Squire, Joseph. Map of the Cahaba Coal Field. New York: Julius Bien and Co. 1890