

Lab 14: Cartographic Modeling

Note: This lab is to be done the last two weeks of the semester.
It is due the end of the semester, via Canvas.

This lab is different from previous labs in that there will be relatively few detailed instructions. During this lab you will have an opportunity to use what you have learned to solve a small problem using spatial data analysis. This miniature example represents the sort of project done daily by many spatial data analysis professionals. We will give you a brief description of the problem, an inventory of data layers, and a desired product or outcome. You will need to put together the spatial and tabular data required to solve the problem.

Our goal is the identification of areas suitable for a park development. We will be working with data from the Marine on St. Croix area. Your job is to identify areas suitable for a 100 hectares (ha) park. The basic criteria are:

- 1) Build only on private land in Minnesota
- 2) Slope less than or equal to 3 degrees
- 3) The entire area needs to be within 200 m of a road
- 4) Must be more than 100m from Lakes, streams, or rivers features
- 5) No building on any wetlands
- 6) Individual polygons for final areas must be larger than 100 hectares (apply this last)

You need to identify areas, which meet all these criteria (AND combinations), so your analysis will include several overlays of spatial data to identify suitable sites.

You are provided with the following data layers. All data should be in the \L14 subdirectory. All layers are in NAD83, UTM zone 15 coordinates, meters, and elevations in meters. Remember, there 10,000 square meters in one hectare.

MARON_STX	A DEM grid of the study area
MAR_BD	A polygon shapefile of major municipal regions from a USGS digital line graph. Ownership codes are in the item MODN_ID. Codes 1, 7, and 8 are Wisconsin, 3 is private land in Chisago County, 9 private land in Washington County , and 2, 4, 5, 6, 10, and 11 either public land or within the borders of Marine on St. Croix.
MAR_HYD	A polygon shapefile, hydrologic features, from a USGS digital line graph.

Lakes, rivers, and ponds are represented as polygons

MAR_WET A polygon shapefile of wetlands with item "attribute", giving USFWS wetlands type (remember, a value for Attribute of OUT contains no data – don't use these areas; see the PDF in the Lab14 data folder which contains a detailed description of the wetland types).

MAR_RD A line shapefile identifying road locations in the study area.

You need to combine these data, using the appropriate buffer, overlay and tables commands in ArcMap to identify the areas that meet the above-listed restrictions. Think of creating a series of binary masks to do this, which you will then overlay. You should use the tools you have learned over the semester to complete this task. **DO A FLOWCHART FIRST, IT WILL REALLY HELP.**

You'll use a few commands repeatedly.

After selecting records, you may either deleting the ones you don't need or separately saving just the records you want to retain; for example, select the layer, right click, Data→Export Features.

A common clean-up operation is Dissolve. Toolbox → Data Management Tools → Generalization → Dissolve. This operation is often done after each step in long sequences of spatial operations as it removes unnecessary interior lines/data. You may Dissolve each layer before creating a common or unique field and performing a Union operation.

Note; you may use Union, Intersection or Erase operations as needed. Intersection is the most common in this type of exercise, as most of the requirements concern "overlapping" requirements. The only requirement that cannot be done with Intersection is the overlay of the Upland polygons (selected from the Wetlands provided layer) and the Buffered Lakes. In that situation you want to keep those polygons which are "away" from the buffered lakes, to do this you this will need to use a Union or a Erase operation.

Once you have prepared a layer (before overlay) you may need to assign a common code for an attribute (create a new attribute named good4wetslope or some similar name, and all those polygons that satisfy the criteria would get a 1, all those that fail at least one criteria, would get a 0). This common code or unique field will help you track this layer's data through later operations.

The next command you will probably use repeatedly is the Union or Intersection command; Toolbox → Analysis Tools → Overlay → Union or Intersection. You use this command to combine two polygon layers. We used this command in Lab 9 and Lab 11. You may sometimes use Intersection instead of Union (Refer to past Labs or ask for help).

NOTE: Before your final step (measuring the polygons to determine those greater than 100 hectares, you **MUST** use Toolbox → Data Management Tools → Features → Multipart to Singlepart. This command will ungroup the polygons allowing the correct number and size to be displayed **AFTER YOU RECALCULATE GEOMETRY.**

While you can convert all the layers to grids and do this as a raster exercise, for nearly everyone it will be easier to do this mainly with vector data. You will want to create a slope file, recode it based on our slope criteria, and convert this to a vector shapefile. Load MARON_STX up (it is a GRID, you can load it directly), calculate the slope with the surface functions, reclassify the slope into 0 and 1 based on whether they are over or $\leq 3^\circ$ (See the Raster Lab 10), select the result, and in the Toolbox → Conversion Tools → From Raster → Raster to Polygon named slpcls.

This lab is due the last week of class. This lab will be worth 30 points, and there will be no late labs accepted. You should turn in:

- 1) **A flow chart** indicating the analytical functions you applied, and the intermediate layers produced; (*hand-sketched is o.k., but only if you write legibly and scan it as a .pdf*). I suggest you use Paraben's Flowcharter that is on the Lab computers or <https://www.draw.io/> ; any format for the flowchart is OK.
- 2) Just the **final data layer**; The easiest way to do this is to select your final data layer and then select Data → Export Features and name the output layer

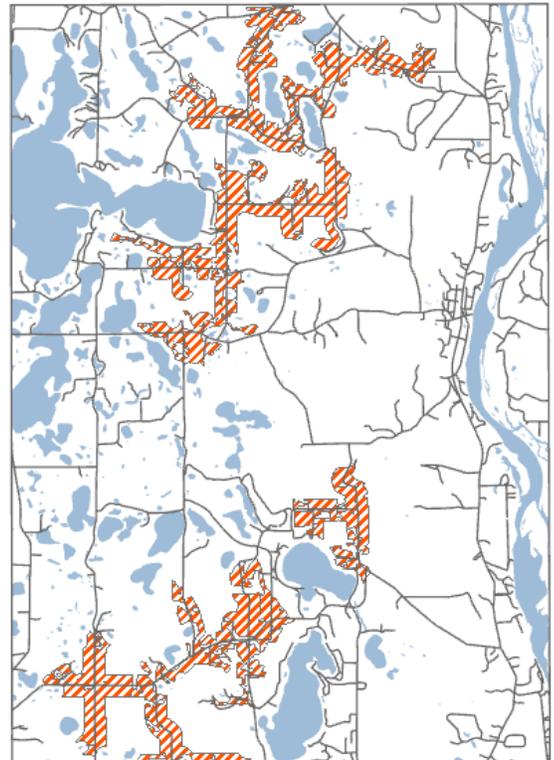
`\\Lab14\FinalDataSubmission.shp`

This will create a shapefile version of your final layer. THEN in Windows Explorer select all the little files that have the same 1st name, that is, FinalDataSubmission. There will be several files (7 or 8), compress these into one ZIP file.

You do this by right clicking on all the selected files (at once) and selecting Send to Compressed (Zipped) folder. Then attach that .zip file to your Canvas submission.

DO NOT submit your Project file (APRX) files or your ENTIRE GeoDatabase.

- 3) **A final map**, (PDF) which identifies the suitable locations, along with the road, and lakes. The view portion of your final suitable area map should look like the adjacent figure. Pay most attention to the location and extent of the light



gray areas on this map, they meet all the criteria. It is quite easy to miss-code a variable, and your areas will not match those below. Roads (dark lines) and hydrography (dark areas) are also included, to help you determine if your final areas are correct.

You should include the title, legend, scale bar, north arrow, your name, etc., i.e., the whole nine yards. You will be graded not only on accuracy, but on map aesthetics, e.g., are the various features identifiable, does the map unambiguously provide the desired information, and are the fonts, title, and legend, etc., appropriate and provide the information we seek? You may also turn in intermediate analyses, if you think they help clarify the analysis and to ensure you'll get maximum credit, but again, the maps should be complete and well done.

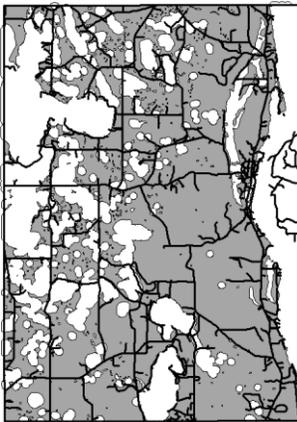
4) **Three additional map panels, all placed on the same page.**

The 1st map panel should contain: wetlands binary class, hydrography binary class, and roads,

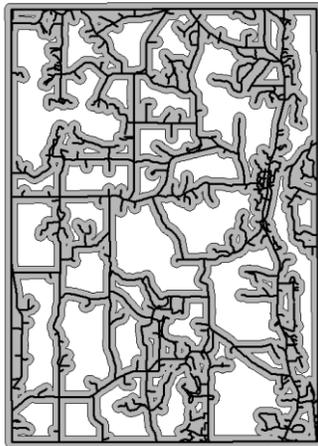
The 2nd map panel should contain: road buffer binary class and roads, and

The 3rd map panel should contain: private in Minnesota, slope binary class, and roads. Include legends, titles, etc. for each of these panels. Examples of the panel content are shown below. (note the roads on these panels are for reference/decoration only)

1st additional map data: non-wetlands and hydrography-buffers criteria, plus roads.



2nd additional map: roads and road buffer.



3rd additional map: private in Minnesota, slope binary class, and roads.

