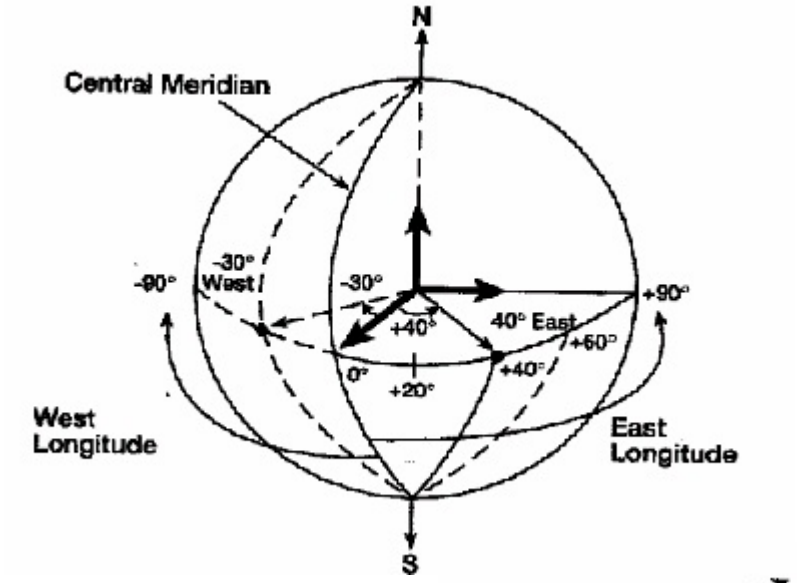
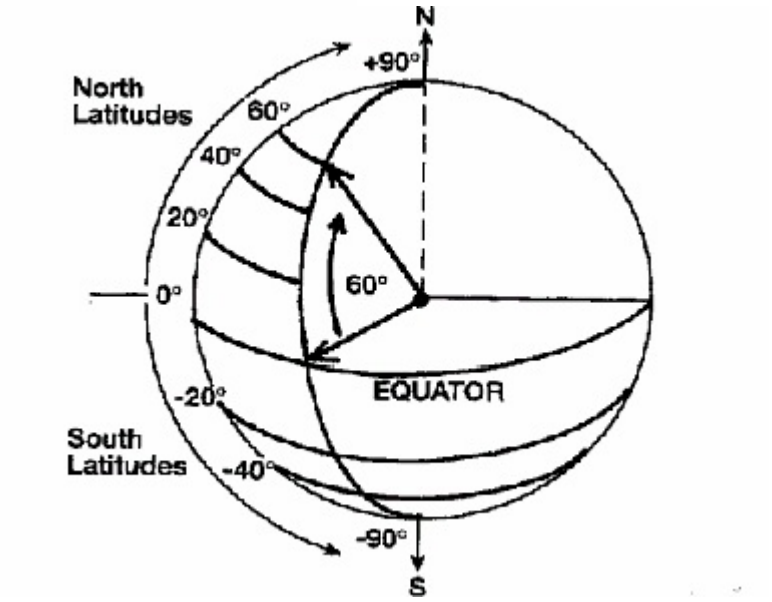
Understanding Coordinates and Projections

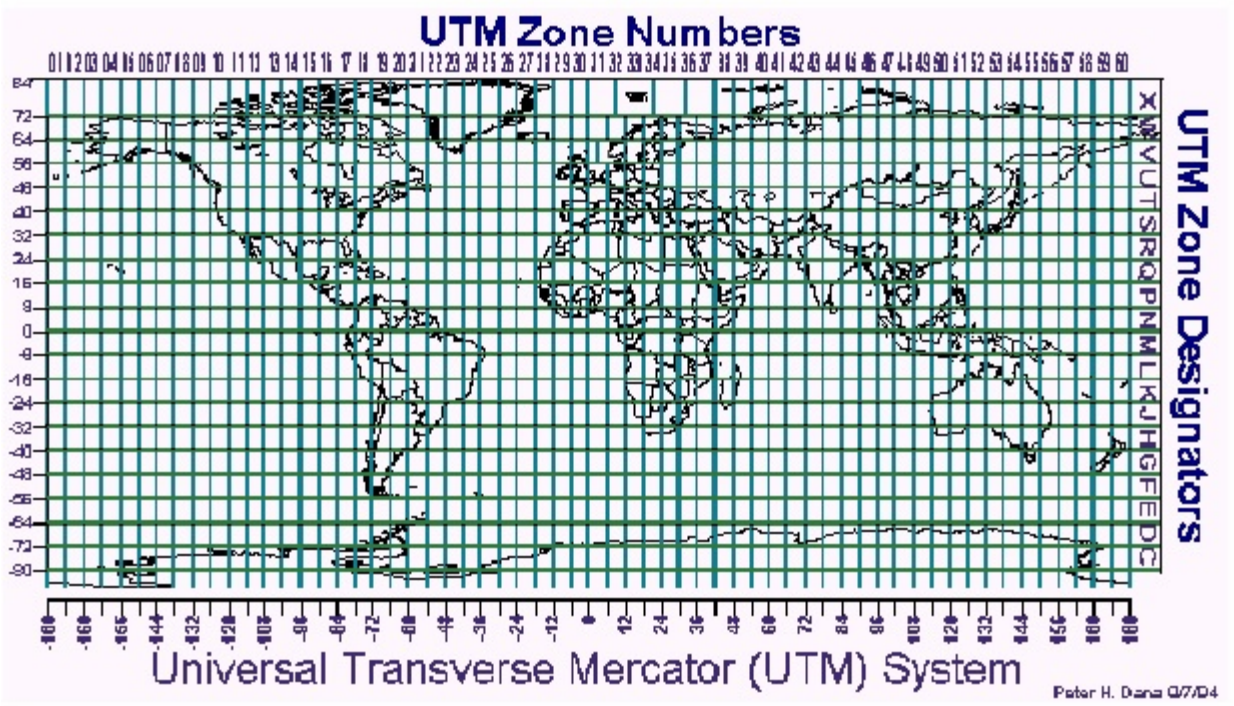
Geographic Coordinate System

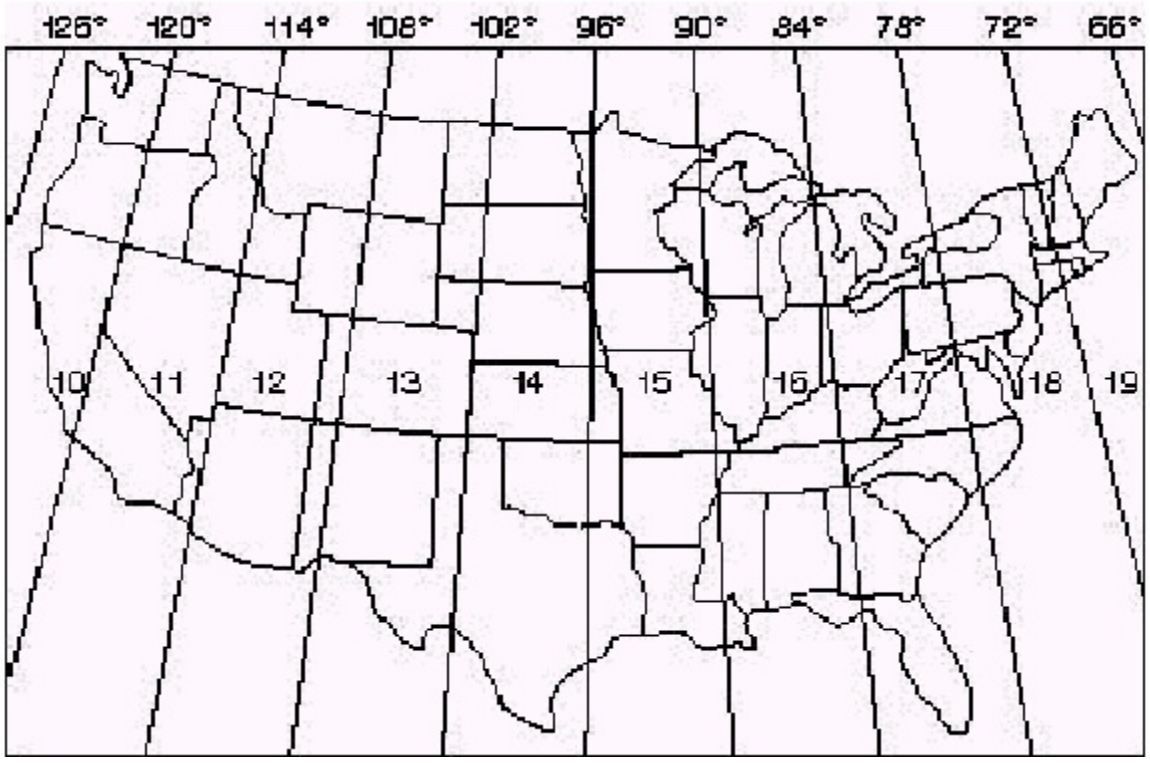




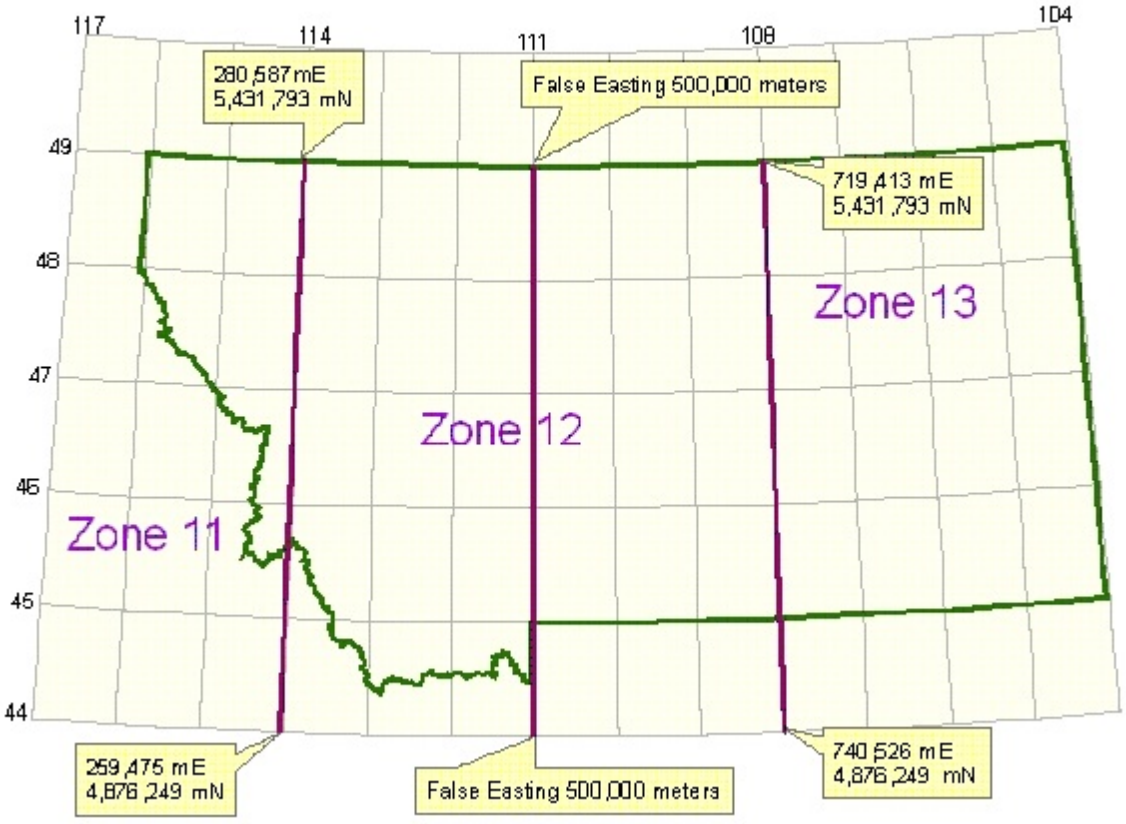
Decimal Degrees - hddd.dddd°
Decimal Degree Minute - hddd.mm.mmm°
Decimal Degree Minutes Seconds - Hddd.mm'ss.s°

Universal Transverse Mercator (UTM)
Metric system, used by all Federal Agencies
Easting lines are the north/south lines and can only be moved east or west
Northing lines run east and west and can only be moved north or south
Locations within a zone (6 degrees Longitude) are measured in meters from the central meridian of the zone and northward from the equator


UTM Zone Numbers
UTM Zone Designators
Universal Transverse Mercator (UTM) System
Peter H. Dana 07/04


126°
120°
114°
108°
102°
96°
90°
84°
78°
72°
66°
10
11
12
13
14
15
16
17
18
19

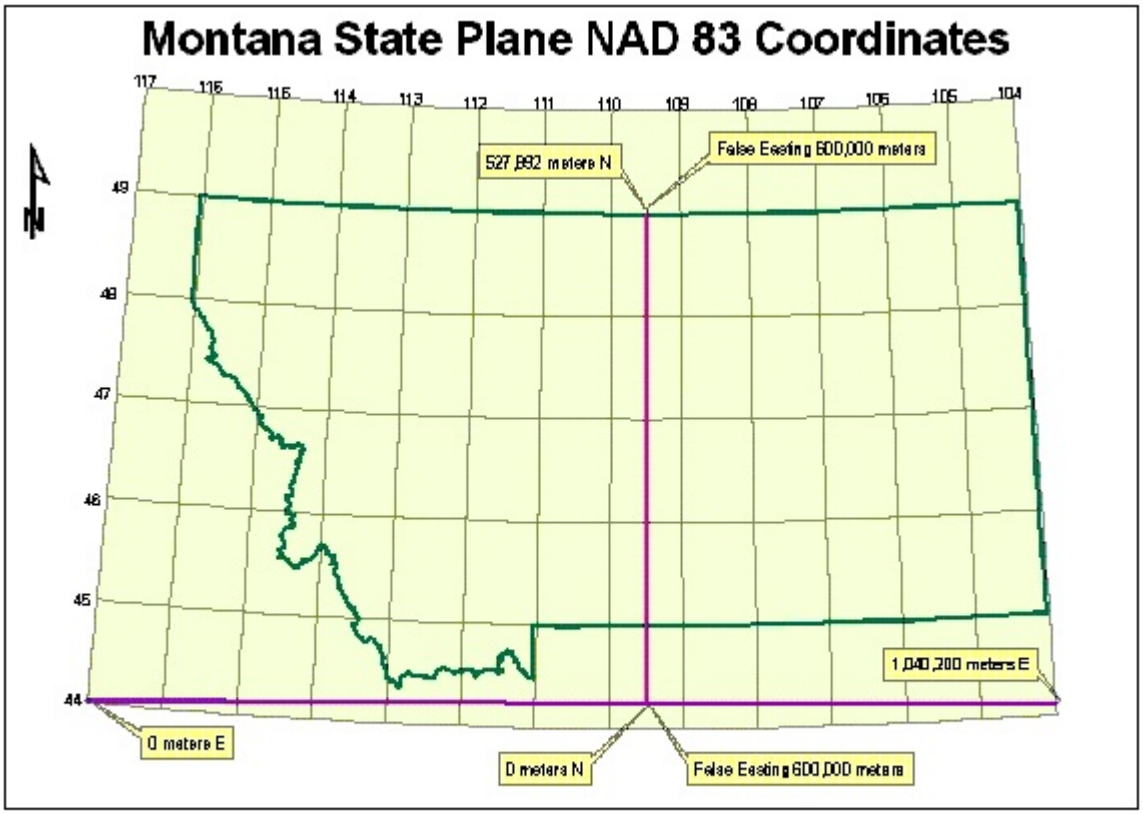
UTM Zones in Montana



State Plane Coordinate System

Based on a grid system.
Each State has one or more zones, using transverse Mercator projection or Lambert projection
Mercator zones were limited to 158 miles East-West direction
Lambert zones were limited to 158 miles in a North-South direction

Montana State Plane



NAD 83 - North American Datum was created in 1983 using an Earth-centered NAD83 Ellipsoid GRS80. This moved the center of the datum south and to the east. This results in about 150 feet of misalignment between NAD27 and NAD 83.

NAD27 - North American Datum Developed in 1927 using the Ellipsoid Clarke 1866. The center on the Meades Ranch, Kansas. If you try to project NAD27 and NAD 83 in the same document your data will be miss aligned by 150-200 feet.

WGS 84 - World Geodetic System This is the common coordinate system used by the GPS receiver. It will align up perfectly with NAD83.

NAD83 and WGS84 are based on newer spheroids are developed from satellite measurement and are more accurate than those developed in the 19th and early 20th centuries.

Comparison of geographic coordinates for Bellingham, Washington

Datum	Longitude	Latitude
NAD 1927	**-122.466903686523**	**48.7440490722656**
NAD 1983	**-122.46818353793**	**48.7438798543649**
WGS 1984	**-122.46818353793**	**48.7483798534299**

Geographic vs projected coordinates

A geographic coordinate system uses a three-dimensional spherical surface to define location on earth. It includes an angular unit of measurement, a prime meridian and a datum.

A projected coordinate system is defined on a flat, two-dimensional surface. This system has consistent lengths, angles, and areas across the two dimension

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Changes in Distance with Latitude and Longitude

Lengths of Degrees of the Meridian

Lat. Degrees	Statute Miles	Lat.	Statute Miles
0-1	68.703	45-46	69.060
1-2	68.704	46-47	69.072
2-3	68.705	47-48	69.084
3-4	68.706	48-49	69.096
4-5	68.707	49-50	69.108
5-6	68.710	50-51	69.121
6-7	68.712	51-52	69.133
7-8	68.715	52-53	69.145
8-9	68.718	53-54	69.156
9-10	68.722	54-55	69.168
10-11	68.726	55-56	69.180
11-12	68.731	56-57	69.191
12-13	68.736	57-58	69.202
13-14	68.741	58-59	69.213
14-15	68.747	59-60	69.224
15-16	68.753	60-61	69.235
16-17	68.759	61-62	69.246
17-18	68.766	62-63	69.256
18-19	68.773	63-64	69.266
19-20	68.781	64-65	69.275
20-21	68.789	65-66	69.285
21-22	68.797	66-67	69.294
22-23	68.805	67-68	69.303
23-24	68.814	68-69	69.311
24-25	68.823	69-70	69.320
25-26	68.833	70-71	69.328
26-27	68.842	71-72	69.328
27-28	68.852	72-73	69.343
28-29	68.862	73-74	69.349
29-30	68.873	74-75	69.356
30-31	68.883	75-76	69.362
31-32	68.894	76-77	69.368
32-33	68.905	77-78	69.373
33-34	68.916	78-79	69.378
34-35	68.928	79-80	69.383
35-36	68.939	80-81	69.387
36-37	68.951	81-82	69.391
37-38	68.962	82-83	69.395
38-39	68.974	83-84	69.398
39-40	68.986	84-85	69.400
40-41	68.998	85-86	69.402
41-42	69.011	86-87	69.404
42-43	69.023	87-88	69.405
43-44	69.035	88-89	69.406
44-45	69.047	89-90	69.407

Length of One Degree of Longitude at Different Latitudes

Lat. Degrees	Statute Miles	Lat.	Statute Miles
0	69.171	46	48.995
1	69.162	47	47.261
2	69.130	48	46.372
3	69.078	49	45.469
4	69.005	50	44.552
5	68.911	51	43.621
6	68.797	52	42.676
7	68.660	53	41.719
8	68.503	54	40.749
9	68.326	55	39.766
10	68.128	56	38.771
11	67.909	57	37.764
12	67.670	58	36.745
13	67.411	59	35.715
14	67.131	60	34.674
15	66.830	61	33.622
16	66.510	62	32.560
17	66.169	63	31.488
18	65.808	64	30.406
19	65.427	65	29.315
20	65.026	66	28.215
21	64.606	67	27.106
22	64.166	68	25.988
23	63.706	69	24.862
24	63.227	70	23.729
25	62.729	71	22.589
26	62.212	72	21.441
27	61.676	73	20.287
28	61.121	74	19.126
29	60.548	75	17.960
30	59.956	76	16.788
31	59.345	77	15.611
32	58.717	78	14.428
33	58.071	79	13.242
34	57.407	80	12.051
35	56.726	81	10.857
36	56.027	82	9.659
37	55.311	83	8.458
38	54.578	84	7.255
39	53.829	85	6.049
40	53.063	86	4.841
41	52.281	87	3.632
42	51.483	88	2.422
43	50.669	89	1.211
44	49.840	90	0.000
45	48.995		

Effects of a decimal place at 45 degrees latitude on accuracy

Width of 1 degree miles

	ft/m per mile		X.1	X.01	X.001	X.0001	X.00001	X.000001	X.0000001	X.0000000001
LATITUDE										
48.995	5280	258693.6	25869.36	2586.936	258.6936	25.86936	2.586936	0.258694	0.025869	0.0000258694
METERS										
48.995	1609.344	78849.81	7884.981	788.4981	78.84981	7.884981	0.788498	0.07885	0.007885	0.0000078850
LONGITUDE										
69.047	5280	364568.2	36456.82	3645.682	364.5682	36.45682	3.645682	0.364568	0.036457	0.0000364568
METERS										
69.047	1609.344	111120.4	11112.04	1111.204	111.1204	11.11204	1.111204	0.11112	0.011112	0.0000111120

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Querying Databases and Files

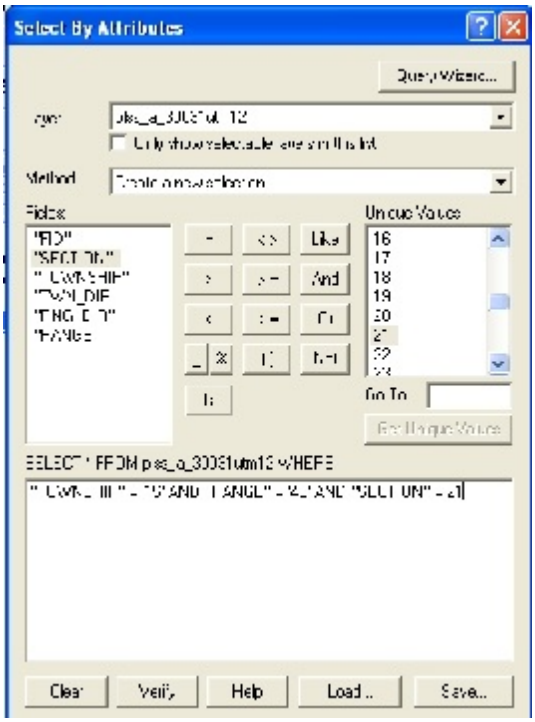
Purpose:
The purpose of this activity is to learn how to reduce the amount of data being examined, to find certain features, to classify features and to do statistics on the selected features.

Activity:

1.Open ArcMap and add Gallatin County **Cadastral** (06cad)layer and UTM Zone 12 Plss file **plss_a_30031utm12.shp**. Both data sets are on the CD provided by the instructors.

2.Click on **Selection** > **Select By Attribute.** The Select by Attribute Dialog will open.

3.We want to know the exact location of Section 21, in Township 1S, Range 4E. To locate this section we will build a query and save that query for modification the next time we want to search for a section.

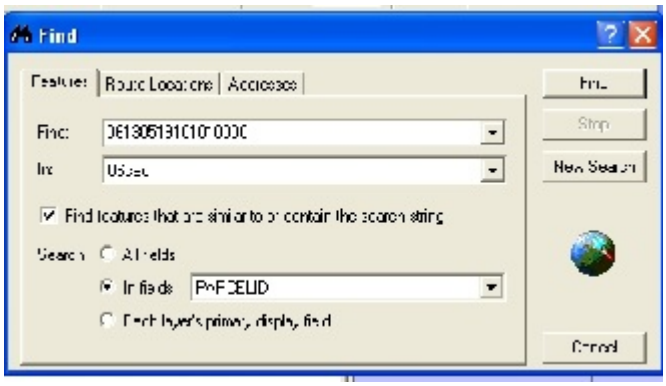


4.In the Select by Attribute dialog, set the layer to = **plss_a_30031utm12.shp.** Write the query by double-click on **Township** = and click on Get Unique Values and a listing of all the values associated with townships will appear. Click on "1S". You can then double-click on the correct value.), click **And,** double-click **Range** = >enter "4E" (Or select from Unique Values), click **And** Double-click on **Section = enter 21 > Verify** to determine if formula is correct > **Apply**. The section will appear as a selected feature in a cyan color. On the Selection Menu, use the zoom in tool to look at the section closer.

5.Before closing the Select by Attribute dialog, save the expression to a folder called expressions. It is suggested that you create a folder and call it Expressions. Call the file **Plss query**. The next time you want to locate a section, and you have opened the Select by Attribute dialog, click **Load and select the expression you saved.** You will need to change the numbers, making sure to only enter numbers between the " " marks.

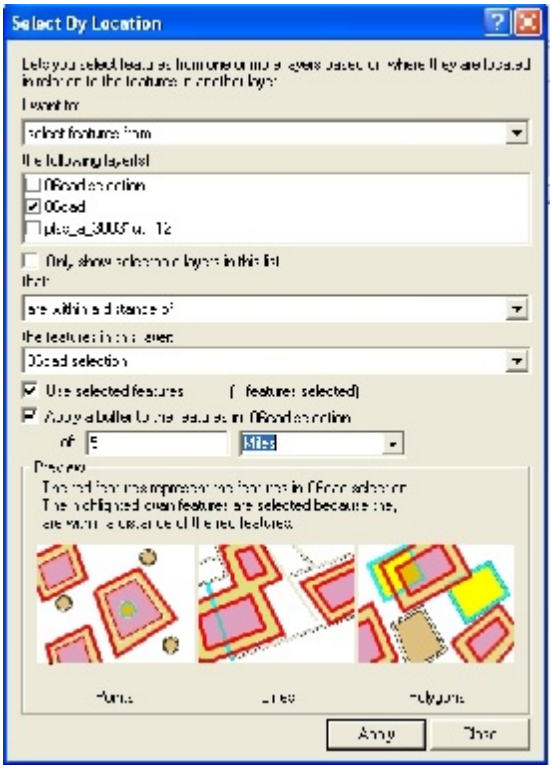
6.An alternative way to find a section is to use the TRS field in the Cadastral layer. To do this, click on the Selection menu > **Select by Attribute**, set the layer to select from to 06CAD. Double-click on TRS, click on = and type in 'T1SR4ES21' (Or get unique Values) > Verify > Apply. On the Selection Menu, use the zoom in tool to look at the section closer.

7.You can search for the property location by any of the features in the Attribute Table. Right-click on the 06cad layer > **Open Attribute table.** Examine the attribute data to learn what is contained in the table. Use the find tool to determine who the owner of ParcelID 06130519101010000 is. Your set up should match the image at the left. Use the identify tool to determine who owns this property.



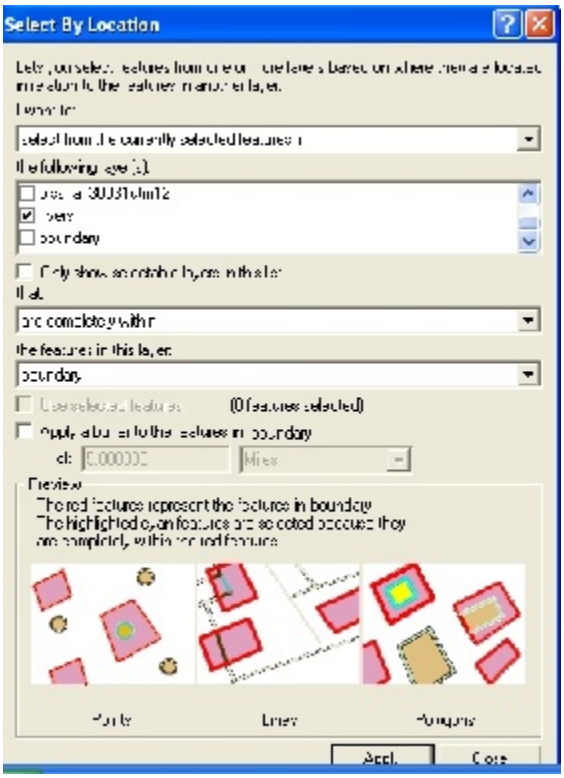
8.You are interested in know who are the private land owners in the county who control grazing acreage larger than 640 acres. Build a attribute query that will select those owners. **Selection > Select by Attribute . Create a query that looks like this: "GENDESCRIP"= 'private' AND "GRAZING_AC" > 640.** Click **Apply. Right-click** on 06CAD > **Open Attribute Table**, at the bottom of the table you should see that 25 records were selected. At the bottom of the Table click on **Selected.** All of the selected files will be shown and the rest of the files eliminated from this selection table. You are satisfied with the search and want to save the table for future references. Right-click on the **06cad layer > Selection> Create Layer From Selected Features**. The selected features will be included in a new layer added to the Table of Contents.

9.Features can also be selected by location. Location means by distance, by intersection with, contained with in etc. Use the **Select Features** tool from the main tool bar(Box with arrow) and click on a location on the **06cad Selection** layer. You may have to zoom in on the area to avoid getting more than one parcel selected. Click on **Selection > Select by Location. In the Select by Location** dialog Complete the sentence so it reads, **I want to select features from 06cad that are within a distance of the feature in this layer: o6cad selection. Check use selected feature. Apply a buffer to the features in 06cad of 5 miles** . Click **Apply**



10.Location and attribute queries can be used together to solve a problem. For example, if you have a client that want 600 plus acres located within 10 miles of a river having a minimum flow of 1500 CFI.

11.Add the Rivers.shp from the State Data and the Boundry.shp from the Gallatin Data. Right-click on the Rivers layer > **Open Attribute Table > Options** (located at the bottom of the table) > **Select By Attribute.** Write a query to find those rivers that have a **MNFLOW > 1500** (This refers to cubic feet per minute.) Selected features will be shown on the map. Next select **Selection Menu >Select by Location** and write a query statement that says: I want to **select from the currently selected features in** the following layers **rivers** that **are completely within** the features in this layer: **Boundary**. Click **Apply**. Right-click on **Rivers > selection > Zoom to selected feature**.



12.Now to find the property larger than 600 acres in the area around the selected river. Double-click the 06cad layer to open the layer properties dialog. On the **Definition tab click Query Builder.** Write a query that selects those properties where TOT_ACRES is greater than 600 > Verify > Ok. You should see the selected river with a minimum flow of 1500 and parcels of property that are greater that 600 acres. All other properties have been removed from the view.

A definition query resembles an attribute query in that you write an expression to find features with particular attributes. The difference is the features satisfying an attribute query are selected, while features satisfying a definition query are displayed and the rest are hidden.

13.Using the O6 CAD Layer, right click on the layer > Properties > Definition Query > Query Builder. Write a query that would select all those private parcels that have a tot_acres greater than 700 acres.

This activity has demonstrated just a few of the ways in which you can query and select data. With a little practice you will be able to locate any data contained in the attribute tables.

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