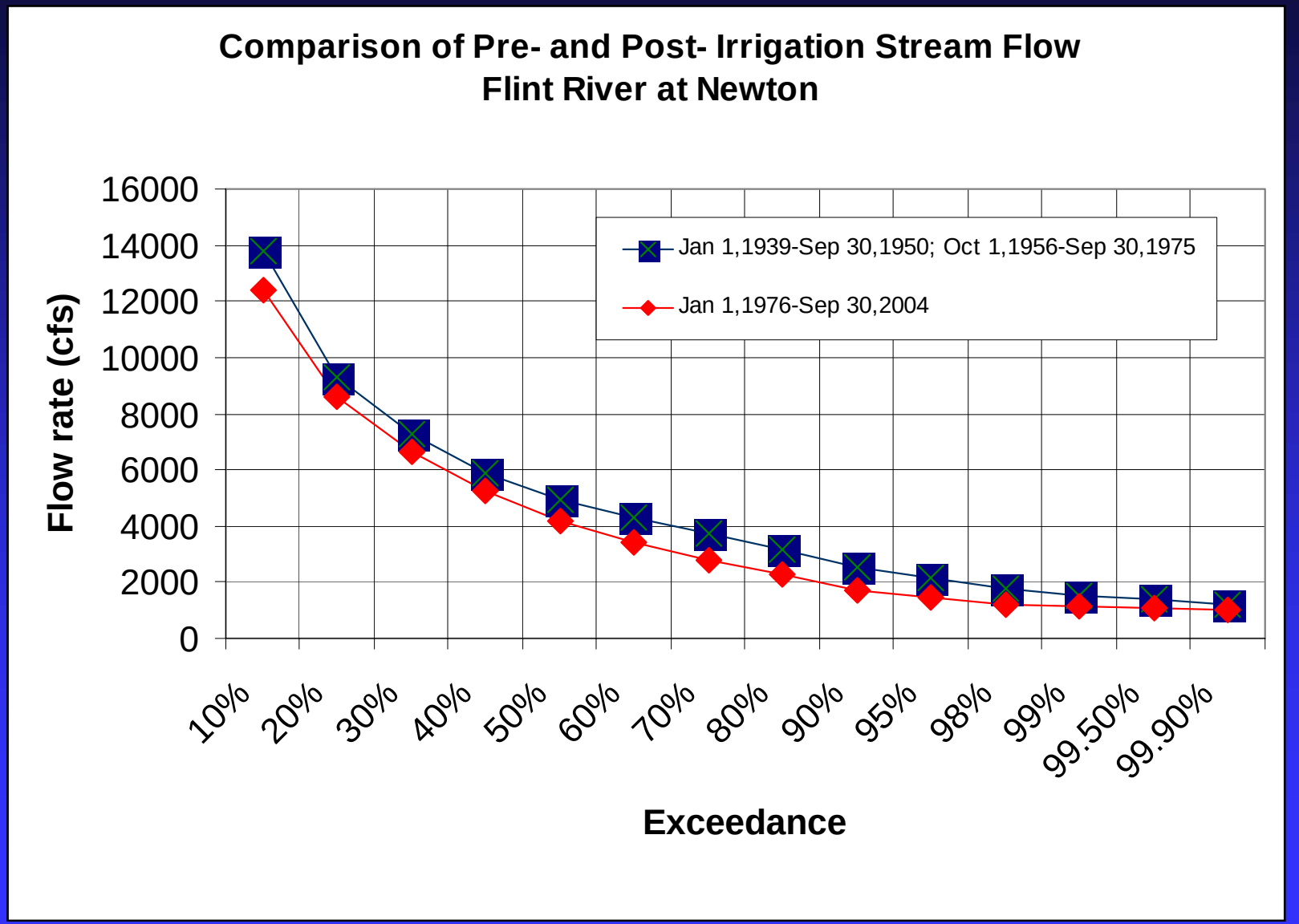
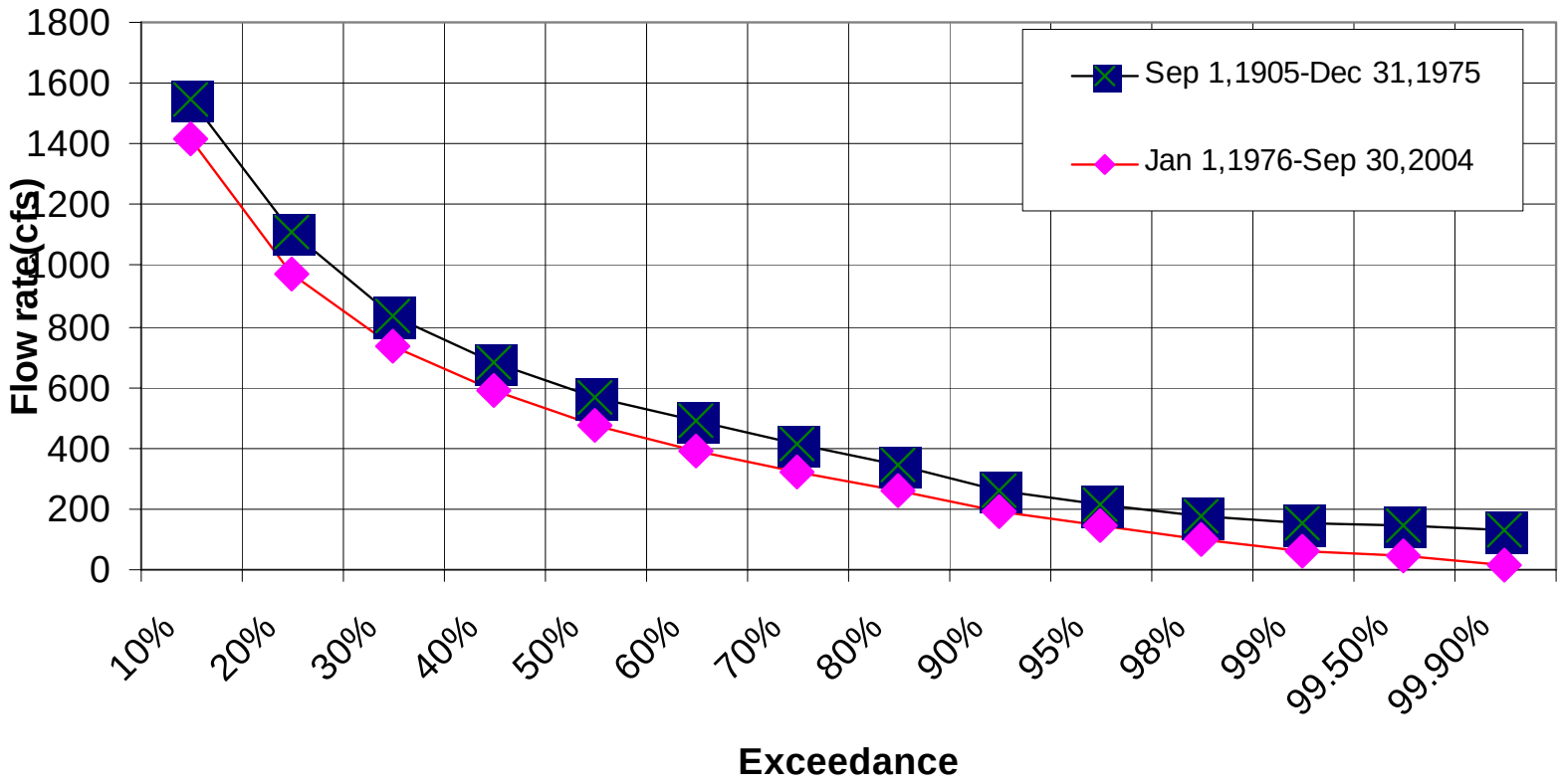
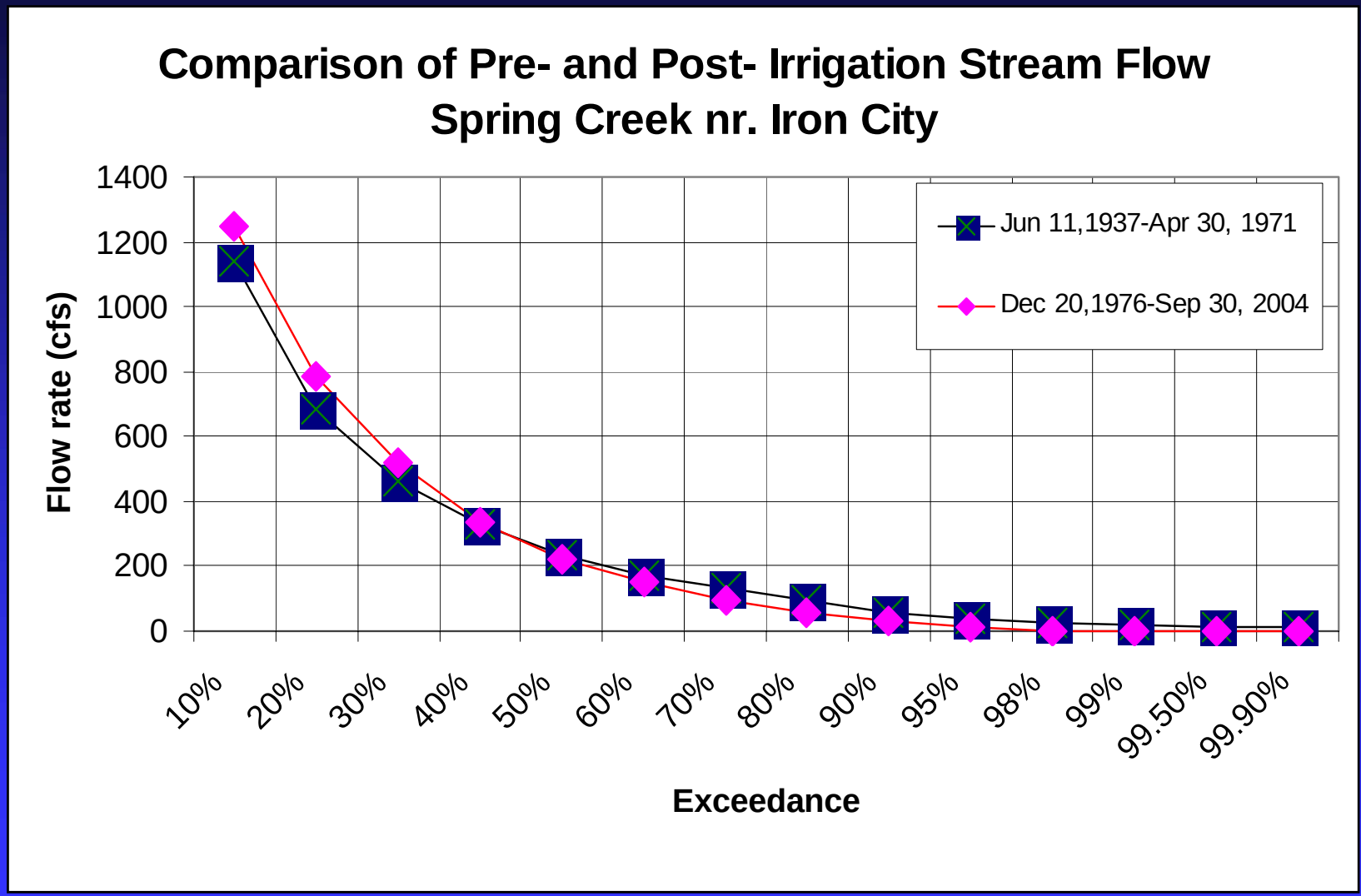
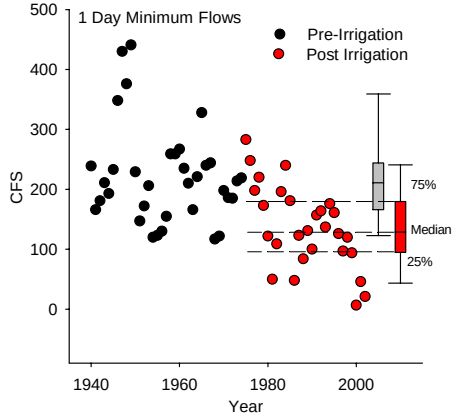

Comparison of Pre- and Post- Irrigation Stream Flow
Flint River at Newton
Flow rate (cfs)
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan 1,1939-Sep 30,1950; Oct 1,1956-Sep 30,1975
Jan 1,1976-Sep 30,2004
10%
20%
30%
40%
50%
60%
70%
80%
90%
95%
98%
99%
99.50%
99.90%
Exceedance

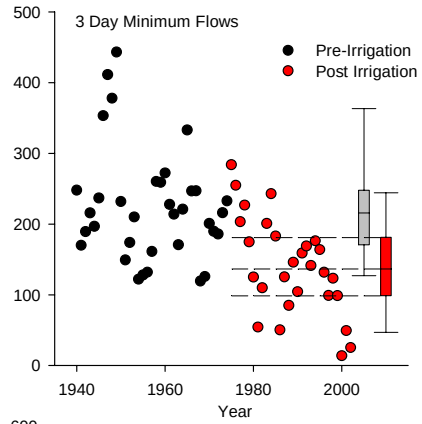
Comparison of Pre- and Post Irrigation Stream Flow Ichawaynochaway Creek nr. Milford

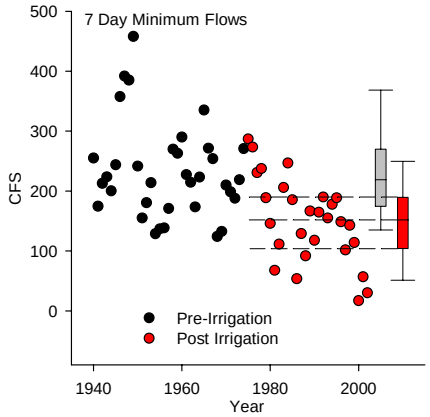


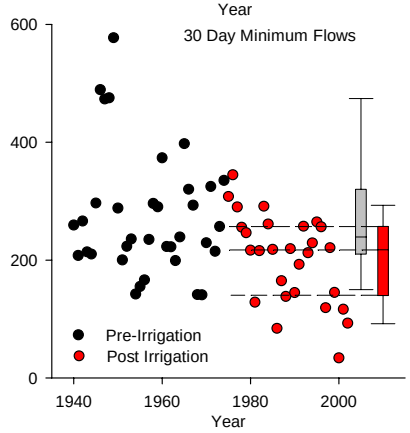

Comparison of Pre- and Post- Irrigation Stream Flow
Spring Creek nr. Iron City
Flow rate (cfs)
1400
1200
1000
800
600
400
200
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
95%
98%
99%
99.50%
99.90%
Exceedance
Jun 11,1937-Apr 30, 1971
Dec 20,1976-Sep 30, 2004

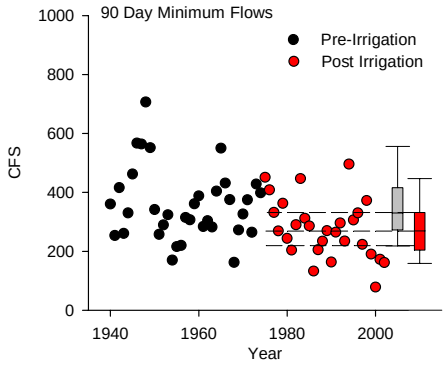
Ichawaynochaway Creek at Milford

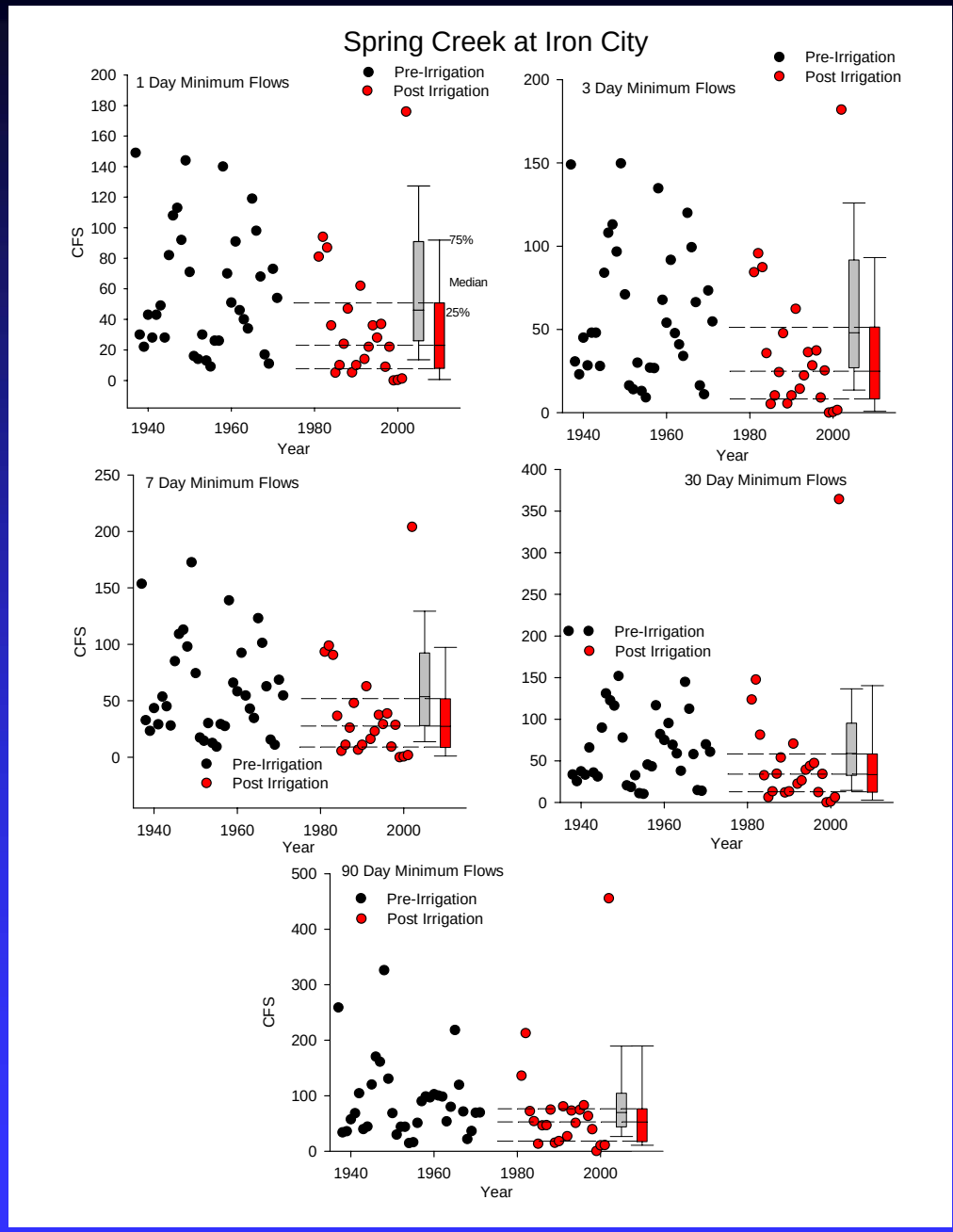


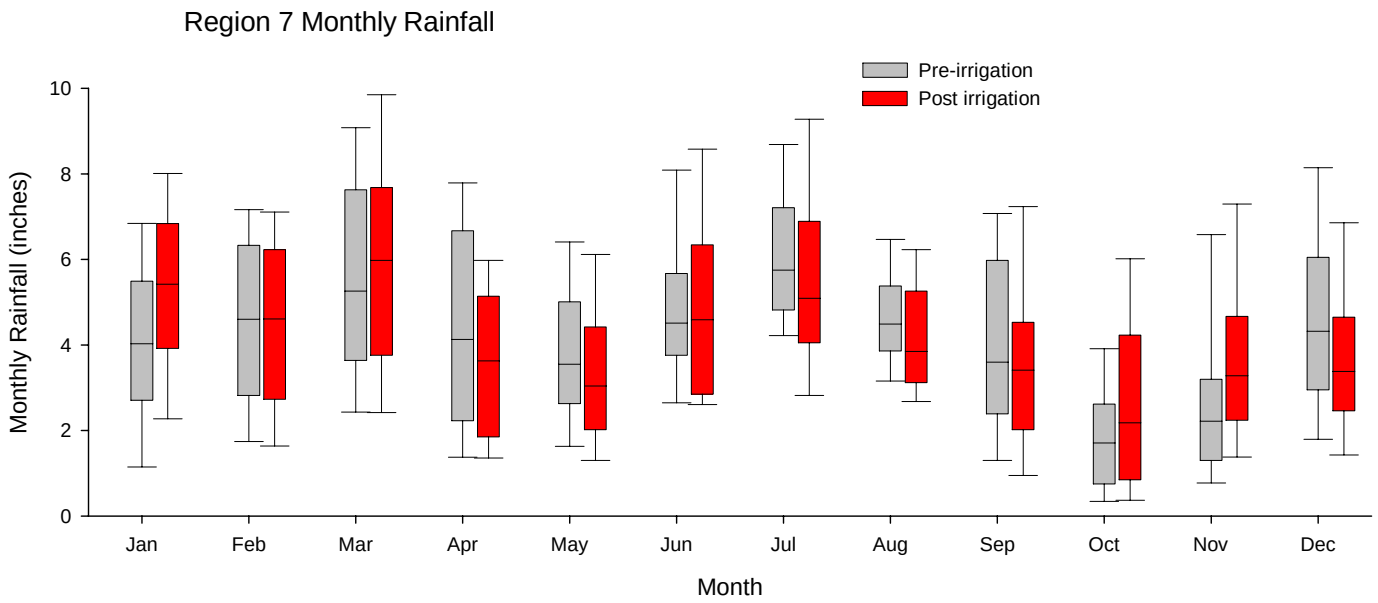




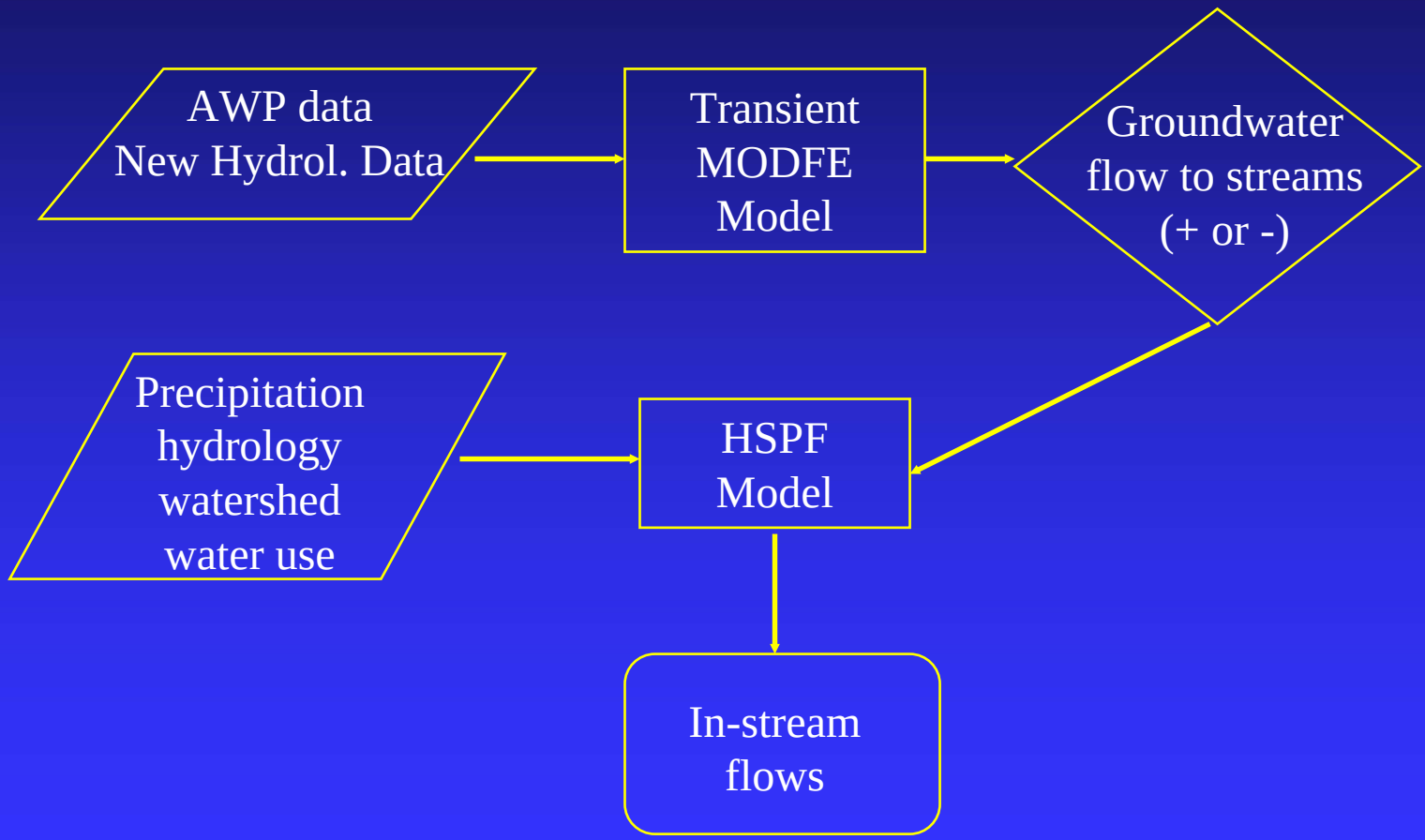





Spring Creek at Iron City
1 Day Minimum Flows
Pre-Irrigation
Post Irrigation
75%
Median
25%
CFS
Year
3 Day Minimum Flows
7 Day Minimum Flows
30 Day Minimum Flows
90 Day Minimum Flows
1940
1960
1980
2000


Region 7 Monthly Rainfall
Pre-irrigation
Post irrigation
Monthly Rainfall (inches)
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Overview of Modeling Process



Calibration and Validation of A Hydrological Model for Spring Creek and Ichawaynochaway Sub-basin Using the EPA BASINS/HSPF Modeling Tool

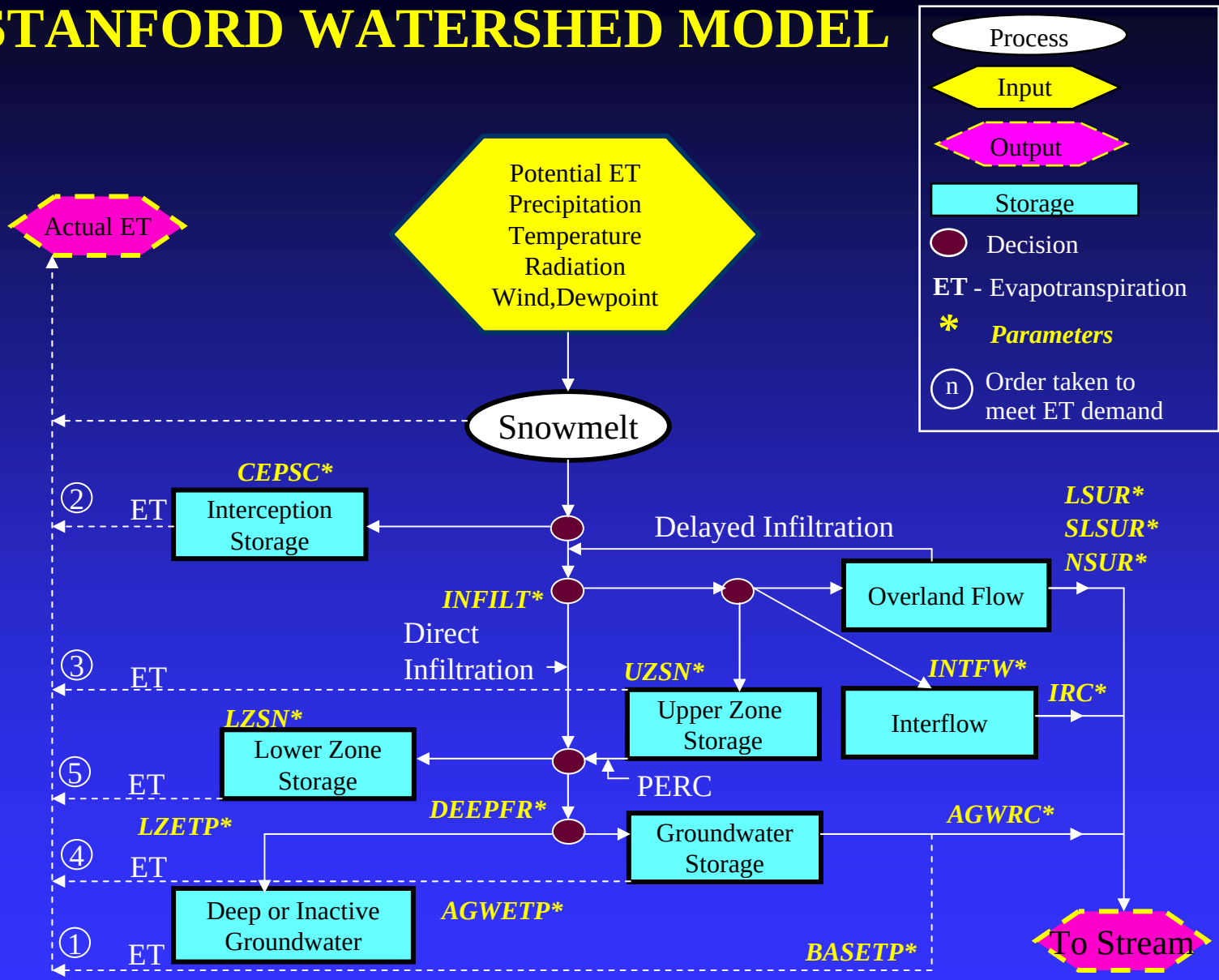
06/26/05

GA EPD

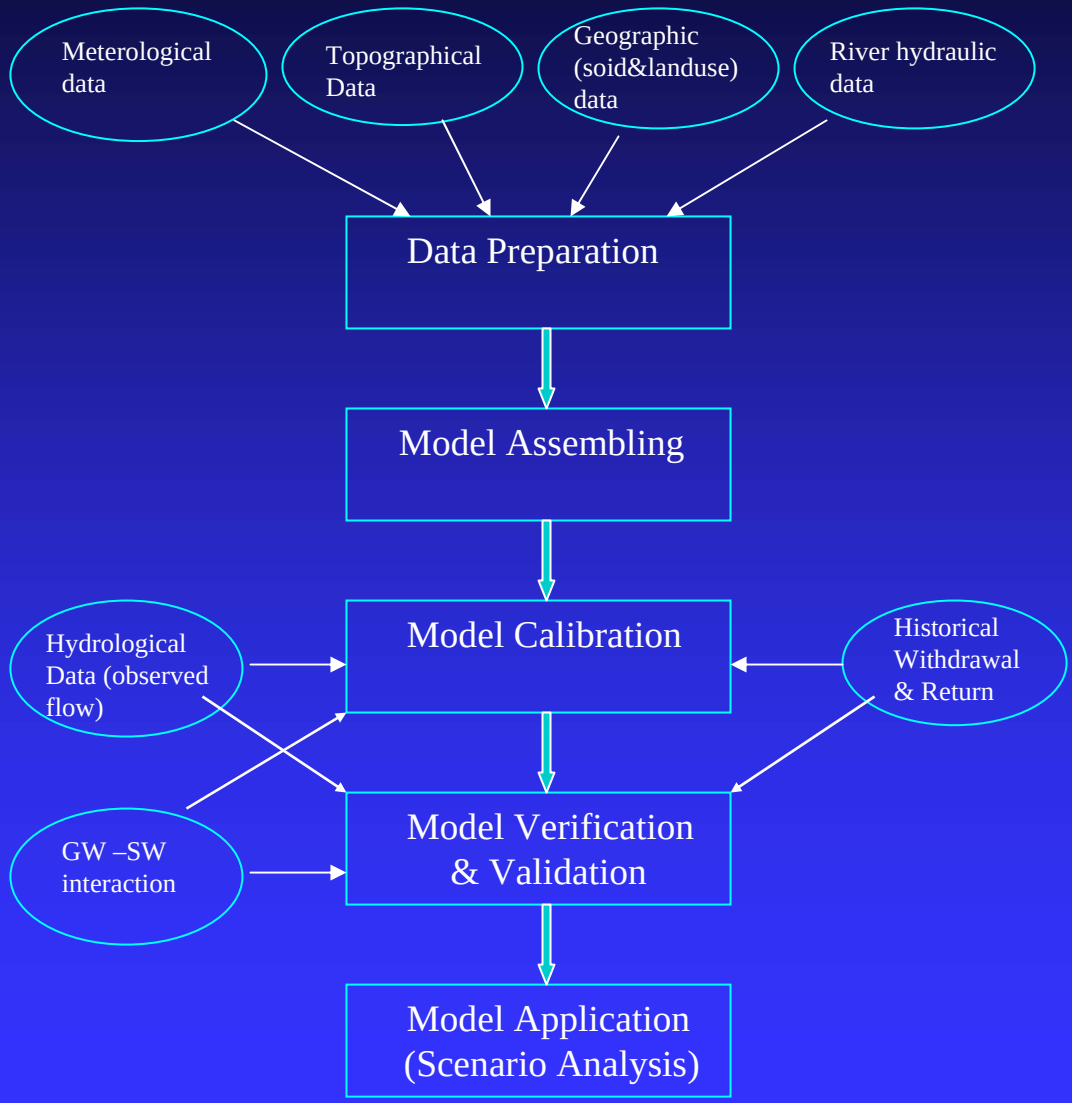
Objective

- To develop a hydrological model for Spring Creek and Ichawaynochaway sub-basin:
  - to simulate stream flow in any place of interest based on the rainfall data.
  - to provide unimpaired flows for basin-wide model.

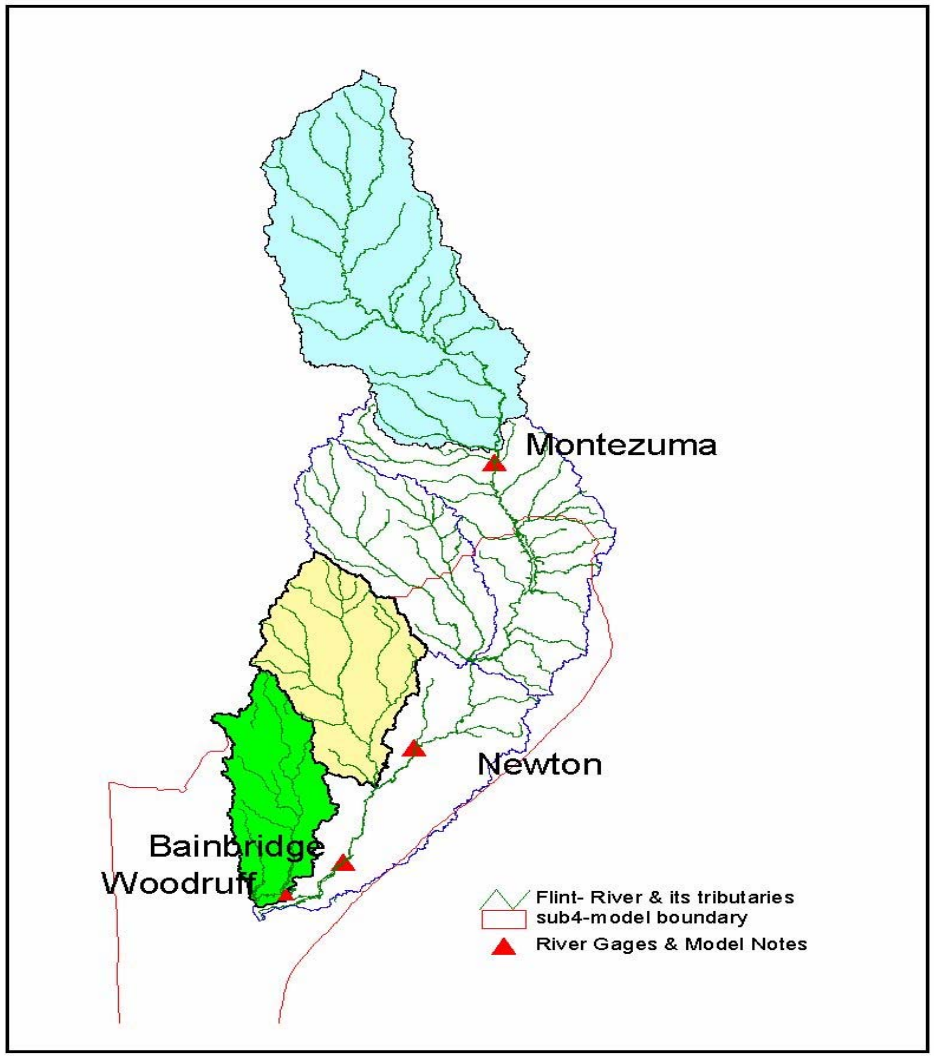
STANFORD WATERSHED MODEL



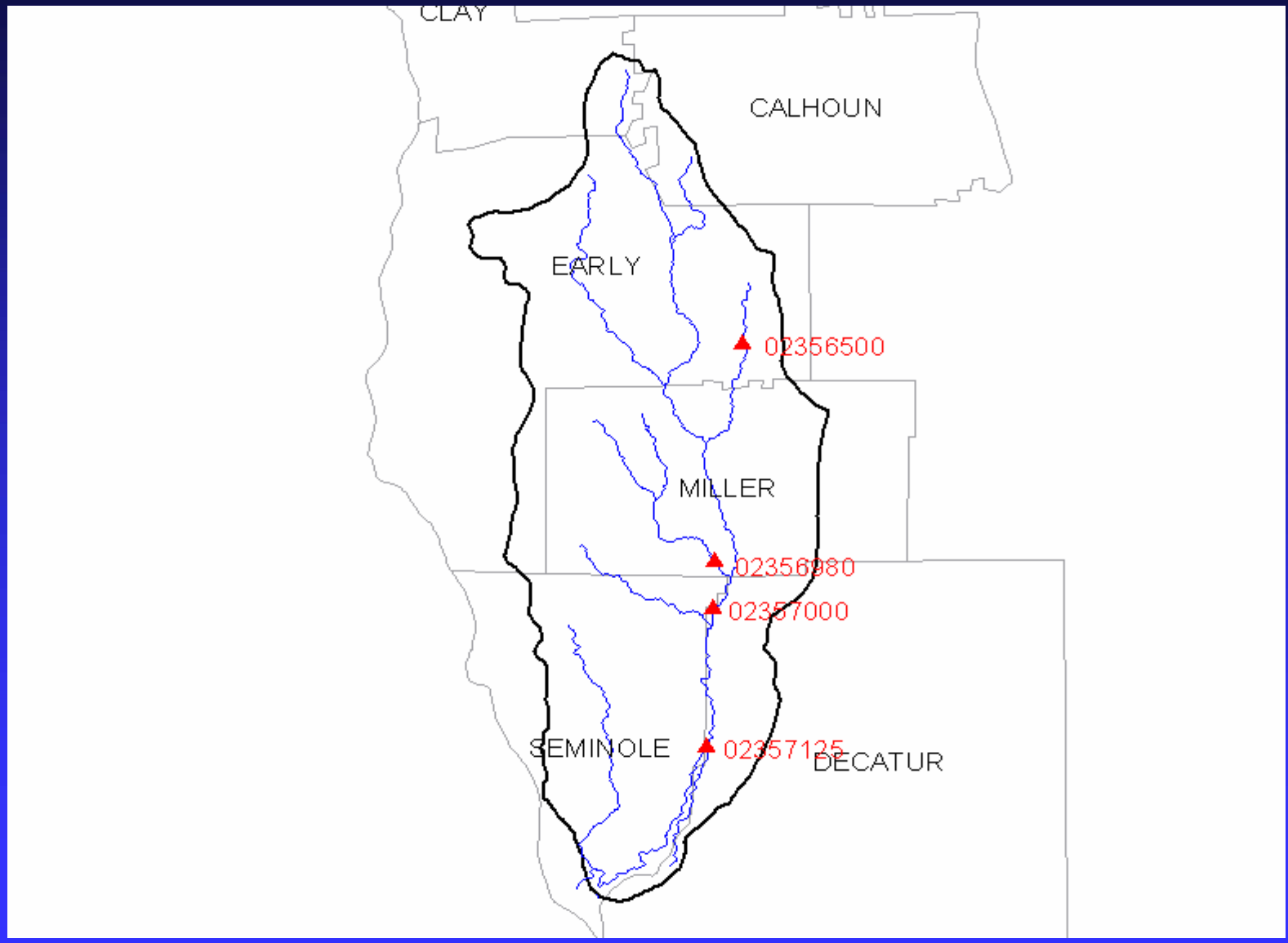
Flow Chart for HSPF Model Development Process



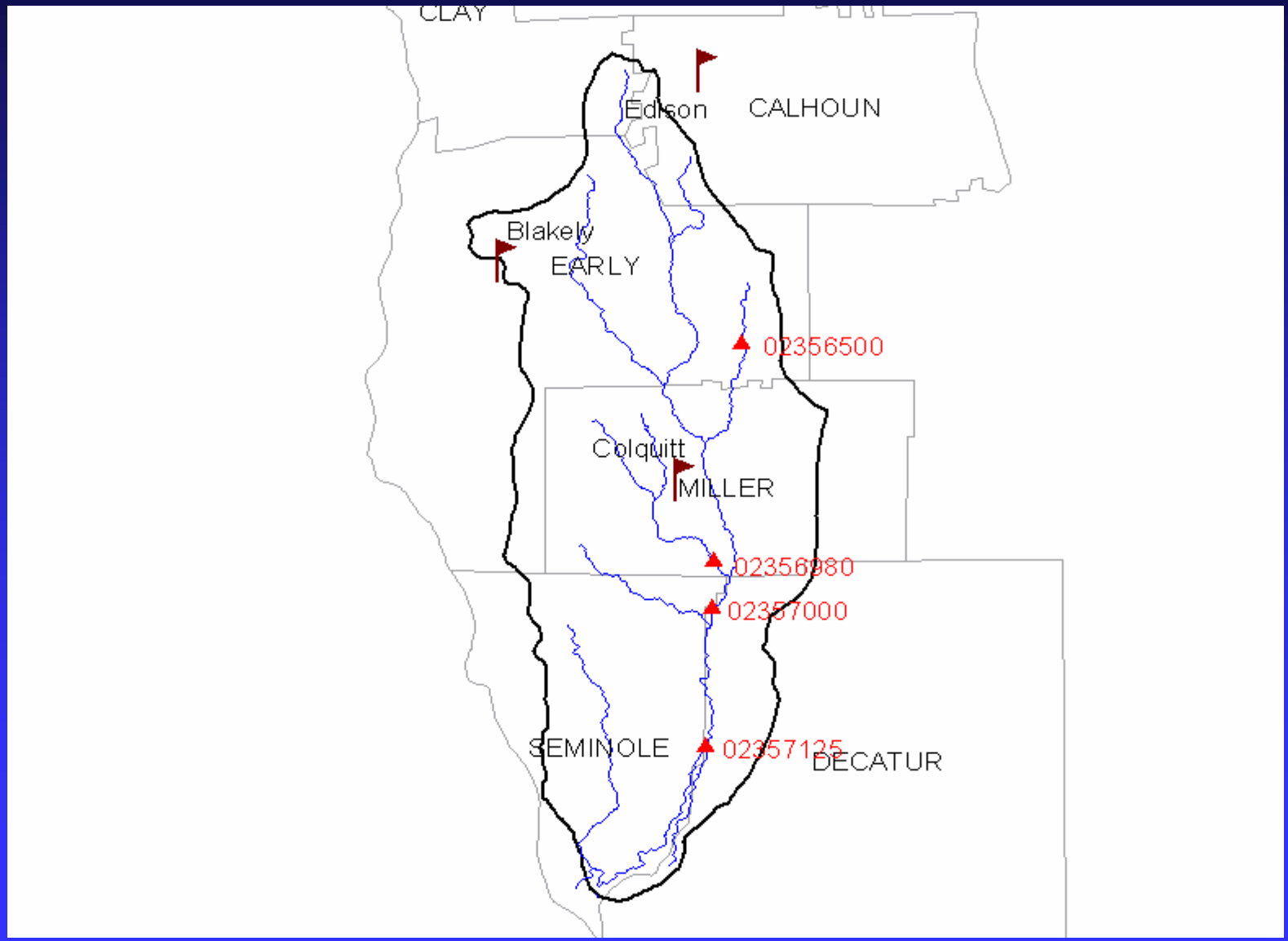
The Spring Creek & Ichawaynochaway in Flint River Basin



Gage Stations in Spring Creek



Weather Stations Near Spring Creek



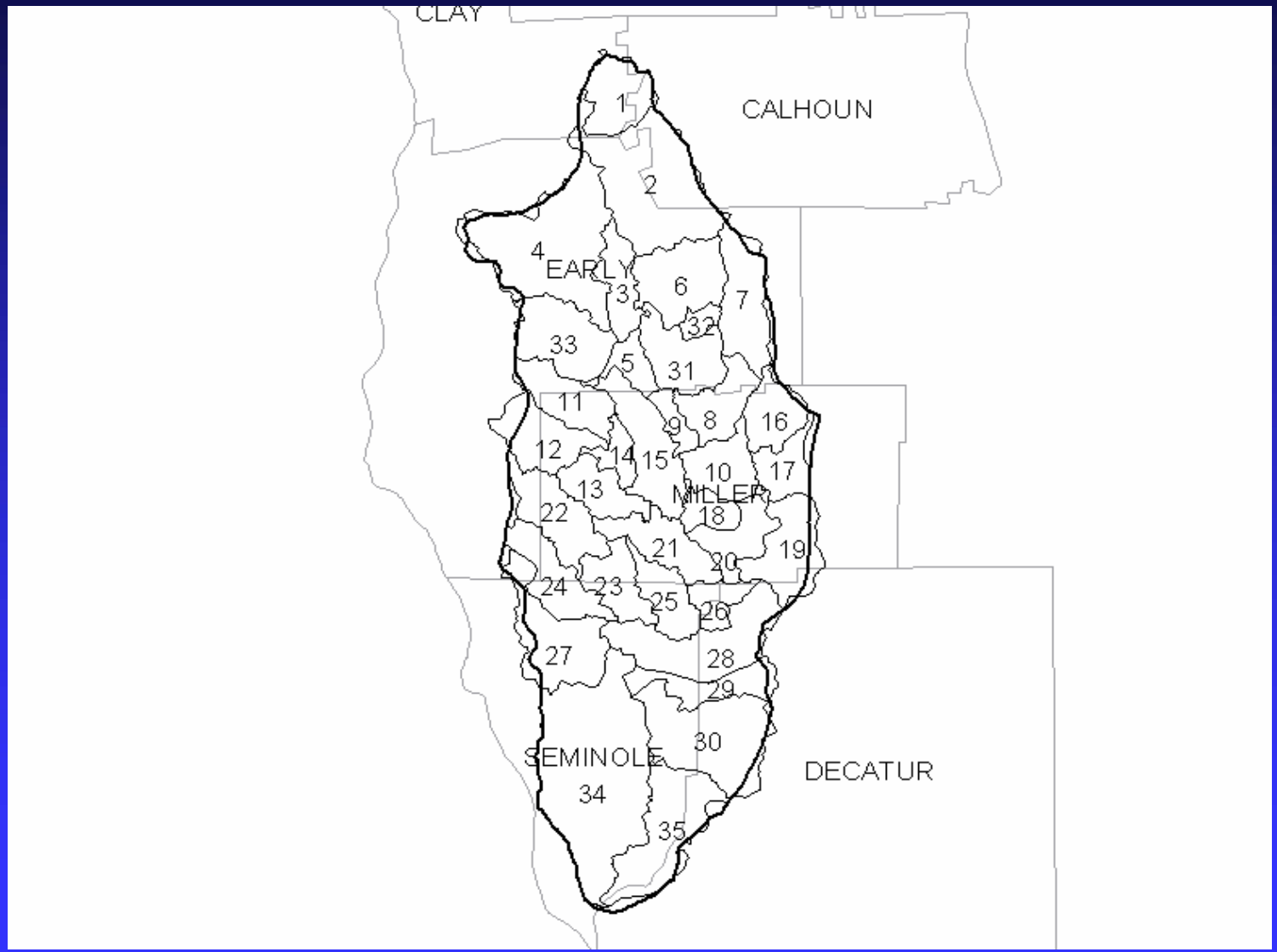
Data – Spring Creek

- Meteorological data
  - Three stations at: Edison, Colquitt and Blakely
- Hydrological & hydraulic data
  - Four gage stations, but only gage near Iron City with long record
  - Channel geometry, DEM, river network
  - Stage-discharge-storage relationships of channels
- Watershed data
  - Landuse
  - Soil property

Data Sources

- Meteorological data
  - GA State Climate Office and NOAA
- Hydrological & hydraulic data
  - Gage stations, (USGS)
  - Channel geometry, DEM, river network (USGS)
  - Stage-discharge-storage relationships of channels (USGS) (Note: hydraulic data was generated by BASINS Tool and may not be accurate)
- Watershed data
  - Landuse (USGS, generated in 1980s)
  - Soil data (USGS)
- Calibrated data: determined by calibration

Sub-basin delineation



Model Calibration – Spring Creek

- Calibration period:

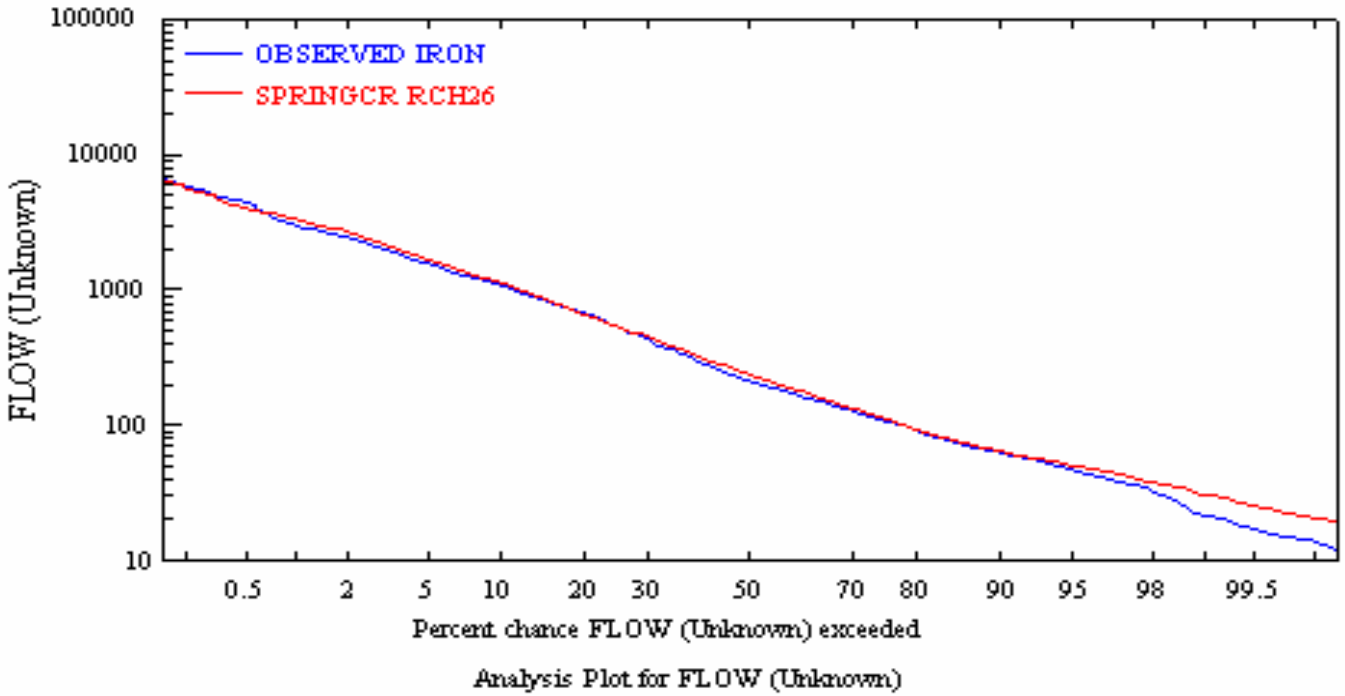
  From 1955 - 1970

- Calibration Indices

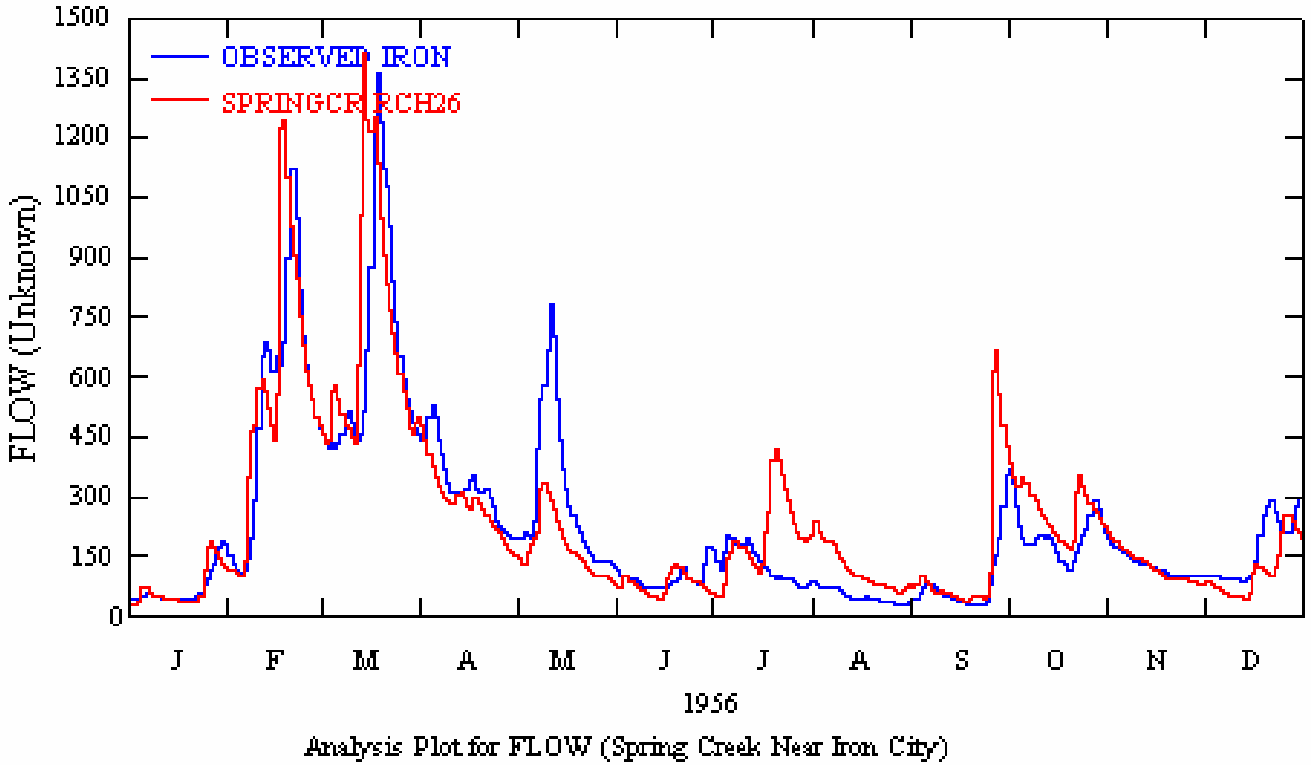
Calibration Period	Correlation Coefficient	Coeff. of Determination	Nash-Sutcliffe Coefficient	Location
1/1/1955 – 12/31/1970	0.85	0.73	0.72	Spring near Iron City

Model Calibration – Spring Creek

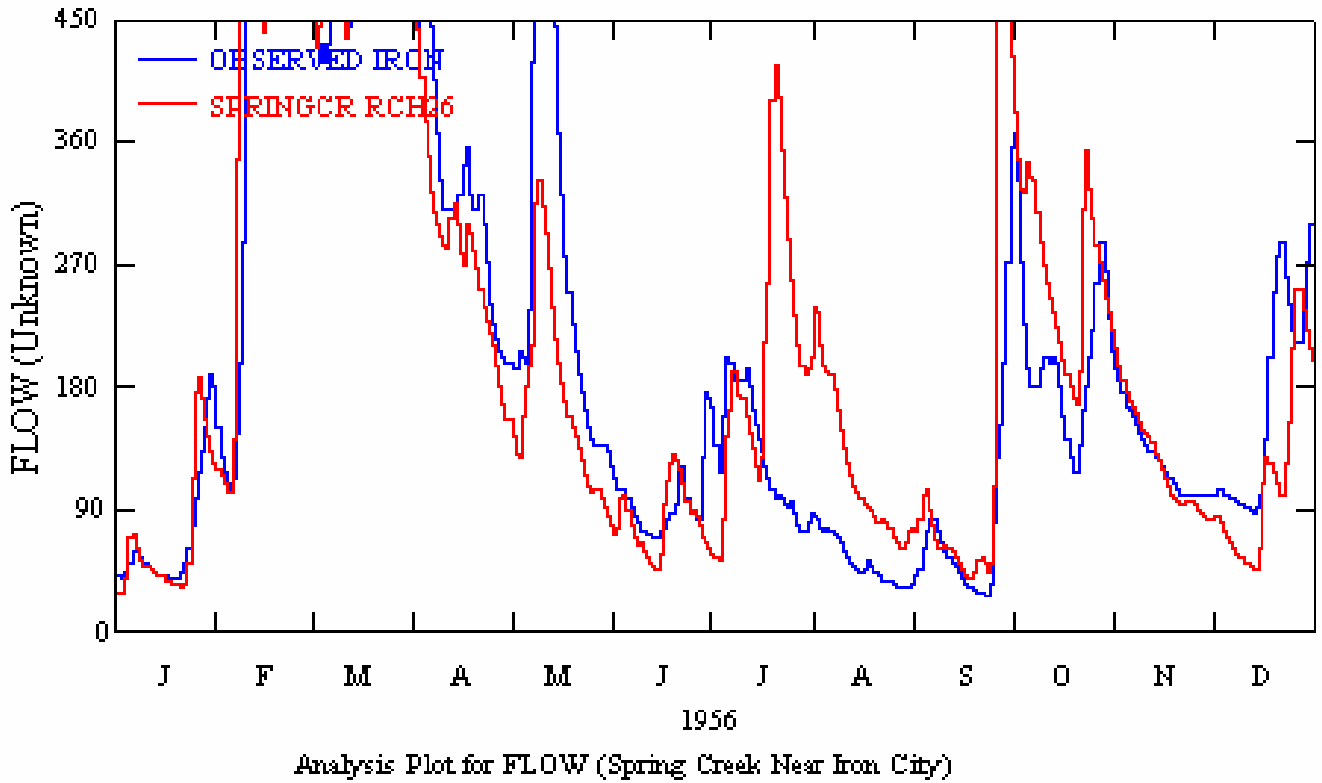
(Comparison of observed and simulated flow duration)



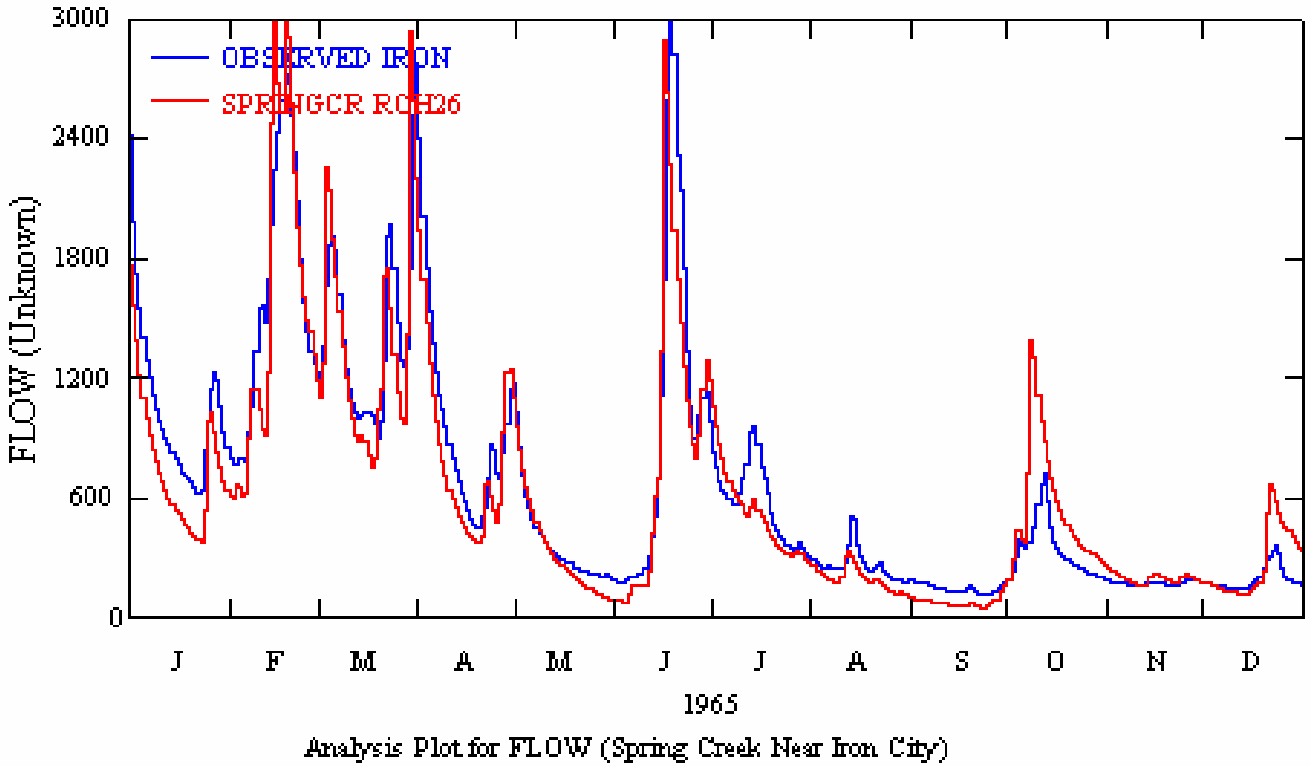
Model Calibration – Spring Creek Year 1956 (Dry)



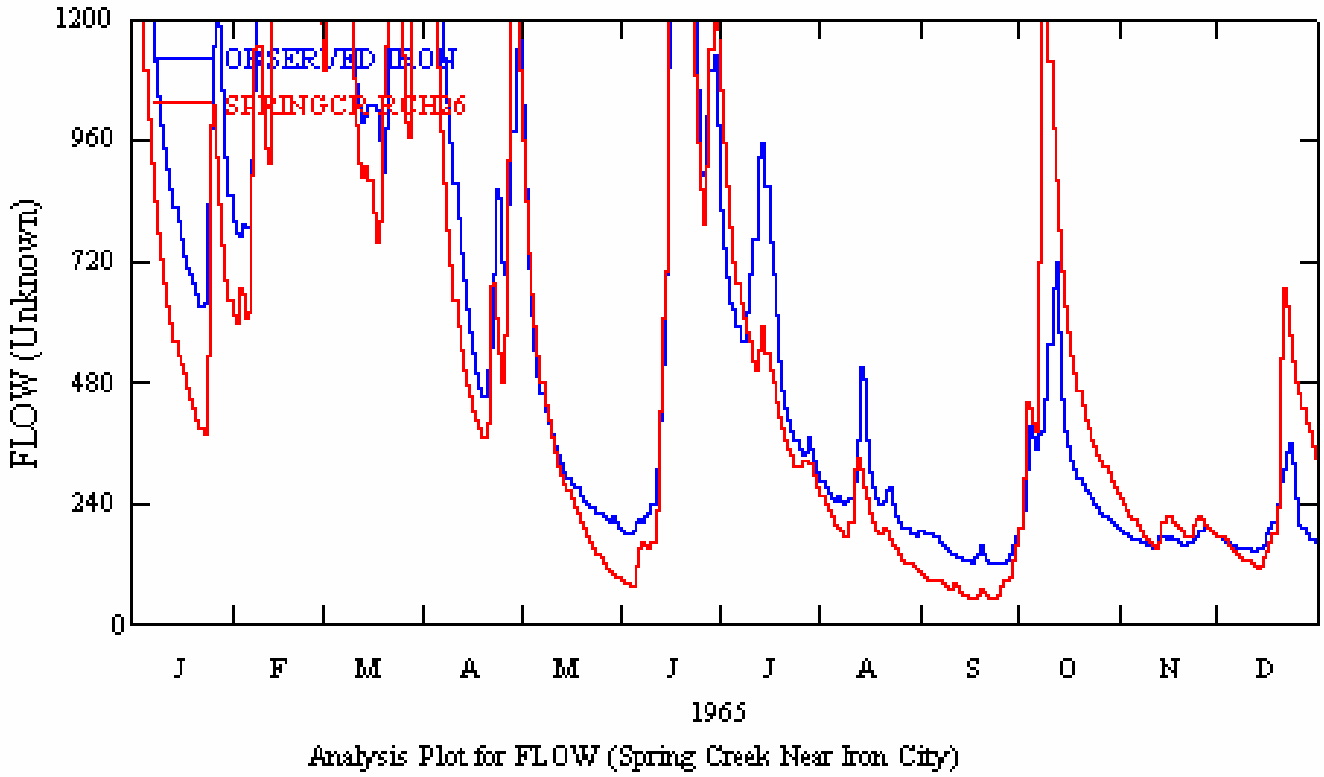
Model Calibration – Spring Creek Year 1956 (Dry)



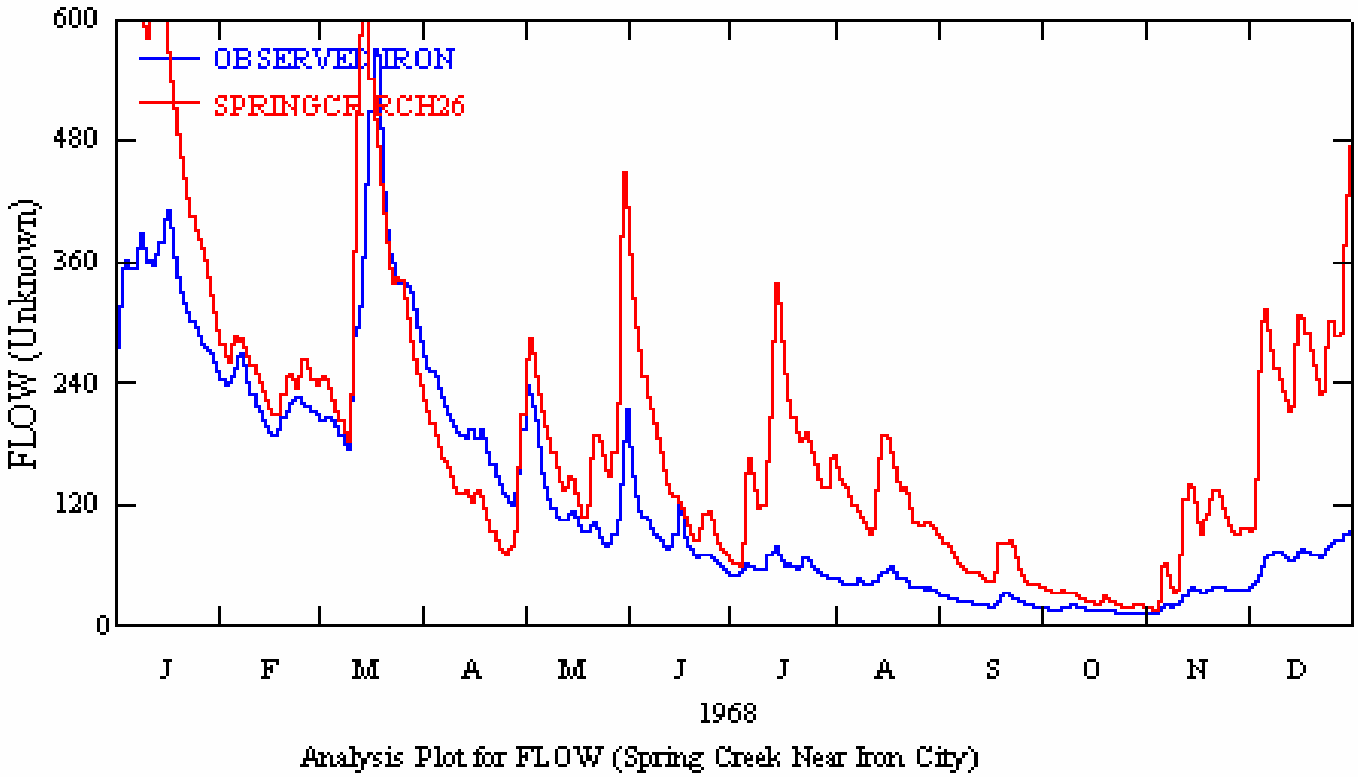
Model Calibration – Spring Creek Year 1965 (Wet)



Model Calibration – Spring Creek Year 1965 (Wet)



Model Calibration – Spring Creek Year 1968 (Drought)



Model Validation – Spring Creek

- Validation period:

  From 1982 - 1995

Model Validation – Spring Creek

-Withdrawal consideration

- Surface water withdrawal:

  10% withdrawal for first-order stream, 90% withdrawal for other streams

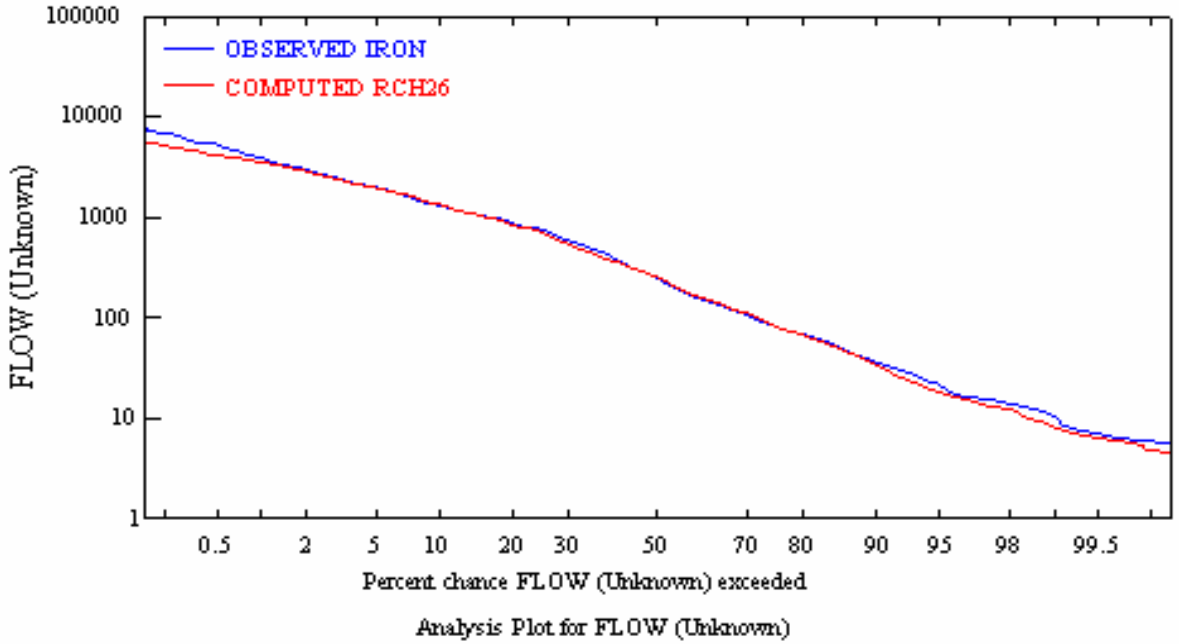
- Ground water withdrawal effect:

  not considered in this validation due to lack of GW effect info.

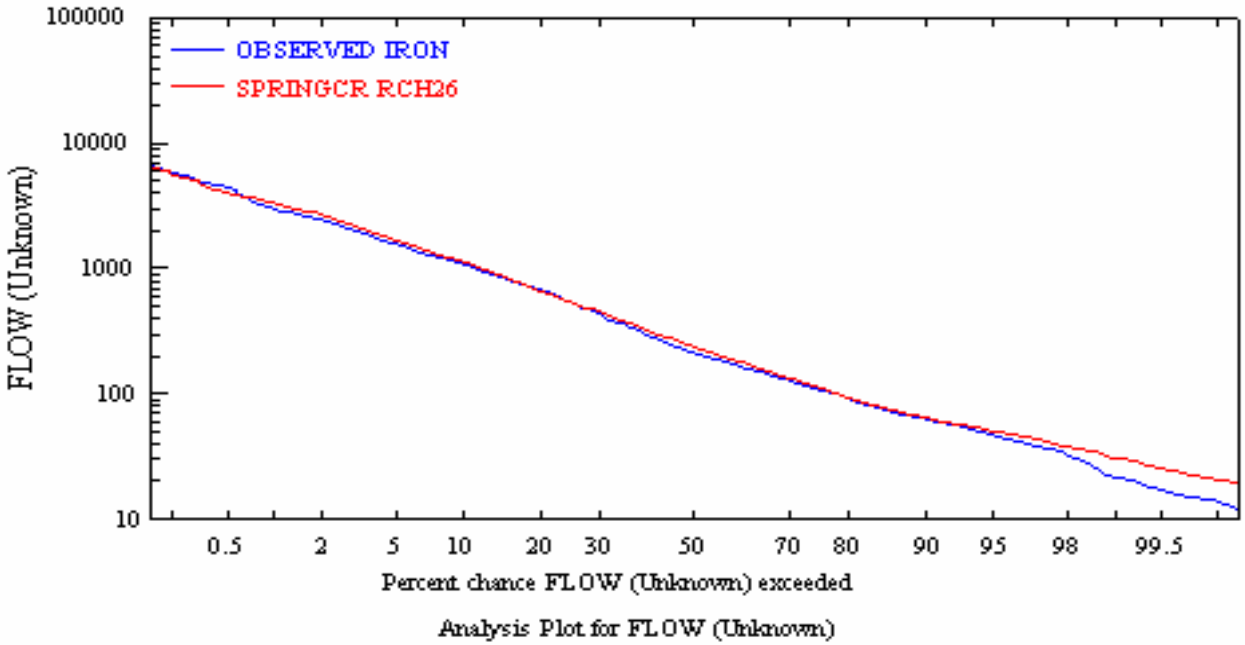
Validation Indices for Spring Creek

Validation Period	Correlation Coefficient	Coeff. of Determination	Nash-Sutcliffe Coefficient	Location
7/1/1982 – 12/31/1995	0.87	0.75	0.68	Spring at Iron

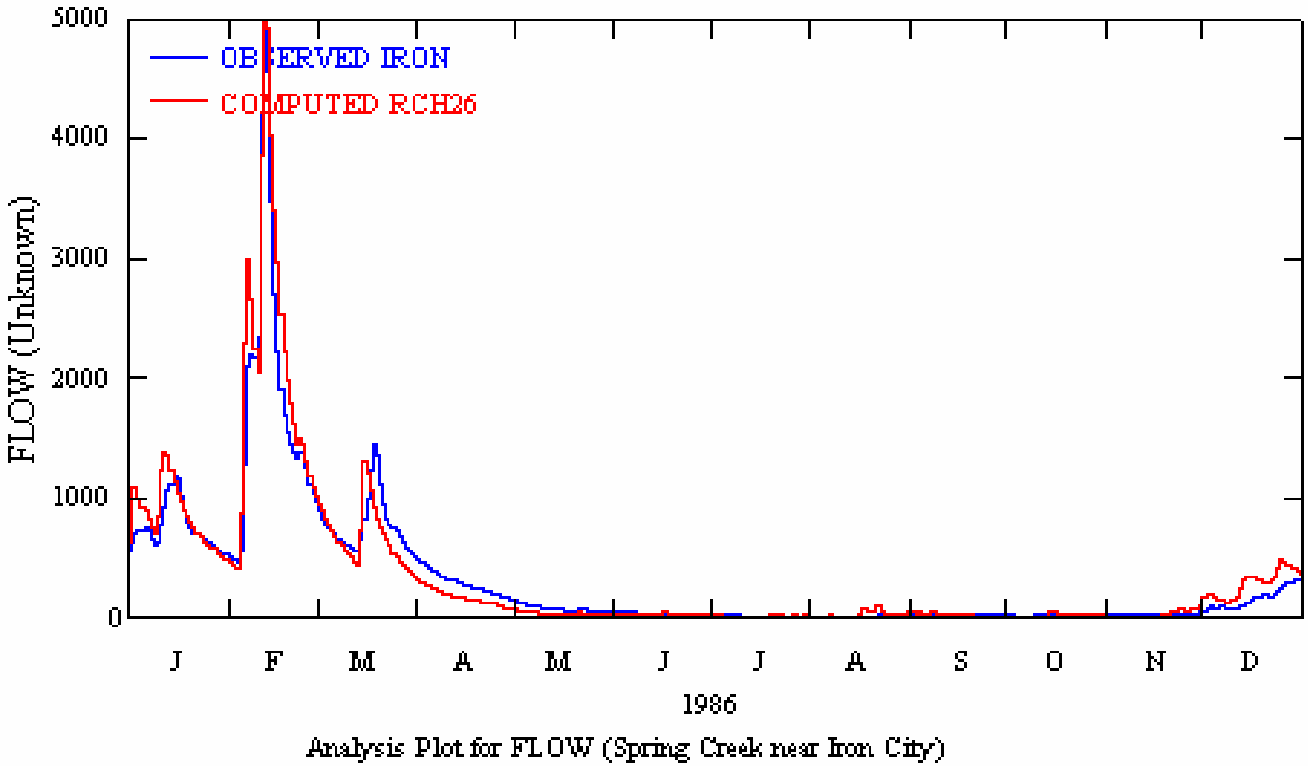
Model Validation - Spring Creek (Comparison of Flow Duration Curve)



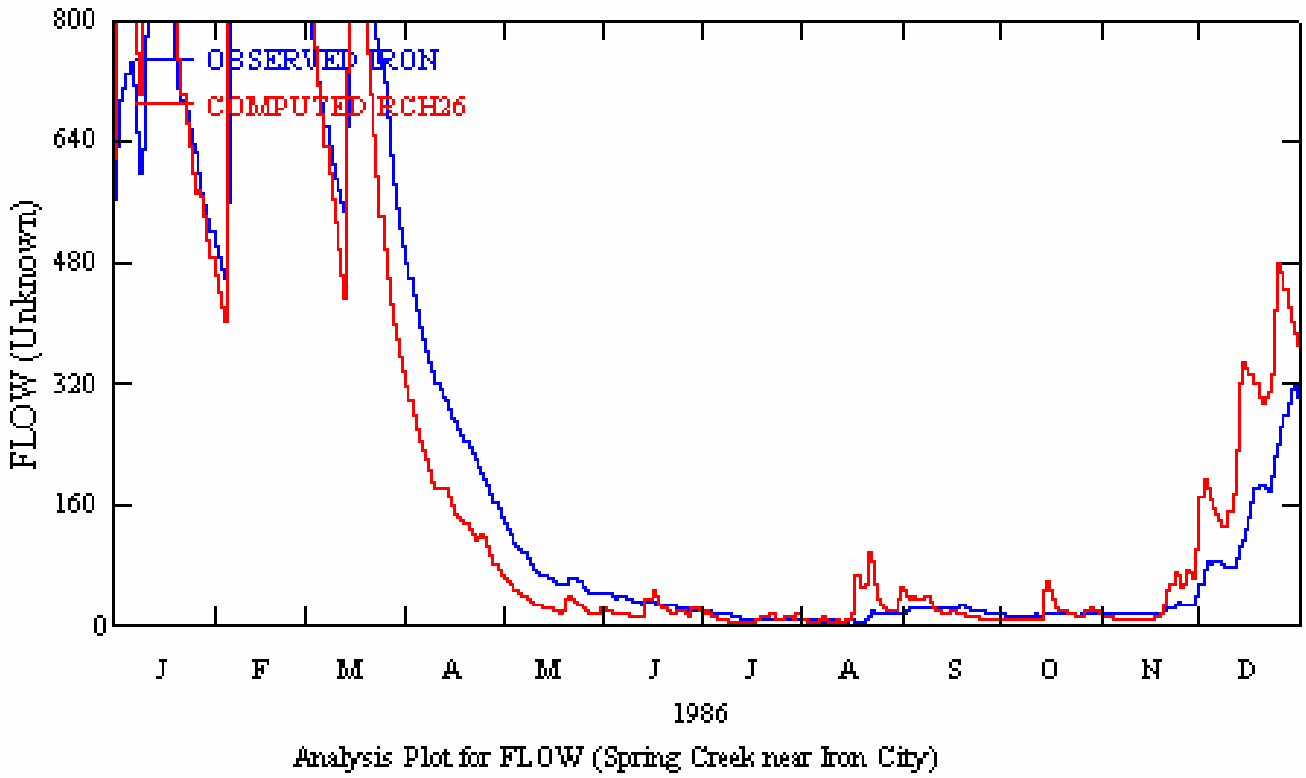
Model Calibration – Spring Creek
(Comparison of observed and simulated flow duration)



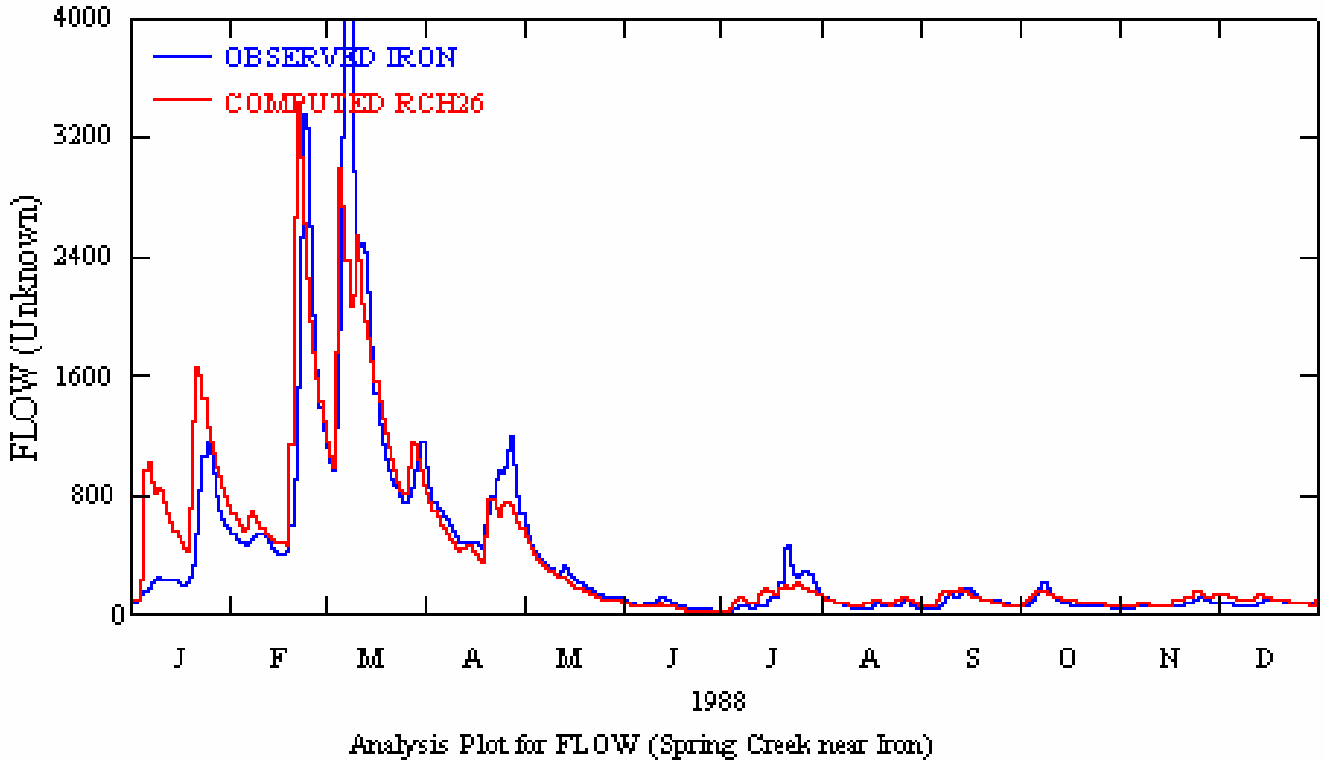
Model Validation – Spring Creek Year 1986 (Drought)



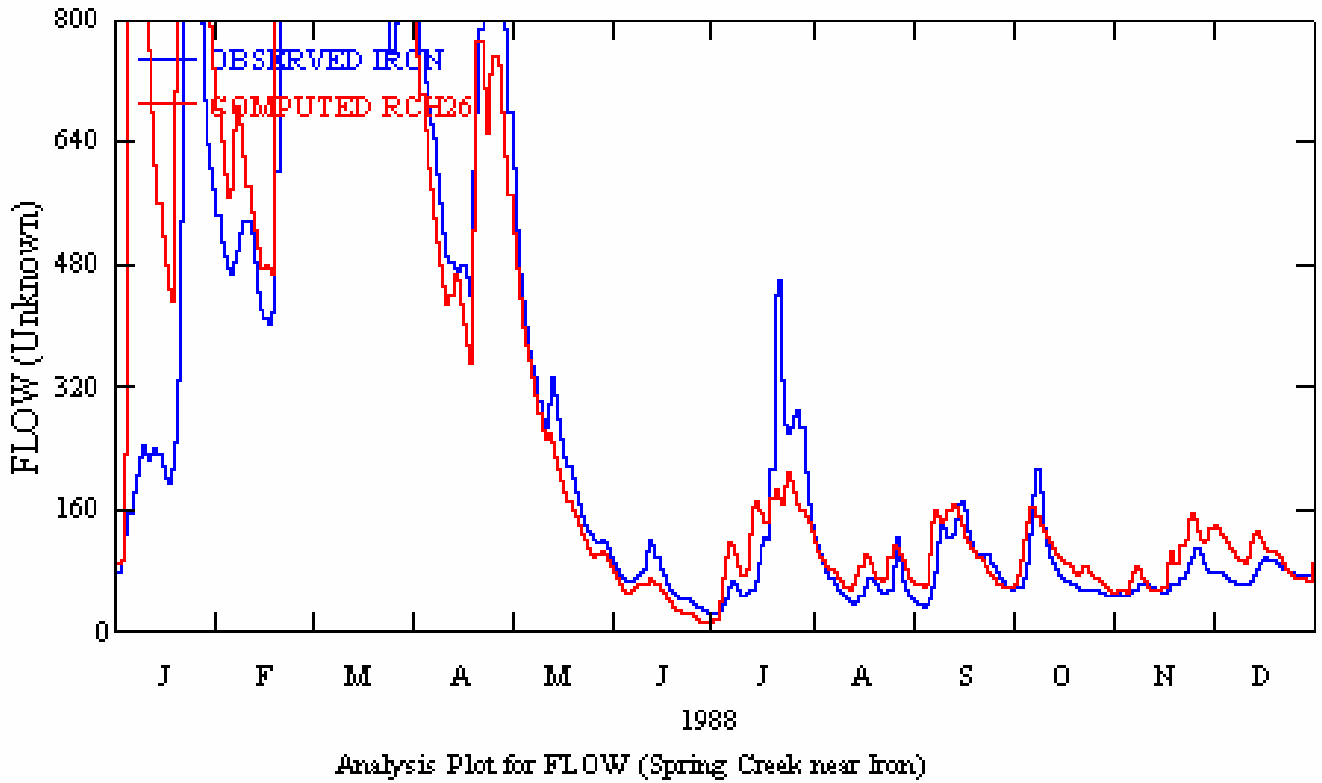
Model Validation – Spring Creek Year 1986 (Drought)



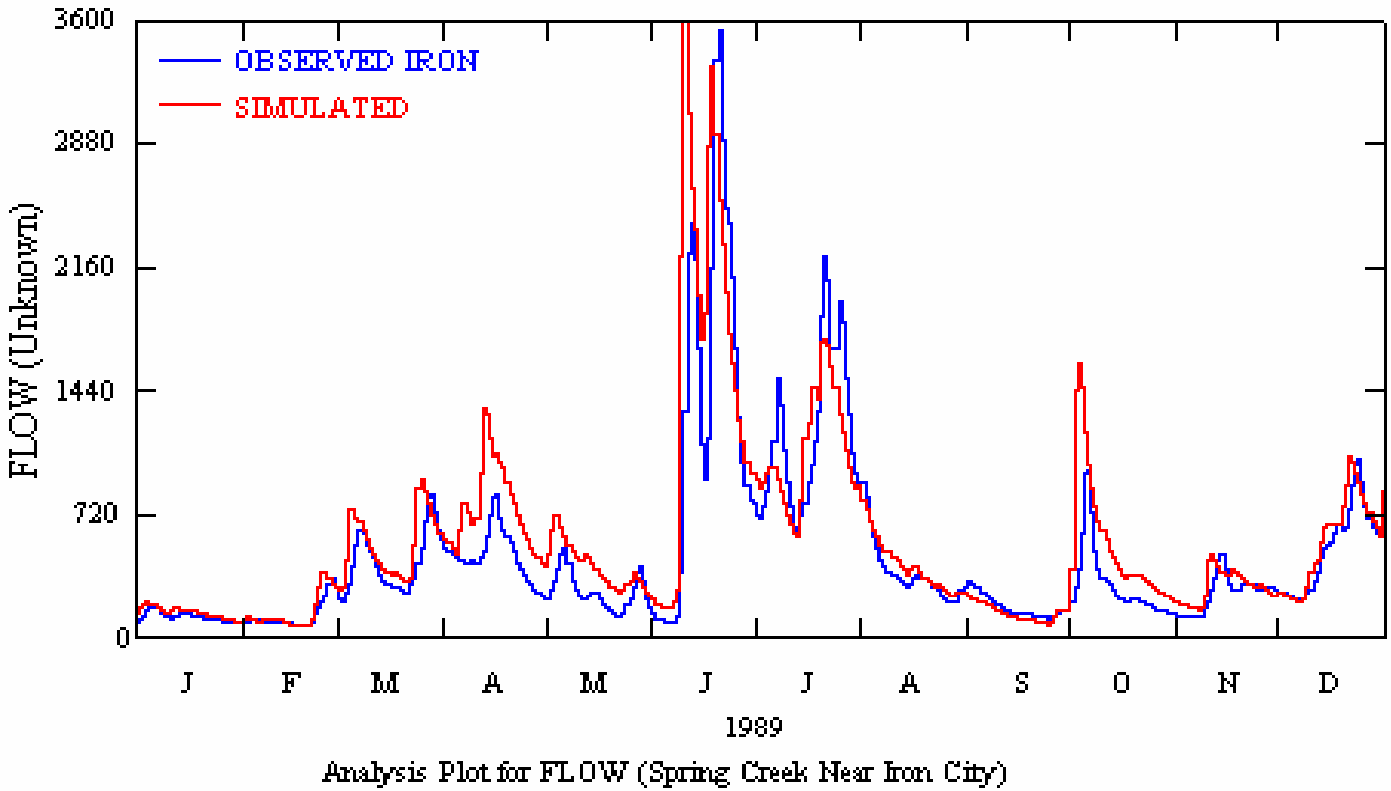
Model Validation – Spring Creek Year 1988 (Dry)



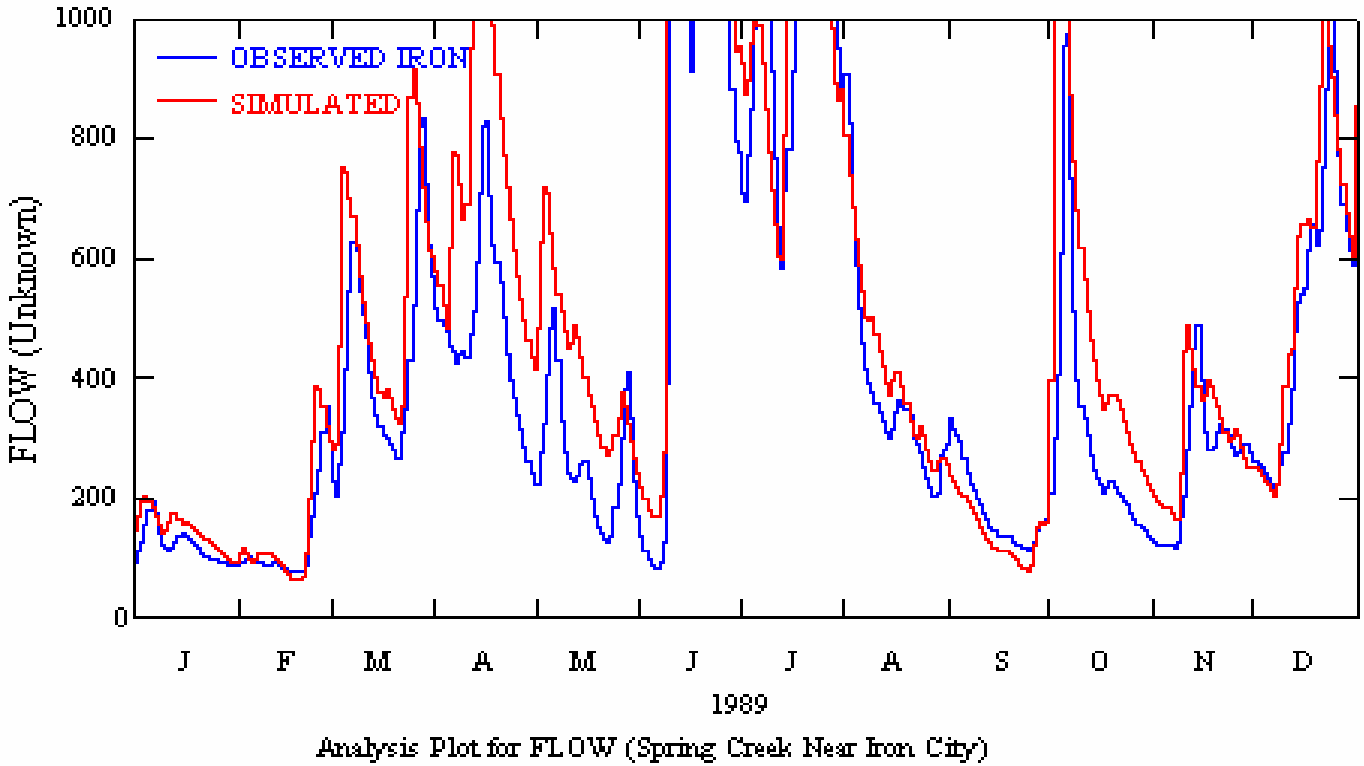
Model Validation – Spring Creek Year 1988 (Dry)



Model Validation – Spring Creek Year 1989 (Wet)



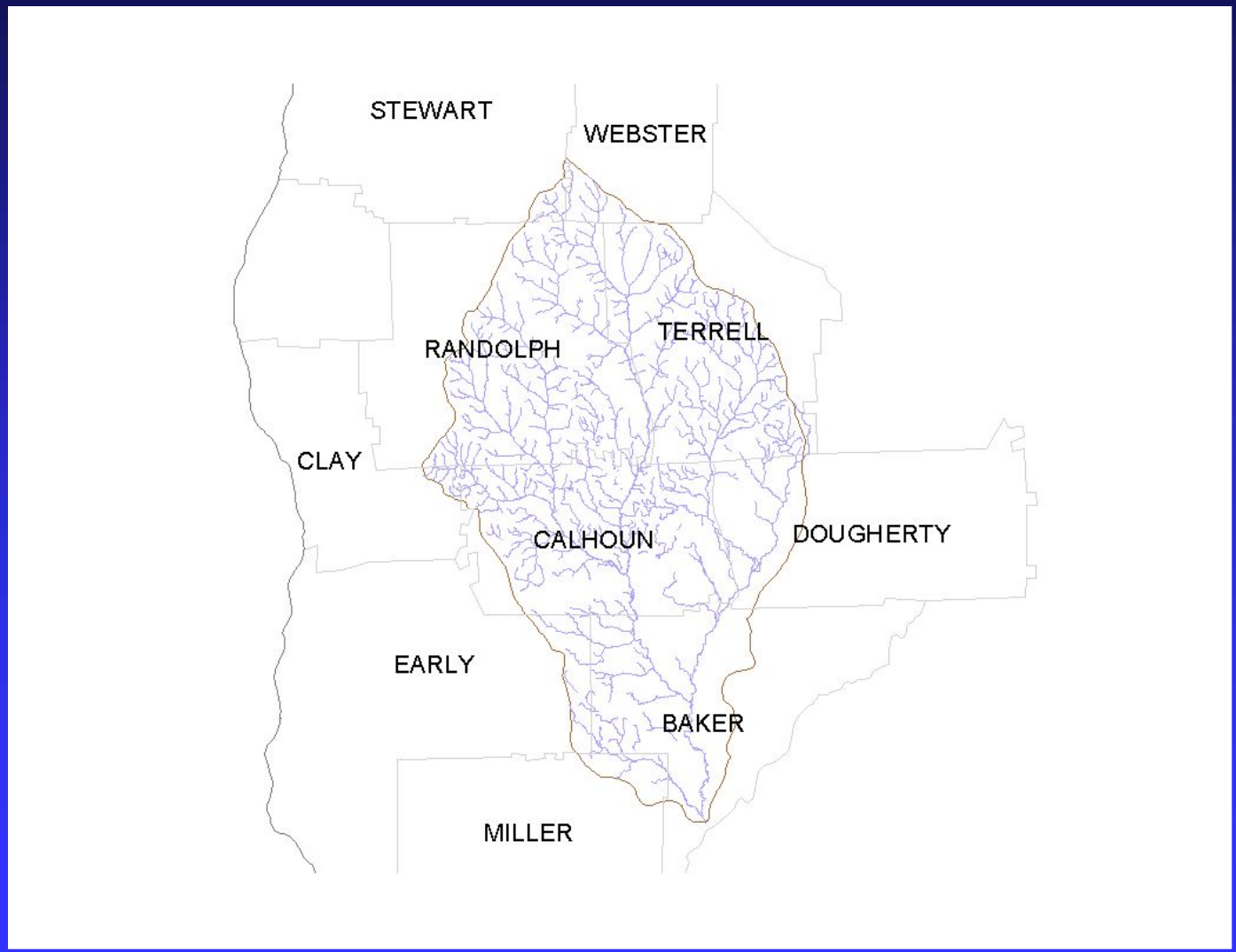
Model Validation – Spring Creek Year 1989 (Wet)



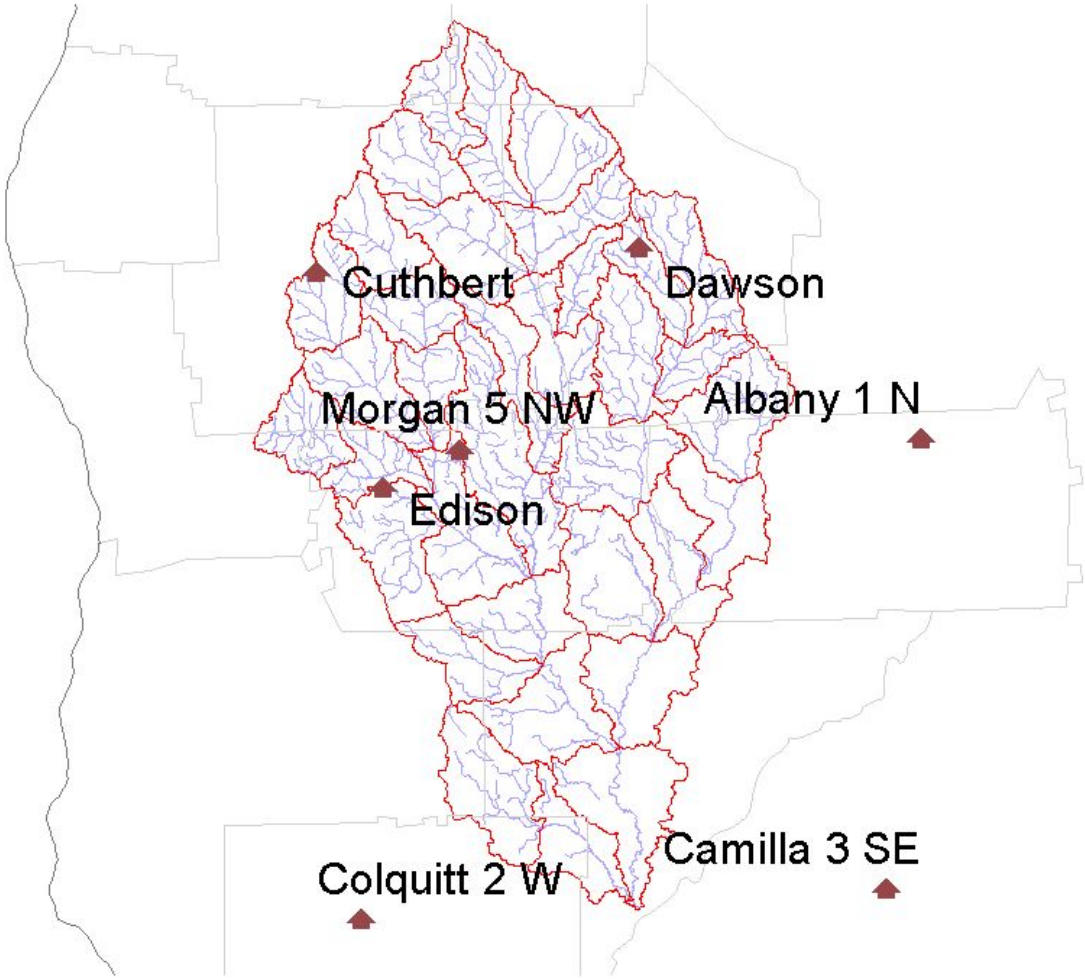
Results Analysis – Spring Creek

- Pre-irrigation calibration: duration curves match very well except low end (>98%) with higher simulated flow.
- Post-irrigation validation: simulated flows are slightly lower in both higher and lower ends.
- Improvement of low flow for pre or post irrigation period will make result of other period worse.
- Comparison of observed and simulated flows indicates general good match of two flow series
- Low flows match satisfactorily.

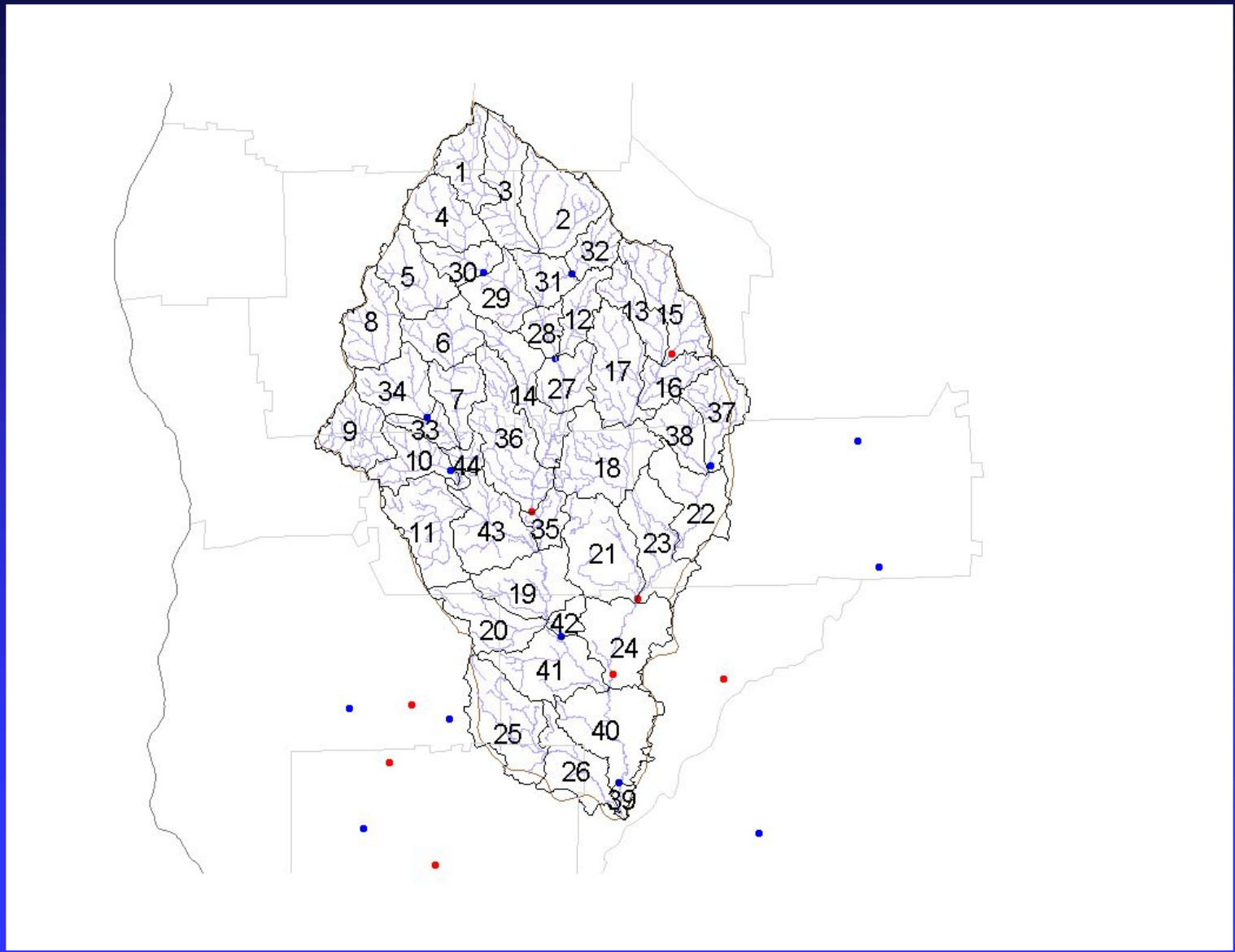
Ichawaynochaway Cr.



Meteorological Records



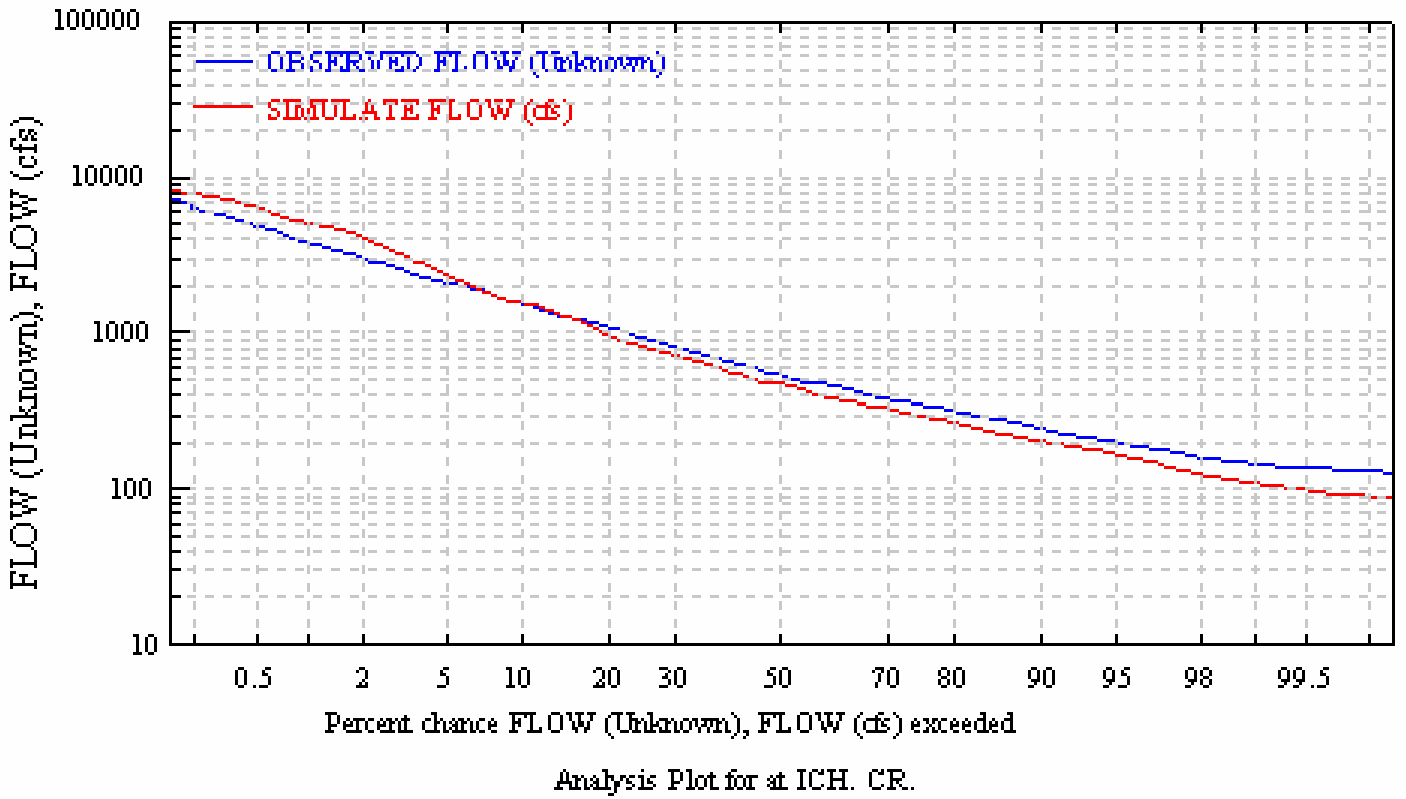
Watershed Delineation



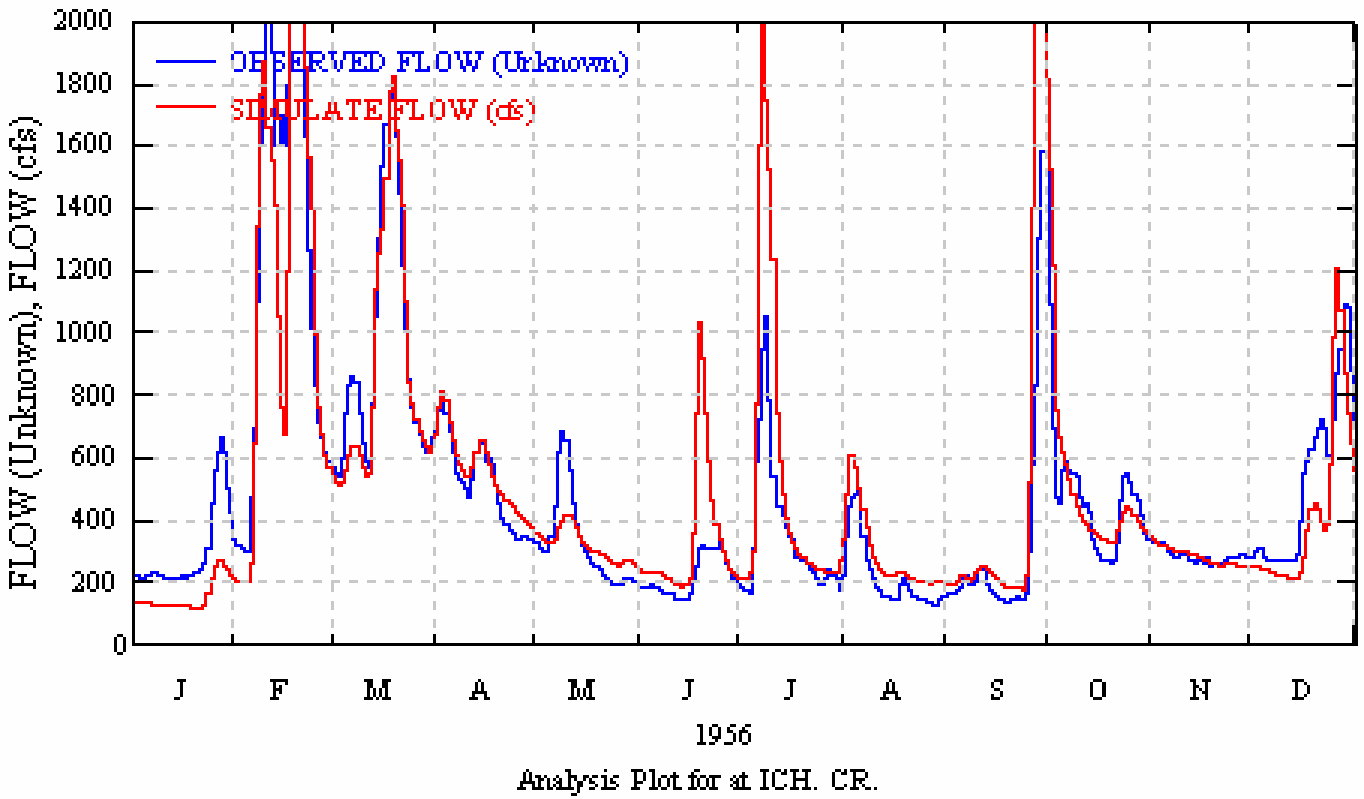
Model Calibration - Ichawaynochaway

- Using in-stream flow data at Ichaway. Cr. Near Milford (Jan. 1950 – Dec. 1975).
- Achieving high value indices (CC = 0.88; COD = 0.78; and NS = 0.77).
- Duration curve of simulation matched that of observation reasonably well.
- Magnitude and timing of low flow seemed acceptable.

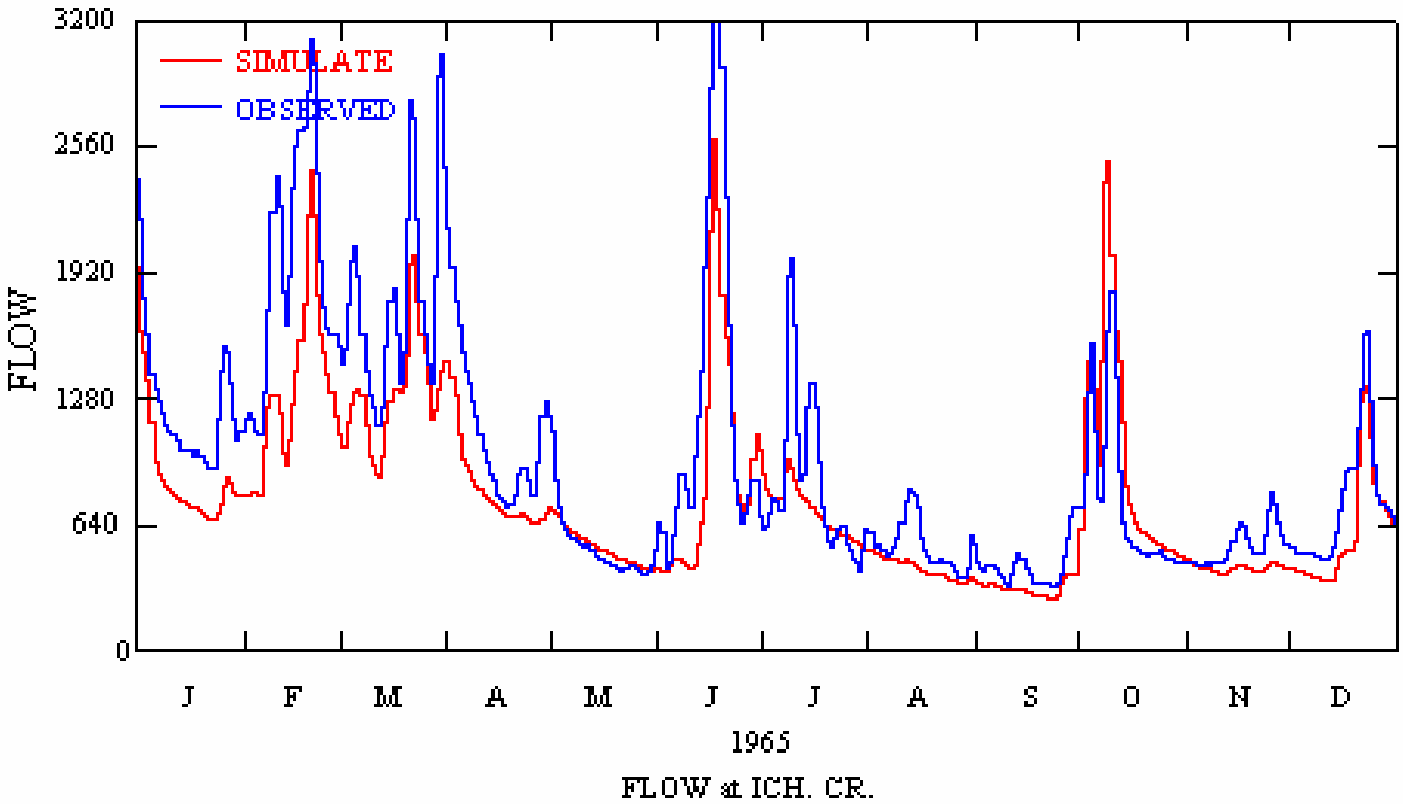
Duration Curve



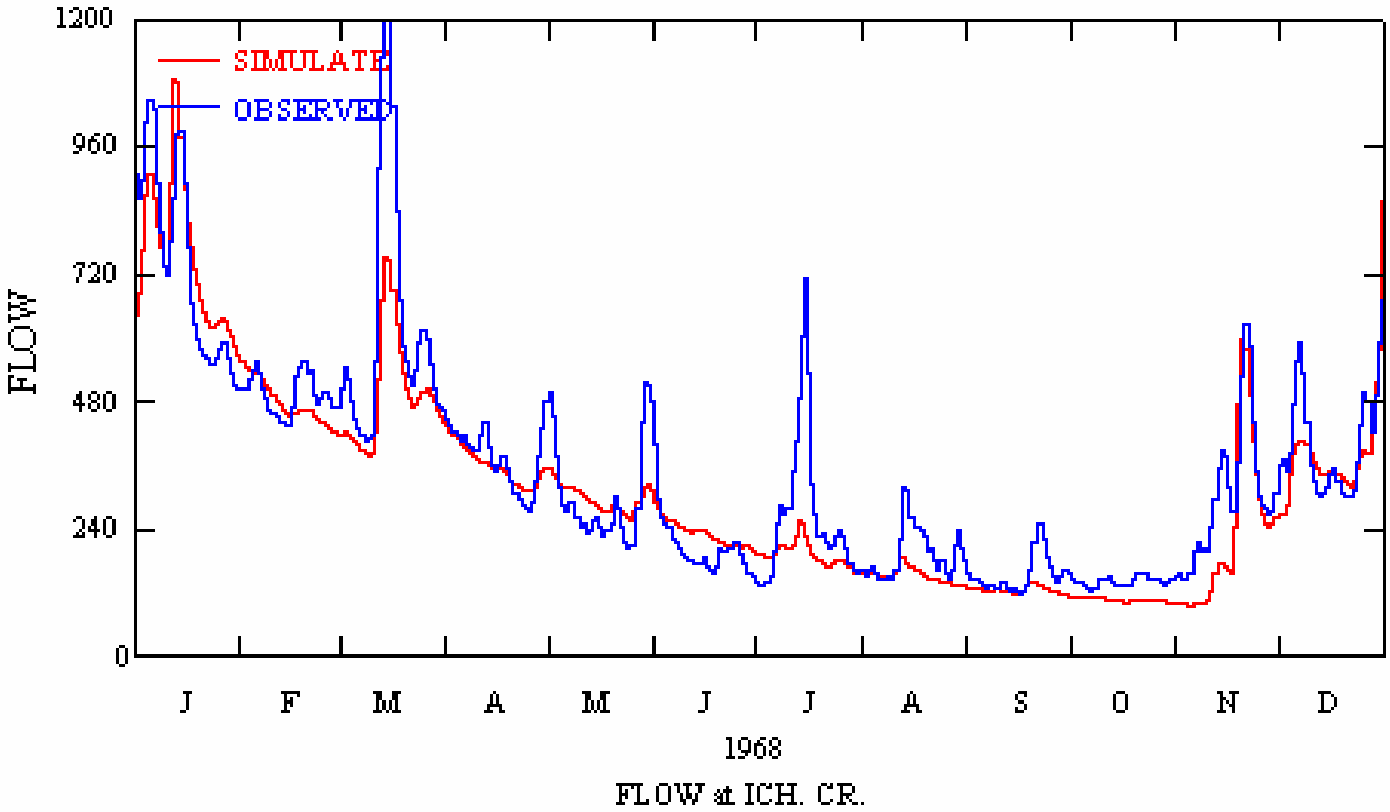
Model Calibration – Ichwaynochaway Year 1956 (Dry)



Model Calibration – Ichwaynochaway Year 1965 (Wet)



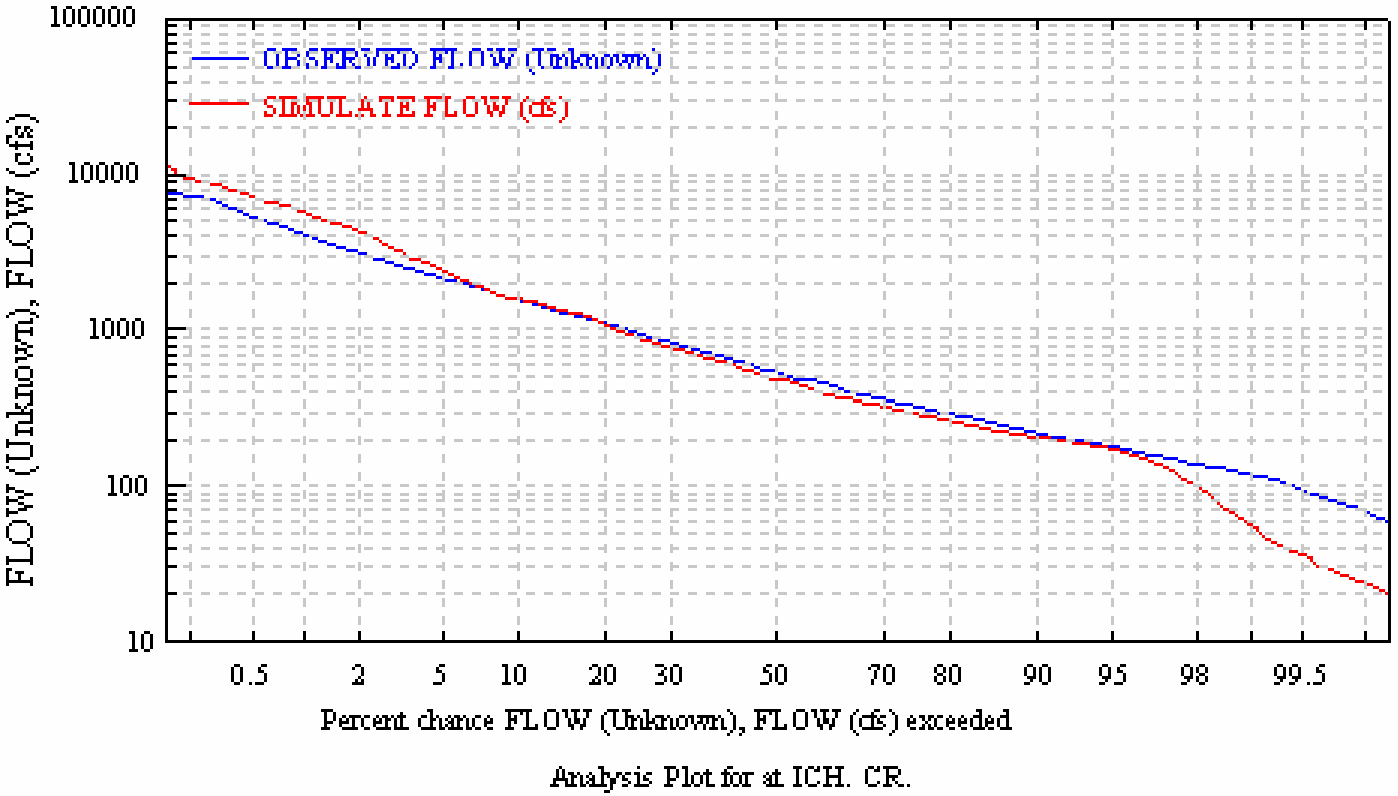
Model Calibration – Ichwaynochaway Year 1968 (Drought)



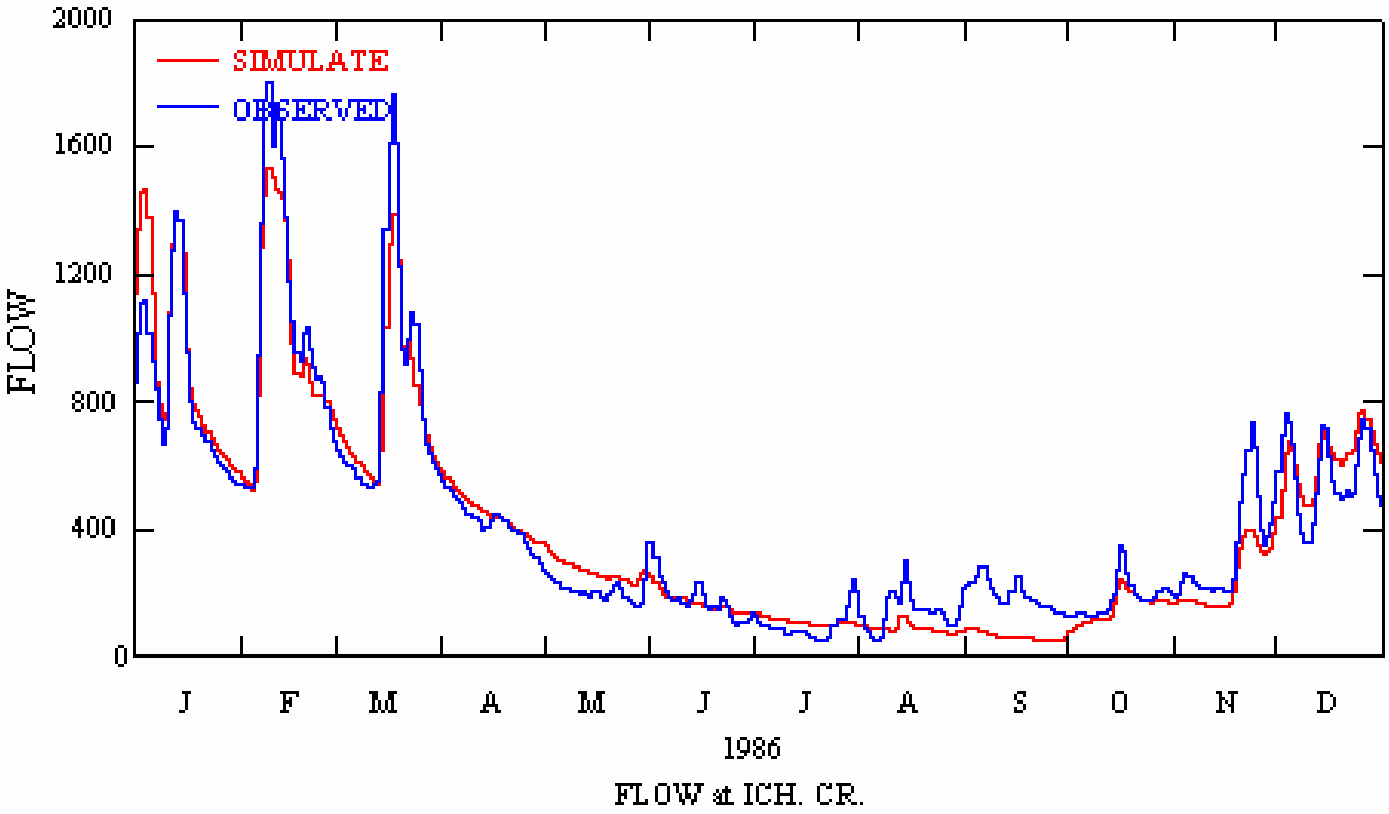
Model Validation - Ichawaynochway

- Using in-stream flow data at Ichaway. Cr. Near Milford (Jan. 1973 – Dec. 1995).
- Achieving similar indices (CC = 0.89; COD = 0.79; and NS = 0.78).
- Duration curve of simulation matched that of observation reasonably well except for the very low end.
- Magnitude and timing of low flow seemed acceptable.

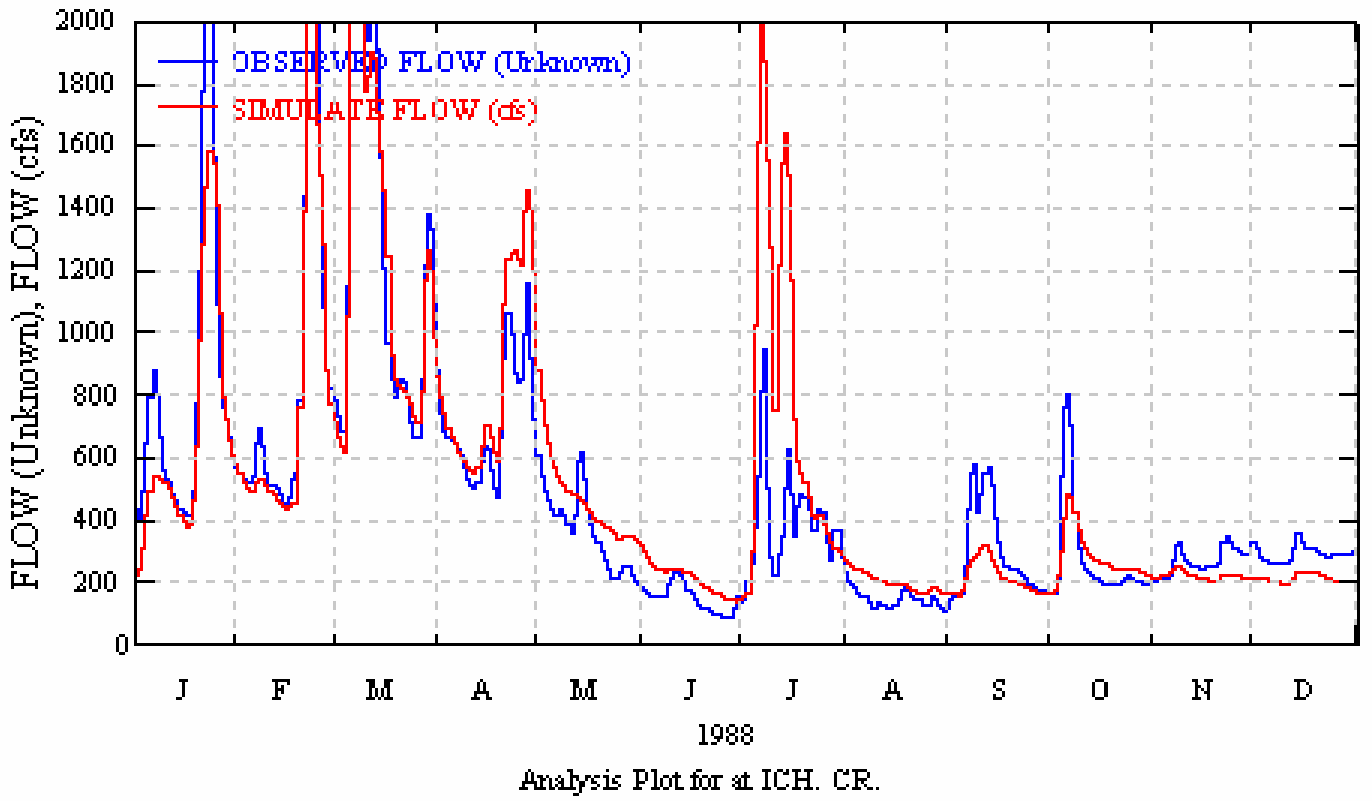
Duration Curve - Ichawaynochaway



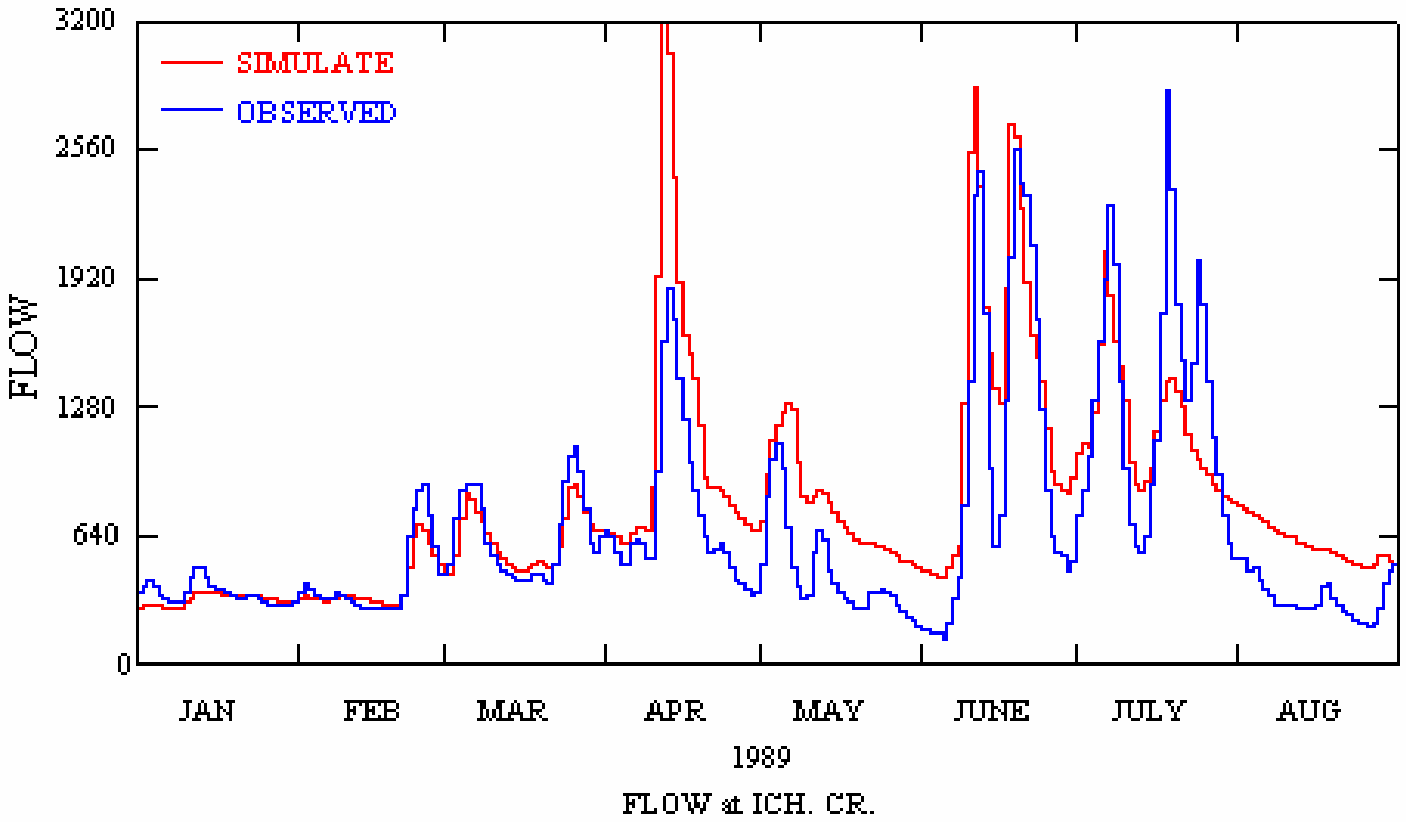
Model Validation – Ichwaynochaway Year 1986 (Drought)



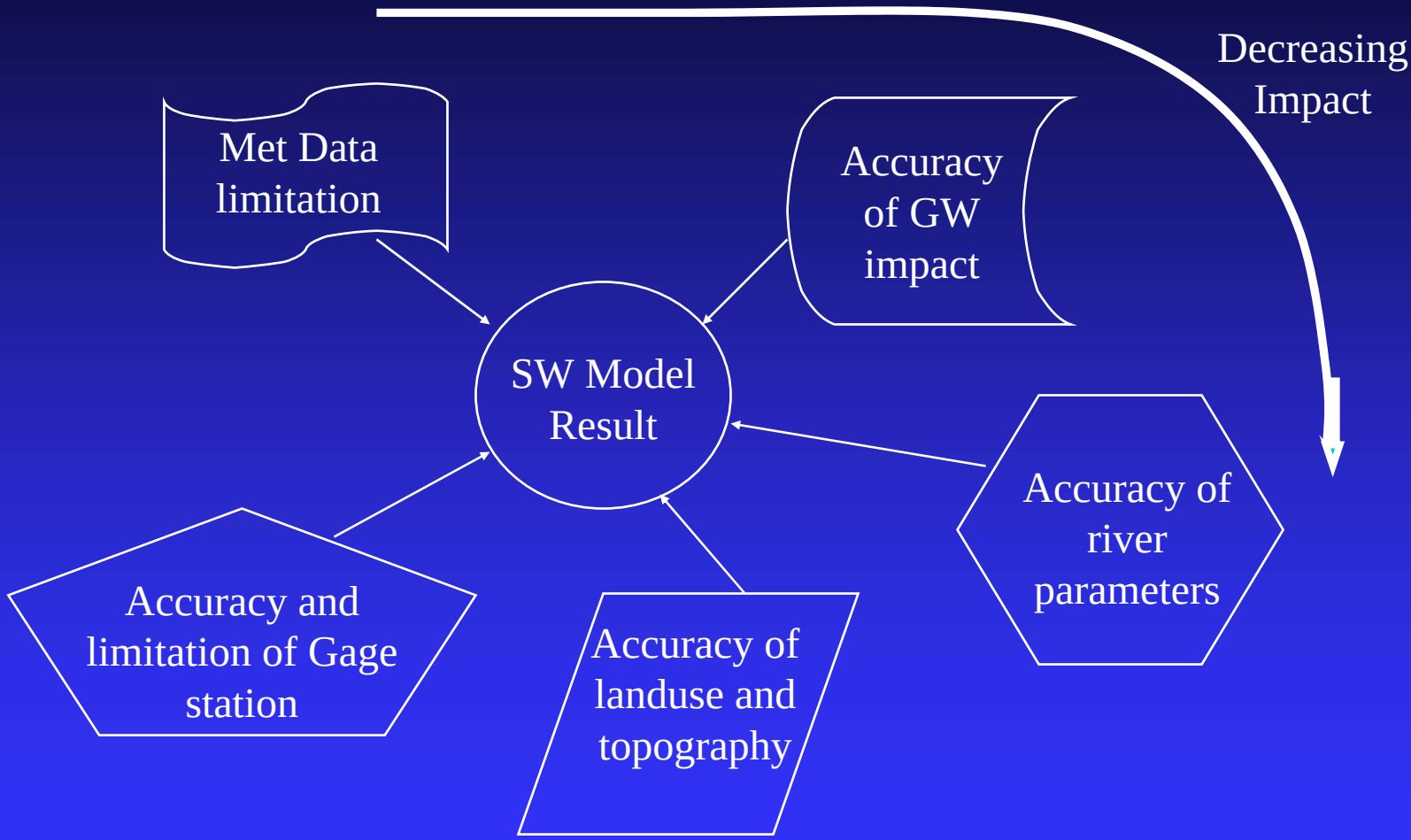
Model Validation – Ichwaynochaway Year 1988 (Dry)



Model Validation – Ichwaynochaway Year 1989 (Wet)



Uncertainty Analysis



Conclusion

- Both the Spring Creek and Ichawaynochaway Creek surface water model calibrations and validations are acceptably accurate except in the lowest 2-5% of the stream flow range.
- In both basins, the modeled agricultural irrigation withdrawals during the validation period lower the simulated stream flow rates compared to the observed flow records in the lowest 2% of the flow range.
- The inclusion of groundwater withdrawal effects in the models is likely to significantly further lower the simulated flow rate in the lowest 2-5% of the flow range in Spring Creek, perhaps reaching 0 cfs in years other than 2001.
- The models are believed to be suitable for all conditions except the lowest 2-5% of the stream flow range. However, for the extreme drought conditions, uncertainties in data input and hydrologic and hydrogeologic processes will likely require additional evaluation for resource management decisions, especially for the smaller tributaries and stream reaches.