



# Exercise 3

## Joining and Relating Tables

### Introduction

In this exercise you will learn how to apply tabular and spatial joins and relate tables.

Upon completion of the exercise, the student will be able to:

- Perform a table join and a spatial join.
- Join attributes from multiple tables of interest.
- Execute a Relate between two tables.
- Test the validity of a relate procedure.
- Gather information from related tables.

### Overview of major concepts:

1. Spatial Join
2. Join Attributes from Multiple Tables
3. Relating Tables
4. Testing the Relate
5. Analyzing the Relate

### Assumptions:

- A basic knowledge of working in ArcGIS
- A basic knowledge of working in Windows
- The data for the course was downloaded and unzipped
- You know the location of the Data folder—pathnames in the exercise start with the Data folder.



## Contents

Introduction .....	1
Required Data & Exercise Assumptions:.....	<b>Error! Bookmark not defined.</b>
<b>Step 1: Spatial Join .....</b>	<b>2</b>
I. Start ArcMap .....	3
II. Perform a Spatial Join .....	3
III. Perform another Spatial Join.....	5
<b>Step 2: Join Attributes from Multiple Tables.....</b>	<b>7</b>
I. Join features based on matching values in key fields stored as separate tables .....	7
II. Set Symbology in Layer Properties .....	8
III. Apply Labels in Layer Properties .....	9
IV. Identify data using the 'Query Builder' .....	10
V. Save and Close .....	11
<b>Step 3: Relating Tables.....</b>	<b>12</b>
I. Open Map .....	12
II. Execute a Relate.....	12
<b>Step 4: Testing the Relate .....</b>	<b>14</b>
I. Select attributes to relate .....	14
II. Perform and examine the relate.....	15
III. Close out.....	19
<b>Step 5: Analyzing the Relate .....</b>	<b>19</b>
I. Select watersheds .....	19
II. Confirm the date range by sorting on the Fire Year Field.....	21

## Part 1: Spatial Join


In ArcGIS, joining attributes involves appending attributes from one layer into the attributes of another layer. ArcMap provides two methods for joining attributes: a table join and a spatial join. In this step you will conduct two spatial joins. First, you will join the attributes from a layer representing 5th-field watersheds to attributes stored in a Fire History layer. The output of the join is a new layer whose attributes contain both fire history and watershed information.

A spatial join tests the spatial relationship shared between the two layers whose attributes you want to join. Depending upon the feature types involved, there are three spatial relationships in which a spatial join will work:

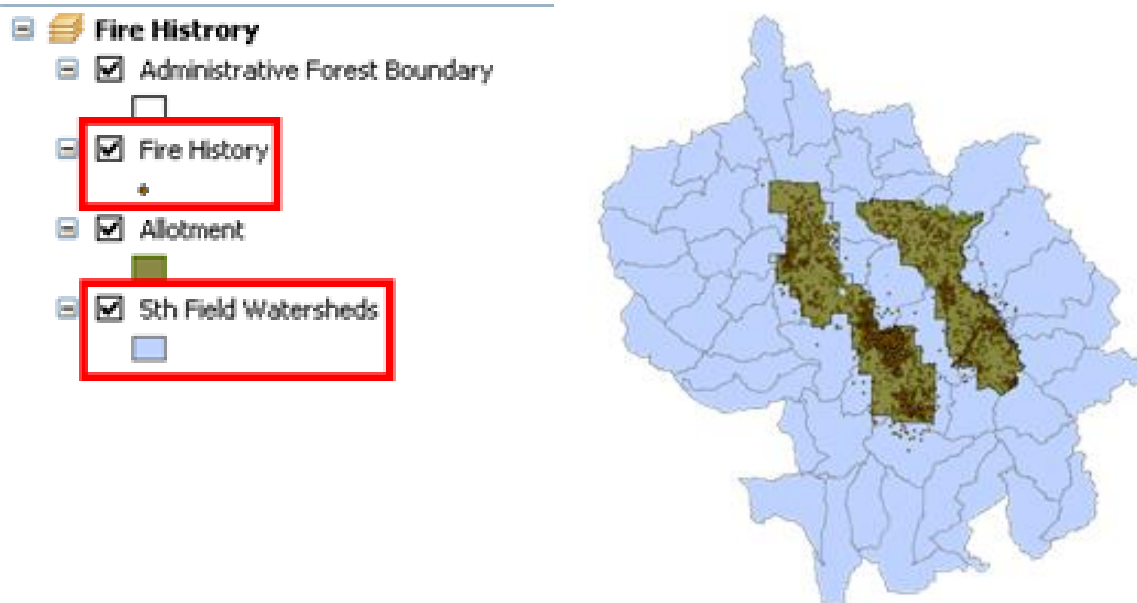
1. Join attributes of the nearest feature (e.g., points nearest to lines).

2. Join attributes of the overlapping feature (e.g., polygons overlapping polygons).
3. Join attributes of the intersecting feature (e.g., points inside polygons).

## A. Start ArcMap

- a. Open **ArcMap**. 
- b. Select the “**Existing Maps**” and click “**Browse for more...**”, and click **OK**.
- c. Navigate to ...\\Data.
- d. Select the **Join\_Tables.mxd** and click **Open**.


In the Data View, a map of Prescott National Forest displays. There are four layers in the map document. (**Pictured below**)



We want to join the watershed attributes to the “Fire History” layer based on the two layers’ spatial location to each other.

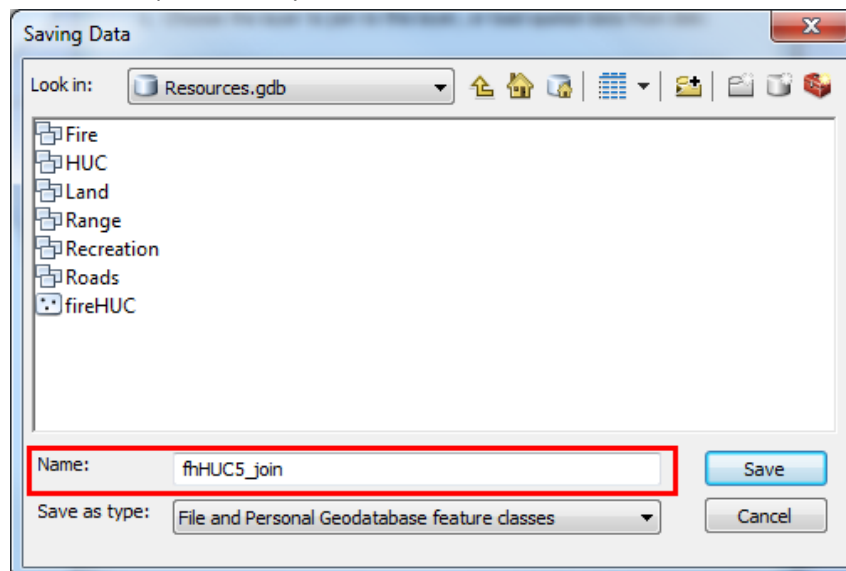
## B. Perform a Spatial Join

- a. Right-click on the **Fire History** layer > **Joins and Relates** > **Join**. (*The Join Data window opens*)

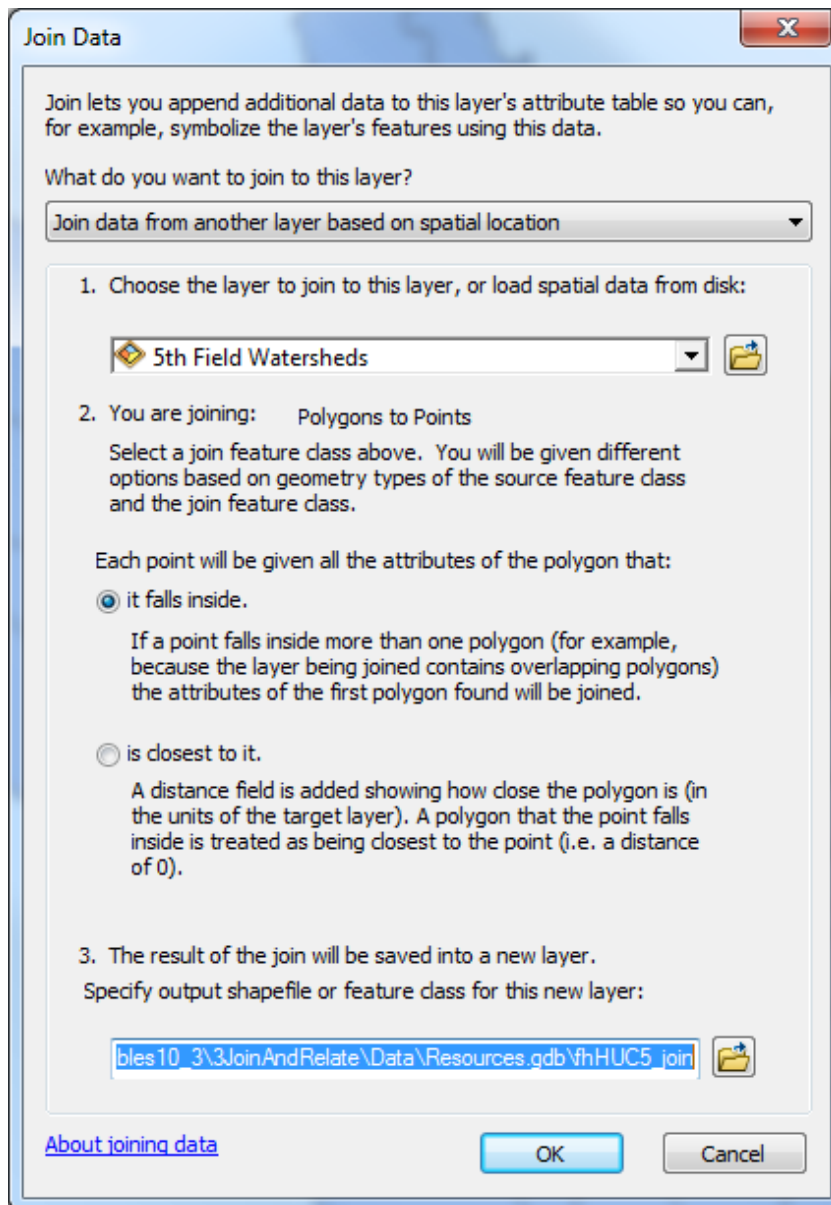
- b. In the drop-down list at the top of the Join Data window, select, **“Join data from another layer based on spatial location.”**
- c. In drop-down list **1**, click the drop-down arrow and select **5th Field Watersheds**.
- d. For section **2**, accept the default option **“it falls inside.”**
- e. In section **3**, click the Browse button and navigate to **...\Data.** 

The Spatial Join command outputs a new dataset, which requires that you specify its name and file location.

- f. In the **Save as type field**, click the drop-down arrow and select **File and Personal Geodatabase feature classes**.
- g. Double-click the **Resources.gdb**.
- h. In the **Name** field, type **fhHUC5\_join**.
- i. Click **Save**. (See below)



- j. Verify that your Join Data settings match the screen capture:



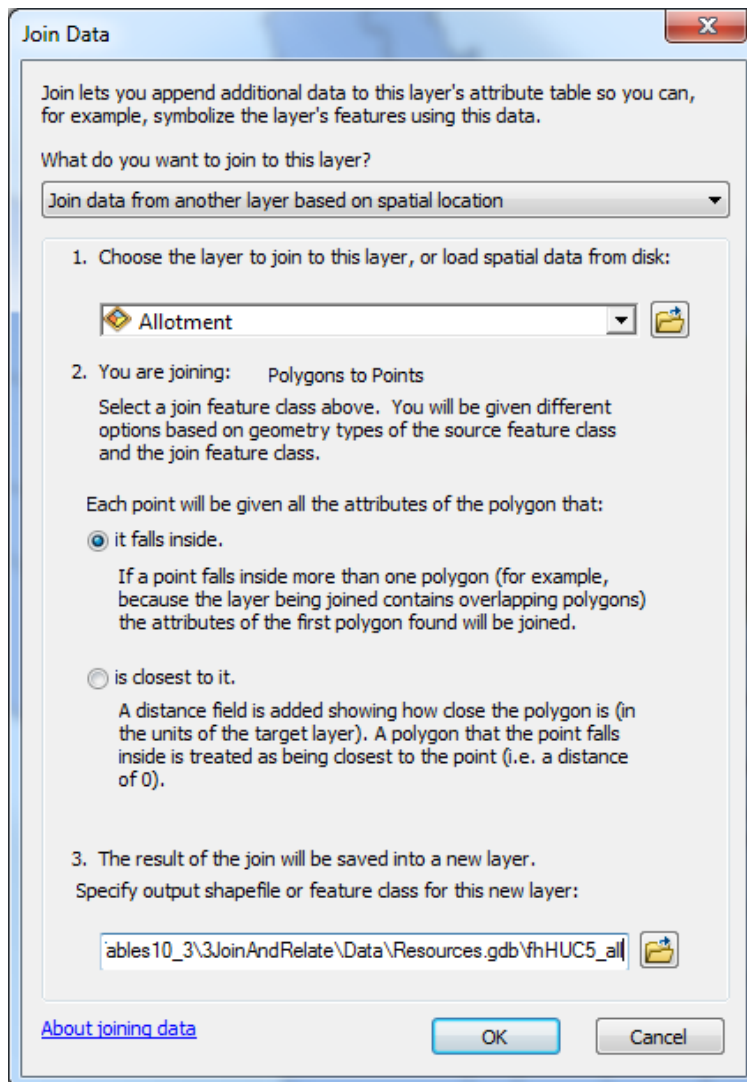
k. Click **OK**.

The progress of the Spatial Join command as it executes can be monitored in the Status bar that will appear on the screen. Once the tool is finished, a new point layer named fhHUC5\_join is added to the TOC. Take a look at its attribute table!

### C. Perform another Spatial Join

Next you will perform a second spatial join that appends allotment data to the output of the previous spatial join. The output dataset will have attribute information on fire history, watershed and allotment properties.

- Right-click the **fhHUC5\_join** layer > **Joins and Relates** > **Join**.
- Verify "**Join data from another layer based on spatial location**" is selected.
- In drop-down list **1**, click the drop-down arrow and select **Allotment**.
- For section **2**, accept the default, "**it falls inside.**"
- In section **3**, click the **Browse** button and navigate to **Resources.gdb** in the ...\\Data folder.
- Verify the Save as type field is set to **File and Personal Geodatabase feature classes**.
- For the **Name** field, enter **fhHUC5\_all** and click **Save**.



- Click **OK**.

Like before, a new layer, this time named **fhHUC5\_all**, was added to the TOC. We no longer need the original layers used in the spatial joins.

- i. Remove the **fhHUC5\_join** and the **Fire History** layers. (*Hint: Right-click on each layer > Remove.*)

The fhHUC5\_all table can now be queried and used for analysis and reporting.

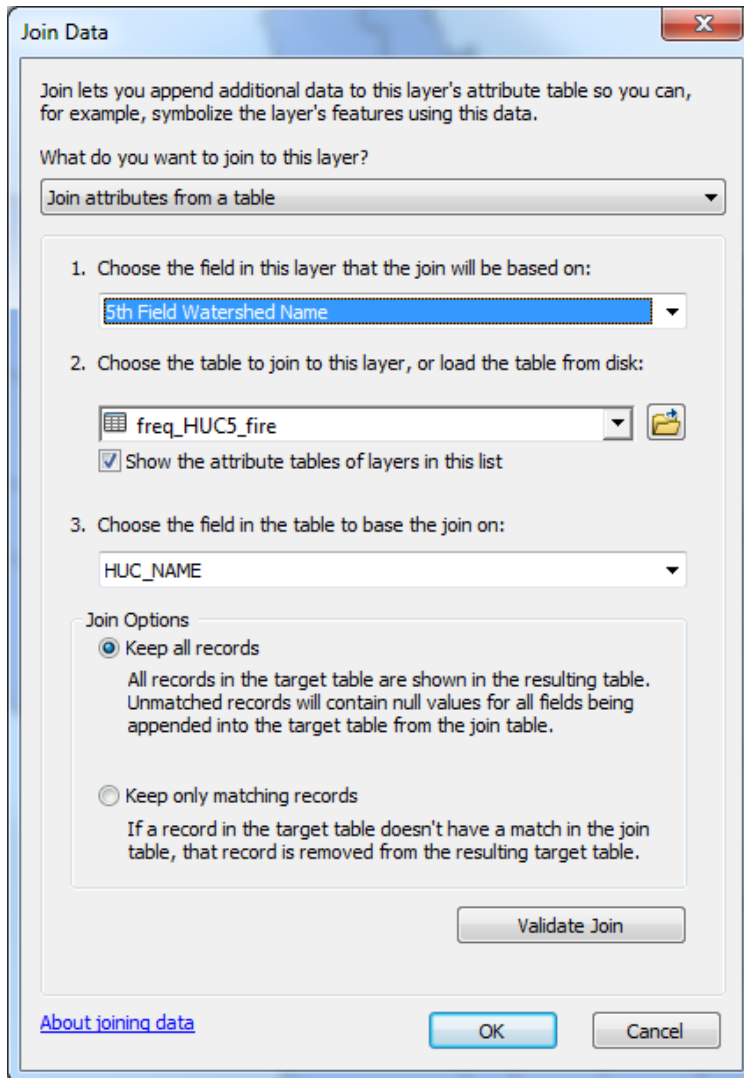
## Part 2: Join Attributes from Multiple Tables

You are tasked with analyzing and reporting those fires that took place in 2005. You have a summary table breaking down the distribution of the 2005 fires by watershed. Twelve watersheds were affected. You will join the summary table to the attribute table of the 5th Field Watersheds layer with the goal of creating a map illustrating the number of 2005 fires in each watershed.

### A. Join features based on matching values in key fields stored as separate tables

Currently, the 5th Field Watersheds layer does not contain any fire details. That information is stored separately in the summary table. A join needs to be performed.

- a. Turn off all layers except the **5th Field Watersheds** layer.
- b. Right-click the **5th Field Watersheds** layer > **Joins and Relates** > **Join**. (*The Join Data dialog window opens.*)
- c. In the drop-down list at the top of the **Join Data** window, select **“Join attributes from a table.”**
- d. From Drop-down list **1**, choose the **5th Field Watershed Name** field.
- e. Verify the table to join is the **freq\_HUC5\_fire** table. (*If not, browse to ...data\Resources.gdb and add freq\_HUC5\_fire table.*)
- f. Verify the joining field name is HUC\_NAME.
- g. Compare your Join Data window to the screen capture below:



**Join Data**

Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.

What do you want to join to this layer?

Join attributes from a table

1. Choose the field in this layer that the join will be based on:  
5th Field Watershed Name
2. Choose the table to join to this layer, or load the table from disk:  
freq\_HUC5\_fire  
☒ Show the attribute tables of layers in this list
3. Choose the field in the table to base the join on:  
HUC\_NAME

**Join Options**

☒ Keep all records  
All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.

☐ Keep only matching records  
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.

Validate Join

[About joining data](#)

OK Cancel

- Click **OK**.
- If a **"Create Index"** dialog box appears, choose **"No"**.

Nothing will appear to be different, but 5 attributes have been added to the 5th Field Watersheds attribute table including information about fires that have occurred in associated watersheds.

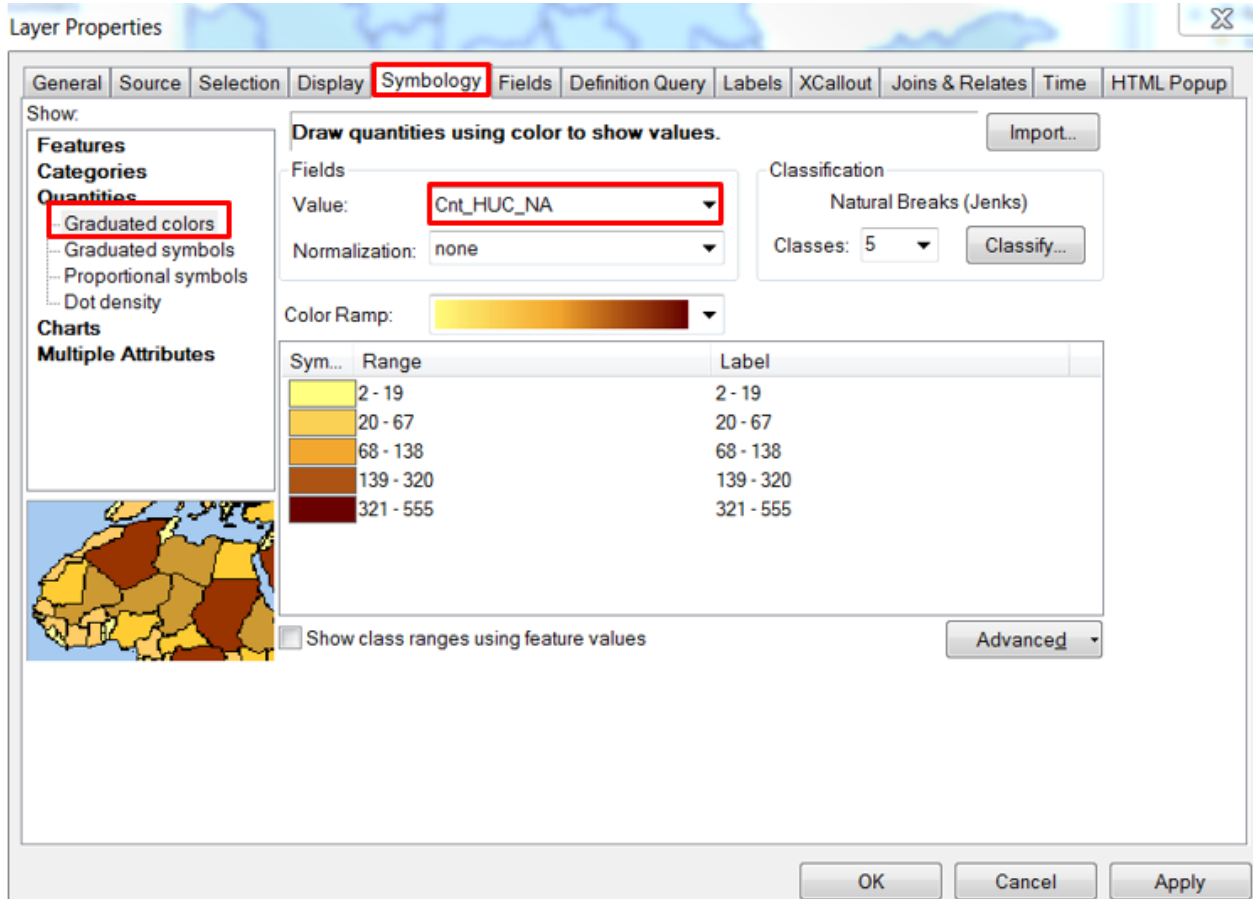
## B. Set Symbology in Layer Properties

With "fire" details joined to the layer's attribute table, we can now symbolize those watersheds affected by 2005 fires.

- Open the **properties** for the **5th Field Watersheds** layer, and activate the **Symbology** tab.



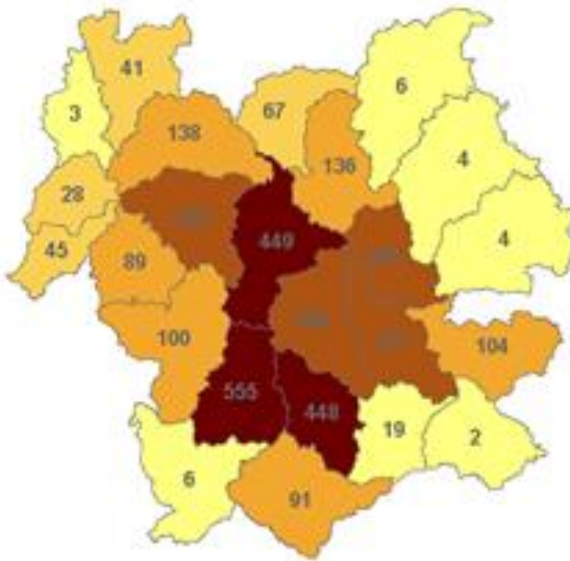
- In the **Show** column, click '**Quantities**' and verify that '**Graduated colors**' are selected.
- From the **Value Field** drop-down, choose **Cnt\_HUC\_NA**.
- Use the **default** Color Ramp:



## C. Apply Labels in Layer Properties

- Activate the **Labels** tab.
- Set the **Label Field** to **Cnt\_HUC\_NA**
- Change the following font properties:
  - TYPE** = Arial
  - SIZE** = 14 pt
  - COLOR** = Gray 50%
  - STYLE** = Bold
- Add a **checkmark** to **Label features in this layer**.
- Click **Apply**.

As illustrated in the screen capture below, the map visualizes the distribution of 2005 fires for each watershed in the Prescott NF.



## D. Identify data using the 'Query Builder'

- Activate the **Definition Query** tab.
- Click the **Query Builder** button.

The Query Builder window opens. You will build a query expression where the frequency of watershed names is greater than zero. The result of the query will be the twenty-four watersheds affected by 2005 fires.

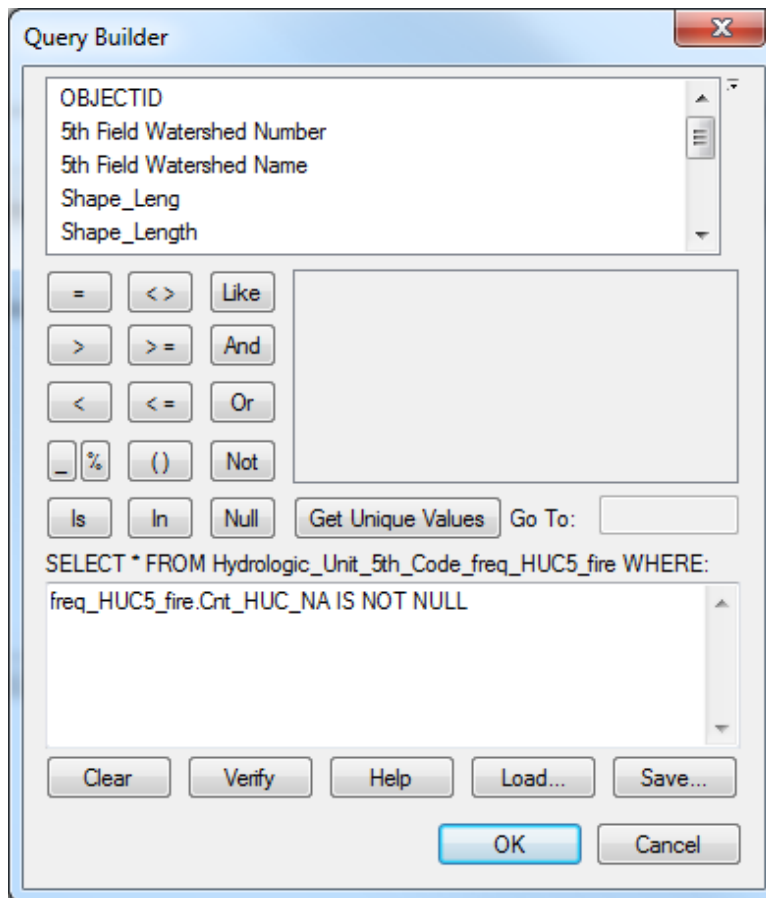
- On your own build the following expression: **Freq\_HUC5\_fire.Cnt\_HUC\_NA IS NOT NULL**

**Q:** Shouldn't we be using "not equal to" (<>)?

**A:** For querying <Null> values, you must use "IS" or "IS NOT".

***The query expression is part of the Definition Query.***

- Click the **Verify** button to see if you are using proper query syntax. If successfully verified, click **OK**. *(Otherwise, you need to correct your query expression.)*



- e. Click **OK** in Query Builder and **OK** for Layer Properties.
- f. Open the attribute table for the **5th Field Watersheds** layer.

Now, how many records make up the layer?

**0                      2                      12                      24**

**FYI:** A Definition Query only functions in the map document. The layer's total number of features and records, (53) has not changed. You can further improve the appearance of the table by turning unnecessary fields off and changing the appearance settings.

## E. Save and Close

- a. From the **File** menu > **Save As**.
- b. Navigate to ...\**Data\Workspace**.
- c. In the File name field enter **Fire\_Join\_Results.mxd**.
- d. Click **Save**.

- e. Click **File > Exit**.

## Part 3: Relating Tables

When tables are related, you can select records in one table in order to see matching records in the related table. You will use the Relate function to answer two questions.

1. Which watersheds contain the Blue Bell allotment?
2. What is the fire occurrence in the “Ash Creek and Sycamore Creek” watershed?

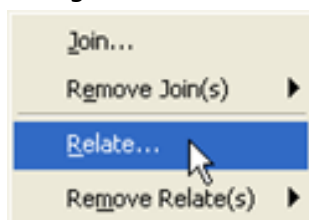
### A. Open Map

- a. Open **ArcMap** (if needed).
- b. Select the “**Existing Maps**” radio button, and double-click **Browse for more...** (If ArcMap is already open, then open a new project.)
- c. Navigate to ...\\Data.
- d. Select the **Fire\_Relate.mxd** and click **Open**.
- e. In the Data View is a map of Prescott National Forest showing four layers:
  - **Administrative Forest Boundary**
  - **FireHUC**
  - **Allotment**
  - **5th Field Watershed**

After a fire occurred in the Blue Bell allotment, a hydrologist is interested in knowing the names of the watersheds containing the Blue Bell allotment. If we relate the FireHistory\_HUC5 attributes to the 5th Field Watershed attributes, we can make a map for the hydrologist. We want to relate attributes between the FireHistory\_HUC5 and 5th Field Watersheds layers.

### B. Execute a Relate

- a. Right-click on the **5th Field Watershed** layer > **Joins and Relates** > **Relate**. (The *Relate dialog window* should open.)

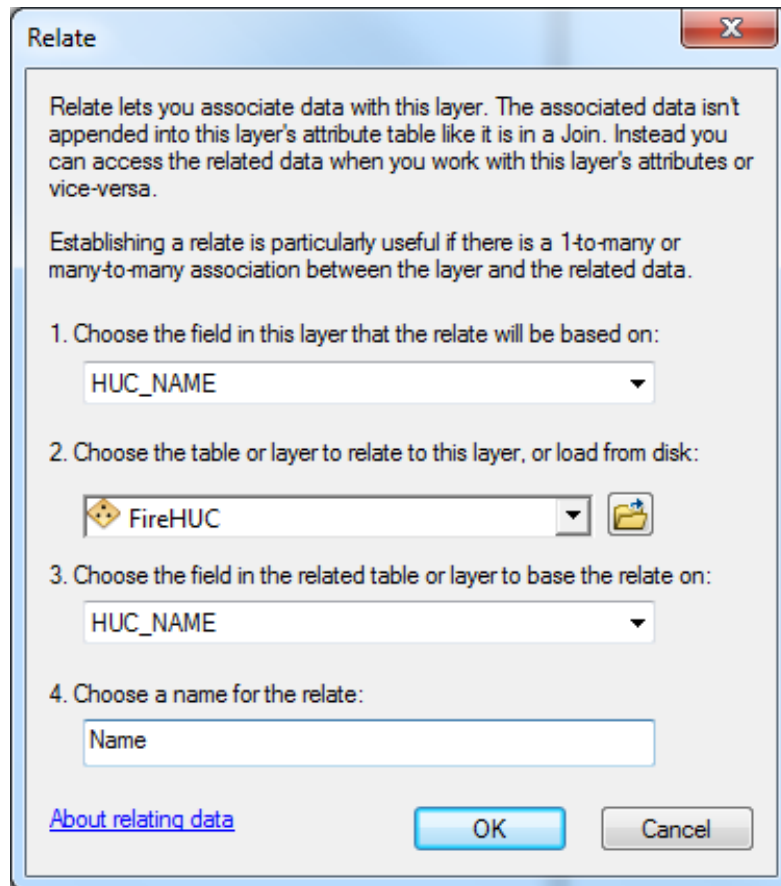


Like the Join command, the Relate command requires that you specify the key field names shared between the two tables to be related. In this example, we will use the HUC\_NAME attribute, which stores watershed names. Unlike the Join command, executing a Relate does not append associated records into a single table. After you create a Relate, you will view selected records in one table and the related records in the other table.

- b. In drop-down list **1**, select the **HUC\_NAME** field.
- c. In drop-down list **2**, select **FireHUC**.
- d. In drop-down list **3**, select **HUC\_NAME** field.

Because the map document may have multiple tables with multiple relations between them, it is a good idea to give the relationship an identifiable name.

- e. For field **4**, type **Name**.
- f. Compare your dialog window to the screen capture below:



- g. Click **OK**.

A Relate called “Name” has been established between the two tables. The Relate is saved with the map document. Let’s use the Relate to answer questions about the data.

## Part 4: Testing the Relate


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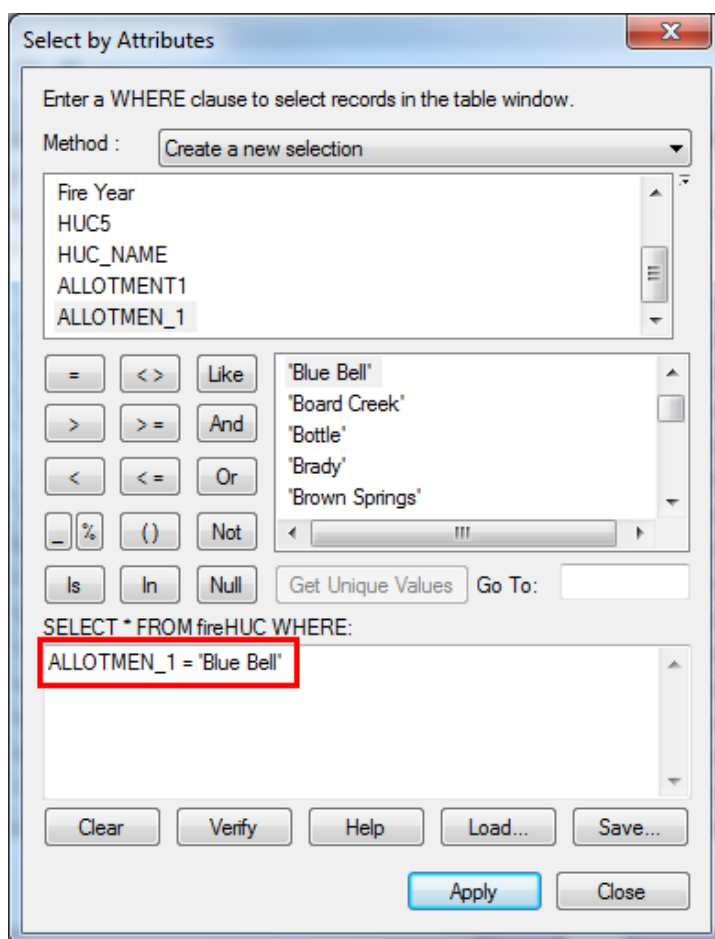
We will test the relationship by determining those watershed names containing the Blue Bell allotment.

### A. Select attributes to relate

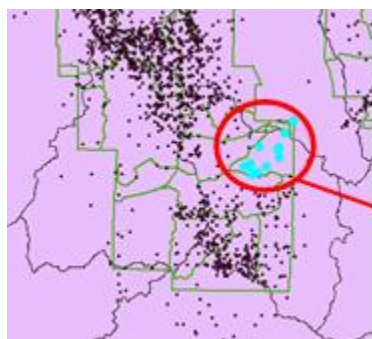
- a. Turn off the **Administrative Forest Boundary**.
- b. Open the attribute table of the **FireHUC** layer. *(Hint: Right-click on the layer’s name. If no records are showing make sure that you are showing all records—not just selected records.)*

In order to test the Relate you just created, at least one of the two related tables must be open.

- c. Click the **Table Options** button  > Select by Attributes. *(The Select by Attributes dialog window opens)*
- d. On your own build the following query expression: **ALLOTMEN\_1 = 'Blue Bell'**
- e. Click the **Verify** button to see if you are using proper query syntax. If successfully verified, click **Apply**. *(Otherwise, you need to correct your query.)*



Highlighted in a light blue, the fire locations within the Blue Bell allotment are shown in the Data View within the screen capture below.



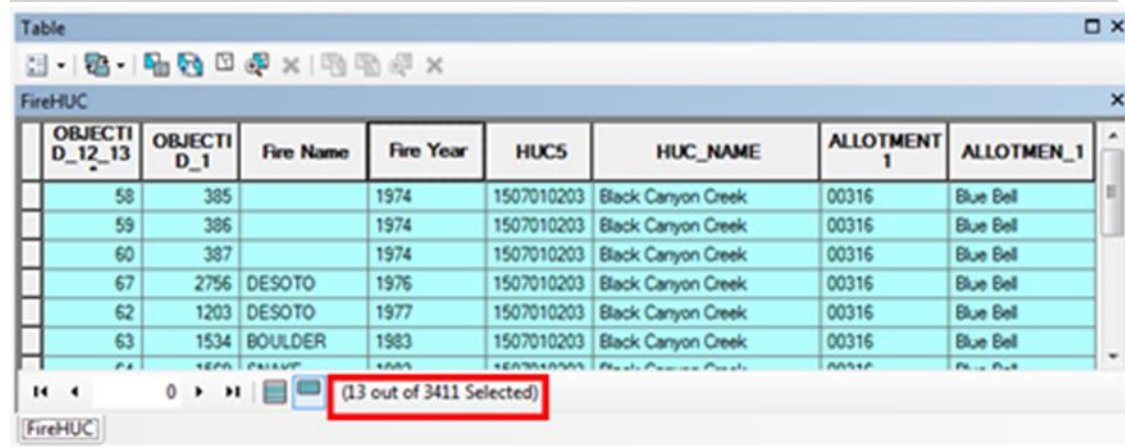
Fires within  
Blue Bell allotment

- f. Close the **Select by Attributes** window.

## B. Perform and examine the relate

- a. Direct your attention back the FireHUC attribute table:

Reported at the bottom of the attribute table, **13 records (out of 3,411)** are selected.

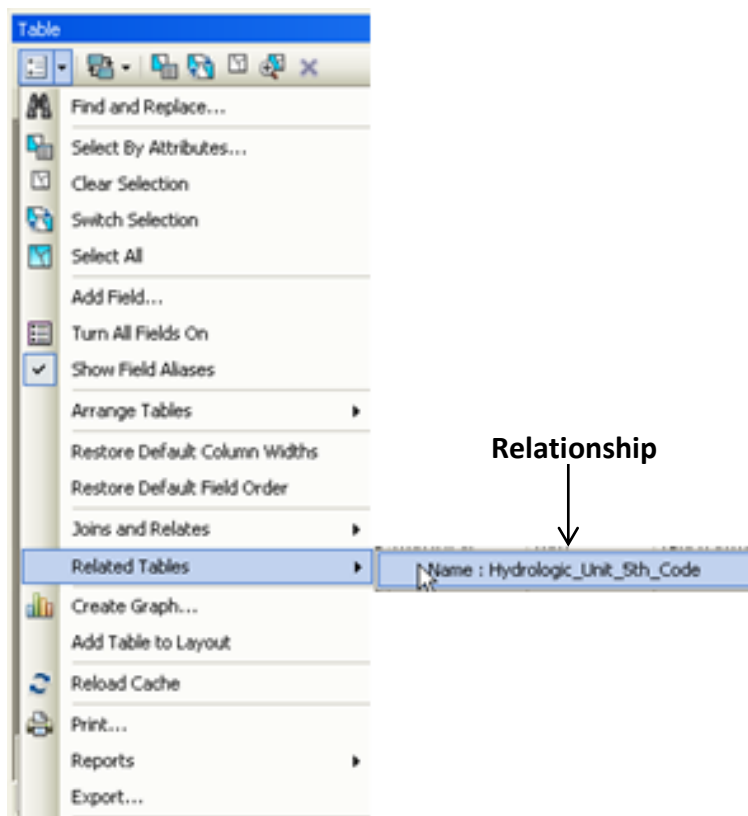


OBJECTID_12_13	OBJECTID_1	Fire Name	Fire Year	HUC5	HUC_NAME	ALLOTMENT_1	ALLOTMENT_1
58	385		1974	1507010203	Black Canyon Creek	00316	Blue Bell
59	386		1974	1507010203	Black Canyon Creek	00316	Blue Bell
60	387		1974	1507010203	Black Canyon Creek	00316	Blue Bell
67	2756	DESOTO	1976	1507010203	Black Canyon Creek	00316	Blue Bell
62	1203	DESOTO	1977	1507010203	Black Canyon Creek	00316	Blue Bell
63	1534	BOULDER	1983	1507010203	Black Canyon Creek	00316	Blue Bell

If you move the table off of the Data View, you will see 13 points selected—all within the Blue Bell allotment. Now that we know which fires occurred in the Blue Bell allotment, we can execute the “Name” Relate. In theory, the related “watersheds” table will automatically open with the associated records selected.

- b. In the attribute table, click the **Table Options** button > **Related Tables** > **Name:**  
**Hydrologic\_Unit\_5th\_Code**. (The attribute table for the 5th Field Watershed layer opens.)





How many watersheds are selected?

0      1      2      5      999

Table					
5th Field Watershed					
	OBJECTID *	Shape *	HUC5	HUC_NAME	Shape_Leng
▶	29	Polygon	1507010202	Big Bug Creek-Agua Fria River	172018.321421
	38	Polygon	1507010203	Black Canyon Creek	142028.970597

1 (2 out of 53 Selected)

FireHUC 5th Field Watershed

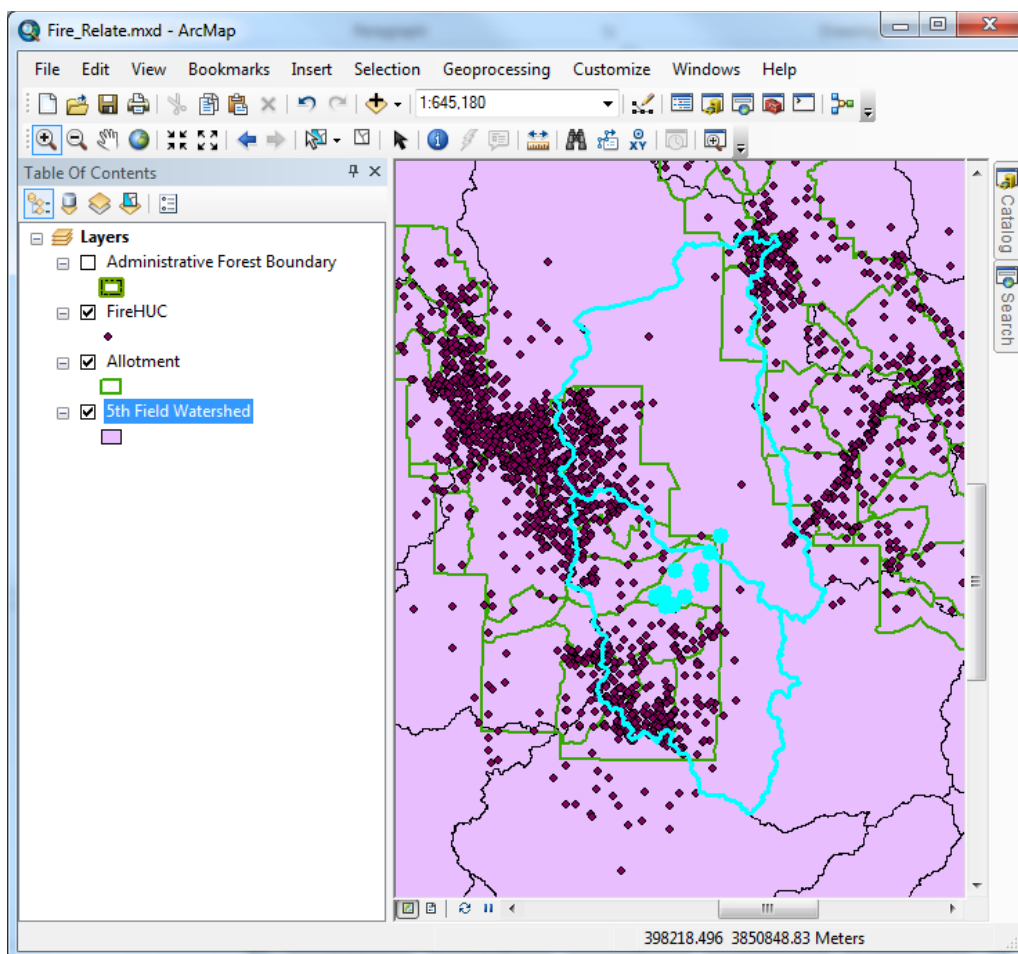
- c. In the attribute table, click the **Selected** button if not already active.  
(Denoted by the red circle in the screen shot below.)

Table					
5th Field Watershed					
OBJECTID *	Shape *	HUC5	HUC_NAME	Shape_Leng	
29	Polygon	1507010202	Big Bug Creek-Agua Fria River	172018.321421	
38	Polygon	1507010203	Black Canyon Creek	142028.970597	

1 (2 out of 53 Selected)

FireHUC 5th Field Watershed

As shown in the screen capture below, the two selected records represent those watersheds containing the Blue Bell allotment.




**Q:** What are the names of the selected watershed?

**A:** The names of the two watersheds containing the Blue Bell allotment are Big Bug Creek-Agua Fria River watershed and Black Canyon Creek watershed.

- d. You can also see the selected corresponding geographic features in the Data View.

### C. Close out

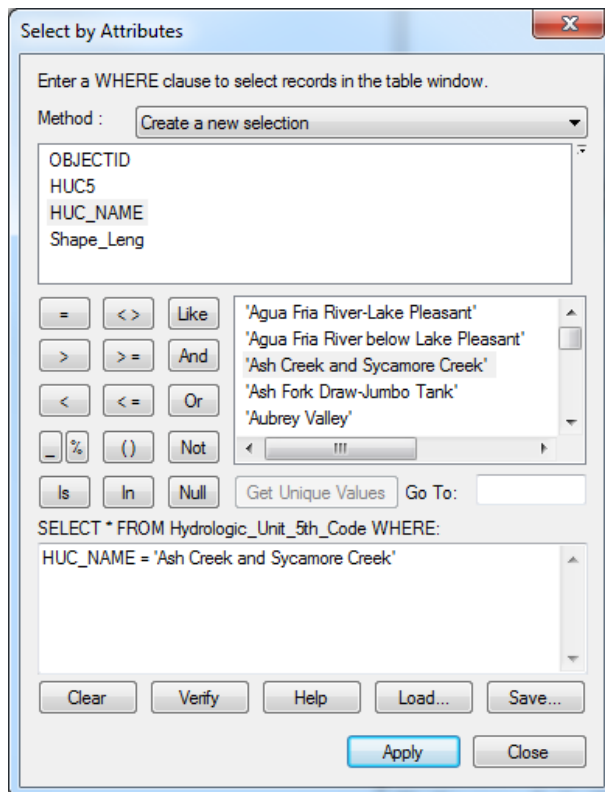
- a. Close all tables.
- b. Turn off the **Allotment** layer.
- c. Click the **Clear Selected Features** button. 

## Part 5: Analyzing the Relate

In the previous step, you executed the Relate from the “FireHUC” table. You can also execute the same Relate in the opposite direction. In this step, you will select the Ash Creek and Sycamore Creek watershed, execute the Relate, and see how many fires occurred in the watershed.

### A. Select watersheds

- a. Open the attribute table of the **5th Field Watershed** layer. (*Hint: right click on the layer's name*)
- b. Click the **Select By Attributes** button.
- c. On your own build the following query expression:
  - HUC\_NAME = 'Ash Creek and Sycamore Creek'
- d. Click the **Verify** button to see if you are using proper query syntax. If successfully verified, click **Apply**.  
(*Otherwise, you need to correct your query expression.*)



There should only be one record selected. This is the Ash Creek and Sycamore Creek watershed. Let's zoom in for a closer look.

- e. Close the **Select By Attributes** window.
- f. Right-click the **5th Field Watershed** layer > **Selection > Zoom to Selected Features**.

The Data View redraws to extent of the selected watershed. Let's find out how many fires occurred in the selected watershed.

- g. In the attribute table, click the **Related Tables** button  > **Name: fireHUC**.

By executing the Relate, the **FireHistory\_HUC5** attribute table automatically opens:

Fire Name	Fire Year	HUC5	HUC_NAME	ALLOTMENT_1	ALLOTMEN_1
CEDAR	1996	1507010201	Ash Creek and Sycamore Creek	00504	Cenega
CEMETARY	2001	1507010201	Ash Creek and Sycamore Creek	00506	Dugas
CHALK	1992	1507010201	Ash Creek and Sycamore Creek	00509	Homer Mountain
CHERRY	1994	1507010201	Ash Creek and Sycamore Creek	00504	Cenega
CIENEGA	1987	1507010201	Ash Creek and Sycamore Creek	00501	Bald Hill

How many fires burned in the Ash Creek and Sycamore Creek watershed?


0      1      2      42      277      3,411

In the Data View, those fire points within the Ash Creek and Sycamore Creek watershed are displayed in the light blue selection color.

**Q:** Why so many fires in the selected watershed?

**A:** The 277 fires that have burned in the Ash Creek and Sycamore Creek watershed span a period of 35 years.

## B. Confirm the date range by sorting on the Fire Year Field

- Close the **5th Field Watershed** attribute table. 
- In the **FireHUC** attribute table, click the **Selected** button.
- Right-click on the **Fire Year** column header > **Sort Ascending**.
- Do a **Sort Descending** on the **Fire Year** Column header.

The oldest fire occurred in what year? \_\_\_\_\_

The youngest fire? \_\_\_\_\_

- Close all attribute tables and clear selected features.
- From the **File** menu > **Save As**.
- Navigate to ...**\Data\Workspace**.
- In the **File name** field, enter **Fire\_Relate\_Results.mxd**.
- Click **Save**.



From this exercise you have learned the two methods for associating multiple tables: Join and Relate. This exercise had you learn the process involved in building and executing a Relate. Use a Relate over a Join when you want to keep attribute information separated to their respective tables. In addition, a Relate is not limited by cardinality (i.e., how separate table records relate to each other). For example, with a Join you must determine if the records to associate share a one-to-one, one-to-many, many-to-one, or many-to-many cardinality. A Join is only correct for a one-to-one or many-to-one cardinality.

**-END OF EXERCISE**

