

FNR 66

Lab 03

Timber Harvest Investment

You have been awarded a contract to evaluate two parcels in a highly timber-productive region. A series of geospatial data has been provided to you. The investment team that hired you wants to know which one of two parcels to purchase for timber harvesting. There are some legal and logistical restrictions to where trees can be harvested. The basic idea is to first determine where logging can be practiced. Secondly we want to know the relative cost/benefit for each parcel. So we will compare the costs for each parcel.

We will be taking raster and vector data, converting them to binary raster data, using raster algebra to combine multiple rasters, and compare with other raster data to exclude regions from logging. We will query these data in three different resolutions. There are more limitations to timber harvesting than is included in this simplified lab.

Background

Trees cannot be harvested in active landslide areas, regions of high slope, and within a horizontal distance to anadromous streams.

The slope limitations to logging are modified by the geology type:

<u>Geology Type</u>	<u>Erodability Class</u>	<u>Maximum Grade (%)</u>
Cretaceous (Franciscan)	3	70%
Tertiary (Wildcat)	2	45%
Quaternary (M1.8 Ma)	1	30%
Other (river channels)	0	0%

The horizontal limit to streams and rivers is based on the "class" of the stream. There are a number of agencies that regulate this and we adopt the two following distances:

Stream/River Class	Distance (feet)
1	150
2 (w/salmonids)	150
2	50

Data and Methods

You are provided with the following in UTM NAD27 zone N 10:

- geology **unit_bnd.shp**
- parcel area **quad_bnd.shp**
- stream polyline **hydro_bnd.shp**
- road polyline **humrd_bnd.shp**
- landslide point **point_slide.shp**
- DEM/slope rasters **lab03_dem, hs, pct**

Book Keeping

You will need to convert the parcels into a raster to be used to discriminate your analyses later in the lab.

Use “conversion tools/To Raster/Polygon to Raster” to generate a raster with values for the two parcels. Input polygon layer: **quad_bnd.shp** Output Raster Dataset: **quad_bnd**

River Buffer

We will create a polygon buffer of the hydro layer, with distances related to stream class. We will convert the polygon to a raster to use in our “logging suitability” raster algebra.

Use “geoprocessing/buffer” to generate polygon layer from **hydro_bnd.shp**. Name it something like **hydro_buffer.shp**

- Select “Field” and use the field with the appropriate distance (look at the fields on the far right).
- Select “Round” end types.
- Select “All” dissolve type.

Use “geoprocessing/intersect” to clip **hydro_buffer.shp** to the parcels **quad_bnd.shp**. Name it something like **hydbuff_bnd.shp**.

Use “geoprocessing/union” to create a polygon shapefile that completely spans both parcels (so we can use it to create a raster next). Use **hydbuff_bnd.shp** and **quad_bnd.shp** and name the output something like **hydro_union_bnd.shp**. Add a field named “no_logging” and select the polygons that are the buffer polygons. Invert your selection and use the field calculator to enter 1 (in the “no logging” field) for the polygons that are not buffered.

Use “conversion tools/To Raster/Polygon to Raster” to generate a raster with values of 0 for the regions that cannot be logged due to their proximity to streams and 1 for the regions not adjacent to streams of certain class. Input: **hydro_union_bnd.shp** value field: **no_logging** cell size: **10** Output Raster Dataset: **buffer_hydro**

Landslide Buffer

We will create a similar exclusion buffer for landslides as we did for streams. Landslides are not point events, but span an area. Unfortunately you are provided with only point data. We will make a simple

assumption about the size of these slides to estimate how to approximate them in our exclusionary analysis. Average landslides that are posed as a hazard to logging in this region are 350 meters wide by 350 meters long. The standard deviation of those measurements is 50. In order to include the variation in these data, we will assume regions within 400 meters of these points may be excluded from our harvest zones.

Use “geoprocessing/buffer” to generate polygon layer (spaced at 200m) from **point_slide.shp**. Name it something like **logging_slide.shp**

Use “geoprocessing/intersect” to clip **logging_slide.shp** to the parcels **quad_bnd.shp**. Name it something like **slide_bnd.shp**.

Use “geoprocessing/union” to create a polygon shapefile that completely spans both parcels (so we can use it to create a raster next). Use **slide_bnd.shp** and **quad_bnd.shp** and name the output something like **slide_union_bnd.shp**. Add a field named “no_logging” and select the polygons that are the buffer polygons. Invert your selection and use the field calculator to enter 1 (in the “no_logging” field) for the polygons that are not buffered.

Use “conversion tools/To Raster/Polygon to Raster” to generate a raster with values of 0 for the regions that cannot be logged due to their proximity to landslides and 1 for the regions not adjacent to landslides. Input: **slide_union_bnd.shp** value field: **no_logging** cell size: **10** Output Raster Dataset: **slide_union_bnd**

Road Distance

The logging company separates out their costs for transportation, so we only need to calculate the cost to get the logs to the roads. We will create a raster that has 10m cells with values representing the Euclidean distance to the nearest road.

Use “spatial analyst/distance/Euclidean distance” to create the distance raster. Name it something like **lab03_rddist.shp**. Source Data: **humrd_bnd.shp** Output cell size: 10 (create a direction raster if you like, it might be fun).

Geology Suitability

We will create a series of rasters that represent their relative erodability.

The **unit_bnd.shp** layer is from the local government geological mapping service. They have mapped the geology at 1:24,000 scale. The company that hired you has classified the geological units into different degrees of erodability. You will take this polygon shapefile and create four new rasters with values related to the erodability of those geological units.

Use “conversion tools/To Raster/Polygon to Raster” to generate a raster with values based on the erodability classes 0, 1, 2, and 3. Class 3 is the least erodible. Name this raster **unit_bnd**

Use “3D analyst/raster reclass/reclassify” to create these new binary rasters. Each raster will have cells of either “0” or “1,” to be used in our raster algebra analysis later.

Input Raster: **unit_bnd**

Reclass field: value

Reclassification Table:

Old values	new values			
	geo 0	geo 1	geo 2	geo 3
Erodability class				
0	0	0	0	0
0-1.1	0	1	0	0
1.1-2.1	0	0	1	0
2.1-3.3	0	0	0	1

Name these rasters something like, **geo_0, geo_1, geo_2, and geo_3**

geo_3 should be a raster that has values of "1" for every raster cell that is of erodability class 3.

Slope Suitability

We will create slope suitability classes similar to the geology erodability rasters.

Use "spatial analyst/map algebra/raster calculator" to query the slope data to create new slope rasters. These result in rasters with values of "1" for cells that are shallower than any given slope (meaning they are suitable).

- Select "lab03_pct" <= 30 for a raster named something like **slope_1**
- Select "lab03_pct" <= 45 for a raster named something like **slope_2**
- Select "lab03_pct" <= 70 for a raster named something like **slope_3**

Exclusion Analyses

We now take all our data and combine them into a logging suitability analysis. For all our rasters, we have placed values of "0" in cells that are unsuitable and values of "1" in cells that are suitable. When we add (sum) these rasters together (with raster calculator), we accumulate all cells that are suitable. When we multiply rasters, only cells that have non-zero values in each raster layer are suitable.

Use "spatial analyst/map algebra/raster calculator" to create a logging suitability raster using the following layers:

- **buffer_hydro**
- **geo_0, geo_1, geo_2, geo_3**
- **slope_1, slope_2, slope_3**
- **slide_union_bnd**

This raster algebra worked for your boss when he did it in the 3rd grade: "buffer_hydro" * ("geo_0" + ("geo_1" * "slope_1") + ("geo_2" * "slope_2") + ("geo_3" * "slope_3")) * "slide_bnd"

Name your output raster something like **logging**

Sampling Strategy

We will create a fishnet of three different resolutions and then query our analytical results at each of these three resolutions. Our final results will be plotted at these three resolutions.

Use “Data Management Tools/Feature Class/Create Fishnet” to generate fishnets at 3 resolutions, 100m, 500m, and 1000m. Name these something like, **net_0100m.shp, net_0500.shp, and net_1000m.shp.**

Template Extent: **quad_bnd.shp**

Number of Rows: 140, 28, and 14 for 100, 500, and 1000 m spacing.

Number of Columns: 220, 44, and 22 for 100, 500, and 1000 m spacing.

Create Label Points: yes! We will use this point layer for our queries.

Geometry Type: polygon

Queries

We will do queries of statistics just like we did for the last lab. We want to know the statistics for the road distance for each location that is not excluded from logging. We will extract data from different rasters and place these data in each of the three sampling fishnet point layers.

Use “spatial analyst/extraction/extract multi values to points” to associate logging suitability information, parcel number/name, and road distance for each point record.

Input point features: **net_0100m.shp, net_0500.shp, and net_1000m.shp**

Input Rasters: **lab03_rddist, logging, quad_bnd**

Use some method to get the statistics of these queries into a table, a plot, or both. Your boss will who you an example of how they did this in a spreadsheet.

Report

Prepare a map that displays your landslide exclusion analyses. Please place some graphical depiction of the relative expense and relative logging suitability for these two parcels. Write a short (1-2 paragraph) report describing your results.

