*LIDAR 1 CuePac*

*User Guide 2020*

*22 December 2020*

Before attempting to install and use GeoCue, please very carefully read the ***GeoCue Installation Guide***. This guide tells you how to install the product suite, how to add GeoCue Client and GeoCue Web users and how to migrate a previously created database. You will not be able to access GeoCue until you have *carefully* followed the steps in the ***Installation*** guide!

NOTE: If you are processing mobile scanner data, you will also need the "xxx MMS CuePac" where xxx is the sensor type (e.g. LYNX).

The default GeoCue Admin password is "geocueadmin" (case sensitive).

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# *NOTICES*



## ***Trademarks, Service Marks***

## *Acknowledgements*

We would like to thank the following companies/organizations for their support in the development of GeoCue and/or LIDAR 1 CuePac

- *ASPRS LIDAR Working Group*
- *BAE Systems*
- *Bentley Systems, Incorporated*
- *DAT/EM Systems International*
- *EarthData*
- *Environmental Systems Research Institute.(ESRI)*
- *Ohio Department of Transportation, Office of Aerial Engineering*
- *Optimal Geomatics*
- *TerraSolid, Oy*

# *Getting Help*

This guide is a replacement to all previous LIDAR 1 CuePac guides.

Please note that the previously combined GeoCue and LIDAR 1 CuePac document has been split into two separate documents.

We are sure that you will experience different problems with GeoCue that range from installation issues to defects that made it through our testing undetected. We hope that you will immediately contact us with any problems or questions and have the patience to work with us through a successful GeoCue deployment.

Please contact us via phone or email for assistance with or comments about GeoCue and LIDAR 1 CuePac.

email:

**support@geocue.com**

Phone:

**1-256-461-8289**

Just ask for GeoCue Support and you will get connected with someone who can assist you. There is usually someone in the office between the hours of 0600 and 1800 CDT, USA on weekdays. Weekends are sort of hit or miss.

Fax (always on):

**1-256-461-8249**

# About this Document

Welcome to the GeoCue LIDAR 1 CuePac User Guide.

Note – We have separated the workflow documents into a volume for each major GeoCue component.

If you are new to GeoCue, you should first work through the examples in the GeoCue Workflow Guide. This document (the LIDAR 1 CuePac User Guide) assumes that you are already familiar with the basic operations of GeoCue. If you find yourself using commands that do not appear to be documented (such as GeoAnalysis), please refer to the GeoCue User Guide.

# Contents

# 1 Introduction

Process Management is the art of organizing and monitoring a workflow with the goals of improving efficiency and quality while simultaneously reducing production costs. Process management can be performed with tools as simple as pen and paper or as complex as automated systems that control chemical plants. The important thing, of course, is that it is done. Like a control system with no feedback loops, production performed without constant monitoring and tweaking generally runs at very low efficiency. In this day of ubiquitous computing, companies who are not implementing rigorous Process Management will have great difficulty in competing with those companies who do constantly improve their processes.

A fundamental belief that we kept in mind in the design of our process management system is that most companies have fairly efficient workflow procedures and tools in place today. Thus an approach of taking on the domain expertise of our customers and asking them to completely retool their approach to production would not make sense. We perceive the major problem not as workflow *definition* but rather managing and controlling the existing workflows. Therefore, our design approach is to build a collection of *framework* tools that can envelope existing workflow procedures and tools with a minimum of perturbation of operations and user training.

The GeoCue geospatial process management system (*GeoCue*) is a generic framework that is easily tailored to manage a variety of geospatial production scenarios such as LIDAR production, digital orthophoto production, traditional photogrammetric production and etc. In fact, *GeoCue* is applicable to just about any production or task management scenario that follows the paradigm of input of data, dividing the data into production “segments” and then processing the data into products. Here we use the term *products* somewhat loosely since products could simply imply a report. For example, we think *GeoCue* is a viable tool for parceling up a task such as intelligence review of image data among analysts.

Most geospatial processing operations can be managed through geospatial and temporal “slicing.” Geospatial slicing involves dividing the project area into manageable subunits that can be parceled out to “production operators.” Temporal slicing is the process of dividing the overall workflow into well defined *process steps*. *GeoCue* contains intrinsic capabilities to accommodate both of these aspects of process management.

The obvious view of process management is typically that of *processing* data into a deliverable product. An example of this is ingesting raw LIDAR data, processing these data through a sequence of production steps and then creating some final delivery product such as contour files. One could come up with a similar scenario for orthophoto production, digital feature extraction and other types of geospatial production. However, the same data management issues occur in scenarios that involve only "intellectual" production such as intelligence review of data. Here the task sequencing is quite similar to geospatial production with steps such as preparing the data for inspection, parceling it up among analysts, providing data specific tools for review, including tools to provide management a synoptic view of the current state of the process and so forth.

We strongly believe that the *GeoCue* product family will be a very valuable addition to many organizations who manage medium to large projects that have a combined spatial and temporal nature. As we realized the value of a general data production environment, we began to carefully architect *GeoCue* to allow it to accommodate a wide variety of tasks rather than focusing on our initial technology area of elevation data processing. An example of the result of this focus has been the inclusion of a variety of technologies within *GeoCue* to allow either end-users or systems integrators to field-extend the system.

An additional important element of *GeoCue* is the inclusion of a web viewing and annotation tool. This viewer can be used to allow remote users to obtain a *filtered*, read-only view of the project. By filtered we mean that a *GeoCue* system administrator can establish the elements that will be included in a remote view by criteria such as the user's login identity. In addition to serving the obvious role of allowing trusted users remote view access to projects, it also serves as a tool to allow ultimate end-use customers real time access to the production project. In addition, the web system includes the ability to create 'annotations' related to a project. This is essentially a web-hosted red-lining system that allows a web user to attach comments to *GeoCue* 'entities' as well as assign resolution 'steps'.

While we believe that many users will be able to deploy GeoCue "out-of-the-box" by using GeoCue and third party developed application *Environments*, the true value of GeoCue will be realized by tight integration into workflow practices. To facilitate this deep deployment integration, GeoCue is designed as a workflow management *development platform.* As will be described in this document, nearly all functions within GeoCue are implemented within a GeoCue Repository Services architecture that is accessible via a GeoCue Application Programmer's Interface (API). To enforce this development philosophy, the developers of

GeoCue have implemented the GeoCue Client using the GeoCue Repository API. Thus we are truly eating our own cooking!

This document is intended as introduction to the GeoCue process management system as well as the Environments provided by the LIDAR 1 CuePac. However, you are strongly encouraged to play around with GeoCue outside of these examples.

# 2 An Overview of LIDAR 1 CuePac

The LIDAR 1 CuePac is a dynamically loadable production *Environment* for GeoCue that provides a comprehensive multiuser LIDAR data processing environment oriented around TerraScan, the premiere LIDAR editing tool from Terrasolid. The basic LIDAR production flow is sketched in Figure 2-1.

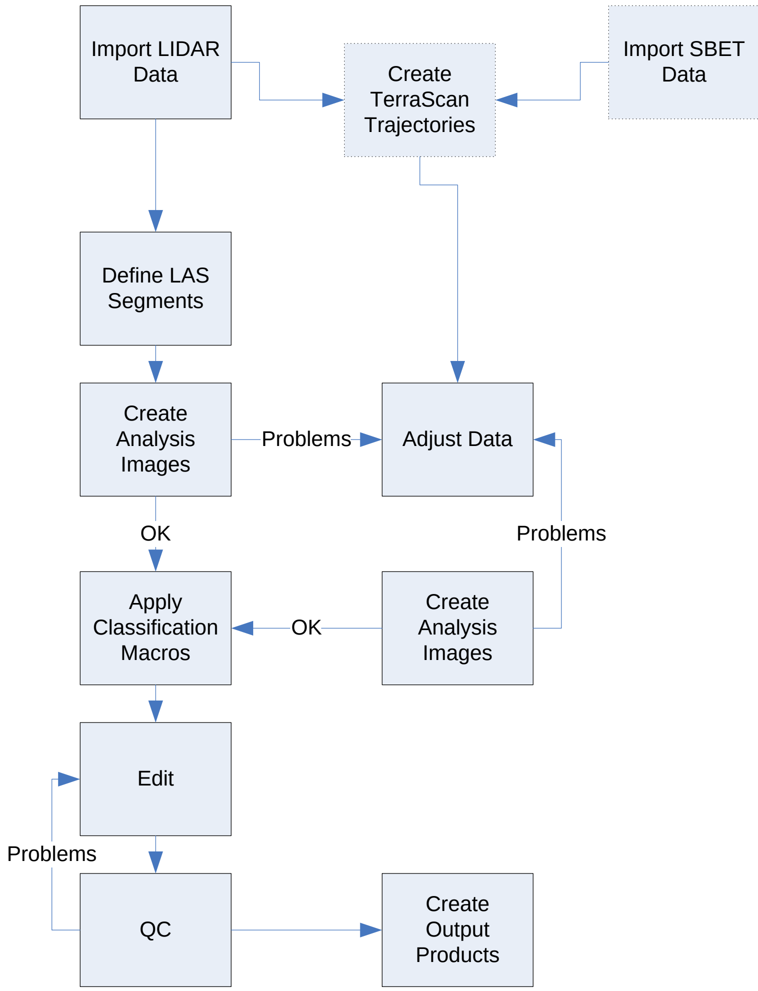



**Figure 2-1 The Basic LIDAR Processing Flow**

# 3 Coordinate System Transformations in LIDAR 1 CuePac

LIDAR 1 CuePac provides complete coordinate transformation capabilities for LIDAR data in LAS format. The actual transformation occurs when the LIDAR data is copied from the referenced input sources to the LAS Working Segments[1].

### 3.1.1 Source Coordinate Systems

LIDAR Sources are assigned their source coordinate system at the time that they are imported into GeoCue. This assignment is written to the Coordinate System section of the *Files* tab of the Source Strip Properties dialog. There are two options for the assignment of the source coordinate system. These options are on the Import Sources dialog (Figure 3-1).

[1] Except in the case of ECEF data which are transformed on import.

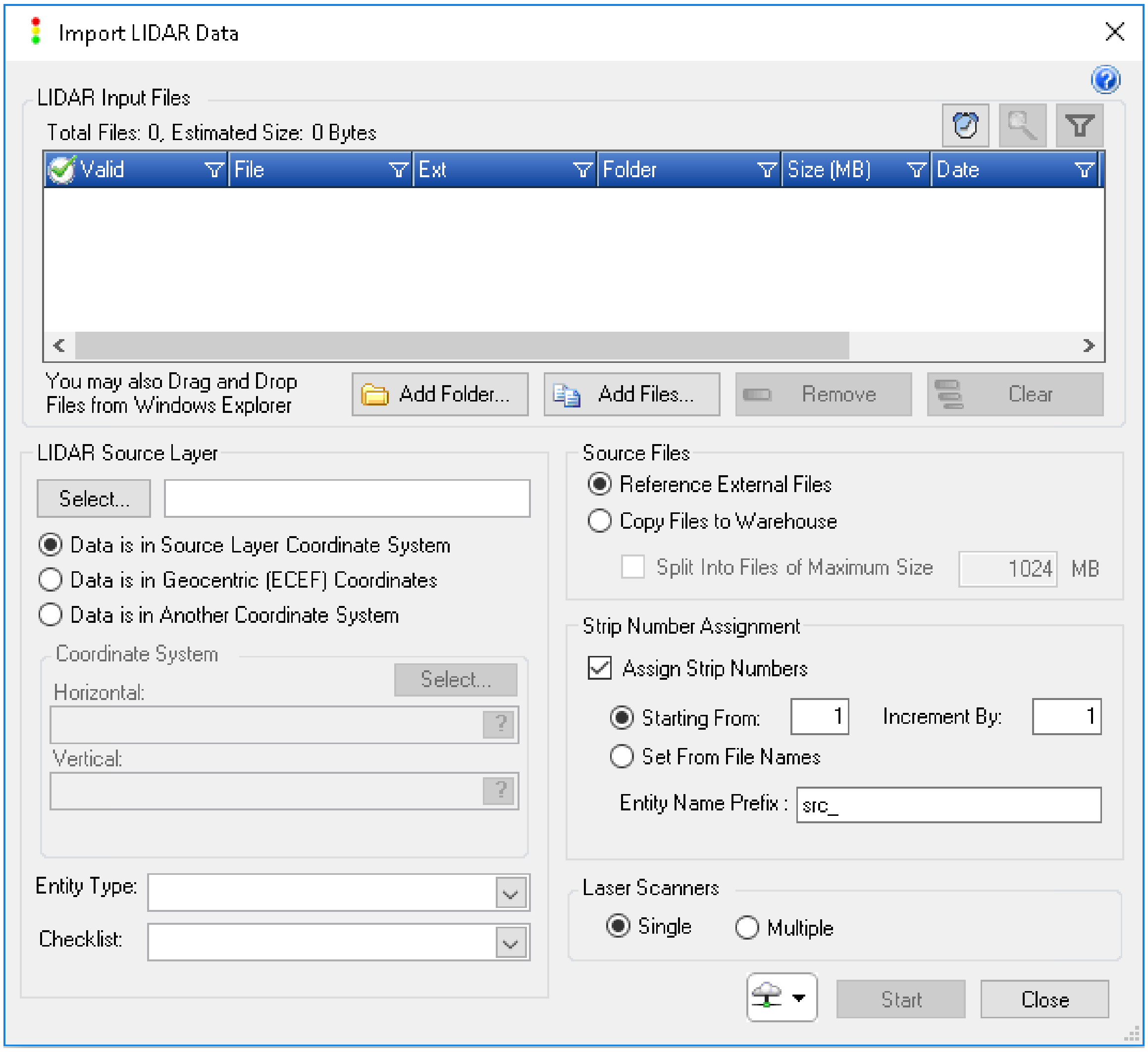



**Figure 3-1 Import LIDAR Data**

Unless your source data are in Earth Center, Earth Fixed (ECEF), set the Source Layer Coordinate Systems (both Horizontal and Vertical) to the coordinate system of the LAS files you are about to import. Thus, for example, with the new coordinate conversion ability of LIDAR 1, you could always output LIDAR data in WGS84 ellipsoid coordinates and use GeoCue to transform the data to the desired product coordinate system during populate working segments. If your data *are* in ECEF (geocentric), define a LIDAR source layer in the coordinate system in which you wish the data to be transformed.

Design Note – Our design desire was to use the GeoTIFF packet within the imported LAS files to determine the coordinate system of the Source LIDAR data. However, we have found the GeoTIFF packet often miscoded. Thus we are forced to rely on user input to define the source coordinate system.

Unless the sources have been declared ECEF on the import dialog, LIDAR 1, during strip import, examines the coordinate system of the Source Layer to which the sources are being input to decide the coordinate system of the source data. It writes this coordinate system information to the Files collection section of the source entity properties.

If the ECEF option was selected on the Import Sources dialog, the *Files* collection coordinate information is immediately set to Geocentric (Earth Centered, Earth Fixed). In this one special case, the Source layer coordinate system can be set to anything at all since it will not be examined to determine the source coordinate system.

Note: We now support the ability to transfer LIDAR data to the GeoCue warehouse during import. When using ECEF, you do not have a choice; the data *must* be copied into the warehouse. This option will automatically be appropriately set.

Design Note – This business with ECEF is asymmetric to the normal method by which the source strip coordinate systems are defined. One would think that the Source Layer would simply be set to ECEF for this case. The difficulty here is that the Layer coordinate system defines the way transformations must be made for the display system. Our Map Display is a two dimensional display view that does not support a native display transform from ECEF to some projected, two dimensional system. Thus we cannot support ECEF as a layer coordinate system.

## 3.1.2 Transforming during Populate Working Segments

LIDAR 1 uses the coordinate system of the imported LIDAR files (located on the ***Files*** tab of the LIDAR Source Strips Properties' window) as the source coordinate system. It uses the coordinate system of the ***Layer*** containing the Working Segment(s) to be populated as the destination coordinate system. If the source and destination coordinate system are different, they are checked for compatibility. If the systems are compatible, each point is transformed (horizontally, vertically or both, depending on the source and destination systems). If the systems are not compatible, the error message of Figure 3-2 is displayed.

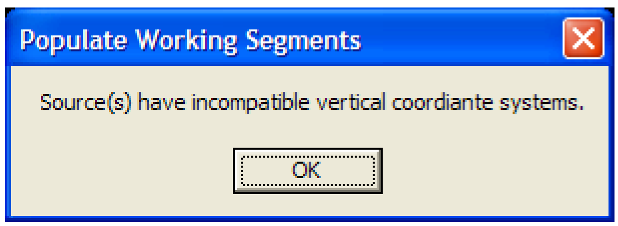



**Figure 3-2 LIDAR Source and Working Segment Layer Coordinate Systems are incompatible**

The possible transformations are shown in Table 3-1:

**Table 3-1 Possible Transformations in GeoCue**

| ***Source*** | | ***Working Segment Layer*** | | ***Resultant Transform*** | |
|---|---|---|---|---|---|
| ***Horizontal*** | ***Vertical*** | ***Horizontal*** | ***Vertical*** | ***Horizontal*** | ***Vertical*** |
| H1 | V1 | H2 | V2 | H1 ► H2 | V1 ► V2 |
| H1 | Unspecified | H2 | Unspecified | H1 ► H2 | Z copied without change |

| ***Source*** | | ***Working Segment Layer*** | | ***Resultant Transform*** | |
|---|---|---|---|---|---|
| ***Horizontal*** | ***Vertical*** | ***Horizontal*** | ***Vertical*** | ***Horizontal*** | ***Vertical*** |
| H1 | V1 | H2 | Unspecified | H1 ► H2 | Z copied without change but no subsequent Z transforms possible |
| H1 | Unspecified | H2 | V2 | *Error declared* – attempt to transform unknown Z to know coordinate system. | |

### 3.1.3 Adjust to Geoid

GeoCue includes an advanced system for declaring and using interpolation schemes for vertically adjusting the coordinates of three dimensional objects such as LIDAR points. This is the type of scheme that is used to apply gravity models to points (orthometric correction).

We deliver GeoCue with the North American Vertical Datum of 1988 (NAVD88) with geoid models 1999 (Geoid 99) and 2003 (Geoid 03). These models are applied simply by selecting the desired Orthometric model from the Vertical Coordinate Selection section of the Coordinate Selection dialog. The United States National Geodetic Survey (NGS) geoid models are delivered with GeoCue Server and these are the models used in the orthometric adjustment.

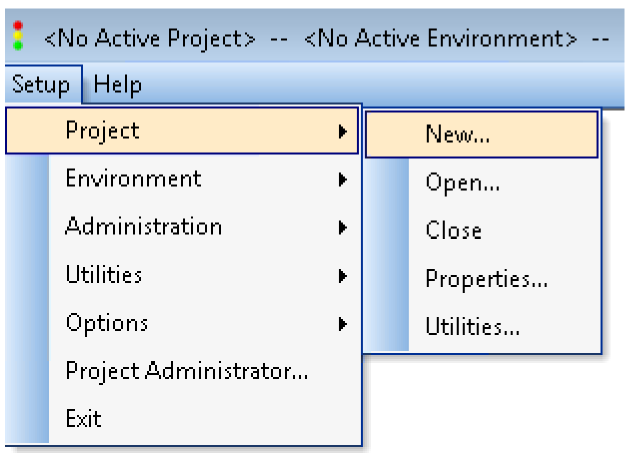
GeoCue Server now incorporates the ability for you to build your own orthometric model. This means that GeoCue supports any orthometric model for which an interpolation grid is available. Please contact us for a Technical Note on installing Orthometric Models if you need this feature.

# 4 Creating a LIDAR Project

In this set of exercises we will create a LIDAR project "from scratch" and perform some project manipulations. We will use 10 of the data strips that were provided with the **Madison** data set included in the GeoCue Sample Data.

## 4.1 Creating a Project

Start up GeoCue and select the option to create a new project from the ***Setup*** menu:




This will bring up the ***New Project*** dialog[2]:

[2] The default coordinate system displayed will not necessarily be the same on your dialog.

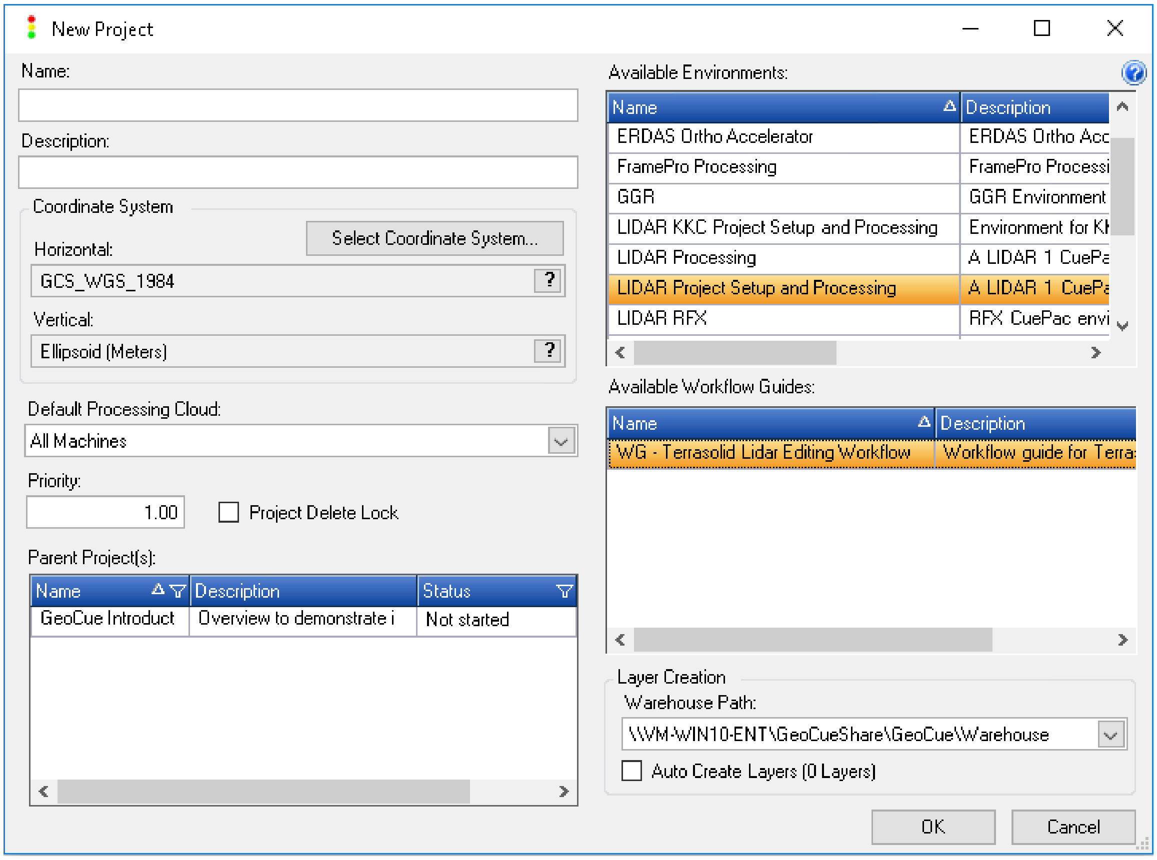



Figure 4-1 New Project dialog

Enter “Madison” as the project name (do not enter the quotation marks) and “Project boundary defined by strips” as the description.  Select the Environment “LIDAR Project Setup and Processing.”

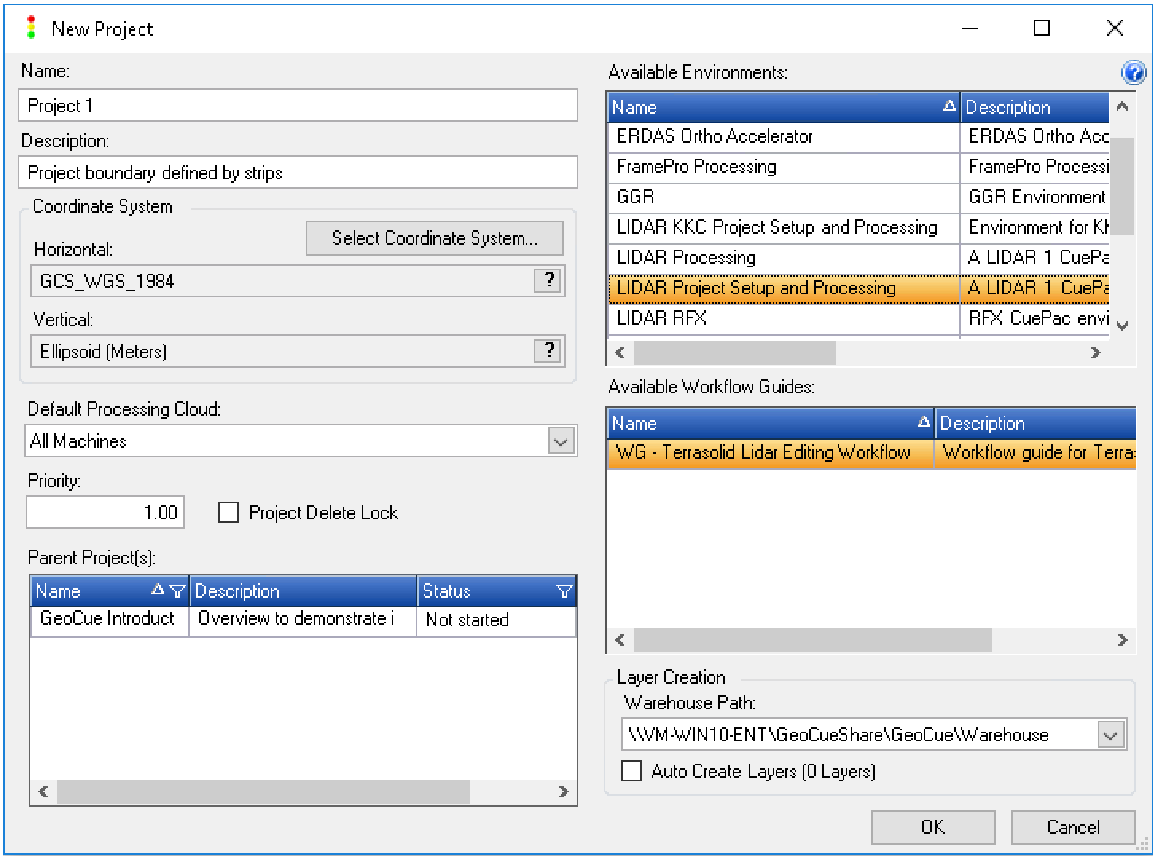
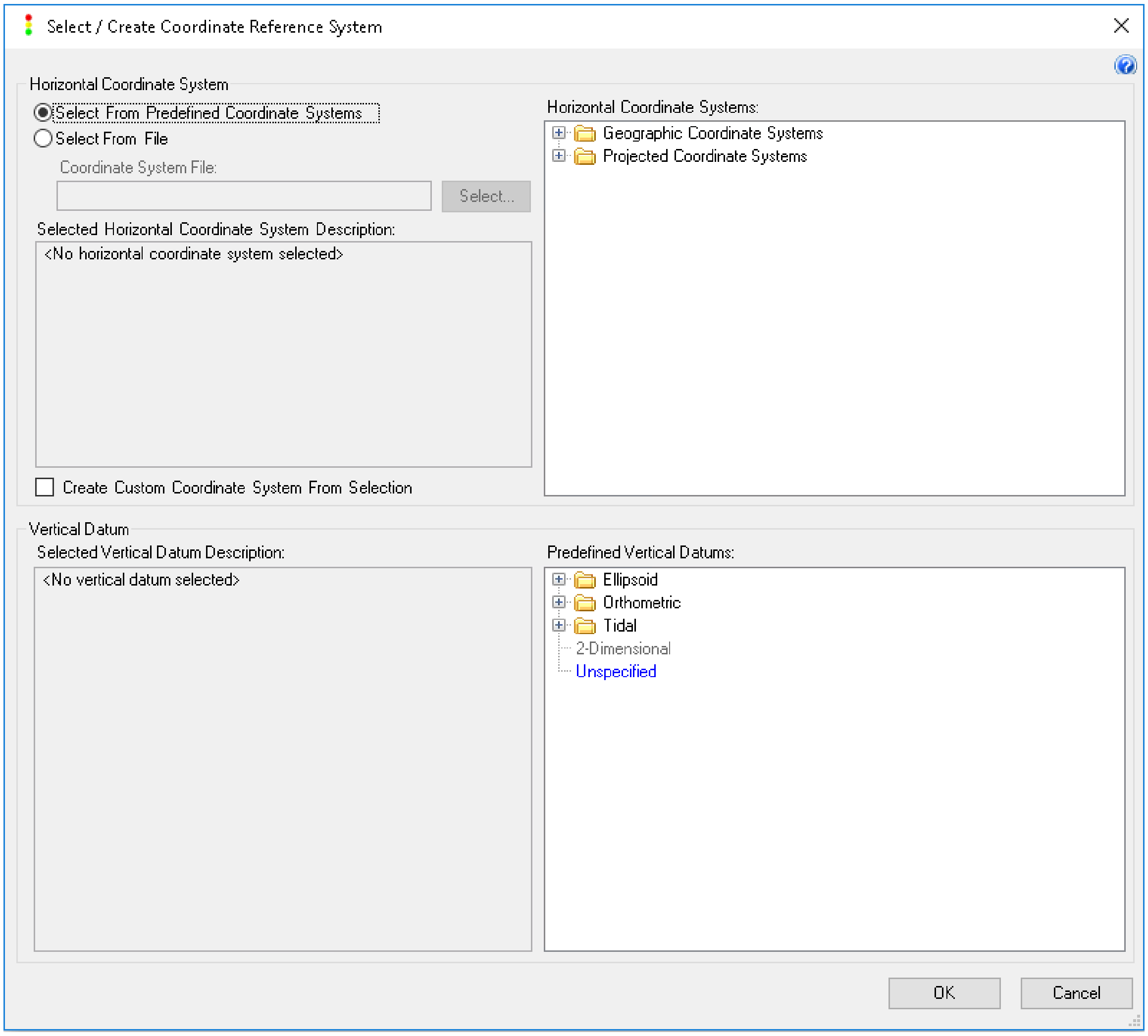



**Figure 4-2 Setting up the initial project**

Press the ***Select Coordinate System…*** button to bring up the coordinate system selection dialog:




## 4.1.1 Selecting the Horizontal System

Under the Horizontal Coordinate System, select the radio button for ***Select From Predefined Coordinate Systems*** (note – the Madison sample LIDAR data are in the NAD 1983, UTM, Zone 16N coordinate system).

Now browse to the selection for “NAD 1983 UTM Zone 16N” (Figure 4-3).

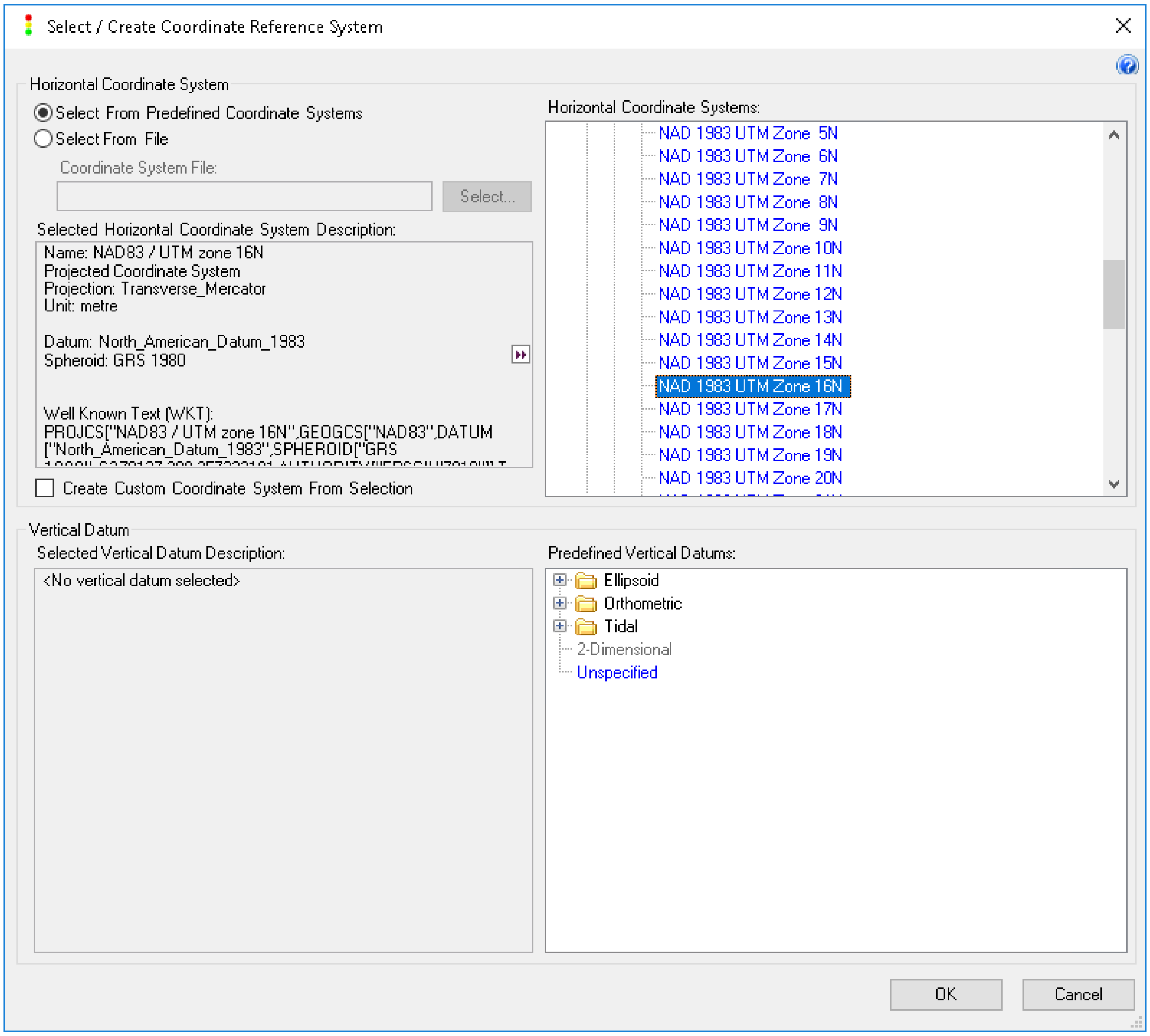



**Figure 4-3 Browsing into the NAD83 UTM folder**

## 4.1.2 Selecting the Vertical System

Under the Vertical Coordinate System section of the dialog, browse to the selection for WGS84 – Ellipsoid (Meters) – See Figure 4-4.

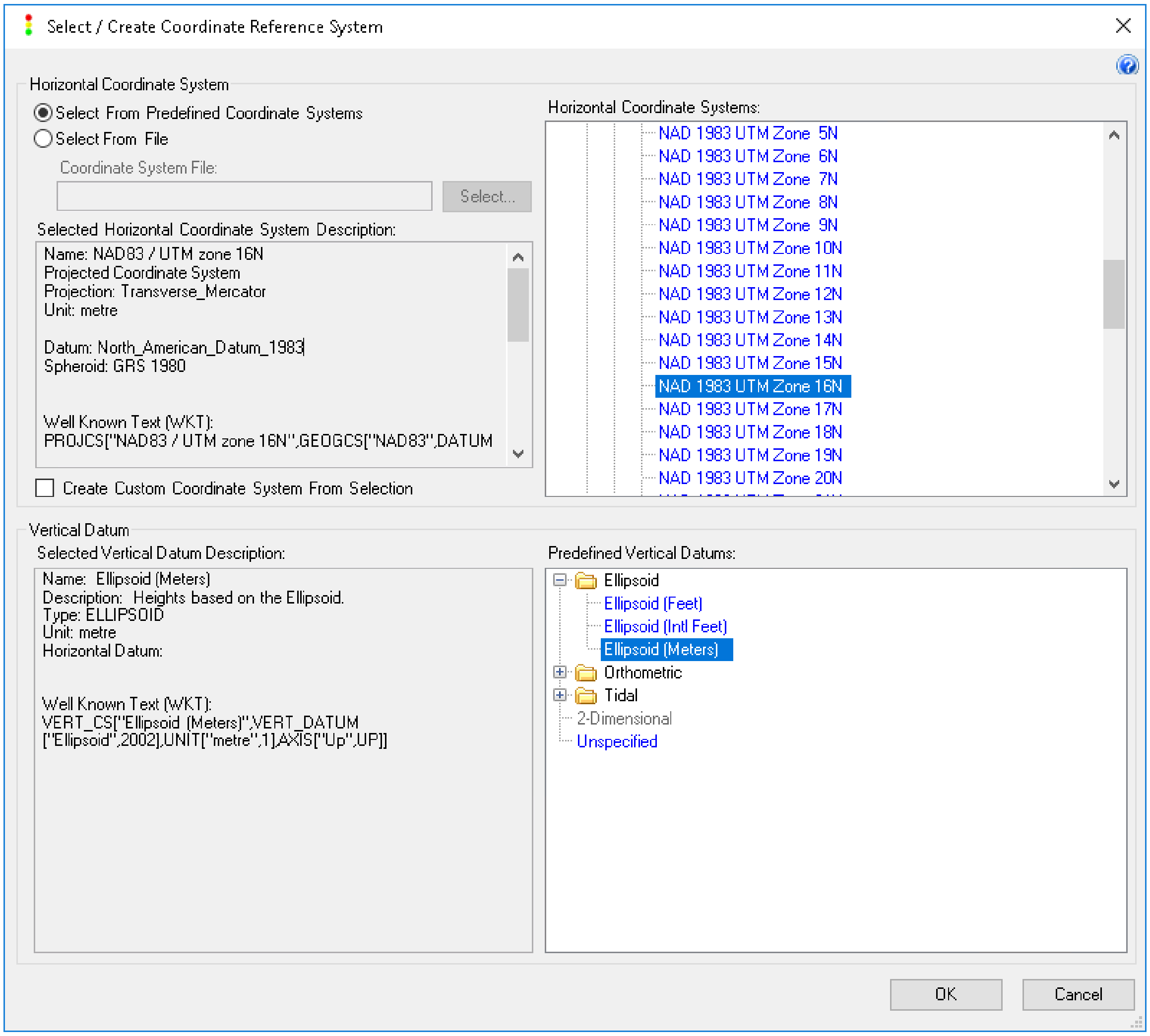



**Figure 4-4 Selecting the Vertical System**

After selecting the coordinate systems, press ***OK*** to dismiss the dialog. This will return you to the ***New Project*** dialog with the selected coordinate systems**.**

### 4.1.3 Completing the Project Creation

This will result in the dialog being filled in as in Figure 4-5. Press the ***OK*** button to dismiss the ***Create Project*** dialog.

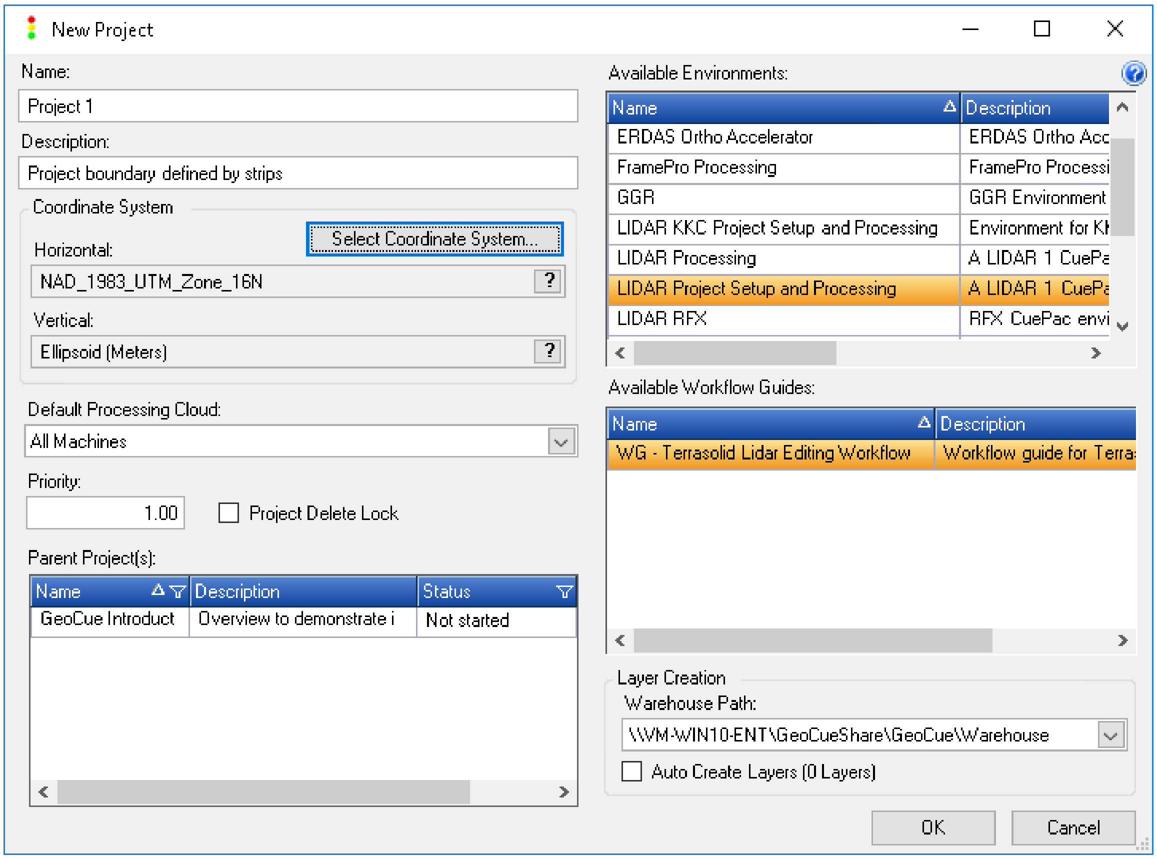
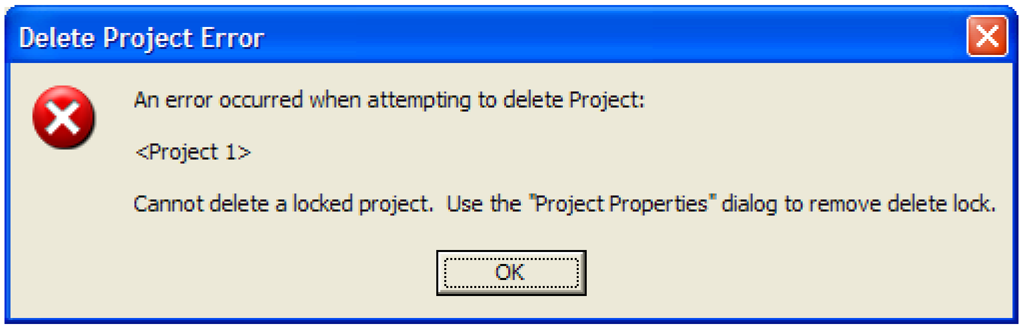



**Figure 4-5 Completed Project dialog**

NOTE – The Delete Lock option on the Create Project dialog allows you to lock the project with respect to deletion. Setting this option causes two events to occur:

- The LOCK column will indicate YES in the Project Open dialog
- Attempting to delete a project that is locked will result in the following error message:




You will notice that a layer has been added to the project with the name "Madison." At this point we have created a new project and assigned the project coordinate system (we chose this particular coordinate system because the LIDAR data we supplied with the project is in this projection). Note that you can see the coordinate system of a layer by scrolling the layer legend.

> Note – The Project Coordinate system will be the default coordinate system that is selected each time you ***Create*** a new layer. You can always override this default and select the coordinate system of your choosing when you create new layers. You can change the default coordinate system by setting a new default option in the Map Coordinate Systems dialog (see GeoCue User Guide)
>
> GeoCue has virtually no restrictions on mixing multiple coordinate systems in the same project. It is probably most useful to choose the Project coordinate system as the coordinate system associated with the bulk of your project data.

## 4.2 Setting the Environment

Ensure that your current ***Environment*** is set to ***LIDAR Project Setup and Processing.*** Recall that the current ***Environment*** is displayed in the title bar of GeoCue to the right of the project name. Recall that you can select the current ***Environment*** through the dropdown menus ***Setup ► Environment.***

# 5 Importing LIDAR Data

In this next step, we will import LIDAR strips into the project and inspect the *properties* of the imported sources.

## *5.1 The Import LIDAR Data dialog*

From the dropdown menus, select *Sources* ►*Import LIDAR…*:

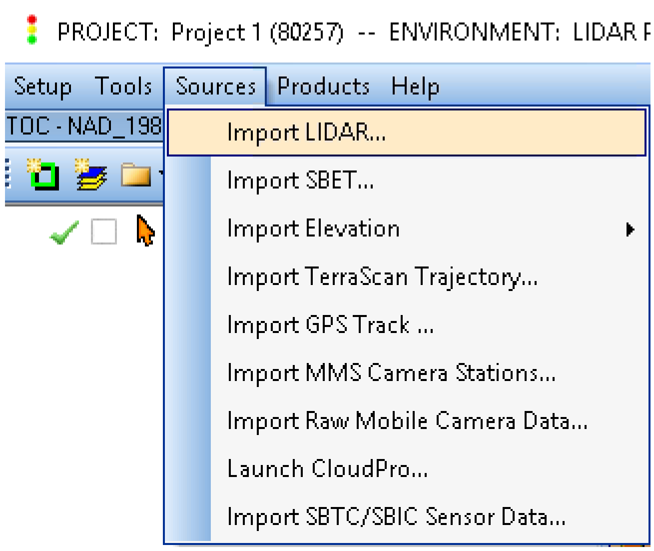



**Figure 5-1 Importing LIDAR Sources**

This will bring up the ***Import LIDAR Data*** dialog (Figure 5-2).

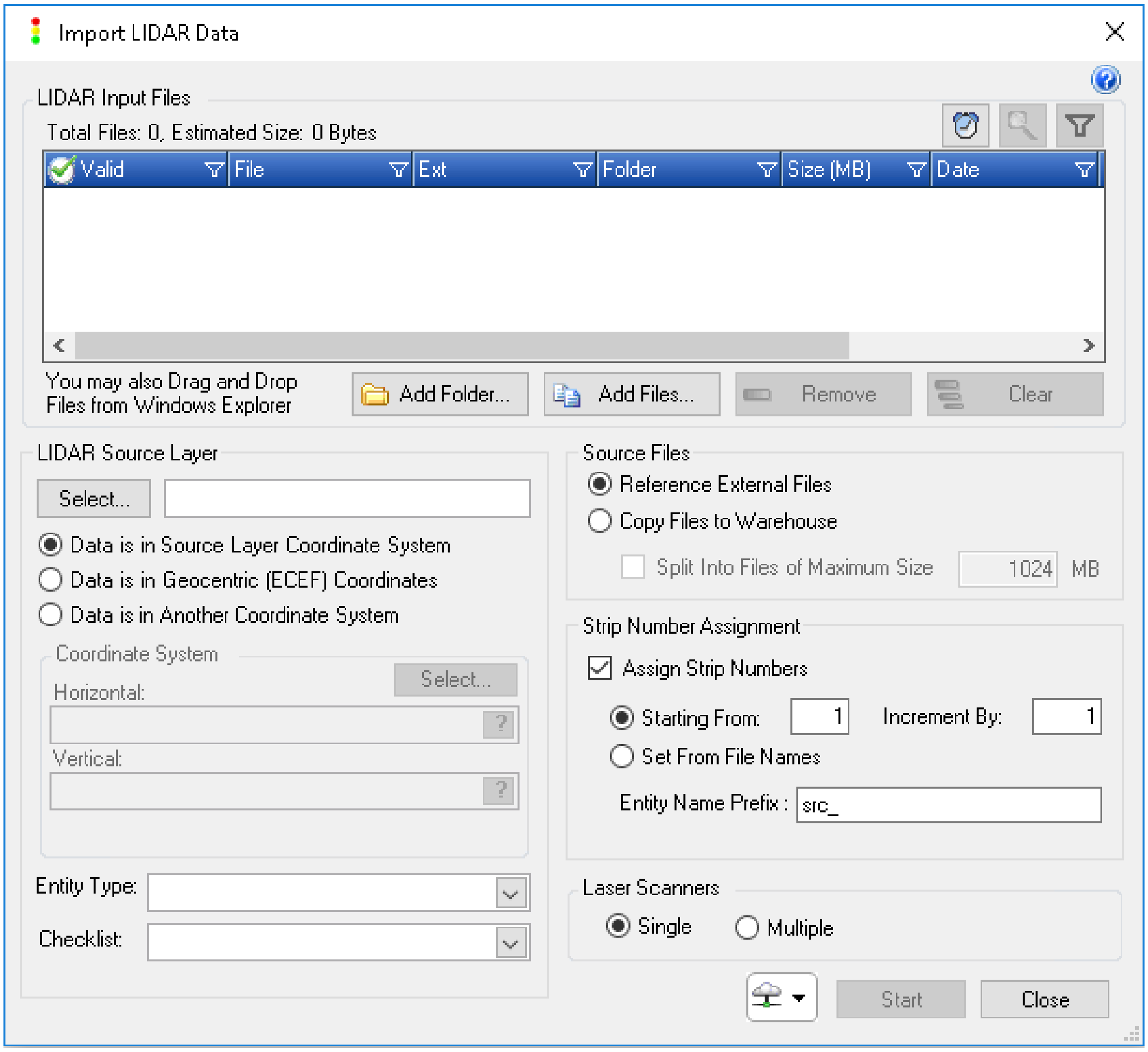



**Figure 5-2 The Import LIDAR Data dialog**

### 5.1.1 Selecting Source Files

Press the “***Add…***” button on the “***Import LIDAR Data***” dialog. This will bring up the standard Windows file browse dialog. Browse to the location of the ten source LIDAR strips in the **Madison** data set that were provided with the GeoCue Sample Data (see the GeoCue Installation Guide to determine this location). Select the files named “Line_003.las” through “Line_016.las” as indicated in Figure 5-3 Selecting Files with the standard file browser. Press the **Open** button to dismiss the dialog.

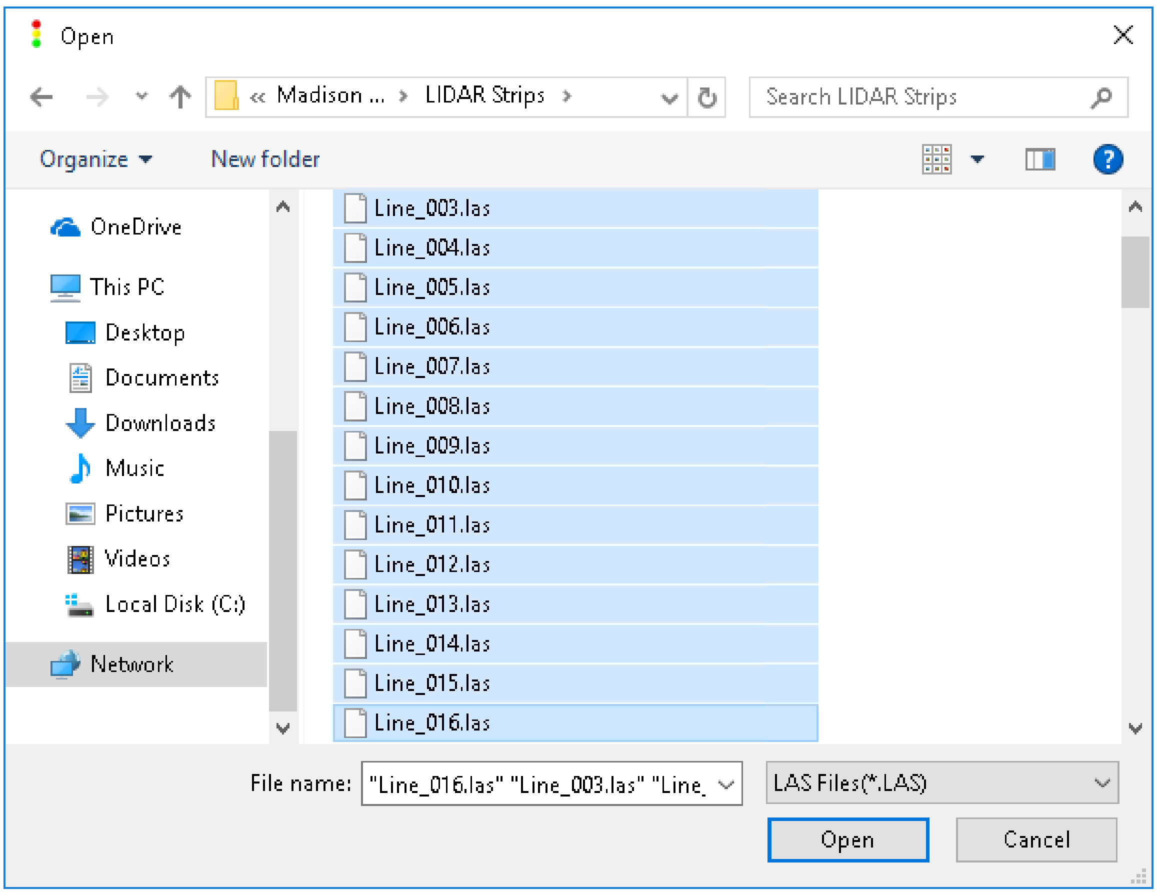



**Figure 5-3 Selecting Files with the standard file browser**

The selected files will be added to the Import LIDAR dialog. Note that you can add data from additional directories by simply pressing the ***Add…*** button again. The file collection in the LIDAR

Import Files section of the dialog is cumulative. You can remove selected files from the list by selecting the files you wish to remove and pressing the Remove button. Finally, pressing the **Clear** button will completely clear all selections, allowing you to start over.

### 5.1.2 Creating a LIDAR Data Source Layer

The next step in bringing data into GeoCue is selecting the layer on which the data representations (*Entities)* will reside. Choose ***Select…*** button under the LIDAR Source Layer section on the dialog. This brings up the ***Select Layer*** dialog.

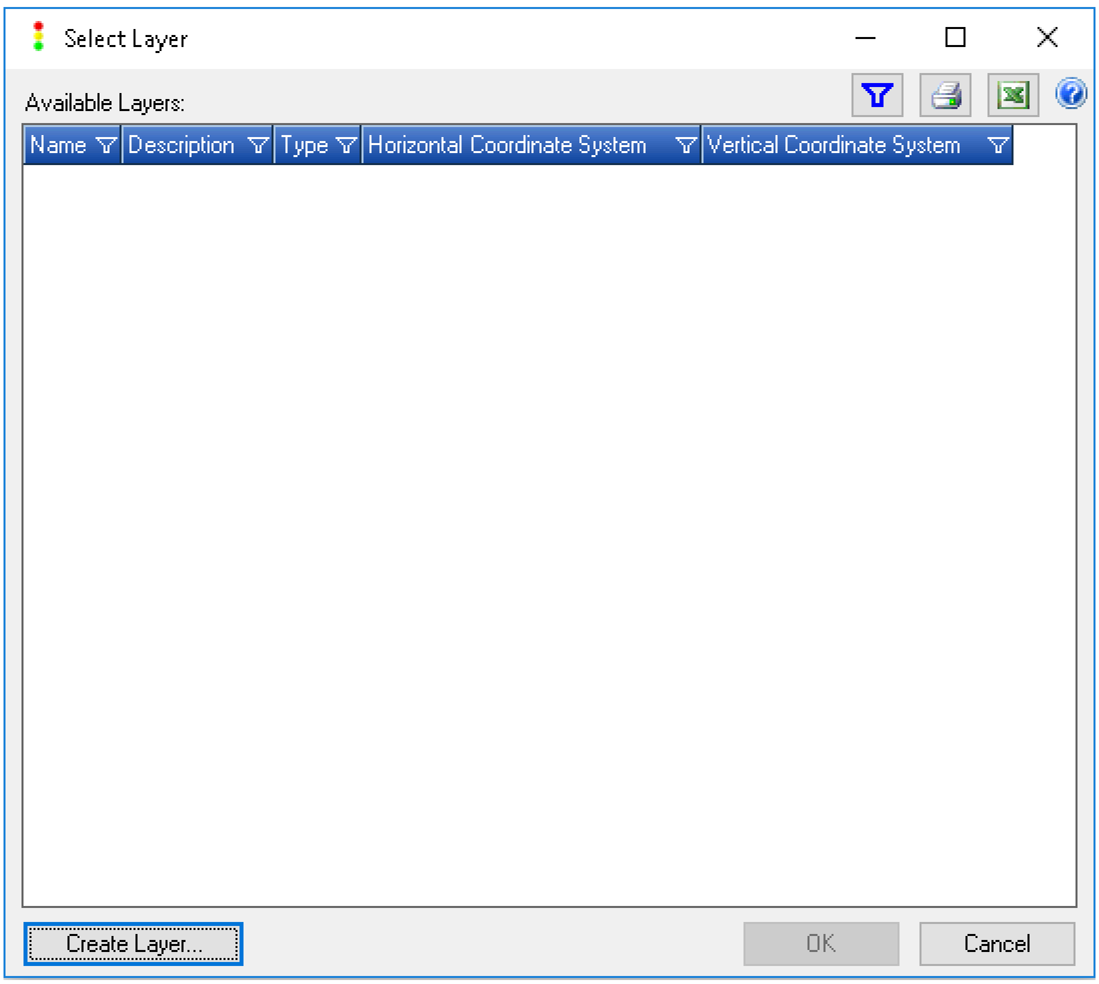



**Figure 5-4 The Select Layer dialog**

GeoCue environments are programmed to *filter* layers such that only layers appropriate for hosted data are presented when you are creating data entities. Since no layers have yet been created in our project that are compatible with LIDAR source data, the ***Select Layer*** dialog is empty. We will need to create a new layer. Select the ***Create Layer…*** button in the lower left of the ***Select Layer*** dialog. This invokes the ***Create Layer*** dialog of Figure 5-5.

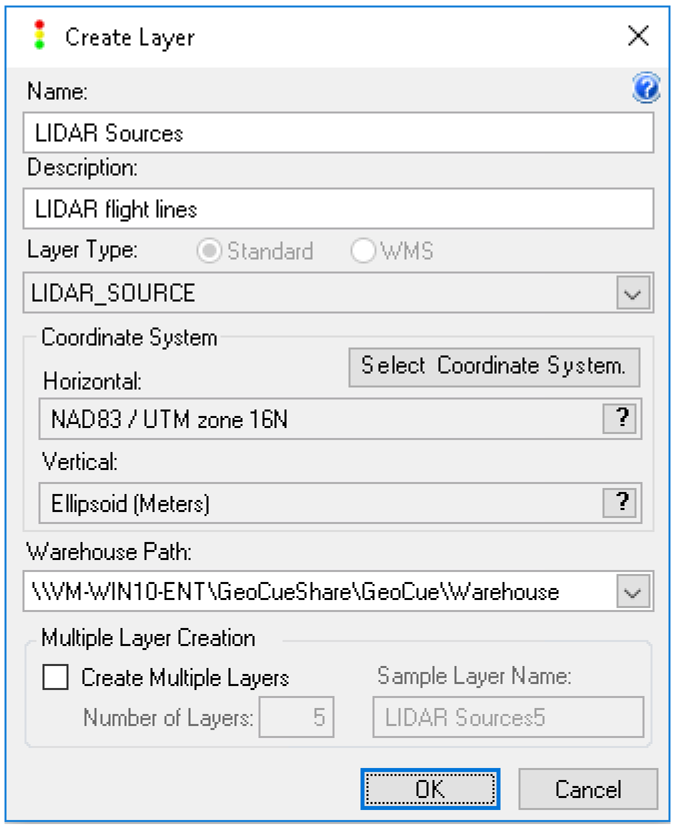



**Figure 5-5 The Create Layer dialog**

Type in “LIDAR Sources” for the Name field and an optional description. The Layer Type is already set to “LIDAR_SOURCE” which is the correct layer type for LIDAR sources. The Coordinate System has defaulted to the Project Coordinate System that we established when we created the project. Since our LIDAR data are in this coordinate system, we will simply accept this.

NOTE – Except in the case of ECEF LIDAR data, it is very important that you select both the horizontal and vertical coordinate systems of the LIDAR source layer to exactly match the horizontal and vertical coordinate systems of the LIDAR data.

The three fields at the bottom of the Create Layer dialog are described in the GeoCue Help system and GeoCue Workflow Guide. They specify where any file data associated with the layer will be stored within GeoCue-managed storage locations (“Warehouses”). Import Sources actually only imports metadata about LIDAR source data, not the data points themselves unless the “Copy files to GeoCue warehouse” is set on the Import Sources dialog.

Press “***OK***” to accept the data in the dialog and dismiss the dialog. At this point, the Import LIDAR Data dialog will appear as depicted in Figure 5-6. If you now examine the Layer legend, you will observe that this new layer has been added to the legend.

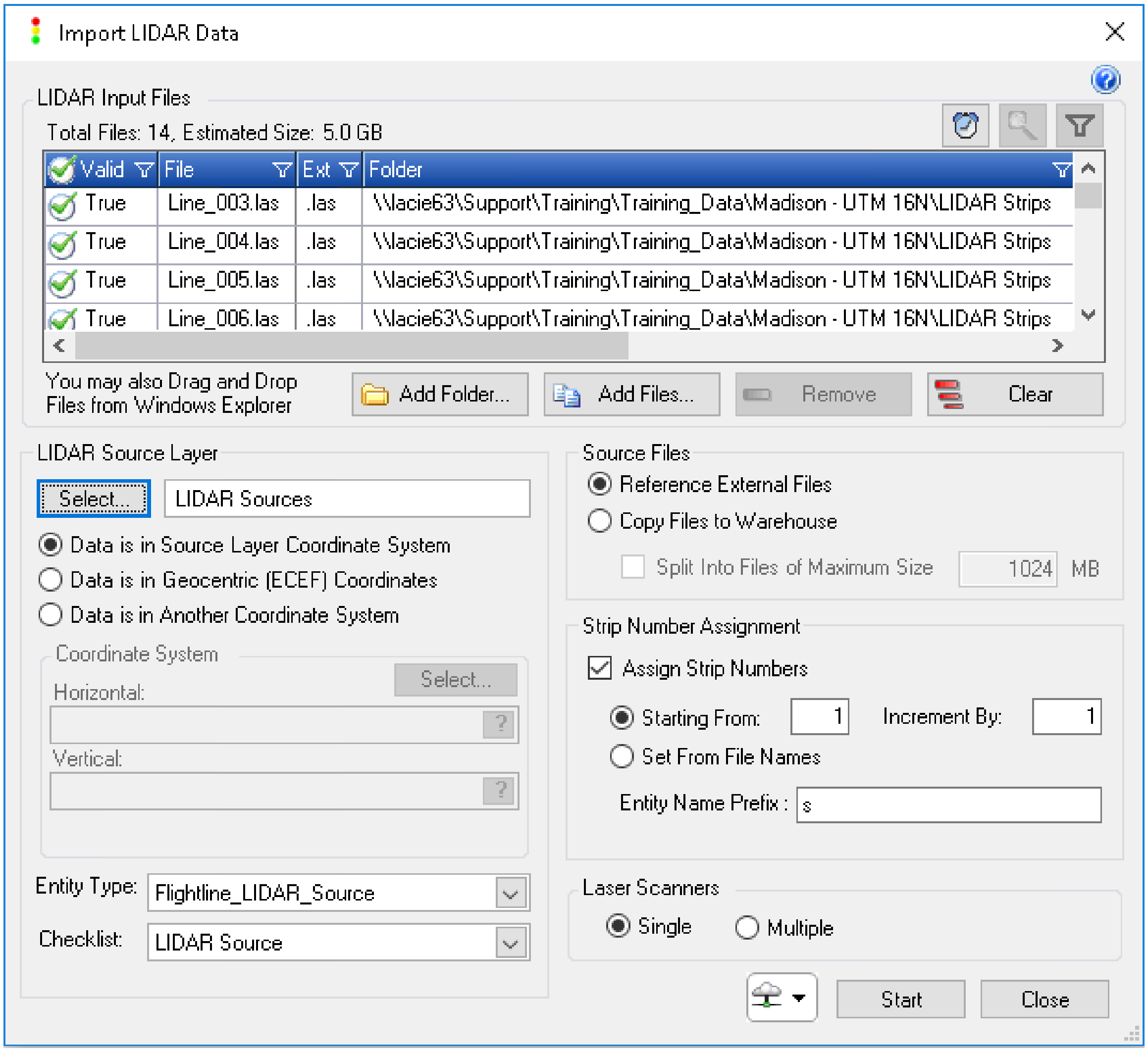



**Figure 5-6 Import LIDAR after file and layer selection**

## 5.1.3 Setting Import Options

The next section of the dialog establishes the coordinate system of the LIDAR data that is to be imported. There are two choices for this assignment:

1. Coordinate system of the Source Layer
2. Earth Center, Earth Fixed (ECEF), also referred to as *Geocentric*

You *must* always set the LIDAR Source Layer coordinate systems to be identical to the actual coordinate systems of the LIDAR points contained within the LAS files that you are importing except if the source LIDAR points are in ECEF coordinates.

If your LIDAR data are in ECEF, set the source layer coordinate systems to the desired working coordinate system. The LIDAR data will be transformed to that coordinate system on import.

> WARNING – If you use the wrong horizontal and/or vertical coordinate system for the imported LIDAR data, you will have to delete the Source Layer and go through *Import Source* again. This can be very time consuming if you have a lot of large sources so be careful!
>
> GeoCue LIDAR 1 CuePac cannot reliably detect the coordinate system in LAS files because many of the vendors who generate LAS files are not correctly adding GeoTIFF coordinate packets to the LAS header.

The data for our example project are in the coordinate system of the layer so choose the first radio button.

### 5.1.4 Setting Entity and Checklist Options

The next section of the dialog allows you to select the *Entity* type that will be used for the sources as well as the associated checklist. Ensure that the *Entity Type* is set to “Flightline_LIDAR_Source” and the *Checklist* is set to “LIDAR Source.” Unless your system has been modified using the Environment Builder, these will be the only available choices.

NOTE: Most dialogs that assign entity types and checklist types have been modified to allow interactive selection of these items. This is in support of Environment Builder, a tool that allows user definition of new entities and checklists.

### 5.1.5 Source Files

The *Source Files* section of the Import LIDAR Data dialog allows you to either *reference* LIDAR data at its source location or copy the data to a GeoCue Warehouse. You should choose the *copy* option if the original source disk will not be available for the duration of your project. An example of this case is when LIDAR data are delivered on a removable disk drive. If, on the other hand, your LIDAR data have been copied to a system disk that will be static for the project duration, choose the *reference* option.

### 5.1.6 Assigning Strip Numbers

The *Assign Strip Numbers* section of the dialog allows you to set your own strip numbers or to let LIDAR 1 CuePac attempt to derive the numbers from the file names that are to be imported. You can also set a name prefix that will be pre-pended to each strip number. If you feel confident that the File Source ID field in your LAS strips are correct, you should *not* check the *Assign Strip Numbers* option.

**NOTE**: Strip Numbers are *very* important in processing data in LAS format. If you are not confident that your source LAS files have proper Source IDs (strip numbers), then assign these during import by checking the Assign Strip Number option.

Strip Numbers *must* be unique within a project. The Import LIDAR Data functions will only check for uniqueness if you have set the Assign Strip Number option. If a uniqueness problem is encountered, a list of conflicts will be displayed and you will be given the opportunity to change your numbering scheme.

Select the option for ***Assign Strip Numbers*** and set starting number and prefix options as shown in Figure 5-7.

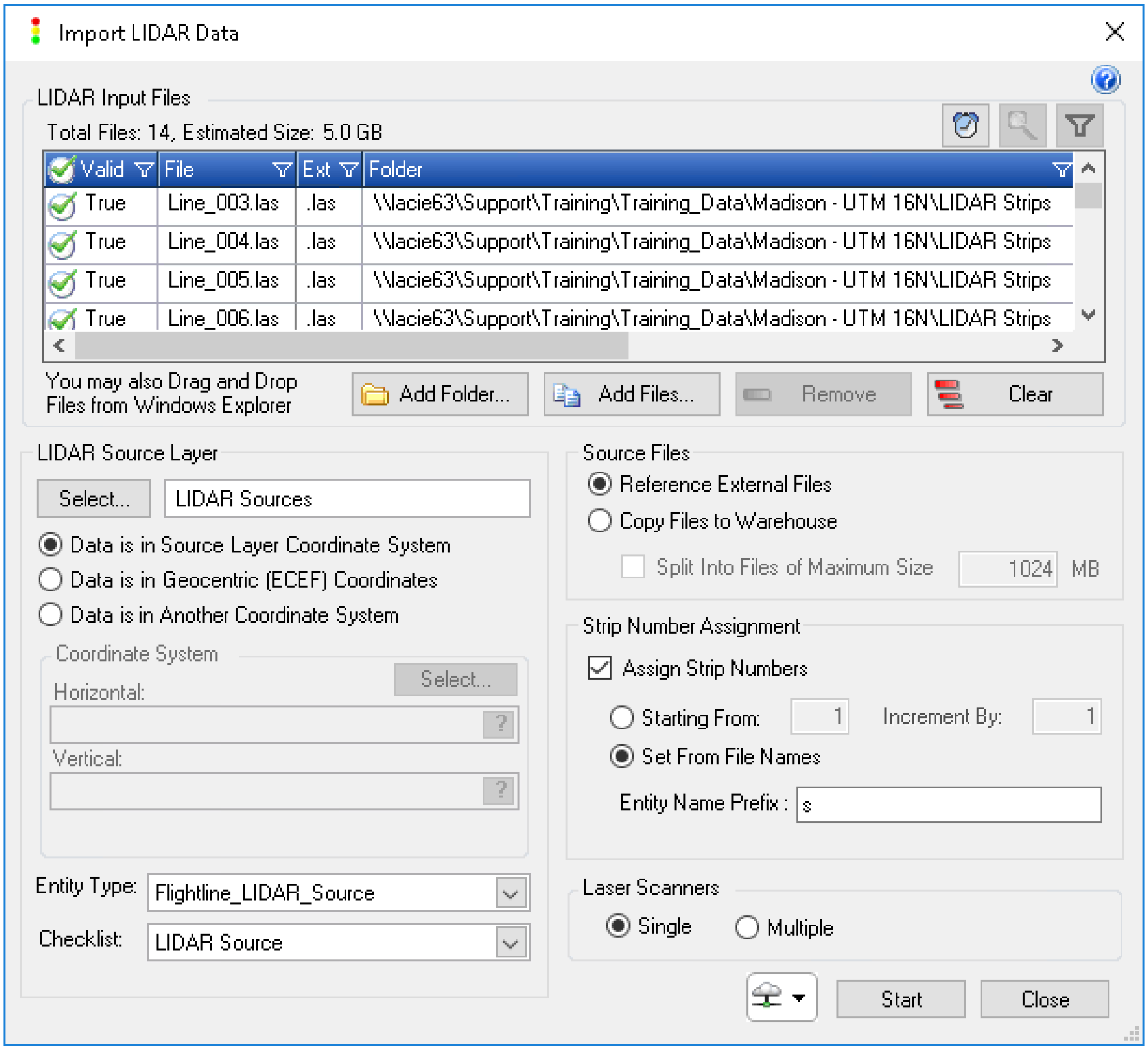



**Figure 5-7 Assign Strip Number options**

NOTE: TerraScan does not currently recognize a particular feature of LAS version 1.1 that allows default Point Source ID assignment. If you need to do direct analysis of source strips (rather than analysis of LAS Segments), select both the *Copy to GeoCue Warehouse* and *Assign Strip Numbers* options on the Import LIDAR Data dialog. The LIDAR 1 CuePac import function will physically write the correct Point Source ID to each file header and to each point record as the data are imported to the warehouse.

We cannot do this fix-up if you select *Reference External Files* since we cannot write to a Reference file.

You will usually want to select the *Assign Strip Numbers* option to ensure that you will be able to create color orthos by Strip ID. The related options are described in the Table 5-1:

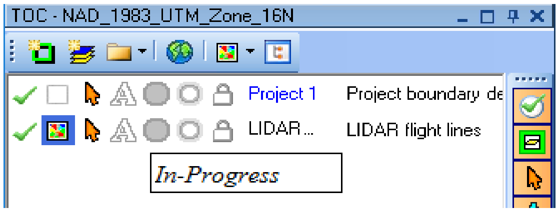
**Table 5-1 Assign Strip Numbers Options**

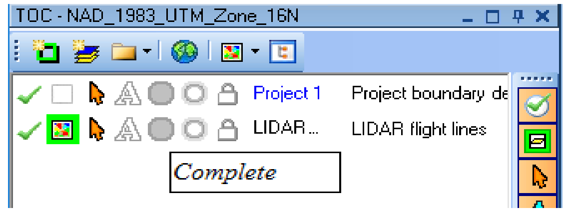
| ***Option*** | ***Description*** |
|---|---|
| Assign Strip Numbers | Checking this option allows you to assign unique numbers to the imported strips.<br><br>"*Starting from*": allows you to set any starting number (1-9,999) and an increment. Once assigned, GeoCue will guarantee a strip number is unique in a given project. The strip name will be shown as 4 digits. For example if "12" is assigned as the strip number, then the strip name will be "0012".<br><br>"*Set From File Names*": causes the numbering scheme used in the original .las filenames to be used for generating strip numbers.<br><br>"*Entity Name Prefix*": additional option allows you to set a prefix for the strip names. For example, S-0001, S-0002, etc. |
| | Unchecking this option will cause GeoCue to use the original .LAS filenames as the entity names and strip numbers will not be assigned. If you chose to *unch*eck this option, the integrity of the "Color by Strip/Source ID" function can not be guaranteed. You could also encounter problems relating TerraScan trajectories to strips in certain TerraScan functions. |

Check the option for ***Fit After First Source Strip is Imported*** and press ***Start*** to begin the import process. The ***Fit*** option will cause the GeoCue Map View to fit to the first strip imported. You will usually want to select this option to ensure that you will be able to see the strips as they are loaded. Press **Start** to dismiss the ***Import LIDAR Data*** dialog and begin the import operation:

## *5.2 Import Status*

You can check the status of the importing on the Source Layer in the legend. It contains a traffic signal graphic next to its name when running Import Sources showing the status "In progress", "Complete", or "Exception".




You can also view details of these processes that are running (or have completed) by double-clicking the layer to open the ***Layer Properties*** dialog:

Select the "**Processing**…" tab on the layer properties dialog will display the "Layer Processing Status" dialog (Figure 5-8).

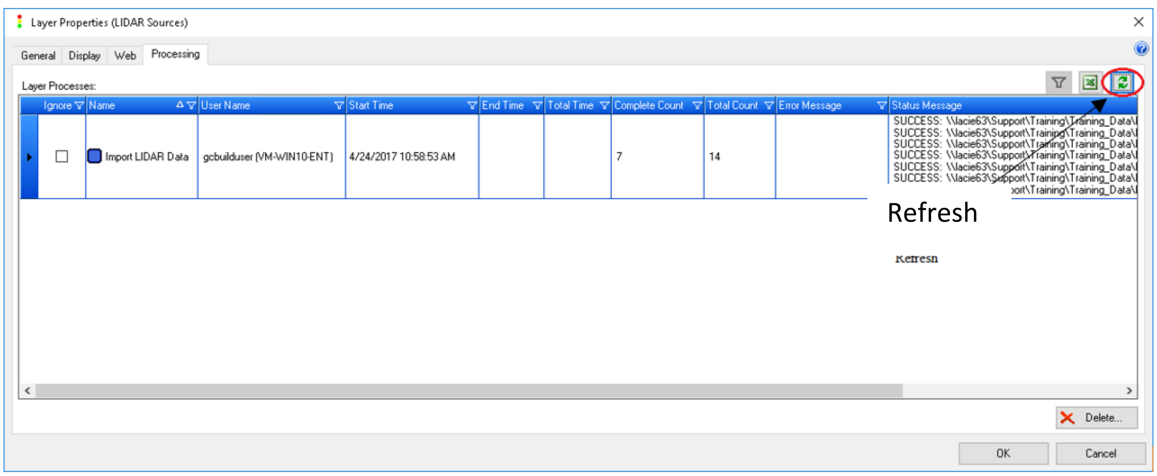



**Figure 5-8 Layer Processing Status dialog**

This dialog allows you to view details of the processes that have been run on the layer. Click the "Refresh" button to get the updated status. To clear entries from the list simply select the process entry and click the "Delete…" button.  For the Import Sources command, the Error Message and Status Message fields are used to list the results of each LAS file.

Note – the first time you invoke an operation in GeoCue that is realized by an external program, you may receive the dialog of Figure 5-9. If you receive this message, select the appropriate networks and click *Allow Access.*

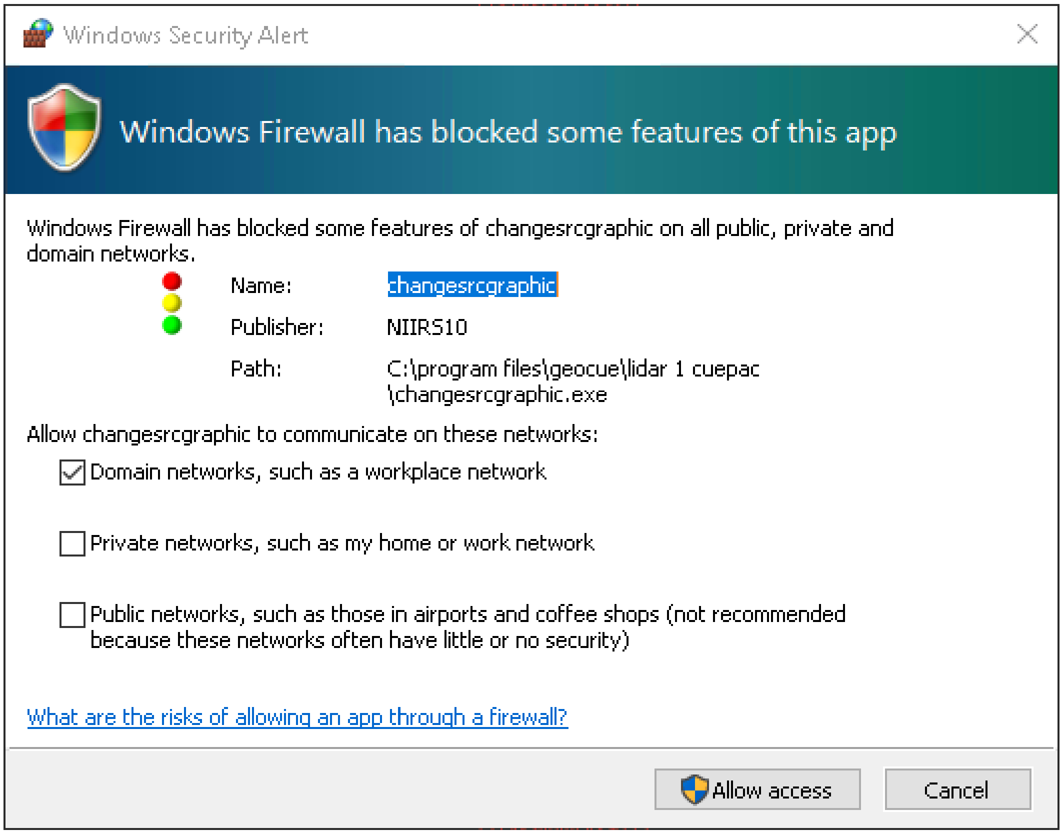



**Figure 5-9 Windows Security Alert**

## 5.3 Import Completion

Upon completion of the load, your display should show the fourteen newly added LIDAR strips (Figure 5-10).

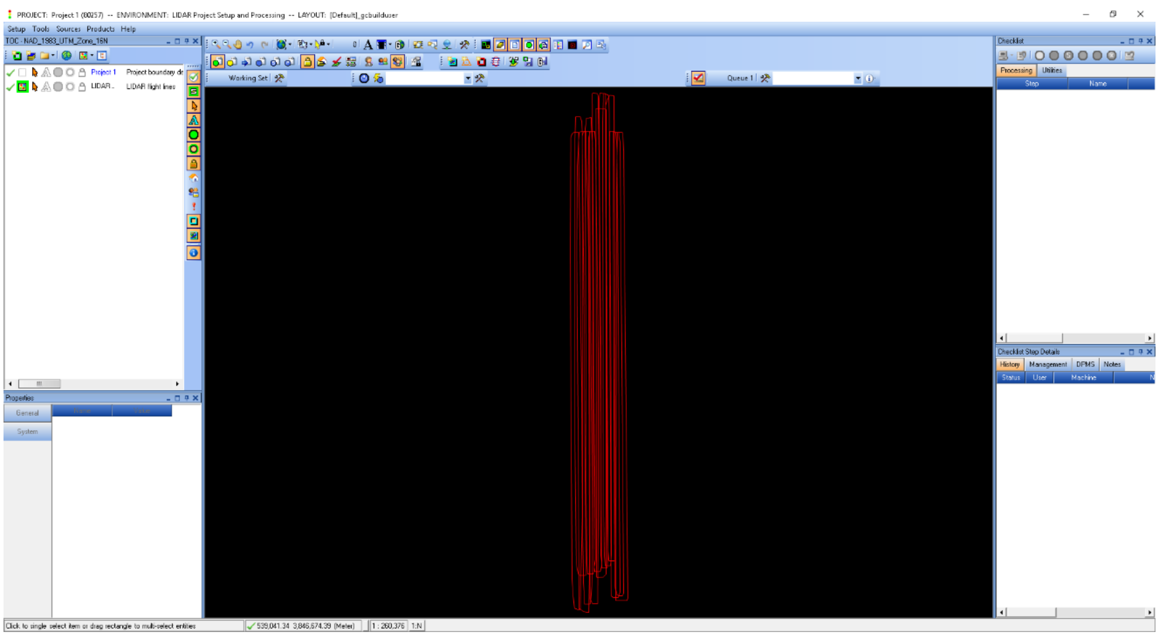


**Figure 5-10 The imported LIDAR strips**

***Design Note*** – When we process LIDAR data, we perform a number of algorithms designed to determine the footprint of the data. We can create two footprints:

- The LIDAR strip boundary – this is an outline of the actual boundary along the outer edge of the strip. There are a number of conditions that may make this an ambiguous perimeter. The primary cause is that LIDAR pre-processing software does not include void points in the data file (we define a void point as firing the LIDAR but not detecting a return. This can happen over highly reflective planar surfaces such as water or very strong absorbers). This *detailed footprint* does not necessarily define the entire collection of points within a LIDAR strip

- Convex Hull – This is the convex hull of the LIDAR data in the normal definition of convex hull. While it does not provide a detail outline of the strip, it is *guaranteed* to encapsulate all points within the strip.

In the current release of LIDAR 1 CuePac, we display the LIDAR Convex Hull as the graphic associated with a strip upon data import. The detailed footprint (or *detailed graphic)* of the strip can be computed and displayed via an optional checklist step on strip entities.

## 5.4 Inspecting Properties

Select one of the strips after the import has completed. You will see properties similar to those shown in Figure 5-11. Switch to the ***Files*** tab on the properties pane and observe the information provided.

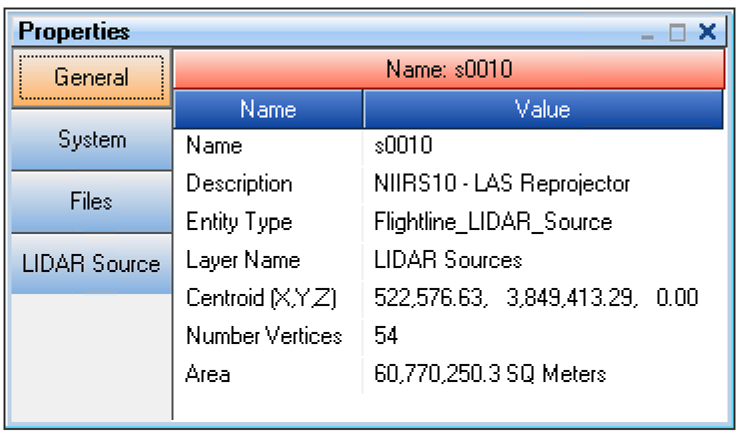



**Figure 5-11 LIDAR Strip Properties**

You should see a display similar to Figure 5-12. Note that the full Universal Naming Convention (UNC) path to the location of the LIDAR file is listed as well as its coordinate system. This is an example of GeoCue tracking project data by reference. When you performed the LIDAR strip import, a LIDAR 1 CuePac utility computed the convex hull footprint of the LIDAR strips. This footprint is used as the polygon graphic that represents the strip on the Source layer. The actual point data remains on disk since image and elevation data are generally too voluminous to store directly in the database. Thus GeoCue will track this external data throughout production such that you need not access physical files each time you need to perform an operation on the data. You can always determine if GeoCue is tracking ancillary files by selecting the entity you wish to inspect and examining the ***files*** tab of its property pane.

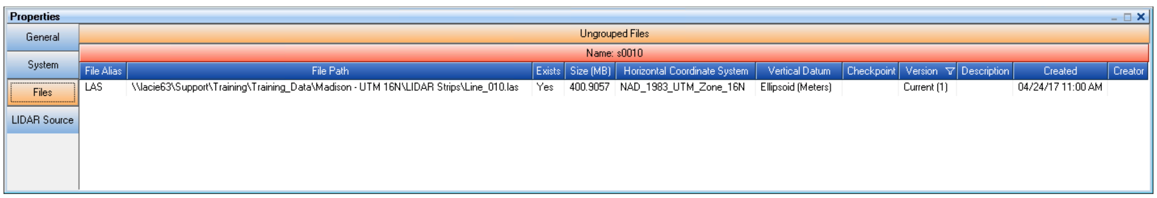



**Figure 5-12 *Files* tab of the Strip Property pane**

Notice also that we have assigned ***Checklists*** to the LIDAR strips. Select one of the strips, add it to your Working Set Queue (Working Set) and observe the Checklist pane. You should see a display similar to Figure 5-13. Note the checklist name in the title bar ("LIDAR Source"). The image on the left displays the 'Processing' tab, while the one on the right displays the 'Utilities' tab of the "LIDAR Source" checklist pane. Note the name of the selected entity (in this case, Strip 10 – "s0010") in the Entity name bar. This bar should be green, indicating that this entity is in your Working Set (if the bar is red, you have selected the entity but it is not in your Working Set). Note that the first checklist item is complete, as indicated by the green filled icon for "Import LAS Flight Lines."

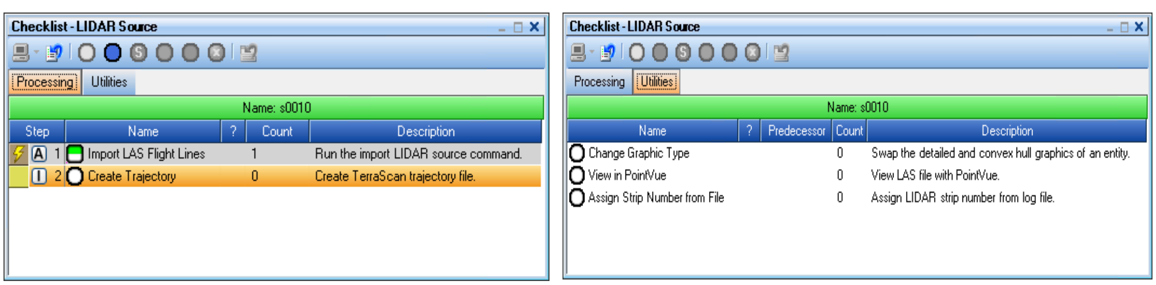
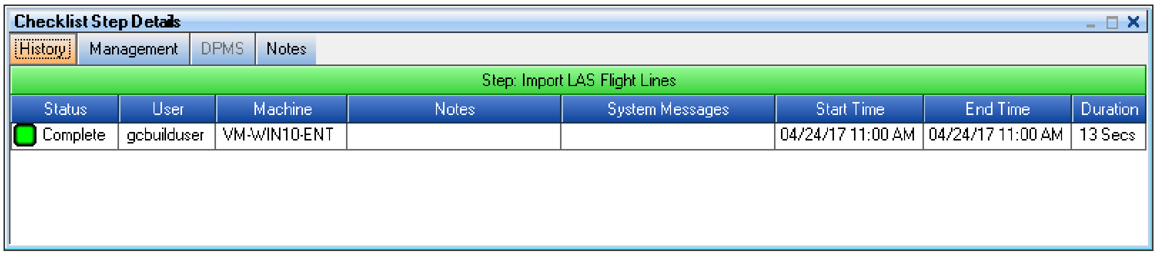



**Figure 5-13 LIDAR Strip Checklist**

You can view information about the history of the production steps by viewing the "Checklist Step Details" pane. If this pane is not currently visible, double click Step 1 in the checklist. You can drag the details pane anywhere you like in the GeoCue frame. This pane should resemble

Figure 5-14. The top image displays the 'History' tab, while the bottom image displays the 'Management' tab of the "Checklist Step Details" pane. Notice that the user, the machine on which the step was performed, the start time, the completion time and the total processing time have been automatically set. Since we did not set any planning data for the step, these fields display either blanks or "NOT SET."



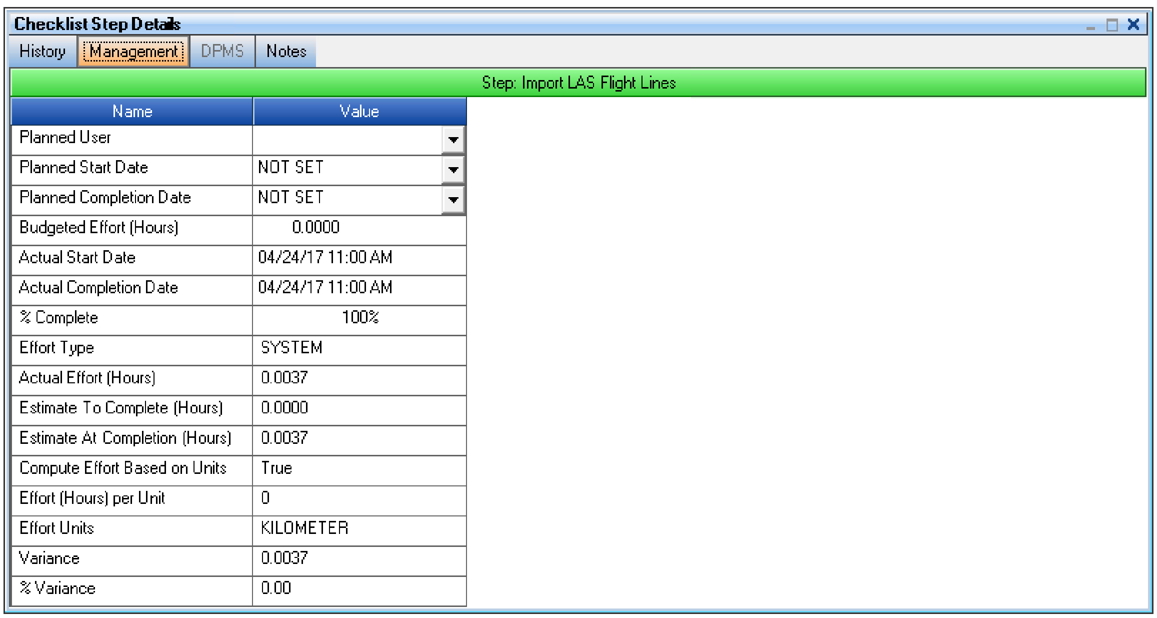




**Figure 5-14 Checklist Details for Strip Import**

Hint – We find the most useful arrangement for the Checklist Step Details pane is to float it over the GeoCue window (just grab its title bar and drag it where you desire) and resize it to a nice, large size that shows all fields.

Now as you click through the steps in the Checklist pane, the details pane will automatically change to reflect the current step (the current step is always displayed in the Step bar at the top of the details pane, just under the title bar).

When you are through examining the details, click the “X” in the upper right of the dialog. This will dismiss the details dialog. The next time you double click a checklist step, the details pane will reappear in the configuration you set during this process.

If you click the next step on the checklist (step 2, “Create Trajectory”), you will note that the actual Start and End times indicate “NOT SET” and there is no tracking history. This is because this step is in the NOT STARTED state (as indicated by the empty icon in the checklist).

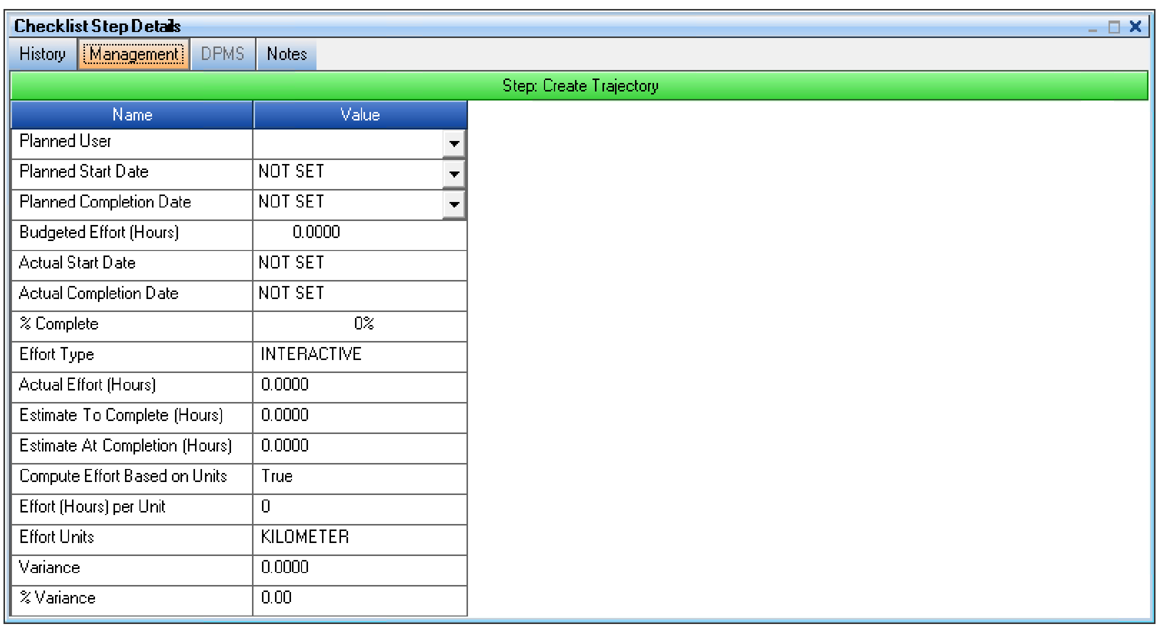



**Figure 5-15 "Create Trajectory" details**

## 5.5 Changing the Display Graphic

Notice in Figure 5-13 the optional process step entitled *Change Graphic Type.* This step allows you to toggle the display graphic of the LIDAR source strips between *Detailed Graphic* and *Convex Hull*. Select several of the LIDAR source strips into your Working Set (remember, you can perform this operation by *selecting* the strips and then pressing the "+" button on the Working Set queue, selecting the strips one at a time and then pressing "+" on the Working Set queue following each selection or by toggling to *Working Set Select Mode* and selecting directly into your Working Set). Your Working Set count should indicate the number of entered items and the checklist pane should be green and set to the first element in your Working Set (the actual first element depends on the order in which you placed the strips into your Working Set).

Click the "Change Graphic Type" process step (it will highlight in orange) and then press the yellow *Set State In Progress* button. You should be presented the dialog of Figure 5-16. This dialog is informing you that you have more than one entity in your Working Set queue but you did not press the Multi-Entity Mode toggle on the State Selection toolbar. If you choose *Process All* from this dialog, all elements will be processed and thus the effect will be the same as had you toggled the Multi-Entity Mode prior to choosing a state transition (this is why we refer to this as the "second chance" dialog). If you press *Process Current*, only the current element in the Working Set queue will be processed. Finally, *Cancel* aborts the operation and no action is taken.


**Figure 5-16 Multi-entity "second chance" dialog**

Press *Process All* and you will be presented with the dialog of Figure 5-17. This dialog allows you to choose the graphic type to display for the source strips associated with the action. Choose *Detailed Footprint* and press OK.

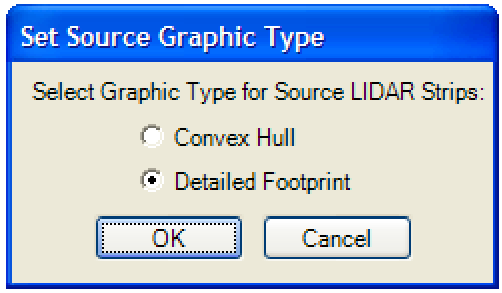



**Figure 5-17 Graphic Type selector**

You will notice that the process step changes to the yellow in-progress color. In short order it will change to green indicating that the strip graphic change has been completed. Process will continue on the other strips. You will notice that the source strip footprint changes to the detailed view as each strip completes. The final state is indicated in Figure 5-18 (we changed all of our footprints to *detailed*).

NOTE – You can disable the *Single-Entity* mode via GeoCue Options settings (Setup ►Options ►GeoCue. This will remove the Multi-Entity mode button from your checklist processing toolbar and GeoCue will always process all entities in the working set queue.

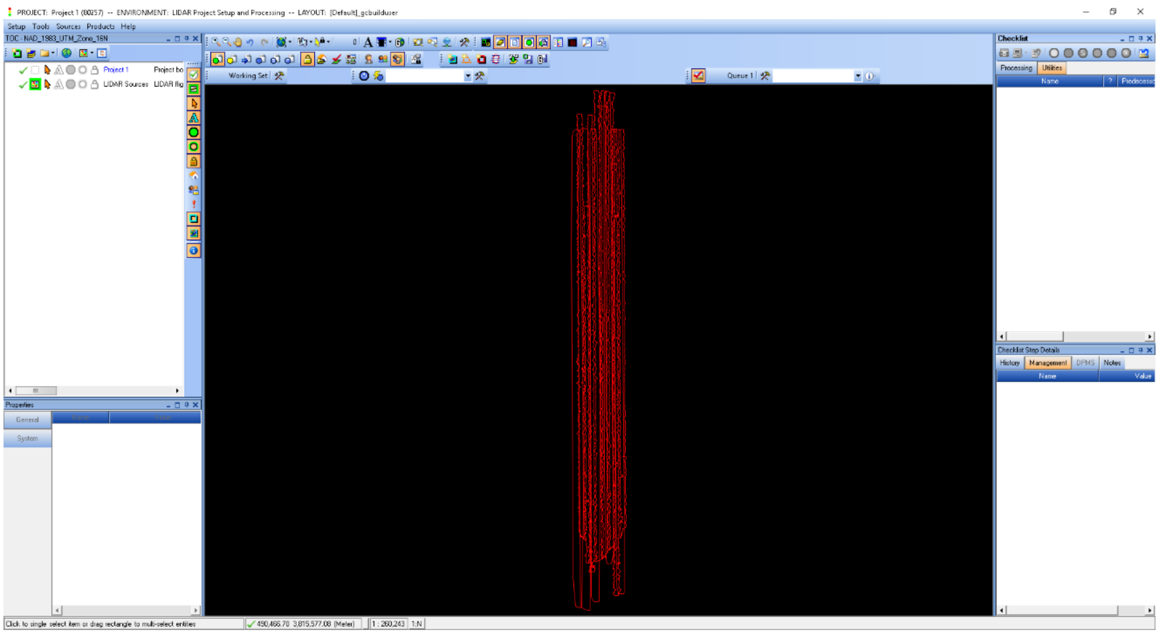


**Figure 5-18 Detailed Graphic display**

Note that you can have a mixed display of Convex Hull and Detailed Graphic display by simply choosing a subset of source strips and swapping their graphic type. You can determine the currently displayed graphic type for a strip by selecting the strip and examining its *Geometry* Extended Info in the properties pane. An example for Strip 4 (“s0004”) is shown in Figure 5-19 where you see the entry for CurrentGraphicType.

> **NOTE:** The first time we compute the detailed footprint for a LIDAR source, we must reread the source. After this first computation, the detailed footprint is stored in the database. Thus the first time you toggle “Detailed Footprint”, the processing time will be the same as for importing the strip. Thereafter, the graphic will rapidly toggle.

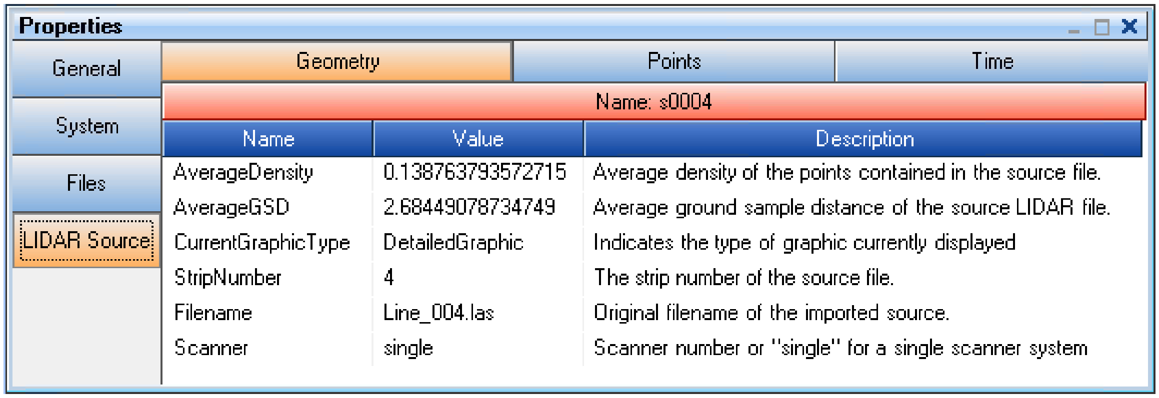



**Figure 5-19 Determining the current graphic display type**

## *5.6 Analyzing Input Strips*

LIDAR 1 CuePac provides several tools for examining geocoded LIDAR strips – visualization, geometric analysis and LIDAR Orthos (LIDAR Ortho generation will be discussed in a subsequent chapter).

### 5.6.1 Ad Hoc Visualization

The first tool we will use is the LIDAR viewing tool, PointVue, supplied with the LIDAR 1 CuePac.

1. Select a LIDAR strip into the Working Set.
2. Select the Utilities Checklist step "View in PointVue" (Figure 5-20)

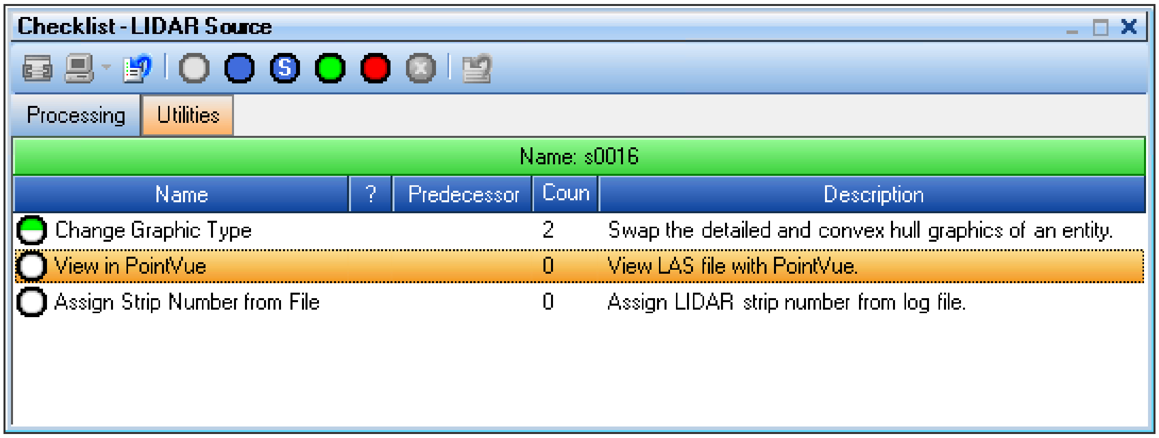



**Figure 5-20 Utilities step "View in PointVue"**

Manipulate the strip in PointVue as you desire. When you are finished, close PointVue.

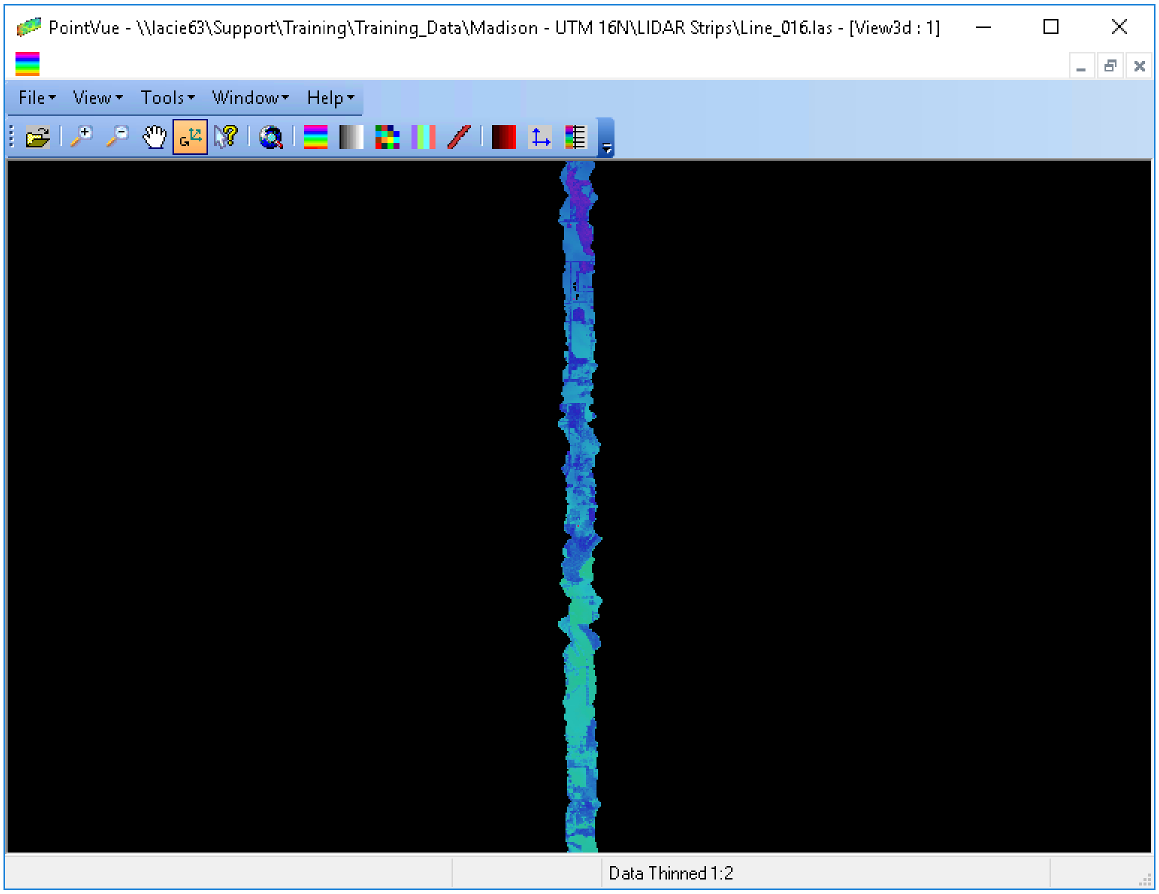



**Figure 5-21 Strip 16 in PointVue**

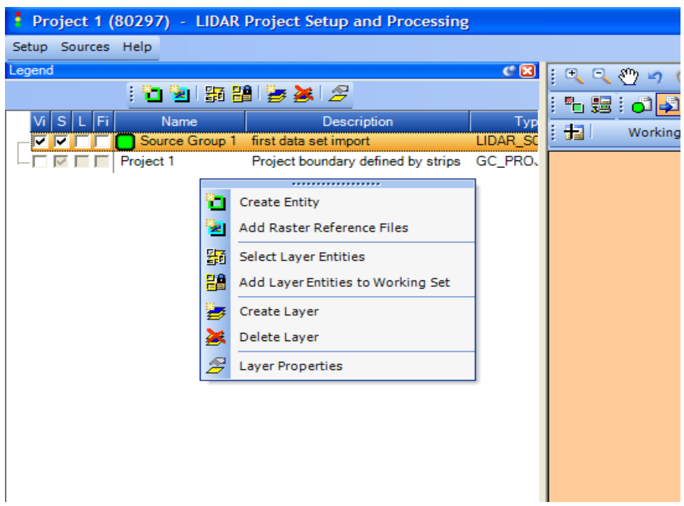
## 5.6.2 Geometric Analysis

In this set of procedures, we will use the computational geometry tools of GeoCue to examine source coverage.

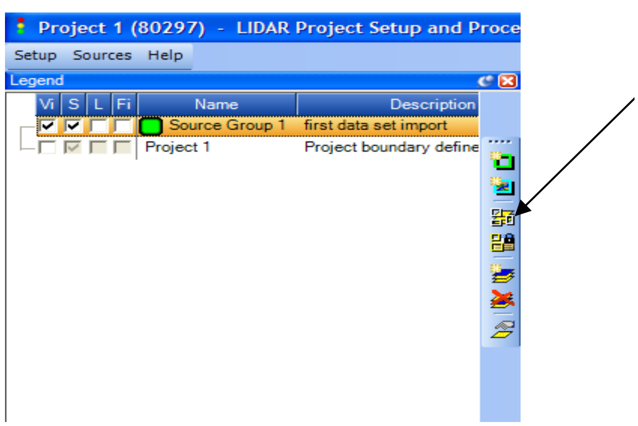
First, ensure that strips ST-0007 and ST-0008 have been set to display their *Detailed Graphic*. *Select* these two LIDAR strips (both strips should highlight in white and your selection toolbar should show "2" as the selected entity count).

HINT – If your strips are highlighting in yellow, this means that you have the Select to Working Set mode activated. Choose the normal *Selection* tool and reselect the strips. Commands act differently on the *Selection* set than they do on the Working Set so it is important to ensure that you have entitles selected into the appropriate queue.

Hint – You can quickly select all of the entities on a layer by right clicking the layer name in the layer legend and selecting "Select Layer Entities" from the right click menu:




or, if you have the legend toolbar displayed (our preferred mode), by pressing the *Select Layer Entities* tool.




*Select Layer Entities* tool

Right click anywhere in the toolbar area (even on a toolbar) and check ***GeoAnalysis*** **(**if it is not already checked). This will display the ***GeoAnalysis*** toolbar. Display the ***GeoAnalysis Options*** dialog by clicking the appropriate icon on the ***GeoAnalysis*** toolbar (the right-most button). Set the options as shown in Figure 5-22[3] and press ***OK***.

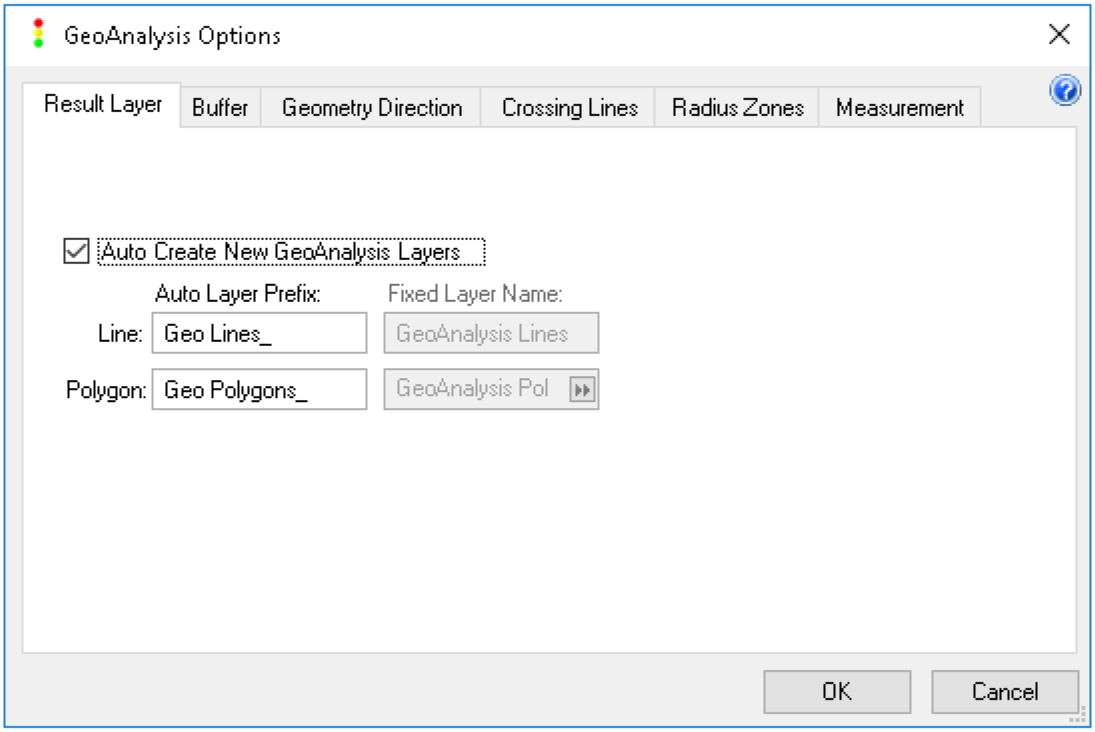
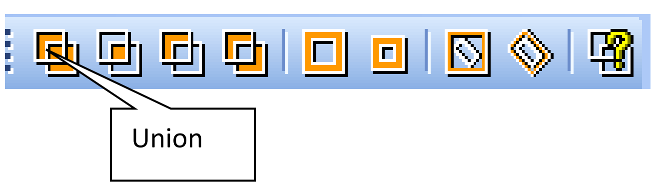



**Figure 5-22 GeoAnalysis Options**

Now press the ***Union*** tool on the ***GeoAnalysis*** toolbar.




[3] See the GeoCue help for a detailed discussion of the GeoAnalysis tools and options.

This will result in the creation of a new layer called "GeoPolygon_1". This new layer will contain the union of the two source strips. You can make this result easier to visualize by turning off the visibility of all of the other layers (by un-checking the "V" option for these layers in the layer legend). Your result should resemble Figure 5-23

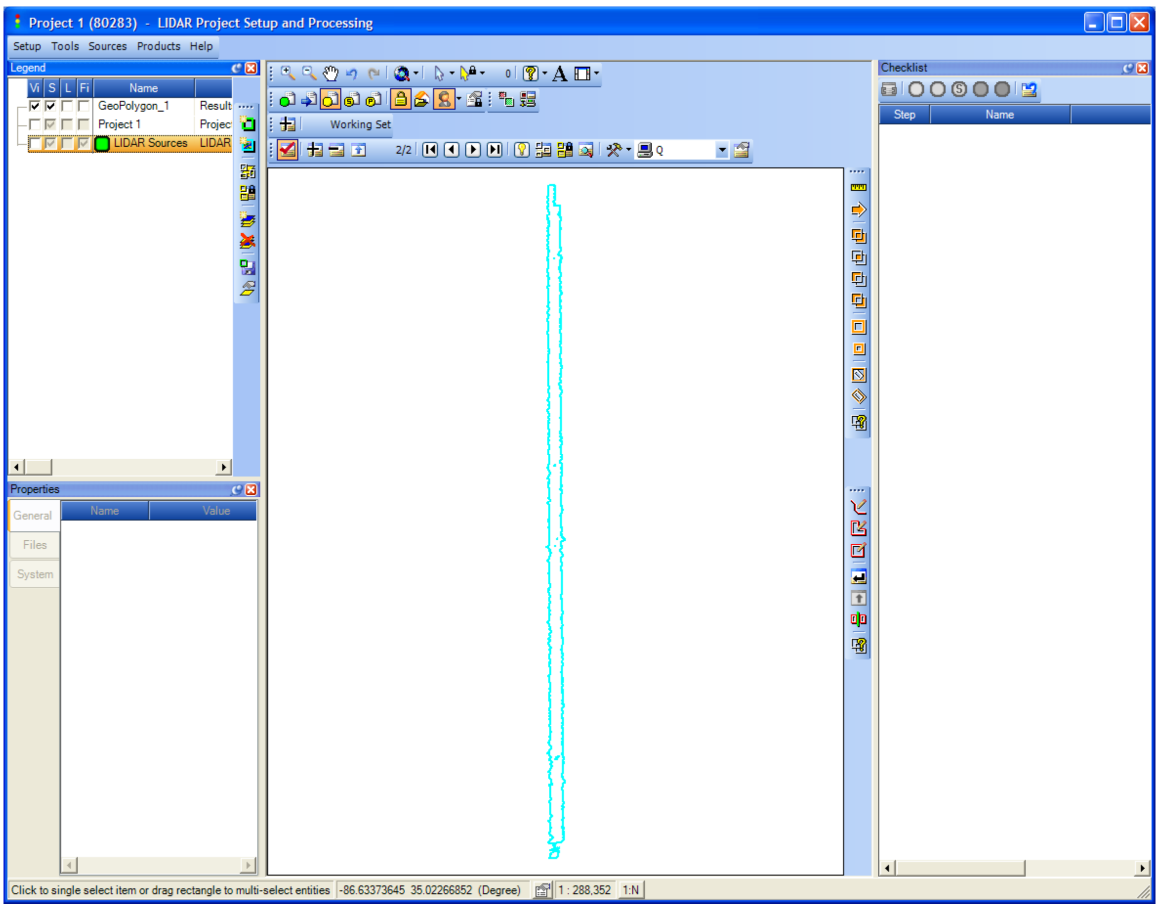



**Figure 5-23 Result of source strip union**

Zoom in on the top area of the graphic around one of the "anomalies" (Figure 5-24).

Notice the “hole” in the data! This anomaly indicates a gap in coverage between two LIDAR strips. At this point you would need to make an assessment of the impact of this problem on production – do you:

1. Is the anomaly simple a water area (and hence not really an anomaly)?
2. ignore the problem?
3. Check to see if it is filled by a different source?
4. re-fly the section?

You can determine the strips causing the problem by experimenting with the geometry commands. Feel free to delete the layers containing the geometry results as they can easily be recreated (but be careful not to delete the Project or Source layers!!!). We set the GeoAnalysis options to create a new layer each time you run a GeoAnalysis tool. This mode usually provides the clearest organization of results.

NOTE: LIDAR “orthos” provide a much more reliable way of testing strip coverage. We present the geometry approach because it can be occasionally useful. In general, however, we do not use it for coverage analysis because it is too difficult to determine water areas.

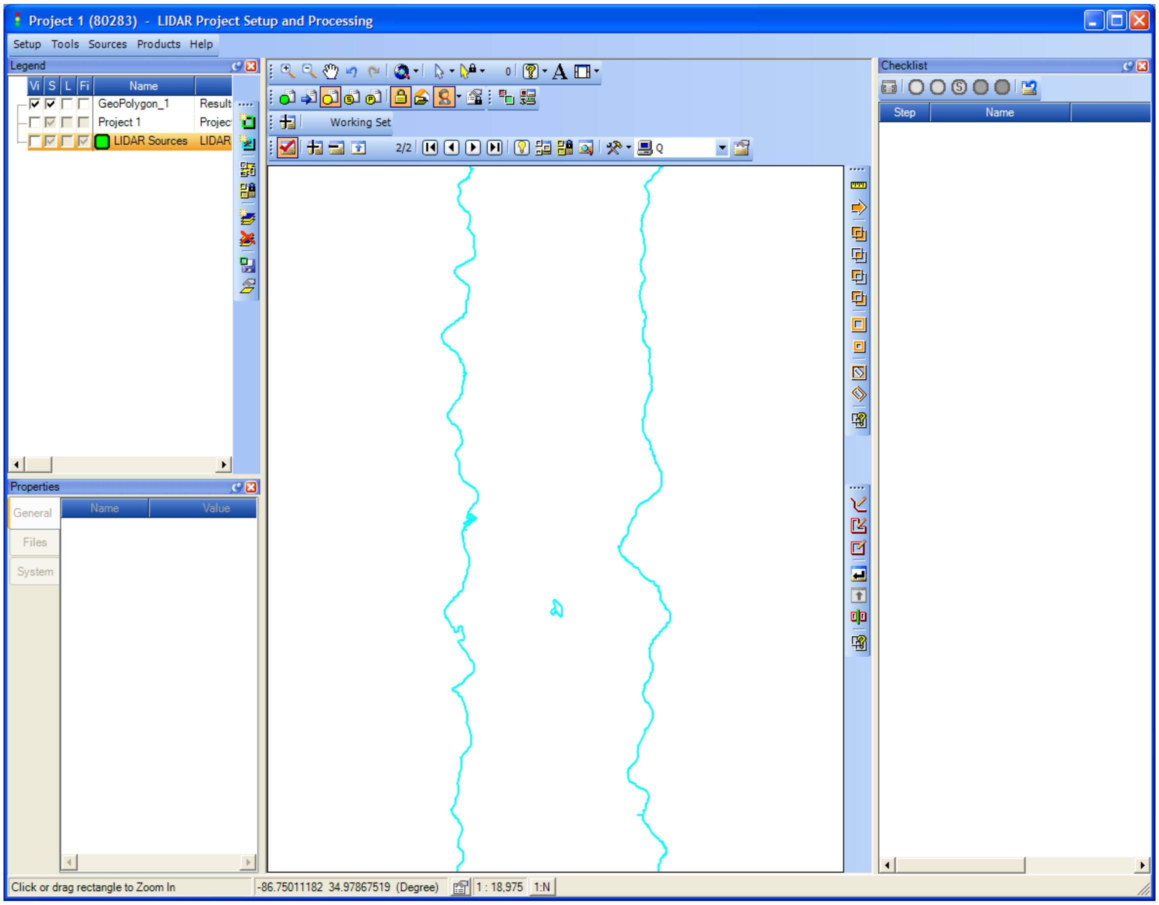



**Figure 5-24 Zoomed view of an anomalous area**

# 6 Importing SBET Data and Creating TerraScan Trajectories

If you are going to analyze LIDAR system calibration in TerraMatch, adjust LIDAR project data (again in TerraMatch) or use functions in TerraScan that rely on trajectories then you will want to import the GPS/IMU data associated with the project.

LIDAR 1 provides tools for importing trajectories compatible with the Applanix *Smoothed, Best Fit Trajectory* (SBET) data format. In addition, it provides tools to very rapidly create TerraScan trajectories from the imported LIDAR sources and the SBET file.

> Beginning with GeoCue 2017.1, LIDAR 1 CuePac also supports importing Inertial Explorer SBTC and SBIC data format. SBTC is Inertial Explorer's extension for the smoothed and combined (forward+reverse) tightly coupled trajectory, while SBIC is the equivalent for loosely coupled processing. In addition, it also provides tools to very rapidly create TerraScan trajectories from the imported LIDAR sources and the corresponding SBTC/SBIC file(s).

We will continue with our example project "Madison" for these exercises. Open this project if it is not still open from the previous exercise. Change all of the Source LIDAR strips back to the Convex Hull graphic display (it is typically easier to see the relations of the trajectories to the sources in the convex hull display.

## *6.1 Importing the SBET*

From the Sources menu in GeoCue, select **Import SBET…** This will invoke the dialog of Figure 6-1.

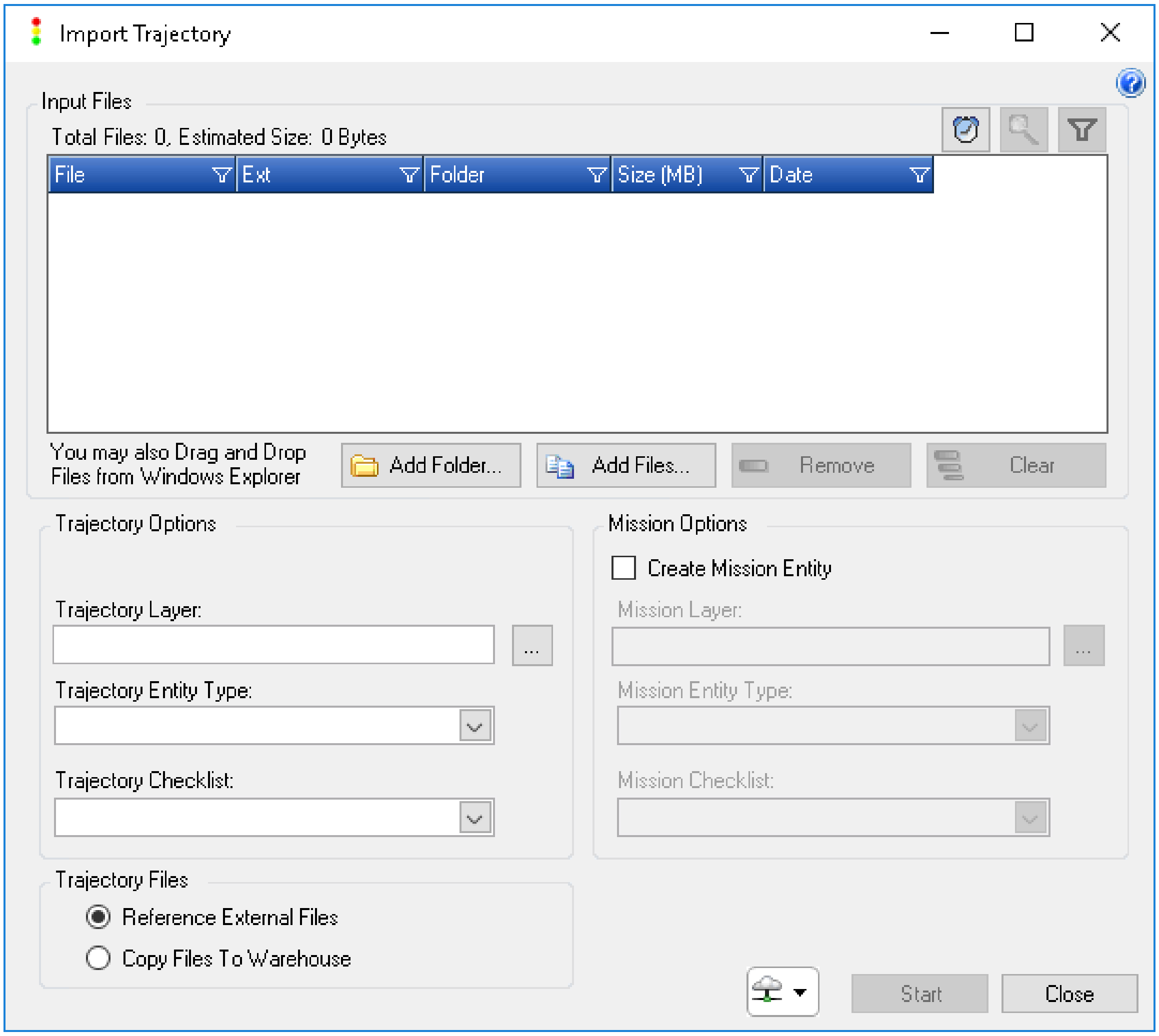



**Figure 6-1 The Import SBET dialog**

One of the elements of the dialog is the selection of the layer on which to display the SBET. Since we have not imported an SBET, you will need to create a new Layer. Navigate through the Select… button to the Create Layer dialog. Create a new layer of type SBET_SOURCE with coordinates WGS84 (geographic) for the horizontal system and Ellipsoid (meters) for the vertical system. We named our layer "SBET." Note that SBET data is copied into the GeoCue Warehouse and thus you will be provided the option when creating the layer of selecting a warehouse. The layer settings that we chose are shown in Figure 6-2.

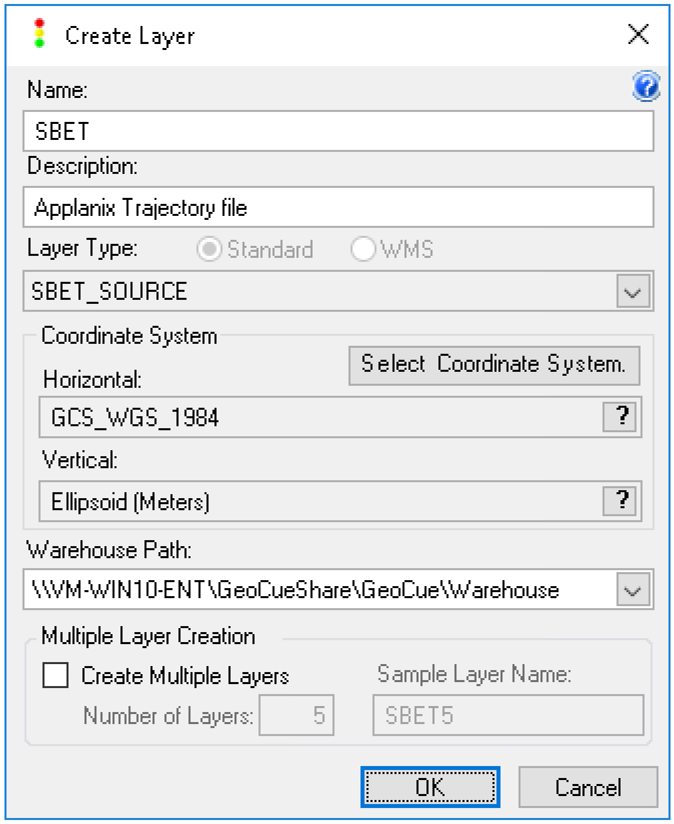



**Figure 6-2 Creating a layer for the SBET import**

NOTE: As of September 2005, all Applanix SBET data are in WGS 84 ellipsoid coordinates, with units of meters for the vertical system. You must ensure that your target SBET layer is in the correct coordinate system!

Press the **Add Files** button on the Import SBET dialog and browse into your GeoCue Sample Data to the Madison data directory. You will see a folder called “SBET.” Browse to this folder and select all of the SBET files (we included all files for the complete project so you will have more SBET files than are needed for our sub-project). You can instead also use the **Add Folder** button to select the folder wherein you have the sample SBET data. Press **Start** to begin the import. As with LIDAR sources, the *Fit after first SBET Imports* option simply fits the display to the first imported SBET. This is usually not necessary if you already have graphics loaded into your project. As with importing LIDAR data, your newly created layer will display a processing status icon. You can monitor the import progress by examining the Layer Properties dialog, Processing tab.

Following the import, your display should resemble Figure 6-3. If you select one of the SBET graphics, you will see the GeoCue stored metadata in the properties pane. You can see which file each SBET references by viewing the *Files* tab of the properties pane.

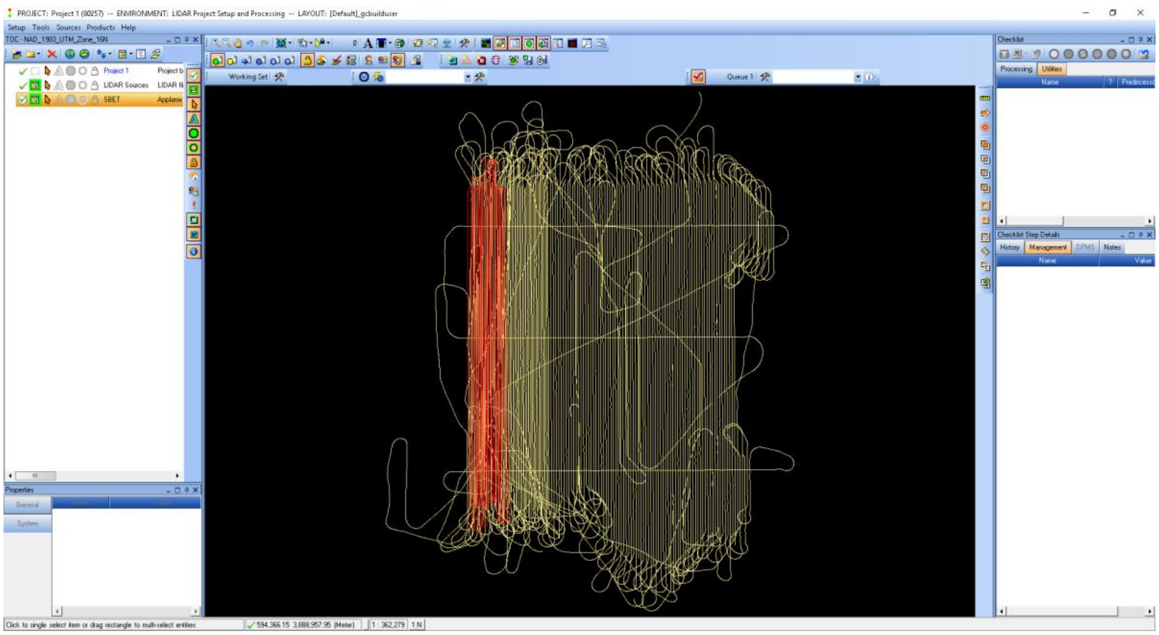


**Figure 6-3 The Madison SBET files**

Like **Import SBET…**, there is a similar interface for importing SBTC and SBIC data format. This process can be launched by selecting **Import SBTC/SBIC Sensor Data…** under the Sources menu in GeoCue Client. The directions given above (Section 6.1) can be followed for importing SBTC and SBIC data format.

## 6.2 Datum Transformation

This section provides a brief look at datum transformations in GeoCue. For details, see the GeoCue on-line help as well as the GeoCue Workflow Guide.

### 6.2.1 Transform Warning

You should notice a yellow triangular warning icon next to your SBET layer in the Layer Legend (Figure 6-4).

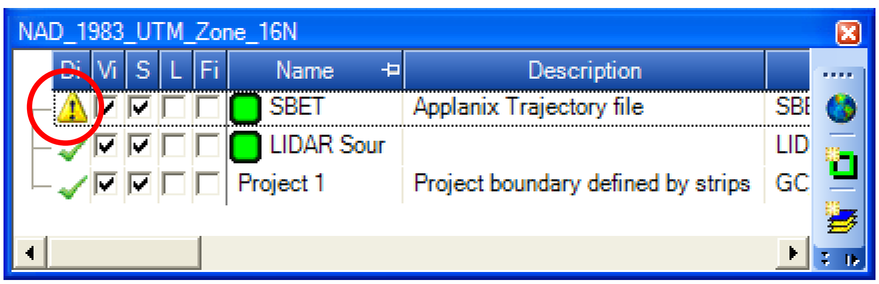



**Figure 6-4 Unapproved Datum warning icon**

This icon indicates that a datum transformation is being performed between this layer and the current Map Coordinate System (see the GeoCue Workflow Guide for details on setting and approving datums) and that the datum transformation in use has not been *Approved*. GeoCue needs to know how to transform data between coordinate systems that are defined using different *datums.* Since our current Map Coordinate System is on North American Datum 1983 and the SBET layer is on the World Geographic System-1984, a datum transformation is in effect.

GeoCue automatically assigns datum transformations for several datum combinations (if no transformation were assigned, you would see a red **X** on the layer and data would not display until you manually defined the transform). However, it is usually a good idea for you to verify that the transformation that GeoCue automatically selected is valid for your project area. This process is called “datum approval.”

### 6.2.2 Viewing Datum Transform Settings

Activate the Map Coordinate System dialog by pressing the Map Coordinate System tool on the Layer toolbar (or right click in the legend and select this option). You will be presented the dialog of Figure 6-5. To examine the selected transform being from WGS-84 to NAD-83, select the first entry in the *Datum Transformations Required for Horizontal Transforms* and press the ***Define…*** button.

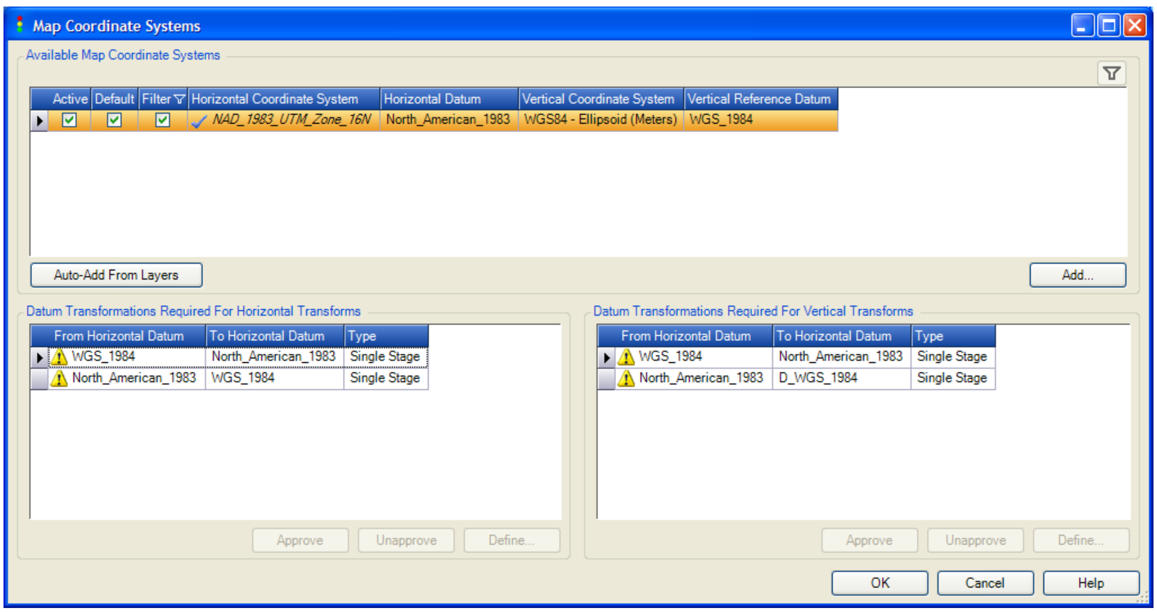



**Figure 6-5 Map Coordinate System dialog**

This will invoke the dialog of Figure 6-6. Note that a single stage transform has been selected by GeoCue. Observe in the Parameters section that the transform type is "Geocentric." Dismiss this dialog by pressing **Cancel**.

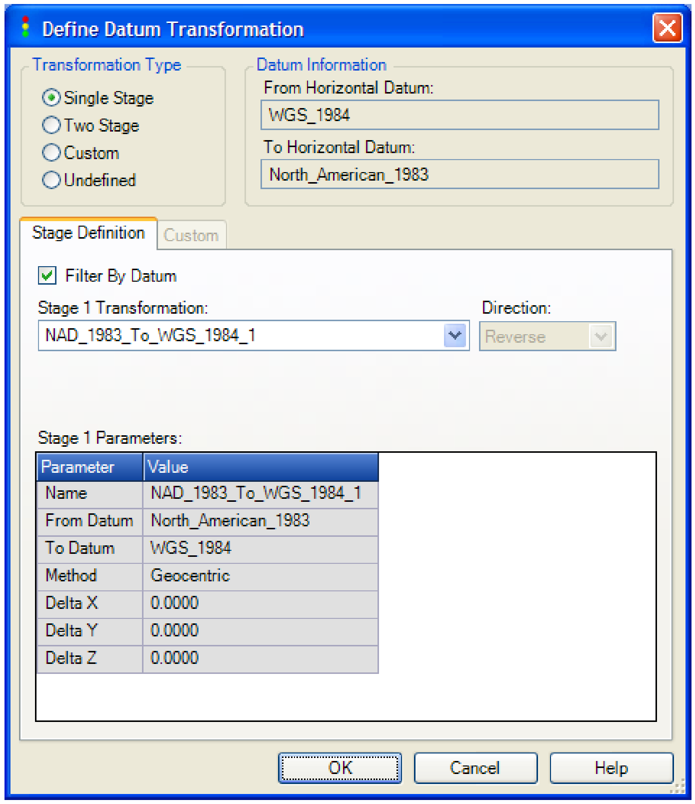



**Figure 6-6 Define Datum Transformation dialog**

## 6.2.3 Approving the Transforms

Select both transform rows in the *Datum Transformations Required for Horizontal Transforms* and press the ***Approve…*** button. The dialog is shown just prior to this operation in Figure 6-7. Following *Approval*, note that the yellow warning icons have disappeared. Dismiss the dialog by pressing **OK.**

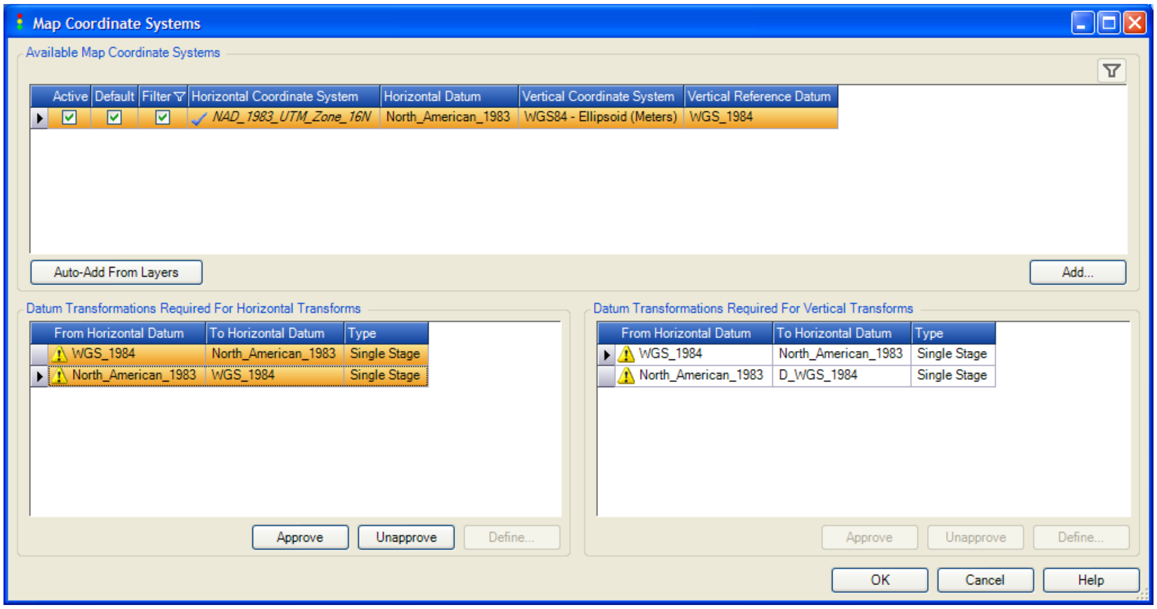



**Figure 6-7 Datum transforms just prior to *approval***

You will note that the warning icons have also disappeared from the SBET entry in the legend.

## 6.3 *Creating TerraScan Trajectories*

LIDAR 1 CuePac contains functions to automatically create TerraScan trajectory files from Applanix SBET data. The trajectory creation routine is accessed via the checklist on LIDAR Sources.

Select all of the sources in the project into the Working Set (your view will be less cluttered if you turn off the display of the SBET files). You will note that the last step in the standard LIDAR Source checklist is *Create Trajectory* (Figure 6-8). Ensure that the *Create Trajectory* step is selected, press the *Multi-Entity Mode* button the on checklist processor and press the *Set State In Progress* button.

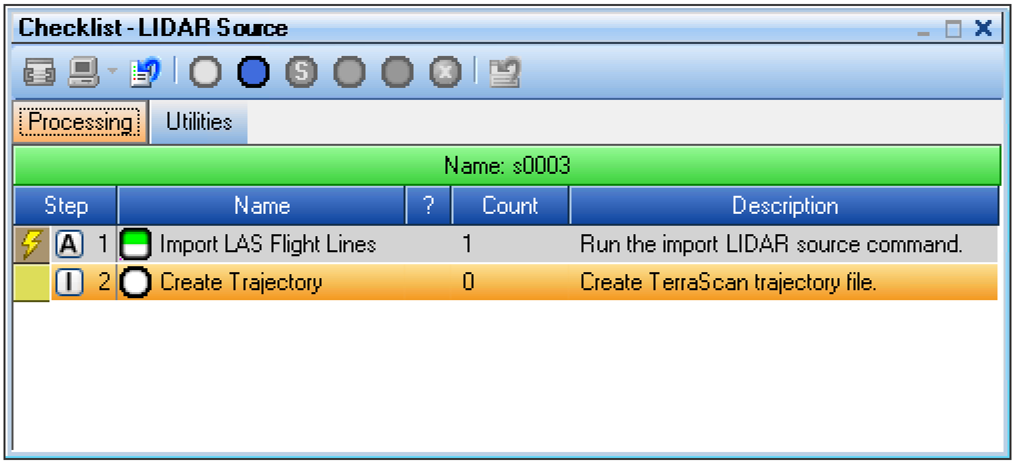



**Figure 6-8 The Create Trajectory step**

This will invoke the dialog of Figure 6-9.

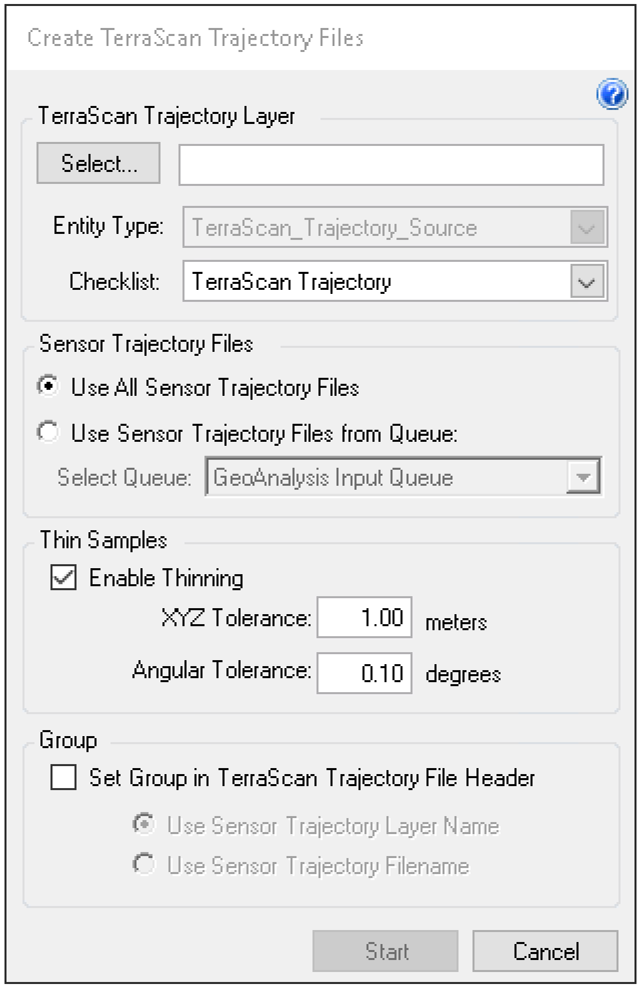



**Figure 6-9 The Create TerraScan Trajectory dialog**

The TerraScan Trajectory Entities are placed on a layer of type Trajectory_SOURCE. The coordinate system of this layer must be the same as the coordinate system that you wish to use while editing data in TerraScan. This is not necessarily the same as the coordinate system of the imported LIDAR data since you will be able to transform these data to a new coordinate system when you "populate LAS segments." For example, if your imported LIDAR data were in UTM but you desired to perform processing in State Plane, set the Trajectory_SOURCE coordinate system to the same State Plane system.

For our example, we will assume that processing will be performed in NAD 83, UTM Zone 16N, meters so just accept the default coordinate system (we named our new layer TS Trajectory).

The second section of the dialog allows you to use either all SBET files present in the project or to use a set defined by placing the desired SBET subset into a name queue. We will use all SBET files.

The final section of the dialog allows you to set *thinning* parameters that will be applied to the SBET when the trajectory files are created. The XYZ Tolerance parameter specifies the maximum deviation from a 3 space straight line that will be allowed before inserting a vertex in the thinned data. The Angular Tolerance specifies the maximum deviation in any of pitch, yaw or roll that will be allowed. If in doubt, accept the defaults of 1.00 meters and 0.10 degrees.

> Note: If you elect not to create thinned TerraScan Trajectory files, your performance in TerraMatch and certain operations in TerraScan will be significantly affected. For more information on thinning, see the TerraScan and TerraMatch User Guides.

Accept the default thinning parameters and press **Start**. You will see trajectory lines appearing on the new Trajectory layer (Figure 6-10).

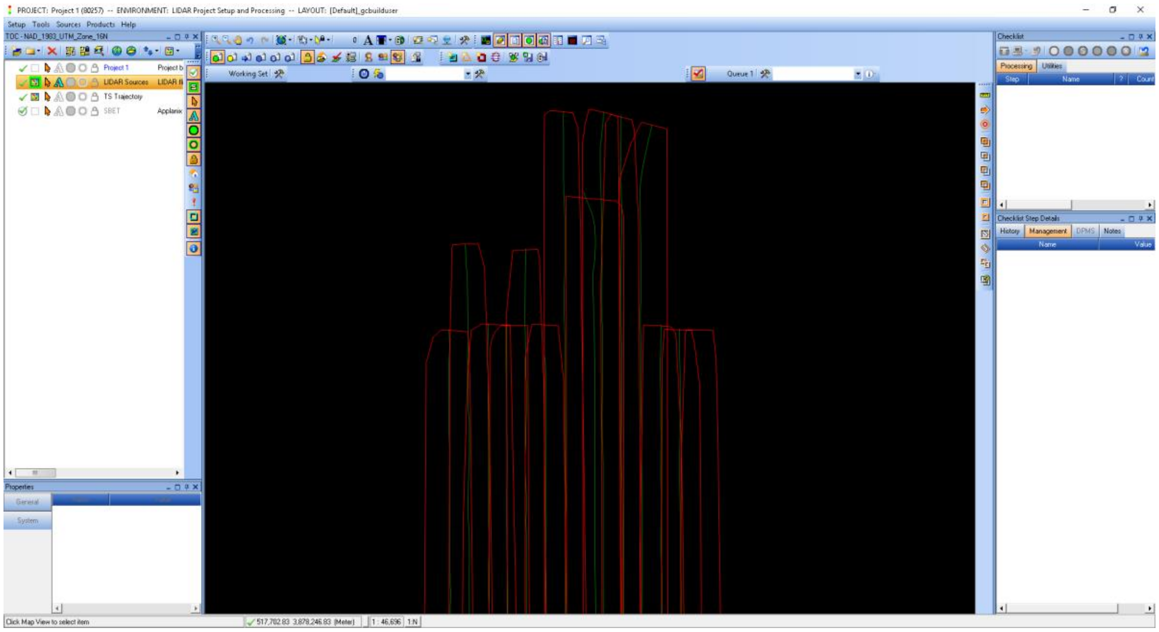


**Figure 6-10 The Trajectory Entities**

## 6.4 Possible Errors when Creating Trajectories

It is possible that no SBET data matches the LIDAR data that you have imported. If we cannot derive a Trajectory, the LIDAR source(s) will fill with red (the error indicator) and the processing history for the Create Trajectory step will indicate the error. For example, we induced an error by selecting an SBET that was not related to a source and placed the SBET in a named queue. We then selected, into the Working Set, the unrelated source and run the Create Trajectory step with the SBET source set to our named queue. This resulted in the display of Figure 6-11 and the checklist history shown in Figure 6-12.

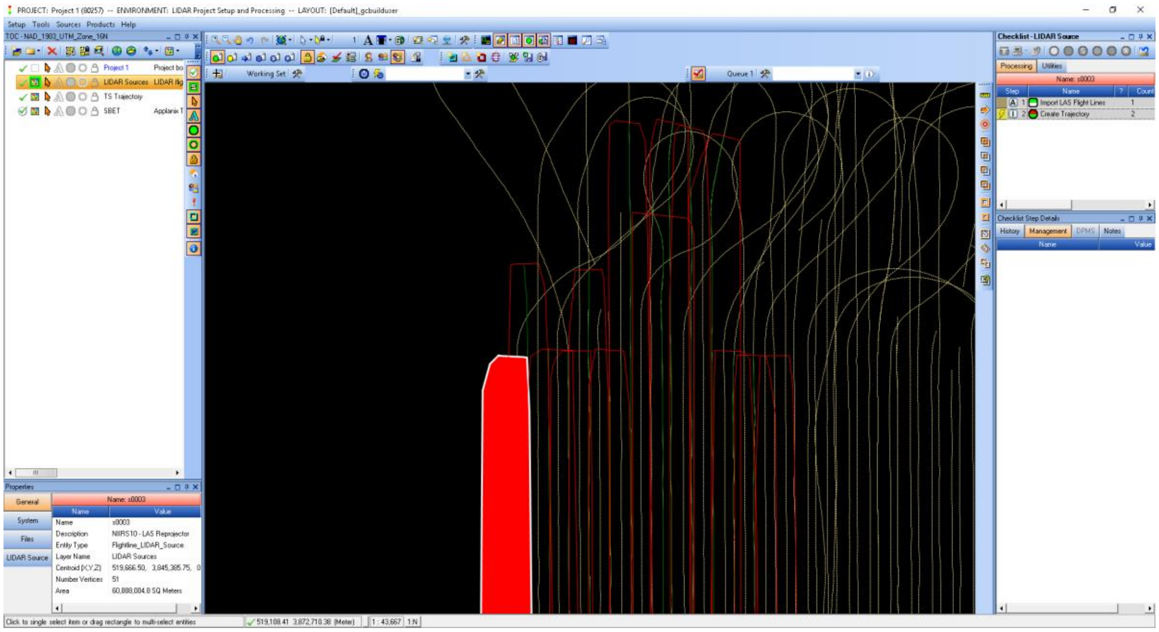


**Figure 6-11 Error Creating Trajectory**

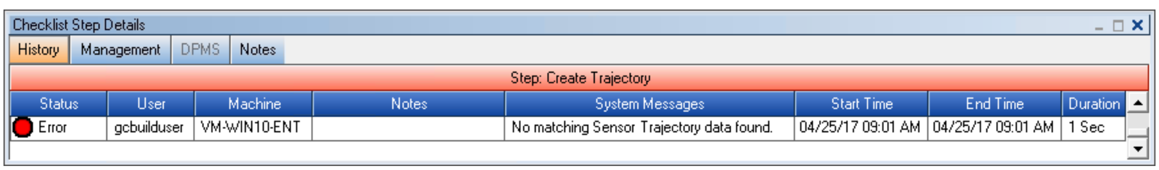



**Figure 6-12 The error log for Create Trajectory**

# 7 Creating LAS Working Segments

One of the most powerful aspects of a GeoCue system is the ability to divide work into *Segments* and parcel that work out to multiple users in a controlled environment. This strategy provides several production advantages relative to a LIDAR workflow. The first is that it subdivides the LIDAR data into processing "chunks" that are small enough to be efficiently processed in an editing environment. The second advantage is that by dividing the work and managing the work units, you can have multiple operators processing data in parallel.

> ***Upgrade Note*** – In version 2.0 of GeoCue, we introduced an entirely new scheme for dividing the project into processing Segments.
>
> The previous method of creating LIDAR Working Segments using the micro tile system is still supported. However, this method will be deprecated in a future version of GeoCue and thus you are strongly encouraged to immediately switch to the new LAS Working Segment scheme described in this chapter. The microtile documentation has been dropped from this version of the LIDAR 1 Workflow Guide.

## 7.1 Locking Layers

It is a good idea to *Lock* layers in GeoCue if you are not doing frequent deletions of entities on those layers. This is particularly true for critical layers such as the GC_PROJECT layer as well as Working Layers (which will be introduced in this chapter). To lock a layer, bring up its *Layer Properties* dialog by selecting the layer in the legend and either right-click selecting Layer Properties or pressing the Layer Properties tool on the legend toolbar. This will bring up the dialog of Figure 7-1. Check the Delete Lock option to lock the layer.

> NOTE – We refer to the layer locking mechanism as a "Delete Lock" because the layer does not become locked against additions. Thus a Delete Locked layer can still have entities added.

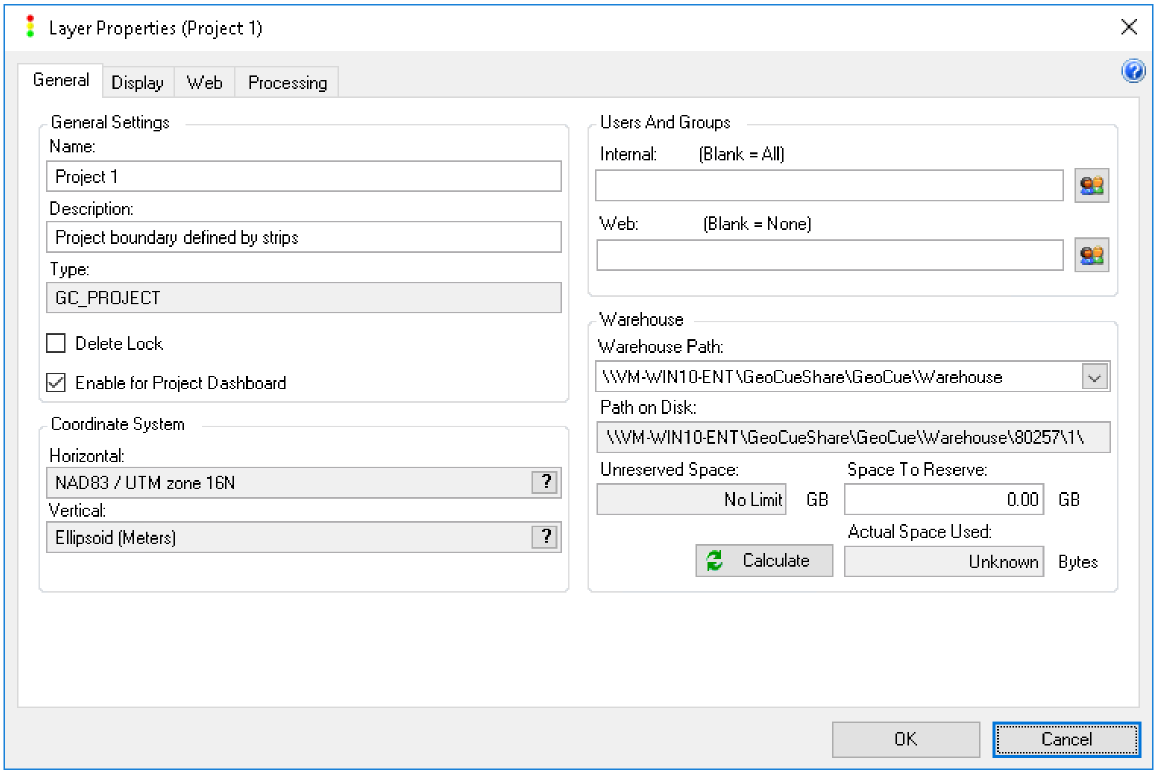



**Figure 7-1 Layer Properties dialog**

> NOTE: You can specify that layers should be created in the *Delete Locked* mode using Environment Builder.

## *7.2 LAS Working Segments*

Beginning with version 2.0 of LIDAR 1 CuePac, we have generalized the idea of a LAS entity. LAS is the American Society of Photogrammetry and Remote Sensing (ASPRS) data standard for LIDAR point cloud data and is the only format for LIDAR supported by LIDAR 1 CuePac.

LAS is a specification that is suitable for any type of elevation data so long as import and export routines exist to move elevation data in and out of the format.

We have added new merge and extract routines to the LIDAR 1 CuePac that work on this generalized LAS point cloud format. Thus in future releases you will be able to add other elevation formats and freely mix these with LIDAR data.

Our standard paradigm in GeoCue is to create an entity, set *population parameters* (if applicable) for the entity and then process the entity based on these parameters. Our new LAS Working Segments follow this paradigm.

LIDAR projects are processed as LAS Working Segments. The general flow is to import LIDAR Sources, create LAS Working Segments and then populate these segments from the LIDAR sources. LAS Working Segments can be created using any entity creation method available in GeoCue including importing their definitions from CAD or SHP files.

Once created, LAS Working Segments can be populated with LAS data from imported LIDAR sources *or* from other LAS Working Segments. This means that you can process LIDAR data according to one LAS segmenting scheme but then use a second scheme for product delivery.

NOTE: You can populate LAS Working Segments from LIDAR Working Segments. This provides forward compatibility for projects that were created in GeoCue versions 1.7 and earlier.

***NOTE*** – Effective with version 2.0, a Project Boundary is no longer required (or desired).

## 7.3 Creating and Populating a Single LAS Working Segment

As an introduction to the process of creating LAS Working Segments, we will create a single segment using the interactive *Create Entity* command of GeoCue.

> NOTE: We will sometimes refer to LAS Working Segments as Arbitrary Working Segments, LAS Segments or simply as Segments – the expressions are equivalent.

### 7.3.1 Creating the LAS Segment

With no layers selected, choose the Create Entity command (using either the legend right-click menu or the legend toolbar tool).

Set the Entity Name to “LAS 1”. Create a new layer of type LAS_WORKING with coordinates set to the Project coordinate system (we simply named our layer “LAS”).

Set the Entity Type to “LAS_Working Segment” and the checklist to “LAS Working Segment”. Your dialog, at this point, should resemble Figure 7-2.

With the placement method set to Digitize Polygon, digitize an arbitrary polygon over the top area of several of the LIDAR sources (the more you cover, the longer it will take to work through the examples).

> NOTE: You can now zoom in, zoom out and pan using the mouse wheel while in a digitize command. This makes precision digitizing much easier. Note that due to this new feature, you must double click (or hold down the

Control key and single click) to complete all digesting operations including digitize rectangle.

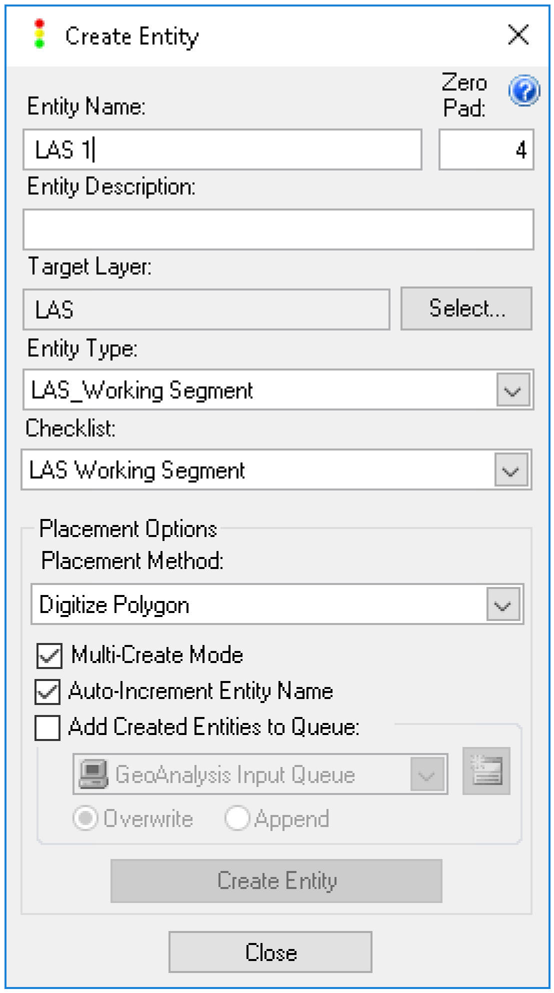



**Figure 7-2 Preparing to create the first LAS segment**

Our resultant LAS segment is shown in Figure 7-3. Select this newly created segment and observe the checklist steps (Figure 7-4). The top image displays the 'Properties' tab, while the one on the bottom displays the 'Utilities' tab of the "LAS Working Segment" checklist. Notice that the *Initialization* step has been automatically set as a result of creating the segment. At this point, the entity geometry has been defined but no LAS data is contained in the segment.

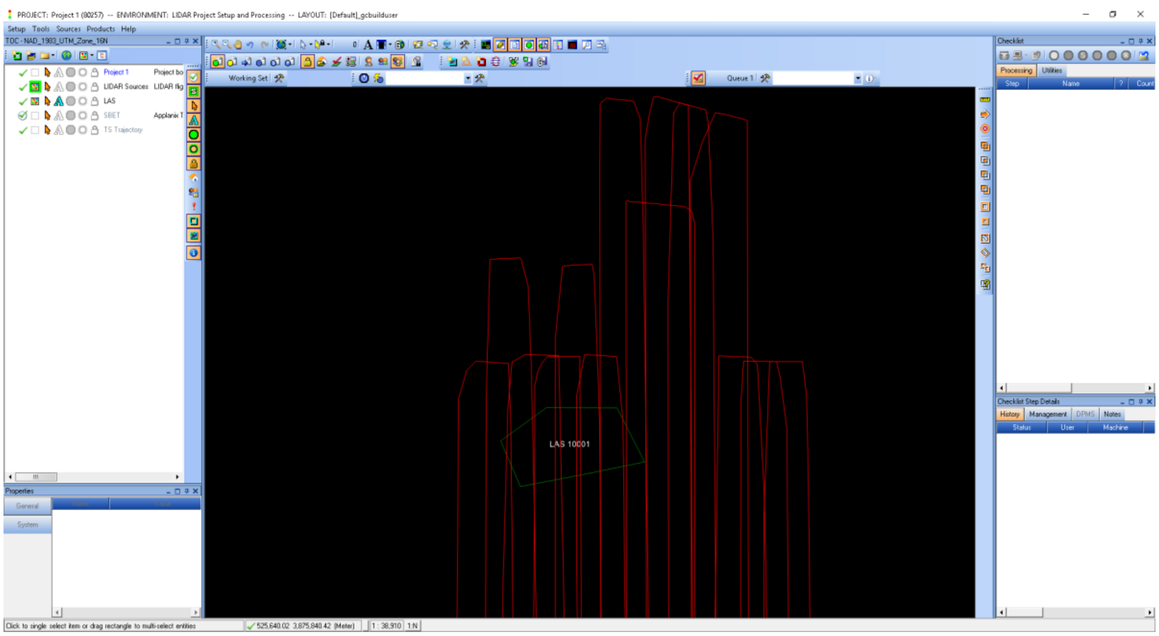


**Figure 7-3 Our Arbitrary LAS Segment**

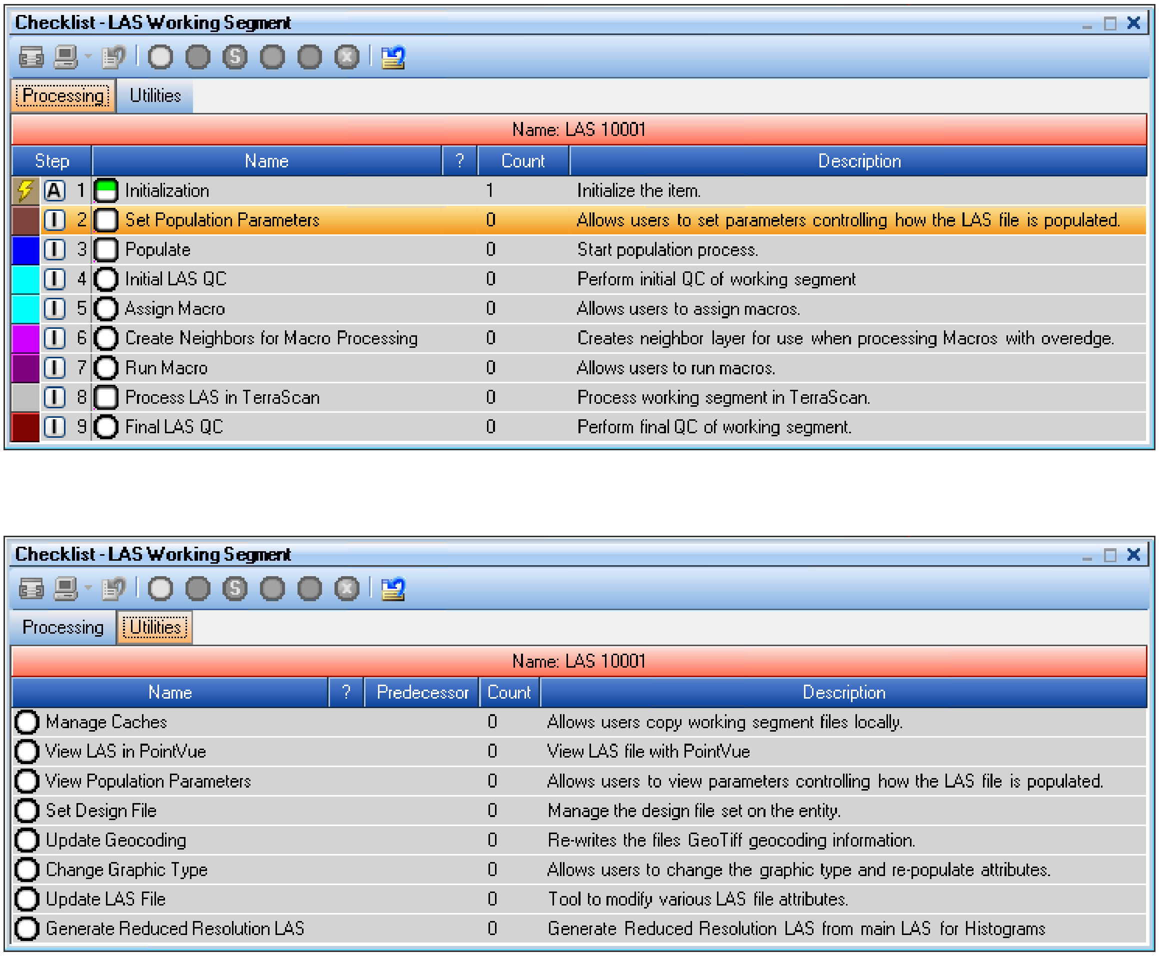



**Figure 7-4 The LAS Working Segment checklist**

## 7.3.2 The LAS_Working Segment Population Parameters

The next step in processing is to set the population parameters on our newly created LAS_Working Segment. Setting the population parameters specifies the source of LAS data for populating the segment as well as the *filter* that can be optionally applied.

Select the newly created LAS Segment into the Working Set Queue and set the *Set Population Parameters* step to ***In Progress***. This will invoke the dialog of Figure 7-5.

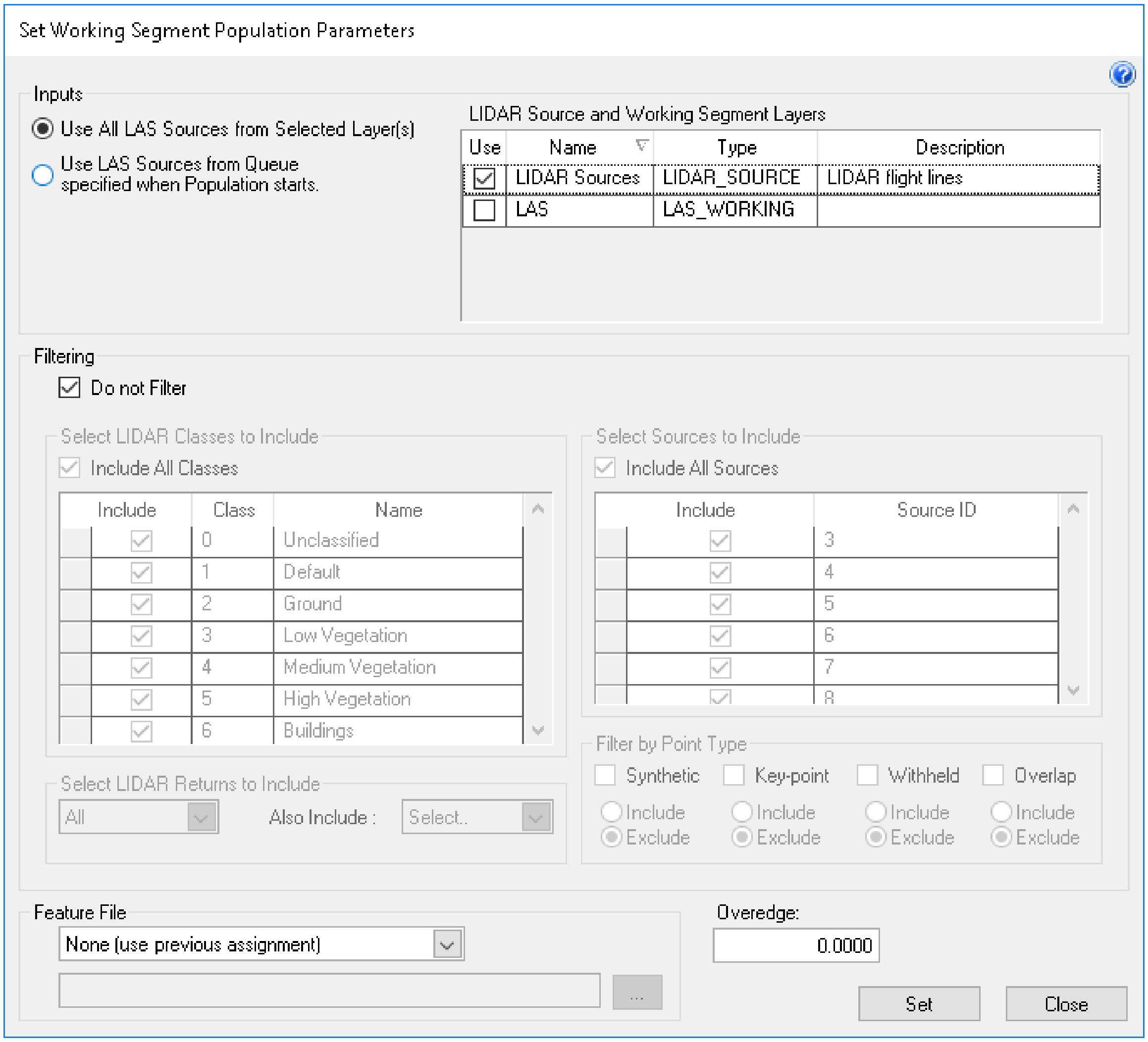



**Figure 7-5 The Set LAS Working Segment parameters**

## 7.3.2.1 Inputs

The ***Inputs*** section of this dialog allows you to specify the sources that will be used in populating the LAS Segment(s) that were selected when the dialog was invoked (the Output or destination). You can elect to populate from any layer that contains LAS data entities (GeoCue's standard database defines layer types of LIDAR_SOURCE and LAS_WORKING as compatible data types) or from source entities that will be loaded into a named queue. Note that you can select the layer that contains the *destination* entities. You should, in general, avoid this except for a special case described in a later chapter.

For our example, we will select the layer named "LIDAR Sources" since this is where we placed our source strips.

Note that you can, in general, select multiple layers from which to populate your LAS Working Segments. This is most useful for scenarios such as placing LIDAR sources on multiple layers.

> NOTE: If you select the Queue method for defining the source of your LAS data, the prompt for the name of the queue will not occur until you actually begin the populate step.

Select the layer LIDAR_SOURCE (it should be selected by default).

#### 7.3.2.2 Filters

The next section of the dialog allows you to *filter* the LAS data as you populate your LAS Working Segments.

If you check ***Do not Filter*** then all points in the source that are intersected by your LAS Working Segments (the *destination)* will be copied. If you uncheck this option, you can filter out specific elements of the source.

> Note: You typically would include all points when initially populating Working Segments from LIDAR sources. The filters are most useful for down stream

processing such as extracting a particular class such as Ground for a product layer.

The following subsections describe the filtering options available. To enable filtering, uncheck the ***Do not Filter*** box.

### *7.3.2.2.1 Classes*

If you wish to include all classes, keep ***Include All Classes*** checked. To specify particular classes to include, uncheck the ***Include All Classes*** box and then check the specific classes that you wish to *include* in the destination. For example, if you wish to include *only* the Ground class, uncheck all classes except Ground.

### *7.3.2.2.2 Sources*

*Sources* refers to the Point Source ID that is an attribute of every point in an LAS file. When you import a LIDAR flight line, you can elect to assign point source IDs (we did this via flight line assignment when we imported sources to our project). You can include or exclude data points based on this IDs. To filter on Point Source ID, uncheck the ***Include All Source*** checkbox. Then check the sources that you wish to *include*.

### *7.3.2.2.3 LIDAR Return*

The LIDAR Return filter applies only to LAS data that originated from a LIDAR system (the LIDAR 1 CuePac LAS system is generalized in that it can process any point cloud data that is in LAS format, regardless of original source). The return terminology is the same as that used in TerraScan.

### *7.3.2.2.4 Point Type*

LAS Specification version 1.1 introduced three attribute flags that can be used to specify special characteristics of a LAS point. As of September 2005 this feature has not been implemented in TerraSolid products. This filter should only be used if you are certain that your LAS generating software has correctly set these attributes.

### 7.3.2.3 Associating a Design File

The final section of the Set Working Segment Population Parameters dialog allows you to associate a MicroStation design file with the segment(s). If you are using TerraScan to do data processing then you will want to associate a seed file to each segment so that TerraScan does not prompt you for a design file each time it is started.

To create a seed file for a segment, check the ***Create associated design file using*** box and browse for your seed file.

## 7.3.3 Set the Parameters

Set the Filtering parameters to ***Do not Filter***. Associate the version 8 MicroStation design file that is located in the MicroStation folder of the GeoCue sample data via the ***Feature File -> Use Existing:*** section of the dialog (your dialog should resemble Figure 7-6) and press **Set.**

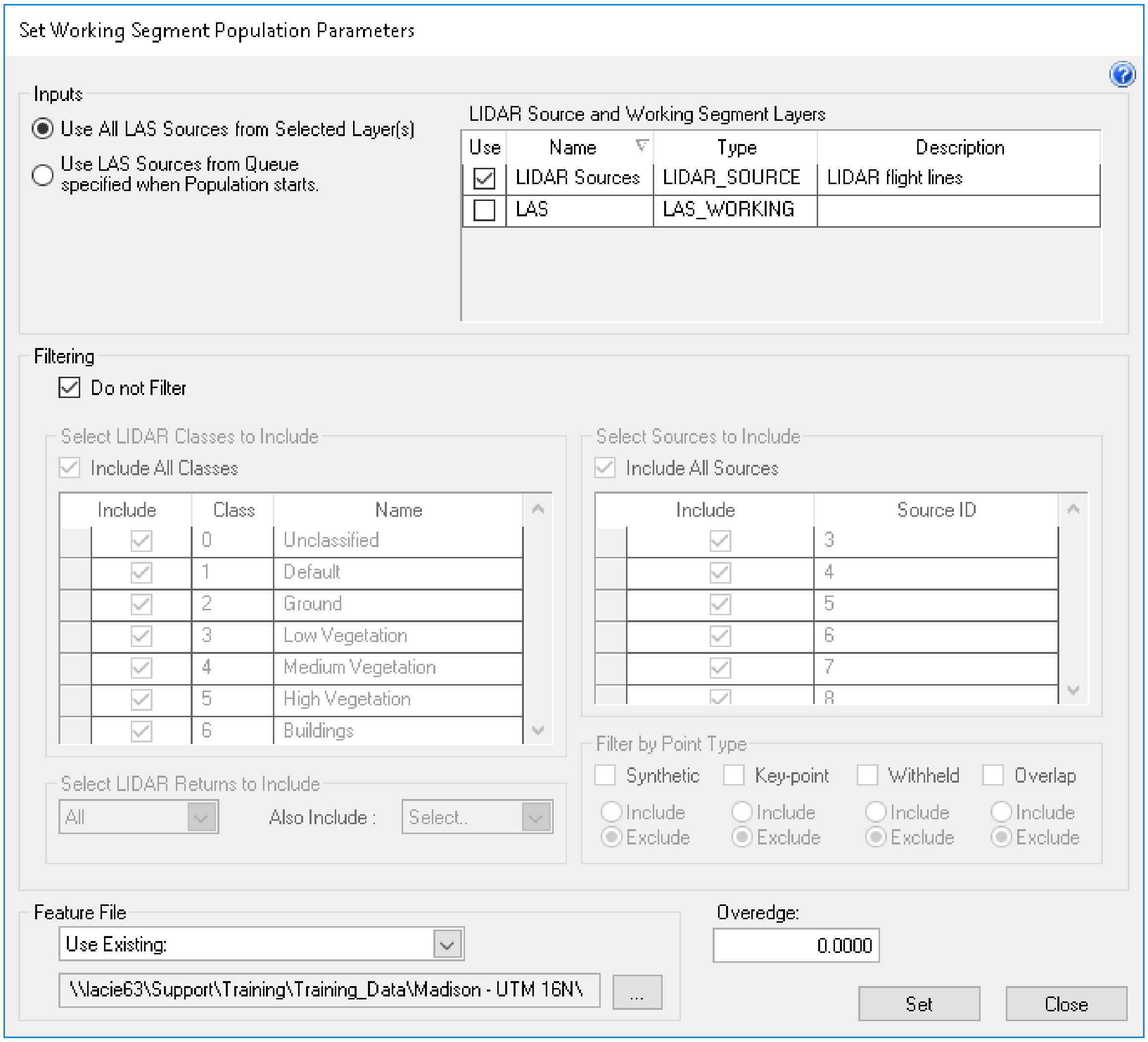
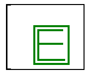



**Figure 7-6 The completed Set Population Parameters dialog**

## 7.3.4 Populate the Segment

The next step is to populate the segment. Restore the segment to the Working Set (you can use the Restore to WS button on the Checklist to quickly accomplish this). If you have GeoCue Enterprise, you will have the option to *Dispatch* the population operation or run the command locally.

### 7.3.4.1 Dispatch Processing 

If you are running in a GeoCue Enterprise environment (and if you are not, contact your purchasing department to upgrade to GeoCue Enterprise since it will provide you significantly enhanced processing), your checklist toolbar will have a new tool present called *Dispatch* (Figure 7-7). Notice in our figure that we have turned off the Single-Entity mode using the GeoCue options and thus the Multi-Entity mode tool does not appear on our Checklist toolbar. The *Dispatch* tool is automatically enabled for any command that is capable of being dispatched.

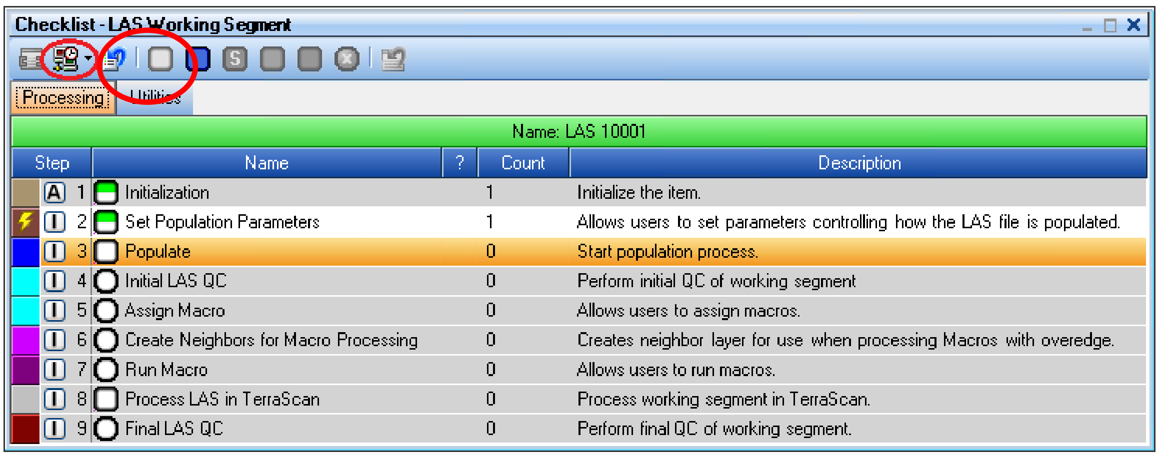



**Figure 7-7 The Dispatch tool**

Set the Populate step to In Progress. This will invoke the *Dispatch* dialog (Figure 7-8). Note that the list of machines displayed in your dialog will depend on your GeoCue constellation.

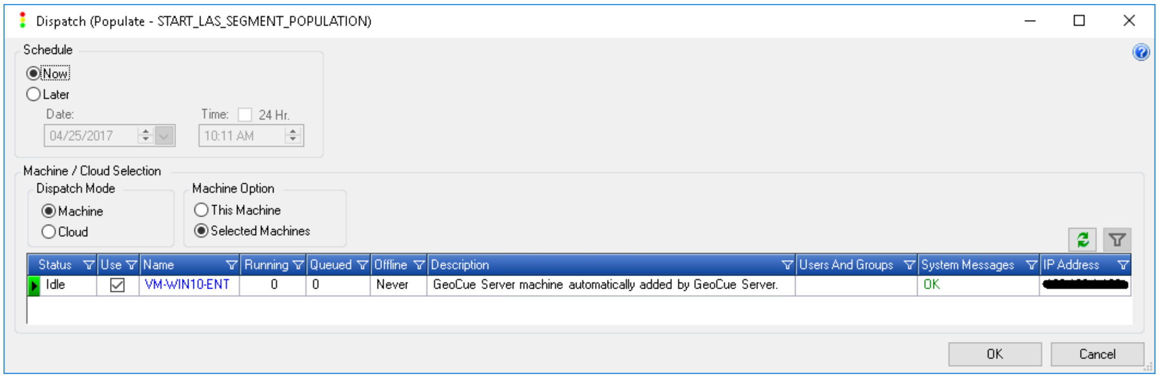



**Figure 7-8 The Dispatch dialog**

The top section of the dialog allows you to *Schedule* the populate to occur at a later time. The lower section allows you to select the machine on which the populate will occur. Note that the *Populate* command can be dispatched (run on a different machine) but it cannot be *distributed* (run on multiple machines simultaneously). Therefore your machine selection will act like a radio control (as you select a new machine, the previously selected machine will deselect). Select a machine from the list and press **OK**. The populate will commence. Note that you can *Dispatch* to your own machine. This is most useful for non-dsitributable commands (such as populate) in that it allows you to set a scheduled execution time.

### 7.3.4.2 Local Processing

If you do not have GeoCue Enterprise, simply select the Populate step and press the In Progress button. This will cause the population operation to begin.

Note – if you do have GeoCue Enterprise but wish to process without using the Command Dispatch System, deselect the Dispatch tool and press the In Progress button.

## 7.3.5 Observing the Population Progress

NOTE: You can check the progress of the population operation by setting the fill status flag to true on the LAS layer and then toggling the *Pending* and *In Progress* buttons on the Symbology toolbar (ensure that you have Filter by Current User/Machine active).

If you activate the display of Read Locks and turn on the LIDAR Source layer, you will observe the source strips being READ LOCKED. We read lock each strip as points are being copied from the strip to the Segment.

It could take 10 or 15 minutes to populate the segment, depending on how many strips you intersected and whether or not your data are remotely located across a slow network.

### 7.3.6 Viewing the Result

You can quickly view the results of the population by restoring the LAS Working Segment to the Working Set queue and setting the optional checklist step, *View in PointVue* to *In Progress.* Your display should resemble Figure 7-9 (of course the exact shape will depend on how you digitized your segment!).

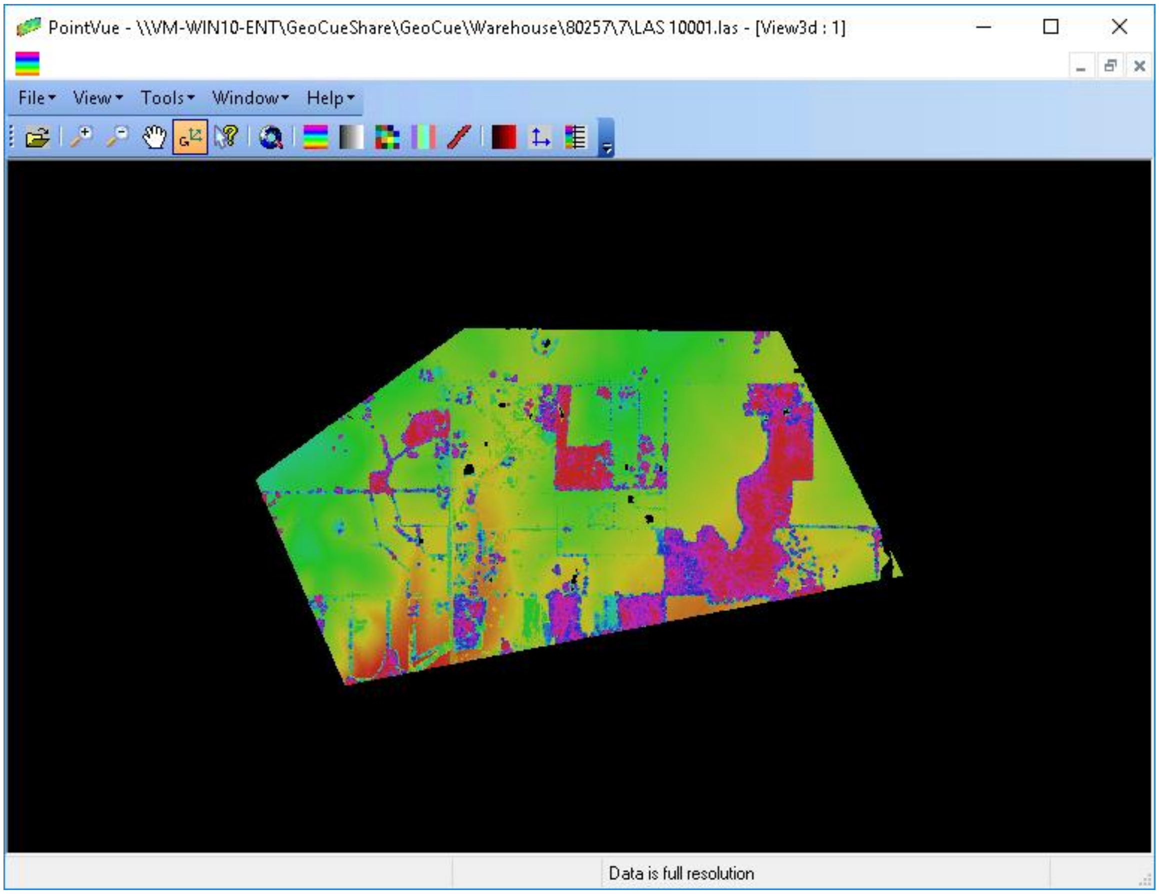



**Figure 7-9 Viewing the Populated Segment by elevation coloring**

It is instructive to also view the population result by Source ID. Set the following parameters in PointVue under ***View Settings***:

- Turn Enable Depth Buffering off on the General tab
- Go to the Source ID tab. Select all rows (select the first row and then Shift select the last row). Press Edit rows and then set New Saturation to 1.00, check the Change priorities box and click the radio button to Set Priorities to Source ID

Now set the view mode to Color by Source ID. Your display should resemble Figure 7-10. This indicates that Source IDs were assigned to each individual LAS point during the Populate LAS Segment operation.

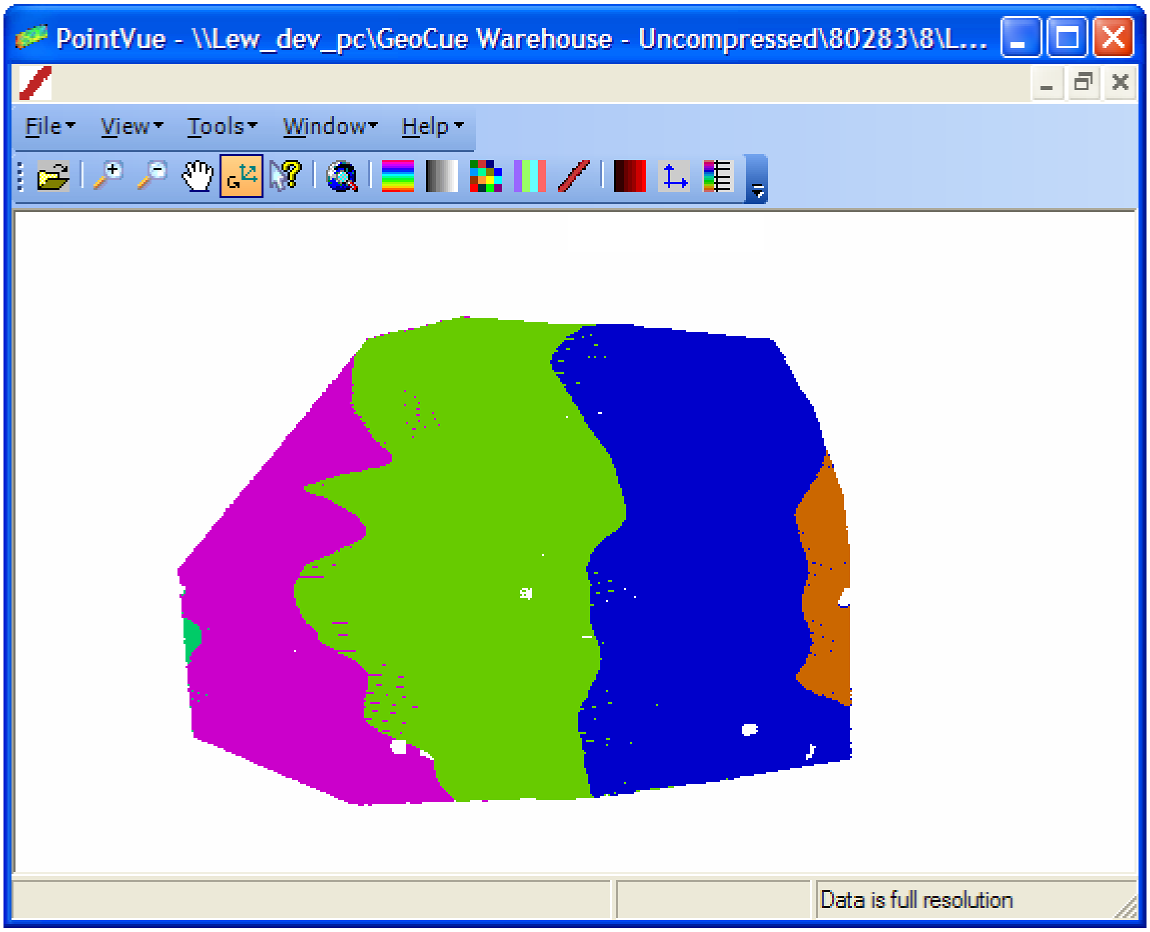



**Figure 7-10 Color by Source ID**

## 7.4 Directly Creating Multiple LAS Segments

You can easily create project-wide LAS Segments by using the gridding tools in GeoCue (see the GeoCue Workflow Guide). We will look at a quick example of this.

We will use a GeoAnalysis Rectangle as an area of interest for the Create Entity gridder tool.

### 7.4.1 Creating an Area of Interest

First, digitize a GeoAnalysis rectangle that represents the area that you want to segment into LAS Working Segments. You can quickly do this by using the Rectangle tool on the GeoDraw toolbar. If the GeoDraw toolbar is not current docked in the toolbar area of your GeoCue Map View, simply right click in a blank toolbar docking area (top of the Map View) and select the GeoDraw toolbar entry. Alternatively, you can right click anywhere in the Map View itself, select ***toolbars*** and then pick GeoDraw. This will activate the GeoDraw toolbar ().Figure 7-11

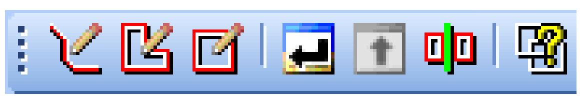


**Figure 7-11 The GeoDraw toolbar**

Press the *Draw GeoAnalysis Rectangle* tool (third tool from the left) and left click (do not drag) the point where you want your rectangle to start. Note that if you do not like your selected starting point, you can right click to back up a point. You can zoom in and out on the Map View as well as pan by using the mouse wheel. Move your mouse pointer to the position where you desire the opposite corner of the rectangle and either double click to form the rectangle or hold down the Ctrl (Control) key and single click. Our rectangle is depicted in Figure 7-12.

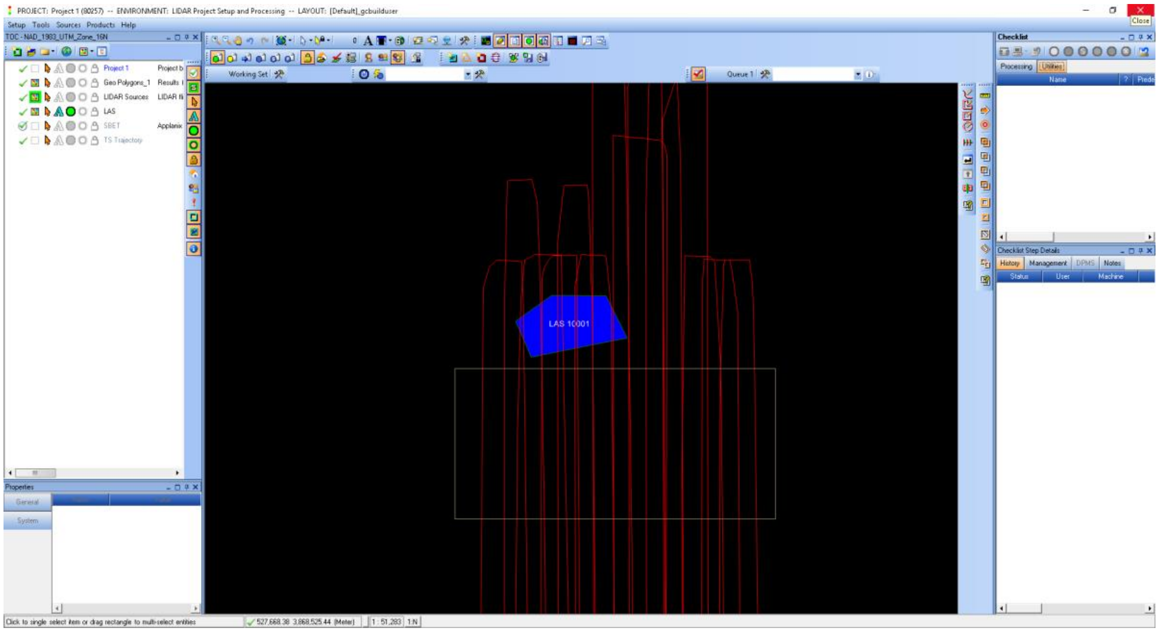


**Figure 7-12 The GeoAnalysis rectangle**

### 7.4.2 Creating a Grid of LAS Working Segments

Select the LAS layer that was created in the previous example and press the Create Entity tool. Fill in the dialog as depicted in Figure 7-13. Note that we set the Entity Name to “L-“. We included a “-“ because the gridder will automatically append an incrementing number to the base name (“L-“ in our example) of each entity. Note that we have set the Entity Type and the Checklist Name to “LAS Working Segment”. Set the placement method to *Place Grid of Entities* and press the **Define Grid** button. This will invoke the gridder (Figure 7-14).

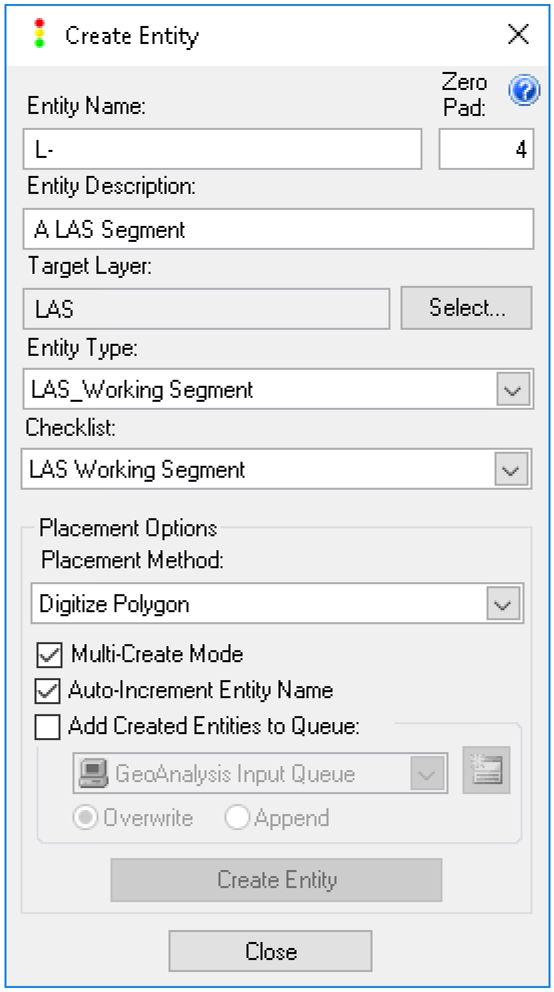



**Figure 7-13 Populating the Create Entity dialog**

*Select* the GeoAnalysis rectangle.

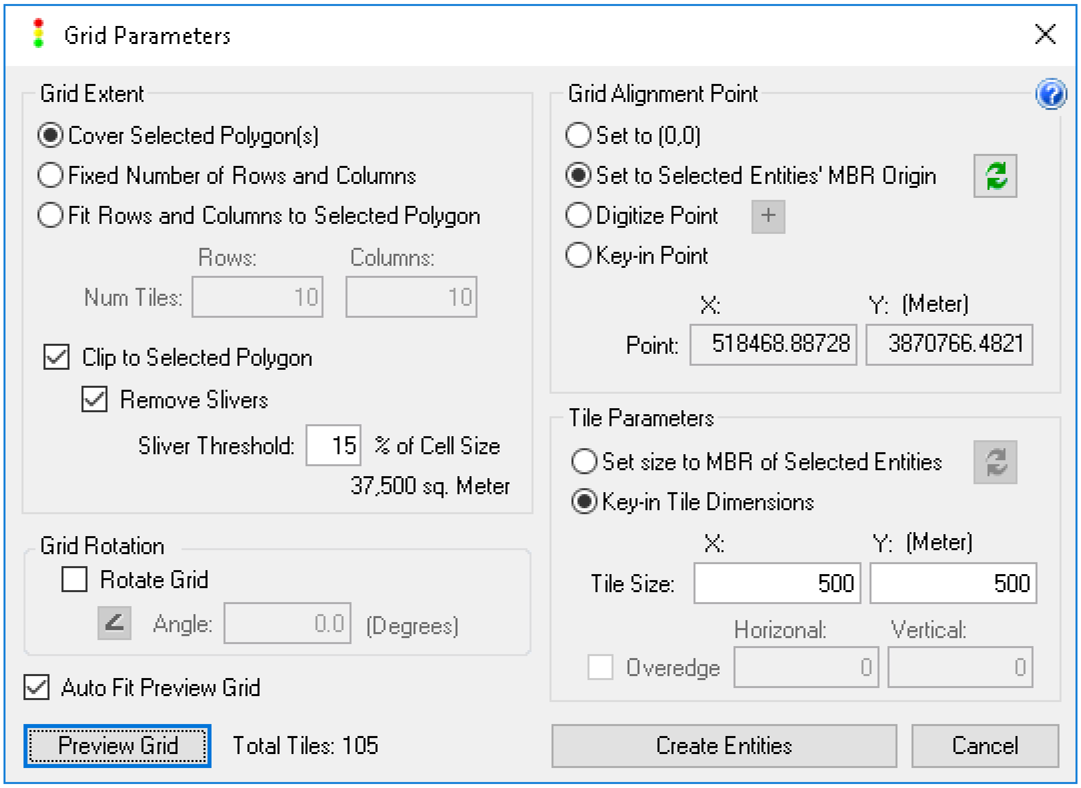



**Figure 7-14 The Gridder**

We have set our grid parameters to create a grid that covers the selected GeoAnalysis rectangle with a gird of tiles that are 500 m X 500 m (see the Tile Parameters section of the dialog). We set our grid origin to be the upper left of the GeoAnalysis rectangle by simply pressing the ***Set Point to MRB Origin of Selected Entities***. We could also have digitized the grid alignment point or set it via keyin. Note that we have elected to ***Clip to Selected Polygon*** and to ***Remove Slivers***. You can preview the grid by pressing the **Preview Grid** button (note that you cannot preview the results of sliver removal). Our previewed grid is depicted in Figure 7-15.

When you are satisfied with your gird construction, press the **Create Entities** button. The progress bar at the bottom of the GeoCue main window will show the processing status. Note that if you have a large number of gridded entities and you select the Sliver Removal option, this processing can take several minutes.

You can now delete the GeoAnalysis layer since we are finished with the rectangle.

The result of our grid creation is shown in Figure 7-16. Note that the last row of small rectangles in our grid preview have been aggregated into the grid cells directly above. This is the effect of the sliver removal option.

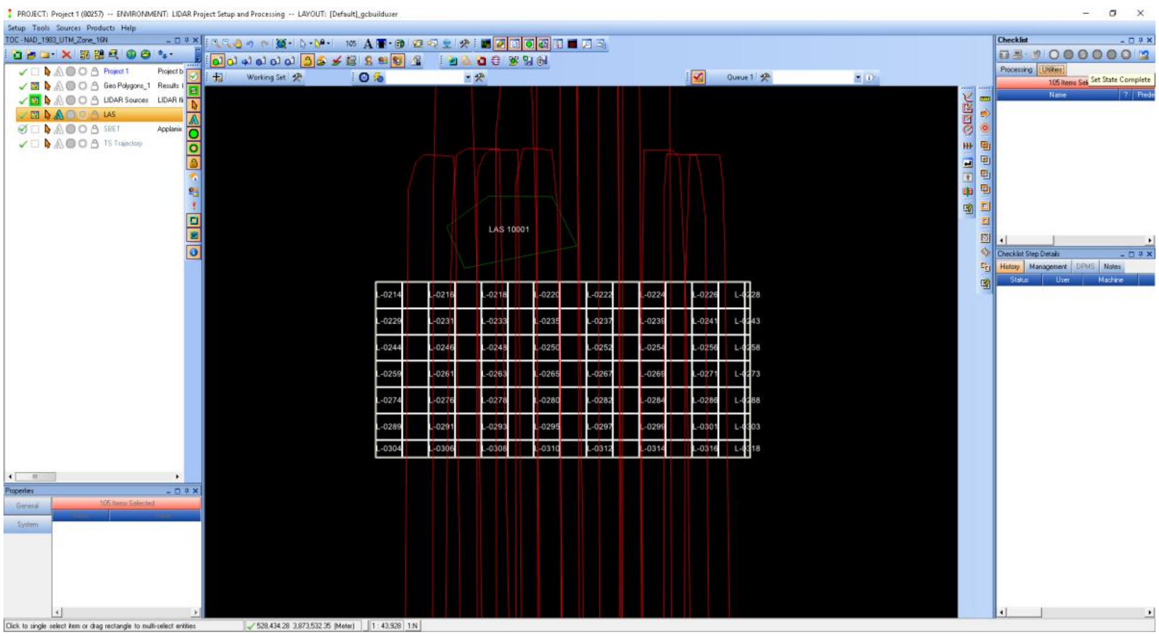


**Figure 7-15 A preview of our grid**

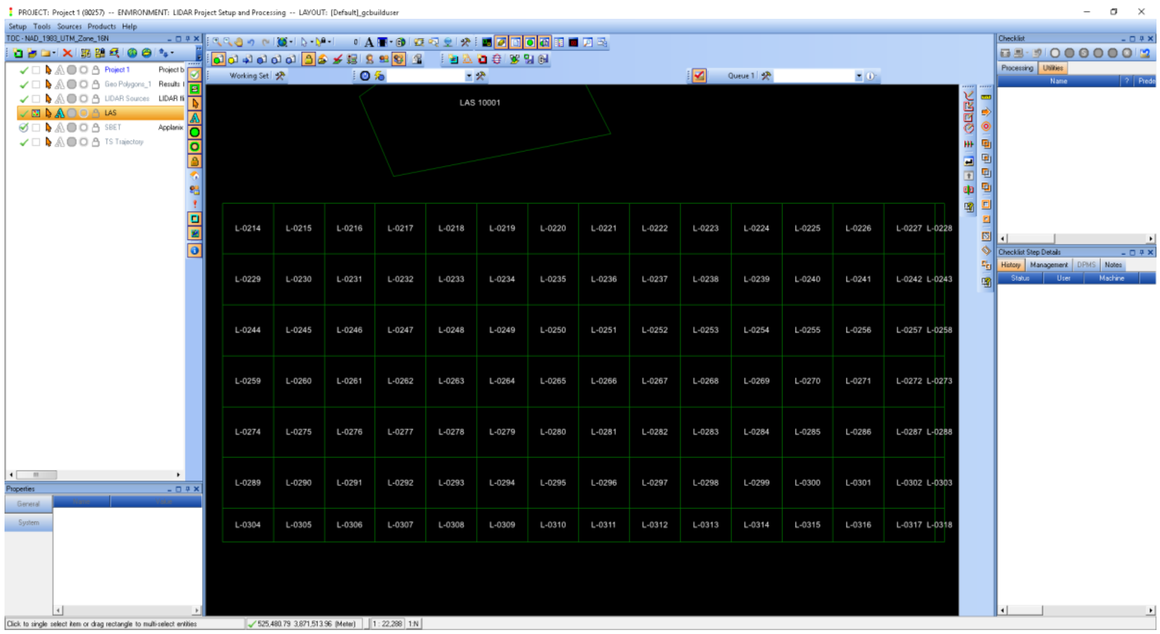



**Figure 7-16 Our Grid of LAS Working Segments**

You could now proceed to Set Population Parameters and Populate these LAS Working Segments just as in our previous example except that you would select multiple entities into your Working Set Queue.

> HINT: If you would like to see the result of sliver removal or want to alter geometries using the GeoAnalysis tools, then first create a grid of GeoAnalysis polygons using the gridder. Use the GeoDraw and GeoAnalysis tools to modify the grid. Finally, use the result as a template in the Create Entity command to create LAS Working Segments using the *Selected Entities Geometry* method.
>
> Using GeoAnalysis entities as templates is, in general, the most powerful and flexible method of creating entities in GeoCue.

## 7.5 Creating LAS Working Segments using LAS Working Boundaries

LIDAR 1 CuePac Version 2.0 introduced another new entity type associated with processing LAS format data. This new entity is called an LAS Working Boundary. The LAS Working Boundary is used:

- To generate tiled LAS Working Segments based on LAS point density
- To group LAS Working Segments
- As boundary definitions for the new LAS Merge tools

We will examine LAS Working Boundaries in several different areas of this workflow guide. The first use we will explore is as a way to create point-count driven LAS Working Segments.

You may have realized that the grid of LAS Working Segments that we produced in the previous section was based solely on the physical size of the grid. This is useful when you need specific tile sizes (e.g. 1 Km x 1 Km tiles). However, during the initial portion of LIDAR processing, we are often gridding data to limit the point count to a reasonable value for our editing tools. This type of construction can be accomplished via a processing routine that we have tied to the LAS Working Boundary.

### 7.5.1 Creating the LAS Boundary

An LAS Working Boundary is a polygonal entity that can be placed on a layer of type LAS_WORKING. Thus in this example, we will create an LAS Working Boundary on the LAS layer that we have been using in the previous examples.

*Select* the LAS layer and press the Create Entity tool on the legend toolbar. Set the parameters of the Create Entity dialog as shown in Figure 7-17. Note that LAS Working Segment and LAS Working Boundary appear on the same Entity Type drop-down list – ensure that you select the correct type! Once you have selected LAS_Working_Boundary, the Checklist drop down will automatically filter out the LAS Working Segment choice.

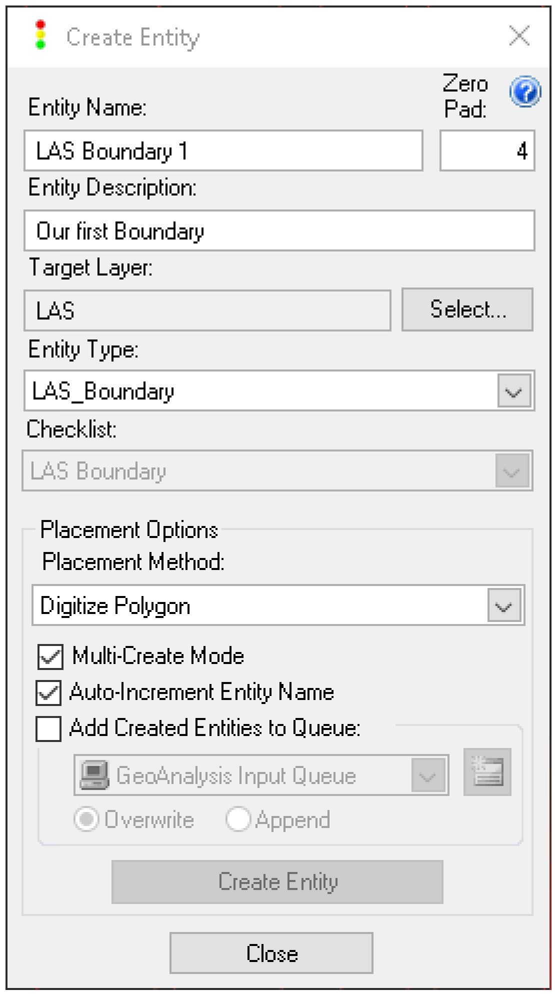



**Figure 7-17 Setting parameters for the LAS Working Boundary**

Digitize a polygonal boundary somewhere over the LIDAR Sources in a area not already covered by LAS Working Segments from previous examples. Our boundary is shown in Figure 7-18. Click the Boundary and observe its checklist steps (Figure 7-19).

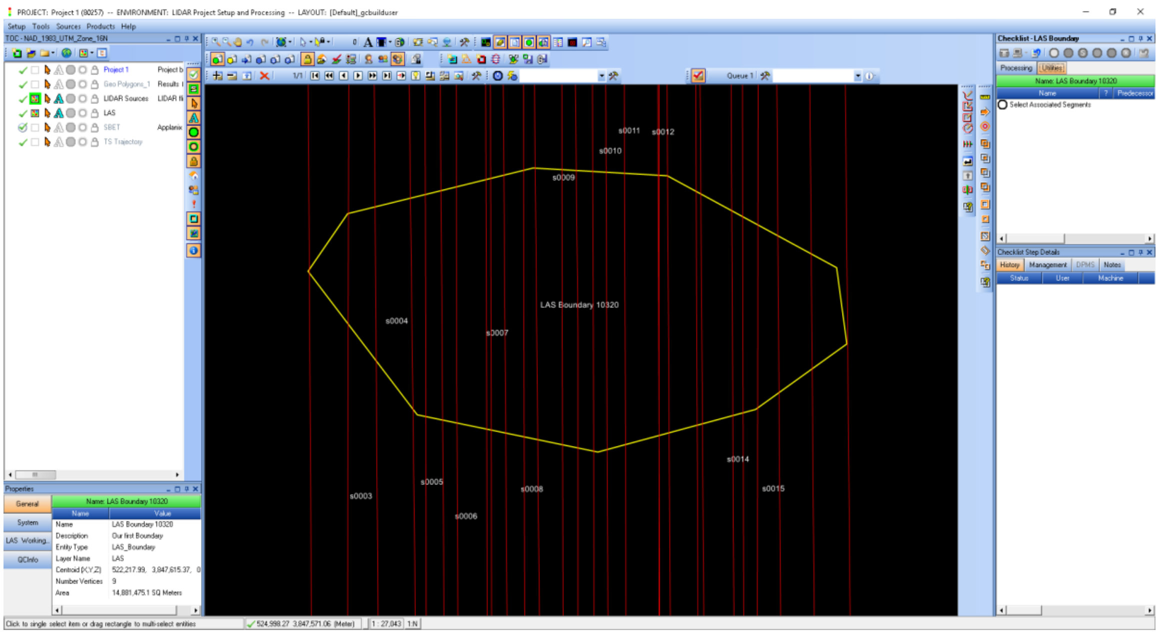



**Figure 7-18 Our LAS Working Boundary**

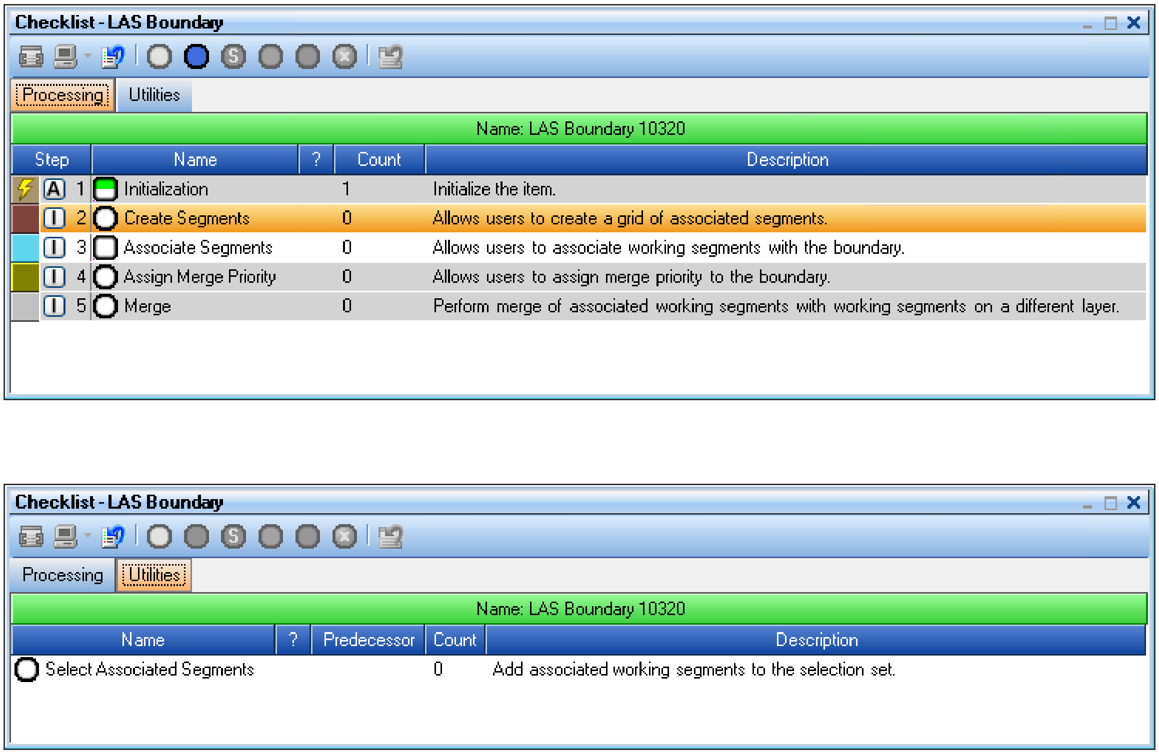



**Figure 7-19 The Checklist Steps for a LAS Working Boundary**

The first step, *Initialization*, is automatically set when the entity is created. It is useful for recording the specific information about who created the entity and when, as recorded in its checklist step history record.

The second step is an optional step that allows you to use a point count driven gridding routine to create LAS Working Segments that will be associated with this boundary. The third step is a required step that is used to associate one or more LAS Working Segments to the Boundary. Since the purpose of an LAS Working Boundary is to enable certain functions related to LAS Working Segments, it is only useful after such associations have been made! If you use step 2 (Create Segments), the association will occur automatically.

The 4th and 5th steps are used in merge operations and will be discussed in that section of this workflow guide.

## 7.5.2 Creating LAS Working Segments

The *Create Segments* checklist step of the LAS Working Boundary invokes a routine to grid a LAS Working Boundary based on the point density of the LAS data that will be used to populate the created segments.

Add the newly created LAS Working Boundary to your Working Set queue and invoke the *Create Segments* step. You will be presented the dialog of Figure 7-20.

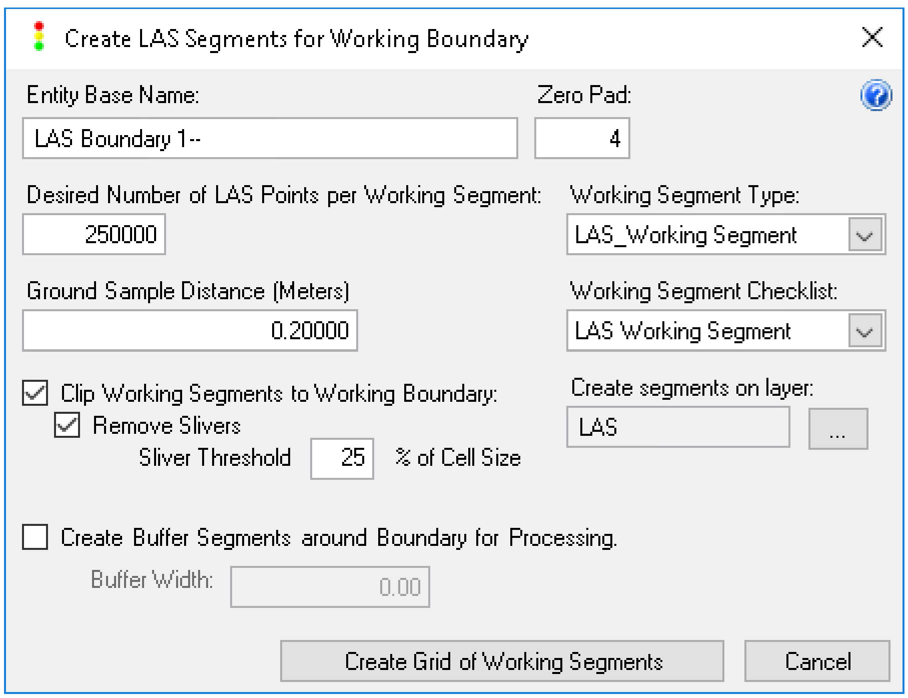



**Figure 7-20 The LAS Boundary Segmenting dialog**

Similar to the Create Entity name field for multiple entity creation, the Entity Base Name will be the prefix applied to each LAS Working Segment created. For example, if you set this to "LL-" then the entities will be named "LL-1", LL-2" and so forth.

The Desired Number of LAS Points per Working Segment is the target number of points you would like in each created segment.

The Ground Sample Distance (GSD) is the point spacing of the data that will be used to populate the LAS Working Segments. You may know this from the flight plan of the mission. If you have no idea of this value, you can examine the metadata for LIDAR Sources that you have imported into GeoCue. You should adjust this factor if your sources have a large amount of overlap. For example, if your sources have 50% overlap you can half the Ground Sample Distance. Our Madison data have an average GSD of 2 meters with a varying degree of overlap. Thus we will use 1 meter as our GSD value.

The Clip Working Segments to Working Boundary will cause the generated LAS Working Segment tiles to be truncated at the boundary of the Working Boundary. The Remove Slivers option functions exactly the same as it does in the GeoCue Gridder.

The *Create Buffer Segments* option allows you to specify that the LAS Boundary should also include edge tiles outside the boundary for algorithms that require edge processing. This can be useful for products such as TerraScan where you need processing macros to use data from adjacent areas.

NOTE – You can now specify custom entity and checklist types. You can also place the Working Segments associated with a LAS Boundary on a different layer than the boundary.

The right-hand section of the dialog allows you to specify an alternative Working Segment Type and Checklist Type. This section is used if you (or someone within your organization) has used Environment Builder to define new entity and/or checklist types

The final setting specifies the layer on which the LAS Working Segments are to be placed. They can be placed on the same layer as the LAS Boundary although we recommend placing them on a separate layer to make visualization and selection easier.

Set the parameters as shown in Figure 7-21 and press the **Create Grid of Working Segments** button.

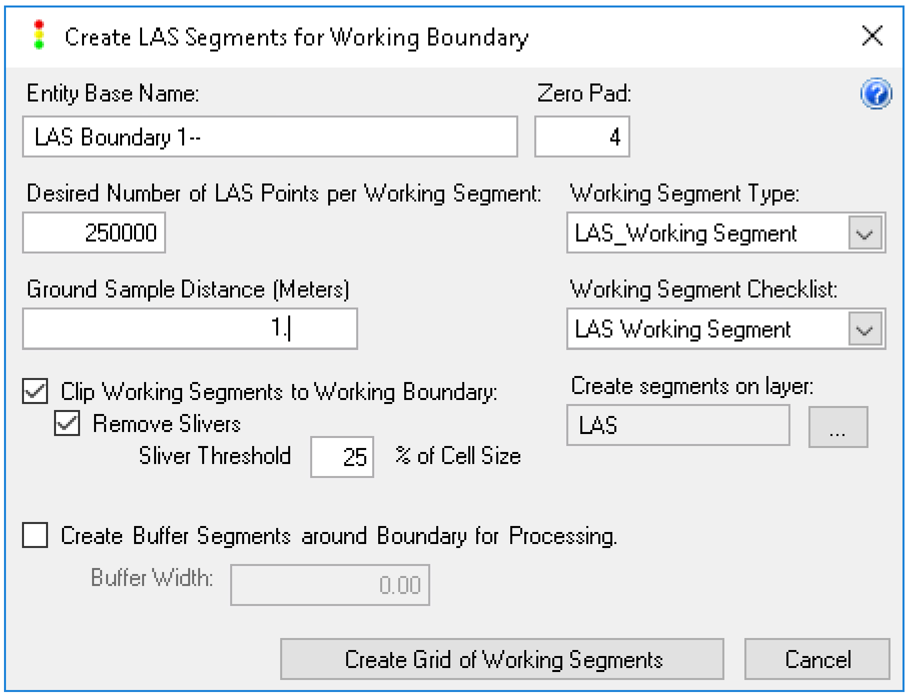



**Figure 7-21 Settings for the LAS Boundary Gridding dialog**

The amount of time required for processing is a function of the size of your LAS Working Boundary, the point count set in the dialog (which, along with the GSD, determines the number of grid cells) and the setting for Sliver Removal (the sliver removal process requires several passes through the data).

The results of our processing are shown in Figure 7-22.

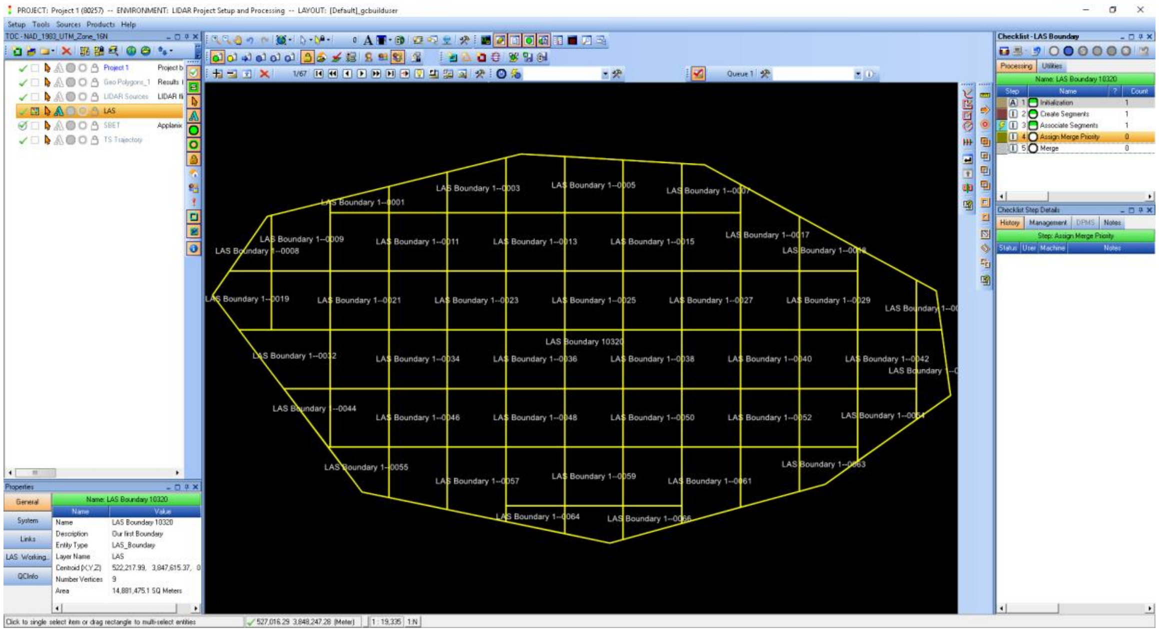


**Figure 7-22 Our LAS Boundary generated LAS Working Segments**

If you examine the checklist once again for the LAS Working Boundary, you will note that the *Associate Segments* step has been automatically completed.

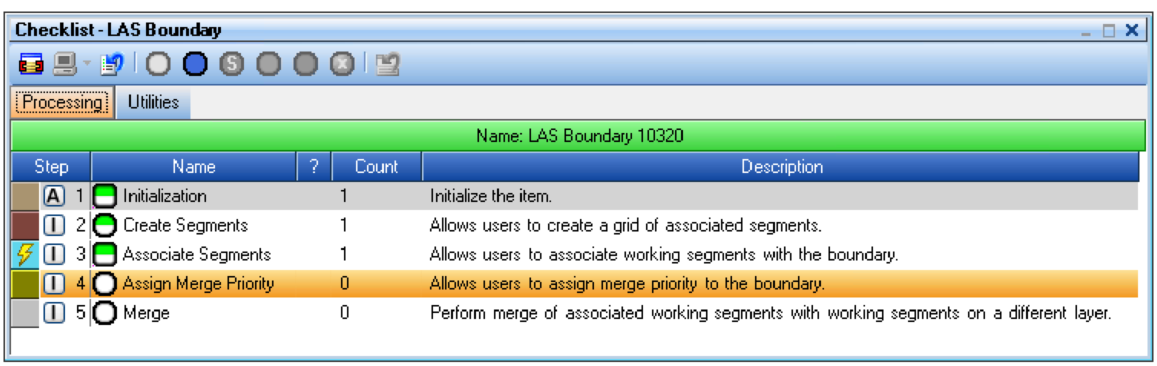



**Figure 7-23 Automatic LAS Working Segment Association**

At this point, the LAS Working Segments that were created are identical to those that would be created interactively as in the previous examples. Thus you can simply select one, several or all of the LAS Working Segments, set their population parameters via their checklists and populate them.

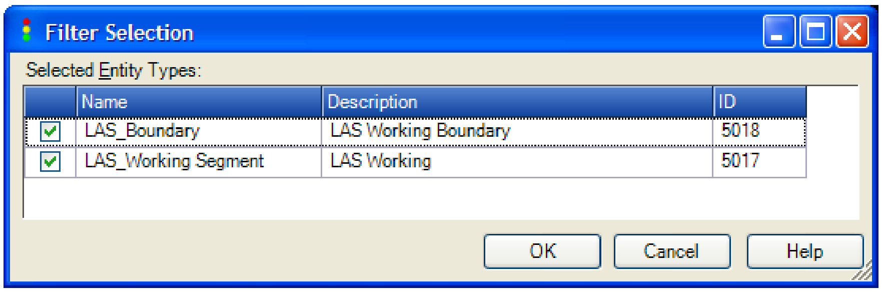
NOTE: The LAS Boundary is now related to its working segments via the new Associativity Engine added to GeoCue 3.0. This means that LAS Boundaries and Working Segments can be modified via the new Link tools. If you are not familiar with these tools, simply use the techniques discussed in this document.

### 7.5.3 Selecting LAS Working Segments using the Boundary Checklist Step

You probably noted that the LAS Boundary contains an optional checklist step - *Select Associated Segments.* This step is used to *Select* LAS Working Segments that are associated with an LAS Boundary.

Add the LAS Boundary to your Working Set. Now execute the optional step, *Select Associated Segments.* The Boundary will be removed from your Working Set and the associated segments will be *Selected.* You can then simply press the "+" button on your Working Set queue toolbar to add these selected segments to the Working Set.

HINT: If your LAS Boundary is on the same layer as the associated segments it can make *Selection* of the LAS Segments confusing since the Boundary and Segments are together. You can use the new *Selection Filter* to sort out the Boundary from the Segments. Simply select the entire group (via, for example, dragging a rectangle) and then choose the *Filter Selection* option from the set of *Selection* tools. Choose the LAS Working Segments from this list.




## 7.6 About LIDAR Working Segments

If you do not have legacy LIDAR projects from GeoCue version prior to 2.0, you can skip this section of the document.

Users of previous versions of GeoCue will note that the new LAS Working Segment is a dramatic improvement over the previous restrictions placed on LIDAR Working Segments (which has to be created via a micro-tiling scheme).

You can still create LIDAR Working Segments by creating a Project Boundary entity and using its checklist. However, this method of processing will be deprecated in a future version of GeoCue. We therefore strongly encourage you to drop this method of processing. The new LAS Working Segment techniques are much more flexible and streamlined.

For forward compatibility, the old type LIDAR Working Segments *can* be used as a source for populating LAS Working Segments. This means that you will be able to use the new merge tools with projects created in version 1.7 GeoCue and earlier.

## 7.7 Summary

We have presented a variety of methods of creating LAS Working Segments in this chapter. In general, you can use any GeoCue entity creation method to generate LAS Working Segments. Additionally, you can create an LAS Boundary and then use the LAS Boundary Checklist Step to create point-size driven LAS Working Segments.

# 8 Setting up the Project

In this section we will set up our project for the examples of the following chapters.

We will continue to use Madison (as set up in the preceding chapters) for our examples.

We will keep the previous layers we created so that you can revisit the prior examples. Turn off all layers except the LIDAR Source layer and the Project Layer. In all of the following work we will use the Project coordinate system unless specifically stated otherwise.

## 8.1 Creating the LAS Working Segments

Create a new LAS_WORKING layer called LAS Boundary 1 in the project coordinate system. On this layer, create an LAS Boundary called "B1" by using the placement method "MBR of Selected Entities" with all of the LIDAR Sources selected. Your GeoCue Map View and Create Entity dialog should resemble Figure 8-1 just prior to entity creation.

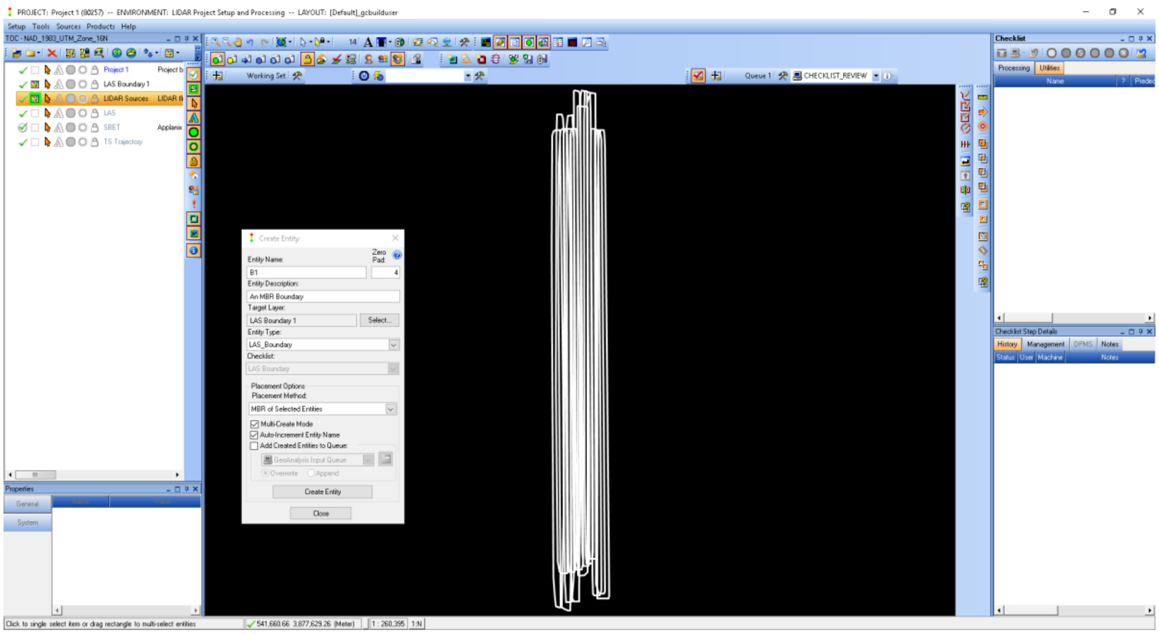


**Figure 8-1 All Sources selected just prior to LAS Boundary creation**

NOTE: Pay close attention to the Entity Type in the *Create Entity* drop-down selector. For many layer types, you will have a choice of several different entity types.

After pressing the Create Entity button, you should have a rectangular LAS Boundary that encloses your LIDAR Sources.

*Select* the newly created LAS Boundary into your Working Set Queue and execute the *Create Segments* checklist step. Populate this dialog as in Figure 8-2 (note that we selected a Ground Sample Distance of 1.2 meters). Create a new layer called “LAS 1” for your segments so that they will be on a layer separate from your Boundary. Press **Create Grid of Working Segments** to produce the LAS Segments.

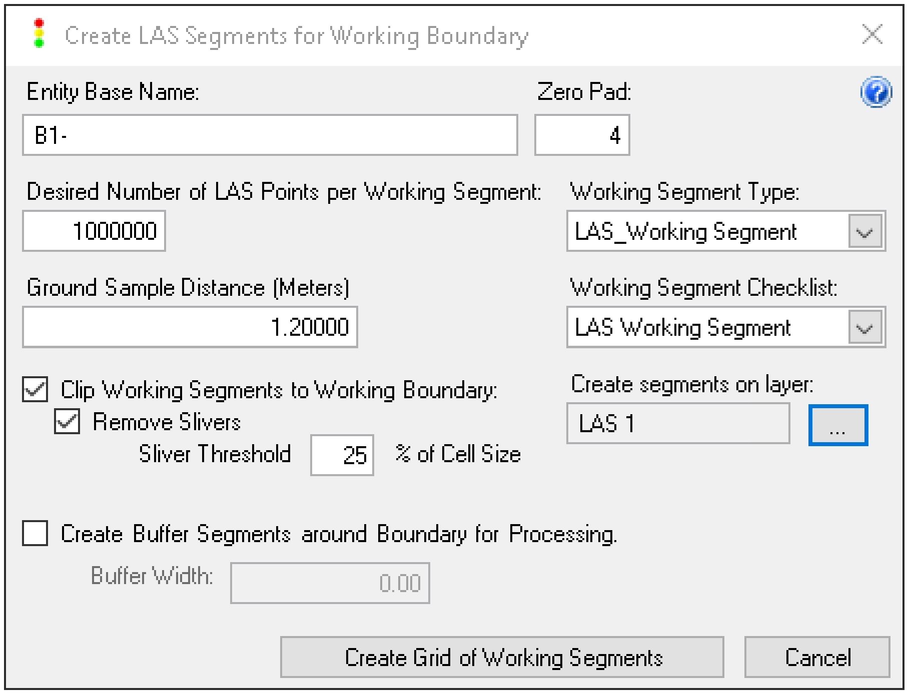



**Figure 8-2 The LAS Segment parameters**

When processing completes, your display should look the same as Figure 8-3.

> HINT – Note that we used a naming convention of *Boundary Name - #* for our LAS naming. Using the Boundary name as the prefix makes it easy to figure out the Boundary that is associated with a particular LAS Segment by simply examining the LAS Segment label.

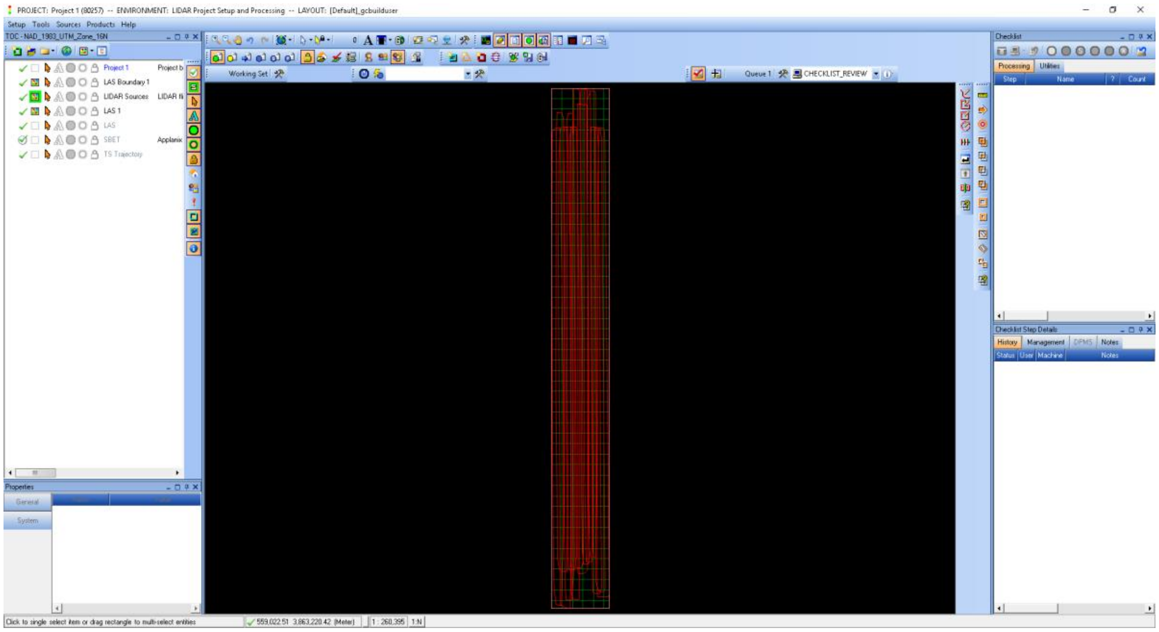


**Figure 8-3 The LAS Boundary and LAS Working Segments**

## 8.2 Setting Population Parameters

Select all of the newly created Segments into your Working Set. You can perform this in one of two ways:

- Select the LAS Boundary into your Working Set and execute the optional step, *Select Associated Segments.* This will add the LAS Segments associated with the Boundary into your *Selection* queue and remove the Boundary from the Working Set. Simply press the "+" button on the Working Set Queue toolbar and all of the LAS Segments will be added.
- Drag the *Selection* rectangle around the entire group of LAS Working Segments, LAS Boundary and LIDAR Sources. This will select everything that has its associated layer (V)isible and (S)electable. Now choose the *Filter Selection* option from the Selection tool drop-down list (Figure 8-4). This will display a table you can use to filter the selection. Leave only the LAS Working Segments checked in this list. Finally, press the "+" button on the Working Set toolbar to add the selected LAS Working Segments to the Working Set queue (this takes a lot longer to explain than it does to actually perform!).

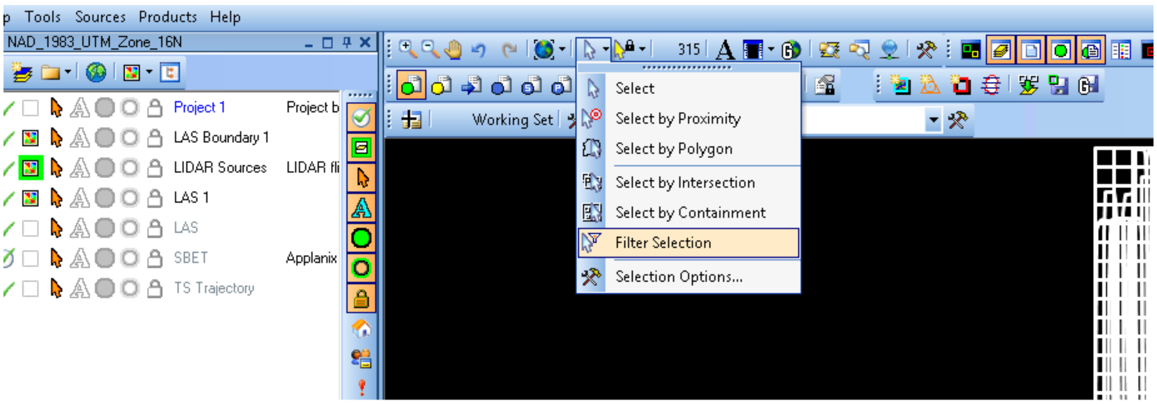



**Figure 8-4 The Filter Selection tool**

With all of the LAS Working Segments that you just created in the Working Set Queue, select Multi-Entity mode and run the *Set Population Parameters* checklist step. Set your population parameters as shown in Figure 8-5. Be certain to set your associated design file path to the location in the GeoCue sample data of the Madison MicroStation seed file, Version 8.

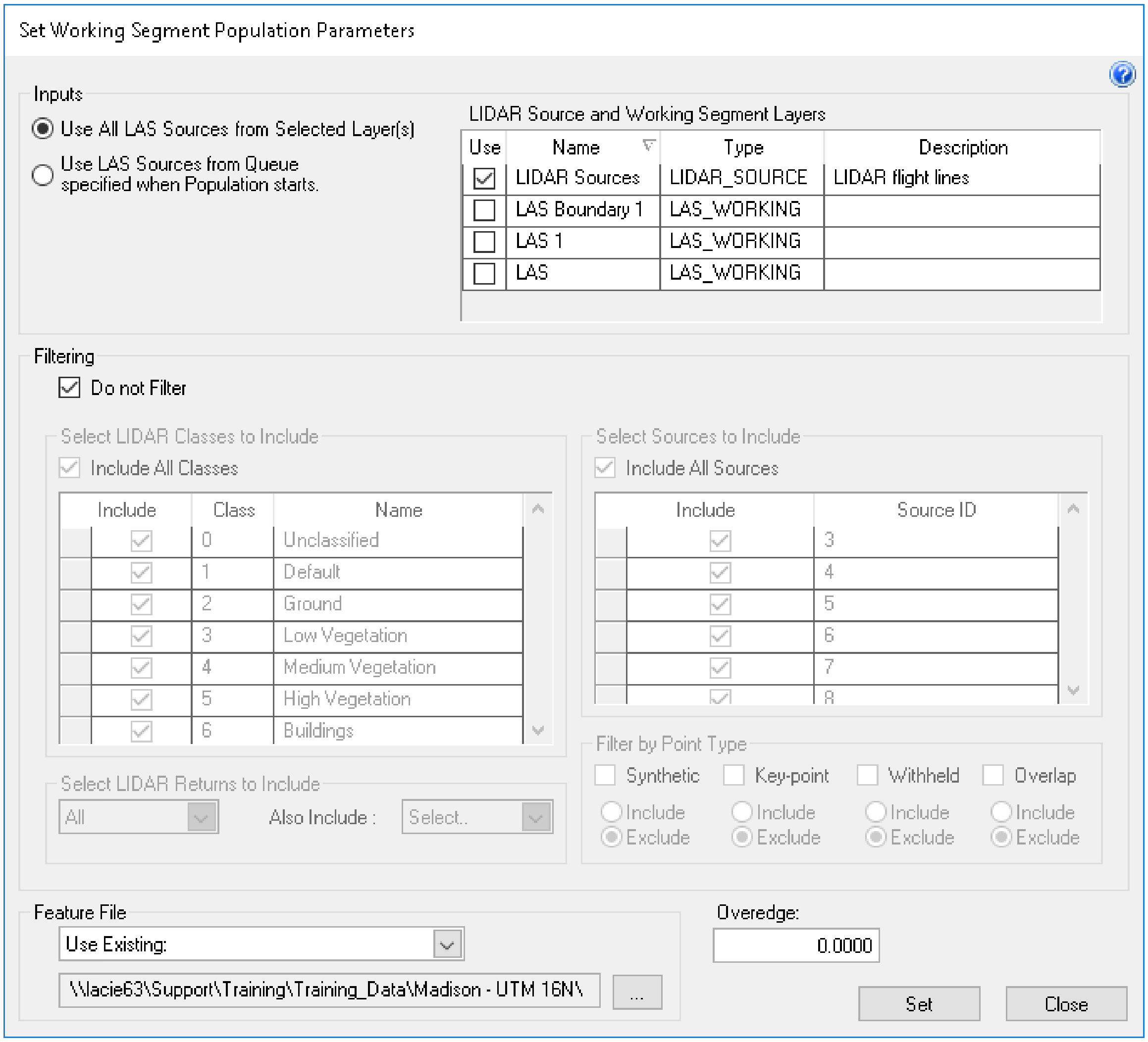



**Figure 8-5 Population parameter settings**

Press **Set** to establish the parameters.

## 8.3 Populating the Working Segments

Select all of the LAS Segments into the Working Set (if you have done no operations since the previous example, you can do this quickly by simply pressing the *Restore to WS* button on the Checklist toolbar). Select the Multi-Entity mode (unless you have turned off the Single Select mode using GeoCue options) and execute the *Populate* step by either dispatching or local processing..

You can observe the population progress by setting the (F)ill option on the LAS 1 layer and using the various options on the Symbology toolbar to observe In Progress, Pending and Complete status.

Note- The Madison sample data set is fairly large, with several GB of data. It will take some time to populate the segments.

You will note (if you observe processing status) that the LAS Segments first go into a state of *Pending* and stay in this state for several minutes. This occurs because the population algorithm must do some preprocessing on the LIDAR strips. During this preprocessing time, we put the LAS Segments into a *Pending* state.

## 8.4 Summary

We will return to the LIDAR working segments that we have created and populated in this chapter after examining control points and reference rasters.

# 9 Control Points

GeoCue has the ability to import files of control points. This version of GeoCue supports the import of control point files in the following formats:

- Generic ASCII
- DAT/EM
- Z/I Imaging

A description of the points is contained in the following table:

| ***Point Type*** | ***ASCII*** | ***DAT/EM*** | ***Z/I Imaging*** | ***Symbol*** |
|---|---|---|---|---|
| Full Control | HV | HV | /pc=XYZ /pt=CONTROL | = |
| Planimetric Control | H | H | /pc=XY /pt=CONTROL | N |
| Vertical Control | V | V | /pc=Z /pt=CONTROL | V |
| Full Check | CP | CP | /pc=XYZ /pt=CHECK | * |
| Planimetric Check | PCP | Not Supported | /pc=XY /pt=CHECK | Q |
| Vertical Check | VCP | Not Supported | /pc=Z /pt= CHECK | M |
| **Tie / Pass** | **PP** | **PP** | **Not Supported** | P |

## 9.1 The Generic ASCII Format

The ASCII format allows you to input general control points. The format is a Comma Separated File (CSV). Thus the separator between fields can be white space, a tab or a comma. The fields are specified in the following table:

| ***Field 1*** | ***Field 2*** | ***Field 3*** | ***Field 4*** | ***Field 5*** | ***Field 6*** | ***Field 7*** | ***Field 8*** |
|---|---|---|---|---|---|---|---|
| Name | Symbol | X | Y | Z | Sigma X | Sigma Y | Sigma Z |

The name must be a continuous string with no blanks or special characters. The Symbol is defined in the table of the previous section. The coordinates of the X and Y value must be in the same system. GeoCue simply reads in the remaining fields and stores them in the Control Point Entity.

## 9.2 Loading a Control Point File

Under *Setup* ►*Utilities* invoke the Import Control… command. You will be presented with the dialog shown in Figure 9-1. We have included a sample file that is in ASCII format so ensure the ASCII radio button is checked.

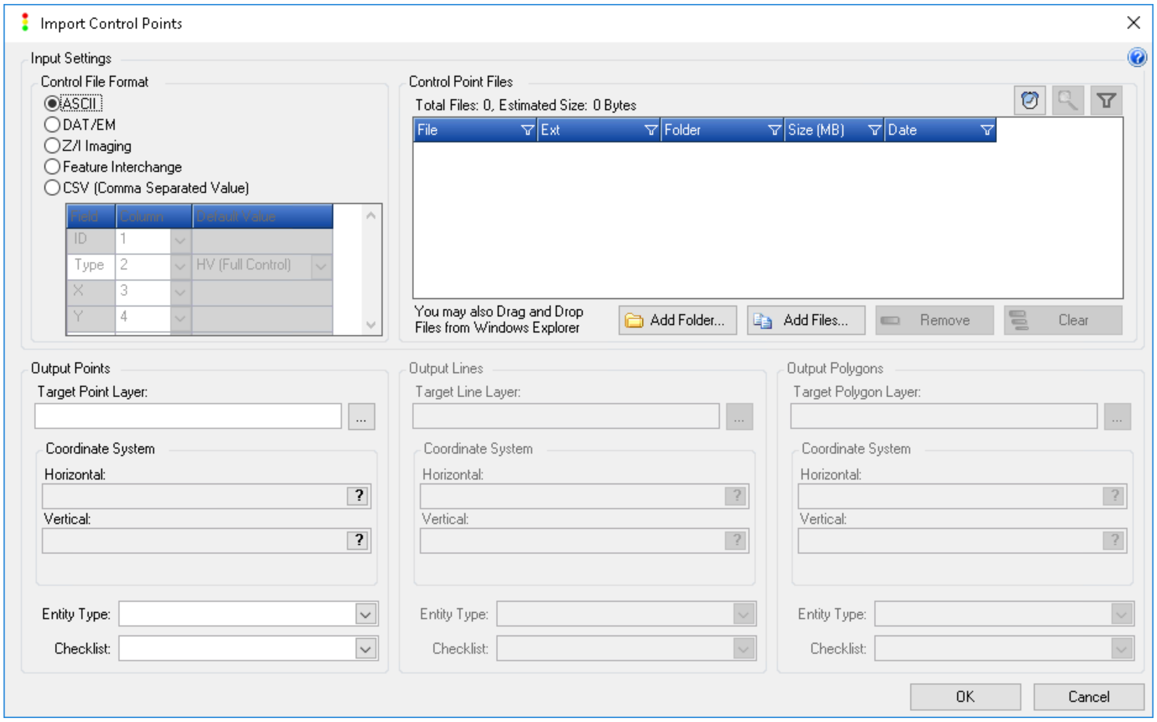



**Figure 9-1 The Import Control dialog**

Control points are placed on layers of type **Photogrammetric_POINT**. This point layer must be in the coordinate system of the control points (recall that all points in a file must be in the same coordinate system). The sample control point file provided is in geocentric WGS84 longitude, latitude. Navigate through the browse button to the right side of Target Point Layer selection, and create a new layer called “Control Points” and ensure that it is in GCS_WGS_1984 coordinates (Horizontal and Vertical). Figure 9-2 depicts the Import Control Points dialog just prior to selecting the file containing the points. Note that the dialog includes drop-down selections for Entity Type and Checklist. You will only have default selections in these drop-downs unless you have extended GeoCue via Environment Builder.

The final step is to browse for the control point file. The sample file is in the Sample data directory in the folder called “Control Points”. The file is named “Madison Test Points.dat” (you will need to ensure that the “Files of Type” filter is set to “all files (*.*)). The completed dialog is shown in Figure 9-3. Press *OK* to initiate the import and dismiss the dialog.

You should now see the control points in the Map View (they will be easier to see if you turn visibility of the LIDAR sources off). Control points are selected just like any other entity in GeoCue. Select one of the control points and examine its properties pane. You will note that the coordinates are stored on the main tab of the properties pane and the sigma values are stored on the Extended Info tab.

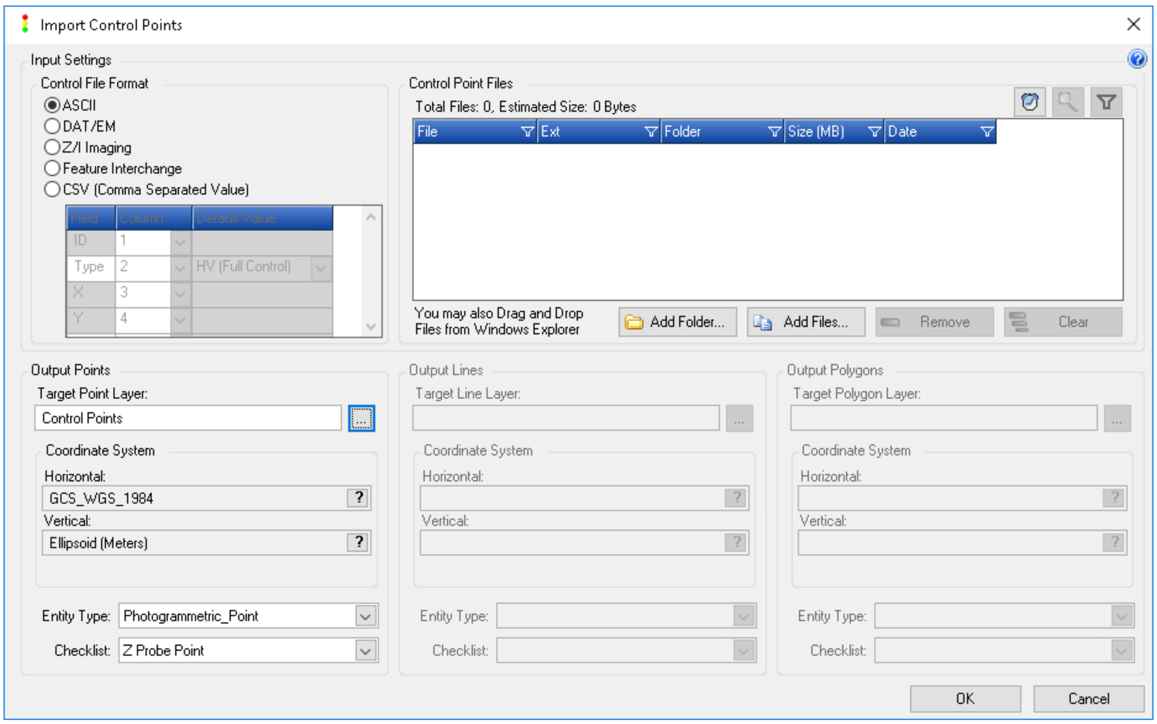



**Figure 9-2 Selecting the WGS84 coordinate system**

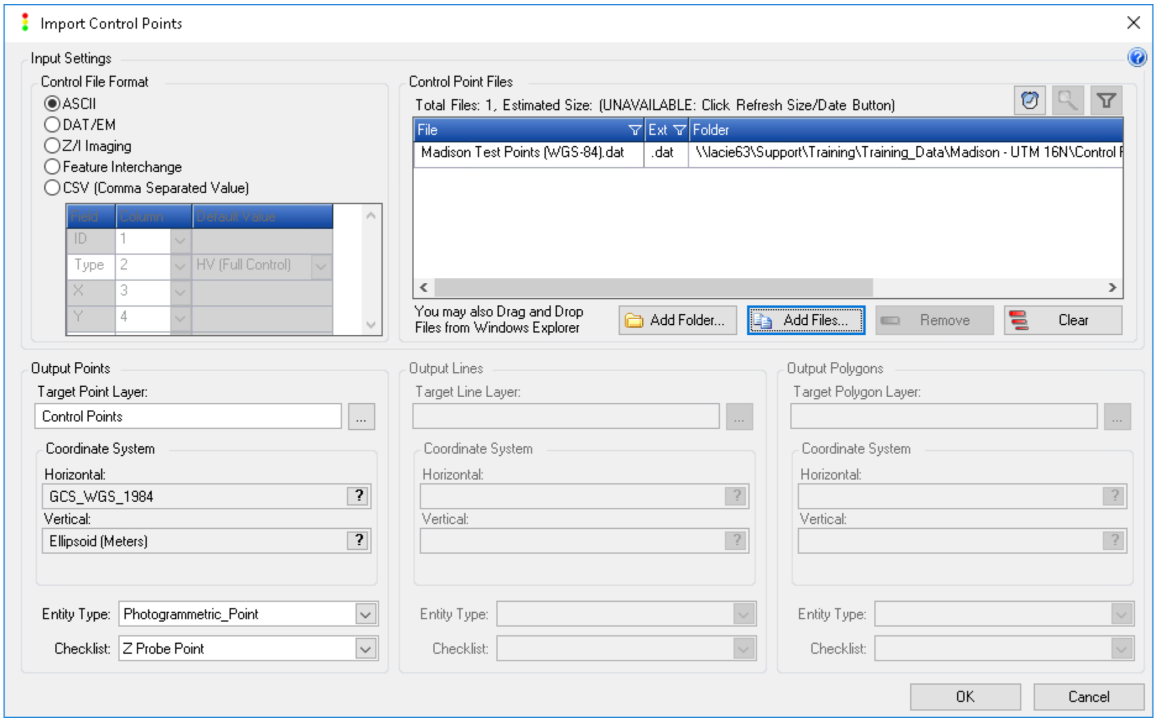



**Figure 9-3 The completed Import Control dialog**

## 9.3 Navigating through Control Points

You can easily visit all of your control points by adding them to either the working set or to a named queue.

Create a named queue called "Control Points" by:

Right-click in the tool bar area of GeoCue and check *Queue 1.* This is depicted in Figure 9-4. Click the 'Queue Manager' button on the Queue 1 toolbar, which in turn will launch the Queue Manager dialog (see Figure 9-5).

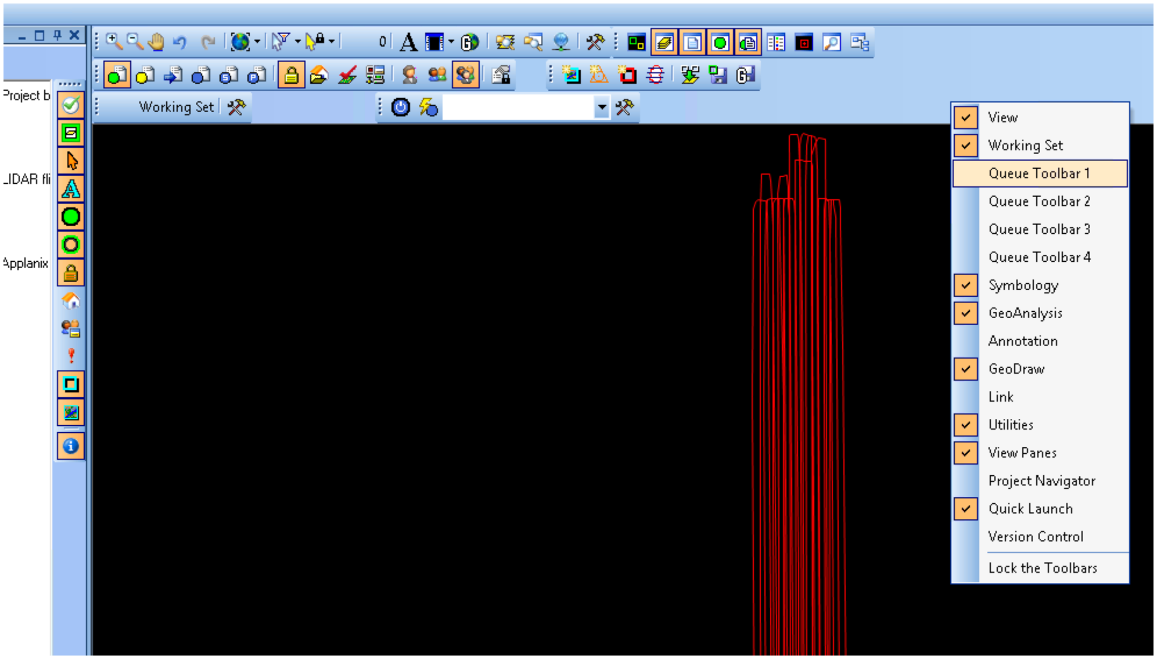
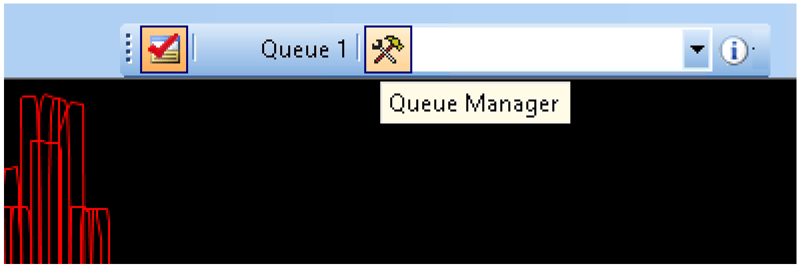



**Figure 9-4 Turning on a Queue**



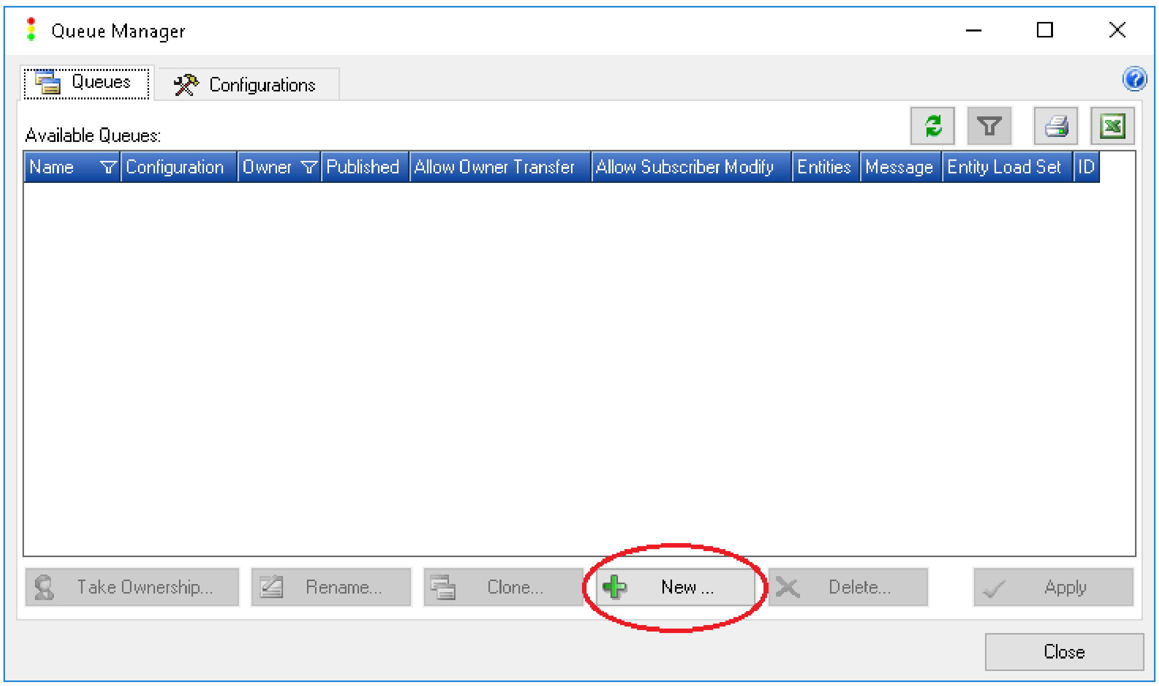




**Figure 9-5 Selecting "New Queue"**

Clicking the ‘New’ button on the Queue Manager dialog will result in the display of the *Create New Queue* dialog (Figure 9-6). Name the queue “Control Points”. If you select the *Publish New Queue* option, the queue named “Control Points” will appear in the queue dropdown list of all users and they will be able to navigate the queue.

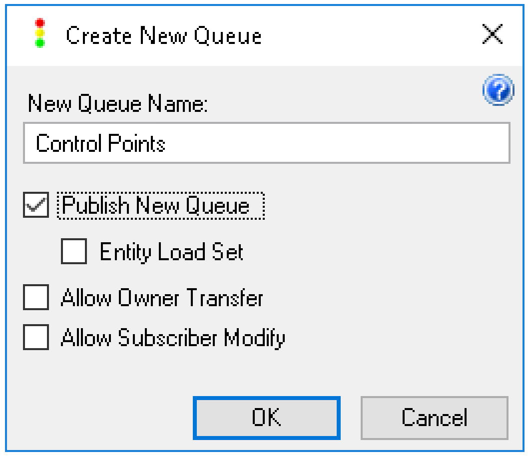



**Figure 9-6  Create New Queue dialog**

Add the control points to the Control Point queue by selecting them and pressing the "+" button on the Control Point queue toolbar (manipulating a named queue is the same as manipulating the Working Set Queue except that you cannot delete[4] items from a named queue). Recall that you can easily select all items on a layer by selecting the layer and then the *Select All Entities* tool on the legend toolbar (or the legend right-click menu).

Set the navigate mode for queues to *Window Center* (recall that this setting is the "?" icon dropdown tool on the *View* toolbar. Now set the display to a zoom level that fits a small part of the view. As you press the forward and back navigation buttons on the Control Points queue, note that the Map View centers on the point. Also notice that the properties pane reflects the metadata of the *current* queue member.

We will visit the control points again in the raster chapter to indicate the automatic changing of coordinate system feature of GeoCue.

[4] Remember that removing items from a queue (an operation you can perform on any queue that you own) is markedly different from deleting items referenced by a queue.

## 9.4 Control Point Summary

Unlike *reference files,* control points are imported into GeoCue. This means that GeoCue is taking a snapshot of the file rather than remaining attached. Thus if you modify a control point file after importing into GeoCue, the changes will not be reflected unless you import the file again. You should be aware that we have not tried to add logic to GeoCue to prevent duplicate control points (although we can if you feel this is important). Therefore we suggest having a one-to-one relationship between control point files and layers if you will be updating the values. Updating then is simply a matter of selecting all entities on the layer to be updated, adding them to the Working Set, deleting them and then re-importing the file to the same layer. If you are not concerned with updating, then you can import all files that have control points in the same projection/datum to a single layer.

Note that you can have multiple control point layers and those layers can be any mix of projections/datums. GeoCue reprojects all of the layers to the Map View coordinate system on-the-fly. You can ascertain the current Map View coordinate system by hovering the mouse pointer over the coordinate readout area at the bottom of the GeoCue frame.

NOTE – The Currently displayed coordinates in the coordinate readout are not necessarily in the coordinate system that you established for the project. The coordinate readout is always in the coordinate system of the currently displayed raster(s). This is discussed in more detail in the raster chapter of this document.

NOTE – We have just started on the inclusion of Control Points (and other point graphic capabilities) in GeoCue. You can expect to see rapid development of new features in this area to include:

- Interactive placement
- Changing symbology and attributes of points
- Inclusion of sigma symbology that scales with sigma
- Other features as we hear from you.

# 10 Reference Rasters

In this section we will add some reference raster to the project and examine clipping rasters to the size needed for a proper display.

"Reference" data in GeoCue is treated differently from project created data in two major ways:

- Reference data is never Write locked since the assumption is that a reference source should not be modified. This means that multiple projects can safely reference these data simultaneously.
- The data referenced by a Reference type entity is never deleted when the referring entity or containing project is deleted.

A number of reference rasters have been included in the Madison data set. These reference rasters are described in the following table.

| ***Directory (relative to top level data)*** | ***File name(s) – Excluding overview and tiff world files*** | ***Description*** |
|---|---|---|
| DRG - NAD27-UTM-N16 | Madison County Composite.tif | A composite of 12 USGS DRGs of the Madison County project area in NAD27 – UTM Zone 16N |
| DRG - NAD83-UTM-N16-Uncropped | NAD83-Greenbrier-Uncropped.TIF<br><br>NAD83-Madison-Uncropped.TIF | Two Individual USGS DRGs of the SE Madison County project area in NAD83, UTM Zone 16N with collars intact. These were created by reprojecting NAD27 DRGs |

| ***Directory (relative to top level data)*** | ***File name(s) – Excluding overview and tiff world files*** | ***Description*** |
|---|---|---|
| DRG - NAD83-UTM-N16 | Madison County Composite.tif | A composite of 12 USGS DRGs of the Madison County project area in NAD83 – UTM Zone 16N |
| DRG - NAD83-UTM-N16 | Ardmore.tif<br>Capshaw.tif<br>Farley.tif<br>Fisk.tif<br>Greenbrier.tif<br>Huntsville.tif<br>Jeff.tif<br>Madison.tif<br>Mason.tif<br>Meridianville.tif<br>Toney.tif<br>Triana.tif | Individual USGS DRGs of the Madison County project area in NAD83, UTM Zone 16N with collars removed.  These were created by removing the collars and reprojecting NAD27 DRGs |
| NaturalVue[5] | NaturalVue_NEAL.tif and a collection of overview and TIFF World files. | A clip of NaturalVue imagery that covers the project area (North-East Alabama).  This image is in NAD83, UTM, Zone 16N |

[5] *NaturalVue* is a trademark of Earth Satellite Corporation.  This image was provided for evaluation purposes by Earth Satellite Corporation.

## 10.1 Raster that requires cropping

You will sometimes want to crop a raster either to remove marginalia or simply to limit the extent of a large raster to the area of interest. In this section we will attach two USGS Digitized Raster Graphics (DRG) files that require cropping (removal of the marginalia 'collar') to the project.

NOTE – Many commands for adding and removing project information are accessed through the *Legend.* There are two ways to access these commands; via the legend right-click menu or by creating a legend toolbar. To create a legend toolbar, perform the following steps:

- ***Right-click*** anywhere in the *Legend* (the pane where the layer information is displayed)
- Grab the right-click menu and drag it to the map view (grab it by the dots that appear at the top of the menu)
- The menu will now convert to a tool bar. You can dock the toolbar in the Legend pane.
- To remove the toolbar, just click the "x" in the upper right corner.

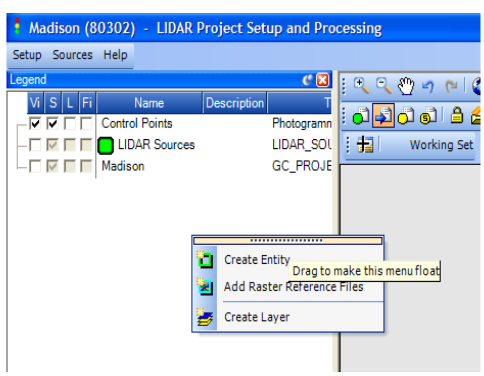



**Figure 10-1 Grabbing the Right-click menu**

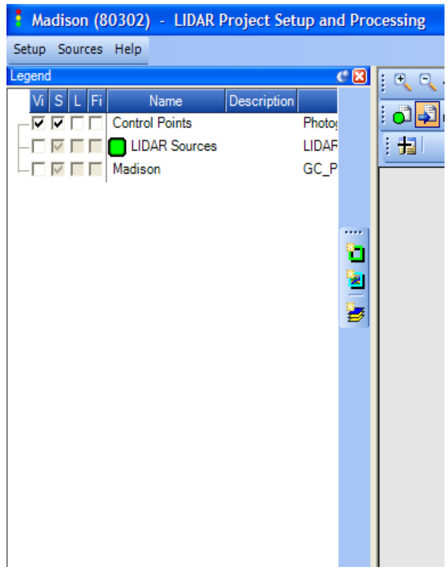



**Figure 10-2 Toolbar docked on right side of legend pane**

### 10.1.1 Loading the Raster

Select the *Import Raster* command by either right-clicking in the Layer Legend or by selecting the toolbar button from the legend toolbar (see the inset box above for instructions on creating the legend toolbar). You will be presented with the dialog of Figure 10-3.

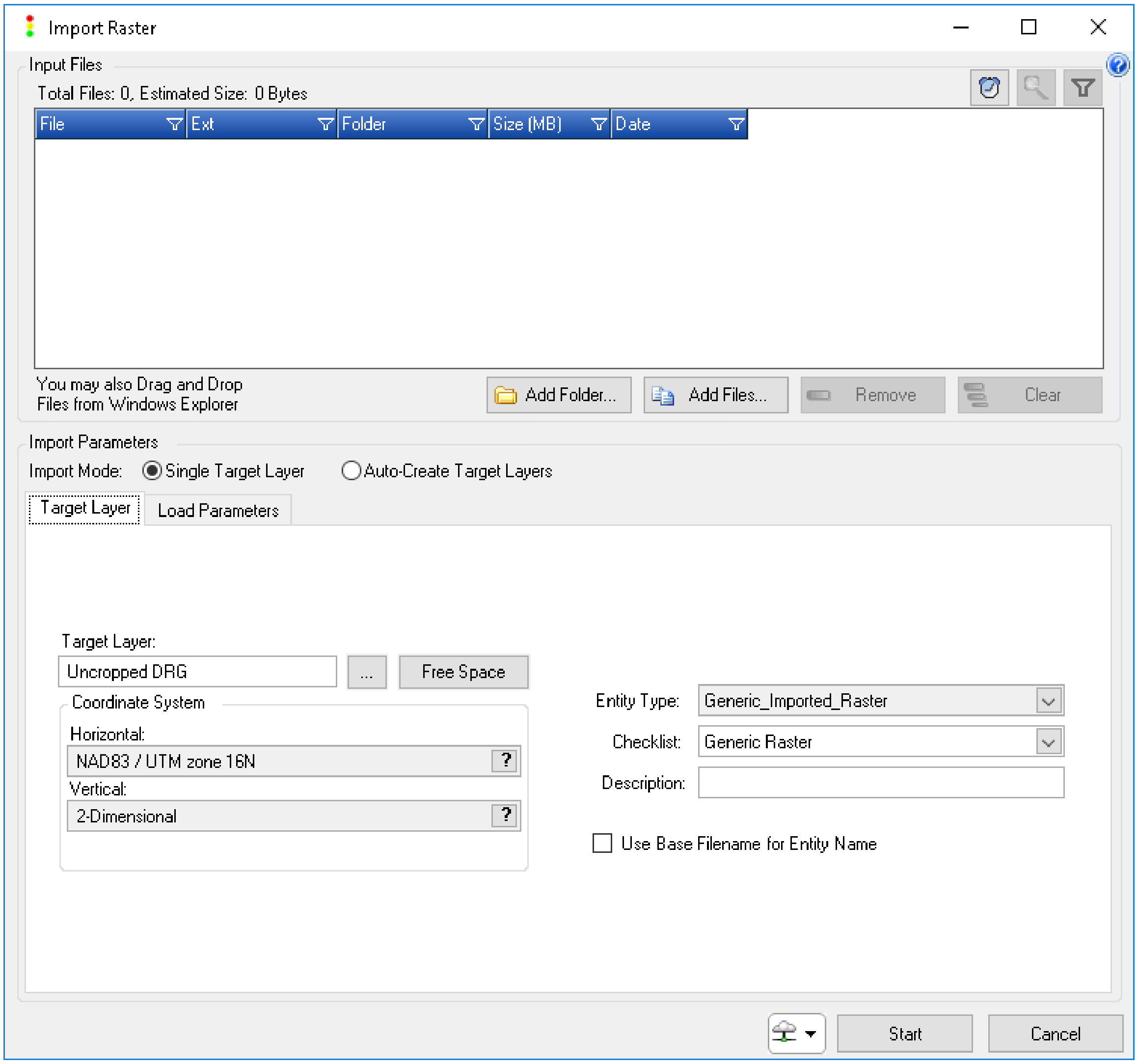



**Figure 10-3 Add Raster Reference Files dialog**

First choose the ***Add …*** button from the dialog. Browse to the directory where you have placed the GeoCue 1.2 Sample Data and select the directory containing the NAD 83 DRG data with collars (this directory was named “DRG - NAD83-UTM-N16-Uncropped” on the Sample DVD). Select both files in the directory (Madison… and Greenbrier…).

NOTE – Previous versions of GeoCue required that you create external overviews to enhance display performance. This is no longer necessary in that GeoCue now produces these automatically.

Next select a layer on which to place the raster. Since we have not yet created a layer, you will need to browse to the ***Create Layer…*** dialog via the ***Select…*** button. A Raster Reference must be placed on a layer of type **Generic_RASTER** and thus the layer selection of the dialog is blank. Create a layer of type **Generic_RASTER** by navigating through the *Select…* button on the dialog. This reference layer must have a coordinate system of NAD_1983_UTM_Zone_16N Name the layer "Uncropped DRG".

NOTE – Rasters are two dimensional entities and hence the Vertical system in not material. You can set this to *unspecified* if you desire.

Note that the Import Raster dialog includes drop-down selectors for the Entity Type and Checklist. This is available for users who extend GeoCue via Environment Builder. If your installation of GeoCue has not been extended, you will not be able to select in these fields.

You can optionally add a description for the raster data. Note that if you are importing more than one entity, the same description will be applied to all.

The Raster File Settings section of the dialog allows you to set various options for the method that will be employed in importing the raster as well as provides an option for loading only footprints (you can load the associated rasters at a later time via the checklist that will be attached to the imported footprints.

Select the radio button labeled *Load Footprints and Raster Files*, under the 'Load Parameters' pane. This will cause a complete load to occur after you press the **Start** button. Your dialog should appear as Figure 10-4 at this point.

Next select the Raster Files tab of the Load Raster Parameters (under the 'Load Parameters' pane) section of the dialog. This will display the options depicted in Figure 10-5. The available options and their affects are listed in Table 10-1.

**Table 10-1 Raster Files options**

| ***Option*** | ***Action*** |
|---|---|
| Reference External Files | Causes GeoCue to reference the raster files at their current location. Use this options if the files are in an optimal display format and you will not need to disconnect the source drive or recover the space. |
| Copy Files to Warehouse | This option copies the raster files to the GeoCue Warehouse associated with the selected layer. The files are left in their original format. This option should be used when you need to recover (or disconnect the source drive) the source space. |
| Copy Files to Warehouse and Convert to TIFF | This option copies the raster files to the GeoCue Warehouse associated with the raster layer and creates an optimal format for performance within GeoCue. Choose this option whenever possible since it will provide the best response.<br><br>Choose the Create Internal Overviews sub-option if the imported rasters will be used within a tool that uses internal overviews. |
| Include Metadata File (XML) | This option will cause GeoCue to attach a file (located in the same directory as the images) having the base name of the image but an extension of XML to the Raster Entity created during import. This option allows you to associated an auxiliary file such as a Federal Geographic Data Committee (FGDC) metadata file with the image. You can ignore this option if you do not understand this statement! |

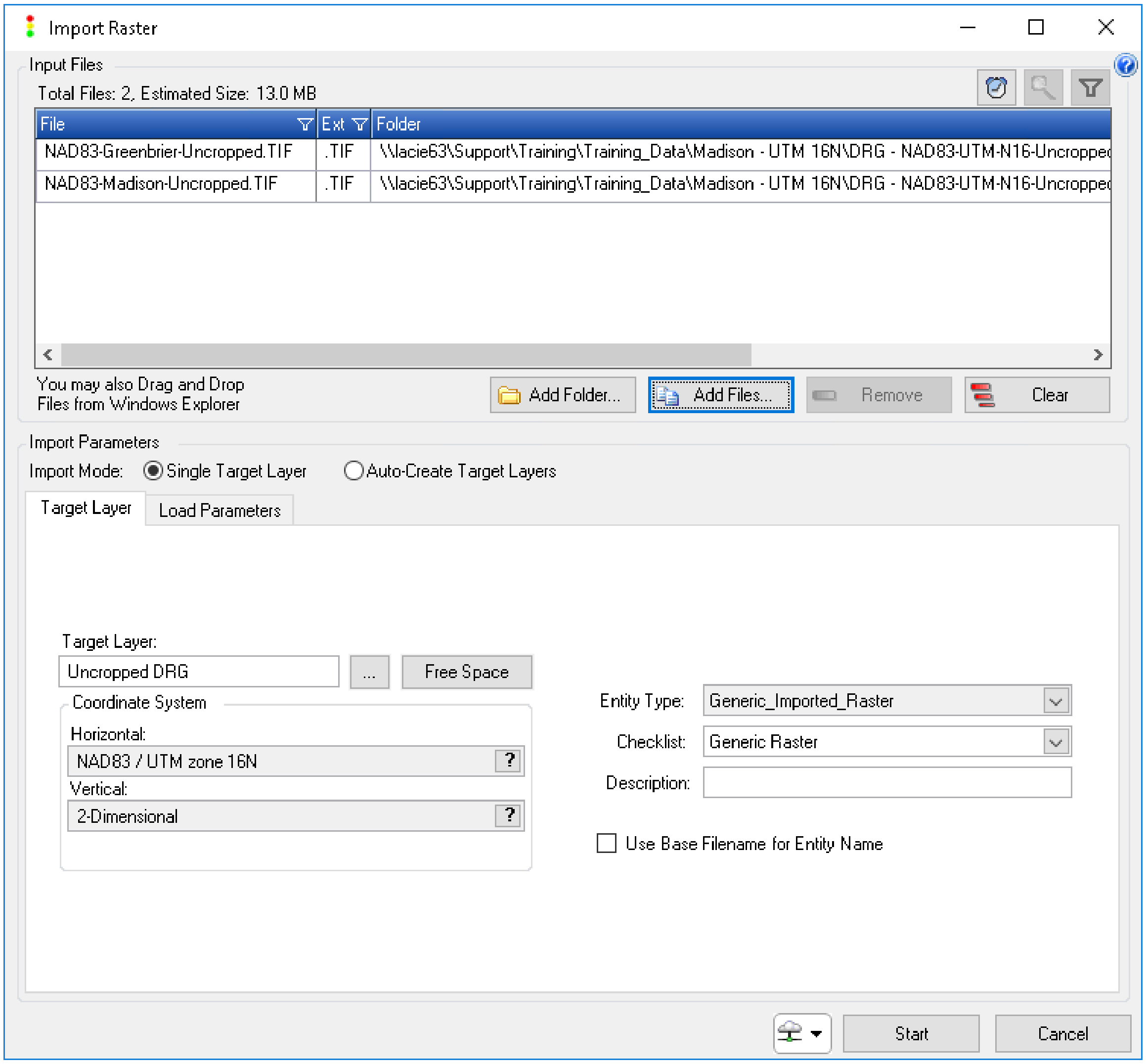



**Figure 10-4 Import Raster prior to setting raster options**

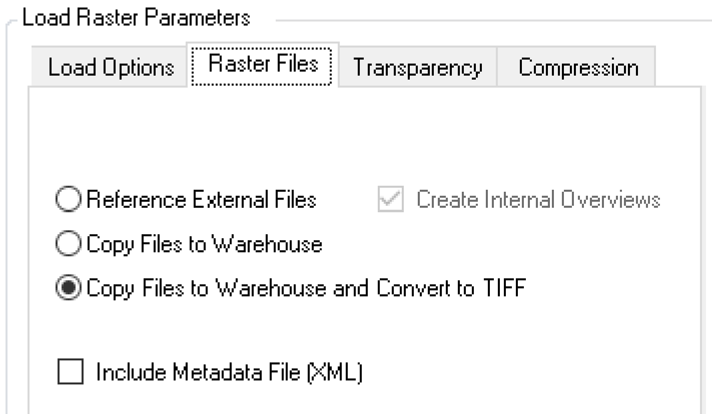



**Figure 10-5 Raster Files tab**

The ***Transparency*** tab allows you to set an RGB value that will be treated as transparent for all images in the import. This is very useful for images such as orthos where a particular color value (usually zero) has been used to mark invalid image areas.

The ***Compression*** tab allows you to apply JPEG compression to images that are being imported and converted. This tab is disabled for all other import choices.

For this example, chose the options depicted in Figure 10-5 and press the ***Start*** button. The raster import will begin. You should see two new footprints in your map view. These footprints represent the outline of the DRGs.

Notice that the layer name in the layer legend[6] has a "+" sign to the left (see Figure 10-6). Click the "+" on the main layer and sub-layers (as they expand) to fully expand the legend entry. Your legend should resemble Figure 10-7 after you have it expanded.

[6] Notice that we have set up our legend with the legend toolbar docked at the right.

The topmost entry of the Raster layer controls the **V**isibility, **S**electability and **L**abels for all sub-layers. Thus these function the same as any layer in GeoCue. We refer to this as the ***Primary*** layer.

Immediately under the topmost layer are two intermediate entries; one for footprints of the rasters and the other for the raster displays themselves. We refer to this as the ***Intermediate*** layer. This intermediate layer provides separate control over the display of the raster footprints and the actual raster data. Notice that if you toggle the **V**isibility option on the footprint layer that the footprints turn off and on. Toggling the **V**isibility option on the Raster entry turns on/off *all* raster entities that have their visibility toggle checked. By default, the Footprint **V**isibility toggle is on and the Raster **V**isibility is off when a new raster layer is created and when a project is first loaded. We default to this combination to improve load performance.

The final sub-layer provides individual control of the display of each raster file that you have associated with the top-most layer. This collection is referred to as the ***Raster Entities***. By default, the rasters are switched on at this level but off at the Intermediate level when a Raster Layer is first added to a project and each time the project is opened. This improves the load performance while allowing you to turn on the entire raster display by manipulating the single toggle at the Intermediate level. Note that the entities at this level of a composite raster layer behave similar to Entities rather than layers. You will note that if you select a raster entity at this level, the ***Delete Layer*** tool disappears from the legend toolbar. To delete at this level, add the entity(ies) to the Working Set and delete using the Working Set delete tool.

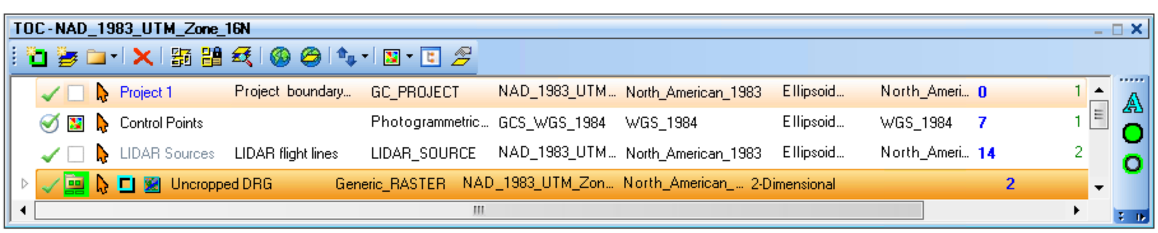



**Figure 10-6 Legend after adding Raster Layer**

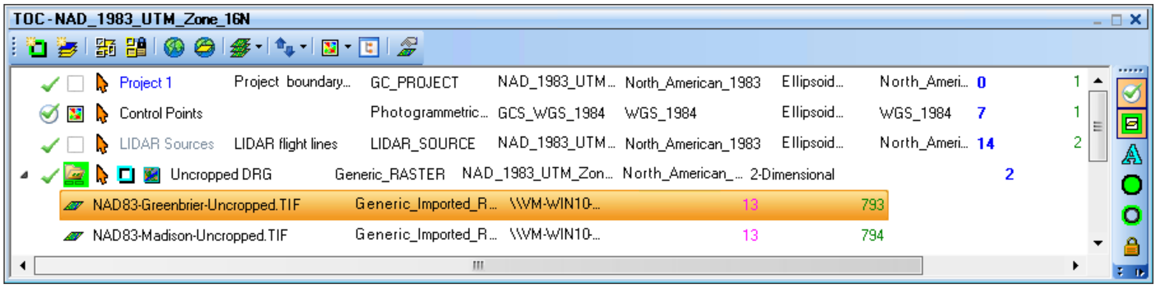



**Figure 10-7 Legend with Raster layer fully expanded**

## 10.1.2 Manipulating Rasters

Raster Entities are *Selected* by selecting the footprint of the entity or by selecting the raster entity in the legend (the lowest tier of a raster Composite layer) and choosing the Select Entities tool from the legend toolbar. Thus you must have the **S**electability option toggled at the topmost layer of the raster collection (the *primary* layer) and the Footprints set to **V**isible on the intermediate layer.

You can delete a raster by adding it to the Working Set Queue (Working Set or WSQ) and selecting the delete button on the WSQ toolbar.

CAUTION – Pressing the delete icon on the Working Set Queue toolbar deletes ALL items in the Working Set Queue, not just the current item. You cannot undo a WSQ delete operation!!

Deleting a Reference type entity in GeoCue deletes the entity from the GeoCue database but it does not delete the file that is referenced by the entity. Thus if you delete a raster entity from a layer (or delete all of the rasters by simply deleting the layer) the reference is removed from the project but the file that you mapped through the reference is left intact. This is the fundamental difference between *Project* and *Reference* entities.

### 10.1.3 Setting a Clipping Region

If you zoom in on a region between the two raster files that you have just added to the project, you will notice a lack of continuity due to the inclusion of marginalia in the data (see Figure 10-8). GeoCue provides a mechanism to indicate a rectangular area within a raster for display.

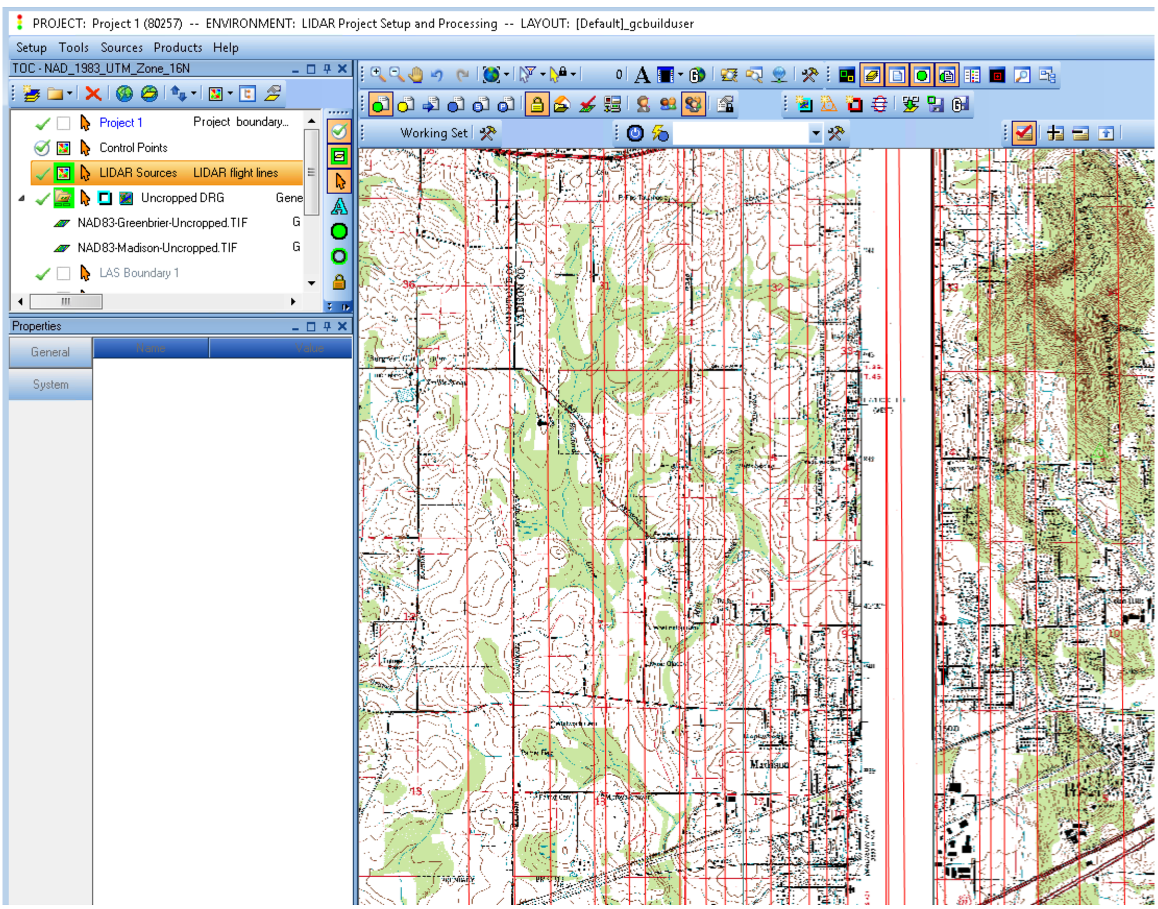



**Figure 10-8 Break in raster due to marginalia**

Turn off the display of all entities except the left raster ("Greenbrier"). Fit the left raster to the display (you can do this by selecting the left raster and click *Fit Selected Entities* on the view toolbar.

Select the left raster in the Legend and click *Raster Properties* in the Legend toolbar (or right-click the raster entry in the legend and select *Raster Properties* from the right-click menu). You will see the dialog of Figure 10-9. Note that you can change the Name of the raster as well as the description. Recall that the name of an entity is the value that is displayed for the entity when you enable **L**abels in the legend. The Layer and Coordinate System are displayed for reference – these values cannot be changed.

HINT – You can quickly locate the corresponding entry in the legend for a raster by selecting the raster in the map view (remember, you have to select a raster by selecting its footprint) and then right-clicking. One of the right-click menu options will be *Select in Legend*. Left-click this option and the corresponding entry in the Legend will be selected (you may need to scroll the legend or expand the corresponding raster entry to see the legend entry).

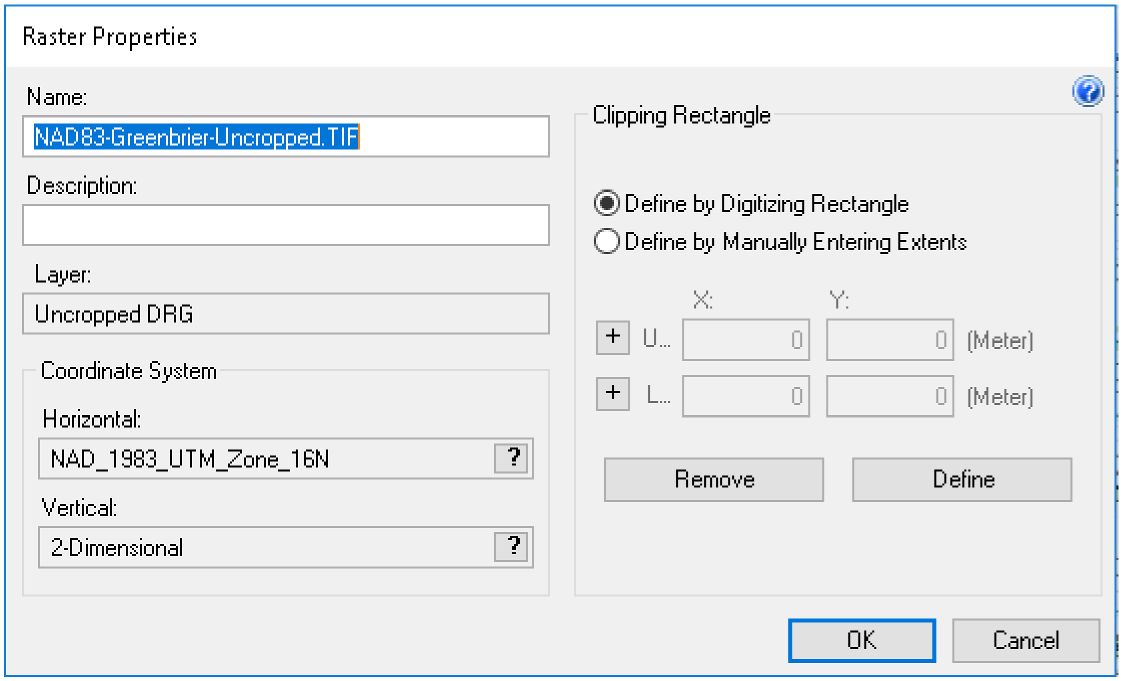



**Figure 10-9 Raster Properties dialog**

There are two methods of defining a clipping rectangle for the raster. The first method is to 'drag' a rectangle over the raster. Make sure the radio button is selected for *Define by Digitizing Rectangle* and press the *Define* button. Drag a rectangle over the raster by pressing and holding the left mouse button over the point of origin of your rectangle then, while continuing to hold down the left mouse button, drag the cursor to the point of termination of your rectangle. When you release the left mouse button, the rectangle (and hence clipping region) will be defined. You should see the raster clip to your newly defined rectangle.

For a large raster such as the DRG on which we are working, dragging a rectangle over the entire raster does not provide sufficient accuracy. If you magnify the display then you cannot drag the rectangle to the opposite corner. For these situations we have provided a precision point selection.

Zoom in on the upper right corner such that you can easily discern the corner edge of marginalia. Set the radio button selection in the **Raster Properties** dialog to *Define by Manually Entering Extents*. This option allows you to key-in the coordinates of the clipping region. We are adding to most dialogs in GeoCue that permit key-ins of values a digitize point selector facility. This is indicated by the presence of a "+" button next to the key-in field (see Figure 10-10). When this button is present, you can press the button and then digitize the value by moving the cursor to the location of the desired point and clicking the left mouse button.

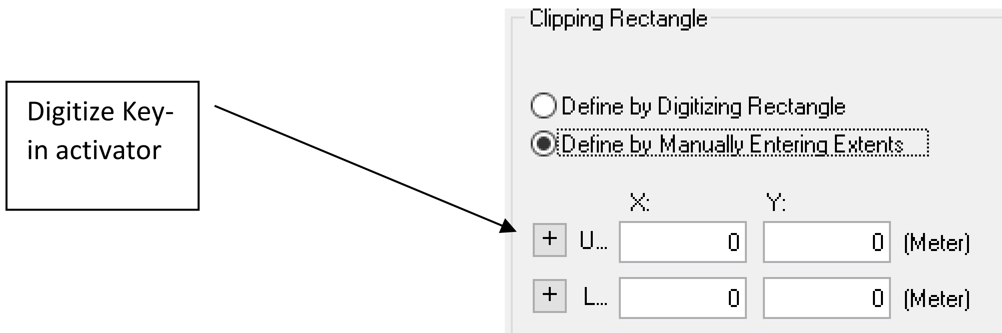



**Figure 10-10 Digitize Key-in indicator**

Try this feature now by digitizing the upper left corner of the raster, using view commands to zoom in on the lower right corner and digitize that corner. When you entered the two sets of coordinates, press the *Define* button to create the clipping boundary.

If you are not satisfied with the clipping boundary that you create, press *Remove* to restore the original boundary and perform the operation again.

When you have completed this for both rasters, you should be able to reduce the boundary discontinuity to a minimum (the quality of the join is, of course, a function of the quality of the geocoding of the original rasters).

## *10.2 Deleting Reference Rasters*

Delete individual rasters the same as you would any other GeoCue entity. Select the raster (recall that you select rasters by selecting their footprints) and add the entity to the Working Set

Queue. Select the delete icon from the Working Set Queue toolbar and click *Yes* in response to the confirmation dialog.

You can also delete the top-level raster layer by selecting the layer and then choosing the *Delete Selected Layer* command from either the legend toolbar or from the legend right-click menu.

## 10.3 Mixed Projection Rasters

While GeoCue supports the mixing of any combination of projections and datums in the same project, there is a restriction that all data entities on the same layer must be in the same projection/datum. Recall that the Primary Layer of a raster composite is considered the layer. Therefore, all rasters within a raster composite must be in the same projection/datum.

GeoCue reprojects vector data on-the-fly. Therefore, any combination of multiple layers of vector data will properly display, regardless of the projection/datum of the individual layers.

GeoCue does ***not*** reproject raster data. Therefore, the Map Display automatically turns off the display of raster layers that are in a horizontal project that is different from the Active Map Coordinate System. You will see a red “X” icon on raster layers that are not currently being displayed. Hover the mouse over the icon to view a message on the reason for the non-display.

## 10.4 Experimenting with a Mixed Raster Project

In this section we will load up a composite DRG in two different coordinate systems and observe the behavior.

Remove the raster layers that you have added to the project in this section by selecting the primary layer (recall that this is the top level of a multi-tier raster layer) and press the *Delete Layer* tool on the legend toolbar (or right-click the layer you wish to delete and select *Delete Layer* from the right-click menu).

Add the NAD 27 DRG to the project by choosing the *Add Raster Reference Layer* from the legend toolbar. You will need to create a layer in the appropriate coordinate system. Browse to the NAD 27 DRG folder in your Sample Data direction and load the file called “Madison County Composite.tif” (it should be the only .tif file in the folder). Remember that raster files are loaded in the “Off” state by default to improve load performance.

Repeat the steps above but this time create a raster reference layer in NAD 83, UTM Zone 16N. Browse to the NAD 83 DRG folder of sample data and load the file called Madison Country Composite.tif (there are also individual DRGs in this folder). At this point you should have two new raster reference layers, one in NAD27 and the other in NAD83.

Delete any control point layers that you might have added in the previous sections and import the control point file called Huntsville Airport.txt from the Control Point directory of the sample data. This file is in WGS84 Geographic and thus must be imported to a Layer of type Photogrammetric_POINT in WGS84 coordinates. Name this new layer HSV Airport Control.

Create a named queue called “Control” and add the points that you just imported (there should be 4 members in the set). Set the queue navigation mode to Window Center. If the HSV Airport Control is not above the two DRG layers, move it above these raster layers by selecting it in the legend and pressing the “Up” tool in the legend toolbar.

Now navigate to the first control point in the Control queue by pressing the “Start of Queue” button on the named queue toolbar. Expand both DRG layers in the legend such that you have access to the raster control on the Intermediate Layer. Turn on the NAD 83 DRG rasters (depicted in Figure 16-10). Zoom the display to a suitable viewing magnification. You should see a control point superimposed over the end of a runway symbol (if the symbol is difficult to see, you can enlarge it via the *Layer Properties*, accessed by selecting the layer and then pressing the *Layer Properties* tool).

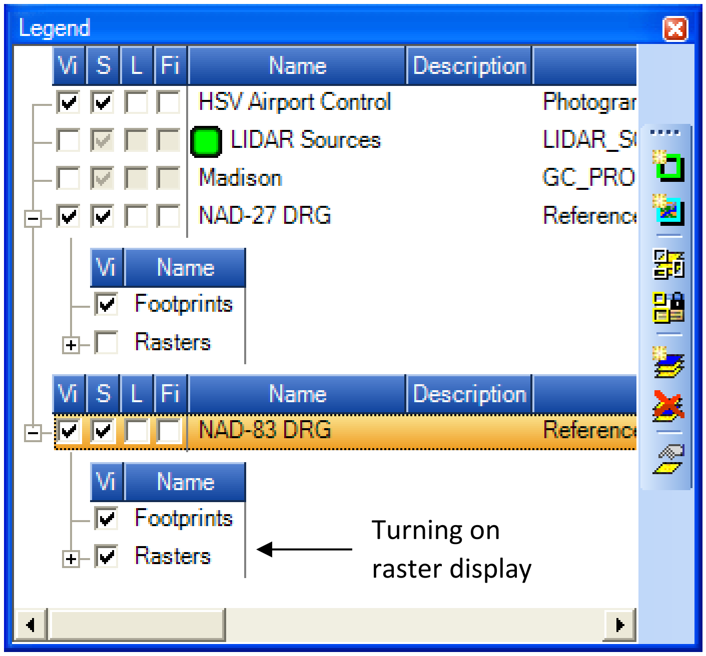



**Figure 10-11 Manipulating the Legend**

Now turn on the raster layer on the Intermediate layer of the NAD 27 DRG and set the current Map Coordinate System to this layer by pressing the Set Active Map Coordinate System tool on the legend toolbar. Note that the NAD83 DRG raster layer has been automatically turned off. The control point is still superimposed in the correct location.

Thus you can see that as long as you place entities on layers in the correct coordinate system GeoCue automatically manages the correct superimpositions.

NOTE – As you navigate through the 4 Huntsville Airport control points, you may notice that one of the points does not appear over the end of a runway. This is because one of the runways has been extended since the DRGs were last updated. We will see this when w Raster on ›rthos made from the LIDAR data.

# 11 General Notes about Rasters and GeoCue

The GeoCue Client Map View is based on the ESRI MapObjects software development kit (GeoCue Server is not). There are several restrictions in the most recent release of MapObjects (Version 2.4) that relate to the processing of raster data. Some of these restrictions we accept in GeoCue client and others we have worked around. It is important that you understand the management of raster data in GeoCue so that you can plan projects accordingly and appreciate some of the display behaviors of the system.

## *11.1 GeoCue does not Support Raster Reprojection*

While GeoCue fully supports on-the-fly coordinate system reprojection for point, line and polygon (in general, vector) data, it does not support the transform of coordinate systems for raster data.

We handle this limitation by automatically turning off raster layers whose horizontal coordinate system does not match the *Active Map Coordinate System*

It is important to note that vectors whose **V**isibility toggle is set will *always* display and will be automatically projected to the coordinate system of the Map Display.

## *11.2 Tiled TIFF, External Overviews*

The optimal raster format for rapid display in GeoCue is tiled TIFF (Tagged Image File Format) with external image pyramids (also called overviews, reduced resolutions data sets, resolution layers or R Sets).

For internally generated raster data such as the LIDAR Orthos generated in LIDAR 1 CuePac, we automatically create these overviews.

For reference rasters, you can generate the overviews during import by selecting the Import Files to Warehouse (Convert to TIFF) option. This option will optimize raster files by converting them to TIFF and generating external overviews.

GeoCue supports either GoeTIFF packets in the raster file (in which case a TIFF World File, tfw) is not required or external TIFF World Files. Make sure that the tfw is appropriately scaled for each reduction in resolution (multiply the scale values by a factor of two for each factor of two reduction in scale).

When you add an external reference raster to GeoCue, we examine the directory to see if overviews are present. If so, they are mapped into the *files* collection of the raster entity. Thus you can tell if overviews are in use by examining the *files* collection.

Note that you can freely mix and match reference rasters on the same layer with the only restriction being that the layer must be in the exact coordinate system of the rasters and that all rasters that are to reside on the same layer must be in the same coordinate system.

WARNING – GeoCue is not intended to be a precision mapping system. You should never use coordinates derived from GeoCue for precision purposes.

WARNING – Our experience shows that USGS Digitized Paper Quad sheets are fairly inaccurate. The primary cause of this inaccuracy is rotation of the raster with respect to the grid. You can expect to see seams between DRGs as a result of this.

We strongly recommend against using scanned quad sheets for deriving coordinates!!!

## 11.3 Collections of Raster vs. Single Rasters

As you saw in the previous sections, GeoCue can manage multiple raster entities on a single composite layer. In addition, GeoCue provides separated control over footprints and the actual rasters. One of our primary design considerations in treating rasters in this manner was to allow them to participate in computational geometry operations. This means that you can, for example, select a raster and compute its intersection with a LIDAR strip.

Because of the granularity that we provide, the decision of using a single raster that comprises a mosaic of rasters or the individual rasters becomes one of operational efficiency.

We have tried to summarize the considerations in the table below (we are considering how you build up a single collection):

| ***Collection Type*** | ***Tiled?*** | ***Overviews?*** | ***Pros*** | ***Cons*** |
|---|---|---|---|---|
| Separate Rasters | Y | Y | Can individually turn off and on subsections | Slower display than a single tiled image with overviews |
| | N | Y | “ | Slow panning |
| | N | N | “ | Slow Zooming, Slow Panning |

| ***Collection Type*** | ***Tiled?*** | ***Overviews?*** | ***Pros*** | ***Cons*** |
|---|---|---|---|---|
| Single Composite | Y | Y | Fastest display | Cannot control turning off and on individual sections<br><br>Cannot build hybrid images (different types and resolutions on the same composite layer |
| | N | Y | | Slow panning |
| | N | N | | Slowest configuration. Use only with sparse files such as DRG |

You can see from the table above that a single composite with tiled overviews provides the fastest display (and it is typically even faster if the imagery is compressed). This is the best choice if you are simply using the imagery for a backdrop (such as DRG or low resolution satellite imagery).

NOTE – We highly recommend Global Mapper (www.globalmapper.com) as a general purpose tool for preparing imagery for use in GeoCue. This tool is less than USD 400 and can perform most of the operations you will want for raster preparation including:

- Reprojection
- Cutting out Regions of Interest
- Cropping the collars from DRGs
- Many other related operations

# 12 LIDAR[7] Orthos

The ability to generate and display "LIDAR Orthos" is a powerful capability in LIDAR 1 CuePac. Using this feature, you can generate a wide variety of images based on LIDAR source data. We will first generate a synoptic coverage data set and then discuss some of the other uses of this feature. The steps used in creating the LIDAR orthos are the same – it is a change in the image generation parameters that produces data useable for different purposes.

## *12.1 Synoptic Coverage*

You can generate a set of LIDAR ortho coverage images immediately after populating working segments. The steps are:

- Create LIDAR Ortho Entities
- Define the ortho image parameters
- Generate the orthos

### 12.1.1 Creating the Ortho Entities

Ortho Entities can be created at any time; however, they cannot be *generated* until the LAS working segments have been populated. Thus you can proceed with the LIDAR Ortho definitions while the population of working segments is in-progress.

The first step is to create a layer on which to place the LIDAR Orthos. Create a new layer with the parameters set as they appear in Figure 12-1. It is useful to include generation information on the layer name or description if you intend to generate a variety of image layers. Note that

[7] While we describe LIDAR Orthos in this section, you can, in fact, use the LIDAR Ortho facility to generate orthos from any elevation source that can be converted to LAS format.

you can always change this later through the **Layer Properties** dialog. Note that the layer *must* be in the same coordinate system as the LIDAR point data (NAD_1983_UTM_Zone_16N for our sample project).

NOTE - LIDAR Derived Raster Coordinate Systems:

LIDAR Ortho Layers *must* be in the same Horizontal Coordinate system as the Working Segment layer from which the raster will be generated. The Vertical coordinate system should be set to *Vertical* coordinate system of the LAS_WORKING layer from which the ortho will be generated.

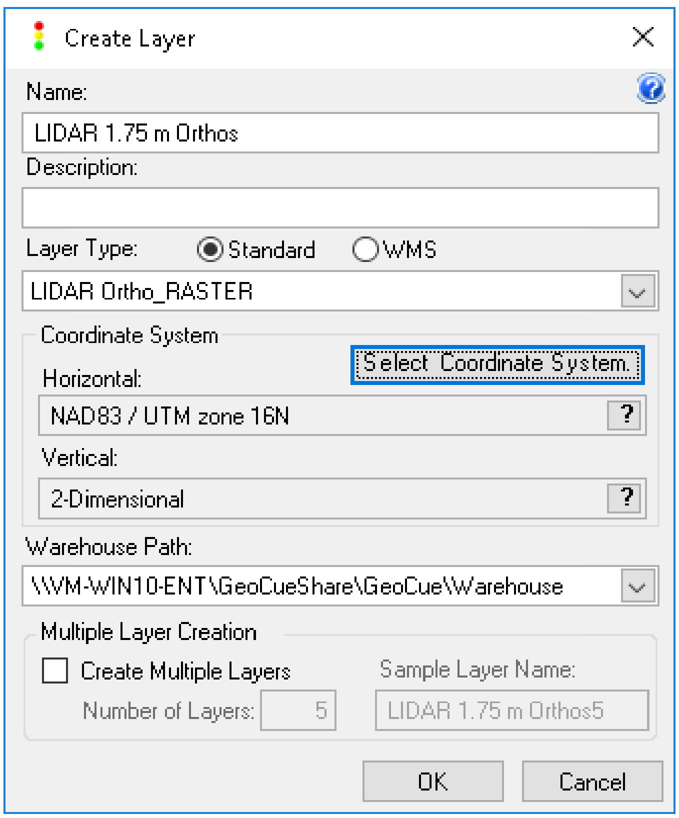



**Figure 12-1 LIDAR Ortho Layer**

Select the newly created layer and then invoke the *Create New Entity* command from either the Layer right-click menu or the Legend toolbar. Populate this dialog as depicted in Figure 12-2.

Note that we have placed a "-"after the entity name because the command we are about to use will create a collection of entities. These entities will automatically be named by appending an incrementing integer to the specified *Entity Name.* Note that the selected placement method is *Place Grid of Entities.* The Entity type and checklist defaulted to the correct values based on the layer selection at the time you invoked the *Create New Entity* command. Verify that your settings for these valued agree with those of Figure 12-2.

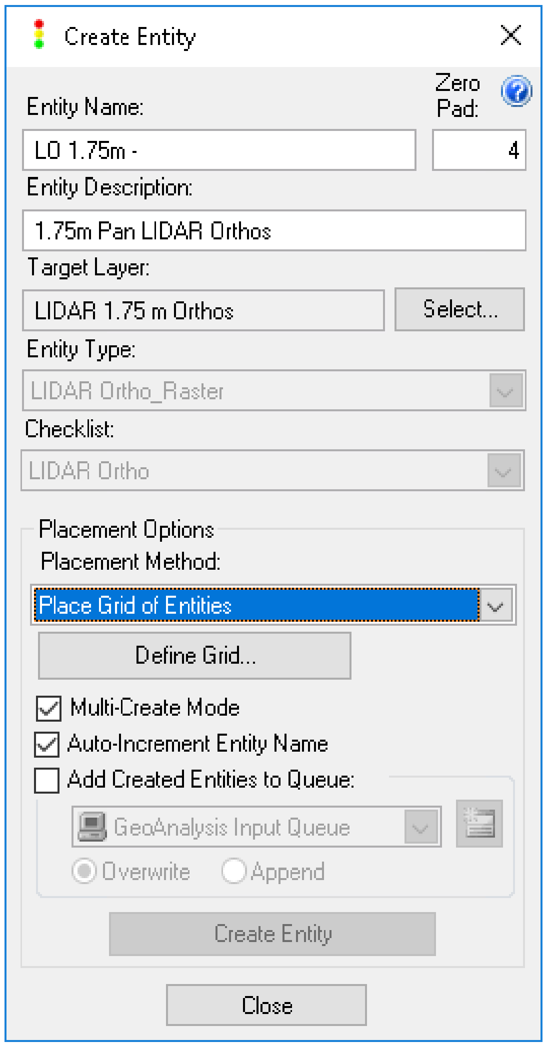



**Figure 12-2 Create Entity dialog just prior to Define Grid...**

Press the *Define Grid…* button on the **Create Entity** dialog. You will be presented with the dialog of Figure 12-3. This Entity placement method allows you to easily create an array of entities of a specified size.

We need to define the size of each of the LIDAR ortho tiles. There are several considerations when making this choice:

- What level of granularity would you like in your ability to turn the display of images off and on? This is a compromise. If you do not care about this granularity, simply make a single LIDAR ortho to cover the entire project. If, however, you would like to compare the LIDAR raster to other rasters (which must be in the same coordinate system if you are going to simultaneously display them), then base the granularity on this decision.
- A second consideration is display performance. Although we use very efficient algorithms in the display of LIDAR Orthos (namely tiling and image overviews), the more images involved in a layer update, the longer the update will take. This argues against a very high level of granularity.

For this practice session, we will make a quick grid of Orthos two wide and 12 high that exactly fit our LAS Boundary. Set your grid parameters as depicted in Figure 12-3. You can press the **Preview** button to view the planned entities.

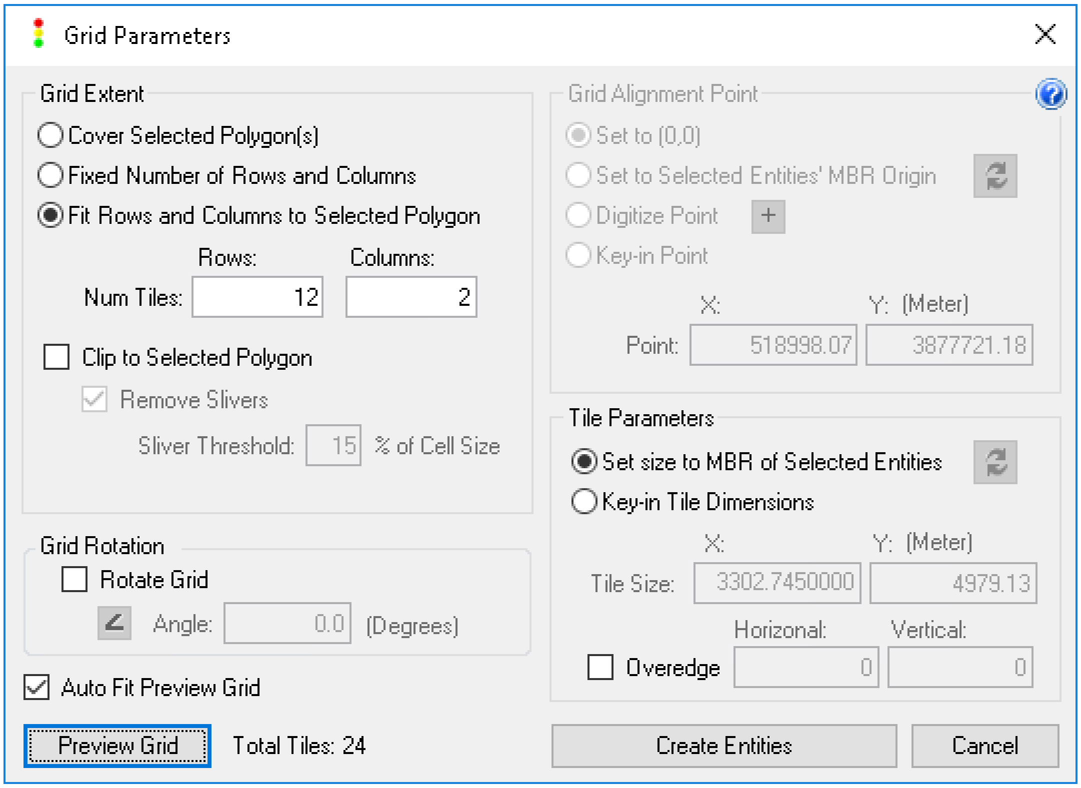



**Figure 12-3 Grid Parameters dialog**

Note – If you have not selected a polygon to which the entities can be fitted, you will receive the warning depicted in Figure 12-4. Simply reselect the LAS Boundary and press **Preview** again. Press **Create Entities** to dismiss the Gridder and create the defined entities.

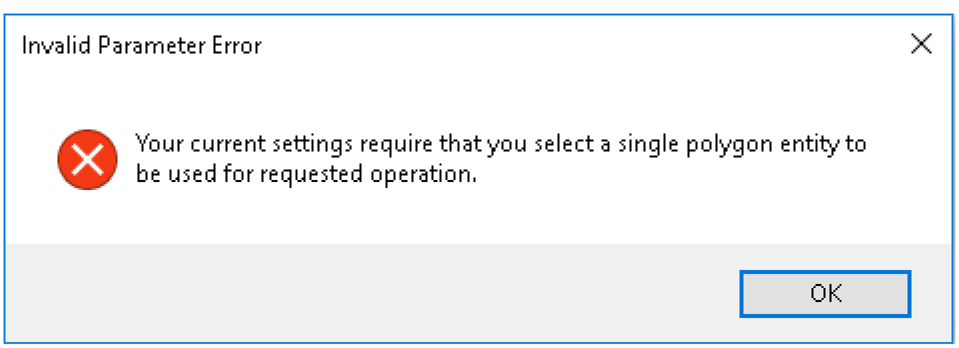



**Figure 12-4 Gridder error when no polygon is selected**

At this point, the dialog should dismiss and the new entities should be displayed (Figure 12-5). You have now created the LIDAR Ortho entities. You can inspect these entities by selecting them (one at a time) and viewing their properties in the Property Pane.

NOTE: As of GeoCue version 2.0, you can create images of any shape. Full transparency is supported for polygonal images.

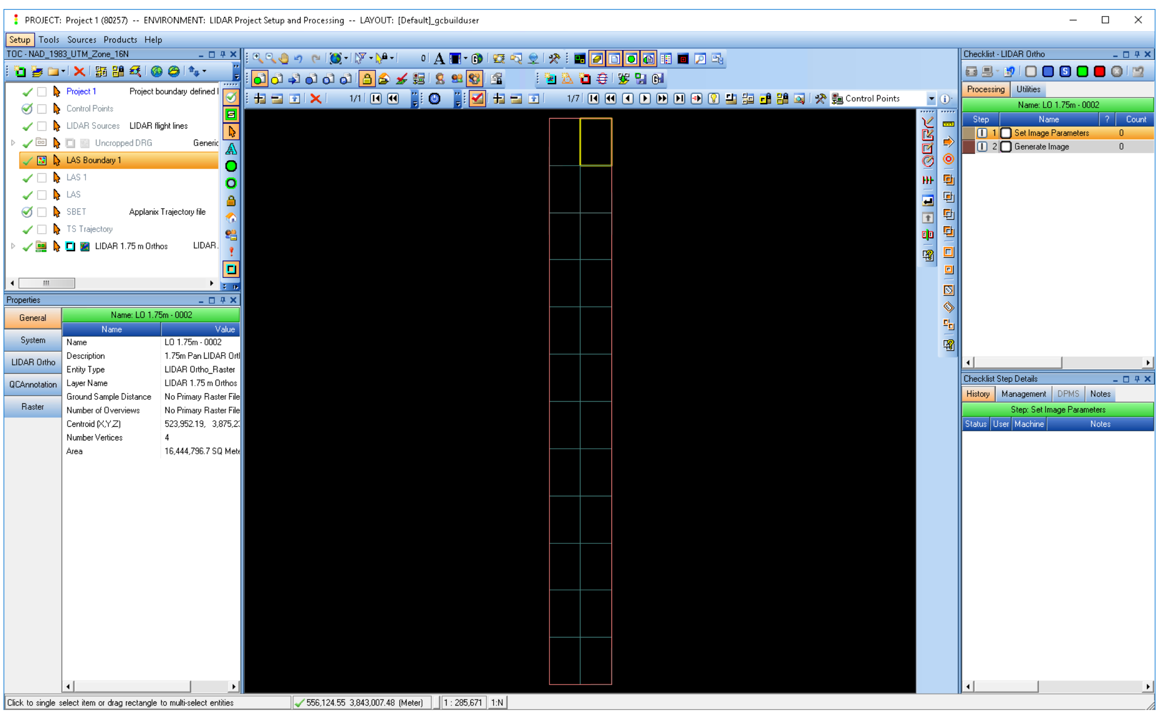
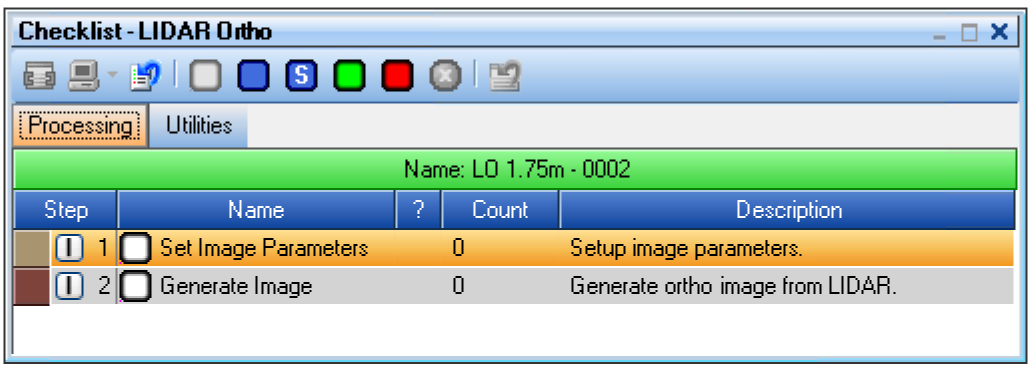


**Figure 12-5 The newly created LIDAR Ortho grid with one in the Working Set**

### 12.1.2 An Overview of Ortho Generation Parameters

Now that the coverage area of each ortho has been defined, the next step is to set the image generation parameters. GeoCue LIDAR 1 allows you to define separate parameters for each ortho. We will demonstrate generating the same parameters for all orthos and note how you can set these individually.

Select all of the ortho entities into the Working Set queue (remember, the easy way to do this is to select the top-most layer of the Ortho group and choose *Add Layer Entities to Working Set* from the Legend command). You should see a checklist display as in Figure 12-6.



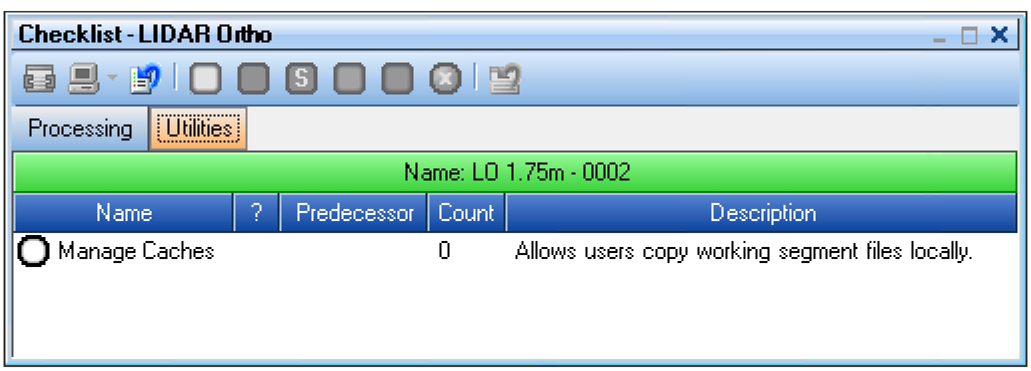




**Figure 12-6 LIDAR Ortho checklist**

Select the *Set Image Parameters* checklist step, press the Multi-Entity mode and press the In-Progress state button.  You should be presented with the Set ***Image Generation Parameters*** dialog as shown in Figure 12-7.

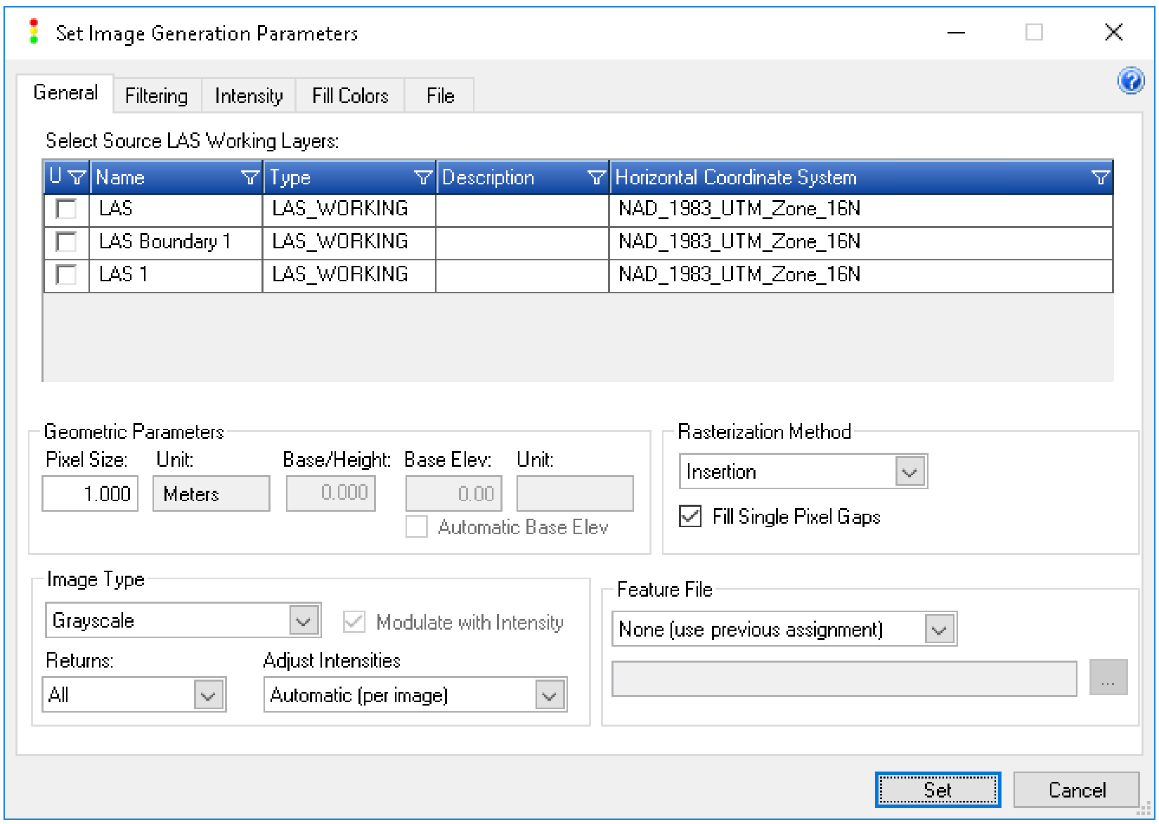



**Figure 12-7 Set Image Generation Parameters (General Tab)**

This dialog is extensive and provides you the flexibility to generate images in numerous formats. Each *Tab* of the dialog is addressed in the following subsections. Note that the particular set of tabs displayed for any given instance of this dialog is a function of the image type selected. We will get back to our project in a moment.

#### 12.1.2.1 General Tab

| ***Option*** | ***Effect*** |
|---|---|
| Selected Source LAS Layers | Select the layer or layers from which you want the LIDAR data sourced (this must be of type LAS_WORKING) |
| Geometric Parameters | *Pixel Size*: As a rule of thumb, a value approximately 1.25 times the LIDAR Average Ground Sample Distance is a reasonable choice for *Insertion* images. For *Interpolated* images, a value approximately equal to your LIDAR data GSD or even slightly smaller can be used.<br><br>*Base to Height Ratio* (enabled when creating stereo pairs): determines the stereo exaggeration of the generated image. The larger this value, the greater the apparent stereo effect. As a rule of thumb, use small values (say around 0.3) in regions of moderate to high terrain relief and use larger values (0.6 and above) where you want to exaggerate stereo relief in relatively flat areas. There is a trade-off in setting this value. Small values of Base to Height Ratio yield higher quality images but lower stereo exaggeration. The greater you make this value, the more the stereo exaggeration but the more you will notice image degradation, particularly in areas of discontinuous changes in elevation such as the edges of tall buildings.<br><br>*Base Elevation* (enabled when creating stereo pairs): should be set to the approximate average elevation of the project area.<br><br>*Unit*: is completed automatically based on the current coordinate system. |
| Image Type | *Image Type*: determines the type of output image (Grayscale or color) and the settings associated with the choice. You can produce LIDAR orthos of type ***Grayscale***, ***Elevation, Class, or Source ID*** and ***Delta Z*** Note that the type of image selected controls what combination of tabs are displayed. These various image types are discussed in the following sections. |

| Option | Effect | |
|---|---|---|
| | Modulate Using Intensity | Selecting this option causes the Image Generator to "modulate" the color with the value of the LIDAR intensity return. This option tends to enhance features within a classification image. |
| | Returns | This option allows you to filter the LIDAR points by return number. Additional options are available via the *Filtering* tab. See section 12.1.2.2.3below for a complete description of filtering by return. |
| | Adjust Intensity | *Off:* Selecting this option means no adjustment will be made to the intensities.<br><br>*Automatic:* Selecting this option means the intensity of the image will automatically be adjusted based on a % clip algorithm.<br><br>*Manual:* This allows you to map the LIDAR intensity data to the generated LIDAR ortho dynamic range (which is 0 to 255 in this version of GeoCue LIDAR 1 CuePac). For example, if you knew your LIDAR project intensity data ranged from a low value of 128 to a high value of 713, then you would set these as the Black Point and White Point values, respectively.<br><br>Select the *Intensity* tab to adjust intensities. |
| Rasterization Method | *Insertion*: Images are created by gridding the image area into square regions, sized according to the selected pixel size. LIDAR points are read and inserted into the appropriate pixel location corresponding to their x, y coordinate. If more than one LIDAR point maps to the same pixel, classification priority is used to determine which LIDAR point to use for the pixel. Classification priority can be set in PointVue. If classification priorities are the same, the point with the higher z-value is inserted. | |

| Option | Effect |
|---|---|
| | *Fill Single Pixel Gaps:* Select this option to fill intensity gaps of 1 pixel in the output image. This option is disabled when the use Interpolation option is selected.<br><br>*Interpolation:* Using multiple LIDAR points to choose the intensity, can provide a better quality image with less jaggedness. When checked, three nearby LIDAR points are used for each pixel to interpolate an intensity value. This option also allows more detailed images to be created by allowing smaller pixel sizes to be selected without resulting in a large number of voids (gaps) in the image. Without interpolation, filling of these voids is limited to one pixel. With interpolation, the maximum area to be filled is specified as an input on the dialog.<br><br>*Max Area*: setting of 16 square-meters, for example, would mean that a 4m x 4m area (or 8x2, etc.) without LIDAR returns would still be filled.<br><br>Interpolation does require a significant amount of computation and memory. As such, the following are suggested guidelines:<br><br>1) Use interpolation only when the desired pixel size is the same or smaller than the nominal LIDAR point spacing. Typically, a pixel size of 1/2 the LIDAR spacing provides the most benefit.<br><br>2) Limit the image dimensions such that an image covers no more than 5,000 LIDAR points in a single dimension. So, using the pixel size recommendation given in 1), images of up to 10,000 x 10,000 pixels will be created.<br><br>As an illustration, assume your LIDAR working segments are such that the LIDAR points are spaced about every 3 feet. Using the above guidelines, the following settings might be selected (with interpolation enabled):<br><br>• Pixel size = 1.5 feet<br><br>• Images sized 15,000 by 15,000 feet. |

| Option | Effect |
|---|---|
| | • Max Area = 20 sq-ft<br><br>The 'Max Area' setting is something of an aesthetic choice. Larger areas mean fewer voids in the imagery. If the LIDAR points have relatively uniform spacing, setting 'Max Area' to the square of 2-3 times the point spacing will typically result in few voids. For the given example, the 'Max Area' was calculated as: (3 * 1.5 ft)2 ≈ 20 sq-ft. |
| **Feature File** | This allows you to associate a file for storing vectors associated with the image tiles. This is primarily used for LIDAR Stereo operations. If you were going to use the LIDAR Orthos for heads-up digitizing you could use this option to assign a vector file to the ortho. |

The *Rasterization Method* controls whether the image values are determined by an insertion type algorithm, or by triangulating an underlying surface and performing interpolation to determine the image values. When Insertion is selected, a checkbox is available that allows the option of filling single-pixel voids by selected a value for the void pixel, based on its neighbors. For interpolation, the *Max Area* parameter controls the maximum triangle area that will be used, which determines how voids are generated when using interpolation. Refer to the on-line help manual for a detailed description of how to set these parameters. See the information below on the ***Fill Color*** tab for details of *voids*.

### 12.1.2.2 Filtering Tab

The ***Filtering*** tab provides several ways to control which LIDAR points will be used to generate a LIDAR ortho image. A point's classification, source ID, return type, and/or point type (per LAS 1.1 specification) can be used to include or exclude a particular point. Filtering using these characteristics applies to all LIDAR ortho image types. The ***Filtering*** tab is shown in Figure 12-8, below.

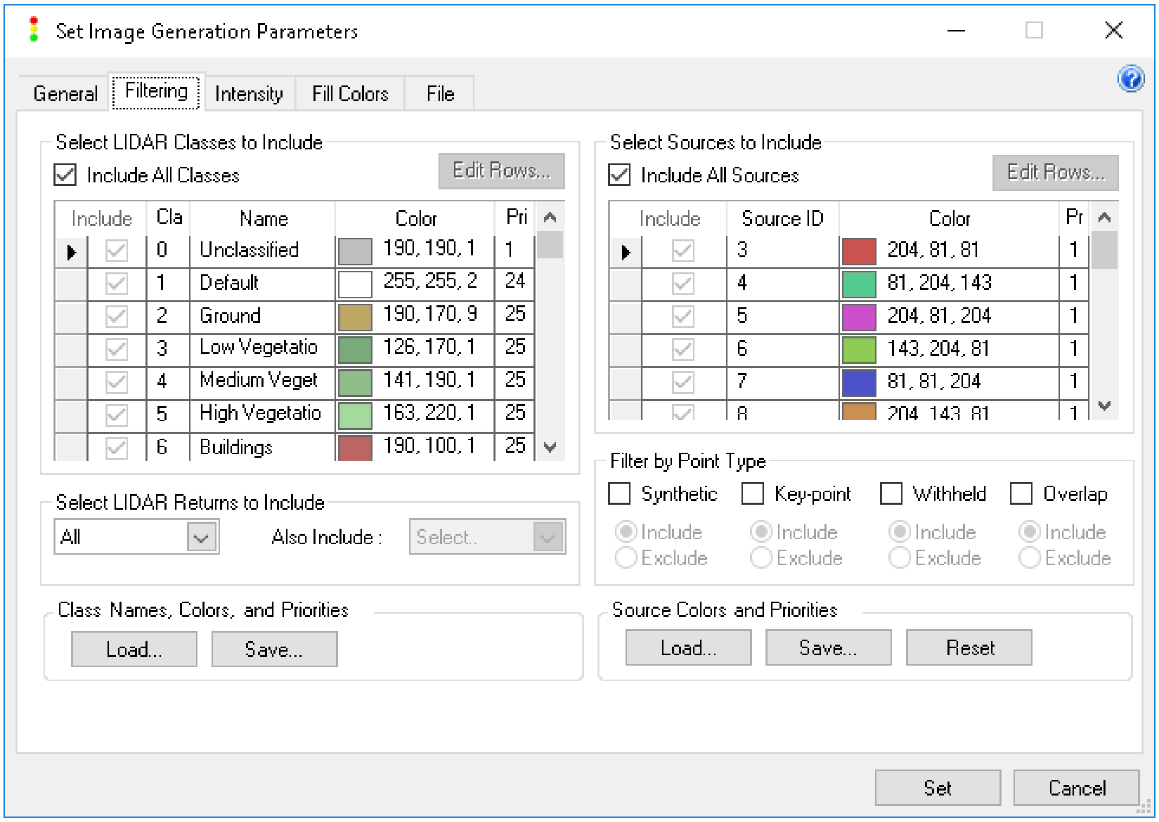


**Figure 12-8 Filtering Tab**

### *12.1.2.2.1 Filtering by Class*

If your LIDAR data has been classified, you may want to make orthos only from a single class, such as ground, or perhaps from only a subset of the available classes. To do this, uncheck *Include All Classes*, and ensure that only the row or rows you want included in your orthos are checked.

If this is the first invocation of the *Set Image Generation Parameters* dialog for this project, the list of classes shown is your default class map. Otherwise, the class map is the last saved on this group of entities. Saving class map information is described in section 12.1.2.2.5 below.

If your selected image type is *Color by Classification* (see ***General*** tab), the displayed colors and priorities will be used to create the ortho images. If *Module with Intensity (General tab)* was selected, the hue will match that of the displayed color, but the intensity will be from the LIDAR data. Otherwise the colors in the image will match exactly those shown in the class map table. Priority value is applicable only when *Insertion* is chosen as the rasterization method. If LIDAR points from different classes are contained in a single pixel, the priority value determines the class assigned to the pixel, and hence its color.

##### 12.1.2.2.2 Filtering by Source ID

Recall that you can assign strip numbers when you importing strips. In LIDAR 1 CuePac, strips can be identified by a strip number or source ID. If you want to make an ortho or orthos that only include data from specific strips, uncheck *Include All Sources*, then check only those source IDs in which you are interested.

##### 12.1.2.2.3 Filtering by Return Type

LIDAR points can be filtered by Returns (All, First, Last, Single, First of Many, Last of Many, Checked Only). Return selection can be made via this tab, or from the ***General*** tab. However, if you want to select *Checked Only* or if you want additional returns to be included in your selection, you must use the ***Filtering*** tab to check the desired returns.

***Returns to Use:***

| ***Selected Return*** | ***Effect*** |
|---|---|
| All | No filtering. Uses all returns. |
| First | Uses first returns, this includes any return with a return number of 1. |
| Last | Uses the last return of a group. Also includes single returns. |
| Single | Uses only "one-of-one" type returns. |
| First of Many | Same as First except single returns are excluded. |
| Last of Many | Same as Last except single returns are excluded. |
| Checked Only | Includes those returns specified by the checked boxes |

#### 12.1.2.2.4 Filtering by Point Type

LAS Specification version 1.1 introduced three attribute flags that can be used to specify special characteristics of a LAS point. As of September 2005 this feature has not been implemented in TerraSolid products. This filter should only be used if you are certain that your LAS generating software has correctly set these attributes.

#### 12.1.2.2.5 Loading and Saving Class Settings

The ***Filtering*** tab displays a map of the relationships between class numbers, names, colors, and priority values. You may change Name, Color, or Priority for a class or set of classes to match your company's or customer's preferred assignments. Simply click in the desired field and begin typing. Clicking *Set* saves those settings only on the entities in the working set when the *Set Image Generation Parameters* command was started. Use *Save* if you want to create a 'Named Class Map' which can be easily restored later by clicking *Load*. To save, in the *Class Names, Colors, and Priorities* group box, click *Save* (see Figure 12-9) and either type a new name, or select from the available names if you want to overwrite an existing named class map.

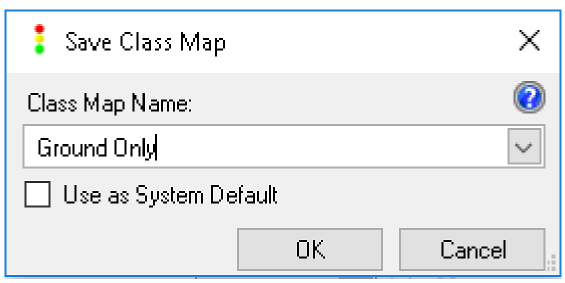



**Figure 12-9 Save Class Map Dialog**

To load a class map, in the *Class Names, Colors, and Priorities* group box, click *Load* (see Figure 12-10), select a row in the list of available class maps, and then click *Set*.

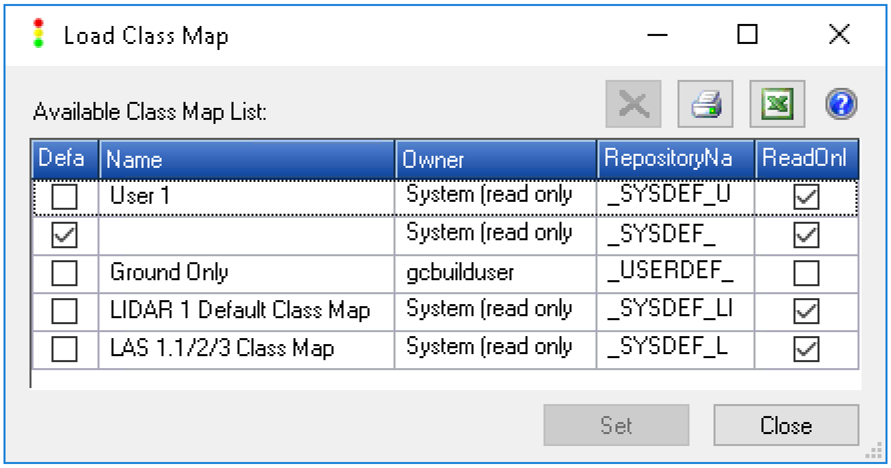



**Figure 12-10 Load Class Map Dialog**

On both the Load and Save dialogs, you can choose to set any Named Class Map as the current GeoCue default. This means that all new projects created in GeoCue will default to using this class map.

Loading and saving Named Class Maps is new in GeoCue Version 5. In previous versions, a single 'System Class Map' was used, modifiable only through PointVue. When you install GeoCue 5.0, those existing settings are imported into a class map called "User 1", which is set as your initial default class map. A GeoCue default class map is also provided and is named "LIDAR 1 Default Class Map". Its class numbers and names match those in the LAS 1.1 specification. This class map cannot be overwritten.

### *12.1.2.2.6 Loading and Saving Source ID Settings*

A unique set of twelve colors are used to represent different source IDs. These colors are evenly spaced around the color wheel and repeat the cycle for every twelve source IDs imported. There is no default source ID to color mapping since GeoCue assigns the first unique color to the lowest source number and continues assigning colors in a modulo fashion thereafter. You can however define and save your own color assignments, as well as source priority values, called Source ID maps. Note that priority is only applicable for images generated via the *Insertion* algorithm. See section 12.1.2.5 for details about source priority.

To change color or priority, click the row, and Color or Priority column and enter your desired new value. Clicking *Set* on the ***Filtering*** tab only saves your changes on the entities that were in the working set queue when you started the *Set Image Generation Parameters* command. To save these changes as a 'Name Source ID Map' for use on other entities or in other projects, click the *Save* button in the *Source Colors and Priorities* group box (see Figure 12-11) and either type a new name, or select from the available names if you want to overwrite an existing named source map.

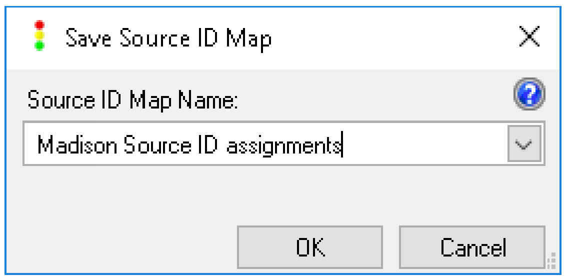



**Figure 12-11 Save Source ID Map Dialog**

To Load a named source map, click *Load* in the *Source Colors and Priorities* group box (see Figure 12-12), select a source map, and click *Set*.

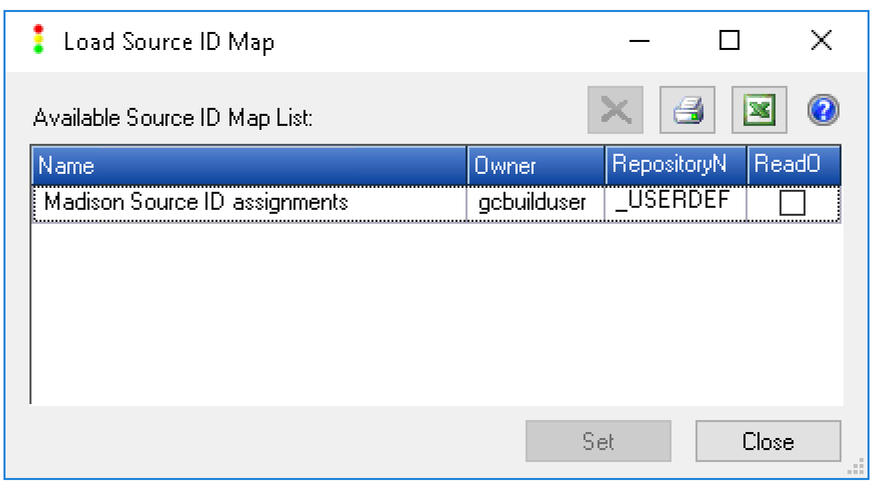
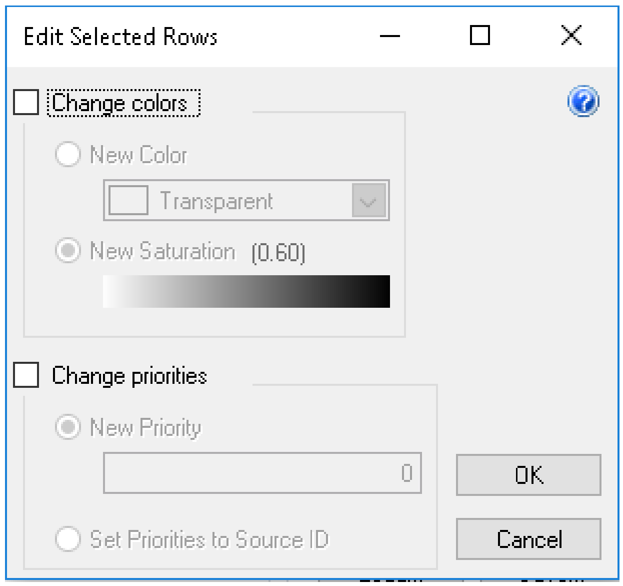



**Figure 12-12 Load Source ID Map Dialog**

#### 12.1.2.2.7 Editing Multiple Rows of Class or Source ID Settings

If you have one or more rows selected, the Edit Rows… button is enabled. Selecting Edit Rows… causes the Edit Selected Rows form to display:




The Edit Selected Rows form allows you to optionally change (via the checkboxes) the color and/or display priority of one or more rows that you have selected. Setting a color to transparent effectively turns off that source in the display.

### 12.1.2.3 Intensity Tab

Intensities can be adjusted by 2 methods - Automatic, Manual, or you can select *Off* for no adjustment.

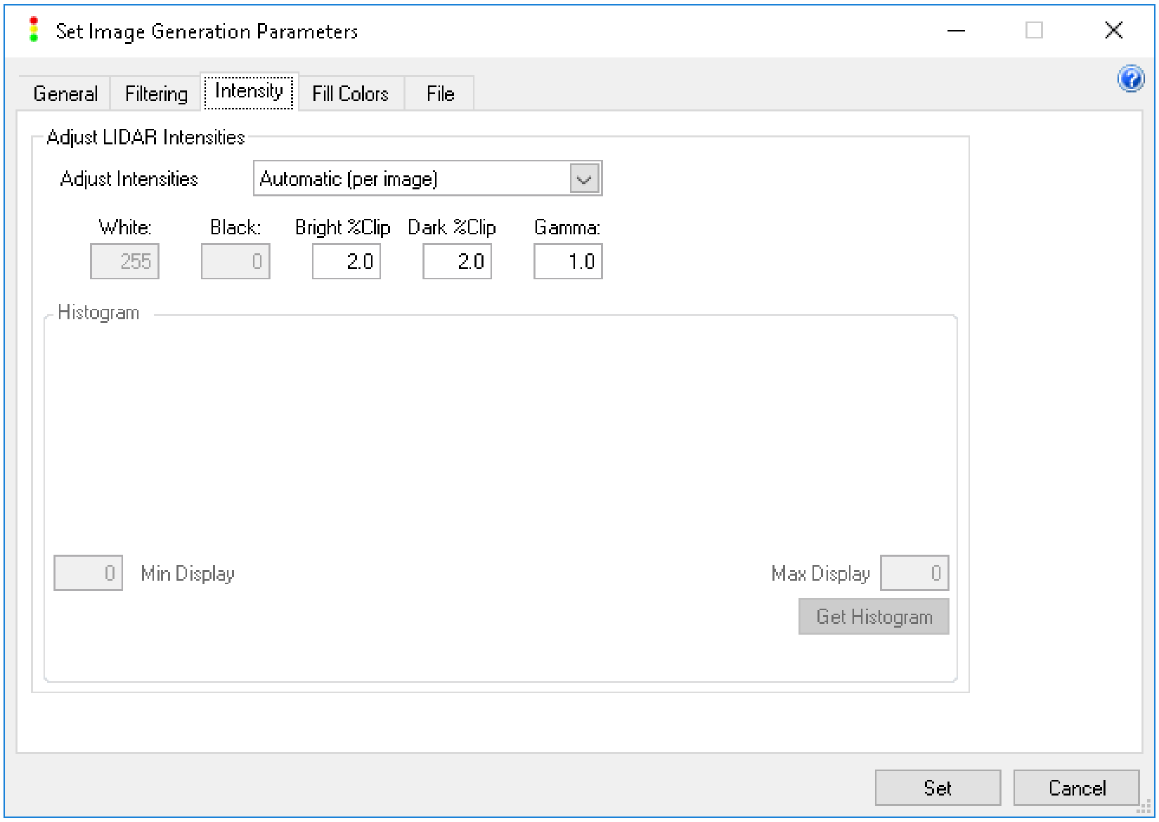



**Figure 12-13 Set Image Generation Parameters (Intensity Tab)**

| ***Option*** | ***Effect*** |
|---|---|
| Automatic | The image will automatically be adjusted based on a % clip algorithm. The algorithm works by setting a small percentage of the brightest and darkest intensities to 255 and 0, respectively, then scaling the remaining values to cover the full display range of the monitor. |
| Manual | This allows you to map the LIDAR intensity data to the generated LIDAR ortho dynamic range (which is 0 to 255 in this version of GeoCue LIDAR 1 CuePac). For example, if you knew your LIDAR project intensity data ranged from a low value of 128 to a high value of 713, then you would set these as the Black Point and White Point values, respectively. The generation algorithm will then map this input range of values to the generation range of 0 to 255 using a linear mapping curve. |

| *Option* | *Effect* |
|---|---|
| Off | No adjustment will be made to the intensities. This means intensities are used directly from the file for setting the image pixel values. Since the images being created are 8-bit grayscale (or 24-bit color), any intensity in the LAS file greater than 255 will be set to 255. |

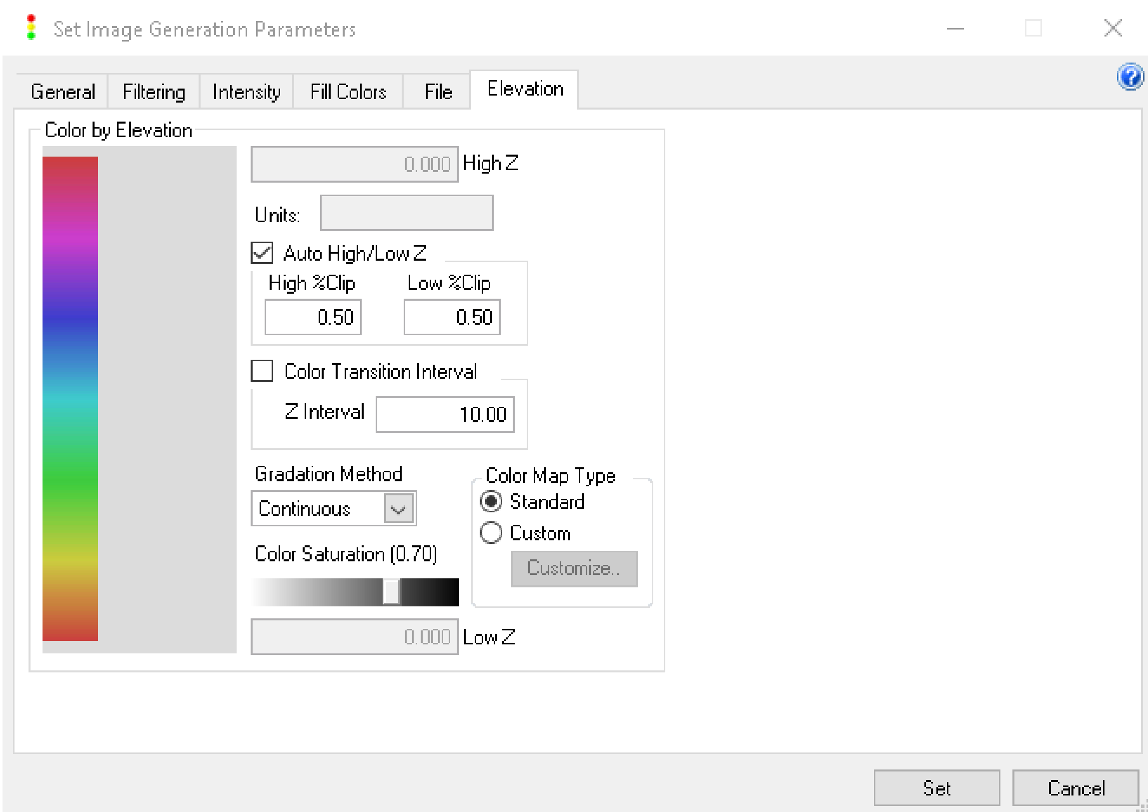
#### 12.1.2.4 Elevation Tab

If you select *Color by Elevation* as your *Image Type* (see ***General*** tab) you can select specific elevation criteria from the Elevation tab.

In order to get a good distribution of colors over the range of elevation values, a linear percent clip based on a histogram of the elevation values is performed. Here, you can change the percent clip applied at the High and Low ends of the histogram.

When coloring by Elevation, colors are determined by specifying Hue, Saturation, and Intensity. The Hue and Intensity values are computed automatically from elevation and intensity information on the LIDAR points. The user may control the color Saturation value that is used by changing the Color Saturation value.

- If you uncheck “Auto High/Low Z”, you can manually set the high and low elevation clip values (% clips ignored in this case).
- If you want to manually control how fast the colors change as Z changes, check the “Color Transition Interval” box and adjust the Z Interval value.  Note that the colors will repeat every 12 * ZInterval units of elevation.
- If you want a palette of 12 discrete colors instead of a continuous range of colors, change the Gradation Method to Discrete.




### 12.1.2.5 Sources Tab

If you select *Color by Source ID* as your *Image Type* in the ***General*** tab, the table of source settings shown in upper right group box of the ***Filtering*** tab determines which source strips to use to make your ortho images. You can check *Include All Sources* or you can pick individual sources by checking the *Include* column checkbox only for those sources in which you are interested. The table also indicates the base color that will be used in the image for a given source. If *Module with Intensity (General tab)* was selected, the hue will match that of the base color, but the intensity will be that of the LIDAR data. Otherwise the colors in the image will match exactly those shown in the table.

The ***Sources*** tab ( Figure 2-1 below ) is also displayed, which allows you to specify if a particular source ID has priority when creating images using the insertion method. This is only applicable if the rasterization method is *Insertion*. If more than one source strip contributes to a given pixel, then the source priority value will determine which color is assigned to that pixel. If this item is left unchecked, the pixel will be colored arbitrarily, based on the “first” LIDAR point encountered for that pixel.

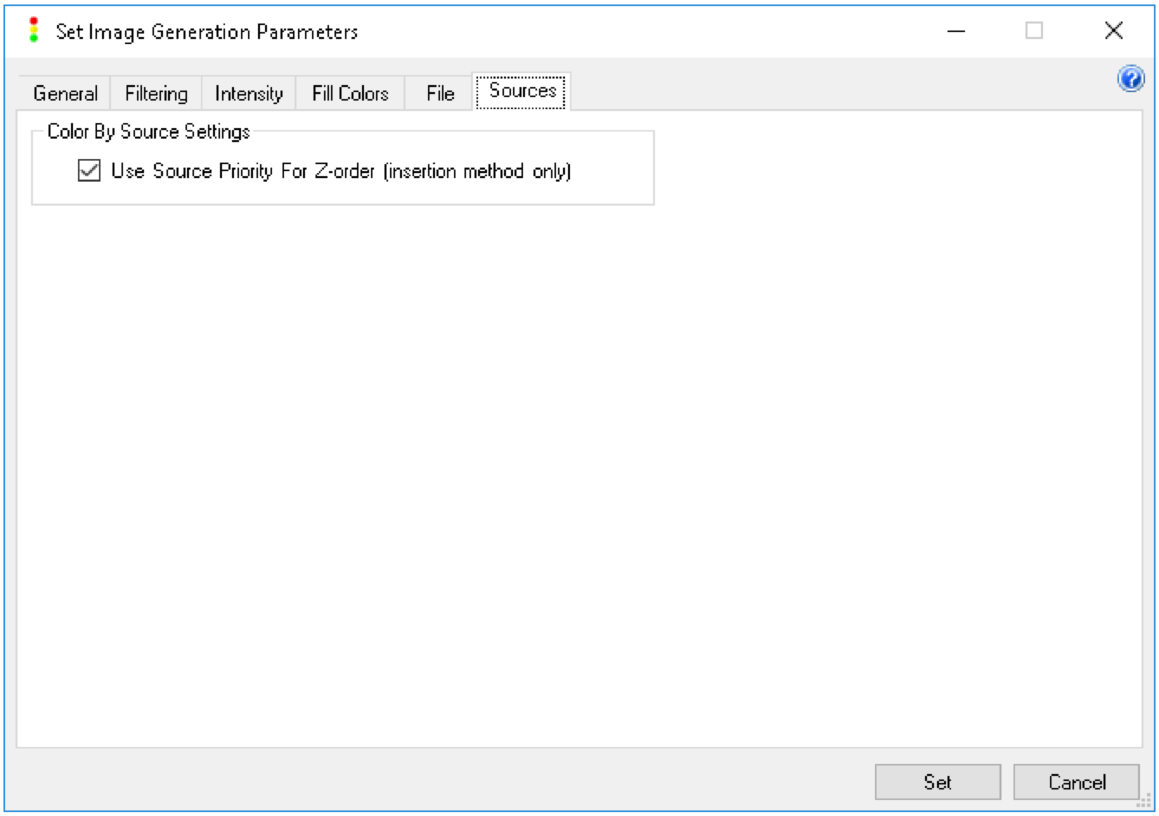



**Figure 12-14 Sources Tab**

### 12.1.2.6 Fill Colors Tab

The Fill Colors tab provides control over how *voids* and *transparency* will be treated.

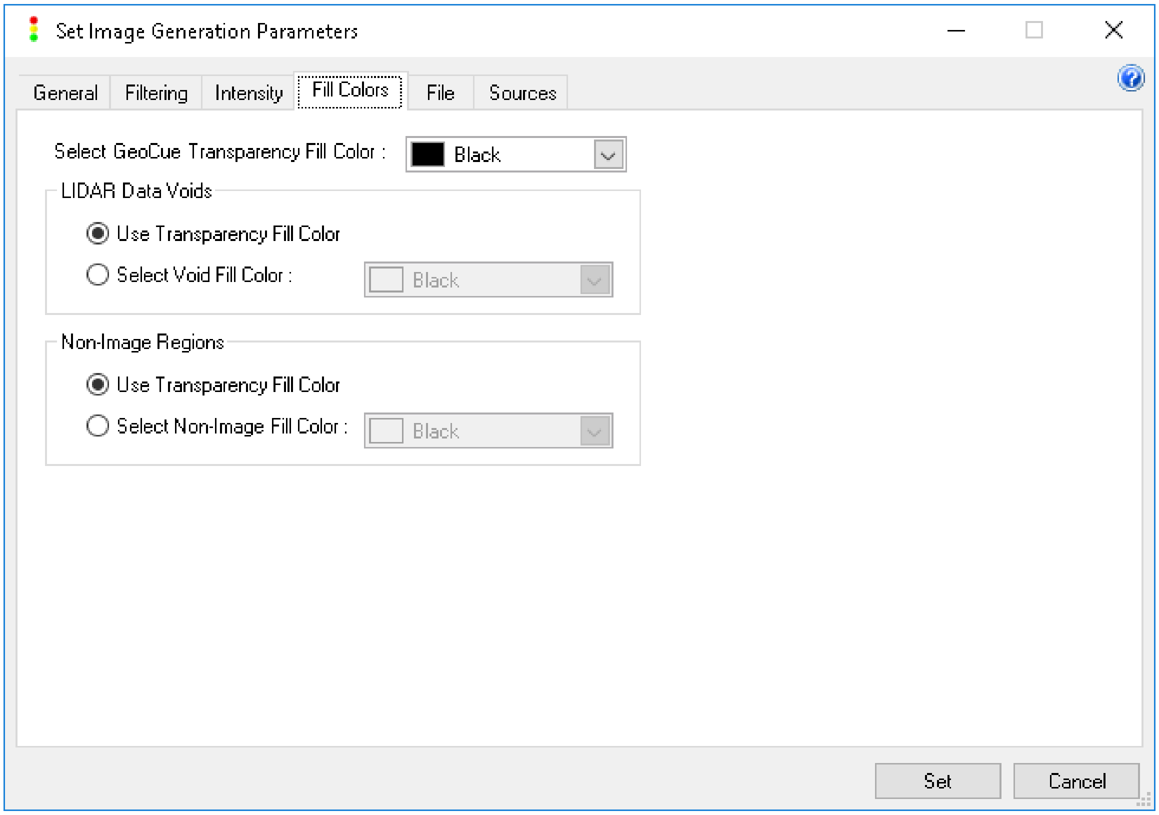



**Figure 12-15 The Fill Colors Tab**

**GeoCue Transparency Fill Color** specifies the color you wish to designate for areas of an image that are set as *transparent*. Transparent regions are created when the shape of an image is not rectangular. This value can also be specified for filling LIDAR voids.

If you are using your generated orthos only in GeoCue, this setting is not particularly important. However, if you use the orthos outside of GeoCue and the system in which they will be used does not support transparency, this is the color that will show in the transparent regions.

**LIDAR Date Voids** is used to set the color for *void* regions. A void is a region of a LIDAR ortho that is inside the polygon that you specified as the entity when creating the ortho (you can use any shape polygon to define an ortho) but does not become *populated* from LIDAR data. This phenomenon can occur when there simply was no LIDAR coverage (for example, high roll angles causing voids along strip edges), a surface material was totally absorbing to the LIDAR signal or a water area caused total, non-nadir reflectance of the beam.

If you set this value to Use Transparency Fill Color, your LIDAR orthos will be “transparent” in the void areas.  This is extremely useful for rapidly locating void areas by simply changing your GeoCue Map View background color.

If you set a specific color for voids that is different from the GeoCue void color, the LIDAR voids will be colored by this value when displayed in GeoCue.

You can imagine that our image generation algorithm (insertion method) lays a grid with the resolution specified in the geometric parameters section (1.75 m in the present exercise) over the LIDAR data that has been copied into the working segments.  The algorithm then “pokes” LIDAR points into the grid.  If a particular grid element never receives a LIDAR point, we call this a **Void**.  **Voids** can be common because the LIDAR post spacing is non-uniform whereas the raster image that we are going to generate is uniform.  The smaller you define the grid with respect to the actual LIDAR post spacing, the more voids created.  This phenomenon is illustrated in Figure 12-8.

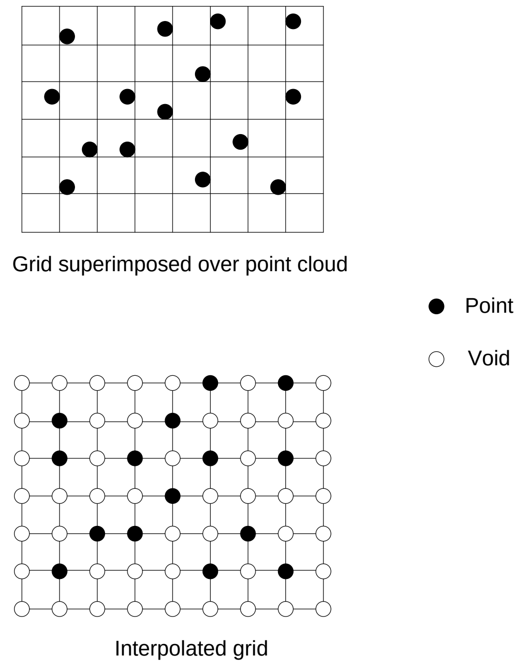



**Figure 12-8 How Voids occur when gridding LIDAR**

**Non-Image Regions**: This setting determines the color scheme that will be applied to areas outside the defined image boundary. Technically, an image must be rectangular since display systems are designed to process images of a constant row size. In GeoCue, we define the true image size to be the Minimum Bounding Rectangle that encloses the polygon that you defined as your image boundary. The regions between the image polygon and the MBR are the *non-image regions.* Set this color to transparent if you wish to "see" through these sections of the image (the normal method of viewing). Set a color other than transparent if you want this regions filled with a solid color.

### 12.1.2.7 The Files Tab

The *files tab* (Figure 12-16) allows you to specify that your image should be JPEG compressed and it also lets you build images that have overedge (applies to rectangular images only).

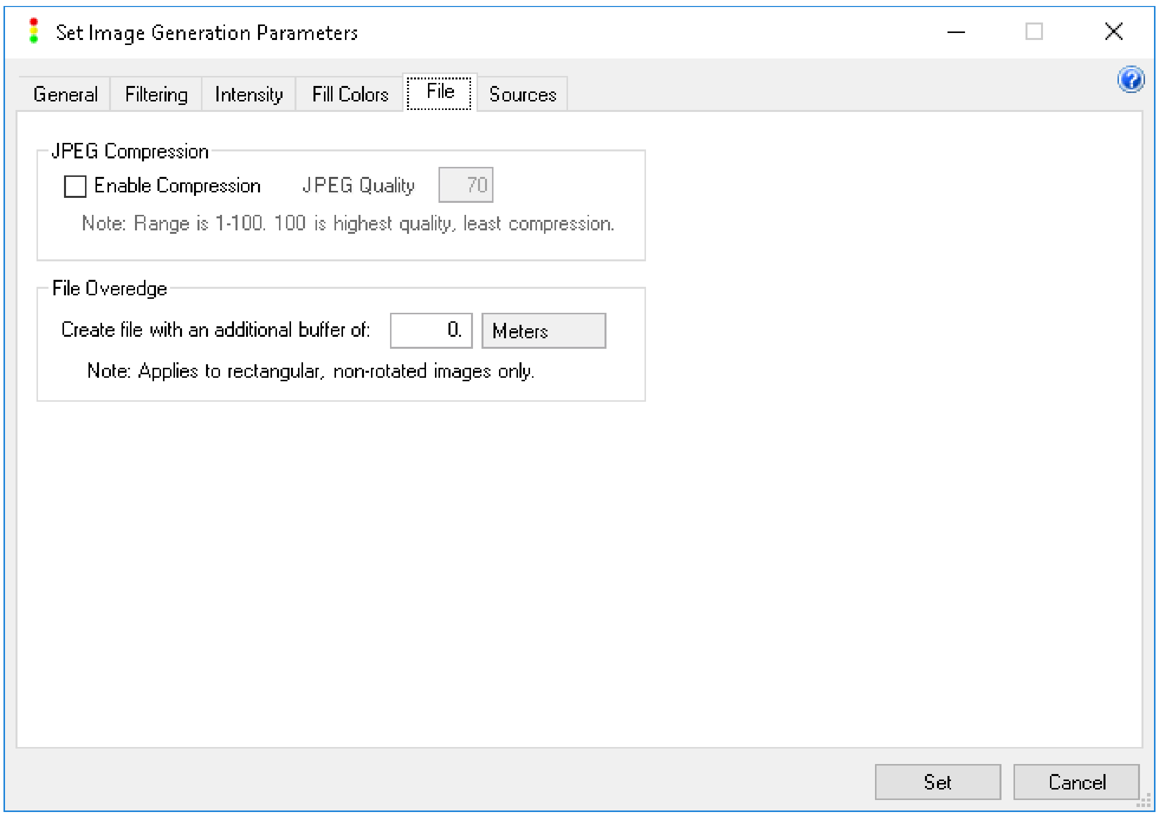



**Figure 12-16 Files Tab**

**Joint Photographic Experts (JPEG) Compression** – Setting this check enable JPEG compression of output images. The quality factor determines the degree of compression. There is, of course, a trade-off between compression and quality. 70 is a reasonable default value for this parameter.

**File Overedge** (applies to rectangular images only) – This parameter allows you to create images that are larger than the entity boundary by the amount specified. This is useful for creating image overlap, particularly when generating Stereo images for data collection. Note that you can also set this value when creating entities when using the Gridder.

### 12.1.2.8 Source Deltas

Source deltas are an image type used for visualizing the elevation mismatch between overlapping sources of LAS data. It is principally used for visualizing elevation differences between overlapping LIDAR flight lines. The dialog tab is shown in Figure 12-17.

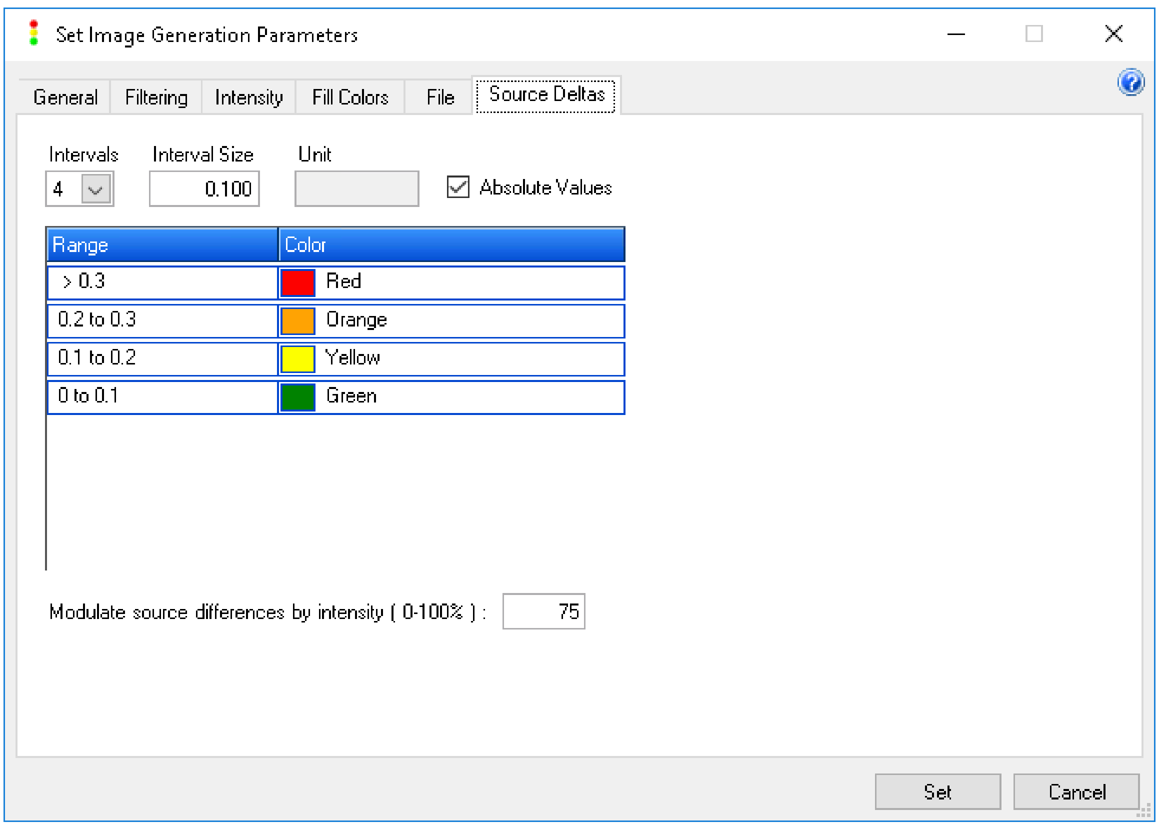



**Figure 12-17 The Source Deltas Tab**

Source Delta Z (dZ) images are generated by *stacking* all of the overlapping data within a cell defined by the pixel size specified on the ***general*** tab and assigning a color based on the maximum deviation within the cell between different sources.

The granularity is controlled by the *Intervals* selection. The interval size specifies the Z threshold at which the color bands apply.

The *Absolute Values* option specifies that you want color bands set based on the absolute differences between the point elevations of the Sources as opposed to a scheme that colors based on differentiation between negative and positive differences. Note that when you have more that two overlapping sources, the absolute values mode is more effective.

### 12.1.3 Setting the Ortho Generation Parameters

Now back to our project. Set the options as shown below. Set Pixel Size to 1.75 since our LIDAR source data has a ground resolution of about 1.75 meters (on average). Select Grayscale for the Image Type and select the Insertion rasterization method. The Fill Single Pixel Gaps option is available for Insertion. Check this option. Set the Adjusts Intensities option to Automatic. This will cause intensity histograms to be collected and used for automatically scaling the LIDAR intensities so as to provide the most visual detail in the images.

Finally, select the *Transparent* option on the Fill Colors tab (We will discuss the other image generation options in a later section) as shown in Figure 12-19. You will usually want to fill voids with the transparency option since this provides complete flexibility in dynamically filling in voids for visualization operations. The options for color fill other than transparency are useful if you intend to export the LIDAR images to software that does not recognize transparency.

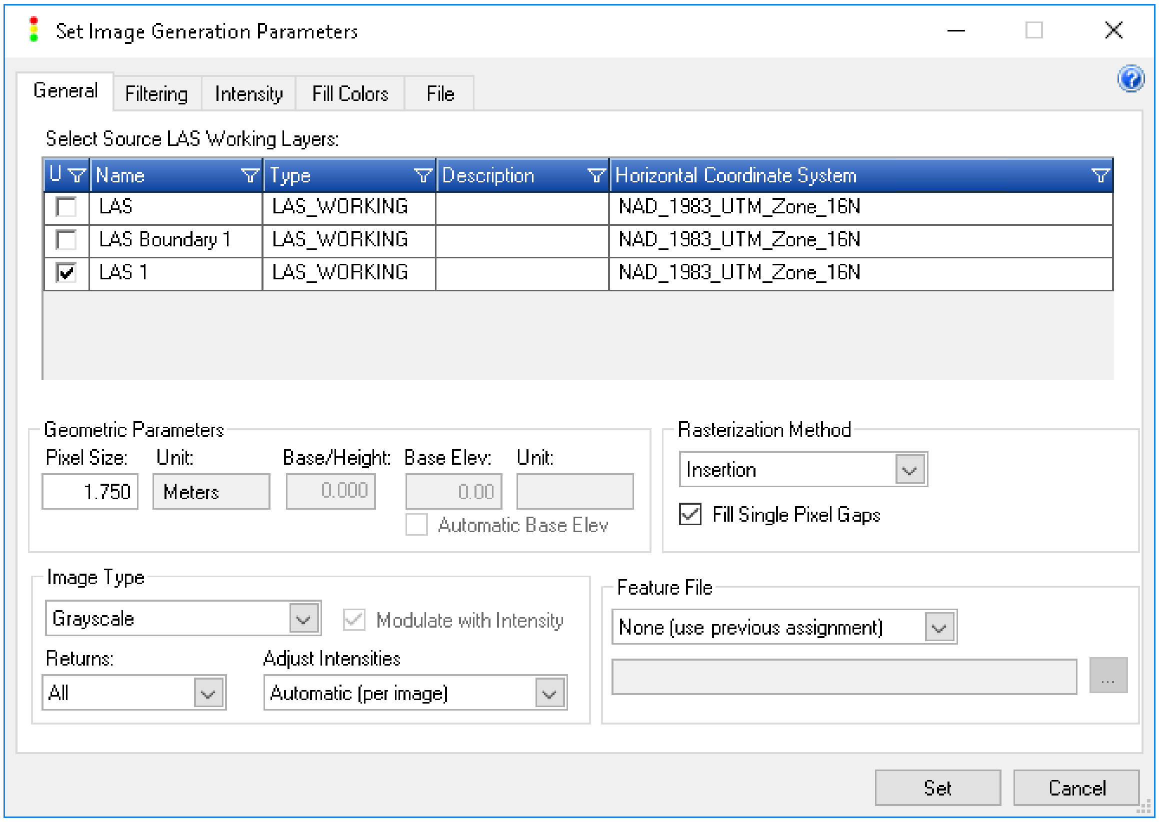



**Figure 12-18 Settings for the General tab**

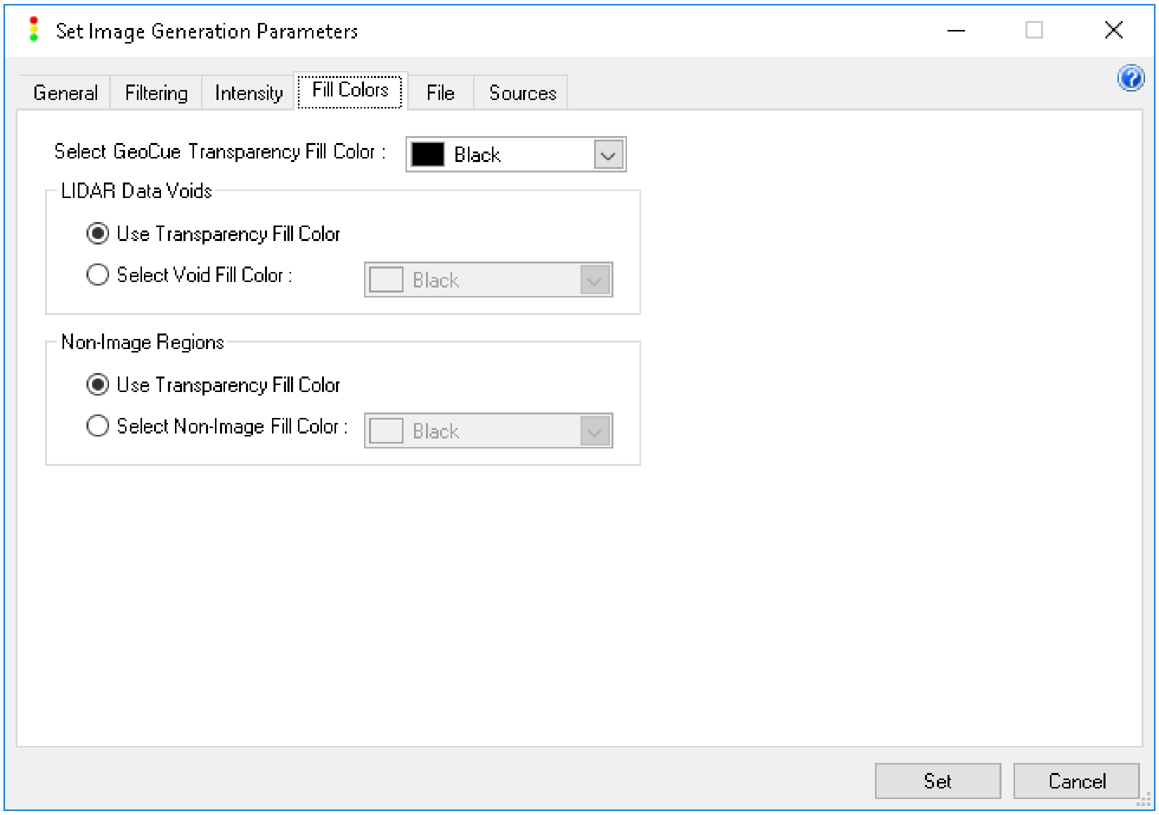


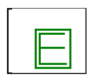

**Figure 12-19 Fill Color options for our first LIDAR Orthos**

Press the *Set* button to accept and apply the parameters to the LIDAR Ortho Entities. You can review the parameters by selecting a LIDAR Ortho entity and examining the Extended Info tab of the Properties pane.

NOTE – GeoCue can support any combination of rasters on the same layer so long as they are all in the same coordinate system. Thus you can individually set LIDAR Ortho parameters to generate hybrid image layers. For example, perhaps you are going to classify a Region of Interest within a large LIDAR coverage area. You might want to set the ortho parameters for all LIDAR Ortho entities to a low resolution except for the tile covering the ROI. This tile you could set to a higher resolution. You can also mix panchromatic and color images on the same layer.

### 12.1.4 Generating the Images

Select all of the LIDAR Ortho entities into the Working Set. Select the *Generate Image* process step (you may need to press the flash entity button to set the checklist display). Press the Multi-Entity button (we want to process *all* of the queued entities) if you have not disabled *Single Entity* Mode in the GeoCue Options selection (in which case the multi-entity mode tool will not appear in your checklist toolbar). Now, depending on your version of GeoCue, you will have two methods of processing the command.

#### 12.1.4.1 Distributed Processing 

If you have the Enterprise version of GeoCue, you will have a dispatch button enabled on your checklist toolbar (Figure 12-20). If you leave this button depressed and press the In-Progress button on the checklist toolbar, you will be presented with the Dispatch dialog (Figure 12-21).

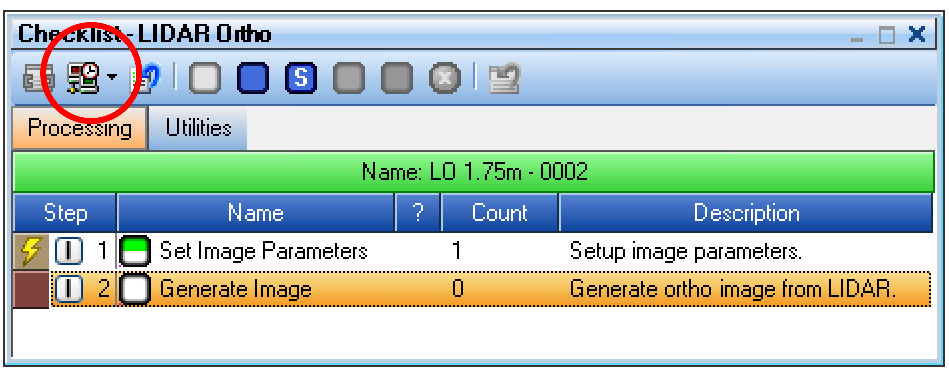



**Figure 12-20 Generate Image step with Dispatch enabled**

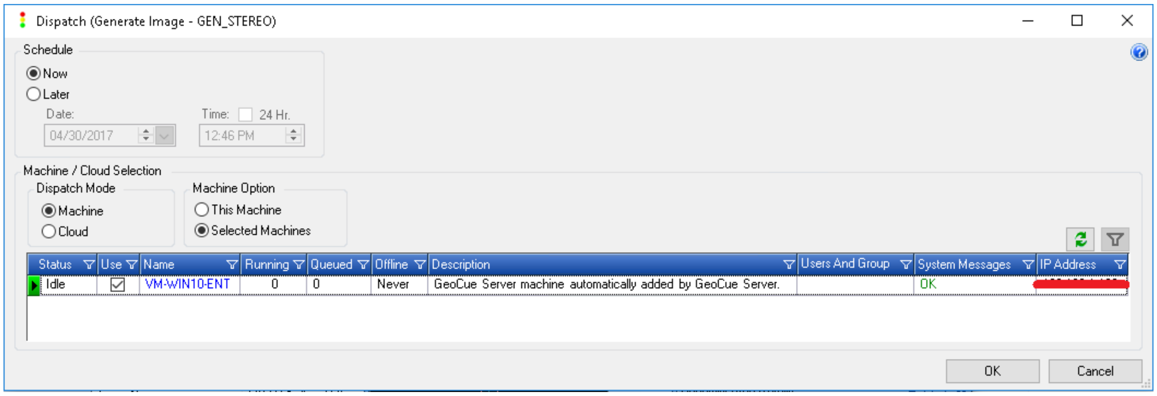



**Figure 12-21 The Dispatch dialog**

Note that unlike when *Populating* working segments, all available machines are selected. This is because Generate Images is a command that can be *distributed.* This means that the LIDAR orthos will be parceled up and sent to all machines that you select in the Machine Selection section of the dialog. Note that detailed information regarding the Command Dispatch System is contained in the GeoCue Workflow Guide.

Select the machines on which you wish to generate the images and press **OK**. The processing will begin.

#### 12.1.4.2 Local Processing

If you do not have the Enterprise version of GeoCue or if you choose not to distribute processing (by disabling the dispatch tool on the checklist toolbar), then simply press the In-Progress button. The image generation process will begin.

### 12.1.5 Exploring the LIDAR Orthos

Expand the LIDAR Ortho layer in the legend and ensure that raster display is turned on for all of the entities. You will see the rasters automatically display as they are generated.

A windowed view of the Huntsville Airport is depicted in Figure 12-22. Notice that we have turned on the display and labeling of the LIDAR source strips. A particular strip is *Selected* (the white strip in Figure 12-22) to illustrate the ability of the backdrop image to provide information on particular strip coverage.

You may notice that there are some coverage gaps in the LIDAR data. An example is shown in Figure 12-23 where you can clearly see in the center of the display a region where, due to aircraft roll, two of the strips missed overlap. Also note that you can see several areas of water where LIDAR pulses were not returned. Since we chose transparent for the void fill, you can see the water pattern of the DRG showing through in these areas!

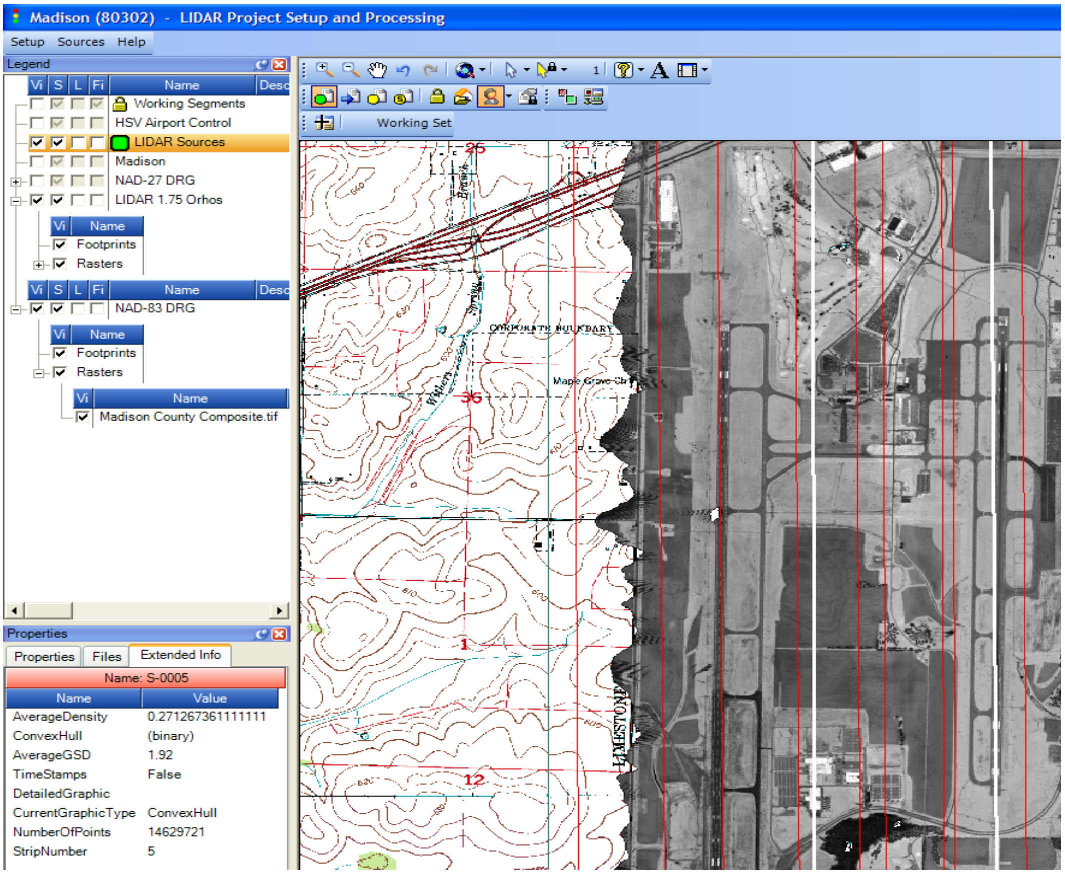



**Figure 12-22 LIDAR Ortho coverage over Huntsville Airport**

It is often difficult to discern areas of low or no reflectance from void areas. A good example is phenomenon over bodies of water where few off-nadir pulses are captured. Notice that since we set our image generation parameter to Transparent for the Voids, you can clearly see the DRGs through the "holes" in the LIDAR Ortho image. We will examine other analysis techniques in the Color image section.

We are continuing to research additional visualization techniques to assist with LIDAR production. Expect to see rapid advances in this area with each new release of LIDAR 1 CuePac.

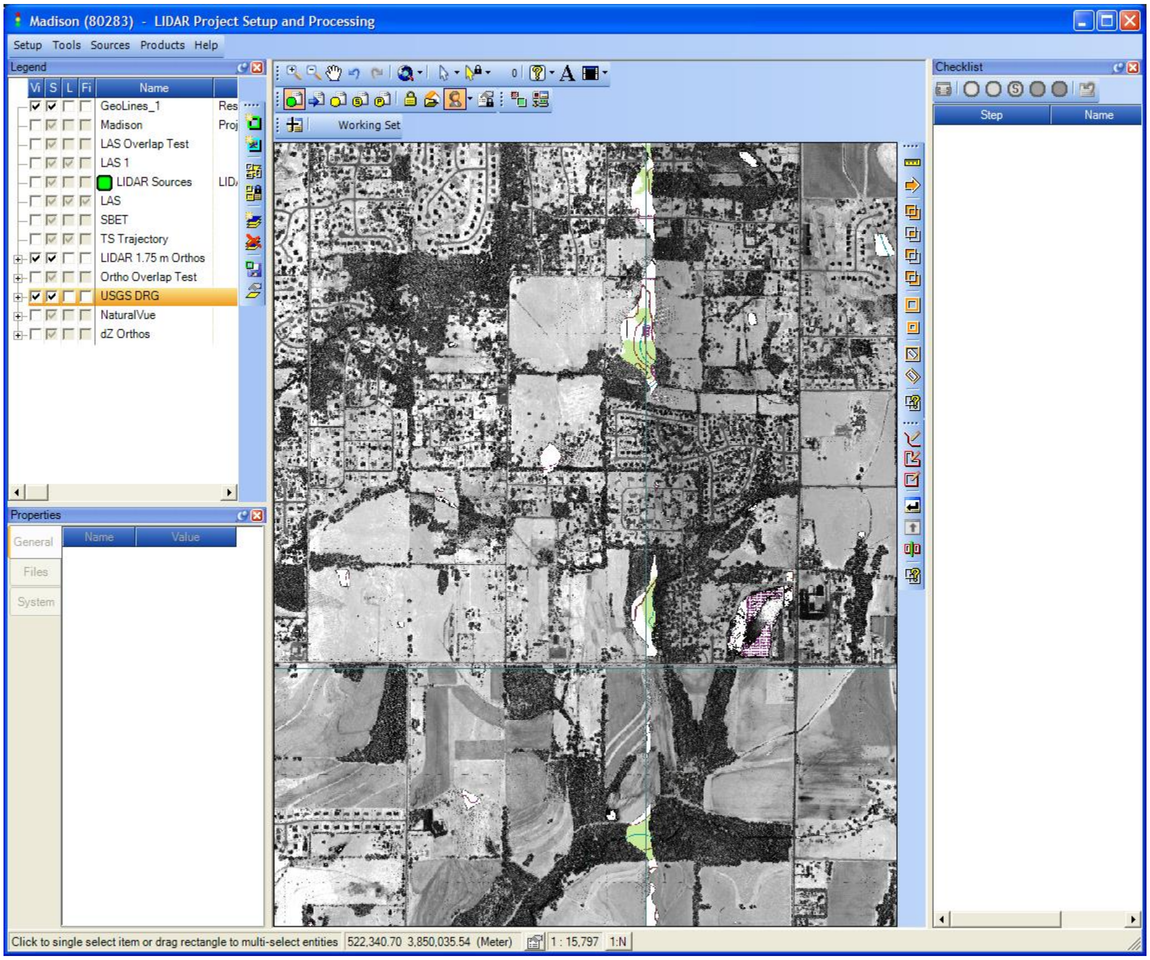


**Figure 12-23 DRG showing through LIDAR 'voids'**

An even better technique of visualizing the areas of voids in LIDAR data is to turn off all layers except the LIDAR Ortho raster layer. Now, using the background color changer tool on the View toolbar, select a dramatic color such as red. You will clearly see the LIDAR voids. This is depicted in Figure 12-24.

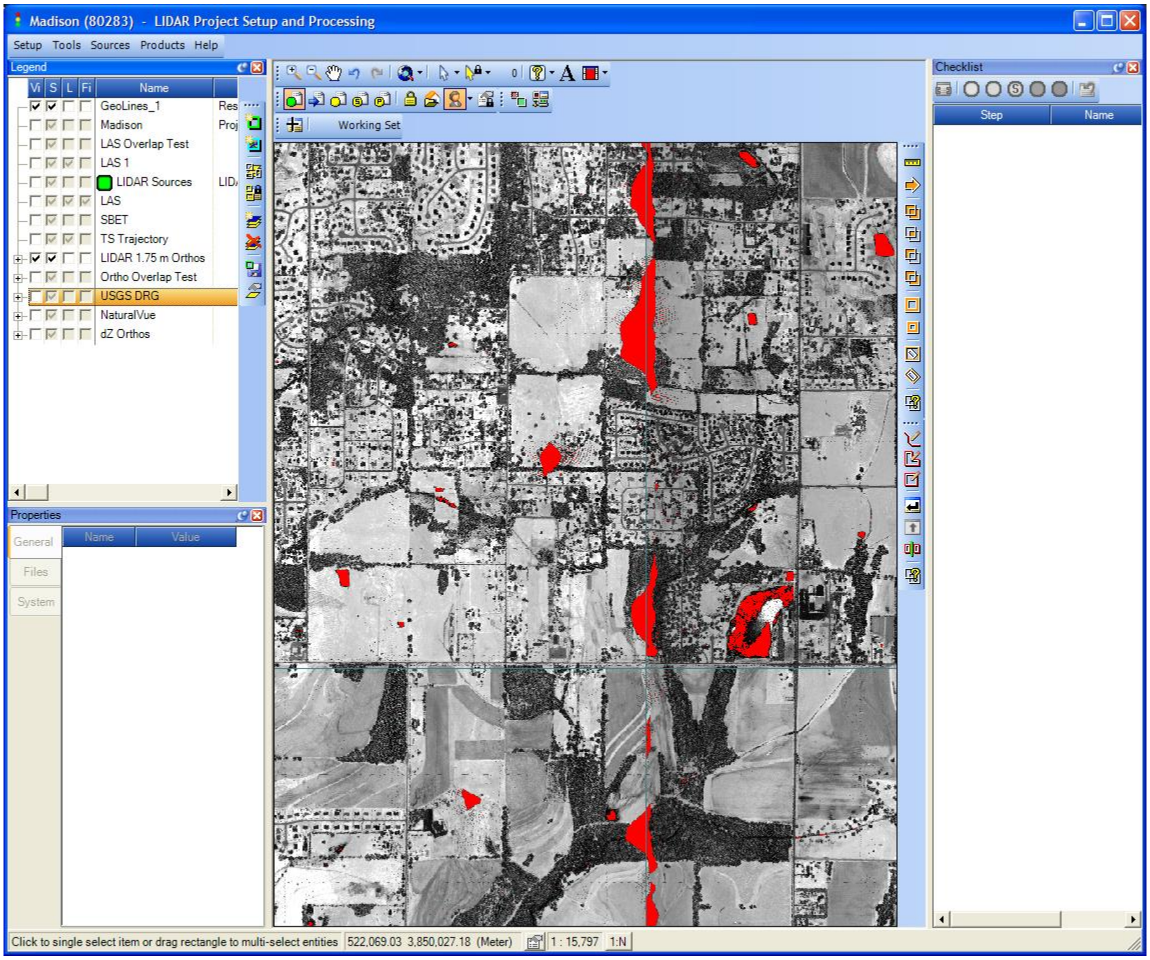



**Figure 12-24 Using Map View background color to highlight voids**

It is apparent that backdrop imagery can provide rich analysis context for LIDAR analysis. Earth Satellite Corporation has generously provided us a sample NaturalVue LANDSAT image of the Madison project area. We reprojected this image to NAD 83 to allow superimposition and simultaneous display of the LIDAR Ortho.

Create a new raster layer in NAD 83, UTM Zone 16N and import the NaturalVue image (it is in the NaturalVue folder in your Sample Data). Move this layer to the bottom of the legend if it does not load in this position. Turn off all layers except the LIDAR Ortho and the NaturalVue.

You should have a display similar to Figure 12-25. Notice how the image not only provides good location information (where is the LIDAR project situated) but also provides good fill-in for water areas. Notice how you can see through the LIDAR voids into the NaturalVue over the Tennessee River in Figure 12-25.

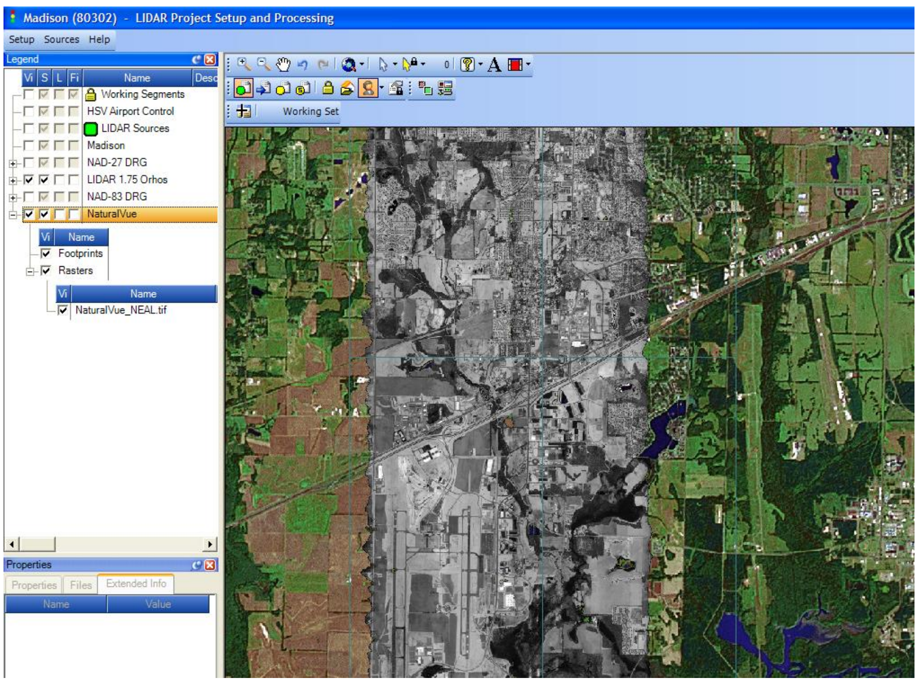



**Figure 12-25 NaturalVue with LIDAR Ortho**

## 12.2 Navigating with the Coverage Image

The coverage image created in the previous section can be used in combination with the Working Segments (from which the images were produced) and PointVue to quickly assess suspicious areas of coverage.

Turn off all vectors in the display by toggling off their (V)isibility toggle in the Legend. (turn off the display of the LIDAR Ortho footprints by deactivating the **V**isibility toggle on the footprint layer of the composite LIDAR Orthos). Deactivate all raster displays except the LIDAR Ortho layer. Set the Map View background color to Red. Pan around in the LIDAR Ortho image and you will note an area where the roll angle was such that there appear to be significant gaps between two fight lines (Figure 12-26).

Now turn on the visibility of the LAS Working Segments and *Select* one of the LAS Working Segments (remember that we named this layer "LAS 1" when it was created) that surrounds an area of the anomaly. If you set up your project identically to the example of the workflows of this document, the segment will be "B1-232". Add this selected tile to the Working Set. The selected tile is depicted in Figure 12-27. Activate the Process Step Checklist pane, select the Initial QC step and press the In-Progress button. This will activate PointVue (or your own viewer if you have customized this step). PointVue will now load with the indicated segment.

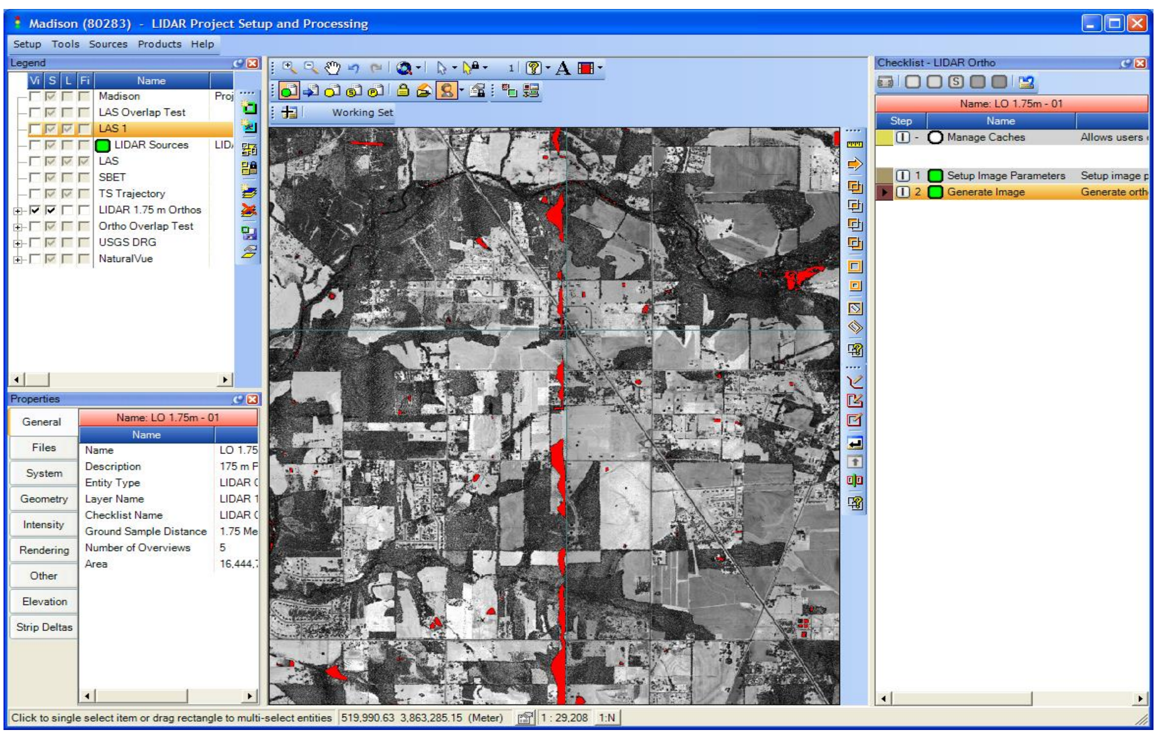



**Figure 12-26 An apparent gap between flight lines**

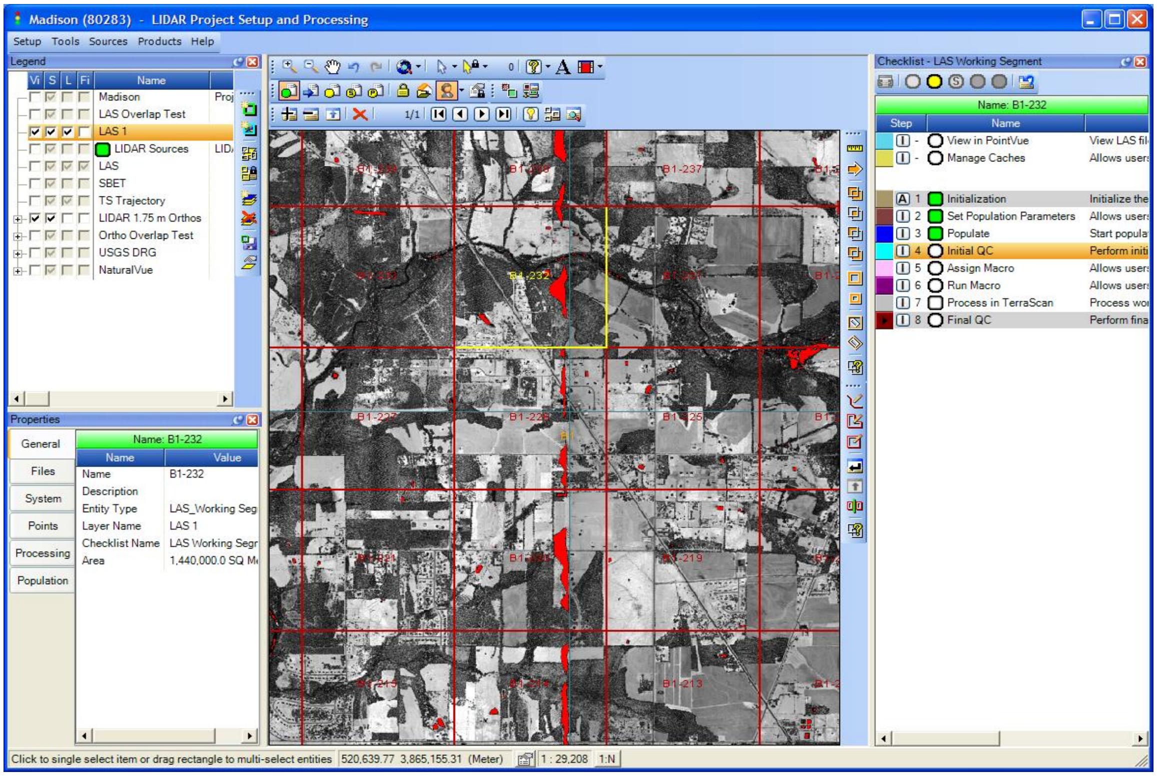



**Figure 12-27 Anomalous Working Tile added to the WSQ**

We have set the view setting in PointVue to color by return (the diagonal strip icon). Note that we can clearly see that the problem is due to a coverage gap rather than an effect such as mirror reflectance from water (Figure 12-28).

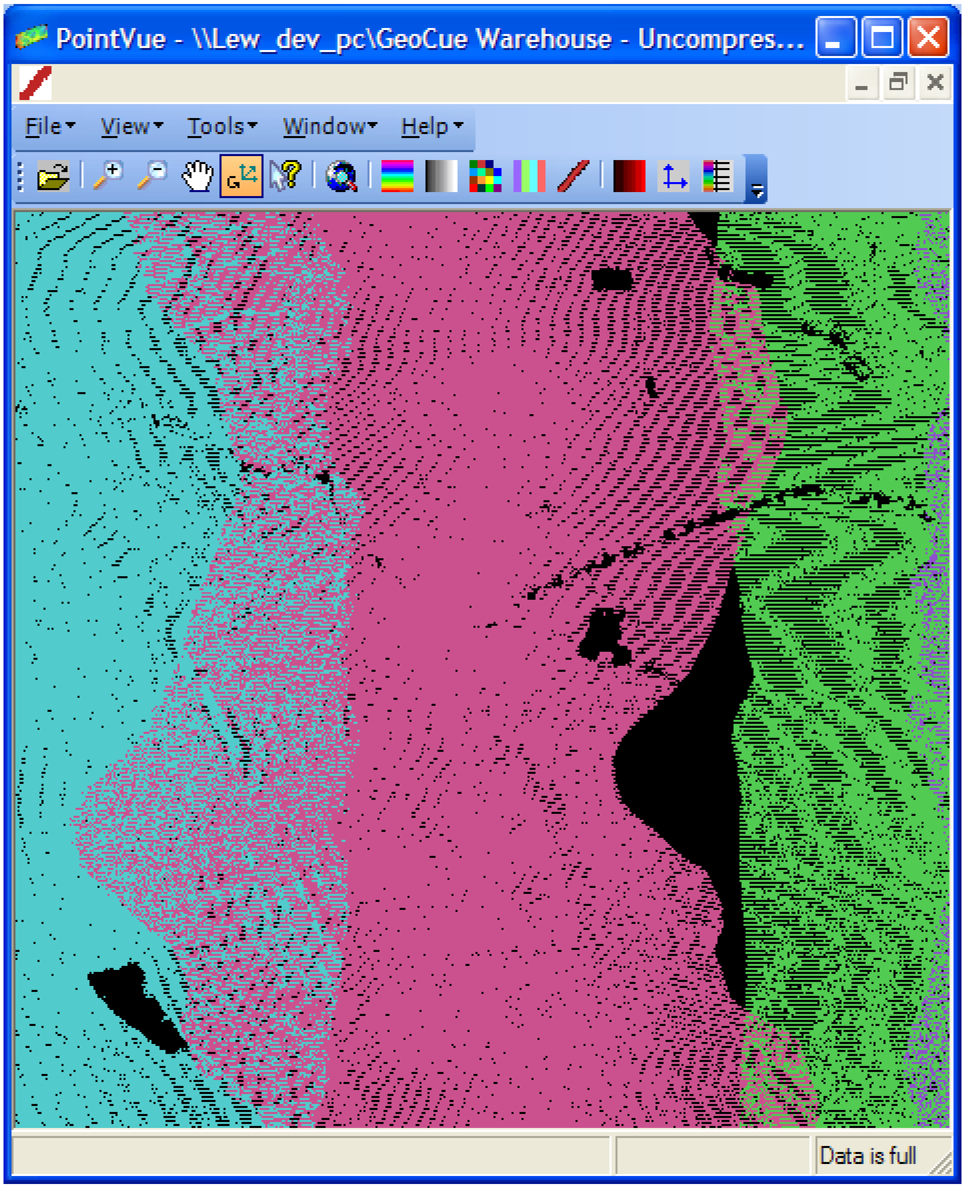



**Figure 12-28 Color by Return in PointVue**

Dismiss PointVue and set the Checklist Step completion status to Complete.

## 12.3 Generating Delta Z Images

Delta Z (or dZ) images are very useful for doing a quick assessment of the quality of the relative height match between overlapping strips. In a perfectly calibrated system with perfect GPS/INS data, we should never see a difference in height where strips overlap. Why should we? – the points represent exactly the same ground location.

In this exercise, we will generate dZ images for our entire Madison sample project.

### 12.3.1 Create the dZ Ortho Layer and Entities

First create a new layer in the project coordinate system called “dZ Orthos” and of type “LIDAR_Ortho RASTER”.

Next create LIDAR Ortho raster entities on this new layer using the previously created grid of orthos as a template. Name these new entities “dZ-“. This step is accomplished by *Selecting* all of the entities on the LIDAR 1.75 m Orthos layer. Now select the new dZ Ortho layer and press the Create Entity tool. Set the name field to “dZ-“ and use the *Placement Method* Selected Entities Geometry. Finally, press **Create Entity.**

At this point you should have a set of rectangular orthos (12 rows, 2 columns) with a layout identical to the 1.75m Orthos we previously created.

### 12.3.2 Setting the Image Parameters

Select all of the dZ orthos into the Working Set, press the Multi-Entity Mode and set the *Setup Image Parameters* step to *In Progress.* This will invoke the Set Image Parameters dialog. Set the parameters in the ***General*** tab as shown in Figure 12-29. Note that when you select Color by Z Differences, the Rasterization mode automatically sets to Insertion. This is currently the only method supported for this image generation technique.

Make sure you have correctly set the *Segment Layer* to "LAS 1", the LAS Working Segment layer that we populated from the Madison flight lines. Also note that we selected 3.0 meters as the Ground Sample Distance for our dZ orthos.

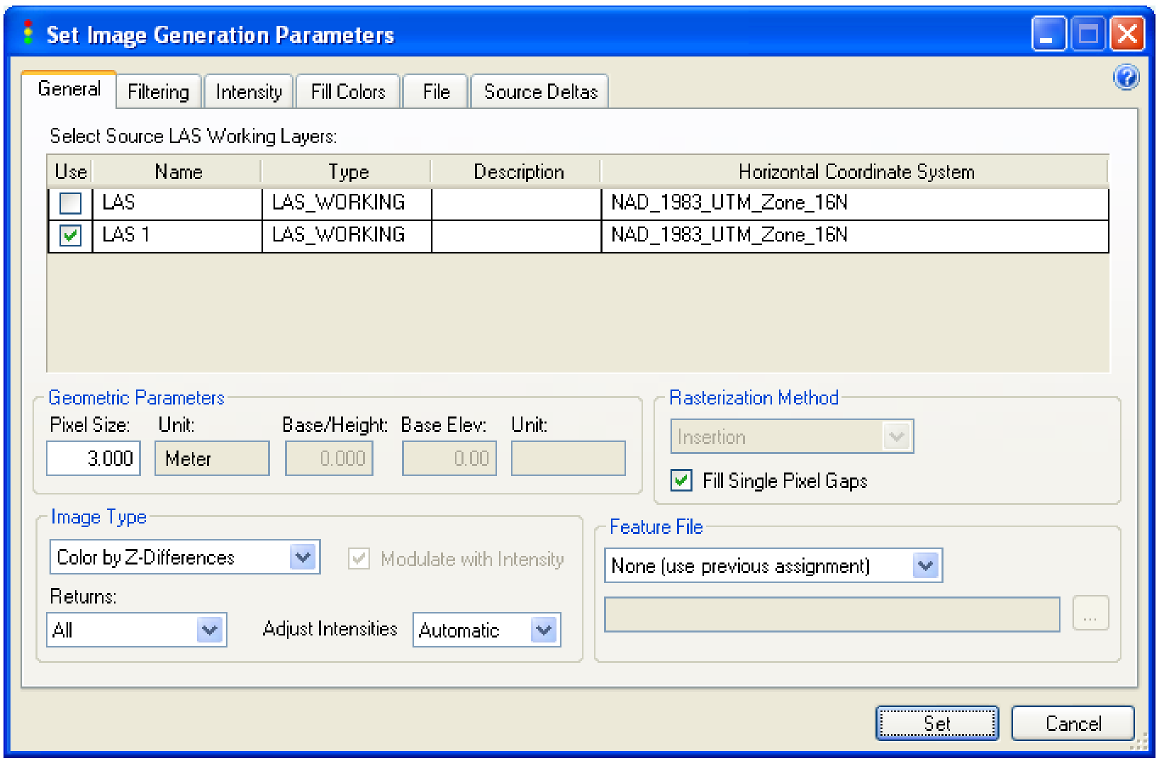



**Figure 12-29 The General settings for our dZ images**

Next select the Source Deltas tab. We will choose the default setting shown in Figure 12-30 for our initial images. After ensuring that your settings are correct, press the **Set** button at the bottom of the Set Image Generation Parameters dialog.

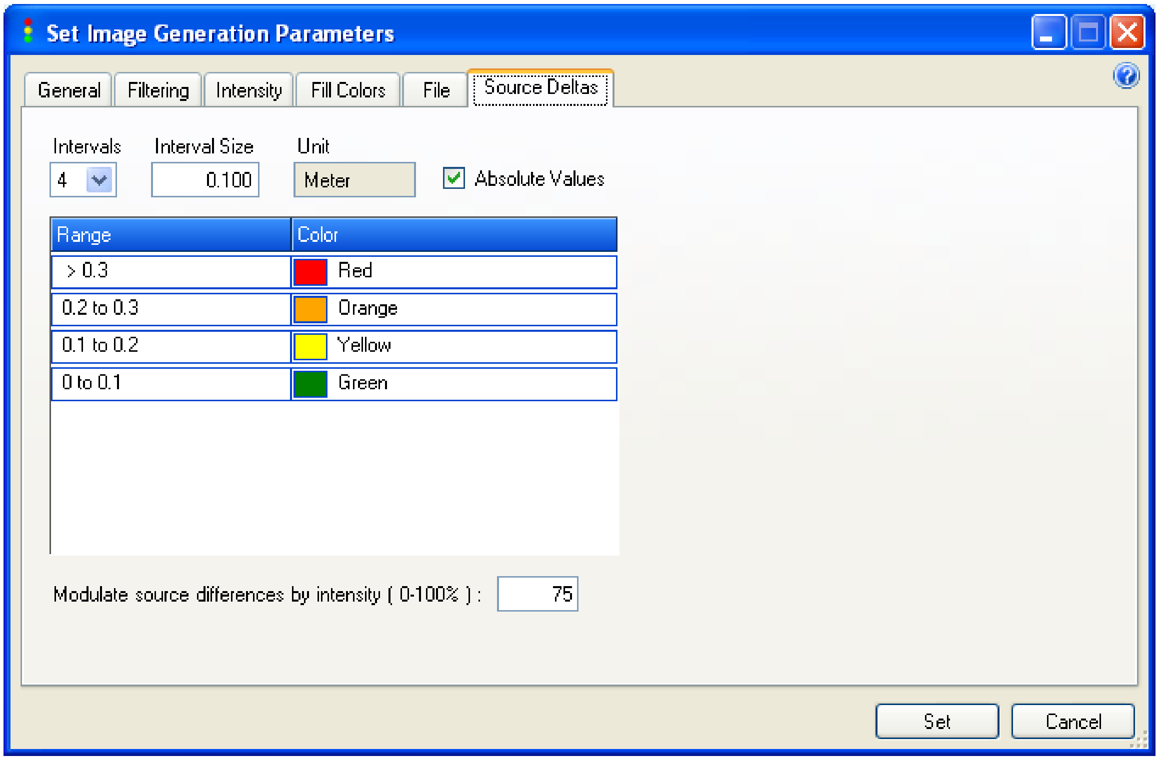



**Figure 12-30 The Source Deltas settings for our dZ Orthos**

### 12.3.3 Generating the Images

Press the Restore to Working Set button on the Checklist toolbar, choose the Multi-Entity mode and set the *Generate Image* step to *In Progress*. Your dZ images will now be generated as a background process (or possibly dispatched if you have GeoCue Enterprise).

#### 12.3.3.1 Interpreting the dZ Images

In Figure 12-31 we show an area of the dZ image in the Huntsville Airport region. Recall our color coding scheme (Figure 12-30).

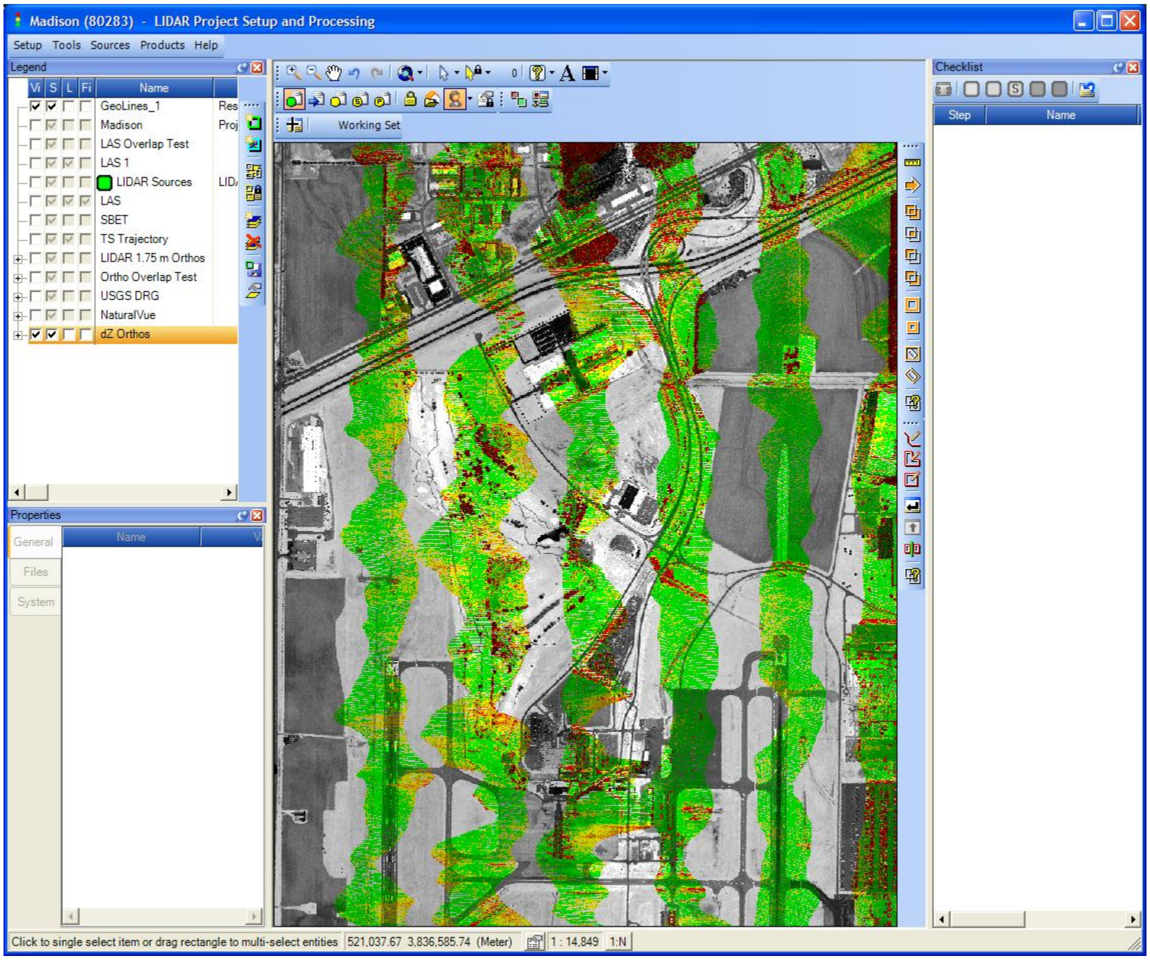



**Figure 12-31 A dZ image in the Huntsville Airport area**

Areas of this image that are green indicate differences between strips of less than 10 cm. Areas in yellow indicate differences between strips of between 10 cm and 20 cm and so forth. Areas that are still in gray scale are areas where no two LIDAR strips overlap (and thus the image shows data from the single LIDAR strip).

Note that areas at the edges of flight lines tend to show a greater Z deviation that do those near the centers. This is typically caused by mirror scale effect. It is most easily cured by setting your LIDAR post processing software to clip the last degree or two of the strip edges. Also note red areas over vegetation. This is caused by some returns reflecting from the ground, some from mid-leaf, some from top leaf and so forth. This condition is normal. Generally areas outside of the extremity of strip edges and on flat surfaces that show significant dZ deviation are areas of concern. These should be further examined in a LIDAR adjustment tool such as TerraMatch.

***CAUTION*** – dZ images are simply a way to perform a quick check of the *relative* vertical fit between overlapping LIDAR flight lines. They should *never* be used as a substitute for quantitative quality assessment tools.

dZ images tell you nothing about the *absolute* accuracy of LIDAR data. A set of flight lines could have perfect vertical fit relative to one another yet still have a systematic error of several meters! Absolute vertical error is *very* common in LIDAR data. Absolute vertical accuracy can only be tested by using independent survey control.

## 12.4 Generating Color by Classification Images

You can generate color images (both ortho and stereo) using the LIDAR classification mapping table. The color ortho images are very useful for obtaining a synoptic view of the classification coverage of a project. The stereo color classification images are very useful for quickly assessing the quality of classification since you can make stereo images that cover very large project areas and then use a photogrammetric display platform for roaming the images.

The color classification images created in this version of GeoCue are created with the same basic "poking" algorithm described in the section on LIDAR Ortho generation. However, in generating color images you are able to specify a *priority* to allow the system to decide which color to make a pixel when two or more LIDAR points intersect the same portion of the image grid. When two LIDAR points land in the same image grid location, the classification with the higher *priority* will take precedence.

In this release of GeoCue, we use PointVue to assign classification colors and priorities.

### 12.4.1 Preparing a Sample Project

The Madison data set has not been classified (other than second returns being pre-classified as vegetation) and therefore we will use the Helsinki data set (provided courtesy of TerraSolid, OY) for this example.

Create a new project with a horizontal coordinate system of Finland_Zone_2 and a vertical system of ellipsoid meters. Import the 4 LIDAR strips (the Helsinki LIDAR strips are located in the Sample Data set directory in the folder "Helsinki"). Define an area for the project boundary and create LAS working segments. Populate the working segments. We built our project by:

1. Creating a new project (H = Finland Zone 2, V = Ellipsoid Meters)
2. Importing the 4 LIDAR Strips
3. Using the GeoAnalysis tools to create a Minimum Area Bounding Rectangle (MABR) of the LIDAR strips
4. Use the MABR as a template to create an LAS Working Boundary on a new LAS_Working layer
5. Use the checklist on the Boundary to create LAS Working Segments (we used the settings shown in Figure 12-32)
6. Populating the LAS Segments (via their checklist) and accepting the defaults on the population parameters dialog

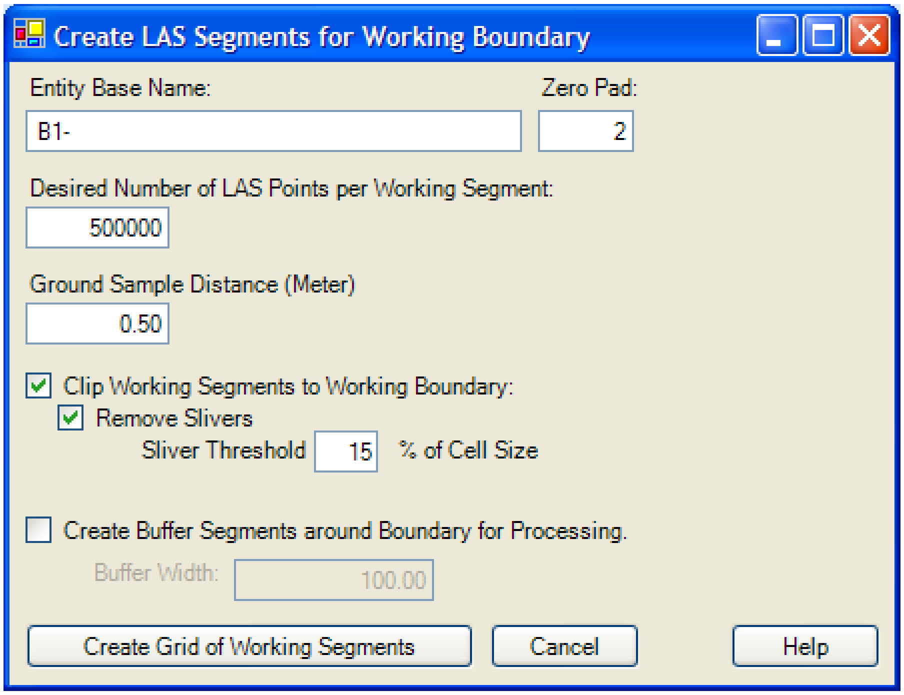



**Figure 12-32 Creating LAS Segments for the Helsinki project**

Note that the LAS working segment definitions that you use for your project do not need to look the same as ours so long as you cover a region of the data area. Our example project is depicted in Figure 12-33 (we activated the detailed footprint for our strip display).

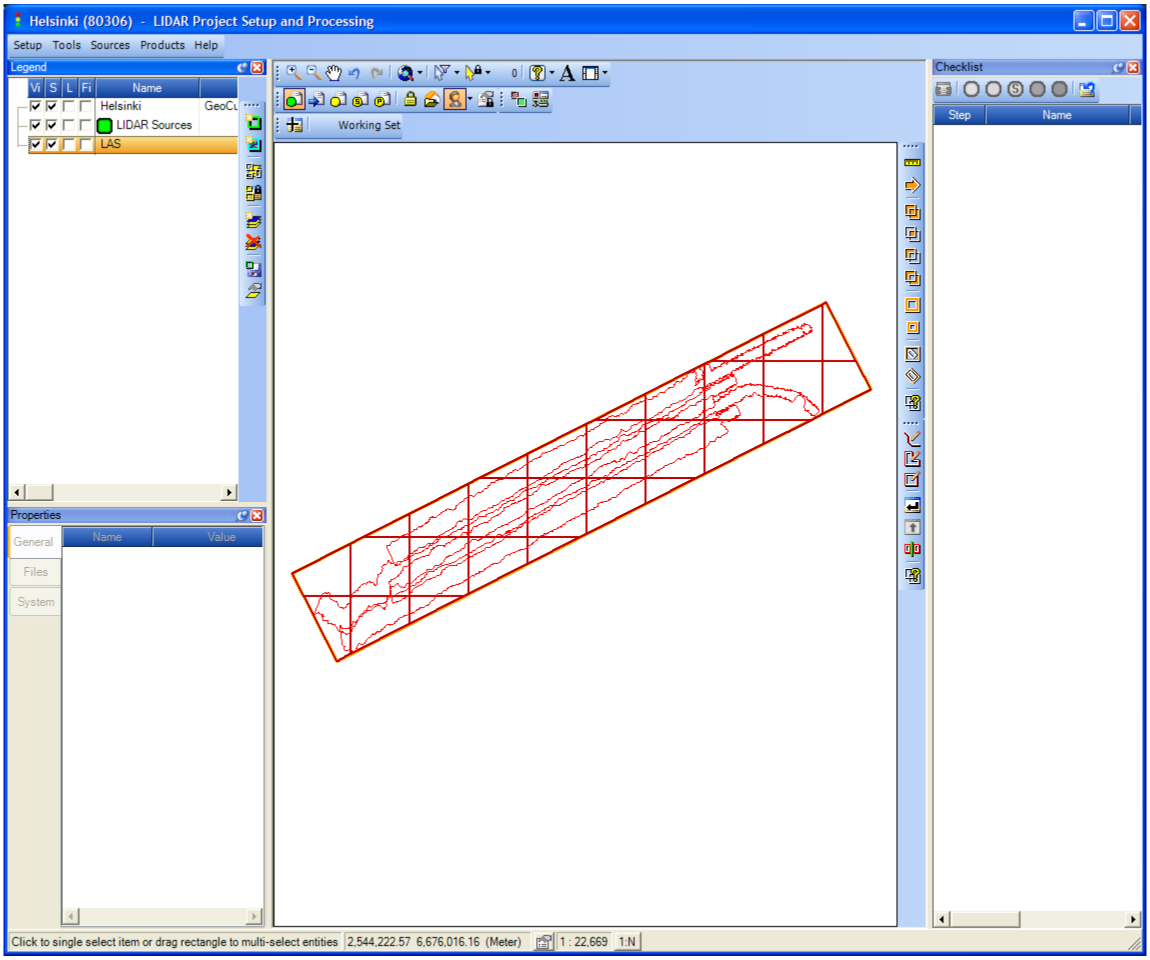



**Figure 12-33 The Helsinki project**

Build a Grayscale LIDAR Ortho of the project area (we simply created a single LIDAR Grayscale Ortho entity by selecting the LAS Working Boundary and choosing the option to create an entity using the geometry of the selected entity). Set the image generation parameters using the values depicted in Figure 12-34 with a ground sample distance of 0.75m (the Helsinki data have a GSD of about 0.6m). Use the image generation parameters depicted in Figure 12-34. Notice that we set *Automatic* as the *Adjust Intensities* option for this project.

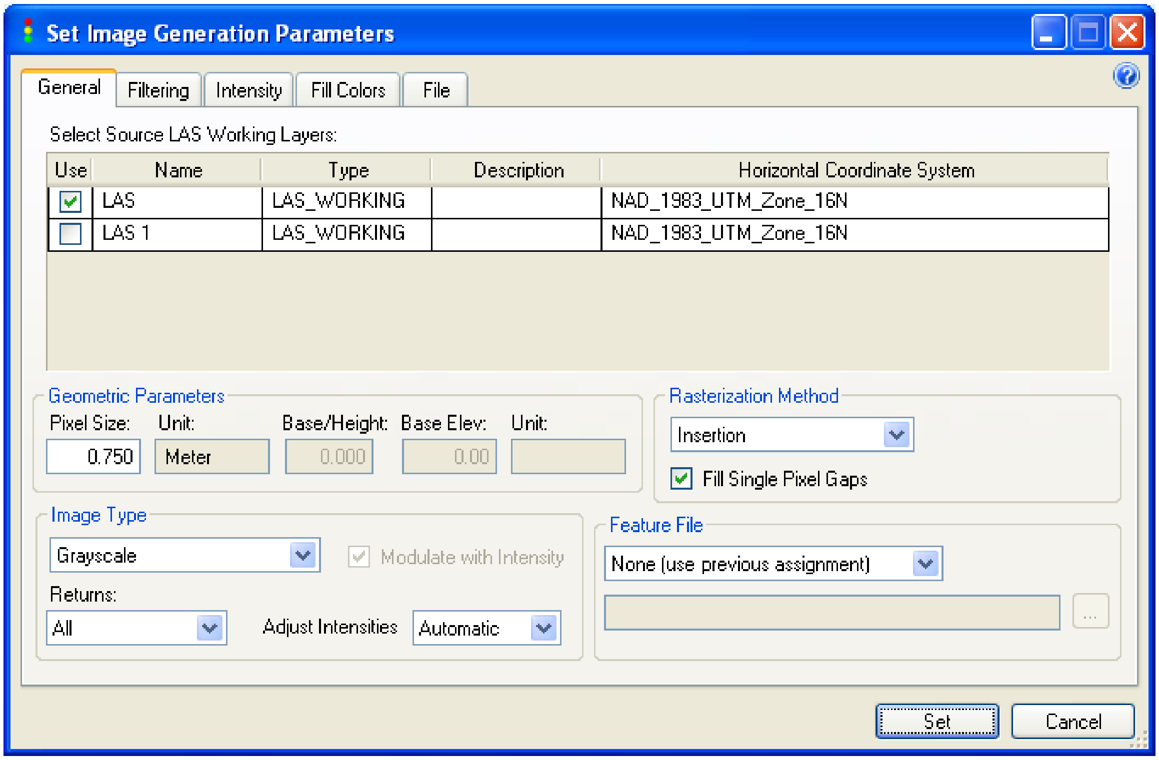



**Figure 12-34 Image generation parameters for the Helsinki panchromatic LIDAR ortho**

Ensure that raster display is activated for the legend entry for the LIDAR ortho and Generate the image (select the LIDAR ortho into the Working Set and process the second checklist entry). Your new ortho should display in the project. This first section of the exercise was simply to ensure that you have properly set up the Helsinki project and can successfully generate a LIDAR Ortho. Your generated image should resemble Figure 12-35

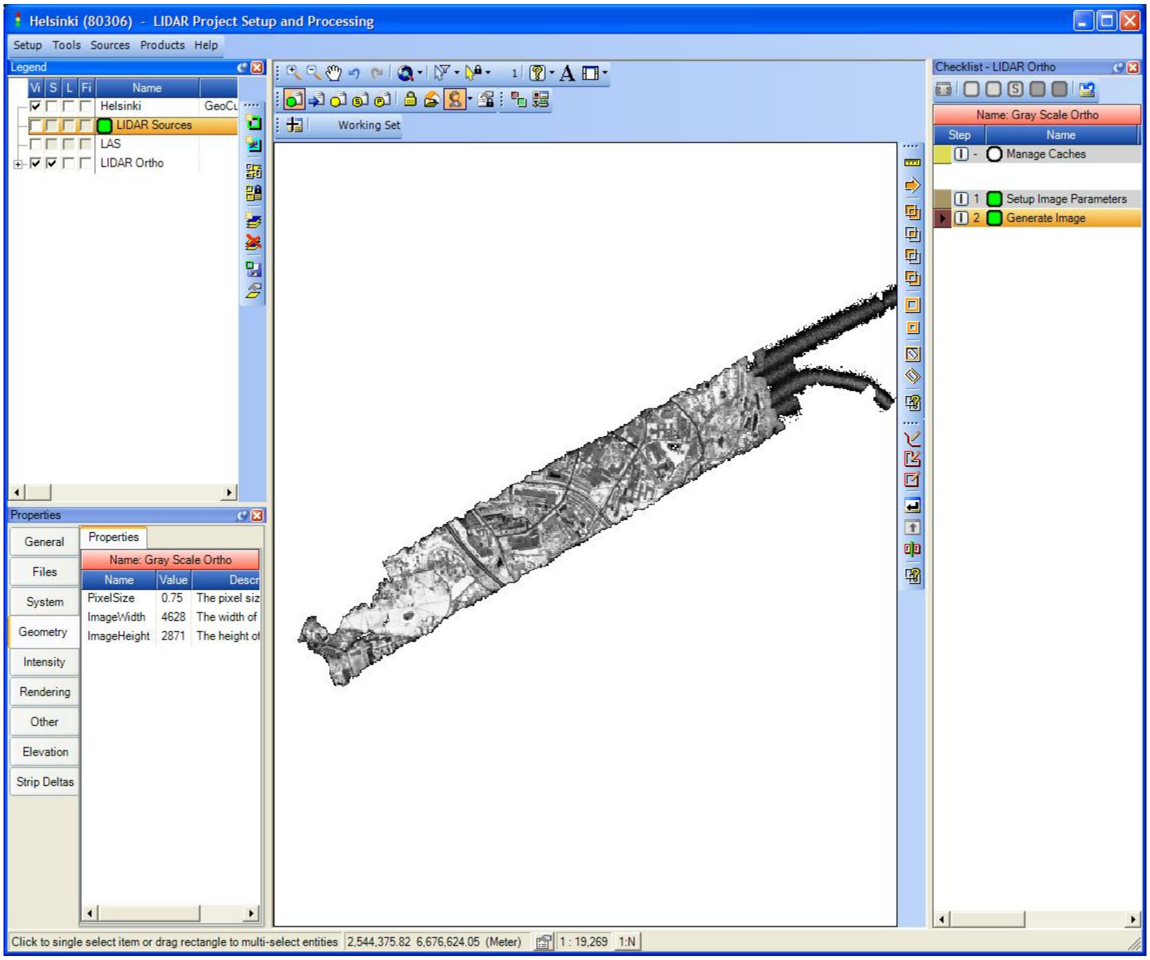



**Figure 12-35 The gray scale Helsinki image**

## 12.4.2 Generating the Color Image

You can generate color LIDAR orthos (as well as color stereo pairs) using the same procedures as outlined in the previous section.

Generate a new LIDAR Ortho entity on a new layer called Classification Orthos with Layer type of LIDAR_Ortho_Raster (you can place the color ortho on the layer on which you placed the panchromatic ortho but placing the color on a separate layer provides more control over display and selection). Create the new color ortho entity by *Selecting* the previous ortho, *Select* the Color Layer in the legend and press the *Create New Entity* tool on the layer toolbar. Name the new entity Color Ortho and choose the placement method *Use Selected Entities Geometry* (the create entity dialog is depicted in Figure 12-36).

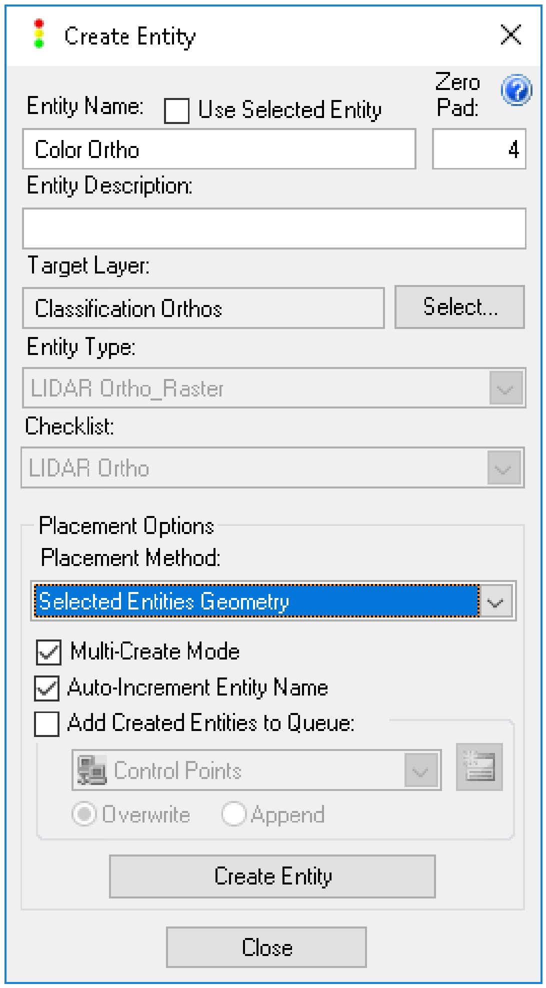



**Figure 12-36 Color Ortho Parameters**

Place the new entity in the Working Set and activate the *Setup Image Parameters* action. Now set the General parameters as shown in Figure 12-37. Note that we have set the *Geometric* and

*Adjust Intensities* parameters to the same values as for the panchromatic ortho. However, this time we have selected the Image Type as *Color by Classification*.

Note that the General tab of the *Set Image Generation Parameters* dialog also has an option called *Modulate Using Intensity*. Selecting this option causes the Image Generator to "modulate" the color with the value of the LIDAR intensity return. This option tends to enhance features within a classification image. Experiment with these parameters by generating an image, examining the result and then changing the parameters and repeating the process.

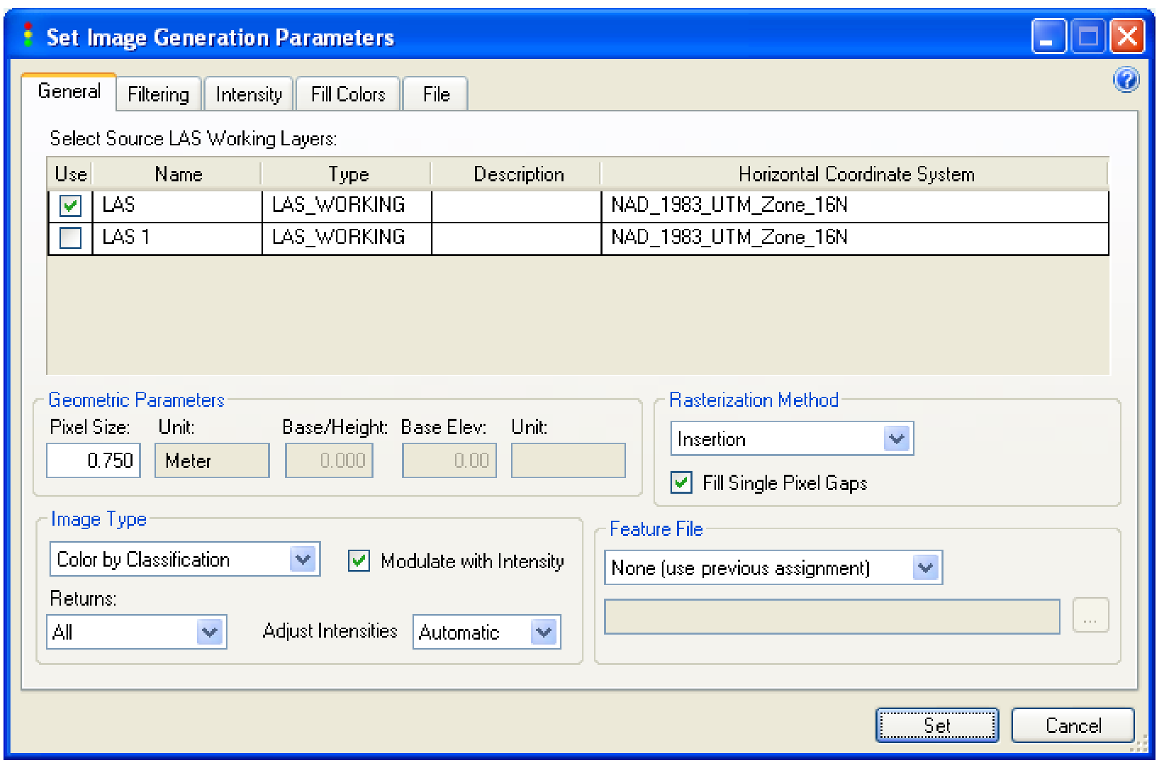



**Figure 12-37 Setting the color ortho parameters**

The colors used in generating LIDAR color images are set using the Settings dialog in PointVue. You would normally establish the color palette a single time for your company's project schemes and thus this is not something required each time you create a LIDAR project.

Bring up PointVue by selecting PointVue by pressing **Start PointVue** button in the lower left of the Image Parameters dialog. PointVue will be invoked with its View Settings dialog automatically displayed. Choose the *Classification* tab. You will see the dialog of Figure 12-38. Notice the column that allows you to set the Priority of the entry. The priority determines which classification will have priority if two or more LIDAR points fall into the same image cell (pixel); higher priority takes precedence. Thus if you set Ground to a priority of 1 and Buildings to a priority of 2, then Buildings will show rather than ground in any image cell containing both classes of LIDAR data. If you reverse these priorities then Ground will show under the same circumstances.

PointVue, when used with GeoCue, allows you to use any number of color and priority schemes. These schemes can be saved and retrieved from external files via the **Save…** and **Load…** buttons. A single storage is reserved within the GeoCue Server for use in LIDAR image generation within GeoCue. This storage is referred to as the *System Classmap*. Any time you want to see what the system scheme is, press **Load System Classmap.**

Press the **Load System Classmap** button*.* This loads the system-wide color classification and priority map that will be used in generating LIDAR Orthos and LIDAR stereo images. Feel free to make changes but remember that in this version of GeoCue, any changes that you make are applied globally (that is, to all projects). If you do change the settings, ensure that you save the new settings by pressing the **Save System Classmap** button when you are complete with setting the classification map.

Exit PointVue when you have completed your Class Map changes.

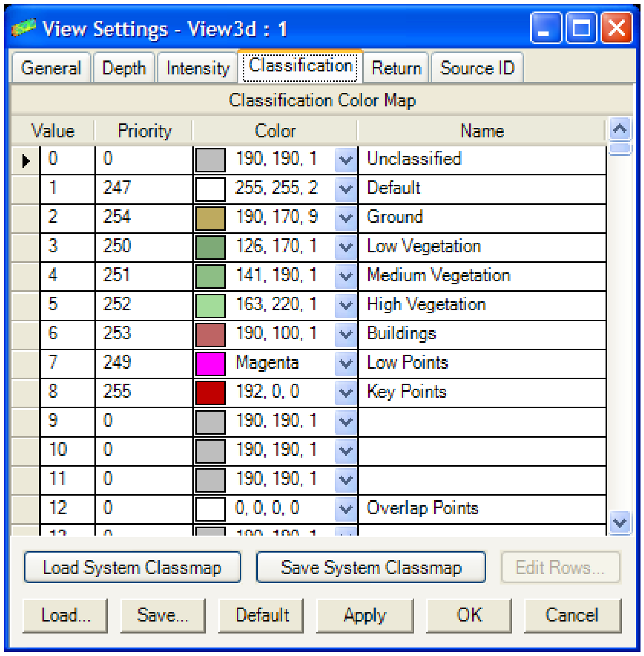



**Figure 12-38 Classification Settings in PointVue**

Select the *Class* tab of the Set Image Generation Parameters dialog. Select the option "Use Saved Entity Settings" and press the **Save System Map Settings to Entity** button (Figure 12-39). This process immediately reads the *System Classmap* discussed above and stores the settings with the ortho entity. The other option, "Use System Class Map Settings at Image Generation Time" defers loading the *System Classmap* until the LIDAR orthos are actually generated. If you often experiment with the *System Classmap*, you should select the option to save the settings with the entity. If, on the other hand, you have a company scheme for color and priority that does not change, you can leave the dialog set to the first option.

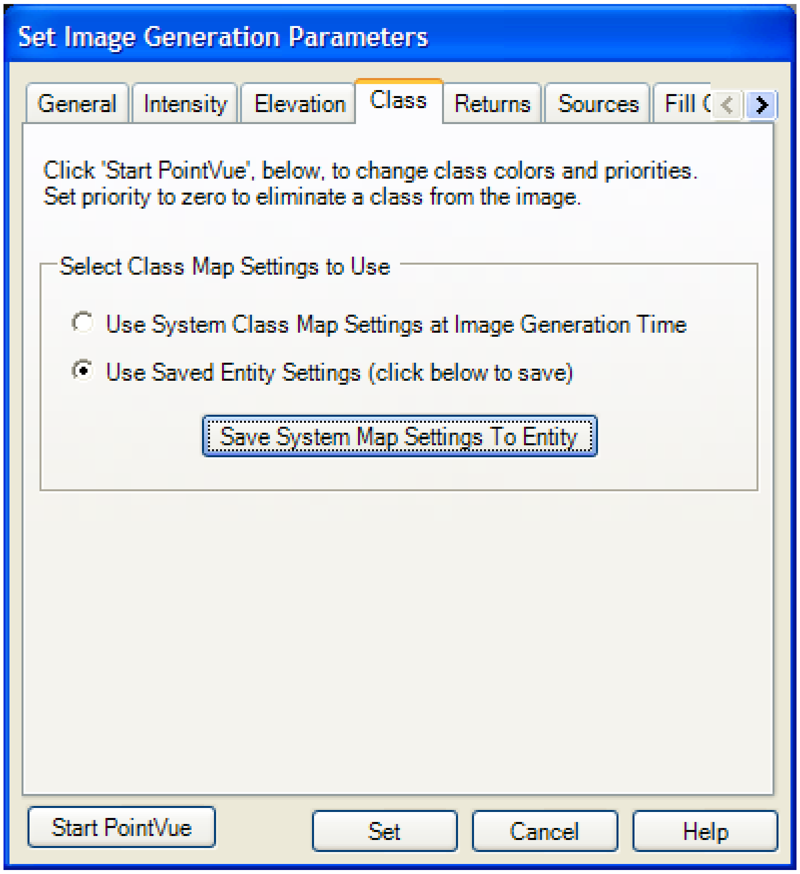



**Figure 12-39 The Class tab settings**

Generate the image using the same procedure as for the grayscale image and examine your results. They should appear similar to Figure 12-40 (don't forget to either move the previously generated gray scale image to the bottom of the legend or turn off visibility of that layer or you will not see your new image).

The data in the Helsinki sample data have been classified using a very rough automated macro. We did not attempt to do correct data classification so you will see many misclassifications!

You can also create other color orthos by choosing a different Image Type in the *Set Image Generation Parameters* dialog. Options are available for *Color by Elevation* and *Color by Source ID*, in addition to Color by Classification.  We encourage you to regenerate these images using various options in the image settings dialog.

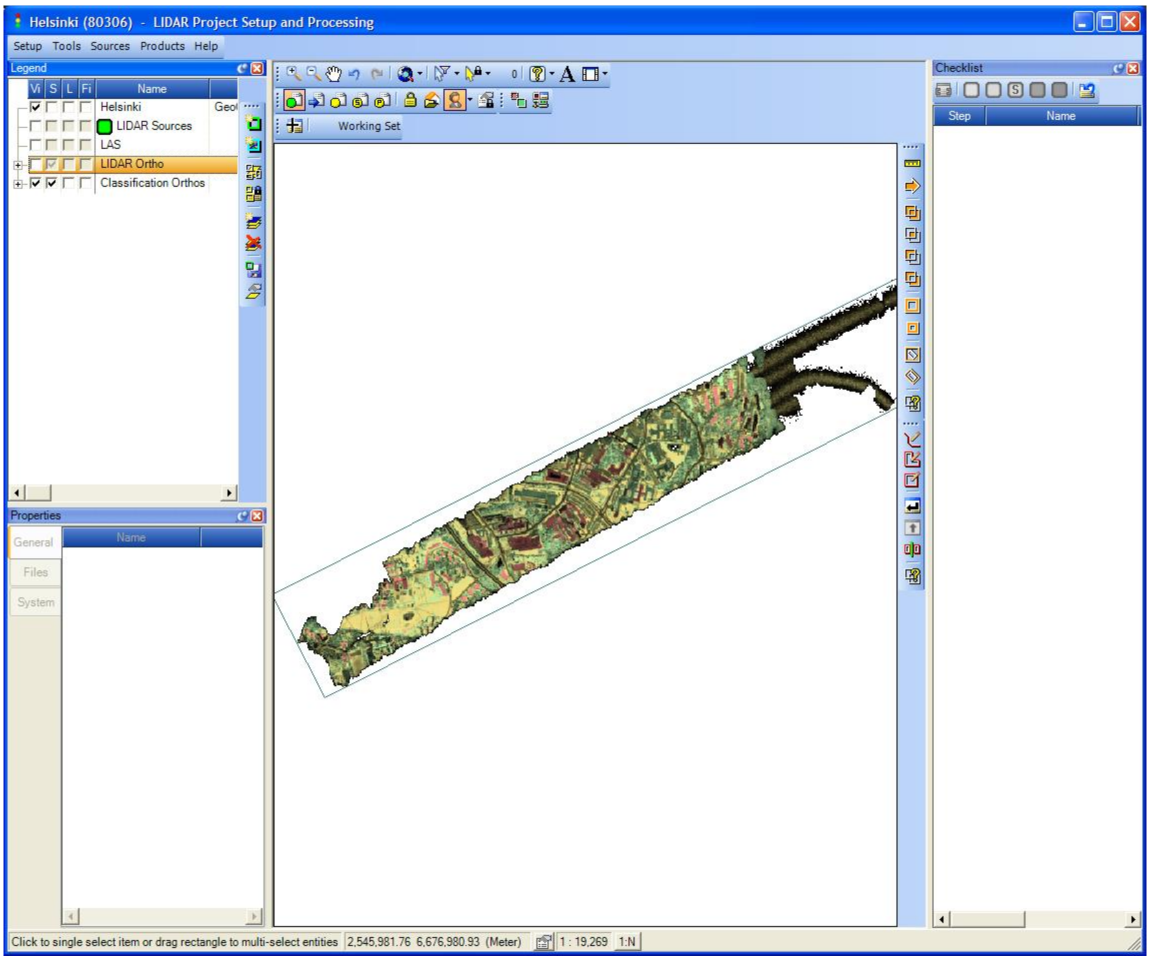



**Figure 12-40 A LIDAR Classification Ortho**

# 13 Quality Checking, History Logging

In this chapter we will go through the steps of Quality Check and Editing. The assumed editing environment for the LIDAR 1 CuePac workflow is TerraScan. The general flow is depicted in Figure 13-1

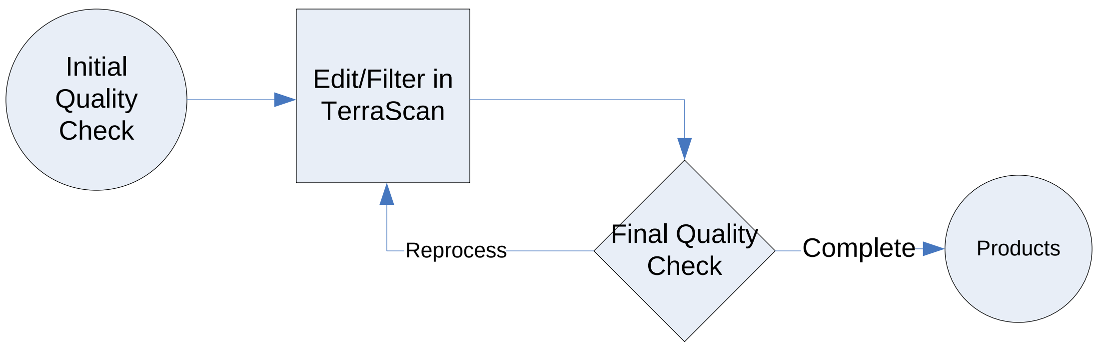



**Figure 13-1 Editing Workflow**

The primary advantage of GeoCue in this section of the workflow is that it takes care of coordinating the various Working Segments between multiple users. Through the status visualization and entity locking tools of GeoCue, it is easy to see at a glance the overall production status of working segments and to review the processing history. Additionally, of course, is the automatic locking that occurs when a segment is opened for review or edit.

Note – We recognize that this may not be your workflow. However, one of the major goals we have with the LIDAR 1 CuePac is to give you an overview of the base capabilities of the system. Remember that GeoCue is designed from the ground up to be tailored to individual workflows. With the *Environment Builder* tools included with GeoCue, you are able to modify the workflow in very easy and flexible ways.

## *13.1 Initial Quality Check*

In this first step of production we will use the viewer included with LIDAR 1 CuePac (***PointVue***) to visualize the data in working segments.

> ***Note*** – In all exercises in this chapter, clear the Working Set prior to adding entities unless we specifically state otherwise.

- Activate ***My Locks*** in the Symbology toolbar.  This will enable us to visualize the lock status of entities.

- Start up GeoCue with the project "Madison" and environment "LIDAR Setup and Processing[8]."

Select a working segment into your Working Set queue.  You should see the following checklist display (your readout will indicate whichever segment you selected).

[8] The environment ***Processing*** is a subset of ***Project Setup and Processing***.  You can use either environment for the exercises of this chapter.

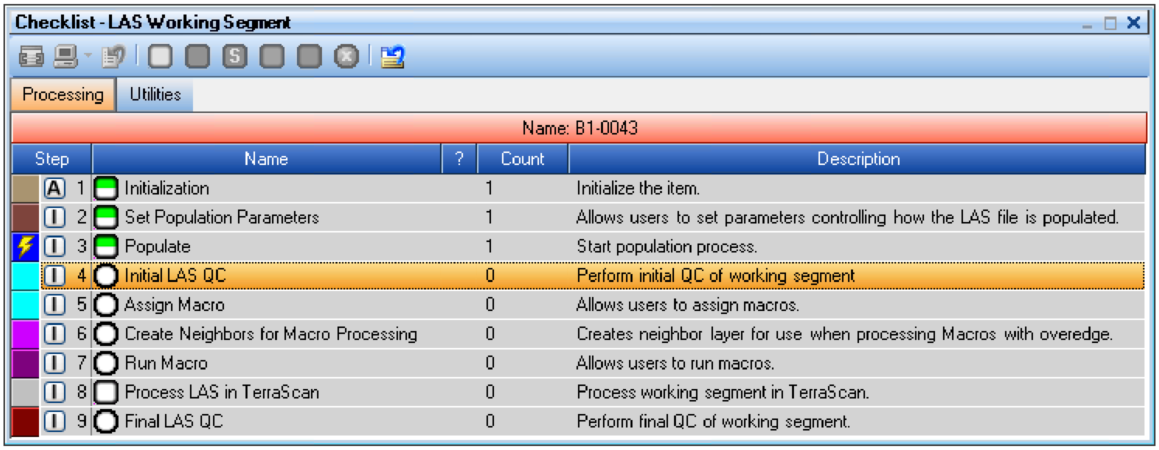



**Figure 13-2 Checklist with B1-173 in the Working Set**

***Note*** - Notice that there are a number of steps enabled in the checklist (white background as opposed to gray) When a checklist step somewhere back in the processing order (with respect to the ***Next Step***) is *actionable*, it means that the step can be "undone." Thus in Figure 13-2, *Set Population Parameters* could be re-executed. You may need to do this, for example, if you brought in new LIDAR data but did not want to have to redefine the working segments. You would simply import the LIDAR sources again (possible even on a different Layer) and re-run the step.

We want to re-emphasize that the checklists in GeoCue are not rigidly set, requiring changes from the manufacturer (us, in this case) to change the workflow. GeoCue *Environment Builder* includes a set of tools that allow you to graphically define checklists and the actions that each step will carry out.

- Select step 4 (*Initial QC)*.

***Note*** - Ensure that the Multi -Entity button is deactivated on the State Transition toolbar (actually it has no affect when there is only one entity in the Working Set but it is a good idea to develop the habit of checking this when carrying out processing steps.)

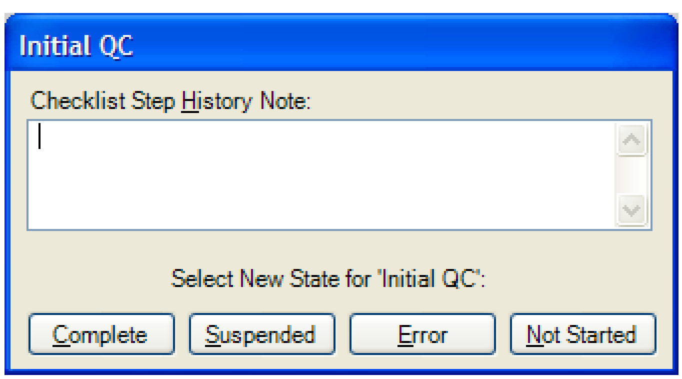
- Now press the ***In Progress*** state transition button. This will invoke ***PointVue*** with working segment loaded.

- Use tools within ***PointVue*** to manipulate and view the LIDAR data contained in the segment (See the on-line help for ***PointVue***).

***Multiuser*** – Perform the following on your remote workstation.

Turn on the Symbology for Working Sets of Others and Locks of Others. At this point you should see a bold purple outline around B1-173. Select B1-173 and inspect its properties. You will see that B1-173 is Locked. The properties will also tell you who has the lock (you, on your other workstation!). Try to add B1-173 to your Working Set.

- When you are finished, exit ***PointVue*** by either clicking the "x" in the upper left of the title bar or by selecting ***Exit*** from the ***File*** dropdown menu. You will be presented the following dialog:



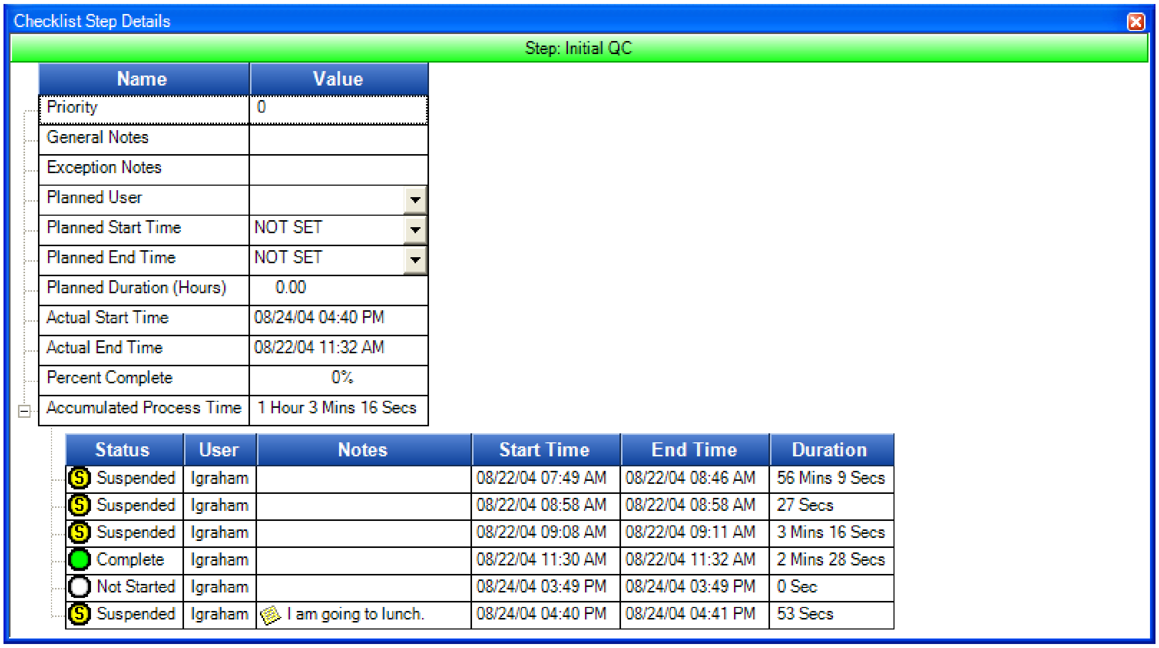
This dialog provides the interface for setting the current status of the checklist state that is being exited. The name of the checklist state is indicated in both the title bar of the dialog as well as the body of the interrogatory. You are provided an edit field to enter a comment in this dialog. The comment that you enter will be posted to the process step history tracking table row for this transaction.

- Enter a comment such as "I am going to lunch" in the History Note field

- Select Suspended as the new state

Now examine the checklist details for the *Initial QC* step of working segment B1-173. You should see a line of history recorded that notes the start, stop and login of the action. Our list appears as shown in Figure 13-3 (note that we have been in and out of this particular step numerous times!) The most recent history entry is always the last entry in the tracking log. Note that this is the entry in Figure 13-3 where we made our "going to lunch" comment.

> ***Note*** – The time during which the process step state setting dialog is displayed is recorded as time spent in the process step. For example, if you exit PointVue from an Initial QC state but do not check a state on the exit dialog for 5 minutes, the 5 minute interval will be added to the QC processing time.



Checklist Step Details

Step: Initial QC

| Name | Value |
|---|---|
| Priority | 0 |
| General Notes | |
| Exception Notes | |
| Planned User | |
| Planned Start Time | NOT SET |
| Planned End Time | NOT SET |
| Planned Duration (Hours) | 0.00 |
| Actual Start Time | 08/24/04 04:40 PM |
| Actual End Time | 08/22/04 11:32 AM |
| Percent Complete | 0% |
| Accumulated Process Time | 1 Hour 3 Mins 16 Secs |

| Status | User | Notes | Start Time | End Time | Duration |
|---|---|---|---|---|---|
| Suspended | lgraham | | 08/22/04 07:49 AM | 08/22/04 08:46 AM | 56 Mins 9 Secs |
| Suspended | lgraham | | 08/22/04 08:58 AM | 08/22/04 08:58 AM | 27 Secs |
| Suspended | lgraham | | 08/22/04 09:08 AM | 08/22/04 09:11 AM | 3 Mins 16 Secs |
| Complete | lgraham | | 08/22/04 11:30 AM | 08/22/04 11:32 AM | 2 Mins 28 Secs |
| Not Started | lgraham | | 08/24/04 03:49 PM | 08/24/04 03:49 PM | 0 Sec |
| Suspended | lgraham | I am going to lunch. | 08/24/04 04:40 PM | 08/24/04 04:41 PM | 53 Secs |

**Figure 13-3  Checklist details for Initial QC of WS-0001**

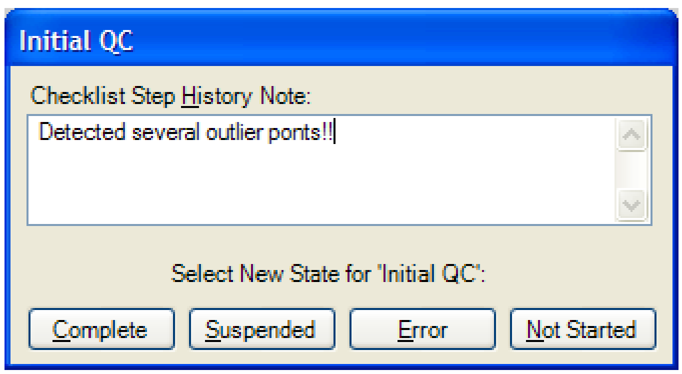
- Repeat the steps above select *Complete* in the process step exit status dialog.

If you now examine the process step history, you will see a second entry in the history.  The recording and tracking features of GeoCue are covered in more detail in a later chapter.

> Note – It is very useful to add a production history note (it should probably be *mandatory* for an error exit status) for transition states other than COMPLETE. Remember that all users can view the production history in real time.  Thus if a first shift operator suspends processing on a working segment because his shift is over, he can add notes about exactly where he was in production in this comment.  The next shift operator can pick up production where it left off with a good indication of the production state.

## 13.2 Setting an Error

- Again clear the Working Set and add B1-173 to the Working Set
- Select "Initial QC" in its checklist and press the IN PROGRESS state transition button. This will bring you into PointVue with B1-173 displayed.
- Exit PointVue but this time insert the comment "Detected several outlier points!!" in the History Note field:




- This time press the Error button on the dialog.

Notice that the checklist step indicator for B1-173, step 4 indicates Error. Also note that the fill symbology for B1-173 immediately turned red. We have reserved the red fill color as the error enunciator.

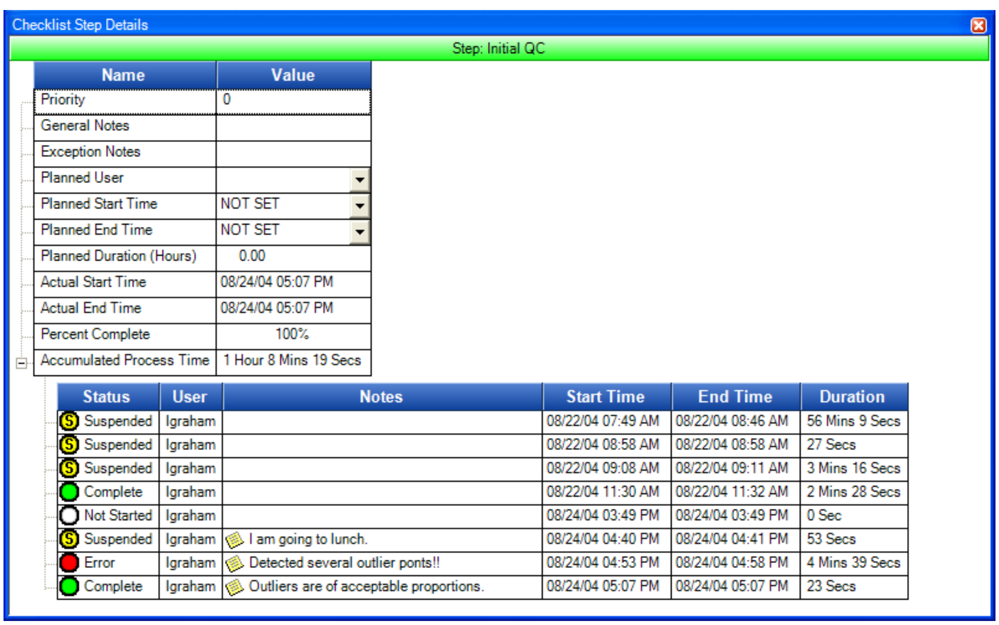
***Multiuser*** – Bring up the project on your remote workstation. Turn off all symbology (via the symbology toolbar tools). Make sure all layers are on.

Notice that the fill symbology for ***Error*** shows through, even with fill symbology turned off. We designed GeoCue such that error conditions would penetrate all other symbologies. Select the entity indicating the error and double click the checklist step flagged with the error state (B1-173, Step 4). Note that the error message is listed in the history log associated with the history step marked as an error.

Thus you can see that error conditions are immediately evident project-wide and figuring out why the error was declared is immediately available without tracking anyone down (now if solving the error were only just as easy!!)

Select B1-173 into your Working Set again, select Step 4 and press the IN PROGRESS state transition button. After PointVue comes up, exit, note the History Note as “Outliers are of acceptable proportions” and select Complete. Notice that the error fill condition immediately clears.

Bring up the checklist details pane for Step 4 of entity B1-173. Note that even though the checklist state indicates successful completion, the history log records the details of the error (see Figure 13-4).



Checklist Step Details

Step: Initial QC

| Name | Value |
|---|---|
| Priority | 0 |
| General Notes | |
| Exception Notes | |
| Planned User | |
| Planned Start Time | NOT SET |
| Planned End Time | NOT SET |
| Planned Duration (Hours) | 0.00 |
| Actual Start Time | 08/24/04 05:07 PM |
| Actual End Time | 08/24/04 05:07 PM |
| Percent Complete | 100% |
| Accumulated Process Time | 1 Hour 8 Mins 19 Secs |

| Status | User | Notes | Start Time | End Time | Duration |
|---|---|---|---|---|---|
| Suspended | lgraham | | 08/22/04 07:49 AM | 08/22/04 08:46 AM | 56 Mins 9 Secs |
| Suspended | lgraham | | 08/22/04 08:58 AM | 08/22/04 08:58 AM | 27 Secs |
| Suspended | lgraham | | 08/22/04 09:08 AM | 08/22/04 09:11 AM | 3 Mins 16 Secs |
| Complete | lgraham | | 08/22/04 11:30 AM | 08/22/04 11:32 AM | 2 Mins 28 Secs |
| Not Started | lgraham | | 08/24/04 03:49 PM | 08/24/04 03:49 PM | 0 Sec |
| Suspended | lgraham | I am going to lunch. | 08/24/04 04:40 PM | 08/24/04 04:41 PM | 53 Secs |
| Error | lgraham | Detected several outlier ponts!! | 08/24/04 04:53 PM | 08/24/04 04:58 PM | 4 Mins 39 Secs |
| Complete | lgraham | Outliers are of acceptable proportions. | 08/24/04 05:07 PM | 08/24/04 05:07 PM | 23 Secs |

**Figure 13-4 Clearing the error in WS-1 does not erase history**

# 14 Processing in TerraScan

In this section we will examine processing LAS Working Segments in TerraScan (we will skip the optional Assign and Process Macro steps for now).

> NOTE – We used the terminology "LAS Working Segment", "LAS Segment" or "Segment" to mean units of processing for LAS format data. TerraScan (a product of Terrasolid, LTD) uses the terminology "Block." When working with TerraScan using LIDAR 1 CuePac tools, these terms all mean the same thing.

## *14.1 TerraScan Processing Options*

LIDAR 1 CuePac provides several options for invoking TerraScan. Open the LIDAR 1 CuePac Options dialog from the top-level ***Setup*** ► ***Options*** ► ***LIDAR 1 CuePac*** command path. You will be presented with the dialog of Figure 14-1.

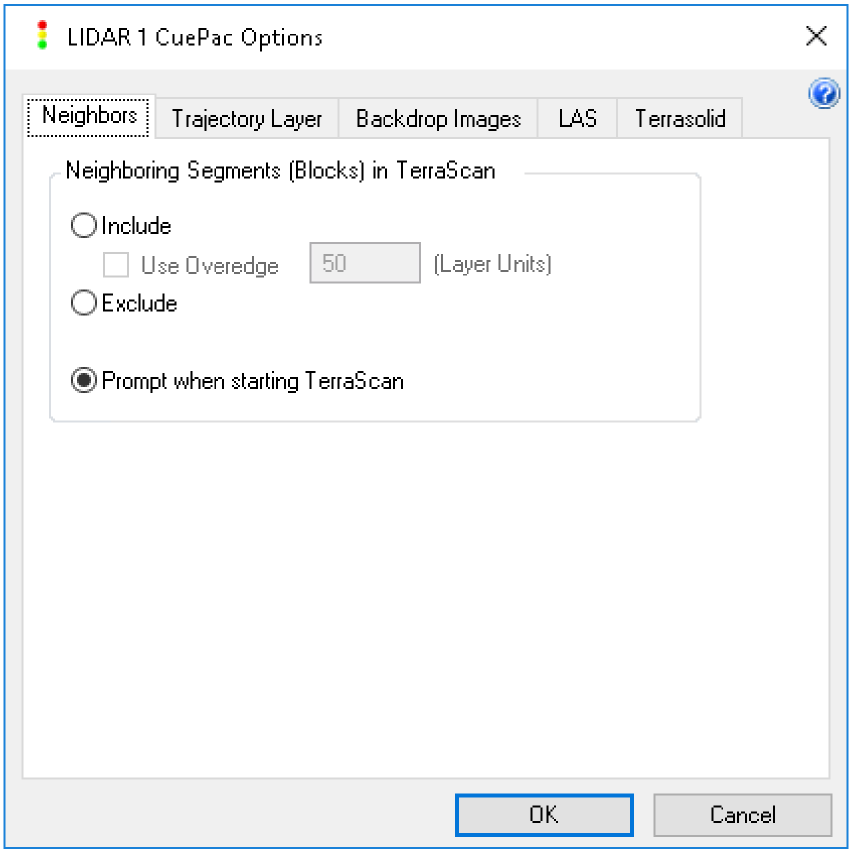



**Figure 14-1 TerraScan Options dialog**

When a Segment or Segments are selected for processing in TerraScan, we first build a *virtual* TerraScan project using the selected segments and, depending on the options selected in the TerraScan options dialog, possibly the *neighbors* of the selected segments.

If you are going to need overedge segments in TerraScan (for example, for macro processing where the macro requires read-only data from the project blocks that surround the blocks on which you are working) then you should set the ***Neighboring Segments (Blocks)*** option to *Include.* If you are opening a single segment (block) and you would like it to open with overedge automatically loaded, you should check the option and specify the amount of overedge in the *Use Overedge* option section.

If you do not want neighboring blocks included in your TerraScan project, select the *Exclude* option.

Finally, if you wish to defer this decision until you actually run TerraScan, choose the *Prompt when starting TerraScan* option.  Each time you invoke TerraScan from within GeoCue you will receive the dialog of Figure 14-2.  Select the option you desire.

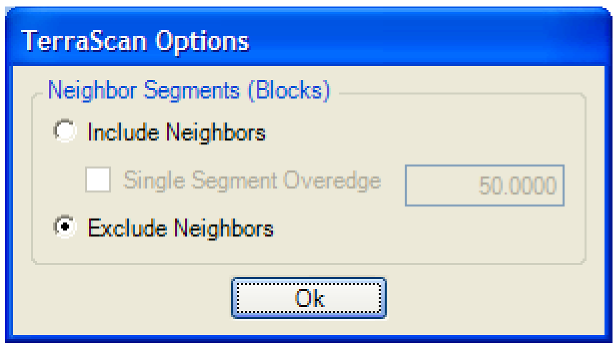



**Figure 14-2 TerraScan "just in time" options dialog**

NOTE:  GeoCue is a multiuser system that employs a multi-level "Entity Locking System" to protect data from being accessed inappropriately by more than one user at a time.  If you *Include* neighbors in a virtual TerraScan project, those neighbors will be READ LOCKED during your editing session and will not be available to other users for WRITE LOCKING (although they could be neighbors of another user's virtual TerraScan project).  Thus, even if you are editing a single LAS Working Segment in TerraScan, other users will be prohibited from editing the segments adjacent to the segment you are editing if you have the *include neighbors* option selected.

## 14.2 Invoking TerraScan on a Single LAS Segment

We will continue to use the Madison project.

- Clear your Working Set
- Select process step 7 (*Process in TerraScan)* in the checklist. Press the ***In Progress*** state transition tool on the Checklist State Selection toolbar. You should see MicroStation come up and load TerraScan.

> Note – If TerraScan does not come up on your system but runs fine outside of GeoCue then ensure that your version of TerraScan is at least version **005.009**. If you continue to experience difficulty, contact GeoCue Support (Phone 256-461-8289 or email support@geocue.com)

Your display will now resemble Figure 14-3. You can verify the selection of the correct working segment by examining the name of the seed design file loaded by MicroStation. This file will be named <Segment Name>.dgn. Notice that the filename “B1-173.dgn” appears in the MicroStation title bar.

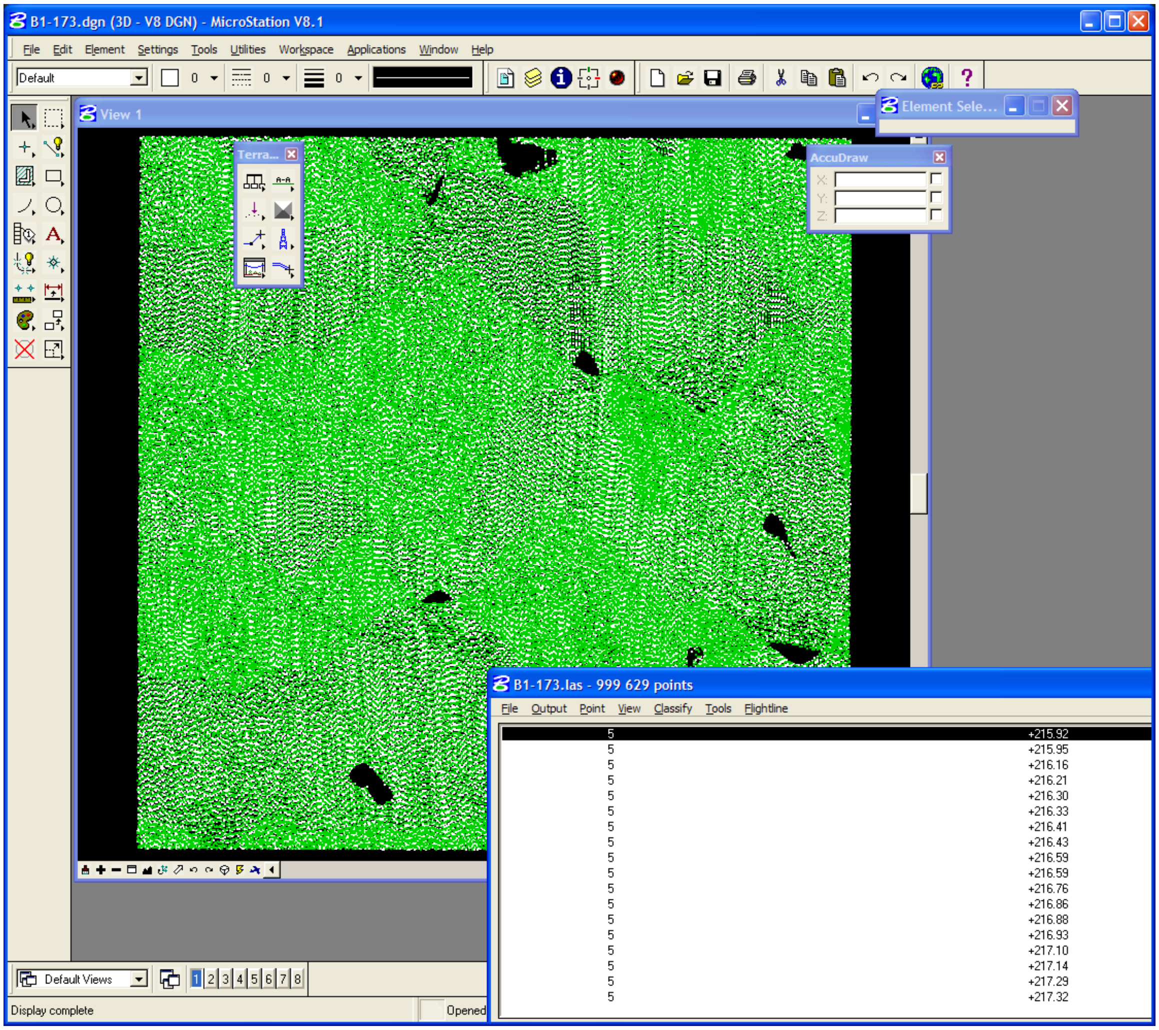



**Figure 14-3 Initial entry into TerraScan with WS-0001**

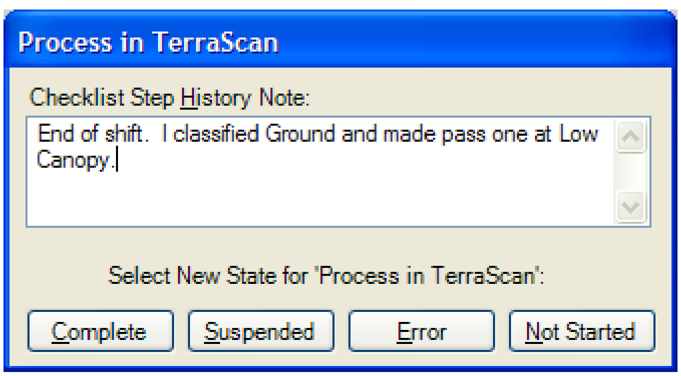
When you invoke TerraScan with a single selected working segment, that segment will automatically load and display. Note – your date may not fill the screen depending on your particular design file. TerraScan always fits the design file elements, not the loaded LIDAR data.

***Caution*** – Do not use the TerraScan ***Read Points…*** command to bring LIDAR data into your editing sessions. To do so will defeat the locking and file management mechanisms of both GeoCue and TerraScan.

You can use the ***Overedge*** parameter (in the TerraScan options dialog of LIDAR 1 CuePac) to specify a buffer range of LIDAR points to be read out of the adjacent segments. This data will be treated as *Reference* data by TerraScan in that when you save the segment, the overlap points will not be saved.

***Caution*** – Do not use the TerraScan ***Save as…*** command to write LIDAR data back to disk. To do so will defeat the locking mechanisms of both GeoCue and TerraScan. Always use the ***Save*** command.

When you exit the TerraScan session, you will be presented the normal process step exit dialog:




If you are just taking a break, chose ***Suspended.*** If you are finished with the working segment, select ***Complete***. We inserted an end of shift note and ***Suspended***.

## 14.3 Invoking TerraScan on Multiple LAS Segments

TerraScan can also be invoked with multiple LAS Working Segments (or "blocks", in TerraScan parlance).

- Select a group of LAS Segments into the working set.
- Press the Multi-Entity mode button (note that many users simply ignore this step and use the "last chance" dialog instead. Either mode is fine.)
- Set the ***Process in TerraScan*** step to In Progress

This time TerraScan will be invoked but no blocks will be loaded. This is the normal startup mode for TerraScan when it is invoked with a *Project.* Bring up the TerraScan ***Project*** dialog and select, under the **Block** menu item, *Draw Boundaries.* Select the MicroStation window in which you wish the boundaries drawn. You will probably have to next fit the view. You should now have a display that shows your selected project blocks. From this point forward, you proceed with processing the same as you would in a stand-alone TerraScan project.

## 14.4 Final QC

The *Final QC* process step functions the same as the *Initial QC* step. When you select this for a working segment, ***PointVue*** is invoked with the selected working segment loaded. If you detect a problem in the segment, you can go back to the *Process in TerraScan* checklist step and re-run TerraScan on the segment.

## *14.5 Summary*

In this set of exercises, you have learned how to process working segments for editing within TerraScan. It is important to note that multiple team members can work on the same project with no danger of "stepping" on each other due to the multiuser locking mechanisms of GeoCue.

# 15 Assigning and Running TerraScan Macros

In this chapter we will cover the procedures for assigning TerraScan macros to working segments and then running them to achieve your desired processing goals. LIDAR 1 allows you to organize your macros in Macro Catalogs. You can have more than one catalog defined in the system, but only one catalog may be active (assigned) to a project at any given time. When assigning macros, you pick them from the active catalog. Before using macros in LIDAR 1, we will first need to create some TerraScan macros.

## *15.1 Creating TerraScan Macros*

You will want to create/test your TerraScan macros prior to assigning them to working segments. You can do this by putting one of your working segments in the Working Set queue and executing the ***Process in TerraScan*** checklist step:

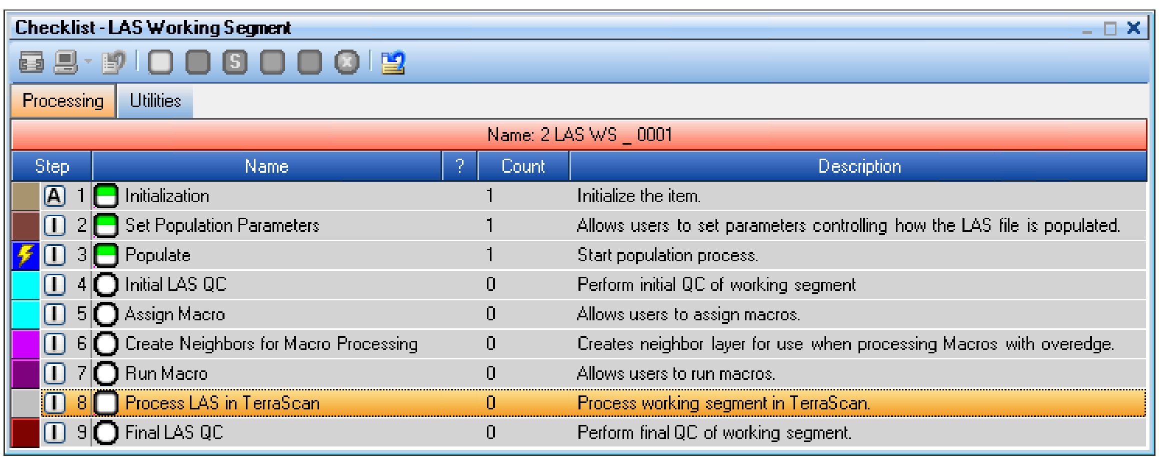



**Figure 15-1 Process in TerraScan Step on Working Segment Checklist**

To create a macro in ***TerraScan***:

1. Choose ***Macro*** command from ***Tools*** pull-down menu in the ***Main*** window. This opens the ***Macro*** dialog (Figure 15-2).

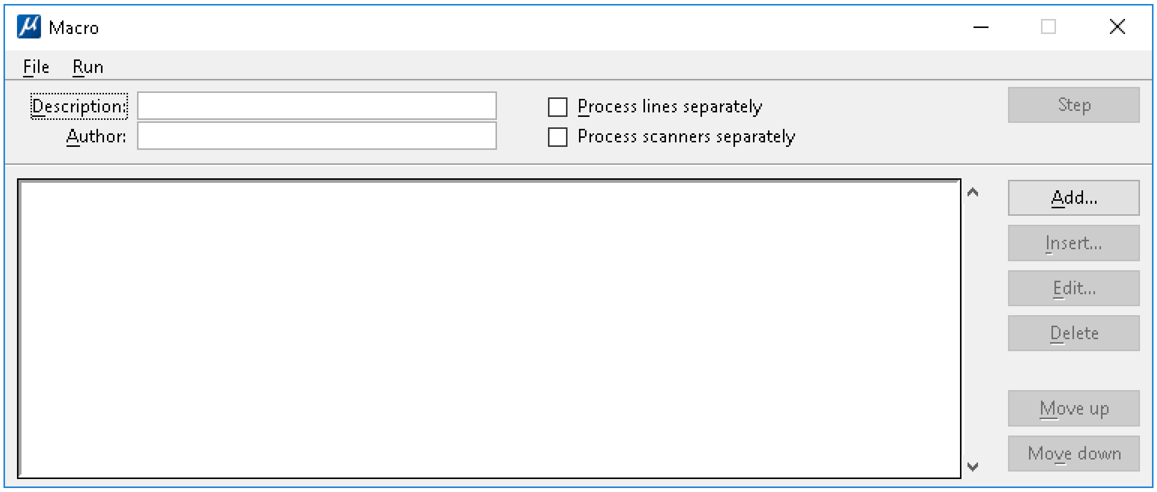



**Figure 15-2 TerraScan Macro Dialog**

2. Enter description of the macro in the ***Description*** field.
3. Enter your name in the ***Author*** field.
4. Click ***Add…*** to add a new processing step to the macro.
5. This opens a dialog for defining the processing step and related settings.
6. Fill settings values and click OK.
7. You can repeat steps 4 and 5 until all desired macro steps are added.
8. Test your macro by selecting Run from the Macro dialog menu. You can run the macro either on the loaded points or on selected files.

Once satisfied with your macro steps, choose ***Save as*** from ***File*** pull down menu to save the macro to a file.

Figure 15-3 shows a macro consisting of one step that thins points of class 1 and changes the class on the culled points to class 13. The macro was saved with a name indicative of the macro characteristics.

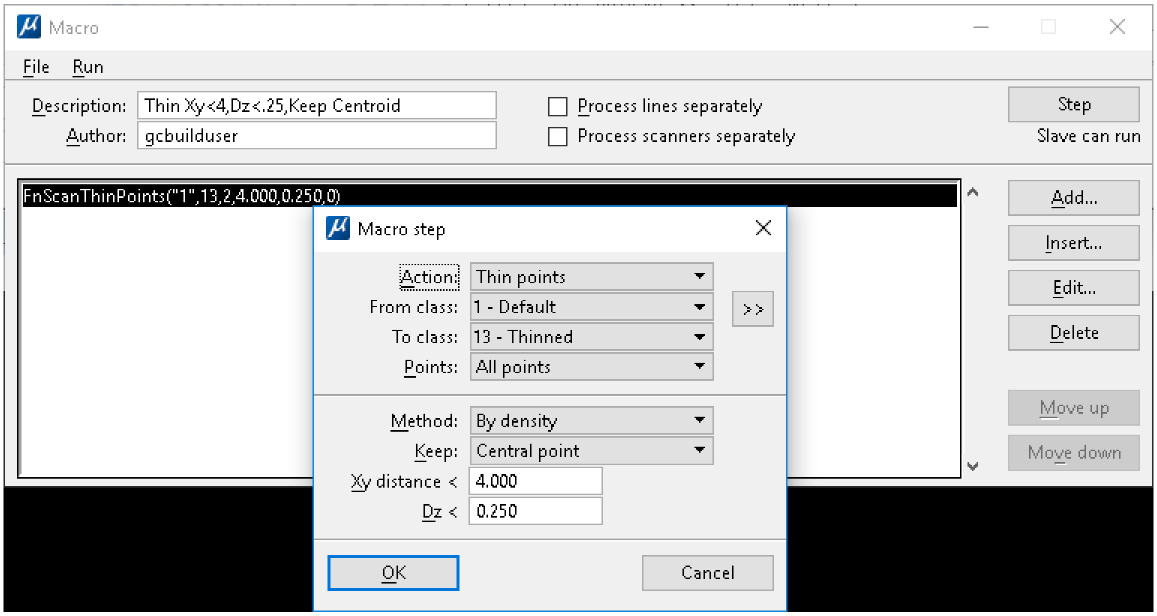



**Figure 15-3 Macro Step Details**

| |
|---|
| NOTE – Some TerraScan macro steps may not be supported fully by the LIDAR 1 macro system. For example, if your macro saves points to a file, LIDAR 1 will not be aware of this. LIDAR 1 always saves the results of the macro back to the LAS file associated with the working segment on which the macro is being run. |

## 15.2 Managing Macro Catalogs

Any TerraScan macros you wish to run from within GeoCue LIDAR 1 must exist in a macro catalog. You maintain these macro catalogs via the ***Manage Macro Catalogs*** application which may be launched via the ***Start Menu: All Programs ▶ GeoCue ▶ LIDAR 1 CuePac ▶ Manage Macro Catalogs***. This invokes the dialog of Figure 15-4.

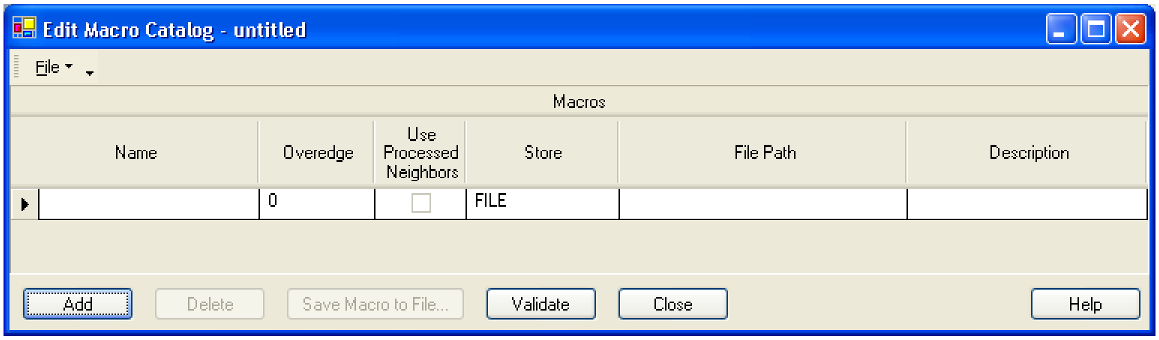



**Figure 15-4 Adding a Macro to a Catalog**

## 15.2.1 Adding Macros

To add a macro to the catalog, press the Add button which adds a new row to the table. Next fill in the fields of the row with the information pertinent to the macro you are adding:

***Name***: The name used to reference the macro during macro assignment/running. If this field is blank when you browse for a macro file, the name will be automatically filled in with the name of the macro file (sans extension and directory information).

***Overedge***: If the macro requires overedge, fill in the amount required (in the units of the LIDAR data).

***Use Processed Neighbors***: If overedge is required, checking this box will cause the macro to use neighboring working segments that have already had the macro run on them (if available). If the box is unchecked, the original neighboring working segments will be used.

***Store:*** Macro storage mode. If ***FILE***, the macro is referenced by the File Path. If ***REPOSITORY***, the contents of the macro file are stored in the GeoCue repository.

***File Path***: Location of the physical macro file. If ***Store*** is ***FILE***, this must be a UNC path. You can browse for the file by clicking the button on the right-hand side of the field.

***Description***: Optional string describing what the macro does. If this field is blank when you browse for a macro file, the name will be automatically filled in with the description contained within the macro file

## 15.2.2 Removing Macros

If you need to remove a macro from your catalog, simply select the row in the table corresponding to your macro (select by clicking in the cell on the left side of the row). Then, press the ***Delete…*** button. You can multi-select rows in the usual way via the Shift and Control keys.

## 15.2.3 Opening and Saving Macro Catalogs

The ***File*** menu on the ***Edit Macro Catalog*** dialog (Figure 15-5) contains several options for opening existing catalogs, saving the currently open catalog, and assigning catalogs to GeoCue projects:

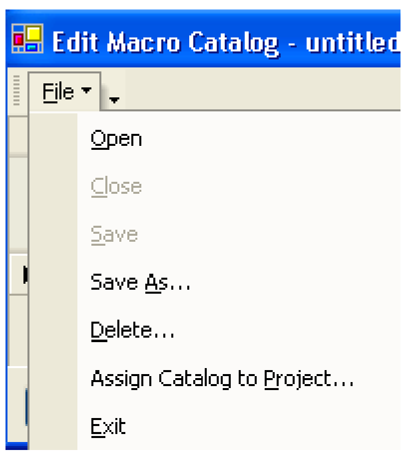



**Figure 15-5 Options on the Manage Macro Catalogs File Menu**

***Open:*** Opens an existing macro catalog from the GeoCue repository. You will be presented with a dialog (Figure 15-6) containing a drop-down list of the available macro catalogs:

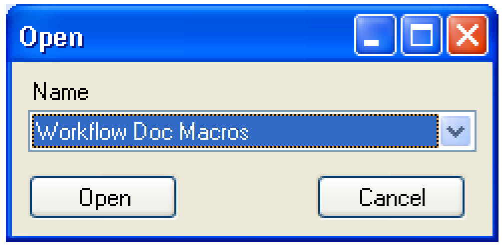



**Figure 15-6 Open Catalog Dialog**

Select the Open button to open a catalog.

***Close:*** Closes a currently open macro catalog.

***Save:*** Saves an existing macro catalog to the GeoCue repository.

***Save As:*** Saves a macro catalog to the GeoCue repository under a new name. You will be presented with a dialog (Figure 15-7) containing a combo-box where you may key in the name of a new catalog or select from a list of existing catalog names:

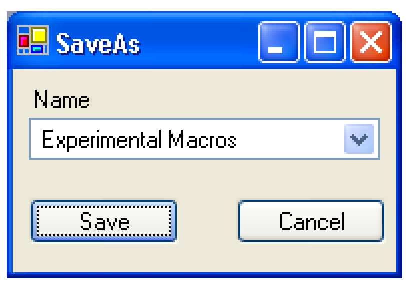



**Figure 15-7 Catalog *Save As* dialog**

***Delete***: Allows you to delete one or more macro catalogs from the GeoCue repository. You will be presented with a list of catalogs (Figure 15-8). Select the ones you wish to delete, and then press the ***Delete*** button:

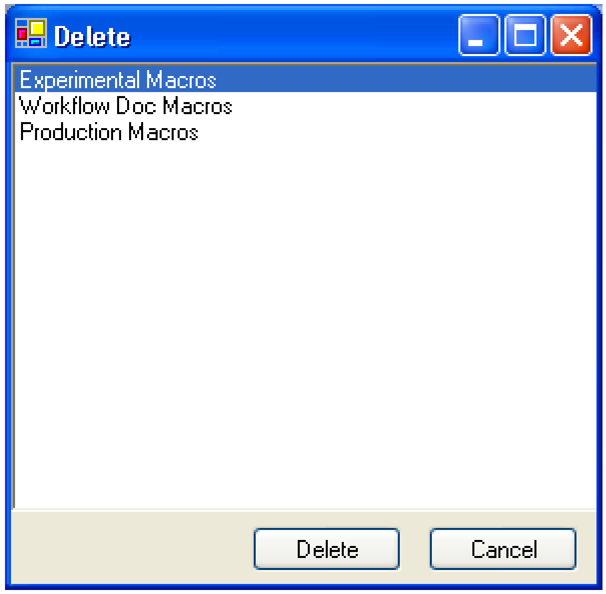



**Figure 15-8 Catalog Delete dialog**

***Assign Catalog to Project*:**

In order to assign and run macros, you must assign a macro catalog to your GeoCue project. Selecting this command (Figure 15-9) will present you with a list of projects and a list of catalogs. Select the Project to which you wish to assign the selected catalog and press OK:

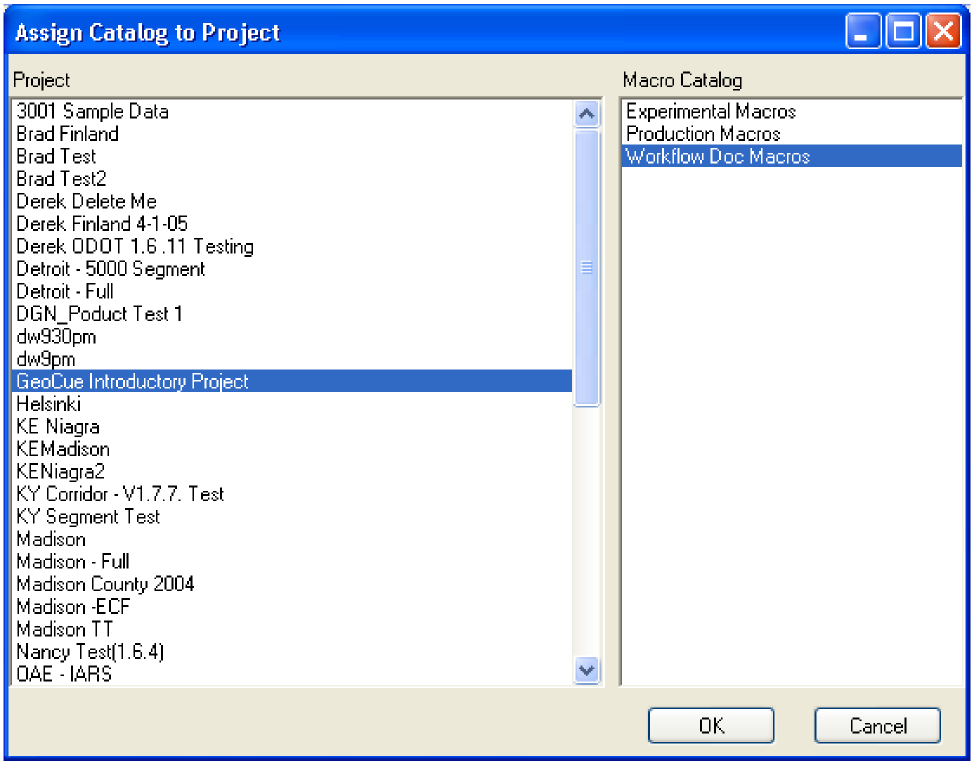



**Figure 15-9 Assigning a Catalog to a Project**

When you click on a project, if a macro catalog has already been assigned, the assigned catalog will appear highlighted in the ***Macro Catalog*** list.

**Exit:** Closes the Edit Macro Catalog form and terminates the Manage Macro Catalogs application.

### 15.2.4 Saving a Macro

If you have chosen to store a macro in the GeoCue repository, you may wish to edit the macro or verify that it does what you think it does. To save a macro to a file, select the row in the table that corresponds to the macro and then click the ***Save Macro to File…*** button. This will present you with the standard Save File Dialog where you may save the macro to a file on disk.

### 15.2.5 Validating the Catalog

When you save your macro catalog to the Repository, the catalog is automatically validated. Validation includes the following checks:

- Are macro names unique?
- Do the macro file paths exist?
- If the FILE storage mode is used, is the File Path a UNC path with at least READ privileges?

You may also validate the macro catalog at any time by pressing the ***Validate*** button. If validation fails, the offending macro(s) are selected in the table.

## *15.3 Assigning Macros to Working Segments*

Once you have a macro catalog assigned to your GeoCue project, you are ready to assign macros from the catalog to your populated working segments. You may assign a different macro to each working segment in your project, or you can assign the same macro to many working segments all at once. We will demonstrate assigning the same macro for all working segments and note how you can set these individually.

Select all of the working segments into the Working Set queue (remember, the easy way to do this is to select the working segment layer in the GeoCue legend and choose *Add Layer Entities to Working Set* from the Legend command). Activate the checklist for the selected entities by pressing the *Flash Current Entity* tool on the Working Set toolbar. You should see the familiar working segment checklist (Figure 15-10).

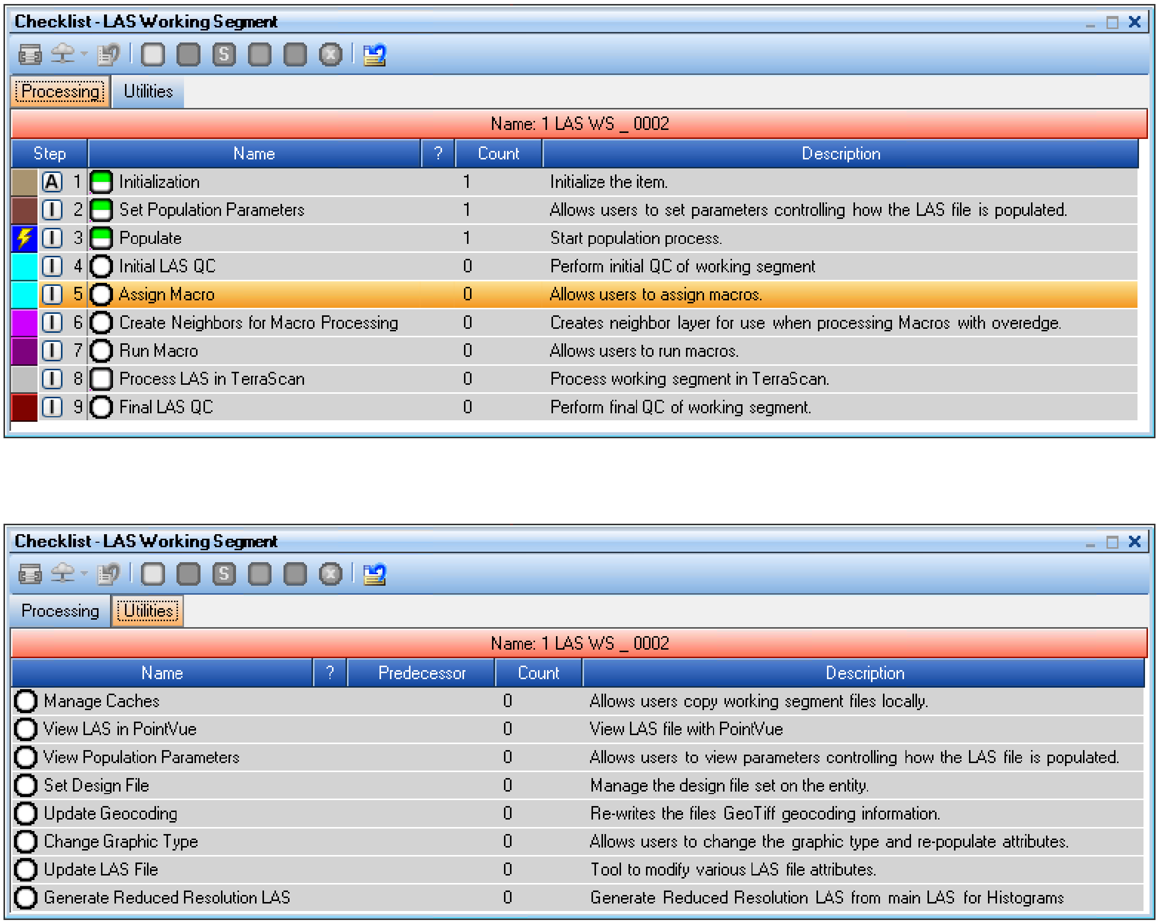



**Figure 15-10 Working Segment Checklist**

Select the ***Assign Macro*** checklist step, press the Multi-Entity mode and press the In-Progress state button. You should be presented with the ***Assign Macro*** dialog box depicted in Figure 15-11.

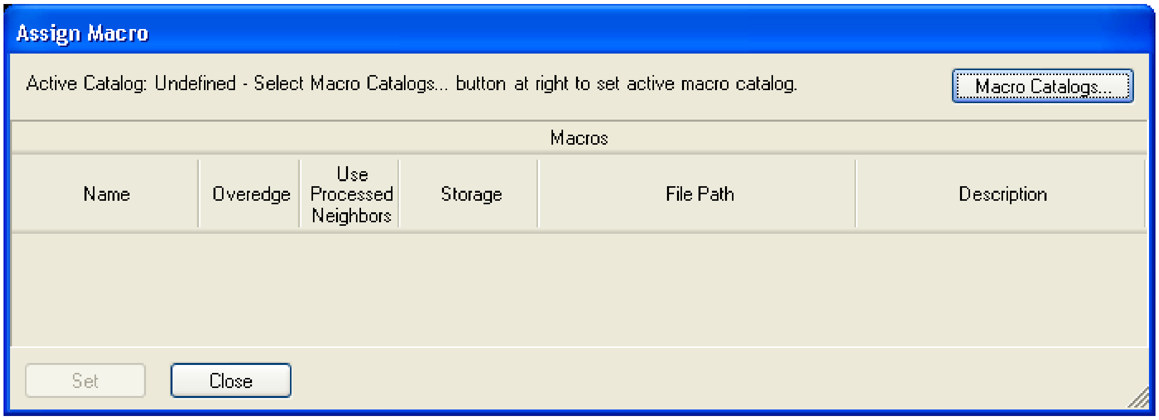



**Figure 15-11 Assign Macro Dialog (no Active Catalog)**

If you have not yet assigned a macro catalog to the current GeoCue project, the dialog will appear as shown in Figure 15-11. Pressing the ***Macro Catalogs…*** button at this time will bring up the ***Assign Catalog to Project*** dialog (Figure 15-9). If you have already assigned a macro catalog to the current project, pressing ***Macro Catalogs…*** will display the ***Edit Macro Catalog*** dialog so you may manipulate the macro catalog associated with the current project. After assigning the catalog, the ***Assign Macro*** dialog will appear as shown in Figure 15-12.

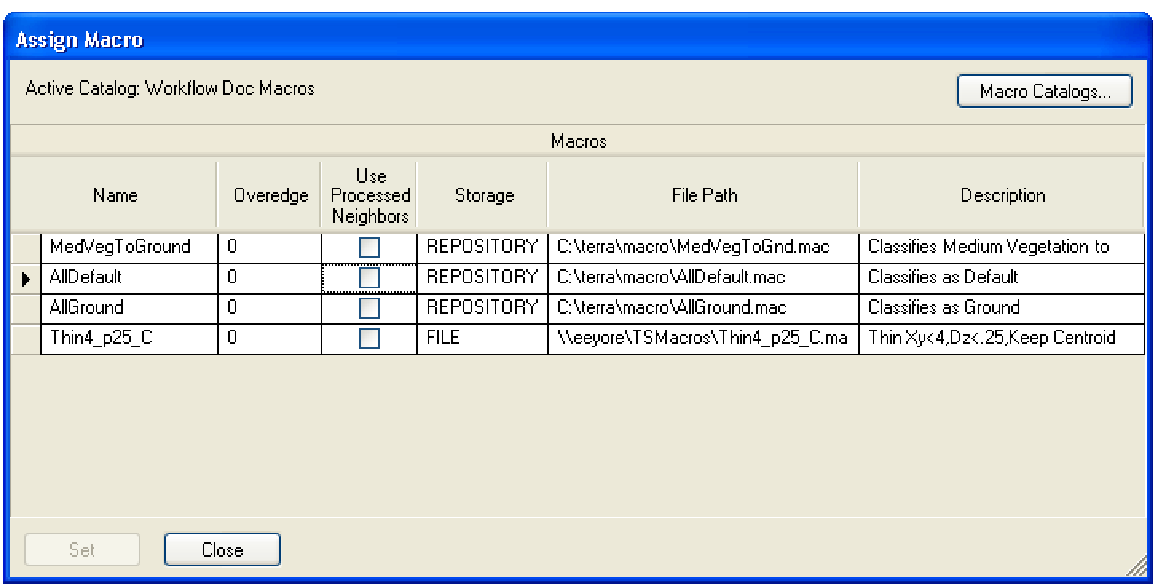



**Figure 15-12 Assign Macro Dialog (with Active Catalog)**

All of the macros in the active catalog are presented in the ***Assign Macro*** dialog in a very similar fashion to the ***Edit Macro Catalog*** dialog. However, none of the information is editable. As with the ***Edit Macro Catalog*** dialog, a macro is selected by clicking in the left-most side of the row associated with the macro. If a macro is selected, the ***Set*** button will be enabled. Selecting the ***Set*** button will assign the macro to the working segment(s) in the Working Set queue. We will select the Thin4_p25_C macro and assign it by clicking the ***Set*** button. This will close the ***Assign Macro*** dialog. If you now select one of the working segments and click on the ***Processing*** tab in the ***Properties*** pane, you will see that the ***Macro*** is indeed Thin4_p25_C.

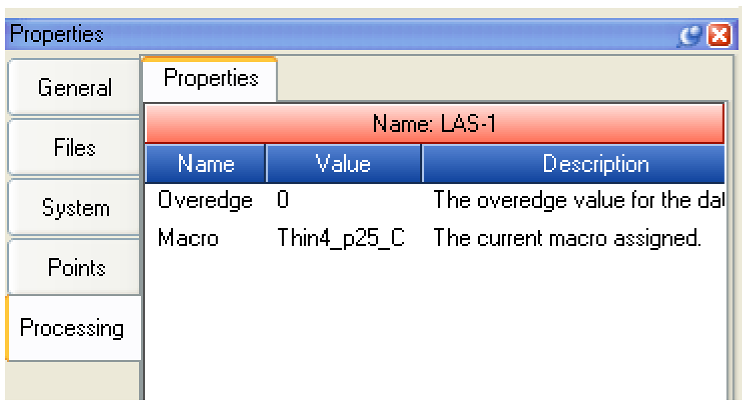



**Figure 15-13 Processing Information in Properties Pane**

Now, click on the ***Assign Macro*** step in the checklist and notice that the history section of the Checklist Step Details (Figure 15-14) shows that macro Thin4_p25_C was assigned to the working segment (the Start and Stop times are not shown here for readability):

| Status | User | Machine | Notes | System Messages |
|---|---|---|---|---|
| Pending | kellison | eeyore | | |
| In Progress | kellison | eeyore | | |
| Not Started | kellison | eeyore | | |
| Pending | kellison | eeyore | | |
| In Progress | kellison | eeyore | | |
| Not Started | kellison | eeyore | | |
| Pending | kellison | eeyore | | |
| Complete | kellison | eeyore | | Assigned macro: Thin4_p25_C |

**Figure 15-14 Assign Macro Checklist Step History**

Note: To assign a macro to one or a few working segments (instead of all working segments on the layer), add the individual working segments to the Working Set queue, then put the ***Assign Macro*** step in progress and follow the procedure outlined above.

## *15.4 Running Macros Assigned to Working Segments*

Now that you have assigned the Thin4_p25_C macro to your working segments, you are ready to run the macro. Add the working segments to your Working Set queue and make sure the ***Run Macro*** step is selected in the checklist. You can run macros in the foreground as an immediate task or, if you have the Enterprise version of GeoCue, you can run the macros as a background (silent mode) task or distribute the macro processing across multiple workstations.

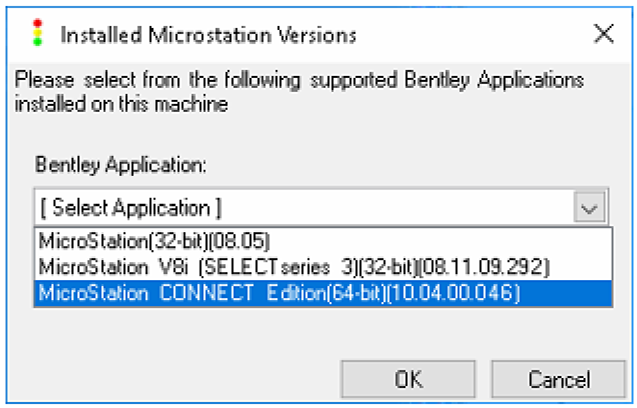
### 15.4.1 Foreground Local Processing

NOTE – Beginning with GeoCue 2017.1, launching TerraScan in Microstation CONNECT Edition is now supported.

Select the Run Macro process step. If you have not set the GeoCue option for Disable Single Entity mode, press the Multi-Entity mode button on the Checklist toolbar (since we want to process macros for all entities in the working set).

If you have the Enterprise version of GeoCue, deselect the *Dispatch* button on the Checklist toolbar.

Finally, press the In-Progress button. If the 'Run Macro' step is being run for the first time and/or if you have not already selected the desired version of Microstation on the "LIDAR 1 CuePac Options" dialog (under the 'Terrasolid' tab), the following dialog will be launched asking you to select the Microstation version you want to use to run this process.




Once the desired version is selected, it will first launch MicroStation and then load TerraScan. Next the GeoCue macro processor will drive it with the commands necessary to run the assigned macros on each of the working segments in the Working Set queue. As each working segment is loaded into TerraScan you will see the status message of Figure 15-15.


**Figure 15-15 Reading Block File message**

For this particular example, the next status message will be as shown in Figure 15-16.

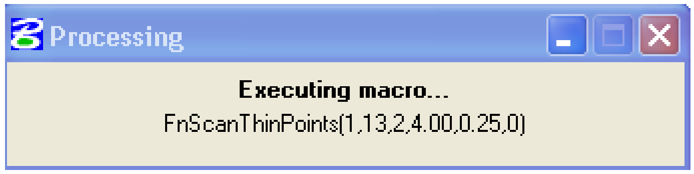


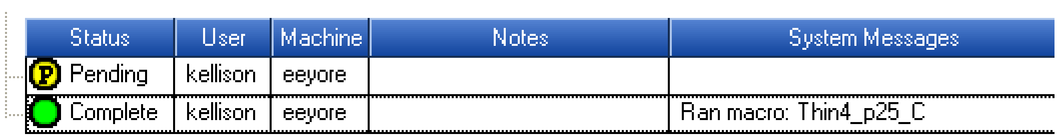

**Figure 15-16 Executing Macro status dialog**

The above messages will repeat for each of the working segments being processed.

WARNING – Do NOT attempt to interact with this instance of TerraScan. This could interrupt the macro processing sequence. For example, TerraScan will allow you to abort a running macro by pressing RESET. GeoCue will not be able to detect this and will report that the macro has been run when in fact it has not.

NOTE – The ***Run Macro*** step requires version 005.005 or higher of TerraScan.

Click on the ***Run Macro*** step in the checklist and notice that the history section of the Checklist Step Details shows when macro Thin4_p25_C was run on the working segment (the Start and Stop times are not shown here for readability):



| Status | User | Machine | Notes | System Messages |
|---|---|---|---|---|
| Pending | kellison | eeyore | | |
| Complete | kellison | eeyore | | Ran macro: Thin4_p25_C |

**Figure 15-17 Run Macro Checklist Step History**

### 15.4.2 Distributed Processing of TerraScan Macros

If you have GeoCue Enterprise, you can distribute TerraScan Macro processing across all machines within your GeoCue constellation that are equipped with GeoCue and TerraScan licenses. This is an extremely powerful feature that will significantly enhance your productivity.

Select the Run Macro process step. If you have not set the GeoCue option for Disable Single Entity mode, press the Multi-Entity mode button on the Checklist toolbar (since we want to process macros for all entities in the working set). Ensure that the Dispatch button is enabled on the Checklist toolbar (this is its default condition for commands that support dispatched processing). Figure 15-18 depicts the Checklist processor just prior to pressing the In-Progress button.

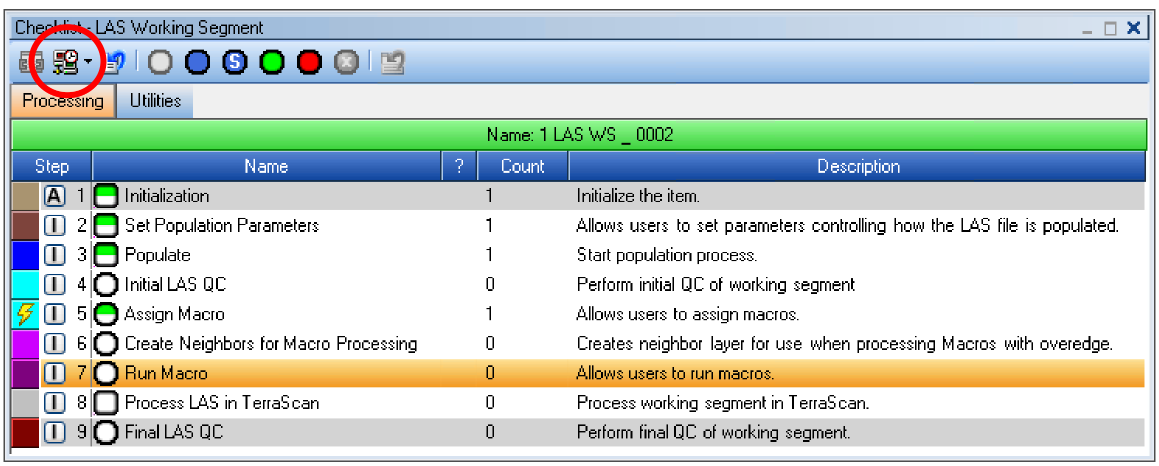



**Figure 15-18 Preparing to Dispatch TerraScan macor processing**

Now press the In-Progress button. This will invoke the Dispatch dialog (Figure 15-19).

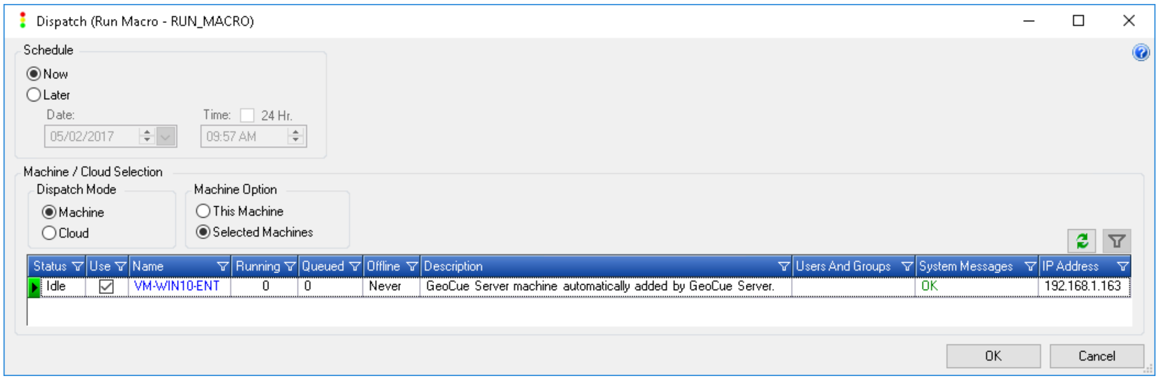



**Figure 15-19 The Dispatch dialog for a distributable command**

Note that, just like for LIDAR image generation, all available machines are displayed and checked. The Dispatch dialog functions the same for all commands of the same type so dispatching TerraScan macros follows the same steps as were previously discussed for generating LIDAR images. You can schedule a delayed processing time via the upper section of the dialog. You can select the machines on which to run the macros from the machine list. When you are satisfied with your selections, press the OK button to launch processing.

You will notice that you are returned to GeoCue without seeing MicroStation start up. However, if you enable Microsoft Task Manager and switch to the Processes tab, you will find MicroStation (ustation.exe) in the list of processes (Figure 15-20).

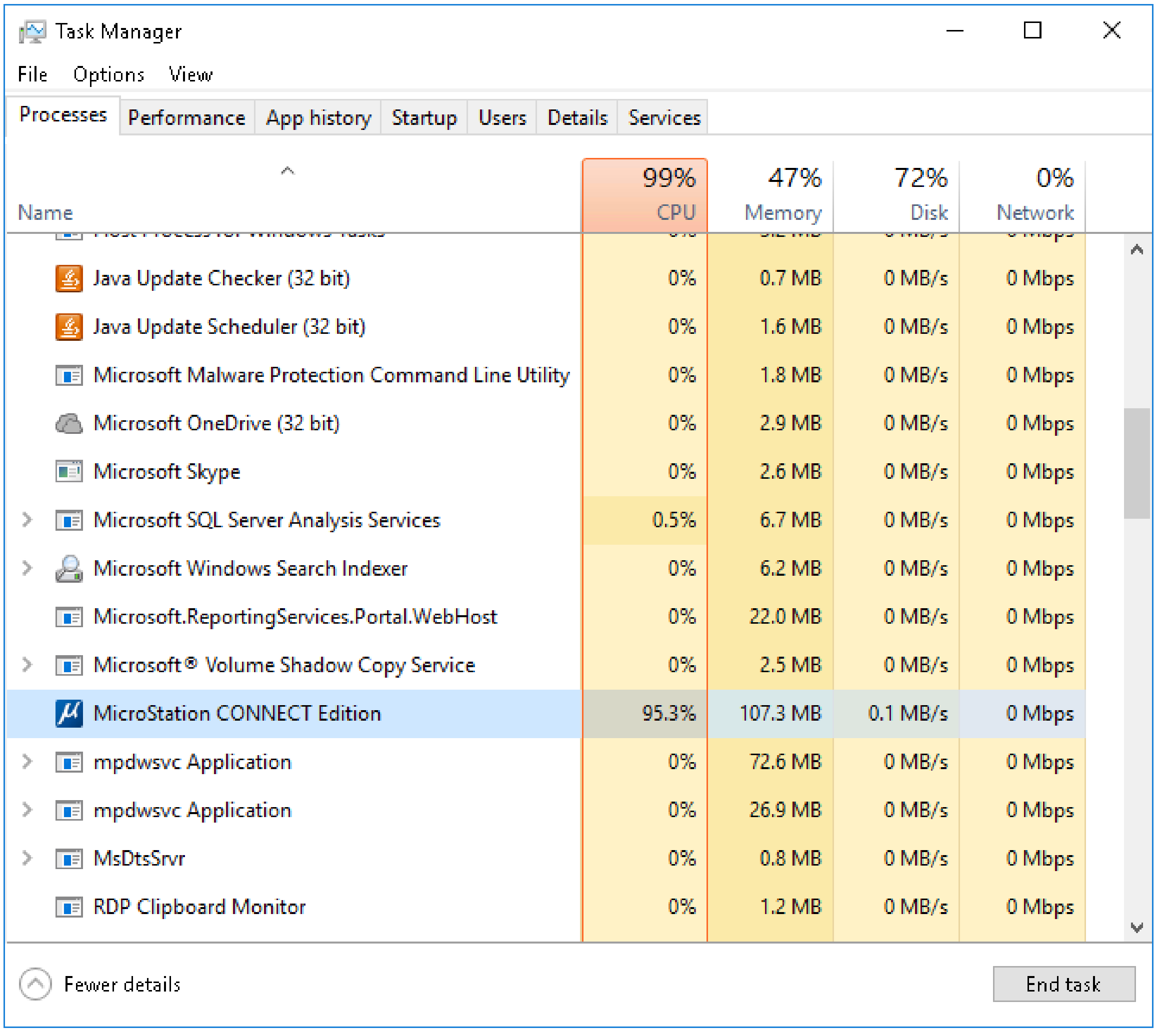



**Figure 15-20 Observing background processing using Task Manager**

When using the Command Dispatch System, GeoCue runs MicroStation for TerraScan processing as a silent background task. This is an extremely convenient mode that:

1. Allows you to run other operations in the foreground on your workstation without being interfered with by the interaction execution of the macro processing.

2. Run a second instance of TerraScan on your workstation to interactively process segments that are not queued for background macro processing or to even switch to a second project and edit data in TerraScan.

## 15.5 Checking Macro Results

You can use the ***Process in TerraScan*** checklist step or ***PointVue*** (you may find the Utilities checklist step ***View in PointVue*** convenient for this) to verify that your macro processing is acceptable. Figure 15-21 shows one of the working segments prior to thinning (PointVue is coloring by class).

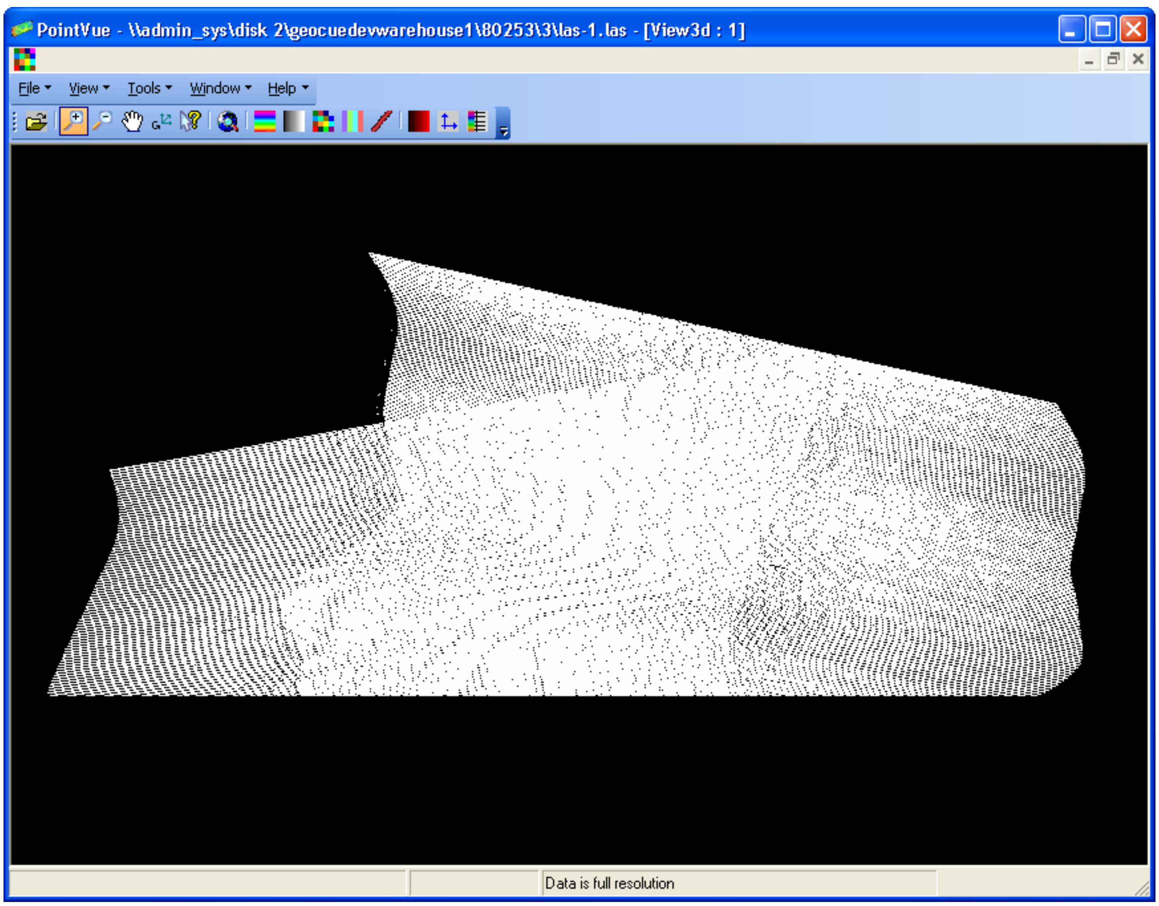



**Figure 15-21 Working Segment before Thin4_p25_C**

Figure 15-22 shows the same working segment in ***PointVue*** after running Thin4_p25_C.

Recall that Thin4_p25_C changes the class on culled points to class 13. We changed the Classification View Settings in ***PointVue*** such that points with class 13 are not drawn (Figure 15-23).

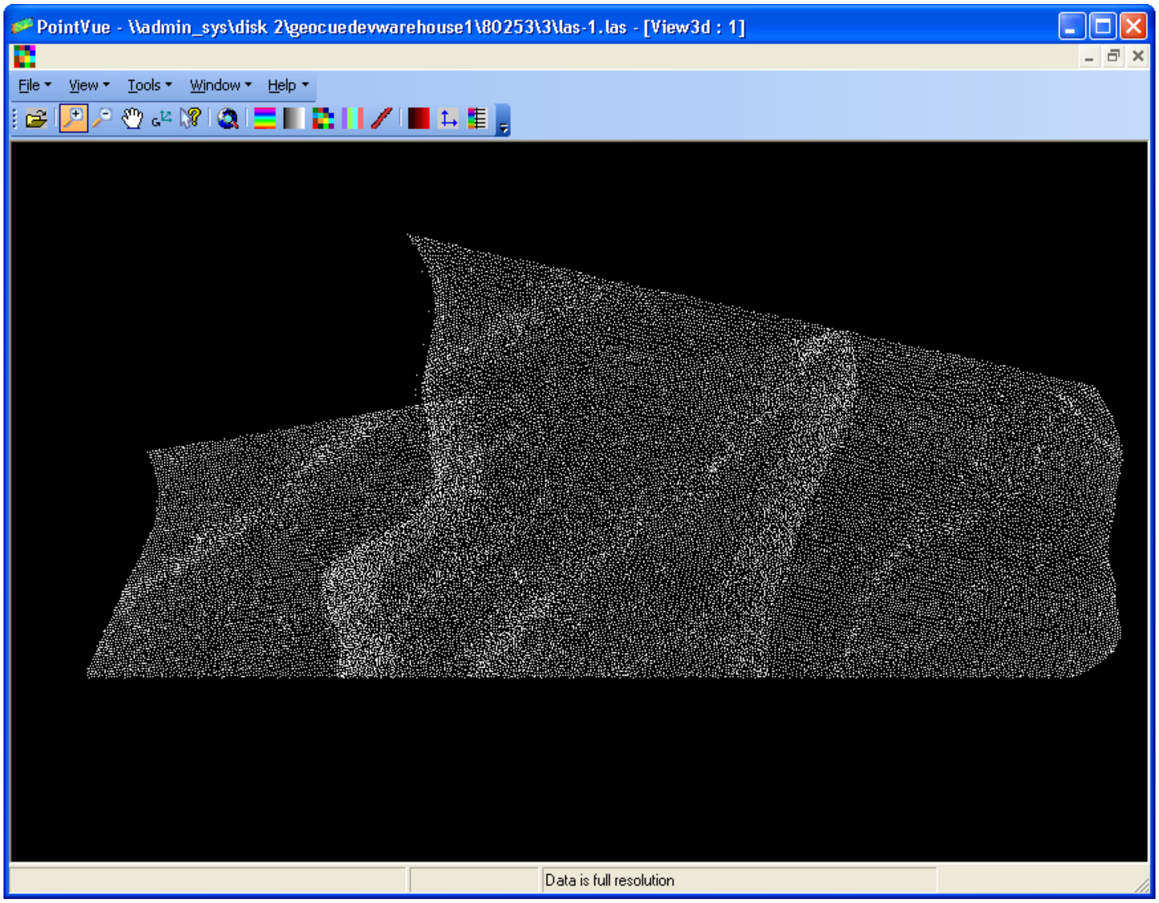



**Figure 15-22 Working Segment after Thin4_p25_C**

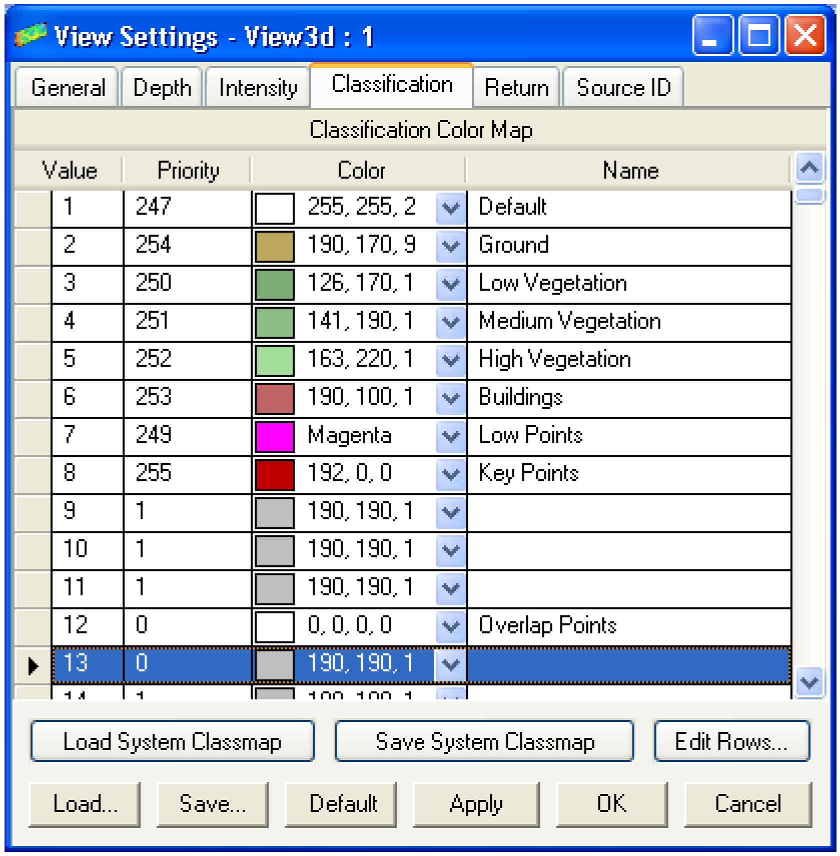



**Figure 15-23 PointVue Settings to Hide Points of Class 13**

## *15.6 Processing Overedge Macros*

TerraScan allows you to specify *overedge* for macro processing. For example, if you specify an overedge value of 25 meters, TerraScan will load each block that touches the block for which you are current processing a macro and include an 25 m overedge into this adjacent block. The problem with this is that there is no way to instruct TerraScan to use pre-macro processed data from these adjacent blocks.

LIDAR 1 CuePac Version 3.0 includes a new Checklist step that creates a layer of overedge LAS Segments that are used when processing overedge macros.  This new checklist step is between *Assign Macro* and *Run Macro* as shown in Figure 15-24.

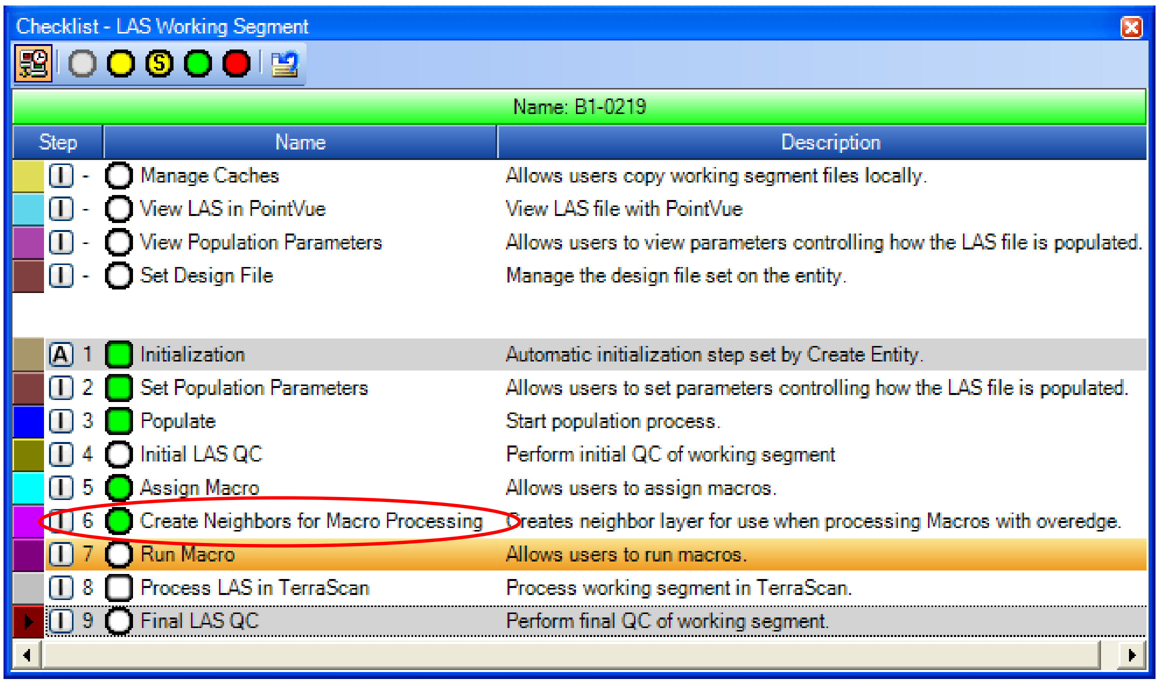



**Figure 15-24 The Create Neighbors for Macro Processing step**

This new capability is quite simple to use:

1. Assign macros to your LAS Working Segments using the *Assign Macro* checklist step
2. Add all of the LAS Working Segments that you wish to run macros against into the Working Set
3. Run the *Create Neighbors for Macro Processing* step
4. When the previous step has completed for all working segments, reselect the segments to the Working Set and run the *Run Macro* step

If the *Create Neighbors* step detects any macro assignments that require overedge, it will create a new layer for the overedge segments. This new layer will have the same name as your original LAS layer with "_NL" appended to the end of the name. It will then copy onto the *_NL layer a replica of the neighbor working segments and make a copy of their LAS data. These working segment "clones" will not have a checklist.

When you actually run the macro, the Run Macro step will detect macros that require overedge. It will then search the *_NL layer for the neighbor segments. If any segments are detected to be missing, an error will be declared for that particular segment.

Figure 15-25 shows an LAS Working Segment layer with a single segment assigned an overedge macro.

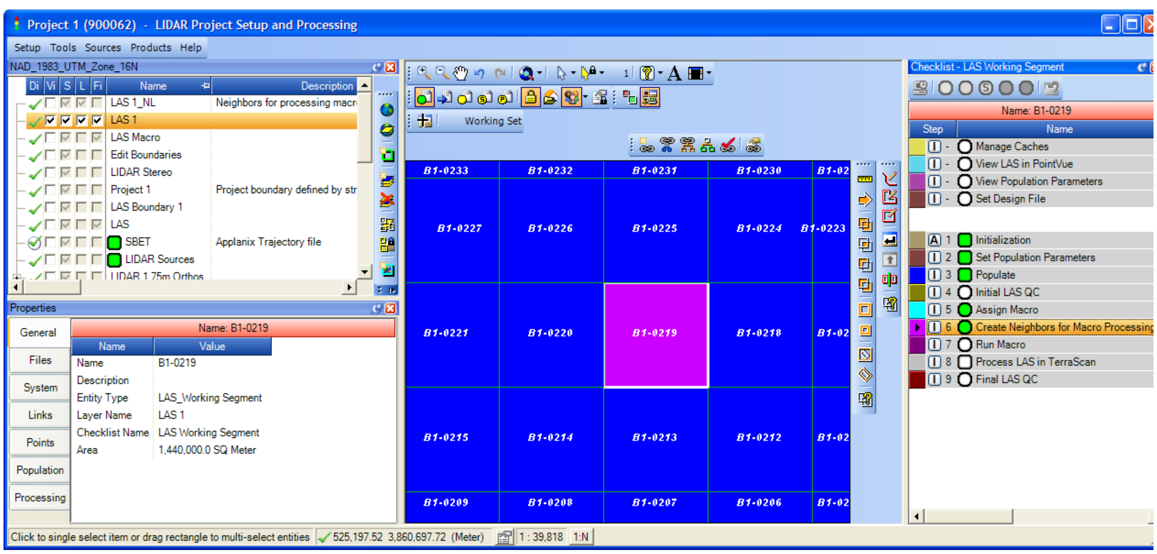


**Figure 15-25 An LAS Segment with an assigned overedge macro**

Figure 15-26 depicts the result of running the *Create Neighbors for Macro Processing* step for all working segments on the layer. Note that only the neighbor segments of original LAS Segment "B1-0129" were cloned onto the overedge layer.

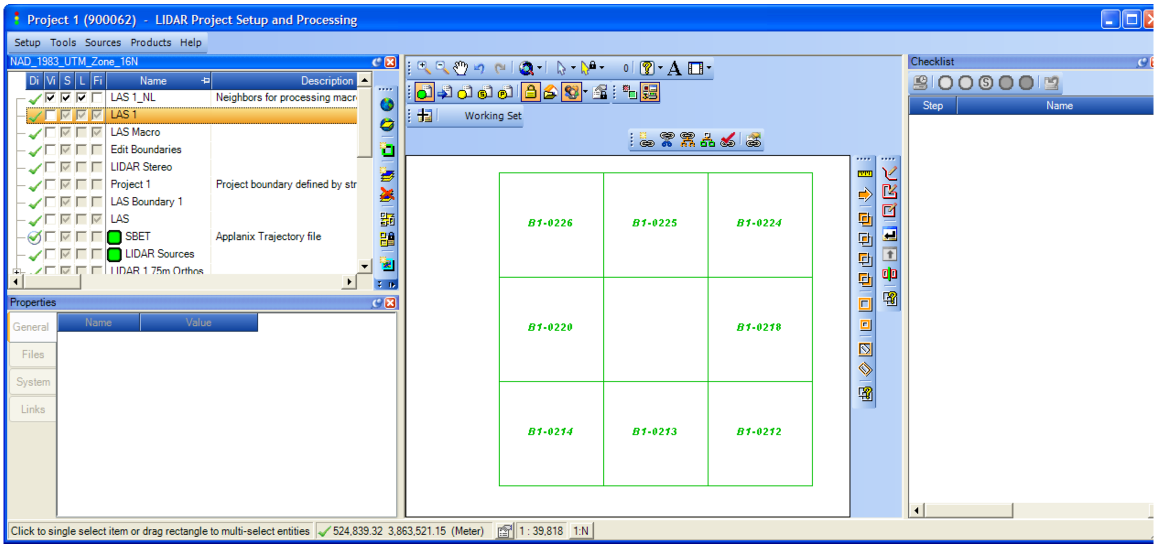



**Figure 15-26 The "clone" LAS Segments created for overedge processing**

## 15.7 Summary

At the beginning of this chapter, we briefly reviewed how to create a TerraScan macro file such that it can be used by the GeoCue LIDAR 1 macro processing system. We learned how to create and manage macro catalogs which are used to maintain a list of macros available for use in LIDAR 1. Then, we learned how to assign macros to and run them on LIDAR working segments. Finally, we saw how we can check the results of running macros.

# 16 LAS Merge

LIDAR 1 CuePac Version 2.0 and later include a sophisticated capability of merging LAS data as defined by LAS Boundaries and Segments. While this capability was primarily developed to support merging the results of arbitrary LAS Segments processed through macros, it can, in fact, be used for any LAS merge task.

## *16.1 An Overview of Merge*

*Merge* is the process of inserting data into a data *container* that already contains data (i.e. *merging* new data into existing data). Merge in GeoCue is controlled by the LAS Boundary. While the LAS Boundary controls the merge definition, it is LAS *data* that is actually merged. LAS data is always contained within LAS Working Segments (or LAS Segments or simply Segments). Thus an LAS Boundary can be considered an LAS Segment *container.* As a container, the LAS Boundary could be empty (in fact, LAS Boundaries are always empty when first created).

NOTE: LAS Working Segments do not need to be associated with an LAS Boundary. The LAS Boundary is useful for:

- Defining LAS Segments based on LIDAR point densities (see the initial chapter on LAS Segmenting)
- LAS Merge operations (this chapter)

In general, it is not always easy to predict the boundary of a merge operation since it can be a function of the data content of the sources to be merged. Therefore, we use only LAS Segments (rather than Boundaries) to define the *target* of a merge.

## 16.2 An Example Merge

We will demonstrate merge using the Madison project. We will perform the following steps:

1. Draw an LAS Boundary around a runway
2. Define Segments in our boundary
3. Use TerraScan to classify all points in the Boundary to Ground
4. Define a new output layer for our merge operation results
5. Define LAS Segments on this target layer and populate from our original source
6. Prepare our Boundaries for the Merge operation
7. Perform the Merge
8. Examine the results

### 16.2.1 Merge Source 1

We will use the “template” method of creating a boundary for our first merge source. This source will eventually be a runway that we will set to the ground class.

Using the GeoDraw *Polygon*, draw a boundary around the west runway of the Huntsville Airport in the Madison data. You can perform this by turning on the display of the 1.75 m LIDAR Orthos that we constructed in the LIDAR Ortho chapter of this document. This technique is called “heads-up digitizing.”

The west runway is the runway on the left in the lower, left hand section of the Madison data. Remember that you can zoom in, zoom out and pan using the mouse wheel while you are digitizing the polygon. You can also delete, point-by-point, by pressing the right mouse button. Our completed GeoAnalysis polygon is depicted in Figure 16-1.

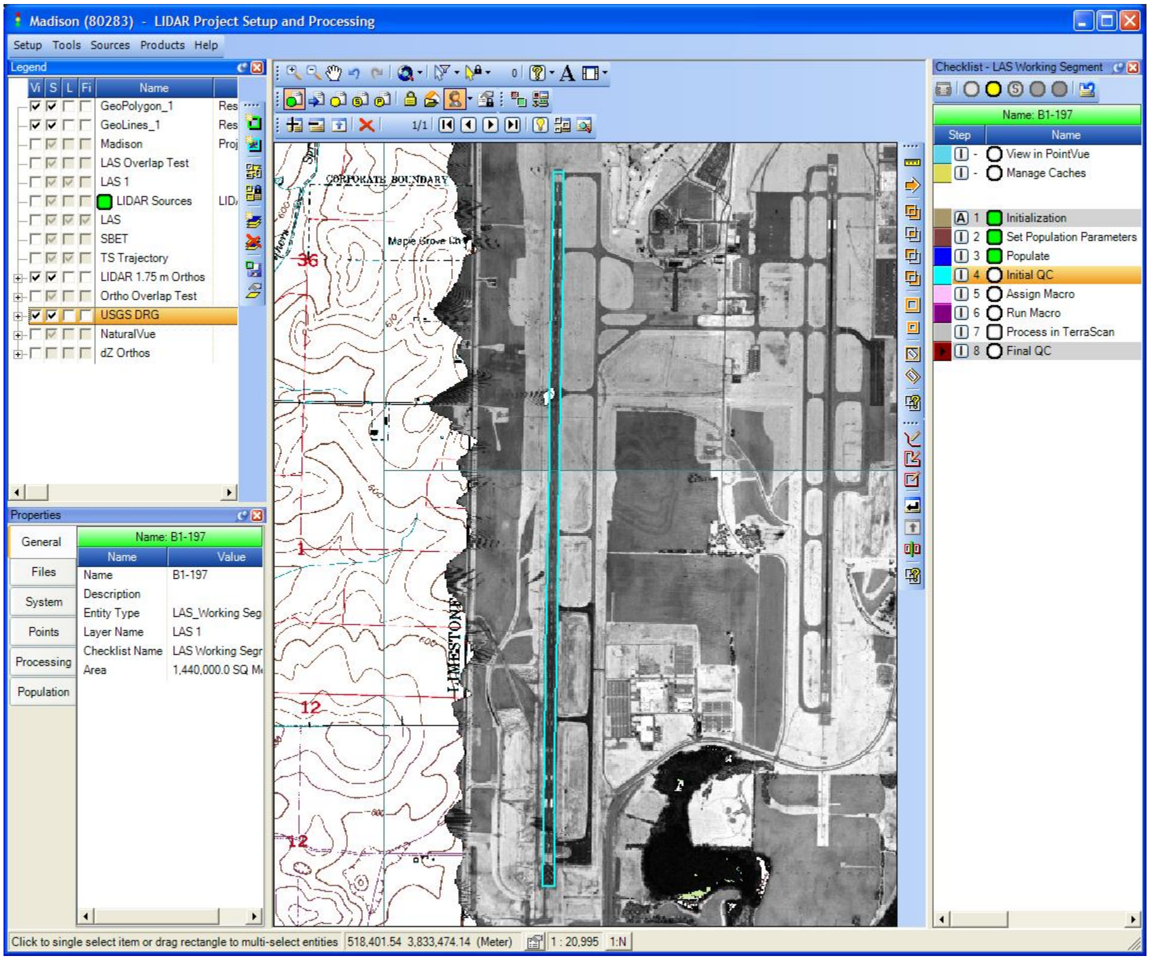



**Figure 16-1 GeoAnalysis polygon of the left runway**

Create a new LAS_Working layer called "LAS – Runway". Create an LAS_Boundary on this layer called "Runway Boundary" by selecting the GeoAnalysis polygon that you digitized around the runway and using the entity placement method "*Selected Entities Geometry.*" Don't forget to set the *Entity Type* to LAS_Boundary (the default for an LAS_Working layer is LAS_Working_Segment).

On this same layer we will create a grid of LAS_Working_Segments. Select the layer and press the *Create Entity* tool on the legend toolbar. Enter "R-" for the name, set the entity type to "LAS_Working_Segment" and set the *Placement Method* to *Place Grid of Entities.* Next press the **Define Grid…** button.

*Select* the Runway Boundary entity and set the grid parameters to those shown in Figure 16-2. Note that we set the *Grid Alignment Origin* parameters by simply pressing the **Set Point to MBR Origin of Selected Entities** button. Also note that we keyed in a Tile Size of 500 meters for X and 500 meters for Y. When you press **Preview**, your display should resemble Figure 16-3. Notice that we have a single column of segments, each spanning 500 meters of the runway. We set up our segments using this technique simply to demonstrate the utility of the GeoCue Gridder.

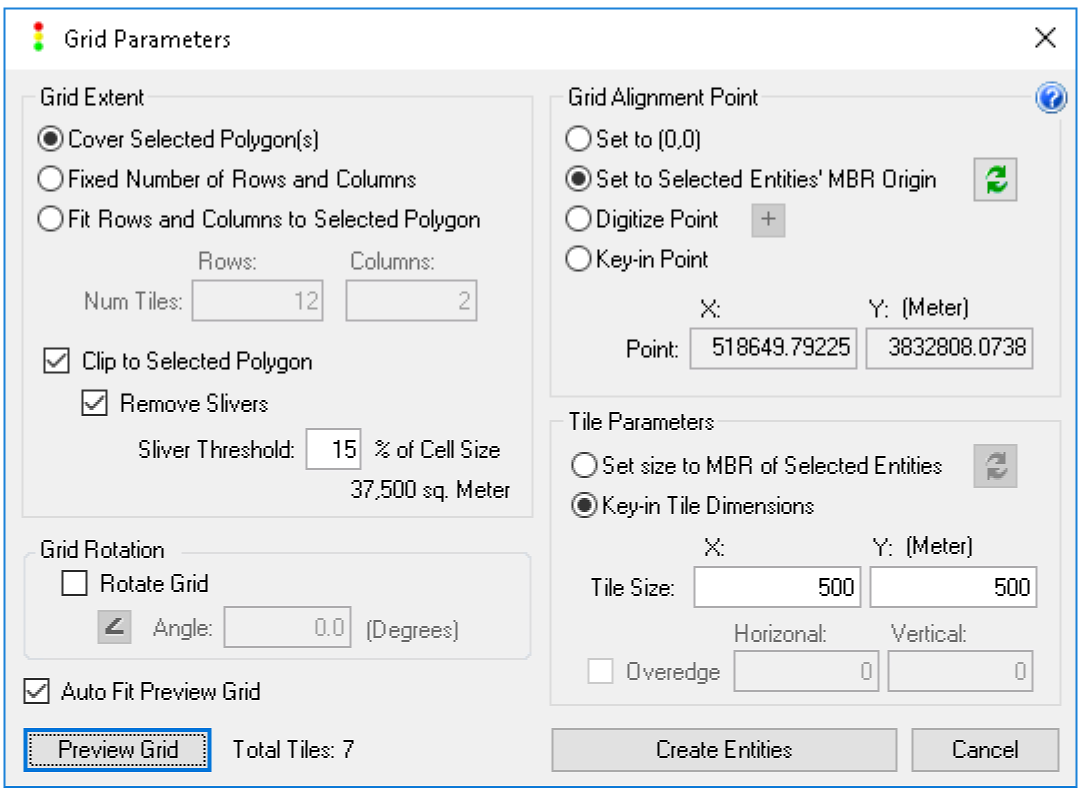



**Figure 16-2 Grid Parameters for the Runway segments**

When you are satisfied that your parameters are correctly set, press **Create Entities.**

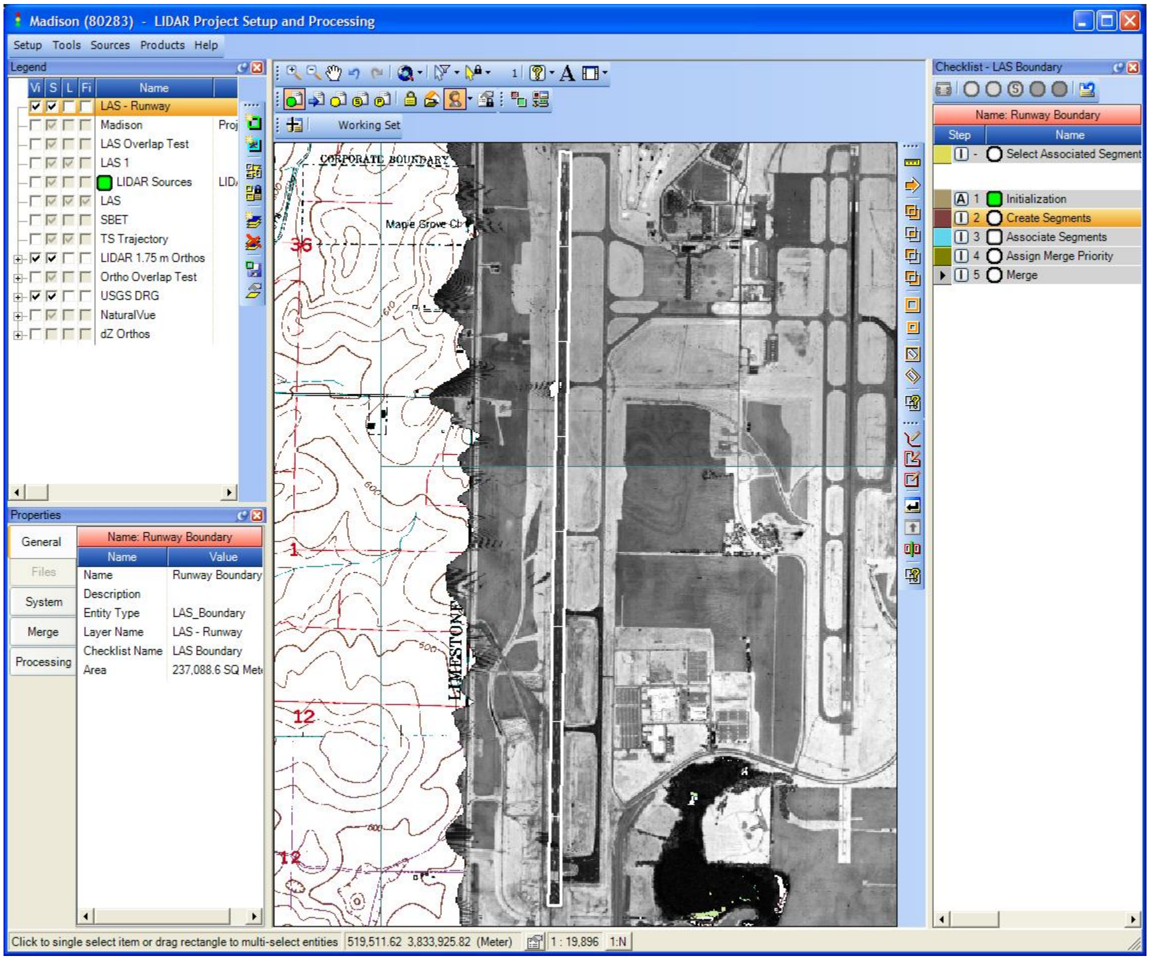


**Figure 16-3 The Preview of our Runway Segments**

We now have created both a Runway Boundary as well as Runway LAS Segments. However, there is currently no association between the two. We need to create this association.

Select the Runway Boundary into your working set. You should see the checklist of Figure 16-4. Notice that the list displays with step 2, *Create Segments*, selected. We do *not* want to execute this optional step because we made our LAS Segments independently of the Boundary (We saw how to use the *Create Segments* step in the LAS Working Segments chapter of this document). We do, however, need to associate the LAS Segments that we created with the boundary. This is done via the *Associate Segments* checklist step.

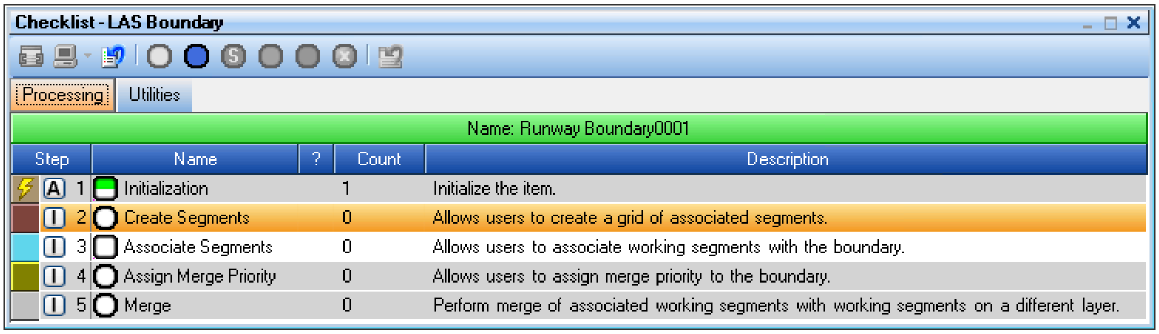



**Figure 16-4 The Runway Boundary Checklist**

Select the *Associate Segments* step and press Set State In Progress button. You will be presented the dialog of Figure 16-5.

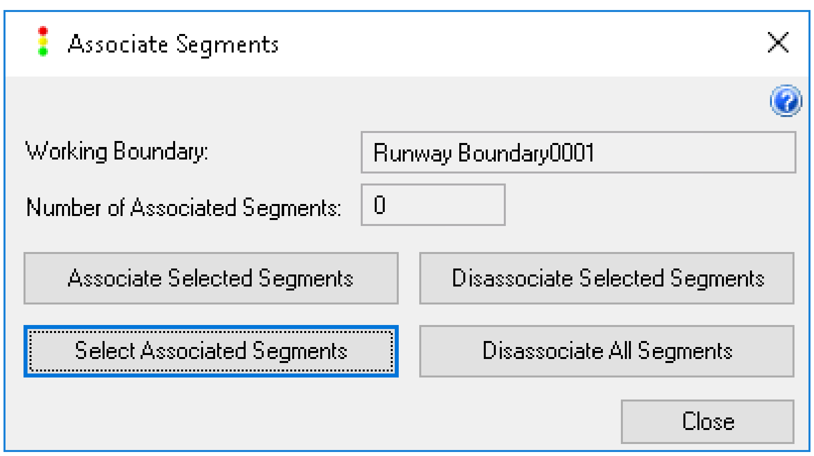



**Figure 16-5 The Associate Segments dialog**

To *Associate* the segments we previously created, simply *Select* the segments and press the **Associate Selected Segments** button. Note that you can have Boundaries selected along with your collection of segments- this command will simply ignore any selected boundaries. This makes it easy to simply *drag* select the Runway segments.

Once you have associated the segments, deselect everything in the Map View by simply clicking in an area of the Map View away from any selectable entities. Now press the **Select Associated Segments** button. You should see all of the LAS Working Segments that were created using the Runway boundary become selected. If not, simply press the **Disassociate All Segments** button and repeat the above process. When you are satisfied that the segments have been properly associated, press the **Close** button. When presented with the Checklist Step completion dialog, press **Complete**. You now have an LAS Boundary with associated LAS Segments.

Next *Populate* the Runway segments by:

1. Selecting the segments into the Working Set (make sure to exclude the Runway Boundary)
2. Execute the Set Population parameters step, setting the dialog to the values shown in Figure 16-6. Note that LIDAR Sources is being used as the layer from which LAS data is being sourced. Note also that we have used the Madison Seed file for the Create Associated Design File option. Press **Set** when complete with the dialog.

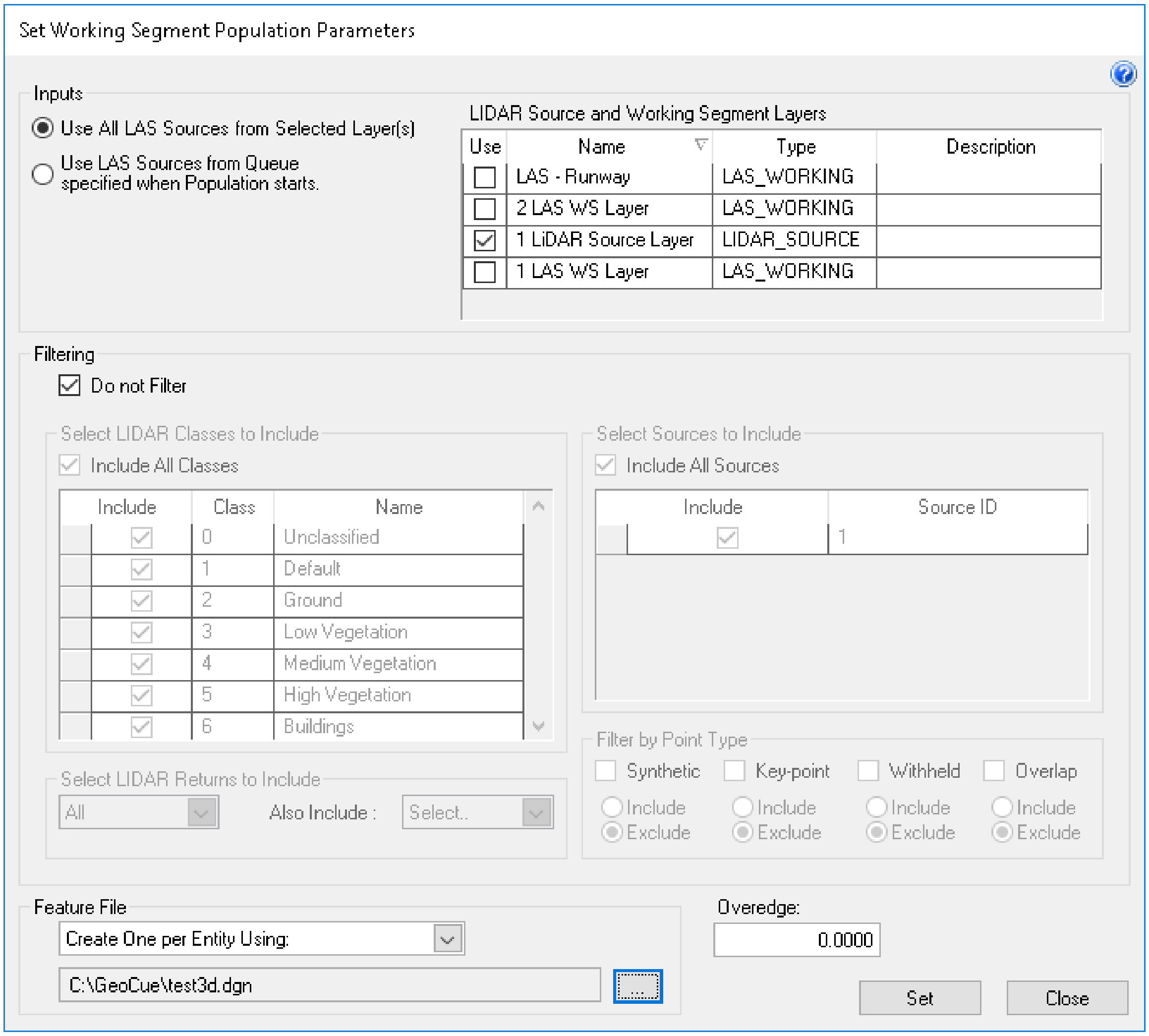



**Figure 16-6 The Runway Segment Population parameters**

Reselect the Runway segments to the Working Set (you can quickly do this by pressing the *Restore to WS* button on the Checklist toolbar). Run the *Populate* checklist step on all of the entities in the Working Set. Note – this will take some time to complete since we selected the LIDAR Sources as the LAS source for population. The LIDAR flight lines in the Madison data set are very long relative to the runway section but, since the data are a random point cloud, the population algorithm must examine *every* source point. Remember that you can track the progress of the population operation by setting the (F)ill option on the LAS Runway layer and selecting the desired fill state from the *Symbology* toolbar.

Set the TerraScan option to *Exclude* neighbors (see Figure 16-7 for the dialog setting and the TerraScan chapter of this document for an explanation of the settings). Select all of the Runway LAS Segments into the Working Set and execute the *Process in TerraScan* step in Multi-Entity mode.

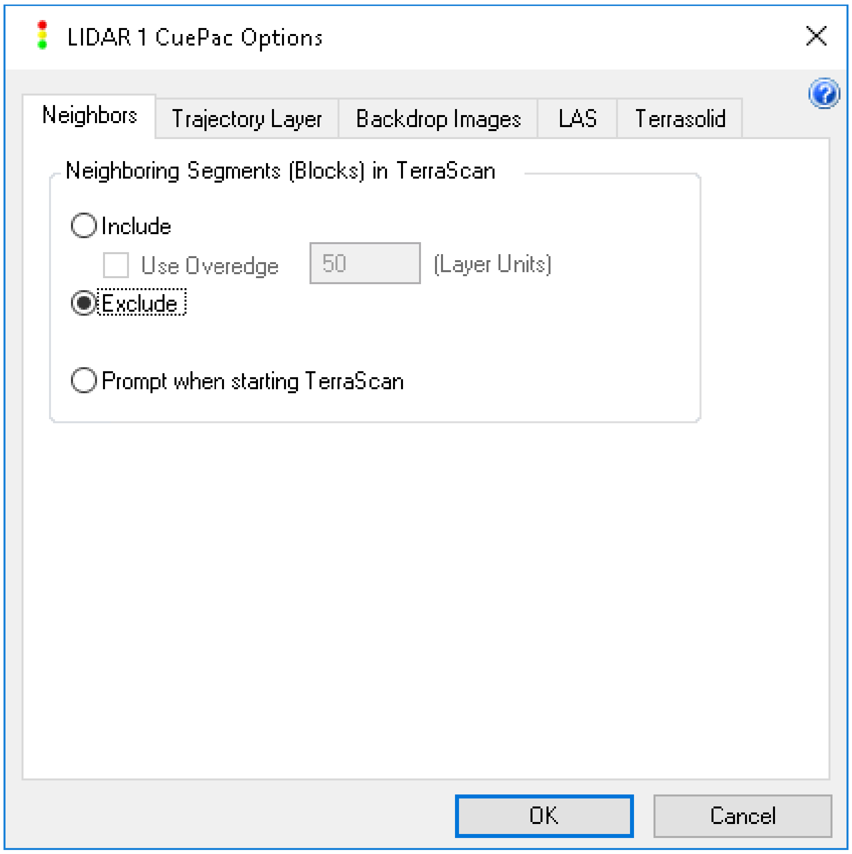



**Figure 16-7 TerraScan neighbors option setting**

Set all points in the Runway segments to the Ground class.

You can easily do this by:

1. Select ***Macro*** from the TerraScan ***tools*** menu
2. Select ***Add…***
3. Select *Classify Points* for the Action option and *By class* for the Routine option and press **OK**
4. Set From class to *Any Class* and To class to *Ground* and press **OK**
5. From the Macro File menu, select the Save As option and save the new macro under the name “RG” (make sure to remember the directory under which it is saved). Dismiss the macro dialog.
6. Open the TerraScan Project menu
7. Under Tools, select *Run Macro.*
8. Set Process to *All Blocks*, Macro to the RG macro you created above, ensure the Save Points option is checked and press **OK.** You should see a scrolling dialog reporting successful completion of each block.

Exit TerraScan

We set our process note to “Set all points to Ground.” as a reminder of our processing step. You can select Runway segments into the Working Set and execute the optional step, *View in PointVue,* to verify that all runway points are set to ground (select the View by Class icon in PointVue – all points should be the Ground color).

### 16.2.2 Merge Source 2

Our example is to merge the runway ground classified data into a set of data surrounding the airport. Thus we will next prepare a layer that contains other data we wish to include in the merge. We will construct a subset of the data around the airport that contains the previous prepared runway data.

1. Create a new layer of type LAS_WORKING called “LAS – Context”
2. *Select* all of the LAS Segments that contain the runway area from the original project layer, LAS-1 (Figure 16-8)
3. Create new LAS Working Segments on the new LAS – Context layer using the *Selected* segments as a template (create the new segments using the *Selected Entities Geometry* placement method). Use a name of “Context –“
4. Set the *Population Parameters on* these new Context Working Segments using LAS-1 as the source layer (note that this will *not* be the layer selected by default on the Set Population Parameters dialog so be careful!). Set the design file option and select the Madison MicroStation V8 seed file.
5. *Populate* the Context LAS working segments (this should go very quickly since the geometry of the destination and sources are the same)

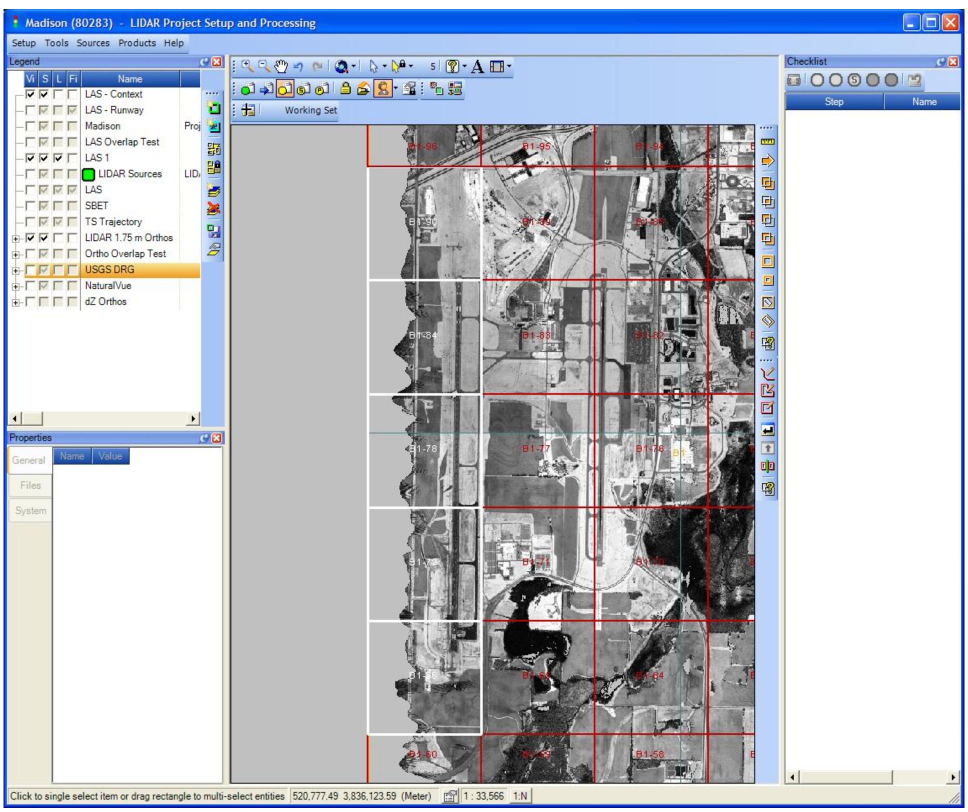


**Figure 16-8 Original Segments from LAS-1 surrounding runway**

The last step is to create a Boundary that encloses our new Context working segments. We will create a boundary that tightly encloses the new segments. Since these segments are orthogonal to the coordinate system and are rectangular, an MBR (Minimum Bounding Rectangle) will do the trick.

1. *Select* all of the new Context working segments
2. Invoke the *Create Entity* command with the LAS – Context layer selected.
3. Create a new entity of type LAS_Boundary, named "Context Boundary", using the placement method *MBR of Selected Entities*
4. *Associate* the Context working segments to this new boundary using the same technique discussed in the previous section

### 16.2.3 Preparing the Destination

*Merge* combines data denoted by one or more LAS Boundaries with data contained in LAS Segments. Thus the destination for a merge is a layer of type LAS_WORKING. This layer must contain LAS Working Segments that span the area that you are interested in obtaining merge results over.

We will construct a single LAS Segment on a new layer to contain our merge results. You should note that the destination can be sub-divided into as many LAS Segments as you desire. For example, if the destination layer define "LAS Products" for delivery, you may want to grid the destination layer into LAS Working Segments that adhere to the delivery tile size specified by your customer.

Prepare the destination by the following steps:

1. Create a new layer of type LAS_WORKING called "LAS – Merge Results"
2. *Select* the Context Boundary entity (make sure you have only one entity selected)

3. *Select* the “LAS – Merge Results” layer and create a new entity of type LAS_Working_Segment named “LAS – Merge Result” using the placement method *Selected Entities Geometry*

You should now have a single new LAS segment that is the same size as the combined Context segments created in the previous section.

### 16.2.4 Merge

We will now perform the actual merge. Our goal is to merge the Context data and the Runway data into the destination LAS segment with the runway data taking precedence.

When two or more LAS Boundaries are to be merged and these boundaries have overlapping areas, you can specify the priority of the boundaries. Boundaries with higher priority will “overwrite” boundaries with lower priority.

Thus the first step of the merge is to establish the priority of the two Boundaries that will act as sources in our merge. We want to create an LAS segment (our LAS – Merge Results segment) that contains as a base set of data the airport area contained in the “Context” segments. Overlaid on that data we want the Runway data that we classified to ground. Thus the operation is essentially “copy all the context data to the destination and then overwrite just the runway area with the ground classified runway data.”

#### 16.2.4.1 Setting Merge Priority

LAS Boundaries can be assigned a Merge Priority if they are to be used in merge operations. Priorities can assume positive, integral values with higher numbers having higher priority. If two or more boundaries are selected as merge sources, those boundaries have overlapping areas and merge priorities are the same, the results are undefined. If no merge priority is set and the boundaries have overlapping areas, again the result are undefined.

We will set the priority of the Context boundary to a value of 1 and the Runway boundary to a value of 2 (giving the runway data higher priority).

Select the Context Boundary and the Runway Boundary into the working set. Its checklist should resemble Figure 16-9. Select the *Assign Merge Priority* checklist step, press the Multi-Entity mode button and set the step to In Progress. This will invoke the merge priority dialog (Figure 16-10).

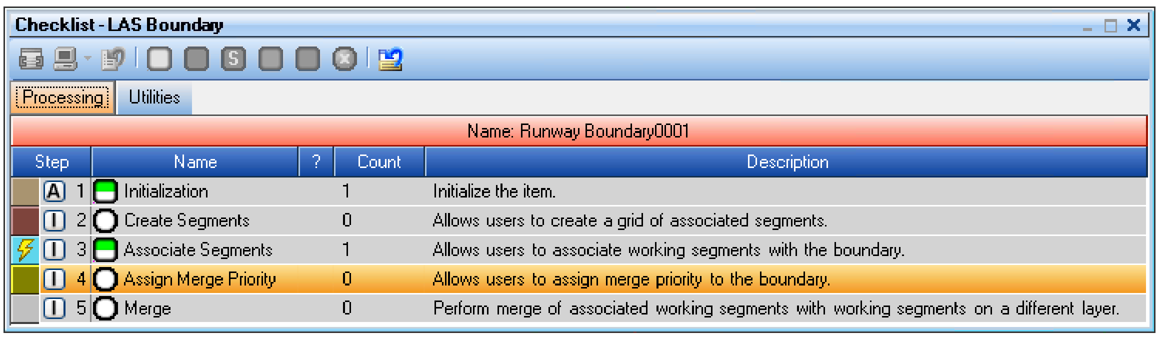



**Figure 16-9 Context Boundary checklist**

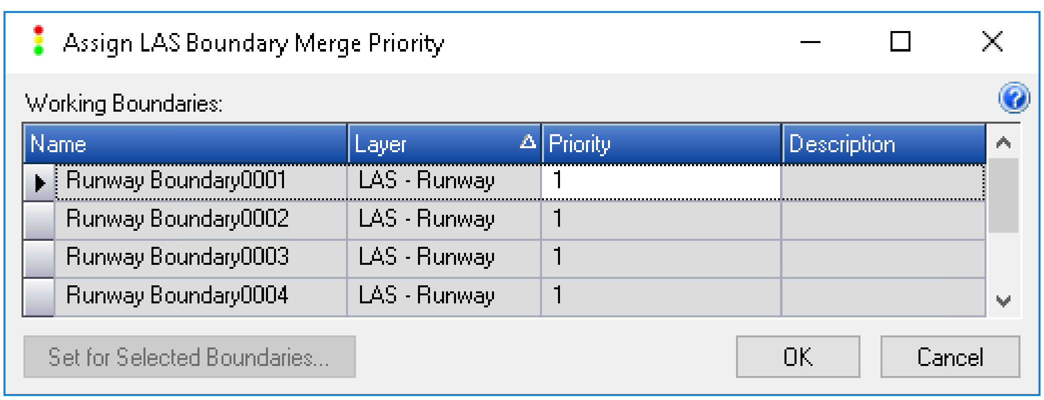



**Figure 16-10 Assign Priority dialog**

Note that this dialog is interactive with the display. If you select a row in the dialog, the corresponding Boundary will *Select* in the Map View. This allows you to easily determine the layout of boundaries in complex projects while assigning merge priorities.

Set the priority of the Runway to a value of 2 and the priority of the Context to 1 (click in the *Priority* field to set the value). When complete, press the **OK** button.

#### 16.2.4.2 Merge

The final step is to actually perform the merge.

Merge is driven through the checklists of the Boundaries that will be the *source* of the merge.

1. Select both the Runway and Context Boundaries into the working set.
2. Activate the Multi-Entity mode and set the *Merge* checklist step to the In Progress state.
3. You will be presented with the dialog of Figure 16-11.

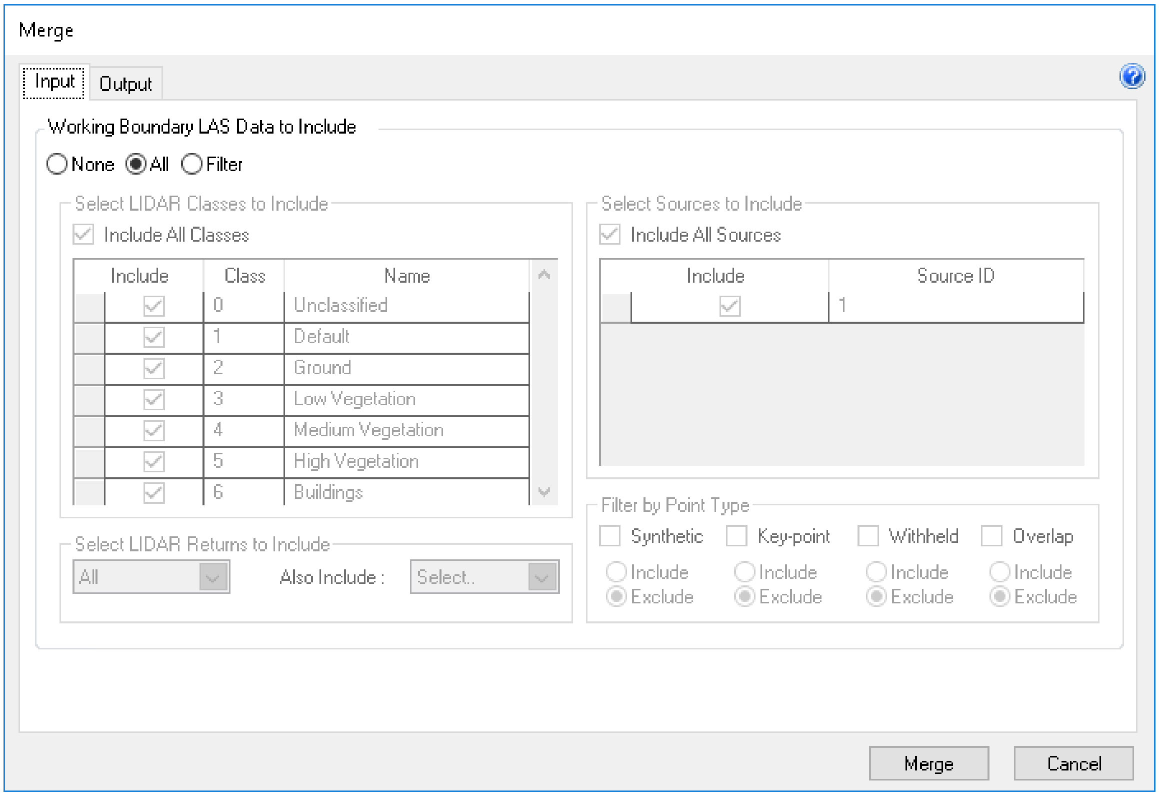



**Figure 16-11 The Merge dialog**

The Merge dialog allows you to filter both the input sources to a merge operation as well as the output. The input filter is the same as that used for *Population* parameters for LAS Working Segments. Thus if you wish to *filter* out certain types of data, set the parameters the same as you would for populating segments. Note that if you select the radio button option of *none,* the effect of the merge will be to insert nothing into the merge area. Depending on the settings you select on the **output** tab, this can have an effect such as deleting the data within the region in the output layer that is coincident with your input boundaries.

We wish to include all data in our input sources and thus leave the Input radio button set to ***All***.

Switch to the **Output** tab. The first action is to select the layer into which the data will be merged. Recall that we set up "LAS – Merge Results" as our destination layer. Press the **Select…** button beside the *Destination Layer* field and select this layer from the Layer Selection dialog.

Merge allows you to merge the input data into output data while retaining selective portions of the output. We are not going to use this feature for our example since we did not populate any of the LAS segments on the "LAS – Merge Results" layer. However, notice that retaining data works similarly to the population parameters using the LAS filter. Leave the radio button set to **None** on this dialog.

Press **Merge** to start the merge operation. You can observe the progress of the merge by selecting Fill Color on for the merge layers and observing the status.

When the merge is complete, select the "LAS- Merge Results" LAS Working Segment into the Working Set and run the *View LAS in PointVue* checklist step. Set the PointVue mode to "Display by Classification." Your display should resemble Figure 16-12. Note that the data we classified to Ground from the Runway Boundary has replaced all data within this boundary area in the Context Boundary area.

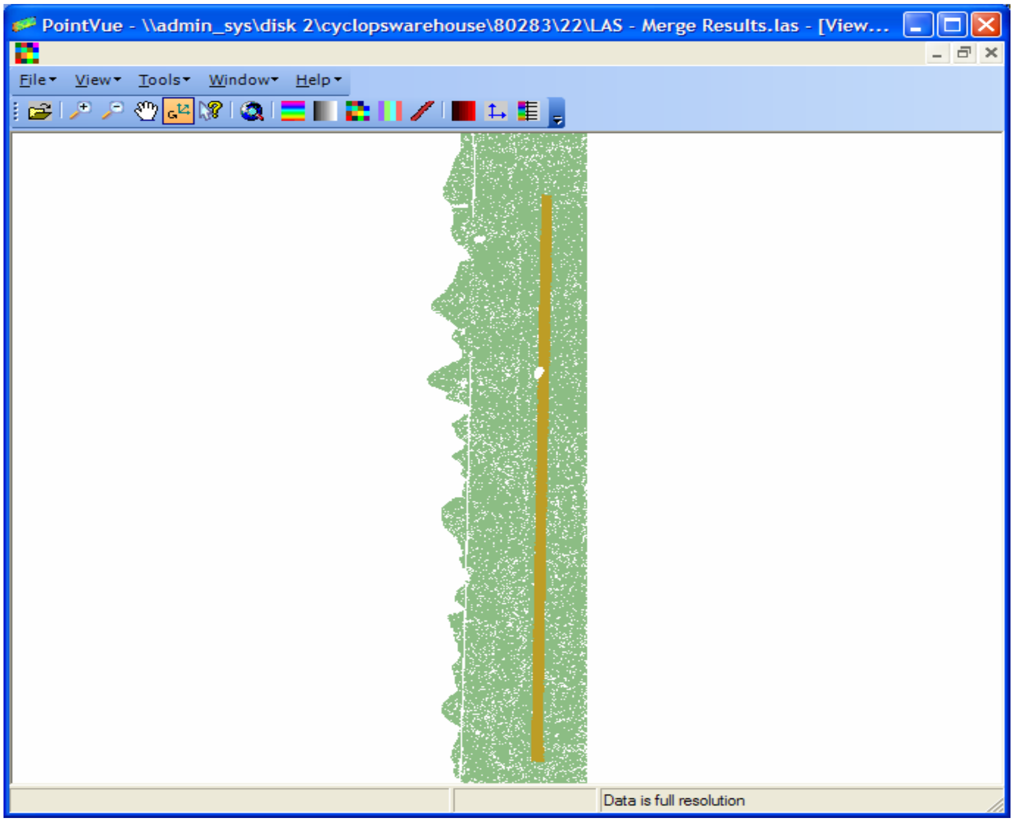



**Figure 16-12 Viewing the Merge result in PointVue**

## *16.3 Summary*

Merge is a very powerful feature in the LIDAR 1 CuePac. For most production scenarios, it is not necessary to use Merge since you can typically accomplish the desired task using Populate. However, when processing arbitrary boundary LAS segments in situations such as TerraScan macros, Merge can prove very valuable in recombining results.

# 17 LIDAR Stereo Images

We have included in LIDAR 1 CuePac the ability to render a pair of stereo images along with an associated stereo model file for use in standard photogrammetric workstations. Using this capability, you can render the LIDAR data (using a variety of tools) into stereo image representations of the data. These images provide a number of advantages in processing LIDAR data:

- You can view, in stereo, very large sections of the project (the equivalent of 100's of millions of LIDAR points)
- You can view stereo images rendered by the Classification color. This is very useful for quickly visualizing misclassifications
- You can directly collect 3D features such as breaklines from the 'imagery'

This release of GeoCue LIDAR 1 CuePac supports the following stereo editing platforms:

- Summit Evolution (from DAT/EM Systems International)
- ImageStation Stereo Display (from Z/I Imaging)
- BAE Systems SOCET SET Version 5.1

## *17.1 Generating a LIDAR Stereo Pair*

The process of generating a LIDAR Stereo Pair (LSP) is similar to generating a LIDAR Ortho image.

We recommend that you first generate a small LSP over an area of interest in case you need to "tune" the generating parameters.

Open project Madison. Create a new layer of type LIDAR_Stereo_Pair_WORKING and name the layer “LIDAR Stereo Pairs.” Set the Horizontal Coordinate system to NAD83 UTM Zone 16N, meters and the Vertical system to Geographic, WGS84, meters.

> NOTE – When creating LIDAR Stereo Models, both the Horizontal and Vertical coordinate systems of the Stereo Layer must be identical to the LAS Working Segment layer from which the Stereo Images will be generated.

Turn off all layers except the LIDAR Orthos. Zoom in on an interesting area of the image. Select the LIDAR Stereo Pairs layer and then press the *Create New Entity* tool. Fill in the Create Entity dialog as shown in Figure 17-1. Note that we will create this test entity by simply dragging a rectangle in the Map View. Dismiss the dialog when you are satisfied with the entity. Our test entity is depicted in Figure 17-2.

Now insert the LSP entity that you just created into the Working Set. You will see the checklist of Figure 17-3 in the checklist pane. Activate the first step and you will be presented with the **Set Image Generation Parameters** dialog that we used in the LIDAR Ortho image generation process. However, note that now the stereo related generation parameters have been activated.

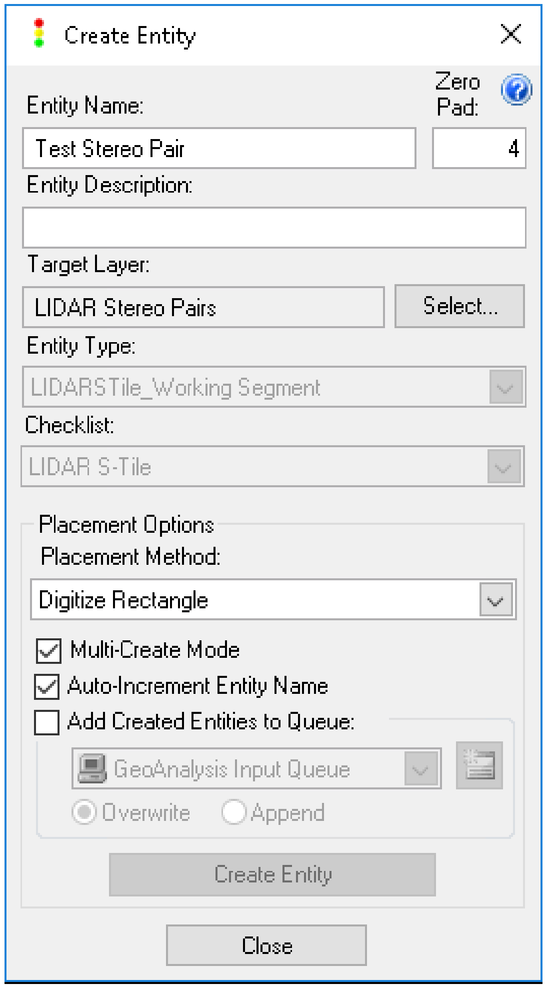



**Figure 17-1 Parameters for a test stereo pair entity**

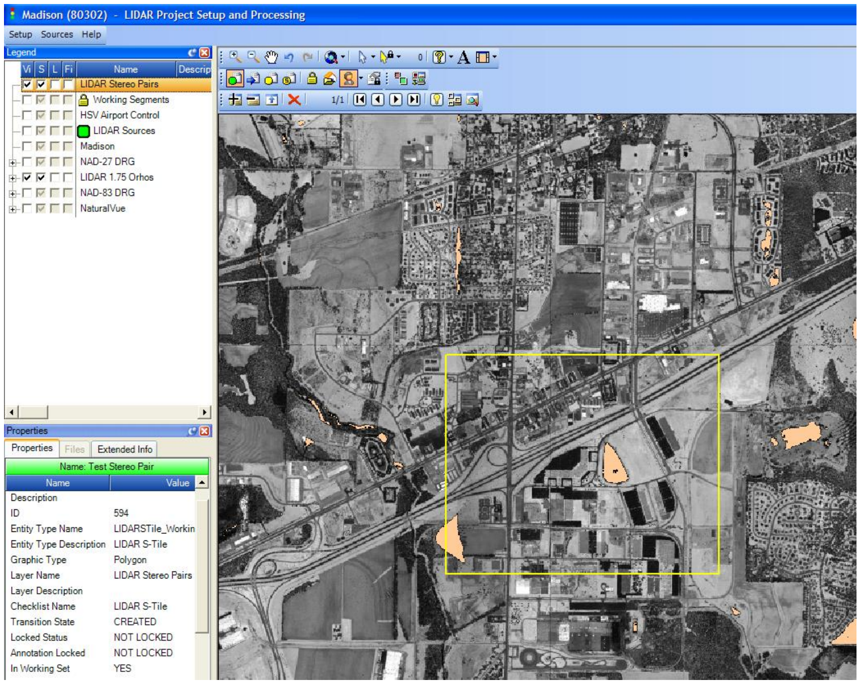



**Figure 17-2 LIDAR Stereo Pair entity created by dragging a rectangle**

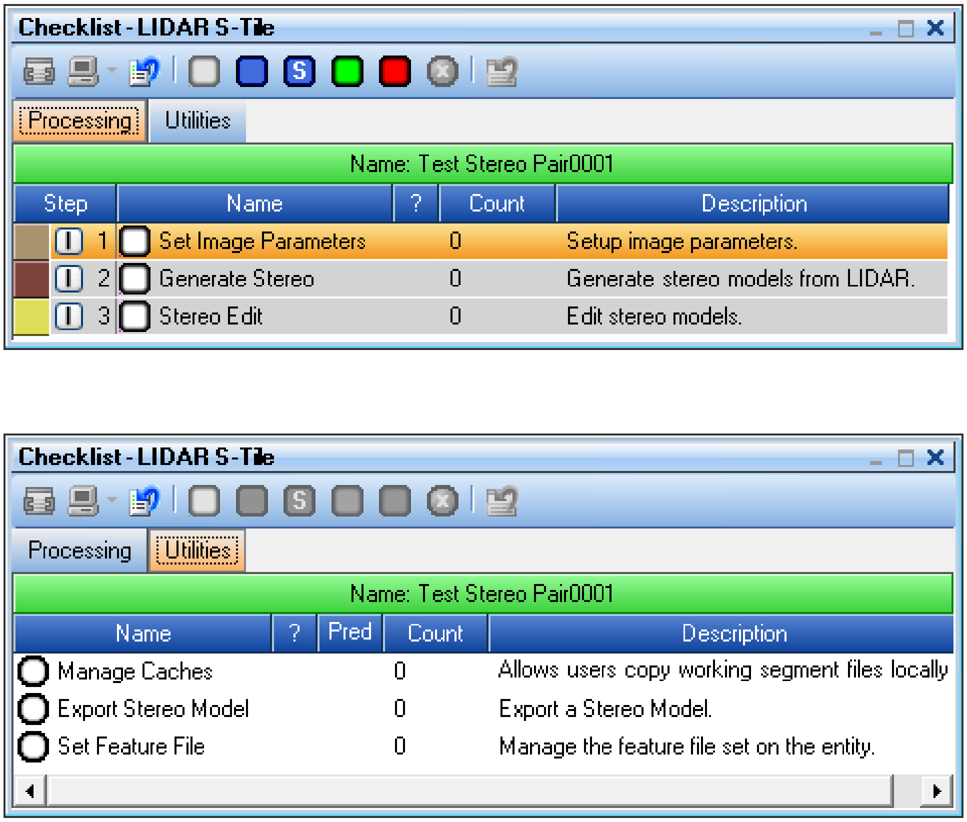



**Figure 17-3 The LIDAR Stereo Pair checklist**

Set these parameters as shown in Figure 17-4. A discussion of these parameter settings follows.

The Base to Height Ratio determines the stereo exaggeration of the generated image. The larger this value, the greater the apparent stereo effect. As a rule of thumb, use small values (say around 0.3) in regions of moderate to high terrain relief and use larger values (0.6 and above) where you want to exaggerate stereo relief in relatively flat areas. There is a trade-off in setting this value. Small values of Base to Height Ratio yield higher quality images but lower stereo exaggeration. The greater you make this value, the more the stereo exaggeration but the more you will notice image degradation, particularly in areas of discontinuous changes in elevation such as the edges of tall buildings.

The Base Elevation should be set to the approximate average elevation of the project area. Pixel size was discussed in the previous section on LIDAR orthos. As a rule of thumb, a value of approximately 1.25 times the LIDAR average Ground Sample Distance is a reasonable value.

Most stereo photogrammetric workstations do not use image transparency. Thus you should normally set this value to black. The exception would be if you intend to export the image to a software package that can use transparency.

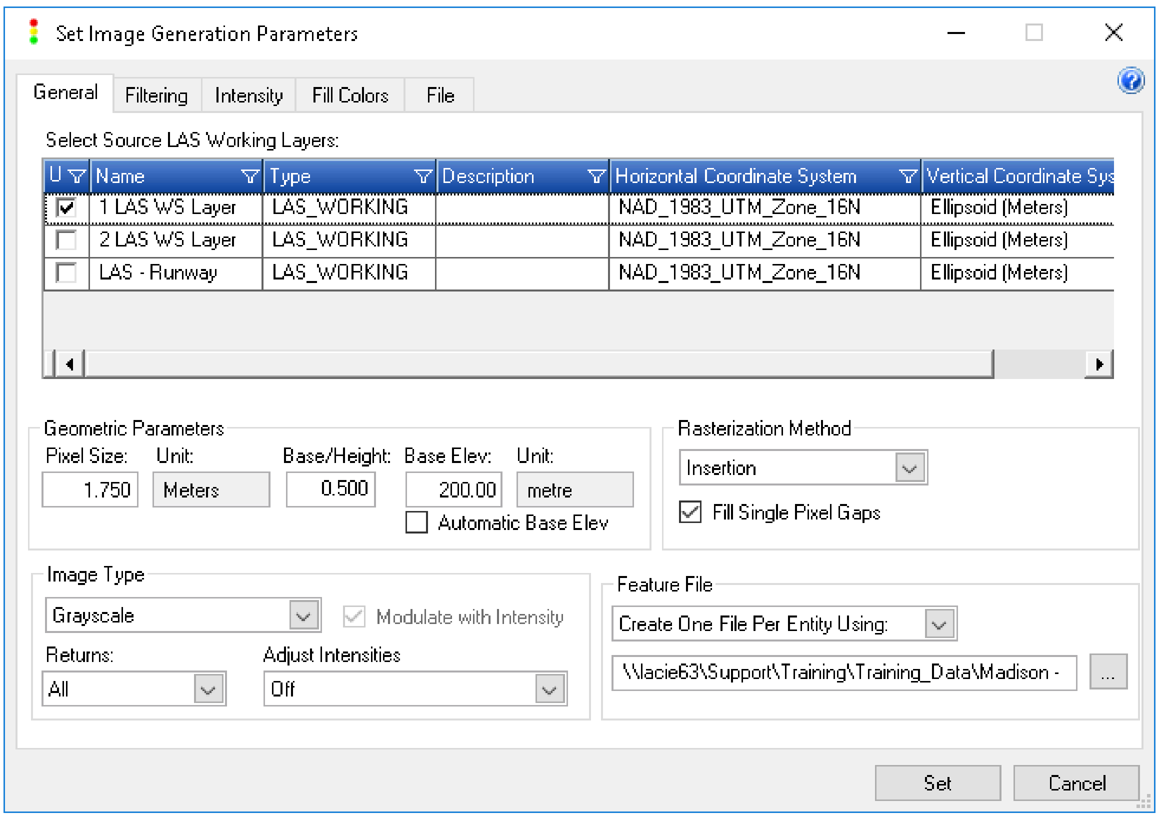



**Figure 17-4 Parameter settings for the test stereo image**

As previously discussed, the feature file allows you to associate a file to contain vectors extracted from the imagery. Photogrammetric software platforms use this both for storage of any collected features and also to establish viewing transformations. We have provided MicroStation seed files for the Madison project in the Sample Data file collection (in the subfolder named “MicroStation Seed Files”). We have selected the option to associate a file per stereo model.

When you have completed the dialog, press *Set* to dismiss and accept the parameters.

The next step is to actually generate the stereo pair. Add the LIDAR Stereo Pair entity to the Working Set and activate the second checklist step (“Generate Stereo”). When this step completes, your stereo pair is ready for viewing!

> NOTE: If you have the Enterprise version of GeoCue, you can *Distribute* the generation of LIDAR Stereo images. This functions identically to generating LIDAR orthos (see 12.1.4.1).

## 17.2 Invoking the Stereo Platform

The LIDAR Stereo Pair that you generated in the previous section is ready for exploitation. To bring it up in your stereo platform, select the LIDAR Stereo Pair entity into the Working Set and activate the third checklist step (“Stereo Edit”).

If, on the off-chance, you have more than one LIDAR 1 CuePac supported stereo package installed on your workstation, you will be presented a pick dialog similar to Figure 17-5.

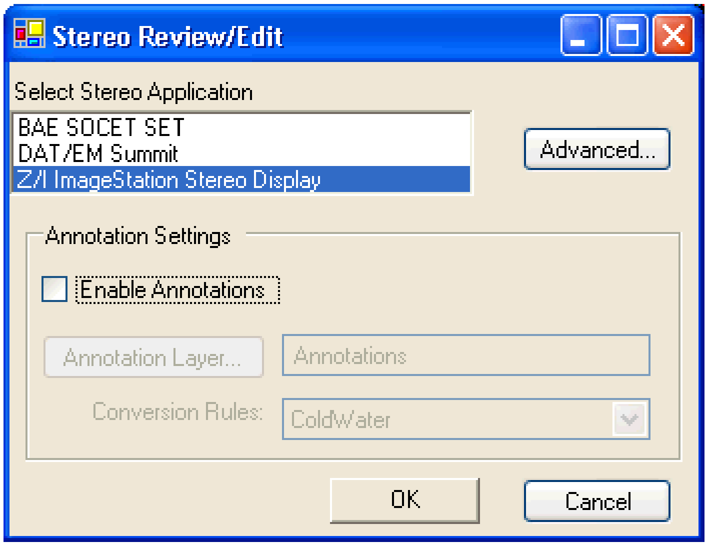



**Figure 17-5 Picking the Stereo Application**

NOTE – The Stereo Review/Edit dialog has an option for *Enable Annotations.* You should leave this unchecked unless you are participating in the GeoCue review of this function. It will be released and documented in the LIDAR 1 CuePac Version 2.0 Release (early 2005).

If you are using an application that expects to be invoked with a CAD file and you did not assign a file when you set the Stereo Image Generation Parameters, you will be presented with a browse dialog with which to select the associated CAD file. An example of this dialog is shown in Figure 17-6.

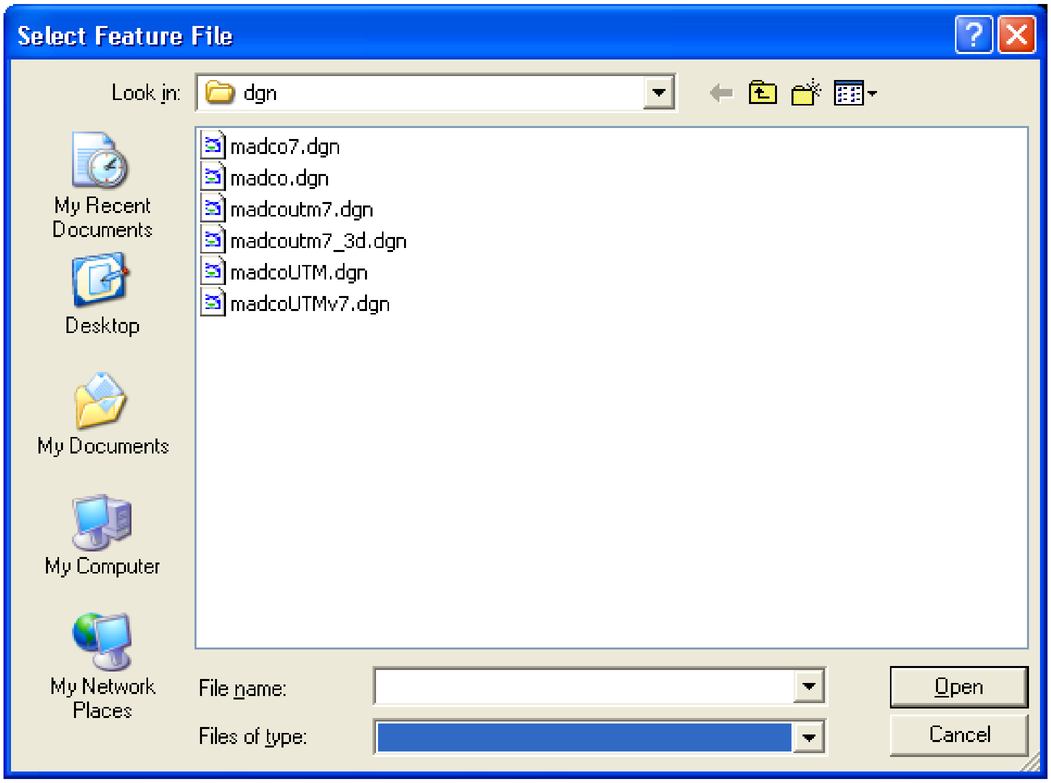



**Figure 17-6 Feature File selection dialog**

## *17.3 Project-wide Stereo Coverage*

You can iterate on the previously discussed steps to achieve the stereo settings that you desire for the overall project. Once you are satisfied with the image generation parameters, create a grid of stereo coverage over the entire project using the same techniques discussed in the LIDAR Ortho section of this workflow document.

Note that there are no particular restrictions on the LIDAR Stereo Pairs other than the requirement that the entity must be created in the same coordinate system as the LIDAR Working Segments and that the entities be rectangular.

You can generate very large LIDAR Stereo images (at least large in terms of the amount of covered LIDAR points!). For example, you can generate a single LIDAR Stereo Pair for the entire sample project.

A useful experimentation technique is to create a different layer for the different types of Stereo Pairs. This allows you to easily keep track of the effect of different resolution settings, the usefulness of panchromatic versus color images and so forth.

# 18 The Stereo Macro Assignment System

The Stereo Macro Assignment System (SMAS) within the LIDAR 1 CuePac is a powerful system that allows you use LIDAR stereo coverage of large areas of projects for both Quality Check and TerraScan macro assignments. This iterative approach to reviewing and reprocessing can save considerable amounts of time as compared to the more traditional approach of reviewing and editing data one TerraScan processing block (LAS Working Segment) at a time.

The general iterative approach is:

1. Perform preliminary macro processing on the project
2. Generate LIDAR stereo images for the entire project based on "color by classification". These stereo images are typically quite large, covering many hundreds of LIDAR working segments.
3. Bring up a LIDAR stereo image in your photogrammetric platform of choice.
4. Review the LIDAR data using tools within the stereo platform such as roaming
5. Draw a polygon around misclassified data using symbology matched to your GeoCue TerraScan macro catalog
6. Exit the stereo platform and run the macro/merge process
7. Repeat at step 2 until you are at the point that interactive clean-up is warranted.

The general process is described in this chapter. We encourage you to experiment with different techniques.

## 18.1 Overview

The purpose of the Stereo Macro Assignment System (SMAS)[9] is to permit users to use LIDAR stereo images to quickly identify areas within LIDAR data that should have certain TerraScan macros run on them and to provide an efficient means to apply the macros once they have been identified. Areas to which macros should be applied are delineated in a MicroStation stereo environment using stereo models derived from the LIDAR data. These LIDAR stereo models allow the user to view data over a much larger area than do direct LIDAR editing tools such as TerraScan. When an area is digitized in MicroStation while SMAS is active, SMAS will do the following on behalf and at the discretion of the user:

1. Create a macro processing boundary (LAS Boundary) in GeoCue that corresponds to the digitized area.
2. Create working segments within and assigned to the macro processing boundary.
3. Assign a macro (based on MicroStation symbology or feature code of the digitized area) to the newly created working segments.
4. Automatically set population parameters on the newly created working segments. Working segments created by SMAS will be populated from the working segments that were used to generate the LIDAR Stereo image.

At a later time, the user may perform the following steps within GeoCue to complete the processing:

1. Populate the working segments created by a SMAS session.
2. Run the TerraScan macros assigned by SMAS.
3. Merge LAS data within macro processing boundaries into a destination LAS layer (See the Merge chapter of this document).

[9] Previously, this was known as the Stereo Annotation System.

## 18.2 Getting Started

Before you can begin a SMAS session, you will need to set up a few things:

- LIDAR Stereo Pairs will need to have been generated
- A Macro Catalog must have been defined that contains TerraScan macros you have created. This macro catalog needs to be assigned to your GeoCue project
- Feature Conversion rules need to be established that will tell SMAS how to assign macros based on either MicroStation symbology or feature code
- ImageStation Stereo Display (ISSD) or DAT/EM Summit stereo application is installed and working on the client machine where SMAS session will take place.

## 18.3 Feature Annotation Rules Editor

You will initially need to establish *rules* that establish a relationship between polygons that you digitize in the stereo review session and your macro catalog[10]. Macro Catalogs are used for general macro processing in TerraScan and have been discussed in a previous chapter of this document. Rule Sets are used exclusively by the Stereo Macro Assignment System (SMAS). When used for macro assignment, your rule sets will have a one-to-one correspondence to your macro catalogs.

### 18.3.1 Invoking the Rules Editor

The Feature to Resolution Action Rules Editor is invoked from the ***All Programs*** selection from Windows. Browse to the editor by following the path (Figure 18-1):

[10] Note – SMAS does not require that you relate a Rule to an existing macro. Using names for rules that do not relate to a macro can be useful for simply annotating problems that will be manually reviewed.

***All Programs*** ► GeoCue ► LIDAR 1 CuePac ► Feature to Resolution Rules Editor

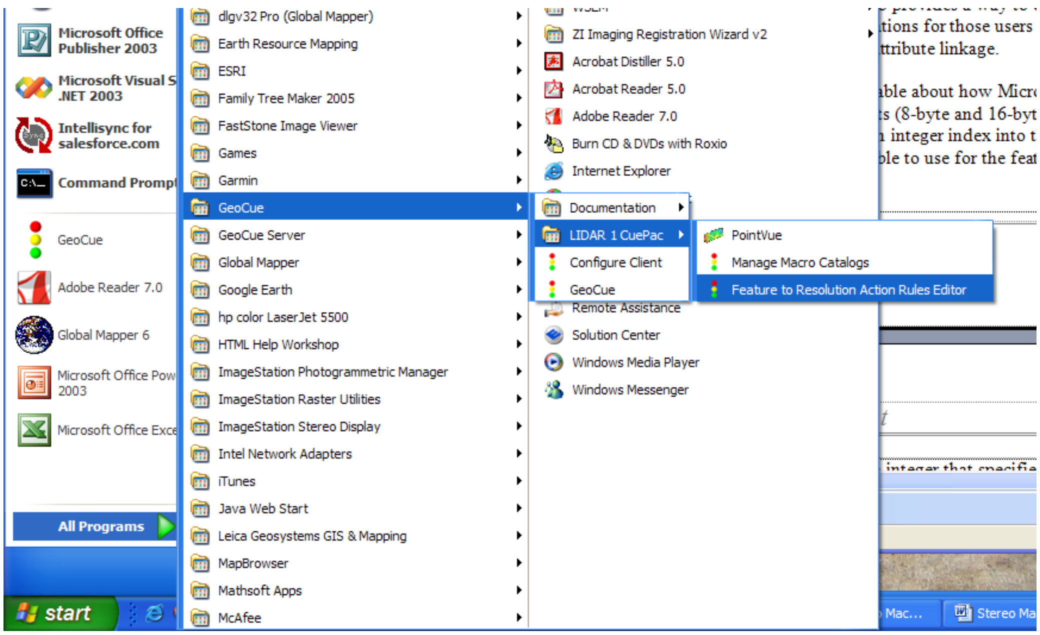



**Figure 18-1 Invoking the Rules Editor**

This will invoke the dialog of Figure 18-2.

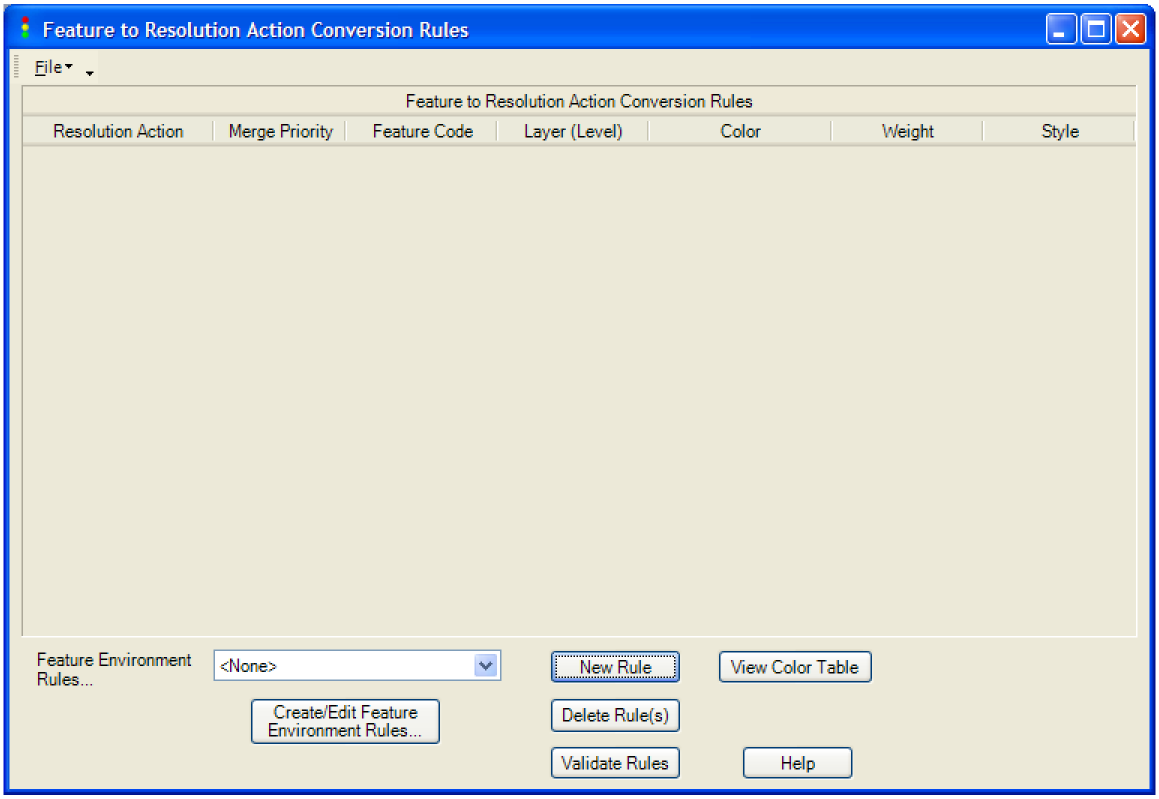



**Figure 18-2 Main dialog of the Feature to Resolution Action Editor**

### 18.3.2 Loading a Macro Catalog

The first step in defining macro assignment rules is to load macros that you wish to use in the SMAS into the editor. Select the *File* drop-down menu and choose the *Load Macros from Catalog* option. You will be presented the dialog of Figure 18-3 Select the Macro catalog that you wish to use in the SMAS session and press **Open.**

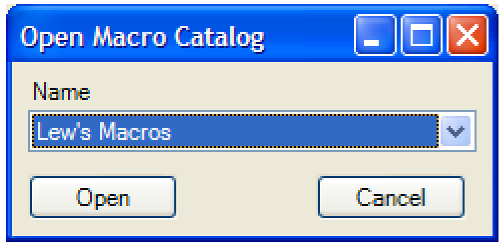



**Figure 18-3 The Open Macro Catalog dialog**

### 18.3.3 Adding a Rule

To begin the process of adding a new rule, press the ***New Rule*** button at the bottom of the Feature to Resolution Action Conversions Rules dialog (Figure 18-4). This will add a blank rule to your current rule set.

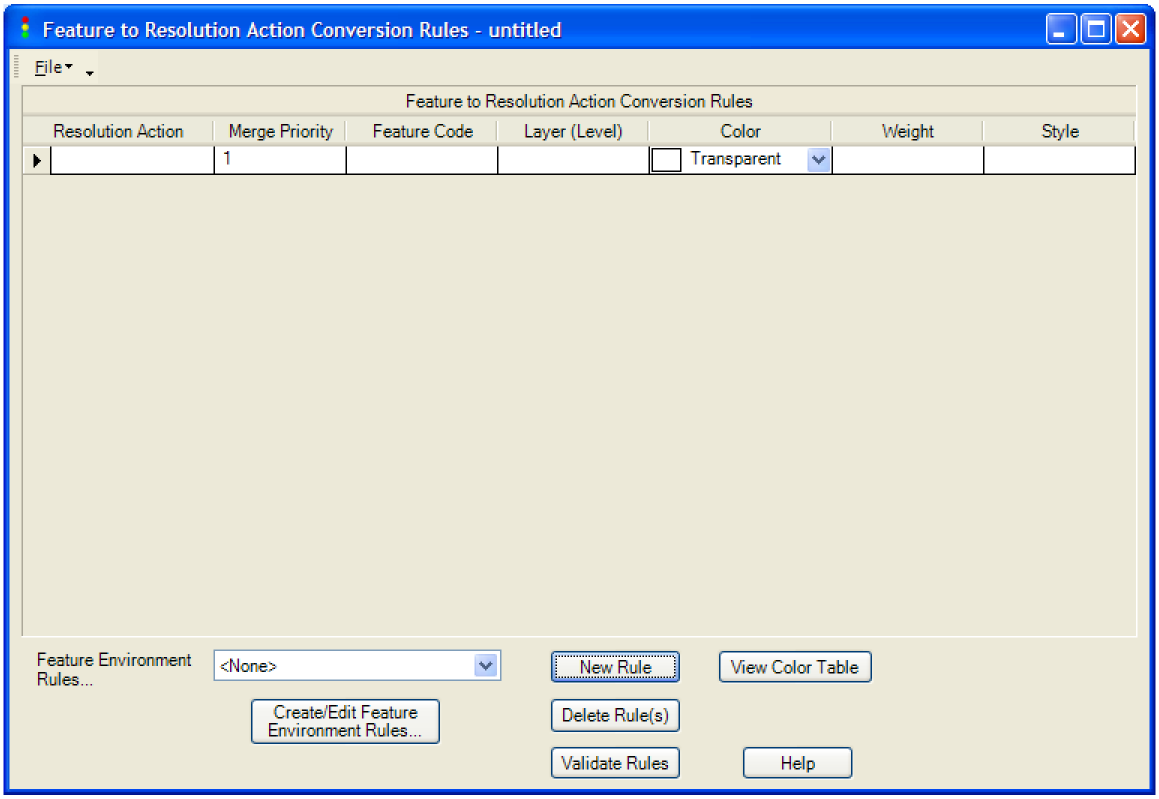



**Figure 18-4 Adding a new rule**

Populate this rule as detailed in Table 18-1.

**Table 18-1 Filling out the rule**

| Rule Entry | Description |
|---|---|
| Resolution Action | Select the macro you wish to apply for this rule from the drop-down list of macros (these are supplied by the Macro Catalog that you previously assigned). Alternately, you can key in a text string that either matches a macro in your |

| Rule Entry | Description |
|---|---|
| Merge Priority | This allows you to specify the priority level at which polygons with this rule applied will be merged (see the Merge chapter of this document) |
| Feature Code | This field is used if your merge technique is a Feature Code from the stereo edit environment as opposed to symbology. This capability is documented in the LIDAR 1 CuePac on-line help system. |
| Layer | The MicroStation layer on which this polygon will be located. |
| Color | The color of the polygon |
| Weight | The line weight of the polygon |
| Style | The line style of the polygon |

### 18.3.4 Deleting a Rule

To delete an existing rule, select the row you wish to delete and press the ***Delete*** button.

### 18.3.5 Saving the Rule Set

To save the current rule set, select *File* ►*Save as* from the drop-down File menu. Create a new name for your rule set and press ***Save***.

HINT: Rule sets have a one-to-one relationship to Macro Catalogs if you are using your rule set to apply macros. Therefore we suggest you use the same name for your Rule Set as you used for the corresponding Macro Catalog.

### 18.3.6 Loading an Existing Rule Set

Click on the Open menu item (from the *File* drop down menu) to open an existing set of rules that you have previously saved. The following dialog will appear:

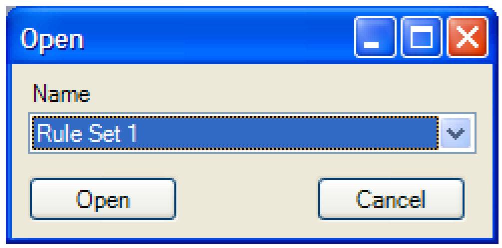



**Figure 18-5 Opening an existing Rule Set**

## *18.4 Preparing for the Stereo Macro Assignment Edit Session*

When using the Stereo Macro Assignment System to map polygons (or coded features) collected in a stereo workstation application and your macro catalog, you must ensure that you assign to your project the Macro Catalog that corresponds to the Rule Set that you will use within the SMAS session. To assign a macro catalog, browse to the macro editor via Window Start ▶All Programs ▶ GeoCue ▶LIDAR 1 CuePac ▶ Manage Macro Catalogs.

WARNING – You must assign only one catalog to a project. If you assign macros to working segments via the Assign Macro process step or via the SMAS and then change to a different macro catalog, your macro execution step will fail for each macro name previously assigned that does not match a name in the new catalog.

## 18.5 Stereo Edit Session

Put one or more LIDAR S-Tiles in your working set and put the “Stereo Edit” step in progress. You will be presented the dialog of Figure 18-6.

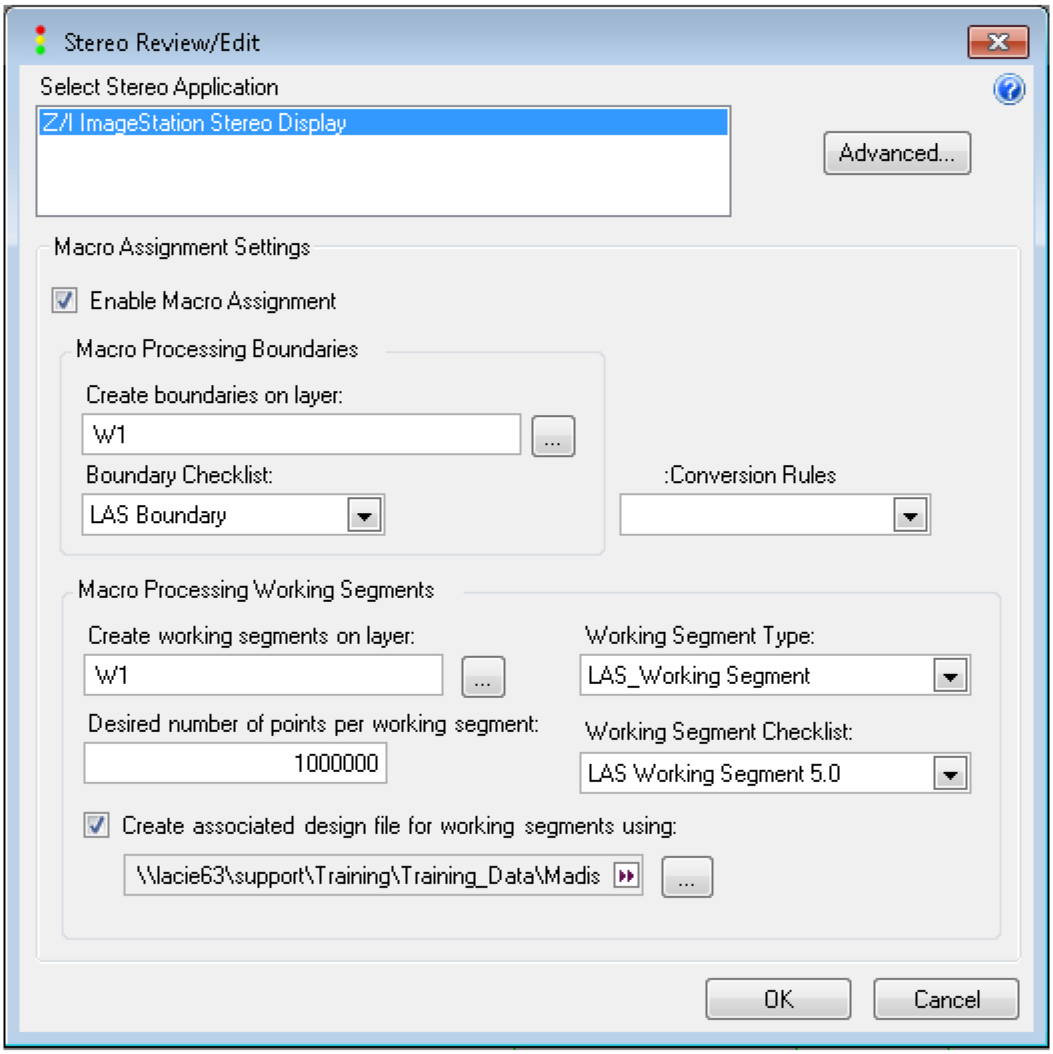



**Figure 18-6 Stereo Review/Edit dialog**

### 18.5.1 The Stereo Review/Edit dialog

In the following subsections we will review the items to be set on this dialog.

#### 18.5.1.1 Select Stereo Application

If you only have one Stereo Application installed (the usual case), only your application will be shown in the Stereo Applications list. If a stereo application that runs with MicroStation (e.g. “Z/I Image Station Stereo Display” or “DAT/EM Summit”) is selected, the Macro Assignment Settings will be enabled.

#### 18.5.1.2 Enable Macro Assignment

If you want to run the Stereo Macro Assignment Session (SMAS), check this box, which will enable the Macro Processing Boundaries and Macro Processing Working Segments settings.

#### 18.5.1.3 Create boundaries on layer

The LAS Boundaries that will be created from your digitized features will be placed on this layer. To pick or create a layer, select the browse button, 

which will display the *Select Layer* dialog (Figure 18-7).

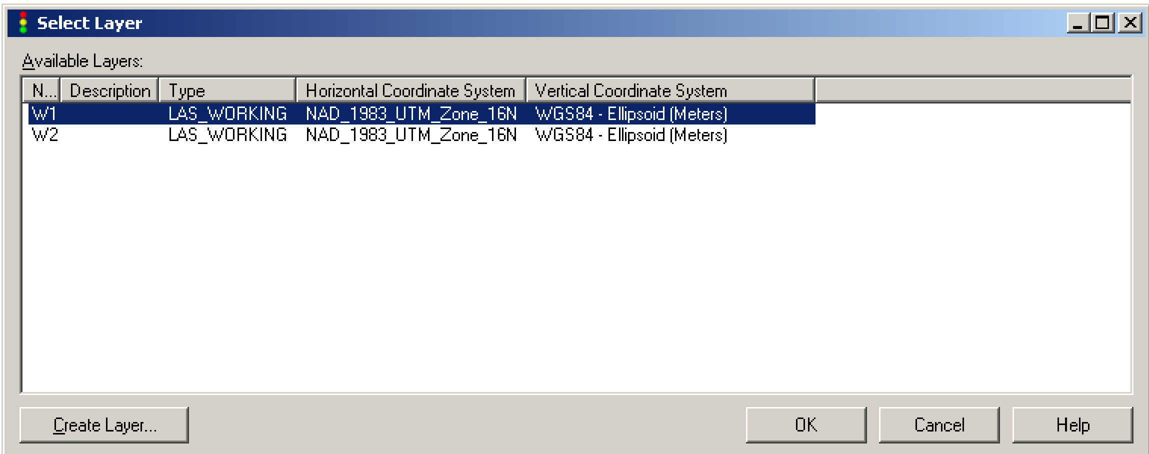



**Figure 18-7 Selecting a boundary layer**

It is highly recommended that you create a new layer for your macro processing boundaries by selecting the *Create Layer…* button, which will cause *Create Layer* dialog to appear (Figure 18-8).

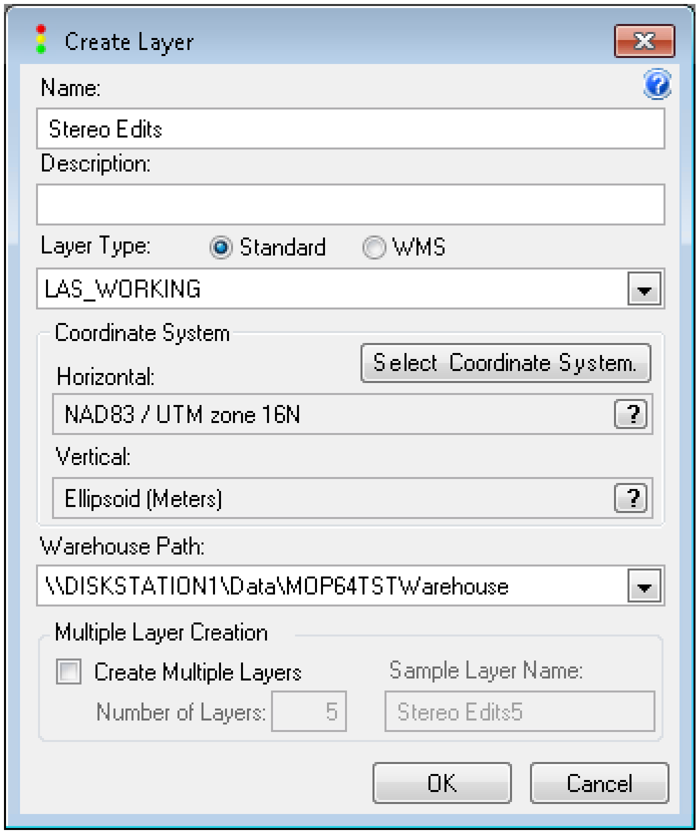



**Figure 18-8 Creating a new Boundary Layer**

Note that the coordinate system has been determined for you (it matches the S-Tile and its underlying working segments layer coordinate system). The layer type is also determined for you to be LAS_WORKING. Select OK to create your boundary layer.

### 18.5.1.4 Boundary Checklist

If you have defined your own checklists for LAS Boundaries, they will appear in this list along with the delivered "LAS Boundary" checklist. Any boundaries that get created during this SMAS session will have this checklist attached.

### 18.5.1.5 Conversion Rules

Any set of conversion rules that you have created from the "Feature to Resolution Action Rules Editor" will show up in this list. Pick the set of rules you wish to use during your SMAS session.

> WARNING: The Rule Set that you select must correspond to your currently assigned project Macro Catalog.

### 18.5.1.6 Create working segments on layer

When a LAS Boundary is created from a digitized feature, one or more working segments will be created and assigned to the boundary automatically by SMAS. You may choose to have your segments created on the same layer as the boundary or you may create your working segments on a separate layer (recommended). The procedure for selecting/creating the working segment layer is identical to that of selecting the boundary layer.

### 18.5.1.7 Working Segment Type

If you have created any of your own working segment types, they will show up in this list in addition to the delivered "LAS_Working Segment" type. Any working segments created via the SMAS session will be of this type.

### 18.5.1.8 Working Segment Checklist

If you have defined your own checklists for working segments, they will appear in this list along with the delivered "LAS Working Segment" checklist. Any working segments created via the SMAS session will have this checklist attached.

#### 18.5.1.9 Desired number of points per working segment

SMAS will use this value and the LAS point density of the working segments from which the LIDAR stereo pairs were made to compute an approximate maximum area for working segments created by SMAS. Making this number larger will result in fewer (and larger) working segments per boundary. Making this number smaller will result in more (and smaller) working segments per boundary. This number is approximate since the point density may vary.

#### 18.5.1.10 Create associated design file for working segments using

If you wish each working segment created by the SMAS session to have a design file attached, check this box and browse for a seed design file.

#### 18.5.1.11 OK

Once you are satisfied with your settings, click the OK button which will launch the stereo environment with your LIDAR Stereo Pair.

### 18.5.2 Stereo Annotations

When you enter the stereo edit session using your stereo compilation software, the *Create Macro Processing Boundary* dialog will remain displayed during the MicroStation session (Figure 18-9). You can create macro boundaries in one of two ways as described in the following subsections.

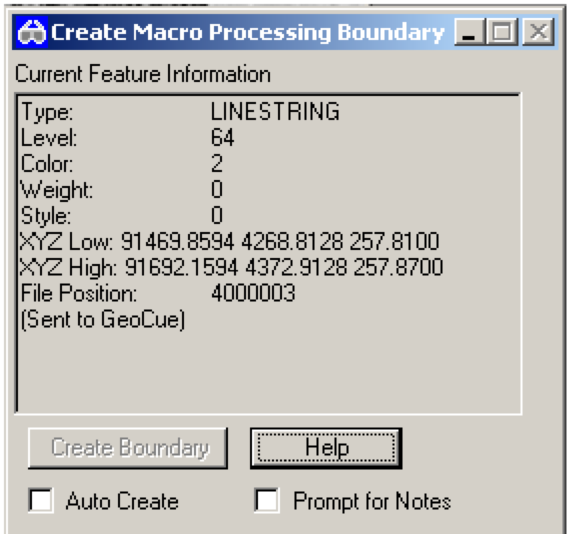



**Figure 18-9 The Create Macro Processing Boundary dialog**

### 18.5.2.1 Auto Create

If you check the Auto Create option in the Create Macro Processing Boundary dialog (Figure 18-9), each time you digitize a polygon (or line segment that the Create Macro function can close), a GeoCue background MDL will attempt to match the symbology (or Feature Code) to a matching symbology (Feature Code) in your Rule Set. If a match is found and you have not checked the *Prompt for Notes* option, a boundary will be automatically created in GeoCue. You can move on to the next annotation.

### 18.5.2.2 Interactive Create

If you do not check the Auto Create option in the Create Macro Processing Boundary dialog (Figure 18-9), when you complete a polygon (or line segment that the Create Macro function can close), you will receive the dialog of Figure 18-10 This dialog allows you full interactive control over the parameters of the boundary that will be inserted in your GeoCue project. If the Create Macro algorithms finds a match between the symbology of the shape you have just digitized (or matching Feature Code if you are in Feature Code mode), the macro field will be populated with the selected match from your current Rule Set. You can override this by either directly typing into the Macro to Assign field or selecting a macro from you current project macro catalog by using the drop down control.

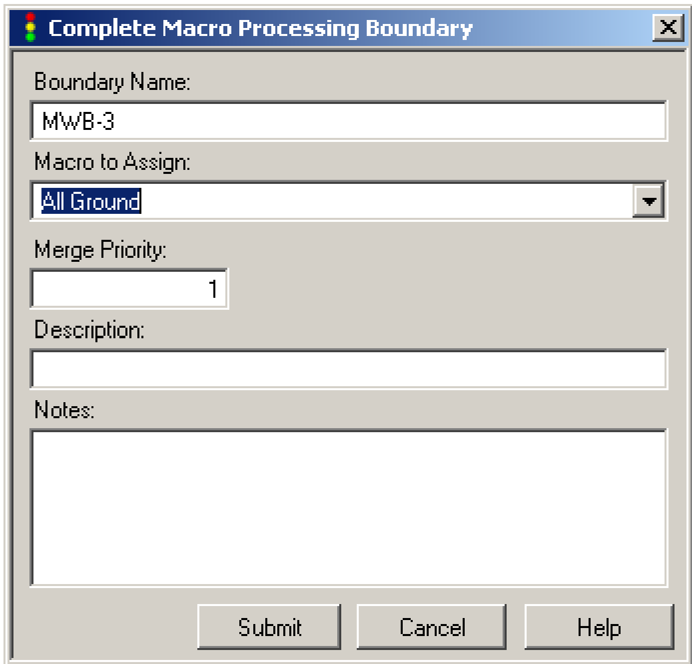



**Figure 18-10 Complete Macro Processing Boundary**

The fields in this dialog and their meanings are described below:

### *18.5.2.2.1 Boundary Name*

The LAS Boundary entity created in GeoCue will have this name. You will usually want to use the name that is generated for you, as it is guaranteed to be unique.

#### *18.5.2.2.2 Macro to Assign:*

The macro to be assigned to the working segments that are created in GeoCue. This list will contain all macros in the active catalog for the project. NOTE: If this list is empty, you probably need to assign a macro catalog to your GeoCue project by running the Macro Catalog Editor.

#### *18.5.2.2.3 Merge Priority:*

The merge priority that will be assigned to the LAS boundary will be set to this value. If there was a Feature to Resolution Action Conversion rule match, this value will be pre-populated with the Merge Priority value from the Feature Conversion rule.

#### *18.5.2.2.4 Description:*

The LAS Boundary that is created will have a description that reads “Run <macroName>” then the text in this field will be appended.

#### *18.5.2.2.5 Notes:*

This text will be added to the Notes sections of the “Associate Segments” and “Assign Merge Priority” checklist steps on the LAS boundary that gets created.

### 18.5.2.3 Completion

Pressing the **Submit** button will cause the LAS Boundary and associated working segments to be created in GeoCue. Continue collecting polygons until you have completed the model.

## 18.5.3 Processing the Annotations

When you exit the stereo application, your designated Boundary layer will contain a polygon for each feature collected during the stereo annotation session for which you associated a macro (or keyed in a pseudo macro name). Each of these boundaries will have a set of one or more *associated* LAS Working Segments. Each segment will have its population parameters preset by the annotation system (you will note that the Set Population Parameters checklist step is set to complete). If you examine the Set Population Parameters history, you will see a system logged message indicating that the parameters were set by the Stereo Macro Assignment System (Figure 18-11).

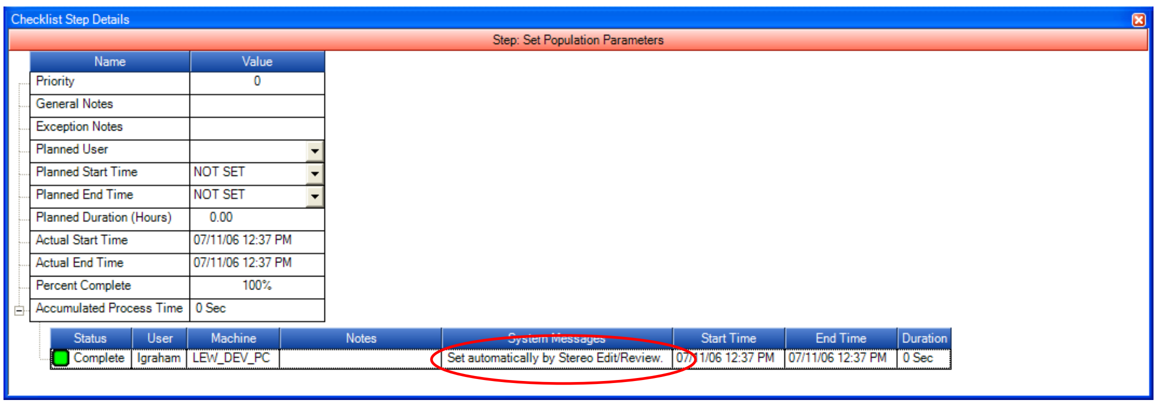



**Figure 18-11 Automatic Population Parameter setting note**

In addition to setting the population parameters, the system has also assigned the appropriate macro to each of the working segments. In versions 3.0 and prior versions, this checklist step will *not* be set to complete even though the macro has been assigned. If you examine the *Processing* tab of the entity's Properties for one of the SMAS generated segments, you will see a macro assignment similar to that of Figure 18-12.

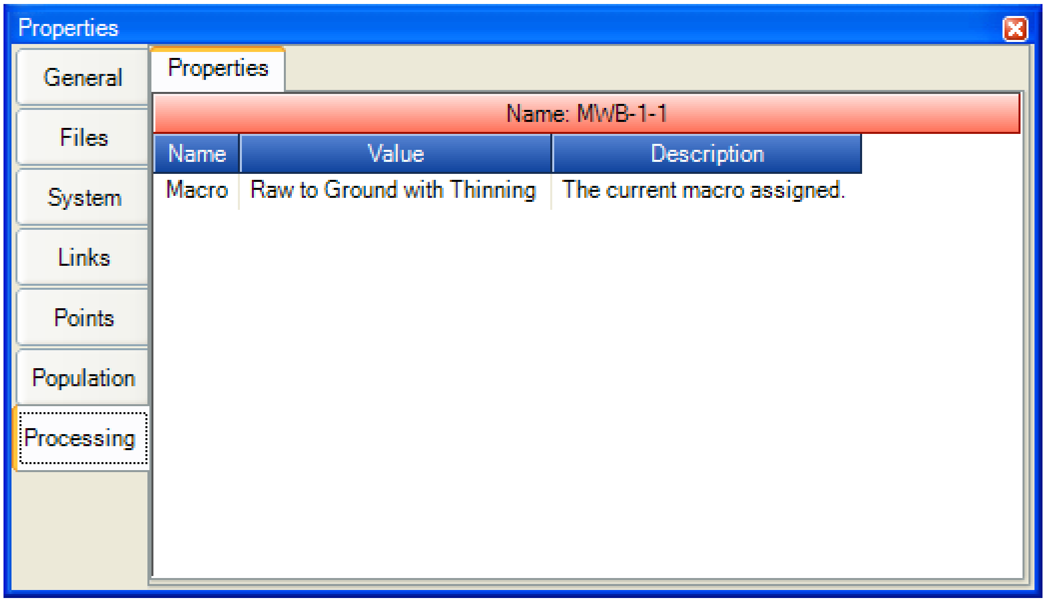



**Figure 18-12 The SMAS assigned Macro**

The steps to processing the annotations are:

1. Select all of the segments into your working set. This is easy if you created a new layer for your Segments and a separate new layer for the Boundaries. Simply select the working segment layer in the legend and press the *add layer entities to working set* tool on the Layer Legend toolbar.
2. Run the *Populate Working Segments* step for all entities in the Working Set
3. Restore the entities to the Working Set.
4. Select the *Assign Macro* step and, rather than setting this to In Progress, press the Set State to Complete button on the Checklist processor. This is done because all of the macros were actually assigned in the SMAS session.
5. Restore the LAS Segments to the Working Set and run the *Run Macro* checklist step to actually apply the assigned macros.

At this point you will have LAS working segments with the appropriate macros applied. You can now, using the boundaries, merge these back into the original LAS layer used to create the

Stereo models (this will replace the original, pre-macro data) or your can merge the original LAS data along with the just processed segments into an entirely new layer (recommend if you are concerned about the possibility of needing to Undo your operations). See the Merge chapter of this document for details on accomplishing either type of merge operation.

## 18.6 Summary

The Stereo Macro Assignment System promises to provide a significant productivity enhancement to the normal cycle of edit-inspect-edit. This is a relatively new capability within GeoCue that we continue to refine with each new release. We encourage you to experiment with this system and provide us your feedback.

# 19 The Annotation Subsystem

GeoCue provides an advanced annotation system that can be used for a variety of purposes. While this system was designed to allow customers with Web access to your projects to make comments on project activities (a form of project redlining), it can also be used independently of the Web. This chapter provides an overview of the use of the annotation system. The section on *Resolution* applies to annotations regardless of their method of creation (Web or GeoCue Client).

## *19.1 What are Annotations?*

Annotations are comments that are added to a project. These comments can be linked to project entities or they can be non-linked (*free-form* or simply *free*) annotations. The use of a linked annotation is to make some production comment about an entity or a group of entities. For example, a production supervisor might want to flag a set of LIDAR working segments with a note that instructs a production operator that the data do not meet quality standards. A free-form annotation, on the other hand, is not associated with an entity. When we designed the free-form style of annotation, we envisioned it as the mechanism to make comments about *Raster* or *Reference* layers.

## *19.2 Annotation Locks*

An annotation lock allows you to place a special type of lock on the entity or entities that you are annotating. This is useful when processing on the entity/entities must be stopped until the noted annotation (typically a problem) must be resolved.

When an entity is under an annotation lock, it cannot be added to a Working Set Queue via the normal procedure of selection followed by the ***Add to Queue*** command on the Working Set. If we were to allow this operation then anyone could still continue to process the entity. Instead, the *Annotation Entity* that has the lock on the referenced entity must be ***Resolved*** by a special annotation resolution command.

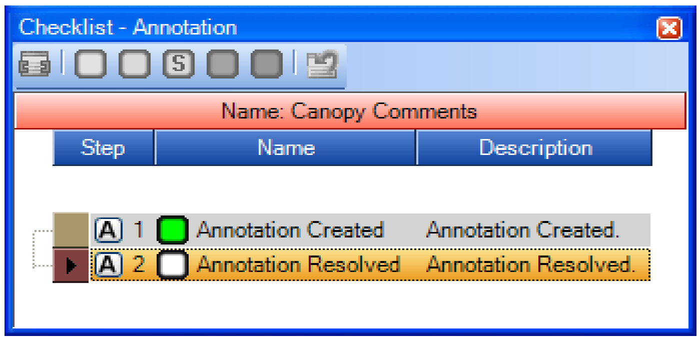
## *19.3 Annotation Types*

GeoCue supports three general classes of annotation. The types of annotations and their descriptions include:

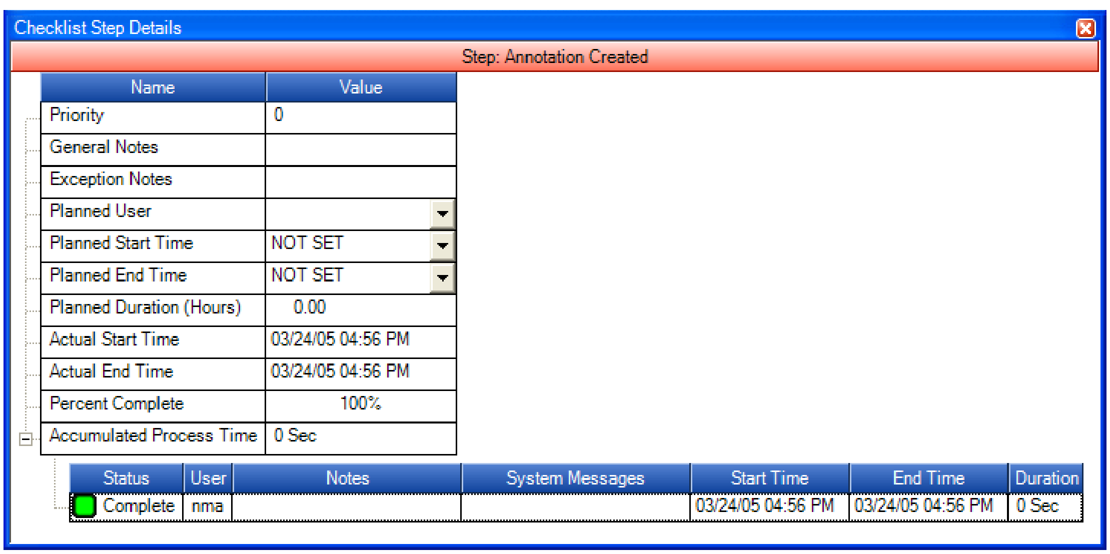
| ***Type*** | ***Description*** | ***Support Entity Locking?*** |
|---|---|---|
| One-to-one | There is one entity referenced by the annotation. | YES |
| Group | A single annotation references a group of entities. The entities that are referenced by the annotation need not be of the same class (for example, a single annotation could be applied to a group containing both a LIDAR strip and a DTED elevation entity). | YES |
| Free | The annotation does not apply to an entity. It is geocoded and thus can be superimposed over a layer that does not have entities (such as a *Reference* layer) and maintain its relative position. | NO |

## 19.4 The Annotation Checklist

In the current version of GeoCue, annotations have a checklist with two entries. An example is:

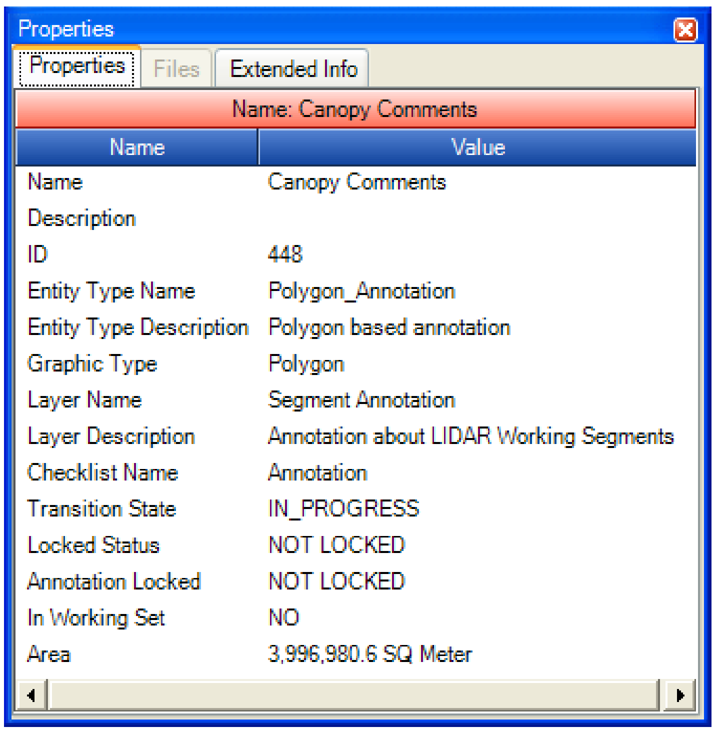



The first step is automatically populated by GeoCue when the annotation is created. The annotation itself (the note being created, either about entities or free form) is encoded in the checklist step details. Examining this for the *Annotations Created* step above:



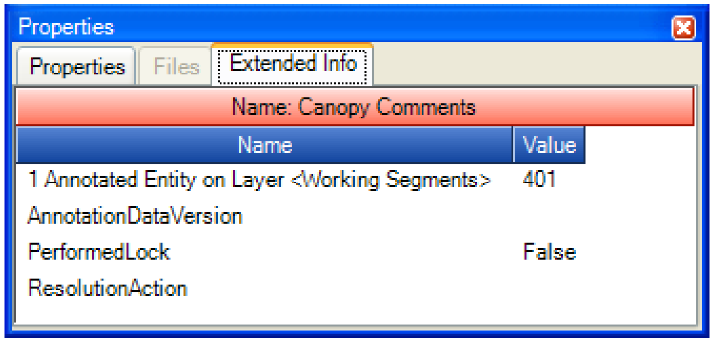
Notice the annotation comment "Check the low points on this segment" that appears in the checklist step General Notes field. You can also see who created the annotation and the time of creation by examining the history log at the bottom of the pane.

As with all entities, you can find out the details regarding an annotation by examining its property pane. Here is the ***Properties*** tab for the sample annotation above:




You can see that the **Entity Type Name** is a *Polygon_Annotation.* This information immediately informs you that this entity is an annotation. Of course, the quickest way to observe the general class of any entity is to observe the type of layer on which the entity resides. Annotations can only be hosted by Annotation type layers.

If you examine the ***Extended Info*** tab of the ***Properties*** pane, you can note the entities that are referenced by this annotation entity:



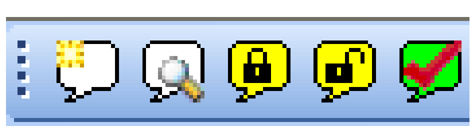

The first line(s) tell you the GeoCue entities that are referenced by this particular annotation entity and the layer on which they reside. In the example above, the annotation references a single entity with Entity ID = 401 on the Working Segments layer.

The field **PerformedLock** in the properties pane tells you if this annotation has an entity under an annotation lock. The field has a value of **False** which indicates that this annotation entity has not ***Annotation Locked*** entity 401.

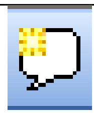
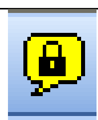
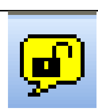
Do not be concerned if you did not follow some of the detail above. It is not really necessary in the creation and resolution of annotations since most of the indicators are graphical.

## *19.5 The Annotation Tools*

Annotations are created, reviewed and resolved via tool buttons from the Annotation toolbar. You can turn the display of the annotation toolbar off and on just like any other toolbar in GeoCue (see section 4.3.5).

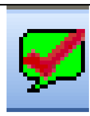


The function of each of these tools is described in the table below:

| icon | Tool | Function |
|---|---|---|
|  | Toolbar "grab" area[11]. | Grab this area to drag the toolbar off the toolbar section and convert to a floating menu. |
|  | Create Annotation | Used to create a new annotation. |
|  | Review Annotations | Use this function when you want to review the *Entities* to which an annotation refers but you do not intend to resolve the annotation. This command does not apply to ***free*** annotations (since a free annotation does not reference entities). The entities referenced by the annotation are placed in a queue named "ENTITY_REVIEW." The annotation checklist is not modified. |
|  | Resolve via Working Set Queue | Use this function when you want to ***Resolve*** the *Annotation* by placing the referenced entities in the Working Set queue. This command sets the annotation checklist step *Annotation Resolved* to ***In Progress*** and places the referenced entities in the Working Set queue. Note that the Annotation Lock (if present) will remain set on these entities until you press ***Finalize.*** This means that you can safely exit annotation resolution prior to completion and resume at a later time. |
|  | Resolve via Entity Review Queue | Use this function when you want to ***Resolve*** the *Annotation* and you can resolve the annotation without the need of placing the entities in your Working Set[12]. This command sets the annotation checklist step *Annotation Resolved* to ***In Progress*** and places the referenced entities in a named queue called **ANNOTATION_REVIEW.** Note that if these entities are under an annotation lock, they cannot be added |

[11] This is the same on all GeoCue toolbars.

[12] An example could be that a supervisor made a note such as "The next time you process segments like these, use the FFT filter with parameter L = 2.1." Thus she is not saying to do anything with the current entities that would require exclusive locking.

| | | |
|---|---|---|
| | | to the Working Set via this route. You must use the ***Resolve via Working Set Queue*** to move the entities into the Working Set. |
|  | Finalize Annotation | Press this button when you have resolved all elements of the annotation. This causes the annotation process step *Annotation Resolved* to be set to complete and, if the annotation has a lock on the entities referenced, the lock is removed. |

## *19.6 Creating Annotation Example*

In this example we will create one each of the different types of annotations supported by GeoCue.

### 19.6.1 One-to-one Annotation

- Again bring up Madison in the environment LIDAR Project Setup and Processing.

- Select WS-1 (do not place it in your Working Set)

- Press the ***Create Annotation*** tool on the annotation toolbar. You will be presented the dialog of Figure 19-1.

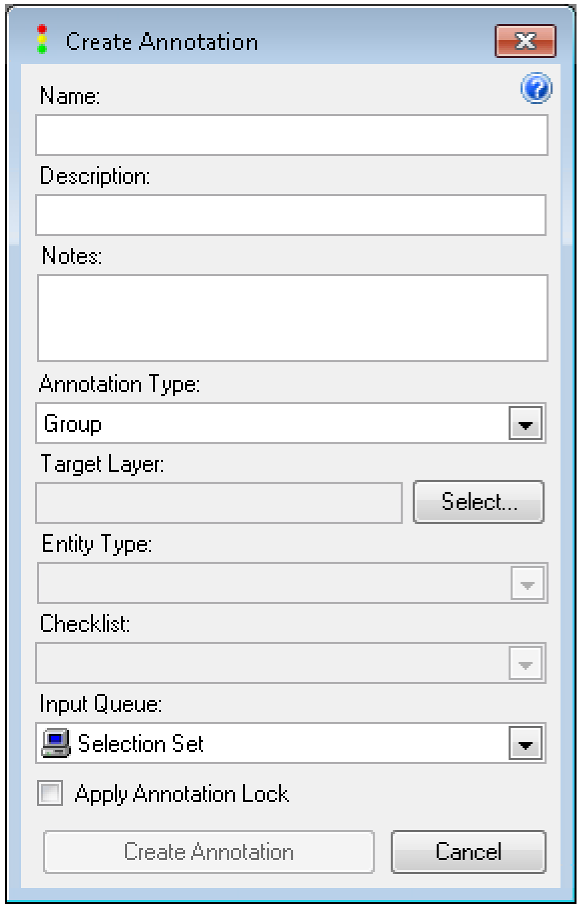



**Figure 19-1 The Create Annotation dialog**

The *Name* is the entity name for the annotation. It is the name that will be displayed when you activate labels for the annotation layer in the legend. It is also the name that will be displayed in the Property Pane and Checklist Pane when you *Select* the annotation entity.

- Enter "Canopy Comments" as the *Entity Name* and leave the description field blank.

The *Annotation Note* is the comment that will be filled in as the *General Note* in the details of the Annotation checklist step, *Annotation Created*. In effect, this **is** the annotation.

- Enter the comment "Canopy removal less than perfect in this segment but it meets the requirements." in the Annotation Notes field.

- Select *One-to-one* in the Annotation Type: field

Press ***Select…*** under Target Layer: The ***Select Layer*** dialog will not offer any choices since there are currently no layers of class ANNOTATION in this project. Select ***Create Layer…*** and populate the layer creation dialog as in Figure 19-2.

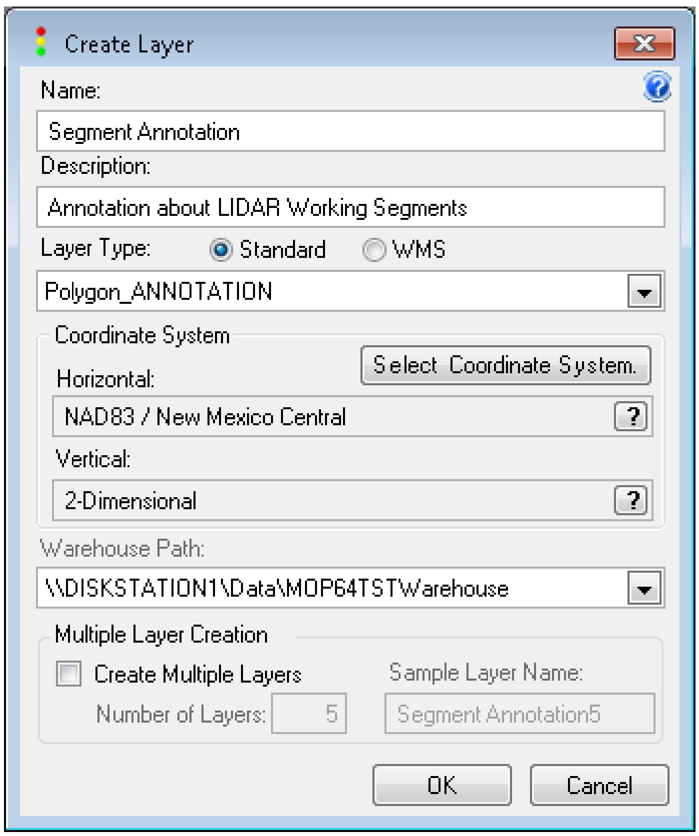



**Figure 19-2 The populated Create Layer dialog for the Annotation layer**

You will notice that there were three choices for the Layer Type: in the dialog – Polygon, Line and Point. We will use only polygon annotation layers in this version of GeoCue when we create annotations from within GeoCue.

- Click OK on the ***Create Layer*** dialog and on the ***Select Layer*** dialog to return to the ***Create Annotation*** dialog. Leave the Checklist set to *Annotation*. It will now appear populated with the layer you just created (Figure 19-3).

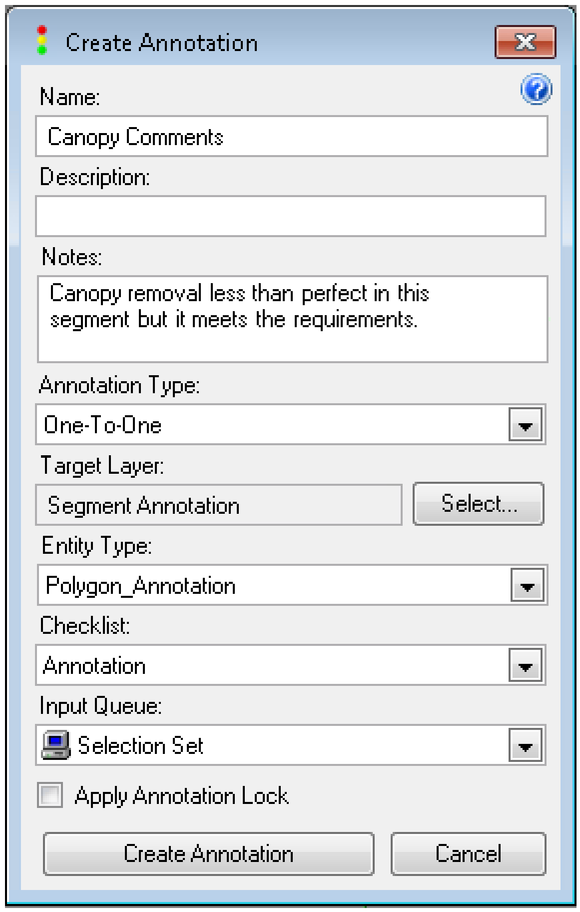



**Figure 19-3 The populated Create Annotations dialog**

The ***Create Annotation*** dialog will allow you to specify any queue as containing the list of entities to which the annotation(s) are to apply (except when the Annotation Type is *free* since *free* annotations do not reference entities). Note that in GeoCue, entities that you ***Select*** are in a (usually) hidden queue called the ***Selection Set***. The ***Selection Set*** is the default queue selected for annotations but you can also choose the Working Set or any named queue.

- For our example, leave Input Queue: set to ***Selection Set.***

- Make sure that the option to *Apply Annotation Lock* remains unchecked and press ***Create Annotation.*** The new annotation entity has now been created.

### 19.6.2 Group Annotation

In this example we will annotate a group of disparate entities and apply an annotation lock. We will recreate the LIDAR data "hole" as the problem that we are annotating. You can reproduce this by repeating the example of Section 5.6.2. The abbreviated steps are repeated here:

- Select all four source strips (your selection queue count should read "4")

- Press **Union** on the GeoAnalysis toolbar

- Delete the large resultant entity on the GeoAnalysis layer and retain the small one that represents the hole in the LIDAR data.

> ***Hint*** – Use Layer and Symbology settings to make visualization and selection easier. For example, turning on the fill symbology makes visualizing the project status easy but obscures entities when attempting to select. Remember also that you can leave entities visible (by keeping the "V" option selected on the host layer) but turn off selectability (by un-checking the "S" option on the host layer).
>
> Note that entities can reside directly on top of one another. Sometimes you may select an entity and not see an associated checklist or properties appear.

This is caused by selecting more than one entity and is typically because two or more entities are directly "stacked." For example, your project currently has an annotation entity directly stacked on top of the working segment WS-1. If you want to select WS-1, turn off selectability of the annotation layer or, alternatively, select by clicking on the edge of the entity rather than dragging a rectangle over the entities. This will cause the "Smart Pick" dialog to display if there is an ambiguity.

We will annotate this hole and the associated working segment.

- Select the GeoAnalysis entity that represents the hole (it is most likely named Union_1).
- Turn on the selectability flag for the Working Segment layer and turn it off for all other layers (ensure that the GeoAnalysis entity remains selected)
- Chose ***Select by Intersection*** from the dropdown icon by the selection arrow. This will result in the Working Segment(s) in which the LIDAR hole is located being selected.

At this point your display should resemble Figure 19-4 (of course your display will differ depending on how your defined your segments and the state of visibility of your layers). Your selection queue should indicate that you have two objects selected (or perhaps more if your LIDAR hole intersects more that one Working Segment).

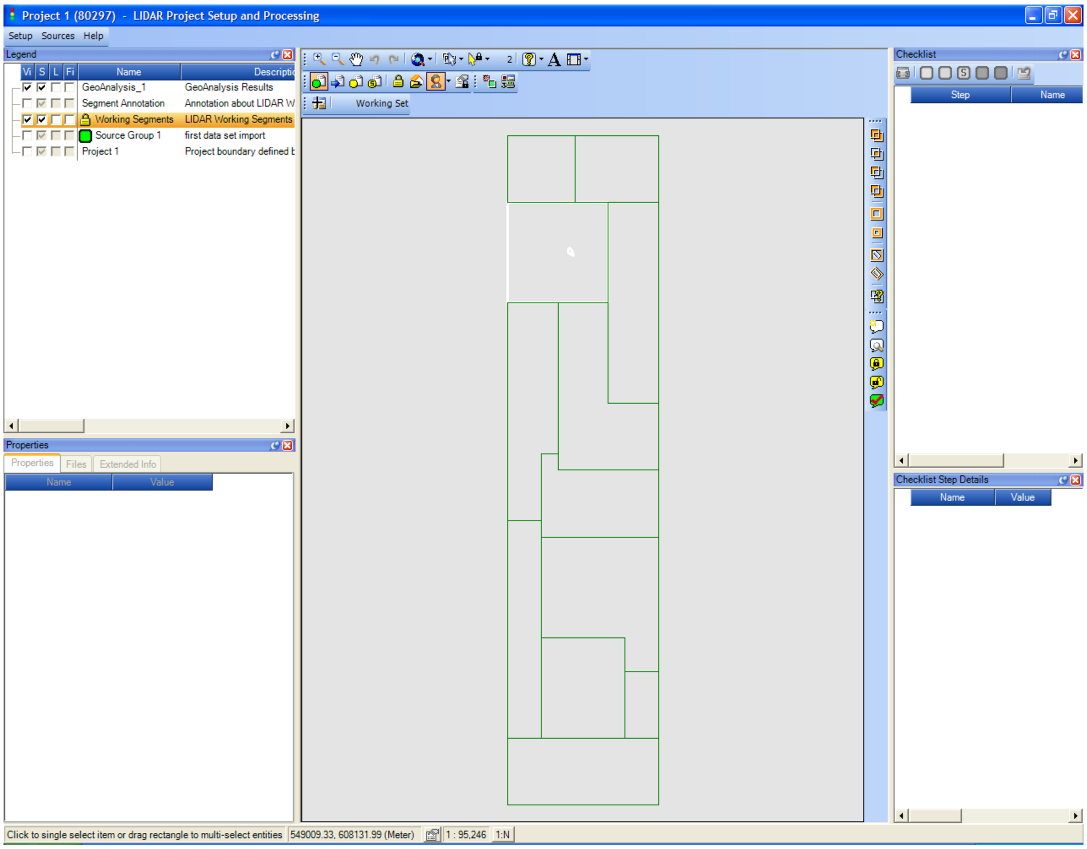



**Figure 19-4 Madison with Segment containing "hole" selected**

We will now create the annotation (ensure that you keep the selected entities *Selected).*

- Press ***Create Annotation*** on the Annotation toolbar

- Populate the dialog as shown in Figure 19-5 (the note "LIDAR coverage problem. Check severity and decide if we need to refly." pertains to the resolution of the LIDAR strip gap). Notice that we are using the Annotation layer that was created in the previous example. This is not required – you could create a new layer if you wanted to sort different types of annotations by layer. However, it must be a polygonal annotation layer. Note the annotation type is **Group** and that we have set the **Apply Annotation Lock**

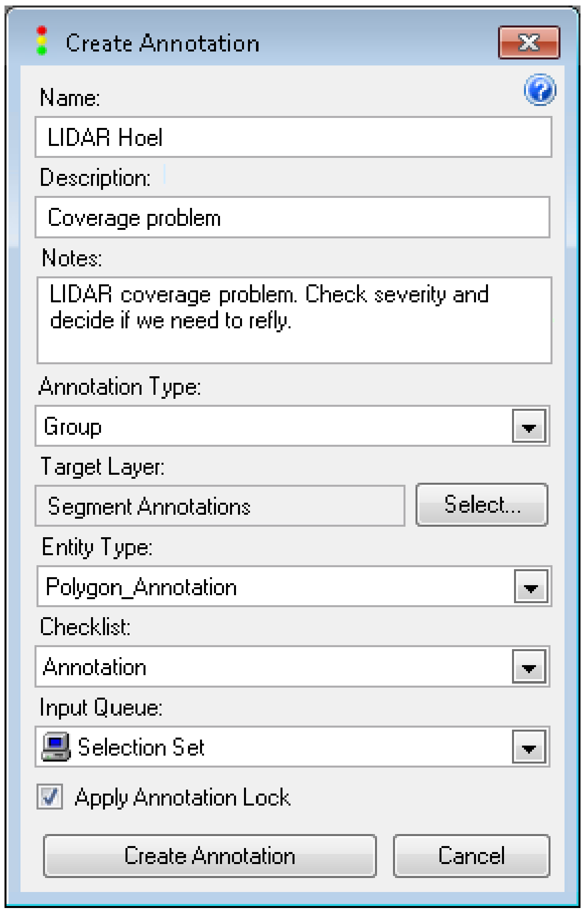



**Figure 19-5 The annotation values for the "LIDAR Hole"**

- Press ***Create Annotation.*** The annotation is created and the dialog dismisses.

It is instructional to select the newly created annotation and examine its ***Properties***, ***Extended Info*** tab (Figure 19-6).

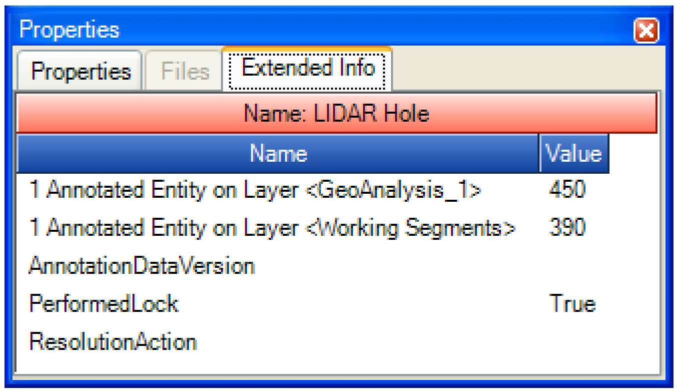
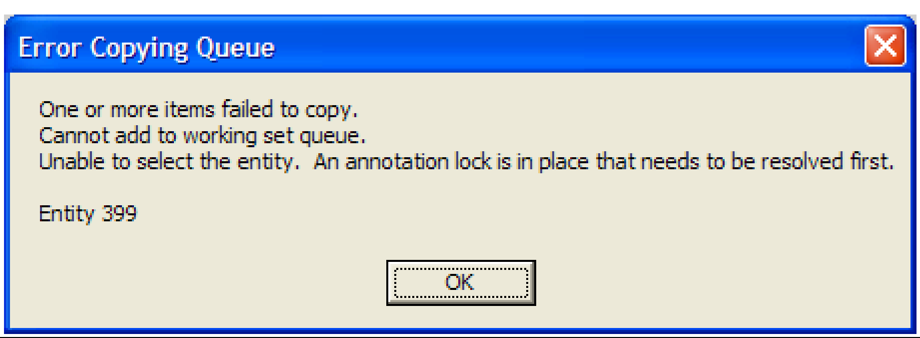



**Figure 19-6 The Group Annotation Properties**

In our example, we have annotated two entities – the GeoAnalysis entity (in our case Union_1) and the Working Segment that contains Union_1 (you will have more than one working segment if your Union_1 intersected more than one working segment). Notice that the **PerformedLock** field is set to True, indicating that this annotation entity has placed *Annotation Locks* on the entities that it references. If you examine the properties of either of these entities you will note that the **Annotation Locked** property is set to True.

To observe the effect of the annotation lock, ***Select*** the entity Union_1 and attempt to add it to your Working Set. You should receive the message box:



### 19.6.3 Free-form Annotations

As the final example of annotations, we will create a free-form annotation. Recall that this is an annotation that is not associated with a reference (or *annotated*) entity.

Invoke the Create Annotation dialog via the annotation toolbar and populate the dialog as shown below:

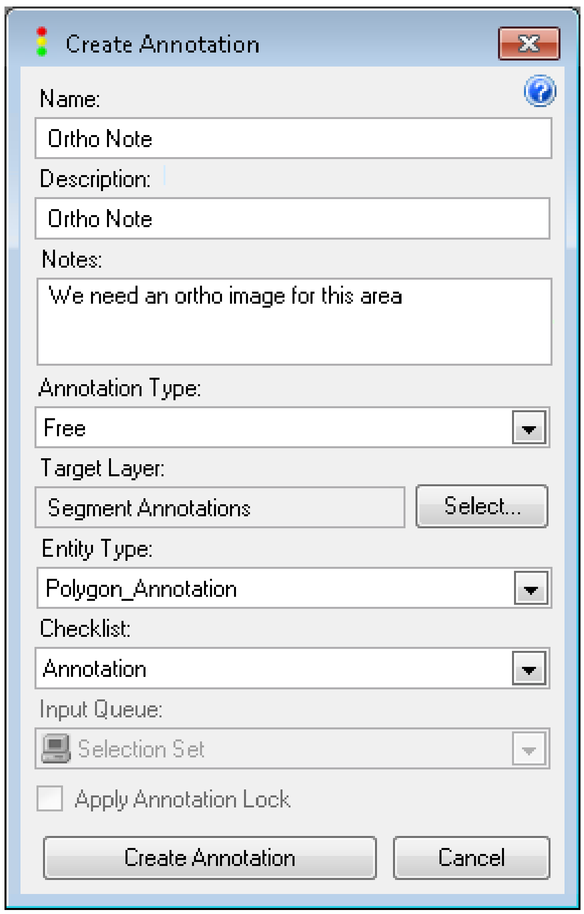



**Figure 19-7 Free Form Annotation inputs**

Note that we have selected ***Free*** as the *Annotation Type:* and that we are again using the same annotation layer.  Notice that both the *Input Queue* and *Apply Annotation Lock* fields are deactivated.  This is because a ***free*** annotation is not associated with a reference entity.

Press the ***Create Annotation*** button.  This time the Create Entity dialog is invoked with all fields pre-populated (Figure 19-8).

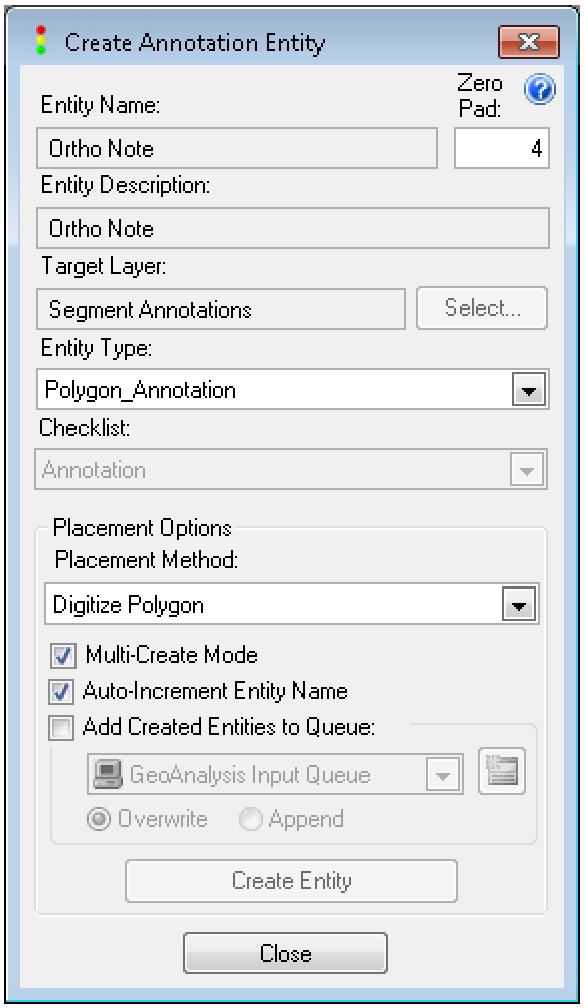



**Figure 19-8 The Create Entity dialog used in Free Form annotations**

Notice that you can use any *Placement Method* to create the annotation. For a review of the different placement methods, refer back to the Create Project chapter where we explored all of these methods in the creation of a Project Boundary. For this example, we will digitize a polygon.

Digitize an arbitrary polygon in the lower half of the project. When you complete the polygon, this dialog will close. See Figure 19-9 for an example of the ***free*** annotation that we digitized. We have ***Selected*** this annotation so that we can see its properties. Notice in the ***Extended Info*** fields of its property pane that there are no referenced entities. Also note the **PerformedLock** field is set to False. This, of course, must be the case since the annotation entity does not reference any entities!

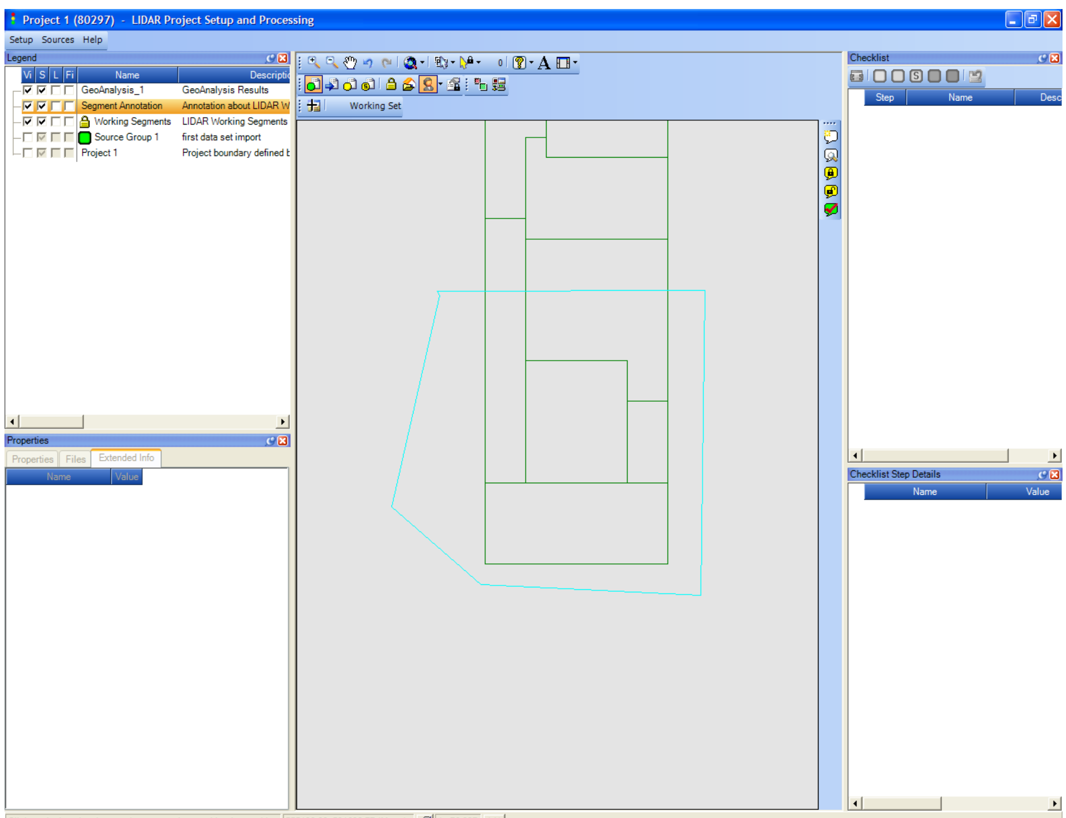



**Figure 19-9 Our *free form* Ortho annotation**

## 19.7 Reviewing Annotations

There are two levels of reviewing an annotation. The first is to simply examine the annotation entity itself. To do this, just select the annotation entity as you would any other entity and view its checklist and properties. The annotation note itself is the **General** comment in the checklist details box for the *Annotation Created* checklist step. Just double click on the checklist state to activate the details pane.

Remember, you never need to add an entity to your Working Set to review its checklist state, checklist details or properties pane.

> Multiuser note – We intentionally designed GeoCue to logically separate ***edit*** operations from ***review*** operations. With this design, anyone (with appropriate permissions) can review any entity in the system, even if the entity is locked for processing by another user. This means that you can observe the status of the project changing in real time as operators work on entities. This design provides *real time* visualization of project state, a key factor in high productivity.

The second type of review that you might want to do is to look at the entities that are referenced by an annotation (this applies to the two types of annotations that reference entities – Group and One-to-one). This capability is provided via the ***Review Entities*** tool on the ***Annotation*** toolbar.

In this exercise, we will review the Annotations that we have created in the previous exercises.

- ***Select*** the annotation named Canopy Comment (recall that this is a One-to-one annotation that is referencing working segment WS-1).

> ***Hint*** – If you select by dragging a selection rectangle (our favorite selection method), you will select at least two entities if you have selectability on for all layers and you are selecting an annotation that references an entity. This is because (in the case of a

one-to-one annotation) the annotation either directly covers its referenced entity or it encloses (the case of group) the referenced entities. Remember that the number of ***Selected*** entities is always displayed as the count by the selection arrow tool. Solve this problem by either turning off selection on all layers except the one from which you are selecting or by point selecting at the edge of an entity and choosing the entity you want from the ***Smart Pick*** dialog.

- Press the ***Review Entities*** button on the ***Annotation*** toolbar. This will cause the referenced entity (entities in the case of a group annotation) to be placed in a queue called ENTITY_REVIEW. This is a normal named queue and thus the entities placed in this queue are not locked. This implies that you can perform entity review for the entities referenced by an annotation, even if they are annotation locked.

You can inspect the referenced entity (entities) by the usual queue navigation tools. When you are finished, you can delete the REVIEW_ENTITIES queue.

## 19.8 Resolving Annotations

Resolving an annotation when that annotation references entities is a two part process. The first step is to begin the resolution process. The second step is to mark the annotation as being resolved (we call this ***Finalizing*** the annotation). For example, if the annotation indicated that a working segment needed additional editing, the resolution of the annotation would begin when you started the edit process and it would complete when the edit on the working segment was complete.

Resolving an annotation that has placed an annotation lock on the entities that it references proceeds a bit differently than resolving a non-locking annotation. We will demonstrate both of these types of resolutions.

### 19.8.1 Resolving a Non-locking Annotation

A *non-locking* annotation is generally applied to entities where work on that entity does not need to stop prior to resolution of the annotation. We created such an annotation when we created our *Canopy Comment* annotation.

- ***Select*** the *Canopy Comment* annotation

- Press ***Resolve via Entity Review Queue*** on the Annotation toolbar

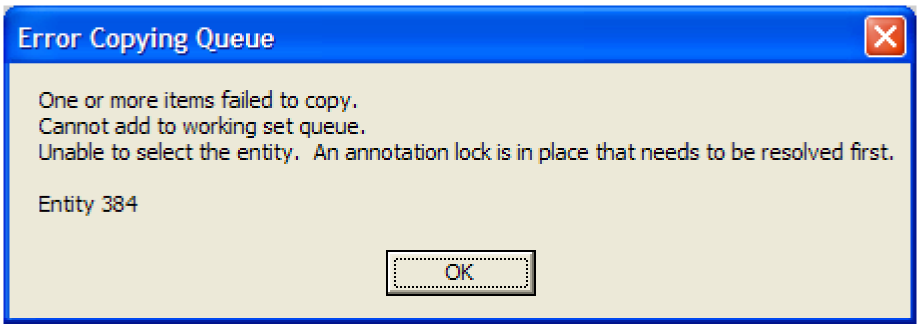
This will cause two actions to occur. First of all, all entities referenced by the annotation will be placed in the named queue ENTITY_REVIEW. The second is that it will set the state of the annotation checklist entry *Annotation Resolved* to ***In Progress.*** You can delete the ENTITY_REVIEW queue when you are through using it for managing the annotated entities.

> ***Hint*** – It is never necessary to delete named queues that GeoCue creates during annotations or problem resolutions. GeoCue will automatically clean up these queues when you exit your instance of GeoCue Client. In addition, GeoCue looks for the named queue before creating a new one. If one is found, it is first cleared and then the new entities are copied in. Thus you also need not worry about creating duplicate queues.

### 19.8.2 Resolving a Locking Annotation

A *locking* annotation is generally applied to entities where work on that entity cannot proceed prior to resolution of the annotation. We created such an annotation when we created our *LIDAR Hole* annotation.

An entity that is locked by an Annotation cannot be added to the Working Set, even by the creator of the annotation, via the ***Add to Working Set*** button on the Working Set toolbar. To demonstrate this, select the Union_1 entity and press the Add to Working Set toolbar button. You will receive a message similar to the following:




The locked entities must be added to the Working Set via the ***Resolve via Working Set Queue*** tool on the annotation toolbar.

- ***Select*** the *LIDAR Hole* annotation
- Press ***Resolve via Working Set*** on the Annotation toolbar

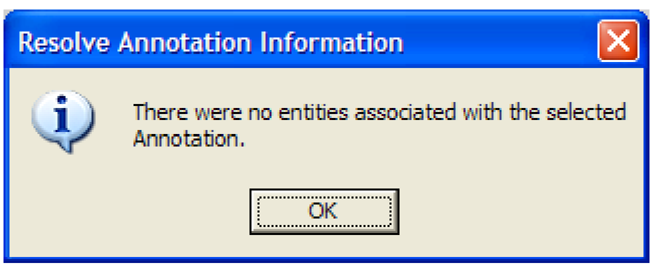
This will cause two actions. The first is that it will add all the entities referenced by the annotation entity to the Working Set Queue. The second is that it will set the state of the annotation checklist entry *Annotation Resolved* to ***In Progress.***

You can now do whatever processing is required to resolve the annotation by working on the entities. Note that if you remove these entities from the Working Set, they can only be placed back in the Working Set via the ***Resolve via Working Set*** button on the ***Annotation*** toolbar.

Note that you can also start the resolution of Locked annotations via the ***Resolve via Entity Review Queue*** tool on the Annotation toolbar. In this case the *Annotation Resolved* checklist step is set to ***In Progress*** and the referenced entities are placed in the ENTITY_REVIEW queue. However, you will not be able to add these entities to your Working Set via the ***Add to Working Set*** tool on the Working Set toolbar. You must use the ***Resolve via Entity Review Queue*** tool on the Annotation toolbar. You might want to use this mode if you want to start the clock on the annotation resolution but you are not yet ready (or do not need) to add the referenced entities to the Working Set.

### 19.8.3 Resolving a Free Annotation

You can begin the resolution of a free entity by selecting either Resolve Annotation button on the Annotation toolbar. You will receive the following benign message:




This is normal since a free annotation does not reference an entity.

- Select the *Ortho Note* annotation

- Press ***Resolve via Entity Review Queue*** and press ***OK*** on the message box

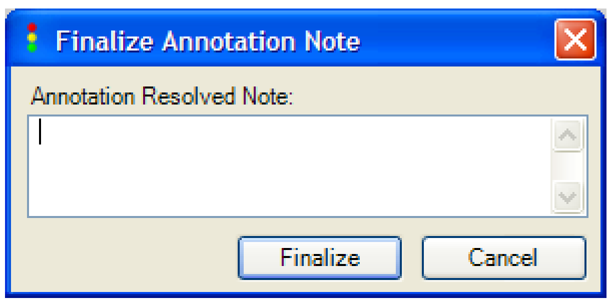
This will cause the Annotation Resolved checklist step to transition to ***In Progress.***

## 19.9 Finalizing the Annotation Resolution

The final step in resolving a resolution is to mark the annotation as ***Complete*** and to remove any locks the annotation entity has placed on entities. For all annotation types, this proceeds as follows:

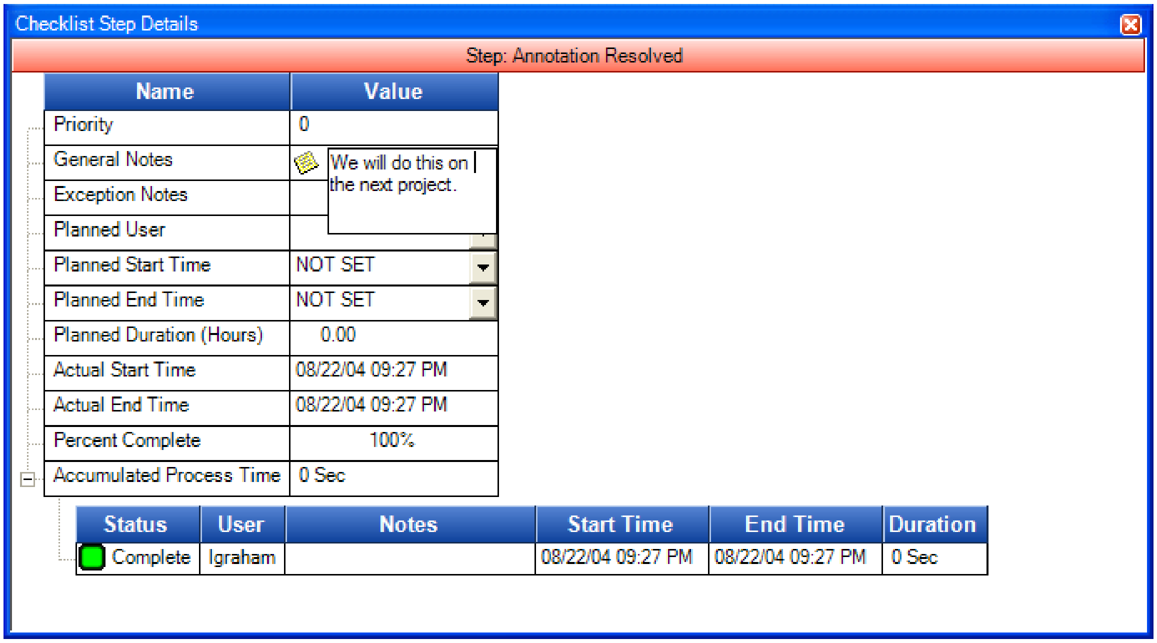
- Select the annotation (ensure you have only a single annotation selected).
- Press the ***Finalize*** button on the Annotation toolbar

This action will result in the following dialog:




Enter a note regarding the resolution of the annotation in this dialog. It will be added as the General note for the *Annotation Resolved* checklist step of the annotation. If you press Cancel, the ***Finalization*** action will be aborted. If the annotation entity is locking referenced entities they will not be unlocked until you press ***Finalize.***

Below is our details pane for the *Annotation Resolved* checklist step of our Canopy Comment annotation.


Checklist Step Details
Step: Annotation Resolved
Name
Value
Priority
0
General Notes
We will do this on
the next project.
Exception Notes
Planned User
Planned Start Time
NOT SET
Planned End Time
NOT SET
Planned Duration (Hours)
0.00
Actual Start Time
08/22/04 09:27 PM
Actual End Time
08/22/04 09:27 PM
Percent Complete
100%
Accumulated Process Time
0 Sec
Status
User
Notes
Start Time
End Time
Duration
Complete
lgraham
08/22/04 09:27 PM
08/22/04 09:27 PM
0 Sec

# 20 Concluding Remarks

We hope that you have enjoyed working with the GeoCue product family. Hopefully you have not discovered too many software defects (bugs).

The primary idea that we would like for you to recognize in working with GeoCue is that it is a general purpose production management system that, when encoded with the appropriate *Environment*, is suitable to a very wide variety of process management problems. As time moves forward, we and third party companies will be releasing a number of different CuePacs for different production workflows and disciplines. Our ultimate goal is that you employ GeoCue on every production workstation in your company. We have a singular focus on improving your bottom-line profitability through enterprise process management.