Predicting Development to Plan for Future Sewer Service Demands in Oconee County, South Carolina
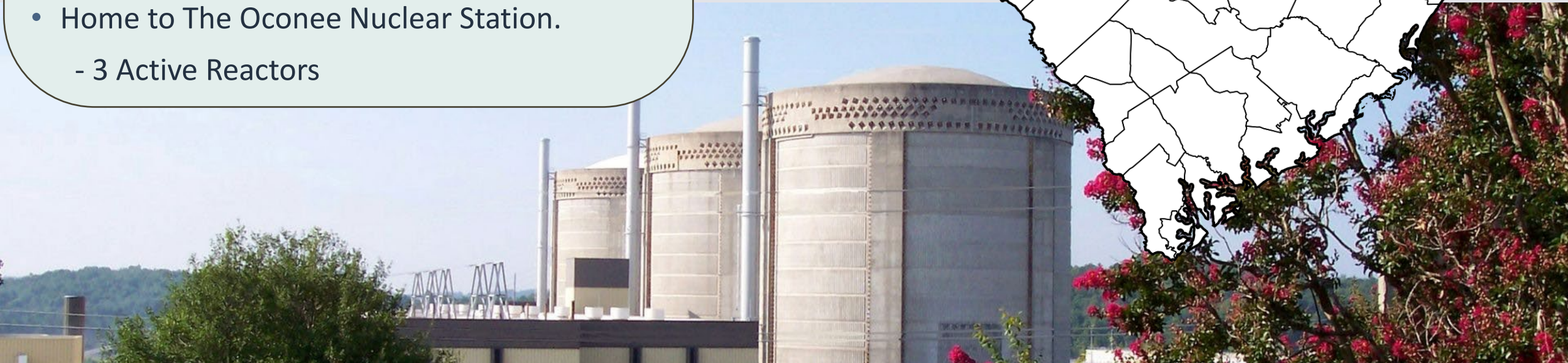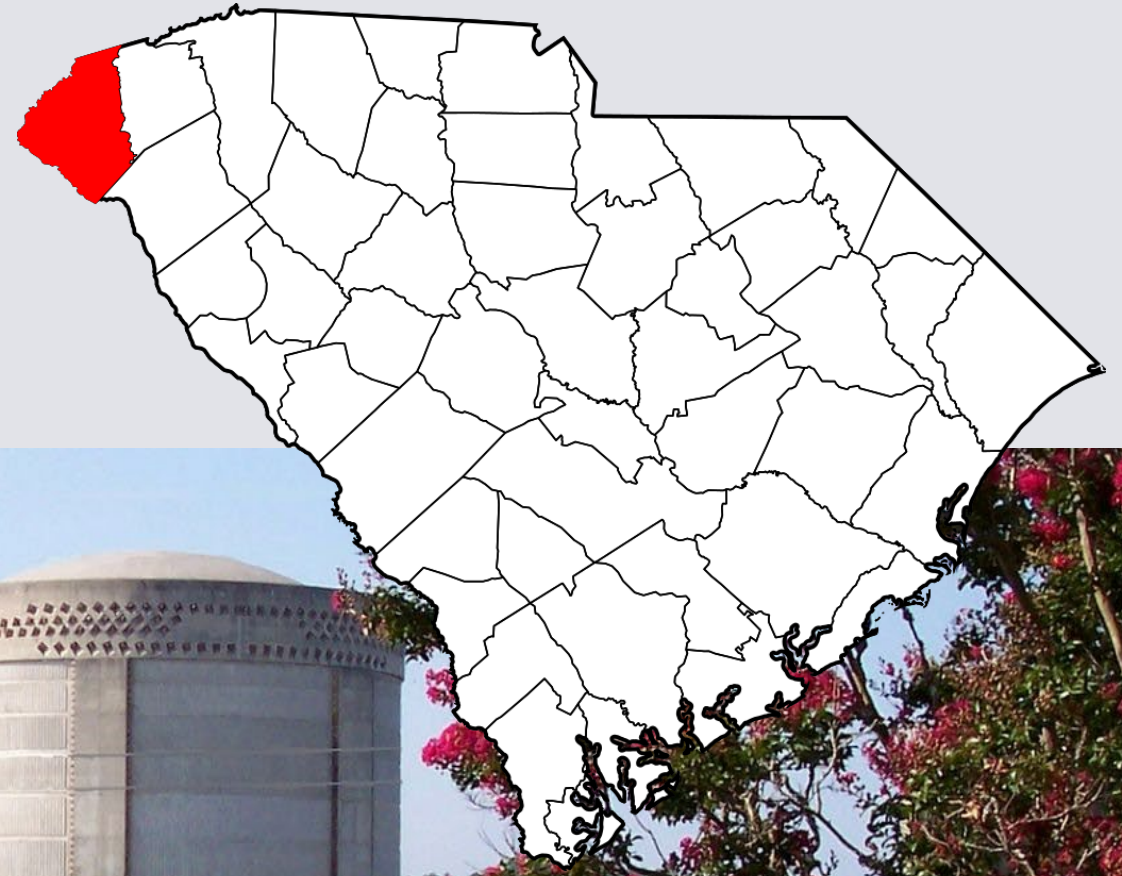
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Penn State MGIS

596A – Peer Presentation

Background of Oconee County, SC

- Oconee County is the western most County in South Carolina.

- Located at the confluence of the GA, NC and SC borders.

- 700 square miles.

- 50 square miles of water, Lake Hartwell, Lake Keowee, Lake Jocassee and the Chattooga River.

- 80,000 Population.

- Home to The Oconee Nuclear Station.

  - 3 Active Reactors

Duke Energy, 2018. Oconee Nuclear Site, digital image, Nuclear Information Center. Accessed on 10-18-2023, https://nuclear.duke-energy.com/2018/07/20/celebrating-45-years-at-oconee-nuclear-station
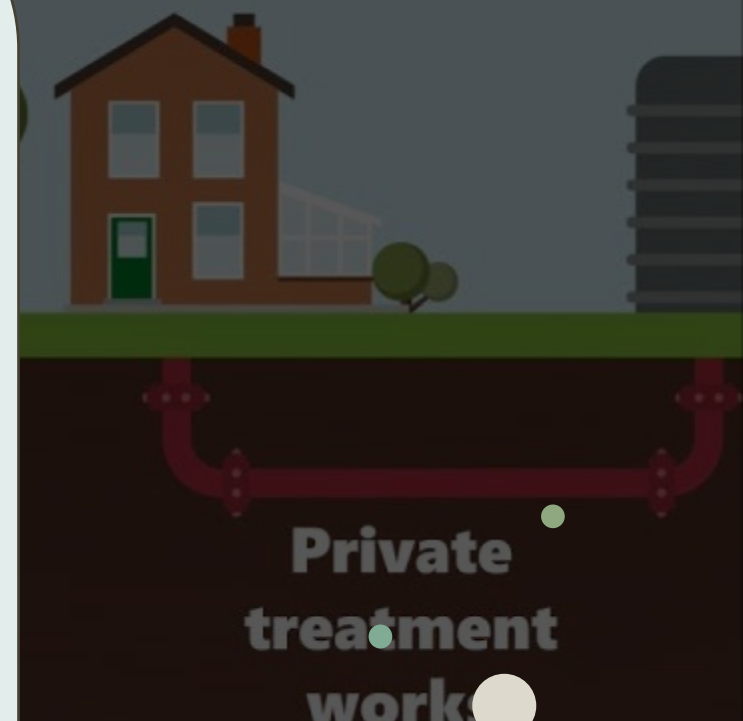
Sewer Service History

- 80% of residence depend on septic tanks for sewer needs.
  - Of 53,000 addresses in County, 9,707 in a Municipality (the main sewer providers).

- Sewer service Municipalities include Seneca SC, Walhalla SC and Westminster SC.

- Growth Context: 13% of addresses were assigned in the last 10 years.

- Oconee County is growing faster than infrastructure (roads, water, sewer services).

Septic tanks

Private treatment works

Septic Systems

- Systems that are installed and maintained property have no major affects on the environment (DHEC, 2019).

- Septic systems needs to be inspected every 1-2 years and pumped ever 3-5 years (DHEC, 2019).

- Poorly constructed or unmaintained septic systems can lead to groundwater contamination with pathogens, chemicals and nutrients (EPA, 2023).

Septic tanks

Private treatment works

Research Reason

- Oconee County is quickly growing:

  -Low Taxes

  - Industry incentives

  - Affordable-Available

    Housing

  - Clemson University

  - Outdoor Paradise

- As the Oconee County GIS Manager, I have a unique perspective inside the workings of government and agencies.

- I see the needs for a comprehensive sewer service plan that starts with predicating future service.

Figure 1: Screen capture of AGOL Oconee County Sewer System Map.

Table 1: List of Organizations and Layer that Oconee County GIS supports.

Organization	Departments	Layers
Oconee County Government	Roads and Bridges	Roads
City of Walhalla	Planning, Zoning	Zoning
Oconee Joint Regional Sewer Authority	Sewer System	Lines, Manholes, Lift Stations
Prisma Health	Ambulance Helicopter	Locations, Landing, Driving Routes
City of Seneca	Water	Lines, Pumps, Traps
Blue Ridge Electric	Company	Powers lines

Project Problems

....Oconee County is growing faster than infrastructure, particularly sewer infrastructure...
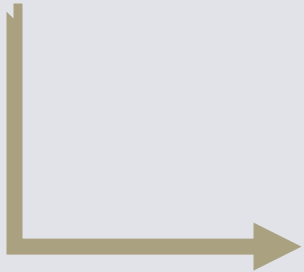
..To plan for future sewer infrastructure, one needs to predict future demand through future growth...
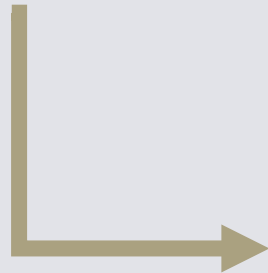
...To predict future growth, one needs a method for determining optimal locations that meet the criteria for future growth....

Why Me?

- Produce Map products that give a geographic context to future development that can be used by all agencies and companies.

Why?

- Current sewer service providers use the response methods for growing sewer infrastructure.
- Sewer service across the County is extremely limited.

Impact of Research

- Sewer Providers can change from reactive to proactive in infrastructure construction.

- County can attract industrial, commercial or residential development.

- Current sewer service providers costs can go down.

- Better impact on the environment.

- Act as catalyst for transportation, electrical, water infrastructure.

- Build a foundation with established baseline for a future comprehensive expansion plan.

Past Research

- Predicting Area Non-Urban to Urban Change Study

- Authors: Jian Lange, Carston Lange and Witold Fraczek

- Study Area: Raleigh, Durham NC

- Raster Cell Analyst Approach

- Developed to predict future land used based on existing conditions and proximity to features of interest.

- This study is important to my research because it uses layers and a baseline which are universal across the United States.

Table 2: List of Features of Interest for the Predicting Area Non-Urban to Urban Change Study (Lange, J., Lange, C. and Fraczek W, 2021)

Features of Interest
Drive Time to Urban Centers
Slopes
Flood Zones
Distance to Freeways
Distance to Protected Areas
Distance to Secondary Roads
Population Growth

Figure 2: Image of Predictive Raster for Durhan, North Carolina (Lange, J., Lange, C. and Fraczek W, 2021)

DATA

Municipalities
- Sewer Lines (Lines)
- Manholes (Points)
- Boundary (Polygons)
- Electrical Service (Lines)
- Water Service (Lines)

United States Geological Service (USGS)
- National Land Cover Database 2021 (Raster)

**Oconee Joint Regional Sewer Authority (OJRSA)**
- Sewer Lines (Lines)
- Service Regions (Polygon)
- Sewer Denied (Point)
- Sewer Requested (Polygon)

Oconee County Government
- County Regions (Polygon)
- Roads (Lines)
- Addresses (Points)
- Boundaries (Polygon)
- Preservation/ Zoning (Polygon)
- Sewer Projects (Polygons)
- Population (Stats-Points)
- Topography (lines)
- Parcels (Polygon)
- Existing Infrastructure (Multiple)

Methodology

Important criteria, including drive time to city center, proximity to main roads and flood zones, will serve as predictors of development.
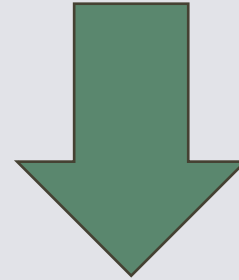
These predictors are used to create new raster layers in ArcGIS Pro.
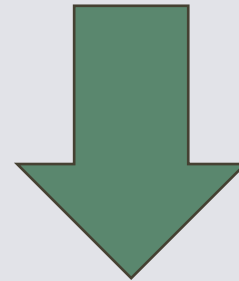
These raster layers are combined with the National Land Cover Dataset to predict areas of existing development, areas unsuitable for development and areas that have the potential for development.

M-1

Establish Study Area

1. Download and Clip National Land Cover Database Raster, using extend of Oconee County Boundary.

2. Protected areas such as National Forest, State Forest and historically significant locations will be masked out of the entire study area.
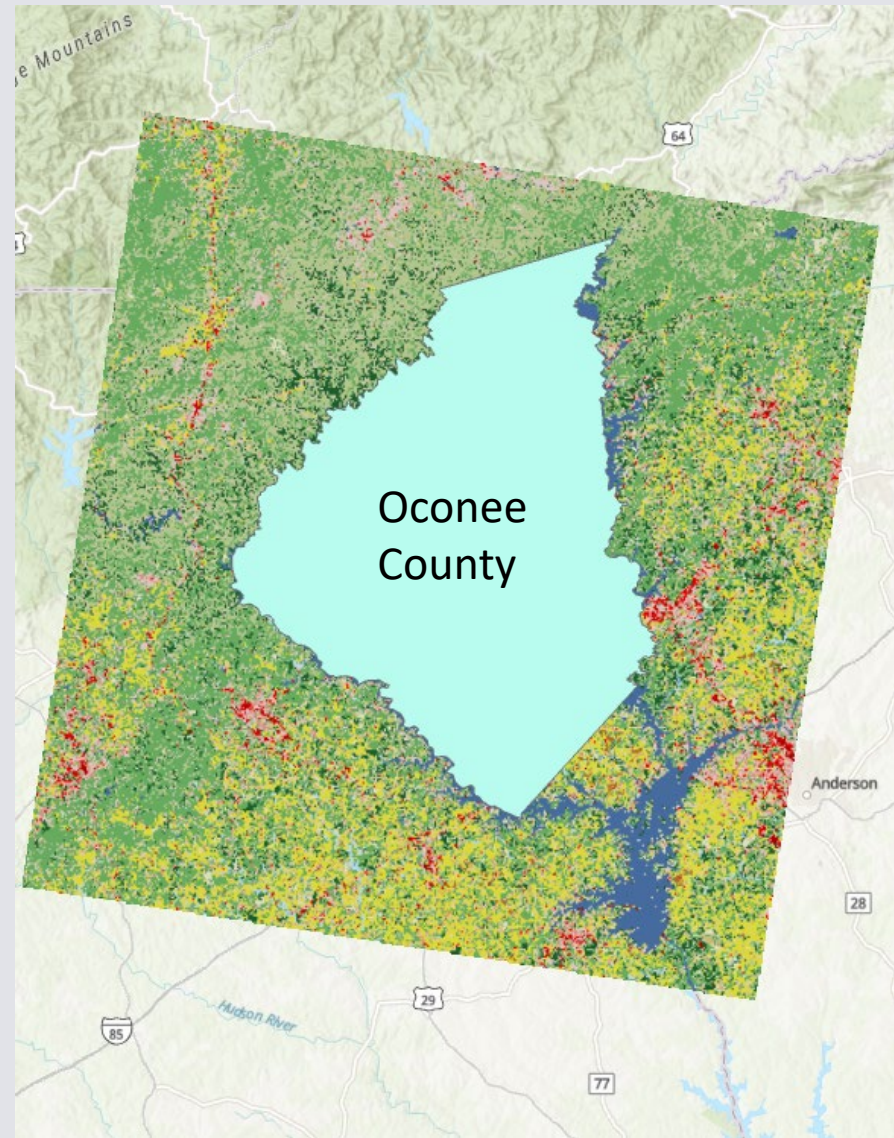

Figure 3: Raster Clip of National Land Cover Database, extend Oconee County.

M-2

Reclassify

Use the Reclassify Tool to breakdown the NLCD's raster to manageable values to be used in evaluation of the study area.
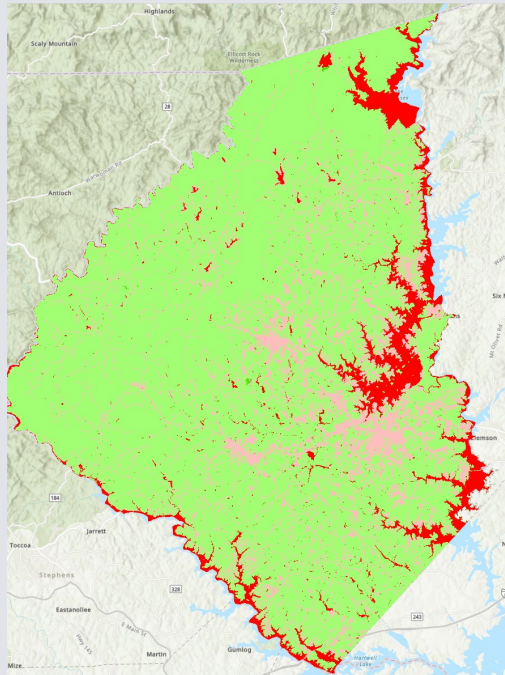

Figure 4: Raster Reclassification, Red negative values, Green positive values.

Table 3: Raster Reclassification Key

Type Code	Cover Type	Reclassify Code
11	Open Water	-5
21	Developed	-4
22	Developed	-3
23	Developed	-2
24	Developed	-1
31	Barren Land	5
41	Forest	2
42	Forest	2
43	Forest	2
52	Shrubs	3
71	Grasslands	3
81	Pasture	4
82	Crops	4
90	Wetlands	-4
95	Wetlands	-4

M-3

Slope

Create Slope using Contour Lines
1. Use Topo to Raster, use Oconee County Extend
2. Used Spatial Analysist
3. Surface->-Slope, Use Oconee County Extend.
4. Create slope surface.

Table 4: Slope Raster Reclassification Codes (Legal Eagles Contractors, 2023)

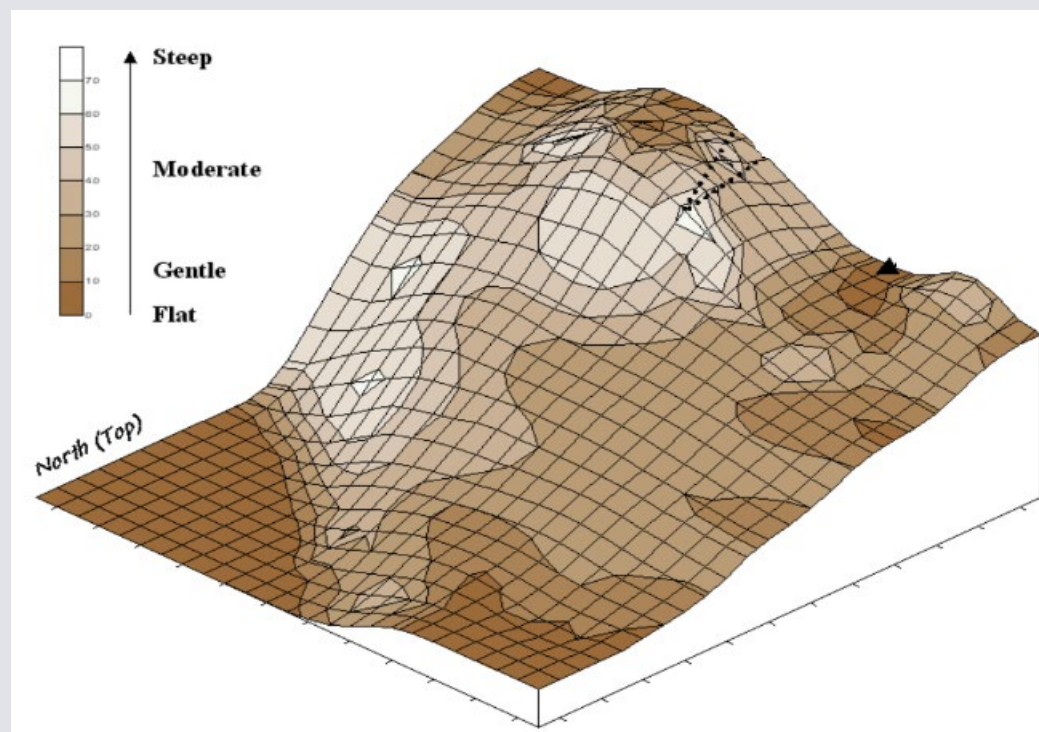| Slope	Raster Code
0-5%	3
6-10%	2
11-15%	1
16-25%	-2
26->%	-3

Figure 5: Example of Slope steepness (Beyond Mapping III).

M-4

Buffers

- Create buffers around features of interest. These buffers will be built with specific distances in mind. Nearer = higher value, further = lower value (except for distance to flood zones).

- Convert buffer polygons to raster, using the distance to source values as the field of interest.

Roads

City Center

Flood Zones

Distance

Highways

Services (Fire – EMS)
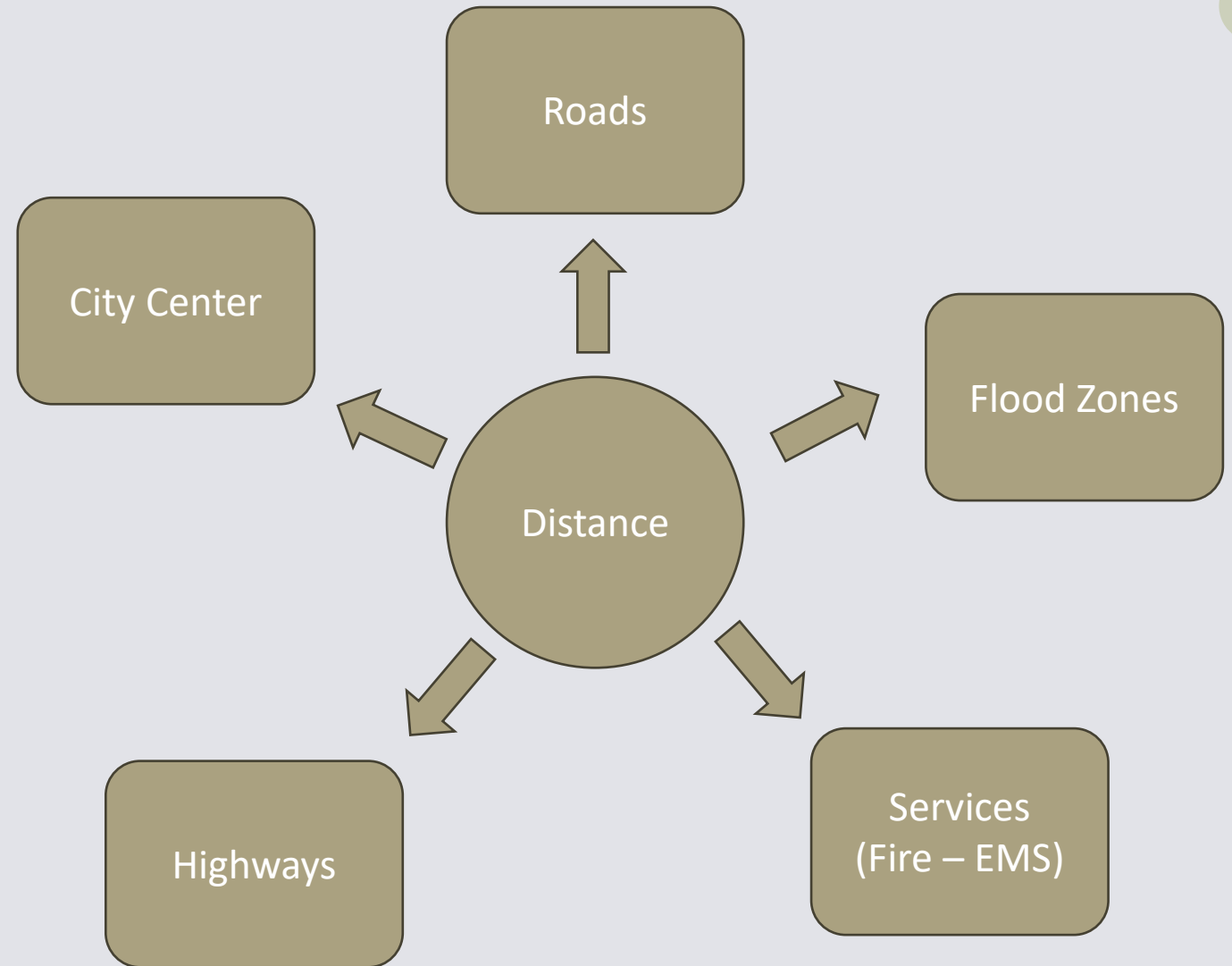
M-5

Combine Rasters

- Using Raster calculator, the following rasters will be combined to result in a layer that has positive and negative values. Values higher will have a higher prediction of development and values lower will have a lower prediction of development.
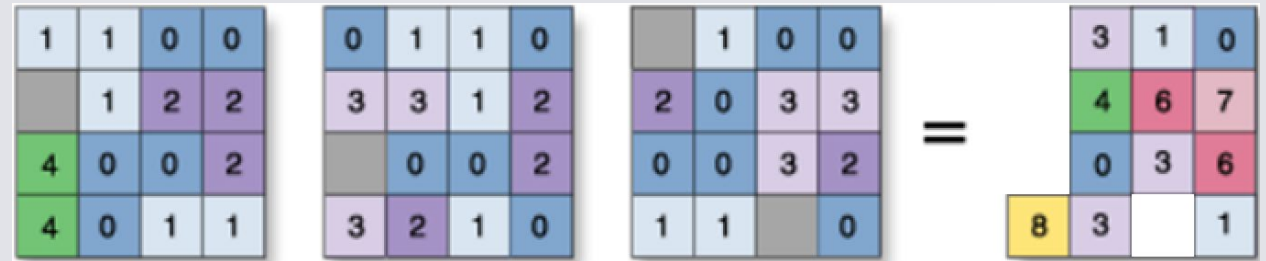

Figure 6: Example of raster addition calculator, (Maita, 2014).

M-6

Raster to Polygon

The final raster will be converted into a vector polygon and can then be used as an overlay of areas that have potential of development.
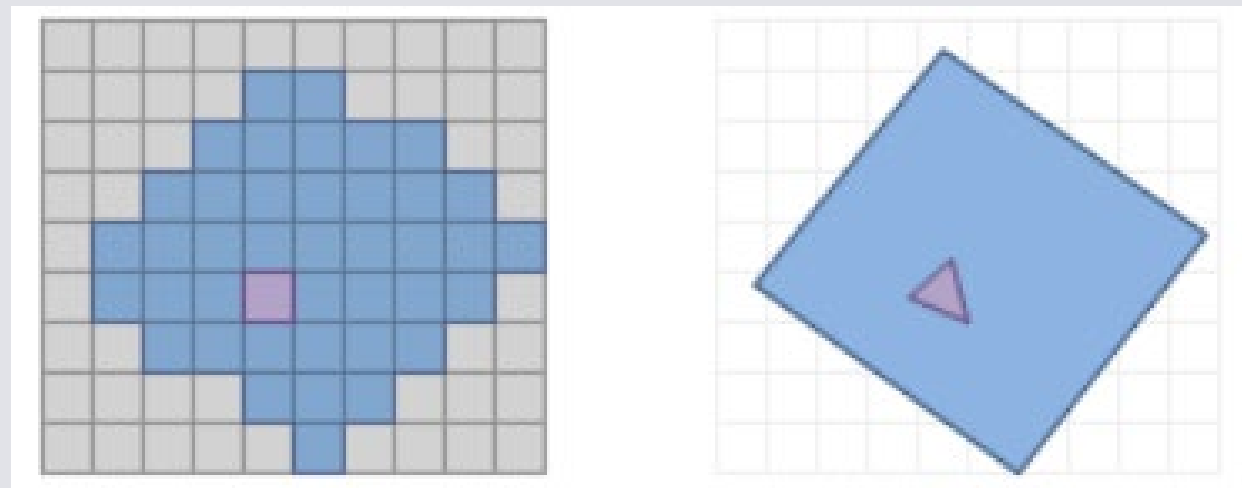

Figure 7: Example of Raster to Polygon Conversion (ESRI, 2023).

M-7

Current Infrastructure

- Overlay the current sewer service layers onto the map to show areas of potential growth with current systems.
- Add in areas of sewer denied and sewer request to show where there is already demand.

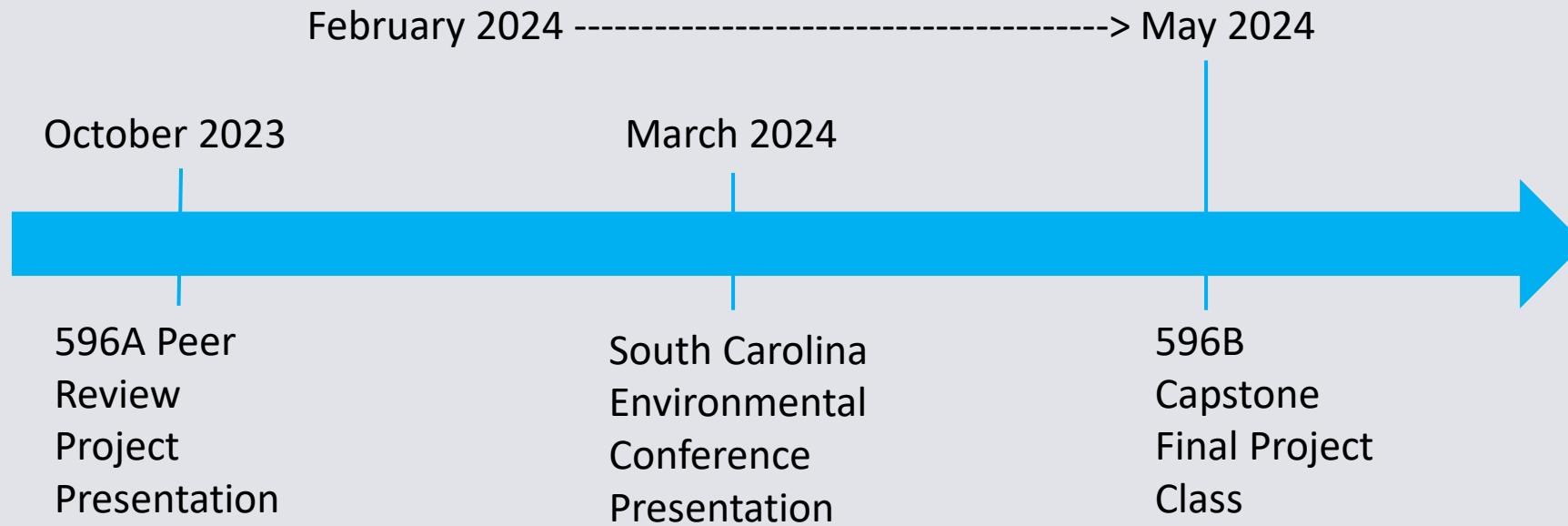Figure 8: Screen capture of AGOL Oconee County Sewer Denied.

Findings..

Expected

- Areas of high density or development will be predicted to have little future growth.

- Areas of little development (fields, forest, barren land) will be predicted to have future growth.

- Areas nearer to major roads will have a higher prediction score compared to areas far from major roads.

- A list of large parcels that have the potential for mass development that fit the criteria.

Preliminary

- Early findings show that the following geographic and human made features will heavily affect an area's ability to become developed.

  1. Slope – Topography
  2. Waterbodies – Wetlands
  3. Zoning – Boundaries

Project Timelines

February 2024 --> May 2024

October 2023

March 2024

596A Peer
Review
Project
Presentation

South Carolina
Environmental
Conference
Presentation

596B
Capstone
Final Project
Class

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Thank You

Questions ?