

# **Apex High School**

# **GIS Feasibility Study**

GIS/LAR 517 GIS Applications in Landscape Architecture &  
Environmental Planning  
Fall 2022 | Harrell  
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# Project Summary

This feasibility study was a part of a GIS class to show how GIS can be used to select a high school site, analyze the site, and visualize a site design.

The study focuses on finding a potential high school site in Apex, NC. The potential site was selected based on the location, acreage, and demographics.

Once the site was selected, it was analyzed. The analysis included finding topography patterns, suitability for buildings, hydrology patterns, and visibility for an entrance. After the analysis, a site design was developed and made into a 3D rendering.

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# Site Selection

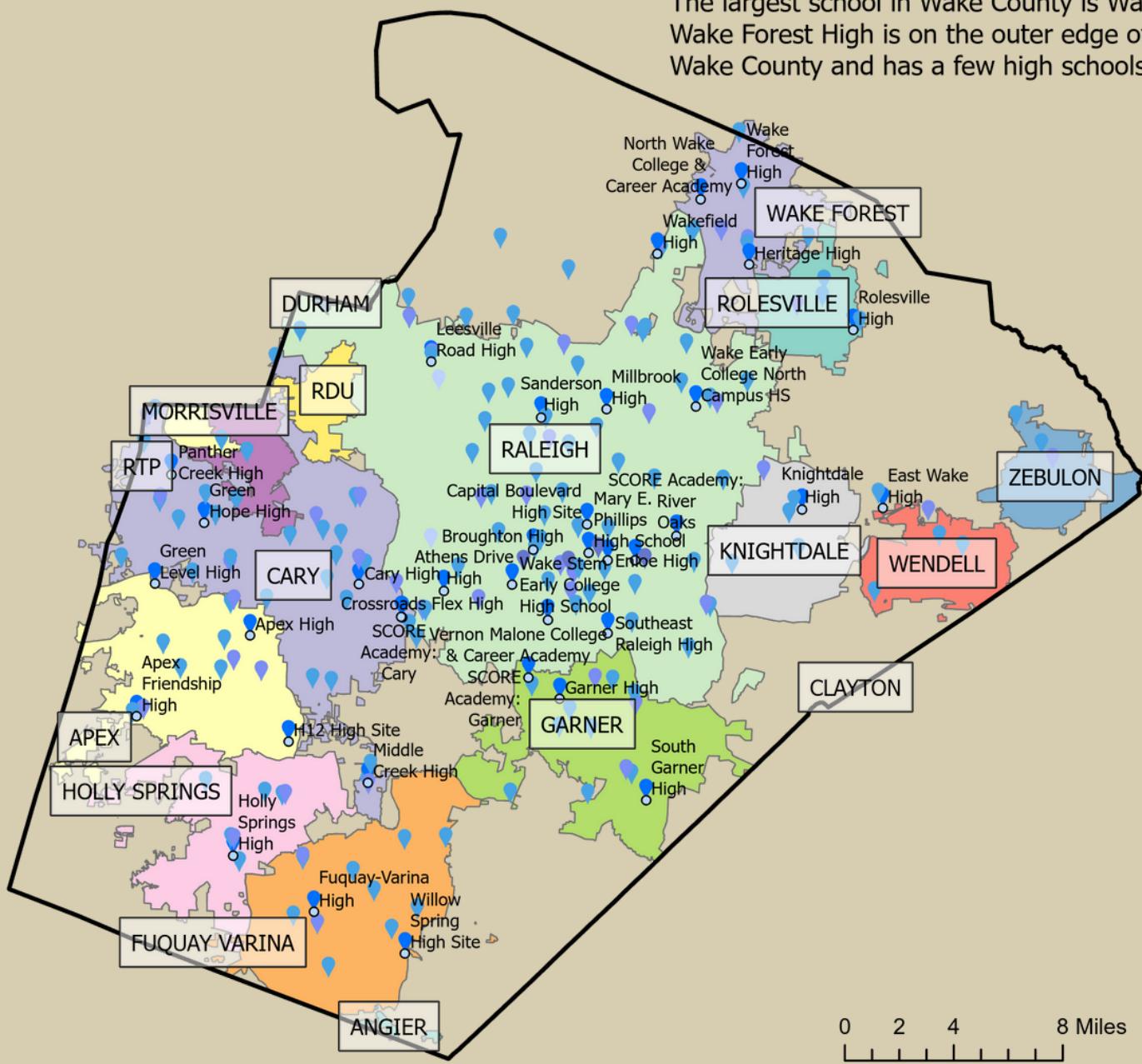
Through this section, the class was introduced to user interface, how to add manage data, formatting, and vector analysis tools. Maps were created based off of Wake County. Municipalities were randomly assigned later on.

Towards the end of the section, a vector analysis was used to select three parcels where a high school could be built. In other sections, these three parcels will be explored in greater depth.

# Wake County Public Schools

Wake County Public Schools is the largest public school system in North Carolina. As seen in the map to the left, a majority of the public schools exist within Raleigh. With most of the schools being centrally located, there are very few on the outer edges of the county.

A major reason for a majority of the schools being located in Raleigh is the number of students in each area. Since Raleigh has the highest population in Wake County, Raleigh also has the highest need for schools. The schools on the outer edges of the county are the only ones available for much larger areas than the inter-city schools, as seen by the map below. Being the only school available in a large area means that the school population is higher. The largest school in Wake County is Wake Forest High. Wake Forest High is on the outer edge of Wake County and has a few high schools located by it.



The map below shows all of the high schools present in Wake County.

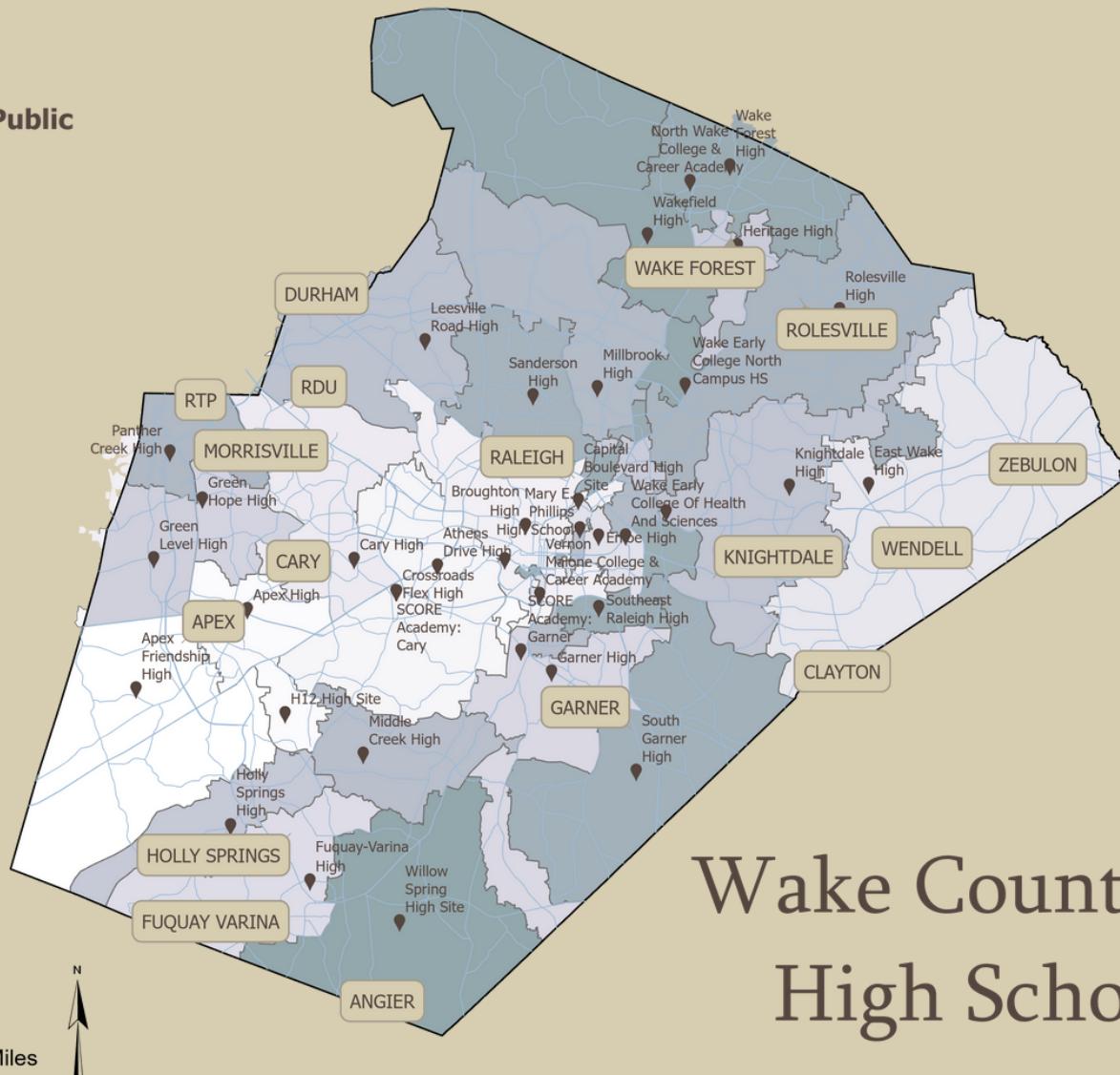
## Wake County Public Schools

### GRADELEVEL

High

### Name

- Apex Friendship High
- Apex High
- Athens Drive High
- Broughton High
- Cary High
- East Wake High
- Enloe High
- Fuquay-Varina High
- Garner High
- Green Hope High
- Green Level High
- Heritage High
- Holly Springs High
- Knightdale High
- Leesville Road High
- Middle Creek High
- Millbrook High
- Panther Creek High
- Rolesville High
- Sanderson High
- South Garner High
- Southeast Raleigh High
- Wake Forest High
- Wakefield High
- Willow Spring High



# Wake County High Schools

# School Capacity

The table below represents shows the tabular data of high schools and along with the number of students. The table was created by using joins. The map below the table represents the total capacity of each high school.

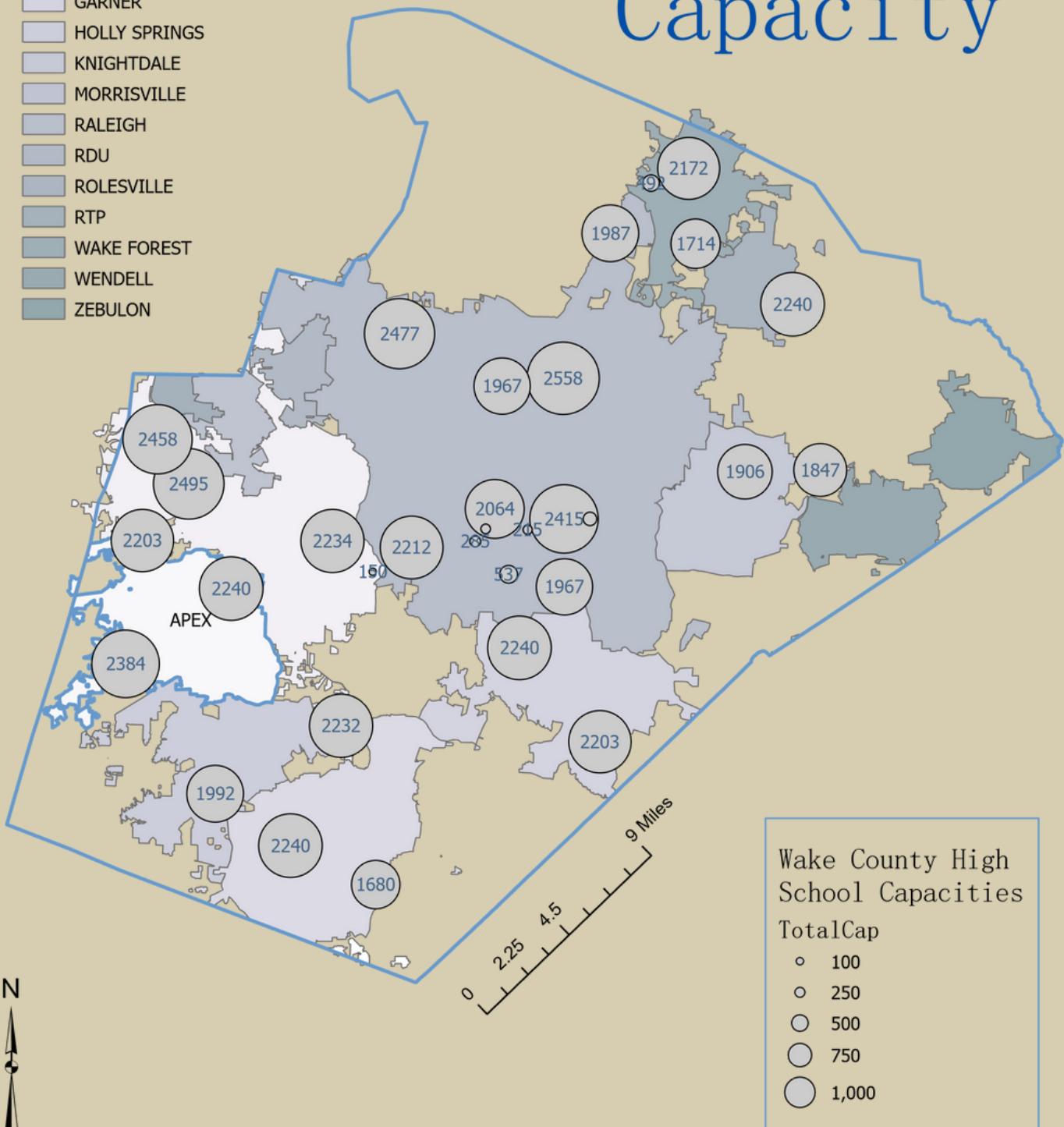
When thinking about building a new school, it is important to think about how many people the school needs to hold. On average, Wake County Schools have around 1,000 students.

Code	Field2	Program Model	Schools	22_23 Proj Student	StudentCap	TrailerCap	TotalCap	CrowdingPerc	Year Built
316	T	Large	Apex HS	2400	2240	0	2240	107.10%	2019
317	T	Large	Apex Friendship HS	2767	2240	6	2384	116.10%	2015
318	T	Med Sci & Global Health	Athens Drive HS	2050	1708	21	2212	92.70%	1979
348	T	Global/Lang Immer/IB	Broughton HS	2100	1800	11	2064	101.70%	1929
368	T	Large	Cary High HS	2000	2234	0	2234	89.50%	1960
386	T	Blended Learning	Crossroads Flex HS	147	150	0	150	98.00%	2016
411	T	Small	East Wake HS	1492	1679	7	1847	80.80%	2009
412	T	GT/IB	Enloe HS	2400	2415	0	2415	99.40%	2009
428	T	Small	Fuquay-Varina HS	2120	2240	0	2240	94.60%	2021
436	T	IB - MYP & DP	Garner HS	1660	2240	0	2240	74.10%	2019
441	T	Small	Green Hope HS	2068	1679	34	2495	82.90%	1999
437	T	Large	Green Level HS (2019)	2210	2203	0	2203	100.30%	2017
445	T	Small	Heritage HS	1915	1714	0	1714	111.70%	2009
455	T	Small	Holly Springs HS	2233	1656	14	1992	112.10%	2006
466	T	Small	Knightdale HS	1700	1714	8	1906	89.20%	2004
473	T	Large	Leesville Road HS	2500	2213	11	2477	100.90%	1993
495	T	Small	Middle Creek HS	1770	1656	24	2232	79.30%	2002
500	T	IB - MYP & DP	Millbrook HS	2350	2174	16	2558	91.90%	2006
518	EC	Early College	North Wake College & Career Academy	382	300	8	492	77.60%	2016
526	T	Small	Panther Creek HS	2400	1714	31	2458	97.60%	2006
546	T	Large	Rolesville HS	2500	2240	0	2240	111.60%	2013
552	T	Small	Sanderson HS	1500	1703	11	1967	76.30%	1968
561	T	Large	South Garner HS	1782	2203	0	2203	80.90%	2016
562	M	Sch. Of Design, Art & Eng.	Southeast Raleigh HS	1451	1679	12	1967	73.80%	1997
581	EC	Early College	Vernon Malone College & Career Academy	342	537	0	537	63.70%	2014
583	EC	Early College	Wake Early College of Health & Science HS	338	375	0	375	90.10%	2006
587	EC	Early College	Wake Early College of Information & Biotechnologies (H11)	150	150	0	150	100.00%	0
588	T	Large	Wake Forest HS	2172	2172	0	2172	100.00%	2011
582	EC	Early College	Wake STEM Early College HS (Dec '21)	252	285	0	285	88.40%	2011
585	EC	Early College	Wake Young Men's Leadership Academy (9-12)	137	215	0	215	63.70%	2014
586	EC	Early College	Wake Young Women's Leadership Academy (9-12)	188	236	0	236	79.70%	2014
595	T	Small	Wakefield HS	2150	1627	15	1987	108.20%	1999
625	#N/A	Large	Willow Spring HS (2021)	1500	1680	0	1680	89.30%	2019

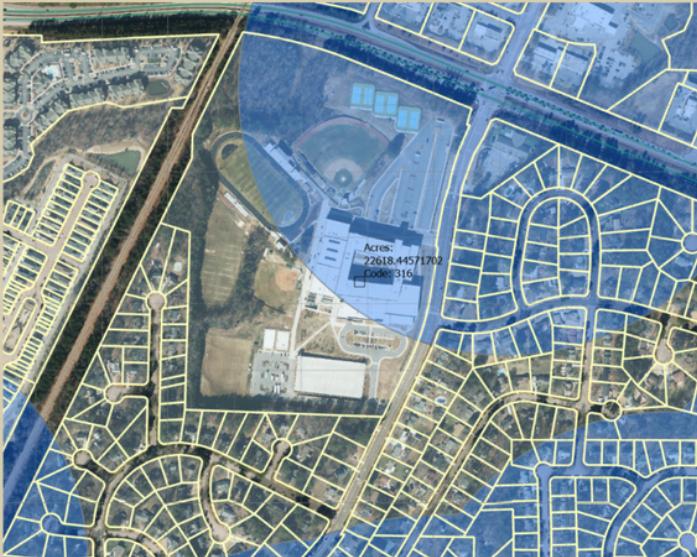
## Counties

- ANGIER
- APEX
- CARY
- CLAYTON
- DURHAM
- FUQUAY VARINA
- GARNER
- HOLLY SPRINGS
- KNIGHTDALE
- MORRISVILLE
- RALEIGH
- RDU
- ROLESVILLE
- RTP
- WAKE FOREST
- WENDELL
- ZEBULON

# High School Capacity

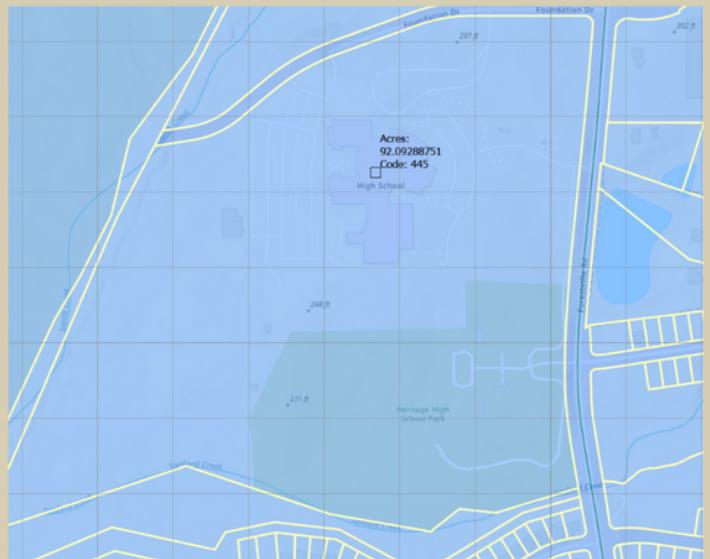


# Precedent Search



When looking at the Wake County High School data, there are schools of all different kinds. To sort through this data it is important to select by attributes present. For the map to the left, I was searching for high schools within my municipality. To do that I selected the Wake County High School data and selected the attributes to only include schools within Apex. From there I selected one of the schools, I ended up choosing Apex High School as seen by the map and photo to the left.

In order to select a high school that has the smallest parcel, the first step was to make sure acres were within the attribute table. After that, to find the one with the smallest attribute I organized the table to be ascending based on acres. From there I found the high school and labelled it. The high school that had the smallest amount of acres is the Heritage School.





The image and map to the left represents the newest high school in Wake County. To find the newest high school, I went to the attribute table and sorted based on year built. This can also be done by using the select by attribute and selecting by year. The school that is the newest in Wake County is Fuquay - Varina High School.



In order to find a school that is within a quarter mile of a greenway, I used select by location. With the buffer that I created, I looked for a dot within the blue buffer and selected it. From there I labeled it. As seen to the right, the school selected was the Wake Young Women's Leadership Academy.

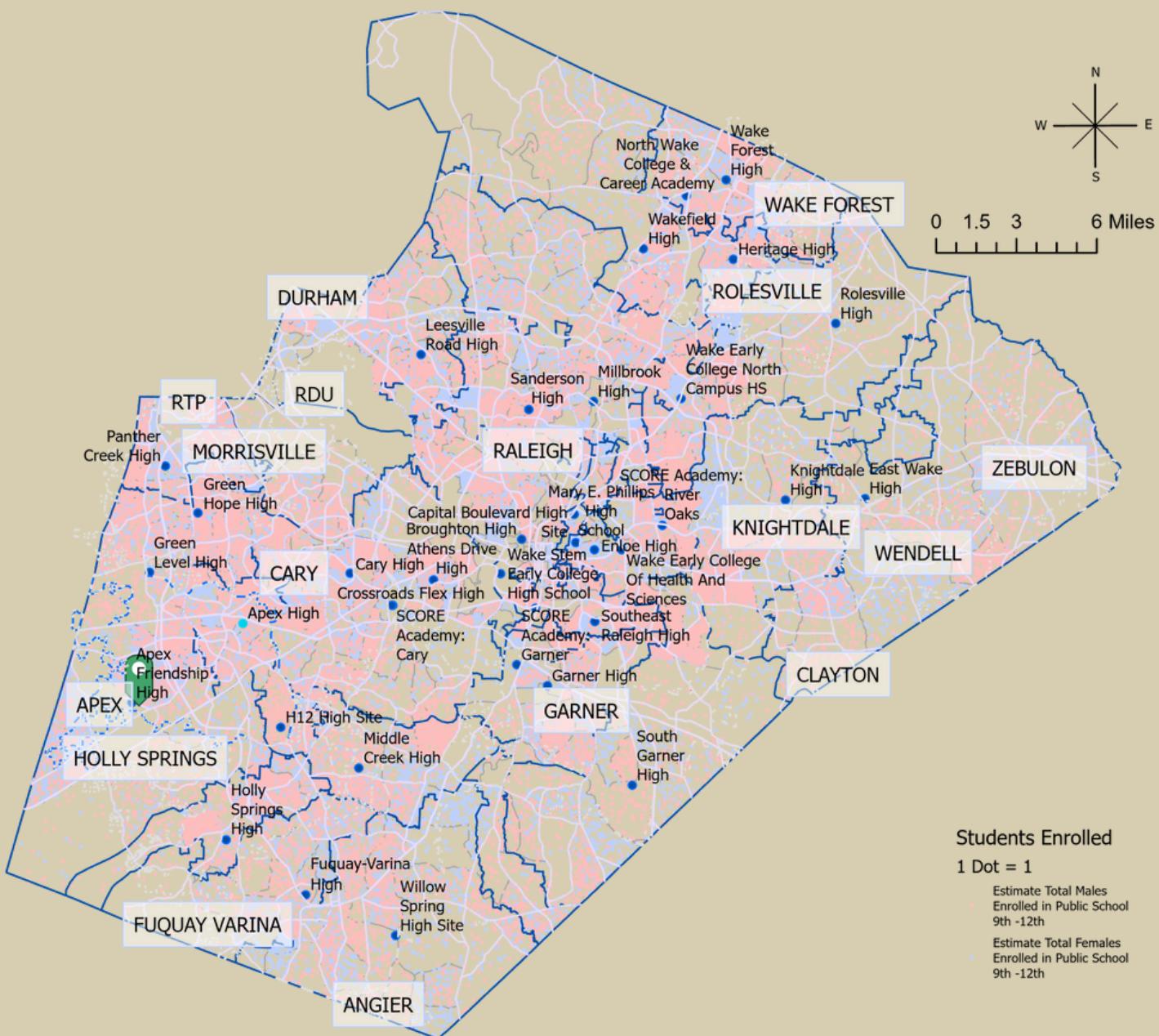


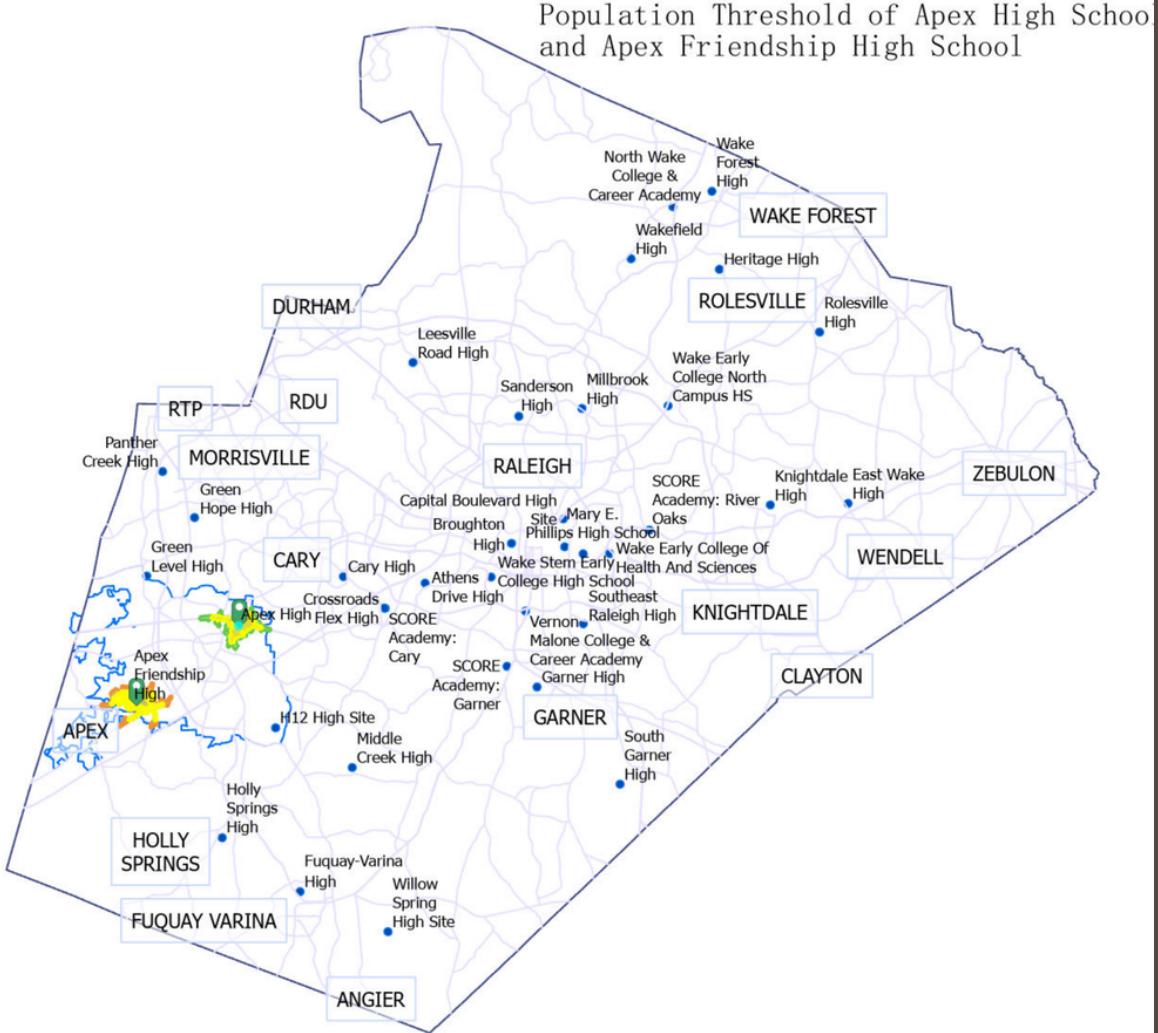
N  
0 50 100 200 Miles



# Student Population

Below this map represents the amount of students currently enrolled in public schools across Wake County. Every dot represents one student currently enrolled in the public school system. Areas that have a dense amount of color represents an area of high concentration of students. Municipalities such as Raleigh, Cary, and Apex have a dense amount of enrolled students due to the higher population within those areas.





Population Threshold of Apex High School and Apex Friendship High School

The map above represents the threshold of the population of Apex High School and Apex Friendship High School. Within Apex, there are four high schools present. Only looking at the population that is serviced by Apex High School and Apex Friendship High School, there is a wide area within Apex that is not served by the two schools. Some of the areas that have a large gap are located in areas in which other high schools are located. One area in Apex that has potential for needing another high school, is the direct center of Apex. This is a potential spot due to the fact that all four of the high schools are located on the outer edges of the municipality.

# Site Selection:

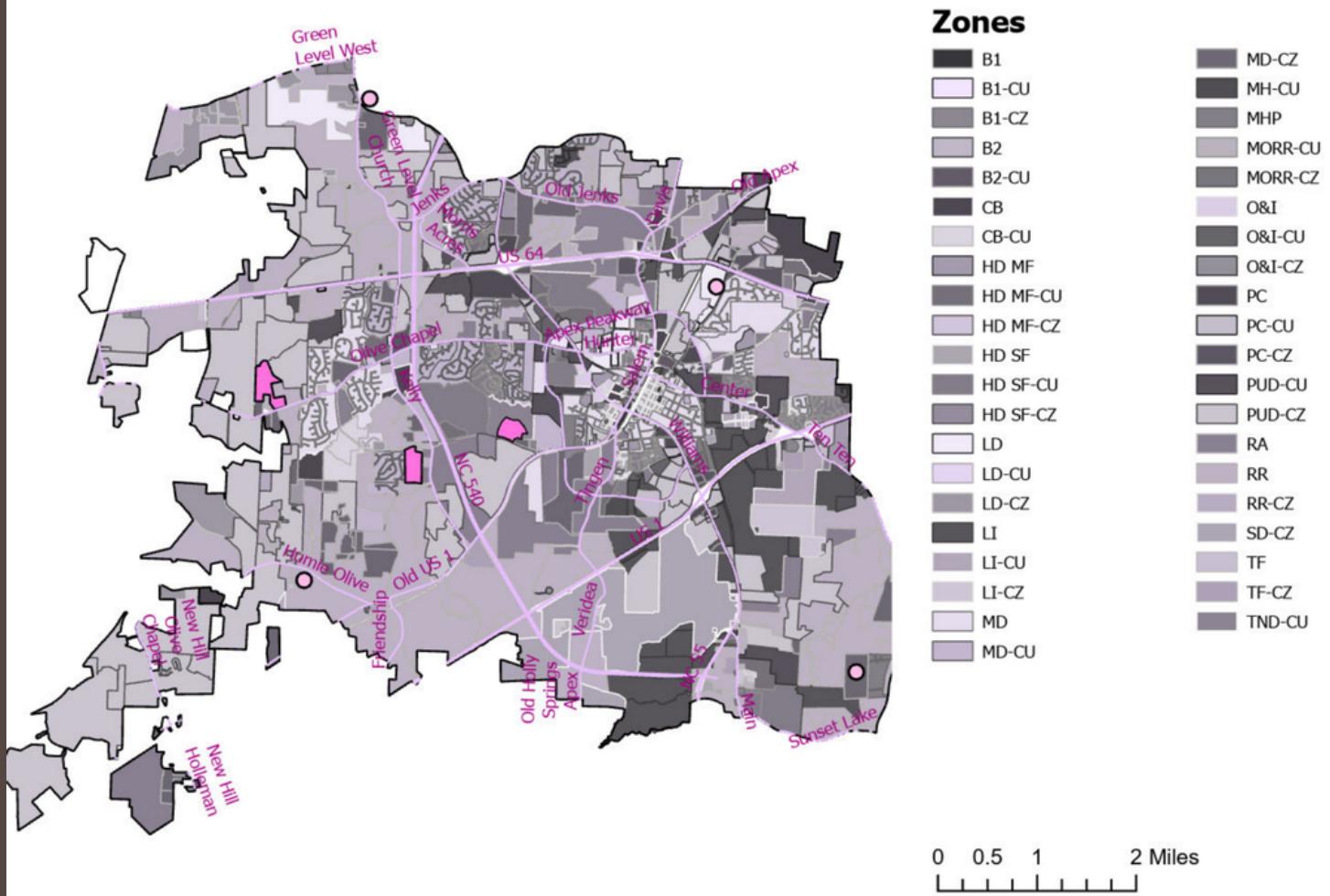
Selecting a new location for a high school there are many elements to think about. The first few elements to look at are the regulations for building a high school. In Wake County it is required for the school to be located only near roads that have a speed limit less than 55 mph. Another element to think about is the size of the parcel.

## Zones Where Schools Can be Built:

- RA
- HDSF
- O&I
- TND
- RR
- HDMF
- B1
- PUD
- LD
- MH
- TF
- STC
- MD
- MORR
- MEC

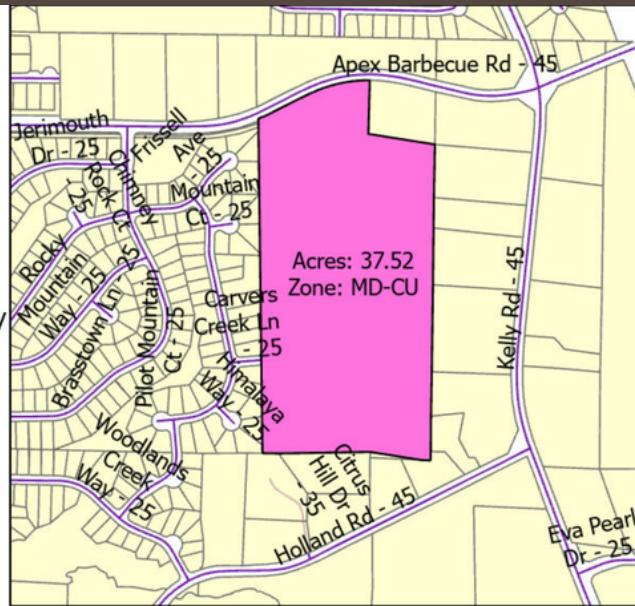
In order to build a high school, Wake County requires there to be at least thirty acres. As well as acres, schools are allowed in only certain building zones (Table 1). One of the last elements to look at is the current location of high schools. There should be a decent distance from the current high schools so more students can be served.

## Zoning in Apex, North Carolina



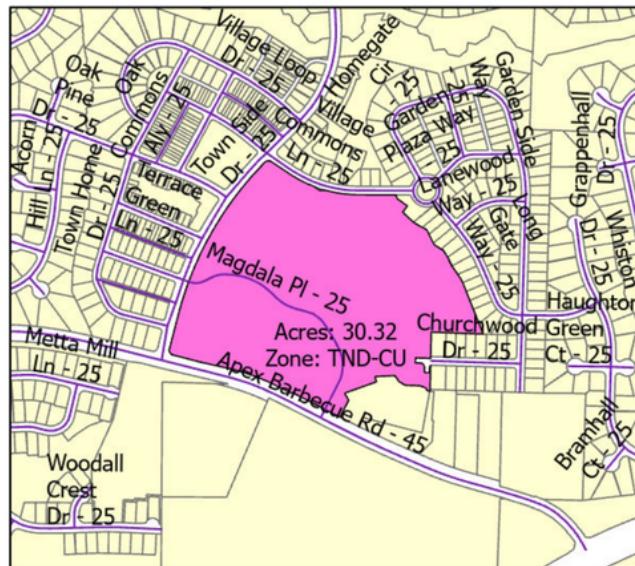
## Site A:

Site A: When selecting potential sites it is important to look at location. Site A's location is close to a neighborhood based on the zone which could potentially mean shorter distances for students to travel. On top of the close location to a neighborhood, Site A is not close to any of the other current high schools.



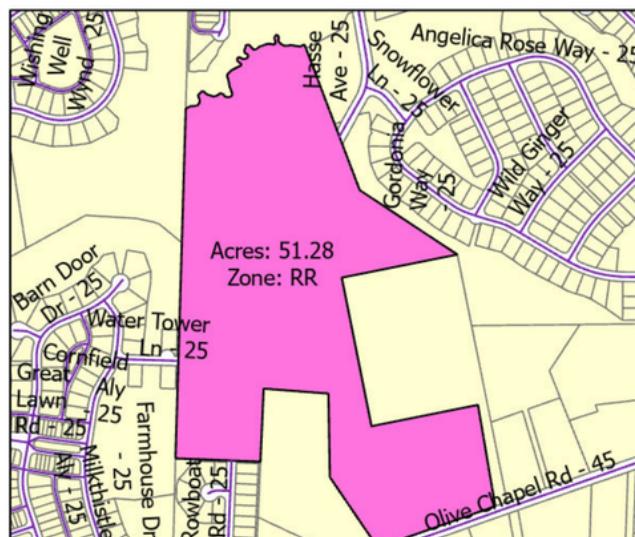
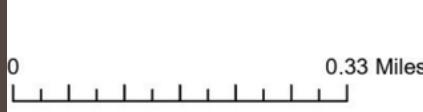
## Site B:

Site B: Similar to Site A, Site B was selected due to its location. While the zoning is not optimal, the location is a great distance from current high schools. Though there are not neighborhoods directly next to location, Site B would be nestled in area where neighborhoods are just down the road.



## Site C:

Site C is located within a residential zone, being so close to neighbors would cut down the distance that students need to travel in order to get to school. Having a shorter distance could potentially cut down on the cost of buses for the school system. Site C is also located a decent distance away from current high schools.



# Site Analysis

The three parcels selected in the previous section, are taken and further analyzed. The areas that are further analyzed includes the terrain, suitability, and hydrology. After the analysis of the three parcels, one will be selected to be used in the site design.

The site analysis uses raster data instead of vector. This means there are different geoprocessing tools used.

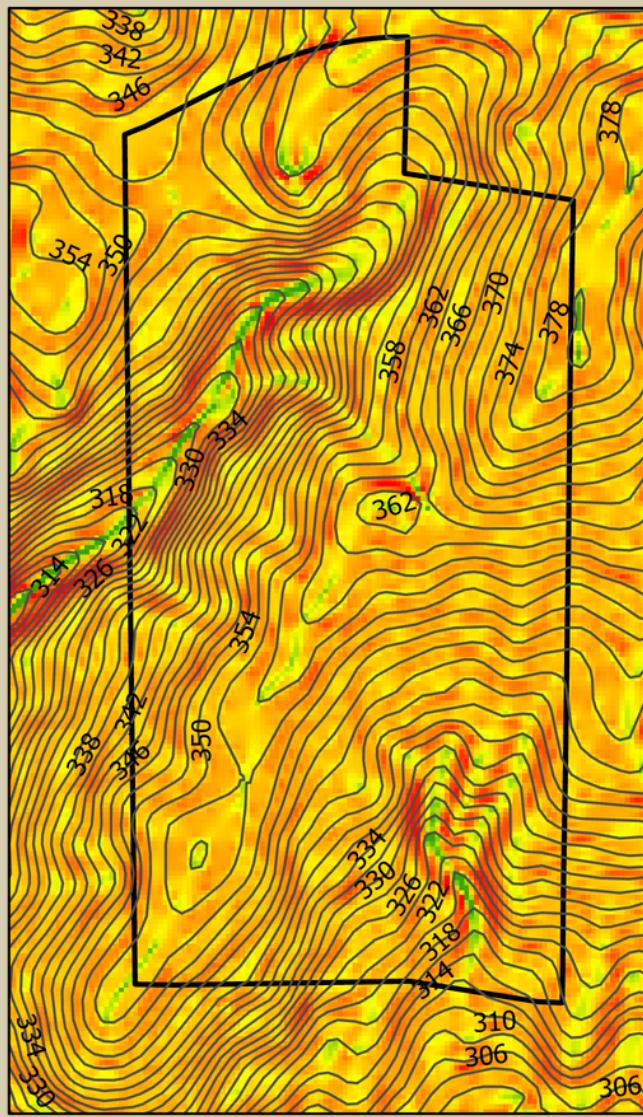
# Terrain Analysis

## Site A

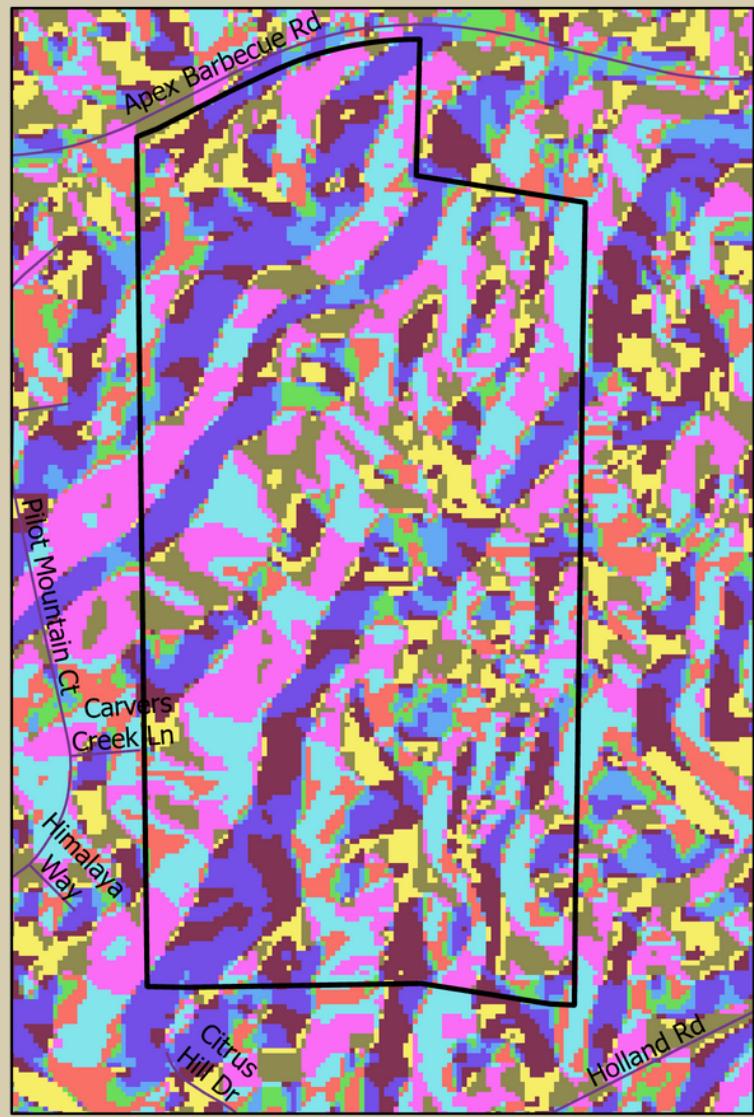
When looking at Site A, it is important to note the wide array of slopes present in the area. With all of the different slopes, this area would most likely have some small hills amongst the acres. These hills also face many different ways, so the hills are not consistent. Though this area is not the optimal site for building, it is an open piece of land that can be built on.

### Elements in Maps

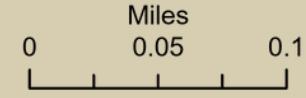
Streets	Southeast (112.5 - 157.5)
Site	South (157.5 - 202.5)
Aspect	Southwest (202.5 - 247.5)
Value	West (247.5 - 292.5)
Flat (-1)	Northwest (292.5 - 337.5)
North (0 - 22.5)	North (337.5 - 360)
Northeast (22.5 - 67.5)	East (67.5 - 112.5)



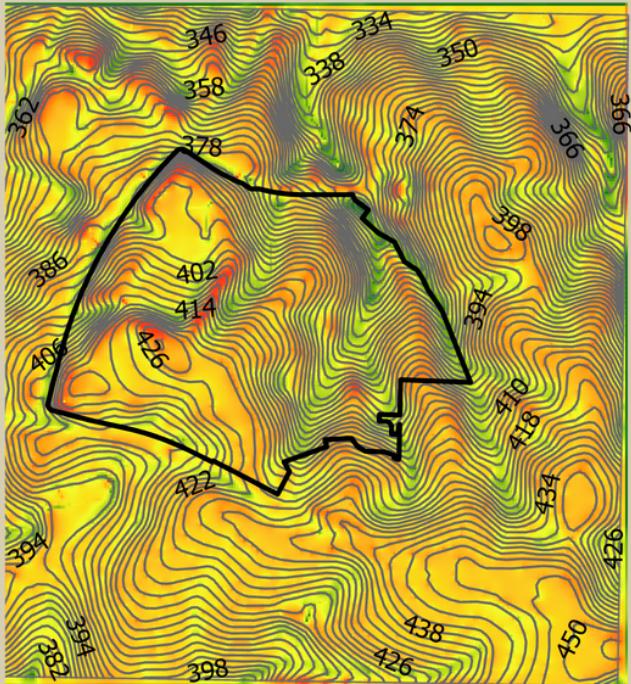
Slope Analysis Map



Slope Aspect Map



# Site B



Slope Analysis Map

Though Site B has very minimal slope change and consistent slope directions. I figured out that this area belongs to a church. Since it is a church, I assume this area would not be usable for a school. If the local government is able to take down existing buildings to make government buildings then this location would be great.



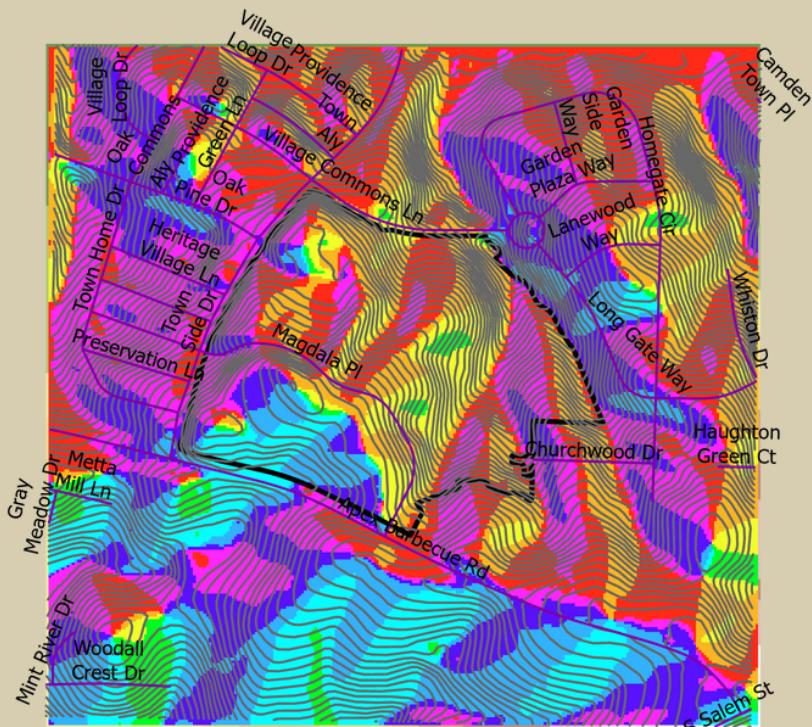
When creating the site analysis of Site B, it was important to represent the different severity of the slopes as well as the directions in which the slopes are facing. Site B has minimal slope differences, there are few spots within this area that have major slope changes. With these minimal slope differences, the directions the slopes are facing are pretty consistent.

- Street
- Contour (2ft)
- Site

## Topography

### VALUE

321.789 - 347.965
347.966 - 368.406
368.407 - 384.368
384.369 - 396.832
396.833 - 406.565
406.566 - 414.165
414.166 - 423.898
423.899 - 436.362
436.363 - 452.324



Slope Aspect Map

0 0.05 0.1 Miles

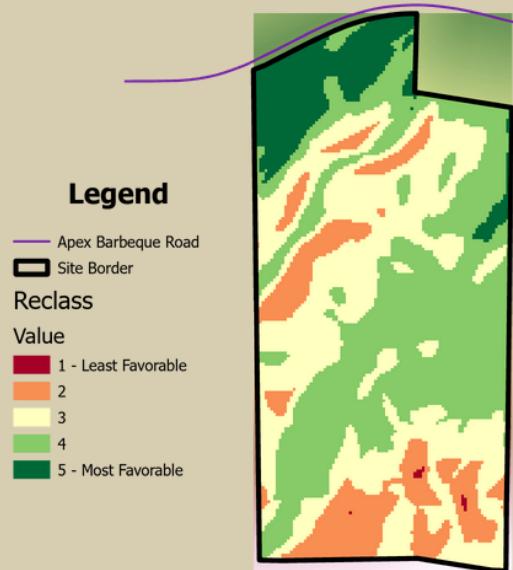


# Suitability Analysis

A suitability analysis was conducted to help determine where the school should be placed on the parcel of land. There were three areas of analysis which were slope, distance from the road, and soils suited for small buildings.

The suitability analysis was conducted on a 5 point scale. On this scale 1 is considered least favorable and 5 is considered most favorable.

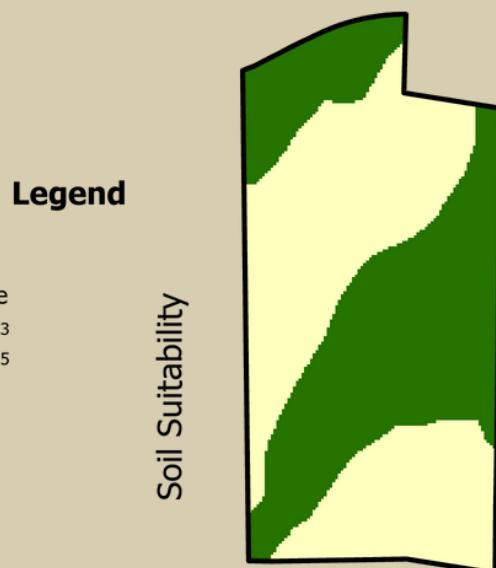
Within these maps there are not consistent findings. The lands slope is constantly changing and does not have a defined pattern. What is consistent based on the soil suitability map, is the type of soil present. Both types of soil present are considered to be favorable.



Distance From Road



Slope Raster



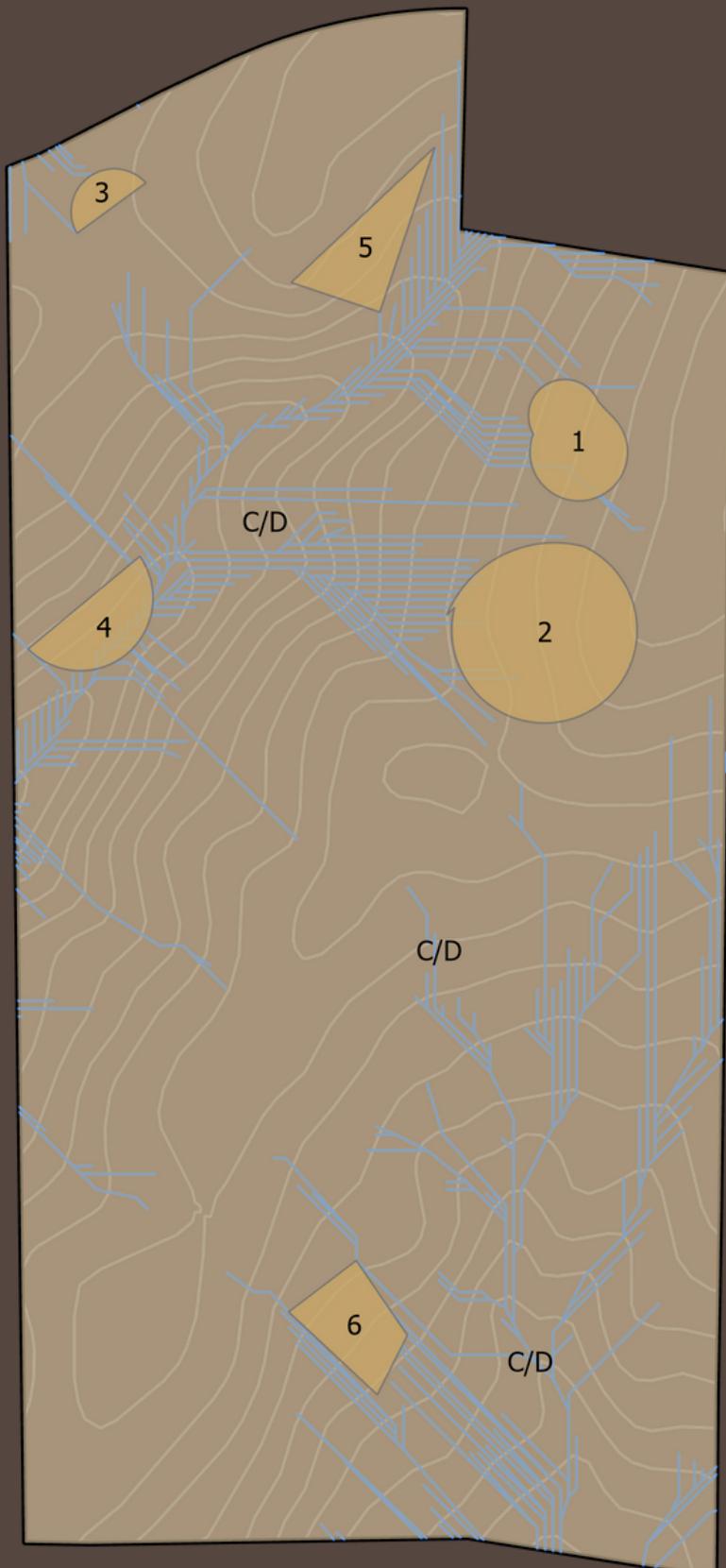
Soil Suitability



# Hydrology Analysis

When looking at potential site locations, it is important to look at the water present within the area. By looking at the basins present within the area, it allows us to understand the way water will move. Knowing the way the water moves allows for stormwater management to be implemented early on within the building. It is important to have stormwater management devices to prevent damage to a future building or potentially ruining a habitat. Another important reason to understand the water flow is to prevent damaging ecosystems that are present.

Area	ID	Type
14954.313129	1	Garden
42705.674449	2	Wetland
4082.245923	3	Garden
12099.050519	4	Garden
13172.920317	5	Wetland
12511.068954	6	Wetland



SCM Polygons

## Soil Ratings

### Rating

C/D

Water Basins

Site Border

2ft Contour Lines

0      0.02      0.04      0.09 Miles

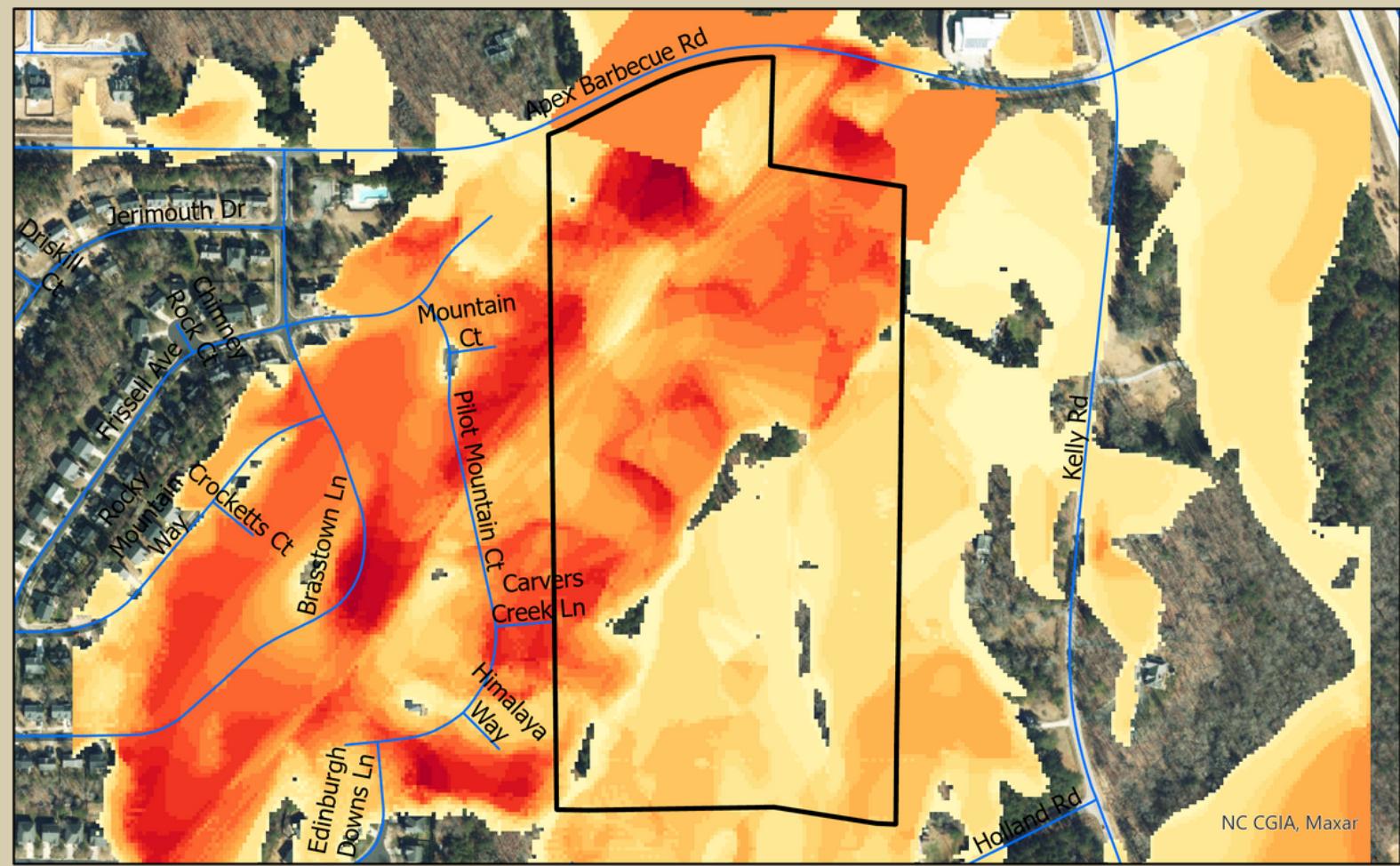
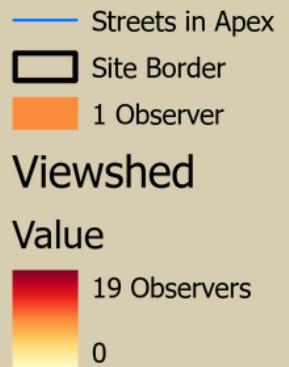


# Site Design

Within ArcGIS Pro, tools can be used to produce a map showing where the buildings are placed in 3D. In this section, a site design was created to represent the school along with the features needed.

# Visibility Analysis

When choosing an area to place the sign for the potential school. It is important to think about placement and how the audience will perceive the sign. Within this area the main audience will be people whom are in cars that are traveling at a speed around 45 miles per hour. It will also be humans who need to observe the sign.



Potential areas in which a sign should be placed.  
Areas that are red are better potential spots.

0 0.03 0.05 0.1 Miles



# Site Layout

This is a digital rendering of what the site could look like with the required amenities. Using GIS in this form is quite difficult, it is hard to move around the individual parts. Every time I would try to move one part I would select more or less parts then intended and it would quickly fall apart.

When placing the individual amenities, I found that the parcel of land did not have much room. It was like one big jigsaw puzzle. I believe it would be helpful to have a wider parcel. The parcel being long and skinny makes it hard to have areas designated to one type of amenity like sports fields.



When moving from GIS to exporting the PNG, the layer for the site features disappeared,

# Sources

<https://www.wakecountyathletics.com/page/show/3008230-heritage-men-s-jv-soccer>

<https://www.clarknexsen.com/project/apex-high-school/>

<https://www.wcpss.net/fvhsribboncutting>

<https://www.wcpss.net/wywla>