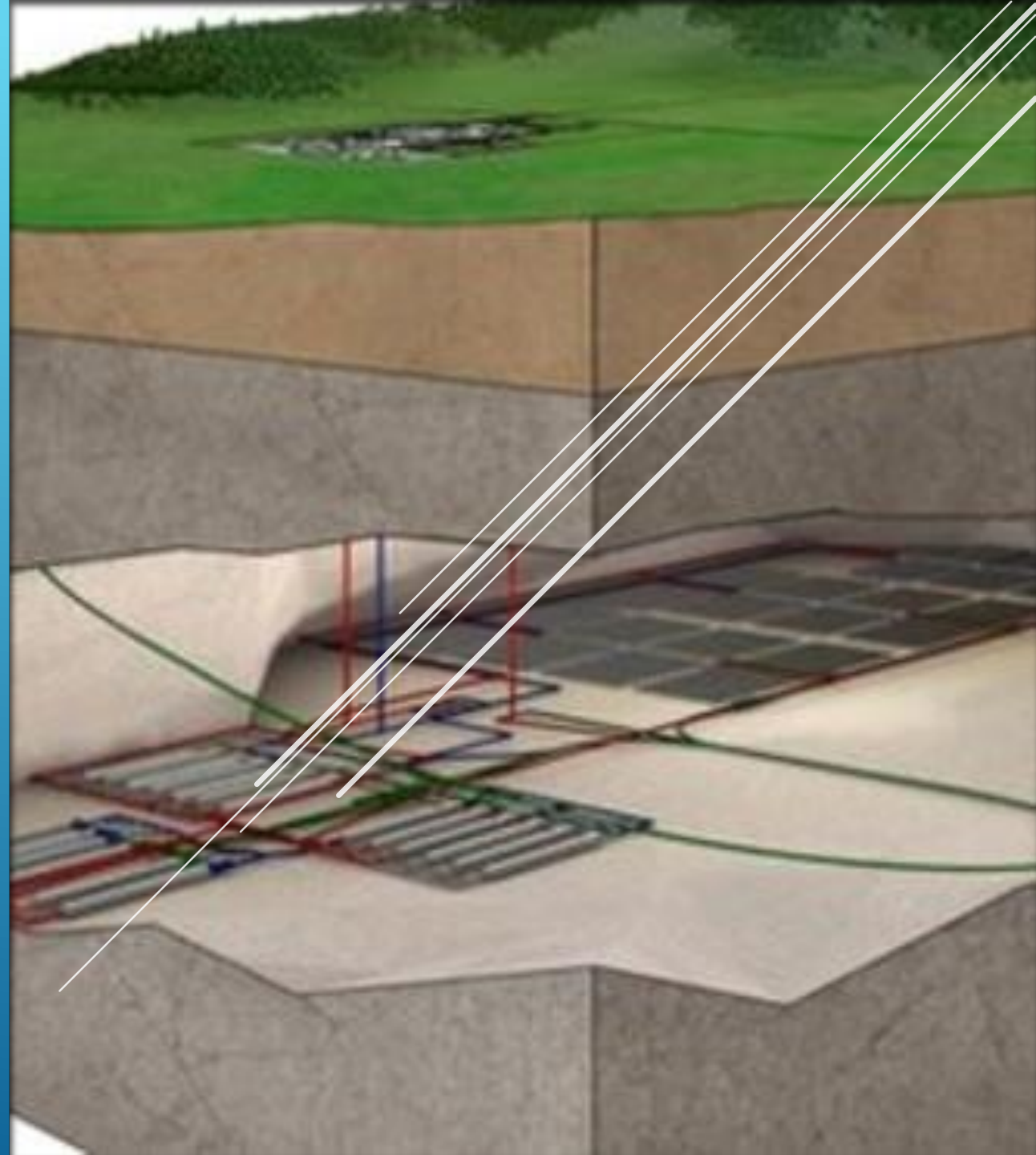


POTENTIAL NUCLEAR WASTE SITES IN SAN DIEGO COUNTY

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GIS IV Final Project

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PROJECT PROBLEM STATEMENT

- Purpose of the project is to find suitable regions within San Diego County for potential sites for nuclear waste
 - Scenario: Nuclear Waste in San Diego county is dangerous due to the high population of people, safe removal of the waste is necessary this analysis will go into how to remove it through burial locations.
 - Problem: Nuclear power plants in San Diego need to dispose of the nuclear waste if an error occurs a Southern California location would make it more accessible and safer for the future to develop more nuclear power plants. A current issue is the San Onofre Nuclear Generating Station located north of San Diego, the power plant had to be decommissioned in 2013 due to generator issue however the nuclear material is still held in the facility for safety. By having a nuclear waste burial location would allow for safer conditions.

CONTINUED....

- Targeted Audience:
 - San Diego County Board of Supervisors
 - Southern California Edison and San Diego Gas and Electric Company (Owners of the San Onofre Nuclear Generating Station (SONG))
- Question:
 - Is there a suitable location in San Diego County for Nuclear Waste disposable through burial?
 - If so will the location be safe for the population around the area even through environmental and human factors considered?
 - Some Condition we will look at:
 - Distance from roads and buildings
 - Low elevation areas
 - Fault zones in case of Earthquakes
 - Urban area safety

METHODS AND DATA

- Methods

1. Distance Analysis

- Topographic data, faults, urban areas, wells, and roads.

2. Terrain Analysis

- Slope and elevation
- 3D Analysis of water basin beneath topography of sites that are suitable
- Geology

3. Weighted Overlay

- Determine percentage importance in each feature and find ideal area for burial location

- Data Sources

- www.sangis.org : Used for topography, fault, groundwater basins, and roads data

STEPS

1. Determine a safe distance from roads and urban areas
2. Basemap of San Diego county to determine our range of study for nuclear burial sites
3. Euclidean Distance from 4 features wells, roads, urban, and faults
4. Create Weighted Overlay
5. San Diego County Slope
6. Elevation of San Diego County
7. 3D Elevation of San Diego County
8. Geologic Analysis of Ideal Site

Tools Used

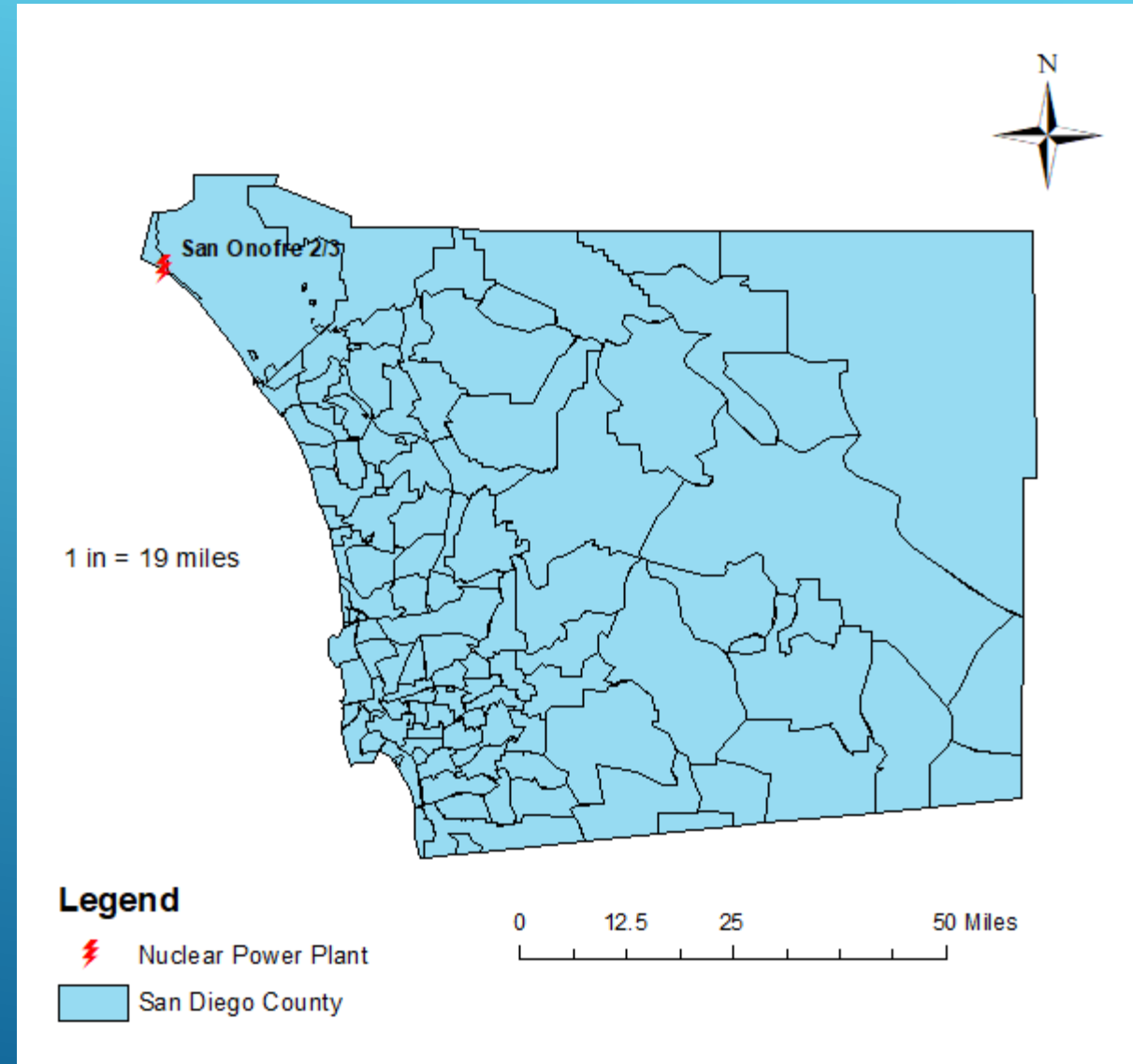
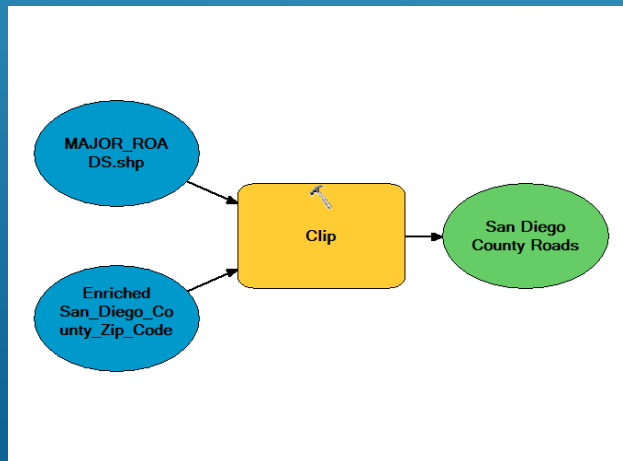
- Clip
- Weighted Overlay
- Create TIN
- Mosaic
- Raster Clip
- Reclassify
- Euclidean Distance
- Slope
- Merge
- TIN to RASTER



RANGE OF STUDY

- Chose San Diego County to be the area of study, this was done to deal with the San Onofre nuclear facility and locate potential areas in San Diego county for burial of waste
- Separated into counties to make it easier to identify which counties the area is
- San Onofre Nuclear Facility located in the Northwest corner of San Diego County
- Used Clip to only consider roads within the boundaries

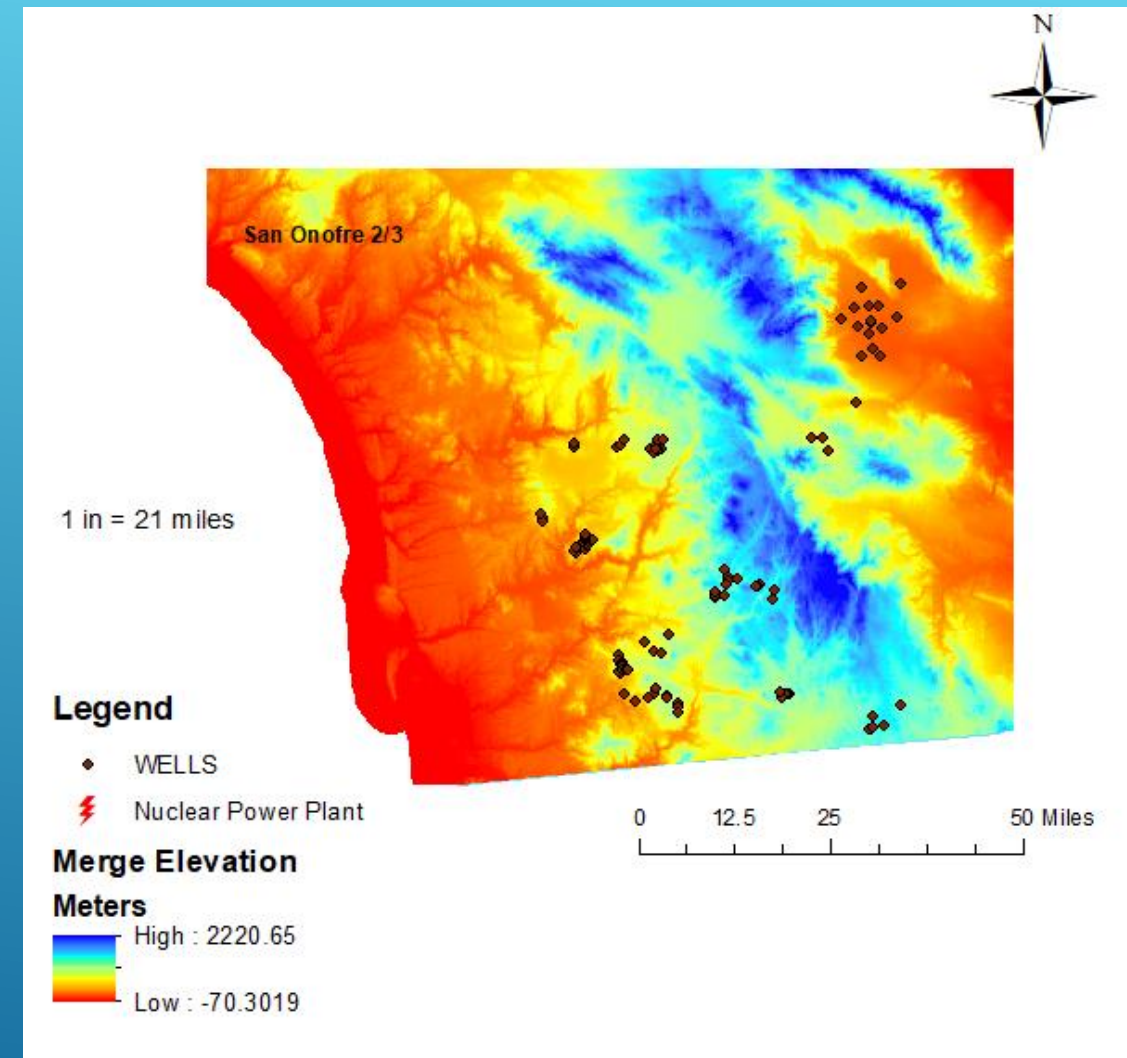
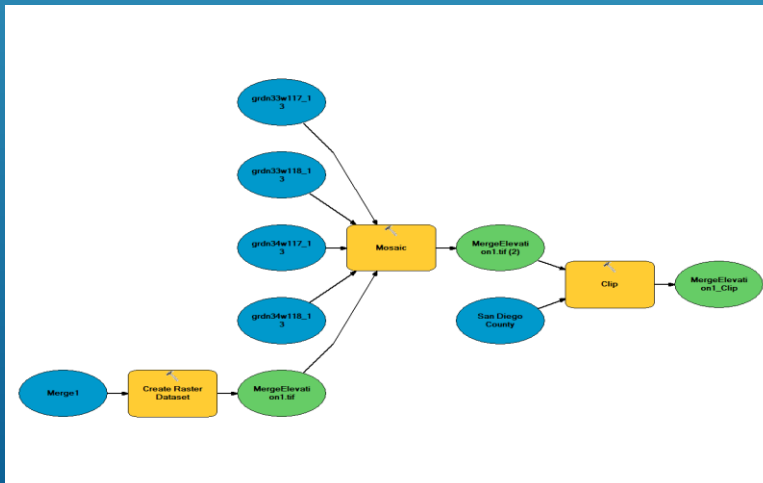
Methods:



ELEVATION MERGE

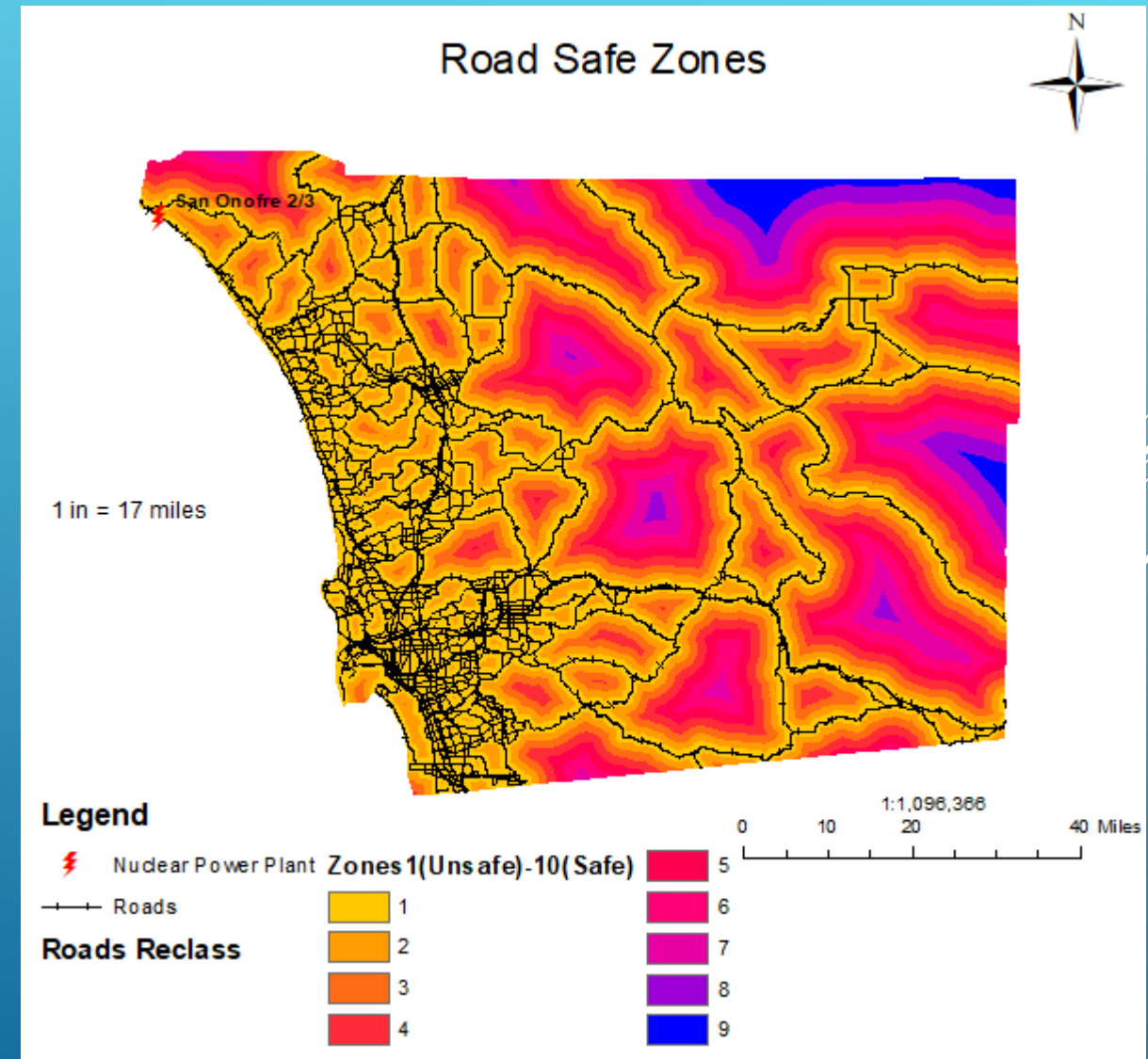
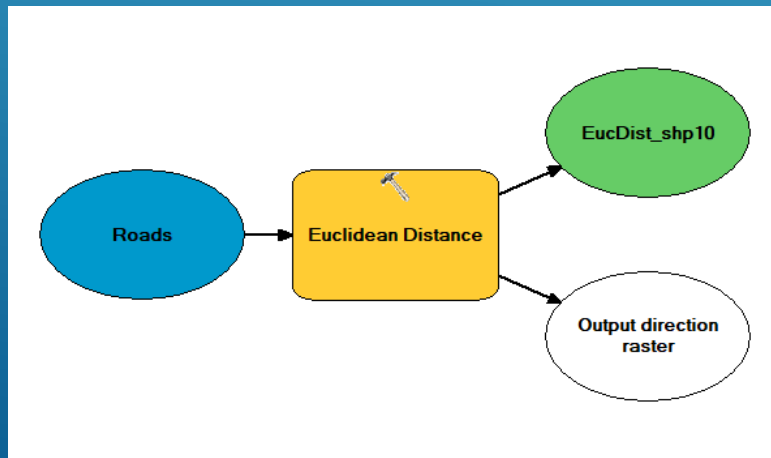
- Collected 4 different rasters from USGS and merged them into one to get full raster of San Diego County, then used Mosaic to blend all of them together and clipped raster data that were beyond the San Diego County boundaries
- Resulted in a raster of elevation with wells and the nearest Nuclear facility identified.
- From the map we can see that the more populated areas are within low elevation and the wells are located in the less populated area as well

Methods:



SAFE AREAS FROM ROADS

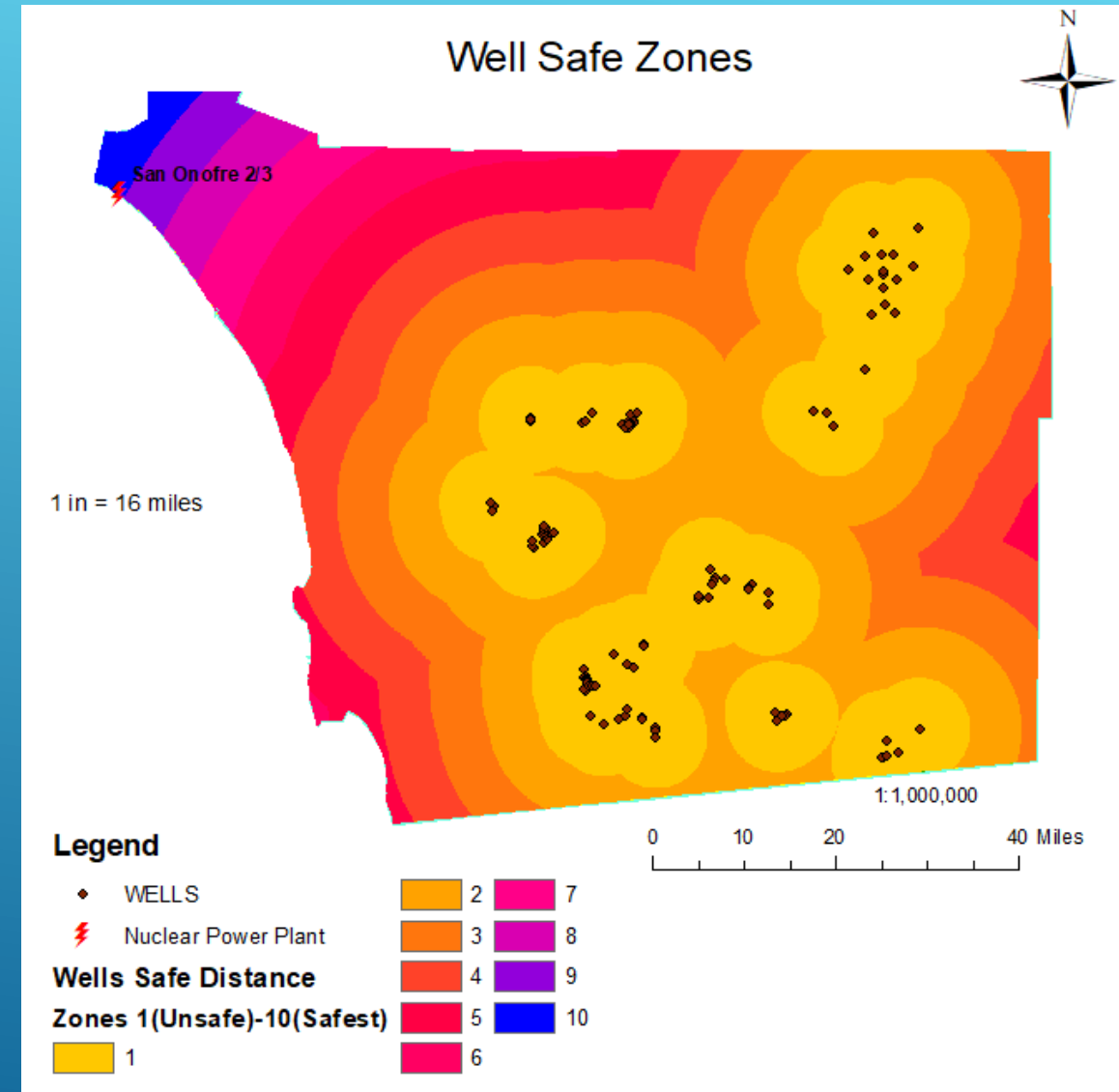
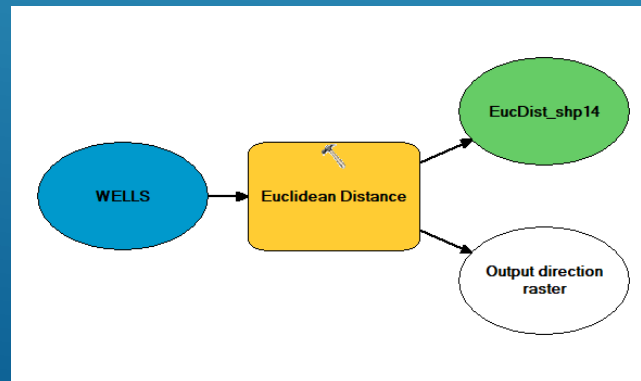
- Safety concerns would be a large amount of activity in an area where nuclear waste is buried that is why distance from roads are necessary to keep people safe as well as find the most inactive areas in SD county
- By calculating the Euclidean distance of roads we can see that there are areas on the east side of SD that have no roads and have safe zones for nuclear waste burial



WELLS EUCLIDEAN DISTANCE

- Wells are important to determine the water table within an area so any areas that are close to a high water table and are in constant use must be avoided to find an area that won't affect the water table in the future due to an accident
- Using Euclidean distance from all the wells in San Diego county we are able to see what region are the safest and which areas should not be built next to these are ranged from 1 being unsafe to 10 being the safest
- This is used to set up the weighted analysis, the influence is 20%

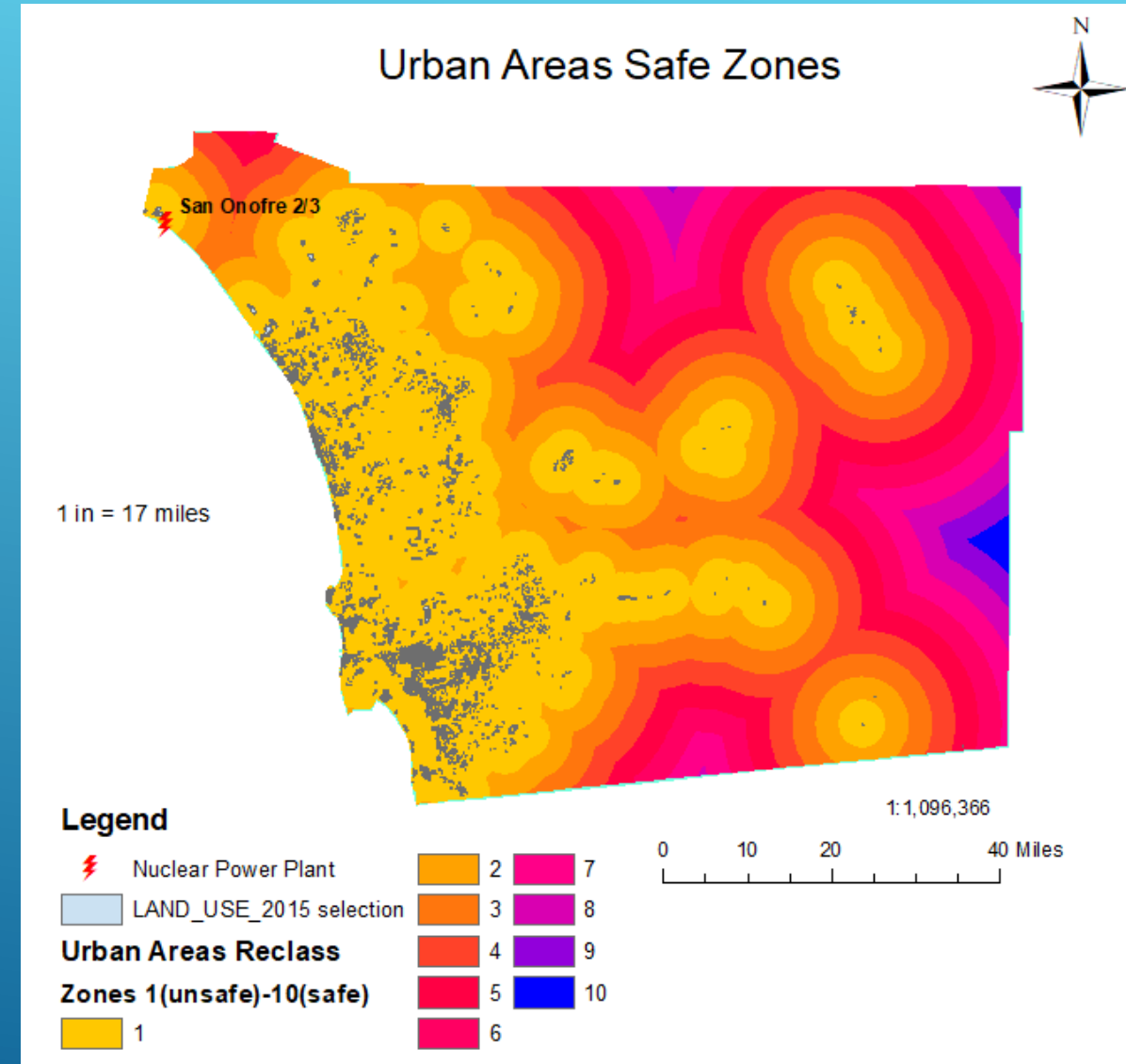
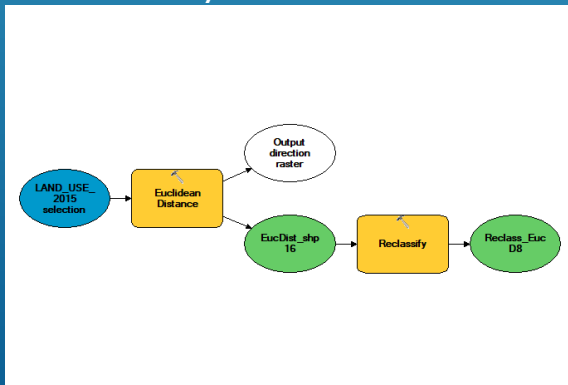
Methods:



URBAN AREAS EUCLIDEAN DISTANCE

- Urban Areas were chosen from all residential homes multi unit and single unit in SD county
- This is an important feature since the burial site has to be far from areas with people due any leaked radiation, this is a precautionary measurement since the depth to what the nuclear waste will be buried is deep also it would be sealed in a bunker
- From this map we can see that the east side of SD County does not have many homes making it the ideal area to have the site
- The influence is set to 35% due the importance of safety concerns of the people

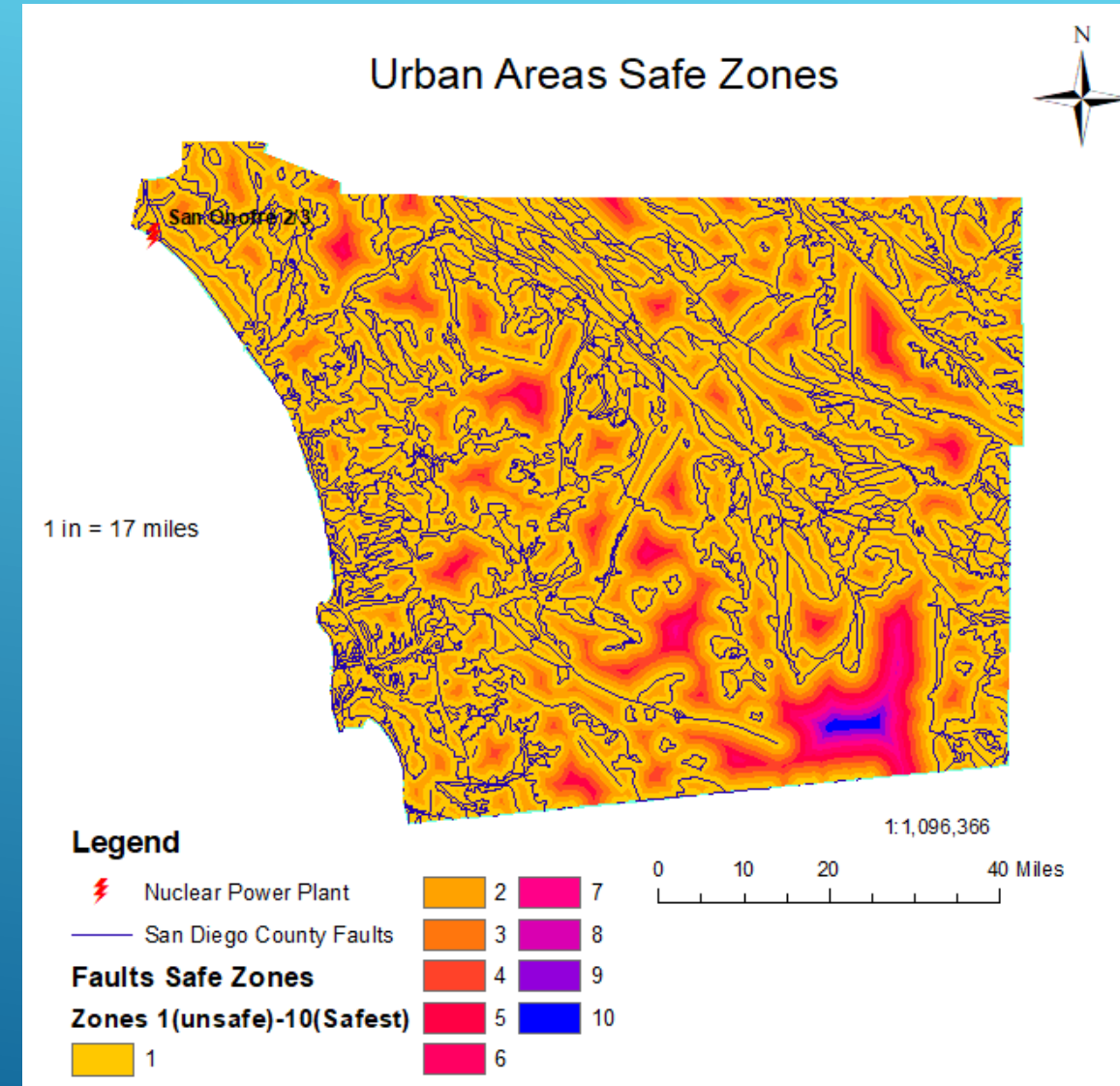
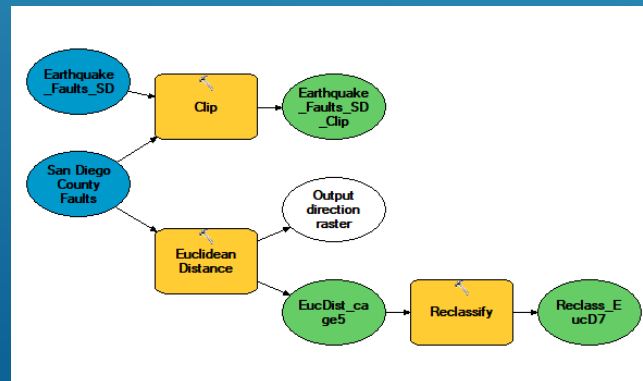
Model:



SAFE FAULT DISTANCE

- Faults are complicated geologic features that surround the area, it is important to take into consideration the risk of earthquakes causing faults to move, a burial location should entail a stable geologic area to be unaffected through time.
- Burial locations are buried deep within the earth from around 250meters to 1000meters for mined repositories and 2000meters to 5000meters for boreholes
- From of Euclidean distance from the fault is SD county the safest location can be seen in the Southeast corner of the map with a zone safety of 10 being the safest.
- This location would be ideal from the fault perspective and should have an influence of 30%

Model:

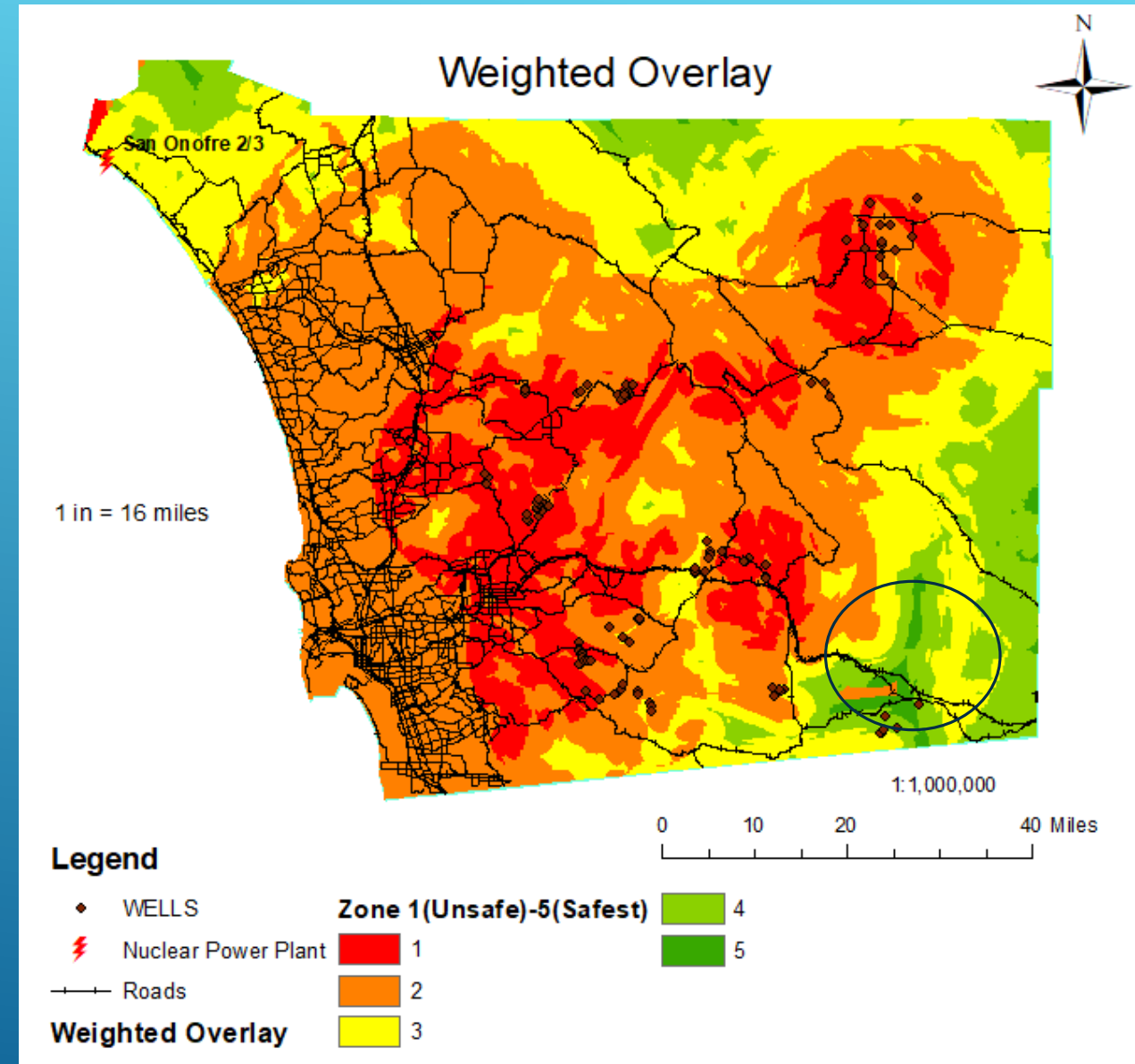
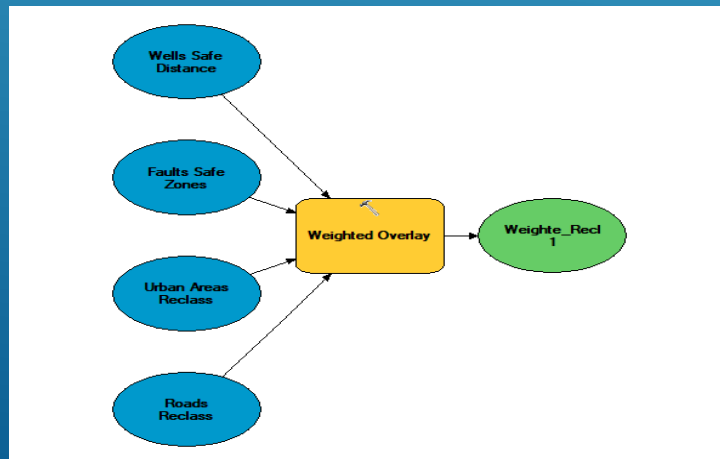


Raster	Influence %	Field	Parameter	Reclassification on Value	Notes
Wells	20%	Value	Euclidean Distance(meters)	1-10	Extent for all layers was the San Diego County layer
Roads	15%	Value	Euclidean Distance(meters)	1-10	Cell Size was set in environment to 113
Faults	30%	Value	Euclidean Distance(meters)	1-10	Distributed into zones to make clear what areas are ideal for burial
Urban Areas	35%	Value	Euclidean Distance(meters)	1-10	Conditions chosen for some of the ideal locations considering basic requirements

WEIGHTED OVERLAY ANALYSIS

- The Weighted analysis takes in the 4 features with set influences and determines the most suitable location from this map we can see that the Southeast corner with a zone 5 safety is ideal for a burial location
- The outskirts of SD county are mostly land so it offers the best area for this project
- The area satisfies several conditions
 - Roads are within safe distance
 - Urban areas are not within the area
 - It is geologically stable area from faults
 - Wells are in reasonable distance

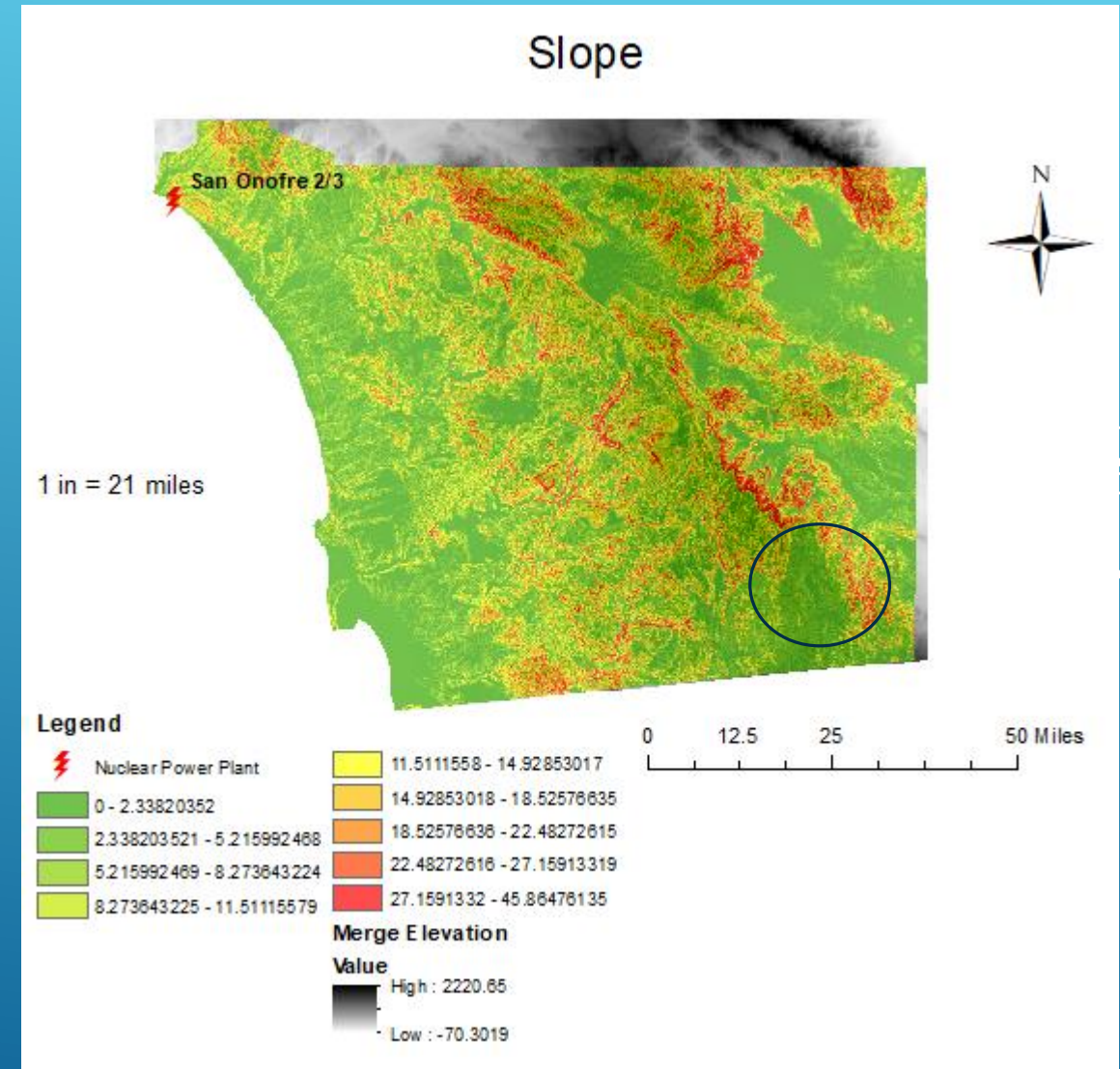
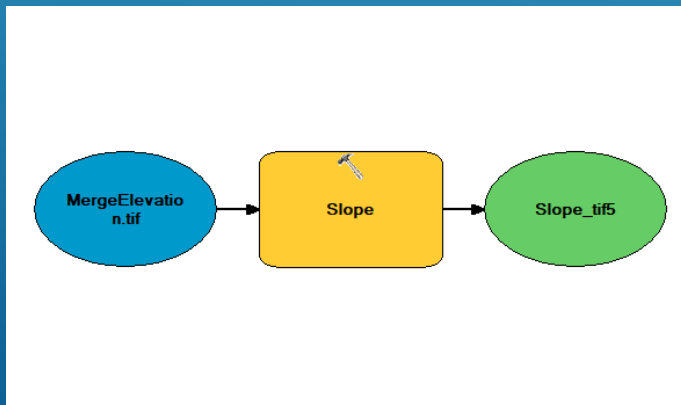
Model:



SLOPE

- Slope of the terrain of the site must be flat due to the need to create boreholes within the surface to lower the nuclear waste into the ground
- This means the elevation of the area does not matter from our slope analysis we can see that out area of interest in the Southeast corner is flat ranging from 0 to 8 degrees slope in the entire area
- The slope is overlaid on top of the SD County elevation raster and set to 20% transparent to see elevation as well in the map
- The location meets all the requirements that a similar project in Yucca Mountain in Nevada met, more geologic analysis of the specific area is needed after this project since this only suggests the ideal location in SD

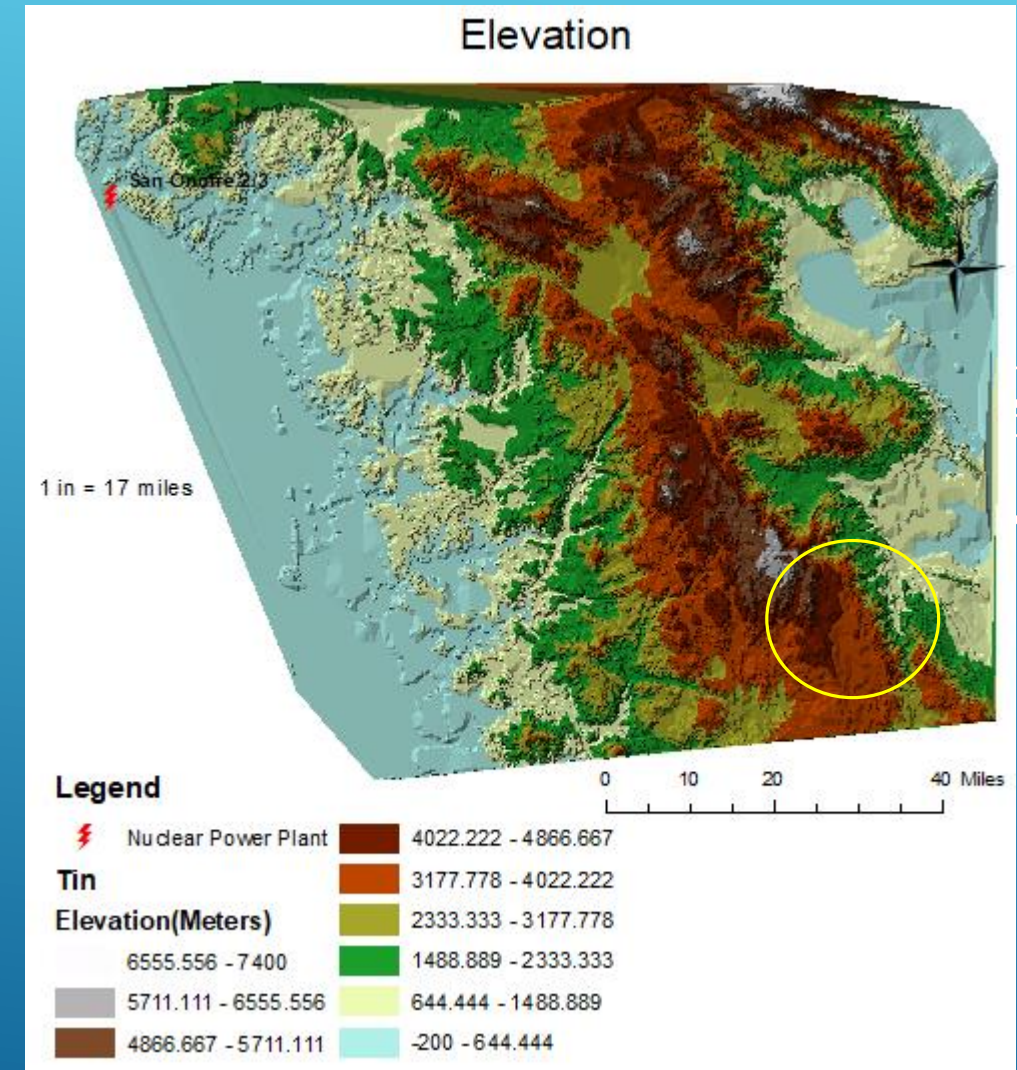
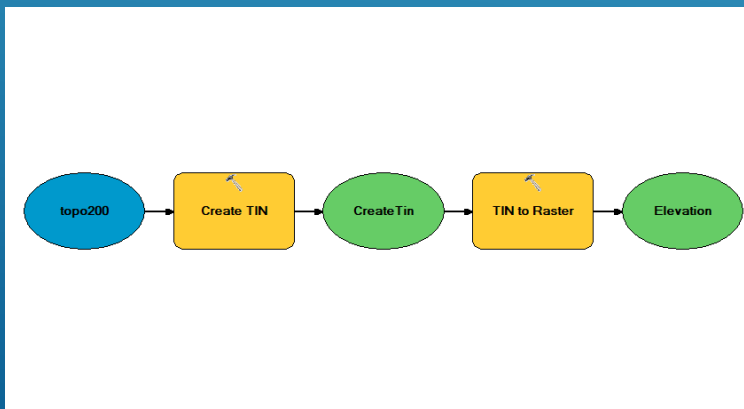
Model:



3D ELEVATION MODEL

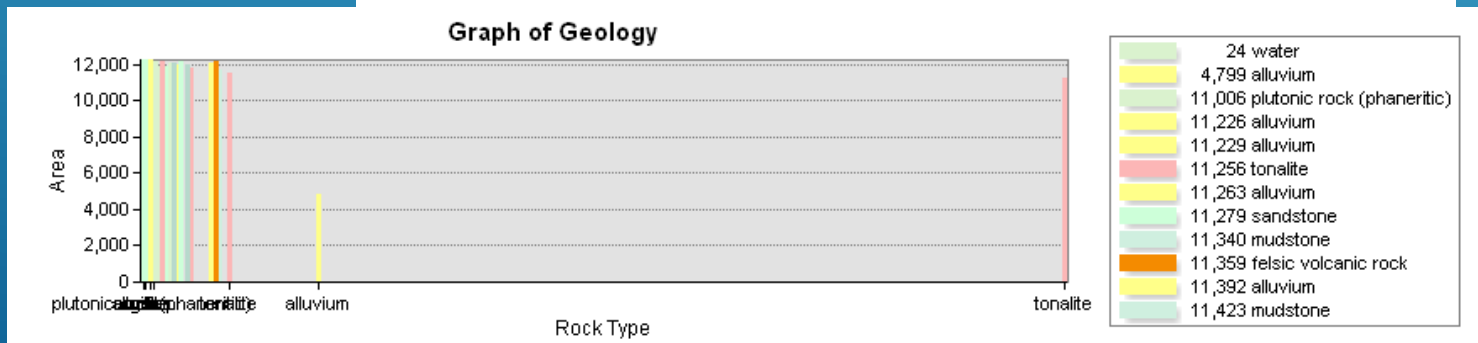
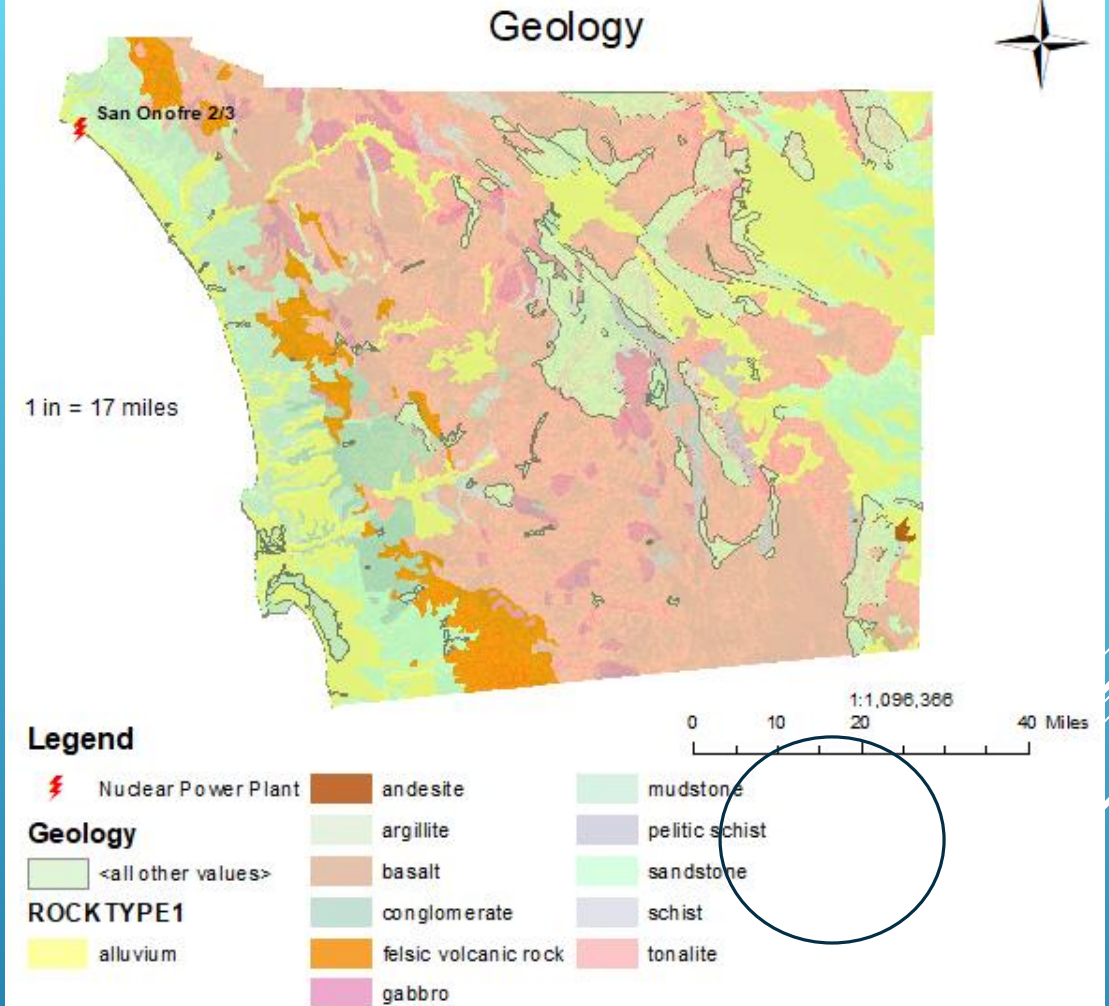
- Attempting to create a 3D elevation model of SD County gives a better understanding of the topography of SD and helps identify why some areas are not suitable for burial sites
- Using the contours layer I was able to create a Tin of SD county, we can see that the areas that are suitable for burial are in the higher elevations that are not ideal for population to live at, this makes these areas perfect for a burial site
- Our area which can be seen in the yellow circle has a range of 4022 meters to 3177 meters in elevation

Model:



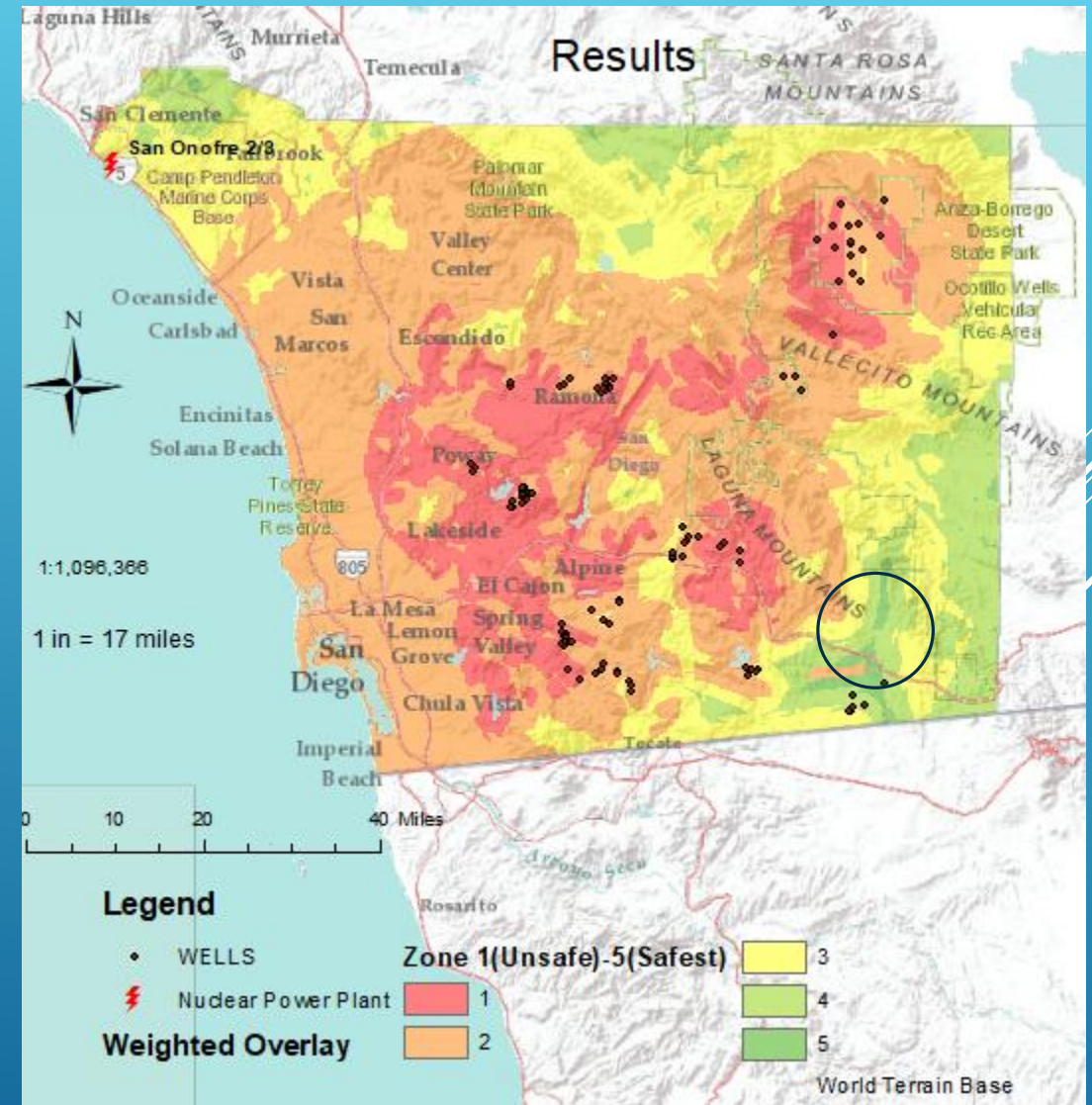
GEOLOGY

- Looking at our area of interest it is important to take into consideration the geologic composition the site will be located some rock types are not ideal to store waste since constant shifting and permeable layers might allow the waste to leak due to a problem
- Our area of interest has a composition of almost entirely Tonalite which is an igneous rock also known as Quartz diorite
- This actually makes it a perfect location for a burial site since the rock is not easily permeable also since this layer of Tonalite is such a widespread area instead of a boundary between two different rock compositions, this allows for a better sealant
- The geologic composition of the site is similar to the conditions in Yucca Mountain in the Nevada Desert which was being considered as the ideal place to store nuclear waste



RESULTS

- There is one location within the boundaries of San Diego County, more areas seem to become available just beyond the boundary towards the Salton sea
- San Diego County is a highly populated making it difficult to find many locations suitable, but due to the lack of hydrogeology going on compared to other areas within California it makes an ideal location Geologically
- Towards the East more areas of availability are present this is near the Vallecito Mountains
- Our location that fits is South of the Laguna Mountain range, creating a borehole within this area is possible due to the lack environmental problems as well as human interaction



ANALYSIS

- Conclusion
 - Weighted Overlay showed ideal location for a Nuclear waste disposal site that is remote
 - Slope and 3D elevation helped determine if the land was flat enough for site
 - Showed that San Diego County may be limited to 1 location for such a site and possibility of avoiding it
 - Geology of location suitable was best suited for the site
 - More 3D analysis would help since different data from instruments can be overlaid on the suitable site
- Recommendations
 - Add more data to analyze look into hydrology of SD County
 - Deeper analysis of sites chosen this might include surveying the area
 - Consider river flow
 - Extend range past San Diego County maybe to southern California to find more sites
- Further Research
 - Consider cost effectiveness of land and project entirely
 - Extensive subsurface analysis of ideal sites
 - Analysis of Water table over a decade from satellites to determine the seasonal rise and fall so a safe burial depth can be determined without being exposed to water

SOURCES

- USGS
 - Topo200
 - cageol_arc_dd
 - Geology
 - Faults
 - Grdn34w118_13
 - Grdn34w117_13
 - Grdn33w118_13
 - Grdn33w117_13
 - SANGIS
 - WELLS
 - LAND_USE_2015
 - Roads
 - Earthquake_Faults_SD
 - Esri.com
 - World Nuclear Association
 - Nrc.gov
 - Nei.org
 - Gao.gov
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- A series of three parallel white lines of varying lengths, slanted diagonally from the bottom right towards the top right, located in the lower right quadrant of the slide.