

Using the NHDPlus for drainage area delineation and site matching

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What is NHDPlus?

- Suite of application-ready GIS products and tables
 - Incorporates the NHD 1:100,000 scale linework
 - Catchments for EVERY stream segment
 - Elevation products from the 30 meter NED (flow direction and flow accumulation)
- Tables – VAA (value added attributes)
 - For modeling inside and outside GIS systems
 - Many attributes already cumulative so know what is draining to a point.
 - Includes NLCD landcover data, temp/precip, elevation, channel slope, mean annual flow and velocity (unit and Vogel), etc.
- Ways of navigating – through GIS networks and through tables
 - Flow tables, start flags, stream levels, order, divergences, etc.

We just had the linework and the catchments – no other tables were available yet.

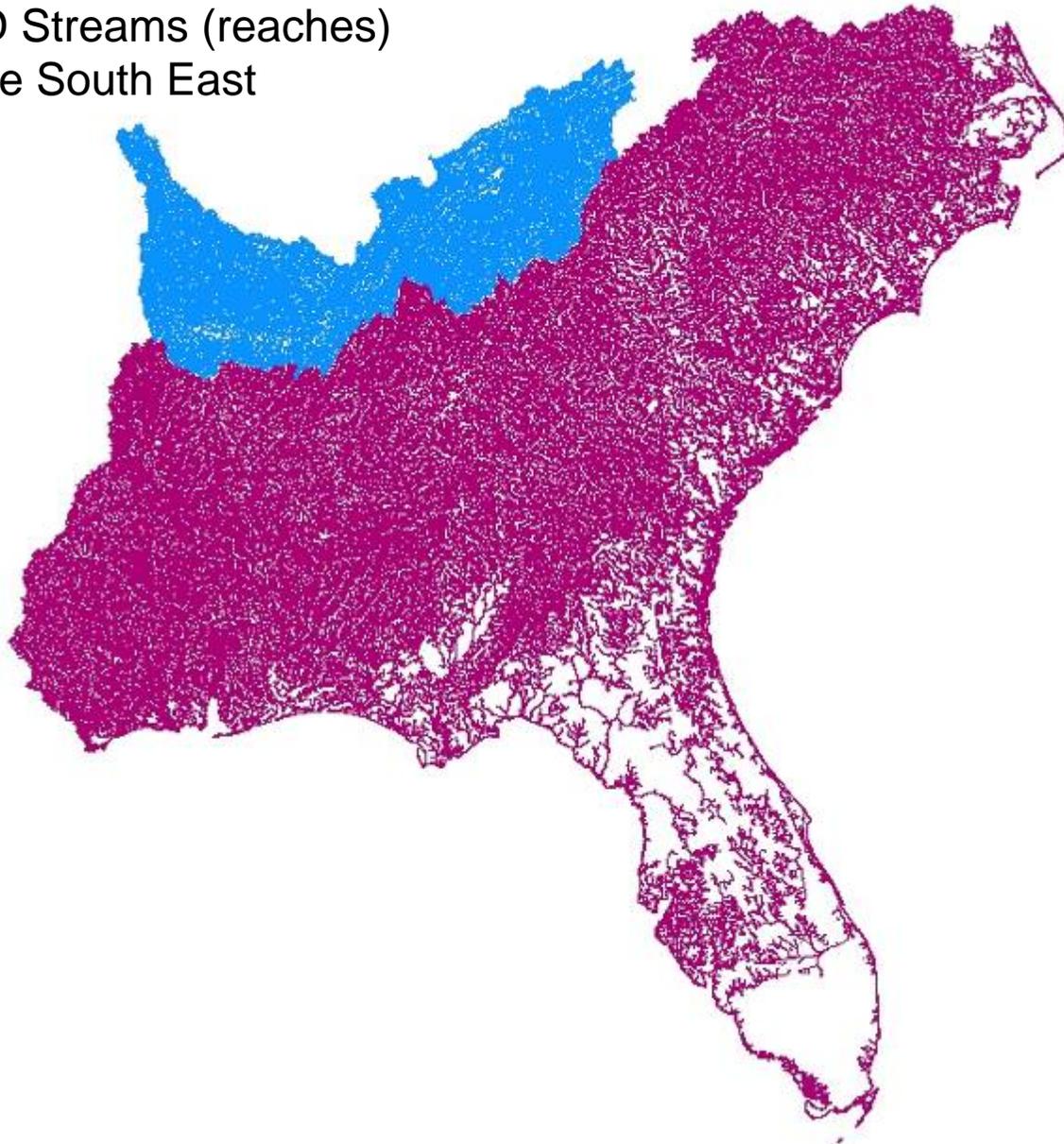
NHDPlus

- NHDPlus linework and catchments (1:100,000-scale) were supplied by Richard Moore, USGS – NH WSC for the South East. Final NHDPlus with all associated attribute tables will be released summer 2006 for the South East.
- The NHDPlus lines (representing streams) have been corrected: flow direction is assigned to each line segment so that flow is in the upstream direction.
- Catchments are defined as the subwatershed that drains to each line segment. Each catchment has a one-to-one correspondence with a stream segment.

MRB2 Study

- The Major River Basin study for the South East (MRB2) is an ongoing effort to characterize water quality and effects of urbanization in the South East.
 - Urban Land Use Gradient study
 - SPARROW model
 - Trends
- Each study examined watersheds within the SE, and needed the basin delineated for the watersheds
- We started with the NHD Plus streams and catchments for the study area to help in the basin delineation

NHD Streams (reaches)
In the South East

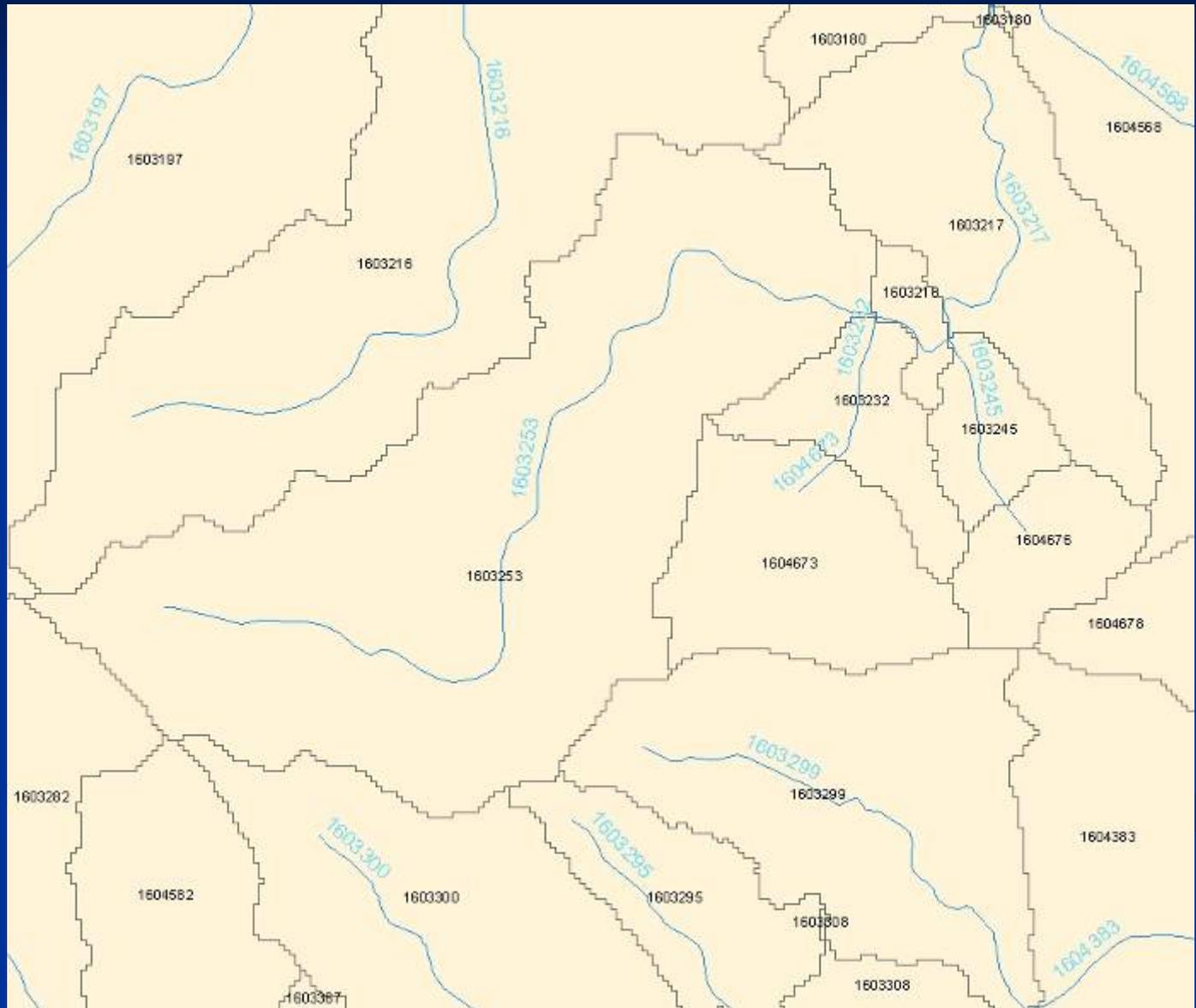


Catchments

- Catchments are formed from elevation data (30-meter NED) and stream reaches so that each reach has a small watershed defining the area that drains to the reach.
- The catchments are related to the reaches so that as traces are done upstream, the catchments are also traced. This allows the user to collect all upstream catchments that flow to a point – the complete drainage area.
- Similar methods have been used in multiple applications (StreamStats, SPARROW, etc)
 - The advantage using NHD Plus is that all catchments are preprocessed and linked to the Reaches of the NHD.



Catchments
and
corresponding
reaches

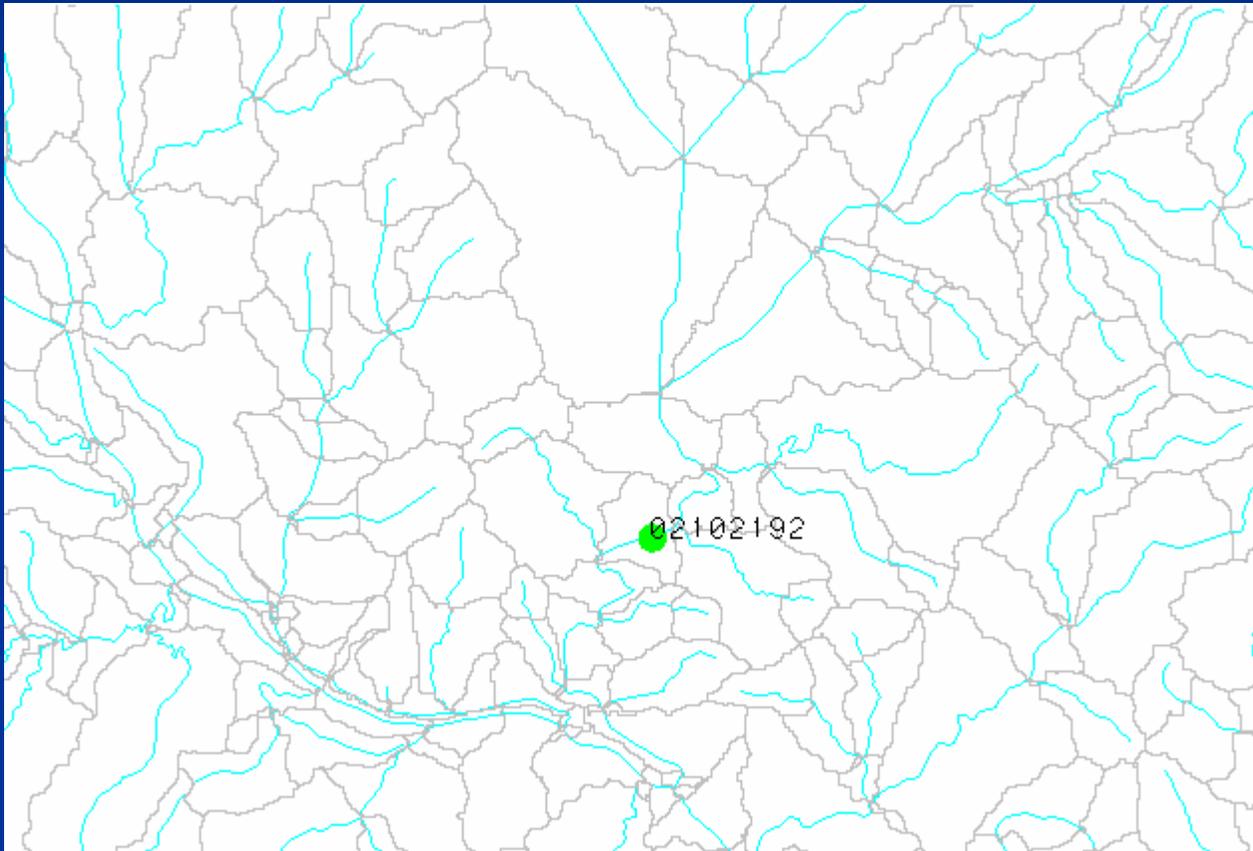


Trace capabilities

- The NHDPlus has been pre-processed to flow upstream.
 - Some corrections were necessary when streams did not connect with upstream reaches.
 - Amls were written to test the connectivity, but manual editing needed to be done to snap streams and connect all drainage networks
- A “trace” of a reach from an outlet point allows the user to find all upstream reaches very quickly.
- Downstream reaches can also be traced.



Example: Site that needs a drainage basin to be delineated

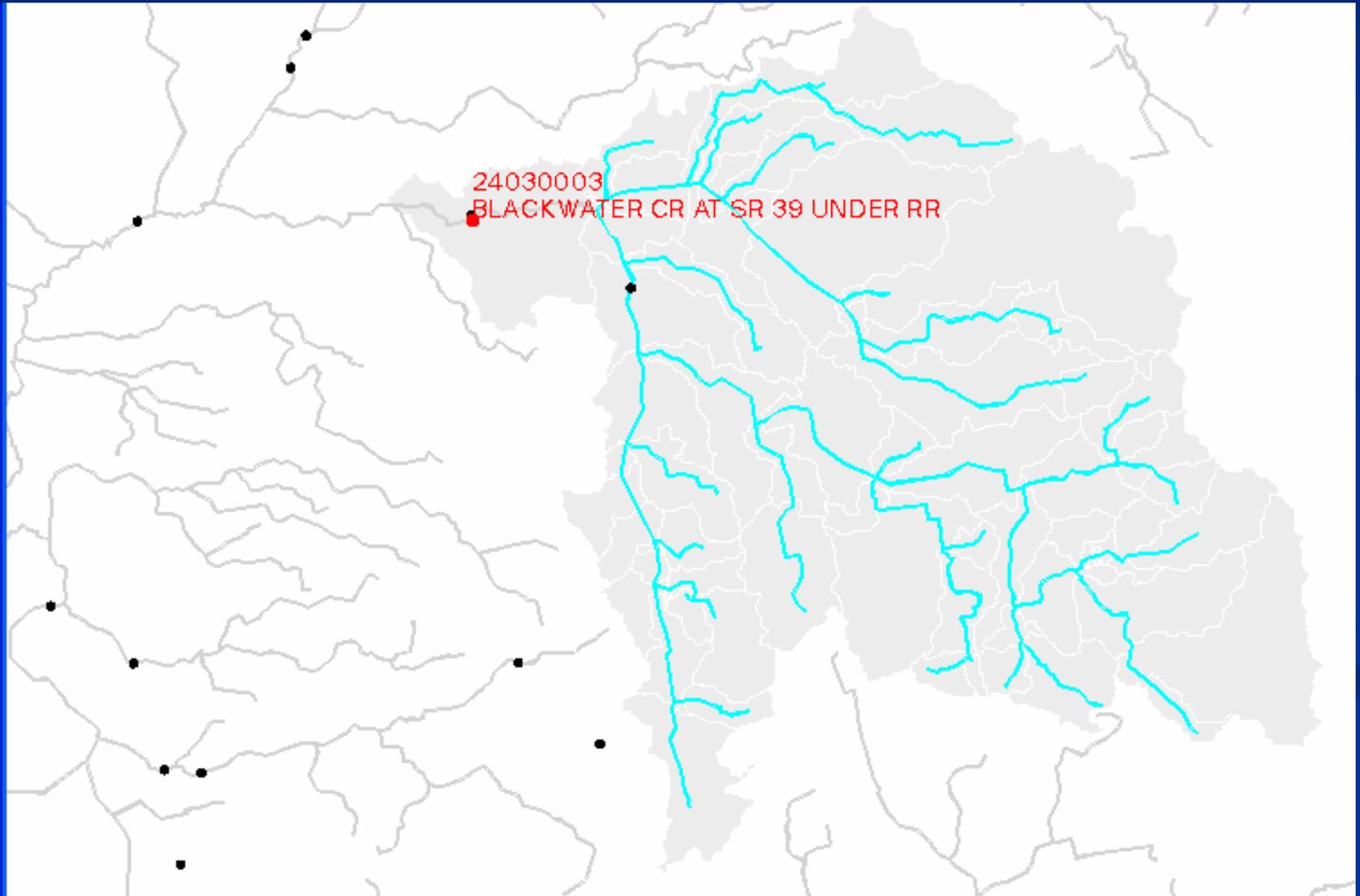


Filling in delineations

- If points were not at a confluence of streams (and so no catchment defined to them), the final line segment was delineated to the station using elevation data.
- Programs were written so that the exterior lines are kept and interior lines deleted.
- This process was used to automate the delineation of hundreds of basins, much more accurately than if we had just used the elevation data.



Trace with catchments identified





Drainage Area Ratio Application

- Used for the SPARROW project in the South East.
- Associated water quality sites with flow statistics from a near, hydrologically connected gaging station.
- Using traces and drainage area calculations, the matches were automated.



Matching STORET data to USGS Gaging stations

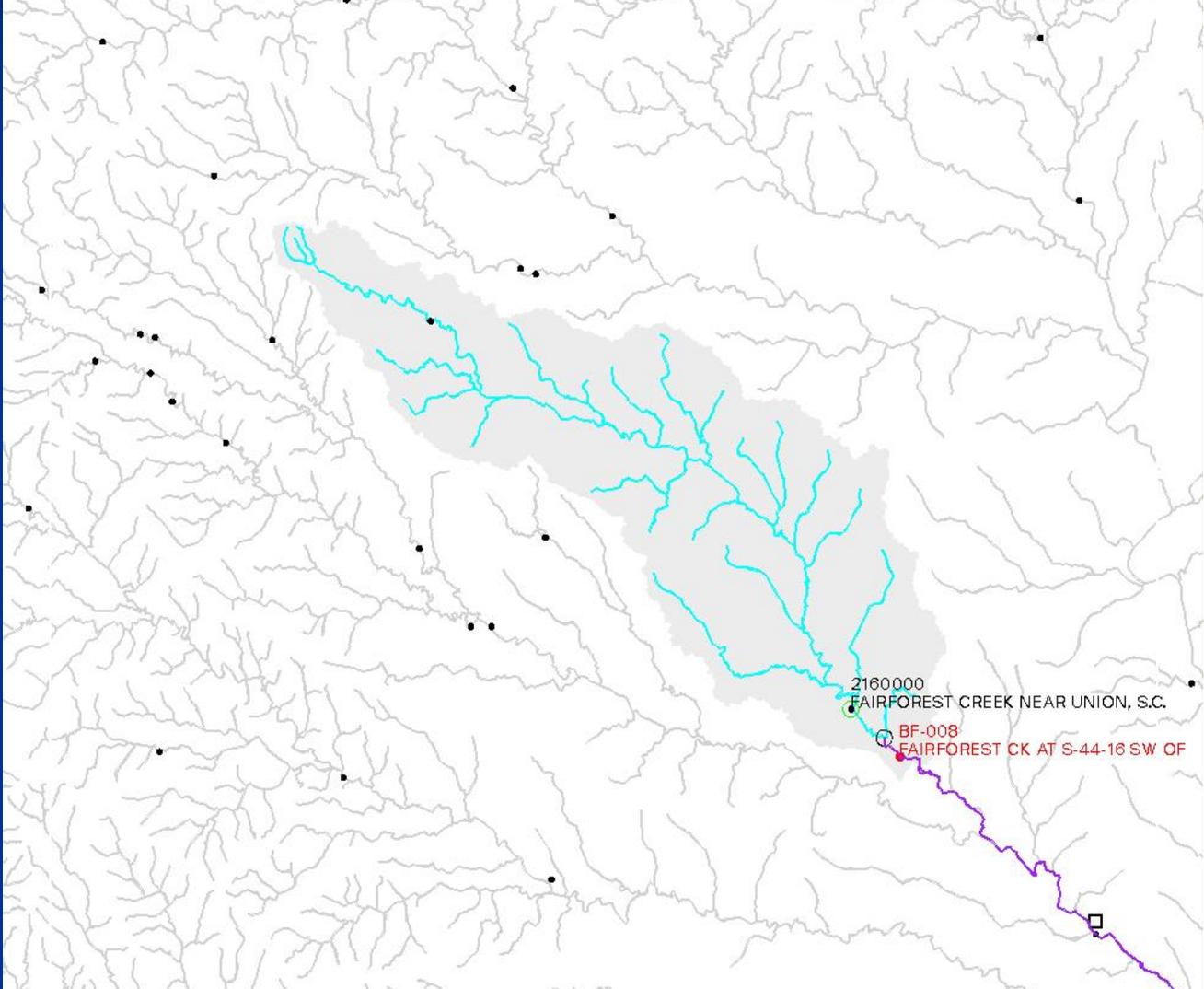
- A large number of STORET sites (1437) are located in the study area.
- If a STORET site had a drainage area ratio of 75% to 125% of a USGS gaging station, the flow statistics from the USGS gaging station could be applied to the STORET site.

Matching STORET with USGS gaging stations

- Analysis was done for each STORET site by automating the trace command to:
 - Find the NHD stream closest to the STORET site.
 - Find the coordinates of the upstream point of the NHD stream.
 - Trace upstream and collect all catchments.
 - Calculate drainage area.
 - Calculate 75% to 125% range of drainage area.
 - Trace downstream and collect all downstream catchments.
 - Overlay the USGS gages with the collected catchments and determine if any had a drainage area that fell within the tolerance.
 - Write the results out to a file that includes stream name, drainage area, site ids and difference in drainage area of both data sets.
 - Create “snap shots” of the watersheds and trace results with stream name information so that verification can occur.

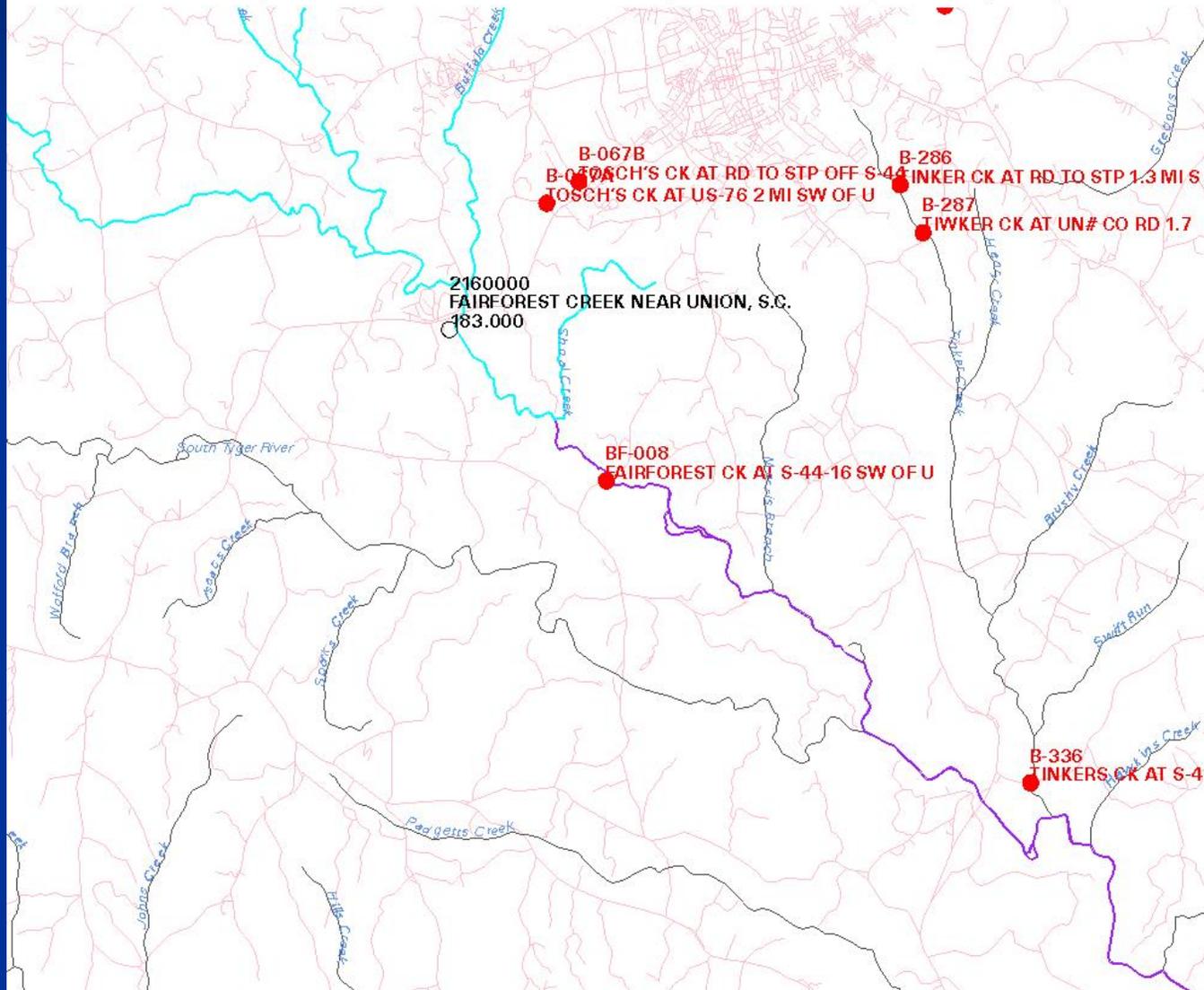
Snap shot of a “good” match

842: STORET SITE: BF-008, NAME: FAIRFOREST CK AT S-44-16 SW OF U, DA: 204.8444716942, 1 matches upstream, 0 matches dow



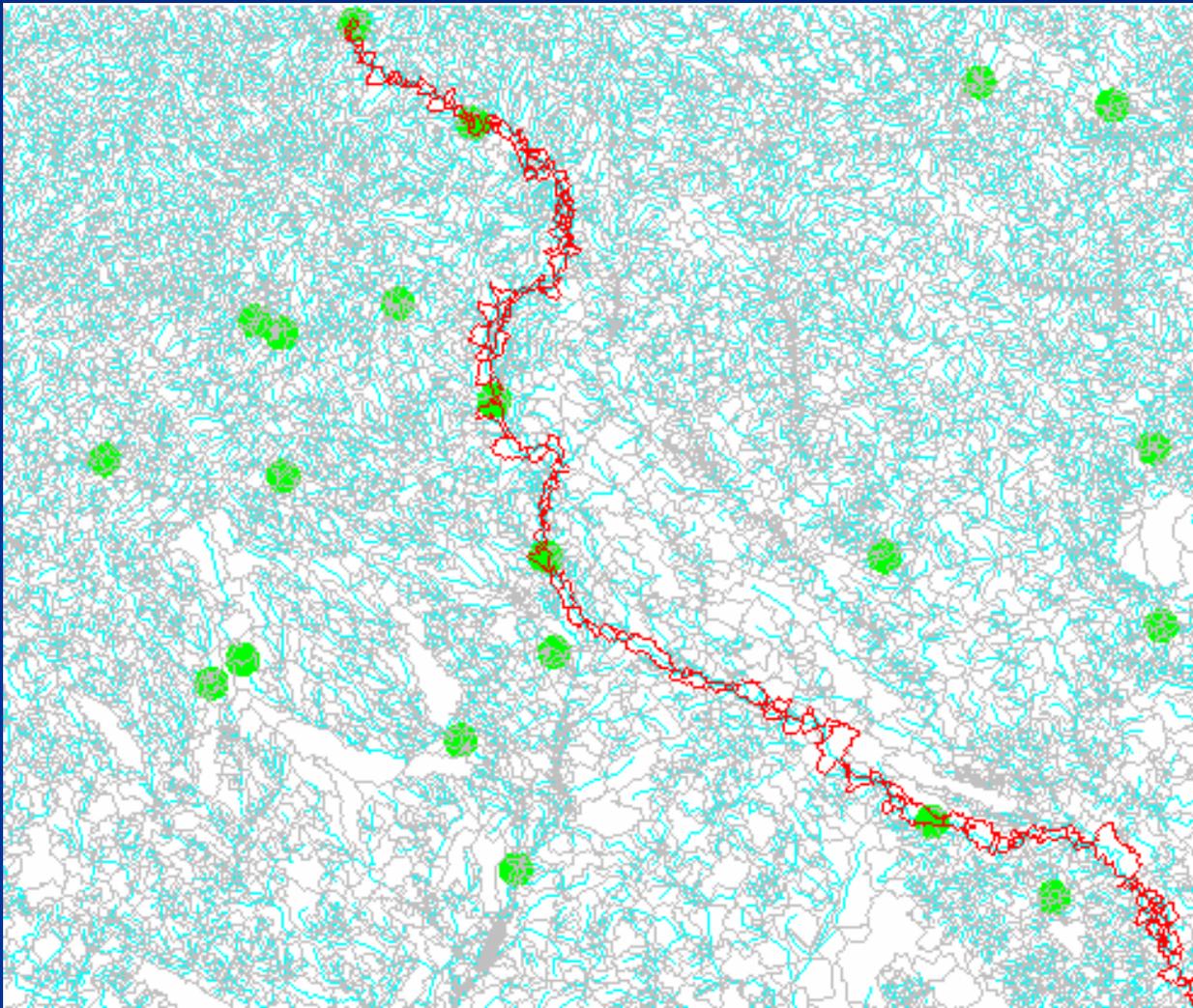
Zoom allows verification

842: STORET SITE: BF-008, NAME: FAIRFOREST CK AT S-44-16 SW OF U, DA: 204.8444716942, 1 matches upstream, 0 matches dow





Trace with downstream catchments identified

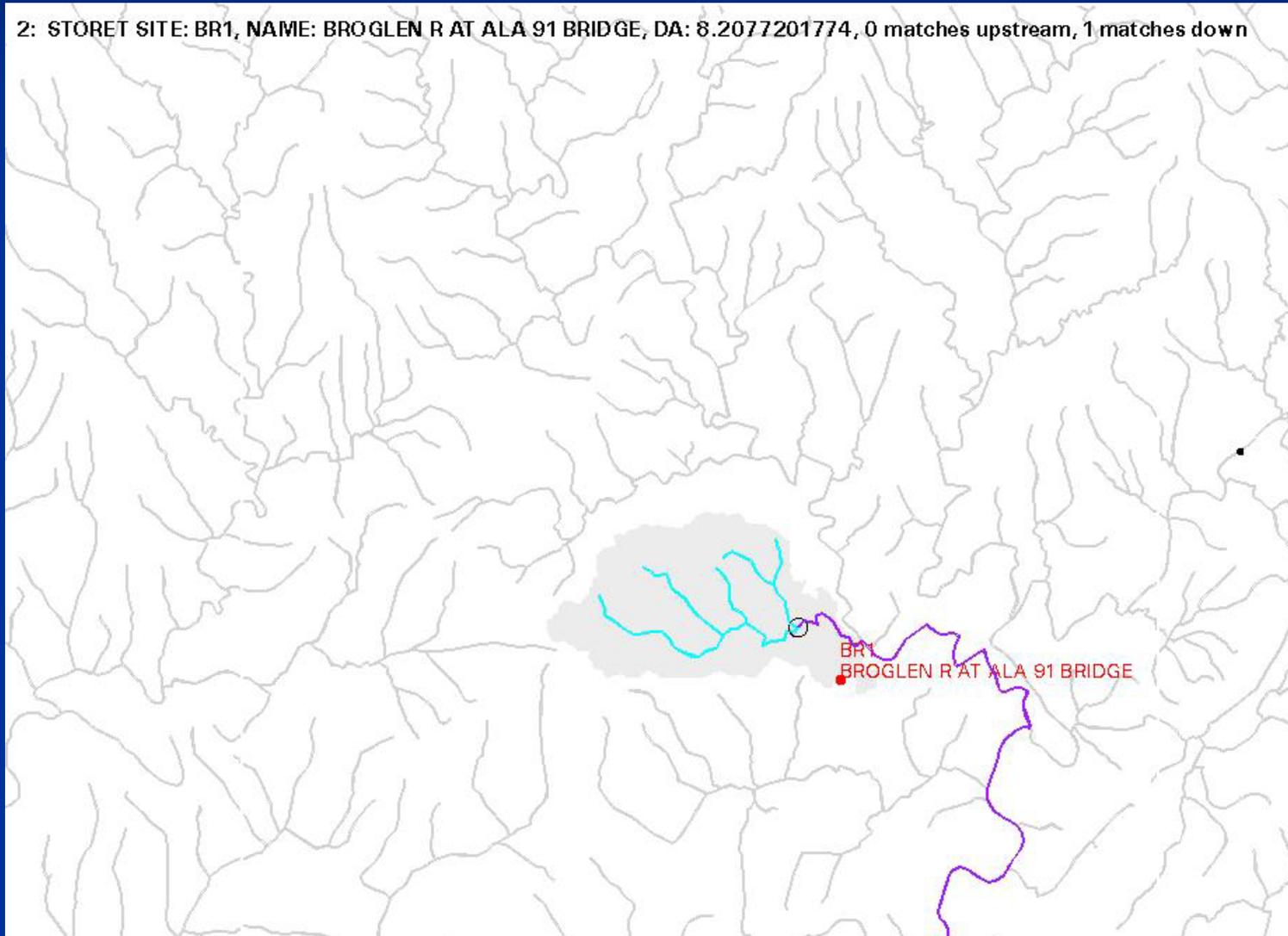


Problems or Sources of Errors

- Estimated 10 to 20% STORET sites were snapping to the wrong stream.
- STORET sites were moved so that the drainage areas were more accurate.
 - Ancillary sources were used: Geonames, Terraserver, National Map, NHD with name fields, roads.
 - Ideally, in-house DRG's and roads used
- No attempt to delineate directly to the point was made – the nearest catchment was used.
- The location and drainage area information for the USGS sites was assumed to be correct.

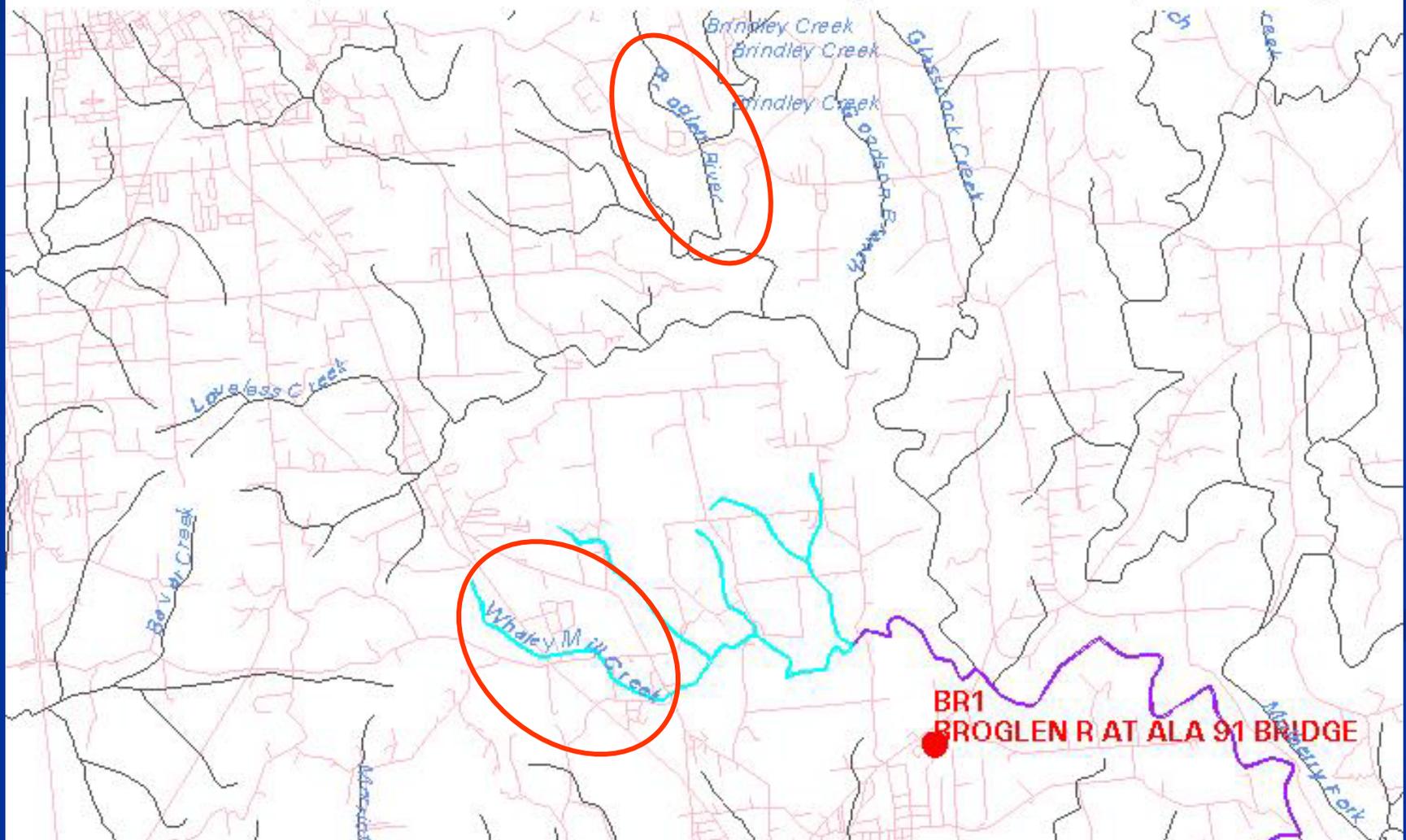
Example of a problem site

2: STORET SITE: BR1, NAME: BROGLEN R AT ALA 91 BRIDGE, DA: 8.2077201774, 0 matches upstream, 1 matches down



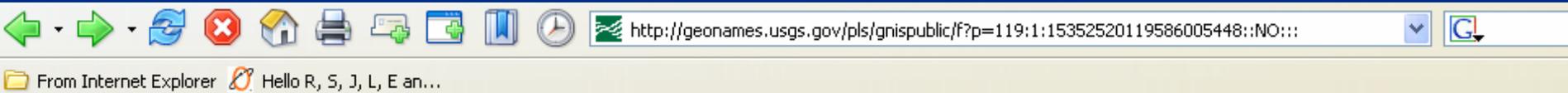
In zoom view, can see that the site is snapping to the wrong stream

2: STORET SITE: BR1, NAME: BROGLEN R AT ALA 91 BRIDGE, DA: 8.2077201774, 0 matches upstream



Using other sources – find site

■ Check GEONAMES online



[Click here to view & print all. \(Use browser print function.\)](#)

Query

Result

What's

Query Form For The United States And Its Territories

Please click the **What's New** tab for important information.

Feature Name:

Exact Match Exclude Variants

Feature ID:

Elevation:

Feet Meters

State or Territory:

County:

BGN Decision Year:

Feature Class:

Date Entered:

Topo Map Name (7.5x7.5):

Check Map State:

Important Links

[GNIS Home](#)

[U.S. Board on Geographic Names](#)

[FIPS55 Query](#)

[Antarctica Query](#)

[Mapping Information](#)

[Click on the field name for help in entering query data.](#)

Send Query

Erase Query



Finds matches

- Choose most appropriate match – sometimes must use County to narrow down choices.

Geographic Names Information System Feature Query Results

Click any column name to sort the list ascending ▲ or descending ▼. Click the feature name for details.

Feature Name	ID	Class	County	State	Latitude	Longitude	Map	Ele(Ft) ▲	BGN	Entry Date
Broglan River	114941	Stream	Cullman	AL	340343N	0864145W	Garden City	515	1964	04-SEP-1980

1 - 1

[Save as "|" delimited file](#)

Click on the TopoZone or Terraserver link

- DRG's are easiest way to verify locations...

Geographic Names Information System Feature Detail Report

Feature ID: **114941**

Name: **Broglen River**

Class: **Stream**

Citation: **Represents a feature name collected during Phase I. Variant names collected during Phase I are coded as US-M120/var.**

Entry Date: **04-Sep-1980**

Elevation(M): **157**

Elevation(Ft): **515**

Variant Names

Variant Name

Brindle Creek [Citation](#)

Mapping Services

Click the link to display the feature in the following map services.

[TopoZone.com](#)

[TerraServer DRG USGS Digital Raster Graphic](#), a digitized version of a topographic map.

[TerraServer DOQ USGS Digital Orthophoto Quadrangle](#), an aerial photographic image map. **Not available for all locations.**

[Tiger Map Server U.S. Census Bureau](#).

[Find the Watershed U.S. Environmental Protection Agency](#).

National Map Viewer - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://nmviewogc.cr.usgs.gov - National Map Viewer - Zoom To Point - Mozilla Firefox

From Internet Explorer

USGS
The National Map

- Overview
- Zoom In
- Zoom Out
- Zoom Back
- Find Place
- Full Extent
- Re-center
- Identify
- Elevation
- Measure
- Clear
- Bookmark
- Print
- Download
- Options

USGS

Zoom to a Point

Select point coordinate format:

Longitude and Latitude in Decimal Degrees

Enter longitude and latitude values in decimal degrees. Coordinates outside of the Viewer maximum extent will not be displayed. Note that most United States domestic longitudes are negative.

Longitude	Latitude	Zoom Level
<input type="text" value="-86.745"/>	<input type="text" value="34.076"/>	<input type="text" value="City"/>

Example coordinates for the Washington Monument:
Longitude -77.03528 ° **Latitude** 38.88944 °

Alabama - William B. Bankhead National Forest
Arkansas - AR-KS-MO Regional National Map Project
Arkansas - Benton County
Arkansas - City of Fort Smith

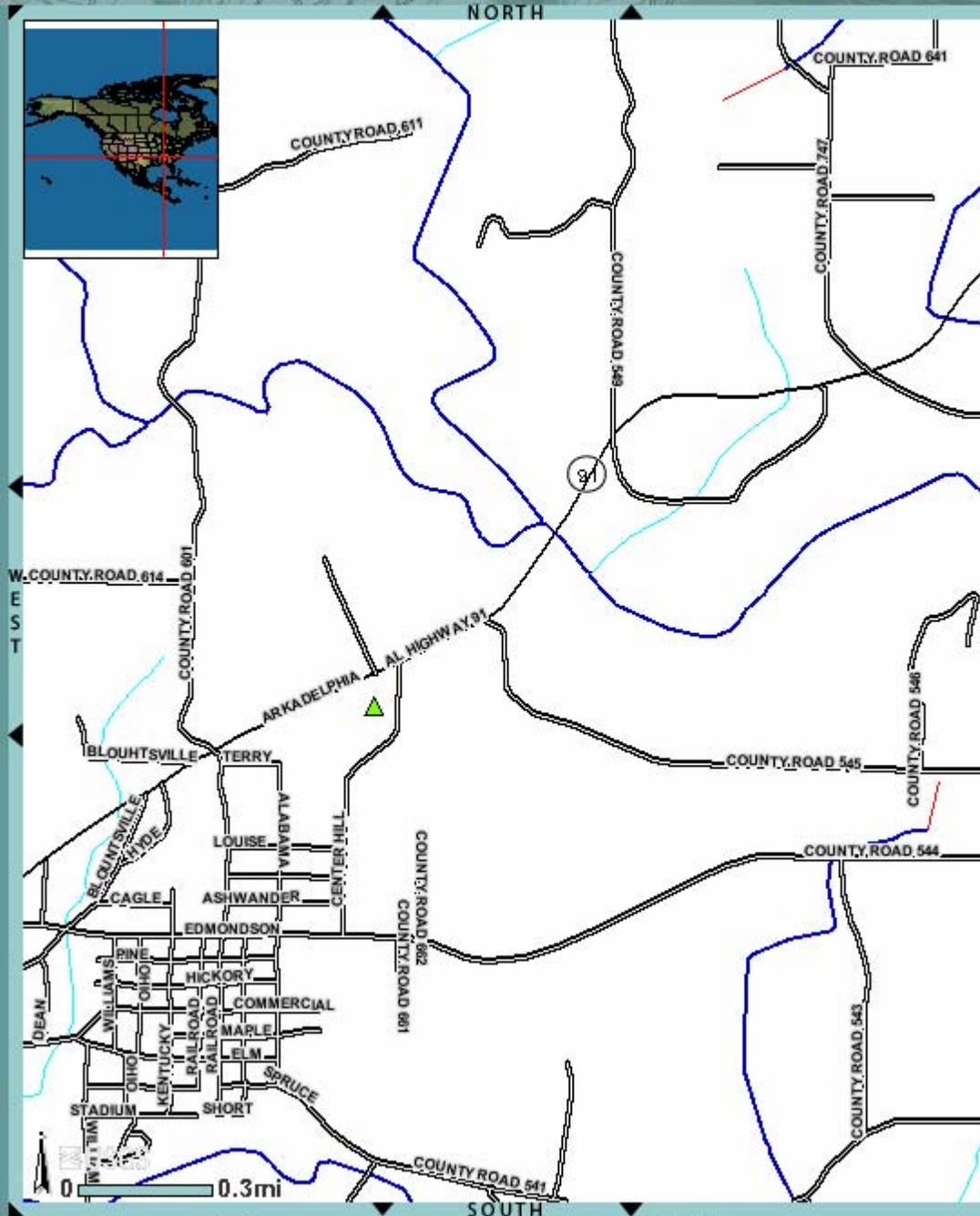
[Address](#)
[Named Feature](#)
[Point \(Longitude-Latitude, UTM, USNG\)](#)
[Extent](#)

USGS
0 450

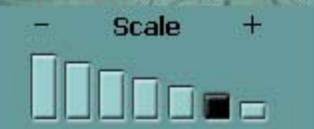
National
Map -
Find
Place



- Overview
- Zoom In
- Zoom Out
- Zoom Back
- Find Place
- Full Extent
- Re-center
- Identify
- Elevation
- Measure
- Clear
- Bookmark
- Print
- Download
- Options



Scale



Layers Legend

- Elevation
- Geographic Names
- Geology
- Hydrography
 - INDEX/STATUS (HYDROGRAPHY)
 - NHD SubBasin High Res Status
 - NHD SubBasin Local Res Status
 - NHD SubBasin Medium Res Status
- LAKES
 - No layers available.
- NHD HIGH RES
 - NHD High Res Area
 - NHD High Res Flowline
 - NHD High Res Line
 - NHD High Res Point
 - NHD High Res Waterbody
- NHD LOCAL RES
 - NHD Local Res Area
 - NHD Local Res Flowline
 - NHD Local Res Line
 - NHD Local Res Point
 - NHD Local Res Waterbody
- NHD MEDIUM RES
 - LABELS
 - NHDAREA_MEDIUM
 - LABELS
 - NHDFLOWLINE_MEDIUM
 - LABELFLOWLINE_MEDIUM

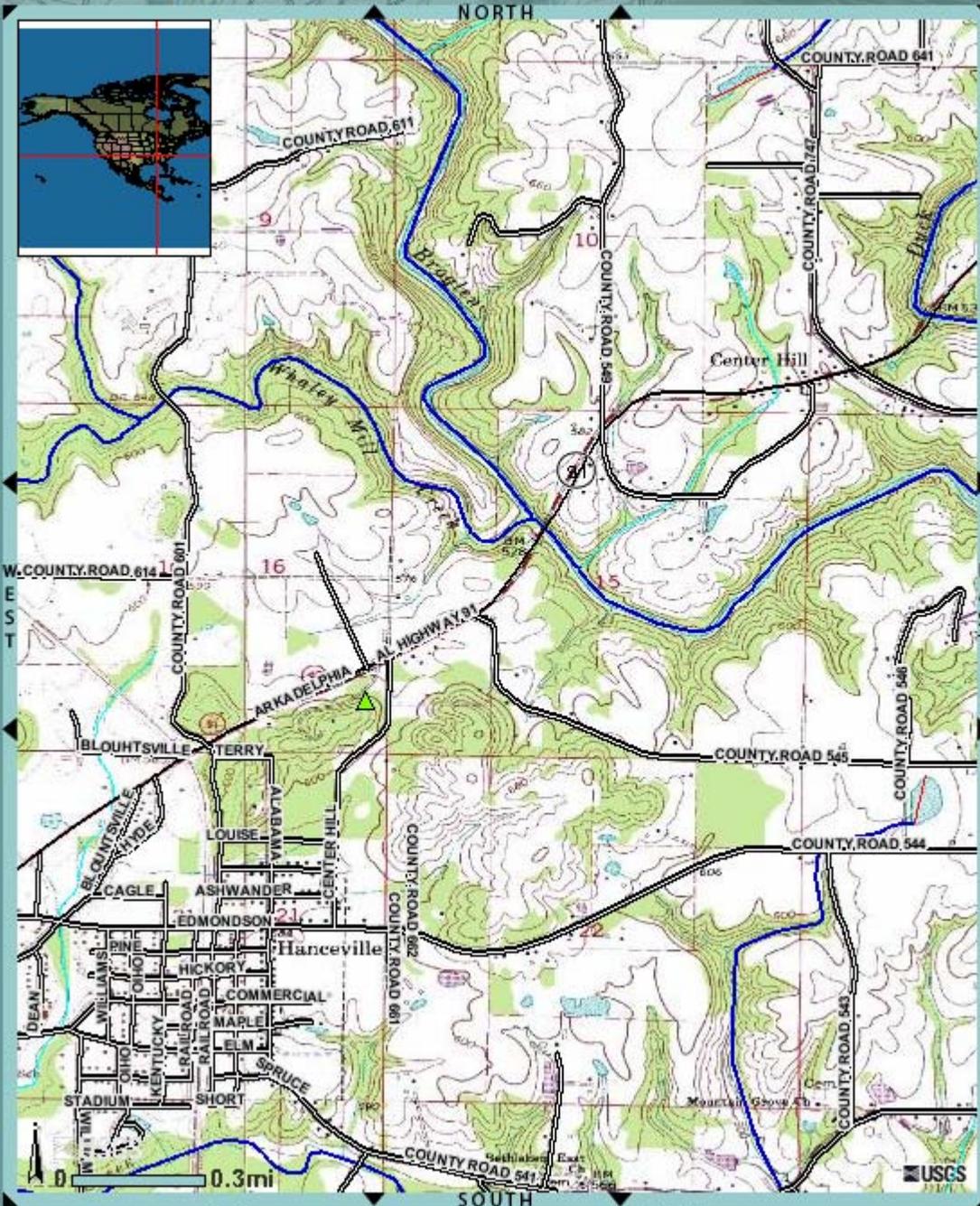
Refresh Map

Turn on high resolution Hydrography and other layers that you help in identifying the correct location.

Roads with labels area also very helpful

DRG's
also
available

-  Overview
-  Zoom In
-  Zoom Out
-  Zoom Back
-  Find Place
-  Full Extent
-  Re-center
-  Identify
-  Elevation
-  Measure
-  Clear
-  Bookmark
-  Print
-  Download
-  Options



Scale



Layers Legend

- National Atlas Streams
- STREAMS
- No layers available.
- WATER RESOURCES
- Realtime Gaging Stations
- WATERBODIES
- National Atlas Waterbodies
- WATERBODY NAMES
- National Atlas Waterbody Labels
- WETLANDS
- Wetland Polygons (USFWS)
- Land Use/Land Cover
- Natural Disaster/Weather
- Orthoimagery
- Other
- Structures
- Topographic Maps
- INDEX/STATUS (TOPOGRAPHIC MAPS)
- 100,000 Index
- 250,000 Index
- 7.5 Minute Index
- USGS QUADRANGLES
- USGS Raster Graphics (Topo Maps)
- Transportation

Refresh Map



Initial results

- 802 STORET sites did not have a USGS gaging station within the defined tolerance.
- 390 found 1 match
- 157 found 2 matches
- 81 found 3 matches
- 23 found 4 matches
- 15 found 5 matches
- 5 found 6 or more matches

Example Results in Spreadsheet

storet_matches.091305

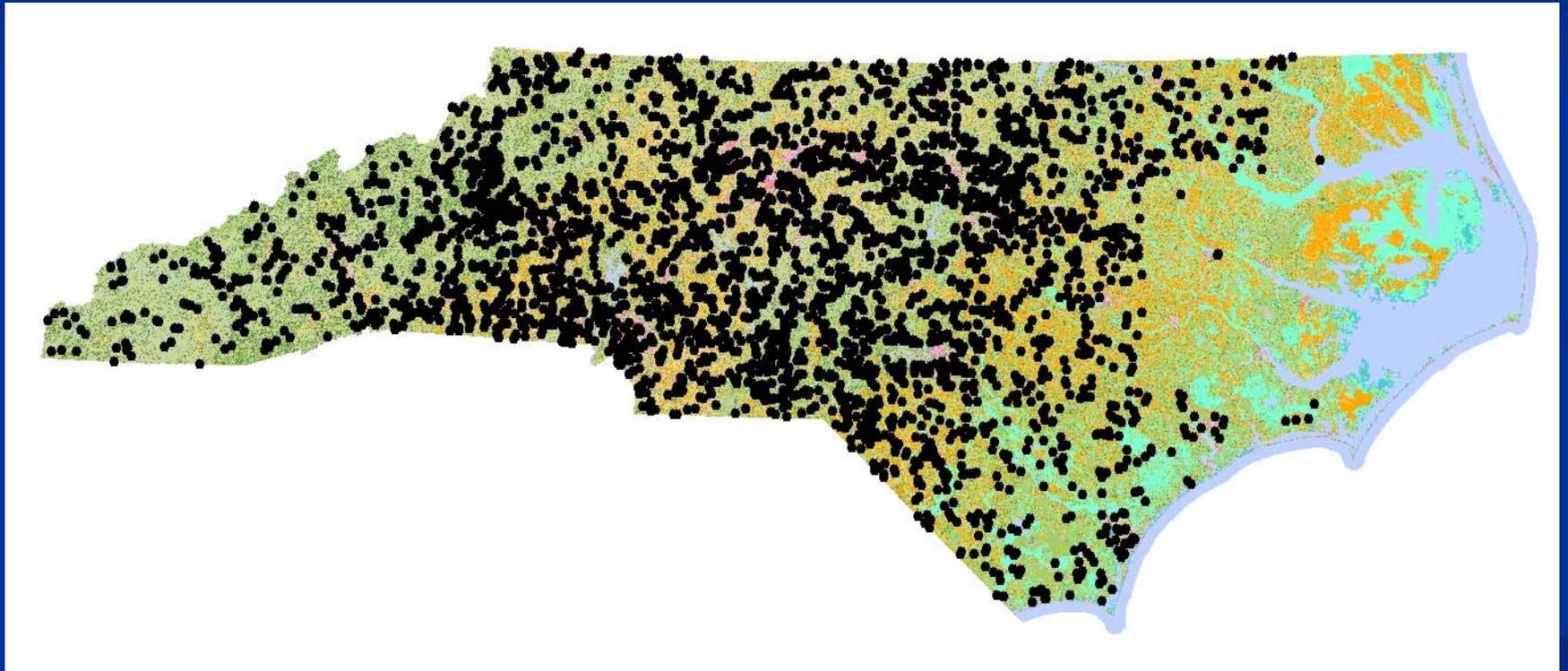
	A	B	C	D	E	F	G	H	I	J
1	STORET_ID	ST_STAID	ST_NAME	ST_DA_SQMI	NWIS_STAID	NWIS_NAME	NWIS_DA	NWIS_STATE	NWIS_HU	DIFF_DA
2	1	B1	BUCK CRE	72.415	0	0	0	0	0	72.41
3	2	BR1	BROGLEN	8.208	2307697	ALLIGATOR C	9	Florida	3100206	0.79
4	3	C1	CAHABA R	16.961	2308889	SEMINOLE L	14	Florida	3100207	2.96
5	4	C2	CAHABA R	200.905	2423425	CAHABA RIV	201	Alabama	3150202	0.09
6	4	C2	CAHABA R	200.905	2423496	CAHABA RIV	226	Alabama	3150202	25.09
7	4	C2	CAHABA R	200.905	2423500	CAHABA RIV	230	Alabama	3150202	29.09
8	5	C3	CAHABA R	334.578	2423555	CAHABA RIV	335	Alabama	3150202	0.42
9	6	C4	CAHABA R	0.645	0	0	0	0	0	0.64
10	7	CL1	CHOCOL	498.074	2404500	CHOCOCLOC	496	Alabama	3150106	2.07
11	7	CL1	CHOCOL	498.074	2404400	CHOCOCLOC	481	Alabama	3150106	17.07
12	8	CL2	CHOCOL	251.599	2404000	CHOCOCLOC	277	Alabama	3150106	25.4

Other Applications

- The Flood Frequency project used the procedure to add thousands of sites to the flood frequency website, linking previously ungaged locations with correct equations for estimating flood frequency statistics.
- Over 3475 miscellaneous measurement sites in 17 River Basins in N.C. were evaluated using the tools for:
 - Spatial accuracy
 - Proximity to gaged sites with 10 years of record of more



Distribution of Ungaged Sites



3475 ungaged sites, 409 gaged sites



Reduce need to check locations

Of the 695 sites in the Broad River Basin, 264 had a calculated drainage area with a difference greater than 10% of the drainage area recorded in the cards database. Only these needed to be checked.

Microsoft Excel - ff_matches_broad_03.xls

File Edit View Insert Format Tools Data Window Help

100%

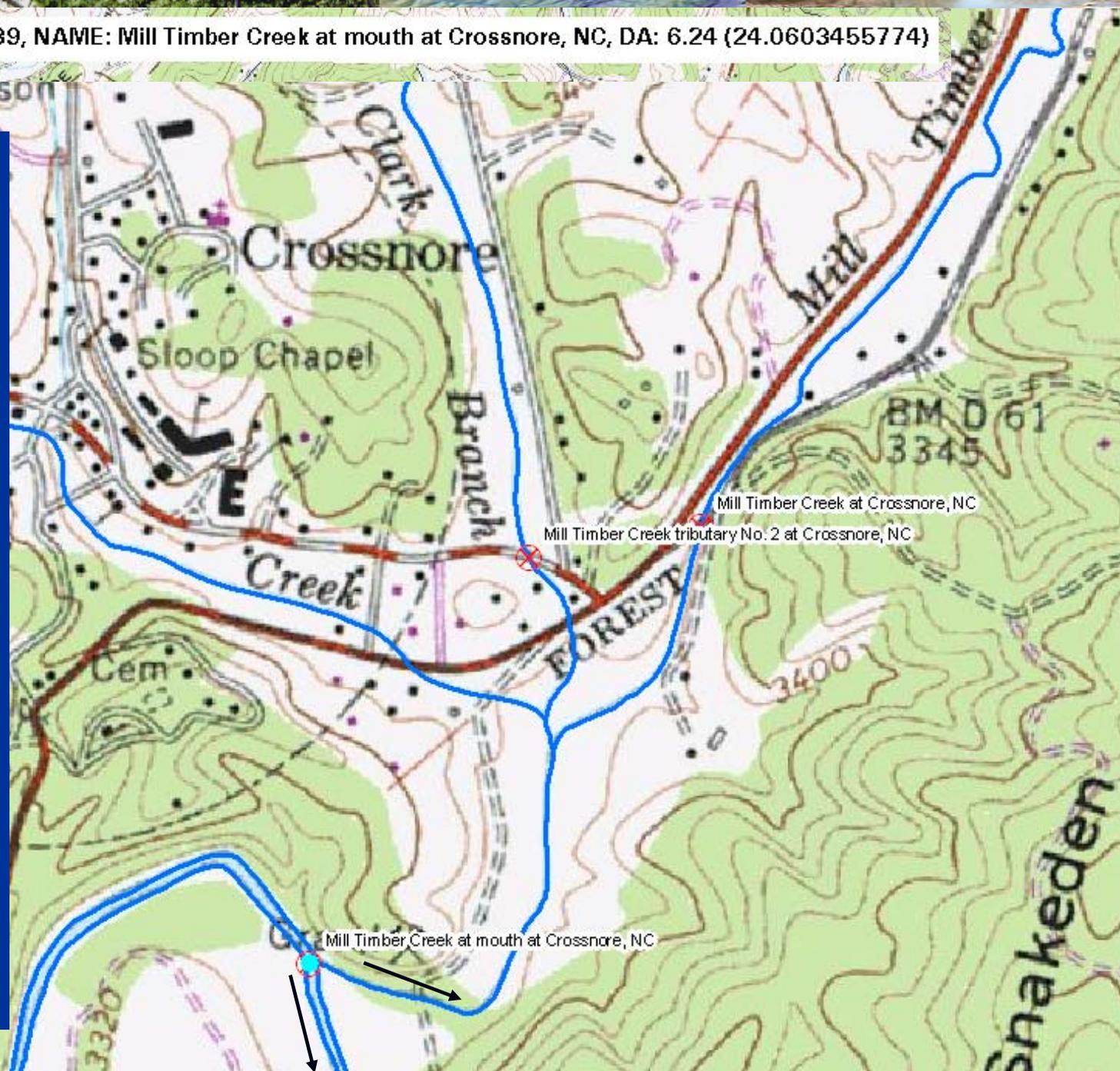
Reply with Changes... End Review...

	A	B	C	D	E	N	O	P
1	FF_ID	MM_STAID	MM_NAME	MM_DACAP	DA_CALC	DA_DIFF	DA_PCT	STATUS
1	FF_ID	MM_STAID	MM_NAME	MM_DACAP	DA_CALC	DA_DIFF	DA_PCT	STATUS
2	1	2139937	Dixon Creek near Upton	0.26	0.868	-0.61	-234.62	good
3	2	2140304	Wilson Creek near Grac	0.72	2.25	-1.53	-212.50	check
4	3	2139902	Honey Branch near Bail	1.1	1.376	-0.28	-25.45	good
5	4	2139901	Johns River near Bailey	1.21	1.228	-0.02	-1.65	
6	5	2139916	Thunderhole Creek near	7.67	7.398	0.27	3.52	
7	6	2139918	Curtis Creek near Globe	1.62	1.747	-0.13	-8.02	good
8	7	213993750	Gragg Prong near Tough	7.33	8.677	-1.35	-18.42	good
9	8	2138288	Linville River at NC High	5.73	6.459	-0.73	-12.74	good
10	9	2138294	Linville River at Linville,	10	11.325	-1.33	-13.30	good
11	10	2139923	Thunderhole Creek at U	10.2	10.142	0.06	0.59	
12	11	2139907	Johns River at Upton, N	4.45	4.433	0.02	0.45	
13	12	2139938	Big Branch near Globe,	0.34	0.339	0	0.00	

Many occurrences of sites on a confluence snapping to the wrong stream segment. The differences in drainage areas are a flag to check the site's location.

In this example:
Drainage area from site file:
6.24 sq mi

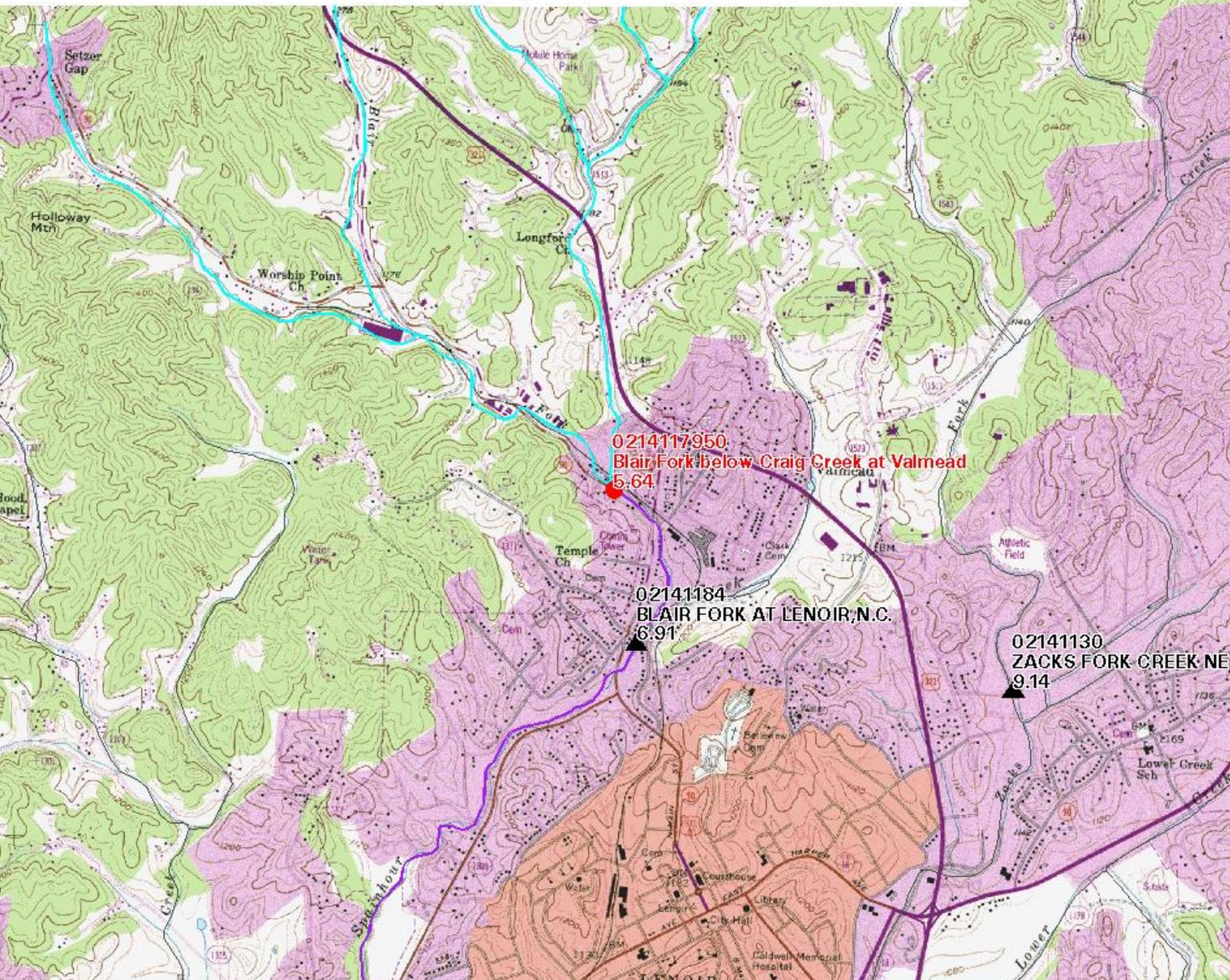
Drainage area calculated from NHDPlus:
24.06 sq mi.





Determines the equation for use in an online application

- Each site was also checked against gaged sites with at least 10 years of record
- The site was tagged with the matching flood frequency site so that the appropriate equation can be used when calculating flood frequency statistics.



0 matches upstream, 1 matches down

02141148





Example results

- 113 sites were within the drainage area ratio of a Flood Frequency gaged site in the Broad River Basin (of 695 sites)
- 124 total matches – 11 sites had multiple matches.

	A	B	C	D	E	F	G	H	
1	FF_ID	MM_STAID	MM_NAME	MM_DACARDS	DA_CALCED	FF_STAID	FF_NAME	FF_DA_SQMI	FF
408	407	2143490	Indian Creek at Crouse, NC	64.4	70.422	2143500	INDIAN CREEK NEAR LABORATORY M	69.2	
409	408	2142647	Lake Norman on Catawba River, NC	1788	1790.704	2142500	CATAWBA RIVER AT CATAWBA, N. C	1530	
410	409	214900110	Broad River below Cove Creek 3.0 miles st	186	184.028	2148500	BROAD RIVER NEAR CHIMNEY ROCK	97	
415	414	2142648	Catawba River at NC Highway 73 near Hic	1778	1790.704	2142500	CATAWBA RIVER AT CATAWBA, N. C	1530	
421	420	2143481	Indian Creek near Crouse, NC	50	52.41	2143500	INDIAN CREEK NEAR LABORATORY M	69.2	
430	429	214360110	Beaverdam Creek at mouth near High Sho	27.3	481.337	2143040	JACOB FORK AT RAMSEY, N. C.	25.7	
450	449	2150740	Second Broad River near Bostic, NC	164	165.625	2151000	SECOND BROAD RIVER AT CLIFFSIDE	220	
459	458	2143740	South Fork Catawba River near Hardins , N	525	528.715	2145000	SOUTH FORK CATAWBA RIVER AT LO	628	
460	459	2149719	Green River at Turner Shoals Dam, NC	138	136.781	2150000	GREEN R NR MILL SPRING N C	174	
465	464	2150000	Green River near Mill Spring, NC	177	180.826	2150000	GREEN R NR MILL SPRING N C	174	
466	465	2152517	First Broad River near Metcalf, NC	216	216.248	2152500	FIRST BROAD RIVER NEAR LAWNDAL	200	
471	470	2150742	Second Broad River at US Highway 74 at f	168	167.893	2151000	SECOND BROAD RIVER AT CLIFFSIDE	220	

Conclusions...

- Using streams and catchments, 2 very time consuming, common tasks were automated and standardized.
- The full NHD Plus datasets will be available Nationwide by the end of the summer.
 - Many other data layers and tables will increase the power of this product.

Questions?

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