

GEOPAK – Vertical Geometry

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General

This workflow will demonstrate how to create, store, display and review existing ground profiles in GEOPAK. The project TIN file will provide the surface information needed for the existing ground profiles. In order to create an existing ground profile, a horizontal alignment, or chain, must be stored in COGO and used as a reference alignment for the profile.

Existing ground profiles are created along the alignment and on left and right offsets from the alignment. Existing offset ground profile information is created at an offset that is approximately the ditch location and existing ground point information is sampled at an offset that is approximately the Right of Way line location.

The existing ground profile on the alignment is created through the **Existing Ground Profile** tool in the Project Manager while the offset ground profiles are extracted using the **Draw Profiles** tool. The ground point information is created using a MDOT specific profile application.

Information on displaying proposed profiles, for plan preparation purposes, will be described in this workflow utilizing the **Draw Profiles** tool. Please refer to the OpenRoads Basics training for further information regarding development of proposed profiles.

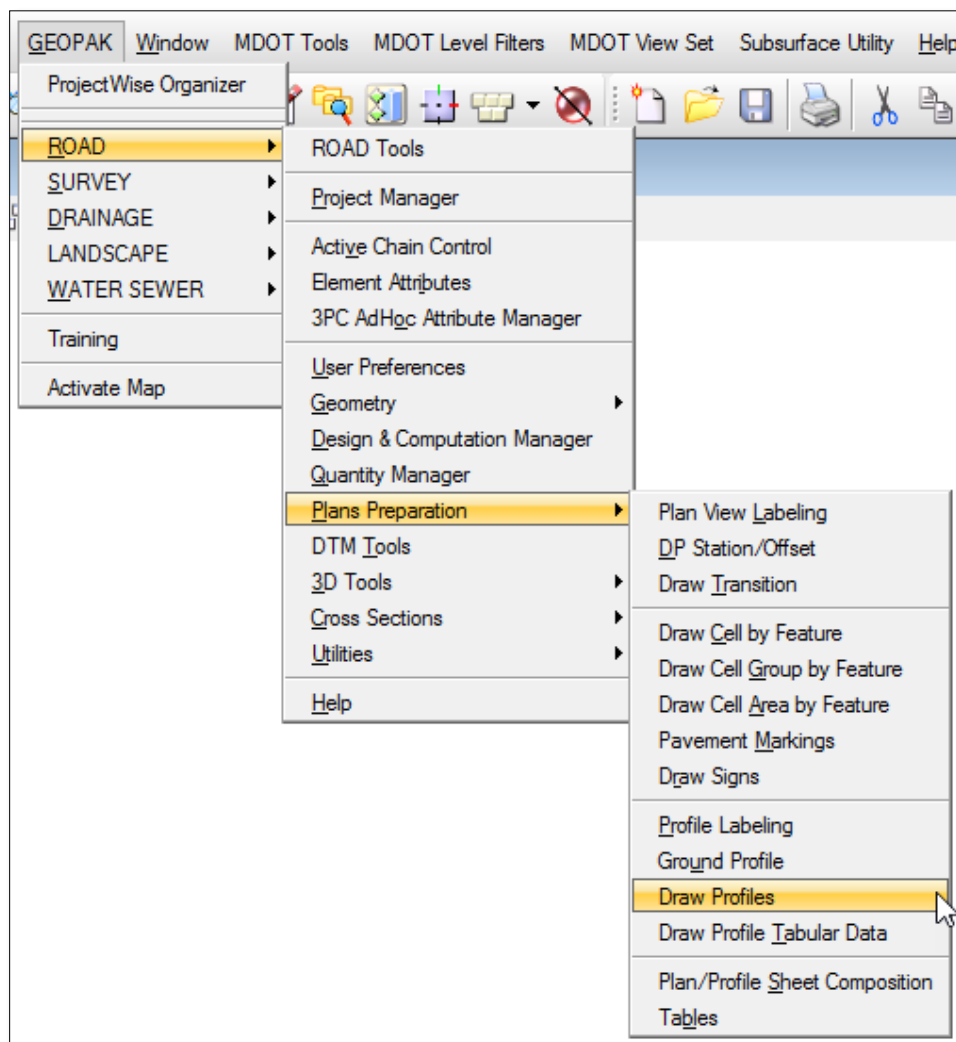


Existing Ground Profiles

Creating a Profile Cell

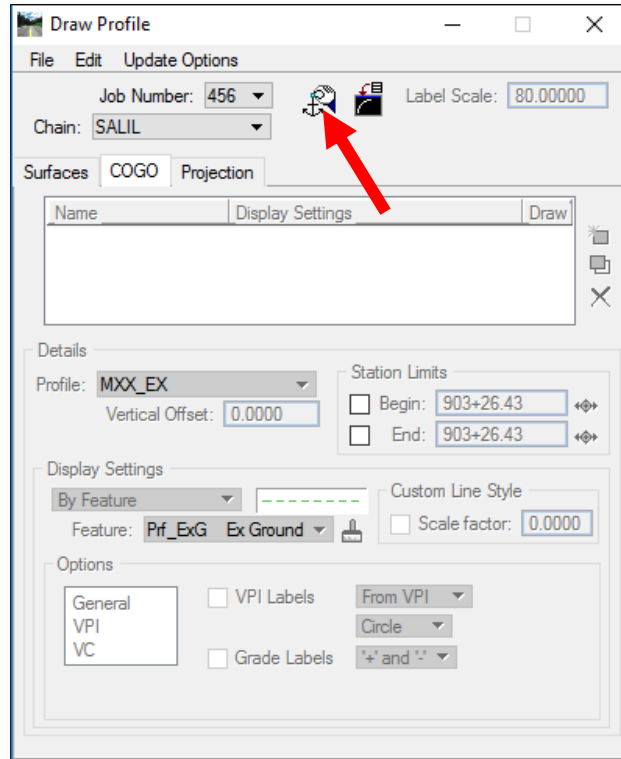
The profile cell stores data so that GEOPAK knows where to display the profile information in the MicroStation design file. The profile cell stores a reference station and elevation along with the horizontal and vertical scale and is the basis for profile plan production.

1. Open **Project Manager** for the desired project to ensure the correct GPK file is referenced. Refer to [Workflow – GEOPAK 1 – Project Manager](#) for information on setting up a project through Project Manager.
2. Open the **Draw Profiles** tool in a desired MicroStation file (**GEOPAK → ROAD → Plans Preparation → Draw Profiles**). This tool cannot be opened from Project Manager dialog.

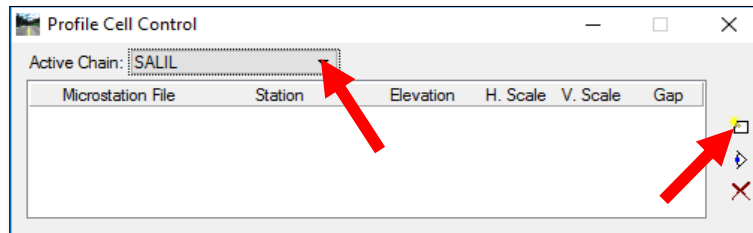




3. In the **Draw Profile** dialog box, select the **Dialog Profile Cell Control** button.



4. In the **Profile Cell Control** dialog, set the **Active Chain** to the desired chain (alignment). Then select the **Place Profile Cell** icon to place the profile cell in the file.





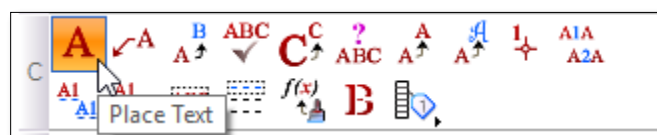
5. The **Place Profile Cell** dialog lets the user define the characteristics of the cell.

- **Station:** Start station for the cell. This will auto populate based on the Active Chain selected.
- **Elevation:** Starting Elevation for the cell. This must be manually entered by the user based on the elevation characteristics of the project.
- **Horizontal Scale:** Defines the horizontal scale.
- **Vertical Scale:** Defines the vertical scale.
- **Gap/No Gap:** If the selected chain has a station equation, this selection allows a gap to be placed at the location of the station equation. MDOT Recommends Profile Cells are created without a gap.
- **Cell Range:** defines the cell range from the starting elevation defined in the Elevation cell. If the selections are changed to Top/Bottom Elevation – allows the user to define the desired elevations.

6. Place the cell in the file by left clicking in the file. No stationing or elevations will be shown on the cell at this point, only the cell characteristics. The stationing and elevation information will be added when the existing and proposed profiles are drawn on the cell.



Note: If the text labeling in the lower left-hand corner of the cell is very large or very small, open the place text tool and ensure the text style is set to Pr_Mask and that the annotation scale of the sheet is on and set to the desired scale. Delete and re-place the cell.

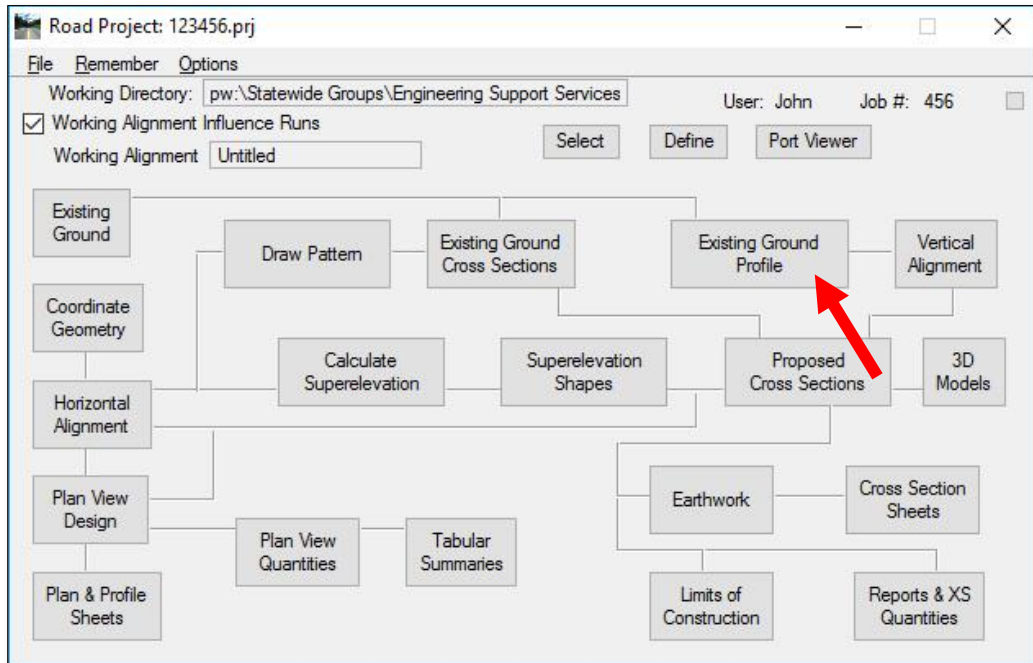




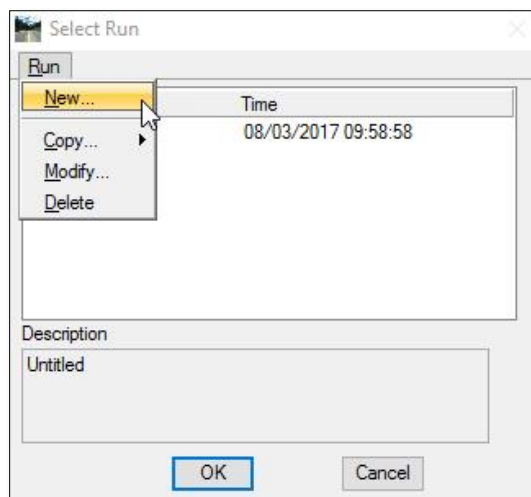
Creating Existing Profile (On Alignment)

The existing ground profile on alignment will be created from the project TIN file and stored in the GPK. To extract a TIN file from the survey terrain, refer to [Workflow – GEOPAK 2 – Digital Terrain Model Analysis](#).

1. Open **Project Manager** for the desired project to ensure the correct GPK file is referenced. Refer to [Workflow – GEOPAK 1 – Project Manager](#) for information on setting up a project through Project Manager.
2. In the **Project Manager** dialog, select **Existing Ground Profile**.



3. In the **Select Run** dialog, select **Run → New**.



NOTE: Do not select or edit the default Untitled run. Create a new run for this process.



4. Enter a **Run Name** in the dialog with no spaces. If desired, enter a description for the run then select **OK**.

New Run Name

Run Name: MXX_Ex

Description: M-XX Existing Ground

OK Cancel

5. In the **Select Run** dialog, select the new run, then select **OK**.

Select Run

Name	Time
MXX_Ex	08/11/2017 11:02:32
Untitled	08/03/2017 09:58:58

Description: M-XX Existing Ground

OK Cancel

6. In the **Ground Profile** dialog enter the following information, then select **Apply**.

- **Profile Name:** Enter the desired profile name for the existing ground profile on alignment. (11 characters or less with no spaces or special characters, underbars are allowed)
- **Job Number:** Ensure the correct GPK file is selected for the desired project.
- **Operator:** Enter the user's initials.
- **Chain:** Select the desired alignment or chain to run the existing ground profile.
- **Offset:** Ensure the offset is set to 0.000
- **Beg Station:** Enter desired start station.
- **End Station:** Enter desired end station.
- **Sample Type Drop Down:** Set Option to Even
- **Sample Spacing:** MDOT recommends 5
- **Data Type Drop Down** select TIN
- **TIN File:** Select the appropriate TIN file for the desired project.

Ground Profile ...

Profile Name: MXX_Ex

Job Number: 456

Operator: JS

Chain: SALIL

Offset: 0.000

Beg Station: 903+26.43

End Station: 1128+82.56

Even 5.000 TIN

Radius of output circle: 10.0

TIN File: OPAK Manual\Data\123456.tin

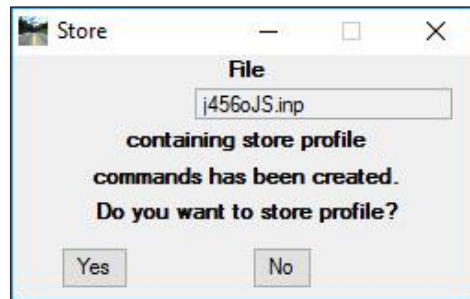
Apply



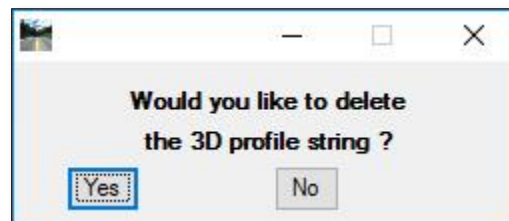
7. Select **OK** on the dialog below to continue.



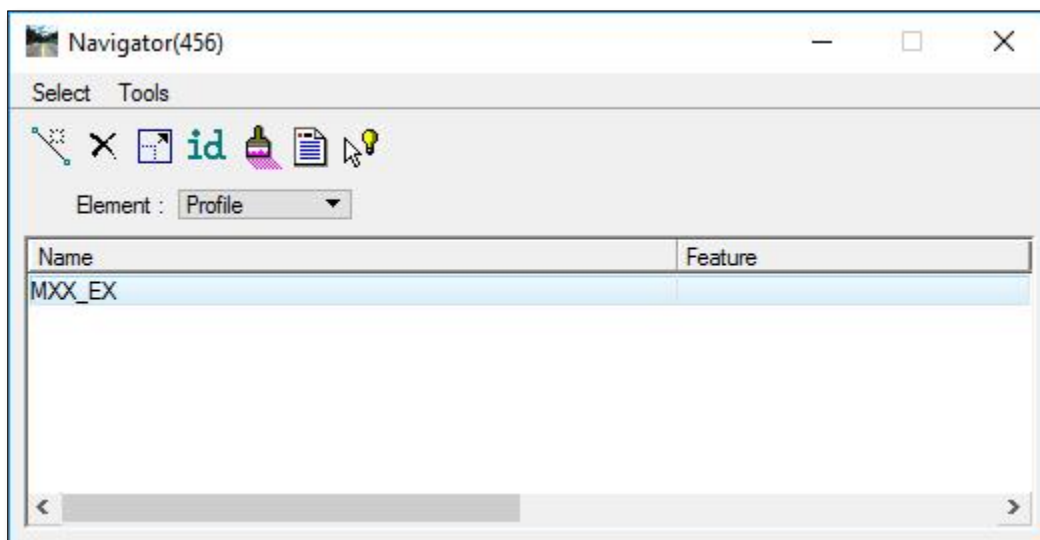
8. The existing ground on the alignment will be sampled from the TIN file at the specified increment. When complete, the user will be prompted to **Store** the profile. Select **Yes** to store the profile in the GPK.



9. In the following dialog, select **Yes** to delete the 3D profile string.



10. The existing ground profile on alignment is now stored in the GPK. To review, go to COGO and access the profile portion in Navigator.

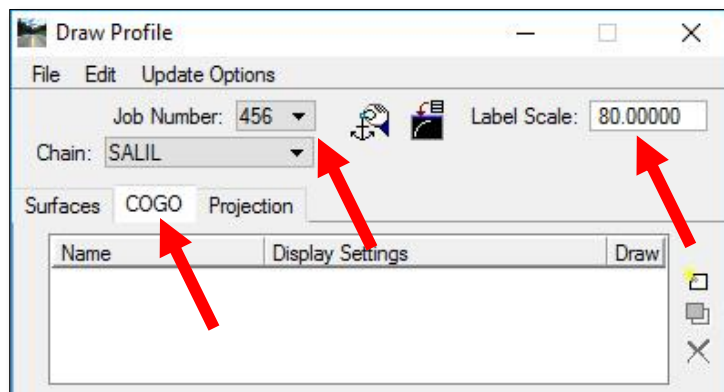




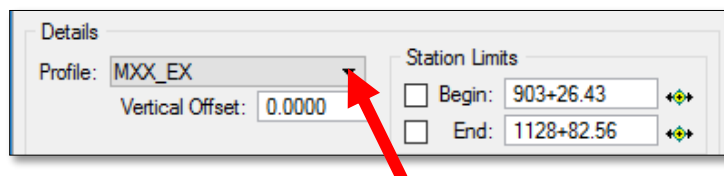
Displaying Existing Profile (On Alignment)

Once the existing profile on alignment has been created and stored in the GPK file, it must be displayed on the profile cell. In addition to the existing profile, the horizontal and vertical axis labels (Stations, Elevations & Strip Grades) are added as part of the process.

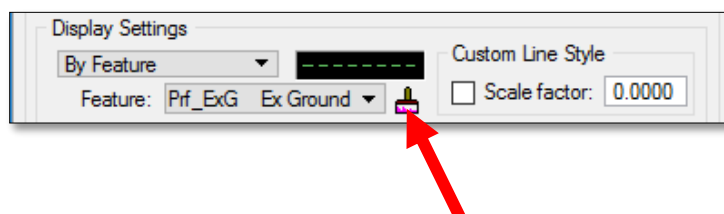
1. Open **Project Manager** for the desired project to ensure the correct GPK file is referenced. Refer to [Workflow – GEOPAK 1 – Project Manager](#) for information on setting up a project through Project Manager.
2. Open the **Draw Profiles** tool (**GEOPAK → ROAD → Plans Preparation → Draw Profiles**) in the DGN file that contains the Profile Cell for the project.
3. In the **Draw Profile** dialog, ensure the **Job Number** shown is the correct GPK number, select the desired alignment for the **Chain** and set the **Label Scale** to the desired annotation scale.
4. Select the **COGO** tab.



5. In the **Details** portion of the **Draw Profile** dialog, select the desired profile. The **Station Limits** will default to the beginning and end station of the selected chain.

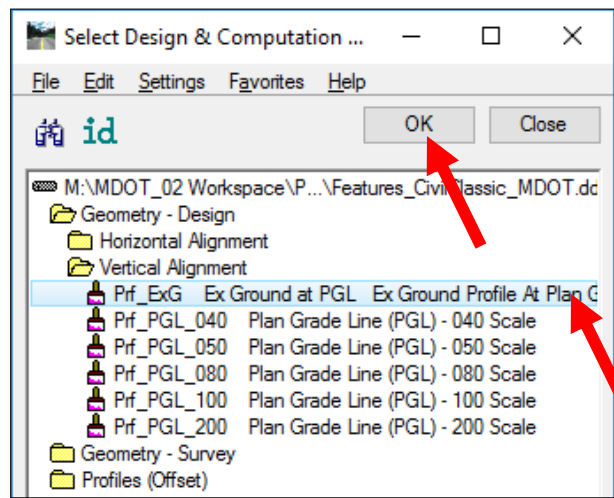


6. In the **Display Settings** portion of the **Draw Profile** dialog, set the line style option to **By Feature**. Set the feature to **Prf_ExG Ex Ground**. If the option doesn't appear in the dropdown, select the **paintbrush** icon.



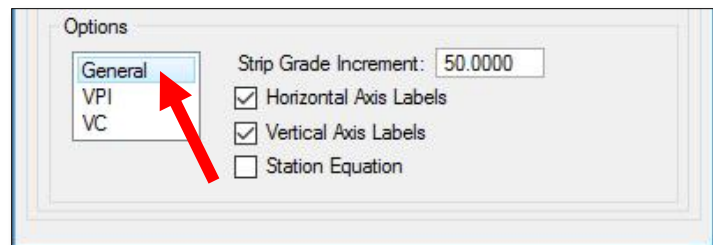


7. Selecting the **paintbrush** icon opens the Design & Computation manager. Navigate to the Vertical Alignment folder under Geometry – Design and select **Prf_ExG Ex Ground at PGL**. Select **OK** to return to the Draw Profile dialog.

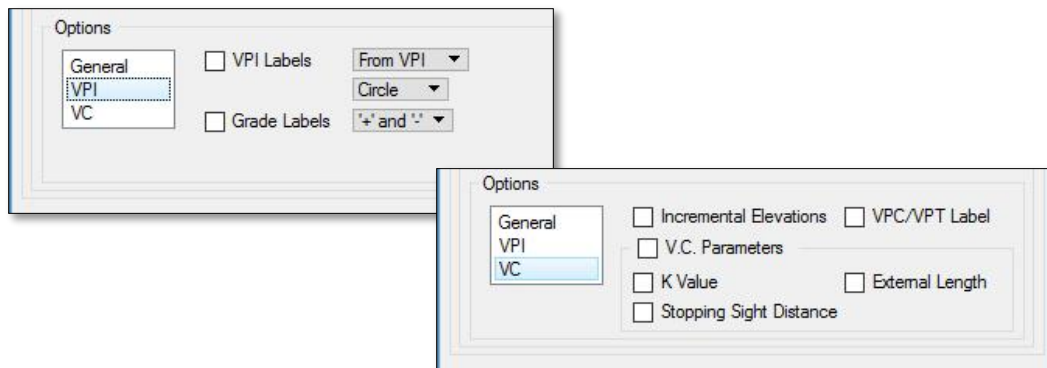


8. In the **Options** portion of the **Draw Profile** dialog, there are three menu selections: General, VPI and VC. Select **General**.

- The **Strip Grade increment** determines the increment that the existing ground strip grades are displayed on the horizontal axis. Enter 50.
- Ensure that the Horizontal and Vertical Axis labels are checked. These will display the stations and elevations on the profile cell.

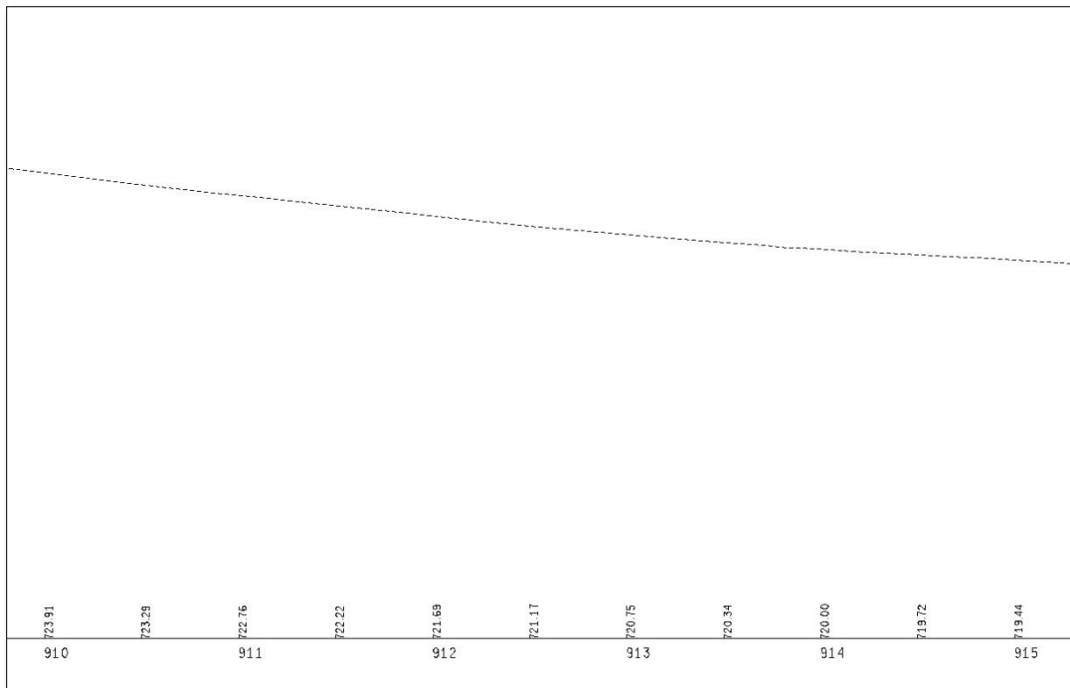
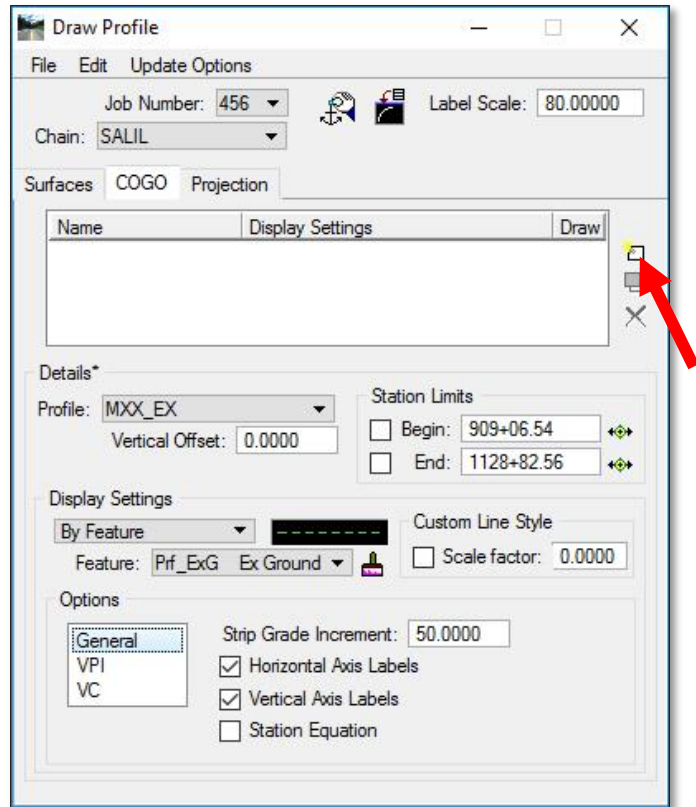


9. In the **VPI** and **VC** options, ensure none of the options are selected. These options will be utilized when the proposed profile is displayed on the profile cell.





10. Once the **Draw Profiles** dialog has been populated for the existing profile, select the **Add COGO Profile Settings** icon to add the existing ground profile on alignment, as well as the horizontal and vertical axis labels to the Profile Cell.

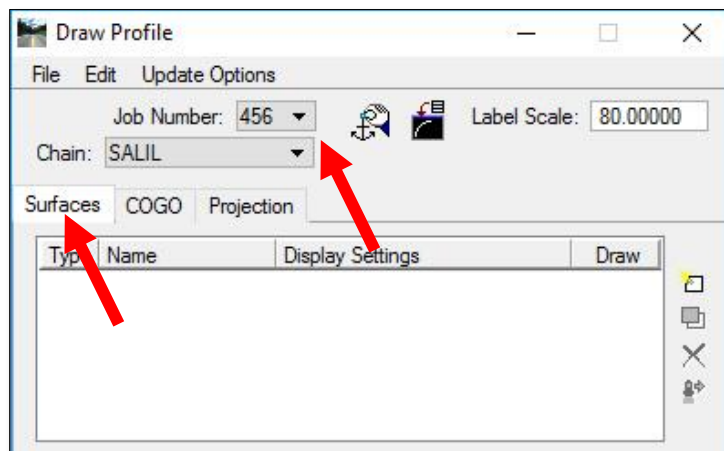




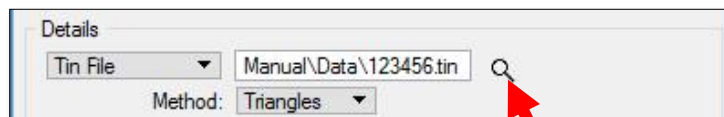
Existing Offset Profiles (Lt & Rt)

Existing offset profiles are developed directly from the **Draw Profile** dialog and are typically shown on the profile cell but are not stored in the GPK file. The offsets used are approximately the ditch location to the left and right of the alignment or just beyond the back of curb when there is no ditch on the project.

1. Open **Project Manager** for the desired project to ensure the correct GPK file is referenced. Refer to [Workflow – GEOPAK 1 – Project Manager](#) for information on setting up a project through Project Manager.
2. Open the **Draw Profiles** tool (**GEOPAK → ROAD → Plans Preparation → Draw Profiles**) in the DGN file that contains the Profile Cell for the project.
3. In the **Draw Profile** dialog, ensure the correct project **Job Number** (GPK) is selected and the **Chain** is set to the desired alignment.
4. Select the **Surfaces** tab.



5. In the **Details** portion of the **Draw Profile** dialog, select the project TIN file. Set the **Method** to **Triangles**.

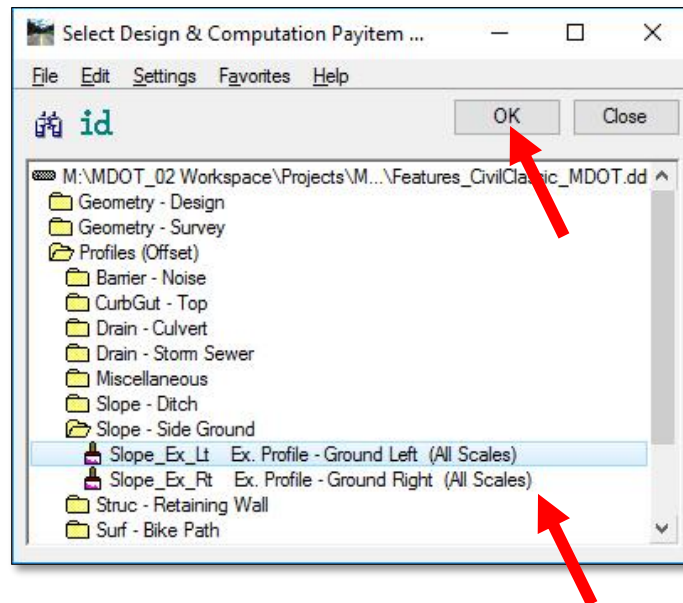


6. In the **Display Settings** portion of the **Draw Profile** dialog, set the line style option to **By Feature**. Set the Feature to **Slope_Ex_Lt** or **Slope_Ex_Rt**. If the option doesn't appear in the dropdown, select the **paintbrush** icon.





7. Selecting the **paintbrush** icon opens the Design & Computation manager. Navigate to the Slope – Side Ground folder under Profiles (Offset) and select **Slope_Ex_Lt** or **Slope_Ex_Rt**. Select **OK** to return to the Draw Profile dialog.

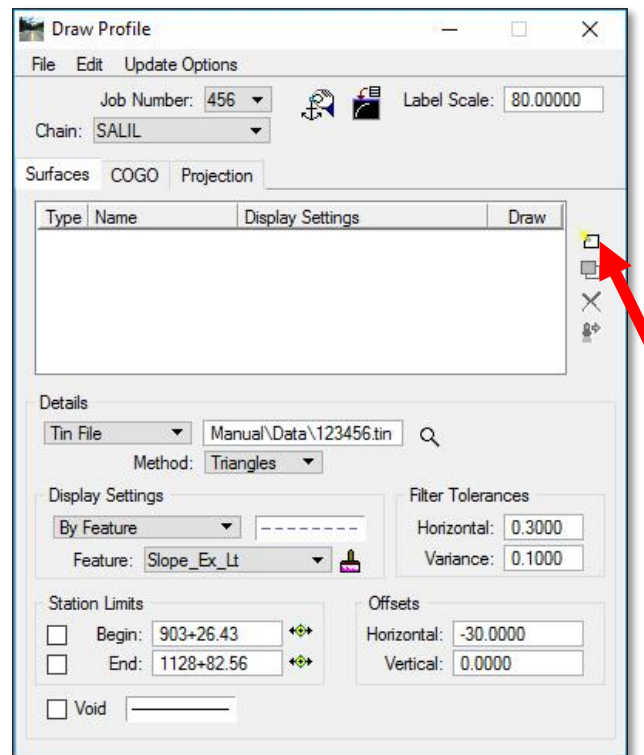


8. In the **Station Limits** and **Offsets** portion of the **Draw Profile** dialog, enter the desired horizontal offset for the side profile. Negative values are to the left of the alignment up-station. Leaving the Station Limits portion un-selected will display the side profiles for the entire alignment.

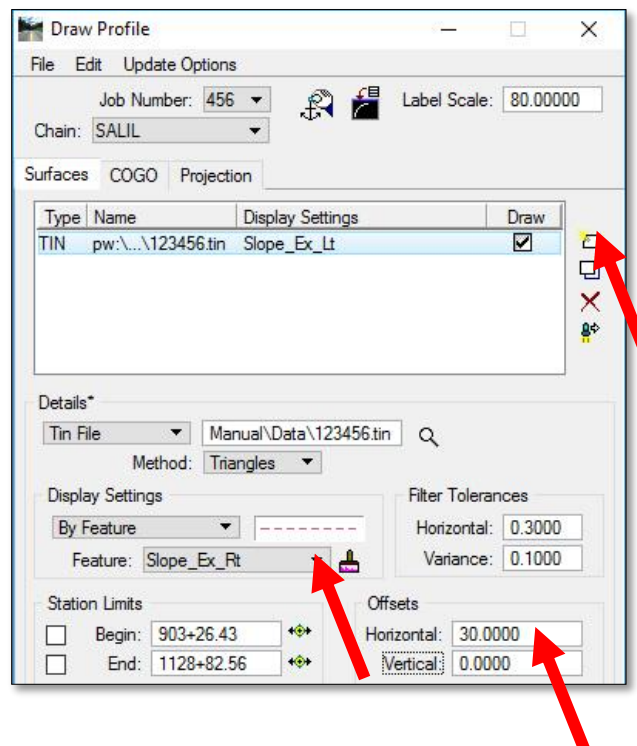




9. When the Draw Profile dialog has been populated for one of the side profiles, select the **Add Surface Settings** icon to add the side profile to the profile cell.



10. Once complete, repeat Steps 5 through 9 to display the remaining offset profile, updating the feature and horizontal offset to the applicable side of the alignment.

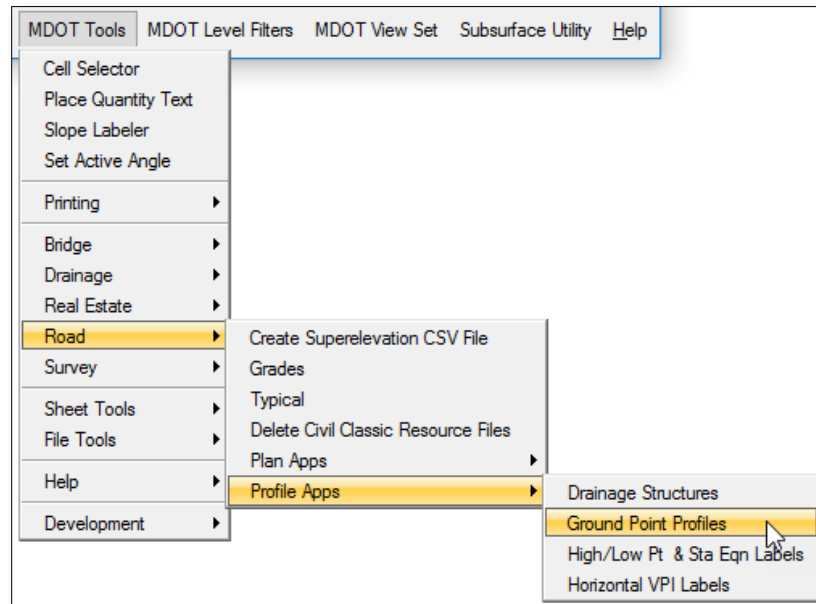




Existing Ground Points (Lt & Rt)

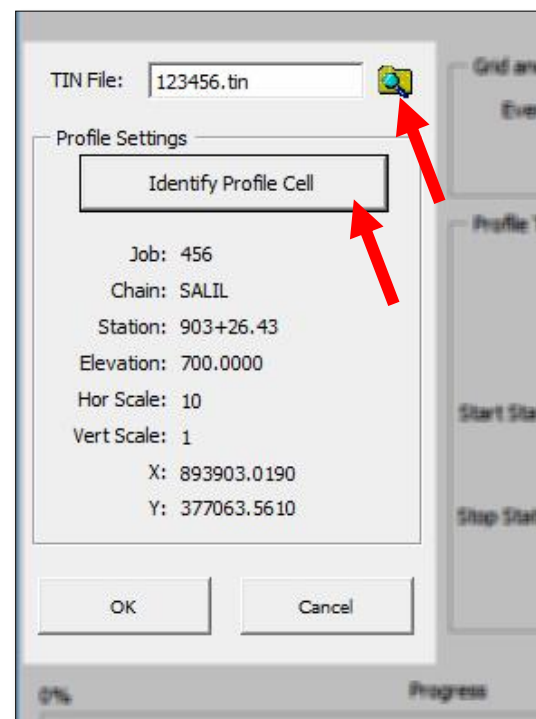
Existing ground points are left and right offset profiles that are displayed as dashes every 50 feet with an offset that is approximately equal to the average Right of Way location. They are added to the Profile Cell utilizing an MDOT specific tool called **Ground Point Profiles**.

1. Open the **Ground Point Profiles** tool (**MDOT Tools → Road → Profile Apps → Ground Point Profiles**).



2. Select the TIN file for the project by selecting the **folder with a magnifying glass** next to **TIN File**:
3. Select **Identify Profile Cell** in the **Profile Settings** portion of the tool and select the previously placed profile cell in the DGN file.
4. Left click within the window to accept the selection. The project information in the **Profile Settings** should match the profile cell selected.

NOTE: If no information is shown the profile cell is not recognized. This tool will not function if the profile cell information is not displayed and the cell will have to be recreated to complete this process.





5. In the **Grid and Plot Information** portion of the tool, enter the desired interval to place the ground points (50 ft) and the applicable drawing scale.
6. In the **Profile To Extract** portion of the tool, enter the desired Left and Right offsets. The start and stop stations are automatically populate based on the selected profile cell. Multiple Regions apply if there are station equations. To note regions in the selected chain, review the chain through COGO Navigator.

NOTE: Do not enter negative values for the Left Chain Offset. The tool will automatically select the correct side of the alignment based on the inputs.

NOTE: Ensure that the offsets from the alignment entered are within the limits of the terrain. If no information is identified at a given interval, the ground point will not be displayed.

7. Once the tool is populated, select **OK** to draw the exiting Ground Points on the selected profile cell. Both the left and right ground points will be drawn at the same time.



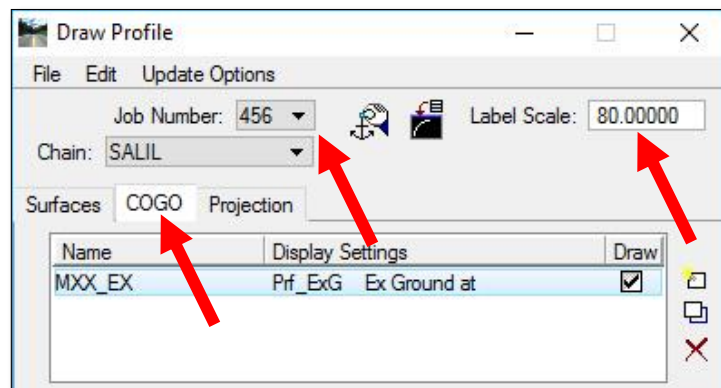
Proposed Profiles

This workflow is limited to describing how to display proposed profiles for plan production purposes that have been stored in the GPK. For further information regarding the creation of profiles, refer to OpenRoads Basics training.

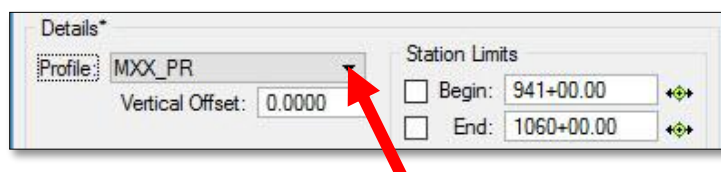
Displaying Proposed Profiles

To display a proposed profile, a profile must be stored in the GPK file for the project. In addition to displaying the proposed profile, the vertical curve information and proposed strip grades will be displayed.

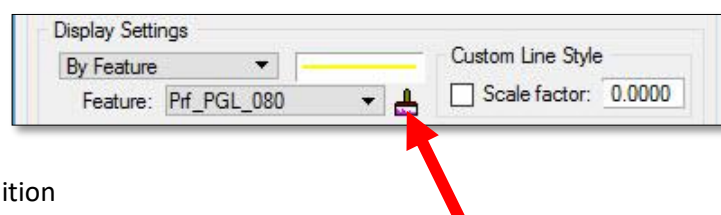
1. Open **Project Manager** for the desired project to ensure the correct GPK file is referenced. Refer to [Workflow – GEOPAK 1 – Project Manager](#) for information on setting up a project through Project Manager.
2. Open the **Draw Profiles** tool (**GEOPAK → ROAD → Plans Preparation → Draw Profiles**) in the DGN file that contains the Profile Cell for the project.
3. In the **Draw Profile** dialog, ensure the **Job Number** displays the correct GPK number, the **Chain** is set to the desired alignment and the **Label Scale** is set to the desired annotation scale. Select the **COGO** tab.



4. In the **Details** portion of the **Draw Profile** dialog, select the desired profile. The **Station Limits** will default to the beginning and end station of the selected chain.

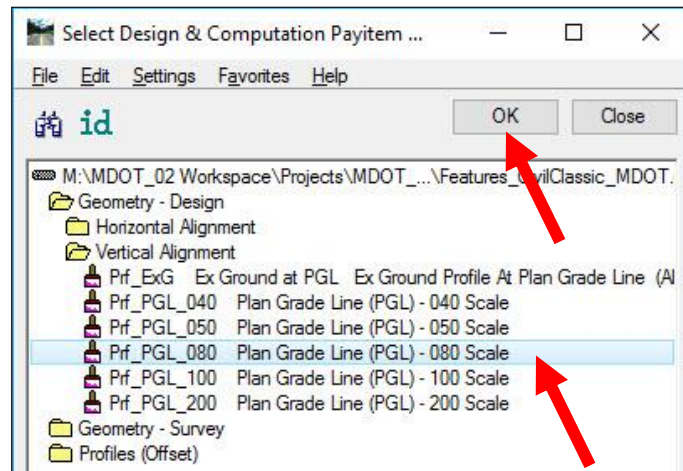


5. In the **Display Settings** portion of the **Draw Profile** dialog, set the line style option to **By Feature**. Set the feature to **Prf_PGL_XXX** that corresponds to the desired scale. If the desired option doesn't appear in the dropdown, select the **paintbrush** icon.



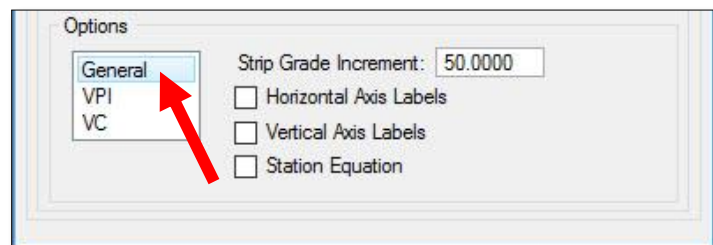


6. Selecting the **paintbrush** icon opens the Design & Computation manager. Navigate to the Vertical Alignment folder under Geometry – Design and select appropriate feature based on the desired drawing scale.
7. Select **OK** to apply the feature style selection and return to the Draw Profile dialog.

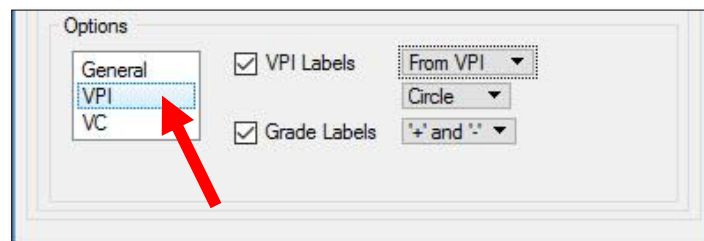


8. In the **Options** portion of the **Draw Profile** dialog, there are three menu selections: General, VPI and VC. Select **General**.

- Enter 50 in the **Strip Grade Increment**. This determines the spacing of the ground strip grades that are displayed on the horizontal axis.
- Ensure the remaining options are **Unchecked**. The horizontal and vertical axis labels were displayed with the Existing Profile.

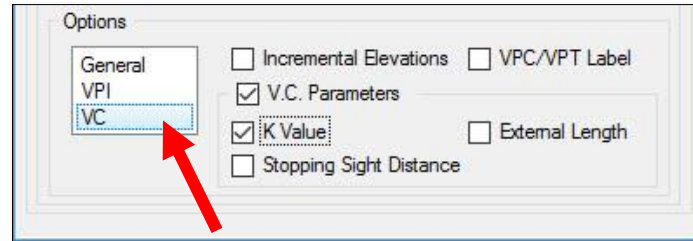


9. Select **VPI** and ensure that the VPI Labels and Grade Labels options are selected. The dropdown information is default based on the selected feature.

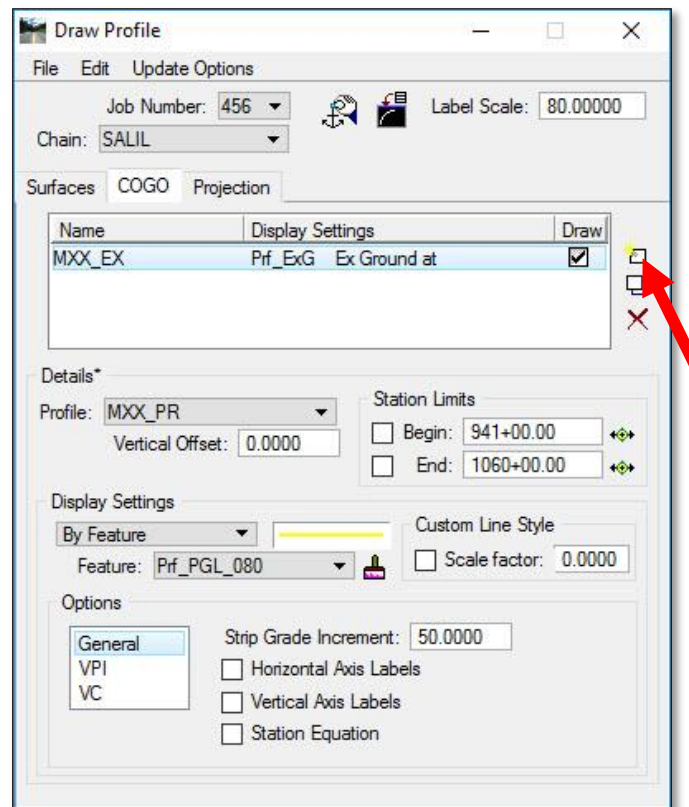




10. Select **VC** and ensure that the V.C. Parameters and K Value are selected.



11. Once the **Draw Profiles** dialog has been populated for the proposed profile, select the **Add COGO Profile Setting** icon. The proposed profile, as well as the vertical curve information and strip grades are displayed on the Profile Cell.

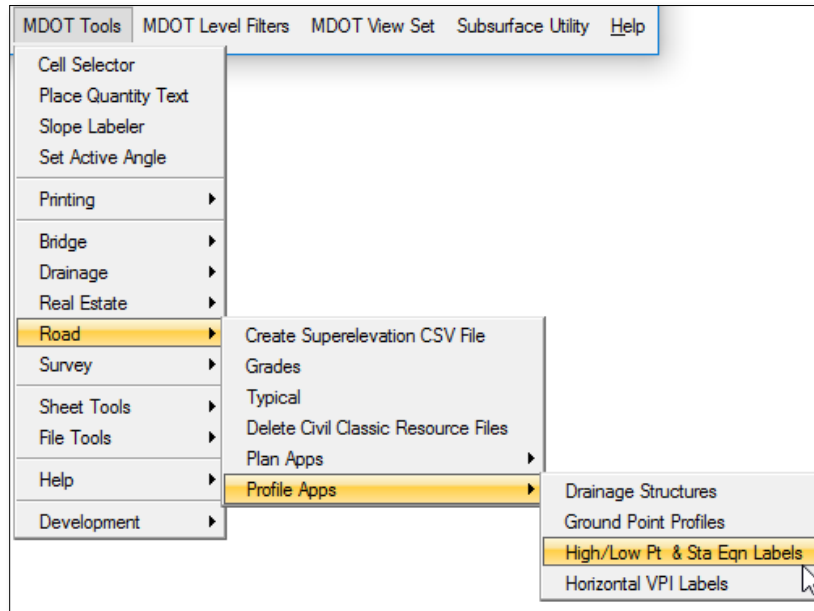




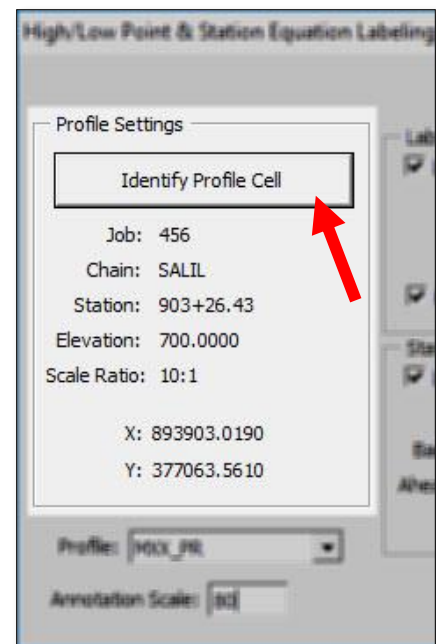
High/Low point & Sta Equation Labels

High and low points, as well as station equation labels, can be added to the proposed profile using the MDOT specific tool called **High/Low Pt & Sta Eqn Labels**.

1. Open the **High/Low Pt & Sta Eqn Labels** tool (**MDOT Tools** → **Road** → **Profile Apps** → **High/Low Pt & Sta Eqn Labels**).



2. Select **Identify Profile Cell** in the **Profile Settings** portion of the tool. Once selected, click on the profile cell in the DGN file. Left click within a window to accept the selection and add the profile cell information to the **Profile Settings**.





3. Select the desired proposed profile and enter the annotation scale for the text.

Y: 377063.5610

Profile:

Annotation Scale:

4. The **Label High/Low Points** and **Station Equations** prefixes are populated with the default MDOT naming conventions. The user can customize what is shown by modifying the selections or changing the Prefix or Suffix on each option.

Label High/Low Points

☒ Label Points

☒ Station Prefix:

☒ Elevation Prefix:

☒ HP/LP Prefix ☐ Horizontal

Station Equations

☒ Label Station Equations

Prefix: Suffix:

Back:

Ahead:

☒ Include Regions in the Label

5. When the dialog has been populated, select **apply** to label the High/Low points and Station Equations for the selected proposed profile.

High/Low Point & Station Equation Labeling

Version 3.0.0

Profile Settings

Job: 456

Chain: SALIL

Station: 903+26.43

Elevation: 700.0000

Scale Ratio: 10:1

X: 893903.0190

Y: 377063.5610

Profile:

Annotation Scale:

Label High/Low Points

☒ Label Points

☒ Station Prefix:

☒ Elevation Prefix:

☒ HP/LP Prefix ☐ Horizontal

Station Equations

☒ Label Station Equations

Prefix: Suffix:

Back:

Ahead:

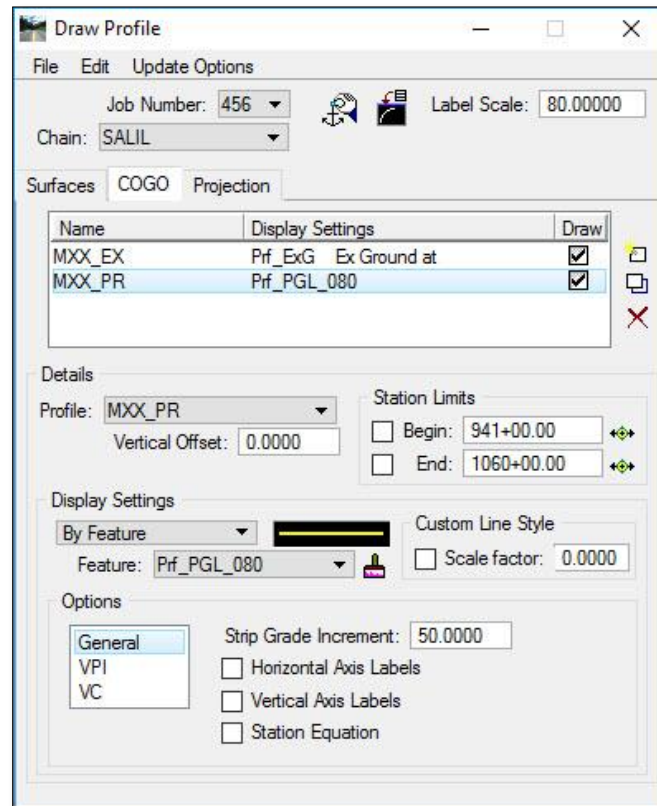
☒ Include Regions in the Label



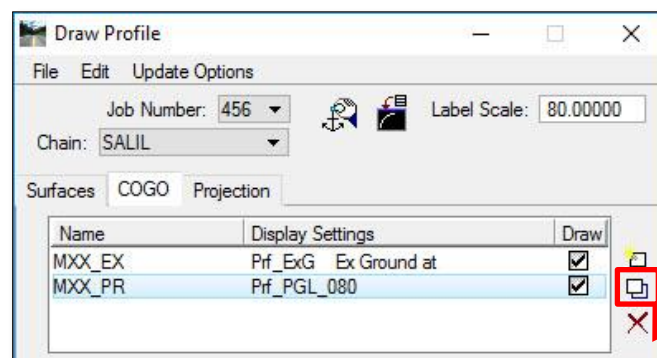
Updating Displayed Profiles

Profiles that are displayed utilizing the Draw Profiles tool are not dynamically linked to the GPK. If any updates are made and stored in the GPK after it has been displayed on the profile cell, it must be updated to account for the changes.

1. Select the profile to be modified from the **Draw Profile** dialog. If desired, make changes to the Details, Display Settings and Options portions of the dialog.



2. Select the **Modify COGO Profile Settings** icon to update the selected profile from the project GPK.



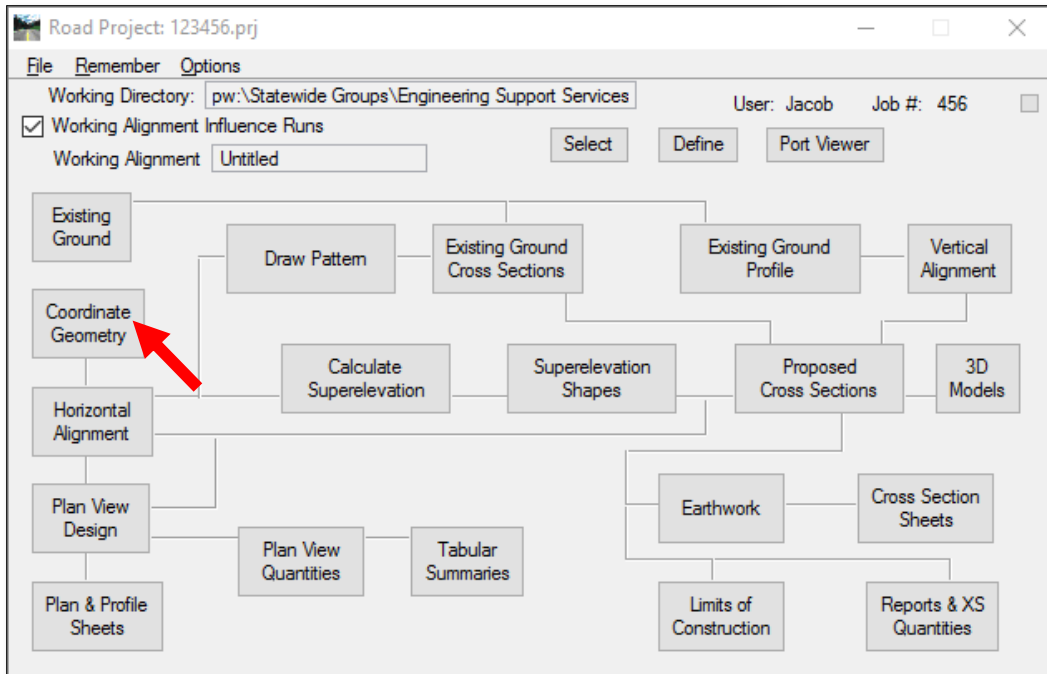


Reviewing Profile Information

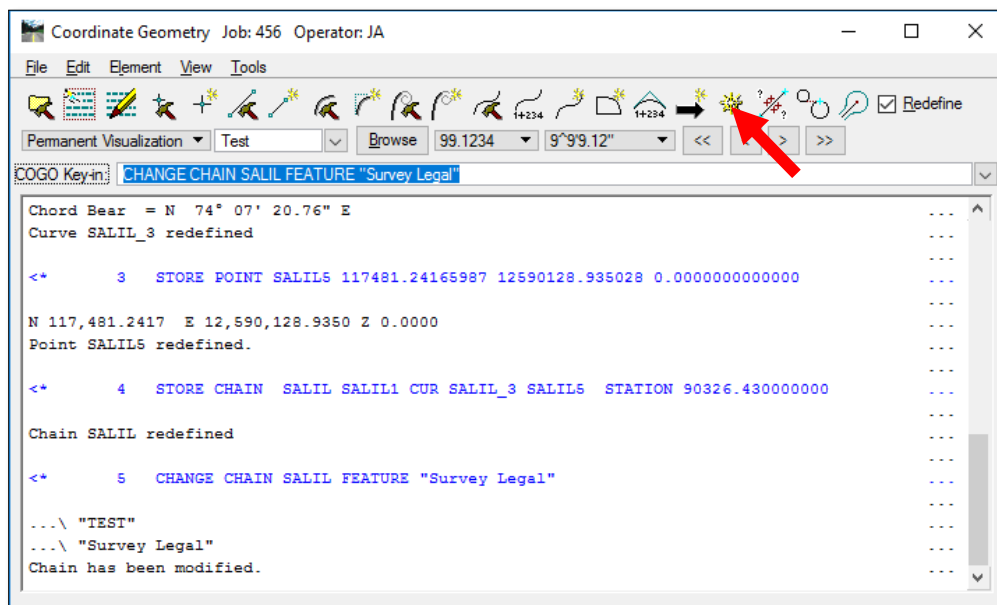
Print / Describe a Profile

The Print/Describe function for a profile stored in the GPK allows the complete description of a profile to be displayed in text format in the COGO window. Information includes all grade and vertical curve data.

1. To describe a desired profile that is stored in the project GPK file, open COGO by selecting **Coordinate Geometry** in the **Road Project** dialog.

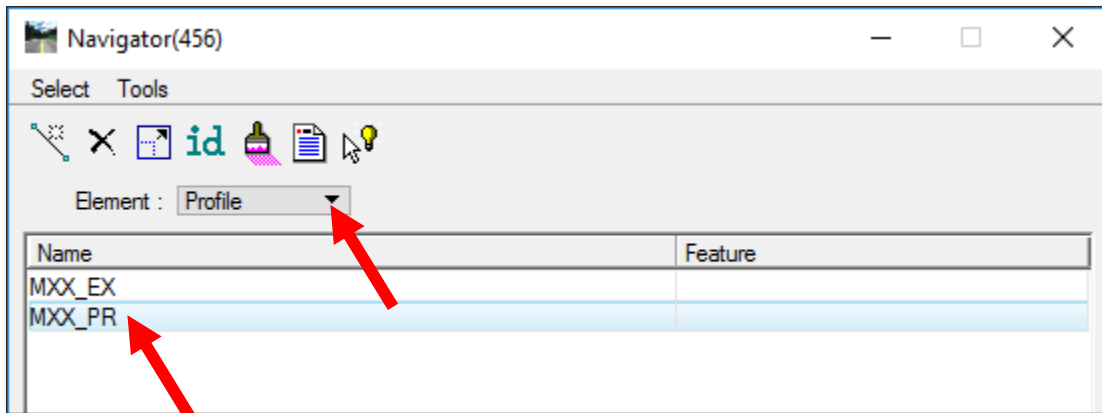


2. Open **Navigator** by selecting the **Navigator** icon on the COGO dialog.



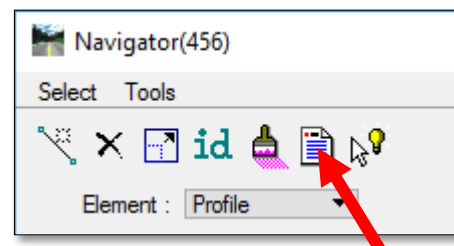


- Once in the **Navigator** dialog, select **Profile** from the Element dropdown. Select the desired profile to describe.



Note: This tool works best with proposed profiles. Existing profiles are developed from the project terrain file and do not include any curve information.

- Select the **Print/Describe** icon. The profile data will be shown in the COGO display window. To obtain a hardcopy print of the data displayed in the COGO window, first highlight the desired data to be printed, then right click and select Print from the menu.



Coordinate Geometry Job: 456 Operator: JS

File Edit Element View Tools

Redefine Permanent Visualization Test Browse 99.1234 9°9'9.12" << < > >>

COGO Key-in: PRINT PROFILE MXX_PR

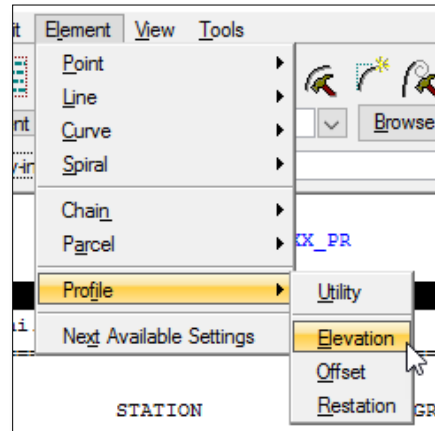
		STATION	ELEV	GRADE	TOTAL L	BACK L	AHEAD L
VPI	1	941+00.00	720.4388				
VPC		950+08.43	728.4397	0.8807	K = 159.7		
VPI	2	954+08.43	731.9627		800.0000	400.0000	400.0000
VPT		958+08.43	755.5200	5.8893			
VPC		961+07.03	773.1056	5.8893	K = 80.3	SSD = 326.7	
VPI	3	963+99.53	790.3319		585.0000	292.5000	292.5000
High Point		965+79.89	787.0297				
VPT		966+92.03	786.2465	-1.3967			
VPC		970+82.50	780.7928	-1.3967	K = 130.5		
Low Point		972+64.80	779.5197				
VPI	4	974+92.50	775.0663		820.0000	410.0000	410.0000
VPT		979+02.50	795.0978	4.8857			



Profile Elevation Analysis

Elevations along the proposed profile can be identified at any single station, or range of stations using the Profile Element tool through COGO for a proposed profile that is stored in the project GPK.

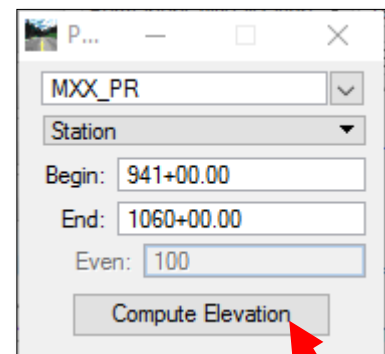
1. Open the COGO window from the Project manager.
2. To obtain Elevation Information at specific station or at a range of stations, in the COGO window box select **Element → Profile → Elevation**.



3. In the dialog that opens, select the desired profile from the dropdown
4. Under the **Station** dropdown select the desired analysis limits.
 - **Station:** Analysis at a single station
 - **Even Station:** Analysis at even stations
 - **Increment Stations:** Analysis at an entered increment

5. Enter the desired stationing limits based on the analysis limits selected.

6. Select **Compute Elevation**



7. The Elevation and location information will be displayed in the COGO window.



Technical Support

Please email any questions, issues or problems associated with this document to:

MDOT-EngineeringSupportTraining@Michigan.gov

Additional Design Services Help and Support can also be obtained through the following email resources:

MDOT-BridgeDesignSupport@Michigan.gov – For help with bridge design software, cells, levels, and workspace tools.

MDOT-Drainage-Utility@Michigan.gov – For help with GEOPAK Drainage, drainage cells and other subsurface utility modeling tools.

MDOT-CaddSupport@Michigan.gov – For help with cells, levels, line styles, dimensions, and other CADD and workspace tools.

MDOT-RoadwayModelingSupport@Michigan.gov – For help with roadway modeling, modeling templates, civil cells and workspace tools.

MDOT-Survey_Support@Michigan.gov – For help with survey data, workflows and processes.