2017 Montana Floodplain Resource Seminar: Lecture 3 RAS Mapper Overview

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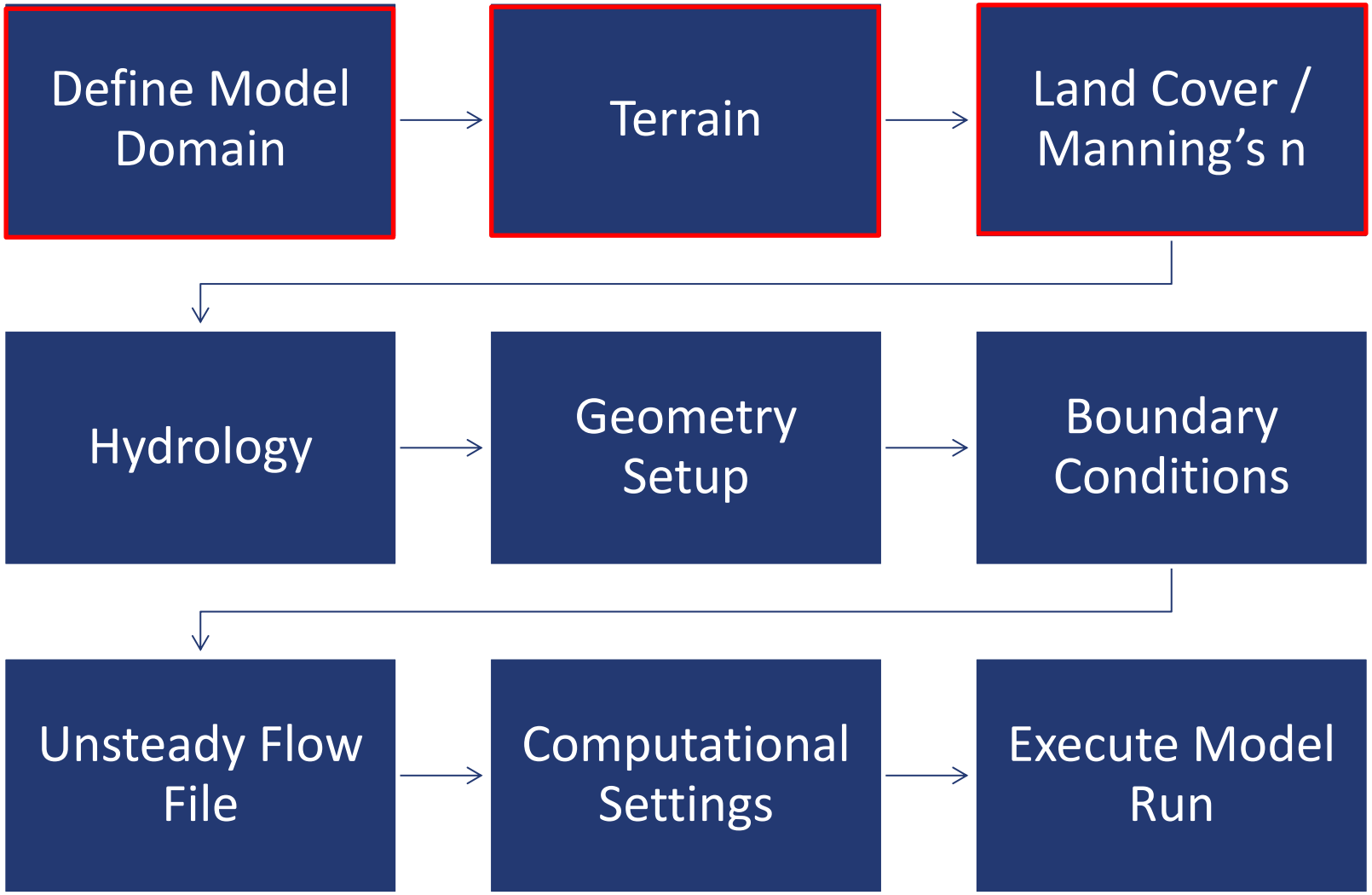
Identify Hazards, Interpret Risks, Integrate Mitigation

Lecture 3 Overview

- Introduction of RAS Mapper
- Defining the Model Domain
- Terrain Data Development
- Land Cover and Manning's Roughness Coefficients

HEC-RAS 5.0 2D Process



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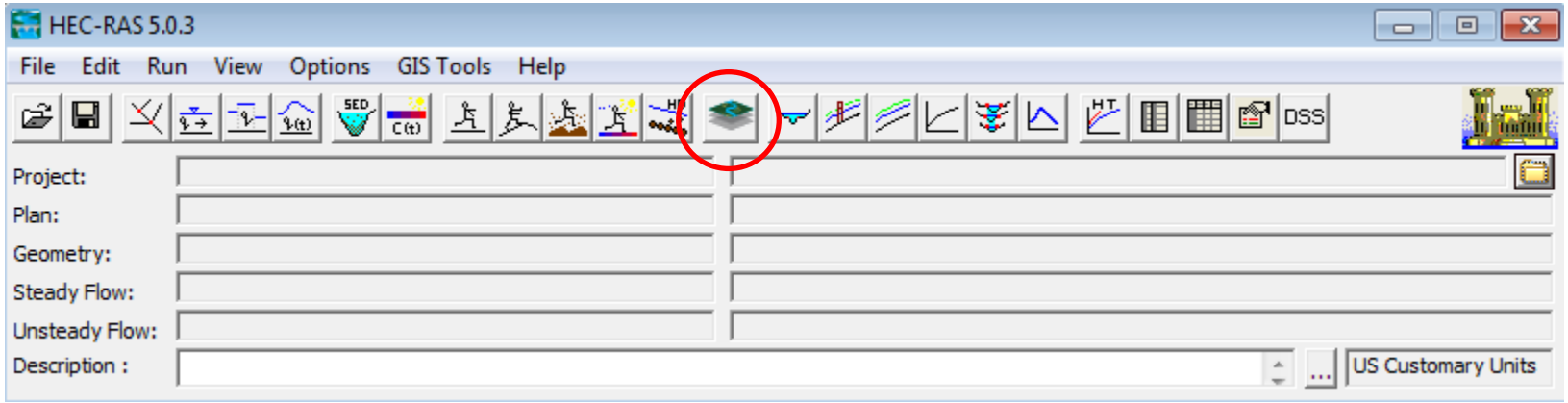
RAS Mapper (for Project Setup)

- New component in HEC-RAS 5.0
  - Set horizontal projection
  - Import terrain data (add channel bathymetry)
  - Load land cover and/or Manning's n regions
  - View/animate/export model results
  - Load background GIS or imagery layers



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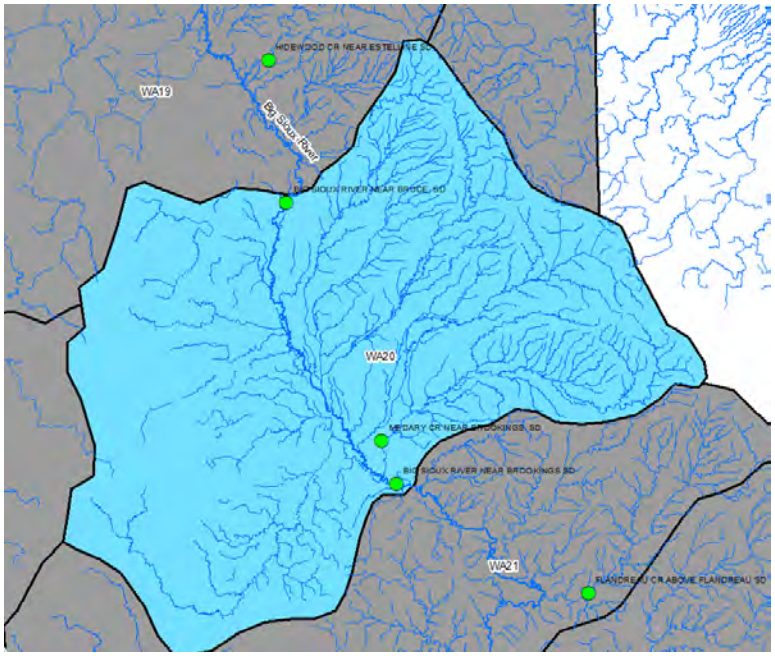
Starting a 2D HEC-RAS Project!

- Model domain definition
  - Additional consideration here will save effort later
- Terrain data development
  - 2D model → High resolution
  - Process/prepare in GIS
- Manning's roughness definition
  - Delineate/process in GIS
- RAS Mapper
  - This is the link to GIS

Defining Model Domain

- Cover project-specific extent
- Available data
  - Terrain, gages, previous studies, calibration data
- Logical hydraulics
- Model size limitations
- Strategic boundary condition locations
- May be an iterative process



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Terrain Data

- High resolution terrain data are critical to accurate modeling results
- General 2D model recommend minimum horizontal resolution of 3 meters (~10 feet or 1/9 arcsecond)
- FEMA specific requirements:

Table 1: Vertical Accuracy Requirements based on Flood Risk and Terrain Slope within the Floodplain being Mapped

Level of Flood Risk	Typical Slopes	Specification Level	Vertical Accuracy: (FVA or NVA*)/ (CVA or VVA**)	LiDAR Nominal Pulse Spacing (NPS)
High (Deciles 1,2,3)	Flattest	Highest	24.5 cm / 36.3 cm	≤ 2 meters
High (Deciles 1,2,3)	Rolling or Hilly	High	49.0 cm / 72.6 cm	≤ 2 meters
High (Deciles 2,3,4,5)	Hilly	Medium	98.0 cm / 145 cm	≤ 3.5 meters
Medium (Deciles 3,4,5,6,7)	Flattest	High	49.0 cm / 72.6 cm	≤ 2 meters
Medium (Deciles 3,4,5,6,7)	Rolling	Medium	98.0 cm / 145 cm	≤3.5 meters

*FVA and NVA are reported at the 95% Confidence Level
**CVA and VVA are reported at the 95th Percentile

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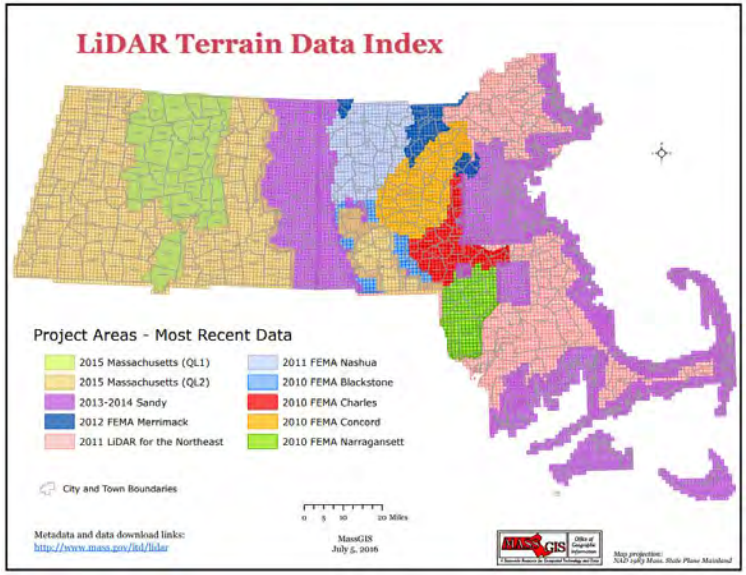
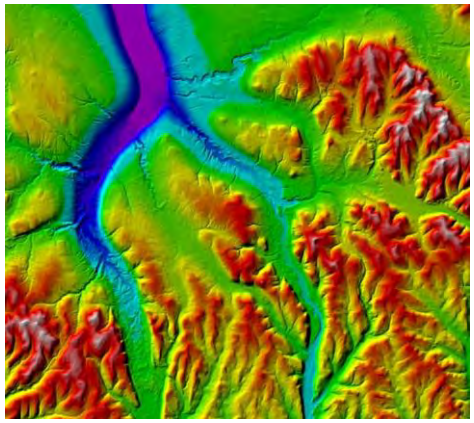
Terrain Type

- Data coverage has increased significantly
- Typically collected via LiDAR
  - Bare Earth; no vegetation, structures, or bridge decks
  - Data may be processed into DEM or may be in raw format
  - Final DEM should be reviewed prior to modeling
- Survey data typically used to supplement LiDAR
  - Structures, bathymetry, design level analysis





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Overview of Terrain Development

Obtain Terrain Data

- Local, state, or federal agencies
- Project specific data
- Other Entities

Process Terrain Data

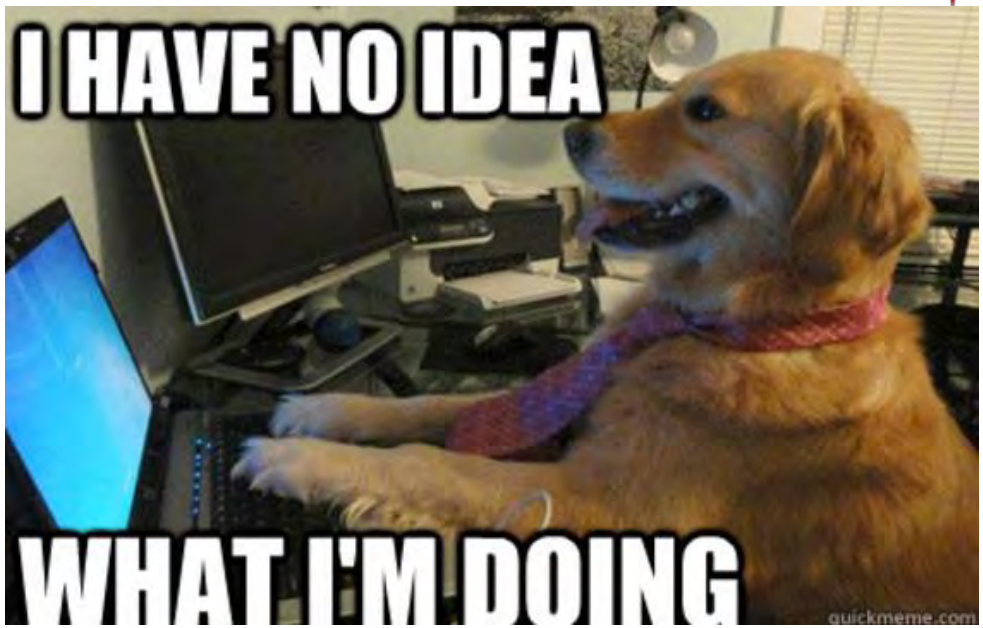
- Convert LiDAR to DEM if necessary
- Horizontal projection
- Merge terrain datasets into single, seamless raster
- Convert vertical units if necessary

Import Data into RAS Mapper

- Make sure coordinate systems are consistent
- Import raster using RAS Mapper
- Import supplemental survey data, if available

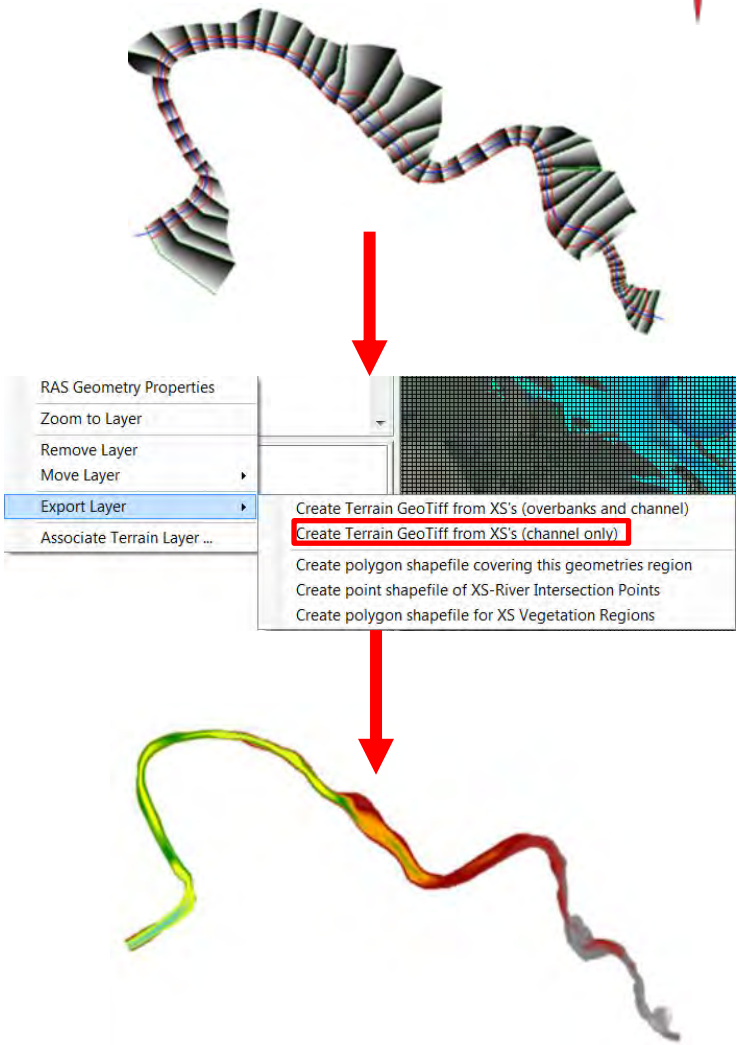
Terrain Processing

- All processing must be done in GIS
- Typically best left to the professionals…but not always feasible
  - Projection
  - Vertical datum consistency
  - Consistent vertical and linear units
  - Acceptable raster format



Terrain Bathymetry

- LiDAR represents water surface, not bathymetry, two options:
  1. Bathymetric data can be added to a RAS model via RAS Mapper
     - Develop 1D geometry data (i.e., sections, centerline, and banks)
     - RAS Mapper generates a surface (interpolated between sections) that can be added to the LiDAR DEM
  2. Account for flow during LiDAR collection in hydrology



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Merging Terrain Datasets

- Often need to combine several different sources of terrain
- Can be done in GIS or RAS Mapper
- Discontinuity at the seam
- Will impact 2D hydraulics
- Different water surface levels during different LiDAR flights

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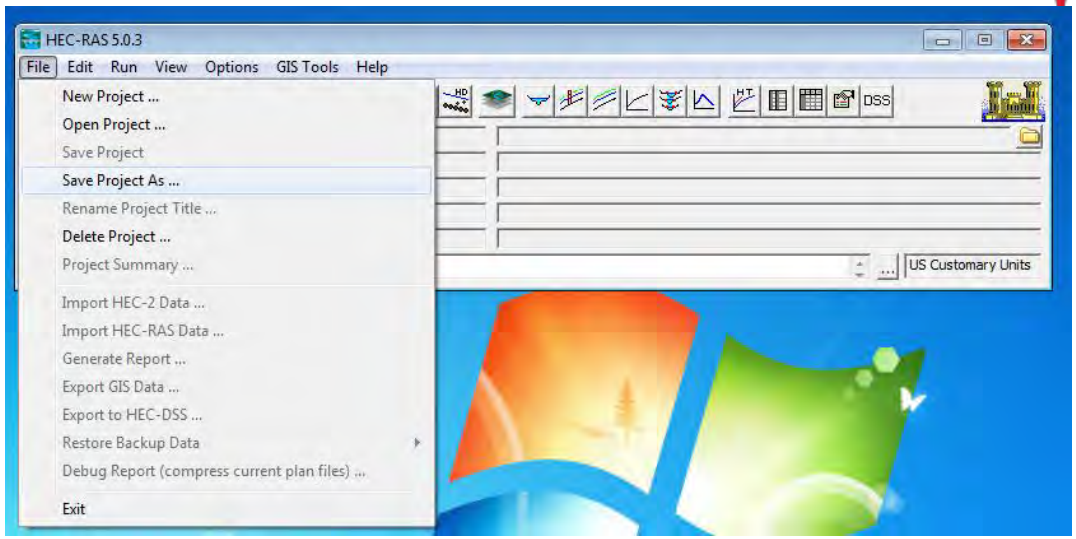
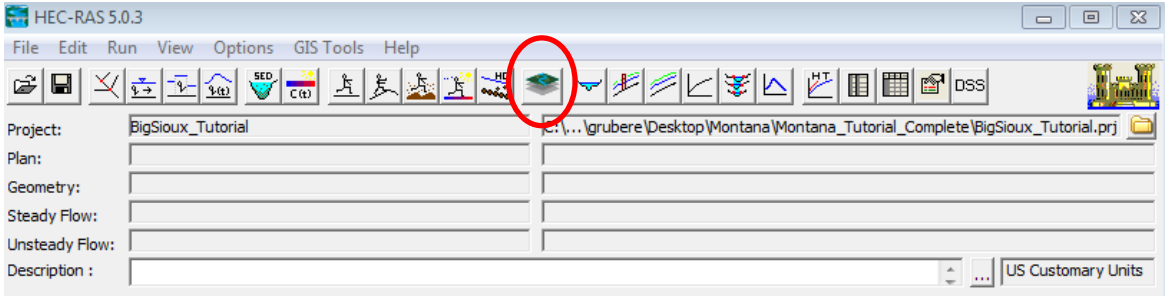
Starting a HEC-RAS Project

- After terrain is model ready, open HEC-RAS
- First step: Start ***New Project*** or ***Save Project As***
- Open RAS-Mapper
  - This is where all of the project setup will occur





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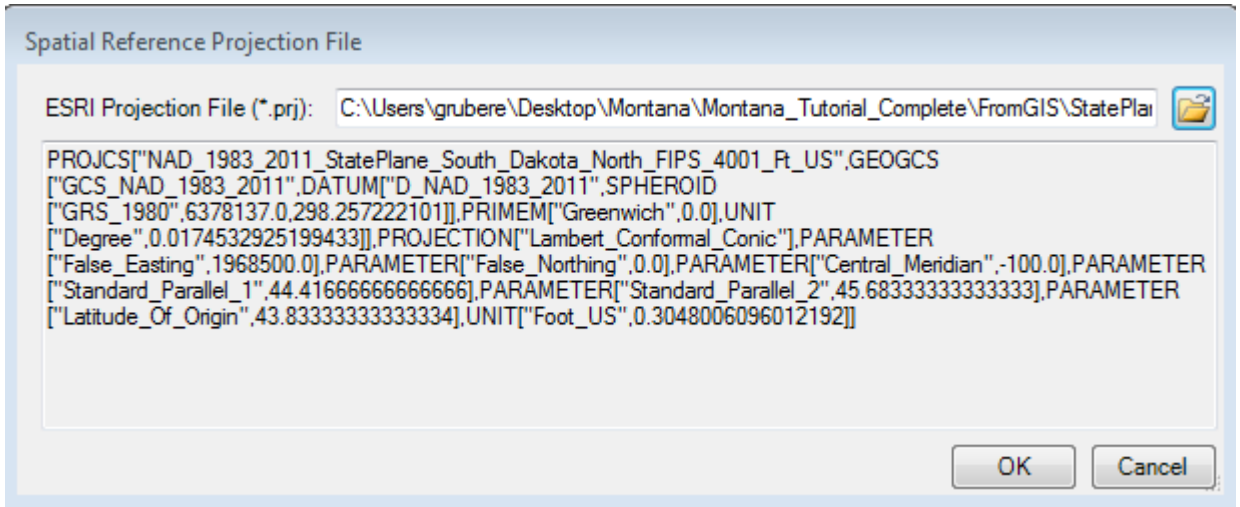
RAS Mapper Spatial Projection

- Set projection for project
  - Under ***Tools*** menu
  - This should be the same as your spatial data in GIS
- RAS Mapper will re-project added map layers into the correct coordinate system for viewing
- If terrain is not in consistent projection, exported results will be incorrect



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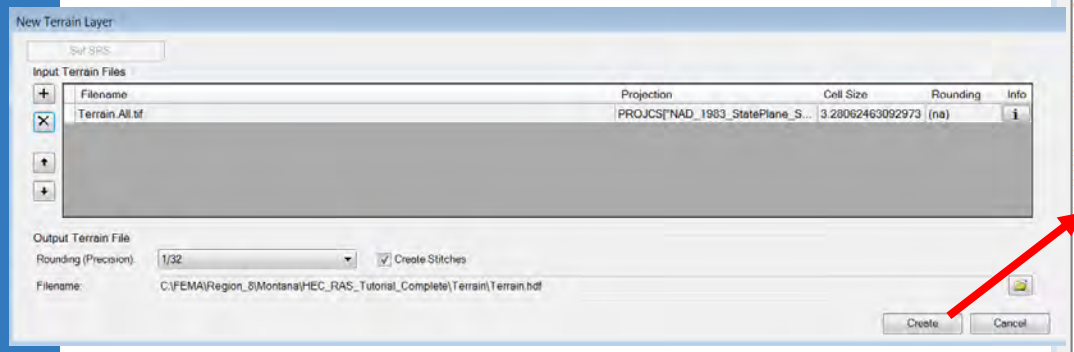
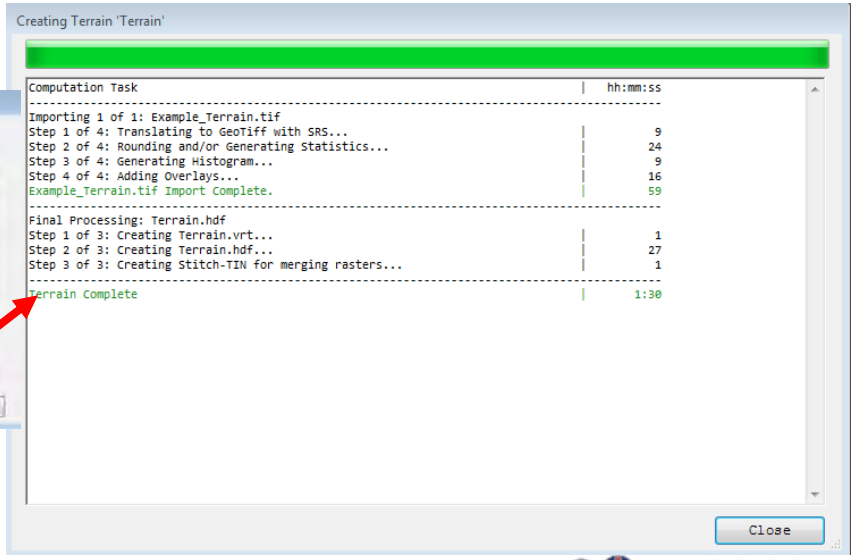
RAS Mapper: Import Terrain

- ***New Terrain***
  - Under ***Tools*** menu ***New Terrain***; use ***+*** to add data; name file
  - This will import terrain
  - RAS copies raster to another TIFF, then converts it to a RAS specific *VRT* format
  - Large datasets may take significant processing time





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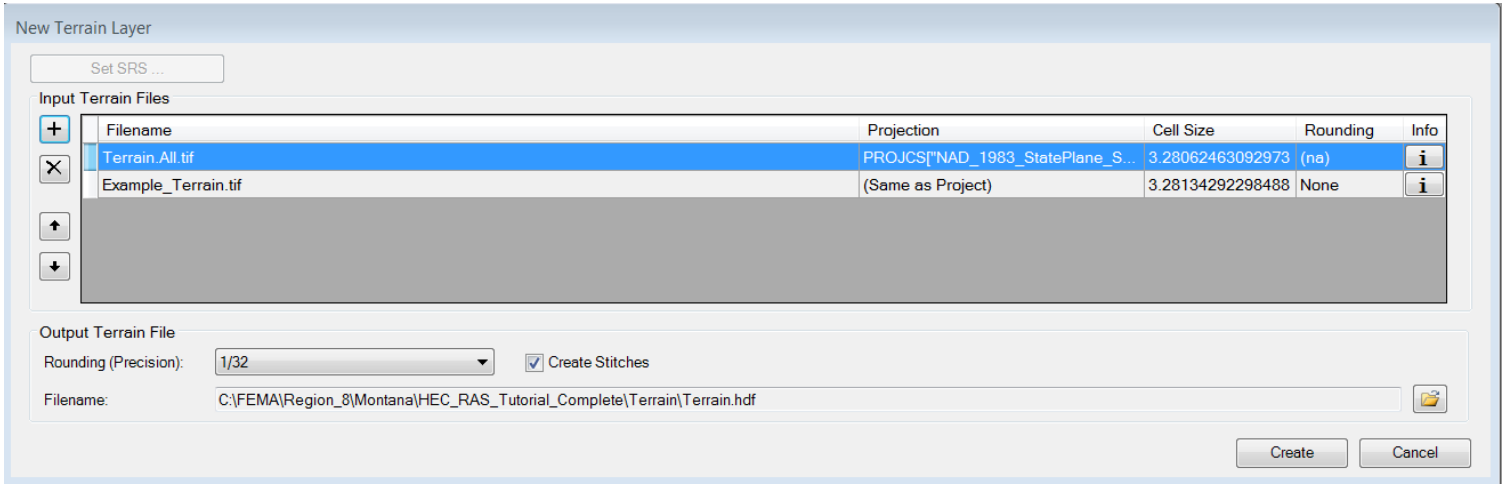
RAS Mapper: Terrain

- Multiple raster DEMs can be loaded into RAS Mapper
  - RAS Mapper mosaics the data together
  - User specifies priority during import process
  - Exported results reference original datasets and produce multiple rasters
  - Use this method to combine channel surface with LiDAR



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Terrain Files

- Multiple Terrain files can be created for a single project (e.g., existing and proposed)
- Each geometry and results file must be associated with a specific terrain file
  - More on this later

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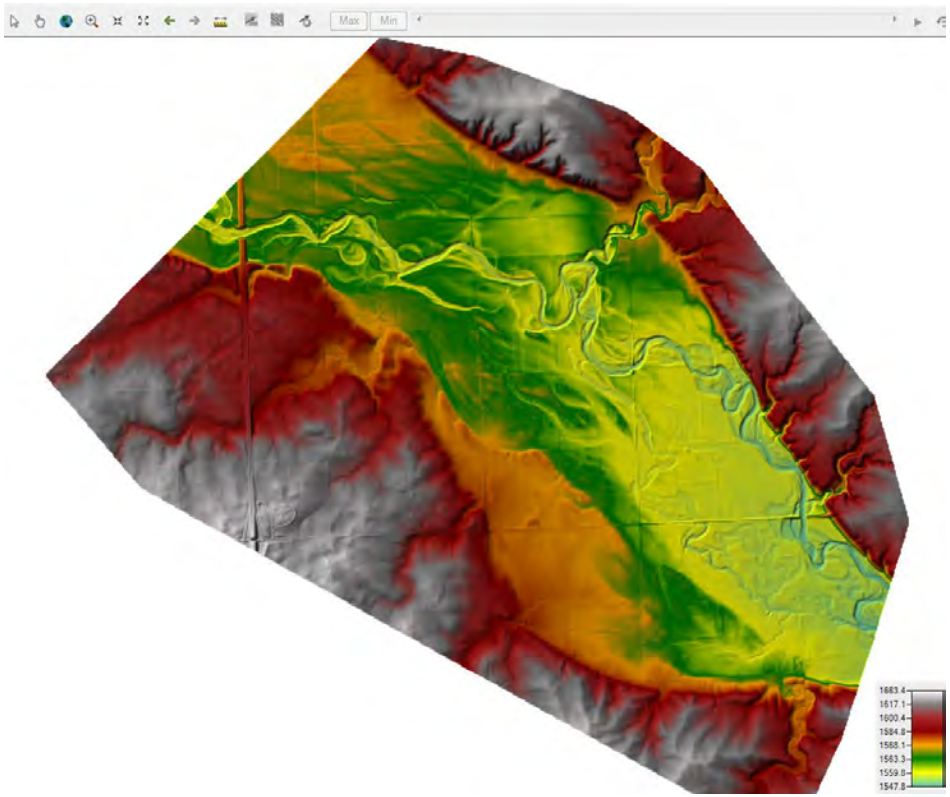
RAS Mapper: Viewing Terrain

- Terrain will appear in RAS Mapper
- Basic tools in GIS for viewing terrain
  - Zoom controls
  - Display options
  - Cut terrain profiles
- Lecture 6 provides details on reviewing results in RAS Mapper



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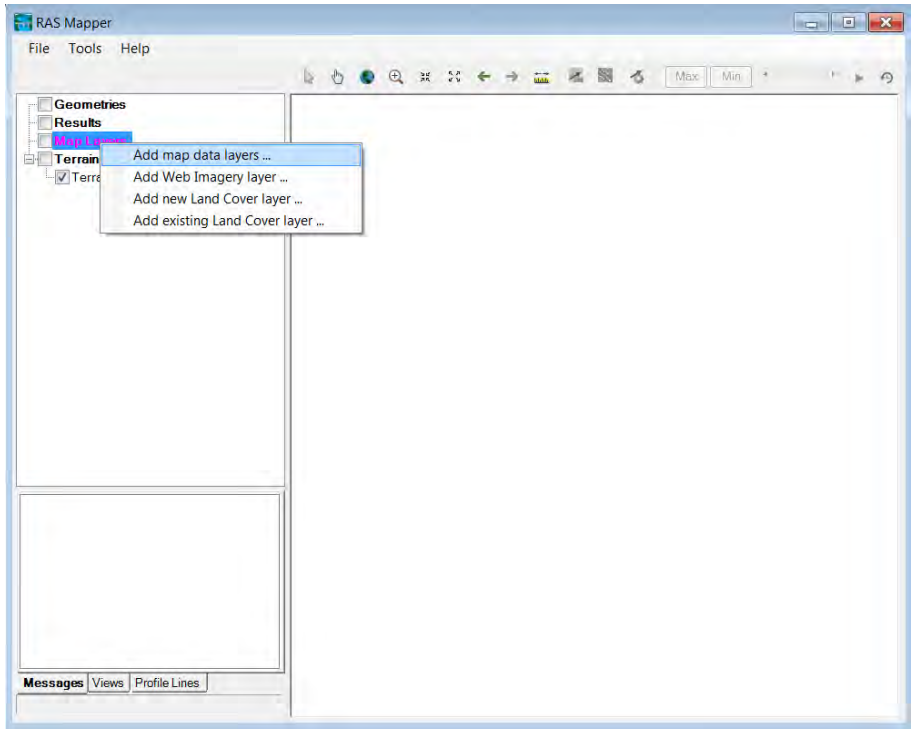
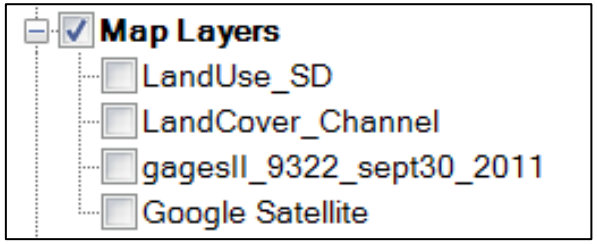
Background Data

- Right click on ***Map Layers*** in catalogue tree
- Aerial Imagery
  - Online sources
  - Saved imagery files
- Shapefiles or images
- These files can all be toggled on in the geometry editor to help delineate features





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Land Cover Data

- User must define land cover in order to have spatially varying Manning's n data
- Manning's n regions are imported through RAS Mapper
- Raster (TIFF) or shapefile format
  - Shapefiles delineated by user in GIS, rasters downloaded from source datasets (e.g., NLCD 2011)
- Multiple datasets can be imported and merged by RAS Mapper, based on user specified priority

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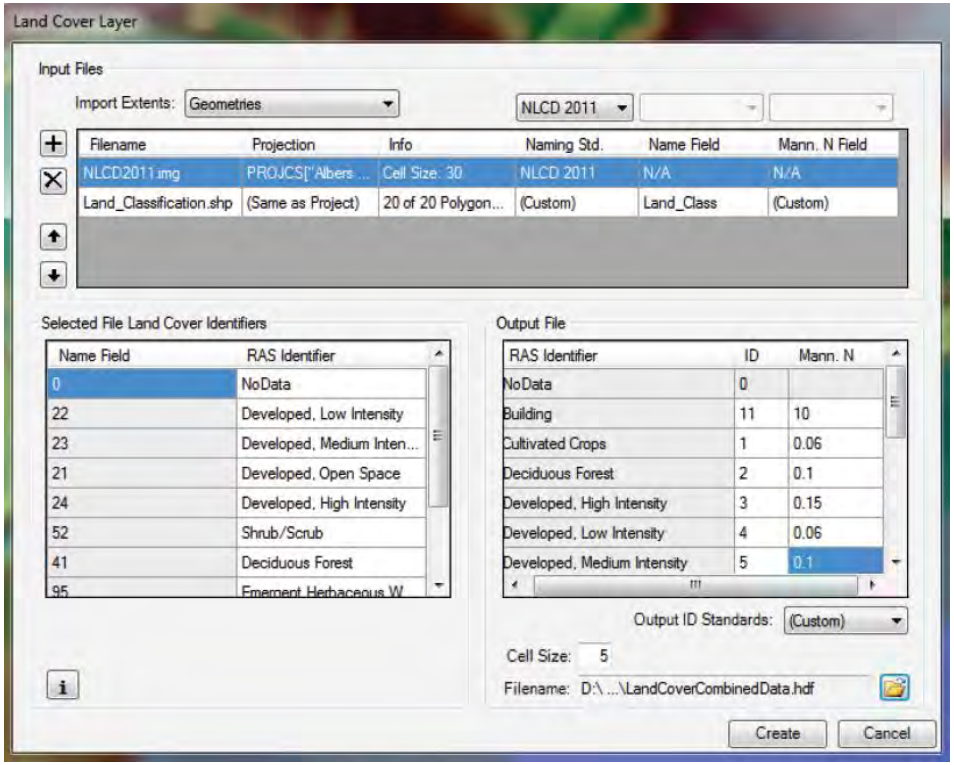
Importing Land Cover

- ***Tools → New Land Cover***
- Import extent
- Naming Convention
  - NLCD, Anderson, Custom
- Edit values in Output File "Mann. N" column
  - If attributed correctly, this will populate from input file
- Multiple Land Cover files can be created for the same project



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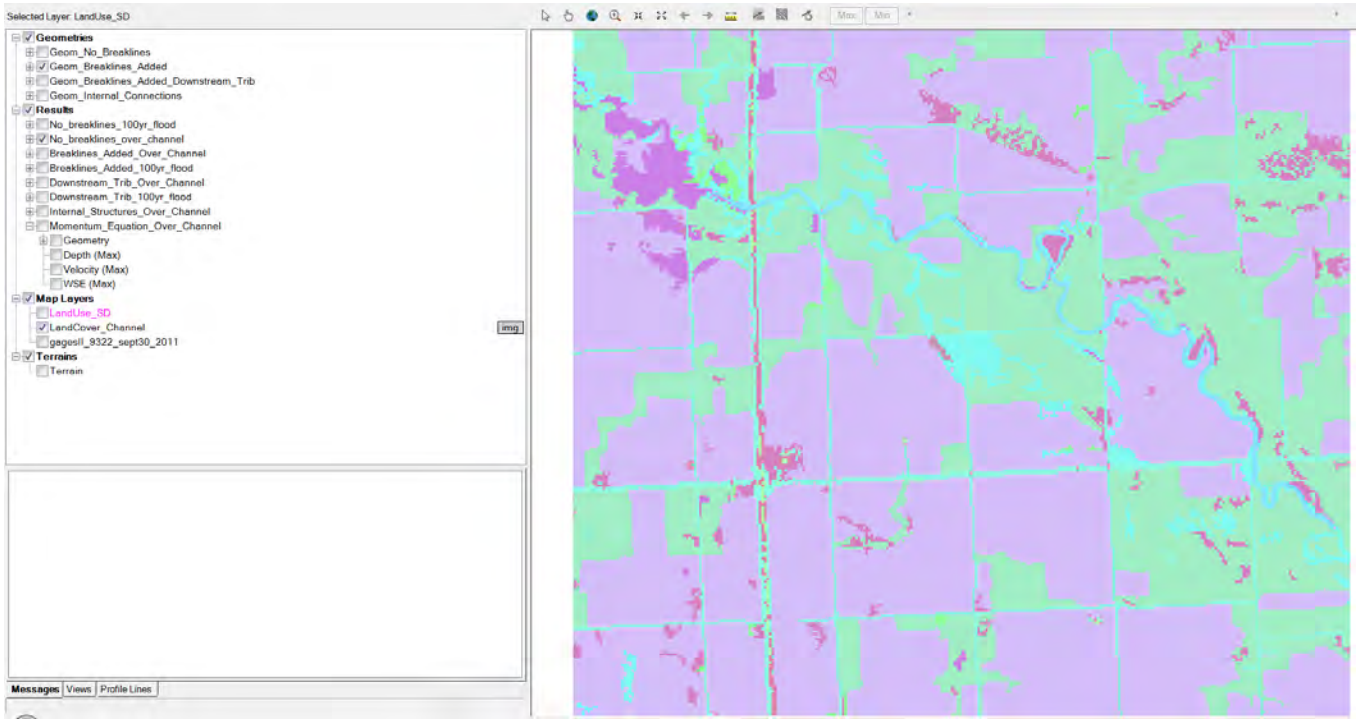
Viewing Land Cover

- After clicking the create button, RAS Mapper will process land cover dataset
- The layer will display under ***Map Layers*** in the table of contents



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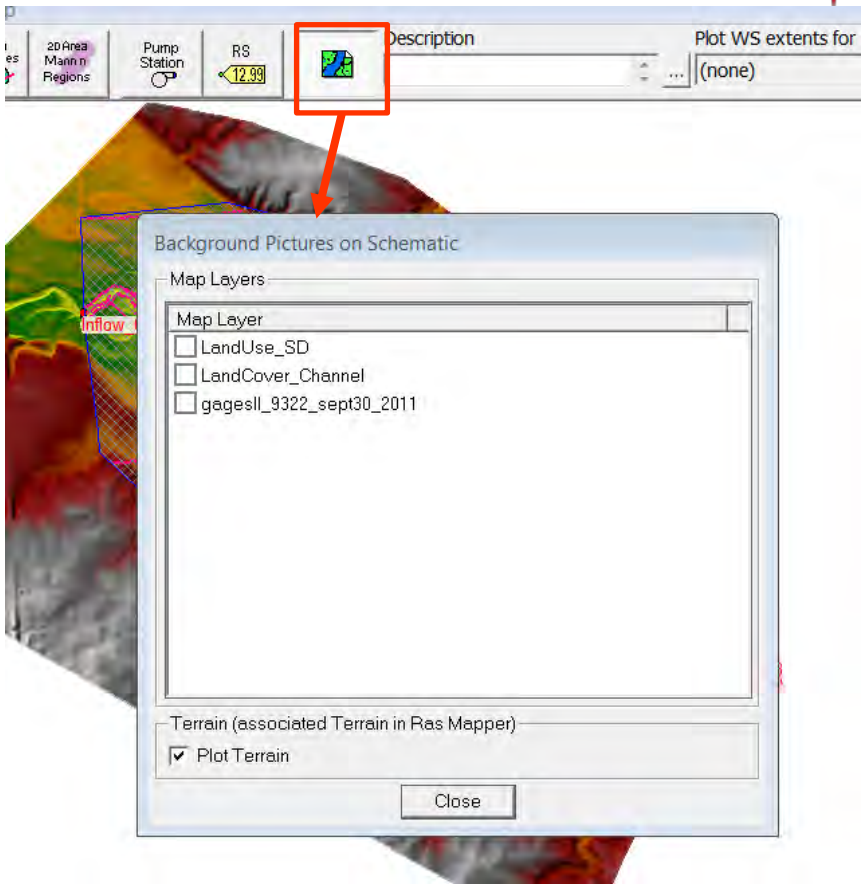
Land Cover Data

- Can view values inside of RAS Mapper and the geometry editor
- Manning's values can be changed for specific regions using geometry tools (Lecture 4)
  - Handy for sensitivity analyses



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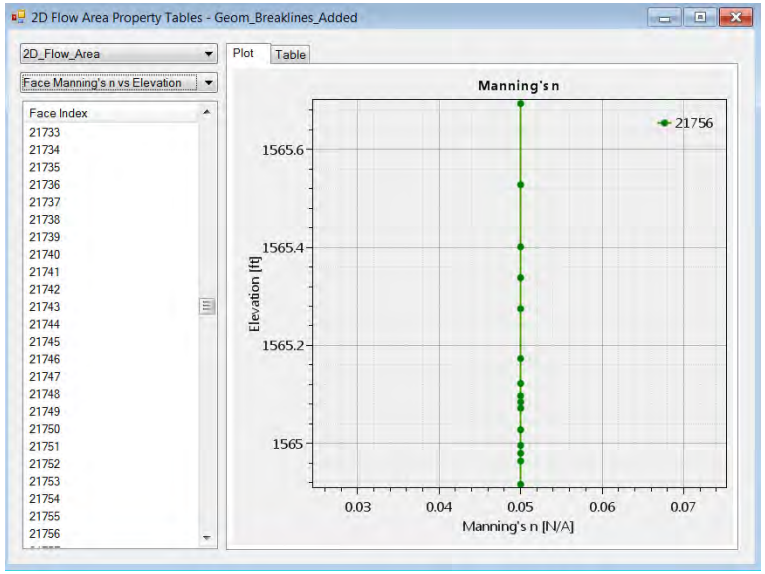
Land Cover into Mesh

- During pre-processing of the mesh, a stage-Manning's n table will be developed for each grid cell
- This table will be referenced during simulation computations



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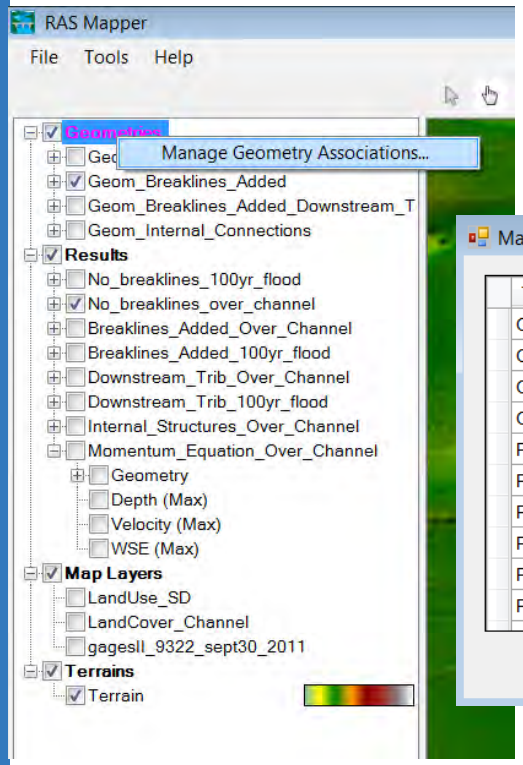
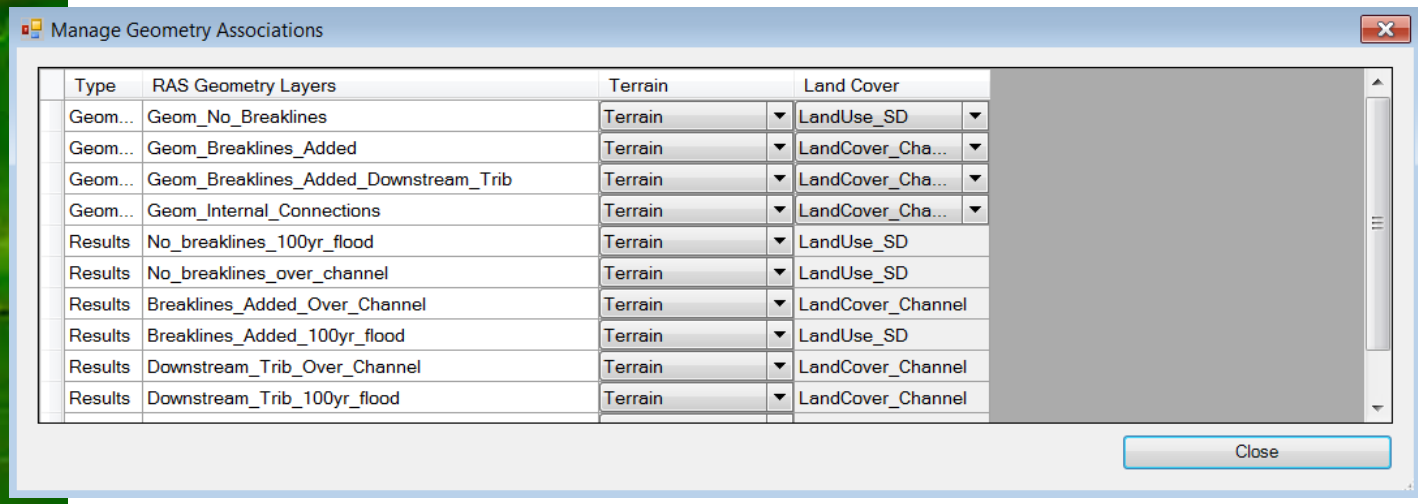
Important Project Set Up

- After creating geometry files, user must associate terrain and land cover with each geometry
- Right click ***Geometries*** in table of contents
- Select desired Terrain and Land Cover for each geometry





Type	RAS Geometry Layers	Terrain	Land Cover
Geom...	Geom_No_Breaklines	Terrain	LandUse_SD
Geom...	Geom_Breaklines_Added	Terrain	LandCover_Cha...
Geom...	Geom_Breaklines_Added_Downstream_Trib	Terrain	LandCover_Cha...
Geom...	Geom_Internal_Connections	Terrain	LandCover_Cha...
Results	No_breaklines_100yr_flood	Terrain	LandUse_SD
Results	No_breaklines_over_channel	Terrain	LandUse_SD
Results	Breaklines_Added_Over_Channel	Terrain	LandCover_Channel
Results	Breaklines_Added_100yr_flood	Terrain	LandUse_SD
Results	Downstream_Trib_Over_Channel	Terrain	LandCover_Channel
Results	Downstream_Trib_100yr_flood	Terrain	LandCover_Channel

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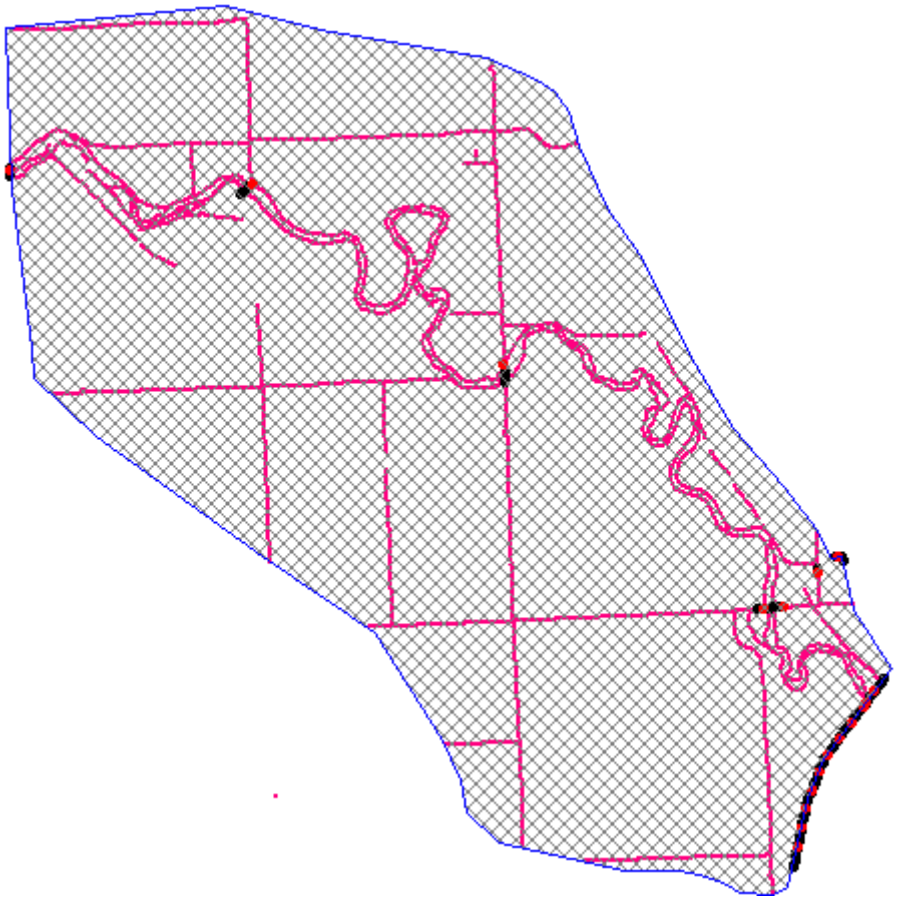
Association Issues

- Terrain not displaying in Geometry Editor?
- Might need to re-associate the terrain/geometry in RAS Mapper

Hey, where's my terrain??



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Additional RAS Mapper Functionality

- Viewing and exporting results
  - Huge improvement from previous versions of HEC-RAS
  - Allows for quick trouble-shooting
- Pre-processing grid cell mesh property tables
- More on RAS Mapper in Lectures 5 and 6

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Questions

Photo from FEMA

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