

Terrain Modifications

Cameron Ackerman, P.E., BC.WRE

USACE, Institute for Water Resources, Hydrologic Engineering Center





Overview

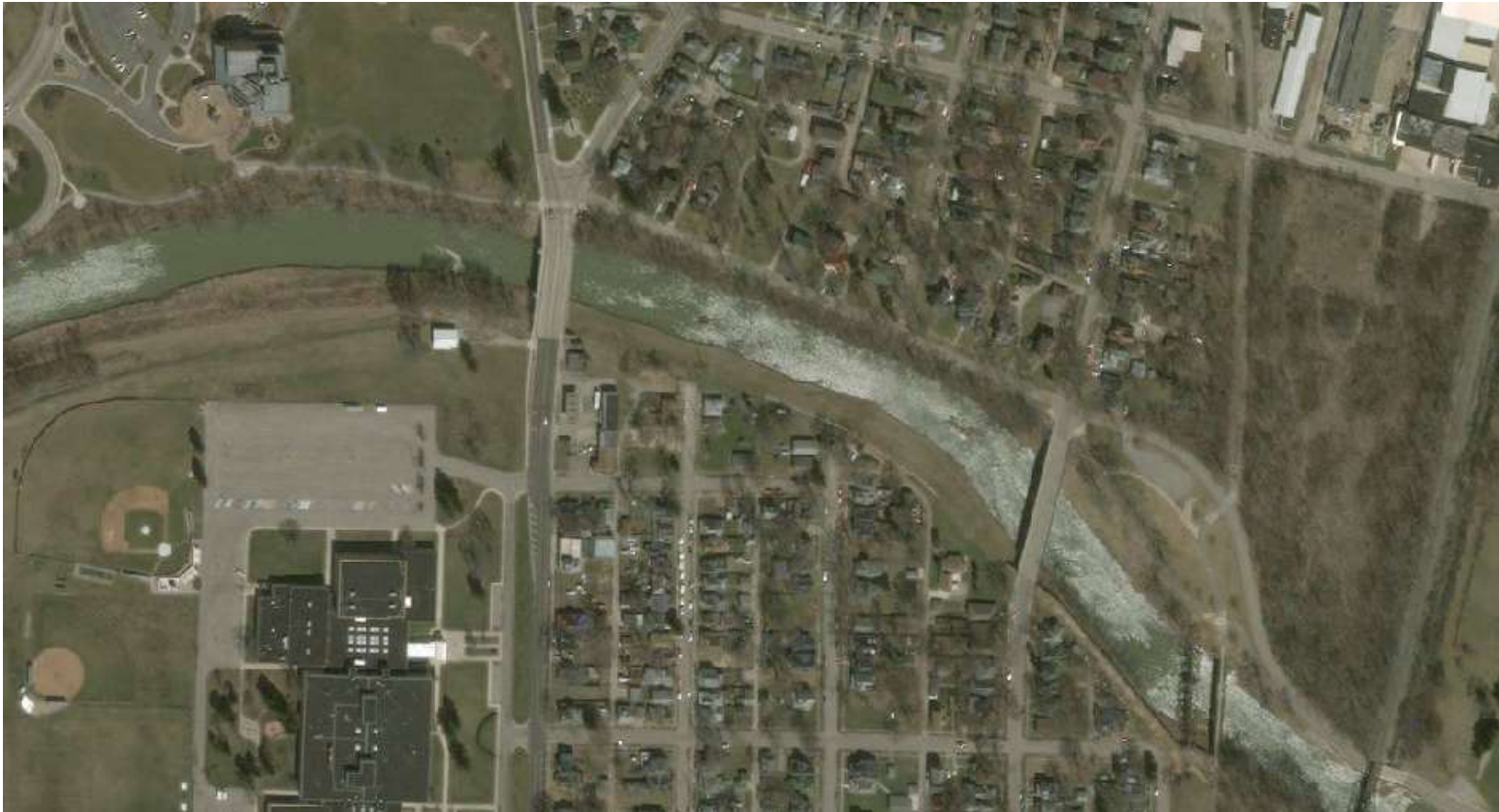
- Terrain Modifications using XS Surface
- Terrain Modifications using Vector Modifications
- National Levee Database (NLD)



Terrain Modifications using XS Surface

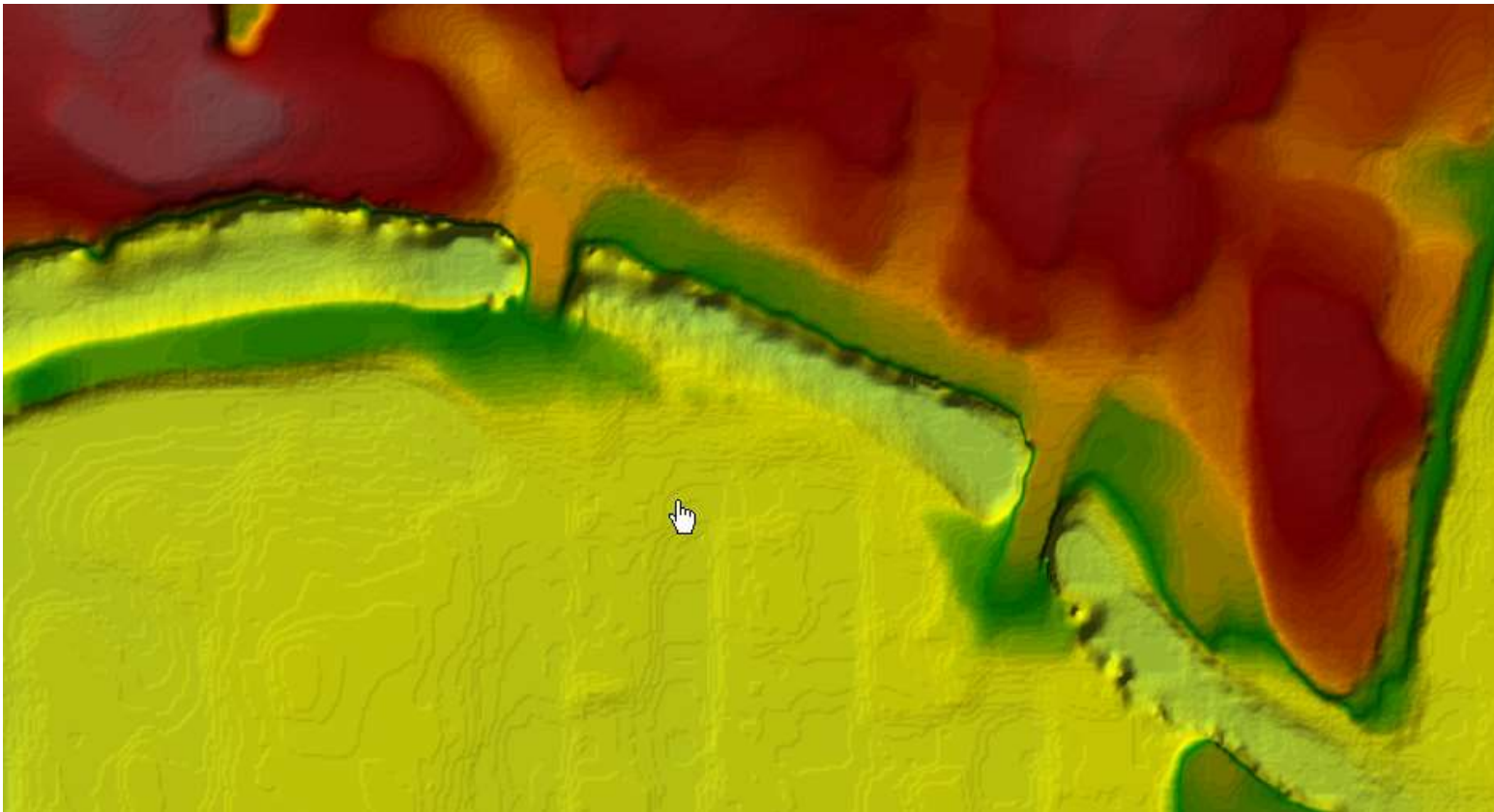
A red square icon containing a white silhouette of a castle with three towers.

XS Surface Example - Bridges



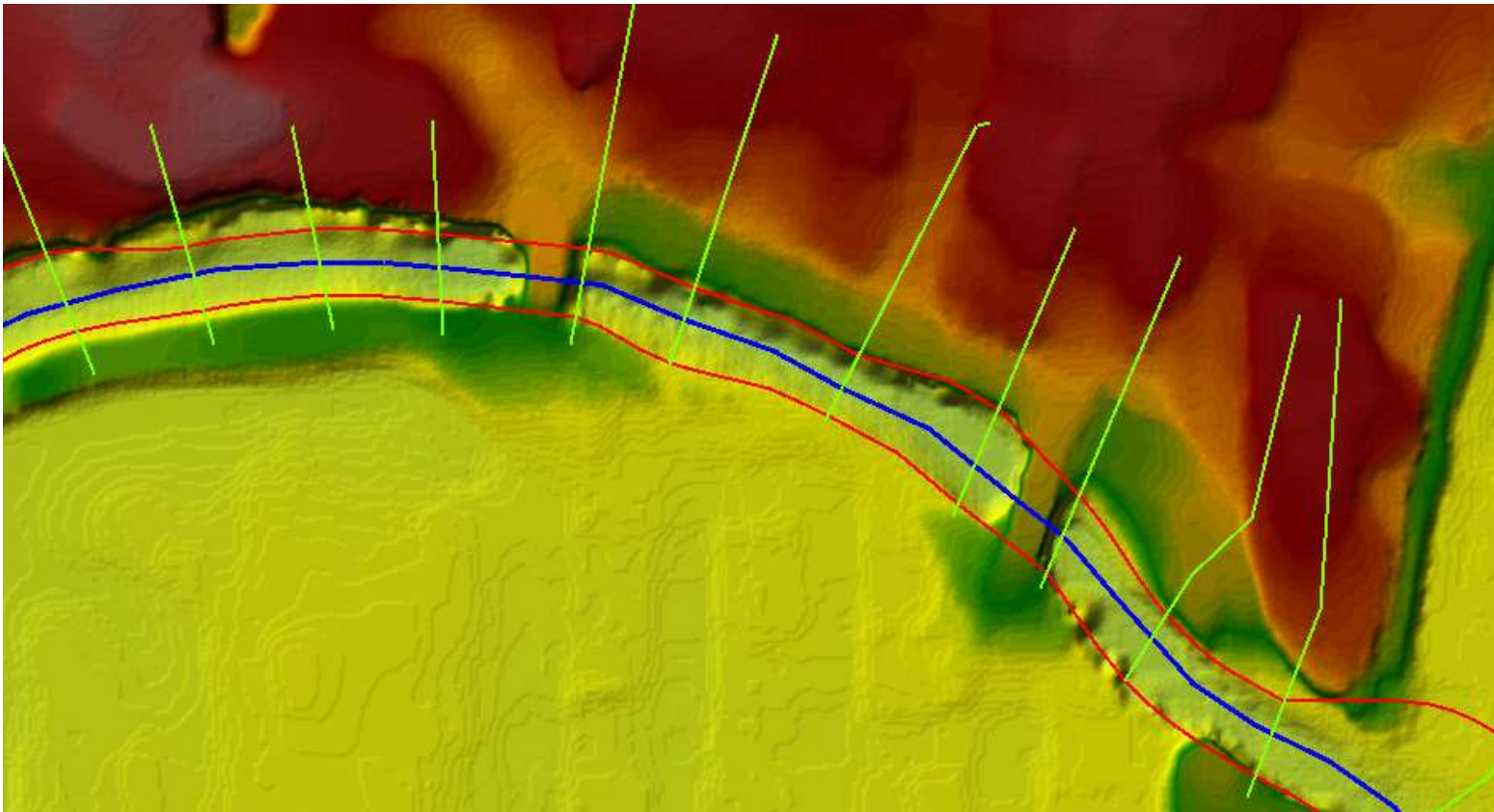
A small red icon of a castle or fortress.

XS Surface Example— Bridges in Terrain





XS Surface Example – Channel Cross Sections





XS Surface Example – Export Interpolated XS



The screenshot displays the HEC-RAS software interface. On the left, a tree view shows the project structure with 'Cross Sections' expanded. A context menu is open over the 'Cross Sections' layer, with 'Export Layer' selected. This opens a sub-menu with the following options:

- Create Terrain GeoTiff from XS's (Overbanks and Channel)
- Create Terrain GeoTiff from XS's (Channel Only)
- Create PointShapefile of XS-River Intersections
- Create Polygon Shapefile of Geometry Region
- Create Polygon Shapefile for XS Vegetation Regions

The 'Export Terrain' dialog box is also visible, titled 'Export Terrain' with a close button (X). It contains the text 'Enter raster cell size' and a text input field containing the value '1'. There are 'OK' and 'Cancel' buttons at the bottom right of the dialog.



XS Surface Example – Merge Terrain Data



New Terrain Layer

Set SRS ...

Input Terrain Files

	Filename	Projection	Cell Size	Rounding	Info
	ChannelOnly.tif	PROJCS["unnamed".GEOGCS["NAD83".DATU...	5	1/16	
	muncie_clip.ftl		5	(na)	

Output Terrain File

Rounding (Precision): 1/32 Create Stitches Merge Inputs to Single Raster

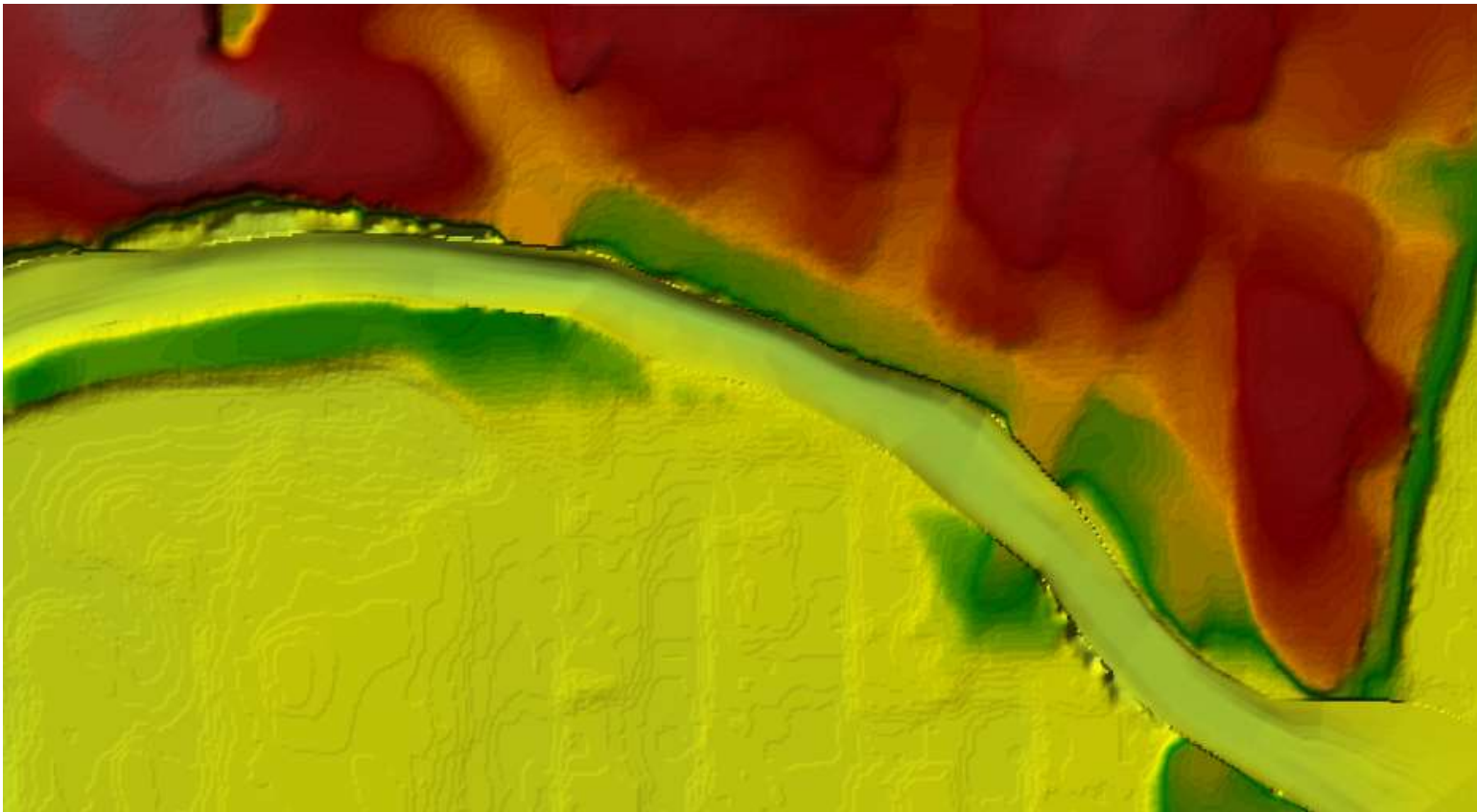
Vertical Conversion: Use Input File (Default)

Filename: C:\...q0heccta\Documents_Projects\RAS Examples\2D Examples\Muncie\TerrainMods\Terrain.hdf

Create Cancel

A small red square icon containing a white silhouette of a castle or fortification.

XS Surface Example – Final Terrain



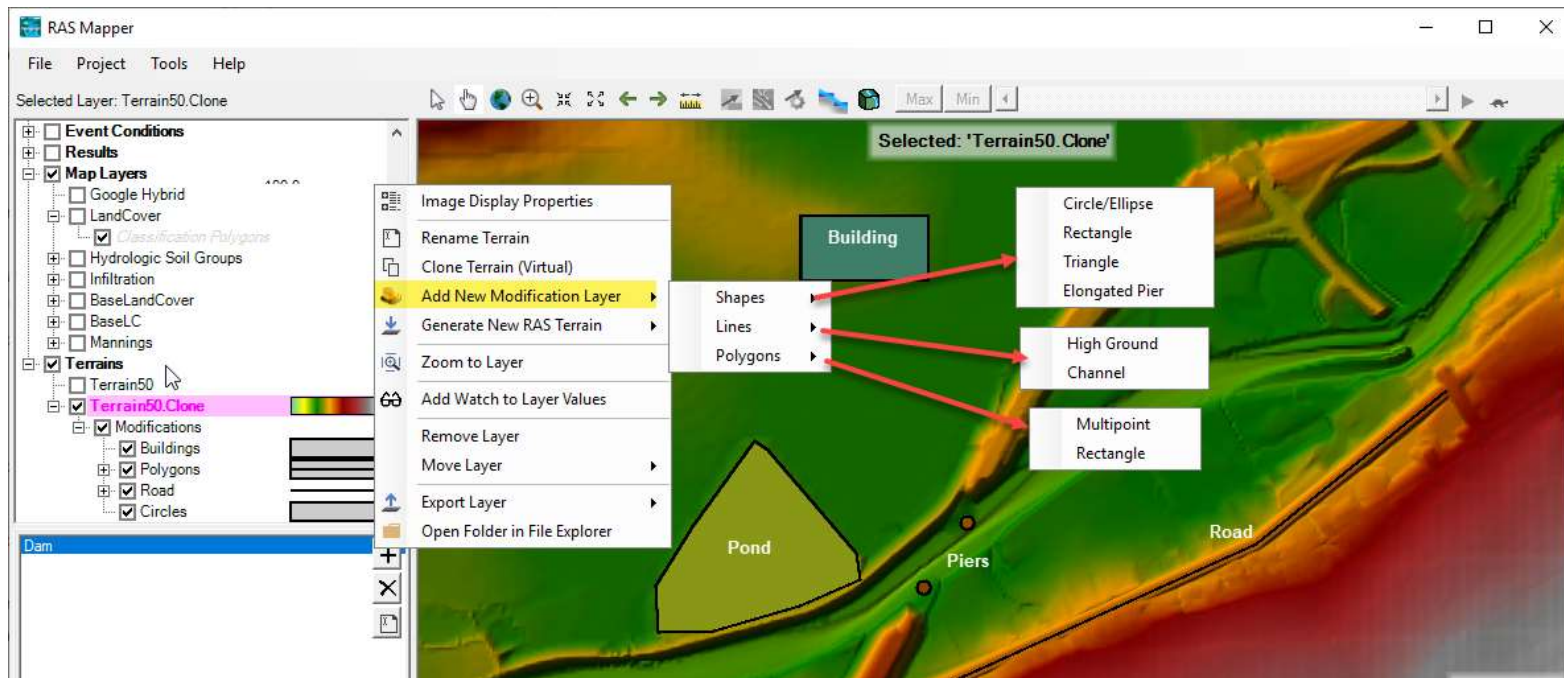


Terrain Modifications using Vector Modifications



Vector Terrain Modifications

- Vector Overrides to Terrain Layer
 - Simple Shapes (Piers), Lines (Channel, Roads, Levees), Polygons (Areas, Buildings)





Shapes - Piers



RAS Mapper

File Project Tools Help

Selected Layer: Piers

- Event Conditions
- Results
- Map Layers
 - Google Hybrid
 - LandCover
 - Classification Polygons
 - Hydrologic Soil Groups
 - Infiltration
 - BaseLandCover
 - BaseLC
 - Mannings
- Terrains
 - Terrain50
 - Terrain50.Clone
 - Modifications
 - Piers
 - Buildings
 - Polygons
 - Road

Dam

Views Profile Lines Active Features Layer Values

(2062826.51, 351720.64 1 pixel = 2.45 ft)

Pier Editor

Name: Pier 1

Modification Method: Replace Terrain Value

Elevation (ft): 575

Rotation Angle (Degrees): 44.7337

Width (ft): 20

Pier Shape

- Use Rectangular Body
- Use Pier Nose
- Use Pier Nose

Round

Sharp

Length (ft): 100

Radius (ft): 10

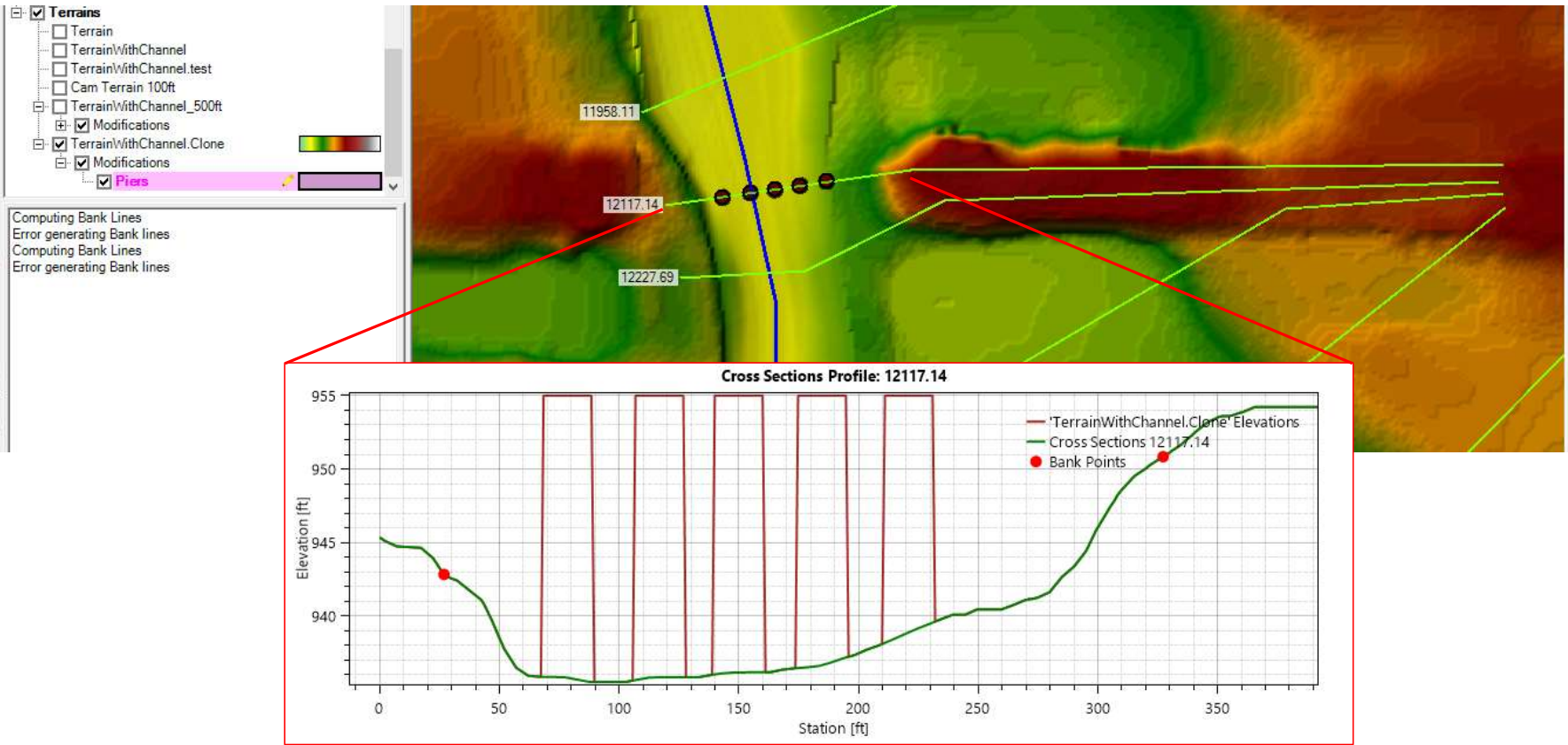
Length (ft): 10

OK Cancel Apply

500 ft

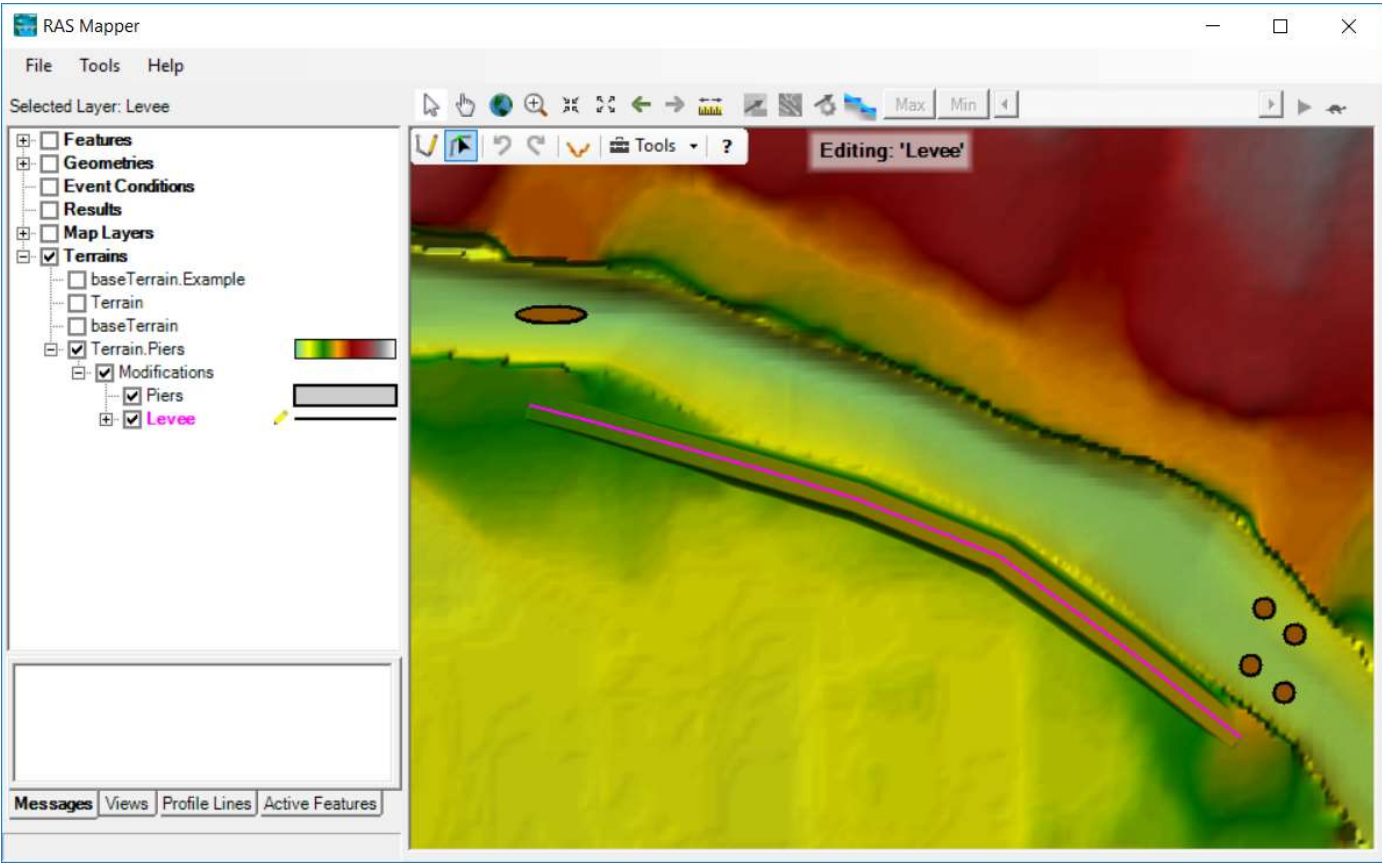


Terrain Modifications





Lines - High Ground





Lines – High Ground



Ground Line Editor

Name (Optional):

Modification Type:

Top Width:

Left Side Slope (H:V):

Right Side Slope (H:V):

Lateral Extent Limits:

Snapping Tolerance:

Polyline Length: 1161.64 (ft)

Station-Elevation

	X	Y
▶ 1	407417.38768188...	1804497.9113489...
2	407251.73357862...	1804628.6909041...
3	407065.73598900...	1804762.3766717...
4	406859.39491302...	1804846.65682952
5	406722.80293314...	1804887.3438022...
6	406469.962459758	1804959.9991106...
7	406379.86987728...	1804983.2488093...
*		

Plot

XS View

Plot | **Table**

Profile Plot

OK Cancel



Lines – Elevation Control Points



The screenshot shows the RAS Mapper interface. On the left is a tree view with the following structure:

- Features
- Geometries
- Event Conditions
- Results
- Map Layers
- Terrains
 - baseTerrain.Example
 - Terrain
 - baseTerrain
 - Terrain.Piers
 - Modifications
 - Piers
 - Levee
 - Control Points

The main map area shows a river channel with a brown line representing a levee. A dialog box titled "Elevation Needed" is open, containing the text "Enter the elevation for this elevation point" and a text input field with the value "941". The dialog has "OK" and "Cancel" buttons. At the bottom of the window, there are tabs for "Messages", "Views", "Profile Lines", and "Active Features". The status bar at the bottom left displays the coordinates "(406823.17, 1804841.66 1 pixel = 2.12 feet)".



Lines – Elevation Control Point



Ground Line Editor

Name (Optional):

Modification Type:

Top Width:

Left Side Slope (H:V):

Right Side Slope (H:V):

Lateral Extent Limits:

Snapping Tolerance:

Polyline Length: 1161.64 (ft)

Station-Elevation | X,Y Data

	Station	Elevation
1	0	943
2	143.51341941785...	944
3	269.12608846422...	944
▶ 4	400	942.5
5	800	942.5
6	823.32691655262...	941
7	970.59058152351...	941
8	1161.6400146484...	941
*		

Plot | Table

XS View

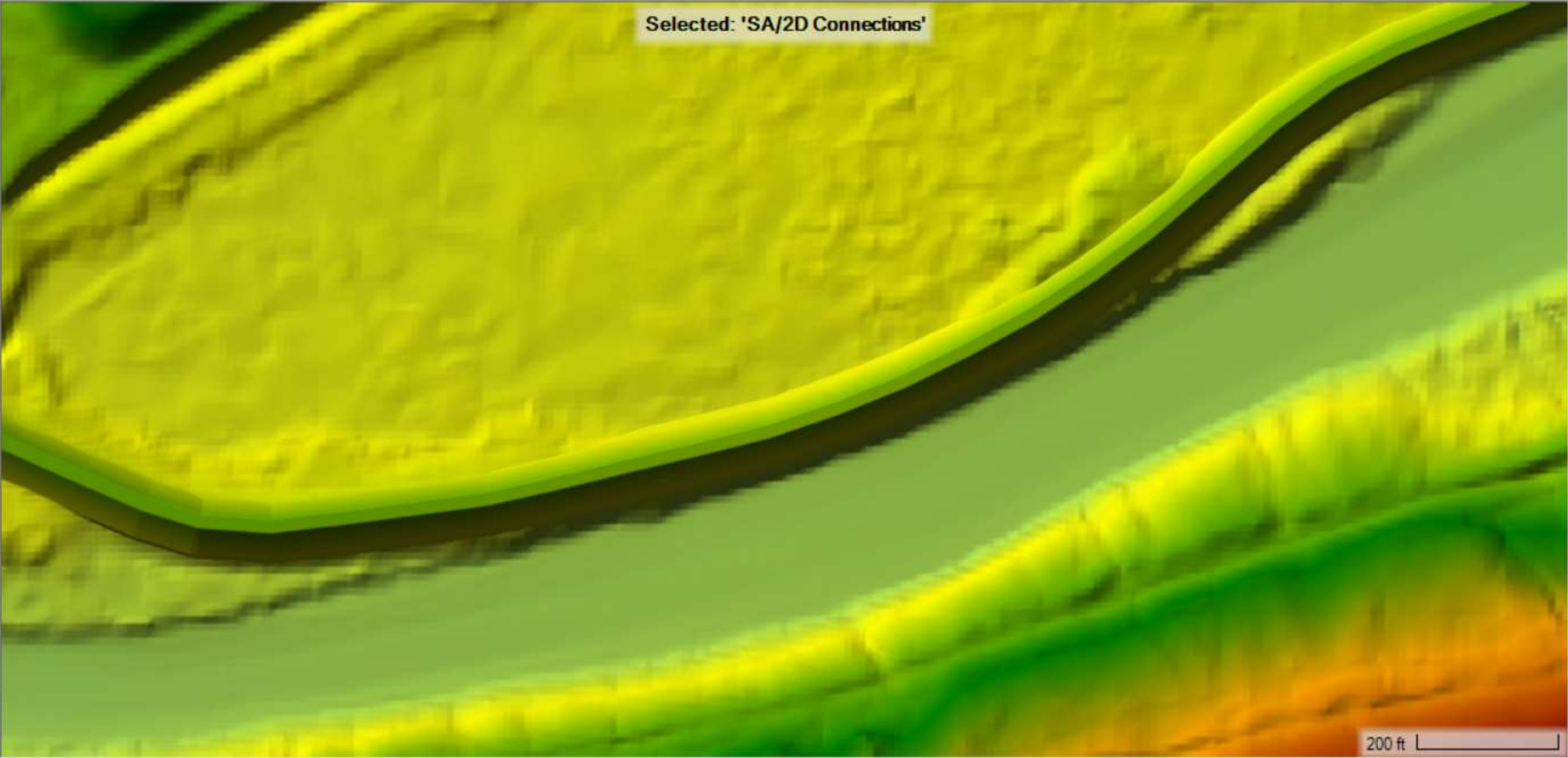
Profile Plot

OK Cancel

- Elevation control points shown in grey



Lines, Levee Lines





National Levee Database (NLD) Download Tool



NLD - Example



← National Levee Database

HOME ADVANCED SEARCH DASHBOARD MAP EXPLORE MORE SIGN IN

SYSTEMS DETAILS Start a new search DOWNLOAD DATA ?

5 System(s) Found

- Muncie Sanitary District - WPC facility
Location: Delaware , Indiana
- Muncie North Central Levee System
Location: Delaware , Indiana
- Muncie South Levee System
Location: Delaware , Indiana
- Muncie Northeast Levee System
Location: Delaware , Indiana
- Muncie Northwest Levee System
Location: Delaware , Indiana

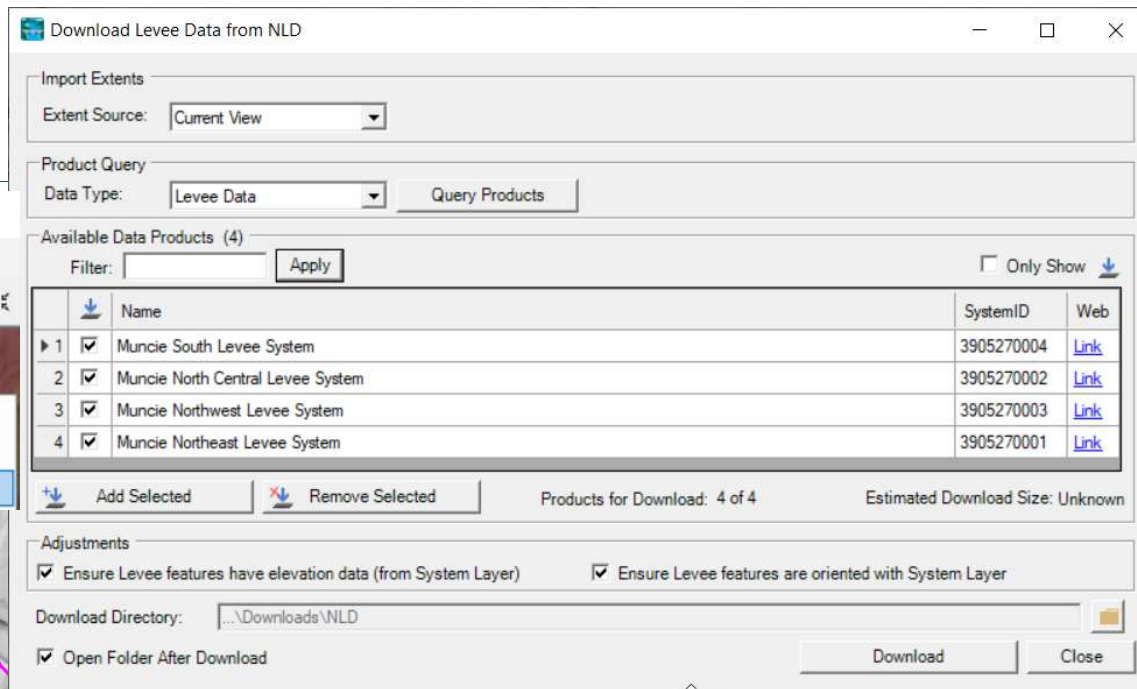
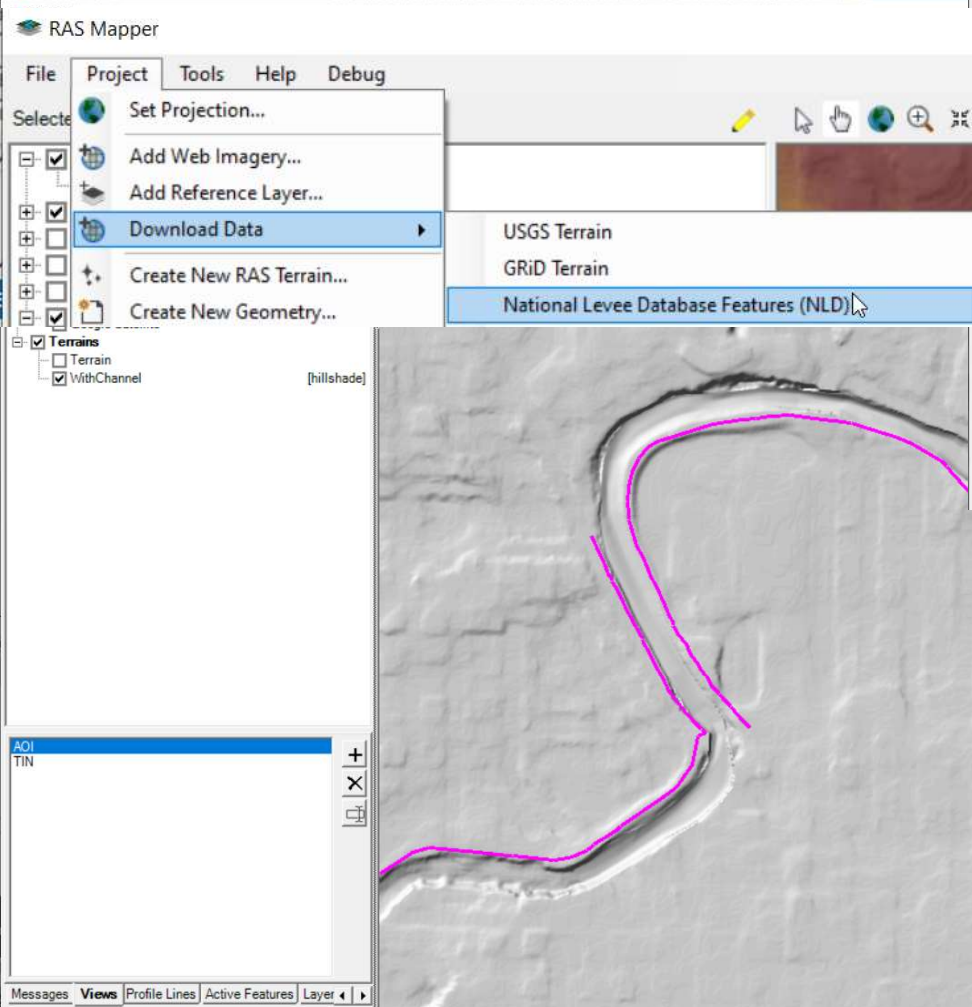
HIDE LIST Layer Controls

Tables (CSV)
Google Earth (ZIP)
Shapefile
GeoJSON
Full Tables (CSV)
Full Google Earth (ZIP)
Full Shapefile
Full GeoJSON

1000 ft 40.191630, -85.375241 16T FK 38303 50292



NLD - Download





NLD – All Data Features



RAS Mapper

File Project Tools Help Debug

Selected Layer: PumpStation

Selected: 'PumpStation'

Messages Views Profile Lines Active Features Layer

(403207.45, 1802774.58 1 pixel = 8.12 ft)

1000 ft

- Features
 - Profile Lines
 - Geometries
 - Plans
 - Event Conditions
 - Results
 - Map Layers
 - Land Cover
 - LandCoverUSGSGrid
 - LandCoverCombined
 - Google Satellite
 - NLD
 - PumpStation
 - RAS Merged Alignments
 - System
 - LeveeArea
 - Borehole
 - ClosureStructure
 - CrossSection
 - Floodwall
 - GravityDrain
 - Centerline
 - LeveeCrossing
 - LeveeStation
 - Pipe
 - PipeGate
 - OtherAlignments
- Terrains
 - Terrain
 - WithChannel

- Name
- Borehole.geojson
 - Centerline.geojson
 - ClosureStructure.geojson
 - CrossSection.geojson
 - Floodwall.geojson
 - GravityDrain.geojson
 - LeveeCrossing.geojson
 - LeveeArea.geojson
 - LeveeStation.geojson
 - OtherAlignments.geojson
 - Pipe.geojson
 - PipeGate.geojson
 - PumpStation.geojson
 - RAS Merged Alignments.dbf
 - RAS Merged Alignments.prj
 - RAS Merged Alignments.shp
 - RAS Merged Alignments.shx
 - System.geojson



NLD – Merged Features

RAS Mapper

File Project Tools Help Debug

Selected Layer: RAS Merged Alignments

- Features
 - Profile Lines
 - Geometries
 - Plans
 - Event Conditions
 - Results
 - Map Layers
 - Land Cover
 - LandCoverUSGSGrid
 - LandCoverCombined
 - Google Satellite
 - NLD
 - RAS Merged Alignments**
 - System
 - LeveeArea
 - Borehole
 - ClosureStructure
 - CrossSection
 - Floodwall
 - GravityDrain
 - Centerline
 - LeveeCrossing
 - LeveeStation
 - PumpStation
 - Pipe
 - PipeGate
 - OtherAlignments
- Terrains
 - Terrain
 - WithChannel

[hillshade]

Messages Views Profile Lines Active Features Layer

(407046.66, 1802206.41 1 pixel = 8.12 ft)

Symbology By Attribute Column

Column: Name

	Value	Point	Line	F
1	Data Gap			
2	floodwall			
3	levee			
4	high ground			
5	railroad			
6	closure			
7	road			

OK Cancel



Levee System Layer

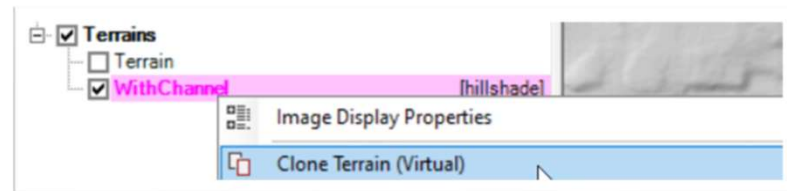


FID	SystemName	SystemID	Name	Width	Left Slope	Right Slope
▶ 0	Muncie South Levee System	3905270004	Data Gap			
1	Muncie South Levee System	3905270004	floodwall	1.8		
2	Muncie South Levee System	3905270004	floodwall	1.8		
3	Muncie South Levee System	3905270004	levee	9	3	3
4	Muncie South Levee System	3905270004	floodwall	1.5		
5	Muncie South Levee System	3905270004	high ground			
6	Muncie South Levee System	3905270004	levee	8	3	3
7	Muncie South Levee System	3905270004	high ground			
8	Muncie South Levee System	3905270004	railroad			
9	Muncie South Levee System	3905270004	floodwall			
10	Muncie South Levee System	3905270004	floodwall	1.6		
11	Muncie South Levee System	3905270004	closure			
12	Muncie South Levee System	3905270004	floodwall	1.6		
13	Muncie South Levee System	3905270004	levee	12	3	3
14	Muncie South Levee System	3905270004	floodwall	1.7		
15	Muncie South Levee System	3905270004	levee	16	3	3
16	Muncie South Levee System	3905270004	high ground			

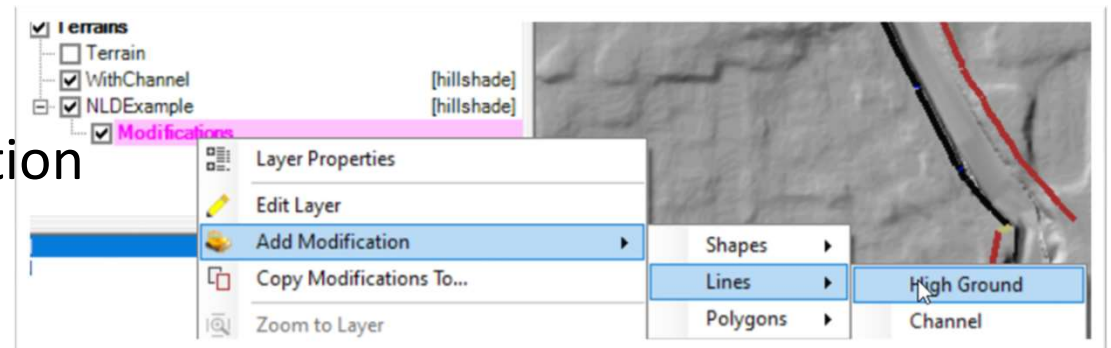


Using NLD for Terrain Modification

1. Clone Terrain



2. Add High Ground Modification



3. Import Features (Merged Layer)
Right-click on modification group while in Edit mode



High Ground Modification

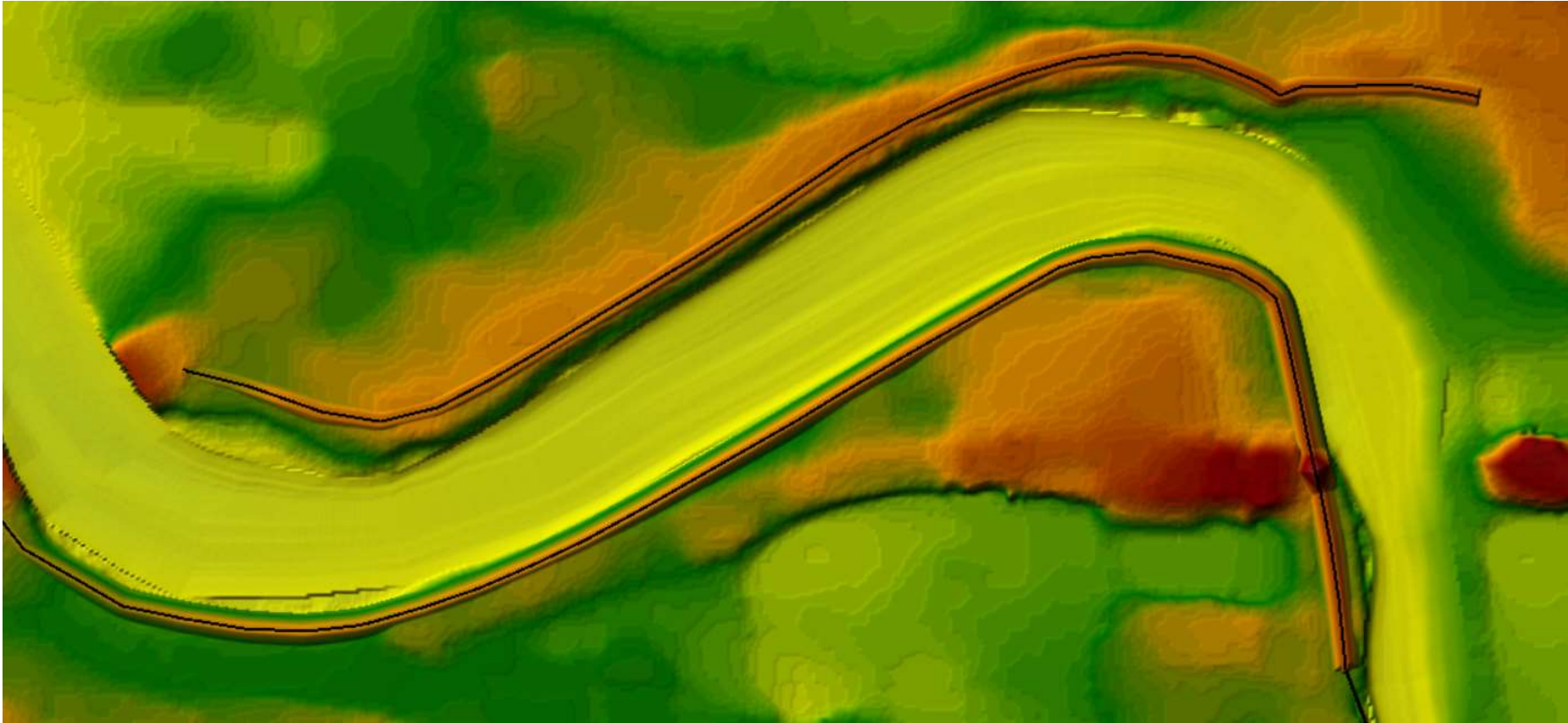


FID	SystemName	Name	Elevation Type	Width	Left Slope	Right Slope	Max Extent	Transition Percent	Elev Pt Tolerance	Computed System Name	Profile
0	Muncie South Levee System	Data Gap	TakeHigher					1	50	Muncie South Levee System	(2 Points)
1	Muncie South Levee System	floodwall	TakeHigher	1.8	0.1	0.1	7.2	1	50	Muncie South Levee System	(10 Points)
2	Muncie South Levee System	floodwall	TakeHigher	1.8	0.1	0.1	7.2	1	50	Muncie South Levee System	(4 Points)
3	Muncie South Levee System	levee	TakeHigher	9	3	3	36	1	50	Muncie South Levee System	(10 Points)
4	Muncie South Levee System	floodwall	TakeHigher	1.5	0.1	0.1	6	1	50	Muncie South Levee System	(7 Points)
5	Muncie South Levee System	high ground	TakeHigher					1	50	Muncie South Levee System	(2 Points)
6	Muncie South Levee System	levee	TakeHigher	8	3	3	32	1	50	Muncie South Levee System	(17 Points)
7	Muncie South Levee System	high ground	TakeHigher					1	50	Muncie South Levee System	(2 Points)
8	Muncie South Levee System	railroad	TakeHigher					1	50	Muncie South Levee System	(10 Points)
9	Muncie South Levee System	floodwall	TakeHigher	2	0.1	0.1	8	1	50	Muncie South Levee System	(3 Points)
10	Muncie South Levee System	floodwall	TakeHigher	1.6	0.1	0.1	6.4	1	50	Muncie South Levee System	(10 Points)
11	Muncie South Levee System	closure	TakeHigher	2	0.1	0.1	8	1	50	Muncie South Levee System	(2 Points)
12	Muncie South Levee System	floodwall	TakeHigher	1.6	0.1	0.1	6.4	1	50	Muncie South Levee System	(5 Points)
13	Muncie South Levee System	levee	TakeHigher	12	3	3	48	1	50	Muncie South Levee System	(15 Points)
14	Muncie South Levee System	floodwall	TakeHigher	1.7	0.1	0.1	6.8	1	50	Muncie South Levee System	(7 Points)

- Flood walls and closure structure defaults – 2ft width, 0.1 side slopes
- “Levee System” is computed – allows for continuous interpolation from segment to segment



Modification Example





High Ground Line Editor

Ground Line Editor

Name: levee

Modification Method: Higher (Terrain/User) Value

Top Width (ft): 16

Left Side Slope (H:V): 3

Right Side Slope (H:V): 3

Max Extent Width (ft): 64

Control Point Snapping Distance (ft): 50

Polyline Length: 3190.00 (ft)

Station-Elevation | X,Y Data

	Station	Elevation
1	0	948.43
2	0.93	948.47
3	3.70	949.04
4	3.70	949.04
5	130.65	949.18

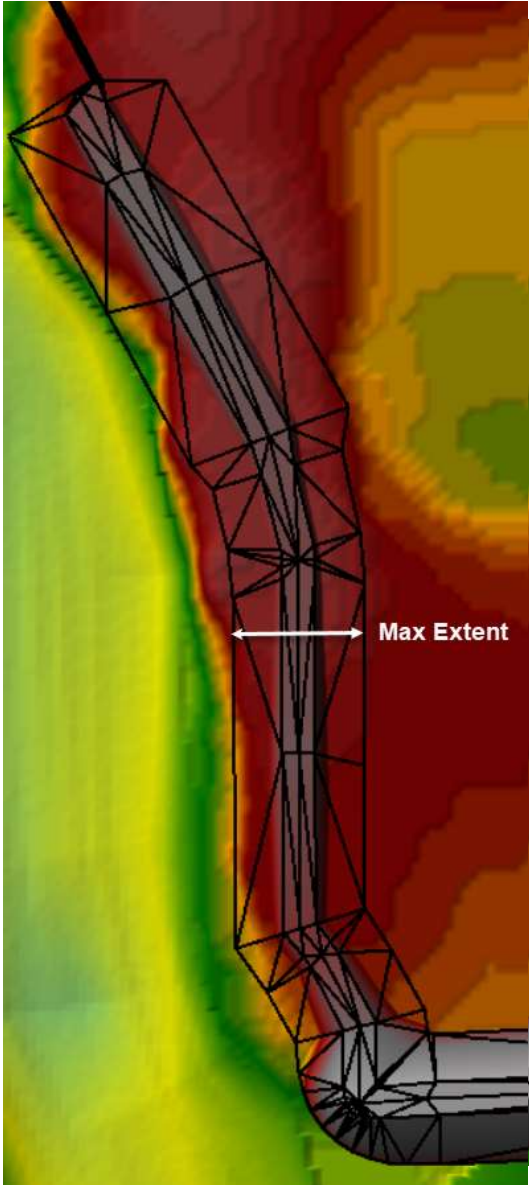
Update Terrain and Plots On Data Change

Plot Plot Terrain

XS View

Profile Plot


OK Cancel





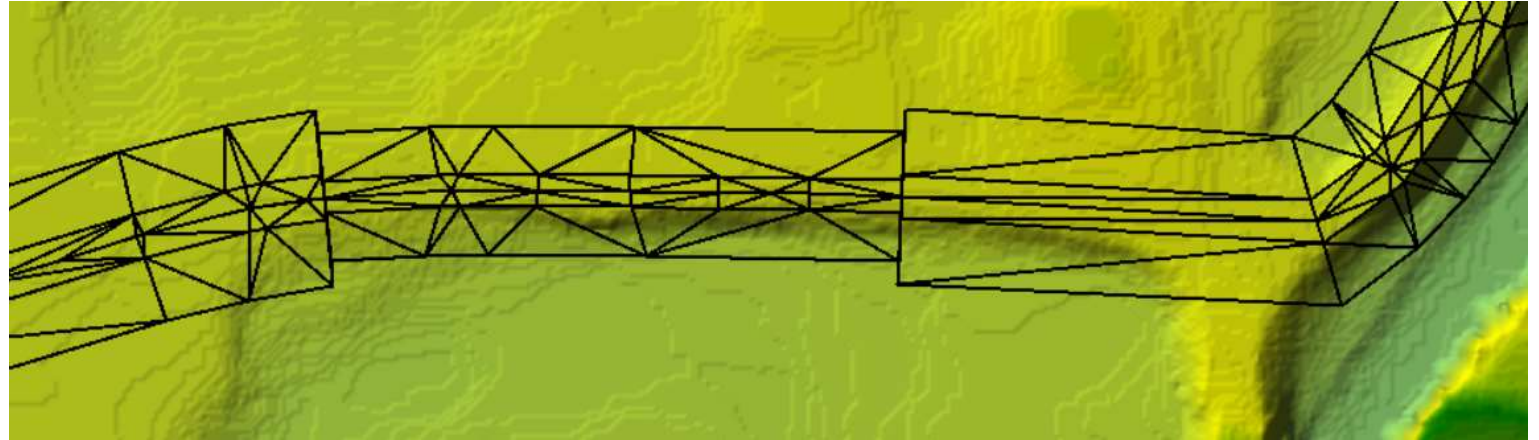
Interpolation along Line Modification



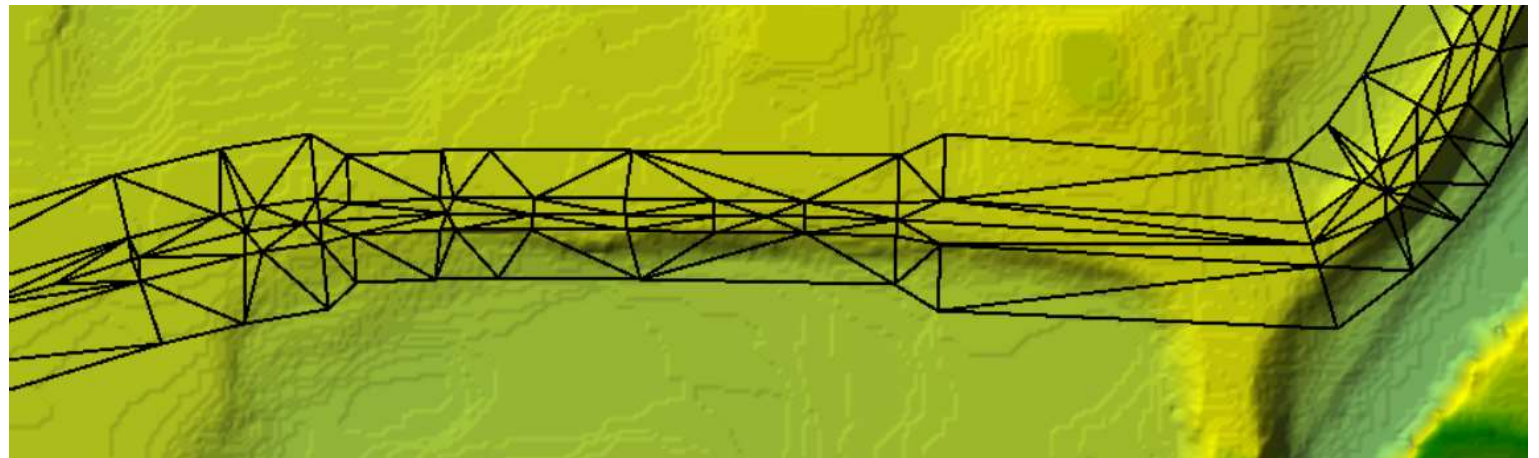


Interpolation – Feature Transition

- None



- Some

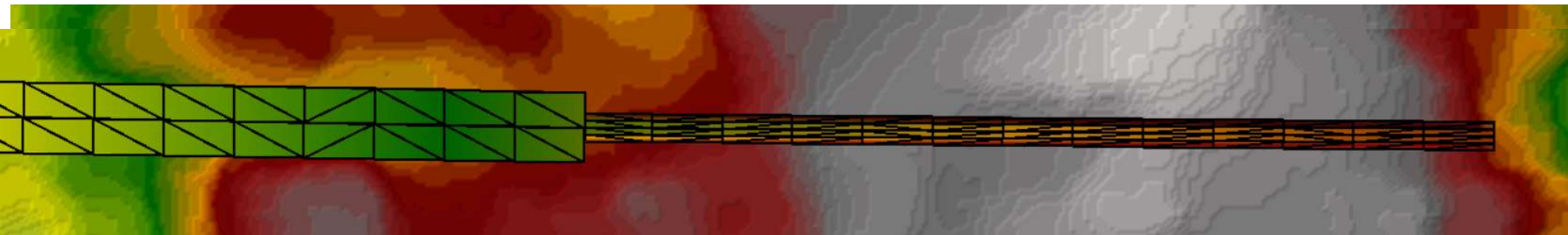




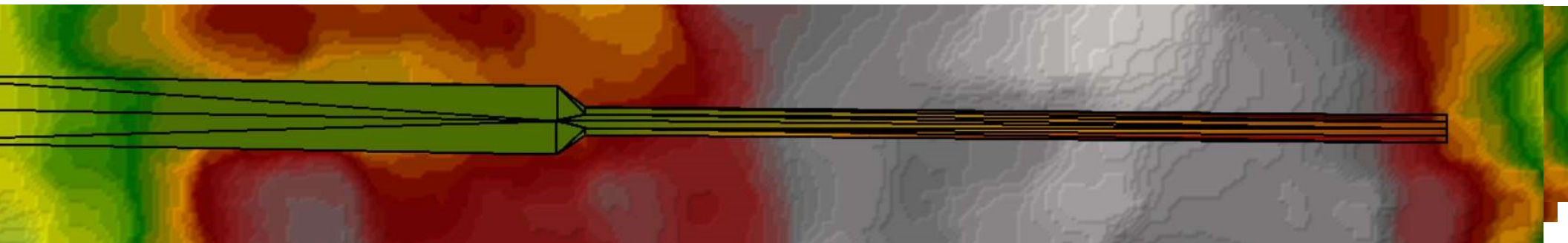
Interpolation – System Name



FID	SystemName	Name	Elevation Type	Width	Left Slope	Right Slope	Max Extent	Transition Percent	Elev Pt Tolerance	Computed System Name
0		Channel 2	TakeLower	20	4	4	40	2	50	
1		Channel 3	TakeLower	100	4	4	100	0	50	



FID	SystemName	Name	Elevation Type	Width	Left Slope	Right Slope	Max Extent	Transition Percent	Elev Pt Tolerance	Computed System Name
0	fakeit	Channel 2	TakeLower	20	4	4	40	2	50	fakeit
1	fakeit	Channel 3	TakeLower	100	4	4	100	1	50	fakeit





Terrain Modification – Focus Areas

- Triangulation
 - Fast
 - Reliable
 - Provide limited user controls
- Rendering
 - Fast
- Consideration for expansive use of new capability
 - Handle good people doing “bad” things 😊

Questions?

