

## Today's Agenda

- Select by attribute
- Select by location
- Manual Selection
- ArcGIS Online
- Project time



This map is a product of the Geographic Information System of The Trustees of Reservations. Source data obtained from 1:25,000 scale USGS topographic maps, field surveys, Global Positioning System (GPS), and the Massachusetts Executive Office of Environmental Affairs, MassGIS. Boundary lines and trail locations are approximate. June 2016.



# Joining tables

Destination table

US Counties					
	OBJ	Shape *	NAME	STATE_NAM	FIPS
	1	Polygon	Lake of the Woods	Minnesota	27077
	2	Polygon	Ferry	Washington	53019
	3	Polygon	Stevens	Washington	53065
	4	Polygon	Okanogan	Washington	53047
	5	Polygon	Pend Oreille	Washington	53051
	6	Polygon	Boundary	Idaho	16021
	7	Polygon	Lincoln	Montana	30053

Source table

popestmt00					
	OBJECTID *	FIPS	POP2002	POP2001	POP2000
	1	01001	45604	44698	43903
	2	01003	147932	144787	141410
	3	01005	28826	28993	29047
	4	01007	21838	21935	20869
	5	01009	52968	52143	51213
	6	01011	11367	11454	11613
	7	01013	20911	21157	21336

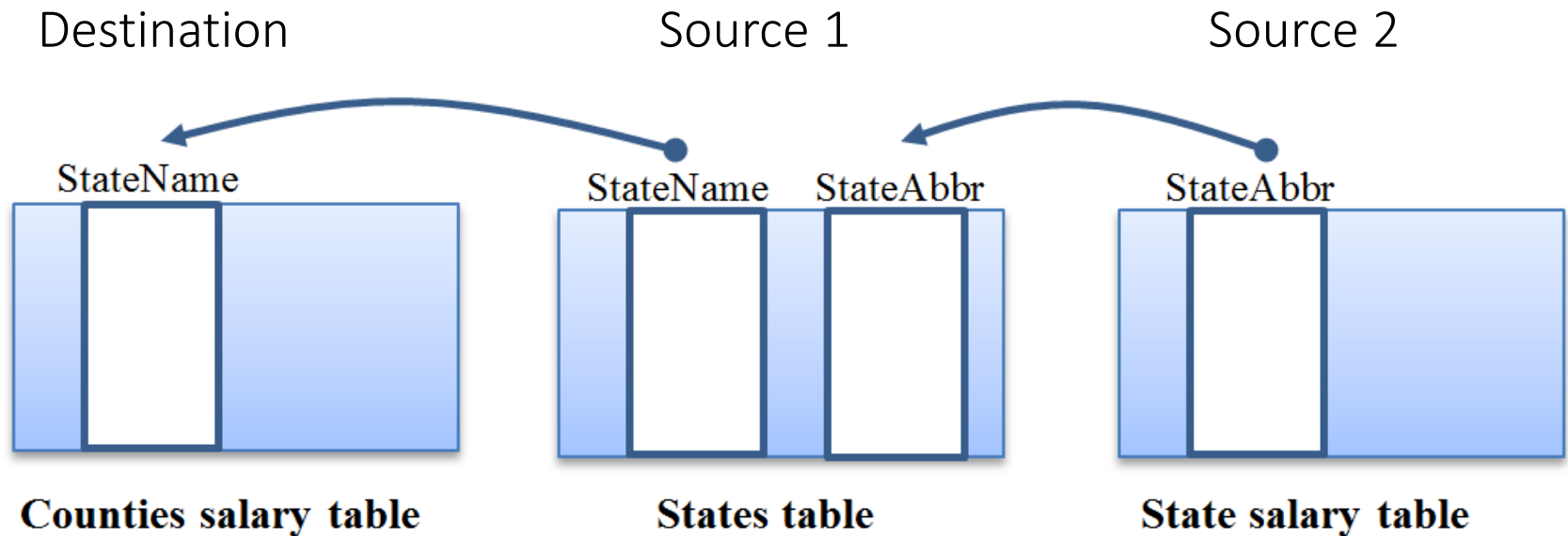
Common field

US Counties										
	OBJ	Shape *	NAME	STATE_NAM	FIPS	OBJE	FIPS	POP2002	POP2001	POP2000
	1	Polygon	Lake of the Woods	Minnesota	27077	1351	27077	4385	4460	4507
	2	Polygon	Ferry	Washington	53019	2962	53019	7268	7290	7292
	3	Polygon	Stevens	Washington	53065	2985	53065	40556	40477	40246
	4	Polygon	Okanogan	Washington	53047	2976	53047	39186	39303	39571
	5	Polygon	Pend Oreille	Washington	53051	2978	53051	12008	11861	11745
	6	Polygon	Boundary	Idaho	16021	560	16021	10085	9946	9924
	7	Polygon	Lincoln	Montana	30053	1623	30053	18691	18691	18840
	8	Polygon	Flathead	Montana	30029	1611	30029	77249	75882	74721

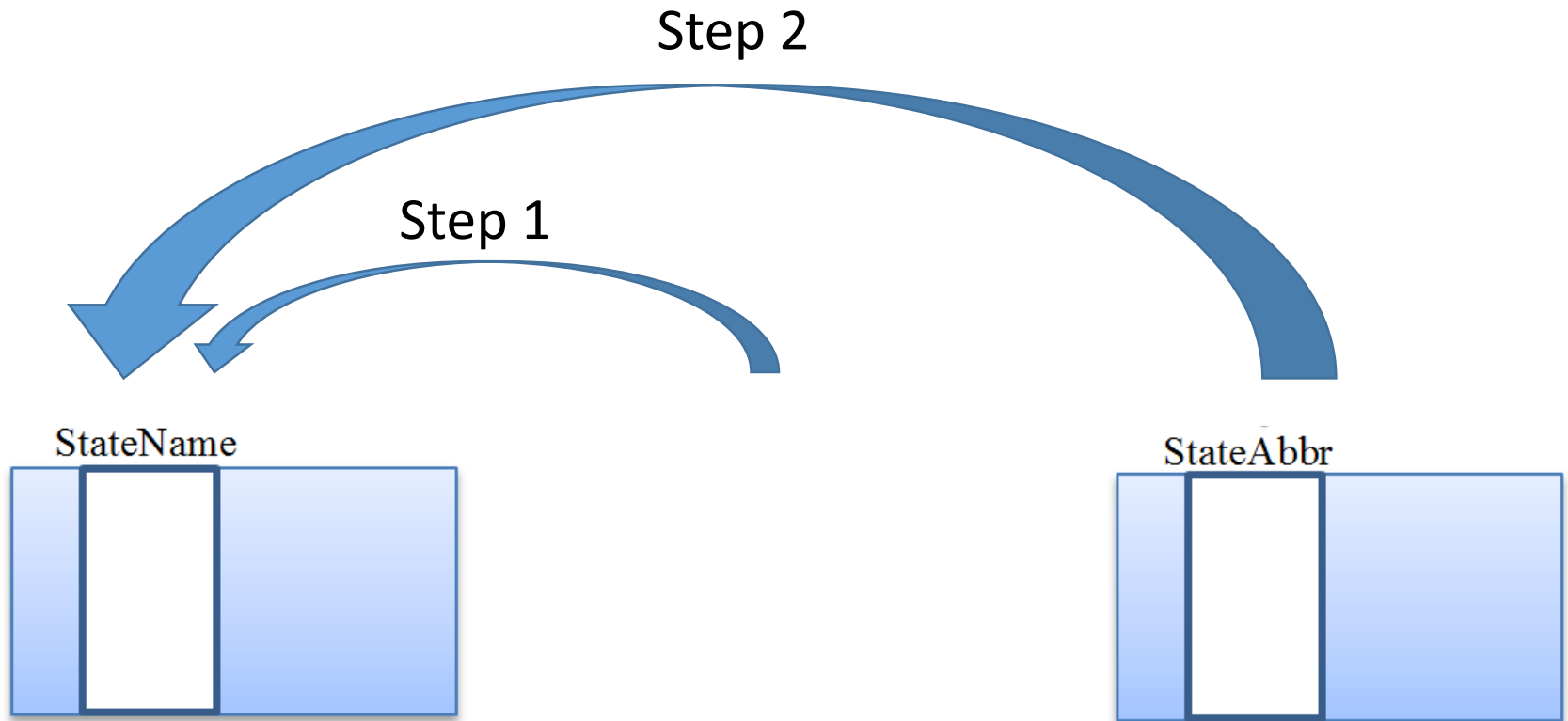
Joined table

# Multiple joins

Goal: Create one table with one field showing average salary in each county and a second field showing the average salary in the state



# Multiple joins

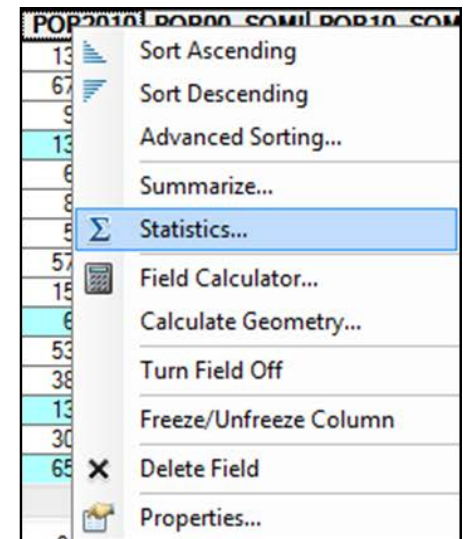
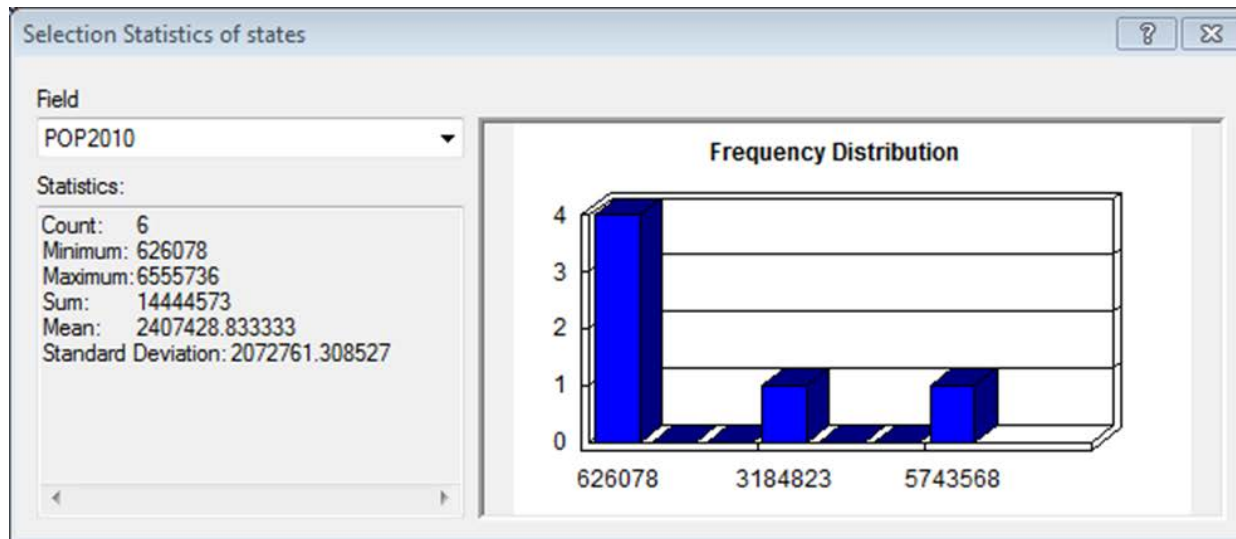


# Table statistics

Often a first step in data analysis

Simple opportunity to think critically about data

Returns statistics only for selected set



# Summarizing tables

Calculate statistics for **groups** of features in a table

Groups by unique values in the one field

Produces another table as output with groups and stats

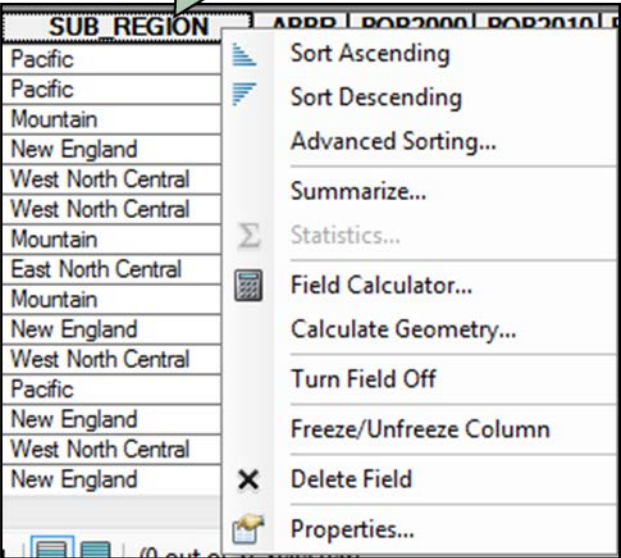
US States						
	NAME	ST	SUB_REGION	ABBR	POP2000	POP2010
	Hawaii	15	Pacific	HI	1211537	1309580
	Washington	53	Pacific	WA	5894121	6756150
	Montana	30	Mountain	MT	902195	983932
	Maine	23	New England	ME	1274923	1338645
	North Dakota	38	West North Central	ND	642200	662194
	South Dakota	46	West North Central	SD	754844	827263
	Wyoming	56	Mountain	WY	493782	548154
	Wisconsin	55	East North Central	WI	5363675	5741617
	Idaho	16	Mountain	ID	1293953	1581697
	Vermont	50	New England	VT	608827	626078
	Minnesota	27	West North Central	MN	4919479	5334772
	Oregon	41	Pacific	OR	3421399	3865839
	New Hampshire	33	New England	NH	1235786	1329915
	Iowa	19	West North Central	IA	2926324	3057995

How many people live in each subregion?

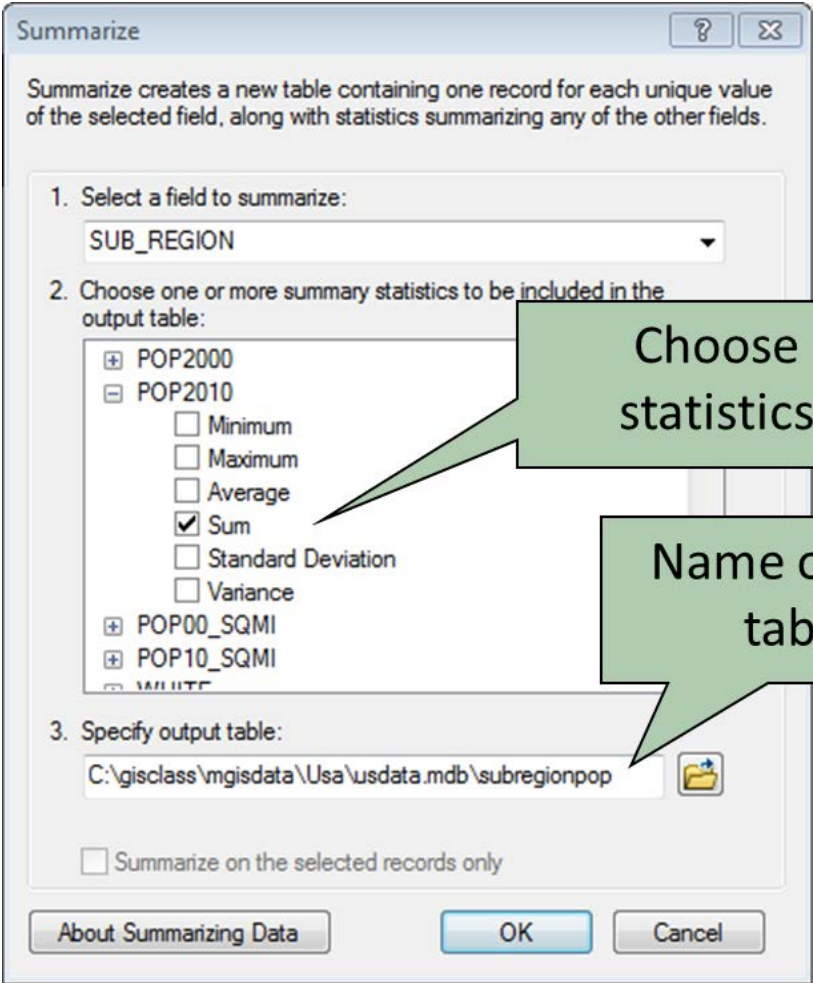
What is the total area of each subregion?

# How to summarize

Right-click  
Subregion field



Sum Pop2010  
Sum SQMI



Choose  
statistics

Name output  
table



# Summarize Output Table

subregionpop				
	OBJECTID *	SUB_REGION	Count_SUB_REGION	Sum_POP2010
▶	1	East North Central	5	47020813
	2	East South Central	4	18438179
	3	Middle Atlantic	3	40940511
	4	Mountain	8	22621196
	5	New England	6	14444573
	6	Pacific	5	50611268
	7	South Atlantic	9	60166524
	8	West North Central	7	20549764
	9	West South Central	4	36420035

Count field always generated  
automatically

# Create map

Could we now create a map of population in subregions? No, there are no features.

Standalone table

subregionpop

	OBJECTID *	SUB_REGION	Count_SUB_REGION	Sum_POP2010
▶	1	East North Central	5	47020813
	2	East South Central	4	18438179
	3	Middle Atlantic	3	40940511
	4	Mountain	8	22621196
	5	New England	6	14444573
	6	Pacific	5	50611268
	7	South Atlantic	9	60166524
	8	West North Central	7	20549764
	9	West South Central	4	36420035

# Joining the table

States layer

	OBJ	Shape *	NAME	ST	SUB_REGION
	1	Polygon	Hawaii	15	Pacific
	2	Polygon	Washington	53	Pacific
	3	Polygon	Montana	30	Mountain
	4	Polygon	Maine	23	New England
	5	Polygon	North Dakota	38	West North Central
	6	Polygon	South Dakota	46	West North Central
	7	Polygon	Wyoming	56	Mountain
	8	Polygon	Wisconsin	55	East North Central
	9	Polygon	Idaho	16	Mountain
	10	Polygon	Vermont	50	New England
	11	Polygon	Minnesota	27	West North Central
	12	Polygon	Oregon	41	Pacific
	13	Polygon	New Hampshire	33	New England

Summarized table

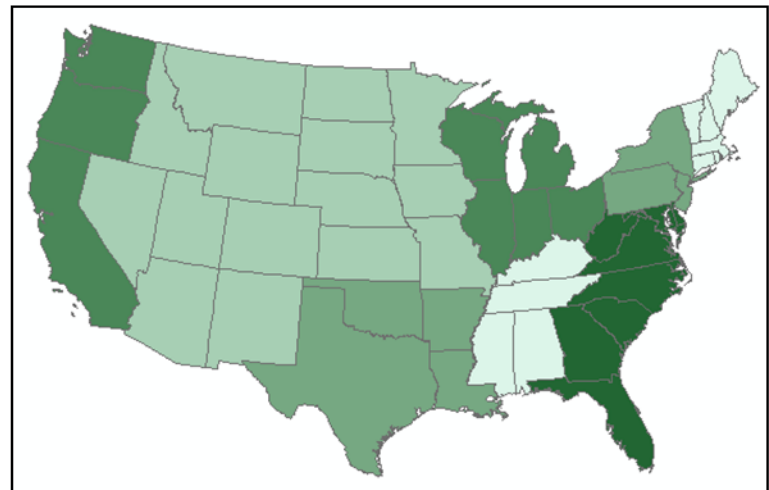
	OBJECTID *	SUB_REGION	Count SUB_REGION	Sum_POP2010
	1	East North Central	5	47020813
	2	East South Central	4	18438179
	3	Middle Atlantic	3	40940511
	4	Mountain	8	22621196
	5	New England	6	14444573
	6	Pacific	5	50611268
	7	South Atlantic	9	60166524
	8	West North Central	7	20549764
	9	West South Central	4	36420035

Fields

Value:

Normalization:

Color Ramp:



# Float precision

Large numbers start to lose precision because the number of significant digits in the mantissa is limited.

- $3.2957239e12 = 3295723900000$

A double-precision floating point allots more storage to the mantissa value

- $3.295723956249723e12 = 3295723956249.723$

# Queries



# What are queries?

Extract certain records from a map or table

Records meet certain criteria

- Aspatial queries
  - All parcels with value greater than \$100,000.
- Spatial queries
  - All parcels that lie completely within the flood plain

# Queries in ArcMap

## Interactive selection

- Choose features by pointing to them on the screen

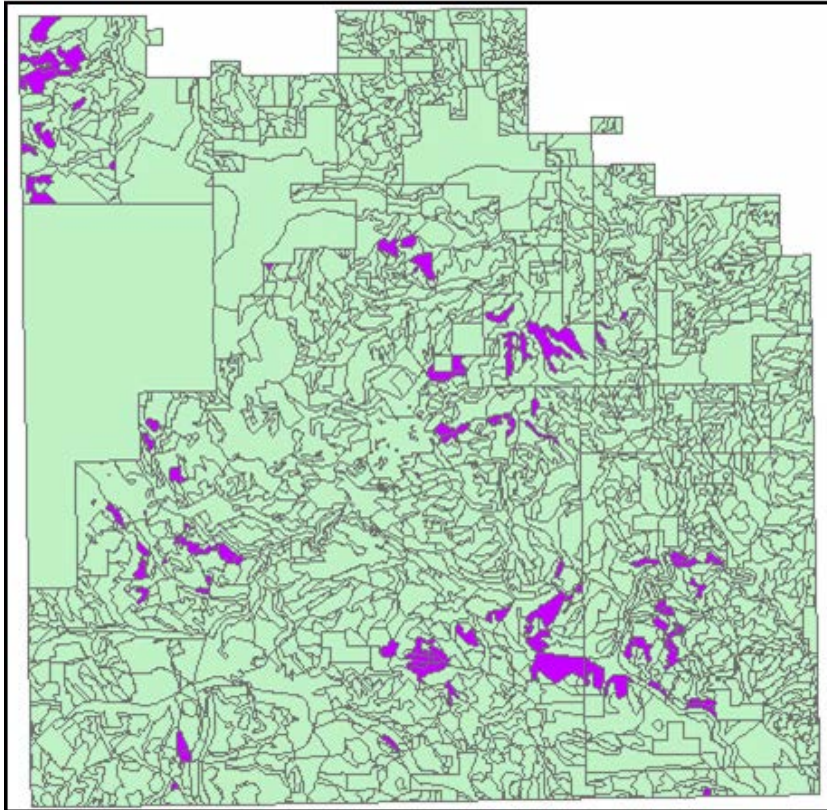
## Select By Attribute

- Select features based on attribute criteria

## Select By Location

- Select features based on their spatial relationships

# Selecting features of interest



[COV\_TYPE] = "TAA"

Selecting aspen stands from a forest vegetation layer.

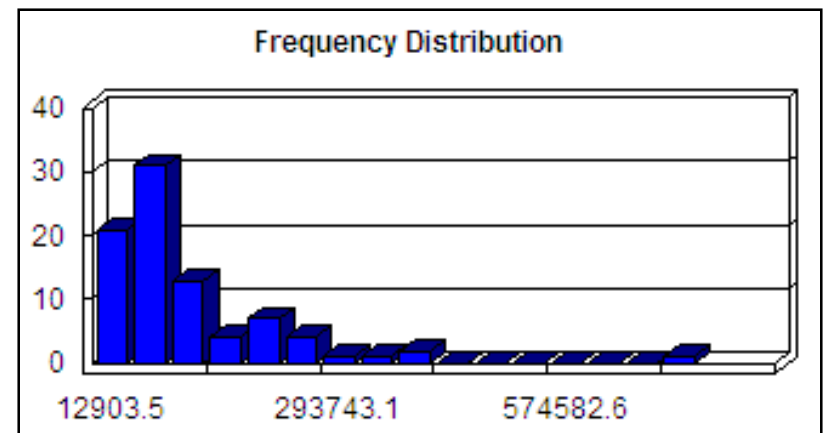
Using statistics on areas (m<sup>2</sup>)

Minimum: 12,900

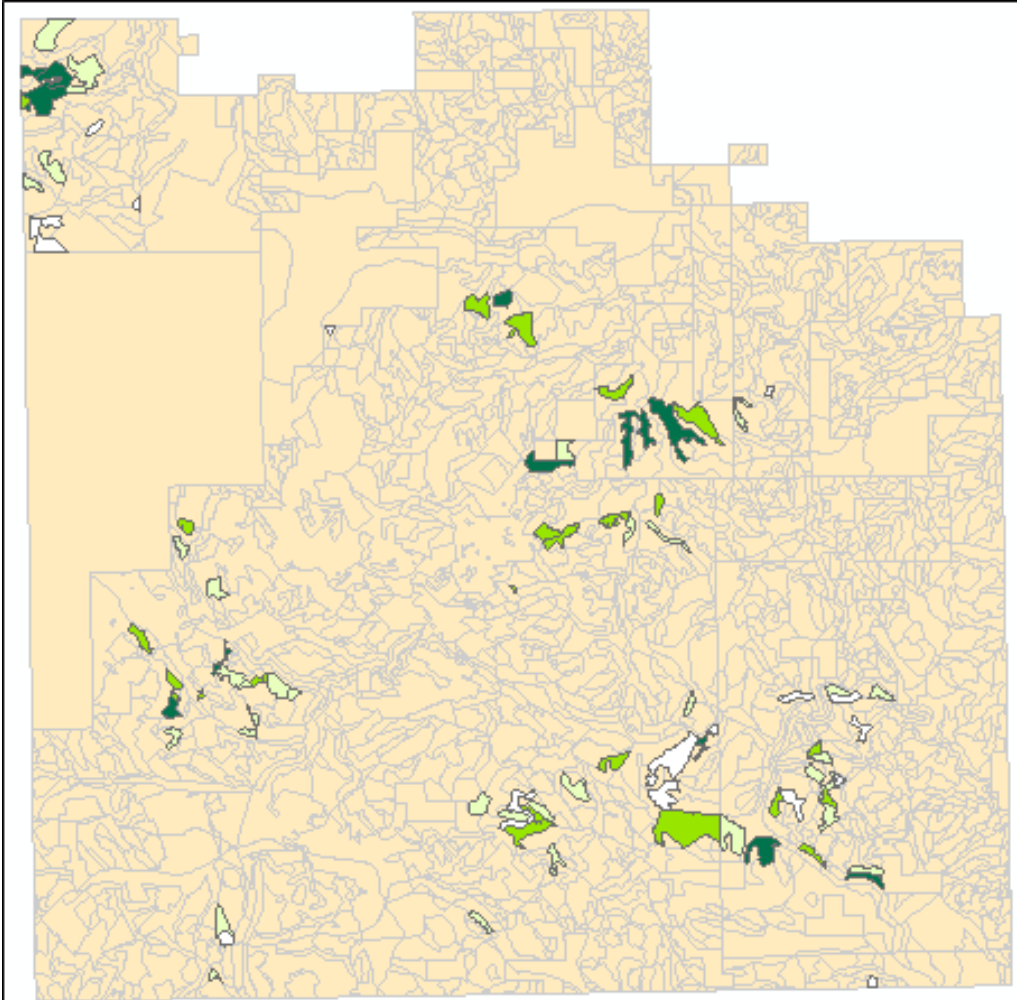
Maximum: 750,500

Sum:

10,529,000



# Exploring patterns

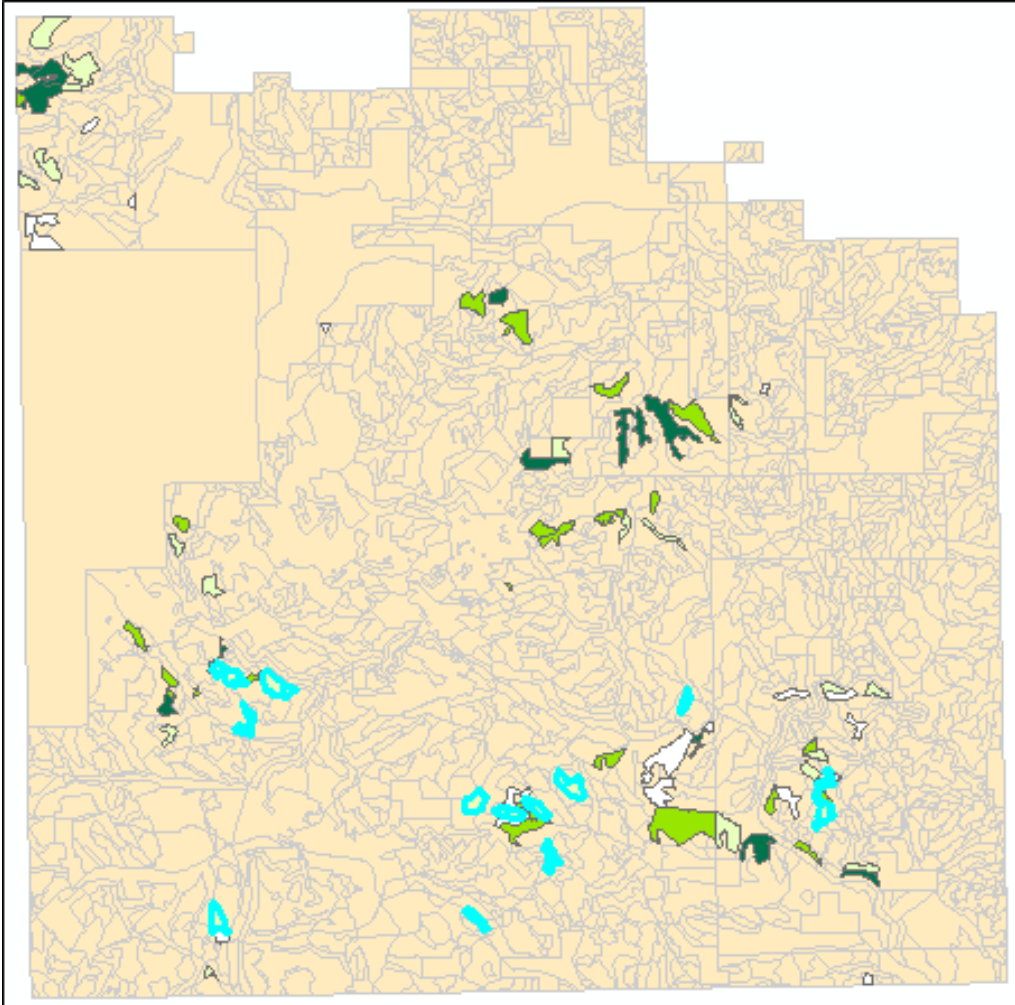


Are aspen stands randomly scattered or clustered?

Do they occur in particular portions of the forest?

What are the distributions of stand densities?

# Isolating for more analysis

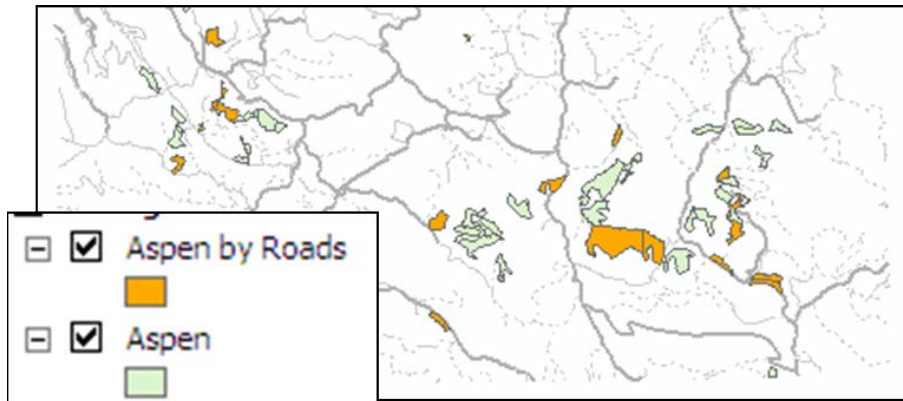


Are there any mature stands with large trees and open crowns? Where are they?

[TREE\_SZ96] = 'L' AND  
[DENSITY96] = 'A'

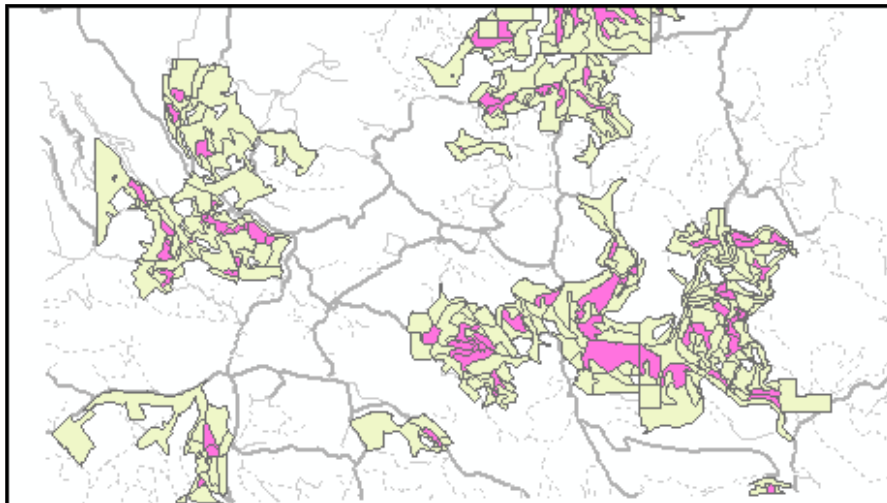


# Exploring spatial relationships



What fraction of stands are intersected by roads?

What types of trees are adjacent to aspen stands?

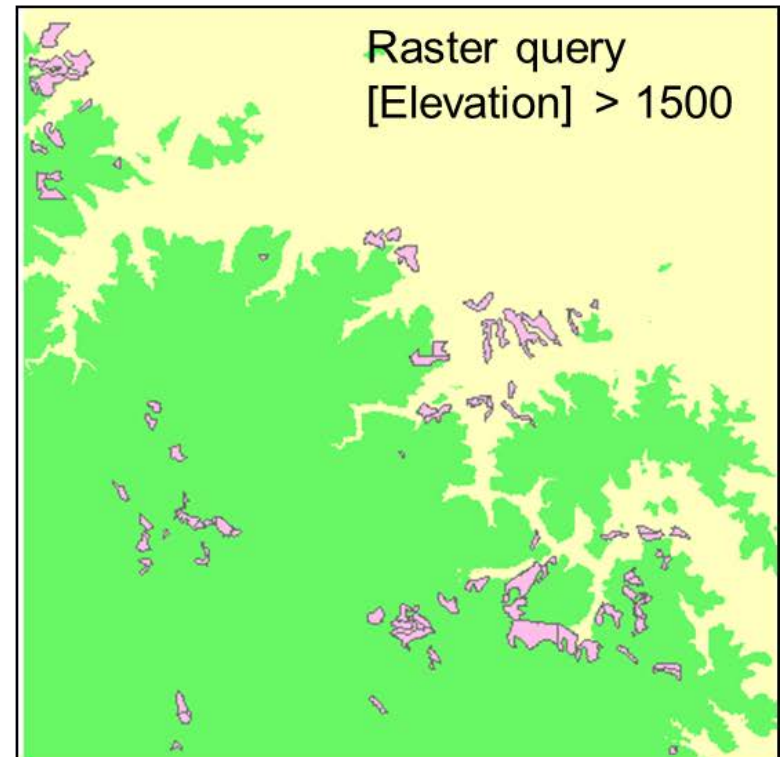
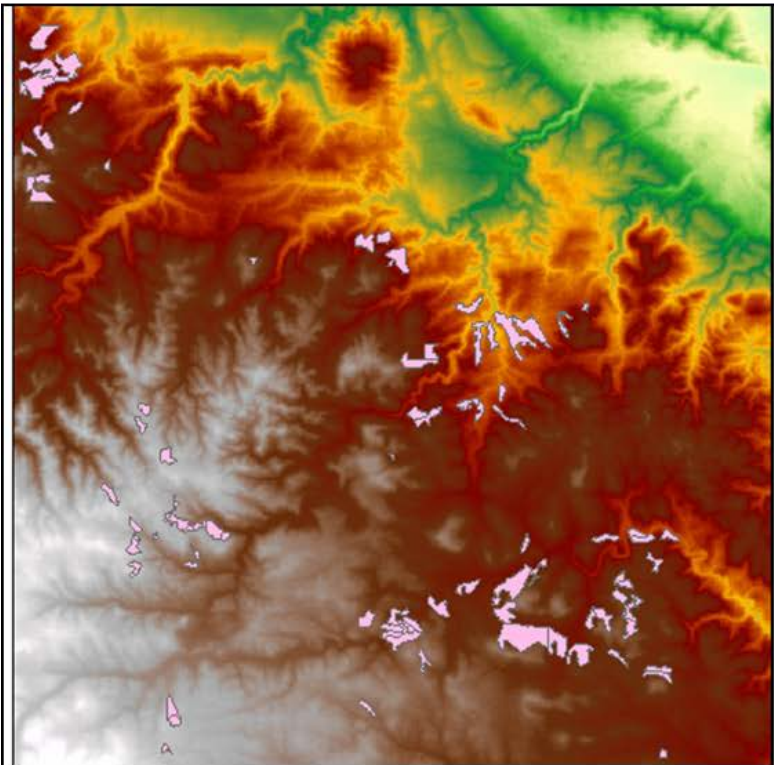


COV_TYPE	Count	Sum_Shape_1_Area
TPP	236	41075786.751212
	33	18307652.679152
TAA	85	10529137.894304
TBO	5	1296700.771798
GRA	5	500328.341753
TWS	5	326514.674681
TLP	1	35111.344044
NFL	1	23186.765917

# Queries involving surfaces

Over what range of elevations do aspen occur?

Do aspen occur above 1500m elevation?



# Attribute queries; SQL Query Examples

Select by Attributes

Enter a WHERE clause to select records in the table window.

Method : Create a new selection

[CNTY\_FIPS]  
[FIPS]  
[POP2000]  
[POP00\_SQMI]  
[POP2010]

= <> Like  
> >= And  
< <= Or  
? \* () Not

Is Get Unique Values Go To:

SELECT \* FROM counties WHERE:  
[POP2010] > 500000

Programs may have an interface to help users build SQL expressions

Clear Verify Help Load... Save...  
Apply Close

Some Valid Queries

```
SELECT *FROM cities WHERE  
"POP1990" >= 500000
```

```
SELECT *FROM counties WHERE  
"BEEFCOW_92" < "BEEFCOW_87"
```

```
SELECT *FROM parcels WHERE  
"LU-CODE" = 42 AND "VALUE" > 50000
```

```
SELECT *FROM rentals WHERE  
"RENT" > 700 AND "RENT" < 1500
```

In most databases, SQL expressions are case-sensitive "Smith" ≠ "SMITH"

# Viewing selected features

States for which POP2000 > 8 million

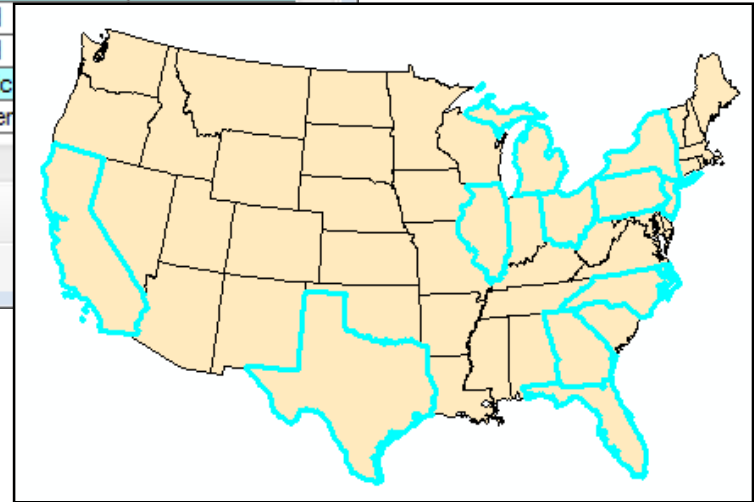
Table

States

	OBJECTID *	Shape *	STATE_NAME	STATE_FIPS	SUB_REGION	STATE_ABB
	15	Polygon	Massachusetts	25	New England	MA
	16	Polygon	Nebraska	31	West North Central	NE
	17	Polygon	New York	36	Middle Atlantic	NY
	18	Polygon	Pennsylvania	42	Middle Atlantic	PA
	19	Polygon	Connecticut	09	New England	
	20	Polygon	Rhode Island	44	New England	
	21	Polygon	New Jersey	34	Middle Atlantic	
	22	Polygon	Indiana	18	East North Central	

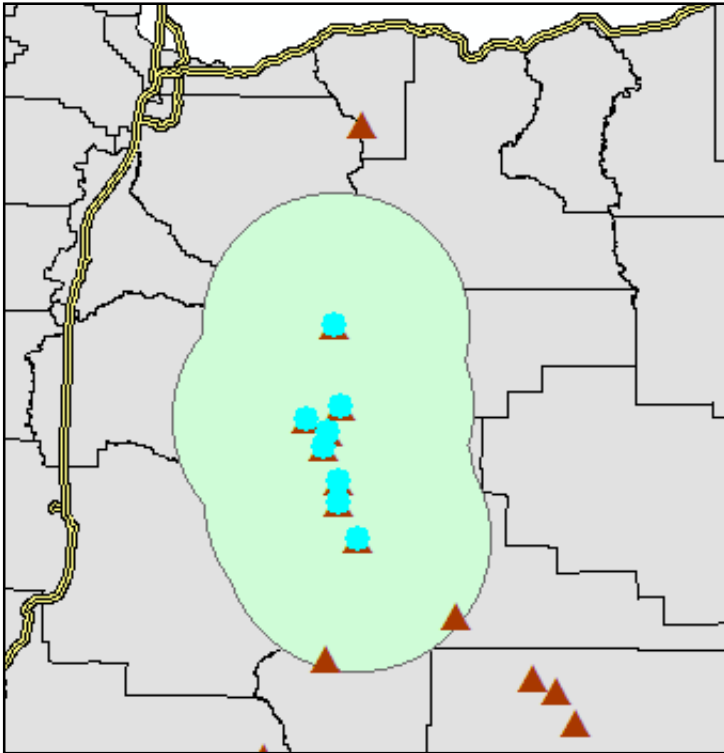
11 out of 51 Selected

States



Highlighted in table  
Highlighted in map

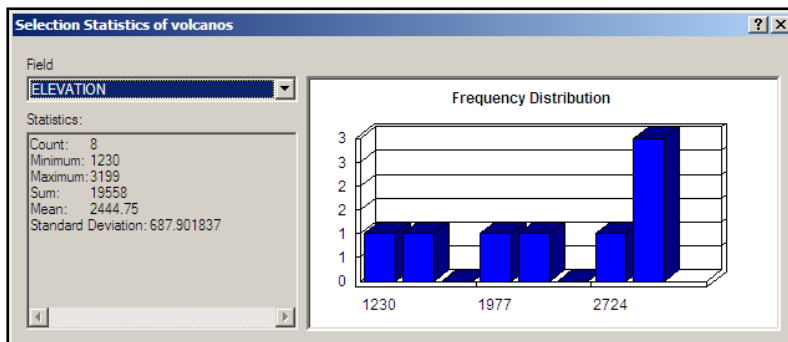
# Using Selected features



Once a layer has a query placed upon it, all subsequent operations on that layer use **ONLY** the selected features.

Volcanos selected, then buffered

Buffer uses only selected volcanoes

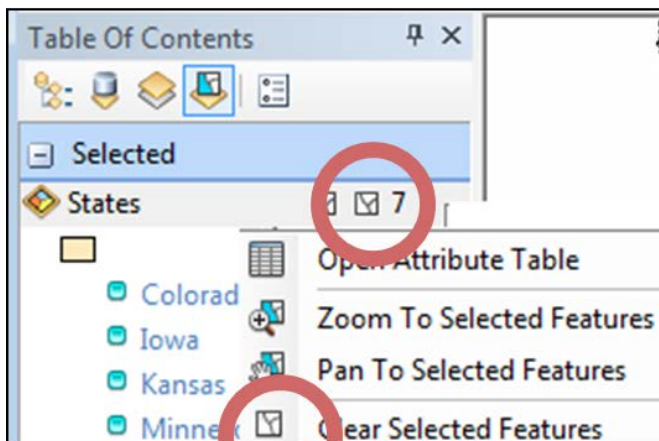
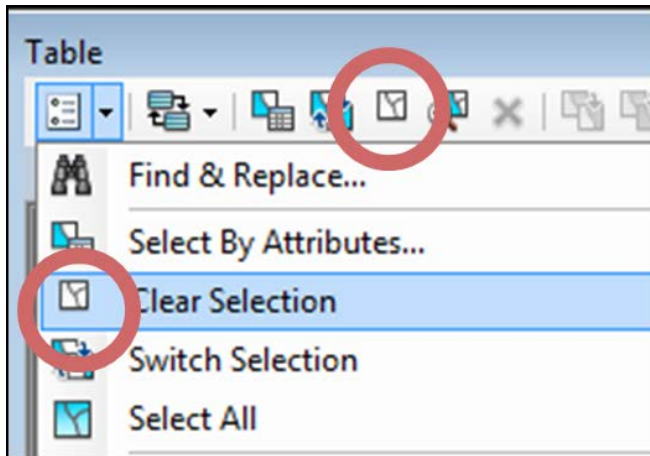


Statistics only include selected volcanoes

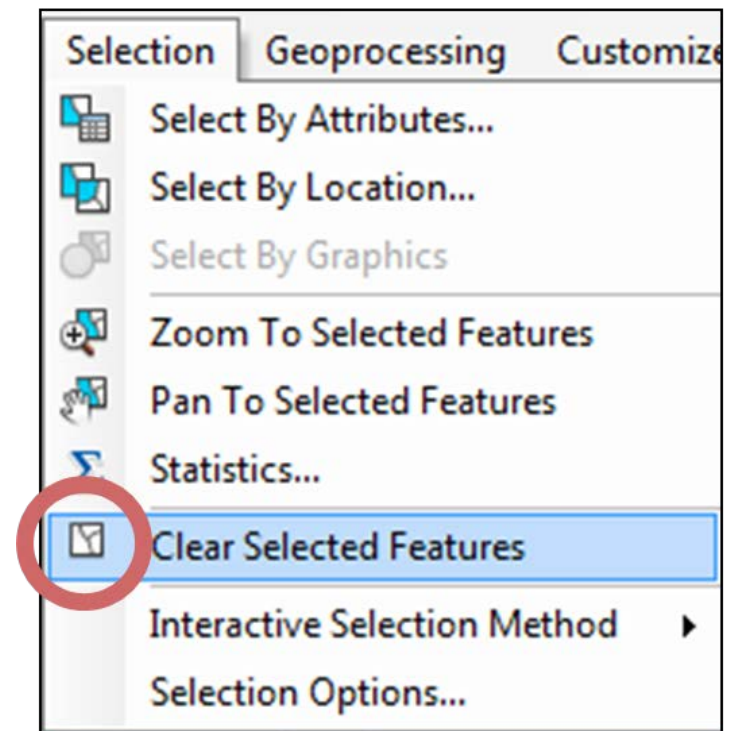


# Clear Selection

One layer/table

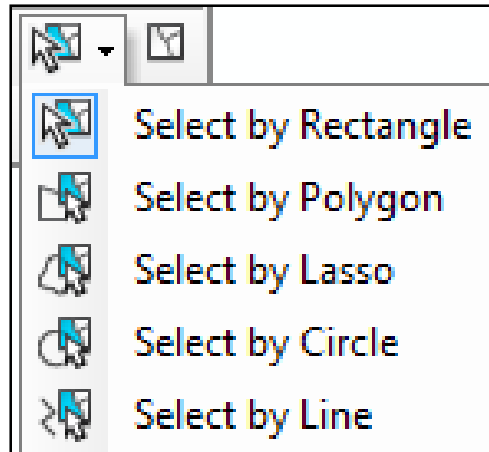


All layers/tables



# Interactive selection

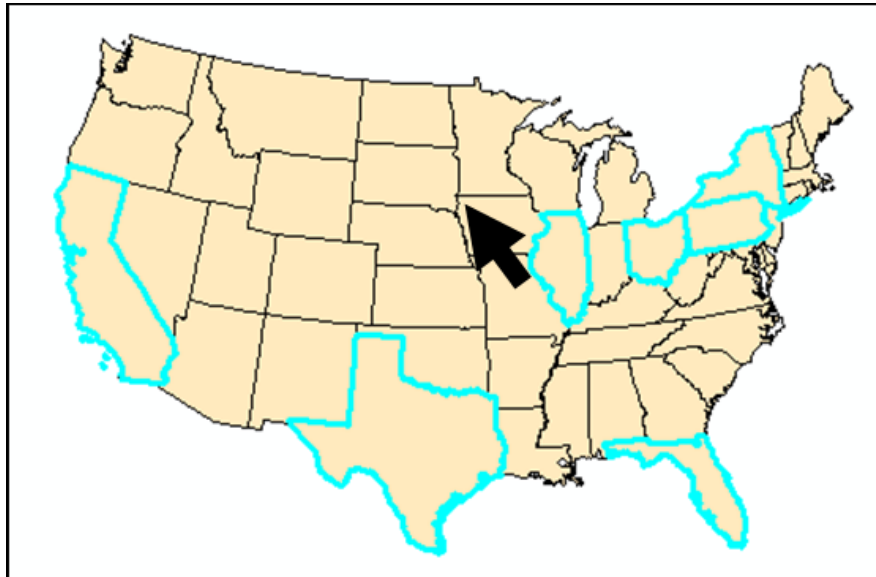
# Interactive Selection



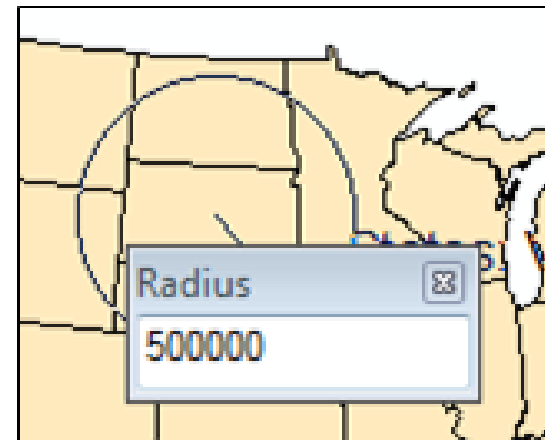
Click on feature to select

Hold down shift key to select more than one feature

Draw a rectangle that passes through features to be selected.



Draw a circle with a specified radius.

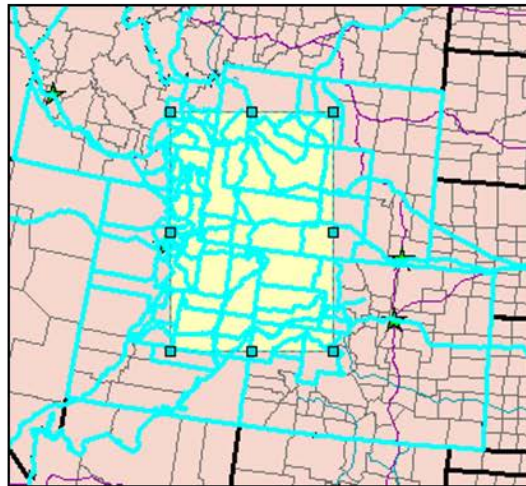


# Selectable Layers

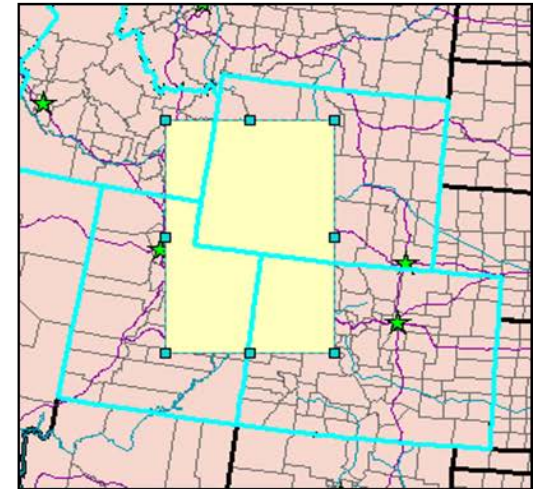
Table Of Contents

Selected		
States	<input checked="" type="checkbox"/>	1
Kansas		
Selectable (no features selected)		
Capitals	<input checked="" type="checkbox"/>	0
Interstates	<input checked="" type="checkbox"/>	0
Cities	<input checked="" type="checkbox"/>	0
Not Selectable		
Rivers	<input type="checkbox"/>	0
Counties	<input type="checkbox"/>	0

All layers selectable



States selectable

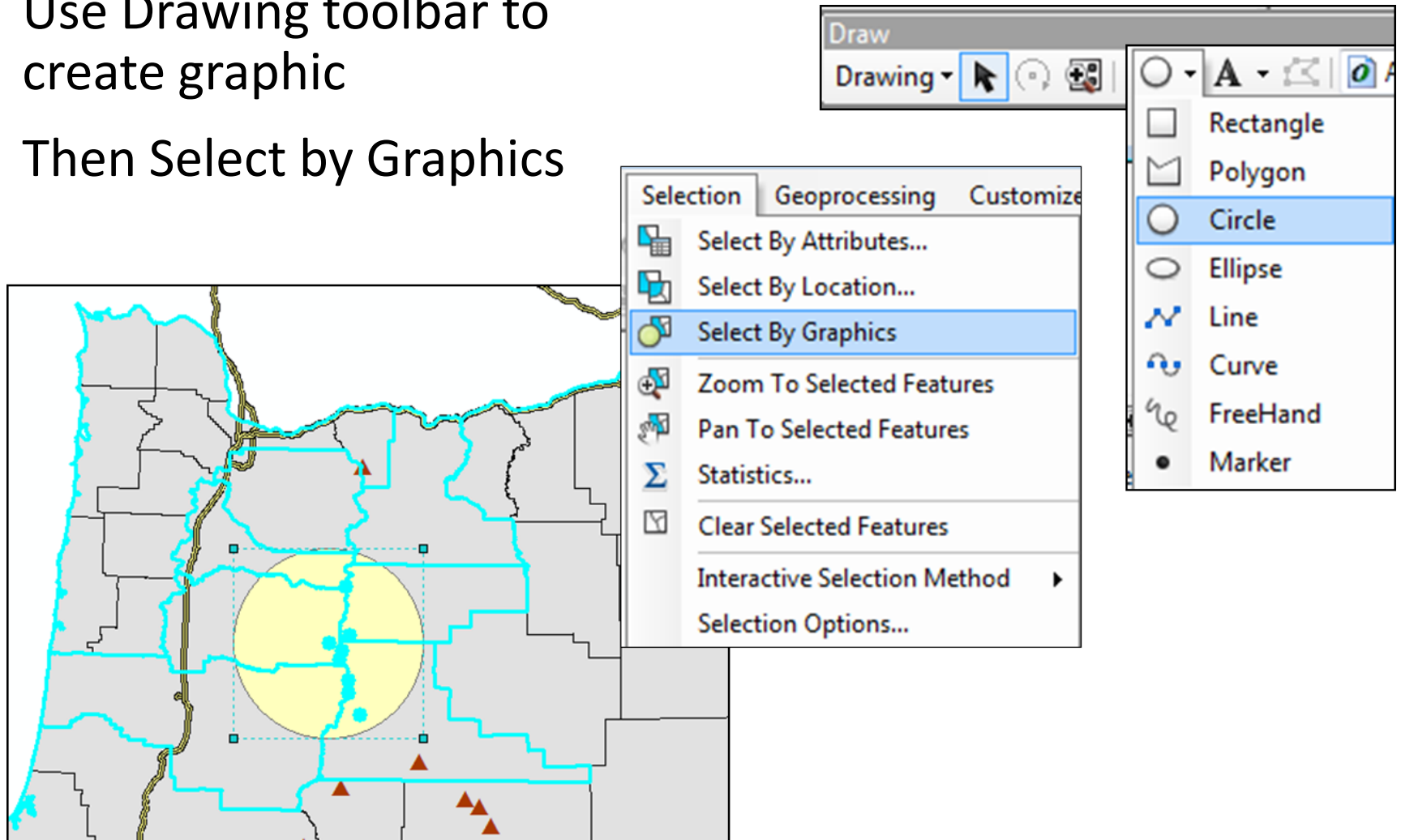


Click to  
toggle  
selectability

# Select by Graphics

Use Drawing toolbar to  
create graphic

Then Select by Graphics





Select by Attributes  
Select by Location

# Select By Attributes

Select By Attributes

Layer: States

☐ Only show selectable layers in this list

Method: Create a new selection

[OBJECTID]  
[STATE\_NAME]  
[STATE\_FIPS]  
[SUB\_REGION]  
[STATE\_ABBR]

= <> Like  
> >= And  
< <= Or  
? \* ( ) Not

Is Get Unique Values Go To:

SELECT \* FROM states WHERE:  
[POP2000] > 8000000

Clear Verify Help Load... Save...  
OK Apply Close

Select layer

Some Valid Queries

```
SELECT *FROM cities WHERE  
"POP1990" >= 500000
```

```
SELECT *FROM counties WHERE  
"BEEFCOW_92" < "BEEFCOW_87"
```

```
SELECT *FROM parcels WHERE  
"LU-CODE" = 42 AND "VALUE" > 50000
```

```
SELECT *FROM rentals WHERE  
"RENT" > 700 AND "RENT" < 1500
```

Note: Shapefile tables use quotes for field names; geodatabase tables use brackets

# Select By Location

Select By Location

Select features from one or more target layers based on their location in relation to the features in the source layer.

Selection method:  
select features from

Target layer(s):

- ☐ Capitals
- ☒ Cities
- ☐ Interstates
- ☐ Rivers
- ☐ States
- ☐ Counties

☐ Only show selectable layers in this list

Source layer:  
Capitals

☐ Use selected features (0 features selected)

Spatial selection method:  
Target layer(s) features are within a distance of the Source layer feature

☒ Apply a search distance  
30 Miles

Help OK Apply Close

Target layer

Source layer

Spatial operator

Selection Geoprocessing



Select By Attributes...



Select By Location...



Select By Graphics

intersect  
intersect (3d)  
are within a distance of  
are within a distance of (3d)  
contain  
completely contain  
contain (Clementini)  
are within  
are completely within  
are within (Clementini)  
are identical to  
touch the boundary of  
share a line segment with  
are crossed by the outline of  
have their centroid in

# Within distance of

Select By Location ✕

Select features from one or more target layers based on their location in relation to the features in the source layer.

Selection method:  
select features from

Target layer(s):

- ☐ Packing Survey
- ☐ Capitals
- ☒ Cities
- ☐ Interstates
- ☐ Rivers
- ☐ States
- ☐ Counties

☐ Only show selectable layers in this list

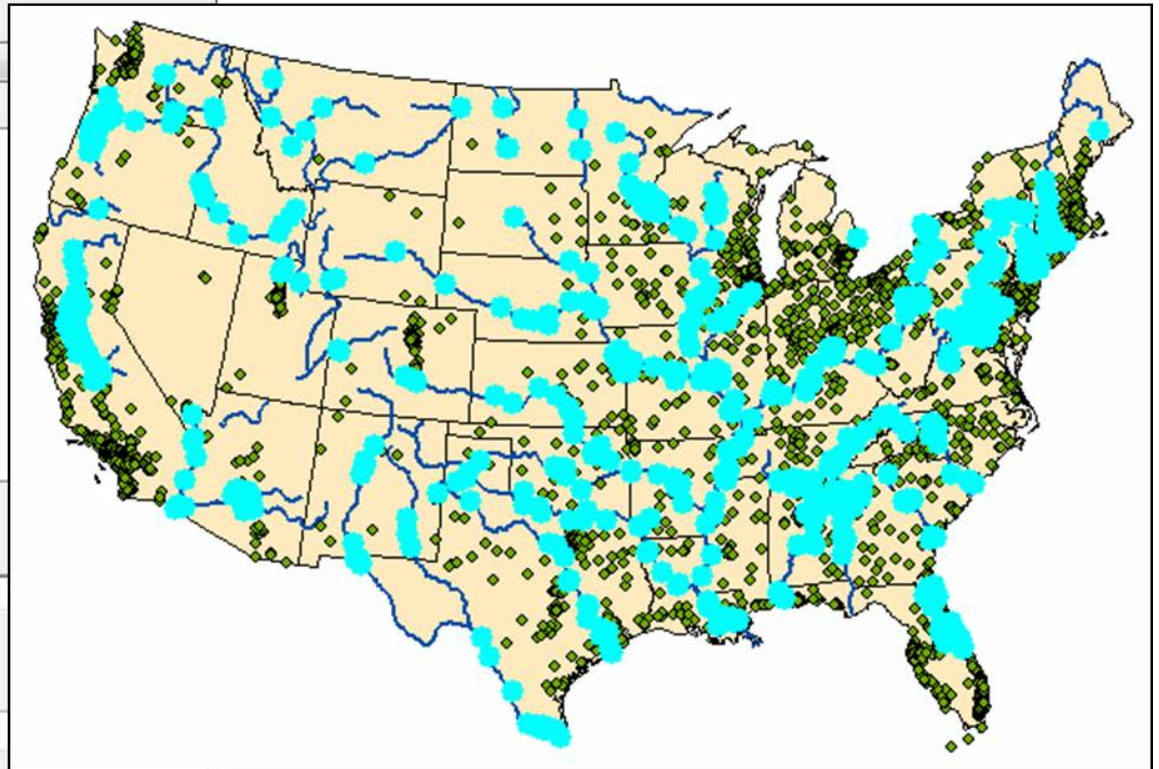
Source layer:  
☒ Rivers

☐ Use selected features (0 features selected)

Spatial selection method for target layer feature(s):  
are within a distance of the source layer feature

☒ Apply a search distance  
15 Miles

[About select by location](#) OK Apply Close



# Using a selected set

Select By Location ✕

Select features from one or more target layers based on their location in relation to the features in the source layer.

Selection method:  
select features from ▾

Target layer(s):

- ☐ Packing Survey
- ☐ Capitals
- ☐ Cities
- ☐ Interstates
- ☒ Rivers
- ☐ States
- ☐ Counties

☐ Only show selectable layers in this list

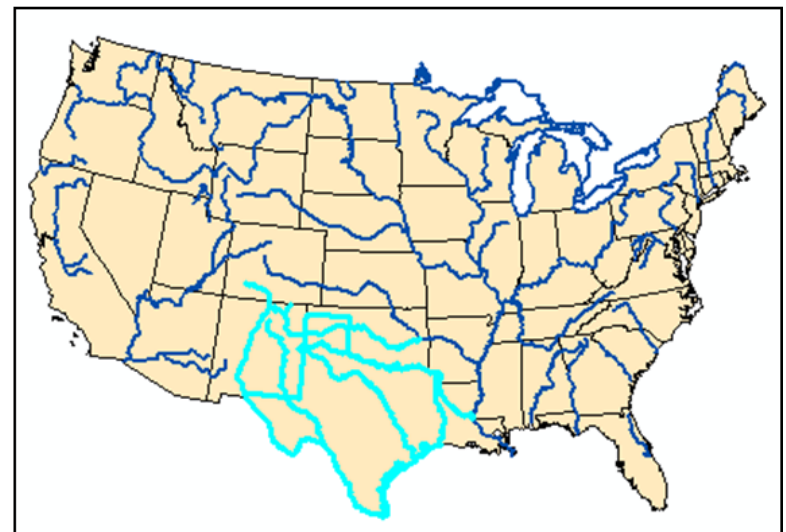
Source layer:  
States ▾

☒ Use selected features (1 features selected)

Spatial selection method for target layer feature(s):  
intersect the source layer feature ▾

☐ Apply a search distance  
15.000000 Miles ▾

[About select by location](#) OK Apply Close





# Within the same layer

Select By Location ✕

Select features from one or more target layers based on their location in relation to the features in the source layer.

Selection method:  
select features from ▾

Target layer(s):

- ☐ Packing Survey
- ☐ Capitals
- ☐ Cities
- ☐ Interstates
- ☐ Rivers
- ☒ States
- ☐ Counties

☐ Only show selectable layers in this list

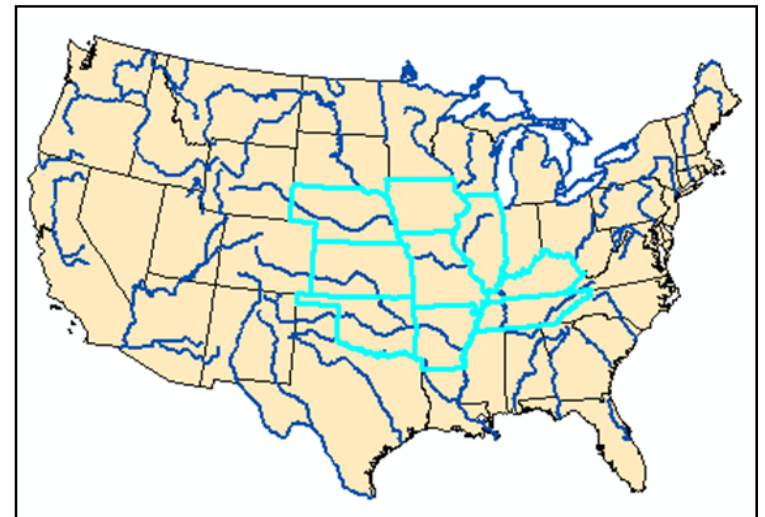
Source layer:  
States ▾

☒ Use selected features (1 features selected)

Spatial selection method for target layer feature(s):  
intersect the source layer feature ▾

☐ Apply a search distance  
15.000000 Miles ▾

[About select by location](#) OK Apply Close



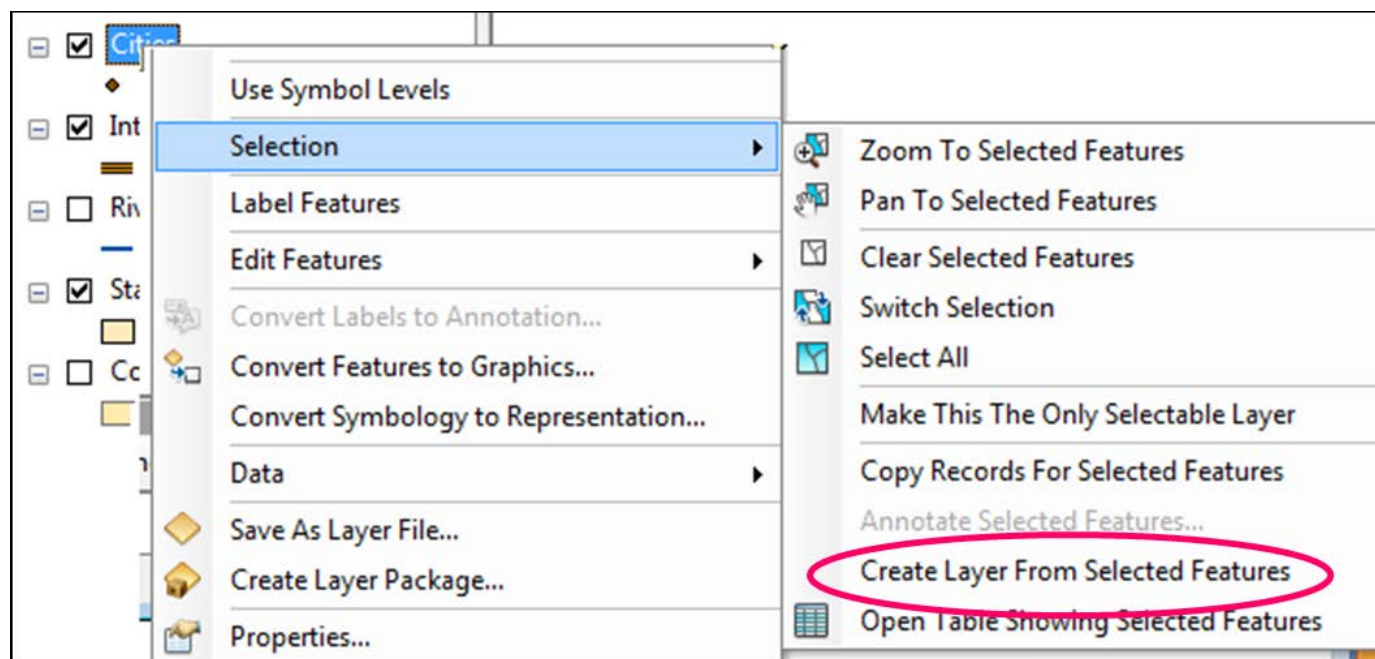
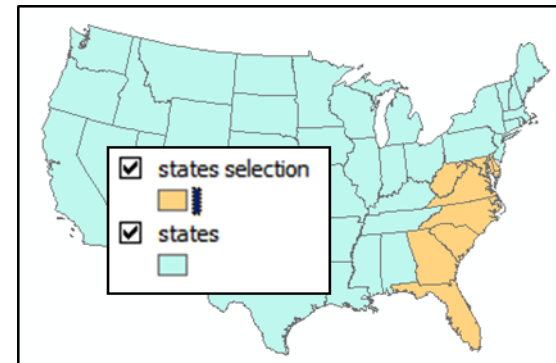


Creating subsets from queries

# Creating layers

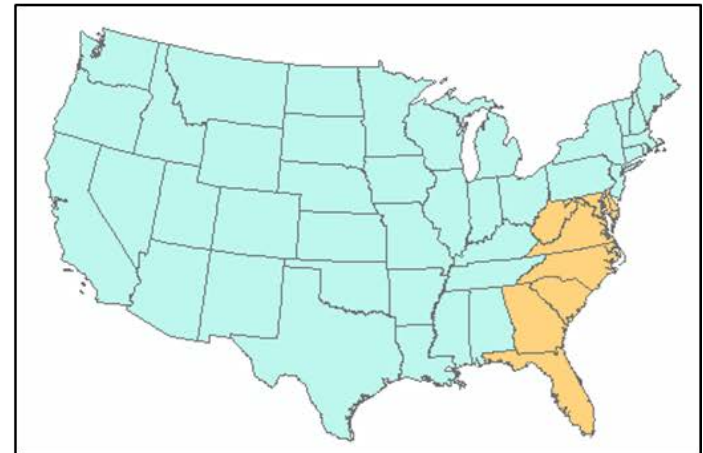
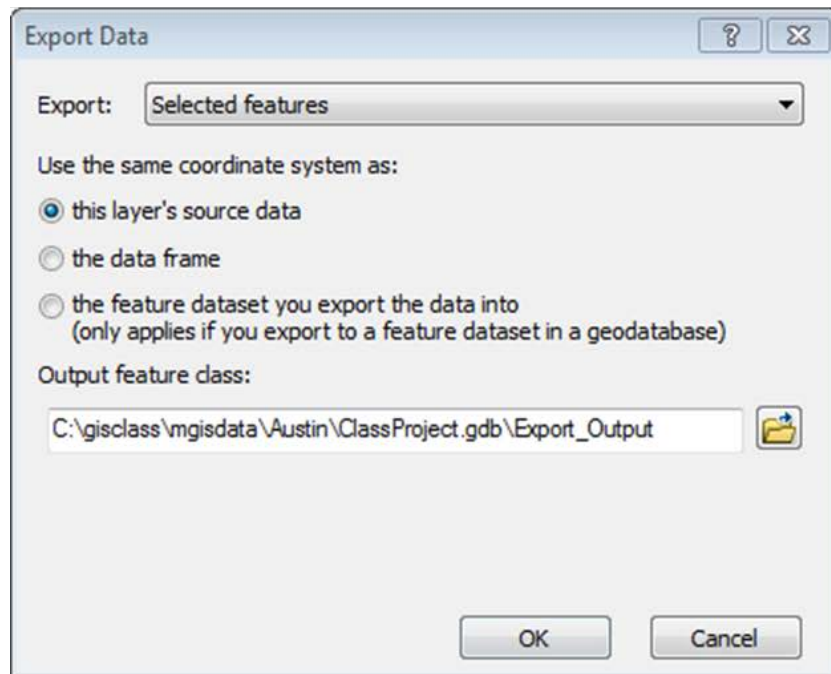
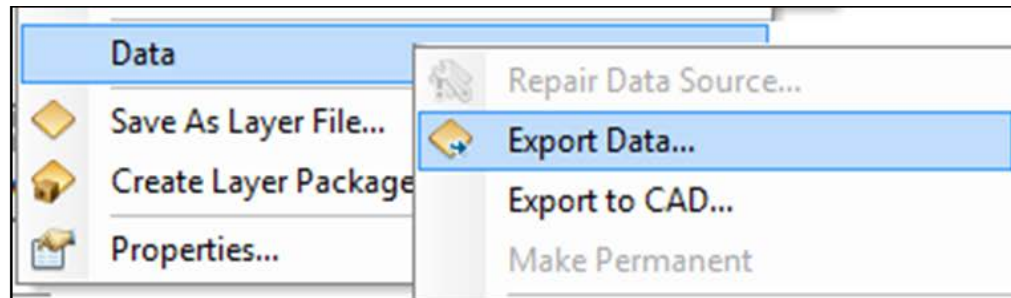
Common operation following a query

Creates a new layer with only the selected features



Note that the new layer still refers to the original feature class with all the features. But it appears to contain only the selected features.

# Exporting selections



Creates new feature class