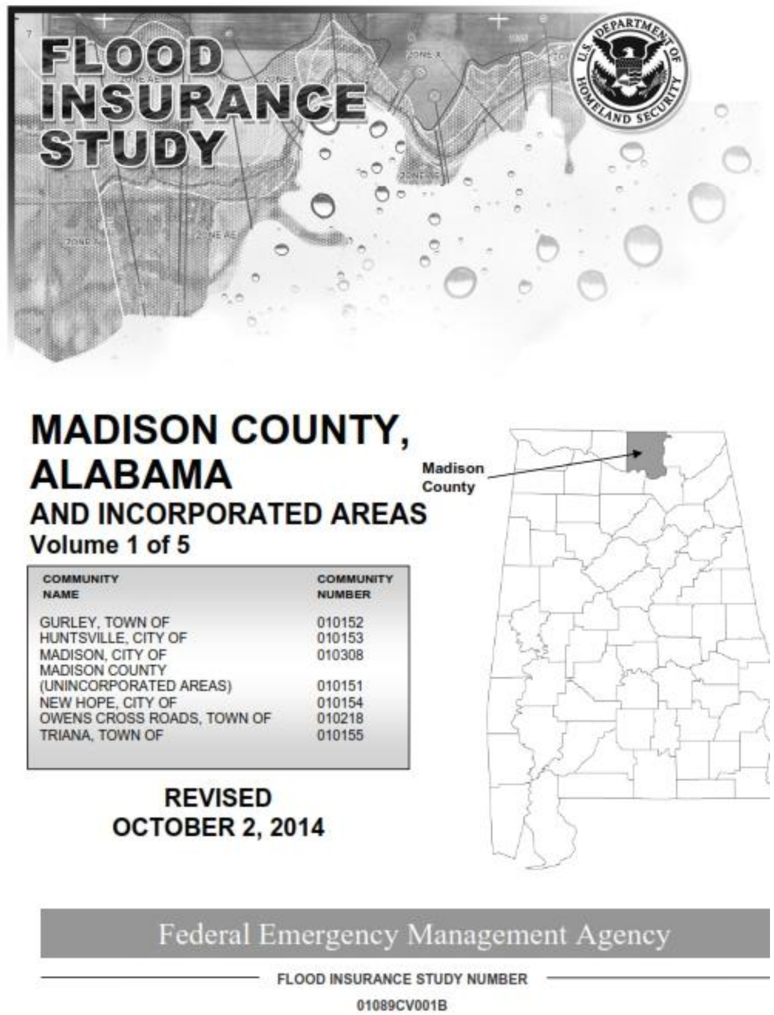
Where Do Flows Come From?

2014 AAFM Fall Conference
Auburn, AL
October 14, 2014

Clay Campbell, PE, CFM
AMEC Environment & Infrastructure, Inc.

Bill Fain, EIT
AMEC Environment & Infrastructure, Inc.

Flood Insurance Study (FIS)



FLOOD INSURANCE STUDY

MADISON COUNTY, ALABAMA

AND INCORPORATED AREAS

Volume 1 of 5

COMMUNITY NAME	COMMUNITY NUMBER
GURLEY, TOWN OF	010152
HUNTSVILLE, CITY OF	010153
MADISON, CITY OF	010308
MADISON COUNTY (UNINCORPORATED AREAS)	010151
NEW HOPE, CITY OF	010154
OWENS CROSS ROADS, TOWN OF	010218
TRIANA, TOWN OF	010155

REVISED
OCTOBER 2, 2014

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
01089CV001B

FIS – Summary of Discharges Table

TABLE 3 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-percent-	2-percent-	1-percent-	0.2-percent-
ALDRIDGE CREEK					
Approximately 952 feet upstream of Rivlin Road	0.37				
Approximately 597 feet upstream of Rivlin Road	0.46				
At Rivlin Road	0.52				
Approximately 329 feet downstream of Rivlin Road	0.61				
At Briarwood Drive	0.86				
At Drake Avenue	1.11				
Approximately 641 feet upstream of Toney Drive	1.21				
Approximately 255 feet downstream of Toney Drive	2.25				
Approximately 1930 feet upstream of Farm Road	3.29				
Approximately 0.4 miles upstream of Carl T. Jones Road	4.82				
At Carl T. Jones Road	6.01				
At Sherwood Drive	6.97				
At Weatherly Road	11.07				
Approximately 0.6 miles downstream of Weatherly Road	13.12				
At Mountain Gap Road	14.10				
At Confluence with the Tennessee River	21.02				
ALDRIDGE CREEK TRIBUTARY 1					
approximately 150 feet downstream of Chaney Thompson Road	*	640	870	950	1,130

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FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance
ALDRIDGE CREEK TRIBUTARY 10					
Approximately 600 feet downstream of Bailey Cove Road	*	1,680	2,360	2,590	3,040
Approximately 350 feet downstream of Bailey Cove Road	*	1,620	2,270	2,490	2,940
Approximately 640 feet upstream of Bailey Cove Road	*	1,480	2,070	2,240	2,610
Approximately 935 feet downstream of Tea Garden Road	*	1,310	1,860	1,970	2,370
At Tea Garden Road	*	1,110	1,630	1,860	2,440

FIS – Engineering Methods

amec

3.0 ENGINEERING METHODS

For the flooding sources stud[…] hydraulic study methods were […] study. Flood events of a magni[…] on the average during any 10-, […] been selected as having specia[…] insurance rates. These events, c[…] have a 10-, 2-, 1-, and 0.2-per[…] during any year. Although the r[…] between floods of a specific ma[…] within the same year. The risk […] greater than 1 year are considere[…] exceeds the 100-year flood (1[…] period is approximately 40 pe[…] increases to approximately 60 […] flooding potentials based on […] completion of this study. Map[…] reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses we[…] relationships for each flo[…]

Precountywide Analyses

Each community within […] Towns of Gurley and T[…] each community's hydro[…] this countywide FIS hav[…] below.

For the portion of the F[…] USGS gaging station o[…] principal source of data […] has been operating sinc[…] from the record using t[…] (Reference 9). The trans[…] was determined by comp[…]

For the portion of the […] discharge-frequency wa[…] between discharge-freq[…] USGS gaging station […] procedures outlined by […] the adopted discharge-f[…]

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Frequency discharges for Limestone Creek were calculated using HEC-HMS, version 3.2. Discharges were adjusted to a Bulletin 17B analysis performed on data obtained at the USGS gaging station No. 03576250, located at US HWY 72. The USGS gage has been collecting nearly continuous data since 1940. Discharges for the 1-percent-annual-chance flood event on Limestone Creek were calibrated to be within 2% of the Bulletin 17B analysis.

Frequency discharges for McDonald Creek and Sherwood Branch were calculated using a combination of HEC-HMS, version 3.3 and XPSWMM, a two dimensional pipe and overland flow model. The XPSWMM portion of the model consisted of the upstream end of Unnamed Tributary to Sherwood Branch and was used as an input to the HEC-HMS model. The 1-percent-annual chance discharges for McDonald Creek were calibrated to be within 2% of the results of a Bulletin 17B analysis of the USGS gaging station No. 03575980 near Patton Road.

Frequency discharges for Huntsville Spring Branch and all its tributaries were taken from the *Flood Study Report – Pinhook Creek Watershed*, published by the City of Huntsville in August 2004 (Reference 48). HEC-1 was utilized to calculate peak discharges on Broglan Branch, Broglan Branch Tributary A,

When are flows revised?

Guidelines and Specifications for Flood Hazard Mapping Partners

Appendix C: Guidelines for Riverine Flooding Analyses and Mapping

- When more recent analysis yields statistically different results when compared to the effective
- When new discharges yield significant differences in the BFEs (>0.5 foot)

Why are flows revised?

Guidelines and Specifications for Flood Hazard Mapping Partners

Appendix C: Guidelines for Riverine Flooding Analyses and Mapping

- To reflect longer periods of record or data revisions;
- To reflect changed physical conditions;
- To take advantage of improved hydrologic analysis methods; or
- To correct an error in the hydrologic analysis performed for the effective study.

Can effective flows be used?

- Yes, if the effective flows can be validated
  - Plus or minus one standard error (68-percent confidence interval) should be used to determine significant difference
- However, the discharges effect on BFEs and SFHA should also be taken into account
  - BFE difference > 0.5 foot = use new discharges
  - Significant change in SFHA = use new discharges
    - Newer topography
    - Changes in hydraulic conditions (channelization, culverts, bridges, etc.)

How to choose appropriate method?

- How much money do you have?
- How large is the basin of interest?
- Are there any gages?
- Is it urban or rural?
- Are there dams on the stream?

Types of Hydrologic Methods

amec

Detail Study (Zone AE)

- USGS Regression
  - Regional
  - Urban
  - Small Rural
- Rainfall-runoff model
  - HEC-HMS
  - Other 1-D & 2-D models
- Gage

Approximate Study (Zone A)

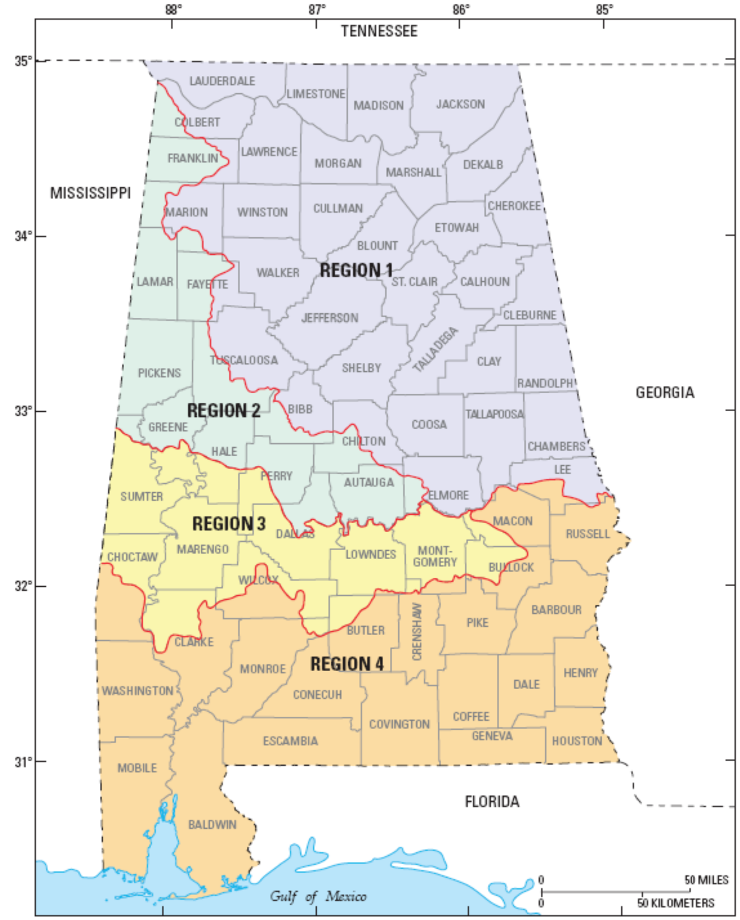
- USGS Regression
  - Regional
  - Small Rural

USGS Regional Regression

Magnitude and Frequency of Floods in Alabama, 2003 (SIR 2007-5204)

Recurrence interval (years)	Regression equations for the indicated flood regions			
	Region 1	Region 2	Region 3	Region 4
1.5	$Q = 184\ A^{0.666}$	$Q = 126\ A^{0.663}$	$Q = 254\ A^{0.565}$	$Q = 157\ A^{0.586}$
2	$Q = 250\ A^{0.656}$	$Q = 166\ A^{0.660}$	$Q = 322\ A^{0.578}$	$Q = 204\ A^{0.590}$
5	$Q = 466\ A^{0.636}$	$Q = 291\ A^{0.652}$	$Q = 562\ A^{0.593}$	$Q = 367\ A^{0.590}$
10	$Q = 650\ A^{0.623}$	$Q = 393\ A^{0.648}$	$Q = 802\ A^{0.592}$	$Q = 499\ A^{0.588}$
25	$Q = 918\ A^{0.610}$	$Q = 532\ A^{0.645}$	$Q = 1{,}206\ A^{0.586}$	$Q = 692\ A^{0.584}$
50	$Q = 1{,}137\ A^{0.601}$	$Q = 642\ A^{0.643}$	$Q = 1{,}559\ A^{0.583}$	$Q = 857\ A^{0.580}$
100	$Q = 1{,}368\ A^{0.593}$	$Q = 763\ A^{0.641}$	$Q = 1{,}930\ A^{0.584}$	$Q = 1{,}036\ A^{0.578}$
200	$Q = 1{,}609\ A^{0.587}$	$Q = 899\ A^{0.638}$	$Q = 2{,}306\ A^{0.588}$	$Q = 1{,}229\ A^{0.577}$
500	$Q = 1{,}943\ A^{0.579}$	$Q = 1{,}109\ A^{0.634}$	$Q = 2{,}798\ A^{0.598}$	$Q = 1{,}502\ A^{0.576}$

Flood region 1	0.50 to 1,027 mi^2
Flood region 2	0.44 to 1,097 mi^2
Flood region 3	0.45 to 607 mi^2
Flood region 4	0.76 to 1,344 mi^2



Base from U.S. Geological Survey digital data, 1:100,000, Universal Transverse Mercator Projection, Zone 16.

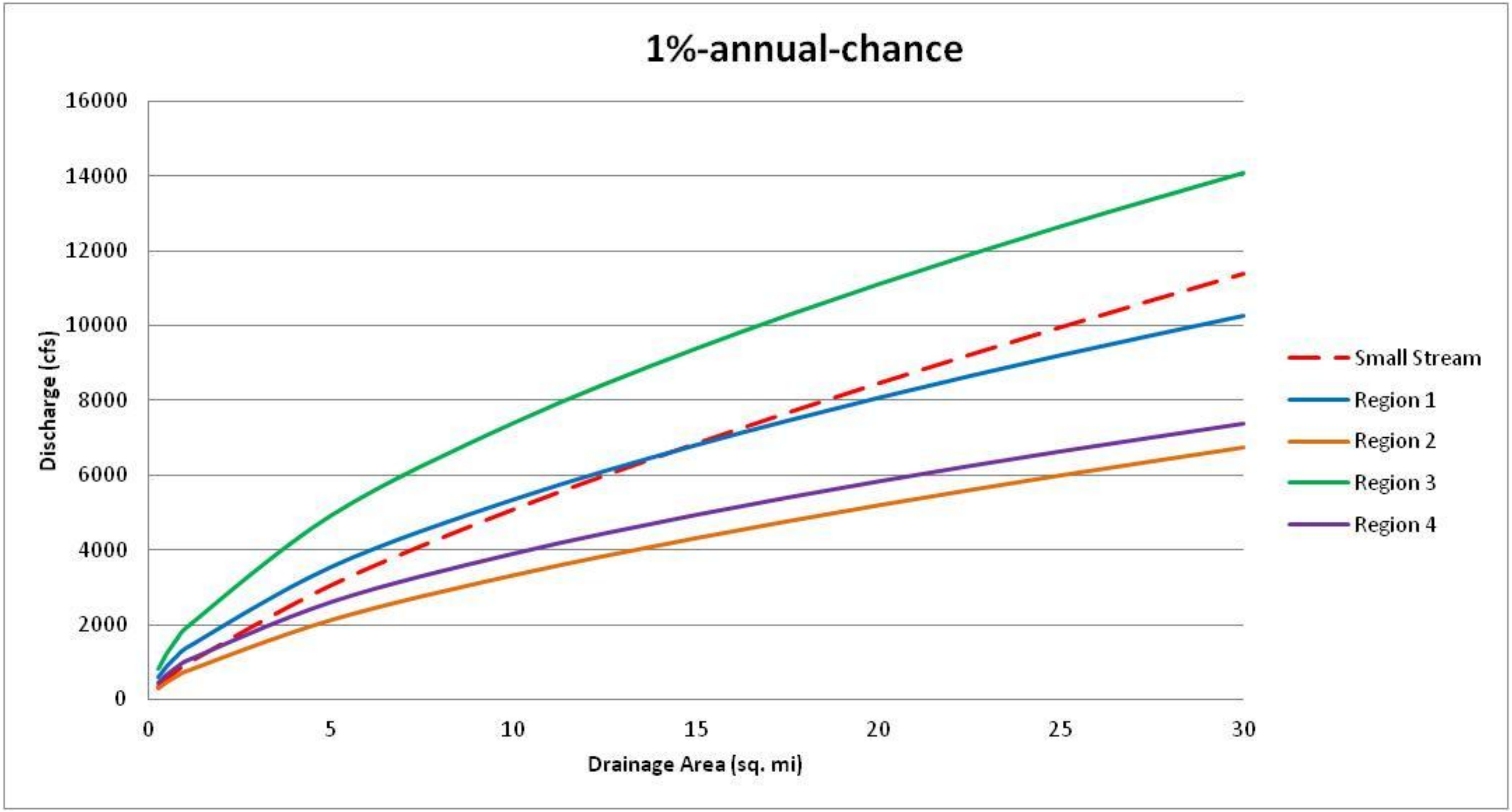
USGS Small Rural Stream Regression

Magnitude and Frequency of Floods on Small Rural Stream in Alabama, 2003 (SIR 2004-5135)

Recurrence interval (years)	Regression equation
2	$Q = 189A^{0.742}$
5	$Q = 331A^{0.732}$
10	$Q = 449A^{0.731}$
25	$Q = 626A^{0.732}$
50	$Q = 776A^{0.733}$
100	$Q = 941A^{0.733}$
200	$Q = 1{,}126A^{0.732}$
500	$Q = 1{,}401A^{0.731}$

- Use for drainage areas less than 15 square miles
- Not to be used where dams, flood-detention structures, or channelization have a significant impact

Small Stream vs. Regional



USGS Urban Stream Regression

Magnitude and Frequency of Floods for Urban Streams in Alabama, 2007 (SIR 2010-5012)

Exceedance probability (percent)	Urban Regression Equations
50	$Q = 95\,A^{0.648} PD^{0.407}$
20	$Q = 226\,A^{0.670} PD^{0.298}$
10	$Q = 306\,A^{0.675} PD^{0.276}$
4	$Q = 417\,A^{0.670} PD^{0.253}$
2	$Q = 513\,A^{0.663} PD^{0.237}$
1	$Q = 618\,A^{0.656} PD^{0.223}$
0.5	$Q = 733\,A^{0.650} PD^{0.210}$
0.2	$Q = 897\,A^{0.642} PD^{0.196}$

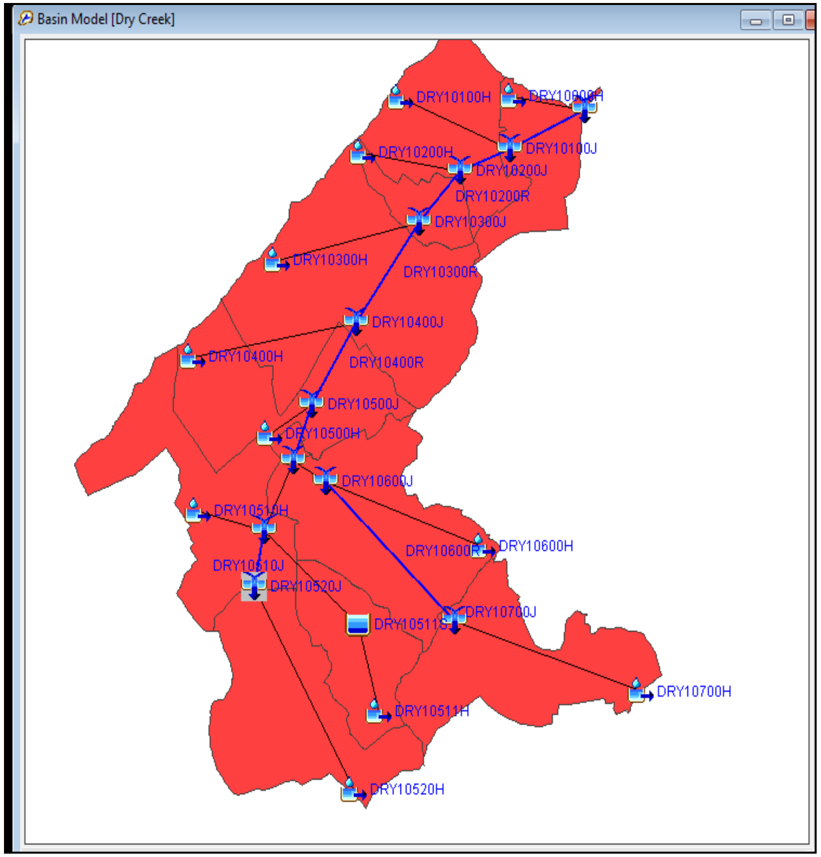
- Range – 1 to 43 square miles
- Percent developed ranging from 20% to 100%
- Not suggested to use in Region 3
- Not to be used where dams, flood-detention structures, hurricane storm surge, or tidal fluctuations have significant impact

Gage Analysis

- Annual peak streamflow
- PeakFQ
  - Flood Frequency Analysis
- Bulletin 17B vs. Bulletin 17C
  - New EMA method
  - Historical Data
  - Thresholds
  - PILFS

Rainfall-Runoff Model (HEC-HMS)

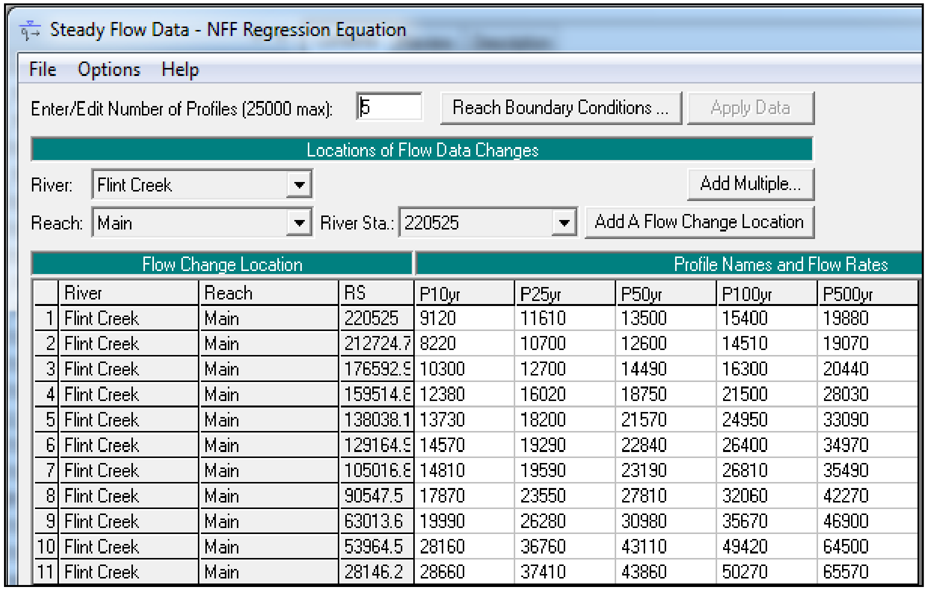
- Parameters
  - Subbasin Area
  - Rainfall Loss
  - Transform Method
  - Routing Method
- Meteorologic Models
  - Rainfall depth for each recurrence interval
- Control Specifications
  - Start and stop time for simulation
- Paired Data
  - Elevation-Area Functions
  - Cross Sections



How are flows used in hydraulics?

- Steady-state
- Flows applied as drainage points in HEC-RAS
- Routed through the hydraulic model

Steady Flow Data in HEC-RAS



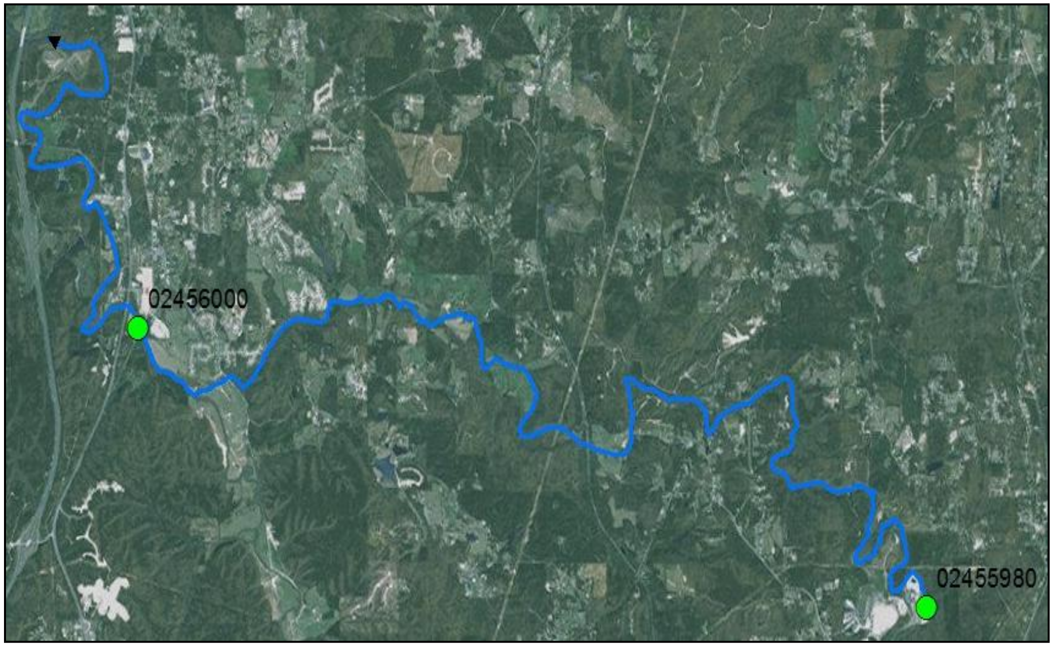
	River	Reach	RS	P10yr	P25yr	P50yr	P100yr	P500yr
1	Flint Creek	Main	220525	9120	11610	13500	15400	19880
2	Flint Creek	Main	212724.7	8220	10700	12600	14510	19070
3	Flint Creek	Main	176592.9	10300	12700	14490	16300	20440
4	Flint Creek	Main	159514.8	12380	16020	18750	21500	28030
5	Flint Creek	Main	138038.1	13730	18200	21570	24950	33090
6	Flint Creek	Main	129164.9	14570	19290	22840	26400	34970
7	Flint Creek	Main	105016.8	14810	19590	23190	26810	35490
8	Flint Creek	Main	90547.5	17870	23550	27810	32060	42270
9	Flint Creek	Main	63013.6	19990	26280	30980	35670	46900
10	Flint Creek	Main	53964.5	28160	36760	43110	49420	64500
11	Flint Creek	Main	28146.2	28660	37410	43860	50270	65570

Example Hydrology Study

- Turkey Creek
  - 12 mile portion of stream in Jefferson County, Alabama
  - 86 mi^2 basin
  - What do I do now?

Which Method To Choose?

- Detailed or Approximate Study?
- HMS Model
  - Size of basin
- USGS Regression or Gage
  - Are there any gages?
  - Yes, 2 gages on the stream



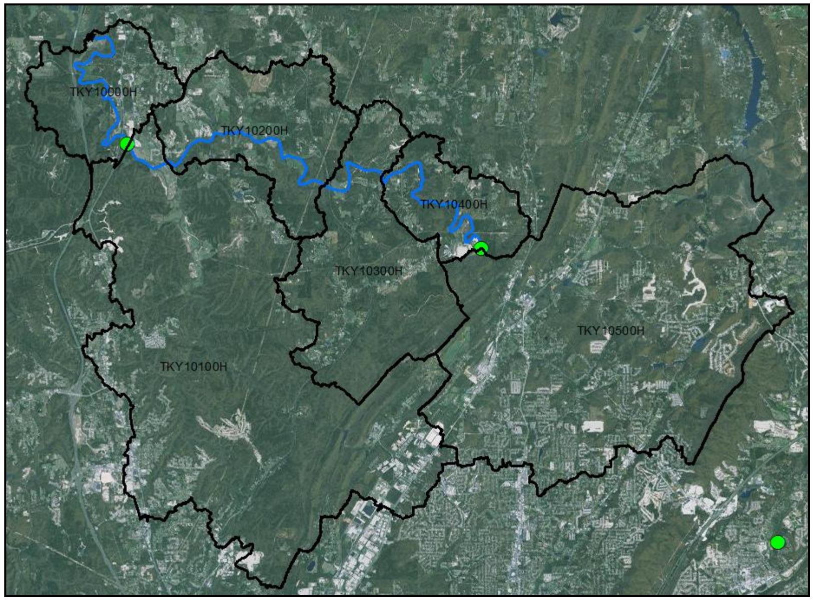
Turkey Creek – Gage Analysis

- Obtain gage information from USGS National Water Information System
- Must have 10 years of record to be valid

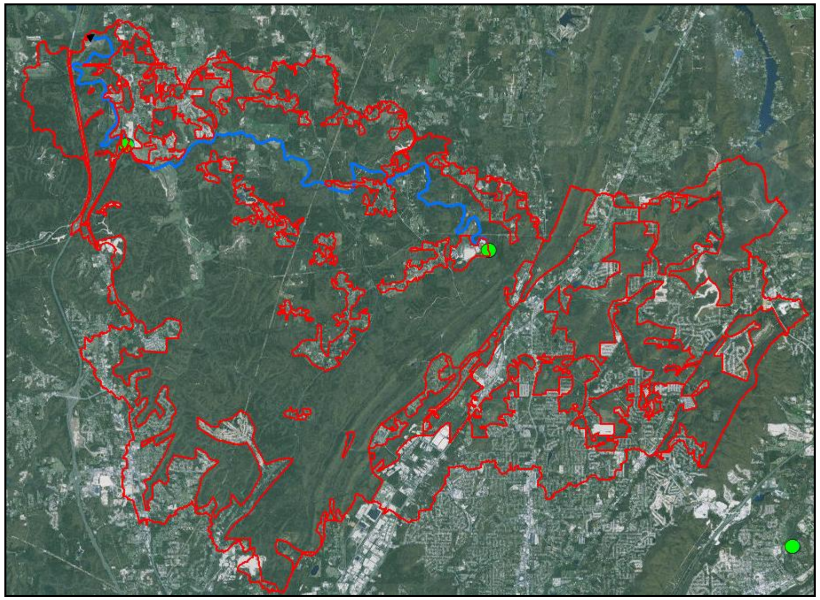
Agency	Site Number	Site Name	Period of Record		
			Begin Date	End Date	Peaks
		Turkey			
USGS	02427700	TURKEY CREEK AT KIMBROUGH AL	1958-03-08	1995-12-19	39
USGS	02455973	TRIB(SWEENEY HOLLOW RD)TO TURKEY CR AT PINSON	2000-03-10	2000-03-10	1
USGS	02455974	TRIB(DS OF BRUMBELOE DR) TO TURKEY CR AT PINSON	2000-03-10	2000-03-10	1
USGS	02455980	TURKEY CREEK AT SEWAGE PLANT NEAR PINSON AL	1988-11-20	2013-05-18	25
USGS	02456000	TURKEY CREEK AT MORRIS AL	1942-12	2011-09-06	47
USGS	02464146	TURKEY CREEK NEAR TUSCALOOSA	1981-03-30	2013-03-24	31

Turkey Creek – Gage Analysis

Delineate Subbasins

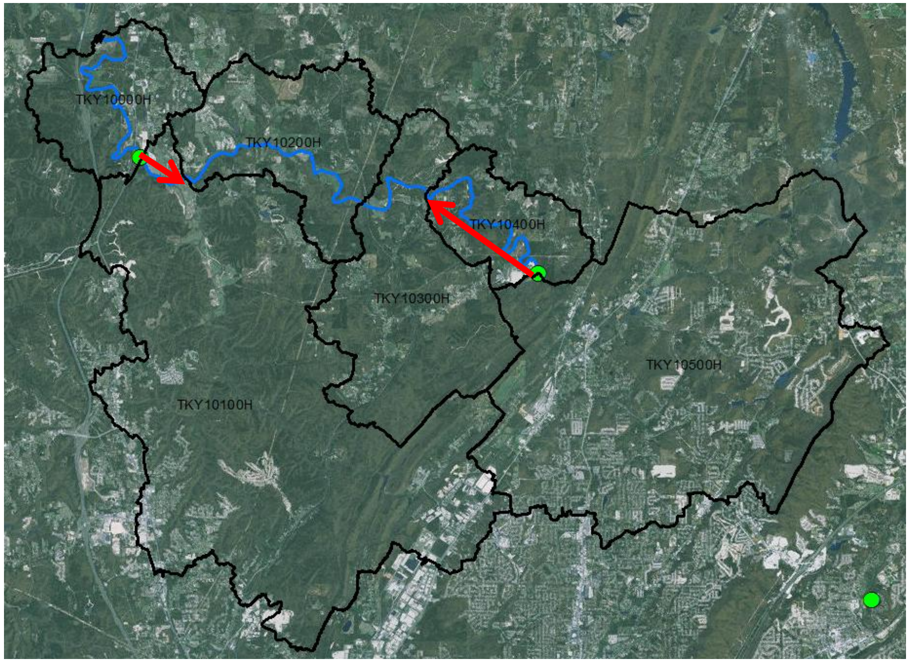


Distinguish Landuse



Turkey Creek – Gage Analysis

- Download gage data and run PeakFQ to complete a Flood Frequency Analysis at the stream gage site
- Transfer flows to delineated locations
- Flows can be moved +/- 50% of the gage area



Turkey Creek – Gage Analysis

- Weight gage flows with regression for a more accurate estimate of flow

Rural

$$\log Q_{g(w)} = \frac{N(\log Q_g) + EY(\log Q_r)}{N + EY},$$

Urban

$$\log Q_{P(g)w} = \frac{V_{p,P(g)r} \log Q_{P(g)s} + V_{p,P(g)s} \log Q_{P(g)r}}{V_{p,P(g)s} + V_{p,P(g)r}},$$

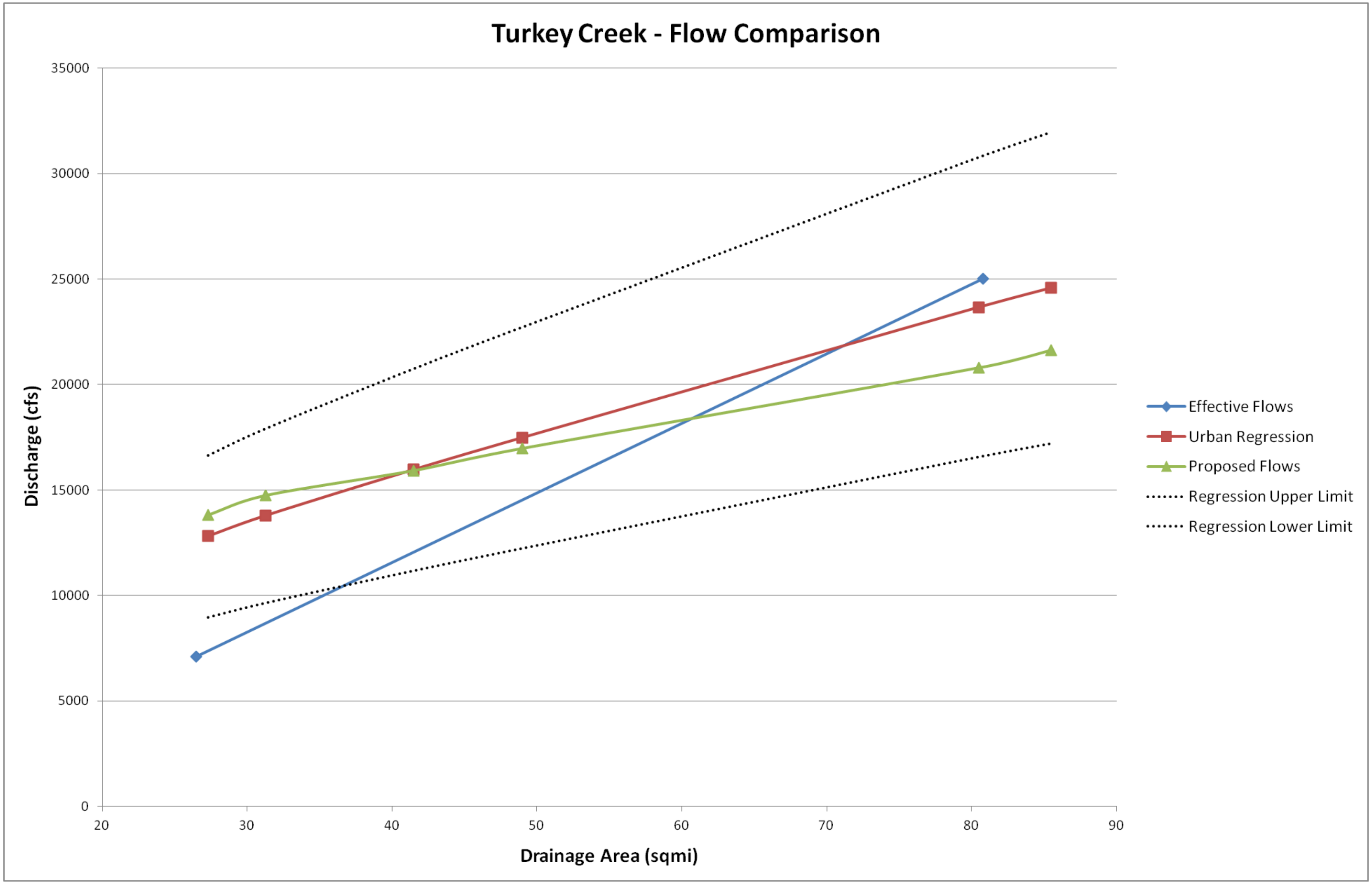
$$Q_u = \left(\frac{A_u}{A_g}\right)^b Q_{g(w)},$$

Move to ungaged site

$$Q_{u(w)} = \left(\frac{2|\Delta A|}{A_g}\right) Q_r + \left(1 - \frac{2|\Delta A|}{A_g}\right) Q_u,$$

Weight with Regression

Flow Comparison



Questions?

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