

Meeting FEMA's Floodplain Boundary Standard

*Quick Generation of Risk Class Maps and
Automated Methods for Conducting Floodplain
Boundary Standard Self-Certification Audits*

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What is the Floodplain Boundary Standard?

Table 1. Floodplain Boundary Standard for Flood Insurance Rate Maps

		Delineation Reliability of the floodplain per study methodology ¹	
Risk Class	Characteristics	Detailed	Approximate ²
A	High population and densities within the floodplain, and/or high anticipated growth	+/- 1.0 foot/ 95%	+/- 1/2 contour 95%
B	Medium population and densities within the floodplain, and/or modest anticipated growth	+/- 1.0 foot/ 90%	+/- 1/2 contour 90%
C	Low population and densities within the floodplain, small or no anticipated growth	+/- 1.0 foot/ 85%	+/- 1/2 contour 85%
D	Undetermined Risk, likely subject to flooding	NA	NA
E	Minimal risk of flooding; area not studied	NA	NA

Standard includes a 38 foot horizontal tolerance
 Requires self-certification audits to demonstrate compliance

How are Risk Classes Defined?

- PM 38:

Can be based on population, growth, repetitive losses

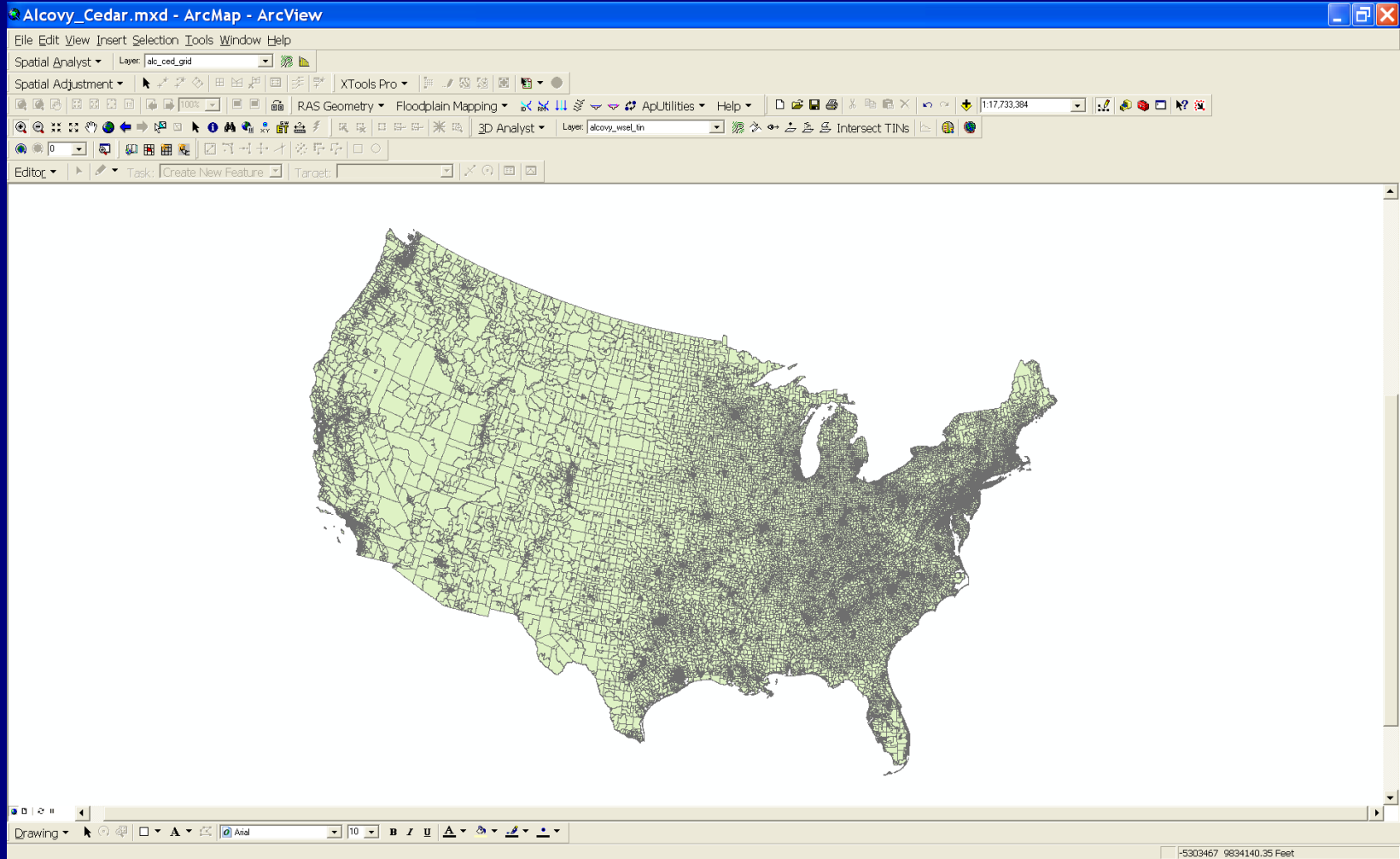
- FBS G&S:

Housing units, flood insurance policies and claims, repetitive losses, declared disasters, critical facilities, state and local ordinances, probability of loss of life or property

Quick Generation of Risk Class Maps

- Developed for and accepted for use in FEMA Region V
- Based on available US Census data: census tract and urban area/urban cluster shapefiles
- Uses three criteria:
 - Population density
 - Population growth
 - Urban/rural areas

Census Tract Data



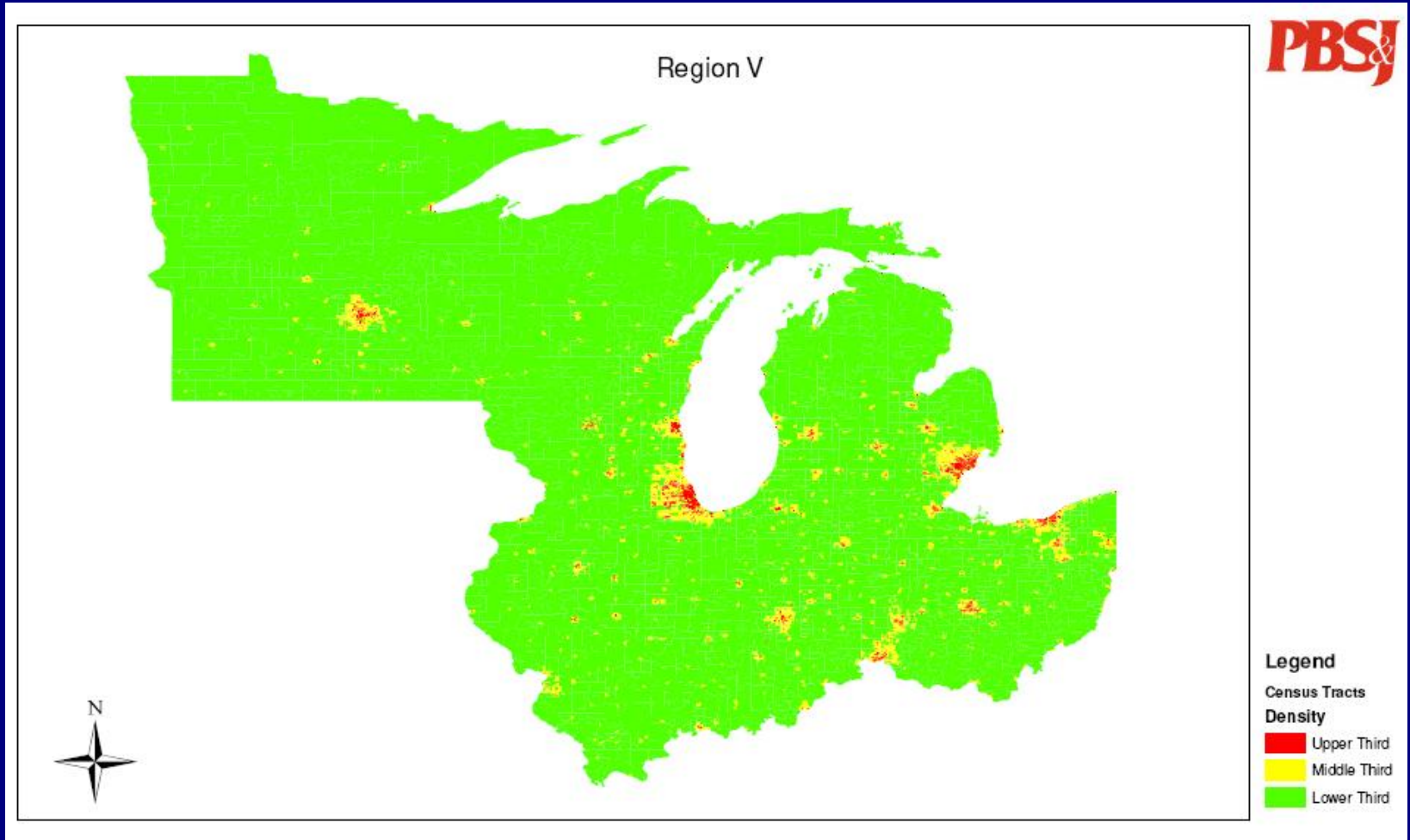
Step 1: Rank by density

- Rank census tracts by density; group into thirds

Region V Statistics, Step 1

Class	% Area	% Population
A	0.65%	30.18%
B	3.56%	36.22%
C	95.79%	33.60%

Region V Map, Step 1



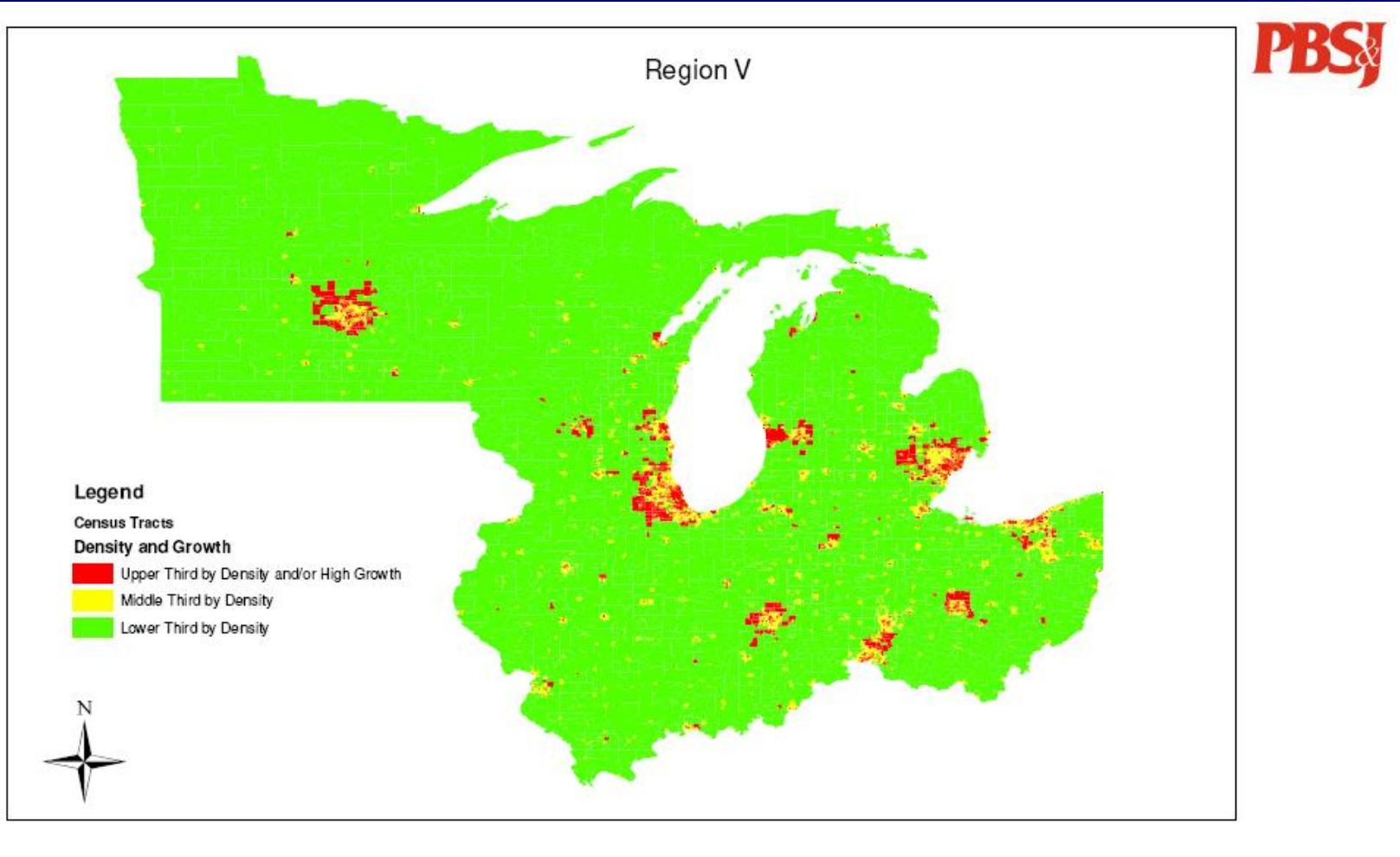
Step 2: Determine high growth areas

- Establish a threshold for high growth
- National population growth was 13%; set threshold for high growth and minimum density
- Move high growth areas from groups 2 and 3 to group 1

Region V Statistics, Step 2

Class	% Area	% Population
A	2.96%	38.81%
B	2.90%	30.66%
C	94.14%	30.53%

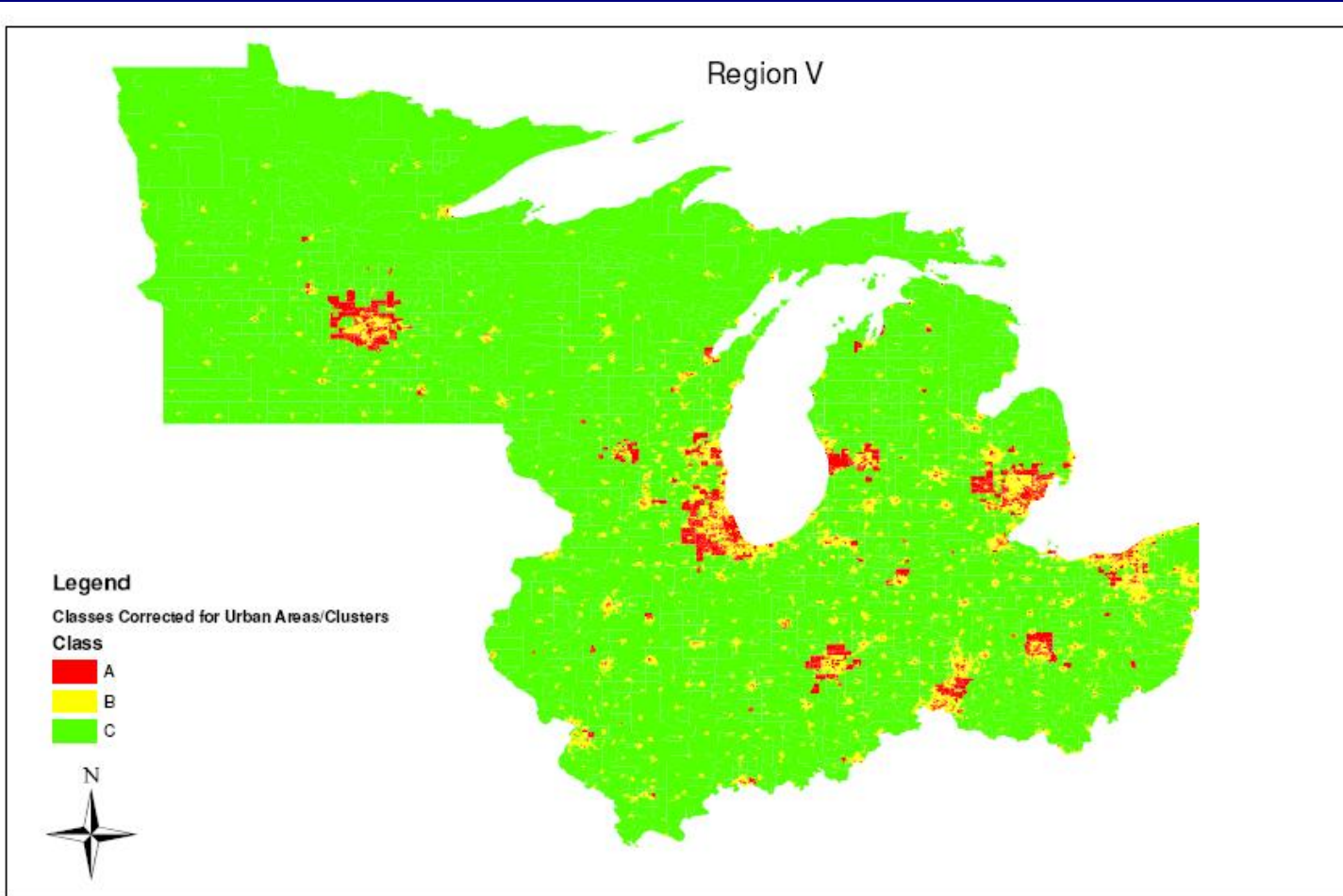
Region V Map, Step 2



Step 3: Determine urban areas

- Use census determined urban area – urban cluster data
- Move urban areas/urban clusters from group 3 to group 2
- This step breaks the census tracts, so population statistics cannot be directly determined.

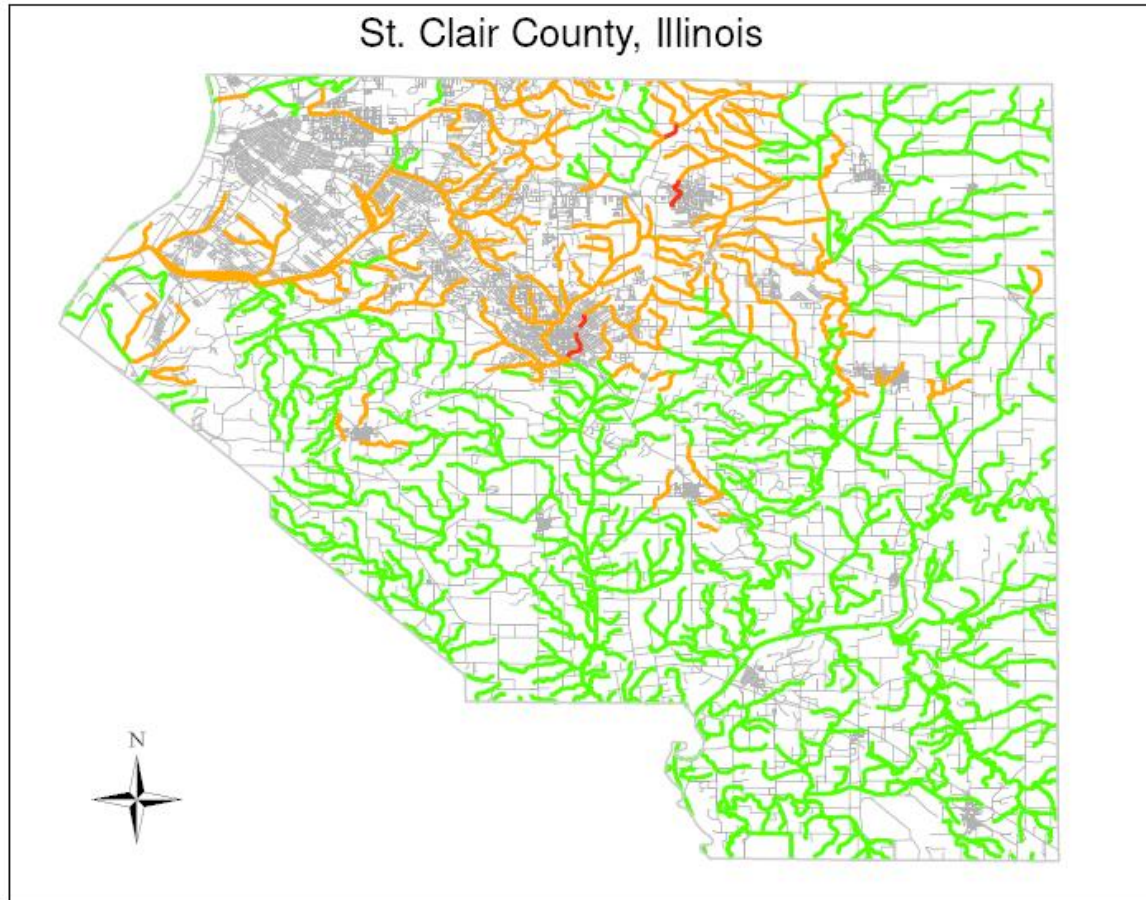
Region V Map, Step 3



Step 4: Join to stream data

- Attribute National Hydrography Dataset medium resolution data with tract risk class
- If a stream segment crosses a risk class, round to higher risk class

Sample Region V Map, Step 4



Legend

- Streams
- Risk Class
 - A
 - B
 - C
- Roads

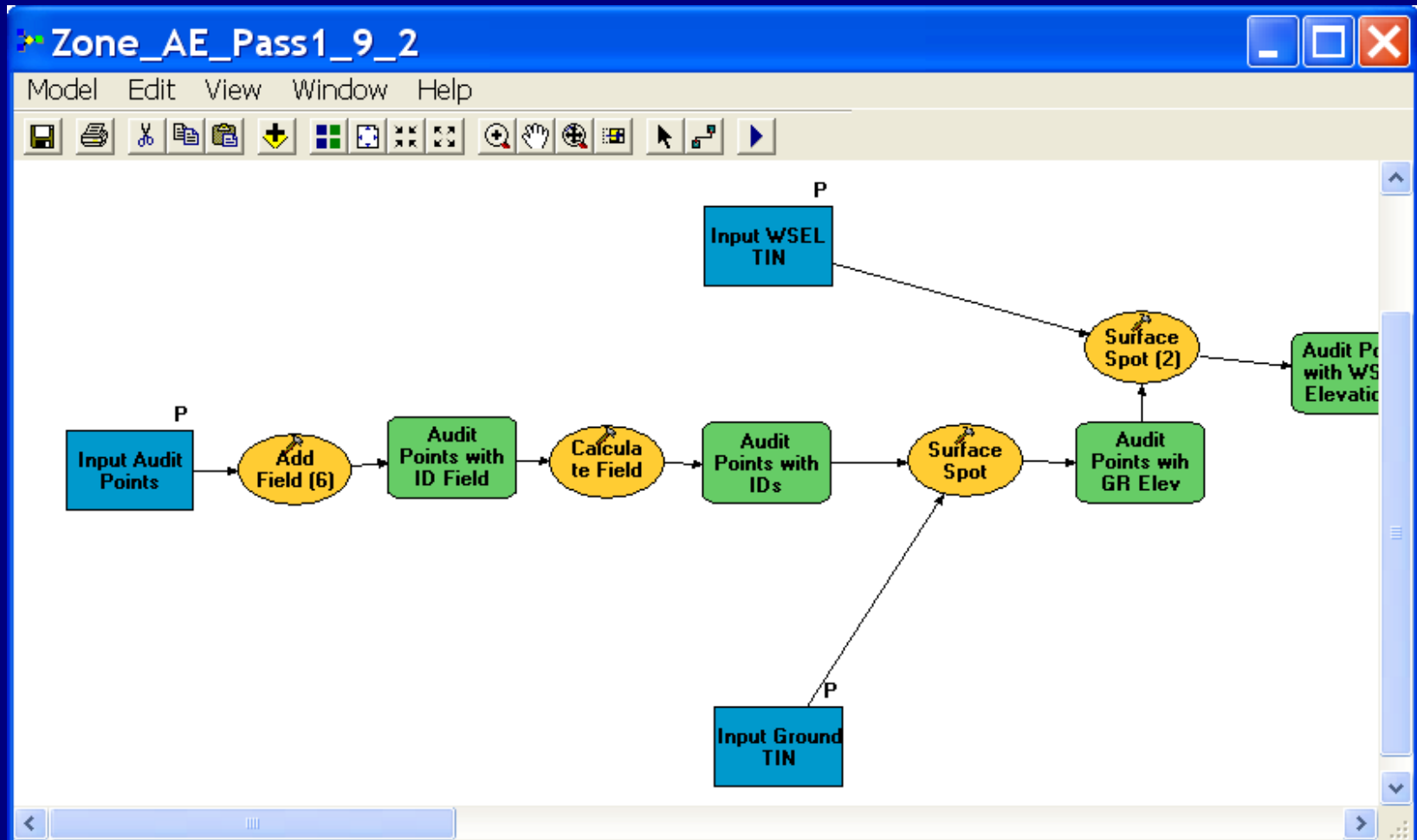
Advantages/Disadvantages

- Advantages
 - Quick to generate
 - Objective
- Disadvantages
 - Does not account for all possible criteria

Basic Principles for Automating Self-Certification Audits

- Follow the steps for GIS-based audits outlined in the FEMA G&S
- Use the tools available with your ArcMap/ArcInfo license; supplement with freeware and scripts available on the ESRI support site
- Link together as many steps as possible with ArcMap ModelBuilder

ArcMap ModelBuilder *Editing Interface*



ArcMap ModelBuilder *Run Interface*

Zone_AE_Pass1_9_2

Input Audit Points
 Blck Br Trib1 audit points

Input Ground TIN
 topo tin

Input WSEL TIN
 wsel tin

Input Tolerance
 1

Help
Input Audit Points
 No description available

OK Cancel Environments... << Hide Help

Basic Steps for Zone AE Audits

Pass 1 – Vertical Tolerance

- Generate points every 100 feet along the boundary
- Create WSEL and topographic TINs
- Pull elevations from each TIN at the test points, and compare to see if in tolerance

Zone AE – Pass 1

Attributes of Alcovy_audit_pts

Pt_ID	GR_Elev	WSEL_Elev	Diff	Tol	InTol1	InTol1_N
3	783.413574	783.783875	0.37	1	PASS	1
4	783.448669	783.309082	0.14	1	PASS	1
5	783.160278	783.220581	0.06	1	PASS	1
6	782.805603	783.141479	0.336	1	PASS	1
7	783.20697	783.055237	0.152	1	PASS	1
8	782.769348	783.032898	0.264	1	PASS	1
9	783.12915	783.018799	0.11	1	PASS	1
10	782.92395	783.00415	0.08	1	PASS	1
11	783.090332	782.993591	0.097	1	PASS	1
12	782.844238	782.979858	0.136	1	PASS	1
13	783.165405	782.963562	0.202	1	PASS	1
14	783.18988	782.845825	0.344	1	PASS	1
15	782.769836	782.836792	0.067	1	PASS	1
16	781.432373	782.462097	1.03	1	FAIL	0
17	782.566284	782.439087	0.127	1	PASS	1
18	783.172729	782.396545	0.776	1	PASS	1
19	781.317261	782.356995	1.04	1	FAIL	0
20	783.241821	782.303345	0.938	1	PASS	1
21	781.837769	782.29248	0.455	1	PASS	1
22	781.802612	782.287048	0.484	1	PASS	1
23	782.47229	782.233704	0.239	1	PASS	1
24	782.024475	782.177795	0.153	1	PASS	1
25	780.311401	782.123718	1.812	1	FAIL	0
26	780.311401	782.123718	1.812	1	FAIL	0

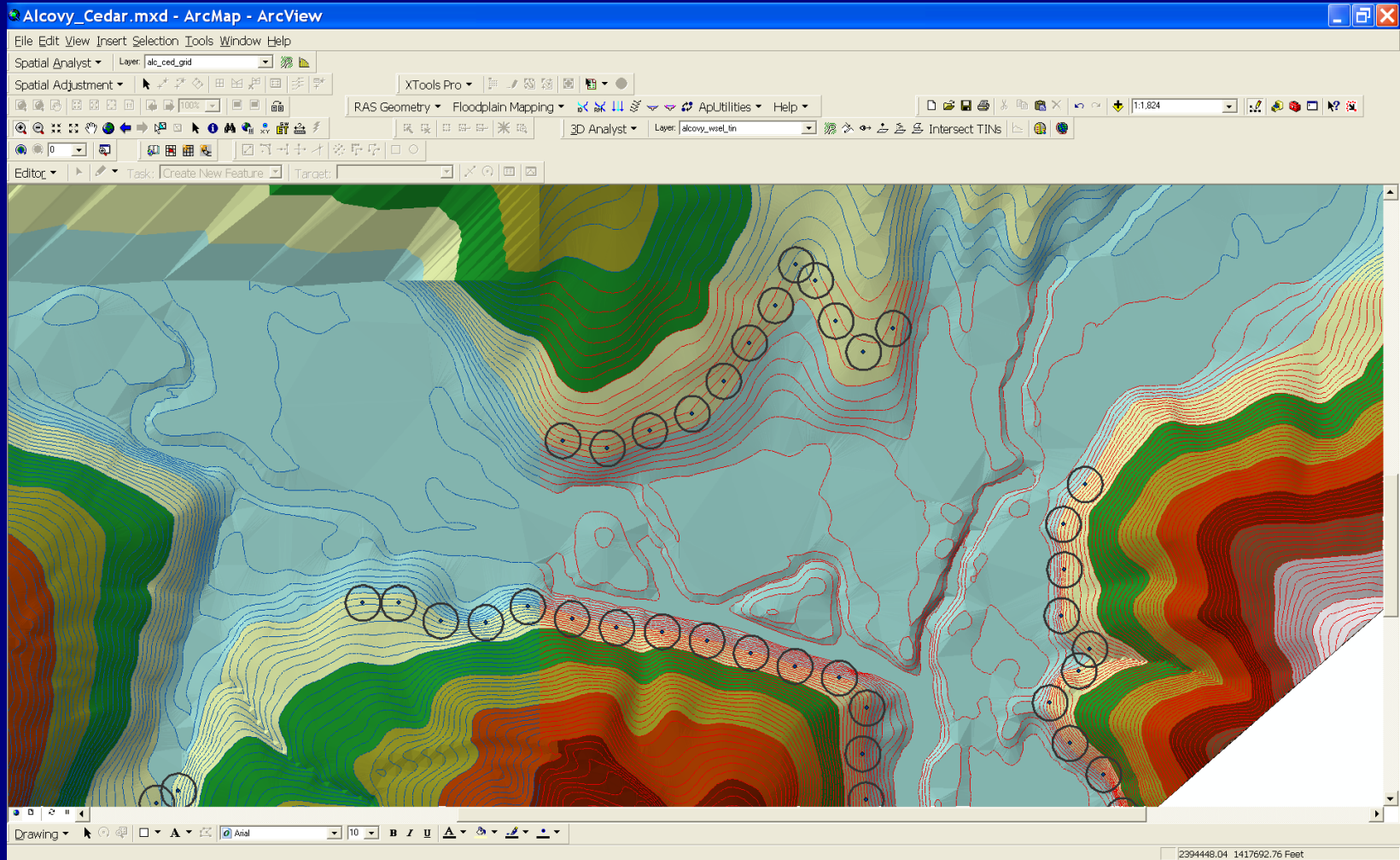
Record: 3 Show: All Selected Records (0 out of 43)

Basic Steps for Zone AE Audits

Pass 2 – Horizontal Tolerance

- Select the points failing Pass 1 and apply a 38 foot buffer
- Determine the minimum and maximum ground elevations within that buffer
- Determine whether the WSEL TIN elevations read at that point fall between the minimum and maximum ground elevations

Zone AE – Pass 2



Basic Steps for Zone A Audits

Pass 1 – Vertical Tolerance

- Generate cross sections every 500 feet along the stream centerline; create pairs of points by intersecting the floodplain with the cross section
- Read elevations at each point from the topo TIN
- Compare elevations of points across stream to verify they are within tolerance

Zone A Audits

FBS.mxd - ArcMap - ArcView

File Edit View Insert Selection Tools Window Help

Spatial Analyst Layer: [stmarygrid] Spatial Adjustment XTools Pro

RAS Geometry Floodplain Mapping ApUtilities Help

3D Analyst Layer: [stmarygrid]

Editor Task: Create New Feature Target:

Layers

- glencoe_audit
- glencoe_audit
- glencoe_audit
- sat_82_audit
- Xsec
- Xsec
- sat_trib_82
- corr_glencoe
- sat_trib_82_r
- stmarygrid Value High : 28.3 Low : 3.88
- Grids
 - unmmd80c
 - unmmd78c
 - srtrib49gri
 - sattrb84_3
 - satllagrid
 - glencoegrid
 - unmmd88gr
 - unmmd81c
 - waverlygri
 - wotrib67g
 - c13039
 - all other

Attributes of glencoe_auditpts_3_fail2

FID	Shape*	FID_Xsec	FIRST_Lo_G	LAST_Lo_Gr	FIRST_Hl_G	LAST_Hl_Gr	InTot2	InTot2_M
0	Multipoint	7	11.955154	12.912131	12.893439	13.810893	FAIL	0
1	Multipoint	8	10.727876	12.280223	10.955063	13.517646	FAIL	0 Tie-in to other Zone A areas
2	Multipoint	9	10.727876	12.537500	10.955063	12.847549	FAIL	0 Tie-in to other Zone A areas
3	Multipoint	10	9.004412	10.918391	9.296658	11.468700	FAIL	0 Tie-in to other Zone A areas
4	Multipoint	11	8.884000	10.204696	8.884000	11.146725	FAIL	0 Tie-in to other Zone A areas
5	Multipoint	12	8.884000	12.360610	9.228099	12.712638	FAIL	0
6	Multipoint	14	13.497340	12.672345	13.872680	13.136227	FAIL	0
7	Multipoint	20	11.759359	12.175548	11.885388	13.860011	FAIL	0 Tie-in to other Zone A areas

Record: 1 | Show: All Selected | Records: (0 out of 32 Selected) | Options

798006.43 421307.86 Feet

Basic Steps for Zone A Audits

Pass 2 – Horizontal Tolerance

- Select the points failing Pass 1 and apply a 38 foot buffer
- Determine the minimum and maximum ground elevations within that buffer
- Determine whether the minimum and maximum ranges on either side of the floodplain overlap

Summary

- Determine appropriate GIS steps
- Determine how to perform these steps using available ArcMap tools
- Automate steps to maximum extent possible using ModelBuilder

Questions?