

Refining an HEC-RAS Model

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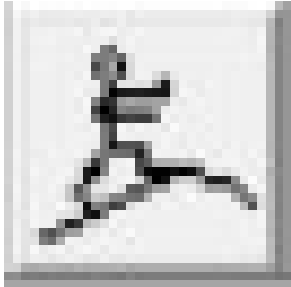
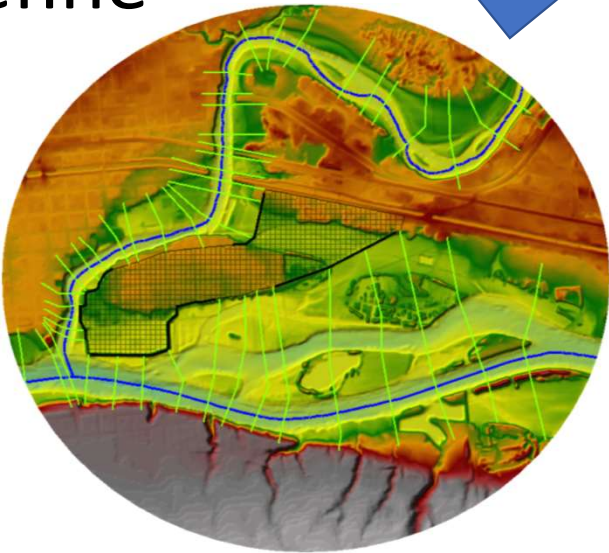




HEC-RAS Modeling Life Cycle

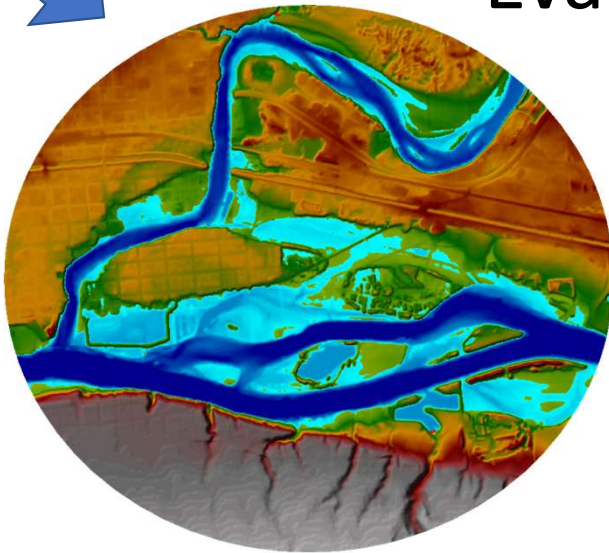


Refine



Run

Evaluate





Overview

- Breaklines and 2D Connections
- Terrain Modifications
- National Levee Database (NLD)
- Manning's n and Land Cover (NLCD)
 - Channel Refinement
 - Classification Polygons



Breaklines and 2D Connections



Breaklines and 2D Connections





Breaklines and 2D Connections



Connection Data Editor - Upper Levee w Terrain

File View Options Help

Connection: Lower Levee [Apply Data]

Description: [Breach (plan data) ...]

Connections

From: 2D Flow Area: BaldEagleCr [Set SA/2D ...] Weir Length: 15779.99

To: 2D Flow Area: BaldEagleCr [Set SA/2D ...] Centerline Length: 15779.99

Overflow Computation Method

Normal 2D Equation Domain Use Weir Equation [Centerline GIS Coords...]

Structure Type: Weir, Gates, Culverts, Outlet RC and Outlet TS [Cut profile from terrain ...]

Flap Gates: No Flap Gates [Clip Weir Profile to 2D Cells...]

Weir / Embankment

Gate

Culvert

Outlet RC

Outlet TS

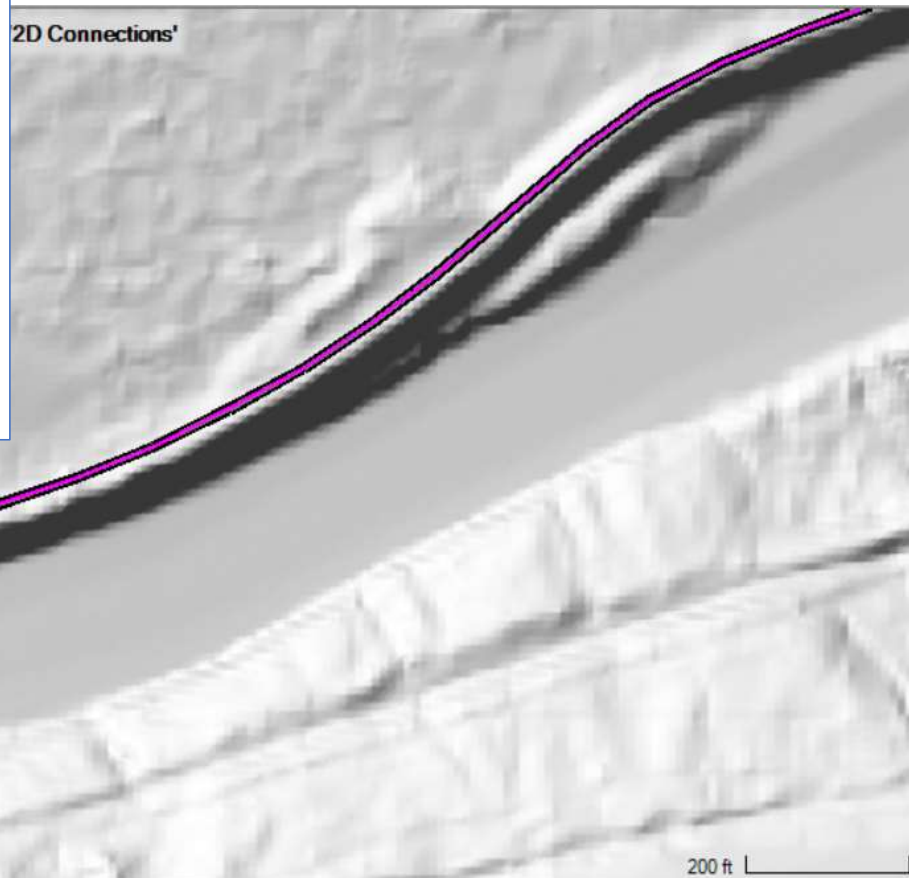
Lower Levee

Elevation (ft)

Station (ft)

Legend

- Spillway
- Extend/Trim to Face Points
- Current Terrain



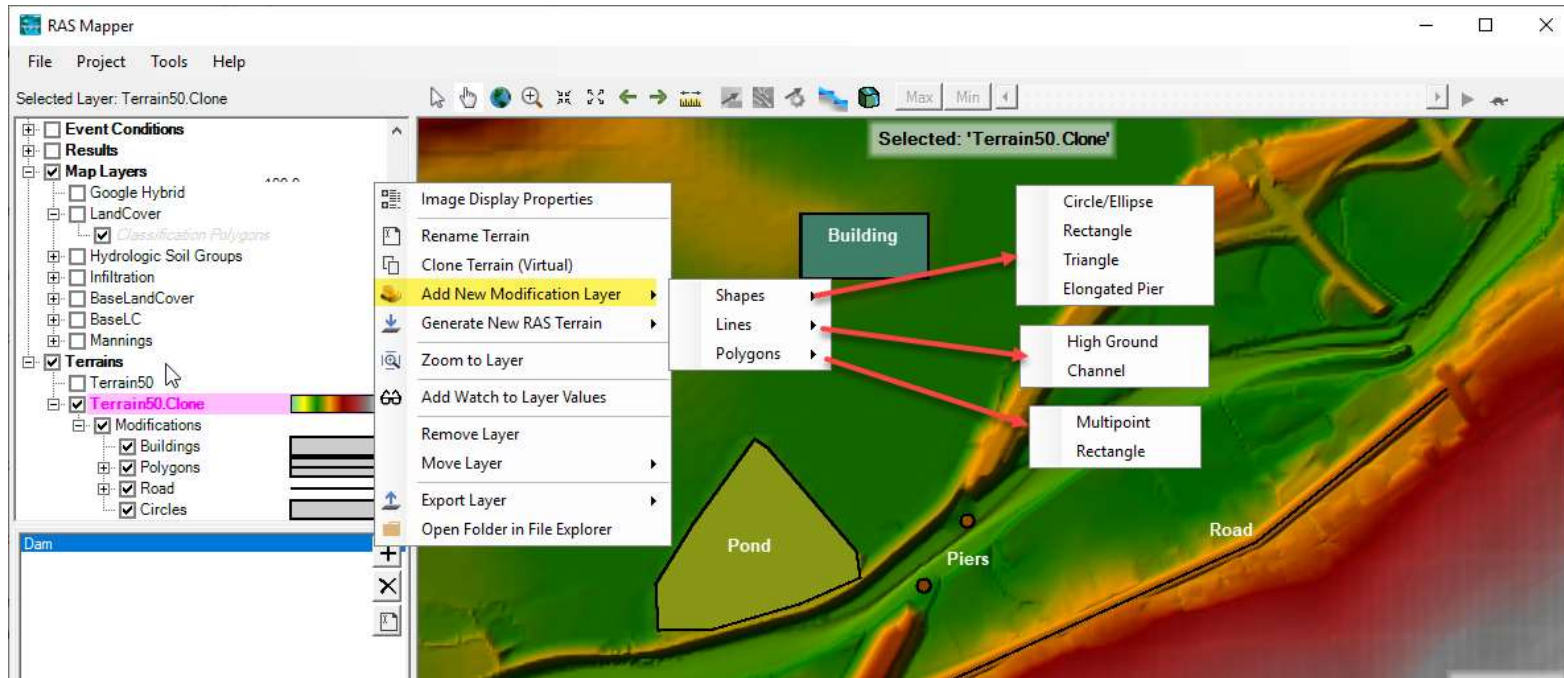


Terrain Modifications



Terrain Modifications

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





Shapes - Piers



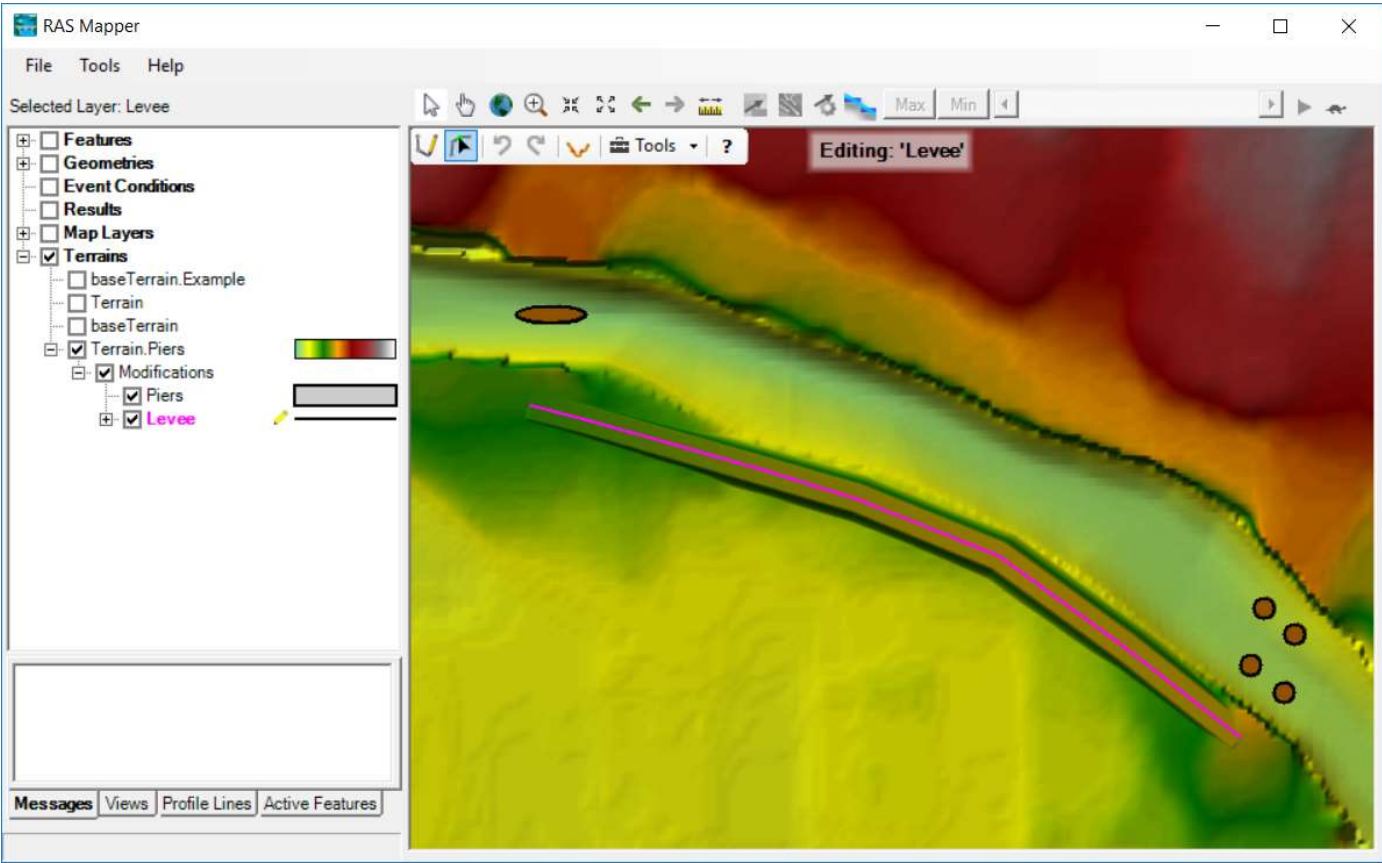
The screenshot shows the RAS Mapper interface with the Pier Editor dialog box open. The dialog box is titled "Pier Editor" and contains the following fields and options:

- Name: Pier 1
- Modification Method: Replace Terrain Value
- Elevation (ft): 575
- Rotation Angle (Degrees): 44.7337
- Width (ft): 20
- Pier Shape section:
 - Use Rectangular Body
 - Use Pier Nose (Round)
 - Use Pier Nose (Sharp)
 - Length (ft): 100
 - Radius (ft): 10
 - Length (ft): 10

The background map shows a topographic view with a pier shape being edited. A scale bar at the bottom right indicates 500 ft. The status bar at the bottom left shows coordinates (2062826.51, 351720.64) and a scale of 1 pixel = 2.45 ft.

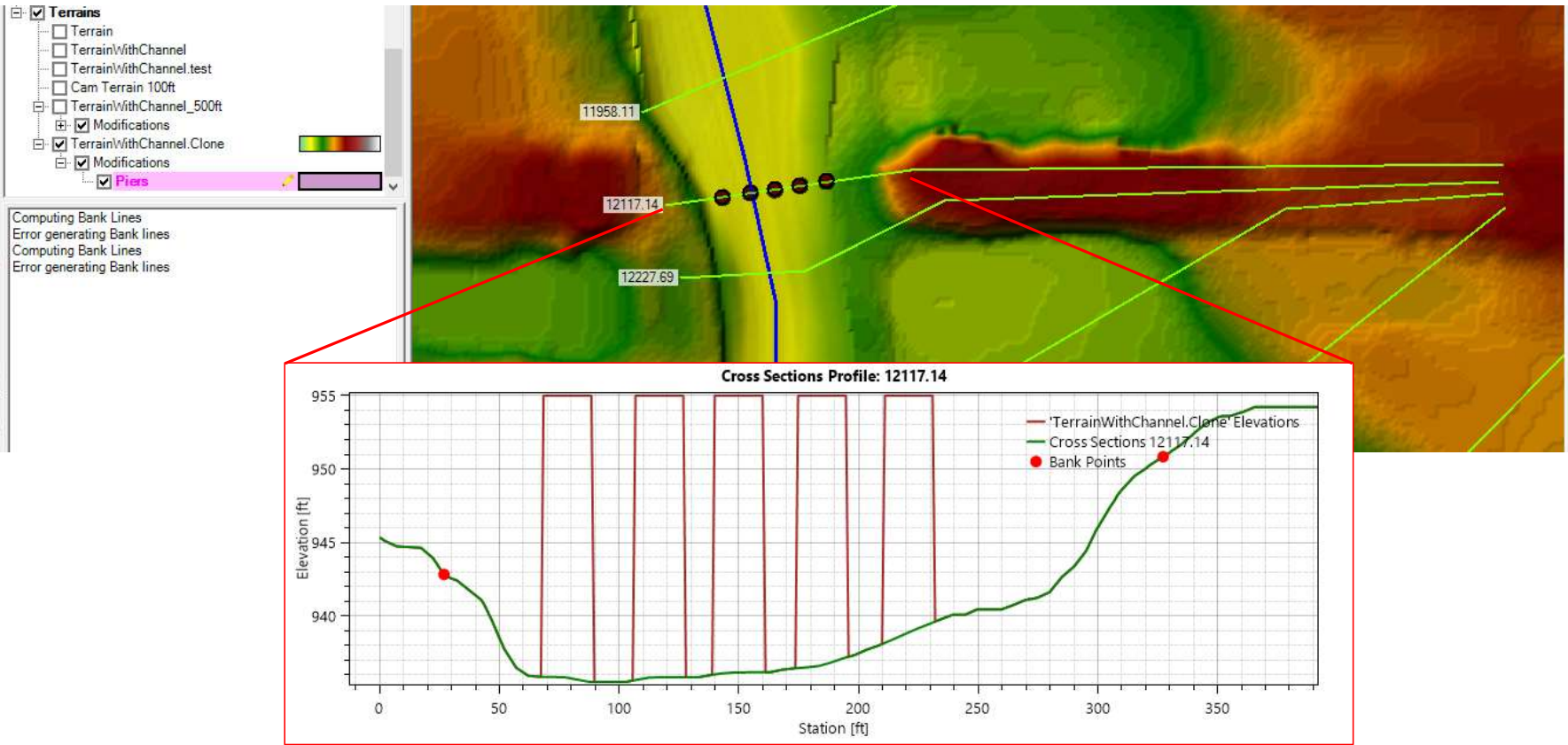


Lines - High Ground





Terrain Modifications





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

Elevation

Station [feet]

Plot

Profile Plot

Elevation [feet]

Station [feet]

OK Cancel



Lines – Elevation Control Points



The screenshot shows the RAS Mapper application window. The title bar reads "RAS Mapper". The menu bar includes "File", "Tools", and "Help". The "Selected Layer: Control Points" is indicated. The left-hand side contains a tree view with the following structure:

- [-] Features
 - [-] Geometries
 - [-] Event Conditions
 - [-] Results
 - [-] Map Layers
 - [-] Terrains
 - [-] baseTerrain.Example
 - [-] Terrain
 - [-] baseTerrain
 - [+] Terrain.Piers
 - [x] Modifications
 - [x] Piers
 - [x] Levee
 - [x] Control Point

Color swatches are visible next to the "baseTerrain.Example", "Terrain", "baseTerrain", "Piers", and "Levee" items. The main map area shows a topographic map with a river channel. A line representing a levee or pier is drawn along the riverbank, with several purple dots representing control points. A dialog box titled "Elevation Needed" is open, with the text "Enter the elevation for this elevation point" and a text input field containing 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 shows the coordinates "(406823.17, 1804841.66 1 pixel = 2.12 feet)".



Lines – Elevation Control Point



Ground Line Editor

Name (Optional): Levee 1

Modification Type: Higher (Terrain/User) Value

Top Width: 40

Left Side Slope (H:V): 2

Right Side Slope (H:V): 2

Lateral Extent Limits: 50

Snapping Tolerance: 20

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

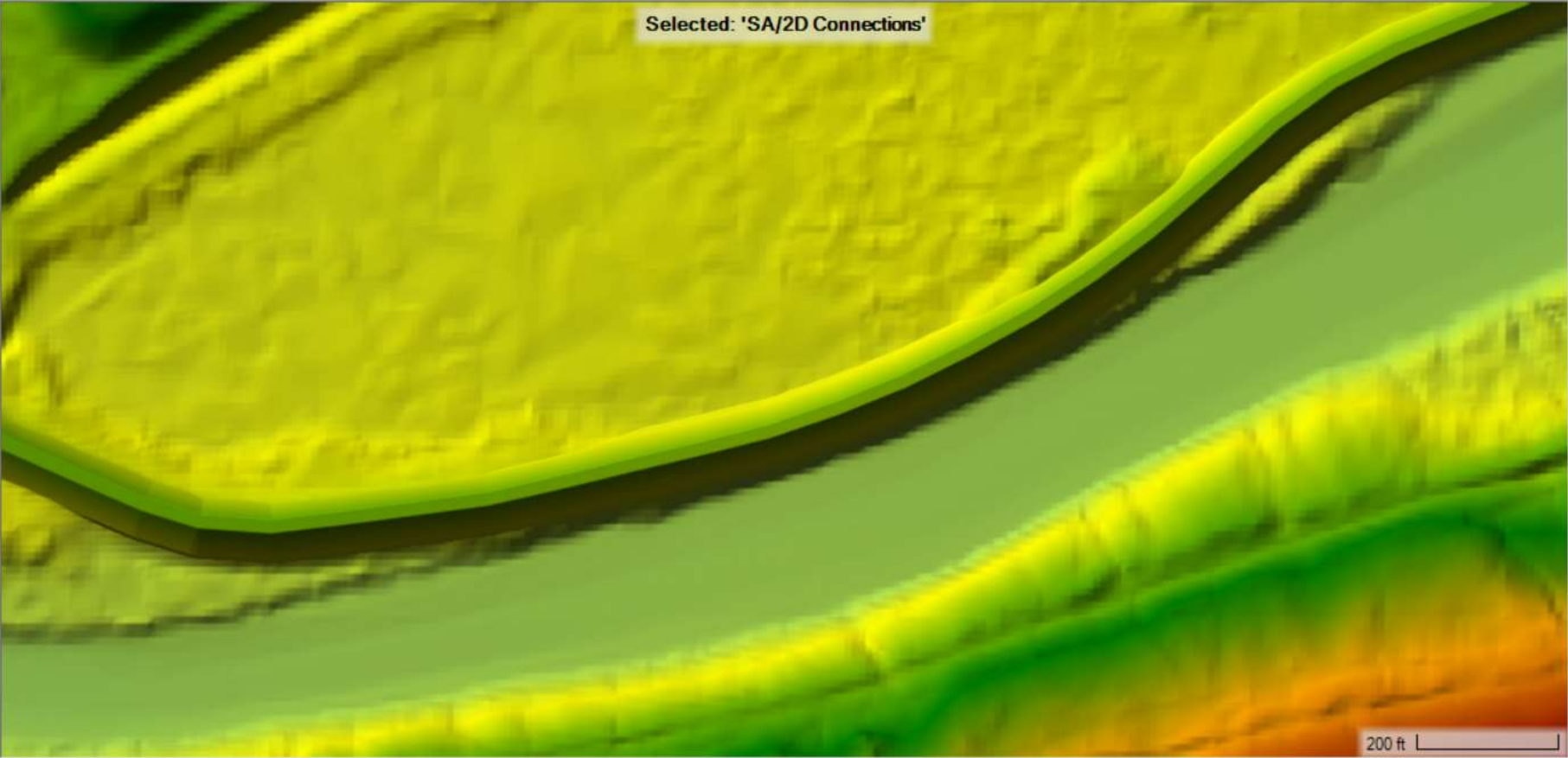
Plot | XS View

Plot | Table | Profile Plot

- 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

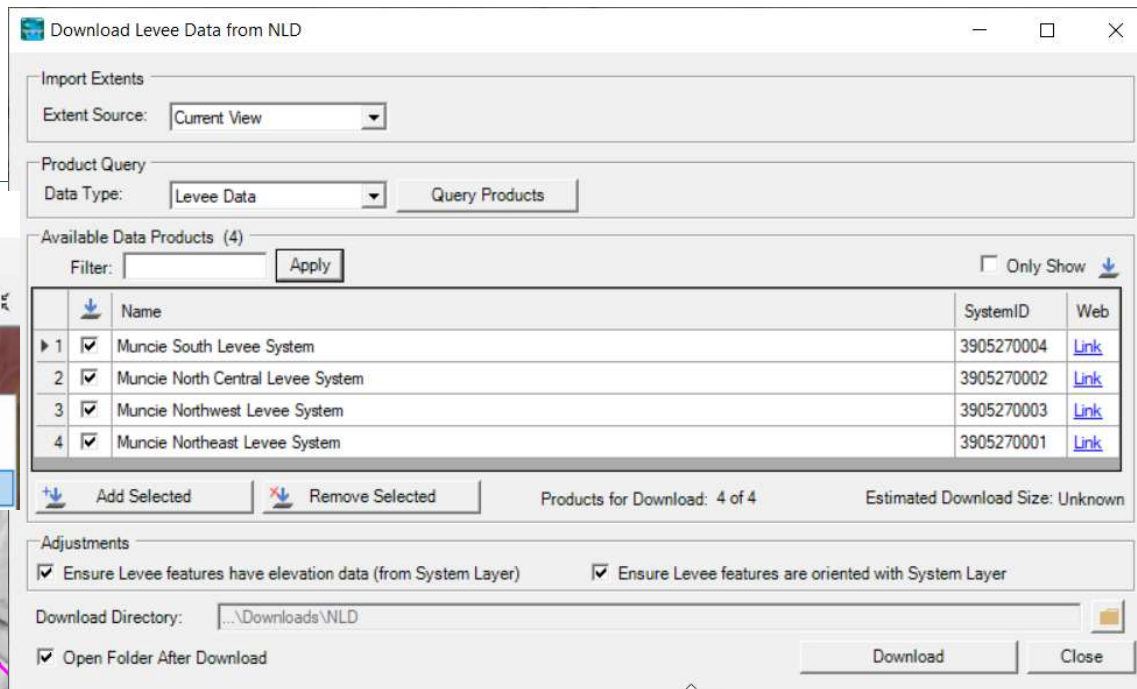
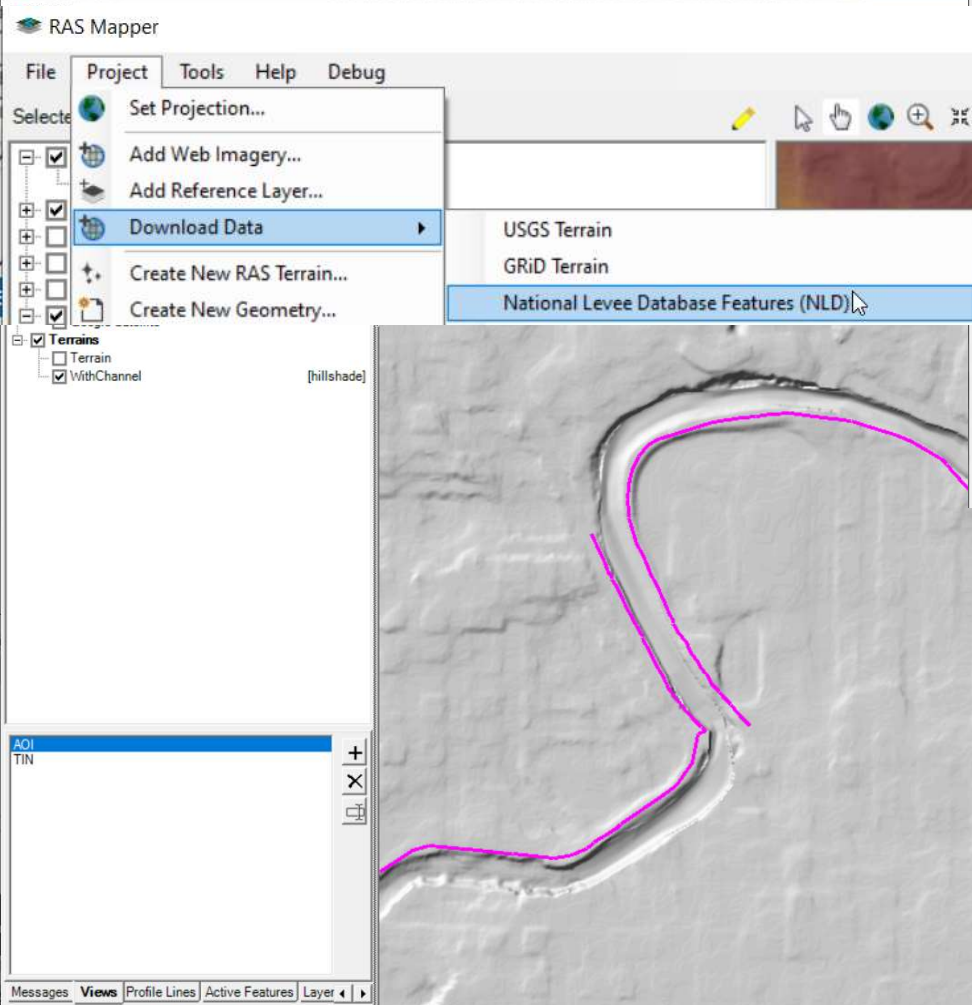
HIDE LIST Layer Controls

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'

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

[hillshade]

Messages Views Profile Lines Active Features Layer

(403207.45, 1802774.58 1 pixel = 8.12 ft)

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

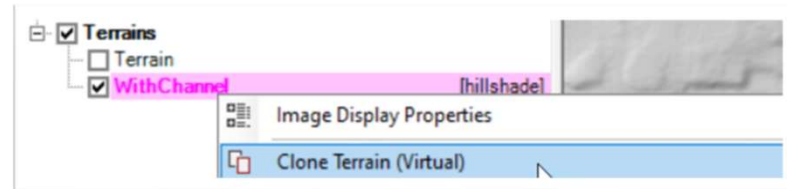


FID	SystemName	SystemID	Name	Width	Left Slope	Right Slope
▶ 0	Muncie South Levee System	3905270004	Data Gap			
1	Muncie South Levee System	3905270004	floodwall	1.8		
2	Muncie South Levee System	3905270004	floodwall	1.8		
3	Muncie South Levee System	3905270004	levee	9	3	3
4	Muncie South Levee System	3905270004	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			

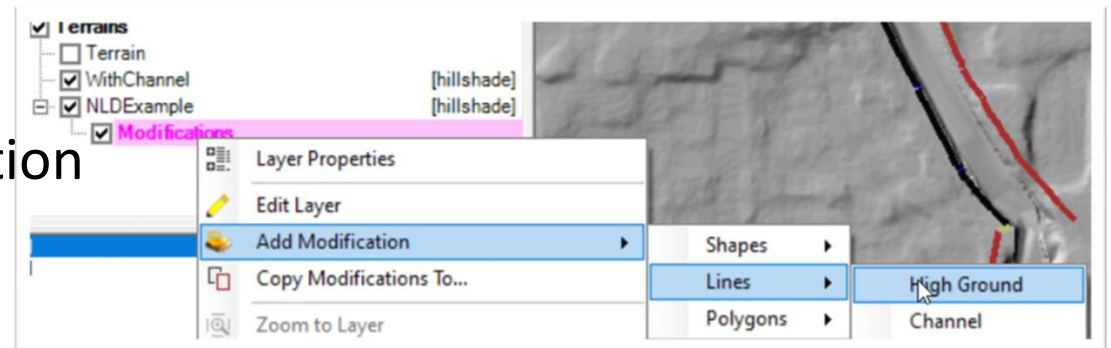


Using NLD for Terrain Modification

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

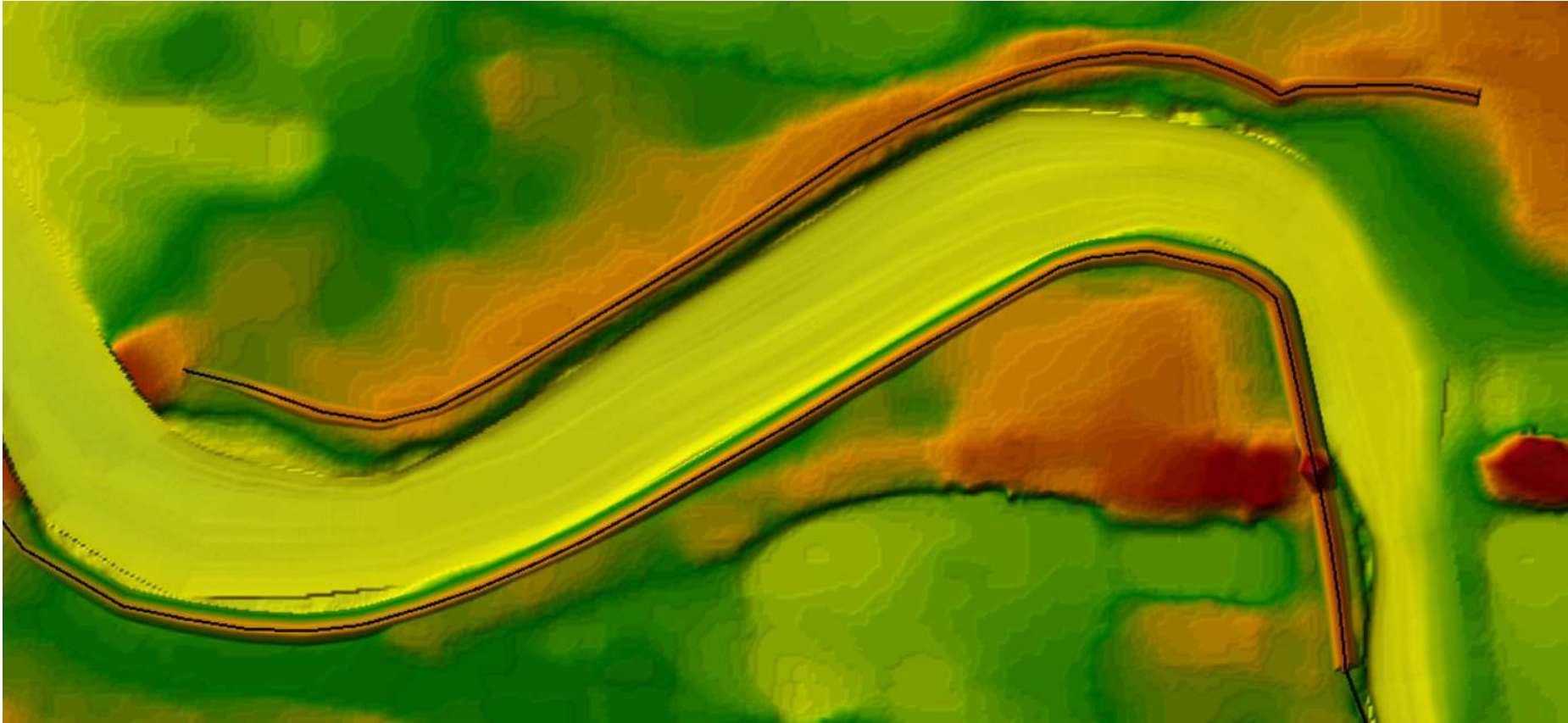


FID	SystemName	Name	Elevation Type	Width	Left Slope	Right Slope	Max Extent	Transition Percent	Elev Pt Tolerance	Computed System Name	Profile
0	Muncie South Levee System	Data Gap	TakeHigher					1	50	Muncie South Levee System	(2 Points)
1	Muncie South Levee System	floodwall	TakeHigher	1.8	0.1	0.1	7.2	1	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

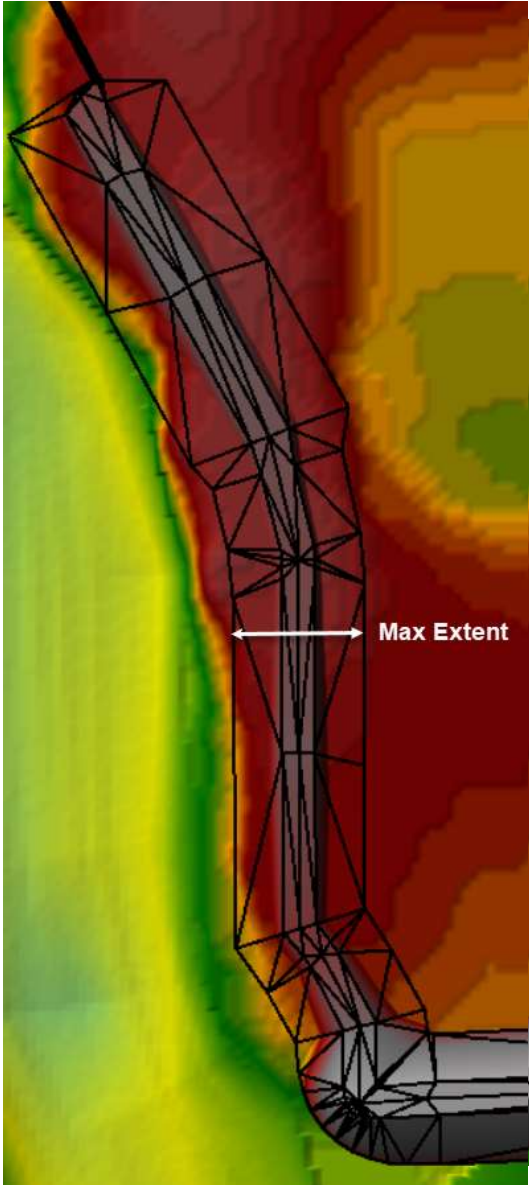
Update Terrain and Plots On Data Change

Plot Plot Terrain

XS View

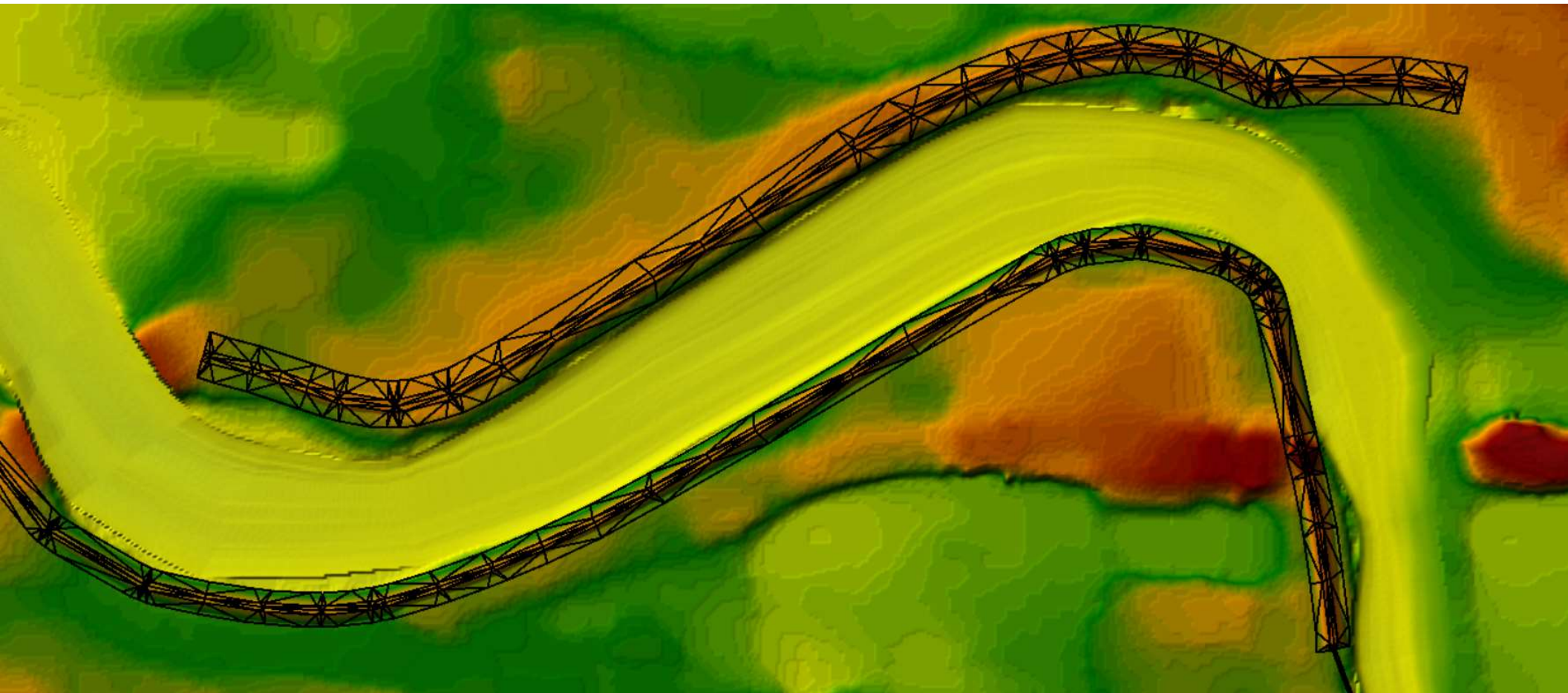
Profile Plot


OK Cancel





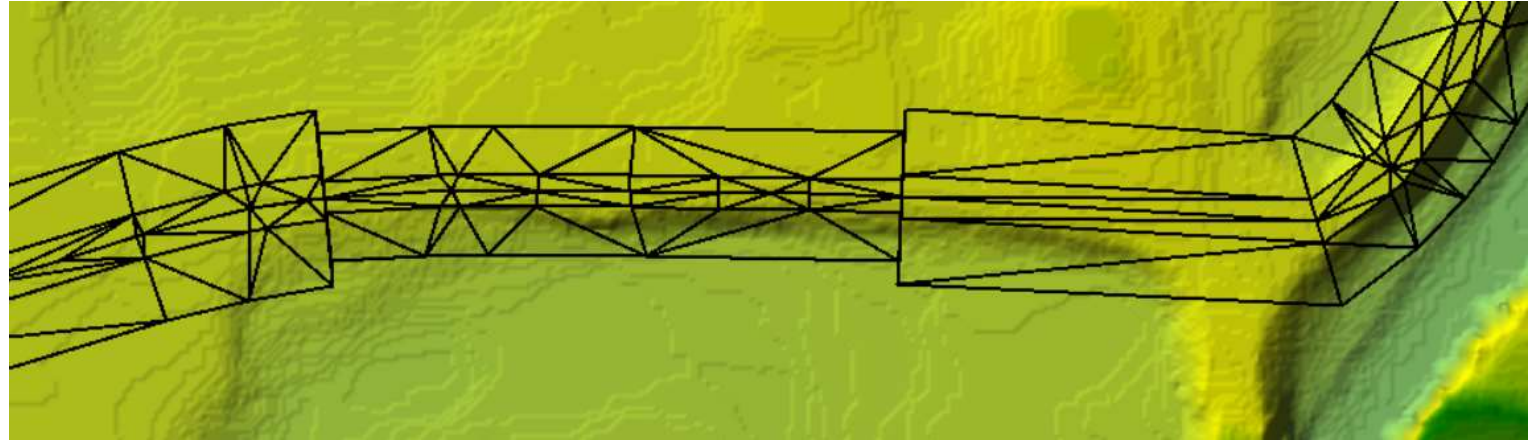
Interpolation along Line Modification



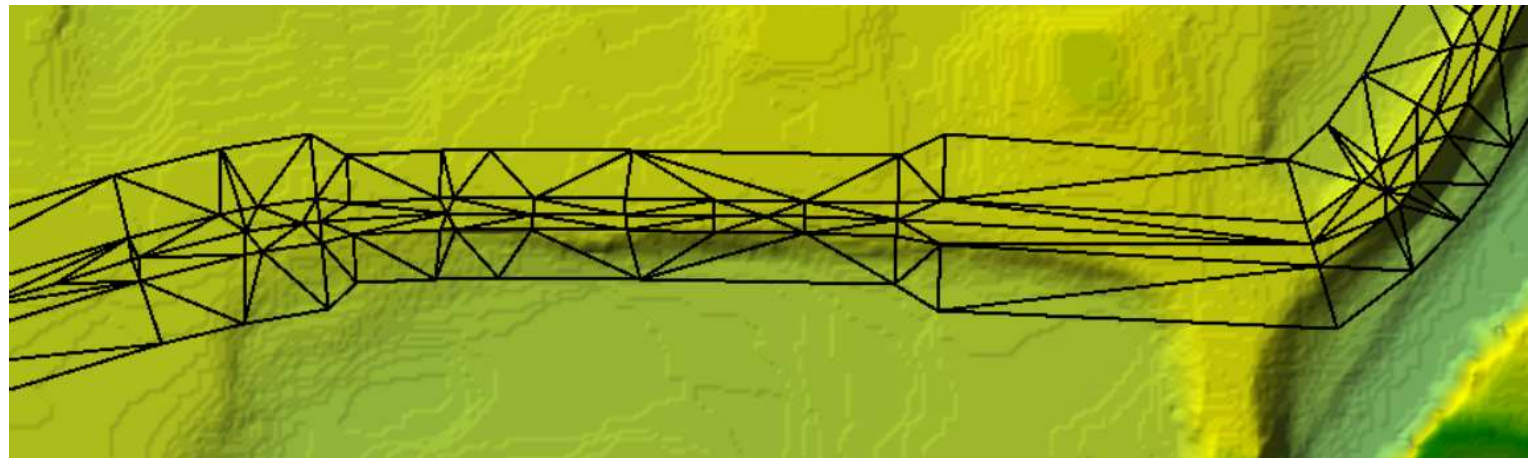



Interpolation – Feature Transition

- None



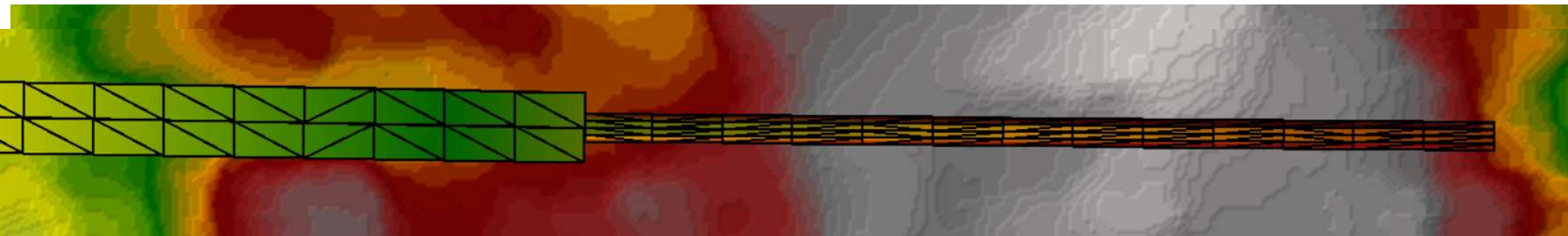
- Some



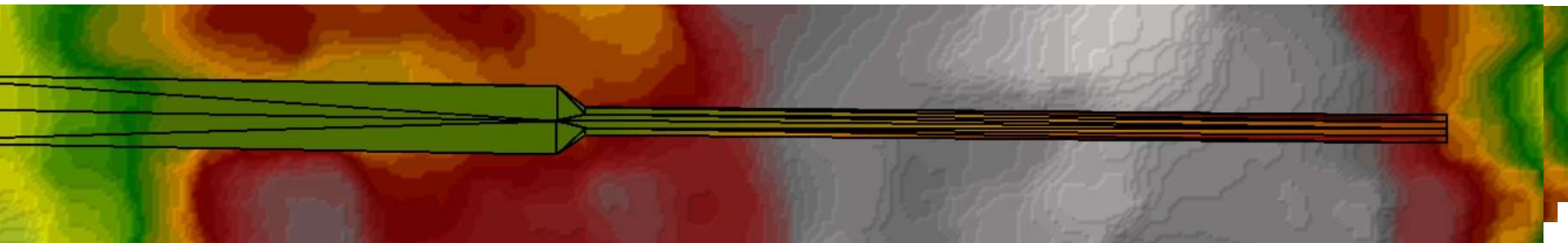


Interpolation – System Name

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 😊



Land Cover and Manning's n values



Land Cover Data Sources

- Support use of Land Cover data for estimating Manning's n values
 - Raster and Shapefile polygon datasets
- NLCD 2019
 - <http://www.mrlc.gov>
(30-m raster)
- USGS LULC
 - <http://water.usgs.gov/GIS/dsdl/ds240/index.html>
(vector or raster)

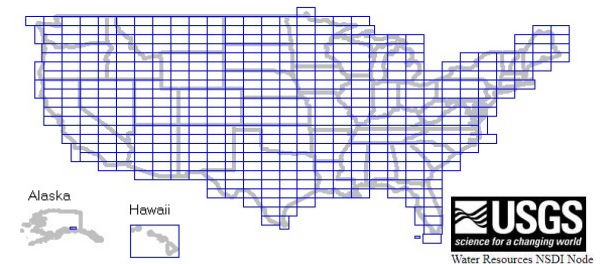
MRLC Celebrating 20+ years of Partnership
Multi-Resolution Land Characteristics
Consortium



Multi-Resolution Land Characteristics (MRLC)
Consortium

Download land use and land cover data sets using clickable image map

Click on the blue polygons on the image to download data sets.

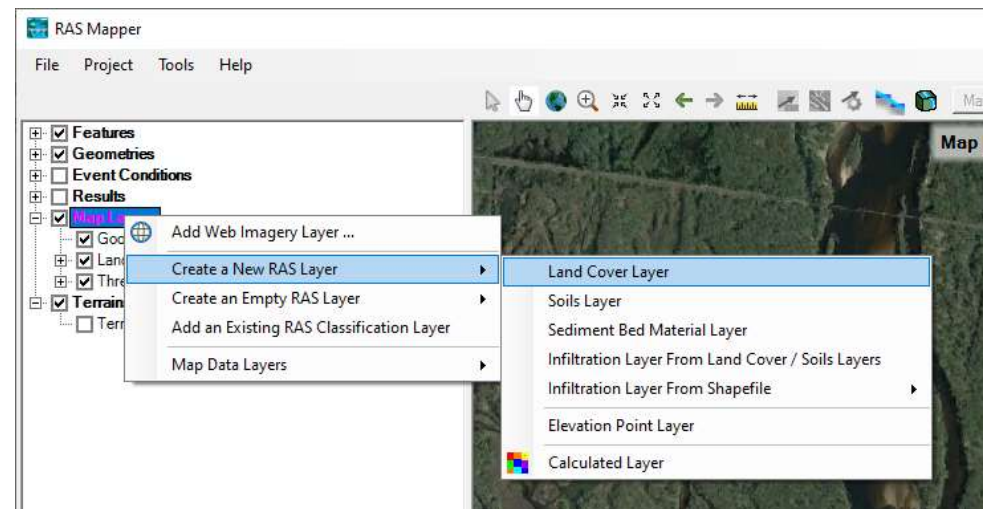
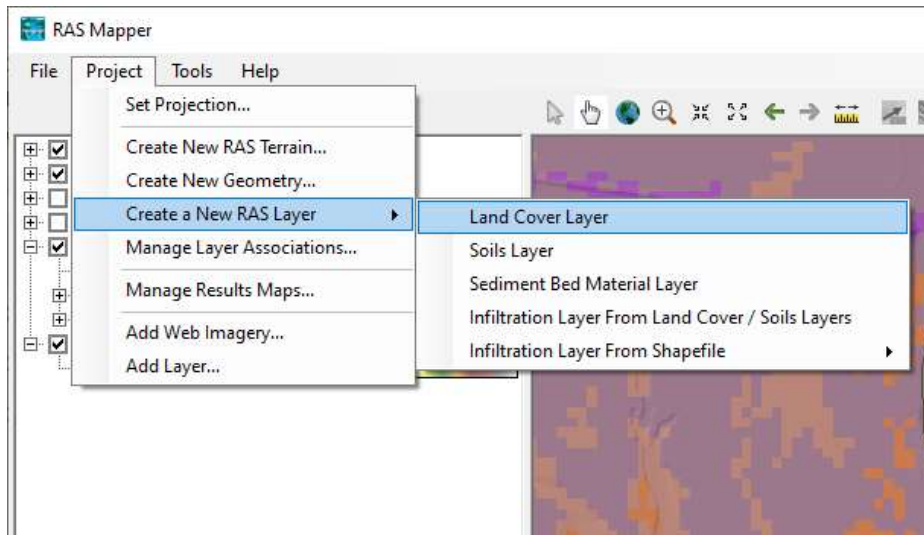




Importing Land Cover Data



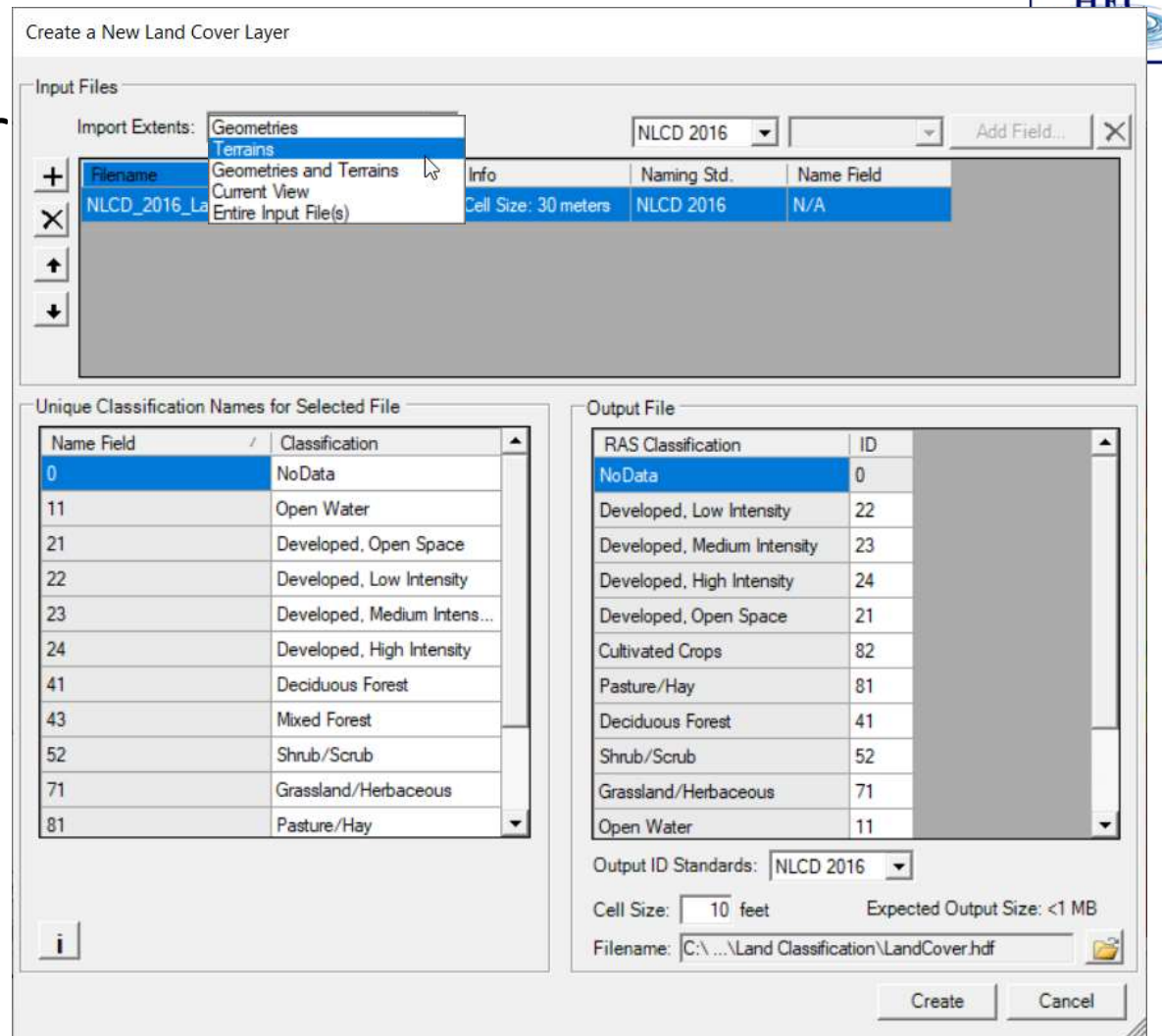
- Define the project domain
 - Terrain model
 - River model construct
- Create a New Land Cover Layer





New Land Cover Layer

- Set Extents
- Add Files
- Reclassify
- Set Cell Size
- Provide Filename
- Create





Land Cover Layer



RAS Mapper

File Project Tools Help

Selected Layer: LandCover

- Features
- Geometries
 - Initial Mesh
- Event Conditions
- Results
- Map Layers
 - LandCover** (Color bar)
 - Classification Polygons
- Terrains
 - Terrain

Messages Views Profile Lines Active Featu

(414891.38, 1798945.86 1 pixel = 22.63 ft)

Select Surface Fill

Surface Symbol Settings

Available Color Ramps: RAS Defaults User Defined

Color Ramp: LCD

Surface Symbol

Classification	Color	Red (0-255)	Green (0-255)	Blue (0-255)	Alpha (0-255)
Open Water	Blue	84	117	168	255
Developed, Ope...	Light Red	232	209	209	255
Developed, Low ...	Red	226	158	140	255
Developed, Medi...	Dark Red	255	0	0	255
Developed, High ...	Dark Red	181	0	0	255
Deciduous Forest	Green	133	199	126	255
Mixed Forest	Light Green	212	231	176	255
Shrub/Scrub	Yellow-Green	220	202	143	255
Grassland/Herba...	Yellow	253	233	170	255
Pasture/Hay	Light Yellow	251	246	93	255
Cultivated Crops	Orange	202	145	70	255
Woody Wetlands	Light Blue	200	230	248	255

Reverse Colors Save Color Ramp

OK Cancel

ID

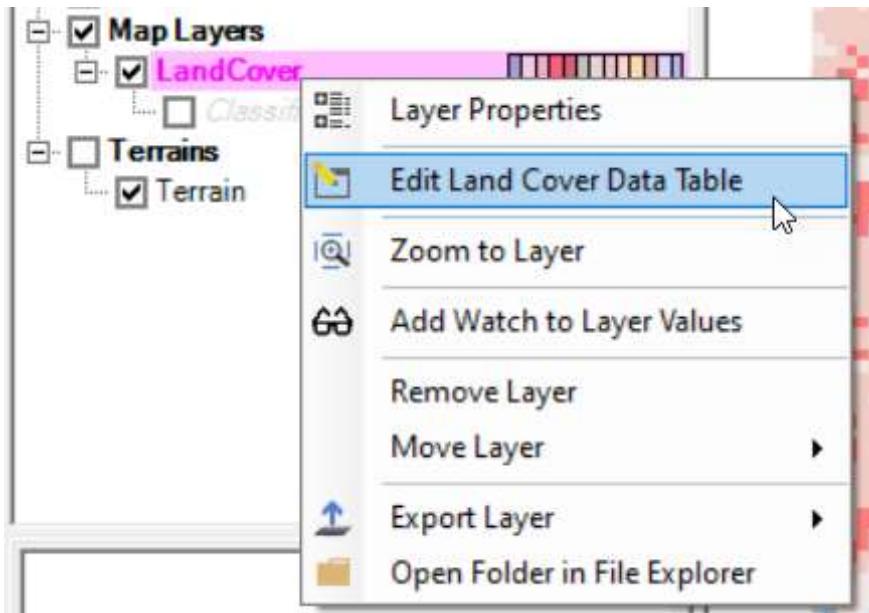
- 11
- 21
- 22
- 23
- 24
- 41
- 43
- 52
- 71
- 81
- 82
- 90
- 95

2000 ft



Manning's n Values

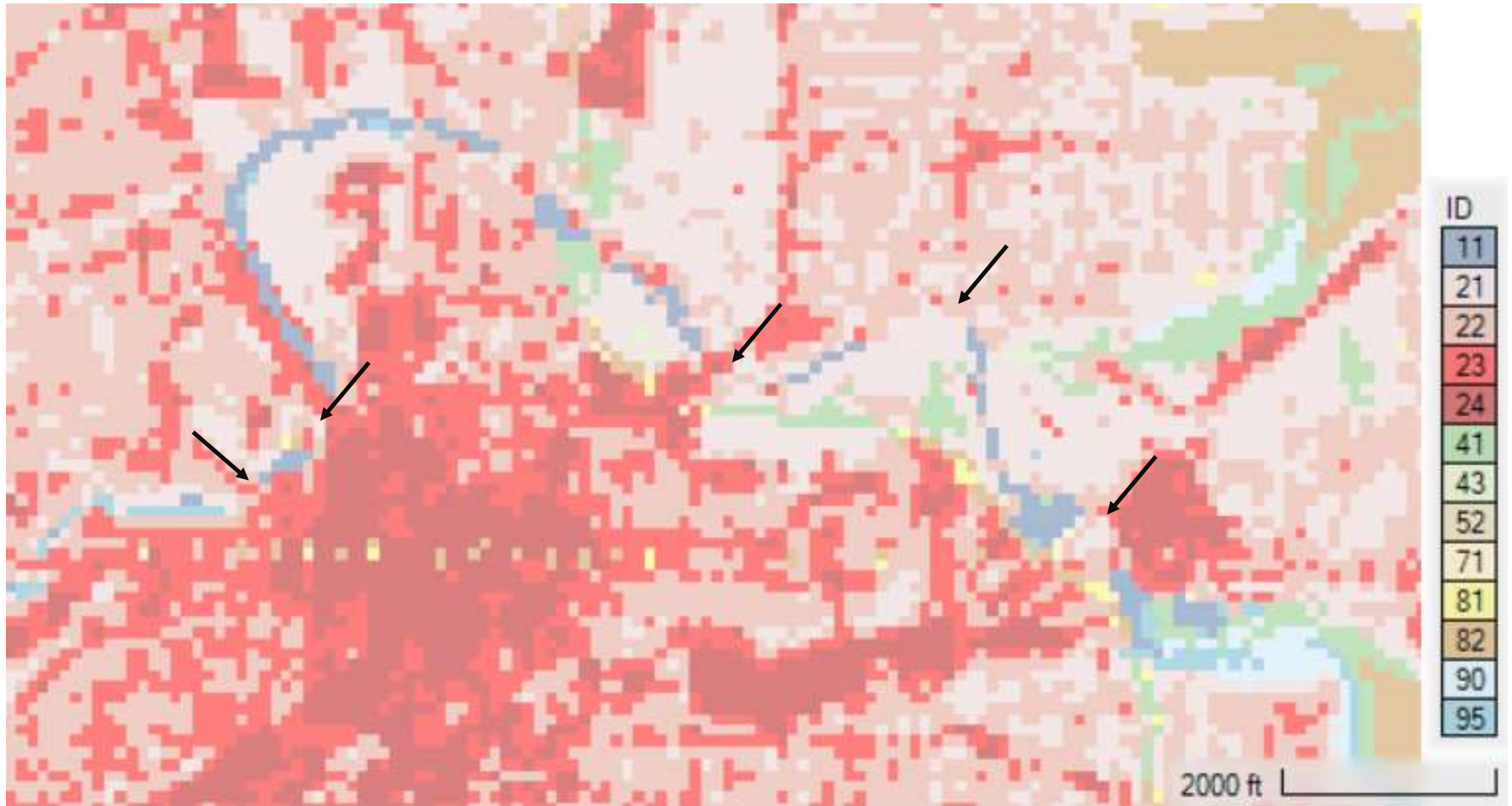
- Provide base Manning's n values



This is the first time you will see “Manning n”

ID	Name	ManningsN
0	NoData	0.066
11	Open Water	0.035
21	Developed, Open Space	0.04
22	Developed, Low Intensity	0.06
23	Developed, Medium Intensity	0.08
24	Developed, High Intensity	0.1
41	Deciduous Forest	0.16
43	Mixed Forest	0.14
52	Shrub/Scrub	0.04
71	Grassland/Herbaceous	0.055
81	Pasture/Hay	0.04
82	Cultivated Crops	0.05
90	Woody Wetlands	0.09
95	Emergent Herbaceous Wetlan...	0.65

Land Cover Layer –Data Issues





Land Cover Classification



The screenshot shows the RAS Mapper interface. On the left is a layer tree with 'Classification Polygons' selected. The main map area displays a pixelated land cover map with a brown channel line overlaid. A 'Classifications' dialog box is open, showing a table with columns for 'ManningsN' and 'Percent Impervious'. The 'ManningsN' value is set to 0.03. The dialog also includes 'OK' and 'Cancel' buttons.

Selected Layer: Classification Polygons

Classification Name: Channel

	ManningsN	Percent Impervious
	0.03	

Messages Views Profile Lines Active Featu

(408171.38, 1798855.36 1 pixel = 22.63 ft)

2000 ft



Land Cover Layer with Vector Polygons



The screenshot displays the RAS Mapper software interface. The title bar reads "RAS Mapper" with standard window controls. The menu bar includes "File", "Project", "Tools", and "Help". Below the menu bar, the "Selected Layer: Classification Polygons" is indicated. A toolbar with various navigation and editing tools is visible, including a globe, zoom in (+), zoom out (-), pan, and a "Max" button. The main map area shows a pixelated land cover map with a blue vector polygon overlaid. The text "Selected: 'Classification Polygons'" is displayed above the map. On the left, a layer list shows "Features", "Geometries", "Event Conditions", "Results", "Map Layers", and "Terrains". Under "Map Layers", "LandCover" and "Classification Polygons" are checked. A color legend is visible next to "LandCover". At the bottom left, a status bar shows coordinates "(404053.40, 1807656.97)" and a scale "1 pixel = 22.63 ft". At the bottom right, a scale bar indicates "2000 ft".

Questions?

