**GIS in Water Resources**
Fall 2018
Homework #1

Goal

The goal of this homework is to reinforce the lecture material on Geodesy, Map Projections and Coordinate Systems by having you identify attributes and perform hand calculations related to coordinate systems and distances between points on a spherical earth.

1. Coordinate System Parameters

The map below shows the continental United States in geographic coordinates overlaid by a grid which has 5° x 5° cells.
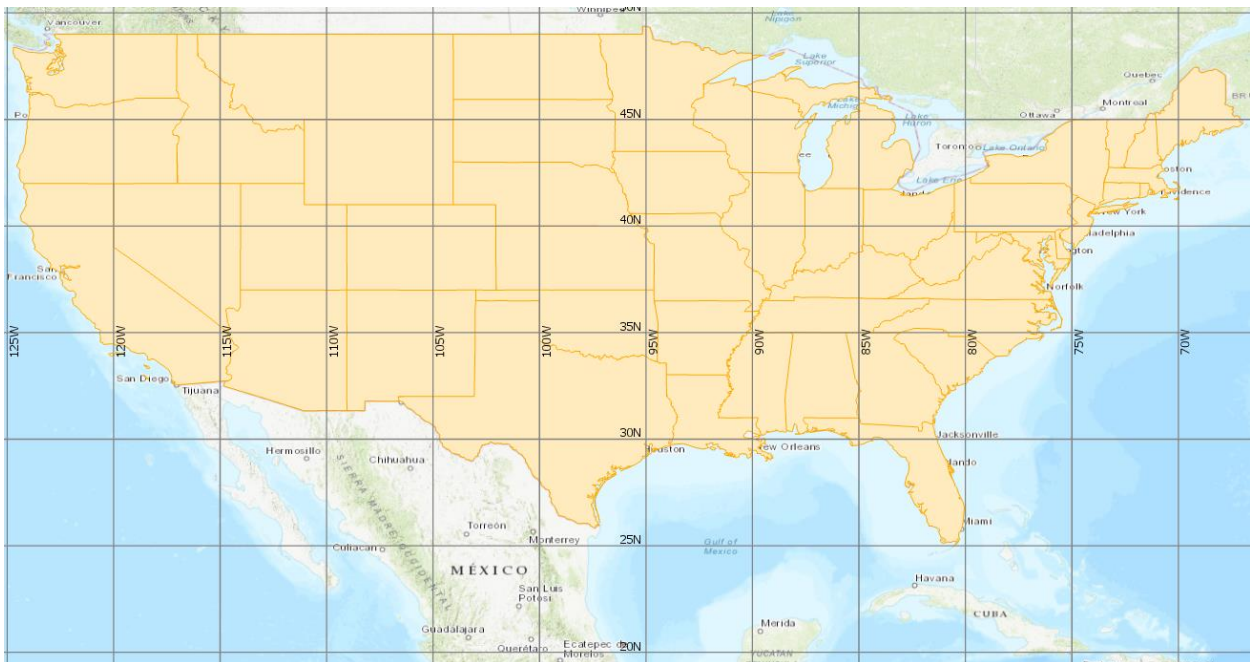
The parameters of the USA Contiguous Albers Equal Area Conic USGS version coordinate system as displayed in ArcGIS are given below. Draw on the map above the Central Meridian, Reference Latitude, and Standard Parallels used in this coordinate system.

Coordinate System Details	✕
Projected Coordinate System	USA Contiguous Albers Equal Area Conic USGS version
Projection	Albers
WKID	102039
Authority	Esri
Linear Unit	Meters (1.0)
False Easting	0.0
False Northing	0.0
Central Meridian	-96.0
Standard Parallel 1	29.5
Standard Parallel 2	45.5
Latitude Of Origin	23.0
Geographic coordinate system	GCS North American 1983
WKID	4269
Authority	EPSG
Angular Unit	Degree (0.0174532925199433)
Prime Meridian	Greenwich (0.0)
Datum	D North American 1983
Spheroid	GRS 1980
Semimajor Axis	6378137.0
Semiminor Axis	6356752.314140356
Inverse Flattening	298.257222101

a) Put a large dot at the intersection of the Central Meridian and Reference Latitude on the map and label this with the (X,Y) coordinates that this location has in the given coordinate system.

b) What earth surface property does the Albers projection preserve regardless of the projection parameters?

c) What earth datum is used with this coordinate system?

d) The geographic coordinates of Salt Lake City are: 40° 45' 39" N and 111° 53' 28" W The coordinates of New York City are: 40° 42' 51" N and 74° 0' 22" W. Calculate the coordinates for each of these in decimal degrees. Express your answers using 5 digits following the decimal point.

e) Note that the latitude of Salt Lake City and New York City is almost the same. Assuming a spherical earth with radius 6371.0 km, calculate the distance in km that New York is East of Salt Lake City along a latitude parallel.

f) Determine the distance that Salt Lake City is north of the Latitude of Origin in km.

g) Calculate the great circle distance between New York and Salt Lake City in km assuming a spherical earth with radius 6371.0 km.

h) Comment on the difference between the answers to (e) and (g) and the potential for fuel saving by airlines flying on great circle routes.

i) Use ArcGIS Pro to determine the precise coordinates of Salt Lake City and New York City in the USA Contiguous Albers Equal Area Conic USGS version coordinate system.

This can be done as follows

Use Excel to create a table with decimal degree Latitude and Longitude (This should be your answer to (d) above.

	A	B	C
1	Name	Latitude	Longitude
2	Salt Lake City	40.	-111.
3	New York City	40.	-74.

Open ArcGIS Pro and create a new project with a Map. Use Add Data to add your Excel Sheet. Right click on the Sheet Table and Display XY Data
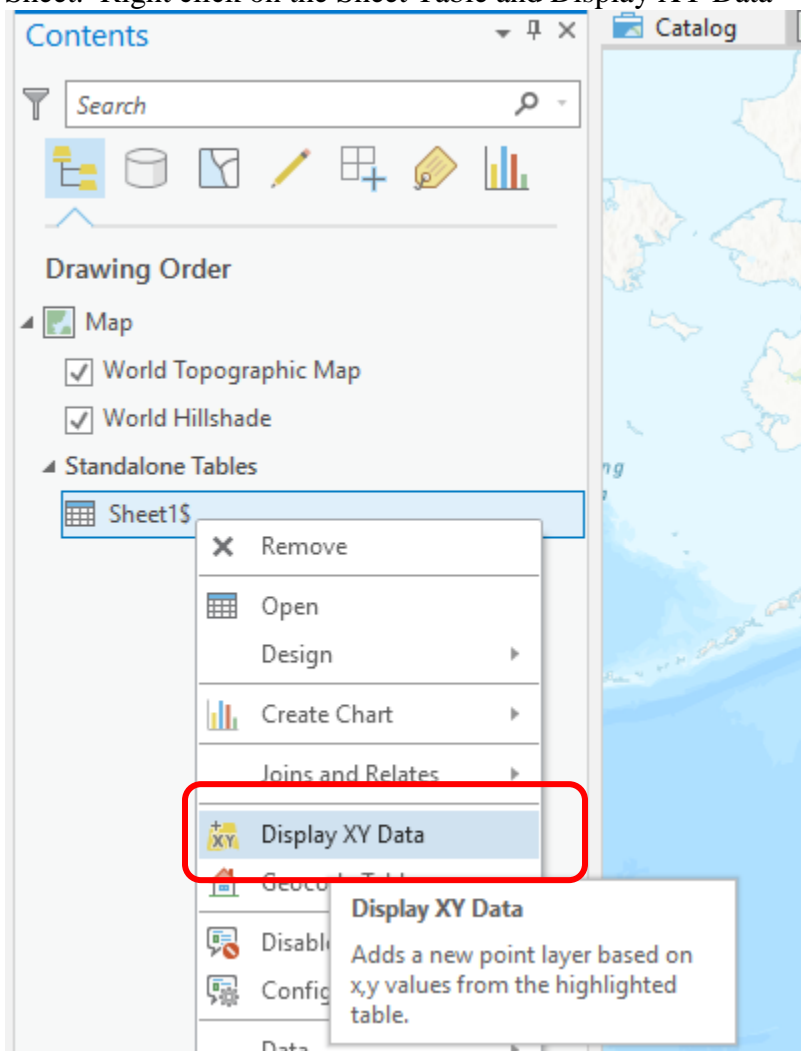
In the XY Table to Point Geoprocessing tool that opens set the Spatial Reference to NAD 1983 in the North America, USA and territories group. Here we are assuming the latitude and longitude information provided are with respect to the NAD 1983 datum.
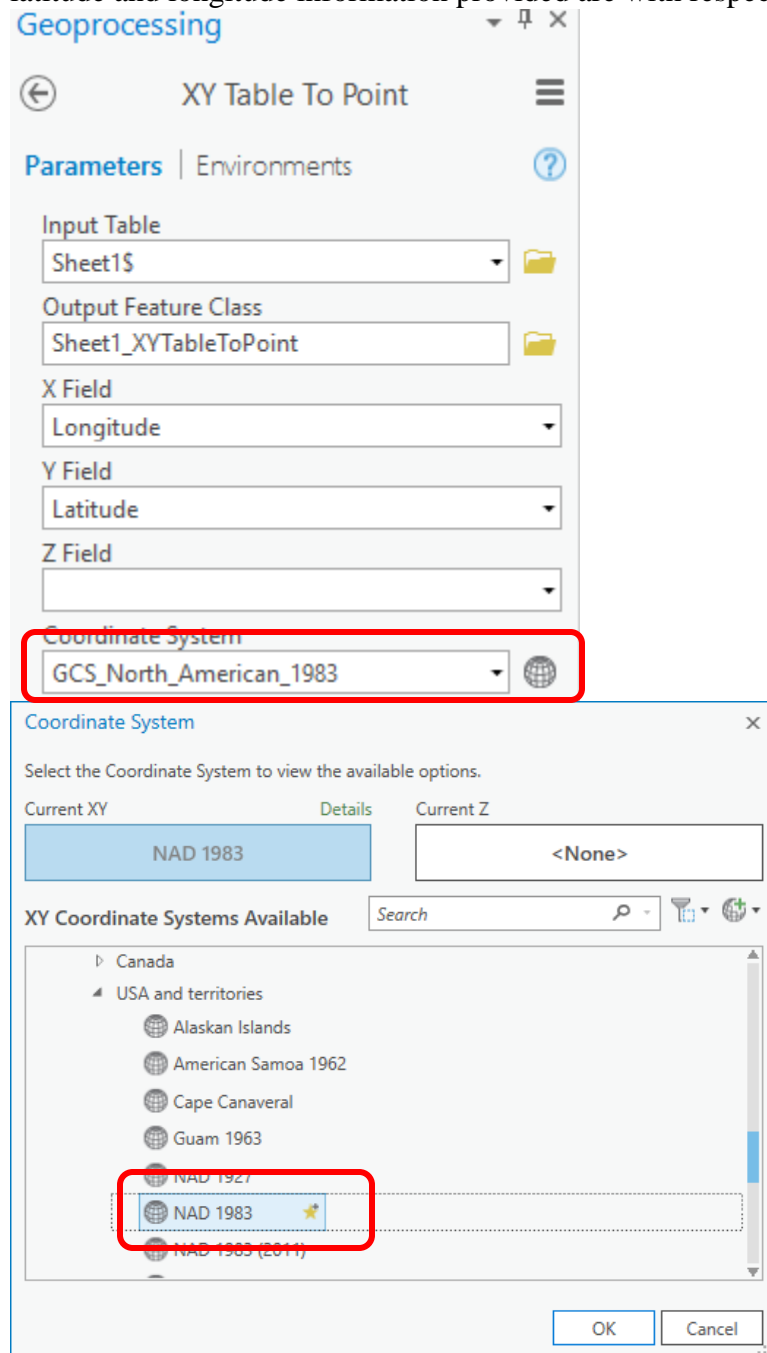

You should see two dots on your map, one for Salt Lake City and one for New York.

In Geoprocessing locate the Project tool and Project your Point Layer to a new Feature Class with USA Contiguous Albers Equal Area Conic USGS version coordinate system (in the Projected, Continental, North America group)
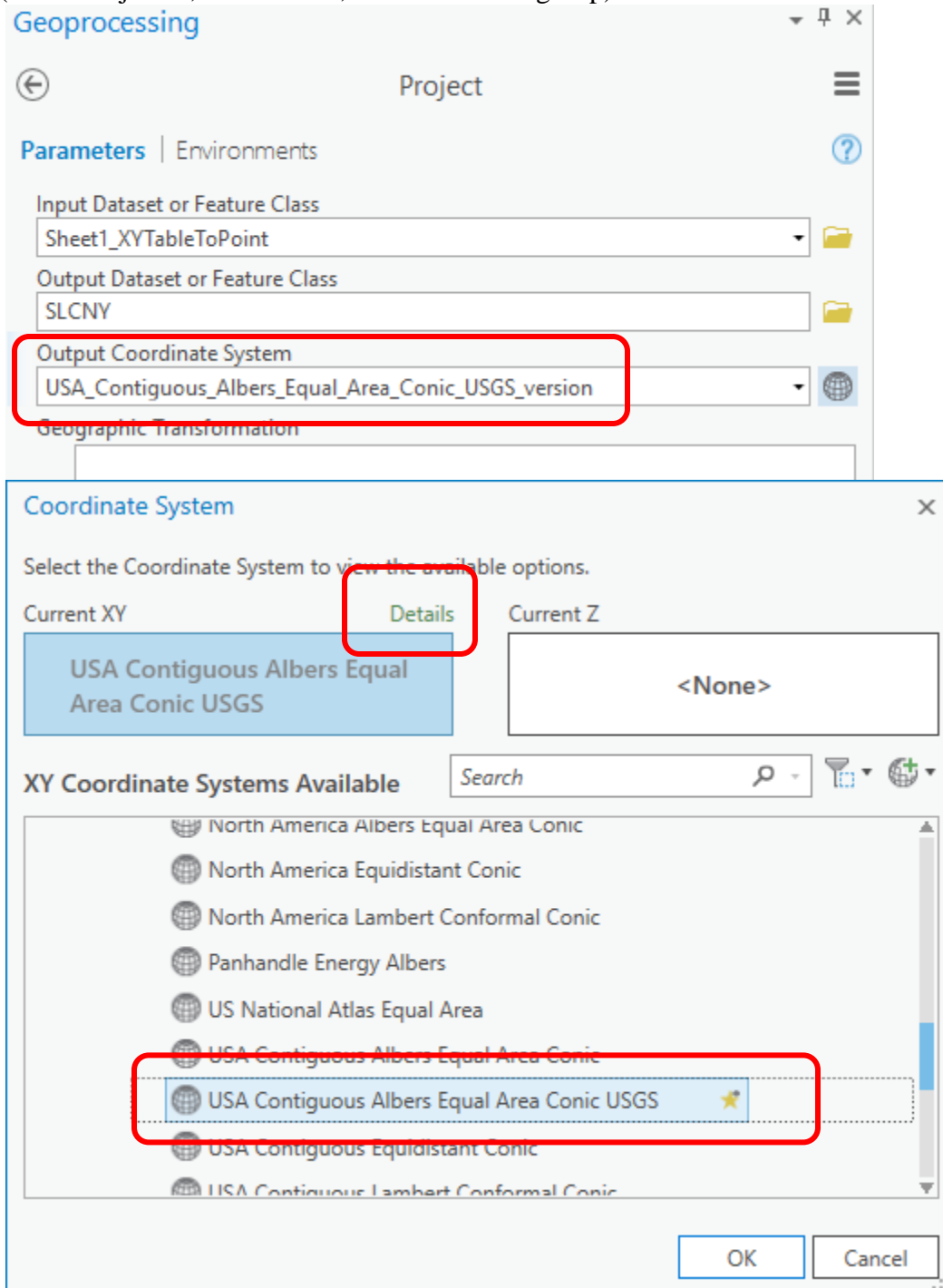
Click on Details for the coordinate system selected to verify that the details of this coordinate system are the same as specified above on page 2.

Locate the Add Geometry Attributes Tool and Run it for this Projected Feature Class
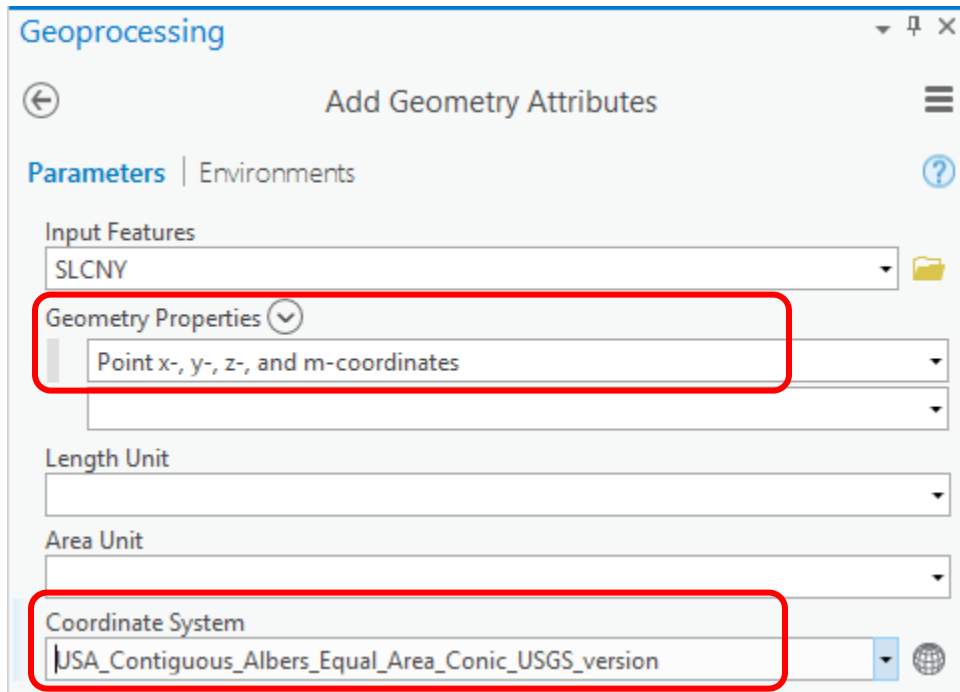
Open the attribute table of the Feature class and report the values of Point_X and Point_Y fields.

j) Reconcile your answer to (f) with results from (i) and comment on any differences.

k) Use the projected coordinates from (i) to calculate the distance from Salt Lake City to New York.

l) Explain why the distances from answers (e), (g) and (k) are different and provide a brief interpretation of these differences.

m) Noting that the UTM system has zones 6º wide and are counted from zone 1 immediately east of the international dateline (-180º to -174º) with central meridian -177º, determine the UTM zones for each of Salt Lake City and New York City.

2. Sizes of DEM Cells

The National Map Elevation Products (3DEP) have data available at 1 arc-sec resolution for most of North America.

The geographic coordinates of UT Austin are: 30° 17' 10" N and 97°44' 22" W. The geographic coordinates of Logan Utah are: 41° 44' 45" N and 111° 48' 30" W 41.

Assuming the earth is spherical with a radius of 6371 km, determine the lengths of the lines AB and BC in meters at these locations.
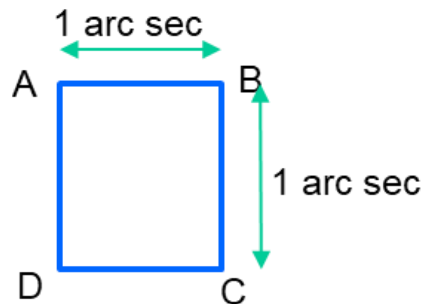
Determine the area of a 1 arc sec grid cell in Logan and in Austin in m^2.