

Site Selection – A new school location

1. Introduction

Site selection, often referred to as suitability analysis, is a form of GIS analysis used to determine the best site such as a new store, school, or animal habitats etc. Anytime you need to perform site selection analysis, your site criteria are the basis for finding geographic areas

Vector analysis sometimes is not efficient or effective in dealing with certain spatial problems. Raster analysis (cell-based processing) introduces a different approach to perform spatial analysis.

In this lab, you will be working on a small case study in raster environment to locate the suitable locations for a new school.

Data location: L:\labs\geog413\data\raster

<u>Spatial Data</u>	<u>Description</u>
<i>landuse</i>	Land use (RASTER)
<i>elevation</i>	Elevation (RASTER)
<i>rec_sites</i>	Recreation sites (SHAPE file)
<i>schools</i>	Existing Schools (SHAPE file)
<i>roads</i>	Roads (SHAPE file)

The criteria for a new school location are listed below

1. The new school should be close to recreation sites (*rec_sites*)
2. The new school should be away from existing schools (*schools*)
3. The new school site should be on relatively flat land and on certain types of landuse (*landuse*)

The procedure is listed below

- Examine the datasets you have.
- Decide which datasets you need as inputs.
- Derive datasets from the given input datasets to gain new information
- Reclassify each dataset to a common scale, giving higher values to more suitable attributes
- Weight datasets that have more influence in the suitability model if necessary then combine them to find the suitable locations.

2. Setting the working environments

- Create a folder **raster** under your geog413 directory.
- Open a new map file and add all the layers listed above.
- Make sure to enable the Spatial Analyst and 3D analyst extensions. Turn off background processing (Geoprocessing->Geoprocessing Options)

Before proceeding, you need to set the analysis environment. Setting the environments for your analysis results enables you to control the output directory for your results

- Click Geoprocessing->Environments

Current/Scratch Workspace:	your local raster folder
Processing Extent:	Same as <i>landuse</i>
Raster Cell Size:	Same as <i>elevation</i>

3. Displaying and exploring data

Symbolize features

- Change the *roads* to red
- Symbolize *landuse* layer with **Landuse** field (unique value). You can change each individual color to better match the cartographic conventions
- Symbolize *schools* with any school symbol and color in red.
- Symbolize *rec_sites* in purple color

Land Type	Color
Agriculture	Yellow
Barren land	Gray
Brush/transitional	light green
Built-up	Orange
Forest	dark green
Water	Dark blue
Wetland	Light blue

Creating a Hillshade

- With **HILLSHADE** tool, create a Hillshade from the *elevation* and save the it as *hillshade* in your local folder

Applying transparency

You will now make the *landuse* layer transparent so the Hillshade can be seen through

- Click *hillshade* in the table of contents and drag the layer below the *landuse* layer if necessary.
- Right-click *landuse* and open the properties window. In Display tab, set Transparency to 40%

The *hillshade* layer can be seen underneath the *landuse* layer, this gives you a vivid impression of the terrain. You can save this map file to your working directory **raster** folder.

4. Deriving Datasets

Deriving data from your input datasets is the next step in the suitability analysis. You will derive the following datasets

- Slopes from *elevation*
- Distance from recreation sites *rec_sites*
- Distance from existing schools *schools*

Deriving slopes

Since the area is mountainous, you need to find the areas of relatively flat land to build on, so you will take into consideration the slopes of the land.

- With **SLOPE** tool, create a slope raster in degree from *elevation* and save the output as *slopes*

Deriving raster distance surface

In this model, it is preferable that the school should be built near the recreational facilities, so you need to calculate the straight-line distance from Recreation Sites.

- With **EUCLIDEAN DISTANCE** tool, generate a raster distance surface to *rec_sites*. Save the output as *dist_rec*
- Create a distance surface to *schools* and save the output as *dist_sch*

5. Reclassifying datasets

In order to combine the datasets, these datasets must first be set to a common scale. That common scale is how suitable a particular location (each cell) is for building a new school. We will reclassify each dataset to a common scale, within the range 1 - 10, giving higher values to attributes within the each dataset that are more suitable for locating the school.

Reclassify *slopes*, *dist_rec*, *dist_sch*

We want to reclassify the *slopes* so that steep *slopes* are given low values, as they are least suitable for building on.

- With **RECLASSIFY** tool, classify *slopes* according the value range showing at right
- Save the output as *slopes_r*
- Classify *dist_rec* (Equal Interval for Method and 10 Classes, take default value range). As you want to locate the new school near recreational facilities, so you will give higher class values (10 – 1) to the locations that close to recreational facilities, as there are the most desirable.
- Name the output raster as *dist_rec_r*.
- Classify *dist_sch* with Equal Interval for Method and 10 for Classes. We want to locate the new school away from existing schools, so you will give higher class values to the locations farther away (1 – 10), as these locations are most desirable.
- Name the output raster as *dist_sch_r*.

Slope range	Slope class
0 -5	10
5 -10	9
10-15	8
15-20	7
20-30	6
30-40	5
40-50	4
50-60	3
60-70	2
>70	1

Reclassify *landuse*

Certain land use types are better for building on than others, taking into consideration the costs involved in building on different landuse types.

You need to reclassify *landuse*. A lower value indicates that a particular landuse type is less suitable for building on. Water and Wetlands will be given NoData as they cannot be used for building on and should be excluded.

- With **RECLASSIFY** tool, classify *landuse* using **landuse** field. Assign 'New values' for each type of land use listed below

Land Type	Class Value
Agriculture	10
Barren land	6
Brush / Transitional	5
Frosts	4
Built Up	3
NoData	NoData

- Now remove the Water and Wetland attributes and change their values to NoData. Highlight Water and Wetland and click Delete Entries.
- Check the check box for Change missing value to NoData. This will result in all the data that are not listed been assigned to NoData value (Water & Wetland)
- Save the output as *landuse_r*

landuser_r shows the locations with landuse type that are considered to be better than others for locating the school (higher values indicate more suitable area).

- Open the Properties of *landuse_r* layer
- Under the Symbology tab, click the 'Display NoData' from the dropdown arrow and choose a proper color (white, gray, or no color) to show NoData value (Water and Wetlands)

6. Weighting and combining datasets

After applying a common scale to the datasets, where higher values are given to those attributes that are considered more suitable within each dataset, you are ready to combine them to find the most suitable locations

If all the datasets were equally important, you could simply combine them at this point; however, you have been informed that it is preferable to locate the new school close to recreational facilities and away from other schools. You will weight all the datasets, giving each a percentage influence. The higher the percentage, the more influence a particular dataset will have in the suitability model. You will give the layers the following percent influence (Each percentage is divided by 100 to normalize the values.)

Datasets	Weight
Reclassified distance to rec_sites (<i>dist_rec_r</i>)	50%
Reclassified distance to schools (<i>dist_sch_r</i>)	25%
Reclassified land use (<i>landuse_r</i>)	12.5%
Reclassified slopes (<i>slopes_r</i>)	12.5%

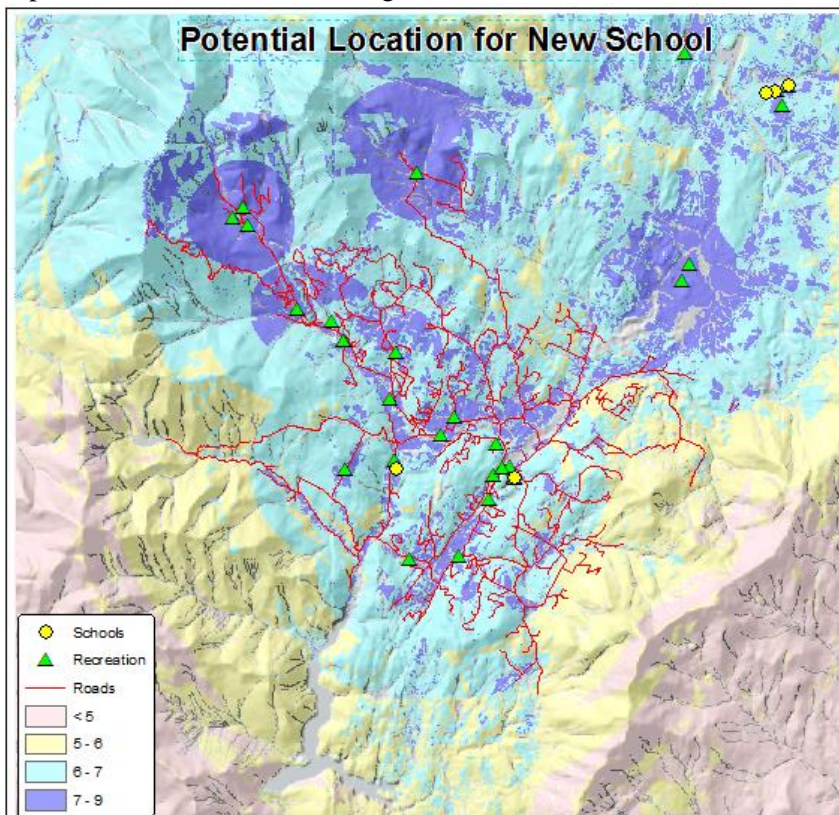
- With **RASTER CALCULATOR** , build following expression

`"dist_rec_r" * 0.5 + "dist_sch_r" * 0.25 + "landuse_r" * 0.125 + "slopes_r" * 0.125`

- Save the output raster as *new_school* in your local folder.

The output raster dataset shows how suitable of an area is for locating the new school, according to the criteria set in the suitability model. Higher values indicate locations that are more suitable.

The suitable locations are those areas that are close to recreation sites, away from existing schools, on relatively flat land, and on certain types of landuse. The higher weightings set for Distance to schools and Distance to recreation sites have a powerful influence on deciding which areas are more suitable than others.



- Open the properties of *new_school*, in Symbology tab, set classes to 4 and classify the value to 5, 6, 7, 9
- Assign a proper color for each class. Change the Label to Not Suitable, Suitable, More Suitable, Most Suitable
- Click the Display NoData from the dropdown arrow and click the color black. This displays values of NoData (Water and Wetlands) in this color. Click OK.
- Right-click on *new_school* and choose properties. Click Display tab and set 40% for Transparency and click OK.
- Turn *new_school* and *hillshade* layers on and turn all the other layers off.

You should now assess these locations to see which might be the best location. This should be done in the field, as well as by examining the data you have on each potential area.

We decide that the best location is somewhere within the area (purple) located at upper left corner, as there are three recreation sites in the neighboring area, the ski resort being one of them. Also, although you know that a considerable volume of traffic already uses the current access road to this potential site, you are involved in plans for constructing an alternative road to this area which will help alleviate the volume of traffic on the current access road.

Assignment 1 - Part B: Locating a site for new fire station in raster environment

Due Jan 30th, 2017. Hand in together with Part A to your instructor (Ping) or drop-off box 2P located at the second floor of building 8. Do not forget your name

Location: Town of Hudson, Massachusetts

Data: L:\labs\geog413\data\hudson

<u>Datasets</u>	<u>Description</u>
<i>fire_stations</i>	Existing fire stations
<i>roads</i>	Major roads
<i>parcels</i>	Land parcel
<i>wetland</i>	Wetland
<i>dem</i>	Elevation
<i>boundary</i>	Town boundary
<i>town_owned.dbf</i>	Lookup table for parcel ownership (join field: AccountNum)

Criteria:

	Weight
○ must be a town-owned property, at least one acre in size and contain less than 20% wetlands	
○ must be located a sufficient distance from existing stations,	20%
○ must be on a relative flat area (prefer slope < 5 degree)	30%
○ must be located close to major road	50%

Environments:

Workspace / scratch space:	your local folder
Processor extent:	same as <i>boundary</i>
Raster cell size:	20
Raster mask:	same as <i>boundary</i>

Deliverable: Make following maps together with discussion about the result and suggestion for the best location. Map1 – 4 should be in one page. Map5 should be on a letter size page. All maps should be symbolized according cartographic conventions and with proper title, legend and scale

- Map 1: Hudson town-owned parcels with area over one acre and contain less 20% wetlands
- Map 2/3/4: Reclassified distance maps to fire station, major roads, and reclassified slope map
- Map 5: Potential sites with ranking together with major roads and existing fire stations

Hints:

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- *Finding the parcels containing less than 20% wetland may need overlay operation and summarize tool to get the percentage of wetland in a parcel. The resulting parcel layer can be used as mask for the last step*
 - *Reclassify the distance of roads and fire station to 10 classes according to criteria. Suggest following value range*
 - *Distance to fire station: 100, 200,500,800,1000,1500,2000, 2500,3000 and the last class with the highest value*
 - *Distance to roads: 50, 100, 200,500,800,1000, 1200,1500,2000,and the last class with the highest value*
 - *Reclassify slope to 5 classes with break value at 5, 10, 15, 20 and the highest value for the last class. Give the ranking 10, 5, 3, 2, 1*
 - *Reclassify the final result to 5 classes with break value at 5, 6, 7, 8, 10*

~~~~~ The End ~~~~~