Case Study 1-2: Identifying Threats of Contamination to Merced County Rivers through Common Geoprocessing Tasks

Engineering 180
Summer Session A 2022
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Assigned: Tuesday, May 31, 2022
Due: Tuesday, June 7, 2022

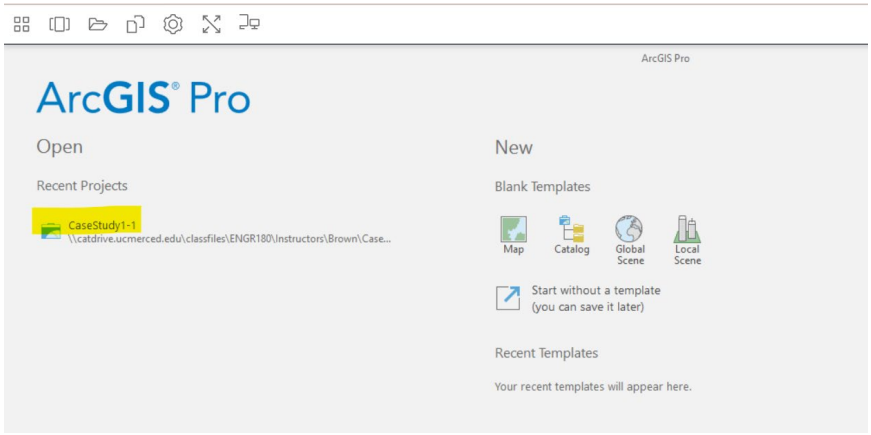
Skills: Opening Pre-Existing Projects, Creating Geodatabases, Intersect, Clip, Buffer, Dissolve, Cartography

Case Study Scenario: You completed importing flat file data for Merced County wells, correctly projecting them, joining additional information, and isolating wells contaminated with hexavalent chromium (CR6). To create the final maps for public meetings, your manager needs you to bring in data of all the rivers in Merced County, then identify any contaminated wells within certain distance, as that is of particular concern to the public.

You will use your pre-existing project from Case Study 1-1 and create a second geodatabase in which you will store your newly added and soon-to-be created data. You'll use some common geoprocessing tools (clip, intersect, buffer, and dissolve) that you'll find yourself using throughout your entire GIS career!

Prep: Download `cdfg_100k_2003_6.zip`, a 1:100,000 scale hydrography shapefile covering the state of California [1] from Catcourses and add it to your previously created `CaseStudy1Data` folder in Classfiles. Unzip the folder or else it wont show up properly in ArcGIS Pro.

1. **Open Your Pre-Existing Project from 1-1**
    a. Log into the Remote Server, Classfiles, and then access ArcGIS Pro.
        i. Make sure you are signed into ArcGIS in the top right corner of the software.
    b. Instead of creating a new project, access your previously created Case Study 1-1 by clicking on it under Recent Projects



2. **Creating a Geodatabase**

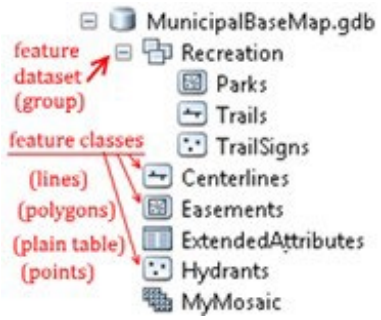
When you created your project for 1-1, ArcGIS Pro automatically created a folder structure and geodatabase for you! You can see this in your *Catalog* Pane.

    a. Within the *Catalog* Pane, click the dropdown arrow for Databases. This is your project geodatabase. Within the geodatabase (.gdb) you should see all of the layers you created in 1-1.

b. We want to add a second, new geodatabase to bring in data for 1-2 to keep our project compartmentalized.

But, what even is a geodatabase(.gdb/GDB)?!

According to Esri, a geodatabase is *"a container that stores spatial and attribute data."* GDBs can contain feature classes that store point, line, or polygon features. They can also store tabular data that lack spatial attributes, such as attribute tables. The GDB assigns unique, integer IDs as identifiers for rows in GDB tables [2].



There are three types of GDBs within the ArcGIS suite, each with a different history and use case [3]. You will typically use File GDBs for your typical use cases. Companies with multiple GIS users use Enterprise Geodatabases to manage multiple people working on the same dataset at once.

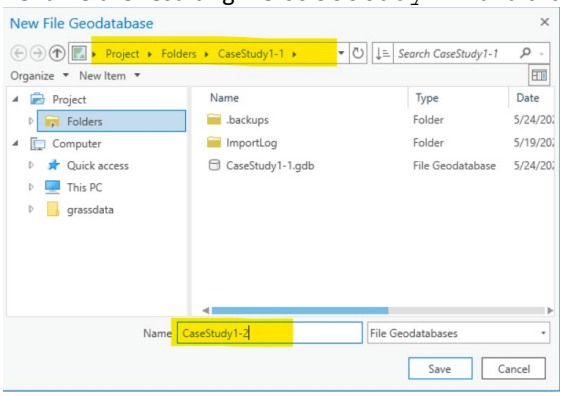
It's important to note the difference between feature datasets and feature classes. Certain operations cannot be performed if your data are in feature datasets, for instance. For more information, refer the "Feature classes" and "Feature Datasets" under the ArcGIS documentation. You typically will only create feature datasets in special circumstances (e.g. creating parcel fabrics).

It helps to look at the symbology to understand what's what. A geodatabase is represented by a canister. A feature dataset is a stack of 3 squares, try to think of them as file folders. Individual feature classes have symbols for points, lines, polygons, rasters, or tables.

There are many ways of creating GDBs in ArcGIS Pro. One simple way is to use the built-in Catalog.

c. Right click on the *Databases* section of *Catalog* and navigate to *New* -> *File Geodatabase*.
   i. When the window for *New File Geodatabase* pops up, confirm it is the same location as your 1-1 geodatabase

d. Rename the resulting file `CaseStudy1-2` and click *Save*.



Now, you can import shapefiles or non-shape tabular data into your GDB.

e. Right click on the GDB that you have just created in *Catalog*.

f. Navigate to *Import* -> *Feature class (single)* to import a single shapefile into your GDB. Note that you will have to specify a name for the feature class under "Output Feature Class" in the resulting window. Import the `cdfg_100k_2003_6` shapefile into your new geodatabase `CaseStudy1-2`, and name it `CaliforniaRivers`.

3. Confirming Projection Information

Confirm all of your projections for each layer. If you have any projections that are *not* in the same projection as MercedCountyCAT, project the layer to match the Spatial Reference of MercedCountyCAT(as learned in Case Study 1-1).

Submit screenshots verifying each layer is in the same projection.

a. Right click and remove the original `CaliforniaRivers` layer you created from the *Table of Contents*. It will still be in the geodatabase, but we don't want to have it in the *Table of Contents* so we don't accidentally work on the wrong layer.

Additional Info: You can import non-spatial, tabular data by navigating to *Import -> Table* (single). There is also the option to import multiple features in the Import menu. With this option, the name of your feature class will be inherited by the file name of the input shapefile or table.

To delete items from your GDB, simply right click on the item in the catalog sidebar and click *Delete*. To load items into your current project, either use the *Add Data* menu item from before (navigate to your GDB in *Folder Connection*s or drag the feature class of interest from the *Catalog* sidebar to the *Table of Contents* sidebar.

For enterprise GDBs, there are special protections called Locks that prevent users from accidentally deleting something someone else is working on. You won't have to worry about that here!

4. Setting your Default Geodatabase

When you are working with more than one geodatabase, you should ensure confirm which GDB is your default. Read here about Default Geodatabases and changing project settings (you do not have to do any of the steps on the page) [8].

a. Look at your two geodatabases in *Catalog*: Which as a little house icon?
b. Right click on your new `CaseStudy1-2` GDB and select "Make Default"

Now, every time you run a geoprocessing task, it will output the resulting dataset into your GDB for 1-2.

Submit a screenshot showing your *Catalog* Pane, including both geodatabases, all their content, and `CaseStudy1-2` geodatabase set to your *Default Geodatabase.*

Vector data operations in ArcGIS

There are several common tools (spatial operations) that most GISers find themselves using on a regular basis. This section of the lab will walk you through some of them.

5. Clip and Intersect

Intersect and *Clip* are two examples of spatial operations that reduce the scope of various input data sets. *Clip* can be thought of as a cookie cutter; We can clip a vector data set to a region defined by a polygon.

If we are only interested in the rivers and streams within Merced County, we can clip this statewide dataset to match the extent of the Merced County boundary.

a. Review the documentation for the *Clip* tool [4] and use it to clip your `CaliforniaRiversPRJ` feature class to the Merced County boundary.
b. You can search for *Clip* and other commonly used tools through the *Tools* Ribbon OR use the search bar. Make sure to select Merced County only before you run your *Clip*. You can do that simply by clicking on it once with your Select tool.
c. Save the output clipped layer as `MercedRiversClipped` to your *Default Geodatabase*

Intersect is very similar to *Clip*, however it preserves all features that intersect, including borders of layers.

d. Try intersecting Merced County and the rivers layers and look at the attributes table (right click in the *Table of Contents – Open Attribute Table*.
e. Save the output intersected layer as `MercedRiversIntersect` to your *Default Geodatabase*.

Compare and contrast the clip and intersect geoprocessing tasks and include a screenshot of either layer for submission.

Buffering Features

You are tasked with identifying the rivers that could potentially be affected groundwater contamination from the sites that had any observations of hexavalent chromium (CR6) for your production quality map the public will be viewing. Your colleague suggested that you start by identifying all regions that lie within 10 meters of potentially contaminated wells. ArcGIS Pro allows you to compute regions of a specified width around a vector feature, with the *Buffer* tool (within the *Analysis* toolbox).

a. Please review the documentation for buffer analysis [5] and the *Buffer* tool [6] and compute a 10 and 40 -meter buffer around the CR6 well locations that you isolated earlier with *Join*.

b. Take a screenshot for submission and be sure to zoom in on a group of wells, so that the buffers are visually apparent. (You must take two screenshots here - one for 10m, one for 40m)

6. Dissolve shapes

In the south-west cluster of well locations, notice how some of the buffers overlap? What if you wanted to merge the buffers together to create one shape? Well, you can do so using the *Dissolve* tool, plus a couple of criteria.

Please take a moment to familiarize yourself with the different input parameters for the *Dissolve* tool in the Esri documentation [7].

a. Merge all of the 10 and 40-meter buffers from the previous step and create TWO separate screenshots for submission (dissolved 10-m buffers and dissolved 40-m buffers).

The key parameter is found under “field_mappings”. Here, we can specify which parameter to dissolve in (with respect to attributes). By selecting “FIRST”, the dissolved polygon will inherit the attributes of whichever polygon appeared first in the attribute list.

7. Main Exercise

Using your new-found knowledge of *buffer* and *clip*, produce a production quality map that shows all monitoring wells within 1 km of a Merced river or stream . Make sure that the river layer is also visible. Export a production quality map of your data and briefly describe the steps you took to produce it. Additional guidance below.

Your output map MUST include 3 geospatial layers: contaminated monitoring wells w/in 1km of a Merced County River, the clipped (or intersected) rivers layer, and the Merced County boundaries.

Your production quality map must include the following “key map elements”: Title, Legend, Scale Bar, North Arrow, Your name/date. When you think about the aesthetics and design (cartography), think about what the public would benefit from seeing – how the colors communicate the message, your word/title choice, etc.

FIRST, answer in written format for submission: What does production quality mean to you?

Then, create your production quality map with the above criteria. Note: this is just the first of many production quality maps you will make in this course. By the end of the session, your cartography skills will improve dramatically as you develop your personal style. You will receive full points for including the appropriate content as instructed, not for aesthetics. That will come later =)

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Deliverables:

- A screenshot showing your Catalog Pane, including both geodatabases, all their content, and CaseStudy1-2 geodatabase set to your Default Geodatabase
- Compare and contrast the clip and intersect geoprocessing tasks and include a screenshot of either layer for submission.
- Screenshot of buffered 10m wells
- Screenshot of buffered 40m wells
- Screenshot of dissolved 10m buffers
- Screenshot of dissolved 40m buffers
- Your understanding of what production quality means
- Your production quality map with 3 geospatial layers and 5 key map elements

Supplemental information:

Presenting spatial data with ArcGIS (recap)

Layer symbology
By default, the symbol used by ArcGIS Pro may be small and hard to read. Right click on the well locations layer. Under *Symbology*, change the markers for all well locations to a larger, more visible symbol. There are a handful of ways to change symbology. You can also double click on the symbol in the Table of Contents.

Labeling map features
Right click your Well layer again. You have the option to add labels to different features in your workspace. *Labeling Properties* lets you add a unique label for each well location that corresponds to the well name. Experiment with different formatting options (go to the Symbol tab). You can also use the *Feature Layer -> Labeling* area in the toolbar ribbon.

ArcGIS Pro Layout view (save to PDF)
Layout view in ArcGIS Pro allows you to prepare your map for a final presentation. This can include adding features such as a compass rose, a scale bar, and/or a legend. FIRST! Make sure your Map you've been working on is zoomed to the extent and symbology you'd like to show on your final map.

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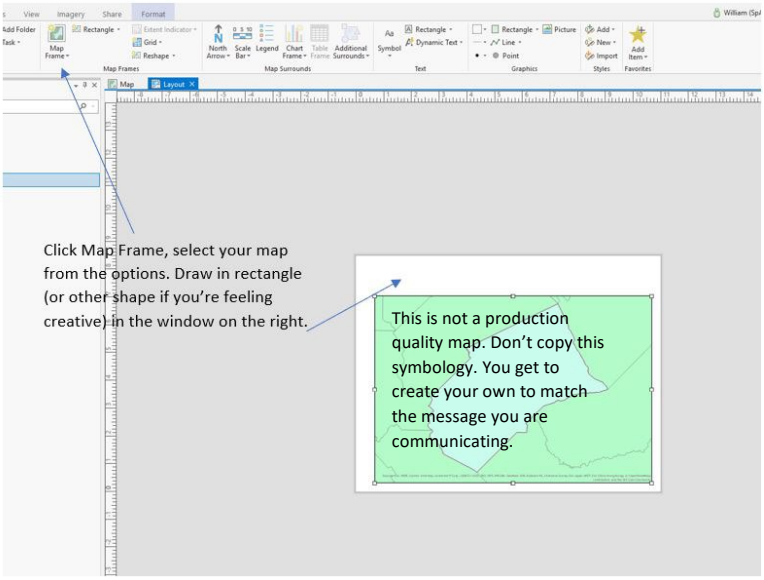

Next, to access the layout view, navigate to *Insert* -> *New Layout*, under the main toolbar ribbon. Choose your paper size (letter landscape works well for the shape of Merced County). In your new *Layout* window, use the_ Map Frame_ drop down to select your map extent, then draw in the shape you'd like you map to be (TA drew this rectangle below).

In *Layout View*, you can add visual figures under the *Insert* menu.

References

[1] CalFish, CDFG, and PSMFC. "1:100k Hydrography" http://www.calfish.org/ProgramsData/ReferenceLayersHydrography/CaliforniaHydrography.aspx

[2] Esri, ArcGIS Desktop Documentation. "What is an ObjectID?" * https://desktop.arcgis.com/en/arcmap/10.3/manage-data/using-sql-with-gdbs/object-id.htm

[3] Esri, ArcGIS Desktop Documentation. "A comparison of geodatabase types" https://desktop.arcgis.com/en/arcmap/latest/manage-data/geodatabases/a-comparison-of-geodatabase-types.htm

[4] Esri, ArcGIS Pro Documentation. "Clip" https://pro.arcgis.com/en/pro-app/help/editing/clip-features-using-another-feature.htm

[5] Esri, ArcGIS Desktop Documentation. "How Buffer (Analysis) works" https://pro.arcgis.com/en/pro-app/tool-reference/analysis/how-buffer-analysis-works.htm

[6] **E**sri, ArcGIS Pro Documentation. "Buffer" https://pro.arcgis.com/en/pro-app/tool-reference/analysis/buffer.htm

[7] Esri, ArcGIS Pro Documentation. "Dissolve" https://pro.arcgis.com/en/pro-app/tool-reference/data-management/dissolve.htm

[8] Esri, Changing Project Settings, https://pro.arcgis.com/en/pro-app/2.8/help/projects/change-a-project-s-settings.htm