

Preliminaries:

-- vector, raster, shapefiles, feature classes



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# Mapping Tabular Data

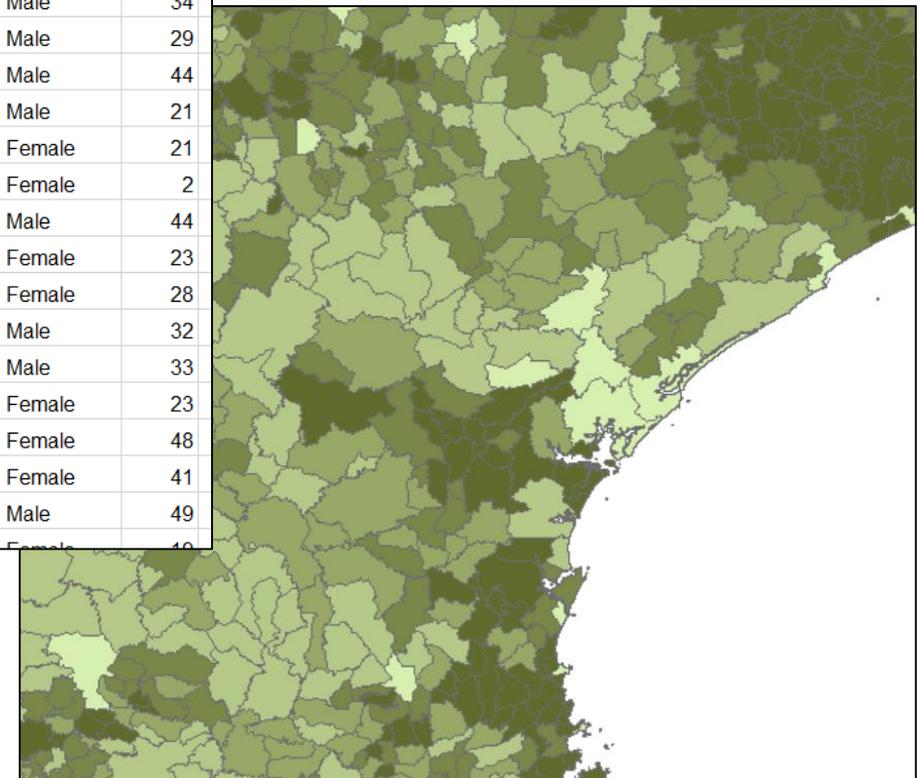
Problem: The available data is somehow not in the right form to create the map you want.

| YearStart | YearEnd | LocationAbbr | LocationDesc   |
|-----------|---------|--------------|----------------|
| 2001      | 2001    | ME           | Maine          |
| 2001      | 2001    | MI           | Michigan       |
| 2001      | 2001    | MN           | Minnesota      |
| 2001      | 2001    | MO           | Missouri       |
| 2001      | 2001    | MS           | Mississippi    |
| 2001      | 2001    | MT           | Montana        |
| 2001      | 2001    | NC           | North Carolina |
| 2001      | 2001    | ND           | North Dakota   |
| 2001      | 2001    | NE           | Nebraska       |
| 2001      | 2001    | NH           | New Hampshire  |

| shape    | dseconds | location        | gender | age |
|----------|----------|-----------------|--------|-----|
| sk       | 240      | Spokane,Wa      | Female | 28  |
| circle   | 5        | Las Vegas,Nv    | Male   | 31  |
| oval     | 120      | Charlotte,Nc    | Male   | 34  |
| light    | 30       | Seattle,Wa      | Male   | 29  |
| light    | 30       | Cotati,Ca       | Male   | 44  |
| triangle | 900      | Phoenix,Az      | Male   | 21  |
| nevron   | 360      | Yuma,Az         | Female | 21  |
| chevron  | 360      | Yuma,Az         | Female | 2   |
| circle   | 30       | Little Rock,Ar  | Male   | 44  |
| light    | 900      | Bolingbrook,Il  | Female | 23  |
| sphere   | 600      | Phoenix,Az      | Female | 28  |
| light    | 20       | Denver,Co       | Male   | 32  |
| oval     | 300      | Memphis,Tn      | Male   | 33  |
| triangle | 120      | Orlando,Fl      | Female | 23  |
| other    | 240      | Bellevue,Wa     | Female | 48  |
| light    | 900      | Atlanta,Ga      | Female | 41  |
| other    | 3        | Seattle,Wa      | Male   | 49  |
| light    | 300      | Murks Beach, Ca | Female | 40  |

Too much irrelevant data?

- Data is not spatial?
- has coordinates?
  - has addresses?
  - has neither, but . . . .



Spatial data is on the wrong spatial units or you need to combine two spatial datasets?

# Data Prep Techniques

| YearStart | YearEnd | LocationAbbr | LocationDesc   |
|-----------|---------|--------------|----------------|
| 2001      | 2001    | ME           | Maine          |
| 2001      | 2001    | MI           | Michigan       |
| 2001      | 2001    | MN           | Minnesota      |
| 2001      | 2001    | MO           | Missouri       |
| 2001      | 2001    | MS           | Mississippi    |
| 2001      | 2001    | MT           | Montana        |
| 2001      | 2001    | NC           | North Carolina |
| 2001      | 2001    | ND           | North Dakota   |
| 2001      | 2001    | NE           | Nebraska       |
| 2001      | 2001    | NH           | New Hampshire  |

| ufoshape | dseconds | location        | gender | age |
|----------|----------|-----------------|--------|-----|
| disk     | 240      | Spokane,Wa      | Female | 28  |
| circle   | 5        | Las Vegas,Nv    | Male   | 31  |
| oval     | 120      | Charlotte,Nc    | Male   | 34  |
| light    | 30       | Seattle,Wa      | Male   | 29  |
| light    | 30       | Cotati,Ca       | Male   | 44  |
| triangle | 900      | Phoenix,Az      | Male   | 21  |
| chevron  | 360      | Yuma,Az         | Female | 21  |
| chevron  | 360      | Yuma,Az         | Female | 2   |
| circle   | 30       | Little Rock,Ar  | Male   | 44  |
| light    | 900      | Bolingbrook,Ill | Female | 23  |
| sphere   | 600      | Phoenix,Az      | Female | 28  |
| light    | 20       | Denver,Co       | Male   | 32  |
| oval     | 300      | Memphis,Tn      | Male   | 33  |
| triangle | 120      | Orlando,Fl      | Female | 23  |
| other    | 240      | Bellevue,Wa     | Female | 48  |
| light    | 900      | Atlanta,Ga      | Female | 41  |
| other    | 3        | Seattle,Wa      | Male   | 49  |
| light    | 200      | Murks Beach,Sc  | Female | 40  |

Too much irrelevant data?

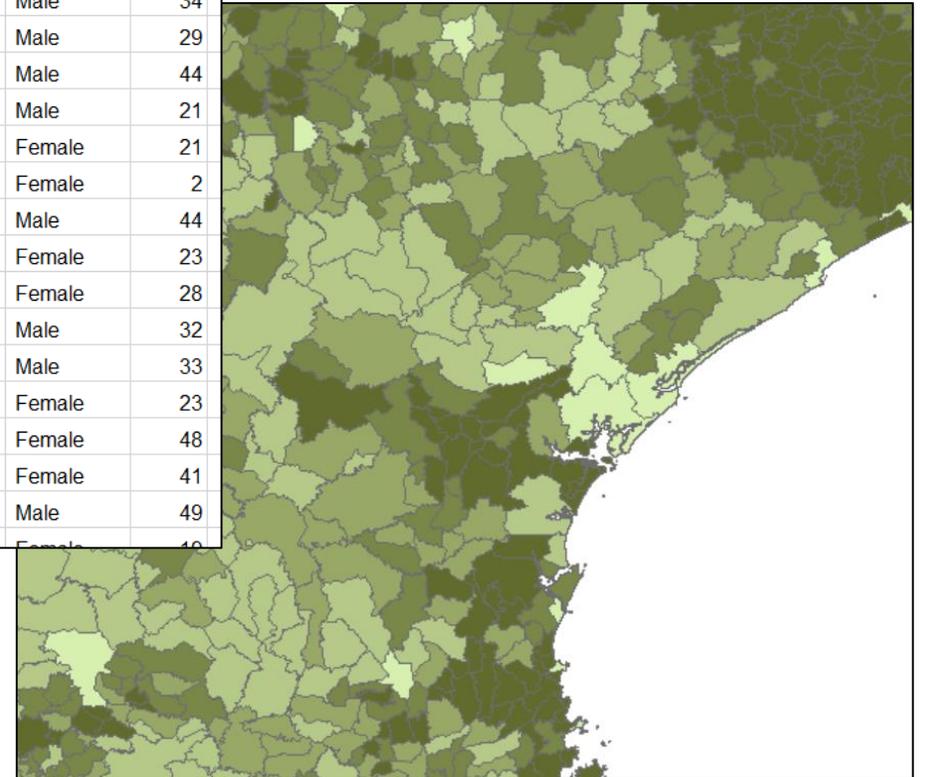
query or "select" a subset of the data

|                   |                            |          |     |                 |        |    |
|-------------------|----------------------------|----------|-----|-----------------|--------|----|
| 11/24/04 02:00 AM | Guillen, Claudia J.        | chevron  | 360 | Yuma,Az         | Female | 2  |
| 5/12/06 06:00 PM  | Rich, Randy L.             | circle   | 30  | Little Rock,Ar  | Male   | 44 |
| 10/28/07 05:30 PM | Peterson, Stacy A.         | light    | 900 | Bolingbrook,Ill | Female | 23 |
| 3/7/08 02:00 PM   | Pacheco-Flores, Rosario I. | sphere   | 600 | Phoenix,Az      | Female | 28 |
| 2/26/09 08:40 PM  | Pytlinski, Brian           | light    | 20  | Denver,Co       | Male   | 32 |
| 10/1/09 06:00 PM  | Stevenson, Walter S.       | oval     | 300 | Memphis,Tn      | Male   | 33 |
| 7/1/11 10:00 PM   | Elbertson, Tamara L.       | triangle | 120 | Orlando,Fl      | Female | 23 |
| 11/8/11 04:40 PM  | Bryden, Lorill S.          | other    | 240 | Bellevue,Wa     | Female | 48 |
| 6/8/12 07:00 AM   | Kelley, Newanna C.         | light    | 900 | Atlanta,Ga      | Female | 41 |
| 5/3/13 01:05 AM   | McCarthy, Christopher J.   | other    | 3   | Seattle,Wa      | Male   | 49 |
| 12/4/13 09:00 PM  | Ellis, Heather D.          | light    | 200 | Murks Beach,Sc  | Female | 40 |

Data table is not spatial?

- has coordinates? **plot XY coordinates**
- has addresses? **geocoding**
- has neither, but . . . .

**"join" data table to a matching shapefile**



Spatial data is on the wrong spatial units or you need to combine two spatial datasets?

**"spatial join" two GIS layers based on location**



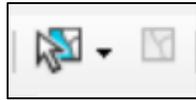
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# GIS Data Queries

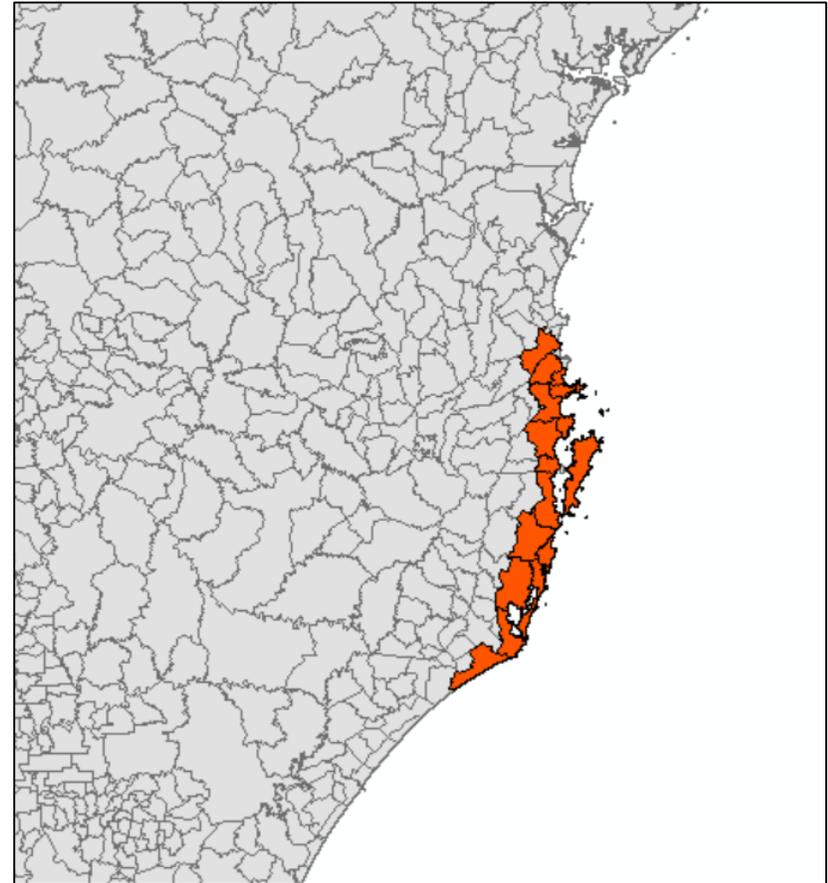
# Why subset? . . . . Your answer will help decide on a method.

- Geographic extent is greater than needed for a small study area.
- Highlight a subregion for cartographic purposes.
- Perform analysis on a subregion.

→ Use simple point and click select.



→ Shift-click allows you to draw a box and select its contents. Control-click lets you choose several separated features.



Point and click Select also works in the attribute table.

Records (each corresponds to a feature)

fields (attributes)

| Town        | State             | Postcode | Address   | Male  | Female | Unisex | DumpPoint | FacilityTy      | ToiletType | AccessLimi | PaymentReq | KeyRequire | Acce | Parking | ParkingNot   | Ac    |
|-------------|-------------------|----------|-----------|-------|--------|--------|-----------|-----------------|------------|------------|------------|------------|------|---------|--------------|-------|
| Hindmarsh   | Western Australia | 6462     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Norseman    | Western Australia | 6443     |           | False | False  | False  | True      | Other           |            | False      | True       | False      |      | False   |              | False |
| Northam     | Western Australia | 6401     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Northampton | Western Australia | 6535     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Onslow      | Western Australia | 6710     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Carnamah    | Western Australia | 6517     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Macleod     | Western Australia | 6701     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Regans Ford | Western Australia | 6507     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Bendigo     | Victoria          | 3550     | Located b | True  | True   | False  | False     | Other           | Sewerage   | False      | True       | False      |      | False   | Suitable for | False |
| Stradbroke  | Victoria          | 3851     |           | False | False  | True   | False     | Park or reserve | Pit        | True       | False      | False      |      | False   |              | False |
| Rosedale    | Victoria          | 3847     |           | False | False  | True   | False     | Park or reserve | Pit        | True       | False      | False      |      | False   |              | False |

(0 out of 18865 Selected)

latest-csv-export.csv

how many selected records

field values

Records can be sorted according to the values in a field.

- Subset based on attributes instead of physical location.
  - limit to certain years
  - limit to certain populations
  - include or remove features with certain characteristics
  - eliminate bad values
- Subset based on a combination of attributes.

→ Use “Select by Attribute.”



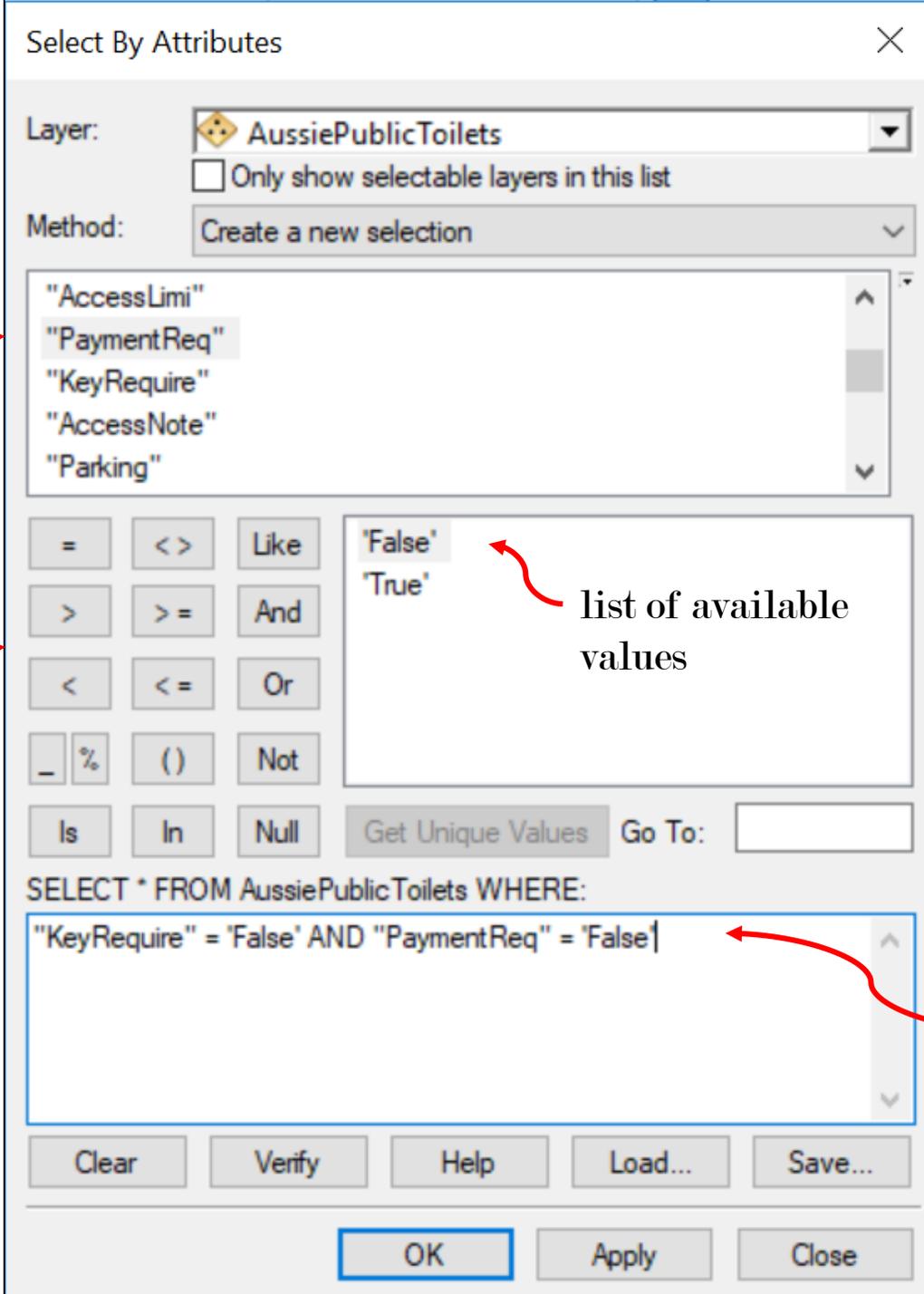
Table

AussiePublicToilets

| Town        | State             | Postcode | Address   | Male  | Female | Unisex | DumpPoint | FacilityTy      | ToiletType | AccessLimi | PaymentReq | KeyRequire | Acce | Parking | ParkingNot   | Ac    |
|-------------|-------------------|----------|-----------|-------|--------|--------|-----------|-----------------|------------|------------|------------|------------|------|---------|--------------|-------|
| Hindmarsh   | Western Australia | 6462     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Norseman    | Western Australia | 6443     |           | False | False  | False  | True      | Other           |            | False      | True       | False      |      | False   |              | False |
| Northam     | Western Australia | 6401     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Northampton | Western Australia | 6535     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Onslow      | Western Australia | 6710     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Carnamah    | Western Australia | 6517     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Macleod     | Western Australia | 6701     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Regans Ford | Western Australia | 6507     |           | False | False  | False  | True      | Other           |            | False      | False      | False      |      | False   |              | False |
| Bendigo     | Victoria          | 3550     | Located b | True  | True   | False  | False     | Other           | Sewerage   | False      | True       | False      |      | False   | Suitable for | False |
| Stradbroke  | Victoria          | 3851     |           | False | False  | True   | False     | Park or reserve | Pit        | True       | False      | False      |      | False   |              | False |
| Rosedale    | Victoria          | 3847     |           | False | False  | True   | False     | Park or reserve | Pit        | True       | False      | False      |      | False   |              | False |

(0 out of 18865 Selected)

AussiePublicToilets latest-csv-export.csv



list of fields

logical operators

list of available values

Compose an expression.

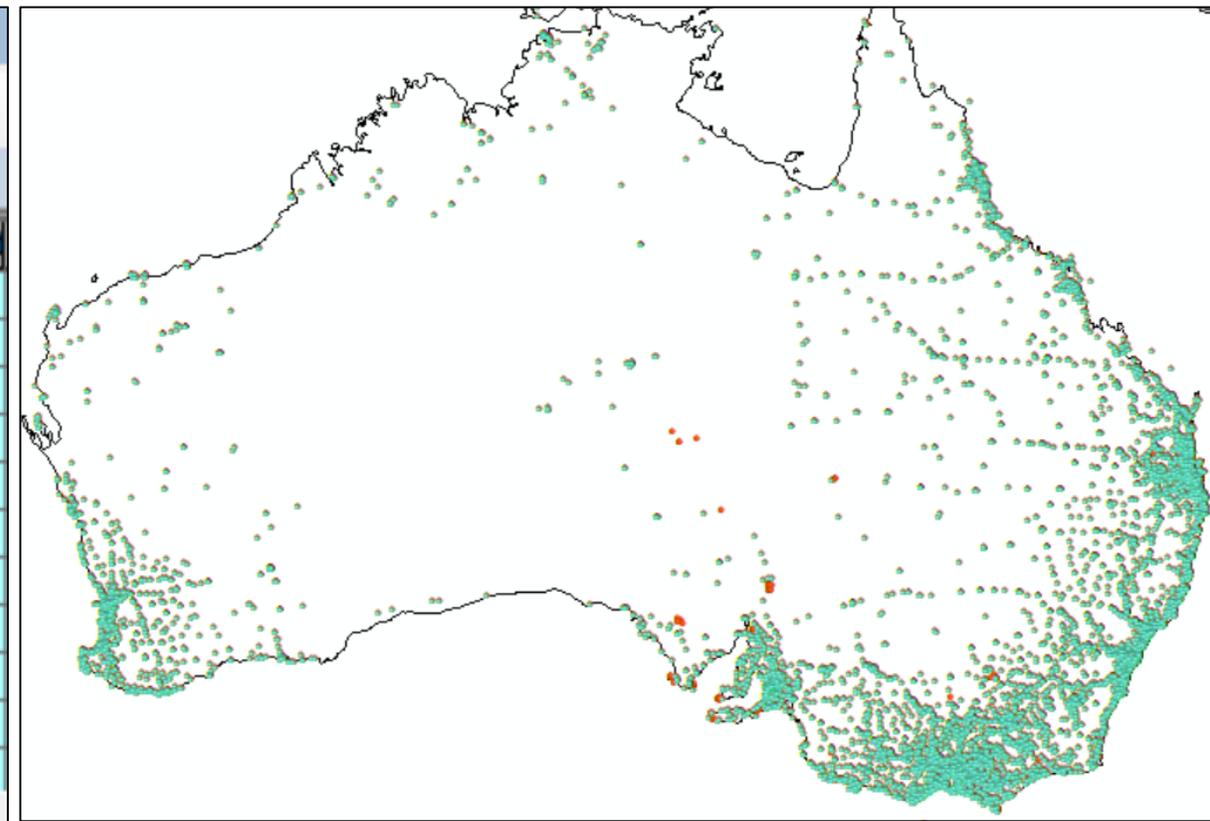
Calculator interface helps build a SQL expression to query the table.

Table

AussiePublicToilets

|   | AccessLimi | PaymentReq | KeyRequire | Acce | Parking | ParkingNot   |
|---|------------|------------|------------|------|---------|--------------|
| ▶ | False      | False      | False      |      | False   |              |
|   | False      | False      | False      |      | False   |              |
|   | False      | False      | False      |      | True    |              |
|   | False      | False      | False      |      | False   |              |
|   | False      | False      | False      |      | True    |              |
|   | False      | False      | False      |      | False   |              |
|   | False      | False      | False      |      | True    |              |
|   | False      | False      | False      |      | False   |              |
|   | False      | False      | False      |      | True    |              |
|   | False      | False      | False      |      | True    | Parking is a |
|   | False      | False      | False      |      | True    |              |

(18293 out of 18865 Selected)



Screened out 572 bathrooms that required a key or payment.

We could pare this subset down even further.

Select By Attributes

Layer: AussiePublicToilets

Only show selectable layers in this list

Method: Select from current selection

Data selection is ephemeral.

While the selection is active, tools run on the layer will only operate on the selected features.

To make several different selections or to set a symbology for a selection, you can “create layer from selected features” by **Right-Click › Selection › Create Layer from Selected Features**.

To keep a permanent copy of the selected subset for re-use, export it as a shapefile by **Right-Click › Data › Export**.





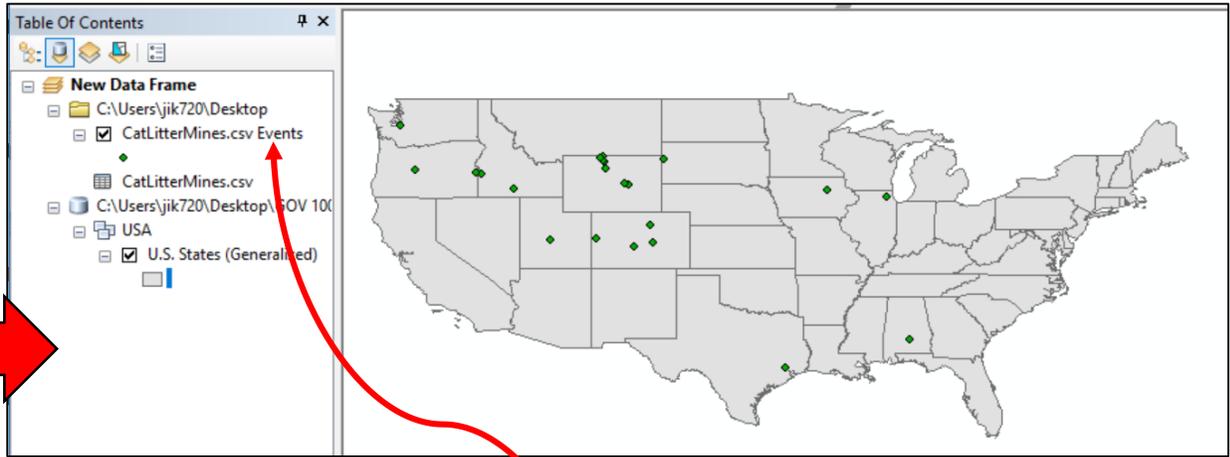
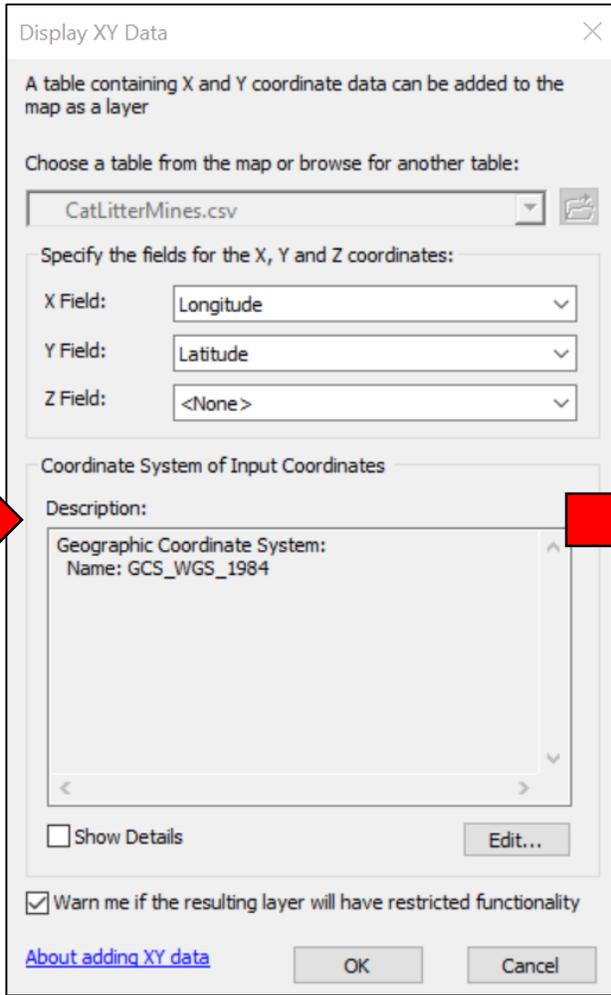
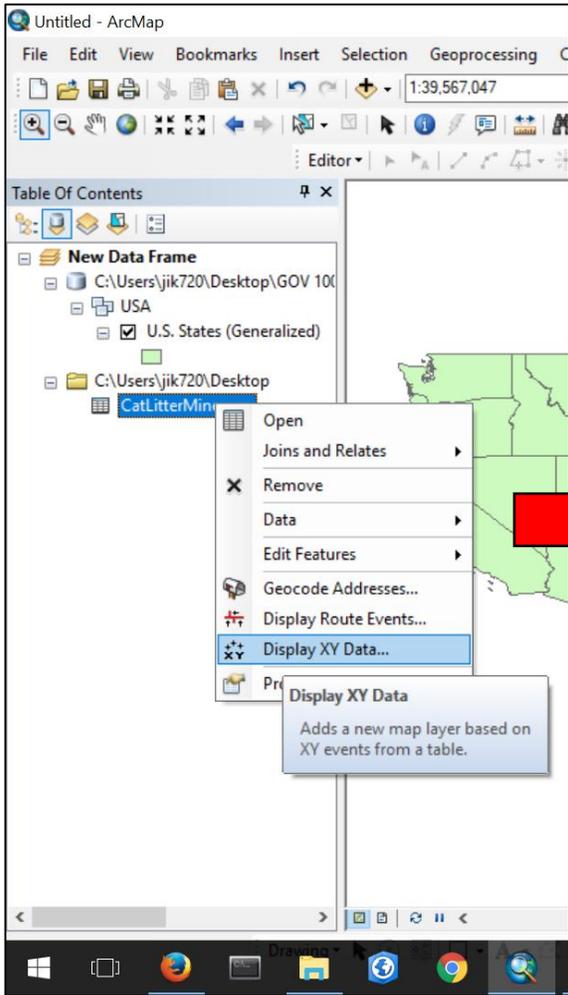
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# Mapping Aspatial Data

Some interesting data are not available as GIS shapefiles or feature classes. The most common format is .csv – a simple text list with values separated by commas. If the file has fields for latitude and longitude (or X and Y coordinates), we can map the records as points.

```
CatLitterMines.csv
1 "Company Name","Executive First Name","Executive Last Name","Address","City","State","ZIP Code","Record Type","Latitude","Longitude"
2 "American Colloid Co","Ben","Grimes","Highway 31","Fort Deposit","AL","36032","Verified","031.955989","-086.554298"CRIF
3 "B H S Marketing","Doug","Massey","3450 County Road 27 # 7","Fort Lupton","CO","80621","Verified","040.049654","-104.810413"CRIF
4 "First Bentonite","Pam","Wedige","215 Teller St","Salida","CO","81201","Verified","038.529675","-105.992003"CRIF
5 "Front Range Winwater Works Co","Marvin","Moler","7006 Space Village Ave","Colorado Springs","CO","80929","Verified","038.782284","-
6 "H & H Environmental Inc","Don","Kendall","360 Teegan Ct","Grand Junction","CO","81507","Verified","039.058430","-108.640610"CRIF
7 "S & B Indl Minerals Na INC","Ed","Jessen","307 Vaughn St","Waterloo","IA","50701","Verified","042.500879","-092.365034"CRIF
8 "Carco Mineral Resources","Colby","Porter","520 Blomquist Ave","Caldwell","ID","83605","Verified","043.665679","-116.702311"CRIF
9 "Walker Water Systems Inc","Cynthia","Coffer","624 Pierce St","Twin Falls","ID","83301","Verified","042.572737","-114.463671"CRIF
10 "American Colloid Co","Jim","Papp","2870 Forbs Ave","Hoffman Estates","IL","60192","Verified","042.075812","-088.198936"CRIF
11 "Able Supply LLC","Kevin","Peterman","60005 Cinder Butte Rd","Bend","OR","97702","Verified","043.979827","-121.362829"CRIF
12 "Teague Mineral Products","April","Tyre","1925 Highway 201","Adrian","OR","97901","Verified","043.708155","-117.087746"CRIF
13 "American Colloid Co","Bill","Rhoades","10881 US Highway 212","Belle Fourche","SD","57717","Verified","044.711099","-103.892781"CRIF
14 "Bpm Minerals LLC","","","554 Highway 212","Belle Fourche","SD","57717","Verified","044.681178","-103.852281"CRIF
15 "Bentonite Performance Minerals","Jason","Bell","3000 N Sam Houston Pkwy E","Houston","TX","77032","Verified","029.935579","-095.339
16 "Redmond Minerals","Rusty","Bastain","6005 N 100 W","Redmond","UT","84652","Verified","039.005692","-111.866180"CRIF
17 "UMAI Bento","","","17306 Pacific Ave S","Spanaway","WA","98387","Verified","047.099030","-122.434370"CRIF
18 "American Colloid Co","Steve","Wilkerson","92 State Highway 37","Lovell","WY","82431","Verified","044.838162","-108.395573"CRIF
19 "Bentonite Performance Minerals","Alan","Synder","789 US Highway 14a E","Lovell","WY","82431","Verified","044.855455","-108.193901"
20 "Black Hills Bentonite","Tom","Thorson","55 Salt Creek Hwy","Casper","WY","82601","Verified","042.848795","-106.323810"CRIF
21 "Black Hills Bentonite Co","Dale","Grenier","1025 Lane 10 1/2","Worland","WY","82401","Verified","044.015207","-107.959879"CRIF
22 "M-I SWACO","Joe","Cheatham","Road 26 Lane 33","Greybull","WY","82426","Verified","044.492938","-108.053228"CRIF
23 "Tolsa Wyoming Bentonite Corp","","","12050 Bucknum Rd","Casper","WY","82604","Verified","043.020074","-106.633091"CRIF
24 "Wyo-Ben Inc","Rick","Magstadt","2700 Road 26","Greybull","WY","82426","Verified","044.598317","-108.146738"CRIF
25 "Wyo-Ben Inc","Steve","Banks","1062 Road 9","Lovell","WY","82431","Verified","044.838162","-108.395573"CRIF
```

Decide whether the coordinates are lat/lon or something else. Lat/lon values are between -180 and 180. Large numbers indicate meters or feet.



An events layer is also ephemeral unless you export it. Most tools will not run on an events layer.

What if there are no latitudes and longitudes given? Or if we don't want the information as points?

→ IF we have a geographic layer (vector)

AND

→ IF the values in some field from the non-spatial table *exactly match* values from a field in the attribute table for the geographic layer

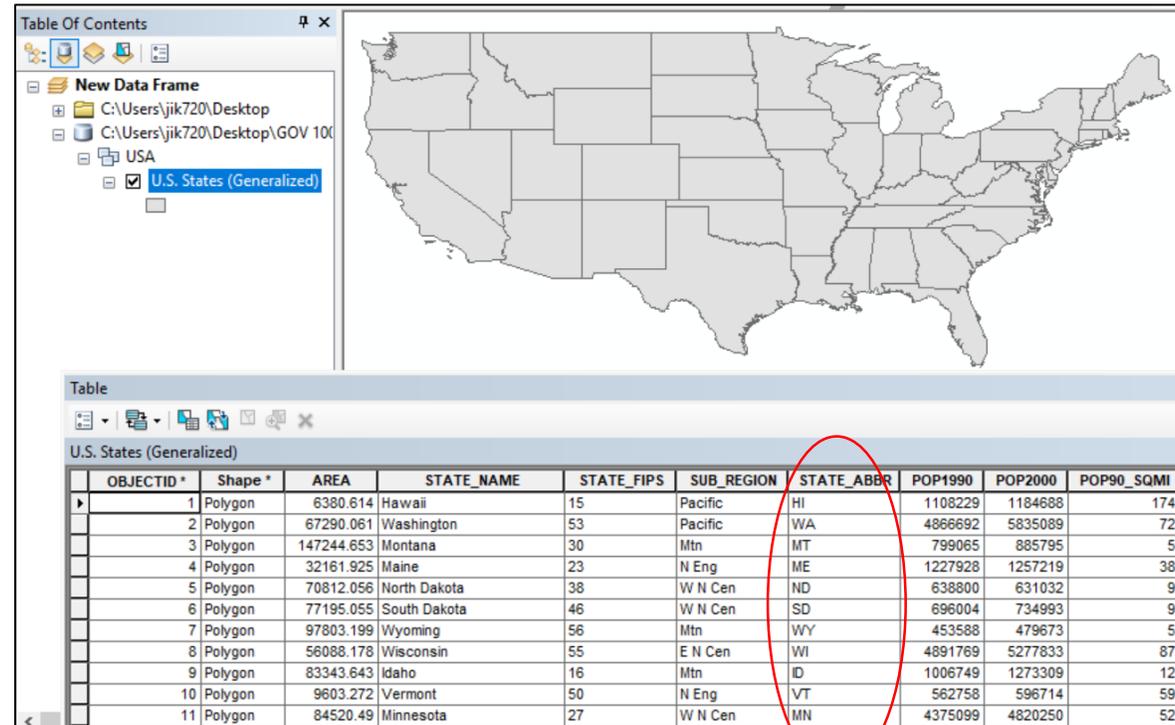
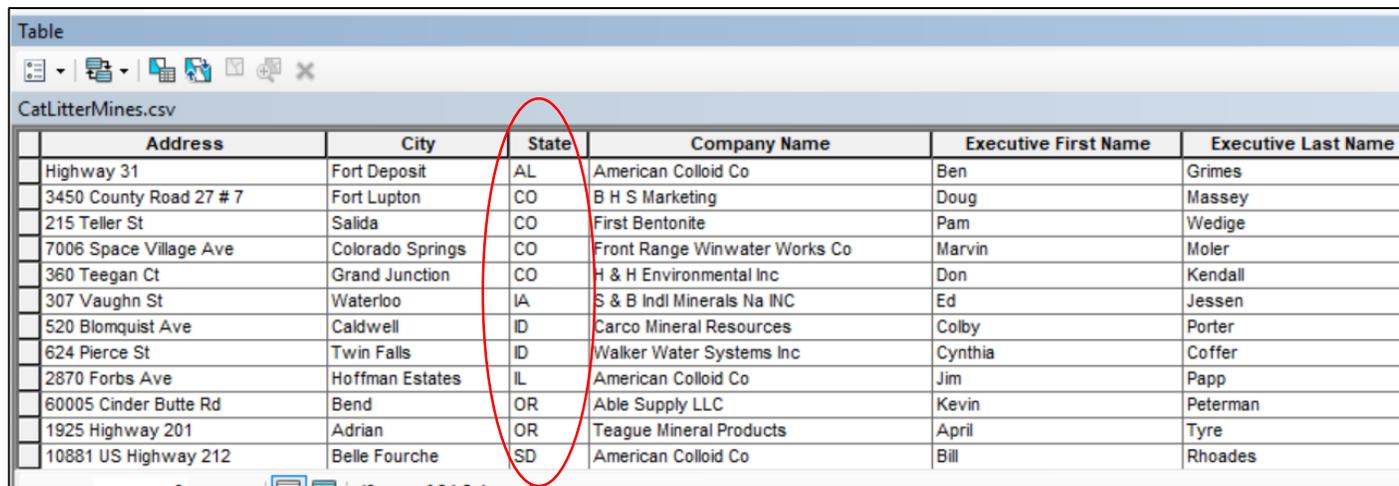


Table Of Contents

- New Data Frame
  - C:\Users\jik720\Desktop
  - C:\Users\jik720\Desktop\GOV 100
    - USA
      - U.S. States (Generalized)

| OBJECTID * | Shape * | AREA       | STATE_NAME   | STATE_FIPS | SUB_REGION | STATE_ABBR | POP1990 | POP2000 | POP90_SQMI |
|------------|---------|------------|--------------|------------|------------|------------|---------|---------|------------|
| 1          | Polygon | 6380.614   | Hawaii       | 15         | Pacific    | HI         | 1108229 | 1184688 | 174        |
| 2          | Polygon | 67290.061  | Washington   | 53         | Pacific    | WA         | 4866692 | 5835089 | 72         |
| 3          | Polygon | 147244.653 | Montana      | 30         | Mtn        | MT         | 799065  | 885795  | 5          |
| 4          | Polygon | 32161.925  | Maine        | 23         | N Eng      | ME         | 1227928 | 1257219 | 38         |
| 5          | Polygon | 70812.056  | North Dakota | 38         | W N Cen    | ND         | 638800  | 631032  | 9          |
| 6          | Polygon | 77195.055  | South Dakota | 46         | W N Cen    | SD         | 696004  | 734993  | 9          |
| 7          | Polygon | 97803.199  | Wyoming      | 56         | Mtn        | WY         | 453588  | 479673  | 5          |
| 8          | Polygon | 56088.178  | Wisconsin    | 55         | E N Cen    | WI         | 4891769 | 5277833 | 87         |
| 9          | Polygon | 83343.643  | Idaho        | 16         | Mtn        | ID         | 1006749 | 1273309 | 12         |
| 10         | Polygon | 9603.272   | Vermont      | 50         | N Eng      | VT         | 562758  | 596714  | 59         |
| 11         | Polygon | 84520.49   | Minnesota    | 27         | W N Cen    | MN         | 4375099 | 4820250 | 52         |



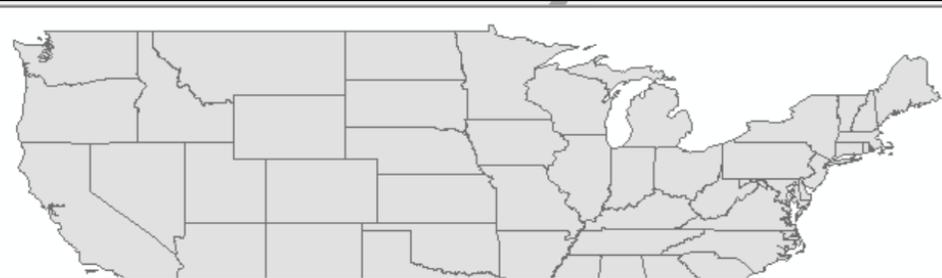
| Address                 | City             | State | Company Name                  | Executive First Name | Executive Last Name |
|-------------------------|------------------|-------|-------------------------------|----------------------|---------------------|
| Highway 31              | Fort Deposit     | AL    | American Colloid Co           | Ben                  | Grimes              |
| 3450 County Road 27 # 7 | Fort Lupton      | CO    | B H S Marketing               | Doug                 | Massey              |
| 215 Teller St           | Salida           | CO    | First Bentonite               | Pam                  | Wedge               |
| 7006 Space Village Ave  | Colorado Springs | CO    | Front Range Winwater Works Co | Marvin               | Moler               |
| 360 Teegan Ct           | Grand Junction   | CO    | H & H Environmental Inc       | Don                  | Kendall             |
| 307 Vaughn St           | Waterloo         | IA    | S & B Indl Minerals Na INC    | Ed                   | Jessen              |
| 520 Blomquist Ave       | Caldwell         | ID    | Carco Mineral Resources       | Colby                | Porter              |
| 624 Pierce St           | Twin Falls       | ID    | Walker Water Systems Inc      | Cynthia              | Coffer              |
| 2870 Forbs Ave          | Hoffman Estates  | IL    | American Colloid Co           | Jim                  | Papp                |
| 60005 Cinder Butte Rd   | Bend             | OR    | Able Supply LLC               | Kevin                | Peterman            |
| 1925 Highway 201        | Adrian           | OR    | Teague Mineral Products       | April                | Tyre                |
| 10881 US Highway 212    | Belle Fourche    | SD    | American Colloid Co           | Bill                 | Rhoades             |

→ THEN we can “join” the two tables.

Table Of Contents

New Data Frame

- C:\Users\jik720\Desktop\GOV 100
  - USA
    - U.S. States (Generalized)
- C:\Users\jik720\Desktop
  - CatLitterMines.csv



Table

U.S. States (Generalized)

| OBJECTID * | Shape * | AREA       | STATE_NAME           | STATE_FIPS | SUB_REGION | STATE_ABBR | POP1990  | POP2000  | POP90_SQMI |
|------------|---------|------------|----------------------|------------|------------|------------|----------|----------|------------|
| 51         | Polygon | 576594.104 | Alaska               | 02         | Pacific    | AK         | 550043   | 624523   | 1          |
| 43         | Polygon | 51715.786  | Alabama              | 01         | E S Cen    | AL         | 4040587  | 4395481  | 78         |
| 47         | Polygon | 52913.232  | Arkansas             | 05         | W S Cen    | AR         | 2350725  | 2566938  | 44         |
| 37         | Polygon | 113712.679 | Arizona              | 04         | Mtn        | AZ         | 3665228  | 4894006  | 32         |
| 25         | Polygon | 157776.31  | California           | 06         | Pacific    | CA         | 29760021 | 33603430 | 189        |
| 32         | Polygon | 104101.231 | Colorado             | 08         | Mtn        | CO         | 3294394  | 4139027  | 32         |
| 19         | Polygon | 4976.566   | Connecticut          | 09         | N Eng      | CT         | 3287116  | 3289062  | 661        |
| 28         | Polygon | 66.063     | District of Columbia | 11         | S Atl      | DC         | 606900   | 513618   | 9187       |
| 29         | Polygon | 2054.586   | Delaware             | 10         | S Atl      | DE         | 666168   | 762227   | 324        |
| 49         | Polygon | 55814.731  | Florida              | 12         | S Atl      | FL         | 12937926 | 15341185 | 232        |
| 45         | Polygon | 58629.222  | Georgia              | 13         | S Atl      | GA         | 6478216  | 7950119  | 110        |
| 1          | Polygon | 6380.614   | Hawaii               | 15         | Pacific    | HI         | 1108229  | 1184688  | 174        |

(0 out of 51 Selected)

When joining data, one table stays intact.

This is the left-hand table, called the **target layer**.

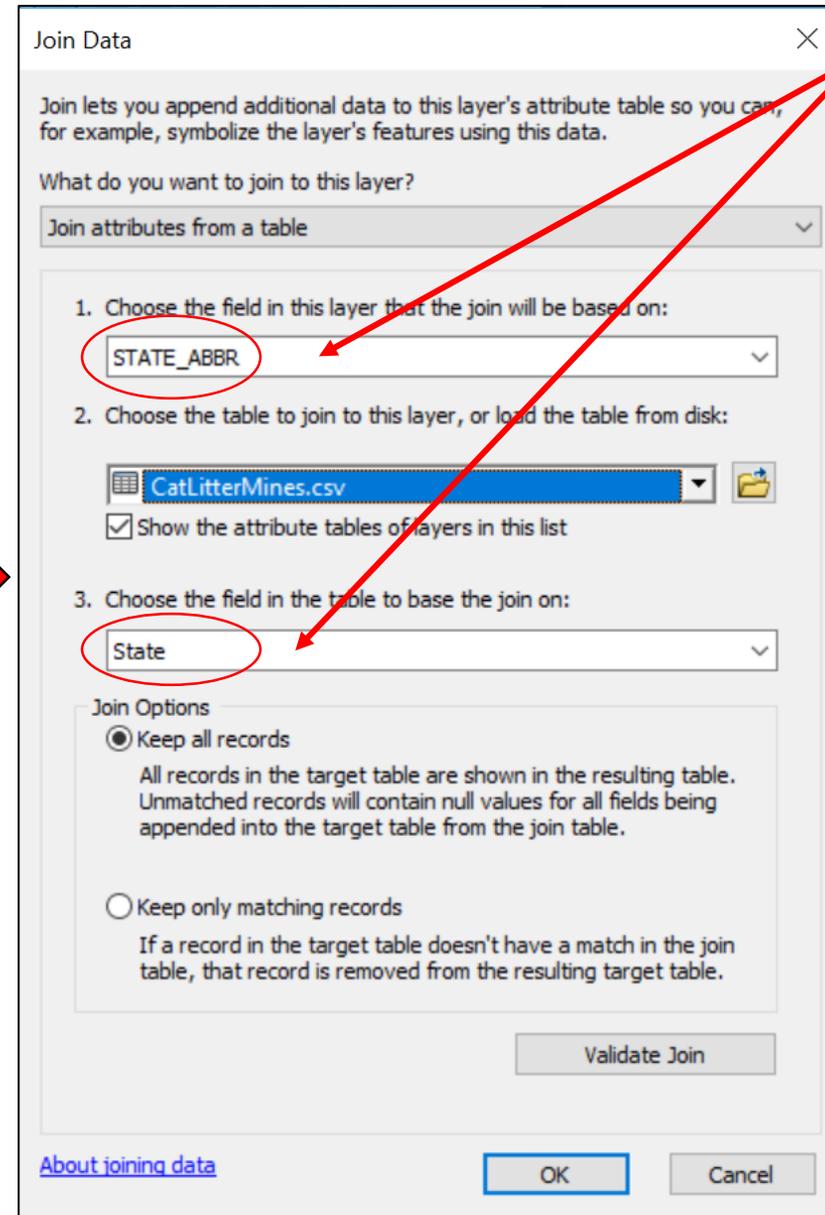
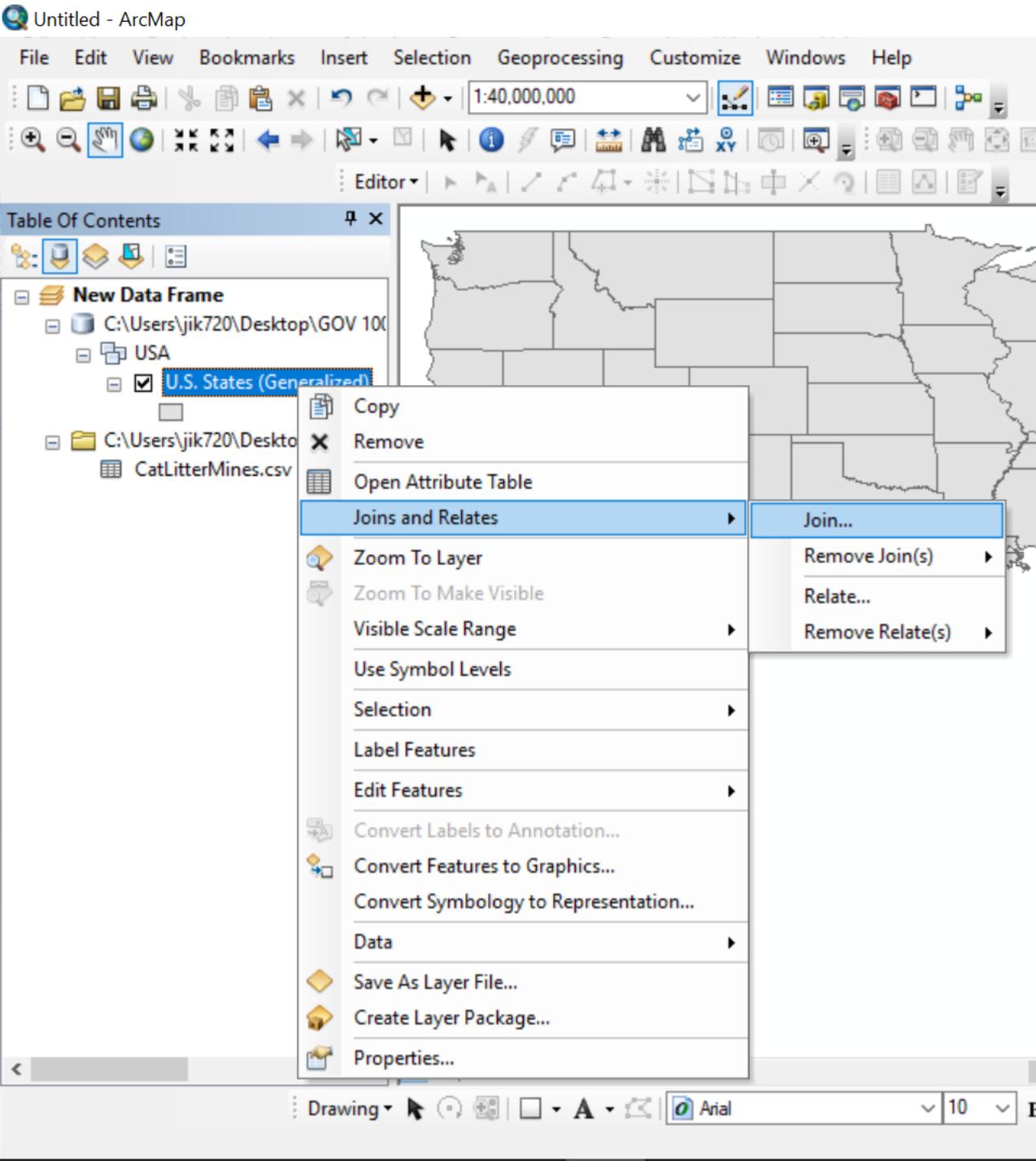
|            |              |    |                     |     |        |       |          |
|------------|--------------|----|---------------------|-----|--------|-------|----------|
| Highway 31 | Fort Deposit | AL | American Colloid Co | Ben | Grimes | 36032 | Verified |
|------------|--------------|----|---------------------|-----|--------|-------|----------|

|                        |                  |    |                               |        |         |       |          |
|------------------------|------------------|----|-------------------------------|--------|---------|-------|----------|
| 215 Teller St          | Salida           | CO | First Bentonite               | Pam    | Wedige  | 81201 | Verified |
| 7006 Space Village Ave | Colorado Springs | CO | Front Range Winwater Works Co | Marvin | Moler   | 80929 | Verified |
| 360 Teegan Ct          | Grand Junction   | CO | H & H Environmental Inc       | Don    | Kendall | 81507 | Verified |

The other table gets chopped apart and matched to the target layer.

This is the right-hand table, called the **join layer**.

After the join, records from the target layer get extra columns containing the relevant information from the join table.



The fields that match exactly are called the join key.

| Shape * | AREA       | STATE_NAME   | STAT | SUB_REGI | STA | POP1990 | POP2000 | POP9 | Company Name            | Execut | Executive | Address               | City          | State  | ZIP Code | Record Type |
|---------|------------|--------------|------|----------|-----|---------|---------|------|-------------------------|--------|-----------|-----------------------|---------------|--------|----------|-------------|
| Polygon | 6380.614   | Hawaii       | 15   | Pacific  | HI  | 1108229 | 1184688 | 174  | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 67290.061  | Washington   | 53   | Pacific  | WA  | 4866692 | 5835089 | 72   | UMAI Bento              | <Null> | <Null>    | 17306 Pacific Ave S   | Spanaway      | WA     | 98387    | Verified    |
| Polygon | 147244.653 | Montana      | 30   | Mtn      | MT  | 799065  | 885795  | 5    | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 32161.925  | Maine        | 23   | N Eng    | ME  | 1227928 | 1257219 | 38   | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 70812.056  | North Dakota | 38   | W N Cen  | ND  | 638800  | 631032  | 9    | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 77195.055  | South Dakota | 46   | W N Cen  | SD  | 696004  | 734993  | 9    | American Colloid Co     | Bill   | Rhoades   | 10881 US Highway 212  | Belle Fourche | SD     | 57717    | Verified    |
| Polygon | 97803.199  | Wyoming      | 56   | Mtn      | WY  | 453588  | 479673  | 5    | American Colloid Co     | Steve  | Wilkerson | 92 State Highway 37   | Lovell        | WY     | 82431    | Verified    |
| Polygon | 56088.178  | Wisconsin    | 55   | E N Cen  | WI  | 4891769 | 5277833 | 87   | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 83343.643  | Idaho        | 16   | Mtn      | ID  | 1006749 | 1273309 | 12   | Carco Mineral Resources | Colby  | Porter    | 520 Blomquist Ave     | Caldwell      | ID     | 83605    | Verified    |
| Polygon | 9603.272   | Vermont      | 50   | N Eng    | VT  | 562758  | 596714  | 59   | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 84520.49   | Minnesota    | 27   | W N Cen  | MN  | 4375099 | 4820250 | 52   | <Null>                  | <Null> | <Null>    | <Null>                | <Null>        | <Null> | <Null>   | <Null>      |
| Polygon | 97073.594  | Oregon       | 41   | Pacific  | OR  | 2842321 | 3356108 | 29   | Able Supply LLC         | Kevin  | Peterman  | 60005 Cinder Butte Rd | Bend          | OR     | 97702    | Verified    |

New fields from joined table, nulls where there was no match.



Joined tables are also ephemeral, and joins are easy to remove. If you will need to use the joined layer repeatedly, be sure to export.

\*Note that this join was “one-to-one.” The states layer still has 51 records. Where there were duplicates, the first record was chosen. There are ways to join one-to-many and many-to-one.

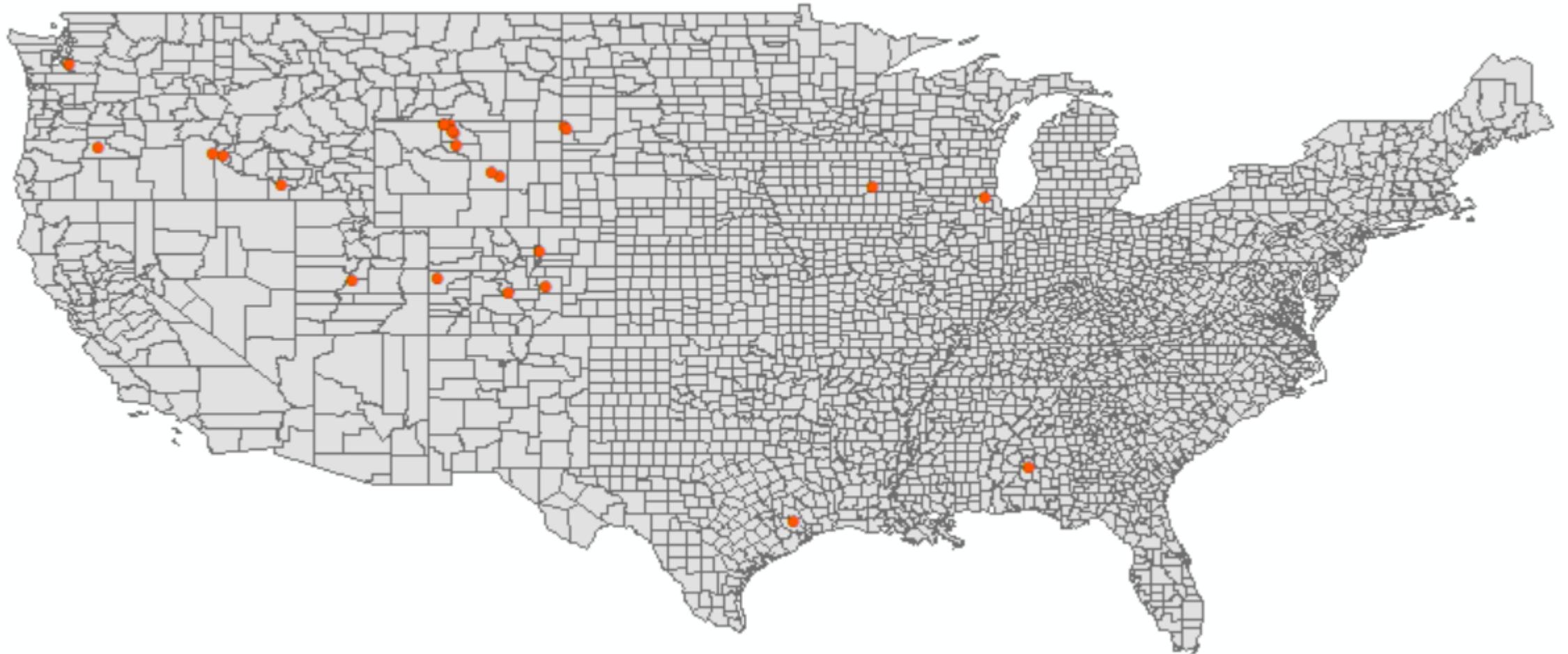


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# Spatial Joins

Sometimes it can be helpful to join two spatial layers together, based on the spatial locations of their features.

For example, it might be useful to know which county each mine is in. Or, we might want to know which counties have a mine and how many.



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 data from another layer based on spatial location

1. Choose the layer to join to this layer, or load spatial data from disk:

U.S. Counties (Generalized)

2. You are joining: Polygons to Points

Select a join feature class above. You will be given different options based on geometry types of the source feature class and the join feature class.

Each point will be given all the attributes of the polygon that:

it falls inside.

If a point falls inside more than one polygon (for example, because the layer being joined contains overlapping polygons) the attributes of the first polygon found will be joined.

is closest to it.

A distance field is added showing how close the polygon is to the point (in the units of the target layer). A polygon that the point falls inside is treated as being closest to the point (i.e. a distance of 0).

3. The result of the join will be saved into a new layer.

Specify output shapefile or feature class for this new layer:

C:\Users\jlk720\Desktop\Lidar\Clips\Join\_Output.shp

[About joining data](#)

In ArcMap, the join dialog box has a spatial option. There is also a toolbox tool for Spatial Join.

When the points are used as the target layer (left-hand), new fields are added showing which county each falls in.

This join is many-to-one -- several mines are joined to the same county, with duplicate copies of the county record.

| FID | Shape | FID_1 | Company_Na                     | Executive | Executiv_1 | Address                 | City             | State | ZIP_Code | OBJECTID | NAME       | STATE_NAME   | STATE | CNTY | FIPS  | AREA      |
|-----|-------|-------|--------------------------------|-----------|------------|-------------------------|------------------|-------|----------|----------|------------|--------------|-------|------|-------|-----------|
| 0   | Point | 15    | UMAI Bento                     |           |            | 17306 Pacific Ave S     | Spanaway         | WA    | 98387    | 109      | Pierce     | Washington   | 53    | 053  | 53053 | 1651.7448 |
| 1   | Point | 11    | American Colloid Co            | Bill      | Rhoades    | 10881 US Highway 212    | Belle Fourche    | SD    | 57717    | 266      | Butte      | South Dakota | 46    | 019  | 46019 | 2254.2821 |
| 2   | Point | 12    | Bpm Minerals LLC               |           |            | 554 Highway 212         | Belle Fourche    | SD    | 57717    | 266      | Butte      | South Dakota | 46    | 019  | 46019 | 2254.2821 |
| 3   | Point | 16    | American Colloid Co            | Steve     | Wilkerson  | 92 State Highway 37     | Lovell           | WY    | 82431    | 286      | Big Horn   | Wyoming      | 56    | 003  | 56003 | 3177.1241 |
| 4   | Point | 17    | Bentonite Performance Minerals | Alan      | Synder     | 789 US Highway 14a E    | Lovell           | WY    | 82431    | 286      | Big Horn   | Wyoming      | 56    | 003  | 56003 | 3177.1241 |
| 5   | Point | 20    | M-I SWACO                      | Joe       | Cheatham   | Road 26 Lane 33         | Greybull         | WY    | 82426    | 286      | Big Horn   | Wyoming      | 56    | 003  | 56003 | 3177.1241 |
| 6   | Point | 22    | Wyo-Ben Inc                    | Rick      | Magstadt   | 2700 Road 26            | Greybull         | WY    | 82426    | 286      | Big Horn   | Wyoming      | 56    | 003  | 56003 | 3177.1241 |
| 7   | Point | 23    | Wyo-Ben Inc                    | Steve     | Banks      | 1062 Road 9             | Lovell           | WY    | 82431    | 286      | Big Horn   | Wyoming      | 56    | 003  | 56003 | 3177.1241 |
| 8   | Point | 10    | Teague Mineral Products        | April     | Tyre       | 1925 Highway 201        | Adrian           | OR    | 97901    | 346      | Malheur    | Oregon       | 41    | 045  | 41045 | 9884.2433 |
| 9   | Point | 9     | Able Supply LLC                | Kevin     | Peterman   | 60005 Cinder Butte Rd   | Bend             | OR    | 97702    | 349      | Deschutes  | Oregon       | 41    | 017  | 41017 | 3051.1469 |
| 10  | Point | 19    | Black Hills Bentonite Co       | Dale      | Grenier    | 1025 Lane 10 1/2        | Worland          | WY    | 82401    | 378      | Washakie   | Wyoming      | 56    | 043  | 56043 | 2233.3898 |
| 11  | Point | 6     | Carco Mineral Resources        | Colby     | Porter     | 520 Blomquist Ave       | Caldwell         | ID    | 83605    | 399      | Canyon     | Idaho        | 16    | 027  | 16027 | 603.2971  |
| 12  | Point | 18    | Black Hills Bentonite          | Tom       | Thorson    | 55 Salt Creek Hwy       | Casper           | WY    | 82601    | 435      | Natrona    | Wyoming      | 56    | 025  | 56025 | 5348.6869 |
| 13  | Point | 21    | Tolsa Wyoming Bentonite Corp   |           |            | 12050 Bucknum Rd        | Casper           | WY    | 82604    | 435      | Natrona    | Wyoming      | 56    | 025  | 56025 | 5348.6869 |
| 14  | Point | 7     | Walker Water Systems Inc       | Cynthia   | Coffer     | 624 Pierce St           | Twin Falls       | ID    | 83301    | 506      | Twin Falls | Idaho        | 16    | 083  | 16083 | 1908.7654 |
| 15  | Point | 5     | S & B Indl Minerals Na INC     | Ed        | Jessen     | 307 Vaughn St           | Waterloo         | IA    | 50701    | 533      | Black Hawk | Iowa         | 19    | 013  | 19013 | 575.4181  |
| 16  | Point | 1     | B H S Marketing                | Doug      | Massey     | 3450 County Road 27 # 7 | Fort Lupton      | CO    | 80621    | 792      | Weld       | Colorado     | 08    | 123  | 08123 | 4063.1763 |
| 17  | Point | 4     | H & H Environmental Inc        | Don       | Kendall    | 360 Teegan Ct           | Grand Junction   | CO    | 81507    | 1168     | Mesa       | Colorado     | 08    | 077  | 08077 | 3326.245  |
| 18  | Point | 3     | Front Range Winwater Works Co  | Marvin    | Moler      | 7006 Space Village Ave  | Colorado Springs | CO    | 80929    | 1231     | El Paso    | Colorado     | 08    | 041  | 08041 | 2116.2196 |
| 19  | Point | 2     | First Bentonite                | Pam       | Wedige     | 215 Teller St           | Salida           | CO    | 81201    | 1248     | Chaffee    | Colorado     | 08    | 015  | 08015 | 1007.8322 |
| 20  | Point | 14    | Redmond Minerals               | Rusty     | Bastain    | 6005 N 100 W            | Redmond          | UT    | 84652    | 1252     | Sevier     | Utah         | 49    | 041  | 49041 | 1926.8975 |
| 21  | Point | 0     | American Colloid Co            | Ben       | Grimes     | Highway 31              | Fort Deposit     | AL    | 36032    | 2623     | Butler     | Alabama      | 01    | 013  | 01013 | 781.8795  |

(0 out of 24 Selected)

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 data from another layer based on spatial location

1. Choose the layer to join to this layer, or load spatial data from disk:

CatLitterMines

2. You are joining: Points to Polygons

Select a join feature class above. You will be given different options based on geometry types of the source feature class and the join feature class.

Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it.

How do you want the attributes to be summarized?

Average  Minimum  Standard Deviation

Sum  Maximum  Variance

Each polygon will be given all the attributes of the point that is closest to its boundary, and a distance field showing how close the point is (in the units of the target layer).

Note: A point falling inside a polygon is treated as being closest to the polygon, (i.e. a distance of 0).

3. The result of the join will be saved into a new layer.

Specify output shapefile or feature class for this new layer:

C:\Users\jik720\Desktop\Lidar\Clips\Join\_Output\_2.shp

[About joining data](#)

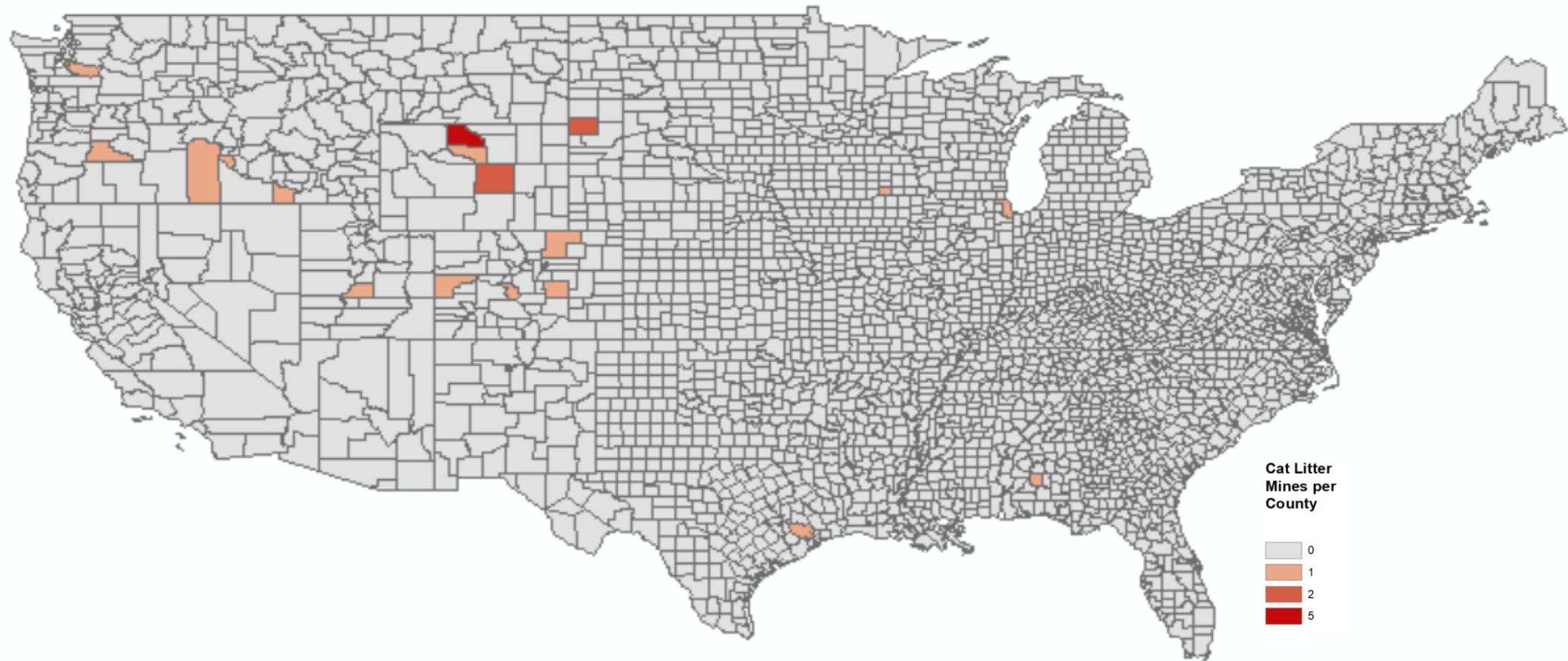
When the county polygons are used as the target layer, new choices have to be made.

New fields are added to the counties, including a count of how many cat litter mines each county contained, and most unhelpfully, the average zip code and coordinates of the mine. Be careful when you ask for statistics!!

This join is one-to-many, where the many mines are summarized to one value per county.

| FID  | Shape   | OBJECT | NAME              | STATE_NAME   | STAT | CNTY | FIPS  | AREA      | POP1990 | POP2000 | POP90_SQ | Count_ | Avg_ZIP_Co | Avg_Latitu | Avg_Longit  |
|------|---------|--------|-------------------|--------------|------|------|-------|-----------|---------|---------|----------|--------|------------|------------|-------------|
| 285  | Polygon | 286    | Big Horn          | Wyoming      | 56   | 003  | 56003 | 3177.1241 | 10525   | 11222   | 3        | 5      | 82429      | 44.724607  | -108.237003 |
| 265  | Polygon | 266    | Butte             | South Dakota | 46   | 019  | 46019 | 2254.2821 | 7914    | 8686    | 4        | 2      | 57717      | 44.696139  | -103.872531 |
| 434  | Polygon | 435    | Natrona           | Wyoming      | 56   | 025  | 56025 | 5348.6869 | 61226   | 63021   | 11       | 2      | 82602.5    | 42.934435  | -106.47845  |
| 108  | Polygon | 109    | Pierce            | Washington   | 53   | 053  | 53053 | 1651.7448 | 586203  | 700858  | 355      | 1      | 98387      | 47.09903   | -122.43437  |
| 345  | Polygon | 346    | Malheur           | Oregon       | 41   | 045  | 41045 | 9884.2433 | 26038   | 28480   | 3        | 1      | 97901      | 43.708155  | -117.087746 |
| 348  | Polygon | 349    | Deschutes         | Oregon       | 41   | 017  | 41017 | 3051.1469 | 74958   | 115342  | 25       | 1      | 97702      | 43.979827  | -121.362829 |
| 377  | Polygon | 378    | Washakie          | Wyoming      | 56   | 043  | 56043 | 2233.3898 | 8388    | 8496    | 4        | 1      | 82401      | 44.015207  | -107.959879 |
| 398  | Polygon | 399    | Canyon            | Idaho        | 16   | 027  | 16027 | 603.2971  | 90076   | 128486  | 149      | 1      | 83605      | 43.665679  | -116.702311 |
| 505  | Polygon | 506    | Twin Falls        | Idaho        | 16   | 083  | 16083 | 1908.7654 | 53580   | 63800   | 28       | 1      | 83301      | 42.572737  | -114.463671 |
| 532  | Polygon | 533    | Black Hawk        | Iowa         | 19   | 013  | 19013 | 575.4181  | 123798  | 119540  | 215      | 1      | 50701      | 42.500879  | -92.365034  |
| 791  | Polygon | 792    | Weld              | Colorado     | 08   | 123  | 08123 | 4063.1763 | 131821  | 171203  | 32       | 1      | 80621      | 40.049654  | -104.810413 |
| 1167 | Polygon | 1168   | Mesa              | Colorado     | 08   | 077  | 08077 | 3326.245  | 93145   | 117425  | 28       | 1      | 81507      | 39.05843   | -108.64061  |
| 1230 | Polygon | 1231   | El Paso           | Colorado     | 08   | 041  | 08041 | 2116.2196 | 397014  | 509408  | 188      | 1      | 80929      | 38.782284  | -104.613156 |
| 1247 | Polygon | 1248   | Chaffee           | Colorado     | 08   | 015  | 08015 | 1007.8322 | 12684   | 15913   | 13       | 1      | 81201      | 38.529675  | -105.992003 |
| 1251 | Polygon | 1252   | Sevier            | Utah         | 49   | 041  | 49041 | 1926.8975 | 15431   | 18968   | 8        | 1      | 84652      | 39.005692  | -111.86618  |
| 2622 | Polygon | 2623   | Butler            | Alabama      | 01   | 013  | 01013 | 781.8795  | 21892   | 21424   | 28       | 1      | 36032      | 31.955989  | -86.554298  |
| 2822 | Polygon | 2823   | Harris            | Texas        | 48   | 201  | 48201 | 1741.4574 | 2818199 | 3302269 | 1618     | 1      | 77032      | 29.935579  | -95.339854  |
| 3085 | Polygon | 3086   | Cook              | Illinois     | 17   | 031  | 17031 | 964.9506  | 5105067 | 5192969 | 5290     | 1      | 60192      | 42.075812  | -88.198936  |
| 0    | Polygon | 1      | Lake of the Woods | Minnesota    | 27   | 077  | 27077 | 1784.0634 | 4076    | 4651    | 2        | 0      | 0          | 0          | 0           |
| 1    | Polygon | 2      | Ferry             | Washington   | 53   | 019  | 53019 | 2280.2319 | 6295    | 7199    | 3        | 0      | 0          | 0          | 0           |
| 2    | Polygon | 3      | Stevens           | Washington   | 53   | 065  | 53065 | 2529.9794 | 30948   | 40652   | 12       | 0      | 0          | 0          | 0           |
| 3    | Polygon | 4      | Okanogan          | Washington   | 53   | 047  | 53047 | 5306.18   | 33350   | 38640   | 6        | 0      | 0          | 0          | 0           |
| 4    | Polygon | 5      | Pend Oreille      | Washington   | 53   | 051  | 53051 | 1445.0286 | 8915    | 11752   | 6        | 0      | 0          | 0          | 0           |

The “count” field allows us to symbolize the map to show the abundance of cat litter mines by county.



\*Note: in ArcMap, the output of a Spatial Join is durable – a new saved shapefile.



