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Pix4Dmapper Additional Steps for Processing UAS Imagery

Introduction

Pix4Dmapper is a photogrammetry software suite compatible with aerial drone imagery that enables you to define areas of interest, select processing options, add ground control points (GCPs), and create and edit point clouds, digital surface models (DSMs), meshes and orthomosaics. Default templates provide automatic processing for new projects and can be customized for more control over data and output product quality.

As you work through this exercise, please refer to the Pix4Dmapper Help Documentation for additional information about each of the steps. The help documentation can be found on the Pix4D website or by clicking the **Help** tab within the software interface.

Objective

- Add to pre-existing knowledge of Pix4Dmapper by classifying and editing point clouds.
- Generate additional outputs such as digital terrain models (DTMs).
- Measure distance and volume using Pix4Dmapper tools.

Prerequisites

- Download and unzip exercise data: Bluebird.zip.
- Install and activate Pix4Dmapper (please see Pix4Dmapper Installation Guide for details).

NOTE: *Check your hardware specifications before beginning this exercise. Search the keyword* ***Settings*** *in your start menu, then navigate to the* ***System*** *tab, and then click on* ***About****. If you have less than 16GB RAM or a slower processor, we recommend selecting* ***3D Maps – Rapid/Low*** *Res for Part 1. C. 1., rather than* ***3D Maps – Standard****. This will decrease processing time.*

If you experience cursor misalignment throughout this exercise, open your ***File Explorer*** *and navigate to your* ***Program Files*** *folder on the Drive you installed Pix4Dmapper. Right click on the pix4dmapper.exe file and in the* ***Properties*** *window, select the* ***Compatibility*** *tab. Enable* ***Disable display scaling on high DPI settings*** *and click* ***OK****. You may need to close and reopen Pix4Dmapper for the cursor to be recalibrated.*

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Part 1: Getting Started

In this first part of the exercise, you will navigate the project creation wizard, which consists of five windows, to configure important settings and options for your Pix4Dmapper project. This section will acquaint you with folder directories where the project outputs will be stored, where you can manage the camera model's parameters, select coordinate systems, and select your processing options template.

A. Create a Project

1. Launch Pix4Dmapper by searching Pix4Dmapper in the Start menu bar and click **New Project**.
2. Name the project Bluebird and set your file directory. Make sure the radio button for New Project is selected and click **Next**.

B. Add the imagery

1. In the Select Images window, click on **Add Images** and browse to the unzipped folder for Bluebird in which the imagery is stored. Select all 114 images and click **Open**, then **Next**. It may take a moment for Pix4Dmapper to read the geotag data.
2. Under Image Geolocation, Coordinate System, click **Edit**. Ensure the radio button for Known Coordinate System (m) is checked and then select **From List** to enter the correct coordinate system information. From the dropdown menu, search for WGS 84 / World Mercator or start to type it in. Select WGS 84 / World Mercator, then hit **OK**. Your coordinate system should now display as WGS 84 / World Mercator. Click OK to return to the Image Properties wizard window.
3. Leave the following parameters as their default values:
   i. Geolocation Accuracy: Standard
   ii. Selected Camera Model: GRII_GRLENS_18.3_4928x3264 (RGB)

NOTE: *If your camera model is not included in Pix4Dmapper's camera model database, or if you want to use internal parameters that more accurately represent your camera, you can add a calibrated camera model of your own to a Pix4Dmapper project. The project must include a minimum of 50 images containing objects at varying distances from the camera, heterogenous textures, a high amount of image overlap and if possible, GCPs. As the images in this exercise are georeferenced from the UAS equipment, we will not be placing GCPs in this exercise. However, it is possible to add your own for more accurate results. This can be done using Google Earth or ArcGIS Desktop.*

To add a custom camera model to your database, select ***Image Properties Editor*** *under the* ***Project*** *tab. Under Selected Camera Model, click* ***Edit****. Under Camera Model, click* ***New*** *and enter a unique name. Under Camera Model Parameters, click* ***Load Optimized Parameters****. Once you have entered the camera model information, click* ***Save to DB*** *under Camera Model and then click* ***OK****. Click* ***No*** *for* ***Save as default assignment****, then click* ***OK*** *again. Save your project once you have entered your camera model's information into Pix4Dmapper's database.*

4. Click **Next**.

5. In the Select Output Coordinate System window, ensure that the Unit is specified as meters (m) and that your previously set coordinate system is displayed.

NOTE: *You can check Advanced Coordinate Options to further explore and set alternative vertical coordinate systems if you want to adjust the geoid height but for this exercise, we recommend using the default setting, EGM 96 Geoid.*

6. Click **Next**.

C. Select Template

1. Under Processing Options Template, navigate to the Standard tab, then select **3D Maps**.
2. Check **Start Processing Now.**
3. Click **Finish** to finalize the initial project setup and begin image processing. You can expect this to take up to and possibly over one hour in terms of run time.
4. When this step is complete, navigate to the **Project** tab and hit **Save**.

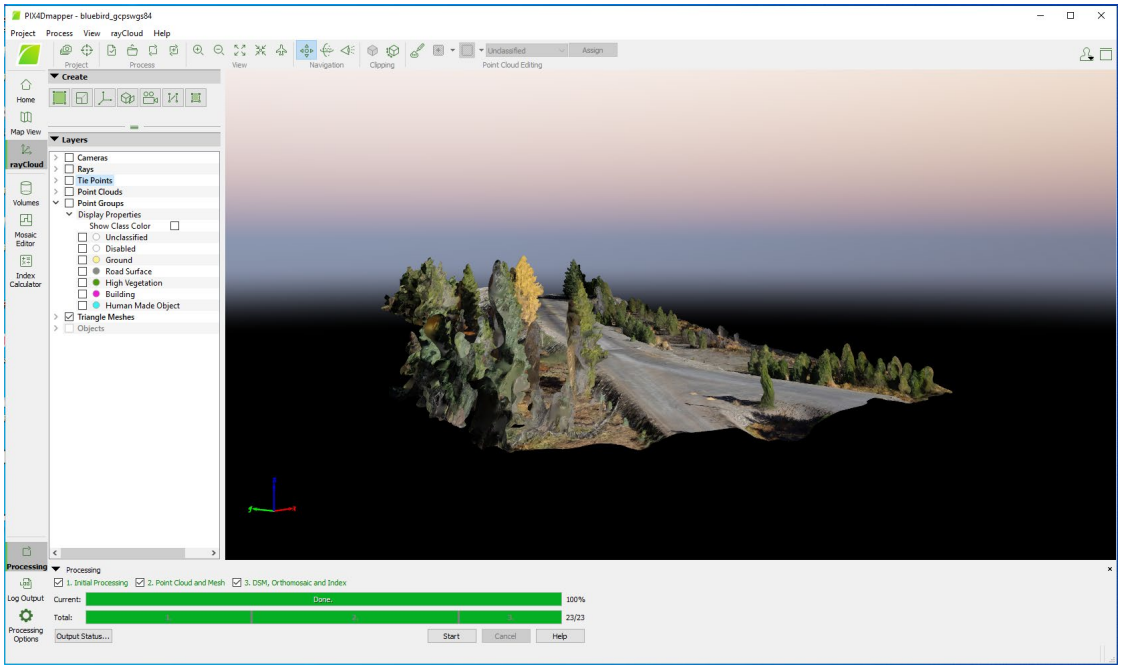
NOTE: *Depending on what outputs your project requires and what imagery you are loading, you can opt for different templates. For producing Point Clouds, DSMs, 3D Meshes and Orthomosaics from aerial imagery, you will select either Standard or Rapid 3D Maps. These options are also good for measuring volumes, digitizing houses and roads and generating contour lines. For producing Point Clouds and 3D Meshes from ground-based imagery, you will select either Standard or Rapid 3D Models. This option is good for 3D models of buildings, statues and objects and video fly-through of scenes. If you opt to use Standard processing for larger image files, you may want to consider running the process overnight.*

Part 2: Adding a Surface

Adding a surface can make a 3D textured mesh or DSM more accurate in terms of representing the geometry of your project area or can improve aesthetic qualities of your products.

A. Adding a Surface to Improve a 3D Textured Mesh

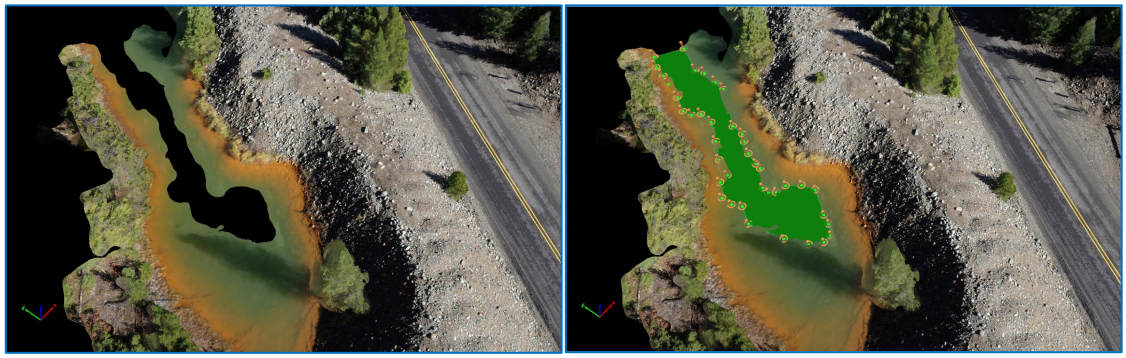
1. In rayCloud, under **Layers**, uncheck all but **Triangle Meshes**.
2. Click **OK** on any warning messages regarding the first time loading of your mesh products.



3. Navigate around your mesh and identify an object in the project area, perhaps an area within the waterbody that appears more uneven than it should, and that you think would be more accurately represented by the 3D textured mesh as a planar surface.

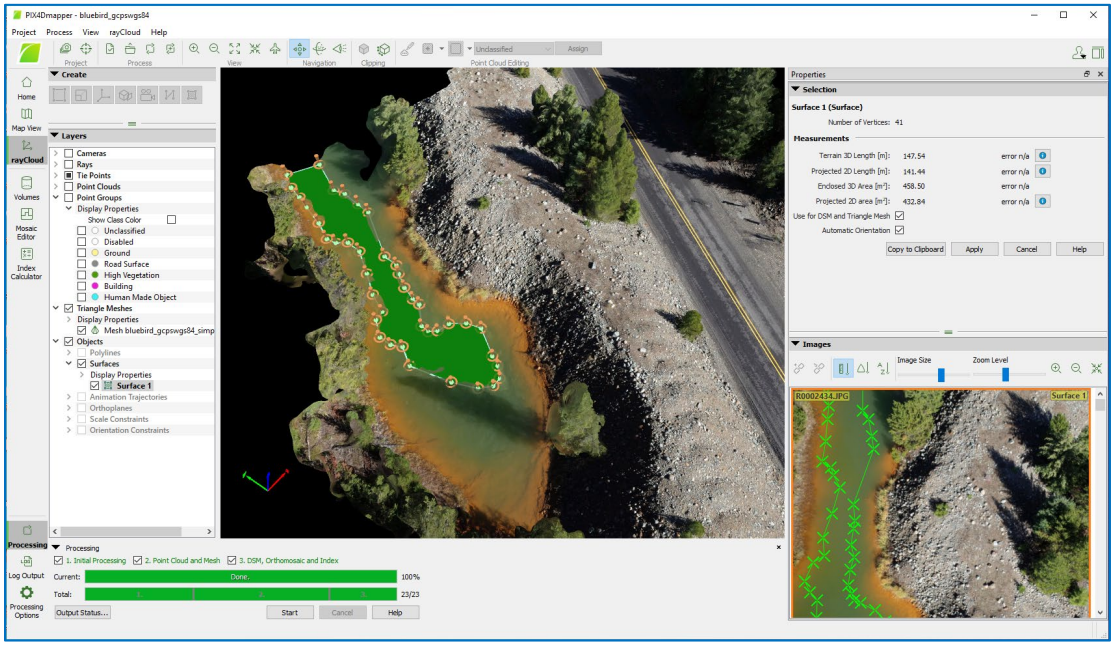
NOTE: *To tilt view your dense point and mesh, hold shift as you left click on your mouse or trackpad and move in the direction you would like to view the generated products from. Use the scroll wheel to zoom in and out. Left click to move horizontally. Click and hold the scroll wheel to orbit. To view all points within your dense point cloud, hit the* ***View All*** *button on the View toolbar.*

4. In the main menu, click **rayCloud**, then click **New Surface**.
5. Click the surface of the 3D textured mesh to add the first vertex. Continue clicking the surface of the 3D textured mesh to add more vertices, right clicking on the last one to finish digitizing the surface.



NOTE: *If you make a mistake when placing a vertex, you have two options to correct its placement. Right click to stop drawing vertices, then in the* ***rayCloud*** *tab on the left-hand side, under* ***Objects****, right click on your* ***New Surface*** *and select* ***Remove****. You can then begin to draw your surface again. Otherwise, you can continue to place your vertices. When complete, navigate to your surface in the dense point cloud and edit the vertices that have been misplaced. Click on the vertex you want to edit. In the right-hand side* ***Sidebar****, the images in which the vertex is present will generate (if these do not display, try minimizing and reopening the* ***Images*** *dropdown tab). Locate and click on the correct location of the vertex in an image and then click* ***Apply*** *under the Selection dropdown. In the* ***Images*** *dropdown, confirm the new location by continuing to click on the updated location in each image. Then click* ***Apply*** *again to save your changes.*

6. Under **Layers**, then **Objects**, ensure that the name of the surface is checked.
7. If the sidebar menu is not displayed, enable **Show Sidebar** under **View** in the main menu. Then, in the sidebar, locate **Selection** and check **Use for DSM and Triangle Mesh** and click **Apply**.

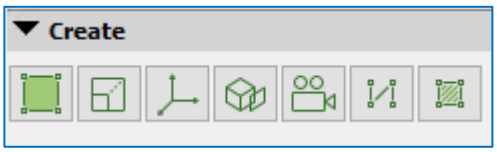


8. In the main menu, under **Process**, click **Generate 3D Textured Mesh**. Click **Save** if prompted to do so. Monitor the progress bar at the bottom left of the screen for status updates, it may take a short while. When the process is complete the progress bar will show **3D Textured Mesh generated**.
9. Under **Project**, click **Save Project**.

B. Adding a Surface to Smooth a DSM (Optional)

1. In the View Toolbar on the left-hand side, click on **Mosaic Editor**. It may take a few minutes to initially load in the DSM and orthomosaic.
2. In the main menu, click **Mosaic Editor** then **View**, and check **Show DSM**.
3. Identify one or more parts of the project area where the DSM appears to be too noisy,

4. In the rayCloud tab on the left-hand side of the interface, locate the **Create** bar as seen in the following figure, and click on the end icon, **New Surface**.



5. Digitize a surface around the part of the project area you have identified, as done in Part 2. A step 5.
6. Under **Layers**, locate **Objects**, and ensure the new surface has been checked.
7. In the sidebar, locate **Properties** and check **Use for DSM and Triangle Mesh** and click **Apply**.
8. Under **Project**, click **Save Project**.

C. Adding a Surface to Remove an Object from a DSM (Optional)

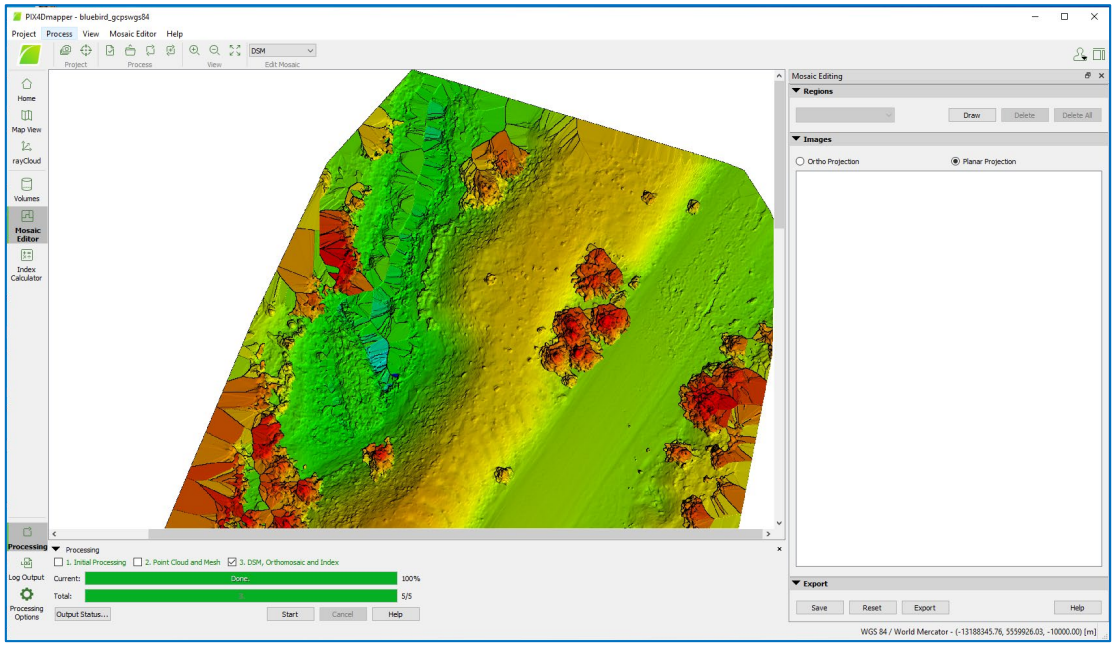
1. Under **View**, click **Mosaic Editor**.
2. Identify an object that is above the ground and irrelevant to the project.
3. Follow Part 2. B. steps 5. through 8. to complete digitizing and saving your new surface.
4. Under **Project**, click **Save Project**.

Part 3: Generating an Updated DSM & DTM

It is strongly encouraged that a dense point cloud always be classified prior to generating a DTM to represent the model's terrain more accurately, which is why for this part of the exercise, we rerun step *2.*, and classify the point cloud prior to generating the updated DSM and a newly generated DTM.

A. Generating an Updated DSM & DTM

1. Click on **Processing Options** on the bottom left-hand corner of the screen. Uncheck step *1. Initial Processing*.
2. Place a check next to step *2. Point Cloud and Mesh* and navigate to Point Cloud Classification under the first tab, Point Cloud. Check **Classify Point Cloud**.
3. Place a check next to step *3. DSM, Orthomosaic and Index* and navigate to Raster DTM under the second tab, Additional Outputs. Check **GeoTIFF**, then click **OK**.
4. In the **Processing** menu, click **Start**. Click **OK** in response to any warning messages that pop up.
5. Once the processing is complete you can access the Mosaic Editor. In the main menu, under **View**, click **Mosaic Editor**. Wait for your DSM and orthomosaic to load by keeping watch on the progress bar under the Processing section at the bottom of the screen.
6. In the main menu, under **Mosaic Editor**, click **View** then check **Show DSM**. As an alternative, select **DSM** from the dropdown menu under the **Edit Mosaic** section of the toolbar located under the main menu
7. Confirm that the corresponding parts of the DSM have been derived from your new surfaces by inspecting the new output.



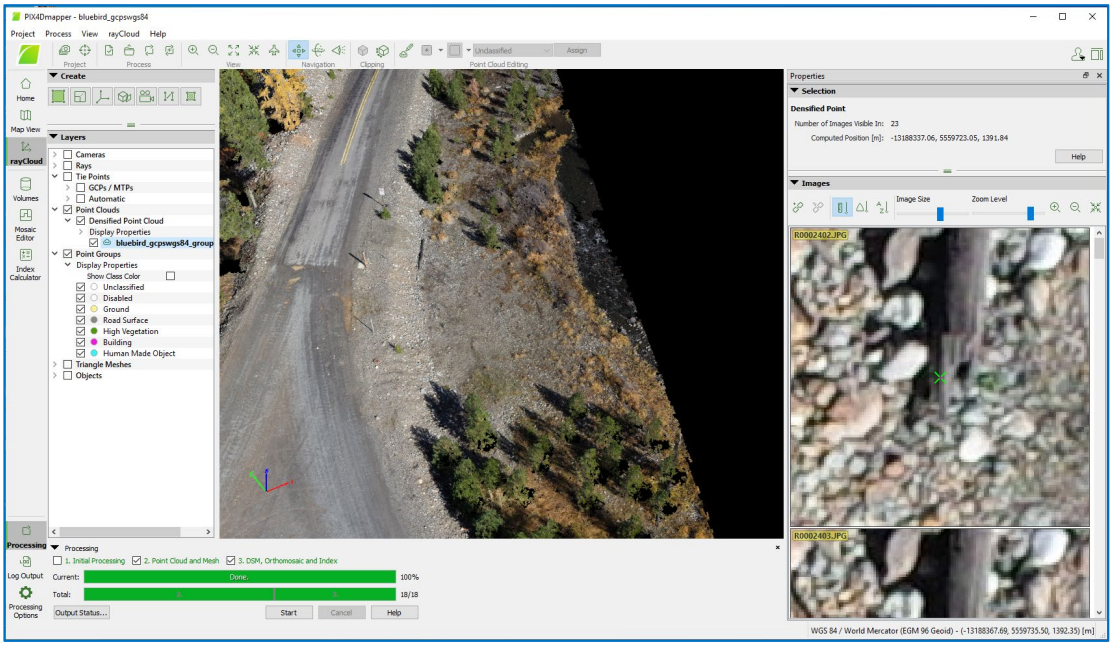
8. To view the DTM, click **Mosaic Editor** in the main menu, then **View**, and then click **Show DTM**. You can also confirm that the DTM represents the geometry of the ground and not above ground objects including structures or vegetation if you made such changes.
9. Under **Project**, click **Save Project**.

Part 4: Measuring Distance

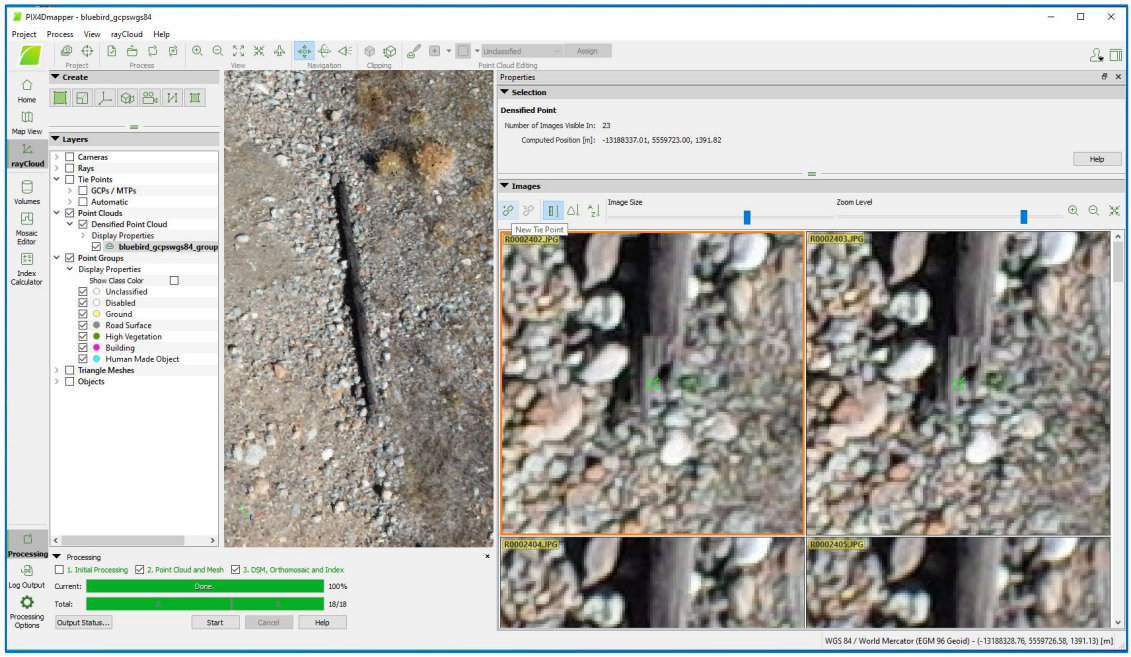
There is more than one way that measurements can be performed within Pix4Dmapper once step *2.* has been completed. One method is to digitize a polyline in the rayCloud's 3D environment, then mark each of the vertices in a sufficient number of images. Another method is to mark each of the features you want to serve as the polyline's vertices, to features marked in images. Each method trades off between accidentally snapping vertices to incorrect features and overall processing time. To avoid snapping errors, be sure to select the correct features in each image – precision is key for accurate measurement calculations.

A. Measuring Distance

1. Click on **rayCloud** in the left-hand side menu. Under **Layers**, uncheck everything but **Point Clouds**.
2. In the main menu, under **View**, enable **Show Sidebar** if it is not already showing.
3. Locate the downed tree trunk towards the mid-south-west portion of the project area as seen in the following figure.

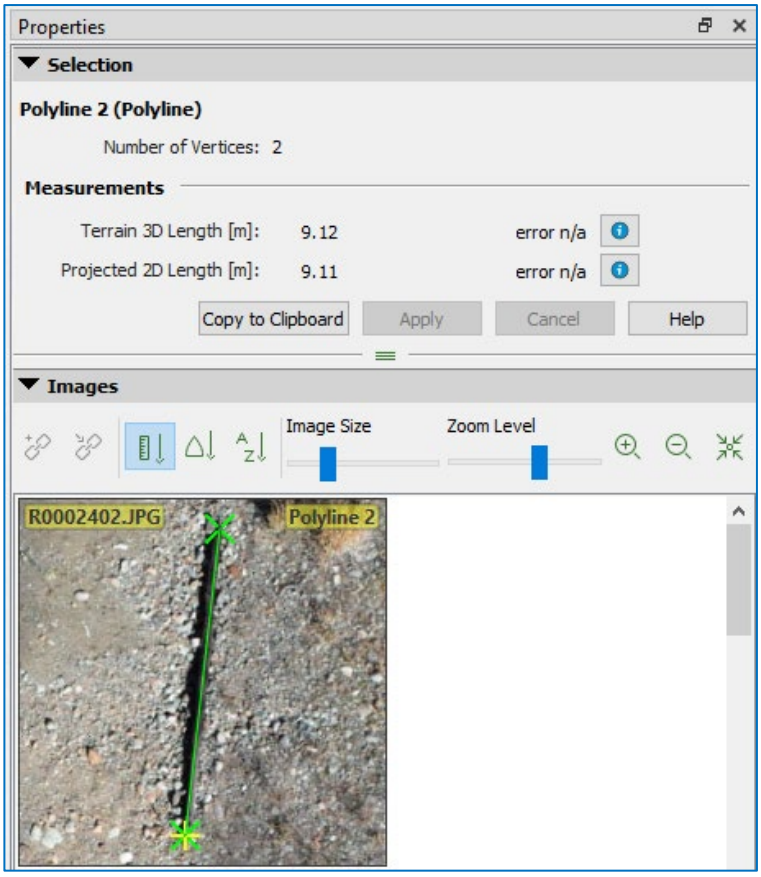


4. Left click on a point in the dense point cloud that represents the chosen feature.
5. Drag the edge of the sidebar to the left so that it fills most of your screen and adjust the size of your image thumbnails by changing the Image Size slider.
6. In the **Images** section, click **New Tie Point** as seen in the following figure.



7. In the sidebar, minimize the **Selection** section to collapse the manual tie point's (MTP) details.
8. Place your cursor on the first image in the list and locate your feature by zooming in or out and panning using your scroll wheel or trackpad.

9. Click on your feature, one end of the downed tree, then locate it in the next image and click on it once again.
10. In the **Images** section, click on **Focus on Selection**, the far button to the right.
11. Mark the feature in other images in the list and then click **Apply** in the **Selection** section of the sidebar to save your changes. Continue until no new images display.
12. Repeat steps 4 through 11 to create a second MTP on your other feature of interest, at the opposing end of the downed tree trunk.
13. In the main menu, under **rayCloud**, click **New Polyline**.
14. In your 3D environment, left click on your first MTP and right click on your second. Note the dimensions of the polyline in the sidebar as seen in the following figure.



15. Under **Project**, click **Save Project**.

Part 5: Measuring Volume

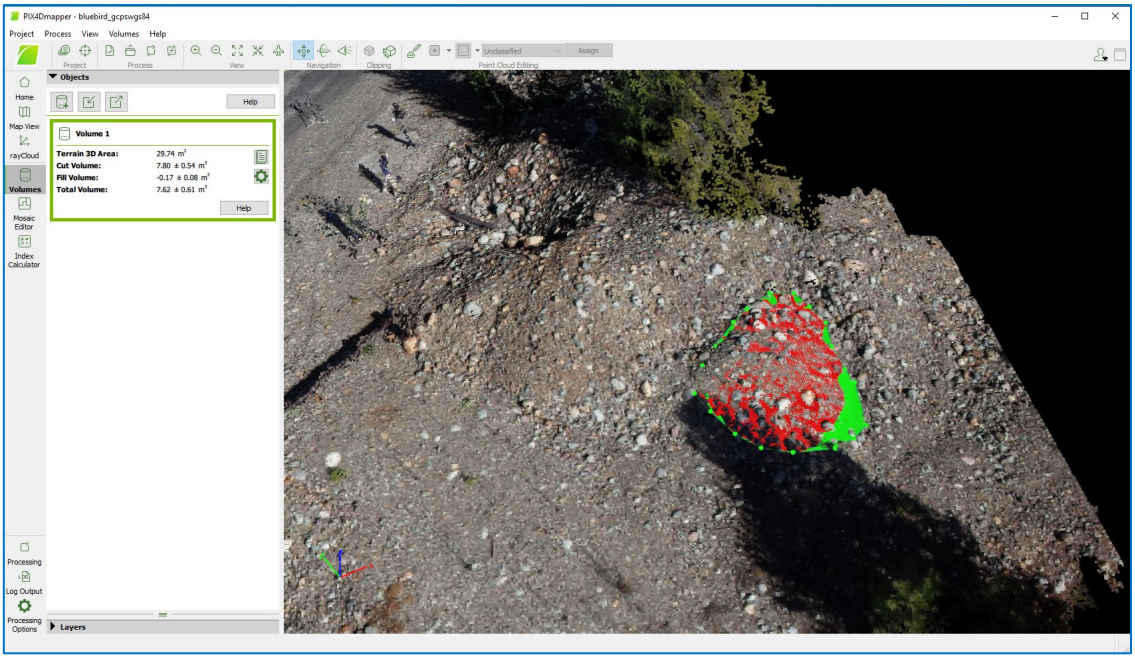
A. Measuring Volume

1. Under **View**, click **Processing** if your Processing menu is not already displayed, and confirm that step *1.*, step *2.*, and step *3.* are green. Under the **View** tab, disable **Processing** and enable **Volumes**.

2. Locate a stockpile, an accumulated reserve of dirt or rocks, where the base of the entire pile is as flush with the ground as possible and does not encounter another structure.
3. Under **Volumes**, click **New Volume**.
4. Click on a point in the dense point cloud that is at the foot of the stockpile. Continue clicking points around the foot of the stockpile, right clicking on the last one to finish digitizing the base surface.

*NOTE: If you make a mistake when placing a vertex, you have two options to correct its placement. Right click to stop drawing vertices, then in the **Volumes** tab on the left-hand side, under **Objects**, hover over **Volume 1** and hit the **Delete** button to start delineating your volume area again. Otherwise, you can continue to place your vertices. When complete, in the **rayCloud** tab, navigate to your volume in the dense point cloud and edit the vertices that have been misplaced. Click on the vertex you want to edit. In the right-hand side **Sidebar**, the images in which the vertex is present will generate (if these do not display, try minimizing and reopening the **Images** dropdown tab). Locate and click on the correct location of the vertex in an image and then click **Apply** under the Selection dropdown. In the **Images** dropdown, confirm the new location by continuing to click on the updated location in each image. Then click **Apply** again to save your changes.*

5. To compute the volume of your object in the Volumes tab, under **Objects**, and **Volume 1**, click **Compute**.



6. Confirm that the volume measurement measures the total cut volume of the stockpile.
7. Under **Project**, click **Save Project**.

Conclusion: Congratulations! You have completed Pix4Dmapper Additional Steps for Processing UAS Imagery! In this exercise, we learned how to use Pix4Dmapper to add surfaces and enhance our DSM and DTM outputs from aerial imagery and measure distances and volumes.

Additional resources, including a few tutorials and a very helpful user forum, can be found on the Pix4D website.