# Lab 3b: Changes to the Green River

For this assignment you will focus on a stretch of the Green River, southeast of Seattle. A quick look on Google Earth and you can see that this river is on the move. Your task in this assignment is to evaluate how the Green River has changed through the years (1940-2009[1]). The first part will be visually presenting how it has changed by producing a map that depicts the river course through time. The second part is to figure out a way to systematically quantify the rates and degree of change through time. This will require that you understand the significance of the map you just created, are able to describe in words what's happening to the channel through time, and put numbers to your description. If you have some knowledge of alluvial river behavior and meander bends, keep thinking about the geologic or environmental conditions that are driving the change you're seeing (i.e., what happened, or didn't happen, between images). If you don't know much about alluvial rivers and meander bends, talk with a classmate who does or with me, Joe, or one of the TAs.

Due: Sunday 11 September at 11:59 pm to Blackboard

Task: Quantify the changes to the Green River between 1940 and 2009. Focus on the stretch of river west of 122°40'W where you have data from all years. This has the most change over time.

Turn in: A map that shows the changes to the Green River and includes a caption describing what is going on, a work flow, and a letter to Uncle Don explaining the lab.

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## Data

The data you'll use for this lab are: a DRG for the area and aerial photos from 1940, 1990, 2002, 2006, and 2009.

## Overview of your tasks

1) First you'll need to digitize the river channel in each of the images.
2) Next you'll need to do something that can quantify the changes to the river channel. You can do this a number of different ways and what you quantify is up to you. You do need to be consistent with your methods across the entire study area and all images. Some possibilities of what you can quantify are: changes in sinuosity (the ratio of the bendy river path to the straight line path), the width of the 'active' channel, the amplitude or frequency of river meanders, the radius of curvature of meanders, or anything else that you think changes over the time period. You'll need to put numbers to your values and make them into a rate per year, so remember that there isn't a consistent time period between images.
3) Finally you will make a map that shows the changes you have quantified. The caption should describe in words what you expect the user to get out of the map.

## Some things to keep in mind

- Images were taken at different times of year so changes to wetted area may be seasonal.
- Resolution – don't try to digitize something that is too small to see in all the images.
- Irregular time intervals for comparison – what happened, or didn't happen, between images?

[1] You did download 1867 data too, but it's not really accurate enough for quantitative analyses.

## Somewhat more detailed directions

1) Use editor to digitize all the river channels. You will make one shapefile with all your lines in it. You may have used editor previously to delete stray bits of hurricane tracks or to draw rectangles around DEMs in the last lab.
    a. First you need to create a new shapefile.
        i. In **ArcCatalog**, open the folder where you would like to save your new file. In the contents tab, right-click and select **new – shapefile**. Name your new shapefile appropriately. Check out the options for feature times (we generally care about point, line, and polygon files). For this first file create a polyline.
        ii. Since this is a brand new file with absolutely no data, you can give your file any coordinate system you would like. Make sure that it is the one you're using for everything else. Click ok.
        iii. Add your new file to ArcMap.
        iv. Add a field to the attribute table for the rivers shapefile called Year where you can put in integer year values. Set the symbology as something that is easy to see too so you can tell what you've done easily.
    b. Next you need to digitize lines.
        i. Open the Editor toolbar (under customize). Click Editor and Start Editing. A new Create Features window should open listing the editable features. Select your rivers layer. (If this window does not open, Click Editor > Editing Windows > Create Features).


        ii. If your rivers layer does not appear in the **Create Features** window, you'll need to create a template feature. Simply click on the **Organize Templates** button in the **Create Features** window (highlighted below).


        (step ii continued) Click **New Template**, select your rivers layer, and click finish. Close the windows. In Create Features dropdown menu, select **Show All Templates**.
        iii. Before you start digitizing real features, try out the different editing options. Here are some basic instructions:
            1. **To create a new feature**, use one of the construction tools from the list at the bottom of the Create Features window. Click once to create a new vertex and double click to finish creating the feature.
            2. **To delete a feature**, select it using the black arrow (Edit Tool) and hit the delete button on the keyboard.
            3. **To move a feature**, select it using the black arrow and drag the whole feature by clicking anywhere on the feature.
            4. **To edit a feature once you've created it**, select the feature, right-click it, and select edit vertices. OR select the Edit Vertices tool on the toolbar.

5. Try out all of the different **Construction Tools** in the bottom of the Create Features window.
6. **Try right-clicking while drawing a new feature**. What options are available to you here? Try some of them out.
7. While you're drawing a feature, see what the other things are that you can do with the editor toolbar. So far you've only been using the straight segment option, but try out a few of the options like the End Point Arc Segment and the Right Angle option. It's unlikely you will use these other options very often, but they are worth knowing about. Feel free to try out any of the other options like parallel, perpendicular, or rotate. If you're confused about how to use any of these tools, try searching for them in the Help tool.
8. Now that you've drawn loads of nonsensical lines, under Editor click Stop Editing and DON'T save your edits. Anything that is not saved will be automatically deleted upon exiting editor mode.
9. There are some other cool things you can play with in the editor toolbar that you may want to try with a new (empty) shapefile (you can do this in your rivers file as long as you are careful not to save your edits). These are useful if you are trying to digitize things so that there aren't gaps between them.
    a. This time we are going to take advantage of the Snapping properties. In the Editor toolbar, open **Snapping-Snapping Toolbar**. Deselect all of the buttons. Start drawing a line and notice that the second vertex no longer snaps to other lines. Now, turn on the far right Edge Snapping button. If you try to select a vertex near another line, it automatically snaps to that line.
    b. Change the snapping tolerance (aka the tightness of the snapping) in the Snapping Toolbar-Options. Try setting it to a relatively high number (>75 pixels) and draw a new line. Ok, so that's probably too high a tolerance. Set it back to something <25 that works comfortably for you.
    c. Draw lines along the edges of the active channel in one of the images. Try to connect all of the edges into an apparently continuous path. You should turn the Vertex Snapping on as well to make this process easier.
    d. When you are done, don't save your edits.
10. Ok! Time for the real work.

iv. Open your attributes table and keep it open and out of the way.
v. Start a new editing session and digitize the water path (aim for the same place on the channel in all images – either the center or one bank) for one image.
vi. When you have drawn your line, **Save Edits** (in the editor toolbar) but don't stop editing. Now add the year of the image to the attribute table for that line.
vii. When you are done with all the images, **Save Edits** and **Stop editing**

viii. A note on making polygons and points: You can digitize polygons and points as well. Try this out with your test (unimportant) shapefile.

2) Now you are ready to work on quantifying river changes.
    a. To do this, you'll follow the directions from Joe to use a Python script. Download and work through Lab3Python from Blackboard. Then come back to this document.
3) Now that you are done with the analysis, figure out a way to display how much the river has changed over the last 20 years. Don't forget that your map must have a caption that includes the quantitative data you measured. You can also display that visually if you'd like.