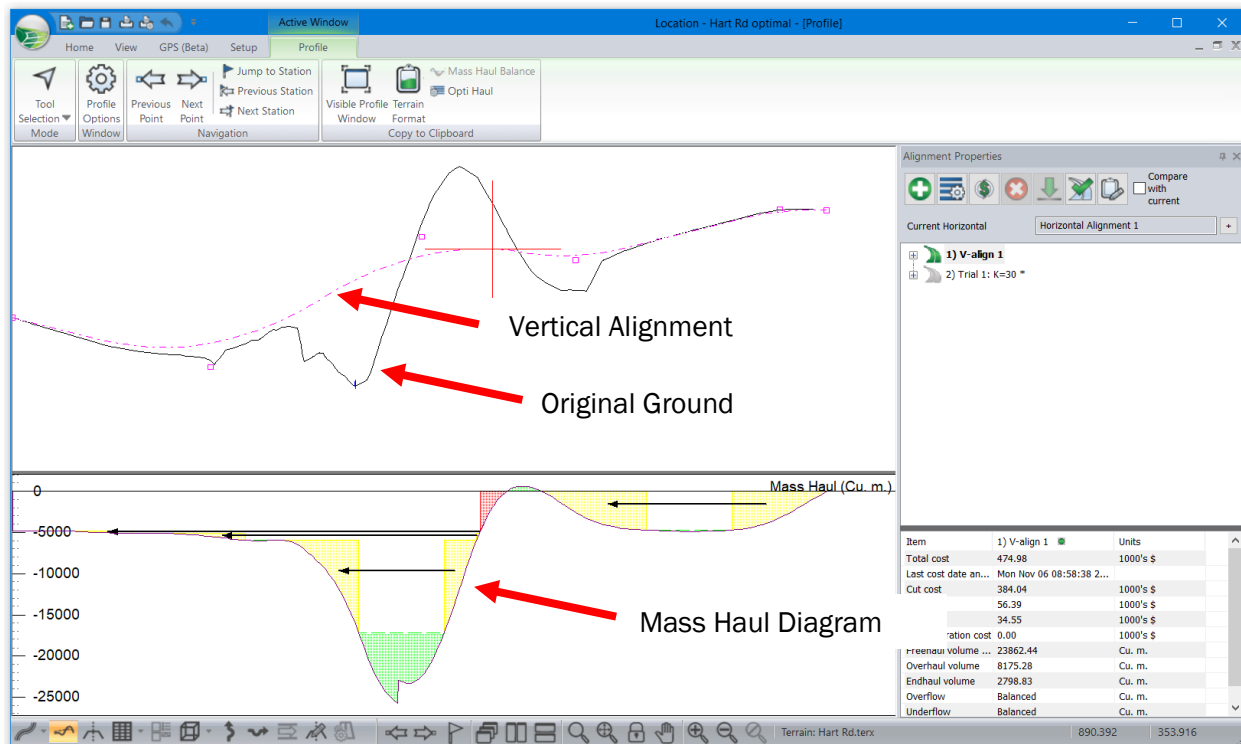


Getting Started

Optimizing a Vertical Alignment





Project File Background...

This file shows a vertical alignment (dot – dash magenta line) and the original ground is a black line. The alignment properties panel is open on the side. The sub-window displays a Mass Haul diagram.



The mass haul diagram is a graphical representation of accumulated volume of material that is cut or filled along the road alignment. The graph depicts the accumulated cut volume minus the accumulated fill volume for vertical station along the road.


The shaded areas in the graph represent the following:

	Free Haul	Material which is pushed or pulled a distance less than the <i>Free Haul distance</i> (100 ft.).
	Over Haul	Material moved beyond <i>Free Haul Distance</i> (100 ft.) and less than the <i>Overhaul Distance</i> (500 ft.).
	Borrow	Material which must be trucked in from outside the road project.
	Waste	Material which must be trucked outside the road project (End haul).

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Things you can do in this project:

Understand how Borrow or Waste Pits and the Mass Haul Diagram Works:

1. Enable the horizontal axis. *Right click* in Mass Haul Sub-Window | *Grid...* button | *check* Display Horizontal Axis.
2. *Home* | *Assign by Range* button one can see where the pits where the are located. These pits show up as vertical line on the Mass Haul diagram.
3. Bring up a section view . *View* | *Tile Vertically* button. Arrange your windows to look as they do in Figure 1.

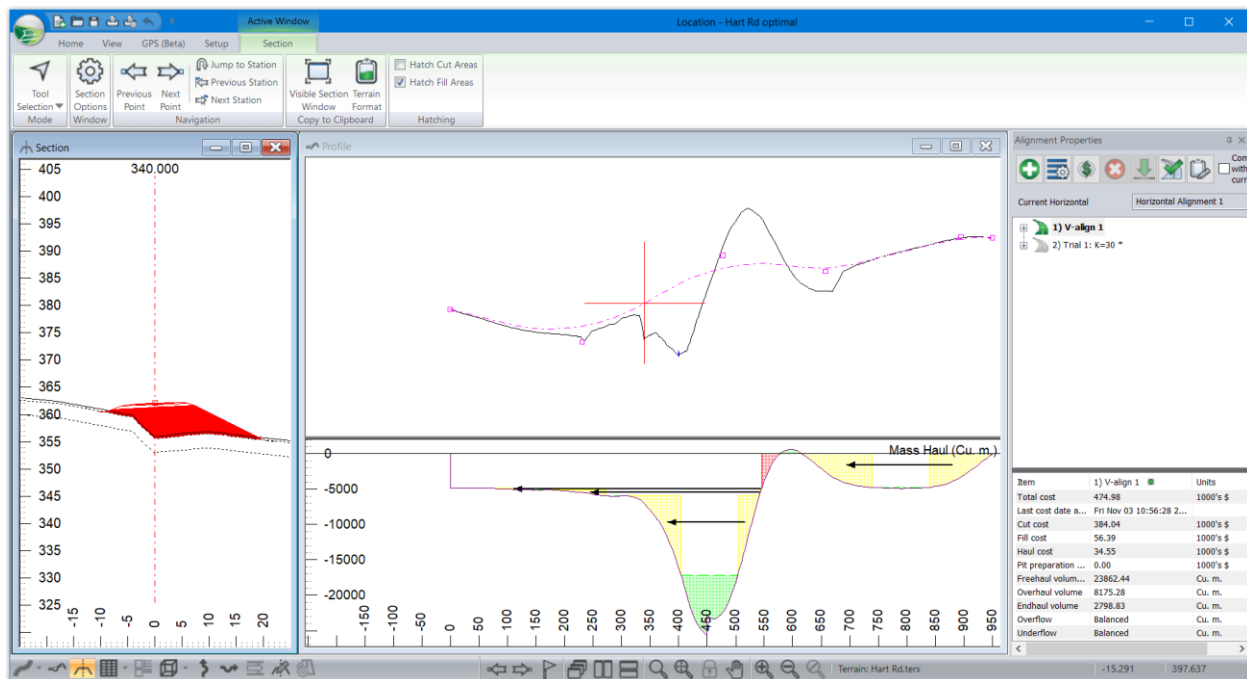





Figure 1 – Section View, Vertical Alignment and Alignment Properties Arranged Vertically


4. In the section window *right click* in the subgrade layer and select *Hatch fill area* for SG.
5. Click along the alignment one can see that up to station 450 the road will require fill. This is why the Mass Haul diagram is on the decline.
6. The yellow parts of the diagram and the arrows show that material is hauled from station 550 to build the first part of the road.

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Use the Optimizer to Determine the Best Fit Vertical Profile:

1. Left click on  1) V-align 1* .
2. Delete the existing vertical profile: *Home | Delete Range* button uncheck All Points, Only leave Profile (Vertical IPs) checked. Press *OK*. The profile should now be deleted.
3. Set the constraints of the alignment: Press the *Options* button  this opens the Vertical Optimization Options dialogue box.
4. Click on the Standards tab. In this first trial, we will use the default *Curves [Fast] Alignment Specification*. This will generate short vertical curves with no tangents between them. As the name suggests, this will solve quickly; you can experiment with the other options later.
5. Also within the Standards tab change the Minimum / Maximum grade to **-5** and **5** and the Curvature (minimum K) Sag/Crest to **60**. Be sure to press the *Add/Edit* button once you have made these changes.
6. Use the optimizer to get an optimal profile: Click on the *process* button , with *Optimal Profile (Softree Optimal required)* checked, press the *Process* button.
7. The optimal vertical profile will now appear on the screen in magenta.
8. Notice the total cost of this alignment.



Develop an Optimization New Trial:

1. In the *Alignment Properties* panel, press the *New* button  to open the *Vertical Optimization Options* dialogue box shown below.
2. Set up the Vertical Optimization Options as in Figure 2

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The screenshot shows the 'Vertical Optimization Options' dialog box with the 'General' tab selected. The 'Name' field contains 'Trial 2'. The 'Description' field contains 'K=40 Max/Min Grade = +/- 10'. The 'Station Range' section has 'All' checked, 'From' set to 0.000, and 'To' set to 950.291. The 'Sections sampled' section has 'All' unchecked, a '+' button, 'Spacing' set to 5.000, and 'Selected pts.' set to 192. The 'Vertical Control' section has 'Min. offset (m.)' set to -10.000, 'Max. offset (m.)' set to 10.000, and 'Vertical Band Center' set to 'Ground'. The 'Accuracy' section has 'Advanced' unchecked. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

Figure 2 – Vertical Optimization Options with the General tab selected


3. Change the K value: Select the *Standards* tab. Change the Curvature to **40** for Sag and Crest. Press *Add/Edit* button. Press *OK*.
4. Press the process button , with the *Optimal Profile* (Softree Optimal required) checked press the *Process* button.
5. One can see the total cost of this alignment in the Alignment Properties Panel.
6. Set Trial 2 to current alignment by pressing the *Set Current* button .
7. Click on *V-align 2: V-align 1 ** and click the box *compare with current*. One can see that building this road using a minimum K value of 30 is significantly less expensive.
8. If you click on *plus* button next to *V-align 2: V-align 1 **, then the *plus* button next to *Constraints* one can see the constraints for that trial.
9. If you have the time you may want to try another trial, starting from step 1, restricting the minimum and maximum grades set to **-5.0** and **+5.0**.

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10. To get more accurate total cost you may want to try changing the Unit Costs for materials:

Press the *Options* button . Press the *Unit Costs* tab and set the Costs as appropriate. Excavation are the costs to cut material. Embankment is the cost to fill material. Haul costs... are controlled using the *Haul costs...* button.

Add another Pit:

1. In the *Alignment Properties* panel, press the *New* button  to open the *Vertical Optimization Options* dialogue box shown below.
2. In the *Vertical Optimization Options* dialogue General tab, keep name as: Trial 2 Change description to: **Mandatory Gravel Pit at 650**
3. Click on the *Pits* tab. Press the *Add...* button. *Select Borrow, Unselect Variable* volume (smart pit), this means that the optimizer will have to use this pit.
4. Set the material to **GR**. Enter volume of **5000 Cu. m.**, and a site preparation cost of \$ **4000**.
5. Press OK to close the *Vertical Optimization Options*, update and re-cost.

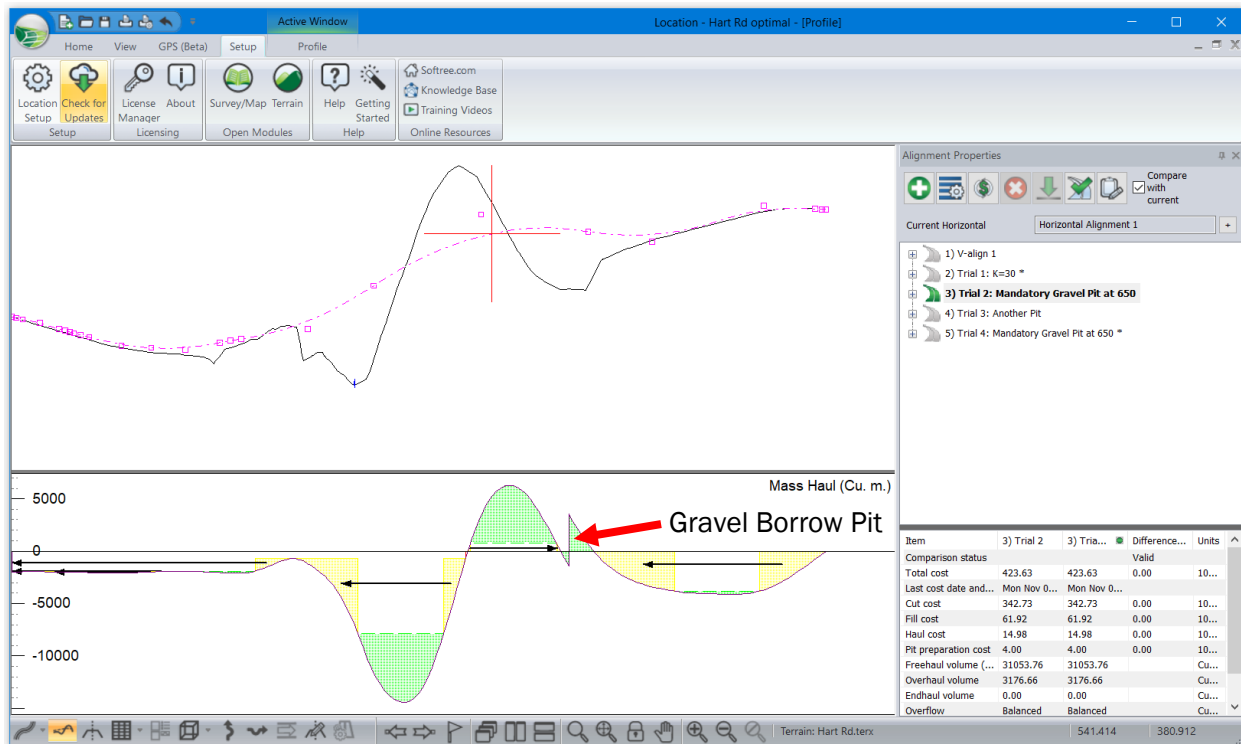


Figure 3 – Vertical Optimization after New (Non-Variable Volume) Pit Added

This trial is more expensive than not having this pit. If a the Variable volume (smart pit) box was checked the optimizer would not have used this pit at all, because the road is less expensive to build without it.