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Title: GNSS Solutions 2.5 Reference Frame Adjustments

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Thesis: GNSS Solutions has been enhanced to support reference frame adjustments. It is now possible to enter control coordinates in ITRFxx reference frame and get NAD83-CORSxx adjusted outputs. However, existing users will need to make a few coordinate system changes to get expected results and to match previous GNSS Solutions results.

Assumption: You want NAD83 adjusted results (not ITRF). If you want ITRF adjusted results you will need to change this procedure slightly.

Short Answer:

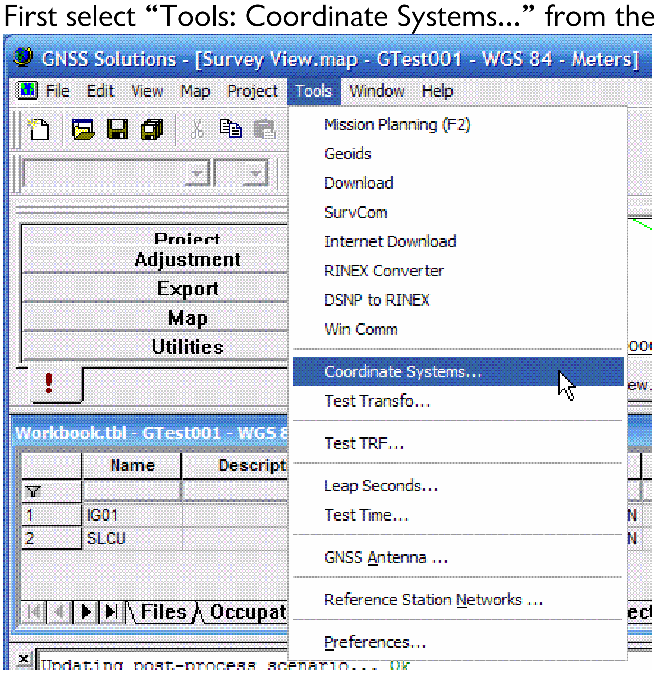
1. Use the predefined WGS-84 system for entering control points in geographic coordinates.

2. Override the default 'Predefined State Plane' Coordinate System to prevent GNSS Solutions from performing a reference frame adjustment.

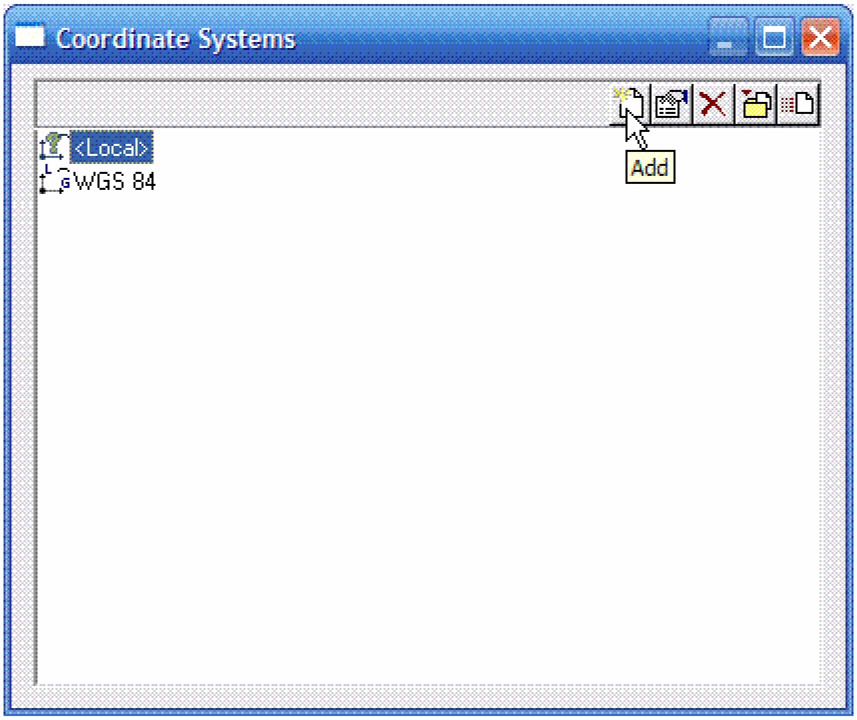
For example: To create a new "Utah Central NAD88" system follow these instructions:

Create A New Coordinate System

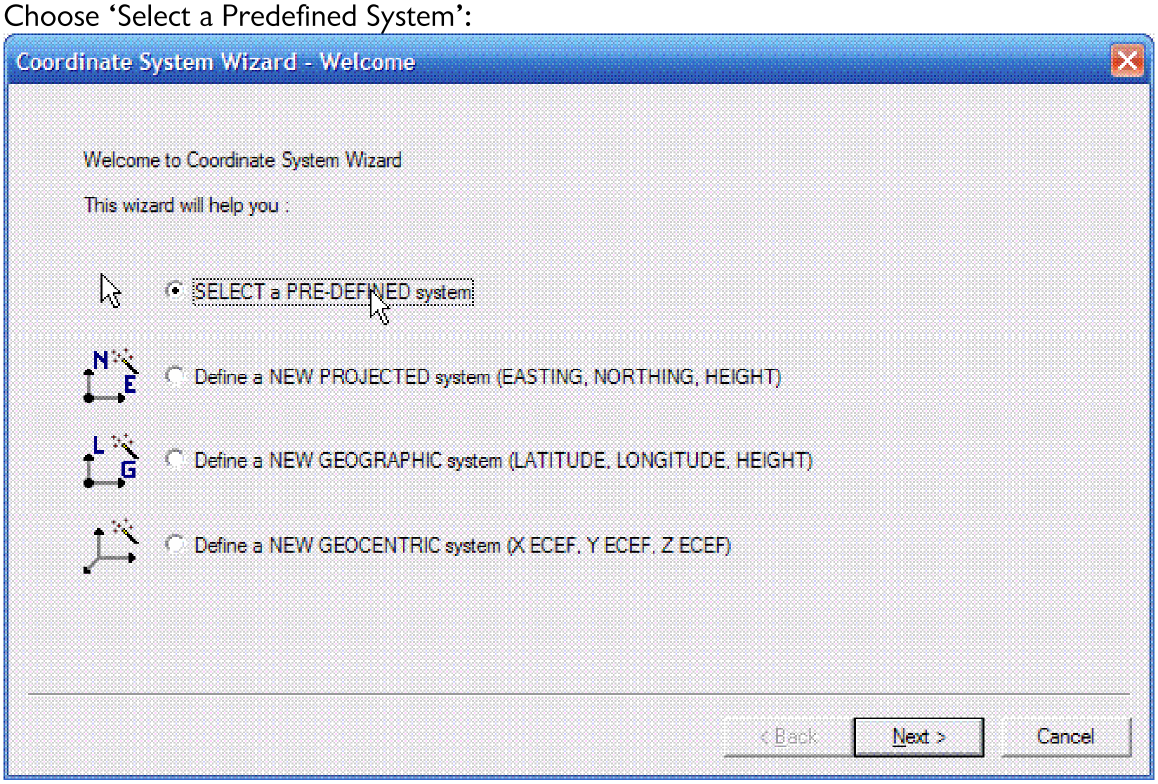
First select "Tools: Coordinate Systems..." from the main menu:



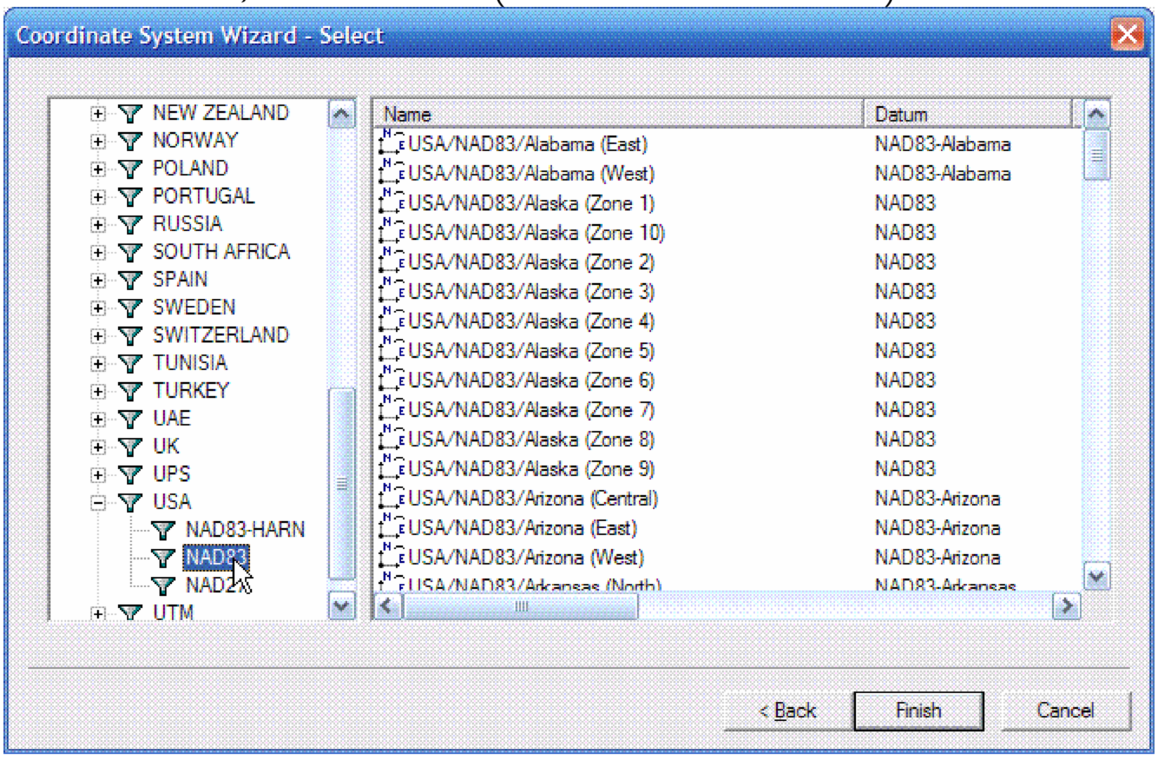
Click the ‘Add’ button:



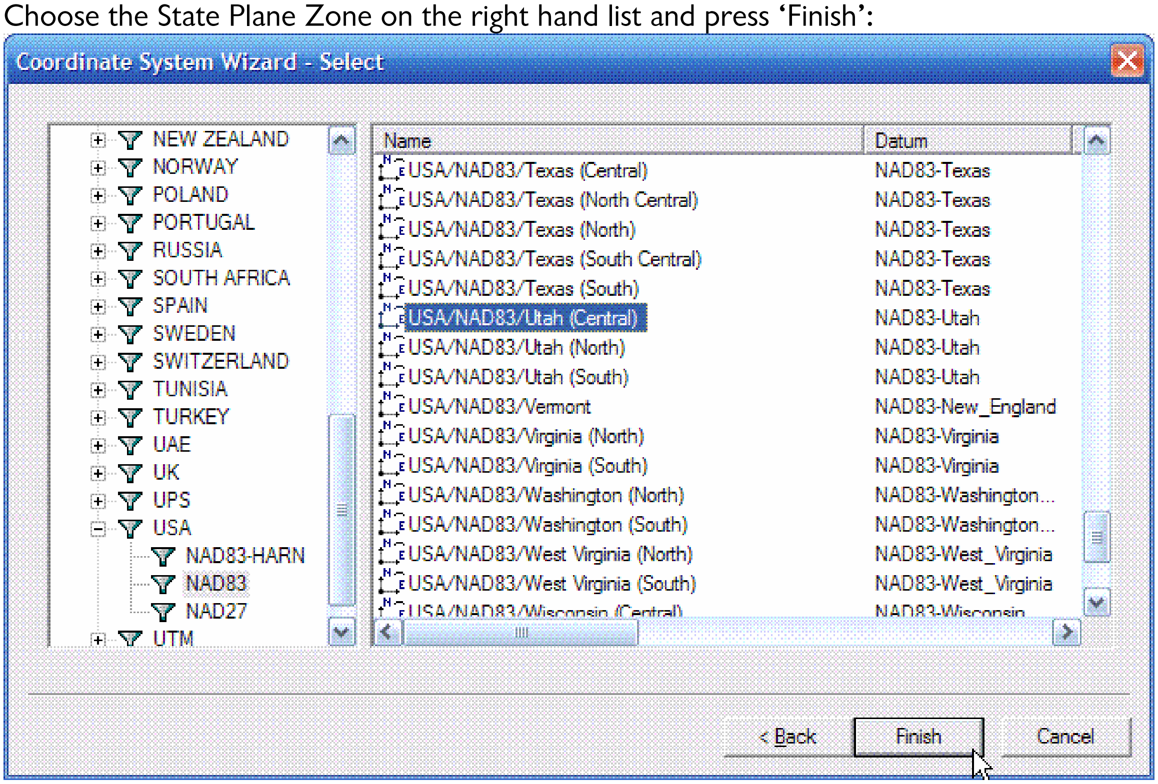
Choose ‘Select a Predefined System’:



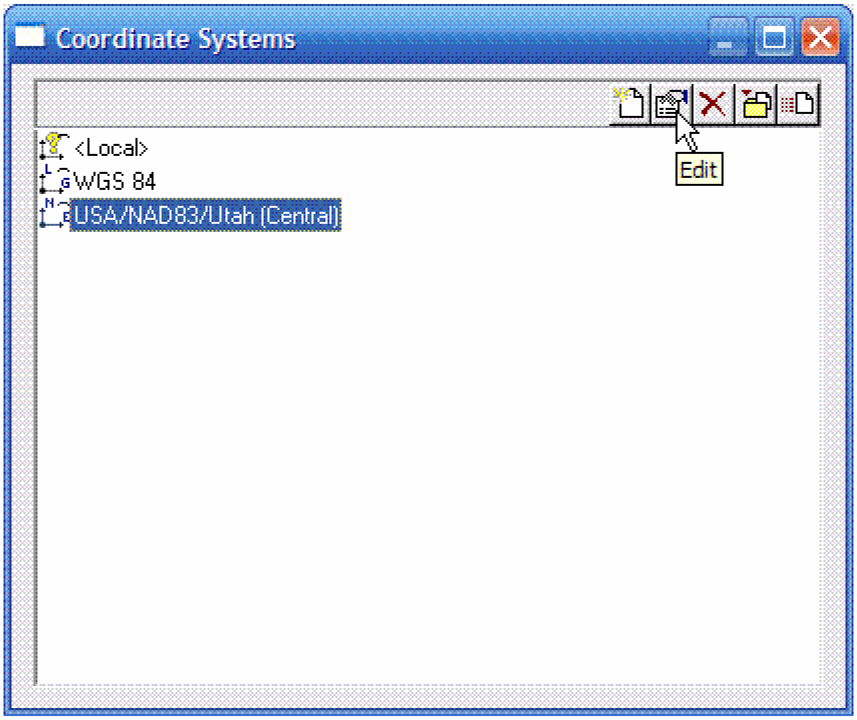
Press Next, then browse to the 'USA' selection on the left list, click on the '+' to display the USA selections, choose "NAD83" (don't choose NAD83-HARN!):



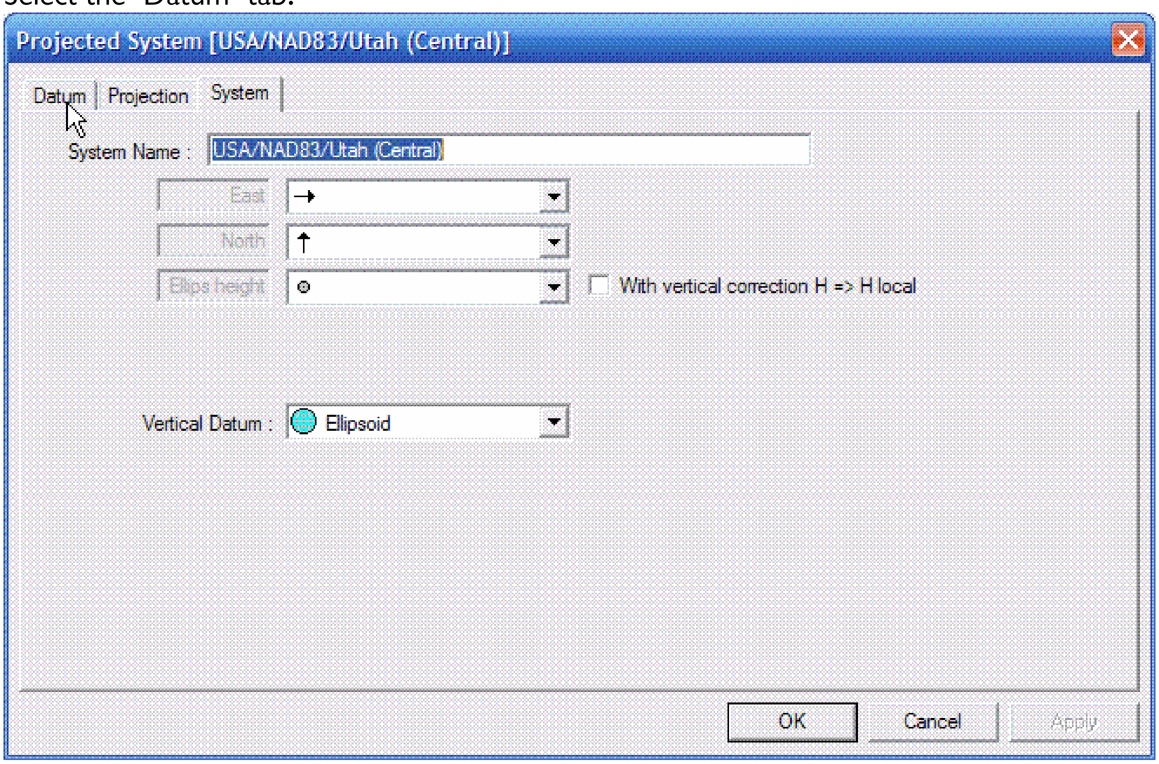
Choose the State Plane Zone on the right hand list and press 'Finish':



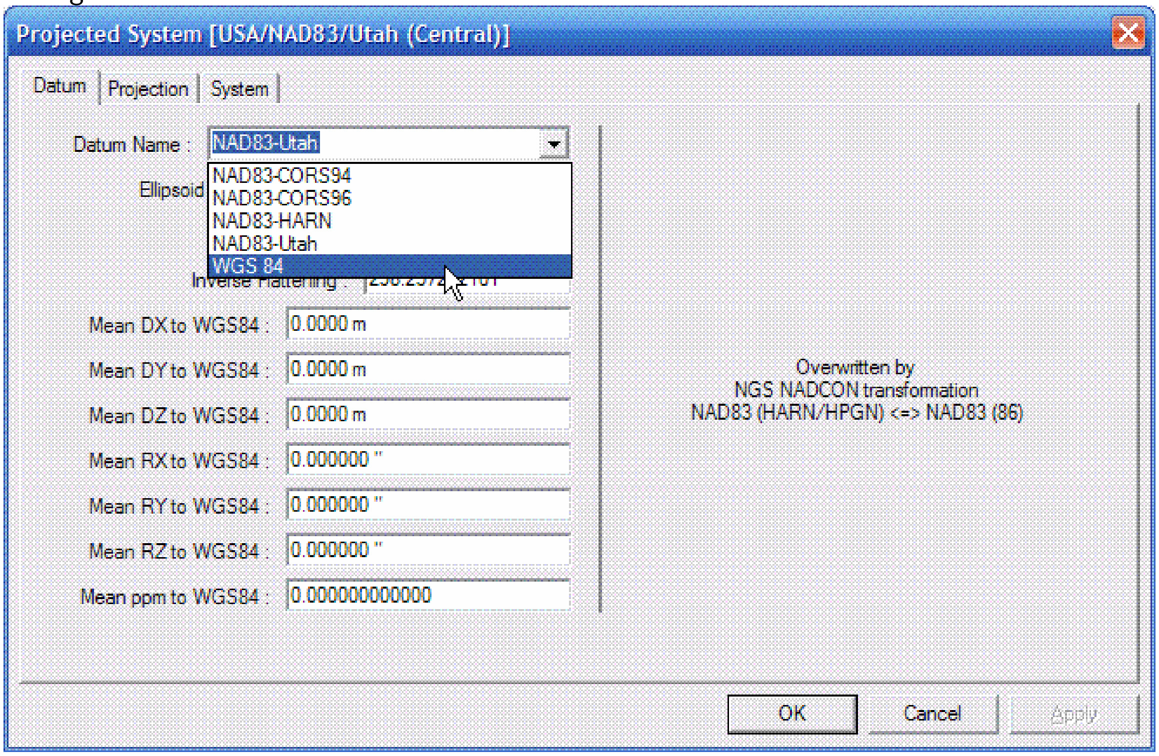
Now edit the new Coordinate System that we just created. Highlight the system and press the ‘Edit’ button:



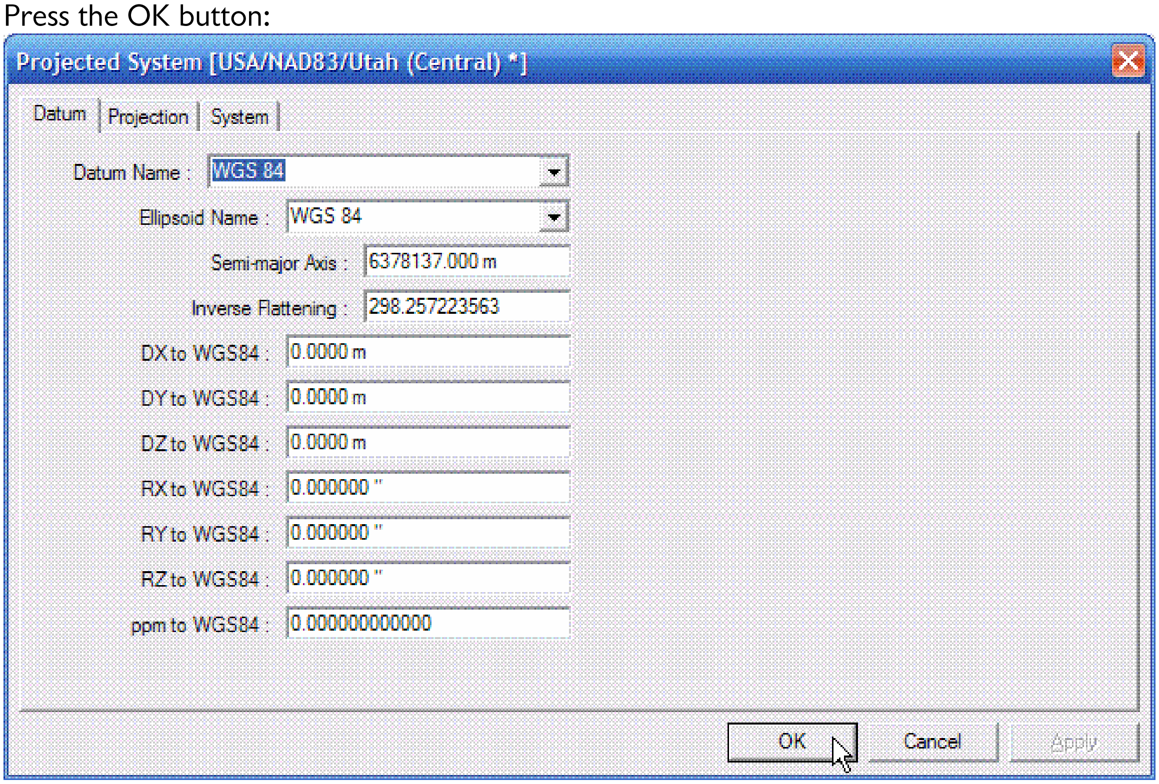
Select the ‘Datum’ tab:



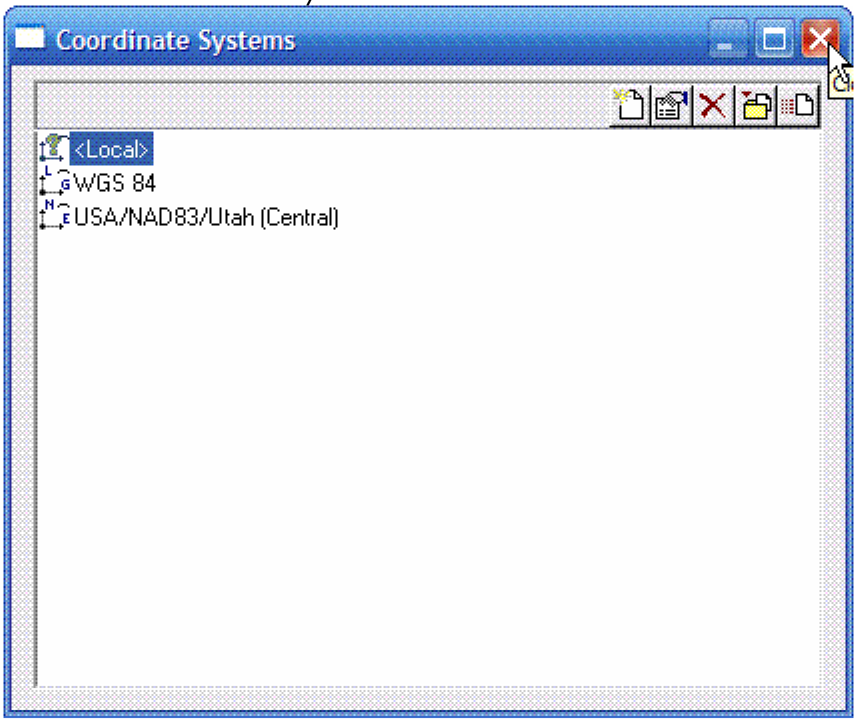
Change the Datum Name to "WGS-84"



Press the OK button:

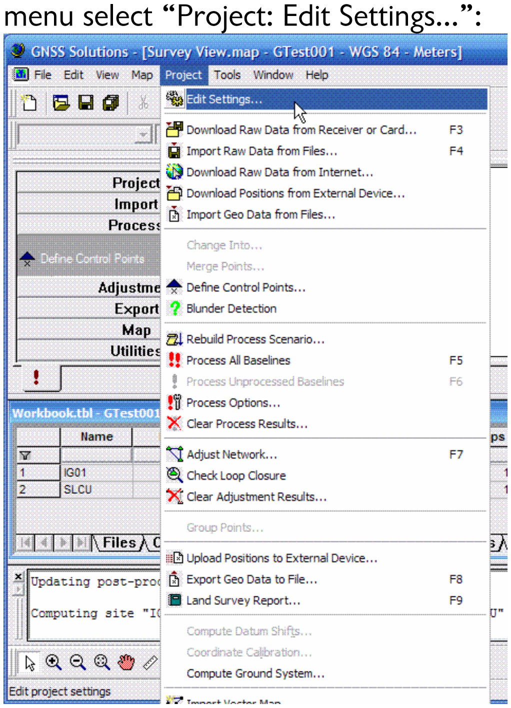


Close the ‘Coordinate Systems’ box:

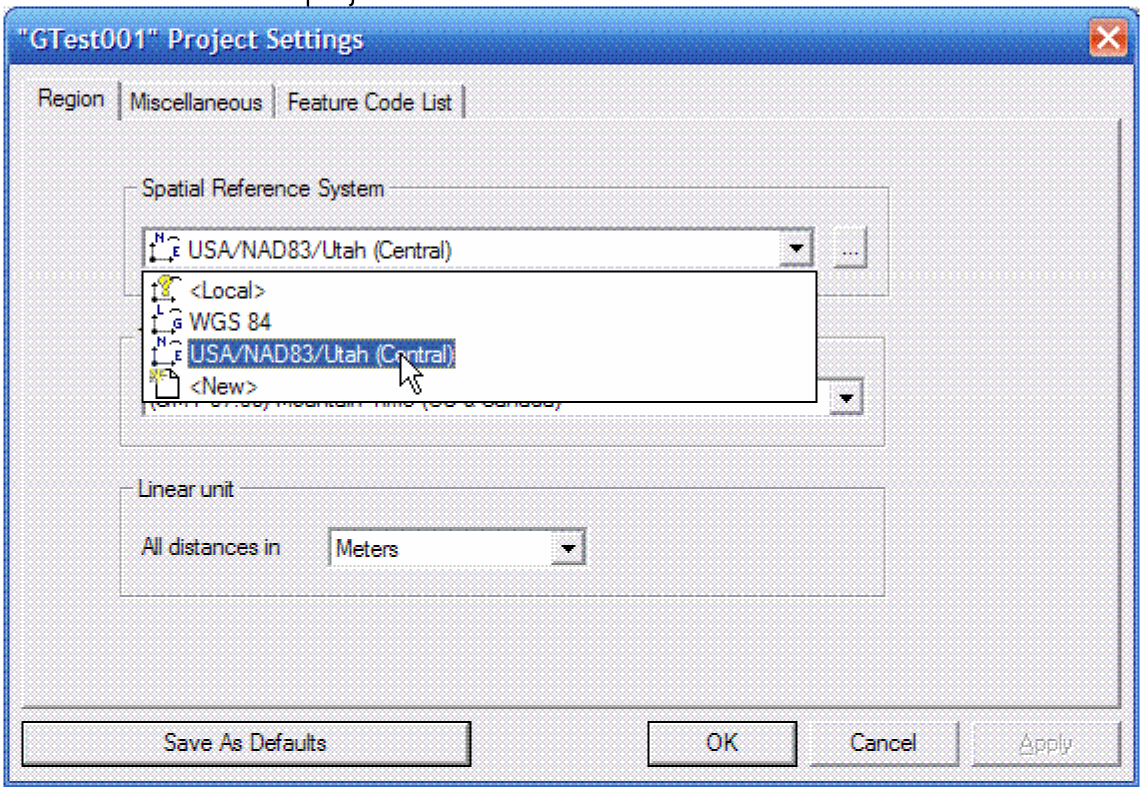


Orthometric Elevations

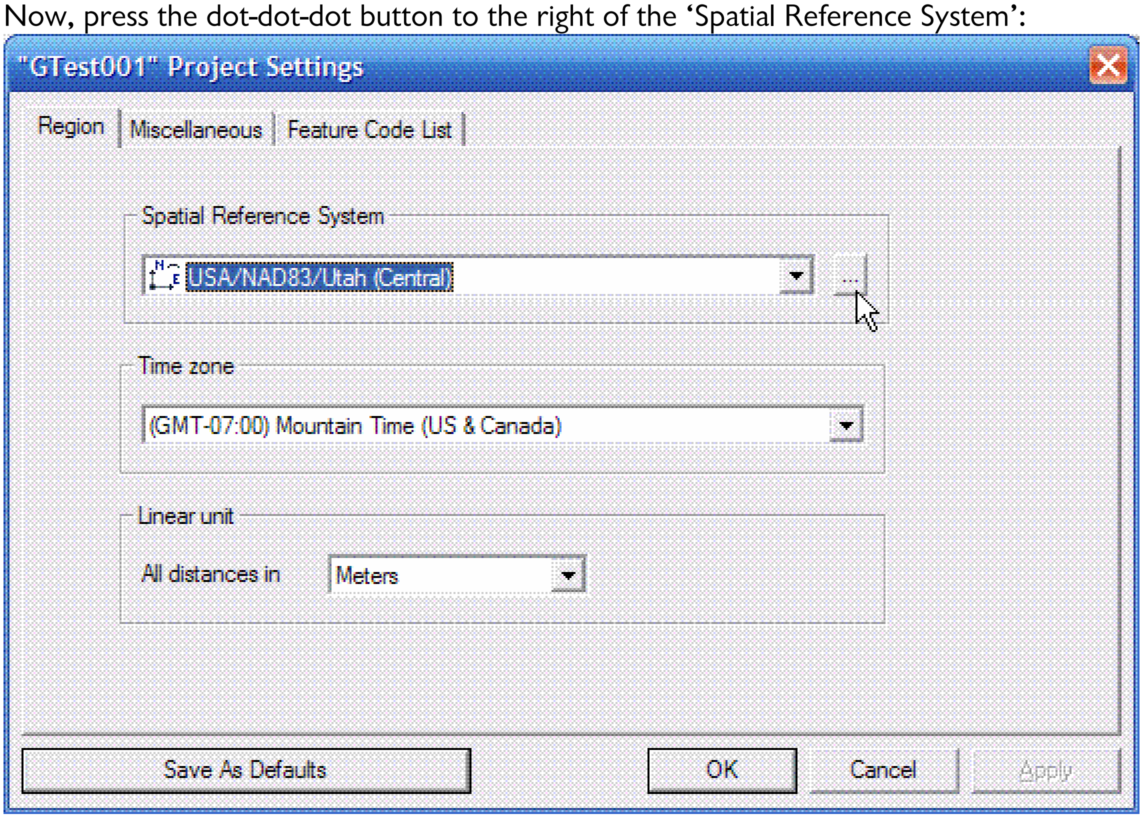
The coordinate system that we just created will have ellipsoid elevations. Lets take a moment and build another coordinate system with orthometric elevations. From the main menu select “Project: Edit Settings…”:



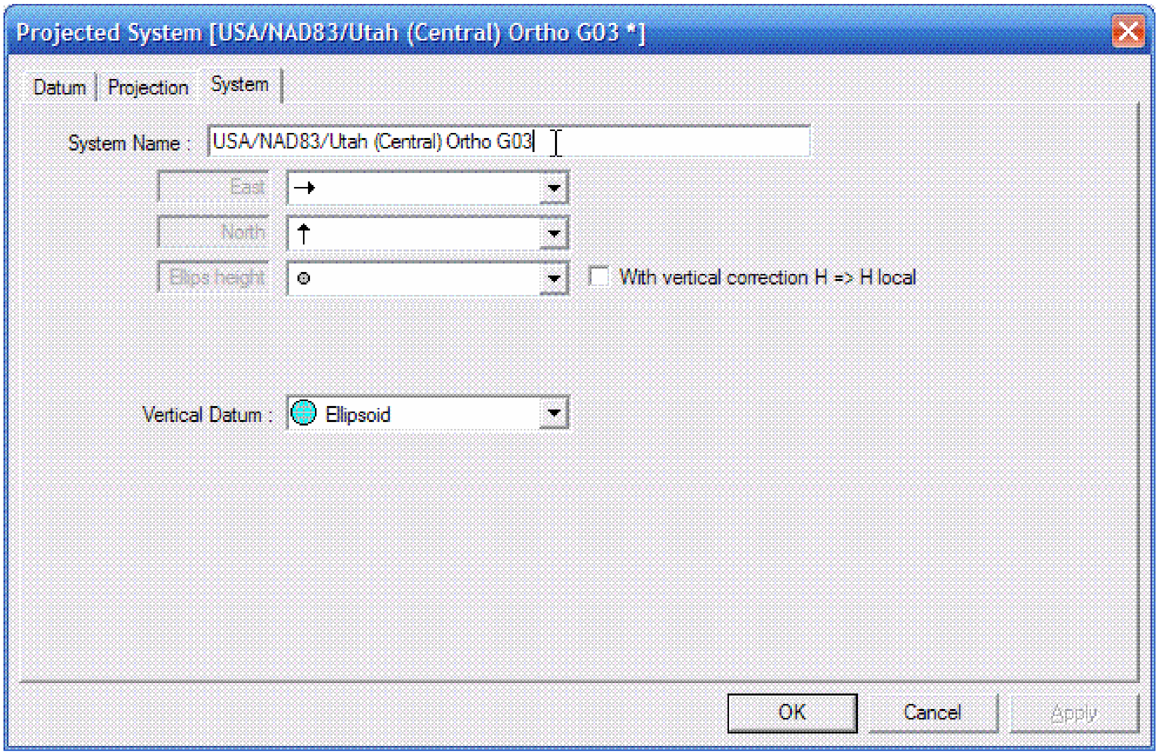
Choose the State Plane projected selection:



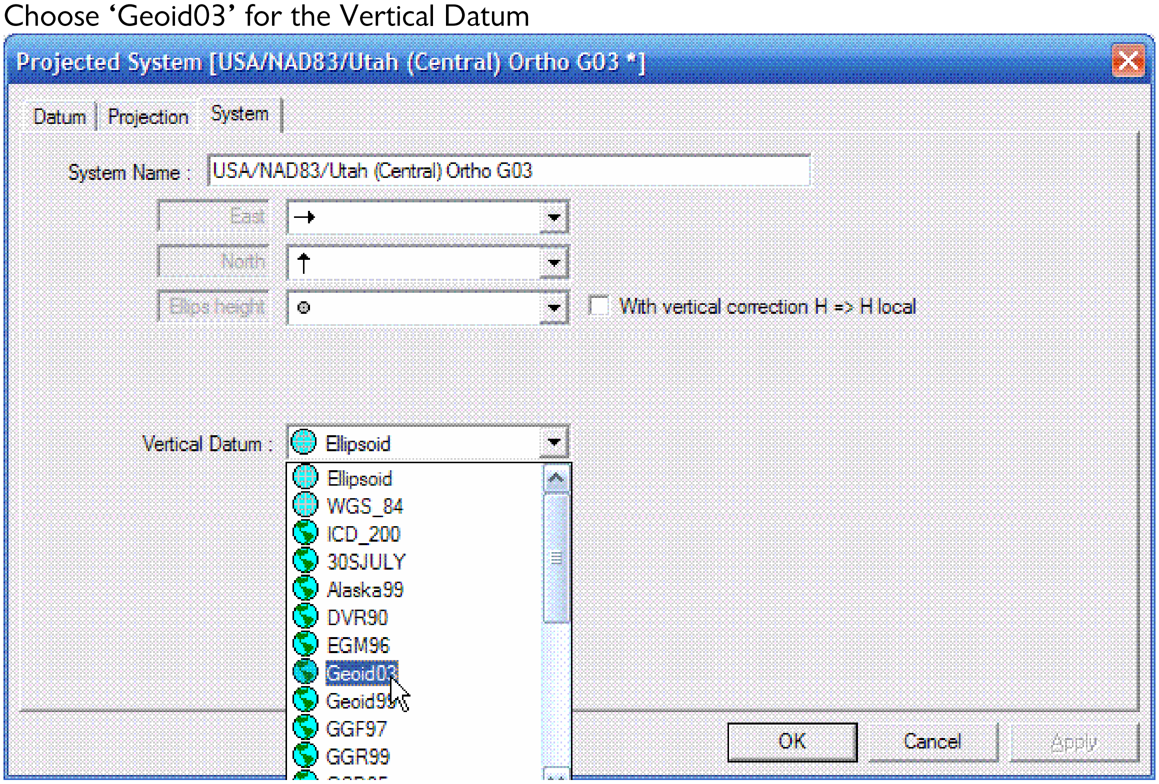
Now, press the dot-dot-dot button to the right of the 'Spatial Reference System':



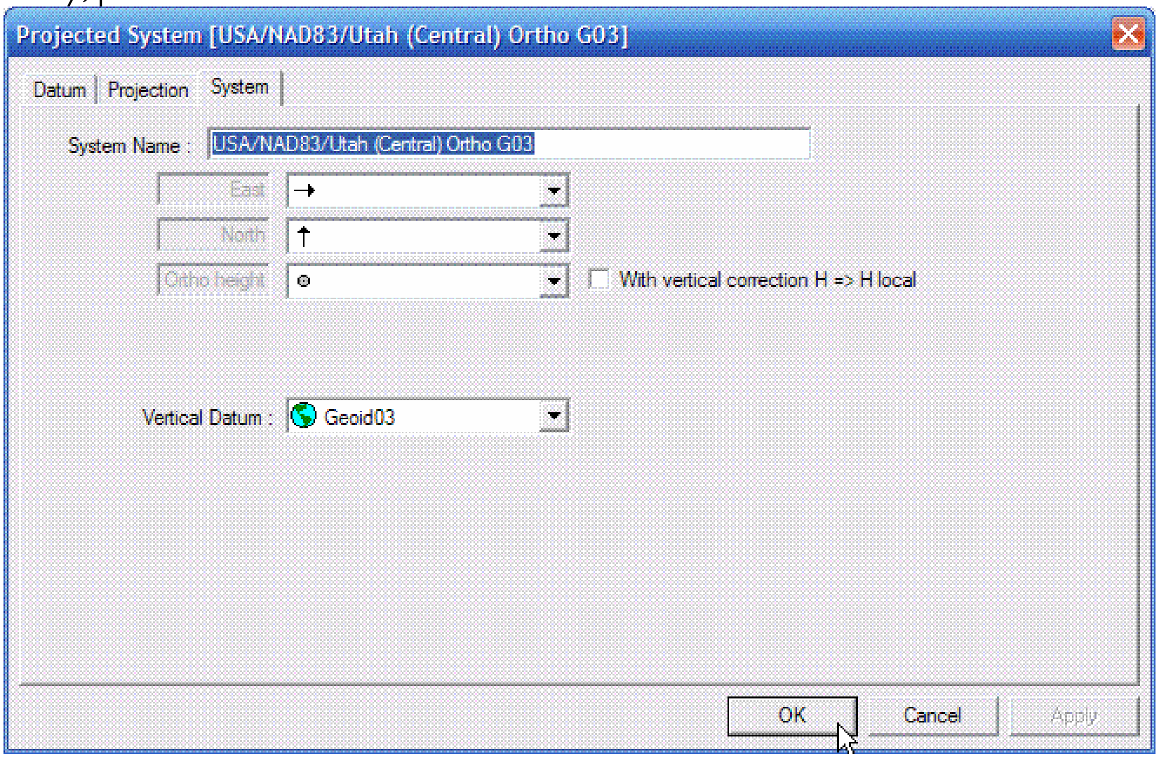
Give the system a new name. I suggest adding “Ortho G03” to the current ‘System Name’:



Choose ‘Geoid03’ for the Vertical Datum



Finally, press the OK button:



Using the New Coordinate System

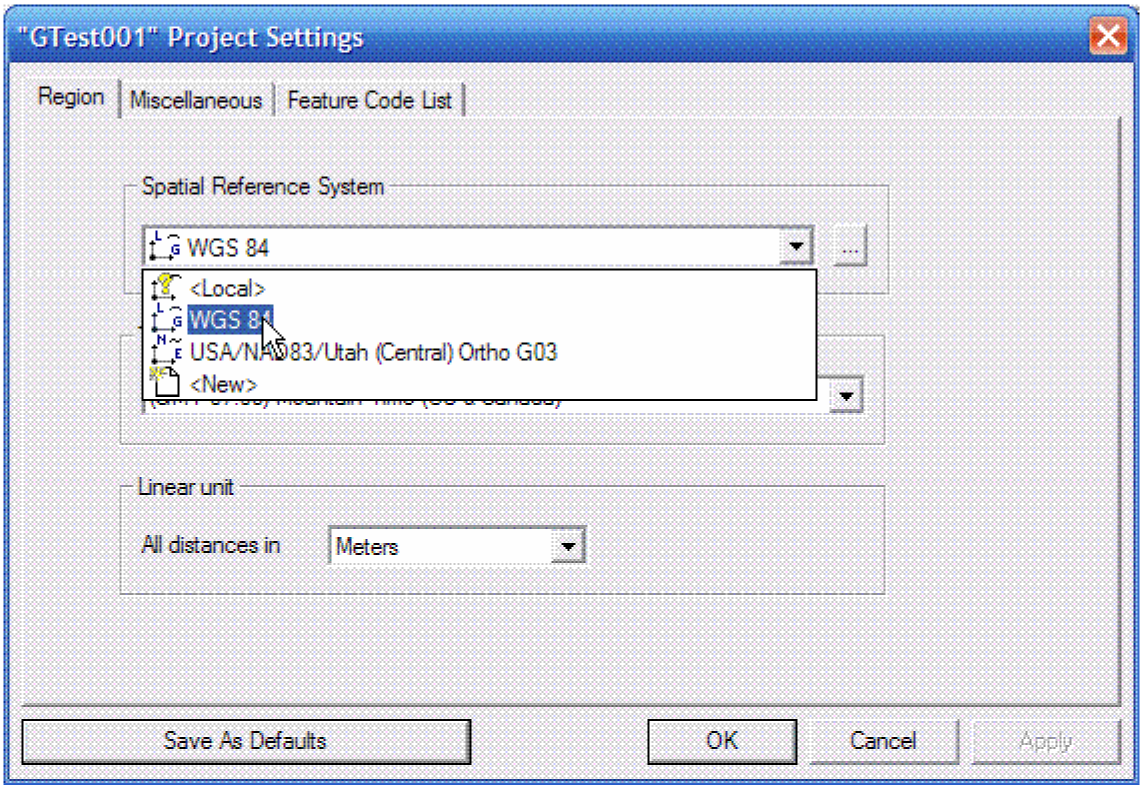
When you enter control positions you are going to be reading geographic coordinates from NGS datasheets. Use the NAD83 adjusted coordinates from the data sheet. Choose WGS84 as the Coordinate System when entering.

Here is a portion of the datasheet for the SLCU CORS station. Note the highlighted values:

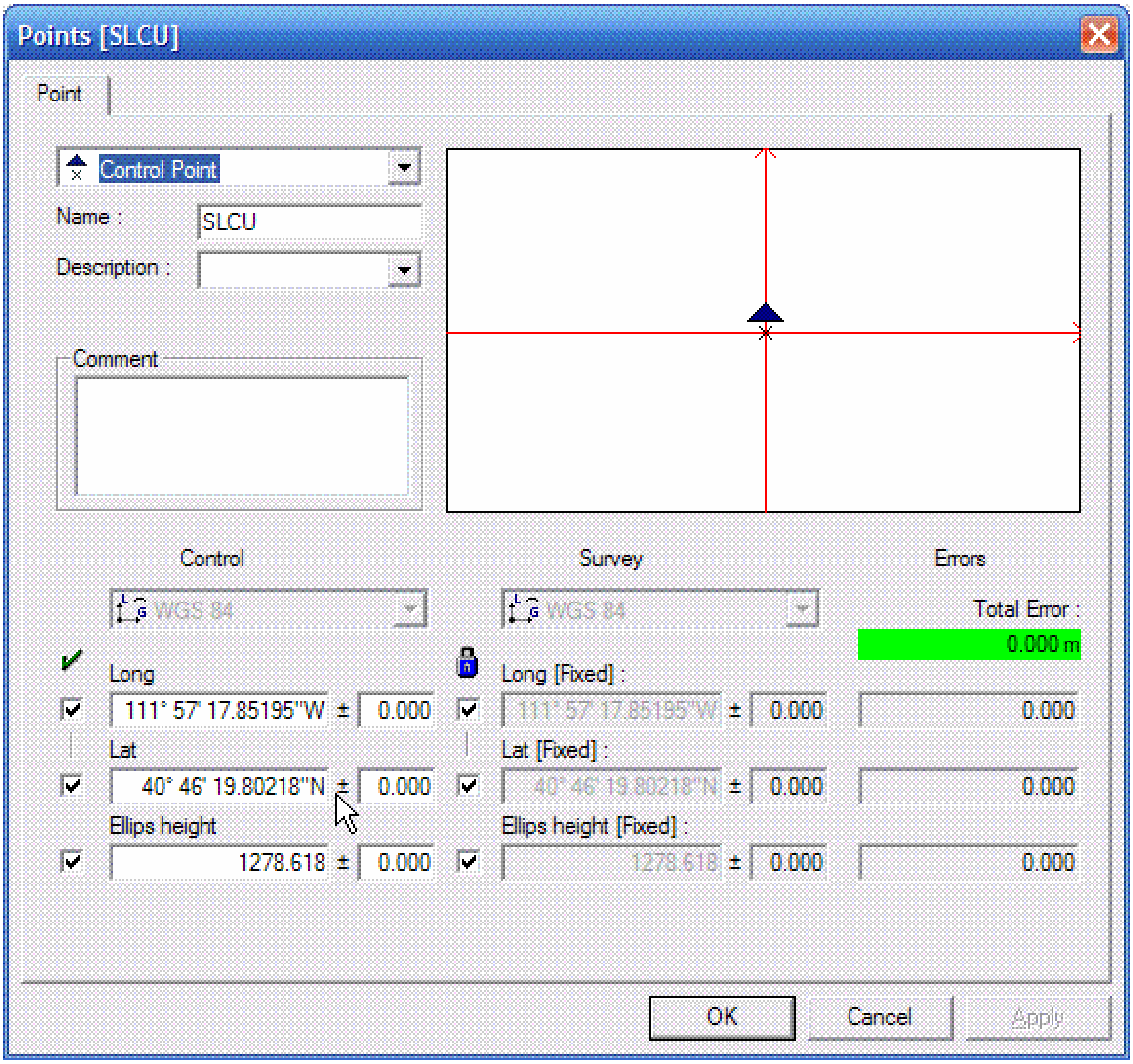
```
                SALT LAKE CITY (SLCU),  UTAH

 Retrieved from NGS DataBase on 08/27/07 at 17:45:27.
 ________________________________________________________________________
|                                                                         |
|        Antenna Reference Point(ARP): SALT LAKE CITY CORS ARP            |
|        -----------------------------------------------------            |
|                            PID = AJ6822                                 |
|                                                                         |
|                                                                         |
| ITRF00 POSITION (EPOCH 1997.0)                                          |
| Computed in Aug. 2007 using 1232 days of data.                          |
|     X =  -1808865.436 m     latitude    =  40 46 19.82371 N             |
|     Y =  -4487249.263 m     longitude   = 111 57 17.89411 W             |
|     Z =   4144130.262 m     ellipsoid height = 1277.965   m             |
|                                                                         |
| ITRF00 VELOCITY                                                         |
| Estimated in Aug. 2007 using 1232 days of data.                         |
|     VX =  -0.0139 m/yr      northward =  -0.0096 m/yr                   |
|     VY =   0.0091 m/yr      eastward  =  -0.0163 m/yr                   |
|     VZ =  -0.0155 m/yr      upward    =  -0.0126 m/yr                   |
|                                                                         |
|                                                                         |
| NAD_83 (CORS96) POSITION (EPOCH 2002.0)                                 |
| Transformed from ITRF00 (epoch 1997.0) position in Aug. 2007.           |
```

```
|     X =  -1808864.866 m     latitude     =  40 46 19.80218 N                    |
|     Y =  -4487250.495 m     longitude    = 111 57 17.85195 W                    |
|     Z =   4144130.186 m     ellipsoid height = 1278.618    m                    |
|                                                                               |
| NAD_83 (CORS96) VELOCITY                                                      |
| Transformed from ITRF00 velocity in Aug. 2007.                                |
|     VX =    0.0035 m/yr      northward =    0.0011 m/yr                       |
|     VY =    0.0101 m/yr      eastward  =   -0.0005 m/yr                       |
|     VZ =   -0.0077 m/yr      upward    =   -0.0131 m/yr                       |
|_______________________________________________________________________________|
```

Select ‘WGS 84’ for the coordinate system when entering these coordinates. From the main menu, choose ‘Project, Edit Settings…’:



Now you can verify the coordinates for the control point:



Once you verify that all control positions exactly match the published coordinate you can choose the coordinate system you want to display. For this example we have

Geographic Coordinates Meters:

Name	Description	Long	Lat	Ellips height
IG01		111° 51' 33.62782"W	40° 44' 09.87023"N	1308.391
SLCU		111° 57' 17.85195"W	40° 46' 19.80218"N	1278.618

Utah Central State Plane NAD83 Ellipsoid Meters:

Name	Description	East	North	Ellips height
IG01		469645.895	2266823.182	1308.391
SLCU		461589.357	2270868.017	1278.618

Utah Central State Plane NAD83 Ortho Meters:

Name	Description	East	North	Ortho height
IG01		469645.895	2266823.182	1325.038
SLCU		461589.357	2270868.017	1295.607

For reference, here is the Geoid03 results for SLCU:

Output from GEOID03

```
                                        latitude        longitude       N
  Station Name                       ddd mm ss.sssss ddd mm ss.sssss  meters
USER LOCATION                         40 46 19.82371 111 57 17.89411  -16.988
```