Bentleyuser.dk Årsmøde 2009

Nordic Civil 2009

9.-11. November 2009, Munkebjerg Hotel, Vejle

Workshop - X11
DTM Analysis and Site Visibility Tools for InRoads V8i

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Lesson Name: Create DTM using Data Acquisition tools

LESSON OBJECTIVE:
Using the ***Data Acquisition*** toolset, build a digital terrain model for future analysis exercises

Data Acquisition toolset

The Data Acquisition toolset is designed (at release – V8i SELECTseries 1) to provide the User with an alternate set of tools to gather data from various sources, and then edit, merge, append and manipulate that data to build a composite surface to begin the Civil Design process.

Supported data sources at this first release are:

- Raw Survey (many formats)
- Current Bentley DTM formats (DTM, TIN, FIL, LandXML)
- Lidar Data (LIS and XYZ)
- Raster data: SDTS, USGS DEM, TIF, Spot Dimap, NTF, Erdas IMG, BIL, ECW, DTED0, DTED1, DTED2

The list of data sources will grow as the toolset matures.

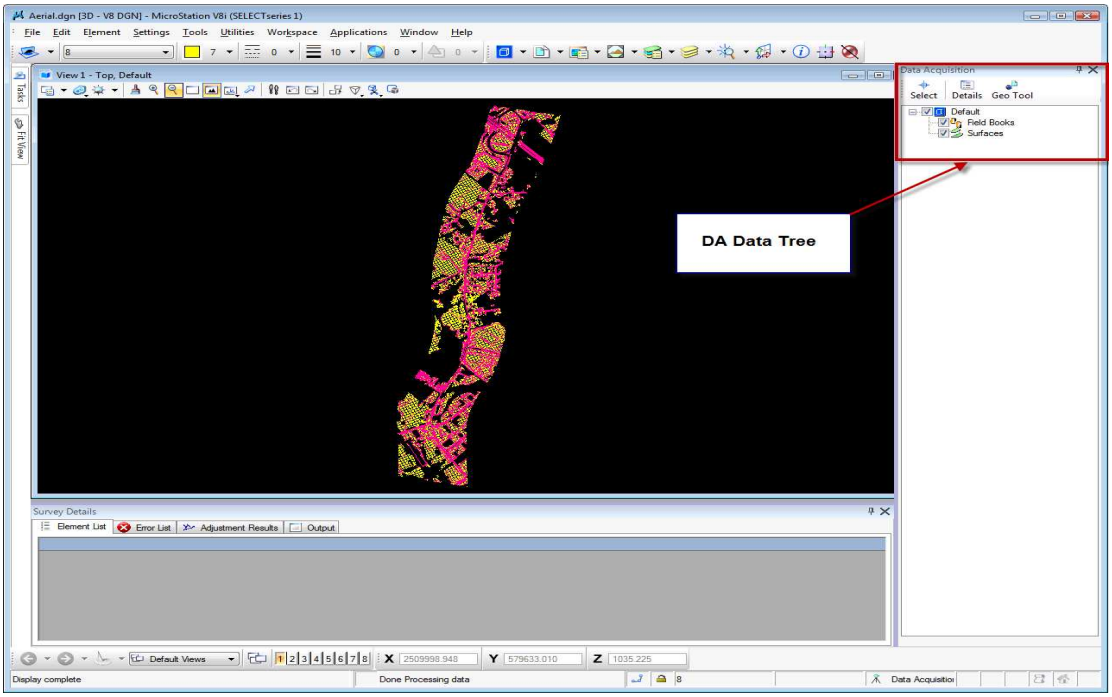
The simplified workflow and interface, and the intuitive nature of the tool operations reflect a glimpse into the future of Bentley Civil's plans for better tools that provide more focused functionality and are easier to use.

EXERCISE: OPENING DATA ACQUISITION TOOLS

This exercise will guide you through the steps activate the Data Acquisition toolset.

1. Open InRoads Suite from the desktop icon or go to Start>Programs>Bentley>InRoads Group (SELECTseries1)>InRoads Suite
2. Open the DGN file … *C:/2009 RBC/IW-1/DATA/Aerial.dgn*
3. Select the **Data Acquisition** tool (*Task menu>Data Acquisition>Data Acquisition*)

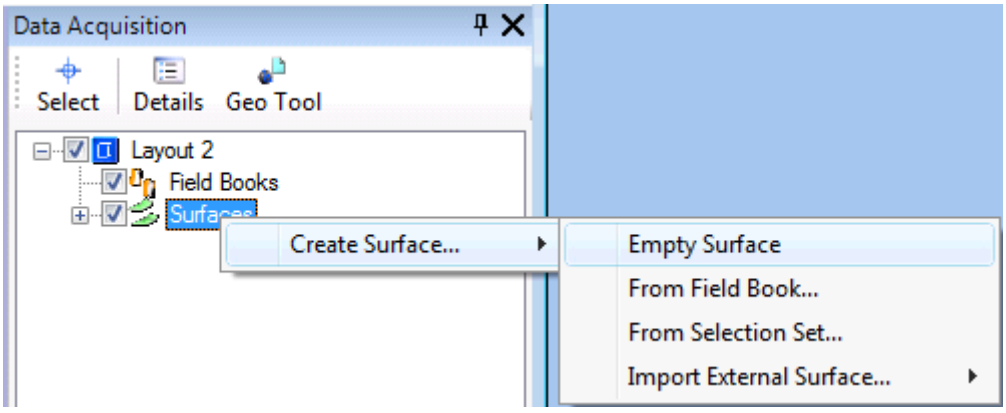
Two new panels will open. The Data Acquisition data tree and the Data Acquisition Details panel. These panels should both be docked. Location of the panels is a personal preference. The image of the docked panels will provide an example arrangement.



EXERCISE: CREATE DATA ACQUISITION SURFACE FROM AERIAL DATA

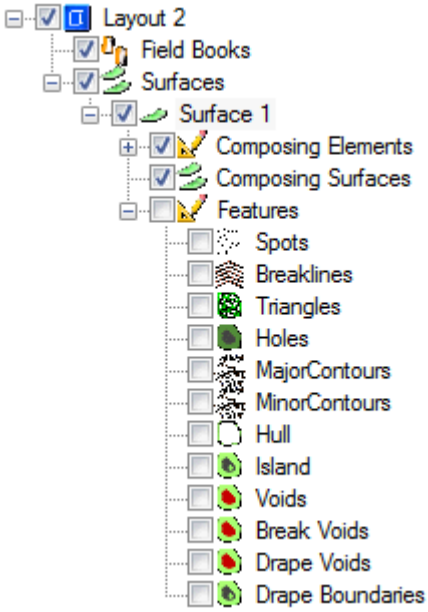
This exercise will guide you through the steps to build a DA Surface from graphical data. In this scenario, the data has been supplied from an Aerial photography company. Similar steps would apply to the creation of a surface from any graphical 3D data.

1. Focus on the DA Data Tree.
2. Right Click on “Surfaces” folder.
3. Create Surface>Empty Surface.



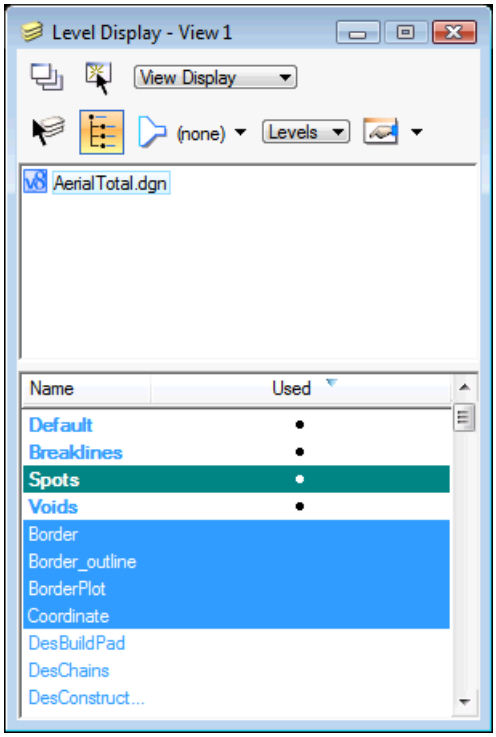
4. A new surface will be created in the DA Data Tree: Surface 1

5. Drill down the Surface 1 data structure until you see the Surface feature list.



We can now select the graphical data that corresponds to the different feature types and import that data into the DA Surface.

6. Select **Level Display**. *(Settings>Level>Display)*.
7. Disable the display for Breaklines and Voids levels



8. Select all of the “Spots” graphical data
9. Return your focus to the **Surface 1>Features** list.

10. Right click on **Spots** label
11. Select **Import Selection**.

    The selected graphical spot data has now been imported into the DA Surface.
12. Disable the display for the Spots level and enable the display for the Breaklines levels
13. Select all of the "Breakline" graphical data
14. Return your focus to the **Surface 1>Features** list.
15. Right click on **Breaklines** label
16. Select **Import Selection**.

    The selected graphical Breakline data has now been imported into the DA Surface.
17. Disable the display for the Breaklines level and enable the display for the Voids levels
18. Select all of the "Void" graphical data
19. Return your focus to the **Surface 1>Features** list.
20. Right click on **Drape Voids** label.
21. Select **Import Selection**.

    The selected graphical Void data has now been imported into the DA Surface.
22. Enable the display for all levels. (*Settings>Level>Display*)

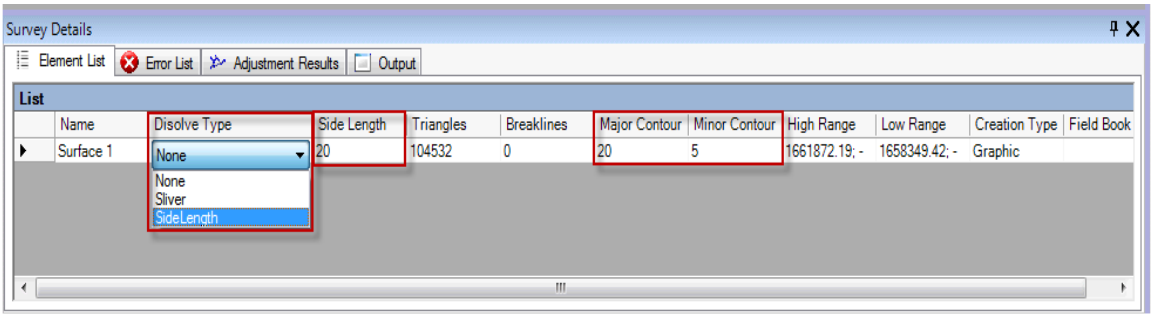
EXERCISE: ENABLE DISPLAY FOR DA SURFACE FEATURES

This exercise will guide you through the steps to display surface features of a DA Surface

1. Focus on the DA Data Tree: **Surface 1**
2. Enable the check mark for Triangles.

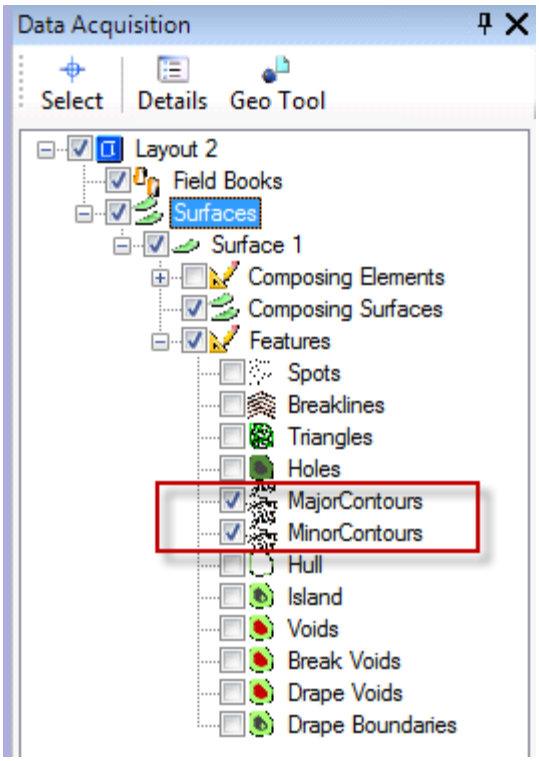
   The triangles for the Surface will now be displayed as transient graphics.
3. We can reset the **Side Length** and **Dissolve** options to "clean up" the outside triangles of the dataset.
4. Focus on the "Survey Details" panel.
5. Select the **Surface 1** item in the panel.
6. Reset the **Side Length** attribute to **120** <Enter>
7. Reset the **Dissolve Option** attribute to **Side Length** <Enter>

   The Surface triangulation should now appear significantly different around the outer edges.
8. Reset the **Minor Contour** attribute to **2** <Enter>
9. Reset the **Major Contour** attribute to **10** <Enter>



Return focus to the **Surface 1** feature enablers on the data tree.

10. Enable **Major Contours** and **Minor Contours** features.



EXERCISE: EXPORT SURFACE 1 TO INROADS DTM

This exercise will guide you through the steps to export a DA Surface to a native Bentley Civil Application DTM. For this workshop, we will export to a INROADS DTM.

1. Focus on the DA Data Tree: **Surface 1**
2. Select **Surface 1**.
3. Right Click>Export to>InRoads DTM

4. Navigate the Save As dialog to the folder ***C:/2009 RBC/IW-1/DATA*** and key in the file name **Surface1.dtm**.
5. Select **Save**.

   This will create a InRoads DTM named Surface1.dtm.
6. Close **Data Acquisition** data tree.

Lesson Name: Load Project Data & Modify Existing Ground DTM

LESSON OBJECTIVE:

Load the Project data, and modify the existing surface digital terrain model for future exercises.

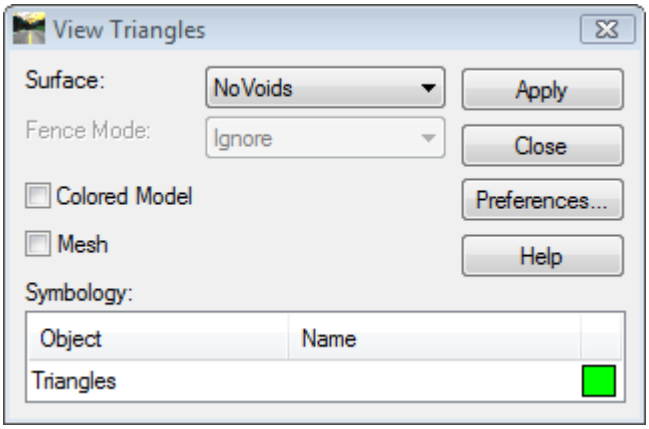
EXERCISE: LOAD PROJECT DATA

1. Open **C:\2009 RBC\IW-1\DATA\Roadway Design.dgn**
2. Open project files **C:\2009 RBC\IW-1\DATA\Project.rwk. (On the InRoads Menu: File>Open>(File Type: Project.rwk))**
3. **File>Open>NoVoids.tin**

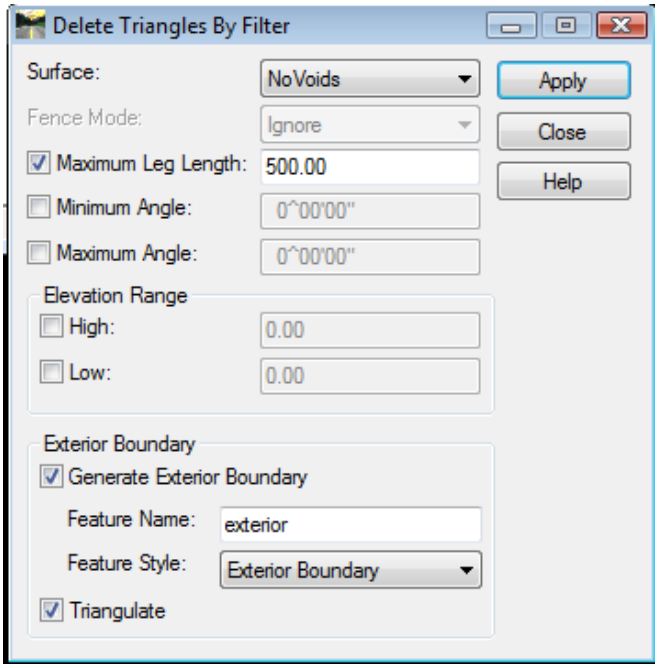
   Note InRoads can now load and converts a GEOPAK Tin file directly. This can be also achieved by dragging and dropping on the InRoads Explorer.

EXERCISE: CREATE AN EXTERIOR BOUNDARY

1. Display Triangles of the NoVoids tin that is now a NoVoids DTM in memory with **Surface>View Surface>Triangles**



2. **Close** the View Triangle Dialog
3. Perform a MicroStation **Fit All** to bring the triangle into view. Notice the slender triangle on the east side of the topography.
4. Create an Exterior Boundary using **Surface>Edit Surface>Triangulate By Filter** with Dialog settings showed:



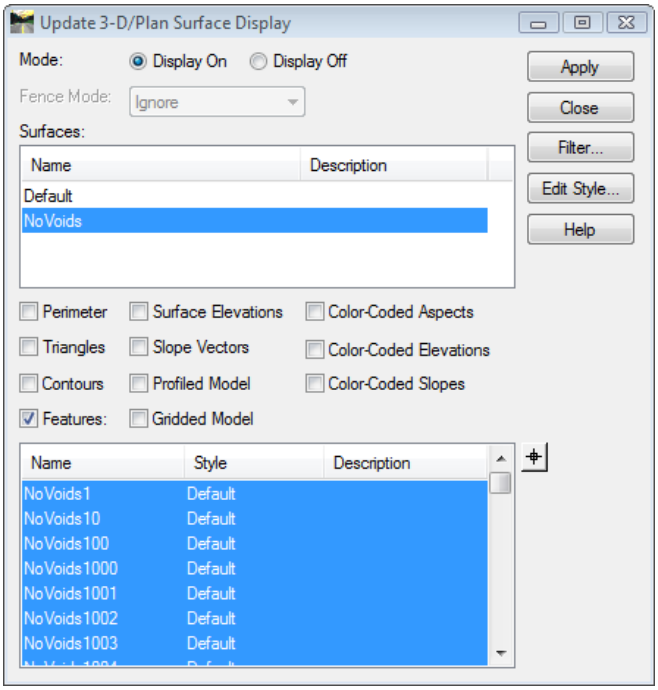
Note: This tool created an Exterior Boundary based on a Maximum triangle length of 500 feet in one step….any of the setting can be used in conjunction with each other to handle more complex analysis quickly.

5. **Apply** and then **Accept** the triangle that are highlighted
6. Confirm the overwrite for original boundary for NoVoid by clicking **Yes**.
7. **Close** the Delete Triangle By Filter
8. Notice the triangles over on the East Side have been atomically removed from view.
9. Go to **Surface>Feature>Feature Properties** and select the Exterior Boundary Feature, near the bottom of the list. What is description populated for this feature?
10. Delete the Triangles with Graphic Group Locks

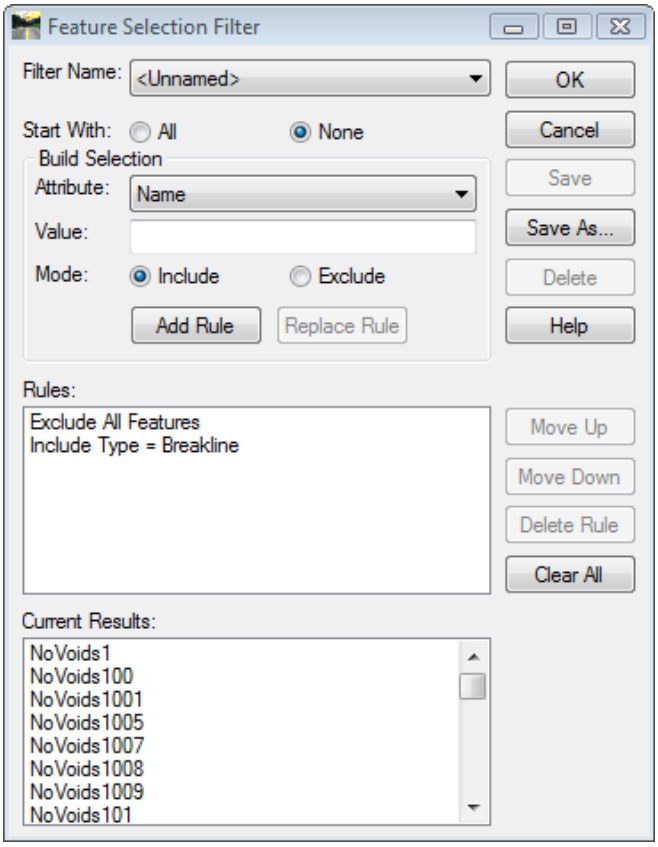
EXERCISE: RESOLVE NEAR FEATURES

The Resolve near Features tool allows you to chain breaklines together that have the same style within a given Horizontal and/or Vertical tolerance. Since the original tin's breaklines were all translated to a style of Default, all of the breaklines will be used in this analysis. This tool is excellent solution to enhance data that is received from outside sources that may not be as clean as desired.

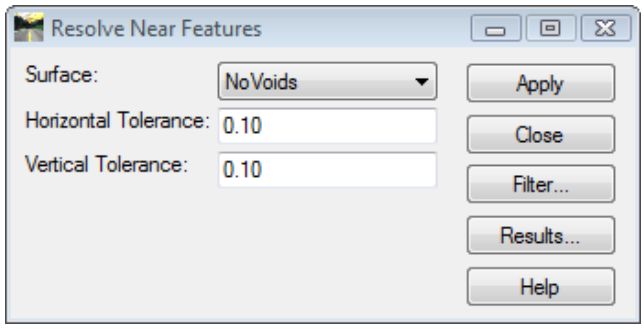
1. Make note of the number of breaklines there are in the surface NoVoids by going to **Surface>Surface Properties**.
2. **Delete** All Graphics in the current DGN, if any are present.
3. Display all the breakline features in NoVoids, **Surface>Update 3-D/Plan Surface Display.** Remember we are only working with the Feature Type = Breakline



4. Press the **Filter** button
5. Set up Filter as follows:



6. Press **OK**. Make sure you turn on the Feature Filter Lock or all the Features will still be displayed instead of just the breaklines….you will know if you did not.
7. **Apply** the tool.
8. Notice the number of centerline feature along the North/South Corridor by snapping to the element. Make note of the number of chains.
9. Set the following settings for **Surface>Utilities>Resolve Near Features** tool and then press **Apply**.



10. **Delete** all the previous breaklines by **Selecting All** and deleting with MicroStation.
11. Redisplay the breakline features as done through Step 3 to 7.
12. Revisit the **Surface Properties** Dialog and make note on the number of Breaklines that currently exist with the DGN.
13. **Triangulate** Surface NoVoid….hint you will need to for the next lesson.
14. Lastly, Toggle off Feature Filter locks and Delete All the graphics in the DGN.

Lesson Name: Create Finished Surface DTM using Roadway Designer

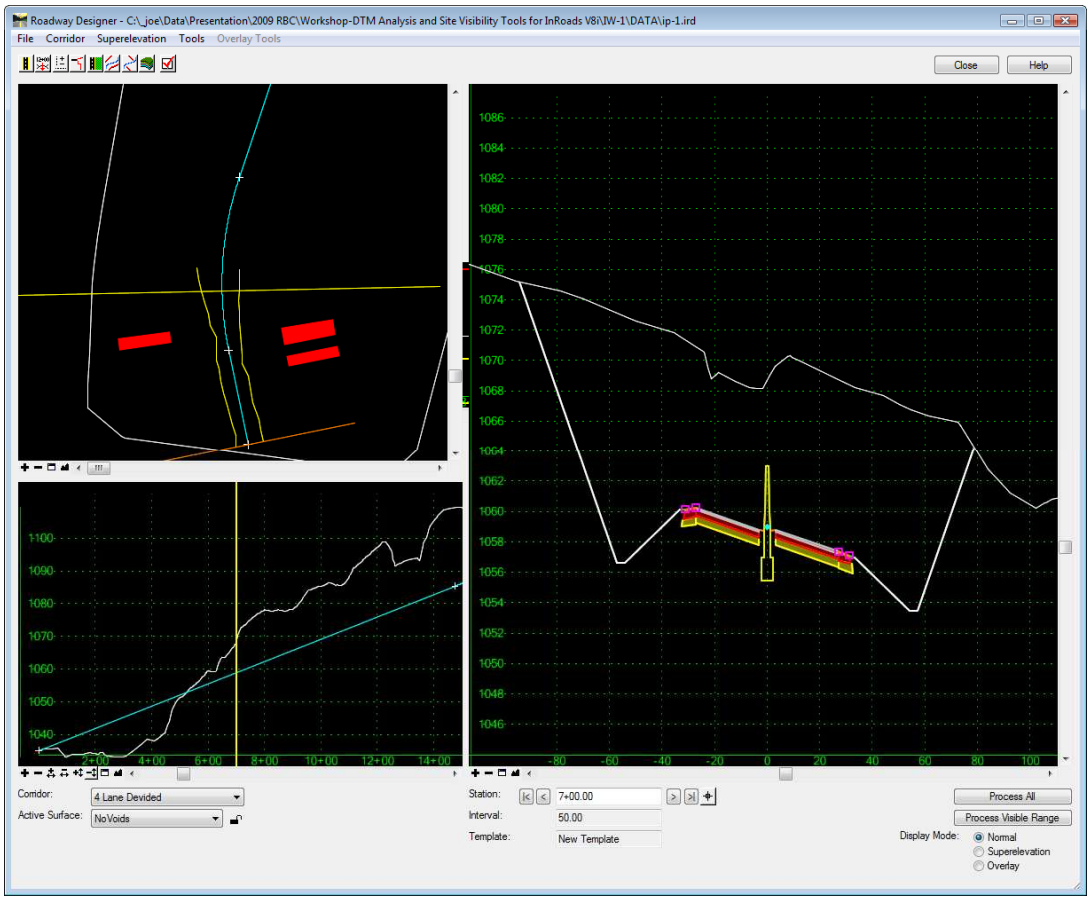
LESSON OBJECTIVE:
Using the ***Roadway Designer*** toolset, build a design surface digital terrain model for future analysis exercises

Roadway Designer
The Roadway Designer is designed to interactively create Highway and Roadway designs using a "template" based system that provides instantaneous visual feedback during the design process.

EXERCISE: CREATE PROPOSED DTM IN ROADWAY DESIGNER

1. Open the Roadway Designer application dialog **Modeler>Roadway Designer**.
   Take a moment to navigate through Roadway Designer, making note of a few new items:
   1. Fill for closed shape Components

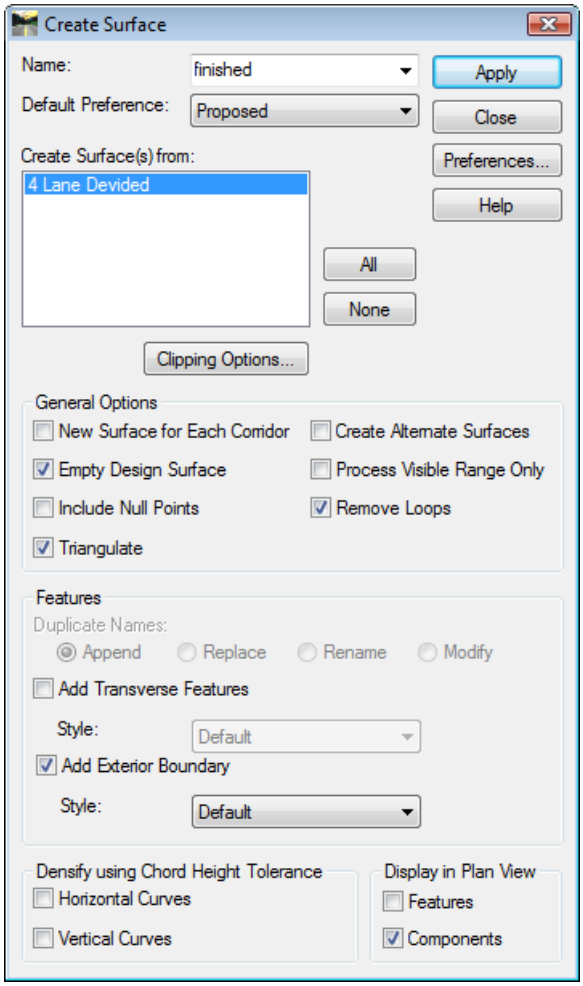
2. Point Control Descriptions, particularly for the Point Controls defining Superelevation
3. Lock Button for the Active Surface
4. Overlay Tools
5. Create Surface Dialog…..to point out a few.



2. Select **Process All**.

   The **Roadway Designer** will calculate and process the template drops at 50 foot intervals for the complete length of the corridor.

3. Close the **Results** pop up dialog.
4. **Corridor>Create Surface** or the **Create Surface** icon.



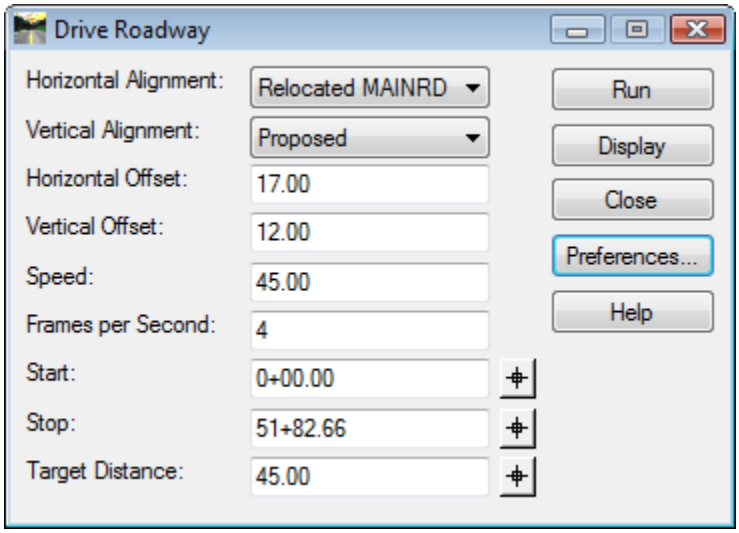
5. Set the Default Preference to **Proposed**.
6. Select **Apply**.
7. Close the **Results** pop up dialog.
8. Close the **Create Surface** dialog.
9. **Save** and **Close** the Roadway Designer application dialog.

EXERCISE: CREATE "DRIVE THROUGH" OF YOUR ROADWAY DESIGN

This exercise will guide you through the steps to create a "drive through" of your roadway design.
There has been some view settings enabled with View 5 of the DGN. We shall generate the drive through from that view.

Hint Please stop and listen to your Instructor before proceeding with this exercise!

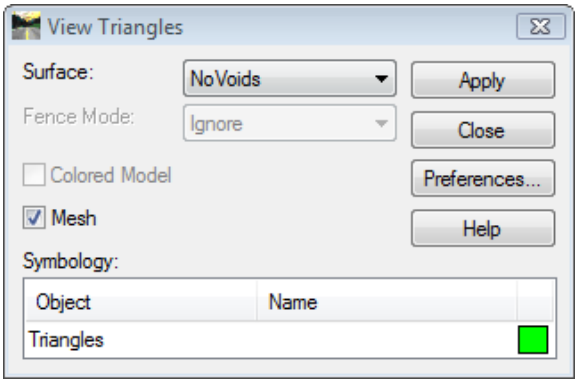
1. Applications>InRoads Group>Modeler>Drive Roadway.
2. Open View 5.
   IMPORTANT: DP in View 5 to ensure it is the "Active" view.
3. Select **Drive Roadway** button from Corridor Modeling dialog.
4. Populate the dialog as shown below.



5. Select **Run** and identify View 5 by DP.

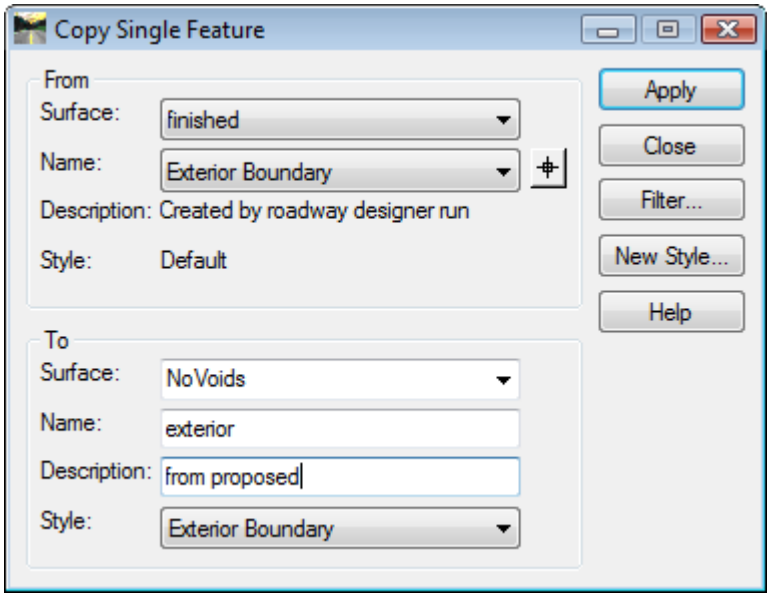
Hint: Modifying the Frames per Second to a smaller number can aid with performance.

6. Display the Existing Ground Triangles as a Mesh. Go to **Surface>View Surface>Triangles** and toggle on **Mesh** and **Apply**



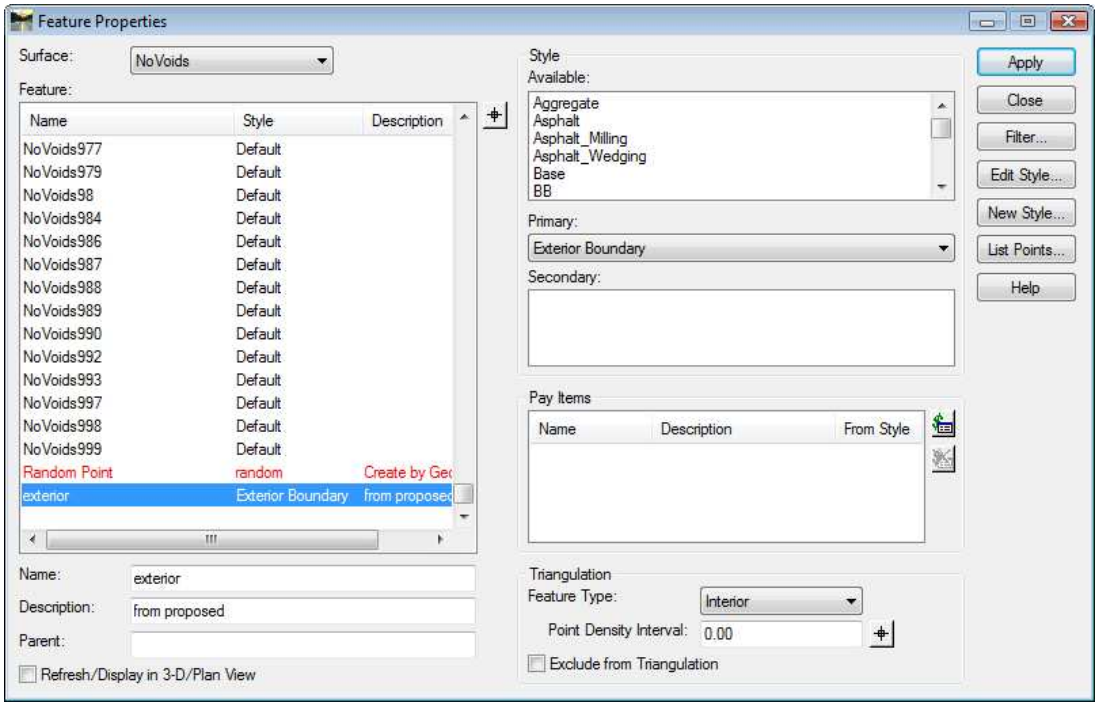
Note: A mesh is a more efficient method on displaying triangles. It also allows raster images to be draped onto them for presentation and visualization.

7. Select **Drive Roadway** and **Run**.
8. This time, Copy the Exterior Boundary of the surface Finished to NoVoids DTM with **Surface>Edit Surface>Copy Single Feature**



9. Change Feature Type from Exterior to Interior in **Surface>Feature>Feature Properties** for NoVoid.

Hint: The Exterior Boundary is at the bottom of the list in NoVoid and make sure NoVoid is your active surface

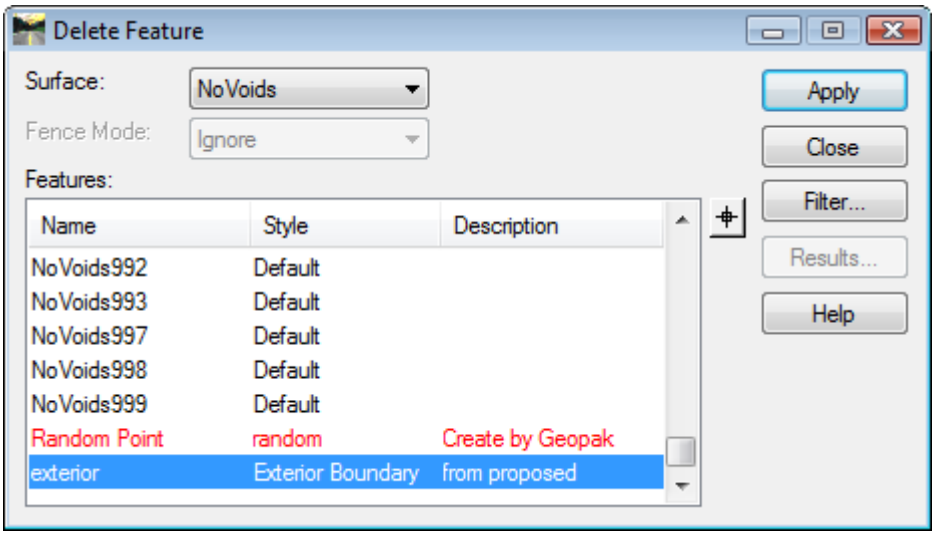


10. Toggle off **Refresh/Display in 3-D/Plan View** and **Apply**
11. **Triangulate** surface NoVoid.

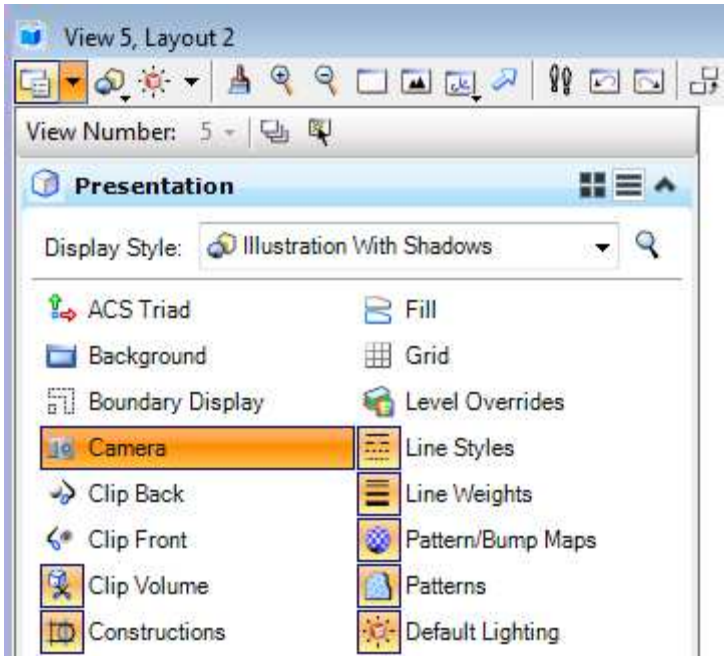
12. Repeat **Surface>View Surface>Triangles** and toggle on **Mesh** and **Apply for NoVoids.dtm**
13. Repeat Drive Way in Step #4.

Note: We modified the extent of the existing terrain model without merging the DTM's, this give us better control for visualization task if needed later down the pipeline.

14. For Future use Delete the Exterior Boundary Feature from NoVoids by using **the Surface>Edit Surface>Delete Feature** tool for the next exercises and then re-triangulate the surface.



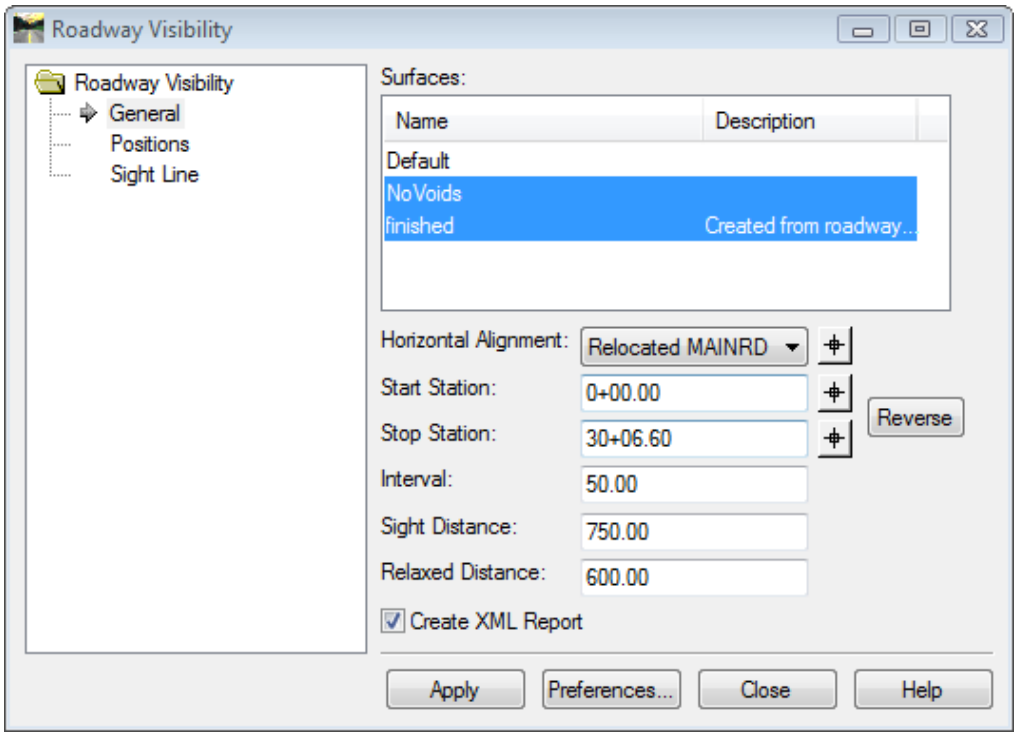
15. Turn off the **Camera** under **View Attributes** and return your view to **Top** and then perform a MicroStation **Fit All.**



EXERCISE: ROADWAY VISIBILITY AND REPORTING

This exercise will evaluate the Sight Distance along the North Bound and South Bound lanes of this corridor using the **Roadway Visibility Tool**. This tool will provide the results graphically and in a XML based report to easily see where the Design Criteria has been met.

1. Select **Evaluation>Sight Visibility>Roadway Visibility**
2. Select **NoVoids** and **Finished**



3. The North Bound Lanes will be analyzed first, go to **Preferences** and select **NB**.

   Note: This sets the values for the North Bound Lanes. We desired 750 ft of SSD but 600 ft would be acceptable. Anything less does not meet 65 MPH design speed as we used to define Superelevation.

4. Examine the setting under the General, Positions, and Sight Lines.
5. Verify the **Create XML Report** is toggled on
6. Press **Apply**
7. Examine the results in MicroStation and in the XML Reports.

   Note: The areas along the Cut Slope on the Horizontal Curve and the areas along the vertical curve fail to meet the design criteria.

8. Repeat for the South Bound Lanes using the delivered **SB** preferences.
9. Examine Results Graphically and in the Bentley Civil Report Browser

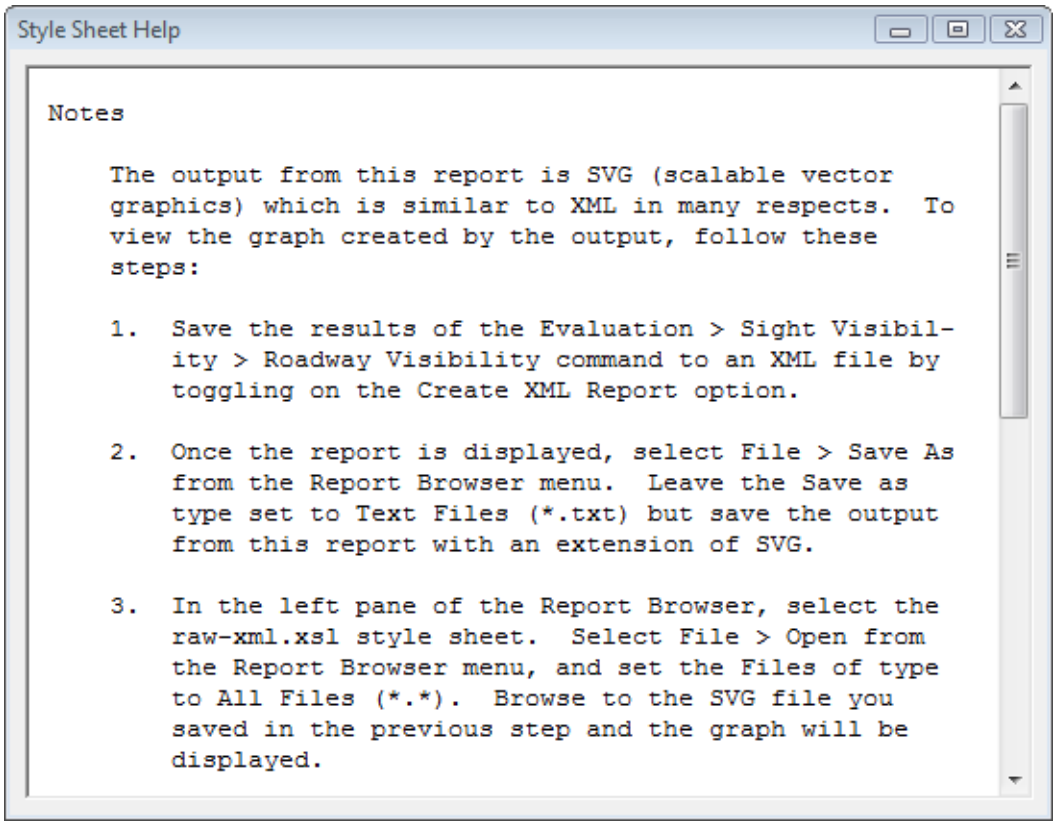
Note:	The South bound lanes has the stationing reversed to match the flow of traffic. The failures on the South bound lanes are mainly due to the median barrier. These SSD issues would be easily resolved by using curve widening tools in Roadway Designer to expand the shoulder width along this median barrier to provide the additional SSD.

Bonus Material: Take time to explore using Actual Distance vs. Sight Distance on the Sight Line tab. Then try reviewing the results with the Drive Roadway tool.

EXERCISE: CREATE BAR GRAPH REPORT USING A SVG FILE

Note:	Remember the RoadwayVisibilityGraphSVG.xsl does not provide formatted results

1. Select **Sight Visibility>Sight Visibility>RoadwayVisibilityGraphSVG.xsl**
2. **Right Click** and Select **Style Sheet Help**



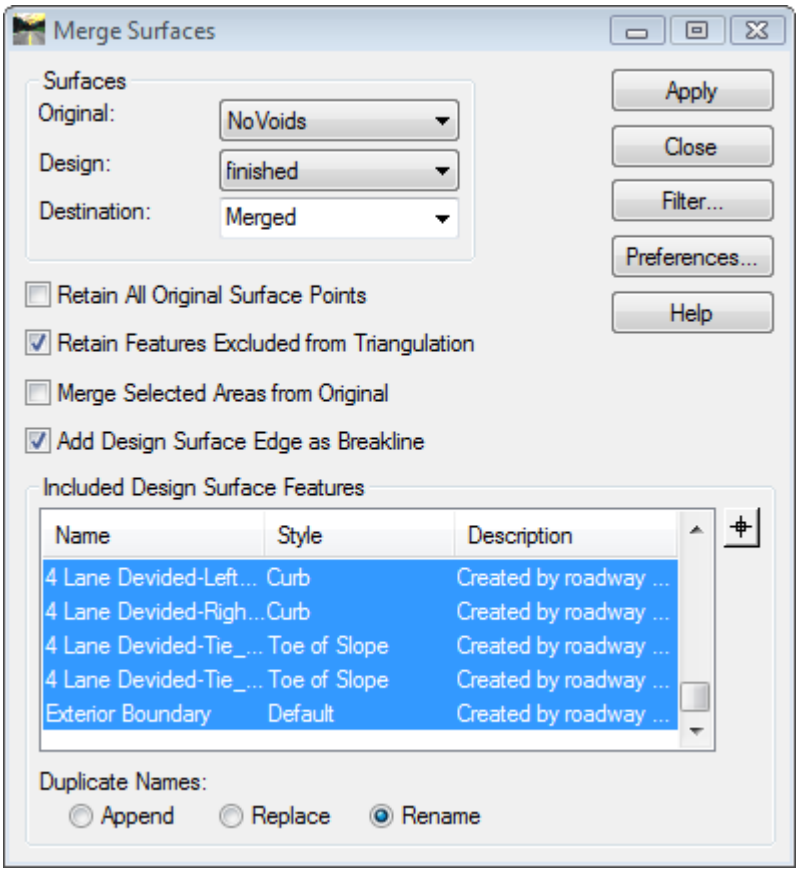
3. The Adobe plug-in is included in this workshop. **Install** Adobe SVG Viewer found at **\IW-1\SVGView.exe**

4. Follow the Style Sheet Help and rerun the North Bound Lanes using the **NB** Preference.
5. Examine Results of the Report Generated.

For future reference the Adobe SVG Viewer can be found at:
http://www.adobe.com/svg/viewer/install/main.html

EXERCISE: CREATE MERGE SURFACES

1. Select **Surface>Edit Surface>Merge Surface**
2. Set the setting as defined in the screen capture below. And then **Apply.**



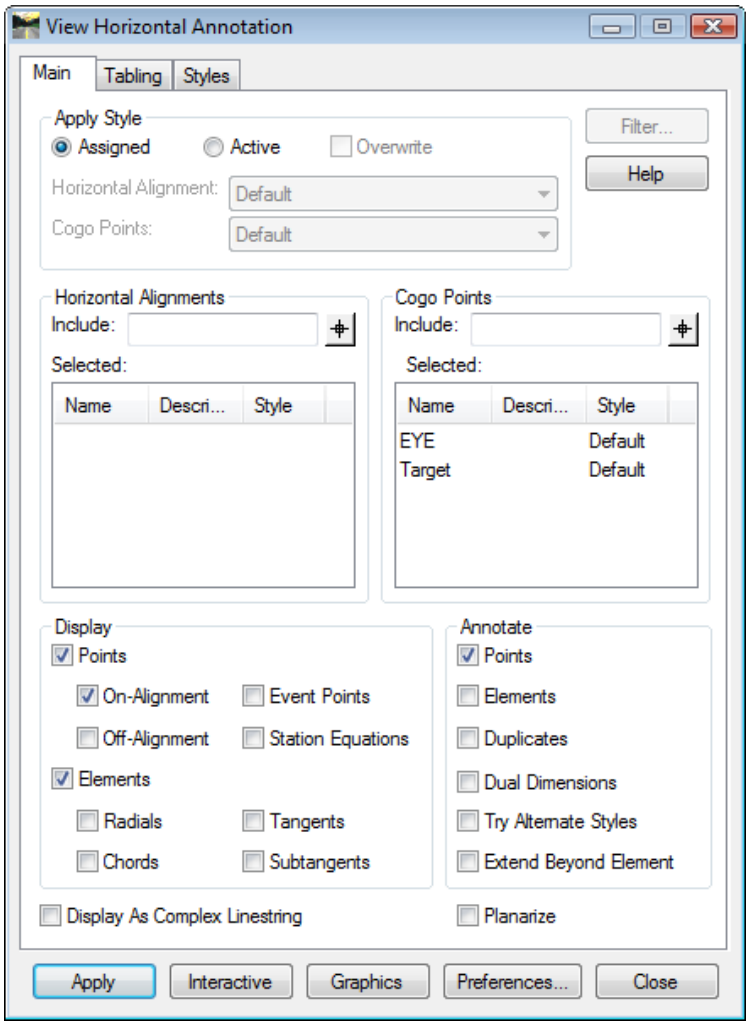
EXERCISE: SIGHT VISIBILITY

Sight Triangles at any intersection is an important part of the design process. A quick analysis can change your design from a simple Stop Condition to high speed ramp. The Surface Visibility tool can help determine what you can see from a critical point, so you can determine the appropriate facility needed for you Design.

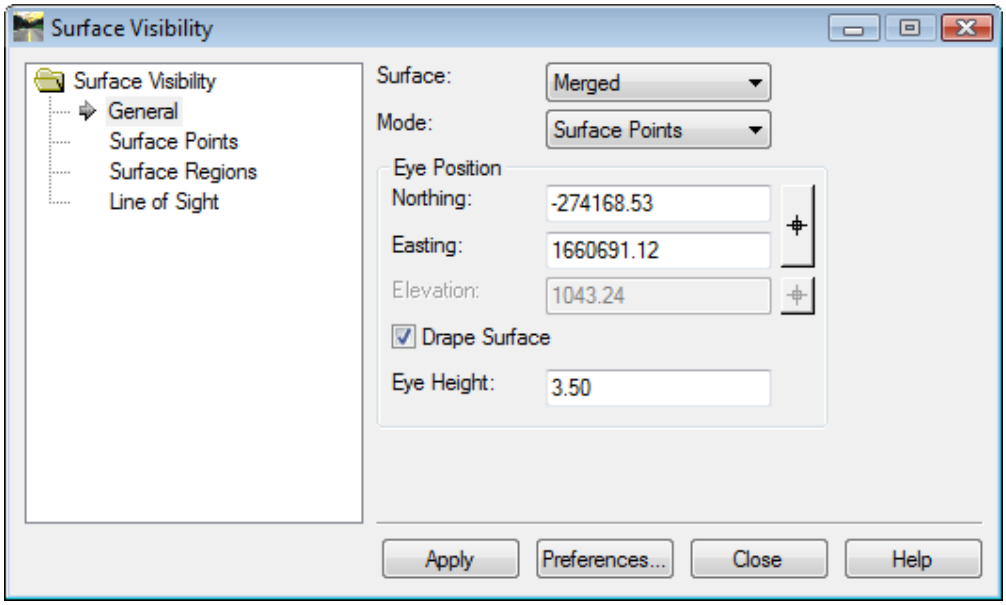
This lesson will determine if an existing stop condition is adequate for newly design corridor and Existing DTM.

EXERCISE: SIGHT VISIBILITY- SURFACE POINTS

1. Display the two cogo points, **Eye** & **Target,** these will be used for references in this exercise. Navigate to **Geometry>View Geometry>Horizontal Annotation** and select these points.



2. Select **Evaluation>Sight Visibility>Surface Visibility**
3. Select the surface named **Merged** under the **General** tab.
4. The intersection being analyzed is at Station 40+60. Locate the cogo point, **Eye**. Set the Eye Position with the pick button and select cross hair symbol to acquire its coordinates.
5. Choose **Drape Surface** and set the Eye Height at **3.5** ft

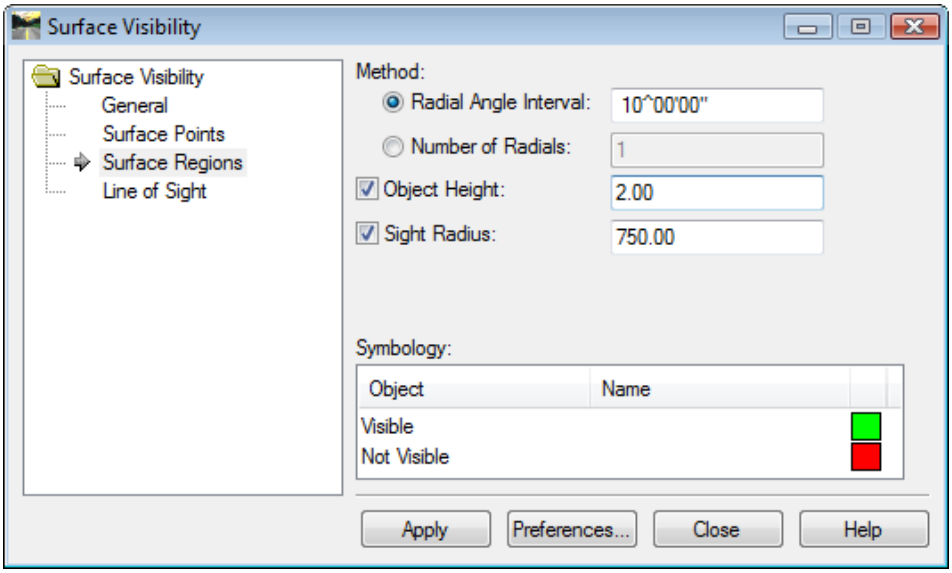


6. Go to the Surface Points tab and set the Object Height **2.0** ft and the Sight Radius to **750** ft.
7. Press Apply and evaluate the results.

Note: Every triangle vertices within 750 ft from the Eye Position is analyzed to see if there is a direct line of sight with taking into account the height of the Eye and the target.

EXERCISE: SIGHT VISIBILITY- SURFACE REGIONS

1. Select **Evaluation>Sight Visibility>Surface Regions**
2. Change the Mode to **Surface Regions** on the General Tab but keep all of the other settings the same.
3. Navigate to the **Surface Regions** Tab.
4. Set the setting as follows:



5. **Apply** the tool.

Note: The tool display the line of sight that is visible/Not Visible radial from the Eye Position out to the desired sight distance. The number of instance is based radial angle interval or number.

EXERCISE: SIGHT VISIBILITY- LINE OF SIGHT

1. Select **Evaluation>Sight Visibility>Line of Sight**
2. Change the Mode to **Line of Sight** on the General Tab but keep all of the other settings the same.
3. Navigate to the **Line of Sight** Tab.
4. Select the pick Button for the Object Position and select the cogo point **Target** located north of the intersection approximately at Station 47+60 in the Southbound lanes.
5. Toggle on the Drape Surface and set the object height again 2 ft
6. **Apply**

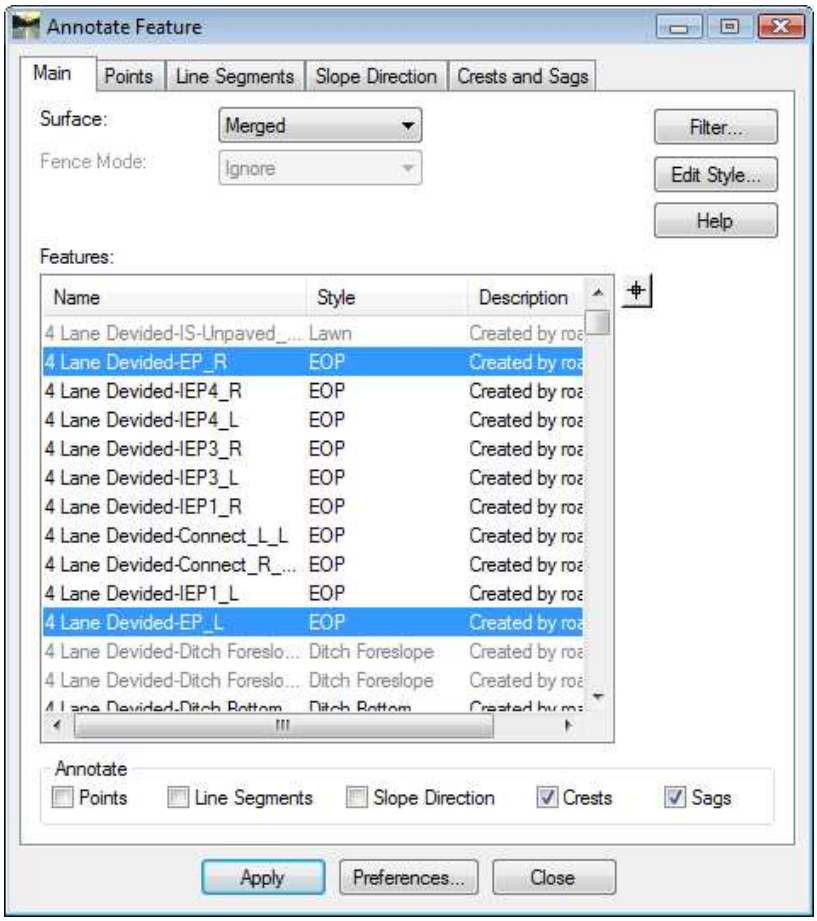
Examine the results. Does a high speed ramp need to be done based only on Sight Distance or does simply improving the existing intersection suffice? What other items need to be considered after completing this simple assessment to determine if an intersection with a stop sign would be adequate.

EXERCISE: LOCATE SAGS AND CRESTS ALONG DTM FEATURES

Locating the Low and High Points is the beginnings of any hydraulic design. Indentifying these point aid in formulating your drainage areas and inlet/culvert locations.

The ability to analyze DTM data for this information prevents one from examining the Vertical Geometry, Superelevation, typical section, and other data.

1. Select **Surface>View Surface>Annotate feature for the surface Merged**



2. Select Points selected in dialog above. Then **Apply** the tool.
3. Evaluate the results.
    1. Why are there 2 crests at 22+00 for the North Bound and 23+00 for the South Bound are at different stations?
    2. Why are several crests and sags bunched together at approximately Station 45+00?