Section 20: Frame Camera Orthorectification

Section Objective

Students will orthorectify an aerial photograph using GPS points as reference Ground Control Points (GCPs).

Class Notes

Frame Camera Orthorectification

Objective: Students will orthorectify an aerial photograph using GPS points as reference Ground Control Points (GCPs).

Task 1: Importing Reference Points

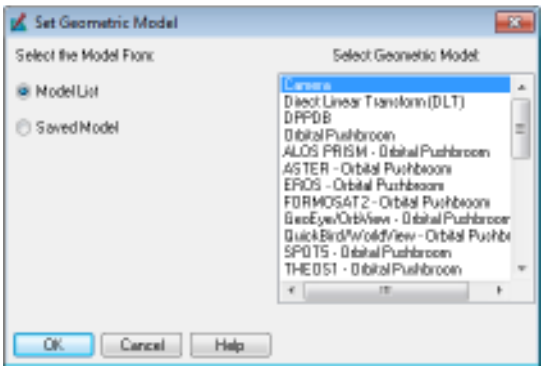
1. Open a Viewer and display the image ***LMK2000_alice_springs.tif***
2. From the Home Tab | Extent Group select **Fit to Frame**

3. Open the Multispectral tab. From the Transform and Orthocorrect group, select **Control Points**

The Set Geometric Model dialog displays

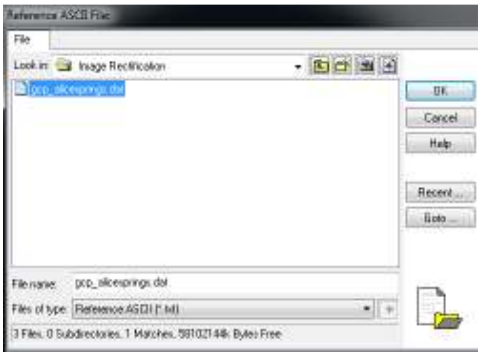
4. Ensure the radio button next to **Model List** is active

5. From the Select Geometric Model list, select **Camera** and Click **OK**



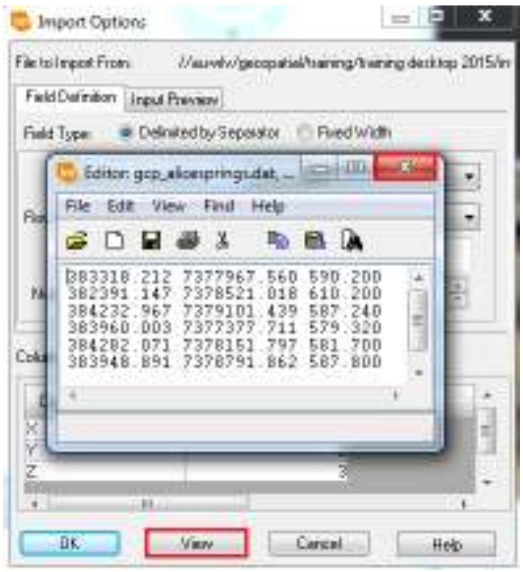
6. The Multipoint Geometric Correction and the GCP Tool Reference Setup dialogs are displayed. The next step you will import Control Points
7. In the GCP Tool Reference Setup dialog that displays, select **ASCII File**, and then click **OK**

8. In the File name text box enter ***.dat** to display the files with only this extension
9. Select **gcp_alicesprings.dat**, then click **OK**.



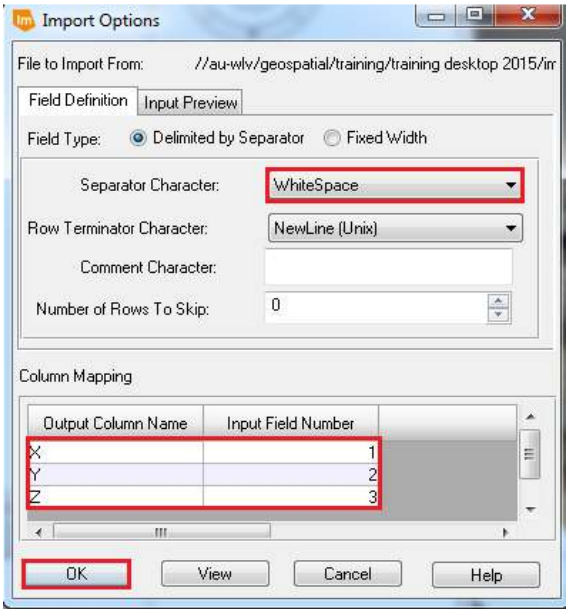
The reference file is a text file of X, Y, and Z coordinates that will be imported into the GCP CellArray

10. To see the coordinates, click the **View** button in the Import Options dialog. Once viewed **Close** the text window.

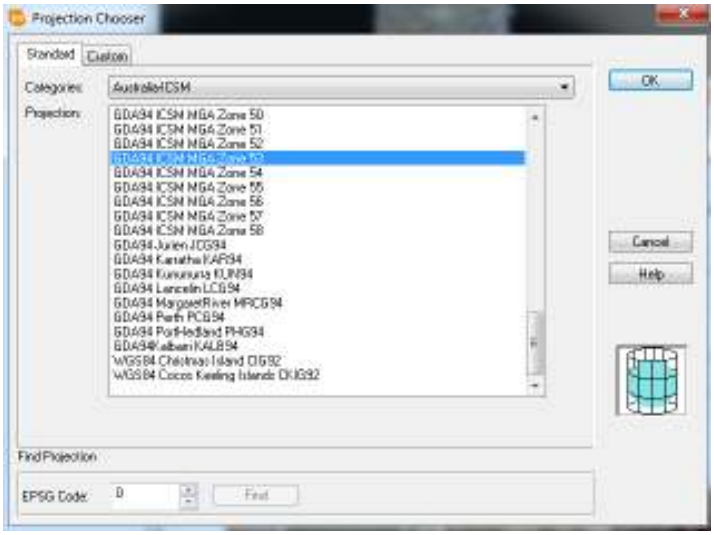


You will import the 6 map coordinates. The "real world" locations of the GPS measurements can be viewed on the following pages.

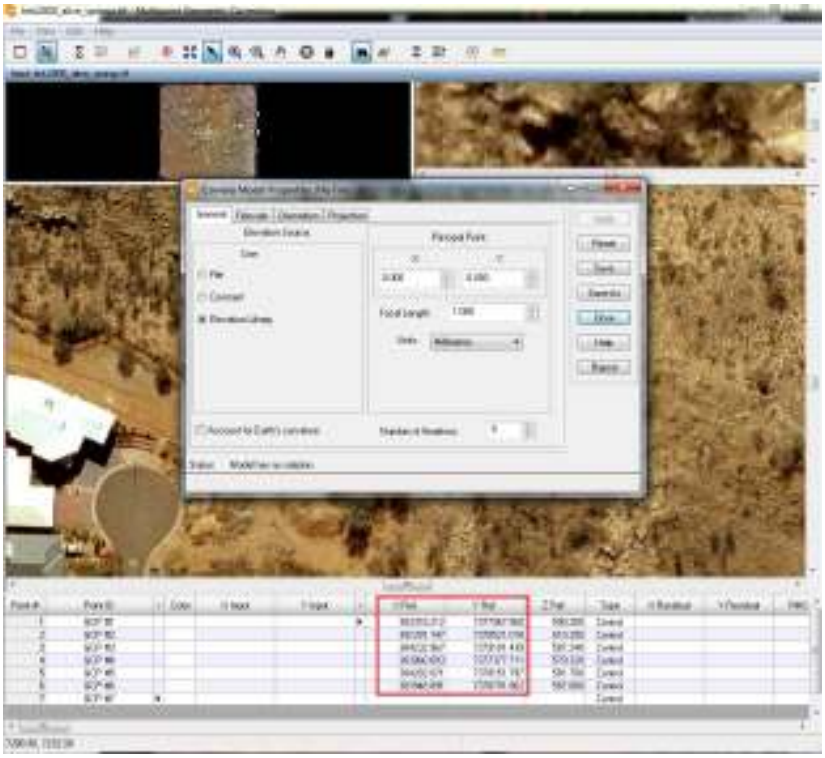
11. In the Import Options window, ensure that the Separator Character is **WhiteSpace**
12. Input the field numbers for your columns as **1, 2, and 3 respectively, for X, Y, and Z** values
13. To verify that your field parameters are valid, click the Input Preview tab, and then click **OK**



14. The Reference Map Information dialog is displayed, asking for the Projection information used to collect the GPS Measurements. Click the **Set** button
15. In the Projection Chooser dialog box, click the Standard tab
16. Click the Projection Type pop-up button, and select Australia- ICSM
17. For the Projection, select GDA94 ICSM **MGA Zone 53** and click **OK**



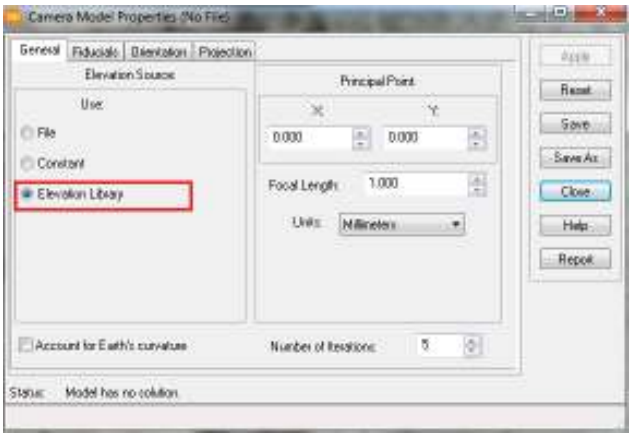
18. Click **OK** in the Reference Map Information dialog
19. In the Multipoint Geometric Correction window, confirm the GCP coordinates are imported correctly



Task 2: Examining Camera Calibration Information

To determine important information regarding the aerial camera, we need to view a camera report, and retrieve data for certain parameters.

1. In the Elevation Source portion of the Camera Model Properties dialog, select the Elevation Library radio button



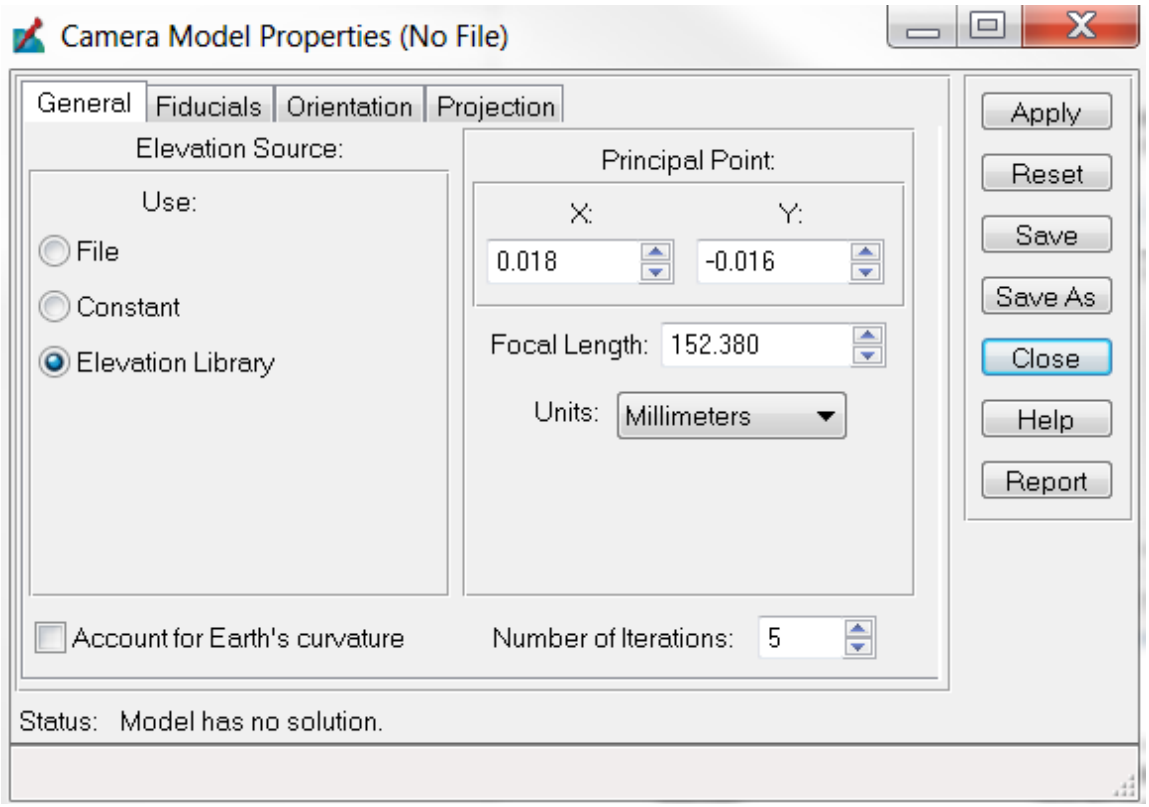
2. From the IMAGINE eWorkspace select File | View | View Text File. This will open the text Editor

3. In the Editor and open the ***camera_calibration.dat*** file. This file holds important information regarding the internal parameters of the aerial camera

4. From camera_calibration.dat, obtain the **Calibrated principal point** labeled ppbs). Input the Principal Point X and Y values in the Camera Model Properties dialog.

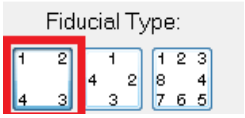
```
begin camera_parameters LMK2000
 focal_length:                          152.38
 ppac:                                  0.034   -0.014
 ppbs:                                  0.018   -0.016
 film_format:                           230   230
 fiducial:                             1   -109.994   109.974
 fiducial:                             2   109.995   110.005
 fiducial:                             3   110.015   -109.996
 fiducial:                             4   -109.996   -110.006
 lens_distortion_flag:                 on
 input_mode:                           linear
 distortion_spacing:                    0   10   20   30   40   50   6
 distortion_deltas:                     0   -1   -1   -2   -2   -2   -
 distortions:                           0   -1   -1   -2   -2   -2   -
 io_required:                          yes
 camera_type:                          frame
 media_type:                           film
 focal_length_calibration_flag:        off
 calibrated_focal_length_stddev:        0.03
 ppac_calibration_flag:                off
 calibrated_ppac_stddevs:               0.003   0.003
 self_calibration_enabled_params:       0
 antenna_offsets:                       0   0   0
end camera_parameters
```

5. From camera_calibration.dat, obtain the **Focal Length** and input that value into the Camera Model Properties dialog as well as the **Principal Points X and Y**



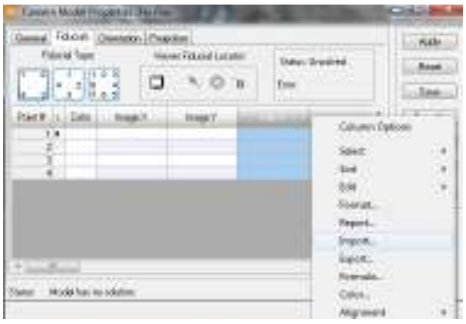
Task 3: Measuring Fiducials

1. In the Camera Model Properties dialog, select the Fiducials tab, and click the button for Fiducial Type as highlighted:



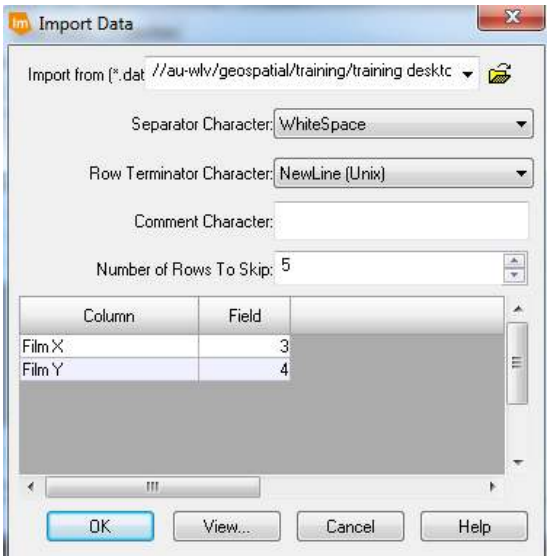
The fiducials were originally measured in a laboratory and the values are stored in the calibration file. The next steps will show how we can import these values.

2. Under the Fiducials tab, select the Film X and Film Y columns so that they turn blue, then **right- click** on one of the selected column headings and select **Import**



3. In the Import From dialog, load ***camera_calibration.dat***
4. Use the pop-up list to change the Separator Character to **Whitespace**
5. Number of Rows to Skip: **5**
6. In the Film X field, input a value of **3**, and in the Film Y field input a value of **4**

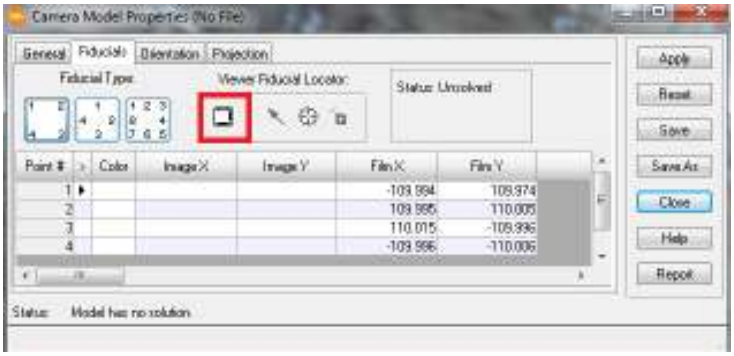
Field represents the column number in the ASCII file, which holds the Film X and Film Y coordinates



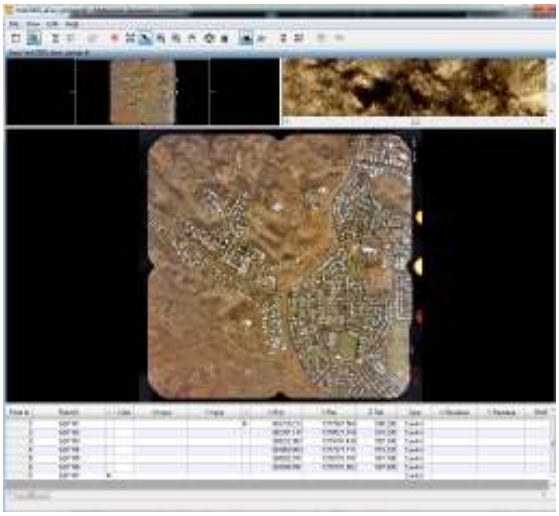
7. In the Import Column Options, click **OK**, then click **OK** in the Import Column Data dialog. This should populate the Film X and Film Y columns

8. Right-click on the FilmX column heading and select, Select | None to deselect the columns Now, measure the fiducial marks in order to obtain their X, Y coordinates in the image

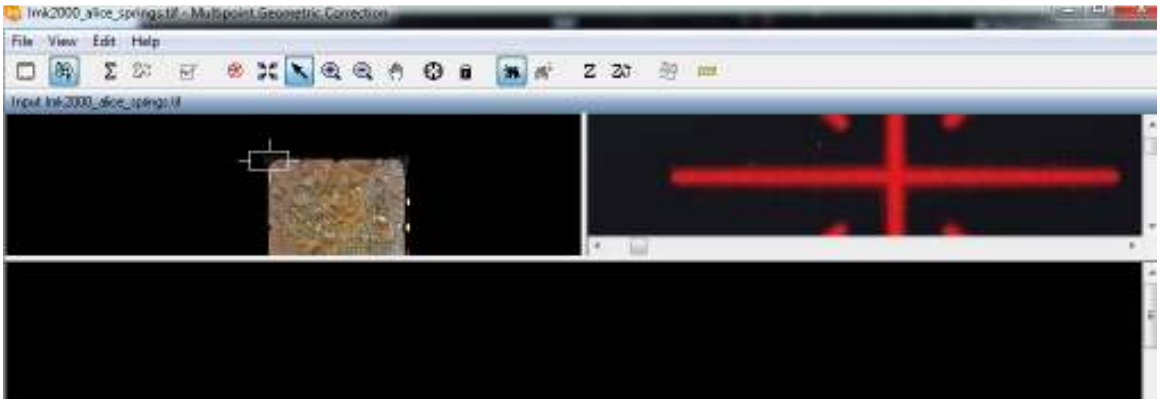
9. In the Camera Model Properties dialog, select the Toggle Viewer Selectors icon



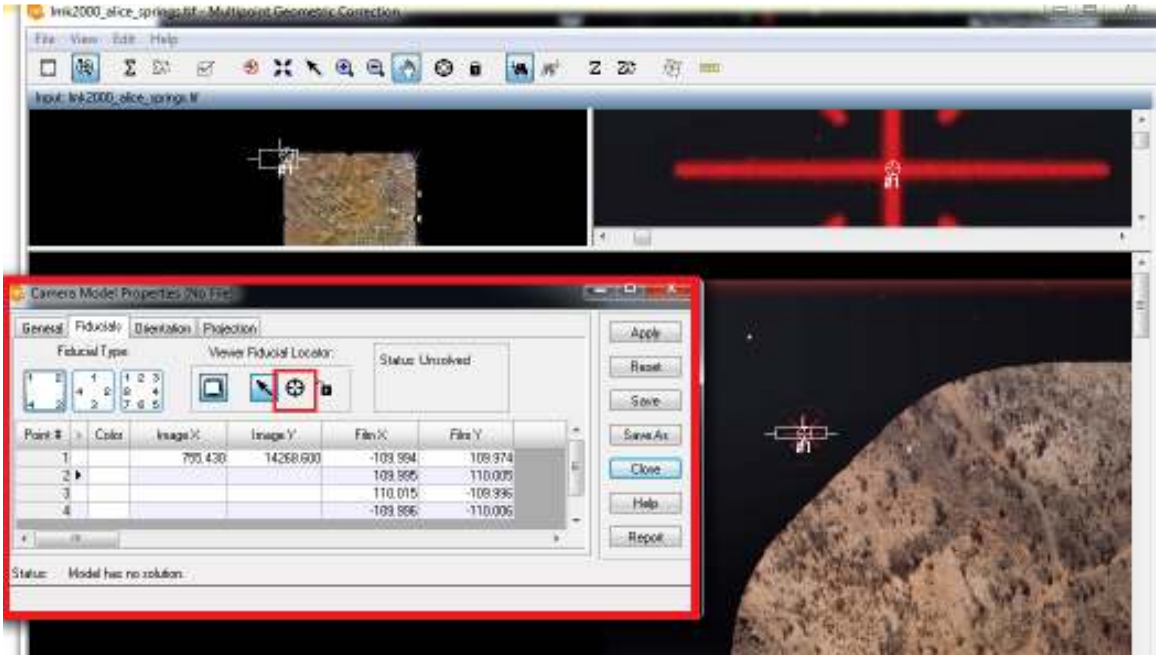
10. Click inside the **Multipoint Geometric Correction** workspace containing **LMK2000_alice_springs.tif**



11. Move the magnifier boxes to the first fiducial location in the upper left had corner of the image, and center over the fiducial mark



12. You can resize the embedded viewers to make them larger by clicking and dragging any corner to a more desired size
13. By dragging in the corner(s) of the link box within the Viewer, the magnified Viewer will zoom into the fiducial mark
14. Click the **Place Image Fiducial icon** (from the Camera Model Properties) and click on the **center of the fiducial to measure** the point



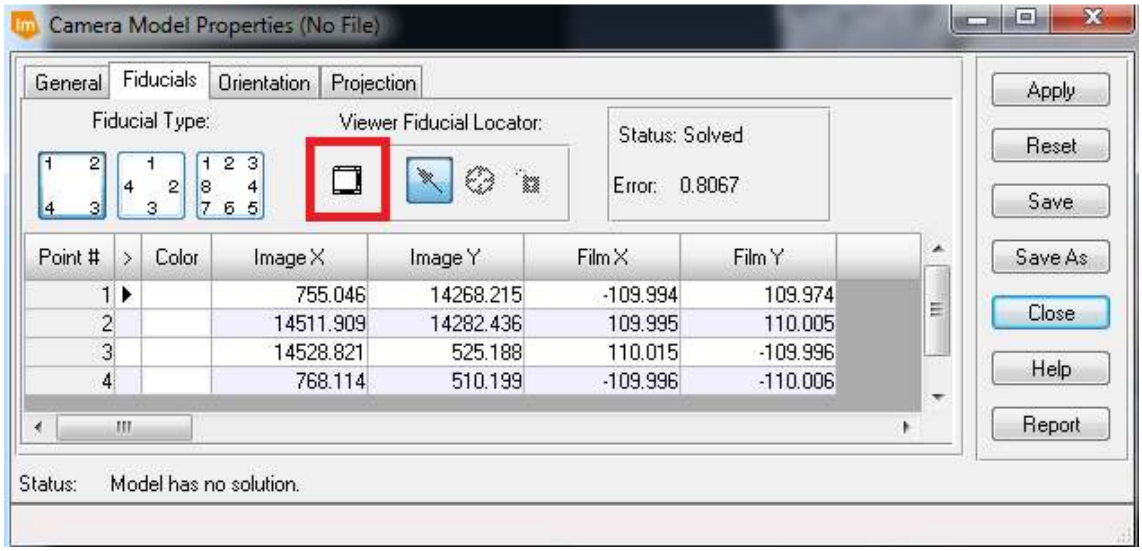
To change the color of the fiducial mark, click in the Color column of the Camera Model Properties CellArray and select a new color.

To change the color of all the fiducial marks, right-click under the Point # column and click Select All. Click on any color patch and select a new color. All eight fiducial colors will be changed. To deselect the rows, right-click under the Point # column and click select none

15. Repeat the previous steps, and **digitize the remaining three (3) fiducials** following a **clockwise pattern**

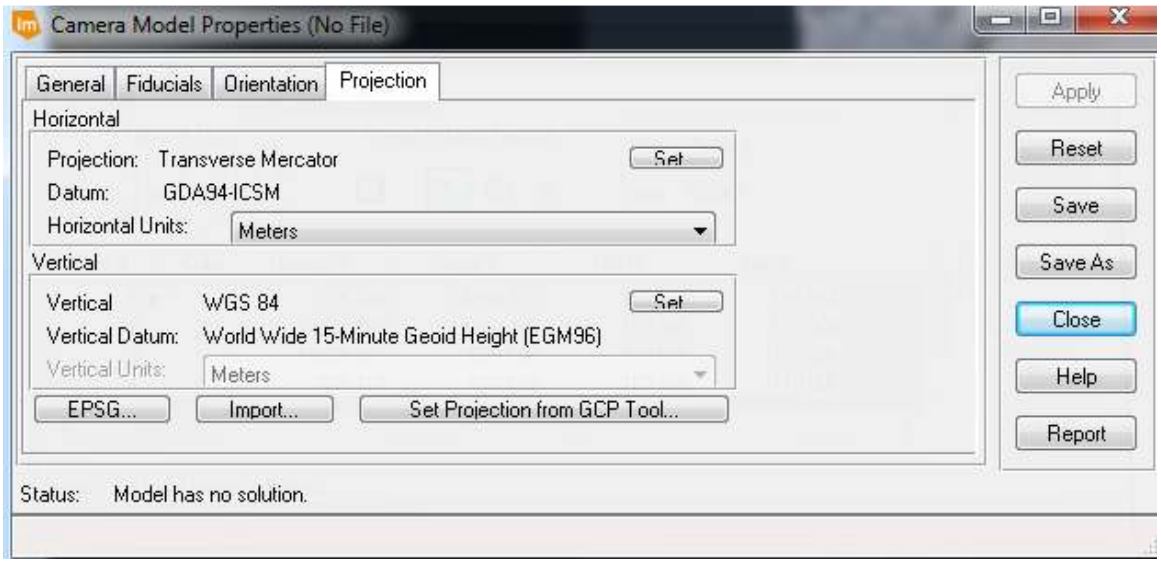
    If the fiducial mark is difficult to see, select Raster | Contrast | Brightness/Contrast, adjust the contrast and/or brightness as desired then click Apply to view the modifications

16. Once complete, click the Toggle Viewer Selectors icon on the Camera Model Properties to stop editing the fiducials

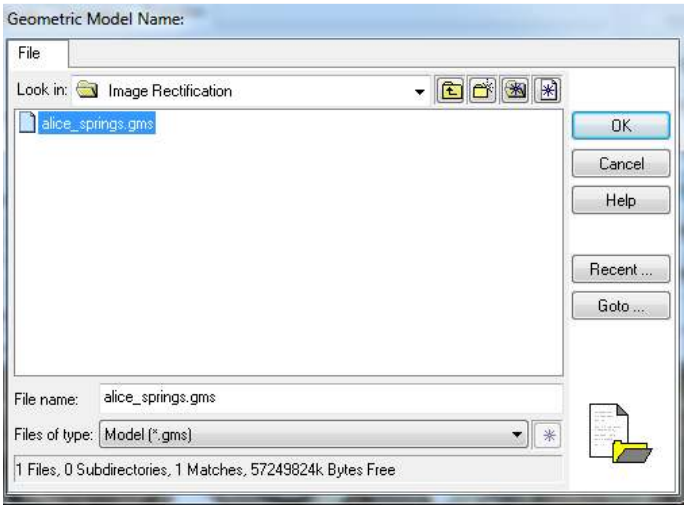


Task 4: Setting Projection and Saving the Model

1. Select the Projection tab, and ensure that the Horizontal settings are set to Projection:
2. Transverse Mercator, Datum: GDA94-ICSM Horizontal Units: meters
3. In the Vertical Group, we will make the Vertical datum of the image the same as the vertical datum used in our elevation source file. Click the Set... button. The Elevation Info Chooser dialog is opened
4. Set the Spheroid to WGS 84 and the Datum to World Wide 15-minute Geoid Height (EGM96). Click **OK**



5. In the Camera Model Properties, click the **Save** button, type ***alice_springs.gms*** as the file containing the geometric model set- tings, click OK, and then in the Camera Properties dialog, click Close.



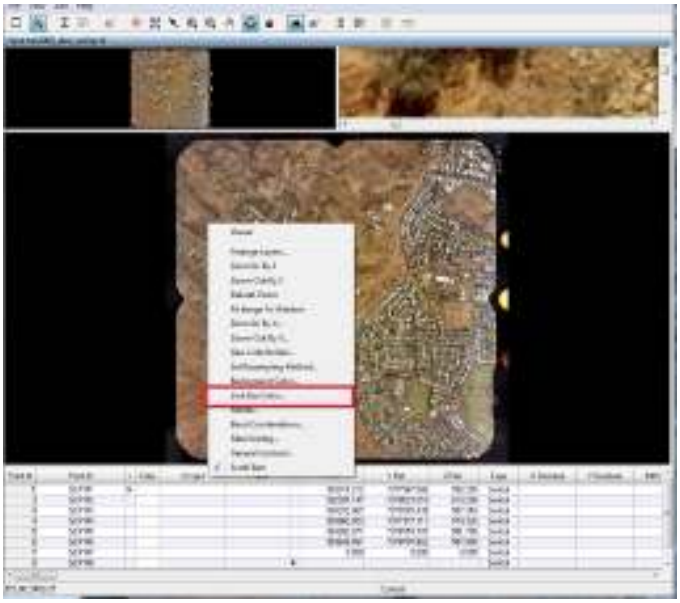
6. This file can now be called upon for future rectification when using the same reference parameters

Task 5: Measuring Ground Control Points

1. Within the GCP Tool Cell Array, click into the **caret** column next to **GCP #1**. This selects that GCP

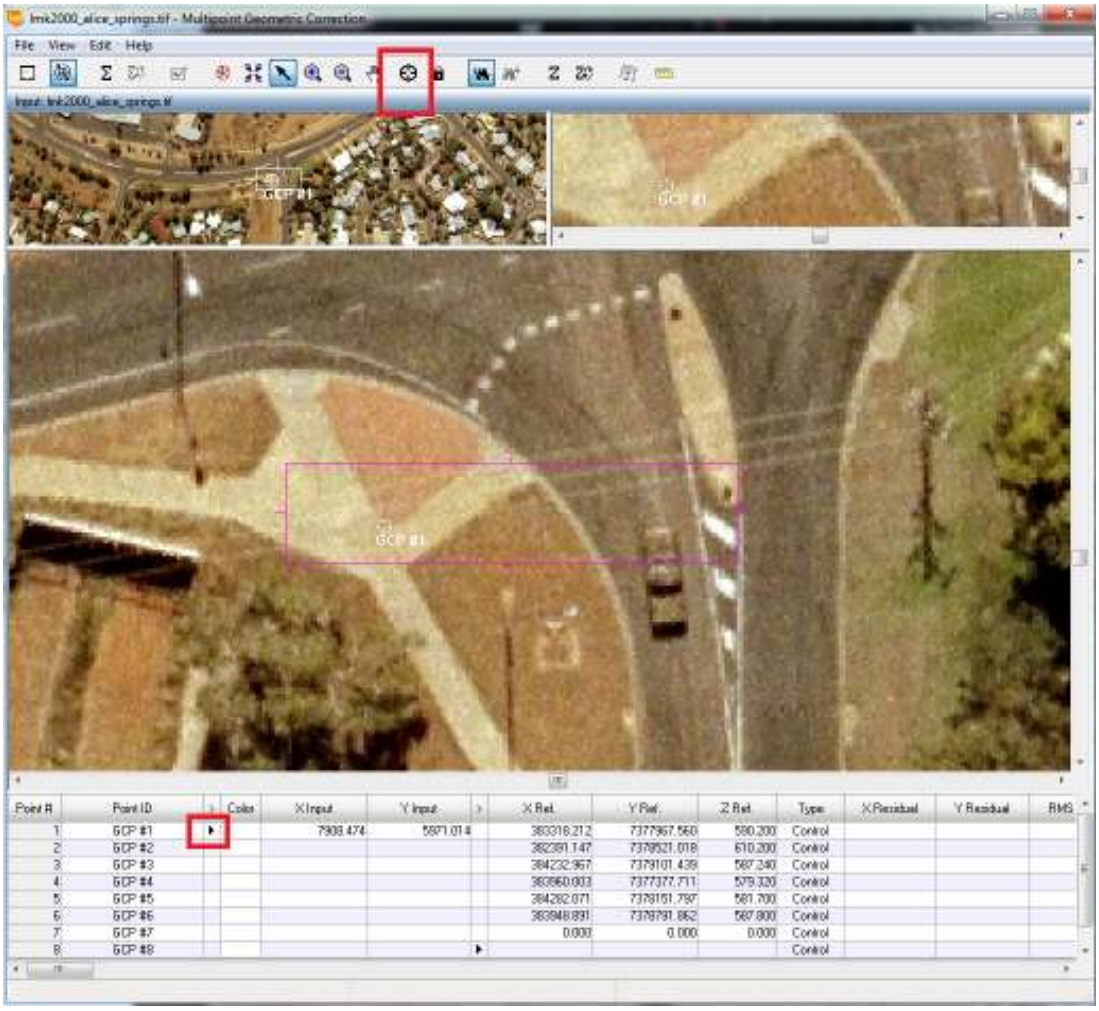
Point #	Point ID	>	Color	X Input	Y Input
1	GCP #1	▶			
2	GCP #2				
3	GCP #3				
4	GCP #4				
5	GCP #5				
6	GCP #6				
7	GCP #7				
8	GCP #8				

2. Right-click in the Main View and select **Link Box Color**



3. **Select a color** that will stand out against the imagery and click **OK**
4. Click the Select GCP icon, then move the zoom link box to the GCP #1 location shown on the FOLLOWING PAGES.
5. If you need to move zoom link box or the GCP, click the Select GCP tool located in the GCP Tools box. If you want to zoom in or out, use the Interactive Zoom icons in the Viewer. You can resize the magnifier Viewer by clicking and dragging any corner. You can also resize the link box at any time, which will zoom your magnifier Viewer

6. **Locate the GCP** corresponding to the Point ID number found on the following pages
7. Ensure that the **caret is located in the row with the GCP for which you are looking**
8. Click the **Create GCP icon** and **digitize the feature** in the Chip Viewer



To make your GCPs stand out visually, select a desired color from the GCP Tool Color column

9. **Repeat** the digitizing process for the remaining **five(5) points**
10. In the GCP Tool, click the **Solve Geometric Model with Control Points icon**
11. The Control Point Error will be reported at the bottom of the GCP Editor.

Once your points are measured, the GCP Tool can solve the polynomial transformation and generate an estimate of the associated error. This is called Root Mean Square Error (RMSE). Control Point Error is the same as RMSE

RMSE is calculated by using the transformation matrix. Measured points are transformed into the new coordinate system, then retransformed into the original system. The difference between the original and the retransformed is the root error

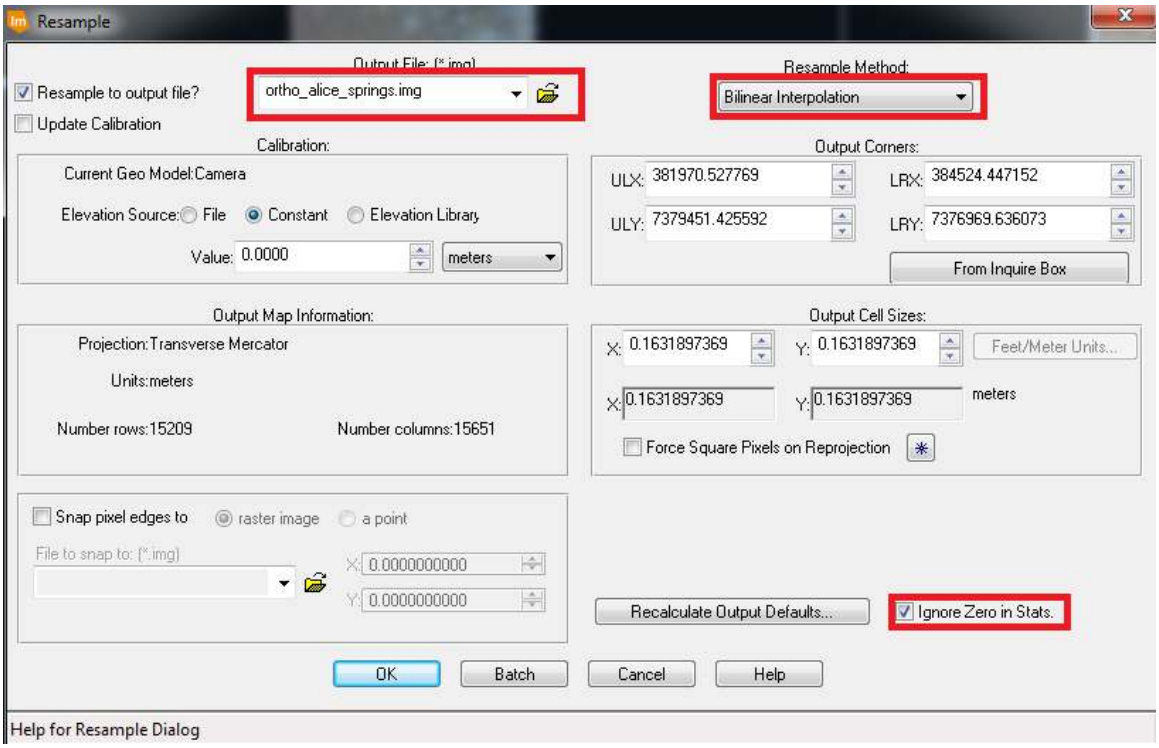
12. You will want the Total RMS to be less than 1.0 pixel. If the RMS is too high, try adjusting, deleting, and re-digitizing your GCPs. You will want to start adjusting those with the highest value in the RMS Error column

Point #	Point ID	>	Color	X Input	Y Input	>	X Ref.	Y Ref.	Z Ref.	Type	X Residual	Y Residual	RMS Error	Contrib.	Match
1	GCP #1			7908.263	5968.349		383318.212	7377967.560	590.200	Control	1.415	-1.894	2.364	1.766	
2	GCP #2			2372.726	9346.081		382391.147	7378521.018	610.200	Control	0.653	1.048	1.235	0.923	
3	GCP #3			13602.118	12880.628		384232.967	7379101.439	587.240	Control	-1.147	0.751	1.371	1.025	
4	GCP #4			11818.519	2303.195		383960.003	7377377.711	579.320	Control	-0.977	-0.384	1.050	0.785	
5	GCP #5			13866.339	7030.818		384282.071	7378151.797	581.700	Control	-0.008	-0.272	0.273	0.204	
6	GCP #6			11815.512	10970.074		383948.891	7378791.862	587.800	Control	0.098	0.752	0.759	0.567	
7	GCP #7	▸					0.000	0.000	0.000	Control					
8	GCP #8					▸				Control					

Note due to low resolution DEM used, this example usually obtains around a 2 pixel RMS Error instead of the usually desired 1 or less

13. Change the carret to a GCP with a higher RMSE value, attempt to improve upon error and click the **Solve Geometric Model with Control Points** icon again to update the model solution
14. Modify your GCP colors so that the Check Points can be identified
15. Try changing different GCP points to Check Points and recalculate the RMSE. This can assist in determining which GCPs may be inaccurate
16. **Repeat** these steps until an acceptable RMS Error is computed
17. To save your GCP measurements, select File | **Save Input as**, and type ***alice_springs_input.gcc*** as the filename
18. Select File| **Save Reference as**. In the File name text box, type ***alice_springs_reference.gcc*** as the filename
19. From the Multipoint Geometric Correction toolbar, click the **Display Resample Image icon**

20. In the Resample dialog, type ***ortho_alice_springs.img*** as the Output File name, and for the Resample Method, use **Bilinear Interpolation**, enable the **Ignore Zeros in Stats** checkbox, and click **OK**

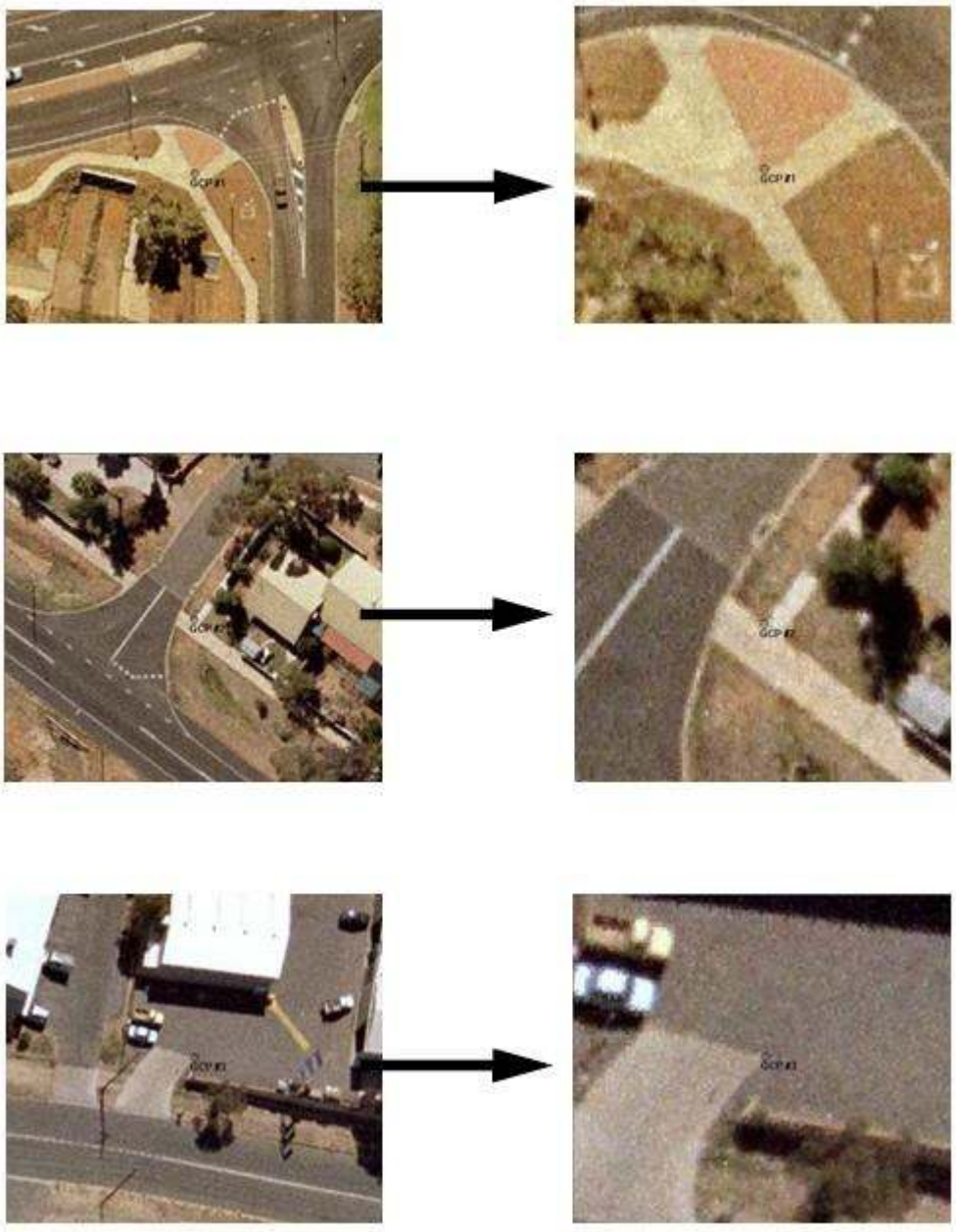


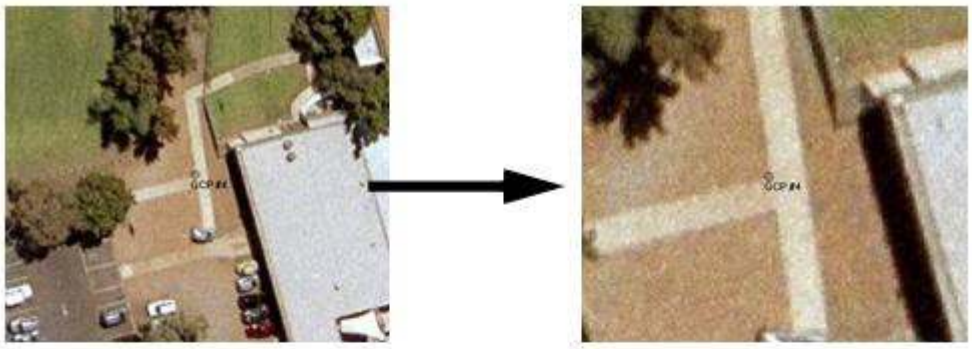
21. Upon completion, click **OK** in the Status box, then Close all dialogs. Select **Yes** when prompted to **Save** current Geometric Model

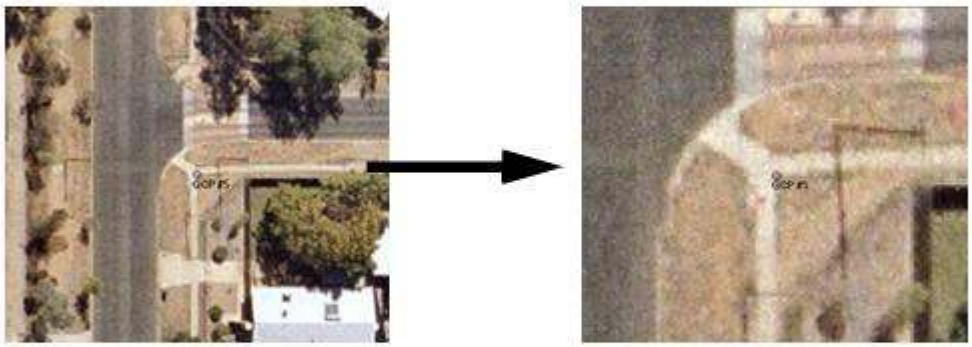
22. In a new Viewer, open and examine the **ortho_alice_springs.img**

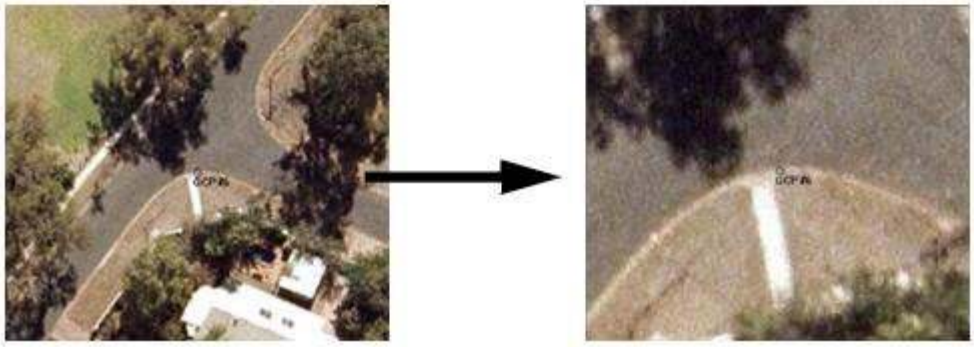
GCP Locations:

GCP Locations









Class Notes