# Original Approximate Method Studies

- Approximate method studies were typically developed using drainage area based regression techniques to find depths above streambed. A flooded area was then drawn on the best available USGS Quadrangles (typically either 10-, 20- or 40-foot contour intervals).

- One method to define the flooded area was to plot a streambed profile based on the rivermile the contour lines cross the streamline. The regression based depths were added to this streambed and the resulting flood profile was interpolated (outlined) based on the shape of the contour lines.

# Possible Methods to Convert Approximate Study Streams Under the New Map Modernization Program

Adapt Old Method

- Drainage area based regression equations
- Use digitally georeferenced USGS quad or best available georeferenced digital map
- Digitize flooded area based on estimating techniques

(Generally NO BETTER THAN original flooded areas, just on better mapping)

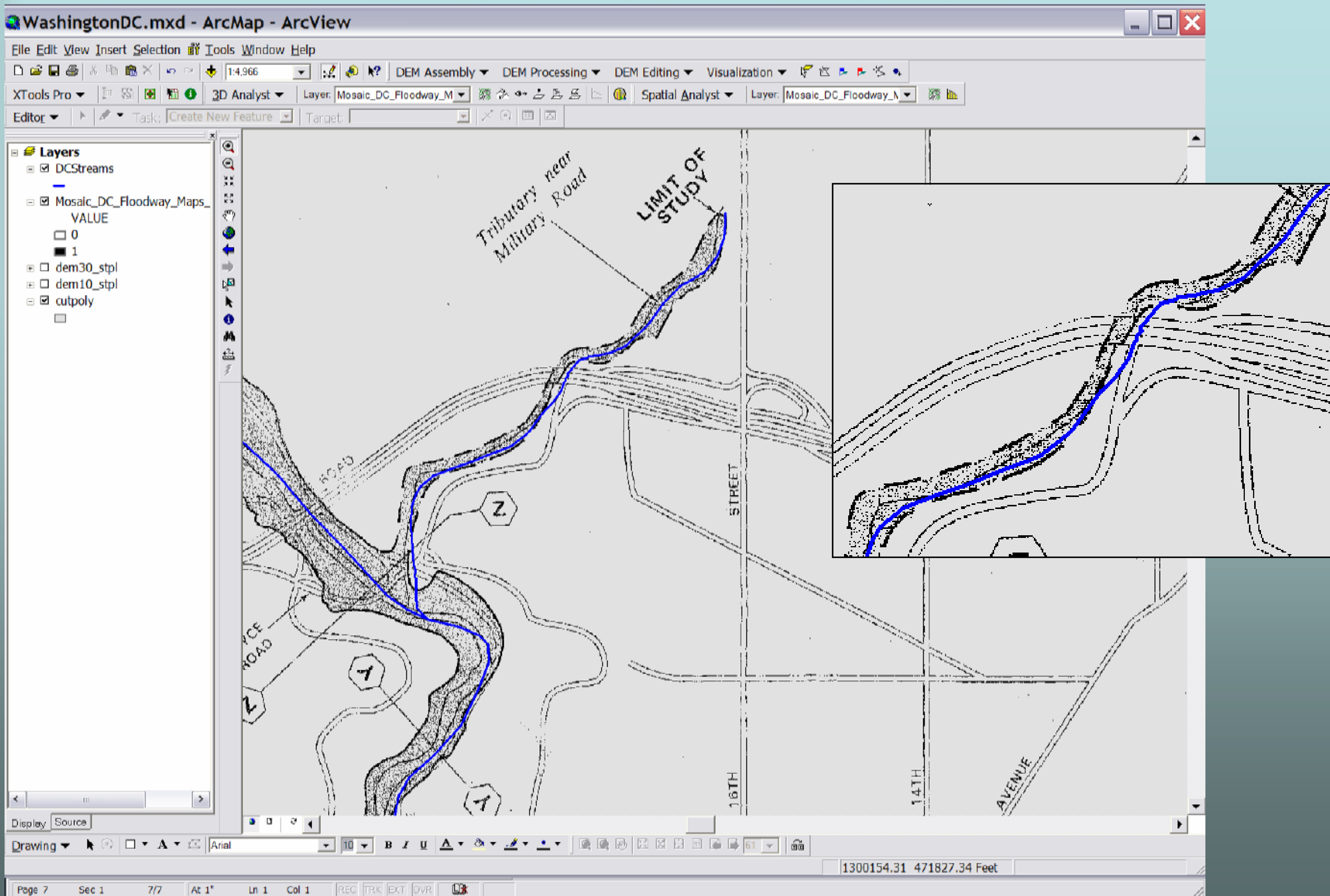
Scan and Digitize

- Scan FIS Map
- Georeference scanned map to digitally georeferenced USGS quad maps
- Digitize flood zone from georeferenced FIS map

(Problems with original flooded area as well as georeferencing problems)

Come Up With a New Method

# Georeferenced Scanned FIS Maps compared with NHD stream data

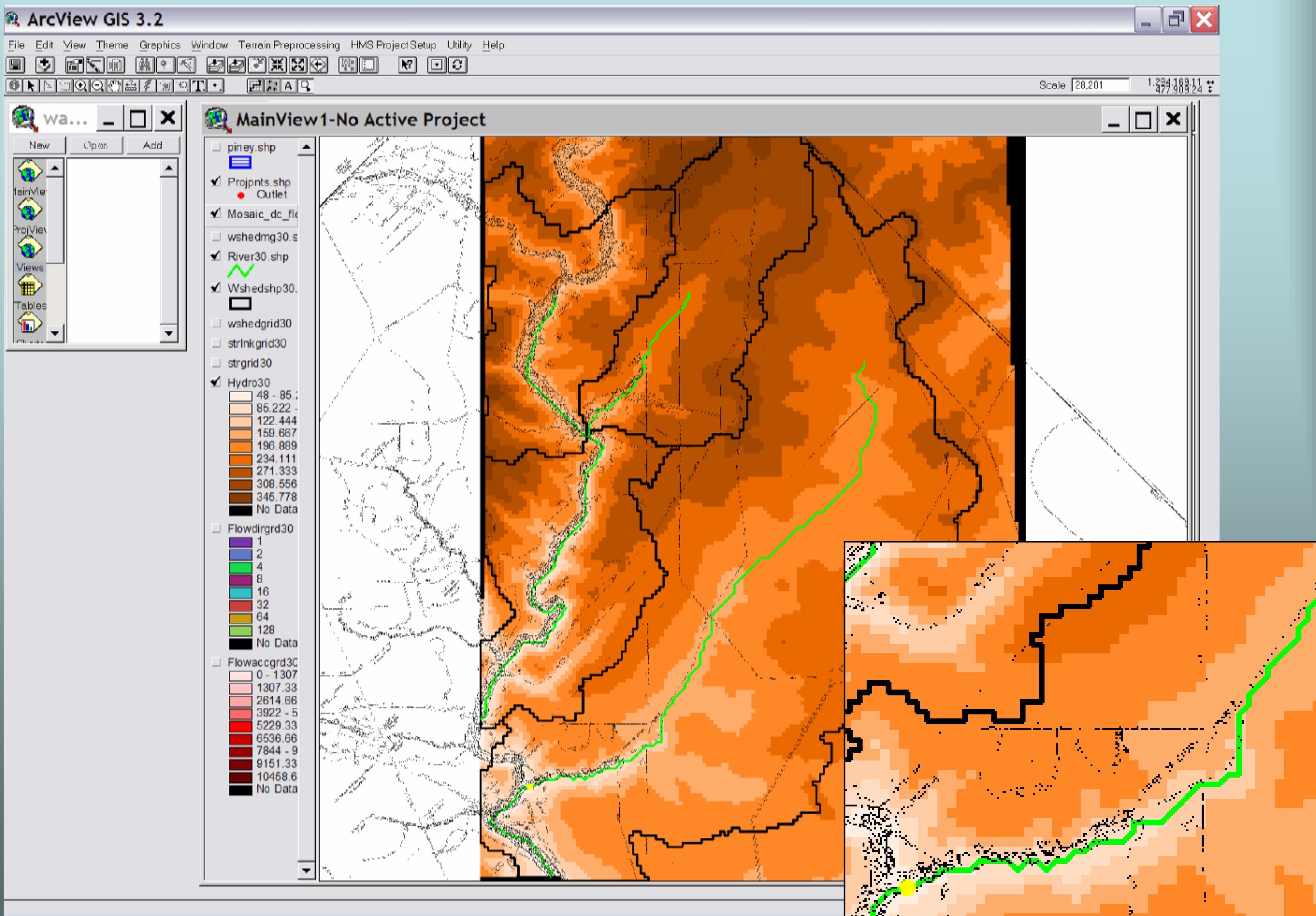


# Any new method should adapt to all available digital mapping options

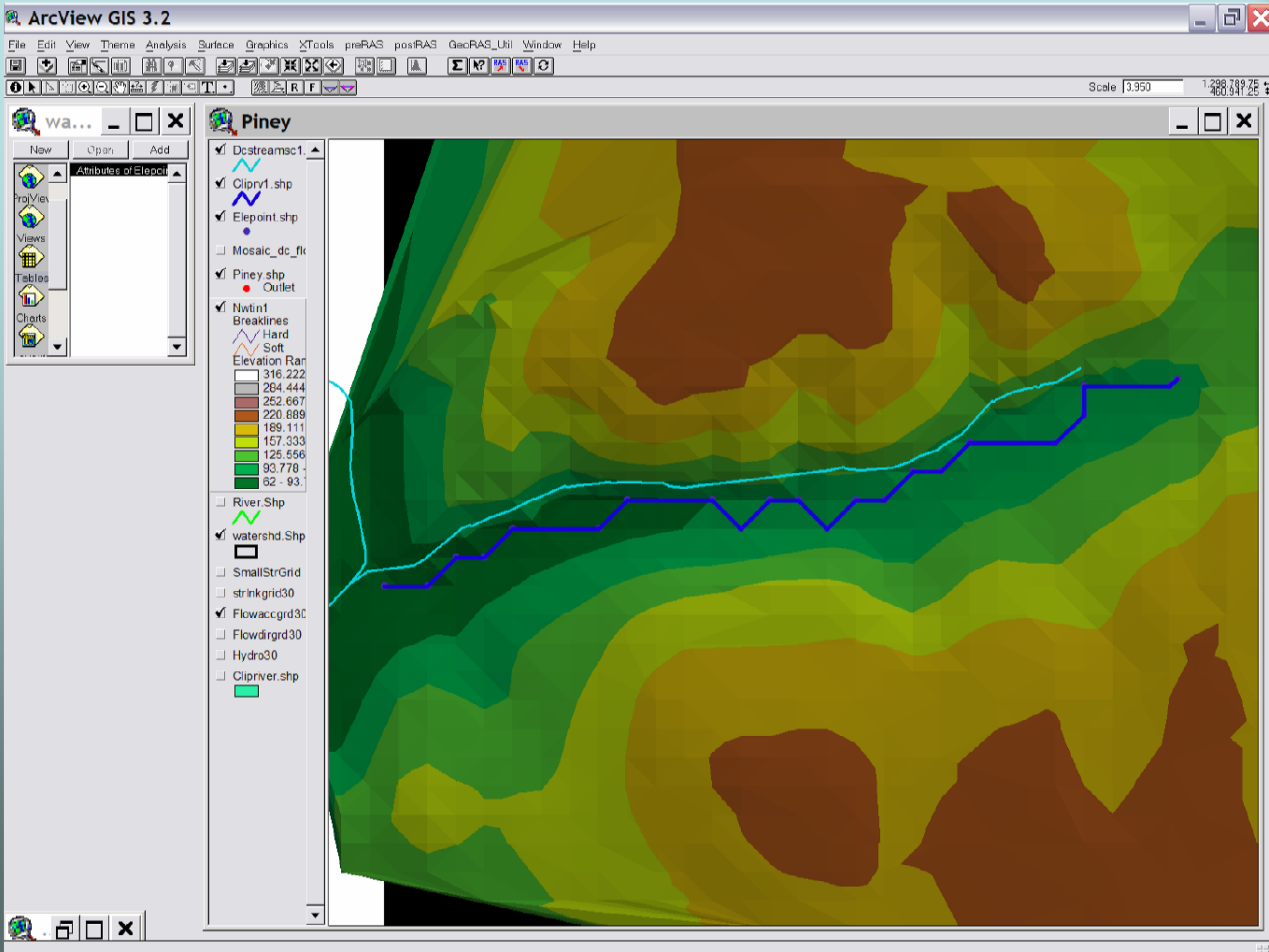
**(so choose a worst case as a test case)**

- 30-meter Digital Elevation Model (DEM)
- 10-meter DEM
- 1-meter DEM
- Light Detection and Ranging (LIDAR) data
- 5-foot or less contour maps

# View of GeoHMS developed subbasin from 30-meter DEM

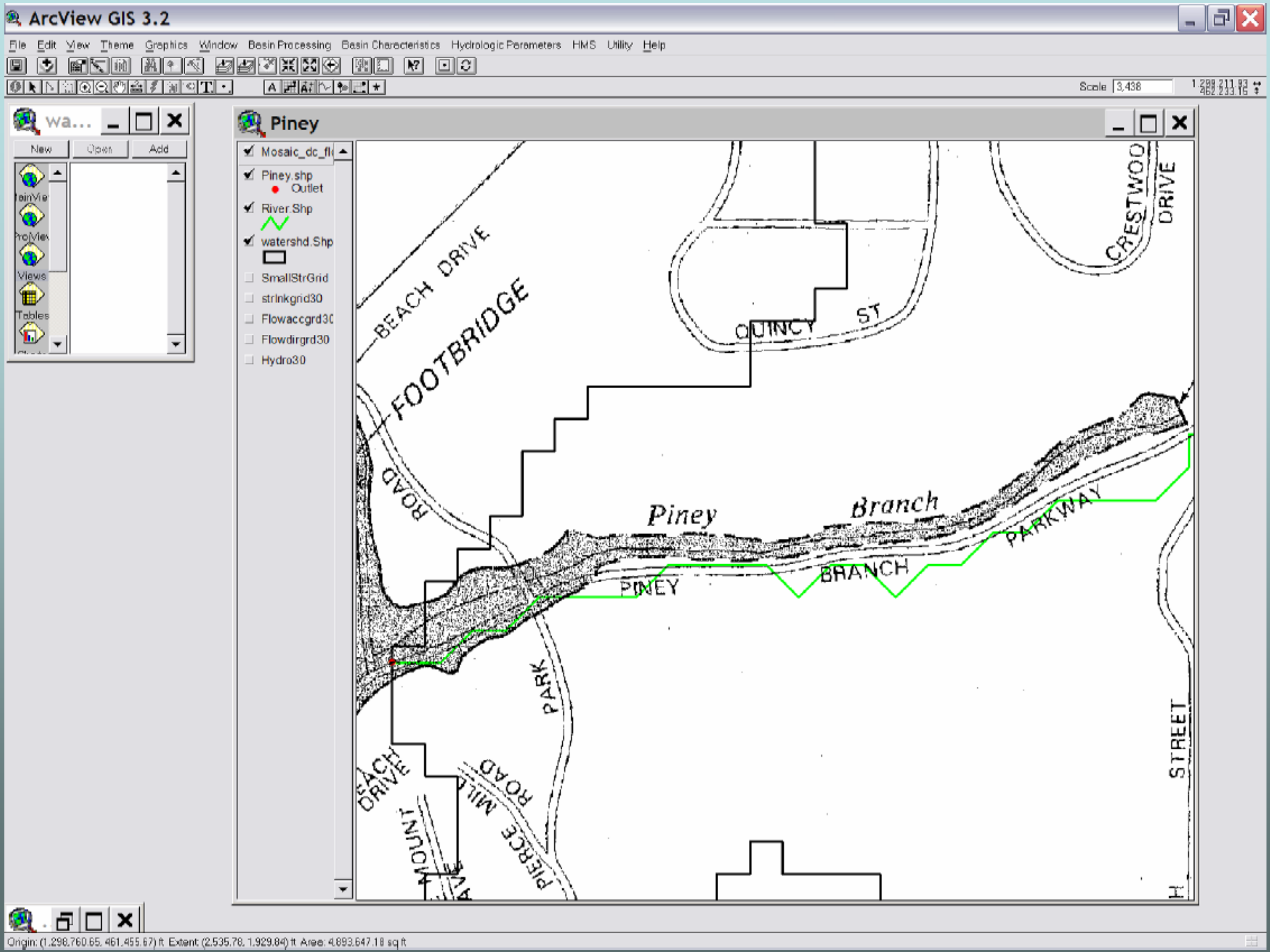


# Comparison of 30-meter DEM GeoHMS flowline and NHD



## Comparison of 30-meter DEM GeoHMS flowline overlaid on FIS Map

### (Can it be possible to use 30-meter DEM data?)



# So Let’s Begin Developing a Better Lightbulb

# Software Needed

- ArcMap 8.3
- Spatial Analyst for ArcMap 8.3
- 3D Analyst for ArcMap 8.3
- EZ GeoWizards for ArcMap 8.3
- Xtools for ArcMap 8.3
- ArcView 3.X
- Spatial Analyst for ArcView 3.X
- 3D Analyst for ArcView 3.X
- Xtools for ArcView 3.X
- GeoHMS for ArcView 3.X
- GeoRAS for ArcView 3.X
- MrSid Extension

# Let’s start with a few simple Steps

## ArcMap 8.3

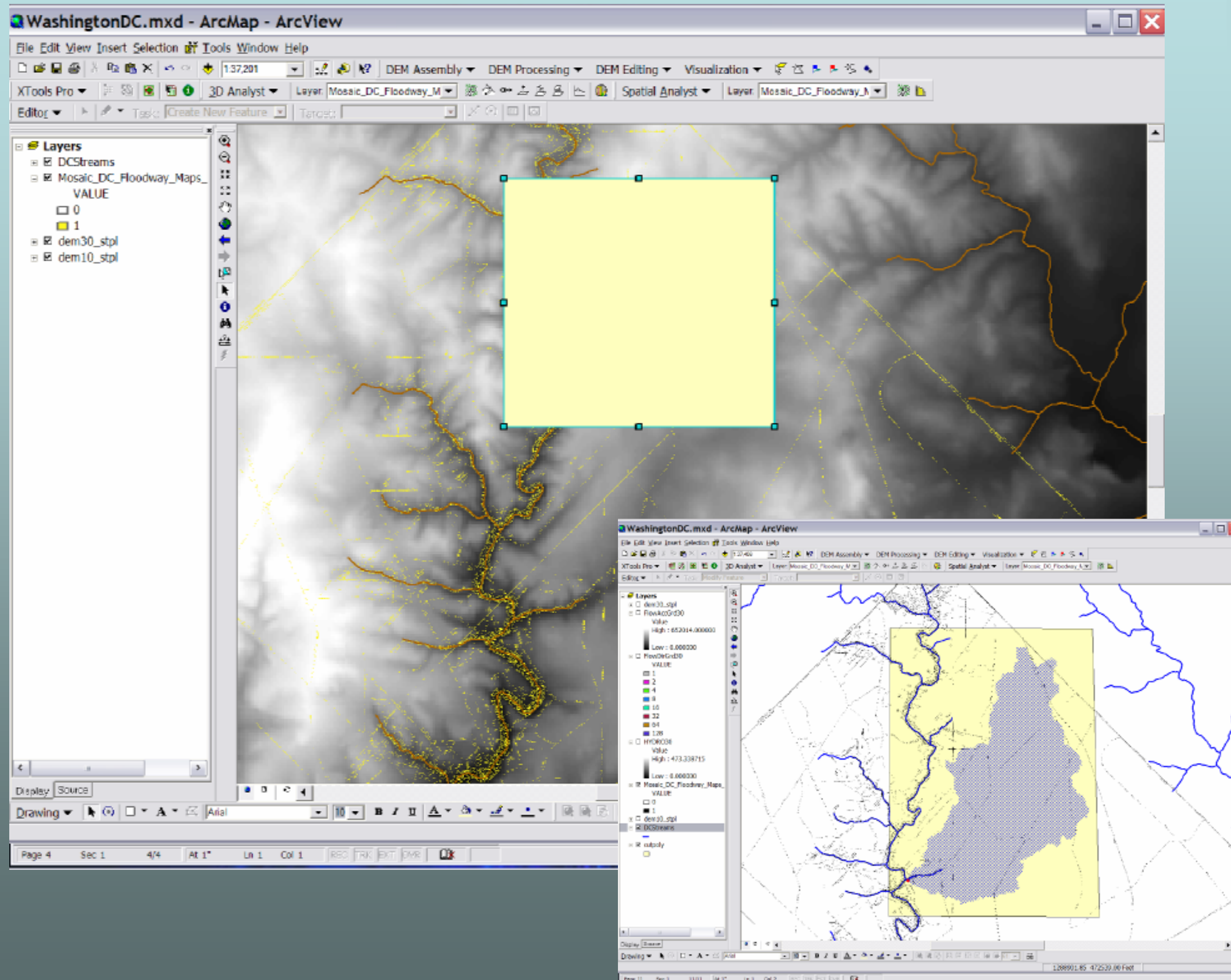
Step 1: Load base data obtained for study
Step 2: Draw a rectangle encompassing watershed
Step 3: Convert rectangle to shapefile
Step 4: Set the Extent of the data
Step 5: Clip data layers
Step 6: Digitize Stream
Step 7: Convert Vertices of the Digitized Streamline to a Points Shapefile and Add Streambed Elevations to Vertices
Step 8: Convert Points Shapefile to a 3D Line
Step 9: Densify the 3D Polyline
Step 10: Convert Dense 3-D Polyline to a Raster
Step 11: Convert 3D Polyline to a Points File
Step 12: Set an Analysis Mask Using the Raster Grid of the Stream Flowline
Step 13: Assign an Elevation to Each Cell of the Stream Grid
Step 14: Reset “Options” in Spatial Analysis
Step 15: Cropping the DEM
Step 16: Create TIN from Clipped DEM
Step 17: Create a Resampled Raster from the TIN
Step 18: Burn Stream into Resampled DEM
Step 19: Create Final TIN from Resampled Grid using 3D Analyst
Step 20: Run the HEC ArcMap Software
Step 21: Create Flowlines
Step 22: Create Top of Bank lines

## ArcView 3.X

Step 1: Prepare ArcView
Step 2: Add data created previously in ArcMap
Step 3: Step through GeoHMS Terrain Preprocessing
Step 4: Create Study Area
Step 5: HMS Basin Characteristics
Step 6: HMS Export File Creation
Step 7: Export Basin Data for Input into EXCEL
Step 8: Import ArcView Table into EXCEL
Step 9: Create a HMS File
Step 10: Import the Basin File Created in ArcView
Step 11: Bring in the Basin Map Created in ArcView
Step 12: Enter the Hydrologic Parameters into HMS
Step 13: Get Hypothetical Rainfall Data from Internet
Step 14: Input Frequency Rainfall Data into a HMS MET file
Step 15: Set a Control Specification and Run Model
Step 16: Begin Developing RAS Export File using GeoRAS
Step 17: Covert Stream, banks and flowlines to GeoRAS Shapefiles
Step 18: Create Cross Sections for RAS model
Step 19: Complete preRAS Processing
Step 20: Create HEC-RAS file to Import GIS RAS file
Step 21: Set Bank Stations and n-values
Step 22: Improve geometry data
Step 23: Input Steady Flow Data, Run and Export GIS data
Step 24: Input UnSteady Flow Data, Run and Export GIS data
Step 25: Run postRAS in ArcView for Steady Flow
Step 26: Run postRAS in ArcView for Unsteady Flow

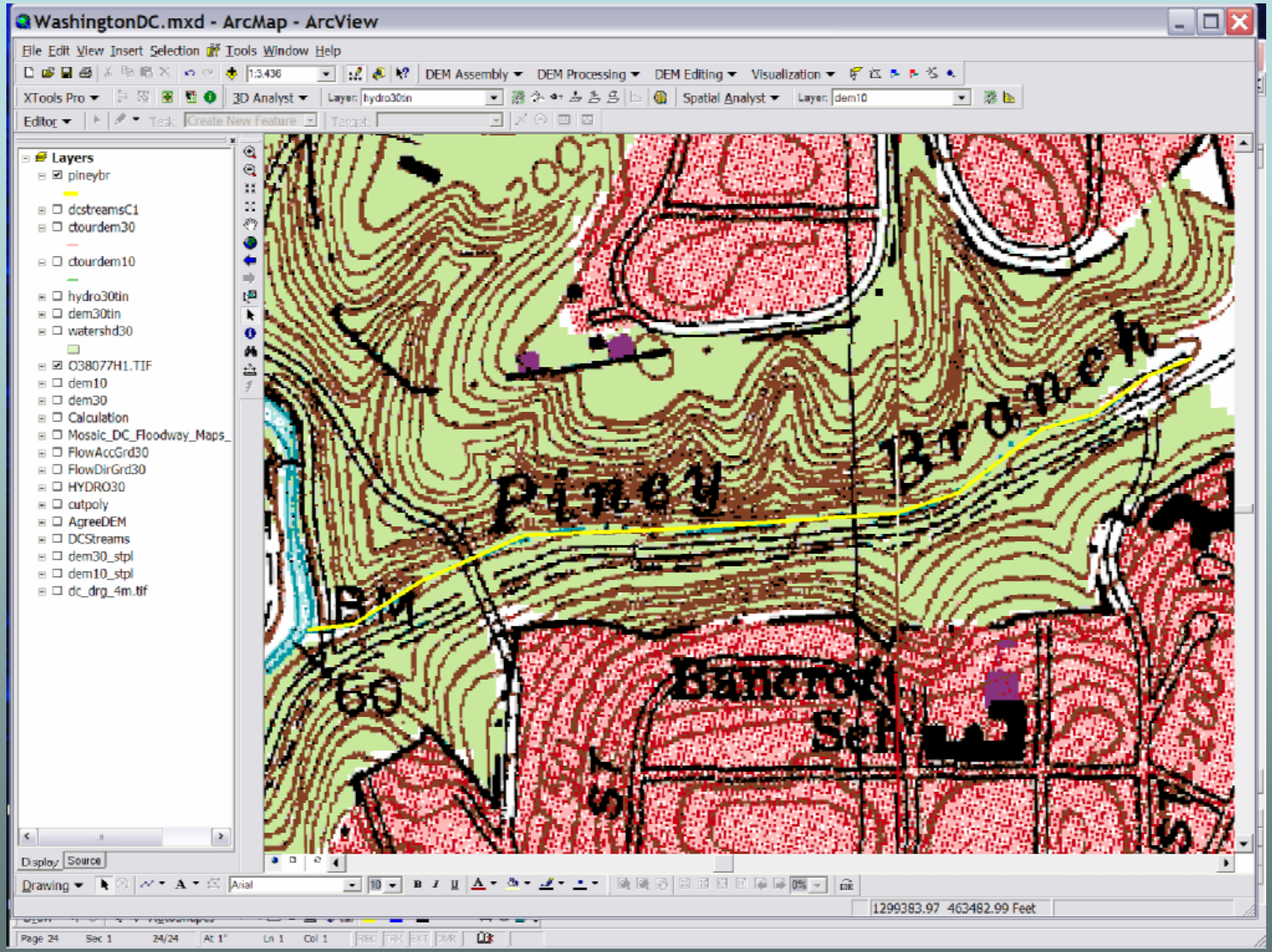
# Clip Only Data Needed!

Step 1: Load base data obtained for study
Step 2: Draw a rectangle encompassing watershed
Step 3: Convert rectangle to shapefile
Step 4: Set the Extent of the data
Step 5: Clip data layers



# Digitize stream using best available data and fewest vertices needed (Quad Map assumed as worst case)

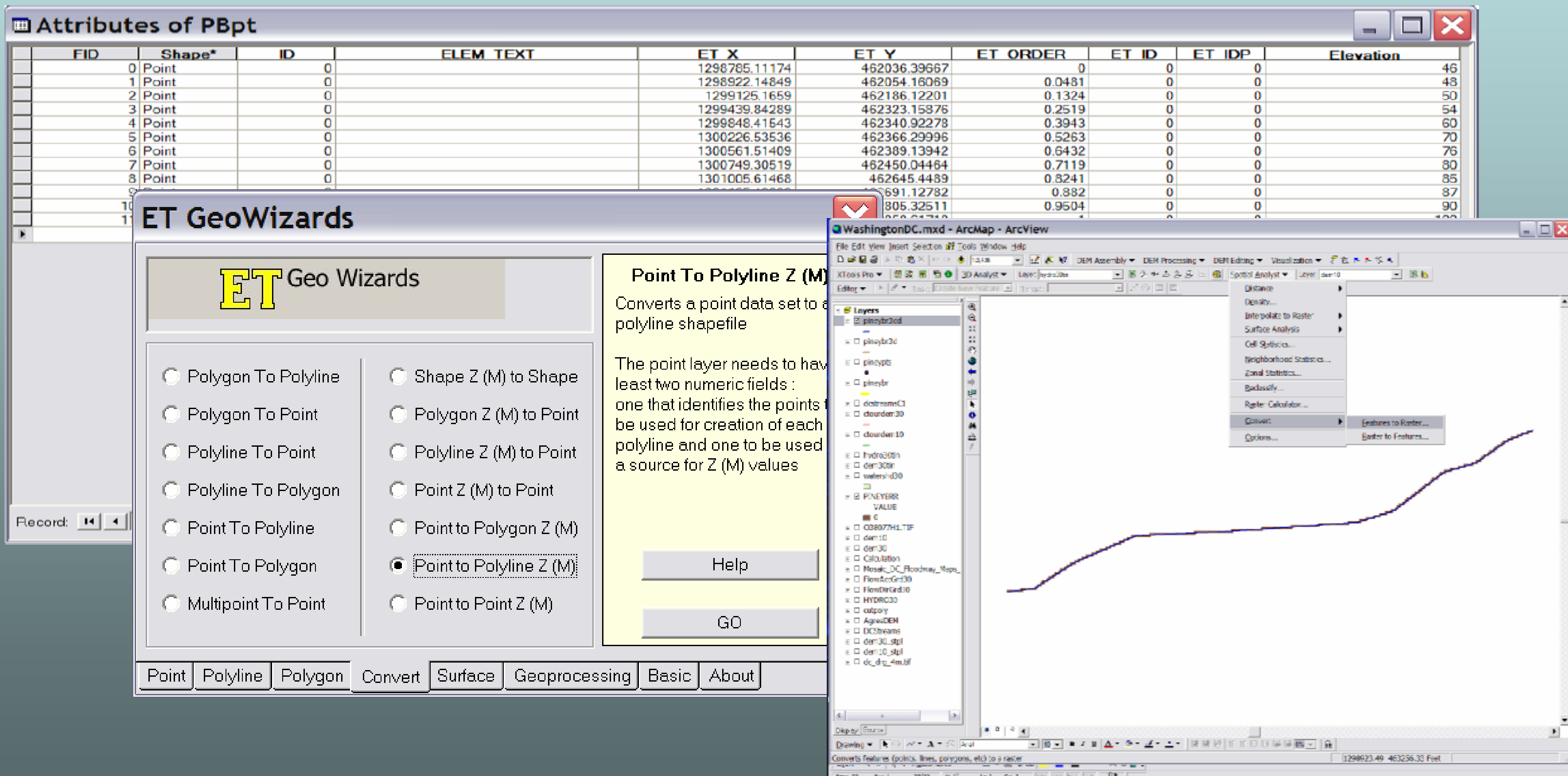
Step 6: Digitize Stream



# Add elevations to each of the vertices defining the stream

Step 7: Convert Vertices of the Digitized Streamline to a Points Shapefile and Add Streambed Elevations to Vertices

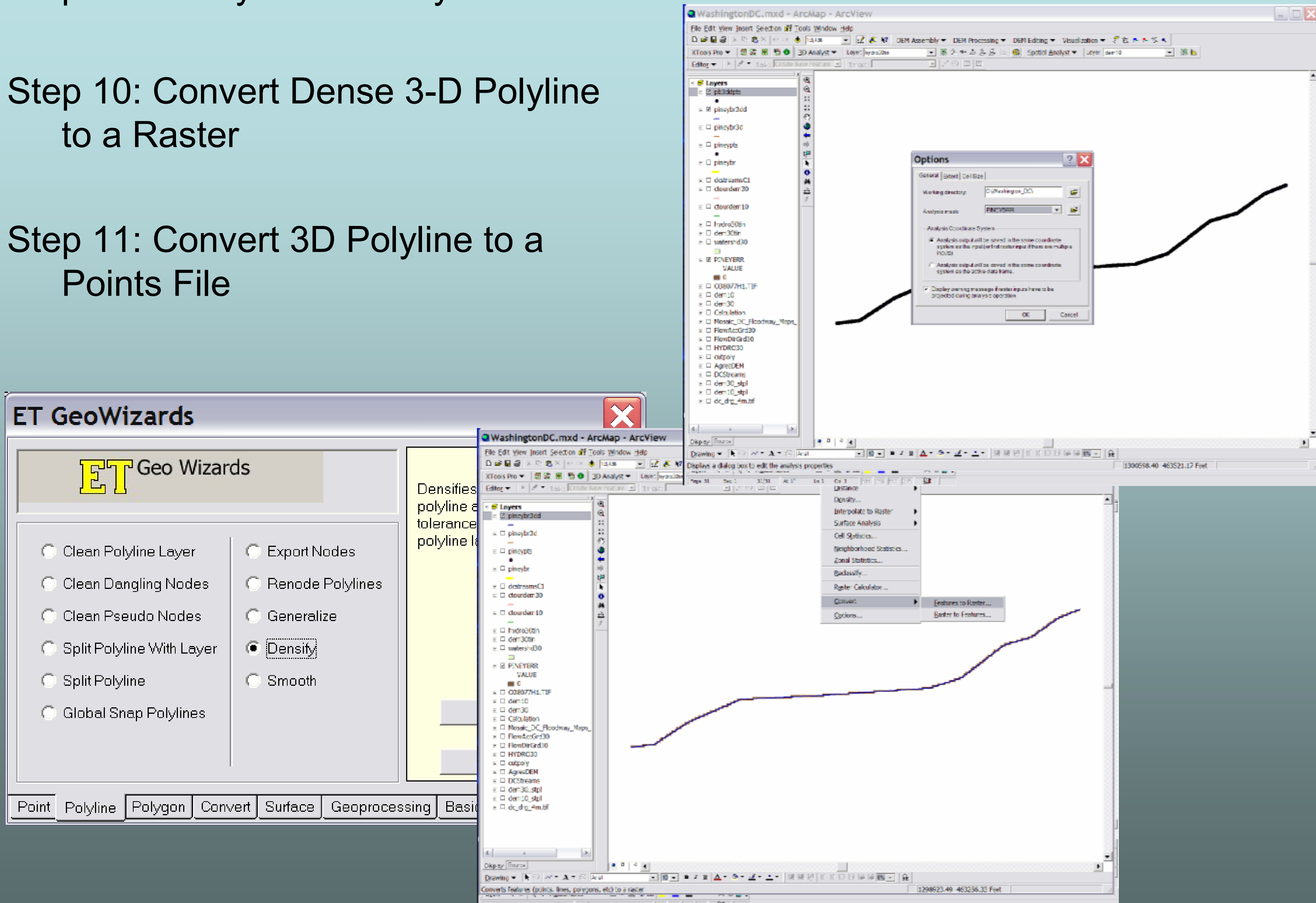
Step 8: Convert Points Shapefile to a 3D Line Vertices of the Digitized Streamline to a Points Shapefile and Add Streambed Elevations to Vertices



Step 9: Densify the 3D Polyline

Step 10: Convert Dense 3-D Polyline to a Raster

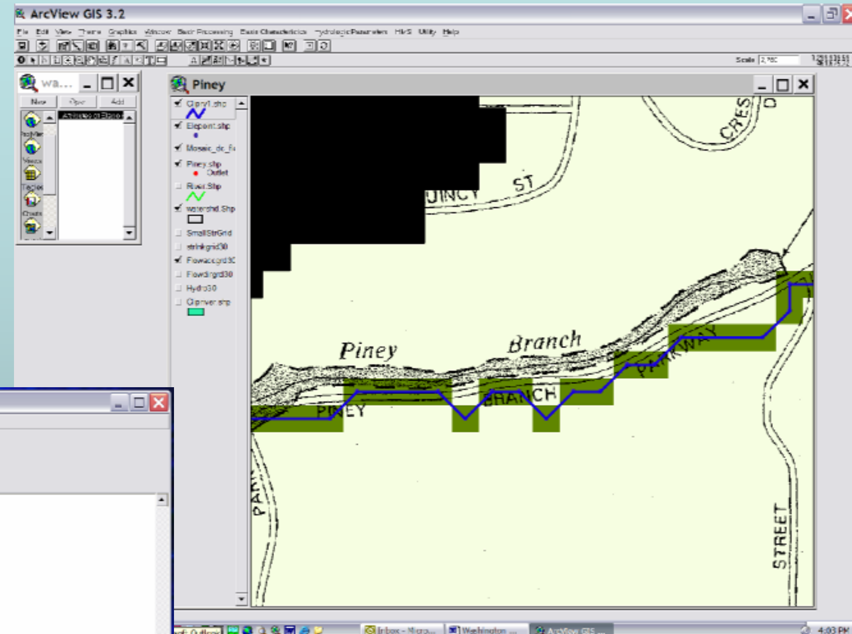
Step 11: Convert 3D Polyline to a Points File

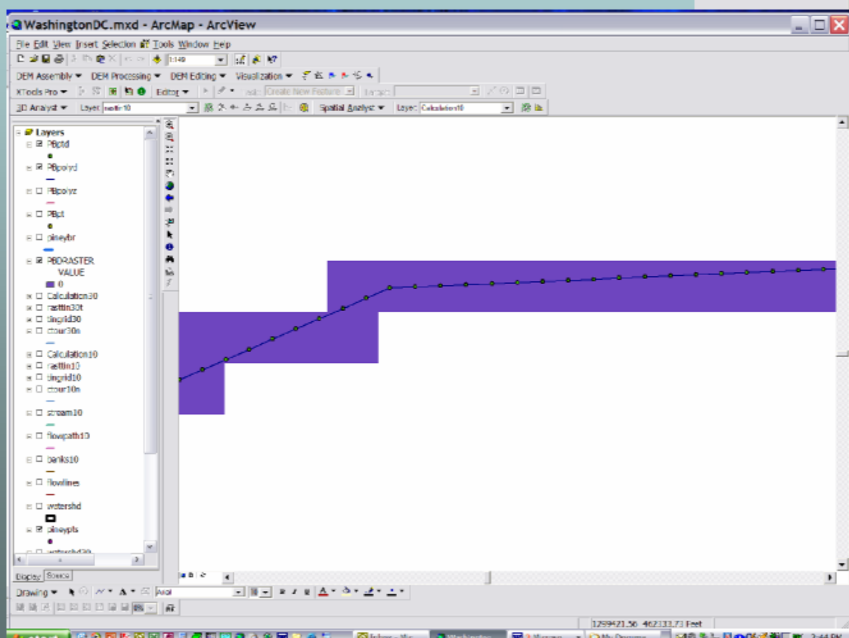


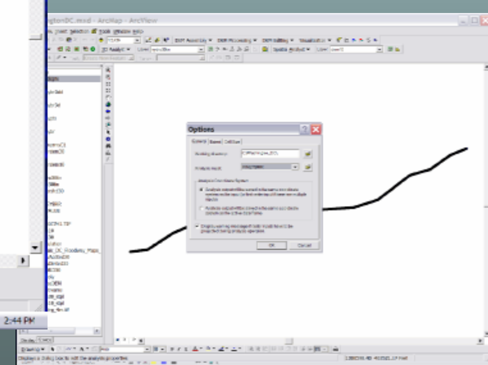
# Properly prepare DEM to burn in stream

Step 12: Set an Analysis Mask Using the Raster Grid of the Stream Flowline

Step 13: Assign an Elevation to Each Cell of the Stream Grid

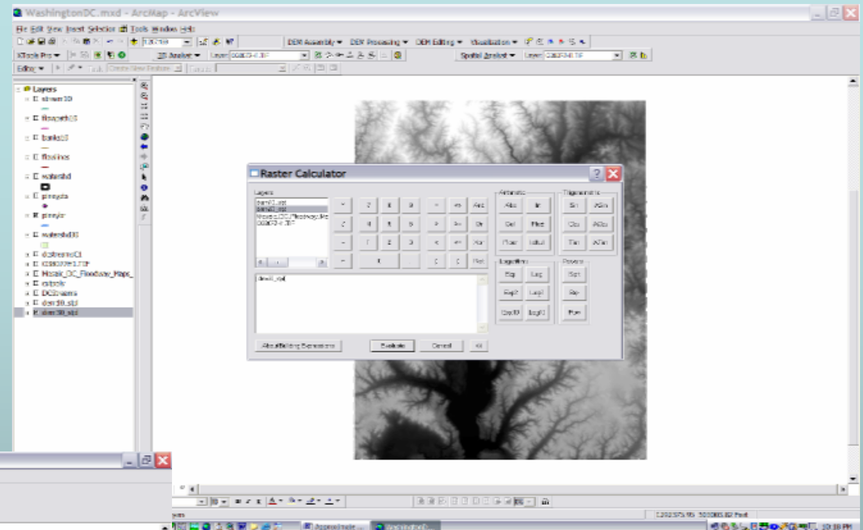


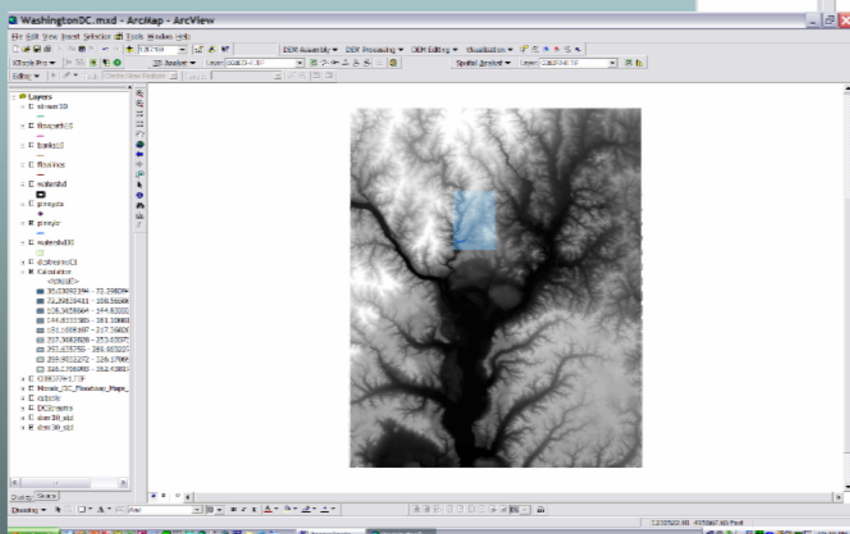



Step 14: Reset "Options" in Spatial Analysis

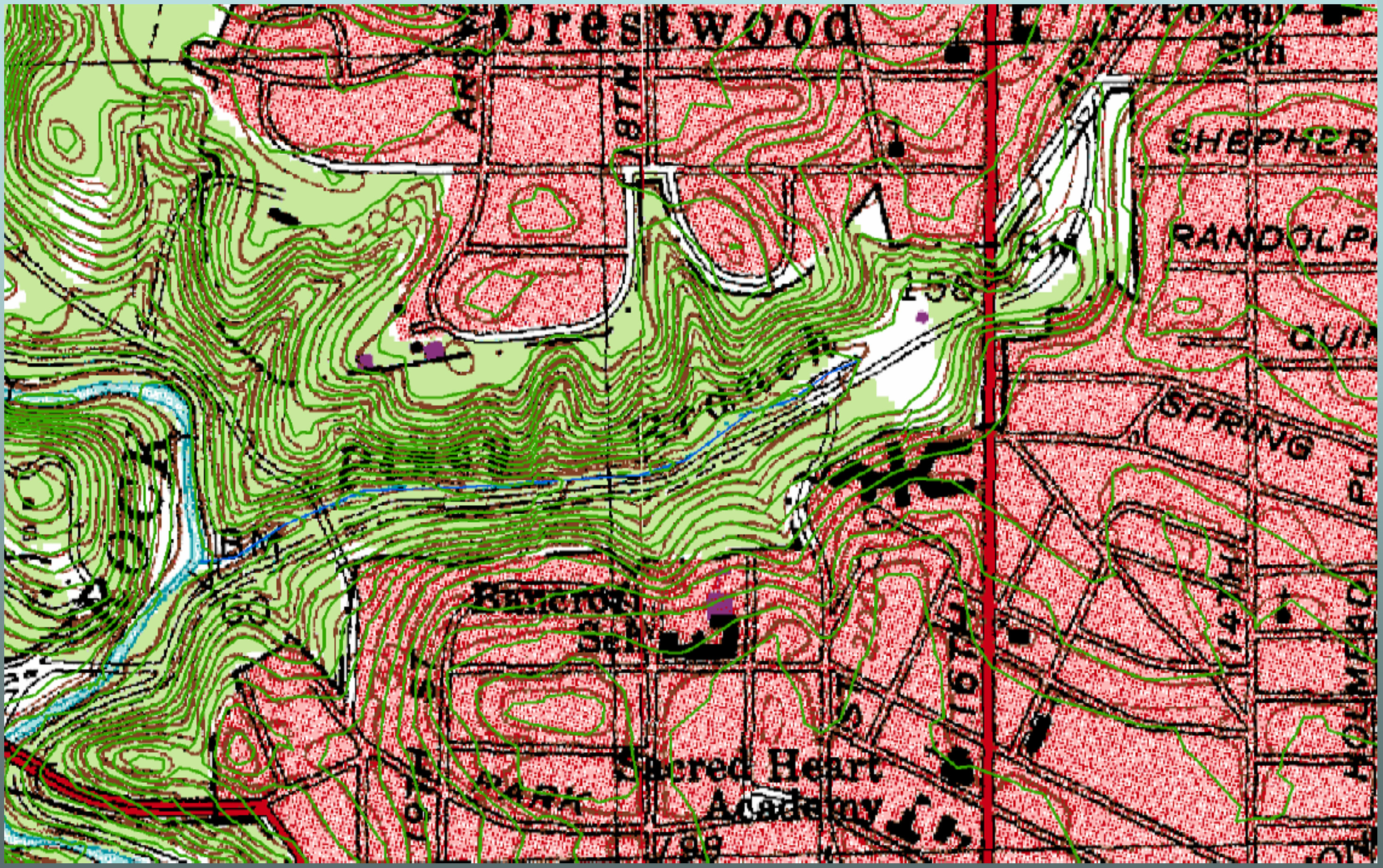
Step 15: Cropping the DEM



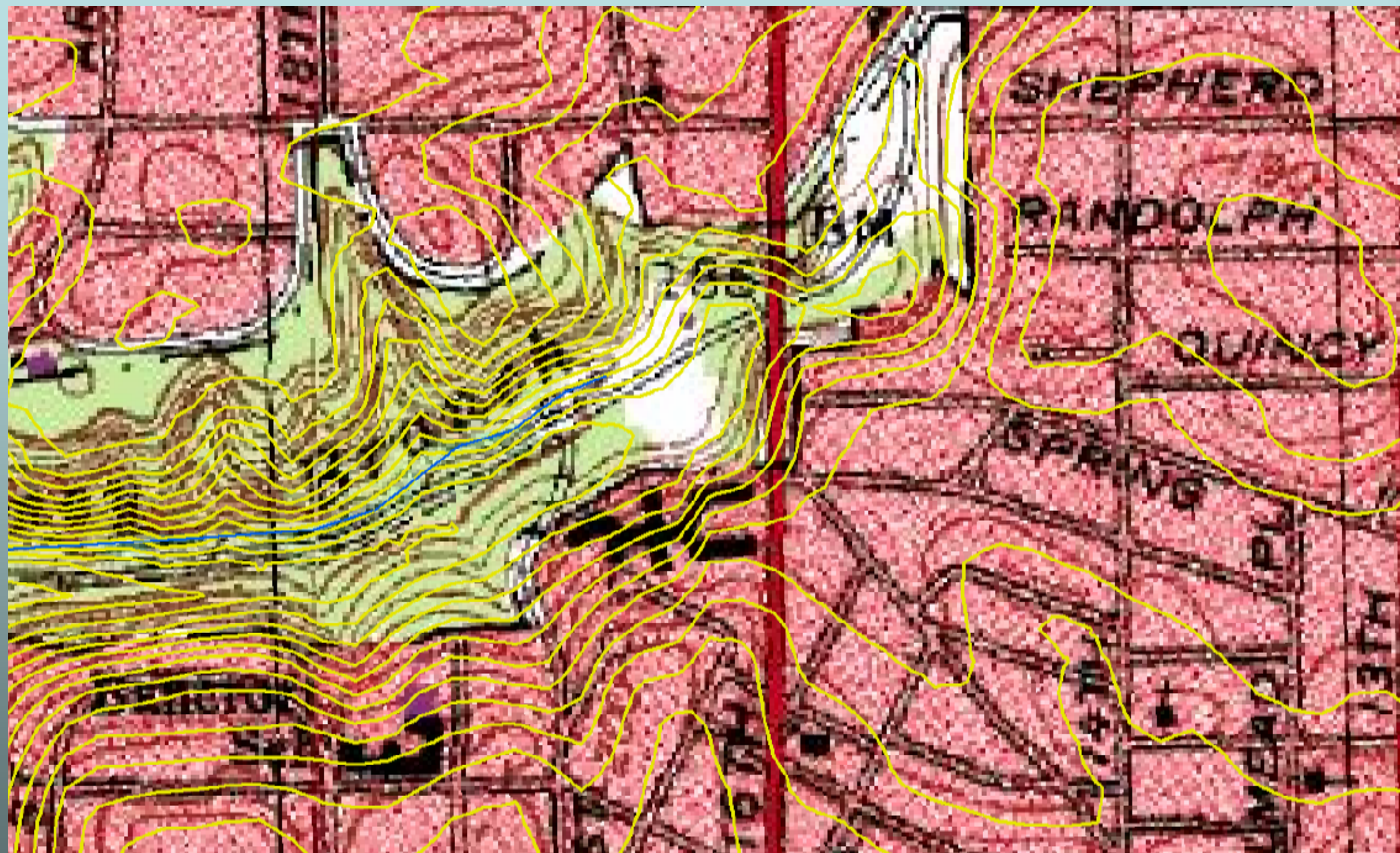
# Quick Check by Comparing 10-meter DEM at this point to 10-foot contour Quad

- Compute Contours to make comparison
- First check 10-meter DEM



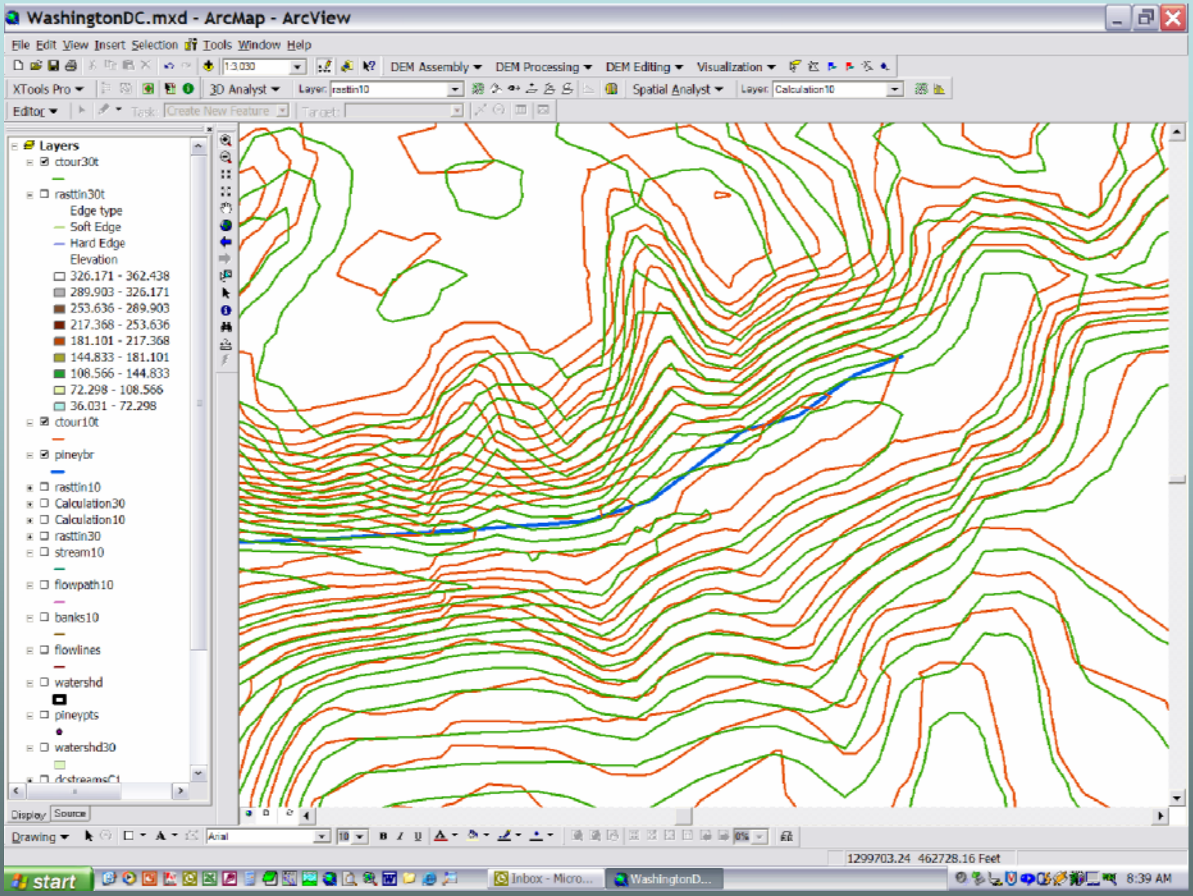
# Quick Check by Comparing 30-meter DEM at this point to 10-ft contour Quad

- Compute Contours to make comparison
- Next check 30-meter DEM



# Quick Check by Comparing 30-meter DEM at this point to 10-meter DEM

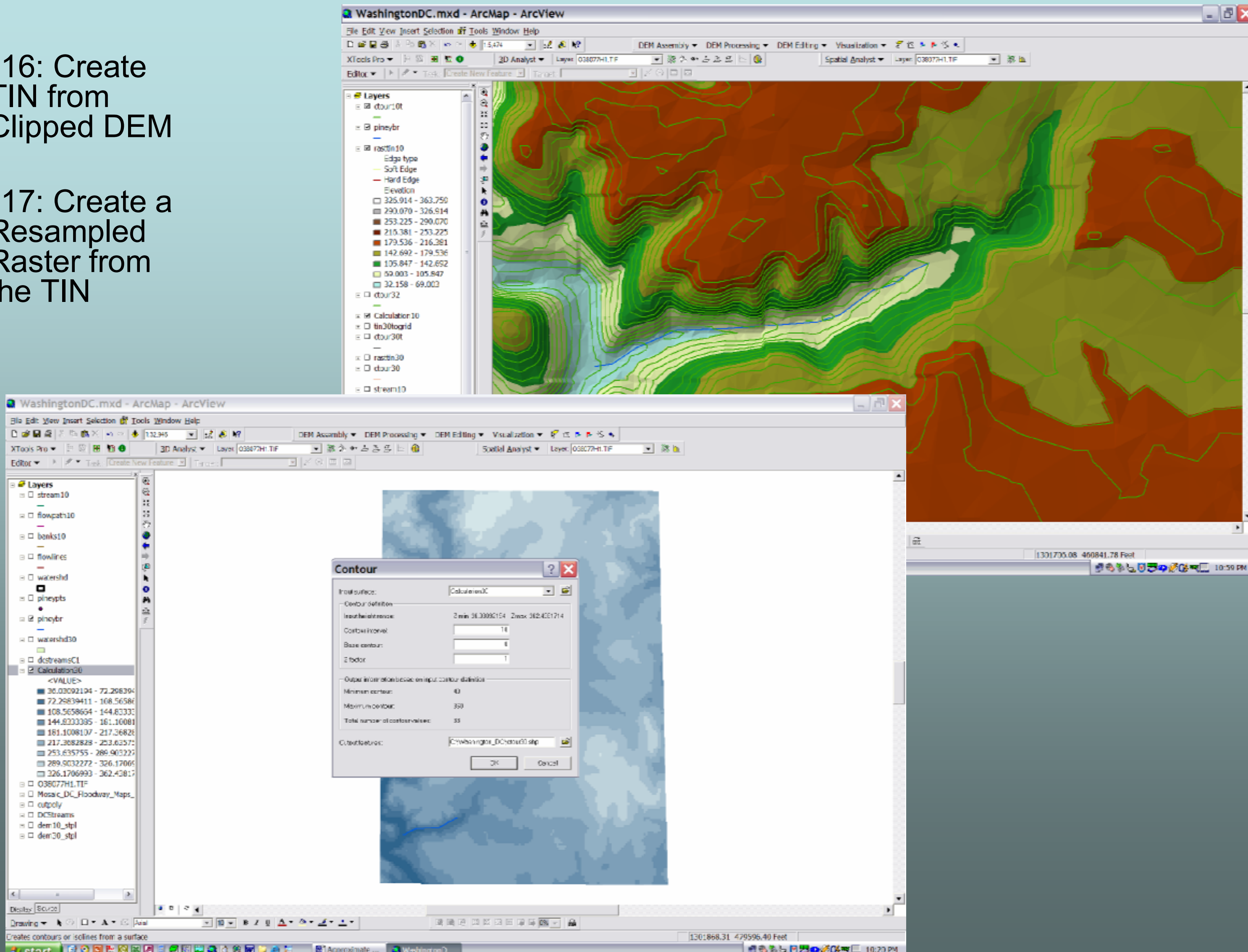
- Overlay of only the Contours to make comparison
- Looks pretty bad so far!



# Create a TIN from 30-meter DEM then Resample a 10-foot DEM from the TIN

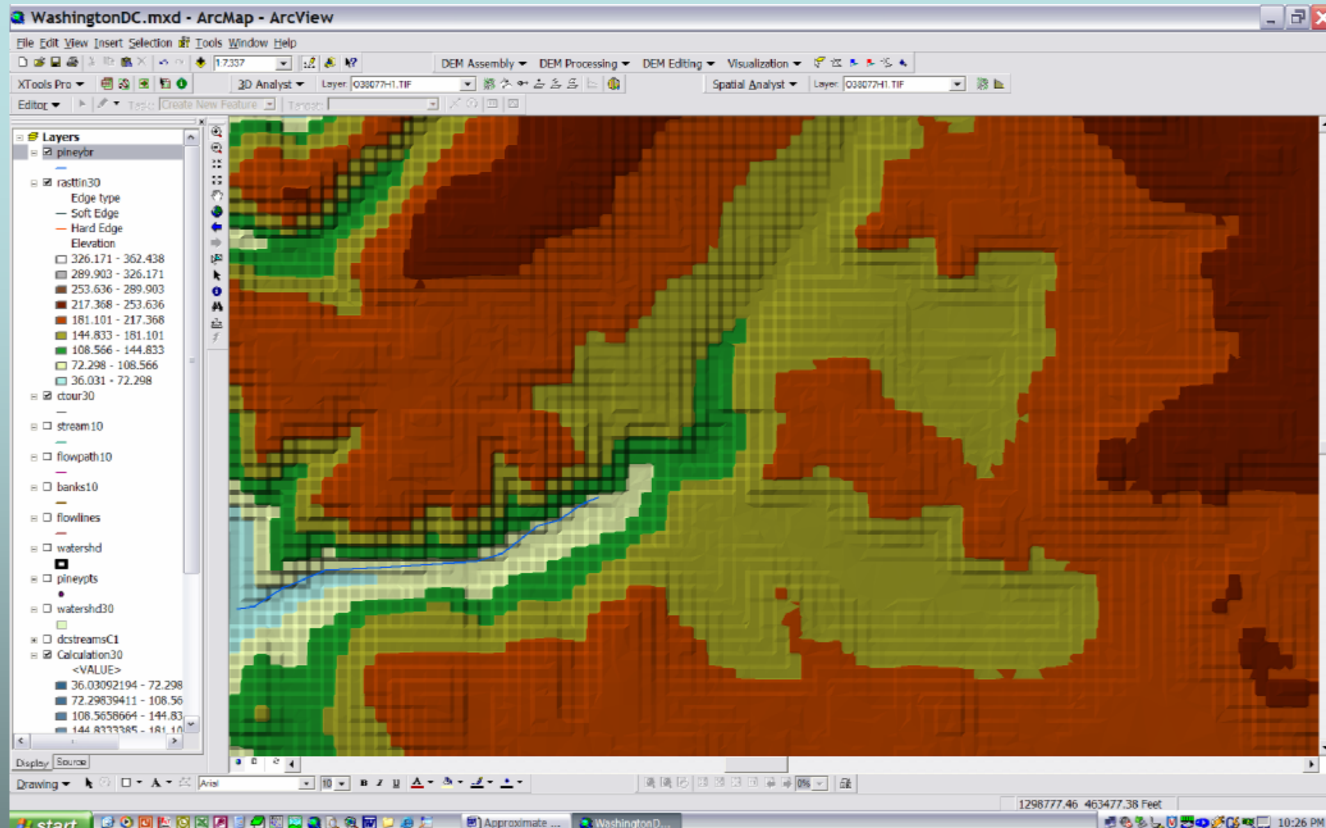
Step 16: Create TIN from Clipped DEM

Step 17: Create a Resampled Raster from the TIN



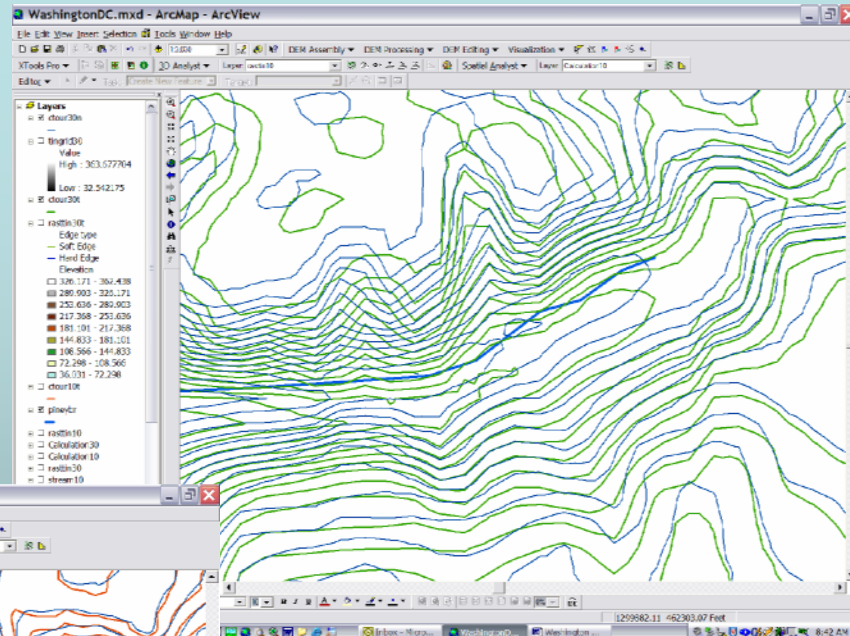
# OOOPs

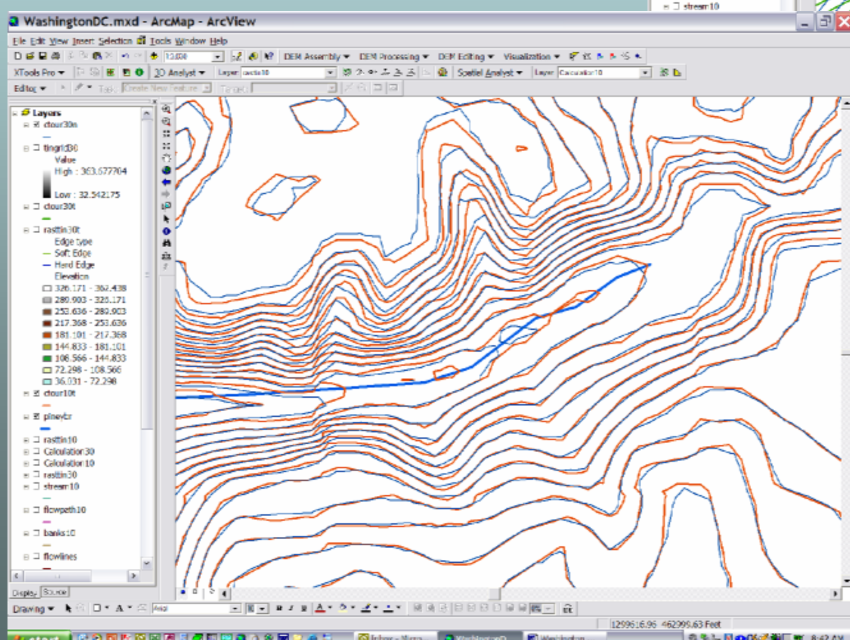
- This is what a TIN looks like if the wrong cell size of the original 10-meter DEM is entered as 10 feet



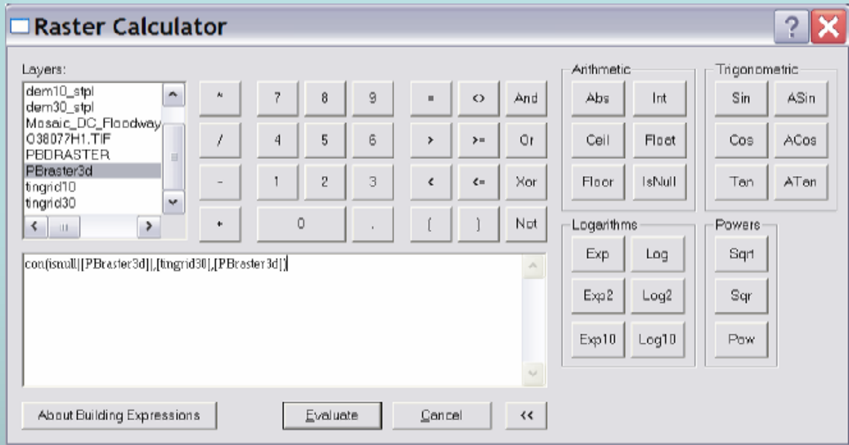
# Improvement by Resampling DEM from a TIN

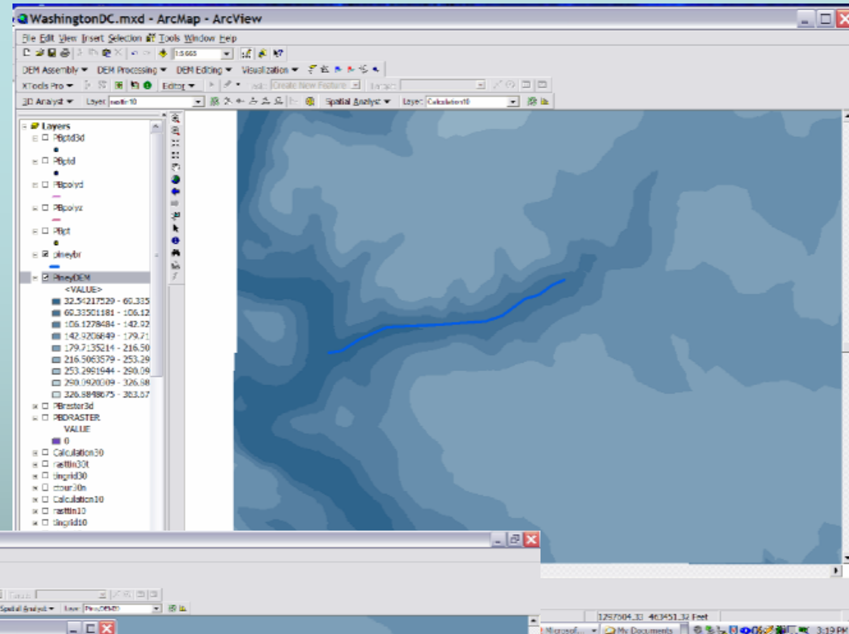
- Let's check for any improvements by resampling a 10-foot DEM from a TIN based on a 30-meter DEM

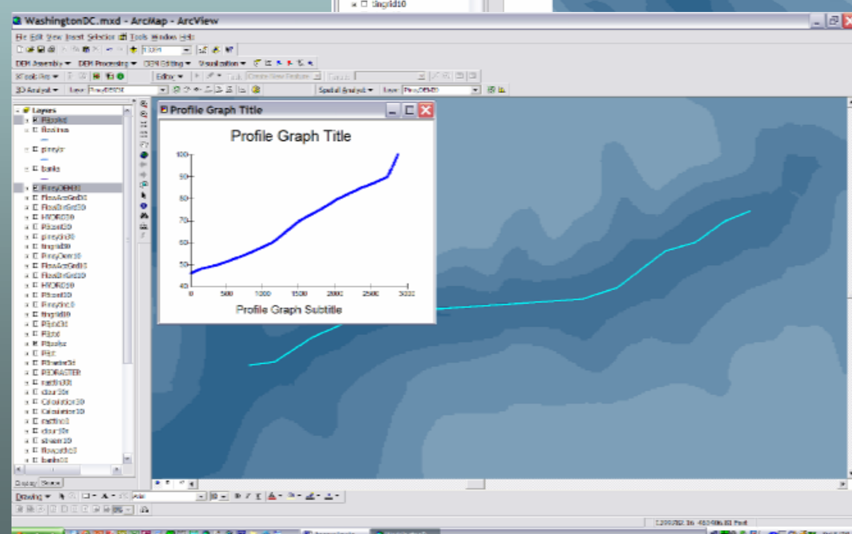


# Step 18: Burn Stream into Resampled DEM using Stream DEM created in Steps 12 and 13



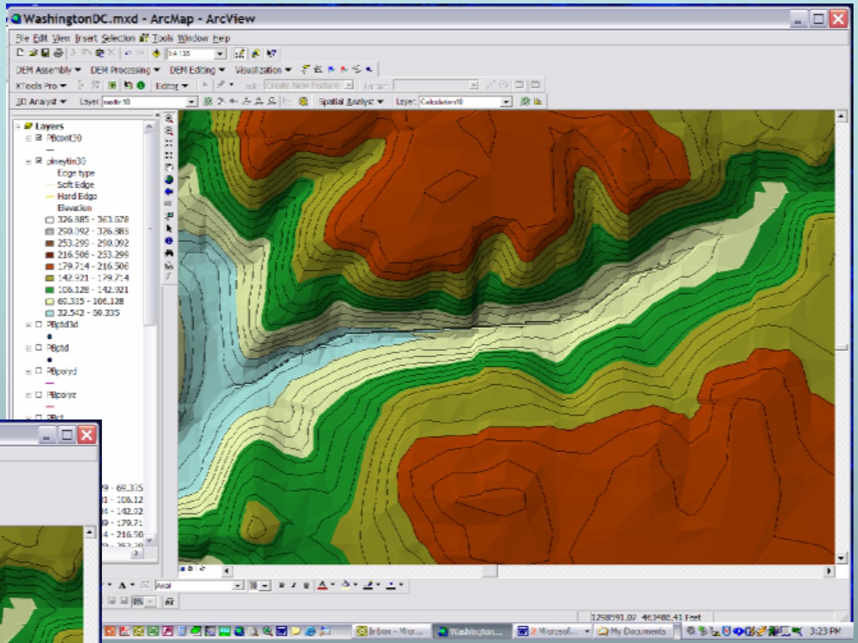



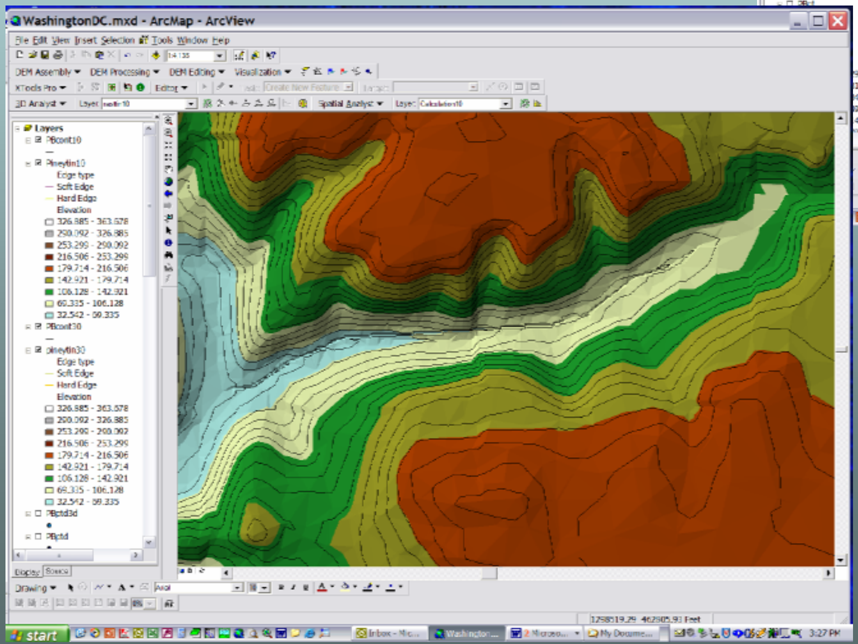




To insure the stream is burned in, the elevations on the grid under the digitized stream line can be plotted

# Step 19: Create Final TIN from Resampled Grid using 3D Analyst

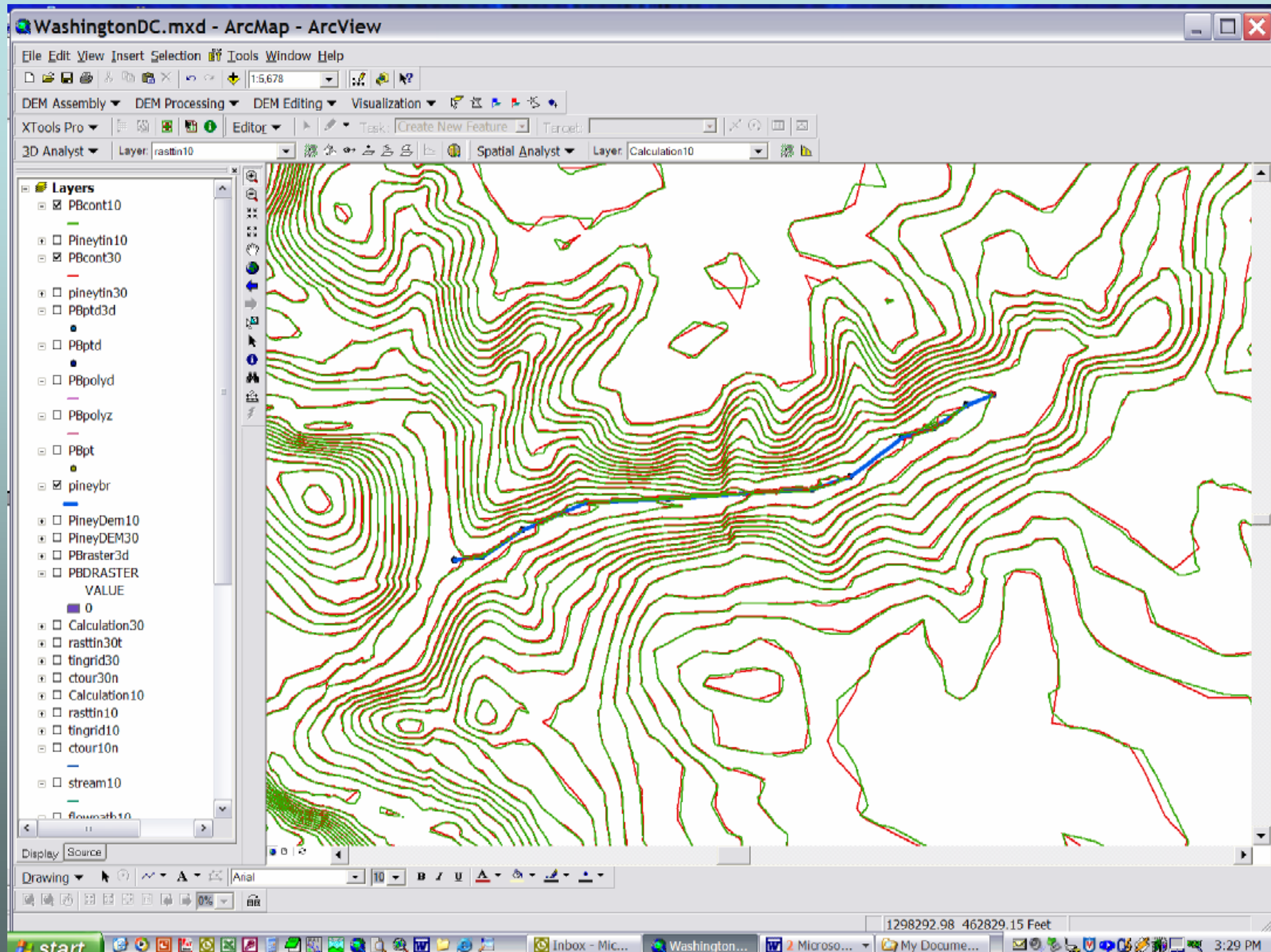
- A comparison is shown here between starting with a 30-meter DEM to starting with a 10-meter DEM and completing all steps through step 19



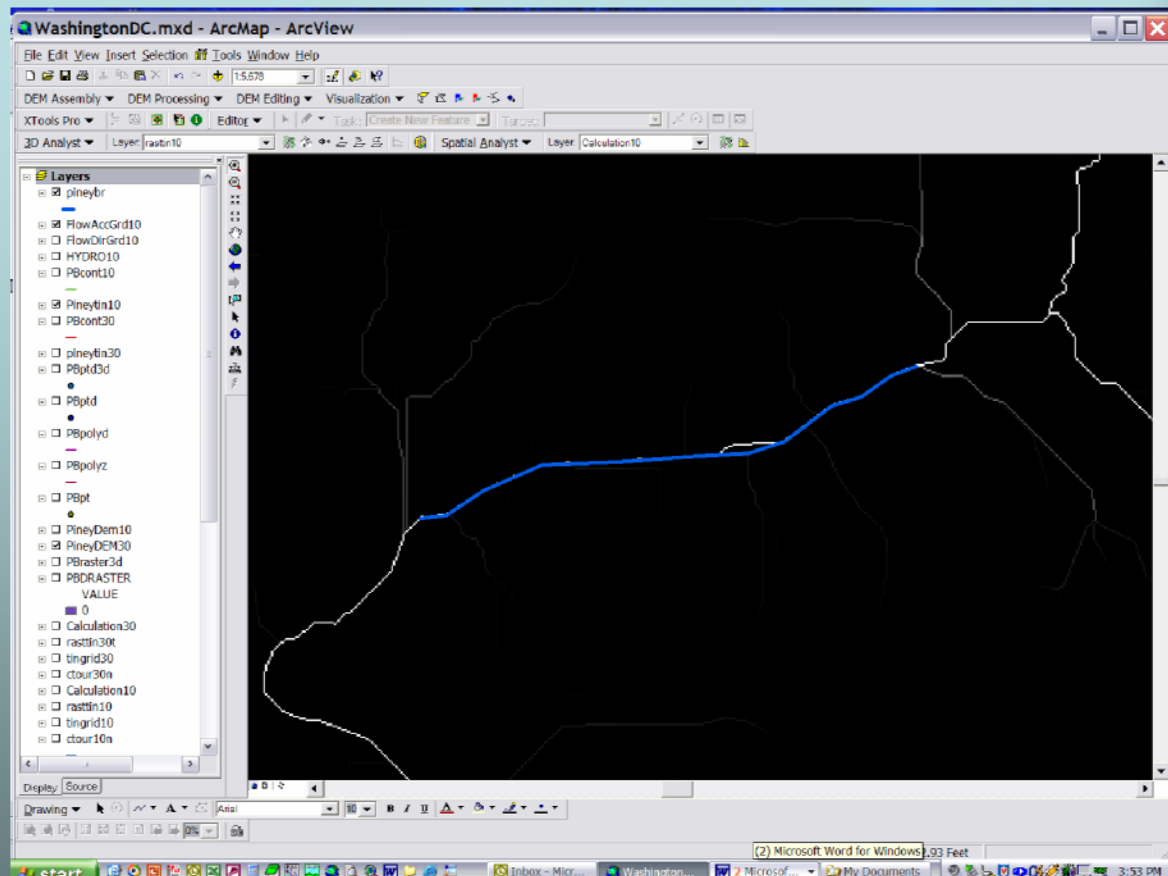

**They are nearly identical**

# This comparison is further emphasized by comparing contours



# Step 20: Run the HEC ArcMap Software

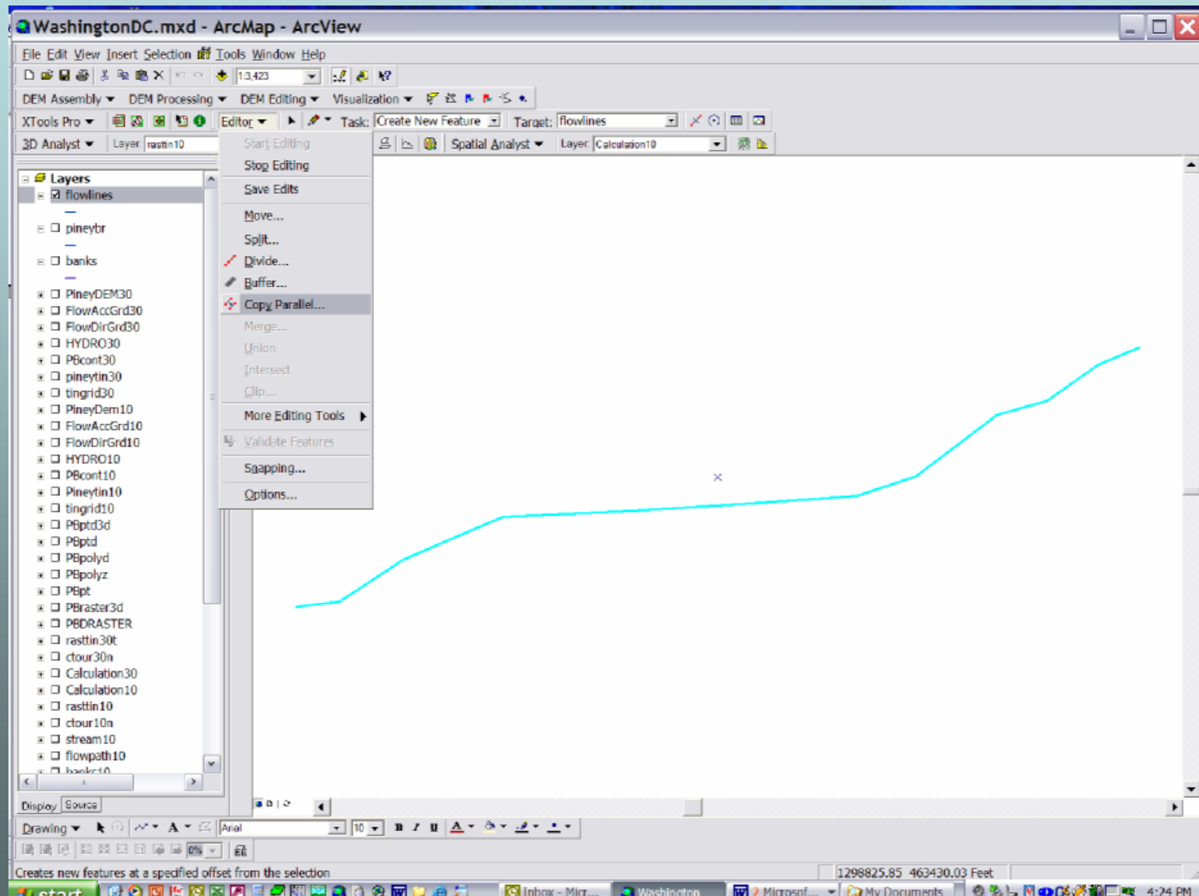
- Although we have finished hydraulically correcting and improving our DEM, there are a few more processes that may be easier to do in ArcMap before we switch to ArcView 3.X.
- Using the HEC ArcMap extension now run the following processes.
- Fill Sinks
- Flow Direction
- Flow Accumulation




Comparison of Flow Accumulation stream lines and our digitized stream line

# Step 21: Create Flowlines
# Step 22: Create Top of Bank lines

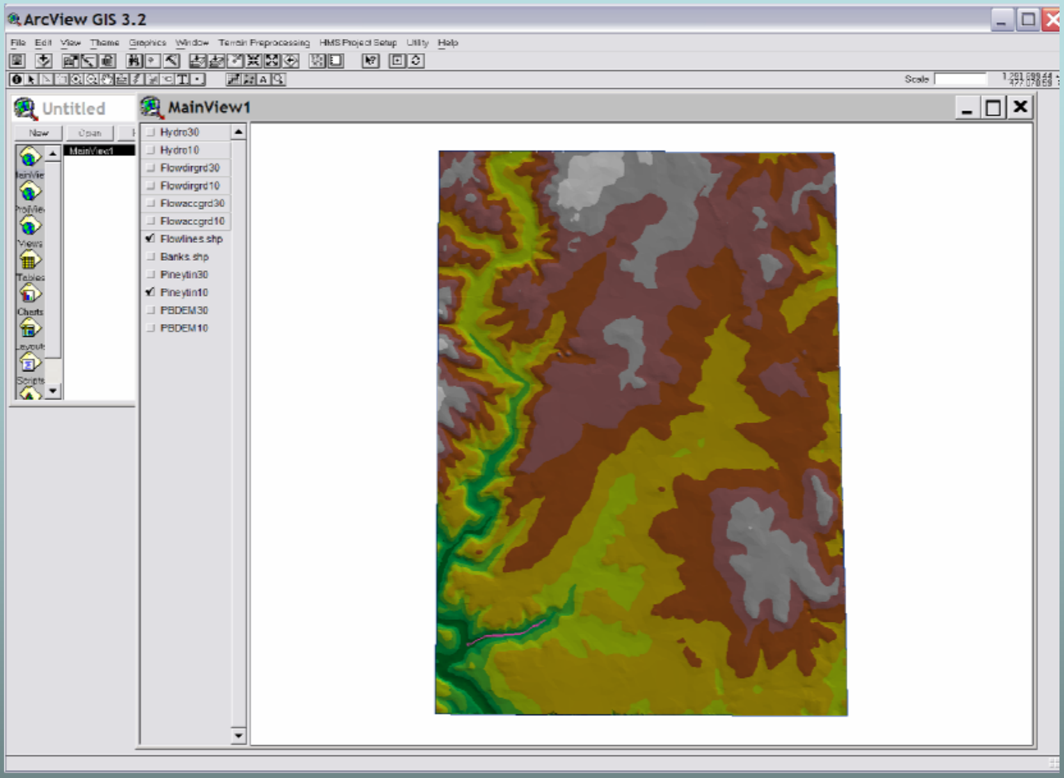
Flowlines and top of bank lines can also be quickly developed by coping lines parallel to the digitized stream line



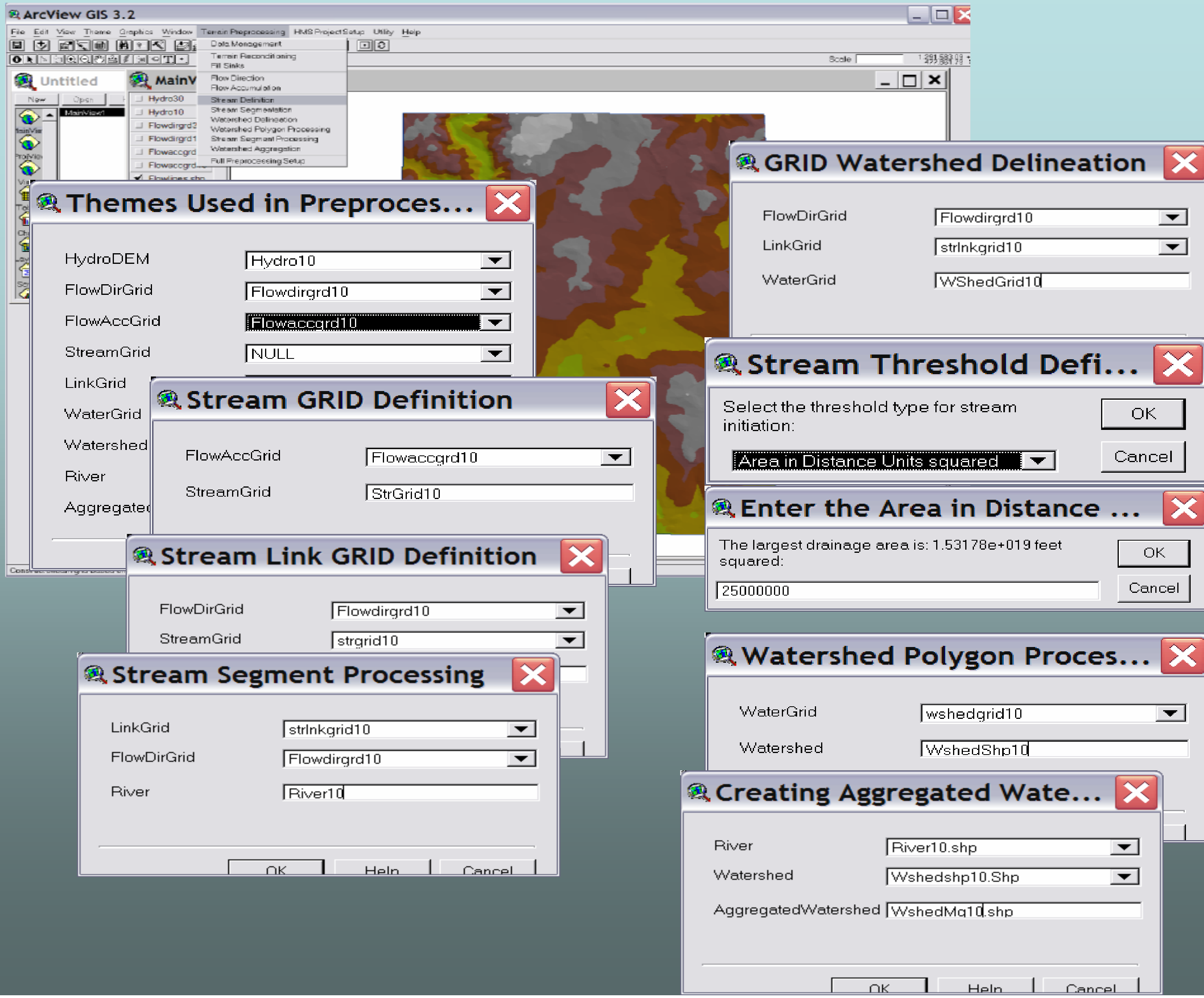
We now switch to ArcView 3.X
and begin using HEC's GeoHMS extension

- Step 1: Prepare ArcView
- Step 2: Add data created previously in ArcMap

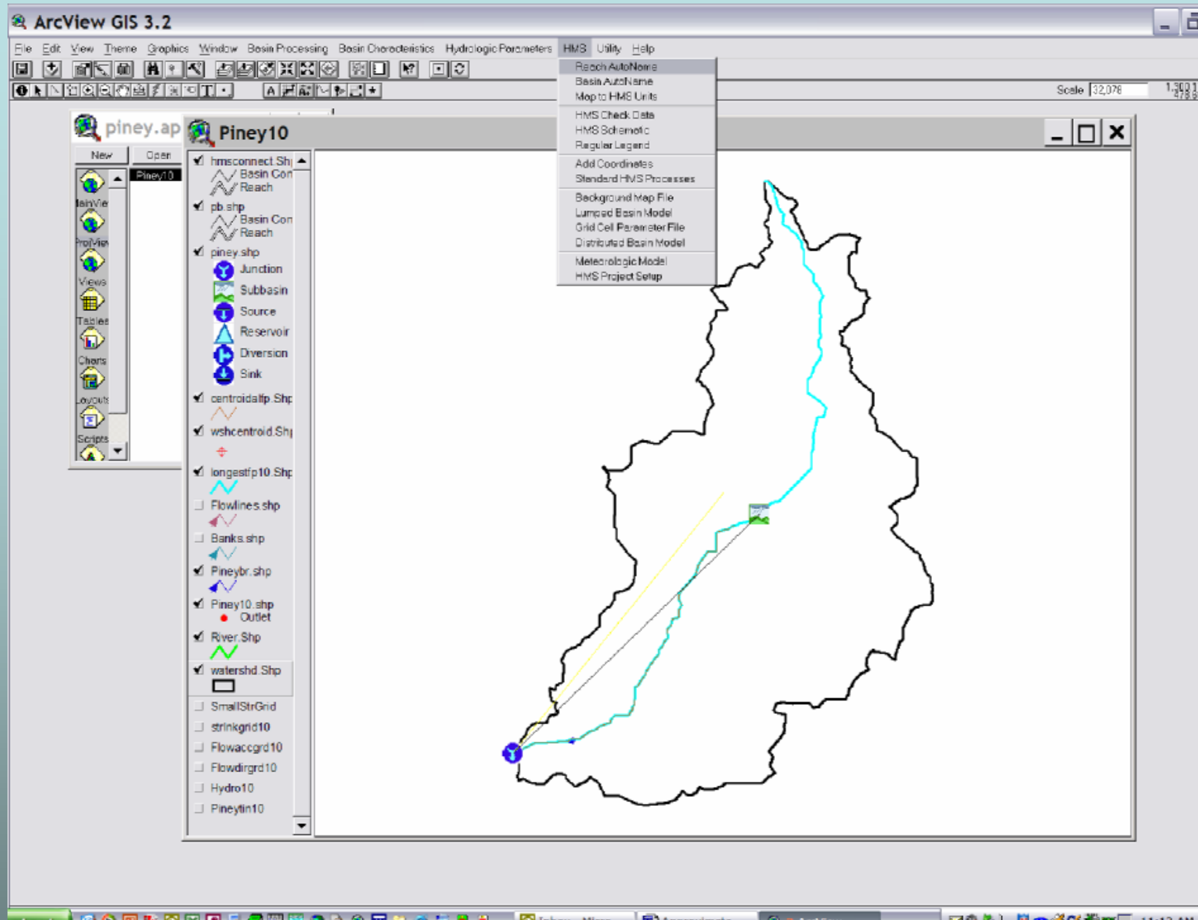
(10-foot DEM with stream burn in)

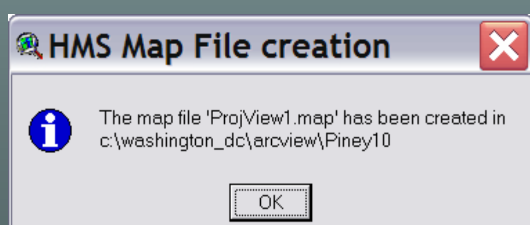


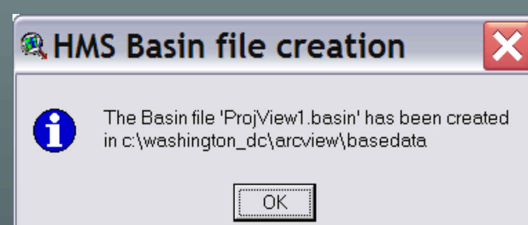
# Step 3: Step through GeoHMS Terrain Preprocessing



# Step 4: Create Study Area

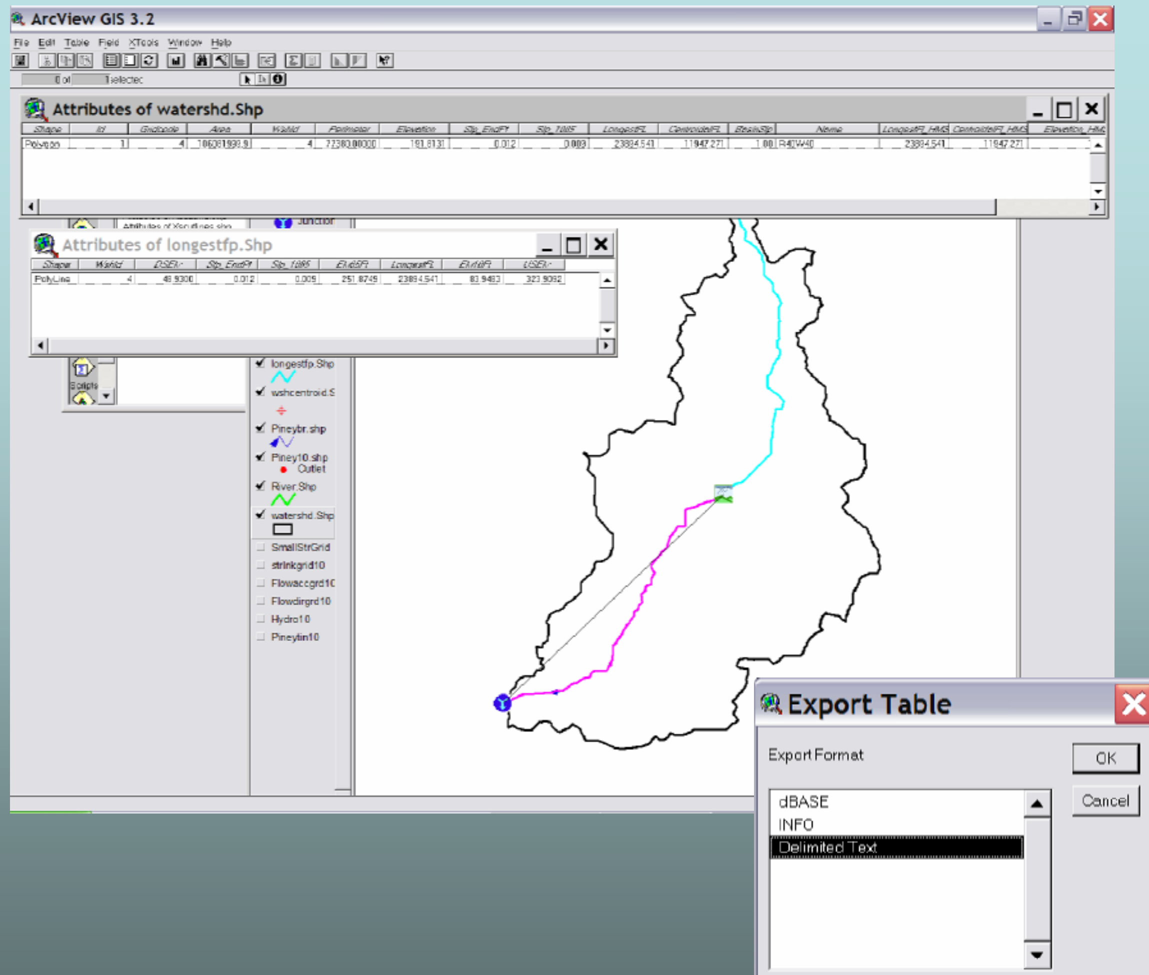


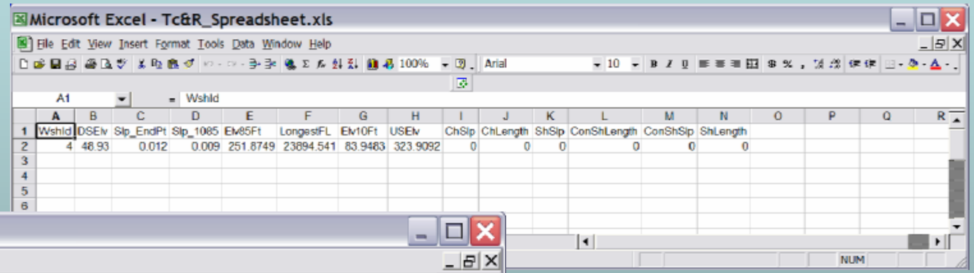
- Step 5: HMS Basin Characteristics
- Step 6: HMS Export File Creation
- Step 7: Export Basin Data for Input into EXCEL

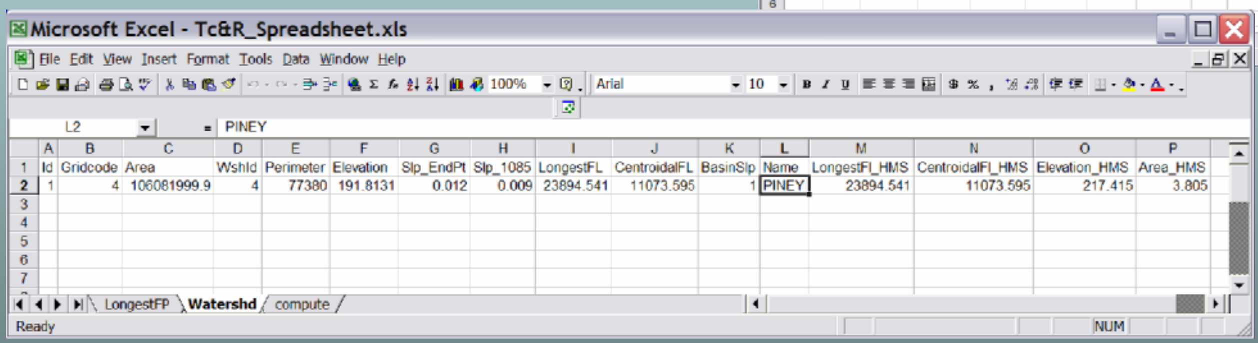
**Note: must select centroid procedure along stream**



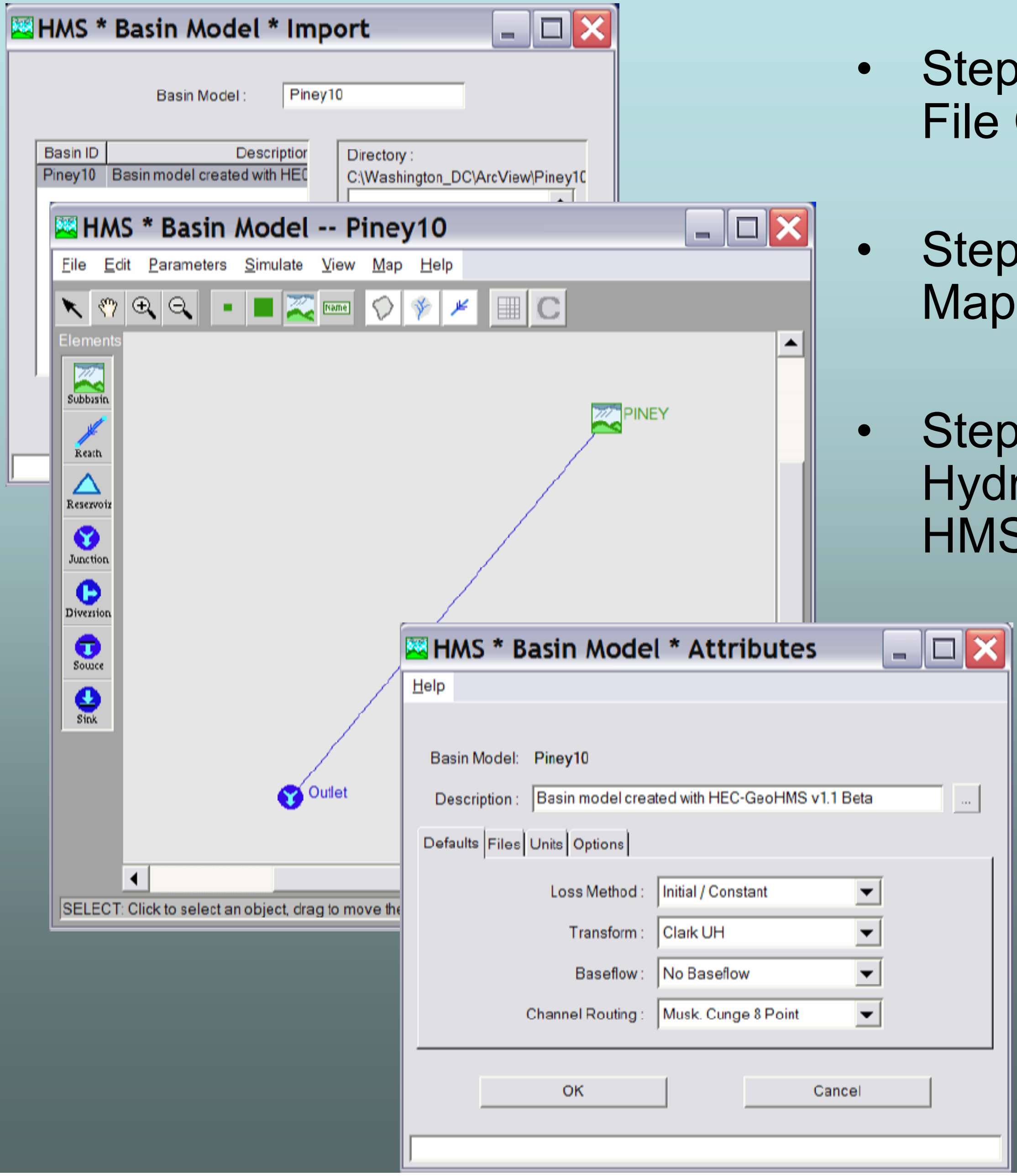
# Step 8: Import ArcView Table into EXCEL

- An Excel spreadsheet has been created that will compute Tc and R values needed for the Clark Unit Hydrograph method within HMS



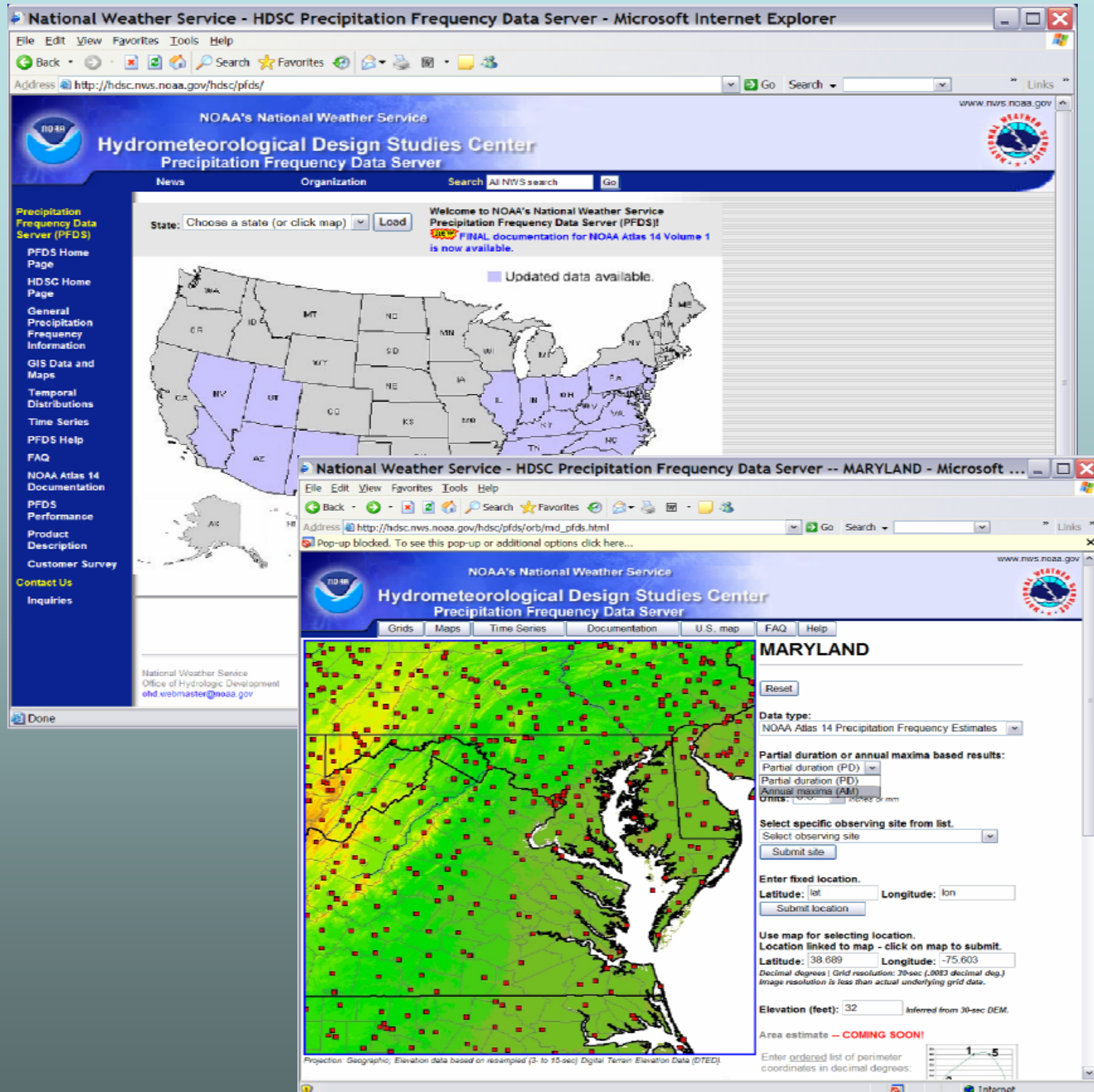



# Step 9: Create a HMS File

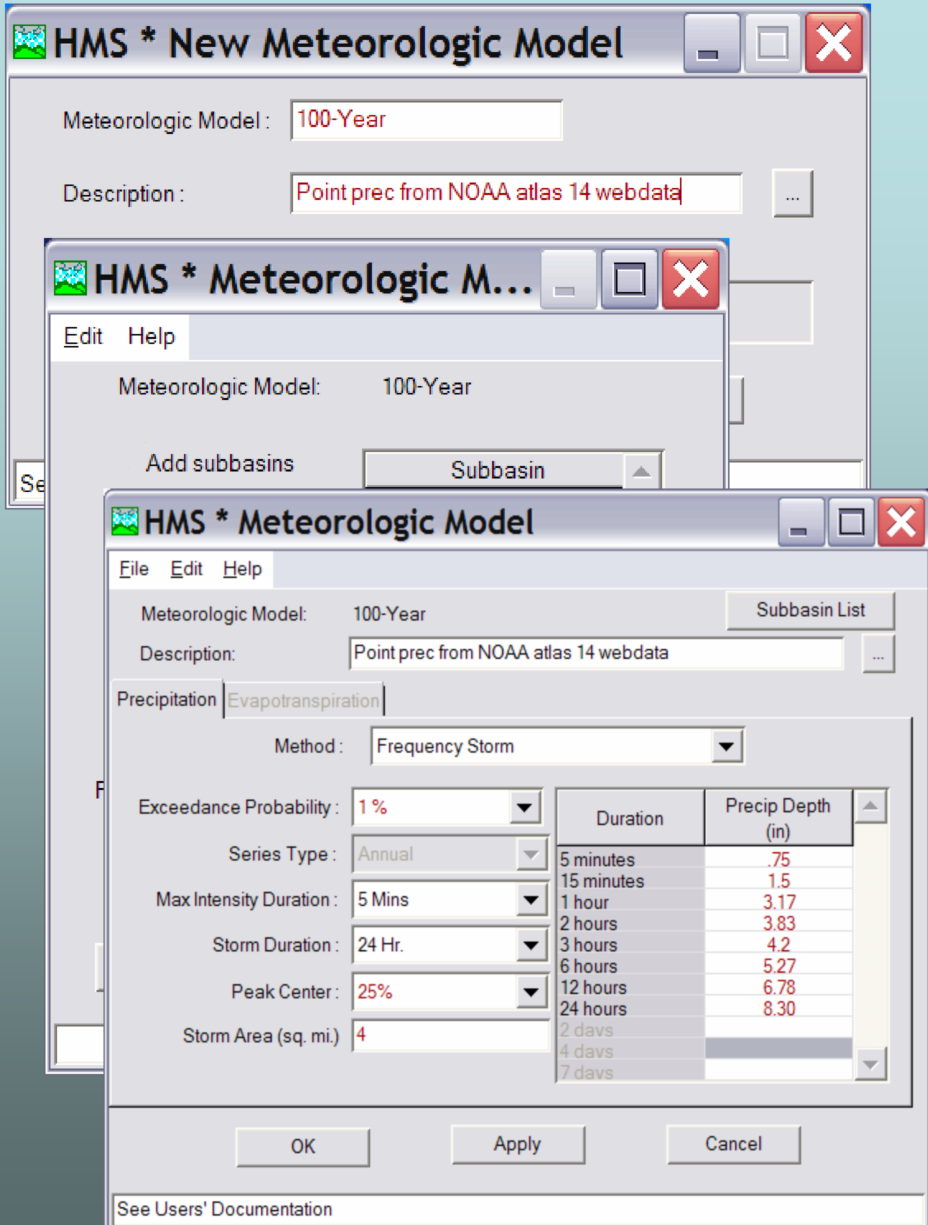



- Step 10: Import the Basin File Created in ArcView
- Step 11: Bring in the Basin Map Created in ArcView
- Step 12: Enter the Hydrologic Parameters into HMS

# Step 13: Get Hypothetical Rainfall Data from Internet



Step 14: Input Frequency Rainfall Data into a HMS MET file




Step 15: Set a Control Specification and Run Model

Note:

You now have both a peak discharge and a complete runoff hydrograph for the 100-year frequency storm.

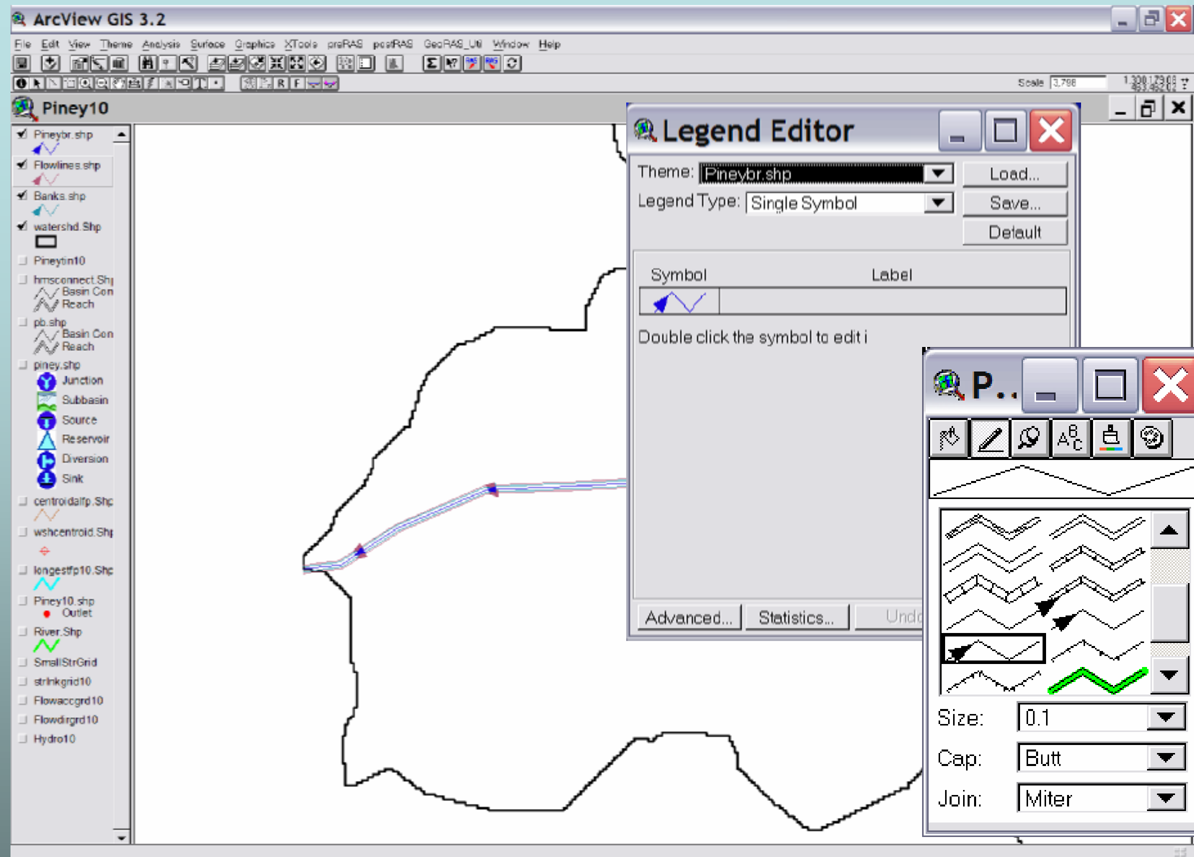
# Now let's develop a HEC-RAS model utilizing HEC's GeoRas

- Step 16: Begin Developing RAS Export File using GeoRAS

- Step 17: Covert Stream, banks and flowlines to GeoRAS Shapefiles

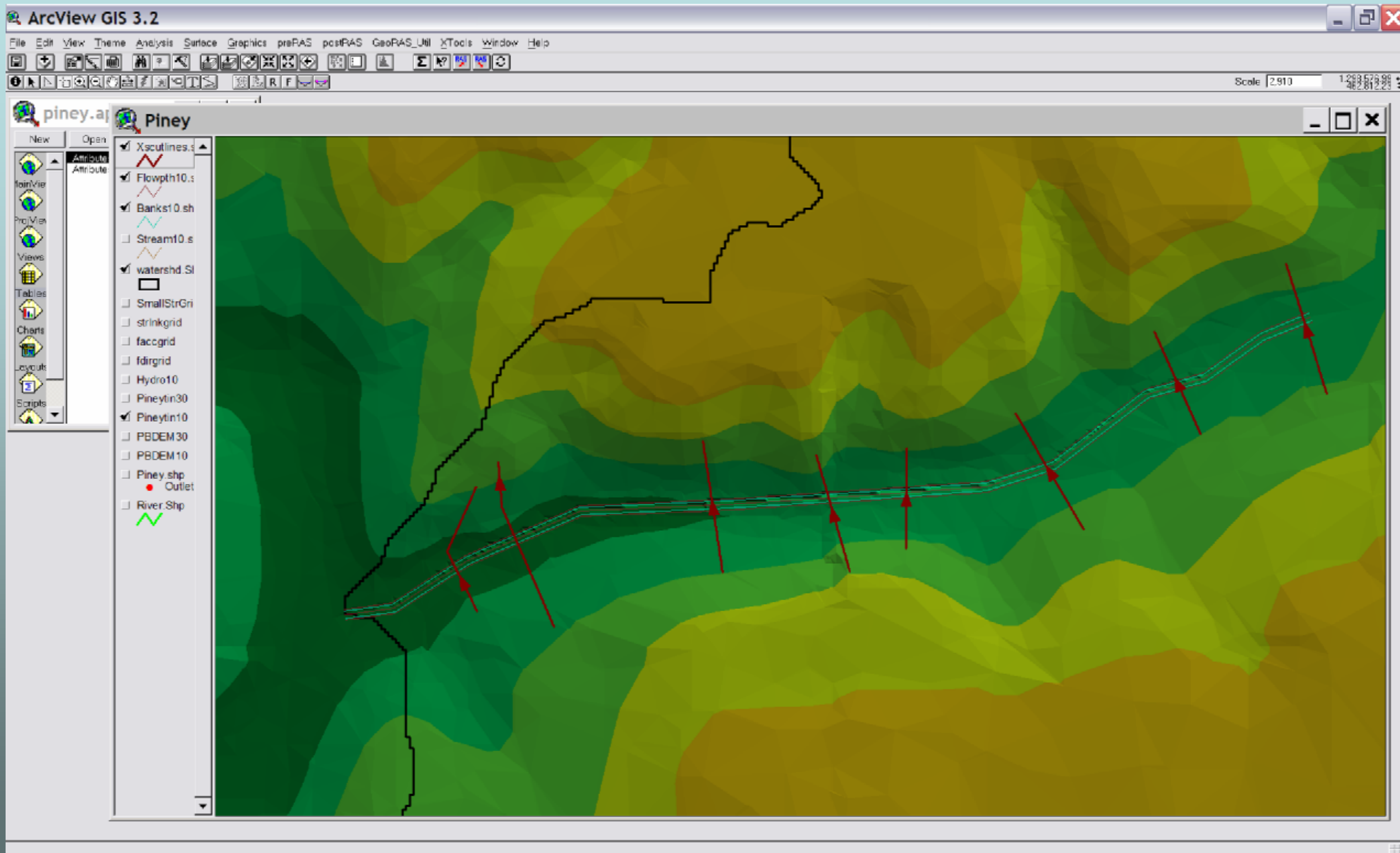
Note:

Change line symbols to lines with arrows to insure proper direction for RAS

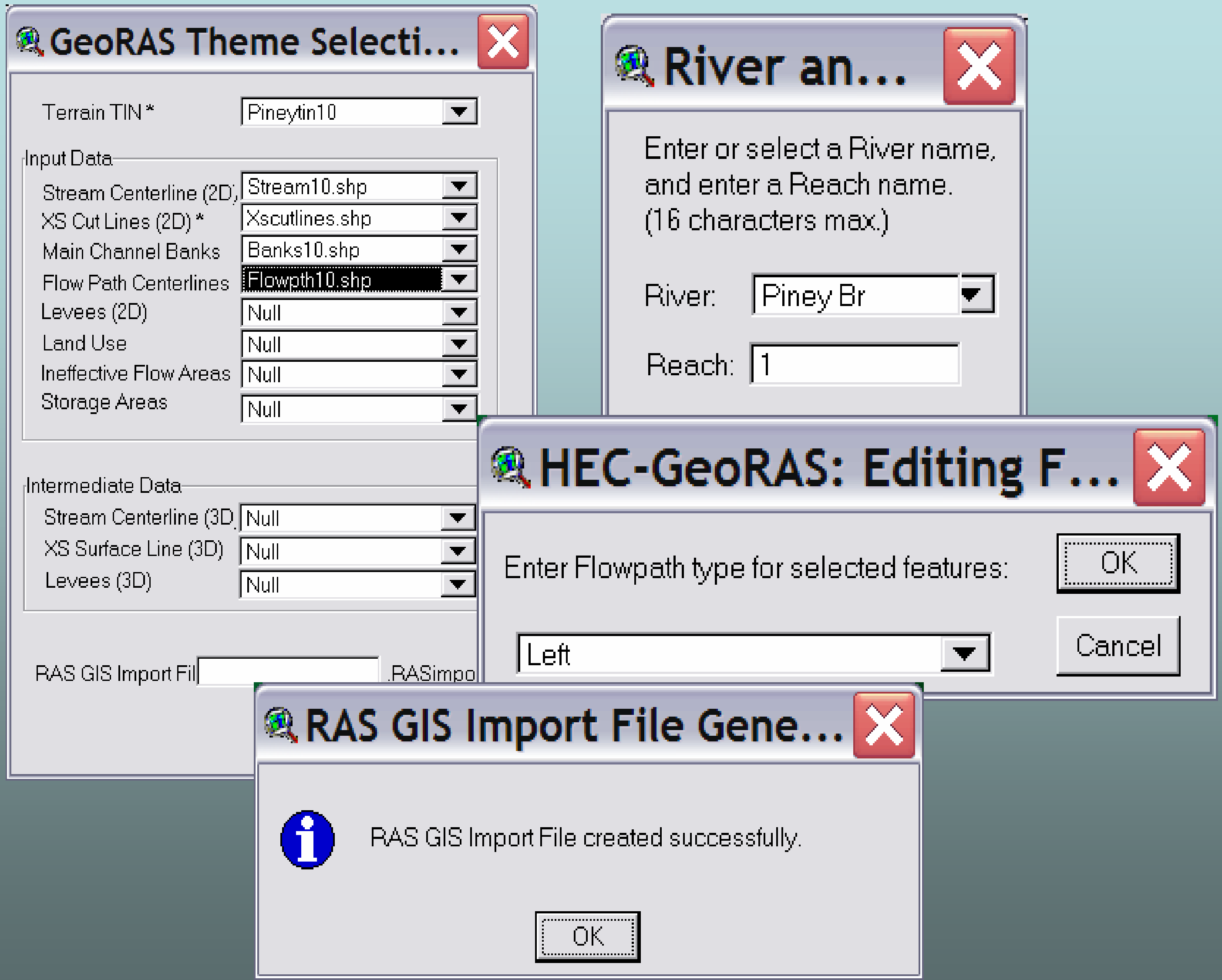


# Step 18: Create Cross Sections for RAS model

Note: Make sure the final TIN file from ArcMap is added into work area

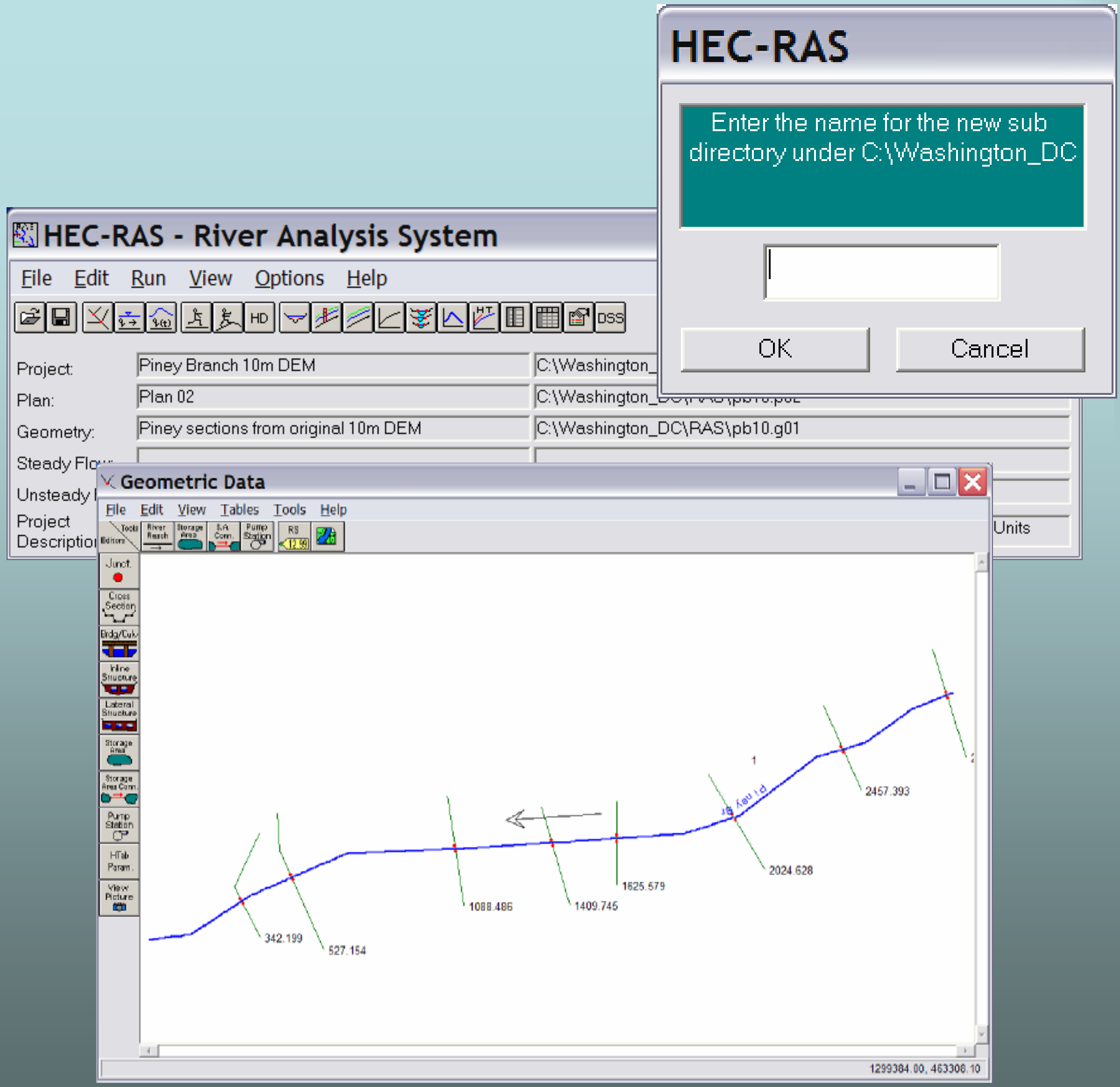


# Step 19: Complete preRAS Processing



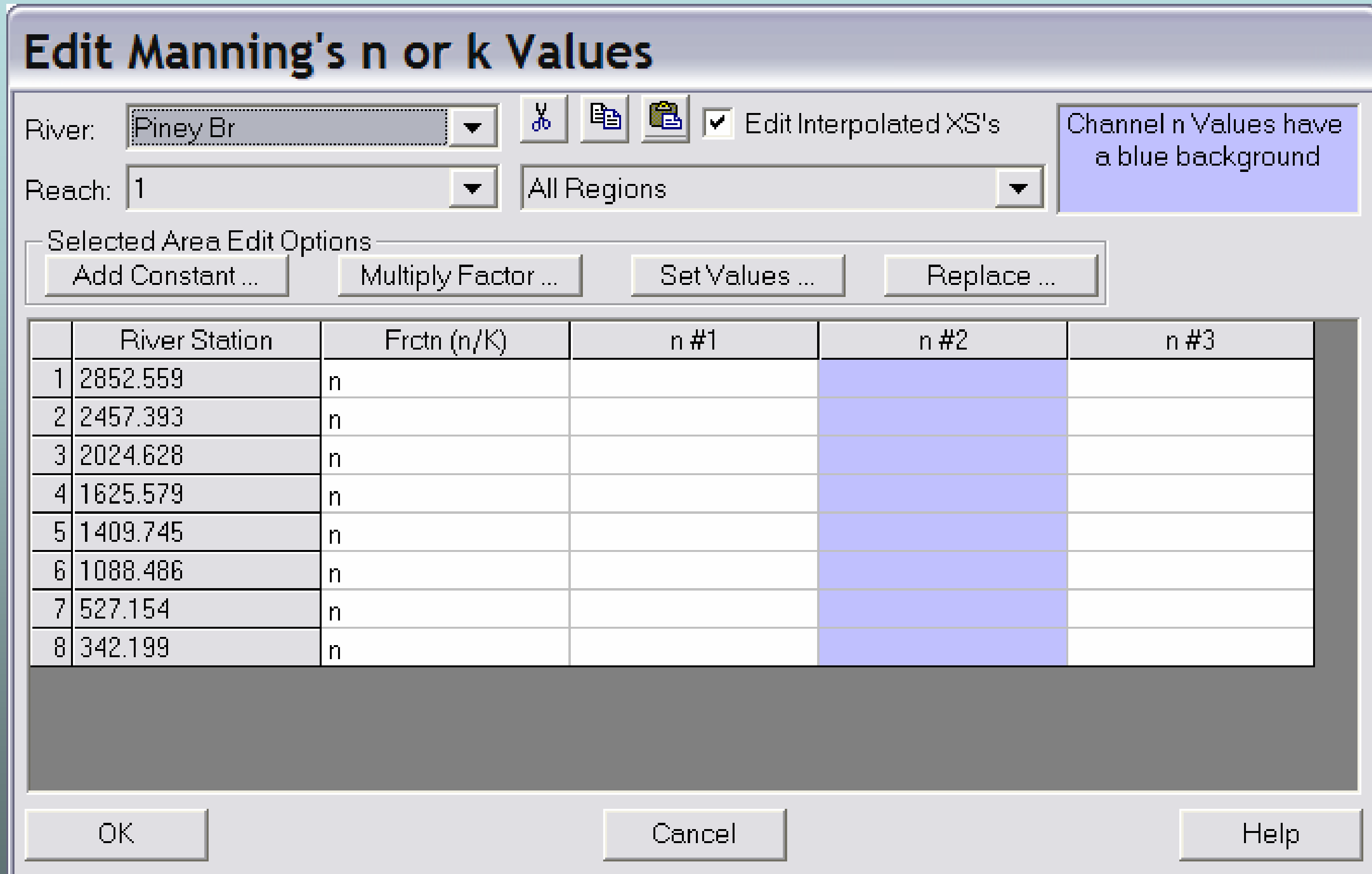
# Step 20: Create HEC-RAS file

Create a RAS project and save, then open Geometric Data in import the export file created in Step 19 by GeoRAS

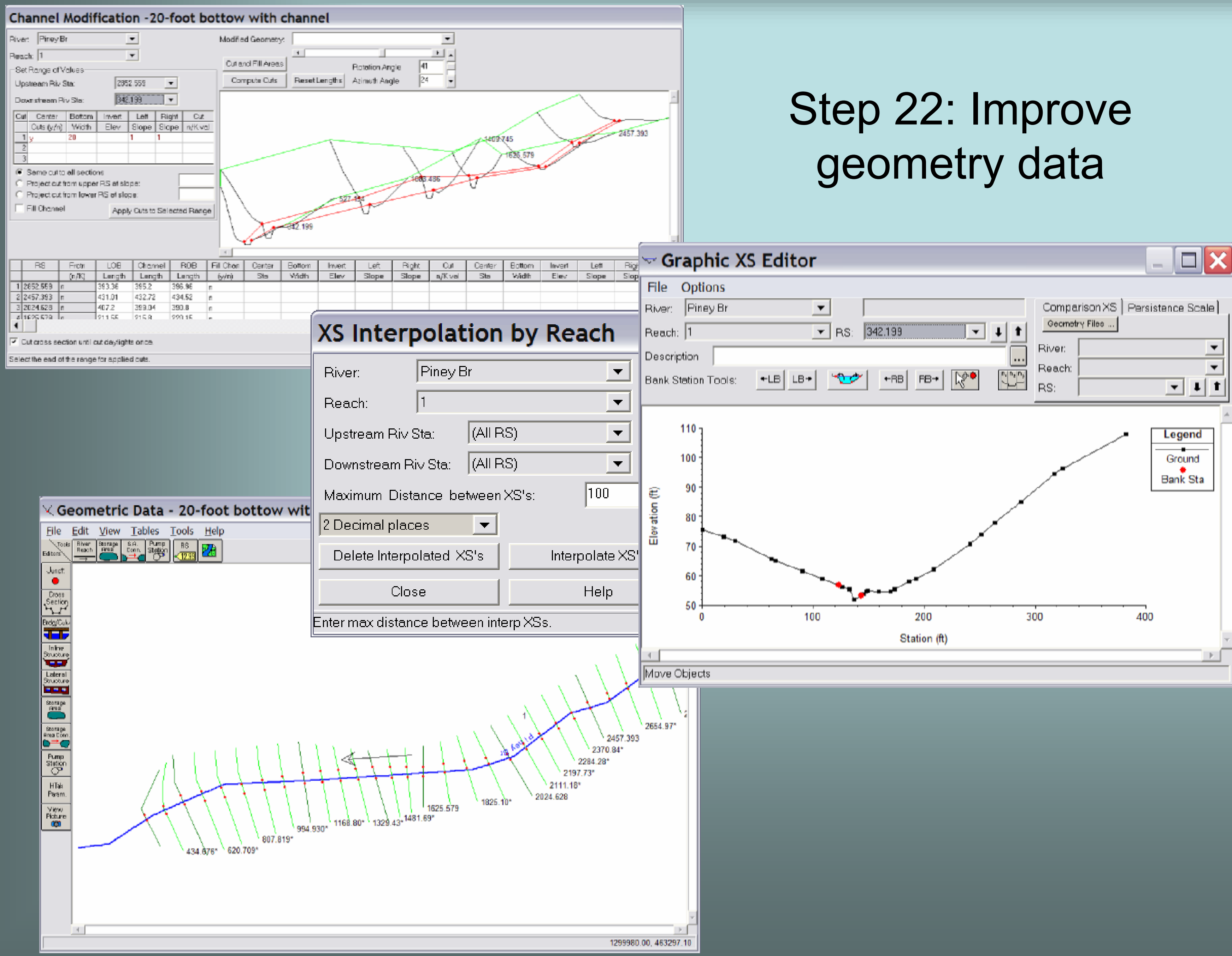


# Step 21: Set Bank Stations and n-values

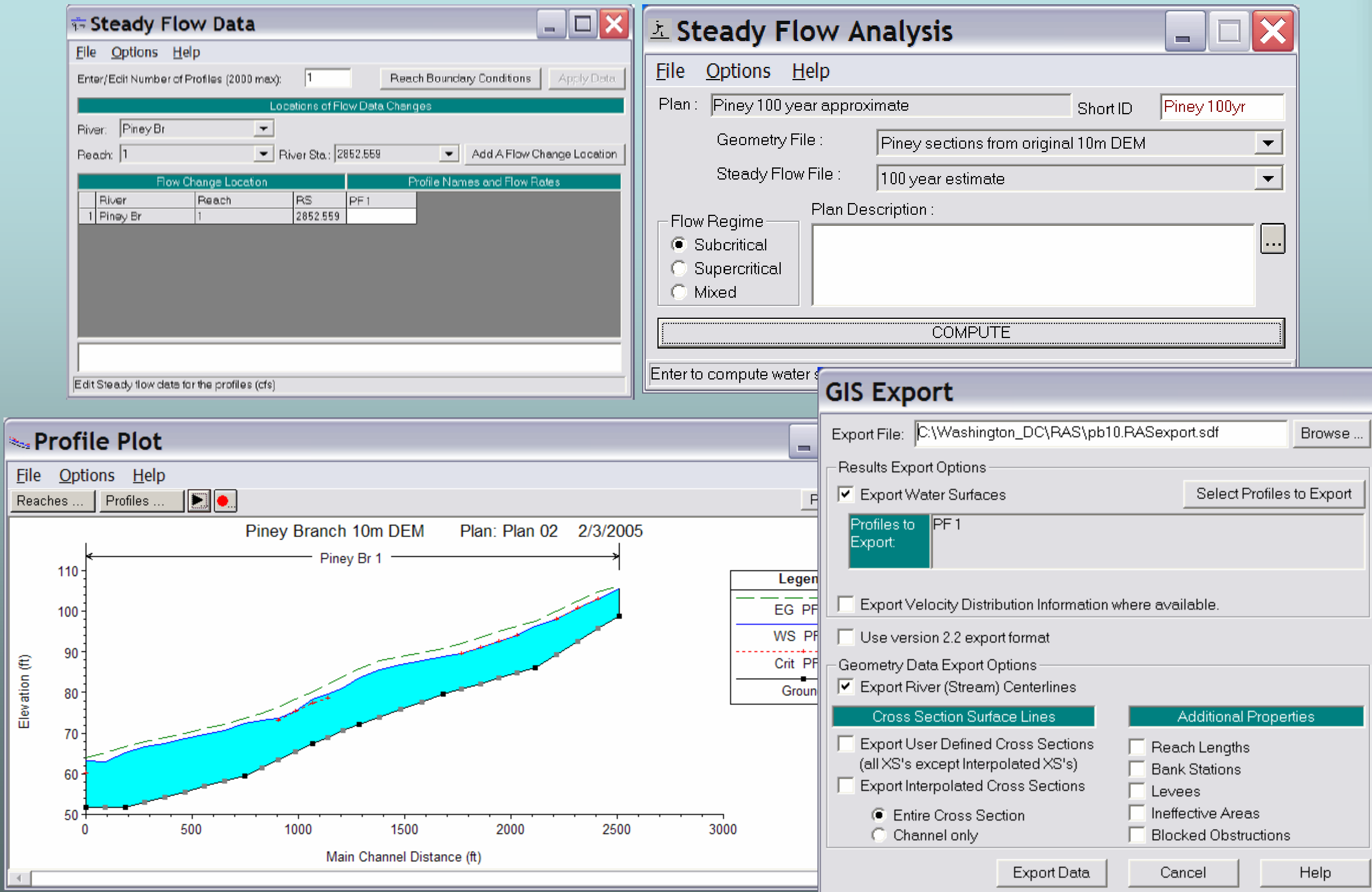
This can be done quickly by setting each column of data at a time



# Step 22: Improve geometry data

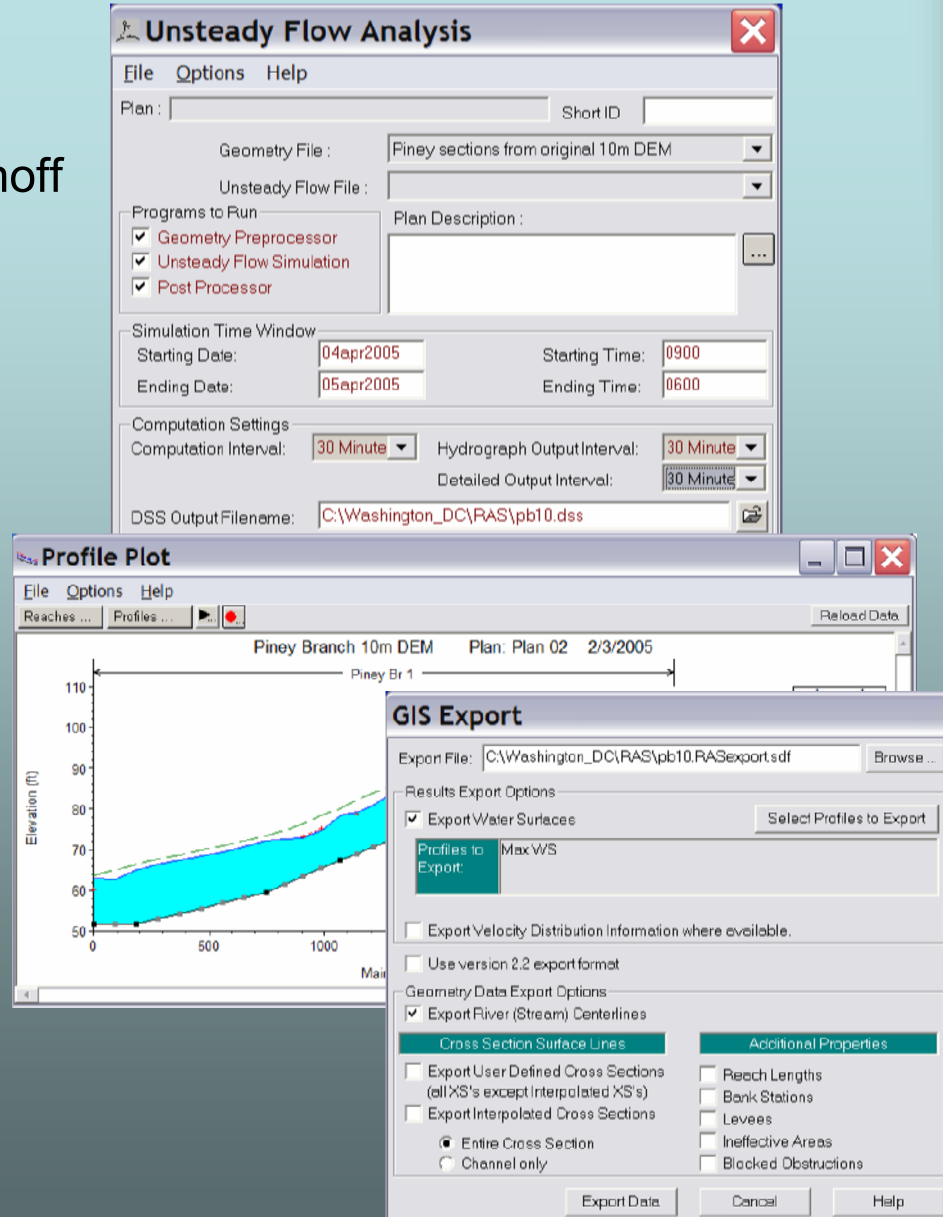


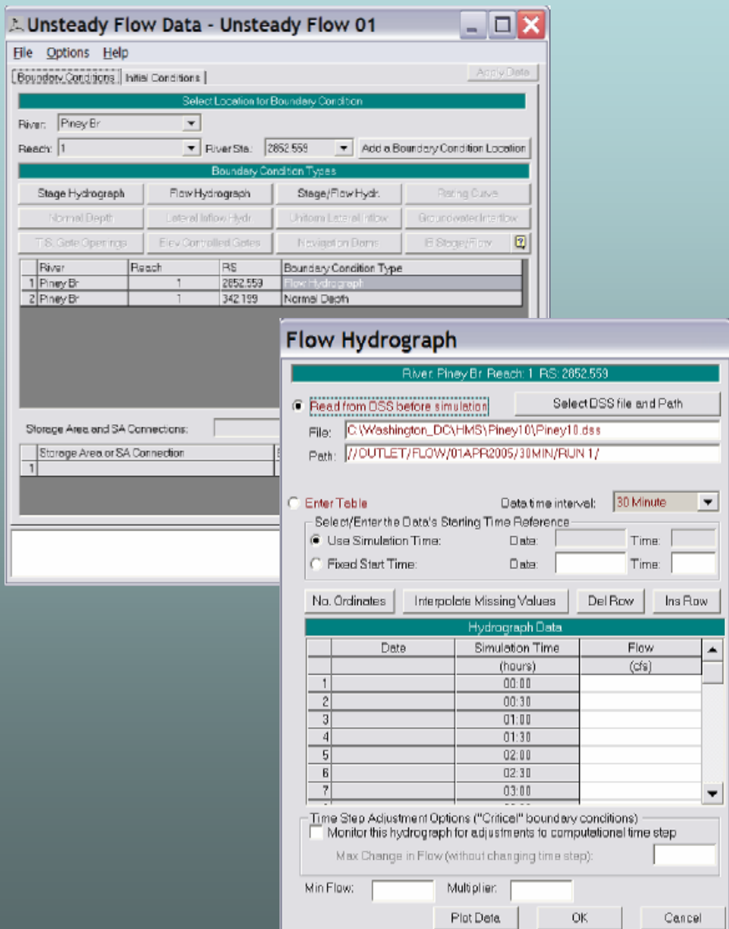
# Step 23: Input Steady Flow Data, Run and Export GIS data



# Step 24: Input UnSteady Flow Data, Run and Export GIS data

Note: It is just a easy to run the UnSteady version of RAS since you have already computed the entire runoff hydrograph in HMS



# Step 25: Run postRAS in ArcView for Steady Flow
# Step 26: Run postRAS in ArcView for Unsteady Flow