

# Conservation Applications of LiDAR

## Basics of Using LiDAR Data

### Exercise #2: Raster Processing

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Joel Nelson, University of Minnesota Department of Soil, Water, and Climate

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# Basics of Using LiDAR Data

## Exercise #2: Raster Processing

<b>Exercise 2: Raster Processing</b> .....	<b>3</b>
A. Training Data Acquisition.....	3
B. Basic Properties - Examining Source Data .....	3
C. Raster Processing .....	4
Activate Spatial Analyst Extension.....	4
Spatial Analyst Tools .....	4
Raster Calculator.....	5
Raster Environments.....	5
Raster Processing – Depressions Example.....	6
Using an Integer Version of a Raster Layer.....	8
Raster Clipping .....	11

## Exercise 2: Raster Processing

### A. Training Data Acquisition

Follow the instructions in Exercise 1: Accessing Minnesota LiDAR Data to download a geodatabase (\*.gdb) file from the MnGeo ftp site. For this exercise, work with a single tile instead of a whole county mosaic.

For the last task of this exercise, you will need to download the Environmental Benefits Index for the same county as your LiDAR tile from [http://www.bwsr.state.mn.us/ecological\\_ranking/](http://www.bwsr.state.mn.us/ecological_ranking/)

### B. Basic Properties - Examining Source Data

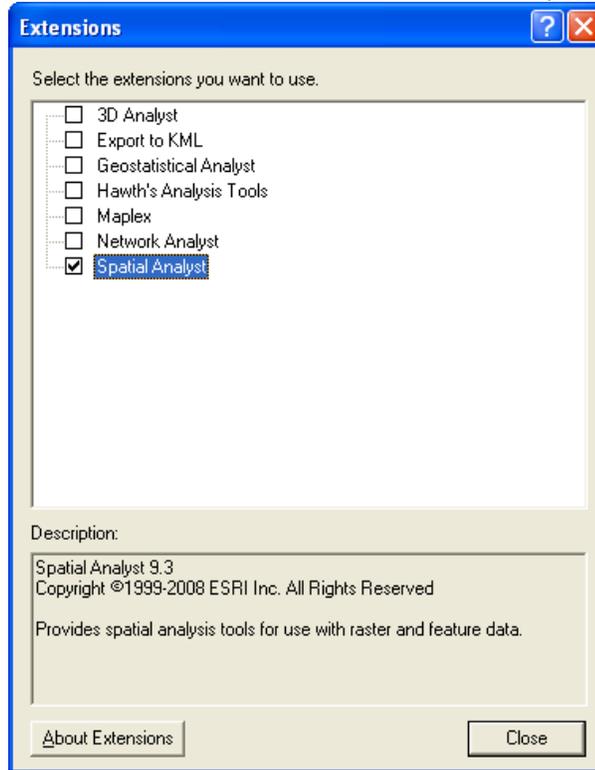
1. Start ArcMap.
2. Select “add-data” , navigate to the folder where you stored the \*.gdb file. Drill down into the \*.gdb file, select the file named “dem01”, and click “Add”.
3. Select this DEM Layer, right-click → **Properties**.
  - Click the **Source** tab in the properties for the layer to get a full description of the layer including *cell size, format, extent and spatial reference*.
  - Now click the **Symbology** tab. Here you can change the color ramp.
  - Put a check mark on the **Hillshade** option to emphasize the terrain features. This does *not affect* the analysis or change the data, but aids in visualization – more on that later.
  - Once you have examined all layer properties, click **OK** to close the layer properties.
4. Open ArcCatalog . Navigate to the \*.gdb file you downloaded.
5. Observe the different notations and icons that ArcCatalog uses between, shapefiles, Arc Grids, etc.
6. Right click the Windows “Start” button, and select Windows Explorer.
7. Navigate to the \*.gdb file you downloaded and observe how the folder and file structure is different for an Arc Grid than for other formats.

**TIP** – Always use ArcCatalog to copy, move, or delete raster data. Arc Grids utilize a two folder system with one folder containing the raster geometry, and the other “info” folder containing tabular information for ALL rasters in the same directory.

## C. Raster Processing

### Activate Spatial Analyst Extension

1. From the **Customize** Menu, select **Extensions** and check-on the Spatial Analyst extension.



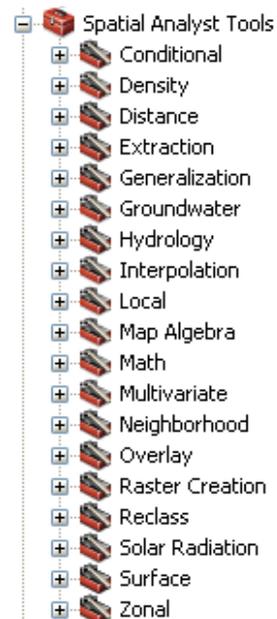
2. Click Close

### Spatial Analyst Tools

1. Launch **ArcToolbox** by opening the ArcToolbox Window.



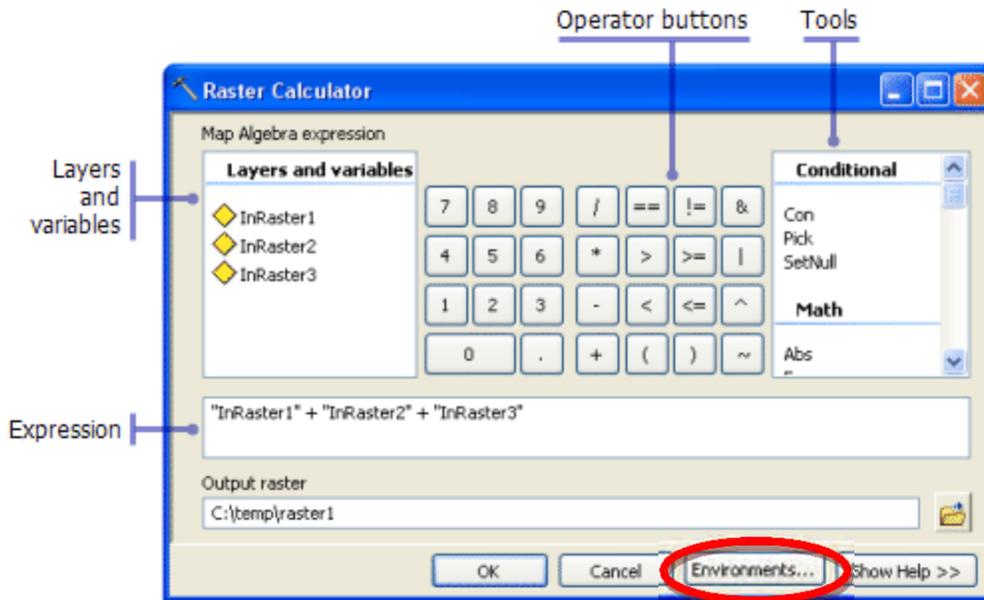
2. Expand the **Spatial Analyst Tools**, and observe the following sub-categories:
  - o Distance
  - o Extraction
  - o Hydrology
  - o Interpolation
  - o Map Algebra
  - o Surface
  - o Zonal



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## Raster Calculator

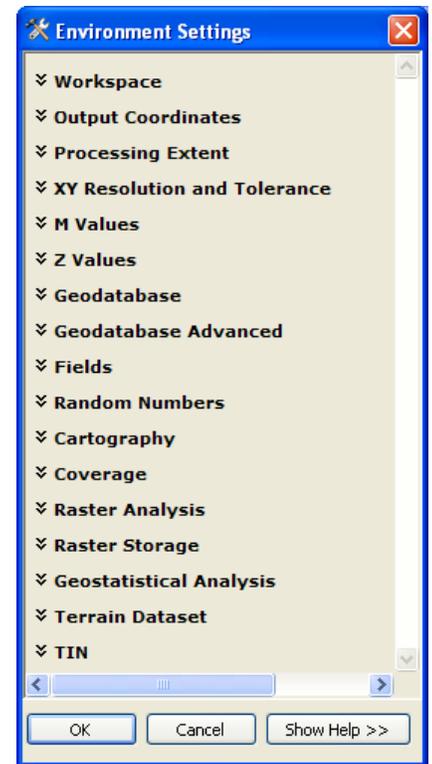
1. Go to **ArcToolbox > Spatial Analyst Tools > Map Algebra > Raster Calculator.** 
2. Observe interface and listen to demo.



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## Raster Environments

1. Go to **ArcToolbox > Spatial Analyst Tools > Map Algebra > Raster Calculator.** 
2. Select **Environments** to access environment settings.
3. Most common raster processing environment settings to manipulate are as follows:
  - o Processing Extent
    - Snap raster
  - o Raster Analysis
    - Cell size
    - Mask
  - o Raster Storage
    - Pyramid
    - Raster Statistics
    - Compression



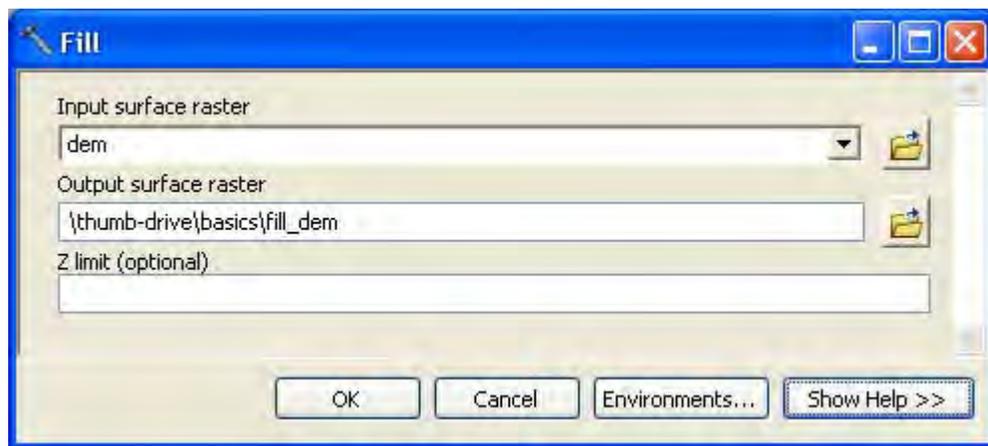
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## Raster Processing – Depressions Example

For the below example, we'll be utilizing our DEM to perform a simple depression identification. You will calculate sinks in the landscape, and then use the raster calculator to isolate those sinks.

### Sink Filling

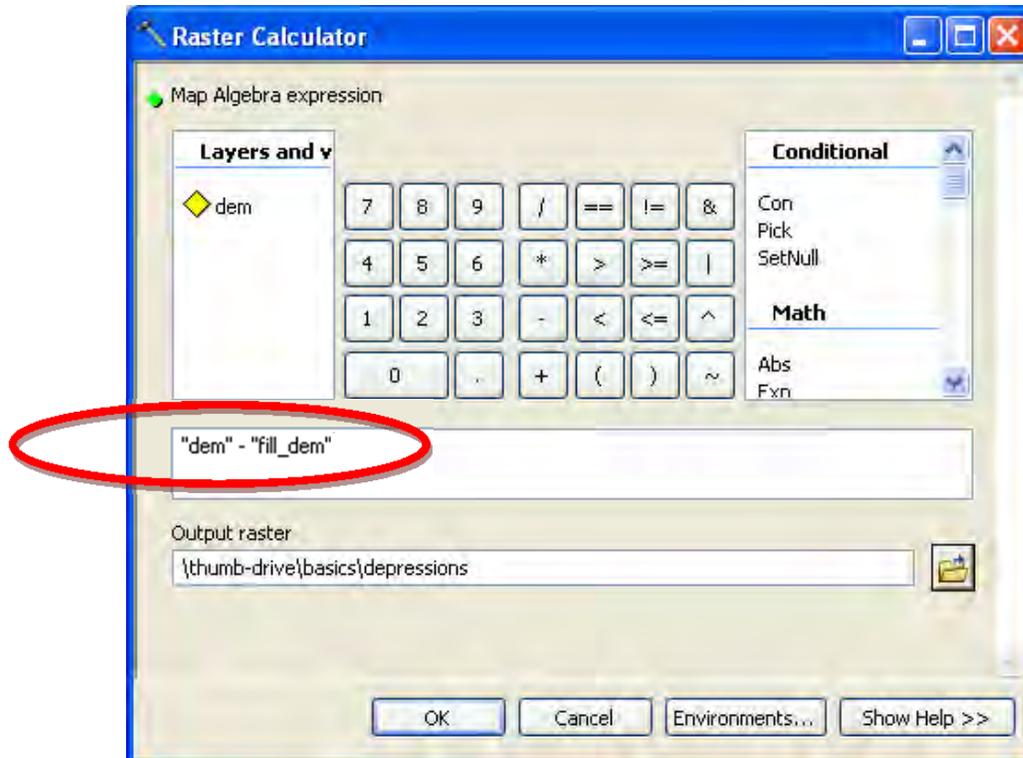
1. Launch **ArcToolbox** by clicking the toolbar icon. 
2. Click on **Spatial Analyst Tools** → **Hydrology** → **Fill** .



3. **Input Surface Raster:** DEM01 (select it from the drop-down).
4. **Output Surface Raster:** Browse to the folder where you want to store exercise files and name 'fill\_dem'.
5. **Z limit:** this is the maximum elevation difference between a sink and its pour point to be filled.
  - o Note: The default will fill all sinks regardless of depth.
  - o Click "Show Help" for an explanation of Z-limit and what values are to be used.
6. Click **OK**. The output surface raster will be added to your map as a new layer.
7. Spend some time zooming in to different parts of the dem, checking layers on/off to see the effect of pit-filling the DEM.

## Isolating Depressions

1. Launch the **Raster Calculator** by clicking on **Spatial Analyst Tools** → **Map Algebra** → **Raster Calculator**
2. Enter formula so the result looks exactly like the formula below: “dem” – “fill\_dem”
3. **Output Raster** – (your folder)\depressions
4. Click **OK** to run the calculation.
5. Observe how negative values for “depressions” indicate depth of depression.



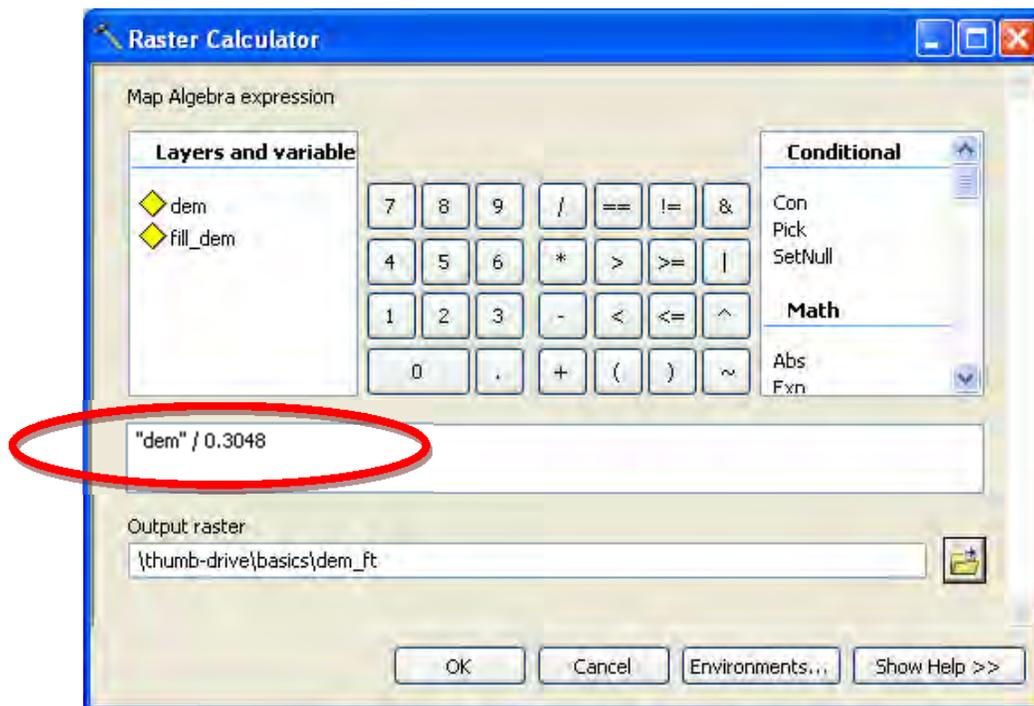
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## Using an Integer Version of a Raster Layer

*Problem* – To make use of the many other raster tools available, it's often useful to have an integer version of the raster. Building a raster attribute table, converting the raster to a polygon, and other functions require it. Data downloaded from the LiDAR FTP server is a single-band raster, type FLOAT. However, if we convert to an integer grid as-is, we lose much of the precision (i.e. decimals) that LiDAR is so renowned for.

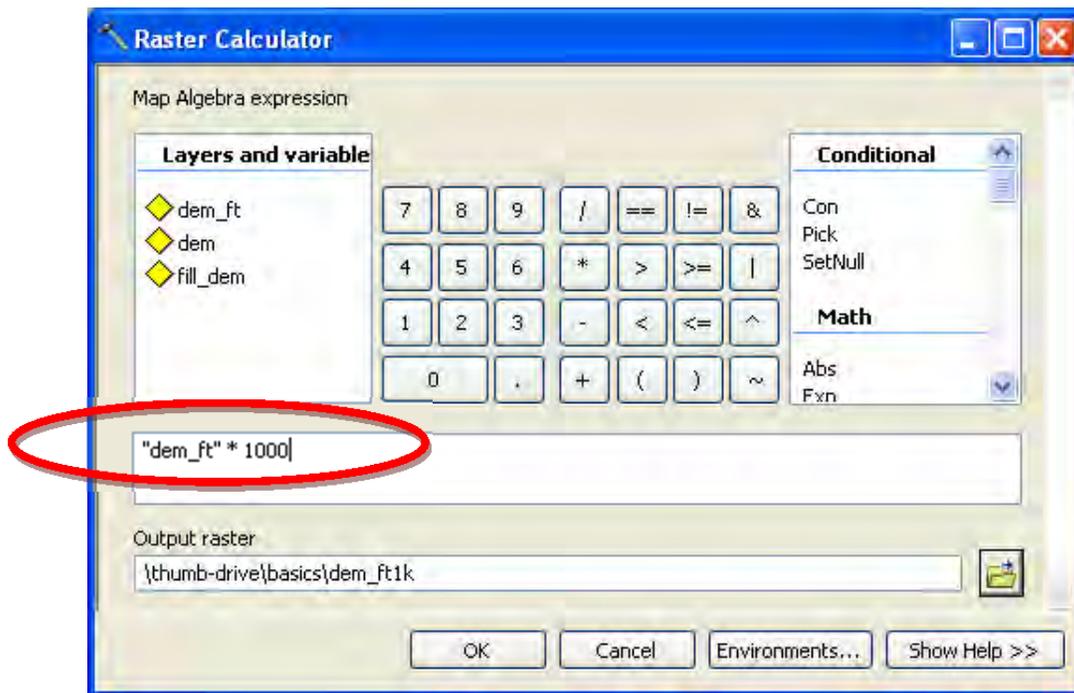
*Solution #1* – Before converting the DEM to an integer grid, we'll preserve some of that precision by converting units from meters to feet.

1. Launch the **Raster Calculator** by clicking on **Spatial Analyst Tools** → **Map Algebra** → **Raster Calculator**
2. Enter formula so the result looks exactly like the formula below: "dem" / 0.3048
3. **Output Raster** – (your folder)\dem\_ft
4. Click **OK** to run the calculation.

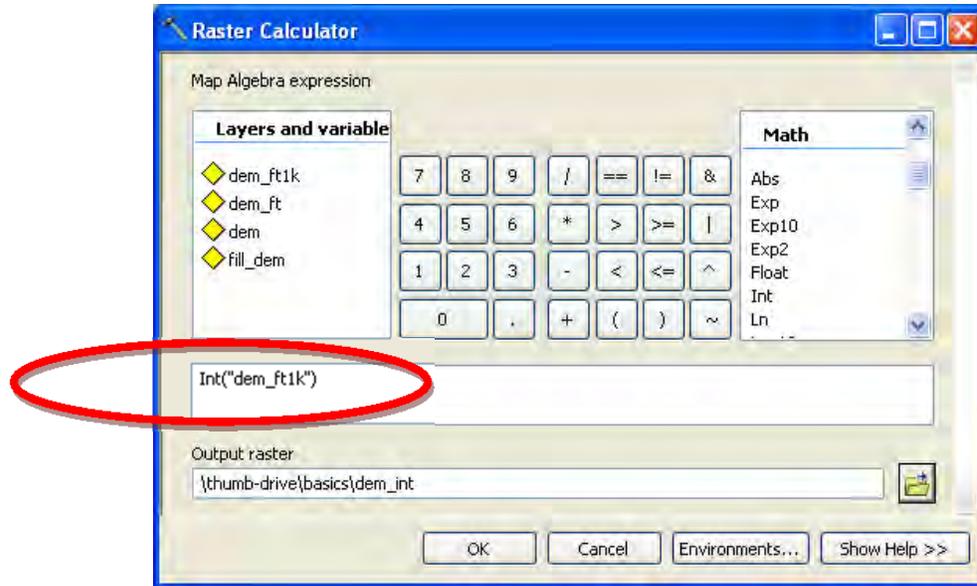


*Solution #2*– Before converting the DEM to an integer grid, multiply the DEM by a specified amount so as to preserve the decimals.

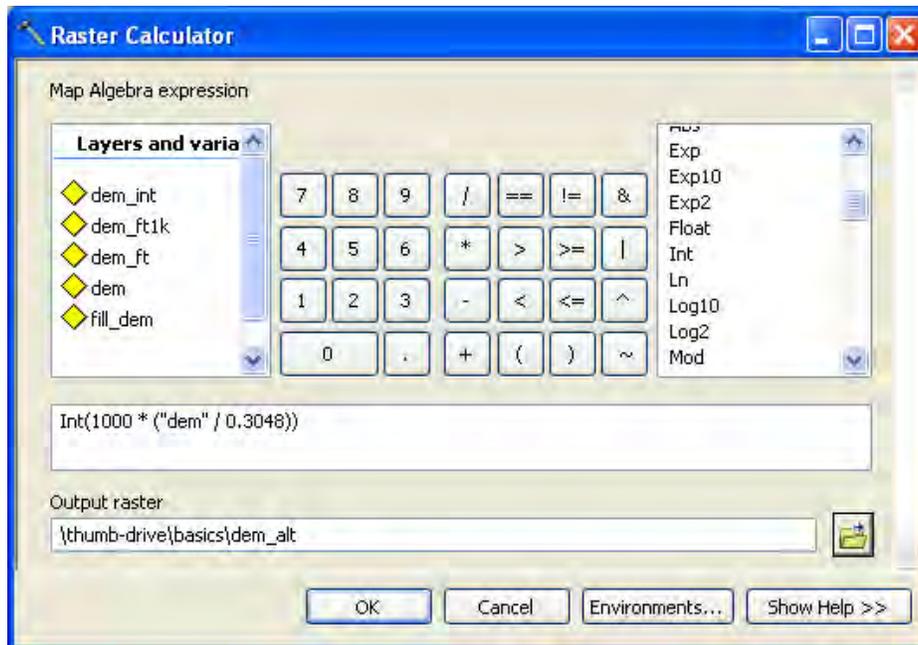
1. Launch the **Raster Calculator** by clicking on **Spatial Analyst Tools** → **Map Algebra** → **Raster Calculator**
2. Enter formula so the result looks exactly like the formula below: "dem\_ft" \* 1000. Multiplying by 1000 will allow us to preserve 3 decimal places. After performing whichever functions are necessary, such as conversion to polygons, we can divide by 1000 to restore to the one-thousandths decimal place.
3. **Output Raster** – thumb-drive\basics\dem\_ft1k
4. Click **OK** to run the calculation.



5. Launch the **Raster Calculator** by clicking on **Spatial Analyst Tools** → **Map Algebra** → **Raster Calculator**
6. Enter formula so the result looks exactly like the formula below: Int("dem\_ft1k").
7. **Output Raster** – (your folder)\dem\_int
8. Click **OK** to run the calculation.



9. Alternatively, we could've done all of these calculations in one window by entering the following:  $\text{Int}(1000 * (\text{"dem"} / 0.3048))$



The point of the long-hand procedure, only to reveal an “easier” way to perform the same calculation is to drive home the point of the Raster Calculator living up to the term “Map Algebra.” Any raster can be utilized with any mathematical and algebraic function to yield a wide array of results. Ultimately, this is one of the key features that makes the raster processing environment so powerful.

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## Raster Clipping

Clipping out portions of raster data to work on as “pilot-areas” is a critical concept used when determining best-practice workflows. In this exercise, we will work with both LiDAR data and a raster that displays ecological ranking of parcels for conservation practices. This layer is called the Environmental Benefits Index (EBI).

### Acquire data for this portion of the exercise:

For more information on the EBI, go to (<http://beaver.nrri.umn.edu/EcolRank/>).

To get a data file for this exercise:

1. Go to [http://www.bwsr.state.mn.us/ecological\\_ranking/](http://www.bwsr.state.mn.us/ecological_ranking/)
2. In the “Download data layers” section on the right, click on “Environmental Benefits Index”
3. Download the shapefile for the same county as the lidar data tile you are using in this exercise.
4. Name the file EBI300.

To make for easier processing, we need to clip this layer (EBI300) to the same extent as the DEM, and use “snap-to-raster” to ensure they have the same spatial origin.

**\*\*NOTE** – There are several ways to clip a raster in ArcGIS. This method, titled “extract by mask” is useful because you can utilize feature data OR raster data for a clip layer (mask).

1. Select “add-data” , navigate to and add the “ebi300” file you downloaded.
2. Go to **ArcToolbox > Spatial Analyst Tools > Extraction > Extract by mask.** 
3. **Input Raster:** ebi300
4. **Mask Data:** dem
5. **Output Raster:** (your folder)\ ebi\_300\_msk
6. Select **Environments**
7. Under **Processing Extent**, set snap raster to: DEM

