

Hopkins Transit Station Analysis (parts 1 & 2)

What You'll Learn:

- Practice various skills using ArcMap.
- Combining parcels, land use, impervious surface, and elevation data to calculate suitability for various uses

Data are in the L:\FNR5131\Semester_Project\Hopkins directory and in a zip file in the week 1 row on the FNR5131 course website.

What You'll Produce: A series of maps, in the four parts of this exercise, depicting various aspects of the study area.

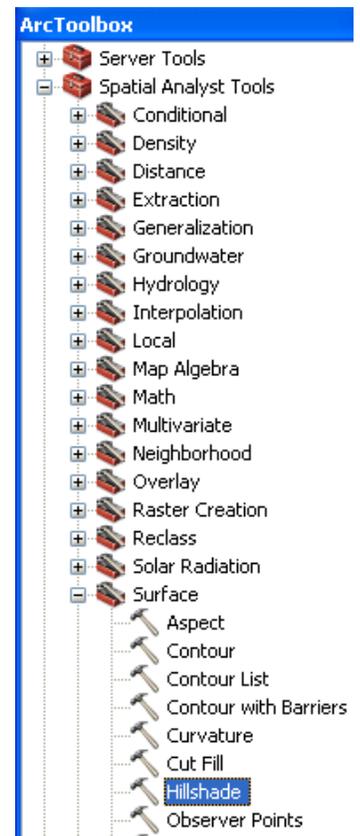
Background: These exercises re-iterate tools taught in labs, and in part 3, introduce additional extensions. The lab descriptions “hold your hand” through most processes, and here we provide a synthesis and application with just the goals and a few pointers, to help you better learn the material to solve problems. In addition, ArcGIS may be extended through add-ons, to add functionality or to fix tools. This lab is a work in progress in response to student request, so parts 3 and 4 aren't defined yet, but we'll likely introduce some new tools in those parts.

Part 1 – (uses skills taught in lessons 1 & 2)

- Create a workspace for this project and copy all the data into a directory.
- Create a base map using ArcGIS Pro.
- Load the proposed station location (station), a 0.7-mile radius circle (station_buffer1), and parcels, into a data view.
- Create and print (PDF) properly titled map, with north arrow, scale bar, your name and simple description in place of a formal legend. Save the map composition (.mxd file) for later work.

Part 2 – Projections, Hillshade, Editing (uses skills taught in lessons 3, 4, 5, & 6)

- Add the “Focus_Zone” shapefile to the project created in Part 1. Examine the properties for each data set, particularly the map projection of each data set (right click the data name in the table of contents, then properties-source). Some data layers are not in our preferred projection, UTM, NAD83 zone 15 meters. Project all offending data layers into our preferred UTM (refer to Lesson 3). Make sure the data frame coordinate system is also set to UTM, NAD83 zone 15 meters. From now on, any reference to data layers is to these new, projected layers.
- Create a hillshade layer from the DEM, and save it as an output grid (ArcToolbox-Spatial Analyst-Surface-Hillshade, specify an output data file – see the graphic on right/below, but also discussed briefly in Lab 6).
- Now create a “buildings” data layers. Use ArcCatalog to create an empty polygon data layer, in the UTM zone coordinate system you are using. Display the NE, NW, SE, and SW, 1-foot resolution images. These images were collected in 2006, a bit later than the rest of your data (from about 2000). Using the images as a guide, digitize the footprint of at all the buildings within the “Focus_Zone” area. If you wish, you may choose a different area, of approximately the same size, and digitize all the buildings within the area (see lab exercises 4 and 5 for methods). Save the data to a new data layer, named something like “buildings.”
- Print(PDF) a properly composed map that shows the hillshade, parcels, buildings, and station location. Place the hillshade on the bottom, the station and buildings on top, and make the parcels transparent (no color or hollow) to make the hillshading visible. Symbolize the parcel lines, buildings, and station so they stand out.



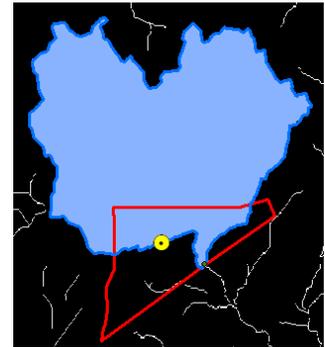
Part 3 – Contributing Watershed, Impervious Surface, and Raster Aggregation

Rainfall runoff, accumulation, and management is important. We want to identify areas with high flow accumulation so that we may avoid flooding within the focus area, and not contribute to problems below the focus area. Here, we wish to identify areas with high impervious surface that drain into the focus area, and areas with high impervious surface that are within the focus area. We will prioritize mitigation for those areas with higher than 35% impervious surface.

Calculate likely runoff flowpaths (see the DEM/Terrain labs, in the ArcToolbox, use the Spatial Analyst Tools, then under Hydrology, choose Fill – Flow direction – Flow accumulation). Display and symbolize flow accumulation to show watercourses draining > 8 hectares. Note that flow accumulation values are recorded as cells, so you'll need to calculate the number of cells for that given area to identify the watercourse. You can find the cell dimension by right clicking on the TOC entry for the flow accumulation layer, then properties – source, and remember the data are stored in UTM meters. The cell dimension is given, so you can calculate the number of square meters per cell, and then the number of cells per hectare,

given that there are 10,000 square meters per hectare. Set the threshold in your symbology at this number of cells, white above, black below, to identify watercourses (visible in the edge areas of the graphic below).

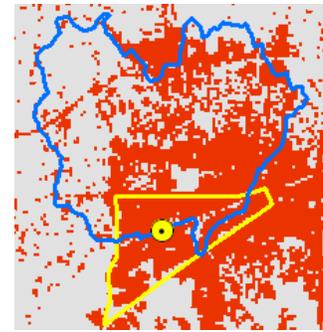
Create a “pour point” at the watershed outlet where it leaves the focus area layer, and calculate the corresponding watershed (you should have an area that appears similar to the graphic to the right – note the pour point is a small green dot at the bottom left, the station location a large yellow dot).



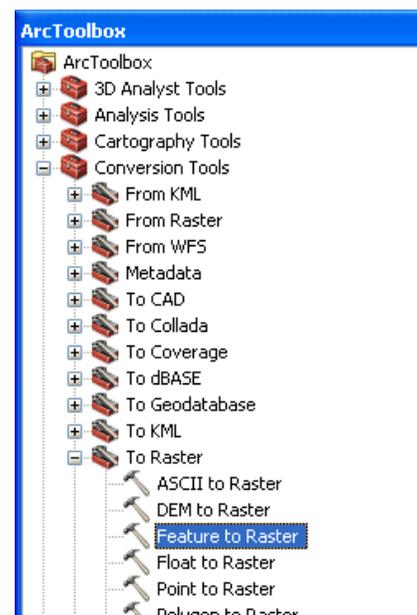
Now we would like to identify areas that have greater than 35% impervious cover within both the focus area and the contributing watershed.

First, load the impervious surface layer. Reclassify the layer (Spatial Analyst-Reclassify) to categorize those areas above 35% to a value of 1, and below 35% as 0.

View the layer and note there is a lot of “speckle.” Clean this up using the Majority Filter tool in the ArcToolbox, under Spatial Analyst Tools, Generalization. Apply the majority filter twice, using either four or eight neighbors, and a majority replacement threshold.



Now we want to clip the impervious surface layer by the aggregate area of both the focus zone and the watershed. Perhaps the easiest way is to combine the vector focus zone and raster watershed area into one raster layer with a value of one in the area and zero outside, and then multiply this by the filtered impervious area layer. To do this, first use Arc Toolbox – Conversion Tools – To Raster – Feature to Raster (see right). If the ID is not set to 1 or some other indicated value, you may want to change it by editing the table prior to conversion.



You can now use the Raster Calculator under Spatial Analyst to combine these two rasters.

The function `con(IsNull([zoneras]), [watras], [zoneras])` applies the conditional function, where `zoneras` is the 0/1 raster of the focus zone, and `watras` is the 0/1 raster of the watershed. If you read the documentation on `con`, it explains that a conditional statement is evaluated (is the raster for the focal zone null). If the condition is true, then you're outside the zone, and it outputs the value for the watershed raster (1 or null). If not, then it applies the value for the zone raster (1 in all cases).

Alternatively, you may convert the raster watershed to a vector, and union it with the focus zone vector, and then convert this to a raster and recode.

Either way, you should end up with a “clipping mask” that looks something like the feature to the right:

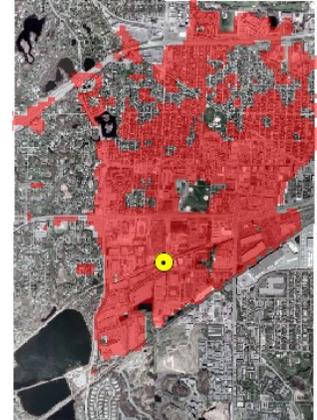


Note that the yellow dot is the proposed train station, and the watershed and focus area are represented. Assign all the cells a value of 1, if they are not so already.

Now, use the raster calculator and clip this area from the filtered impervious surface layer, via multiplication.

Create and Export → File to a PDF that shows the areas greater than 35% impervious surface. Set the symbol for <35% to no color, and >35% to red. Set the transparency to 50% (Properties – Display tab, then fill the transparency box with a 50% value).

Display these over the images, for a layout pane that looks similar to at right, and add a legend, North arrow, scalebar, and title, as usual.



Turn this map in.

Part 4 - High density population service areas, existing and to develop

Your remaining tasks are to create a map that depicts a) parcels which currently fall (completely or partly) within areas of high population density, and b) areas with low population density that are also inexpensive, and thus candidates for increasing population density.

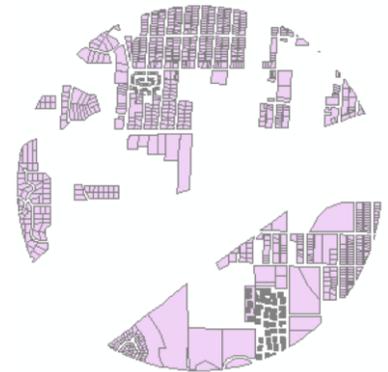
For a) calculate population density from the Shady Oaks census data layer. Note that these data are bit messy, population are in the populatio2 item, and there are some small polygons that are artifacts/errors. Also note that these data are in UTM NAD83 Zone 15N coordinates, but this is not recorded for these data (no prj file), so you will likely need to fix this (ArcToolbox, the data management tools, projections).

Add a float or double column, calculate the area in sq km for each polygon (to 4 decimal places at least). Select and delete polygons with areas < 0.0049 sq km, add another column, and calculate the population density.

Identify areas with a population density greater than or equal to 1000 persons per sqkm within the boundary of shady_oak_census. Save these polygons to another data layer, named something like CenHiDen.

Identify polygons in the Shady Oaks parcels layer that intersect with these high-density census areas (use the tool we learned earlier to select, top row of main window, Selection, Select by location, select features from parcel_shady_oaks that intersect with your CenHiDen layer). Save these parcel polygons to a new layer and clip them to the Station Buffer1 layer.

Remove all the parcel/polygons with a value = 0 in the TOTALVAL column (these are public lands). You should have a set of polygons similar to the figure at the right.



Now, identify candidate areas for increased density.

Go back to the parcels_shady_oak layer, and add a value per square meter column, similar to your calculation for population density for the census data layer. You'll need to create a column and calculate the area via calculate geometry, and then create another column to hold the value per square meter. Total value for the parcel is in the item TOTALVAL, divide by area to get value per square meter. Delete those parcels with totalval of zero, these are public or restricted land. Within the area of the station buffer, identify those parcels that have a value per square meter < \$60/sq meter. Now, select from these low-cost parcels those parcels that have a popden of less than 250 people/square kilometer (as you did above, first identify the census areas with low popden, then select by location). Clip to the study area and save these low population, low value areas as those appropriate for acquisition. The candidate areas are shown in blue, at right.



Turn in a map that shows both these two high-density sets within the study zone (see right), in a map of the study area. Include the aerial photographs in the background, the current high-density areas, proposed new high density areas, and the station location, as well as a title, scalebar, north arrow, name, and legend.