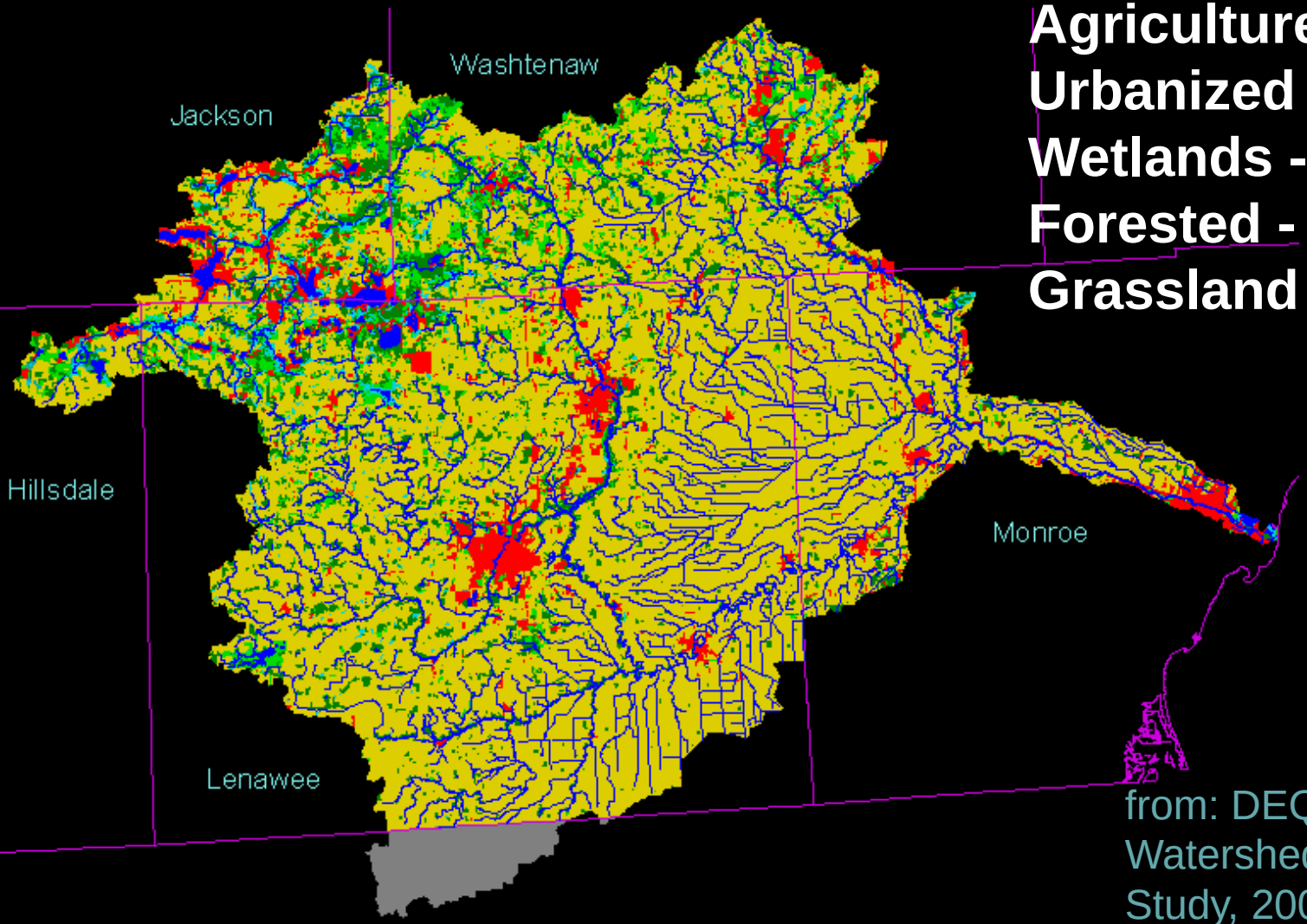
Tracking Macroinvertebrate Trends in Water Quality with Respect to Flow Conditions and other Variables

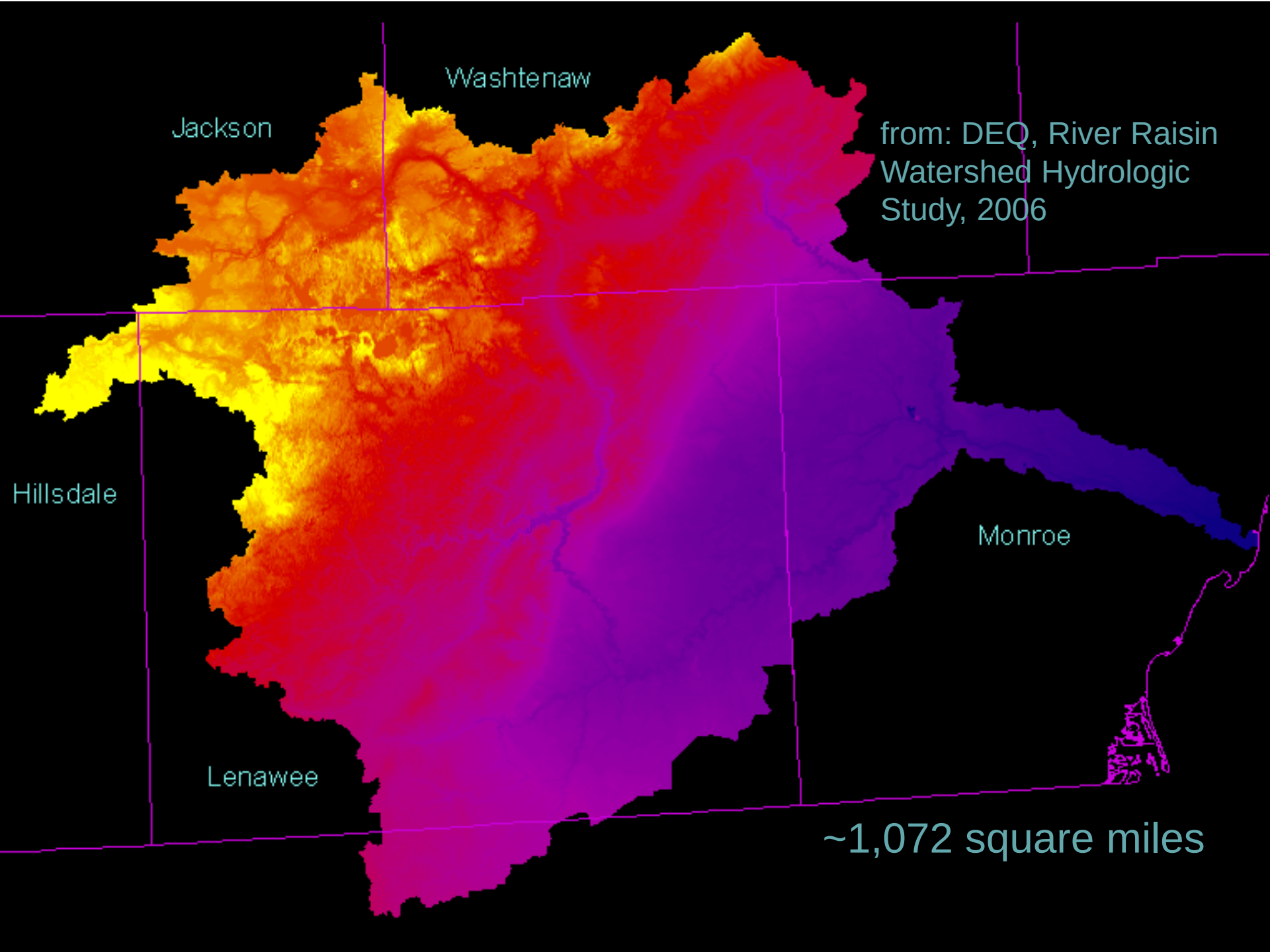
Jim Martin
Associate Professor
Biology Department, Adrian College
Adopt-A-Stream Director
River Raisin Watershed

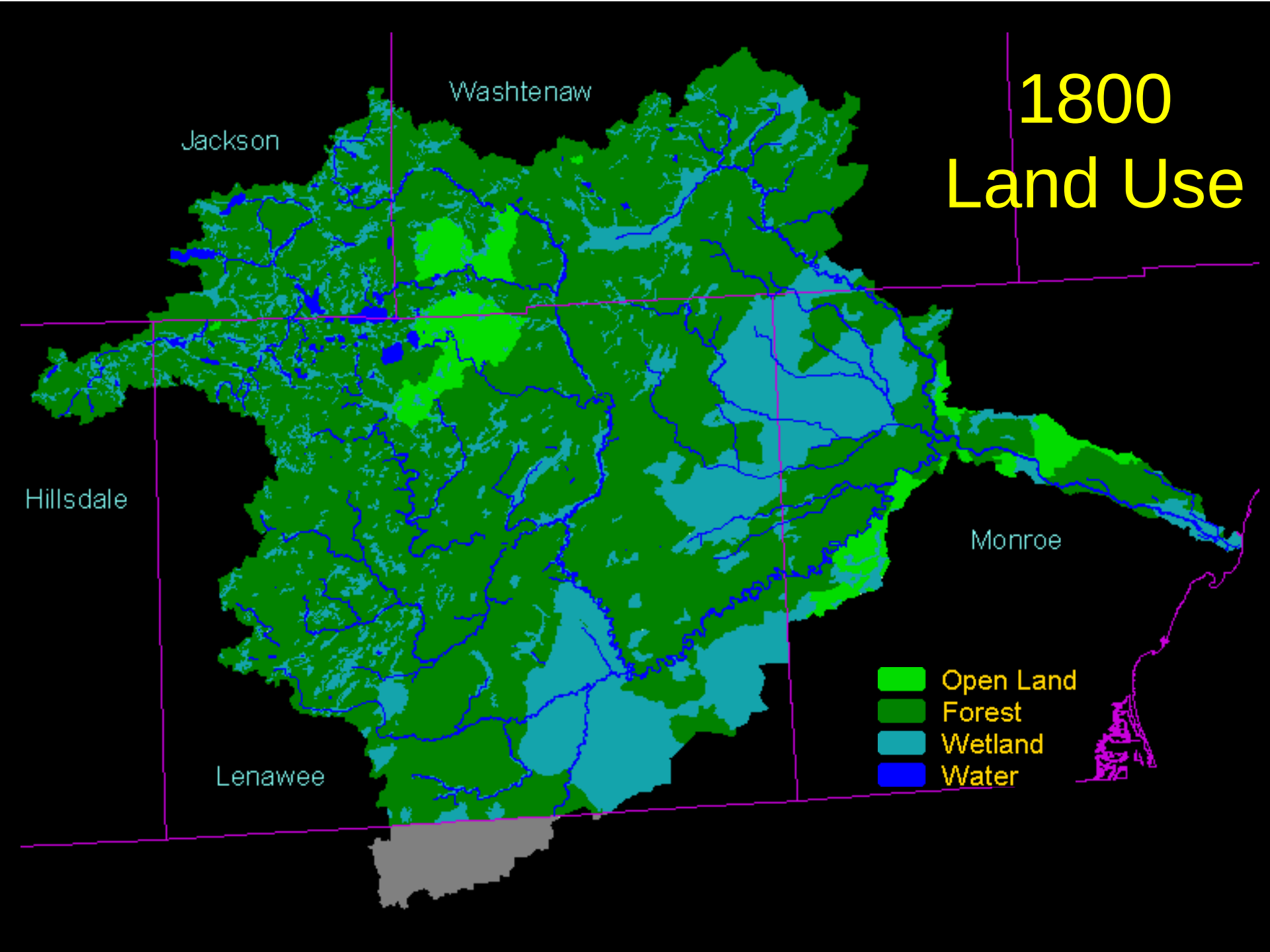
~180,000 people

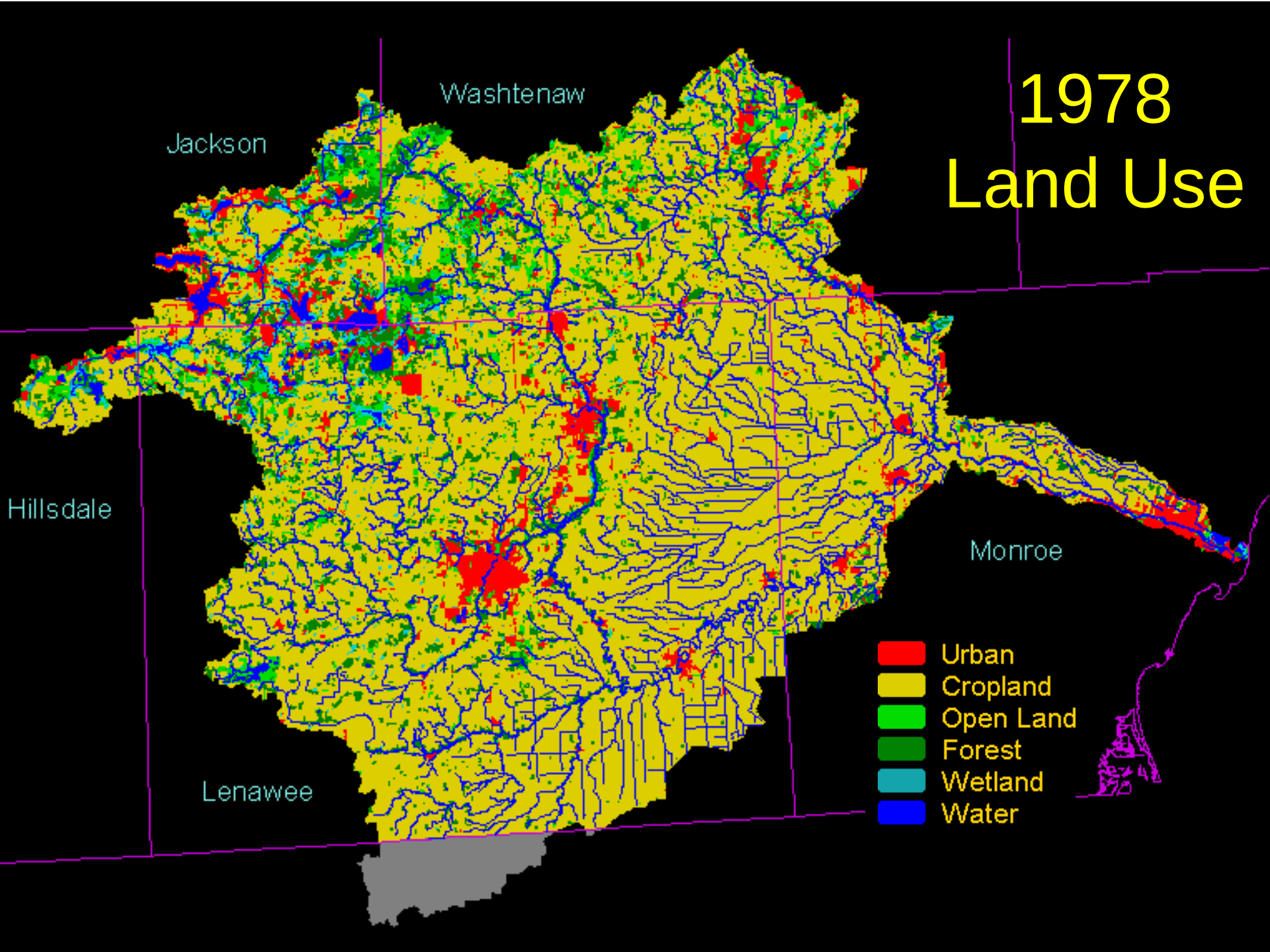
Agriculture - 65%
Urbanized Areas - 11%
Wetlands - 8%
Forested - 7%
Grassland - 7%

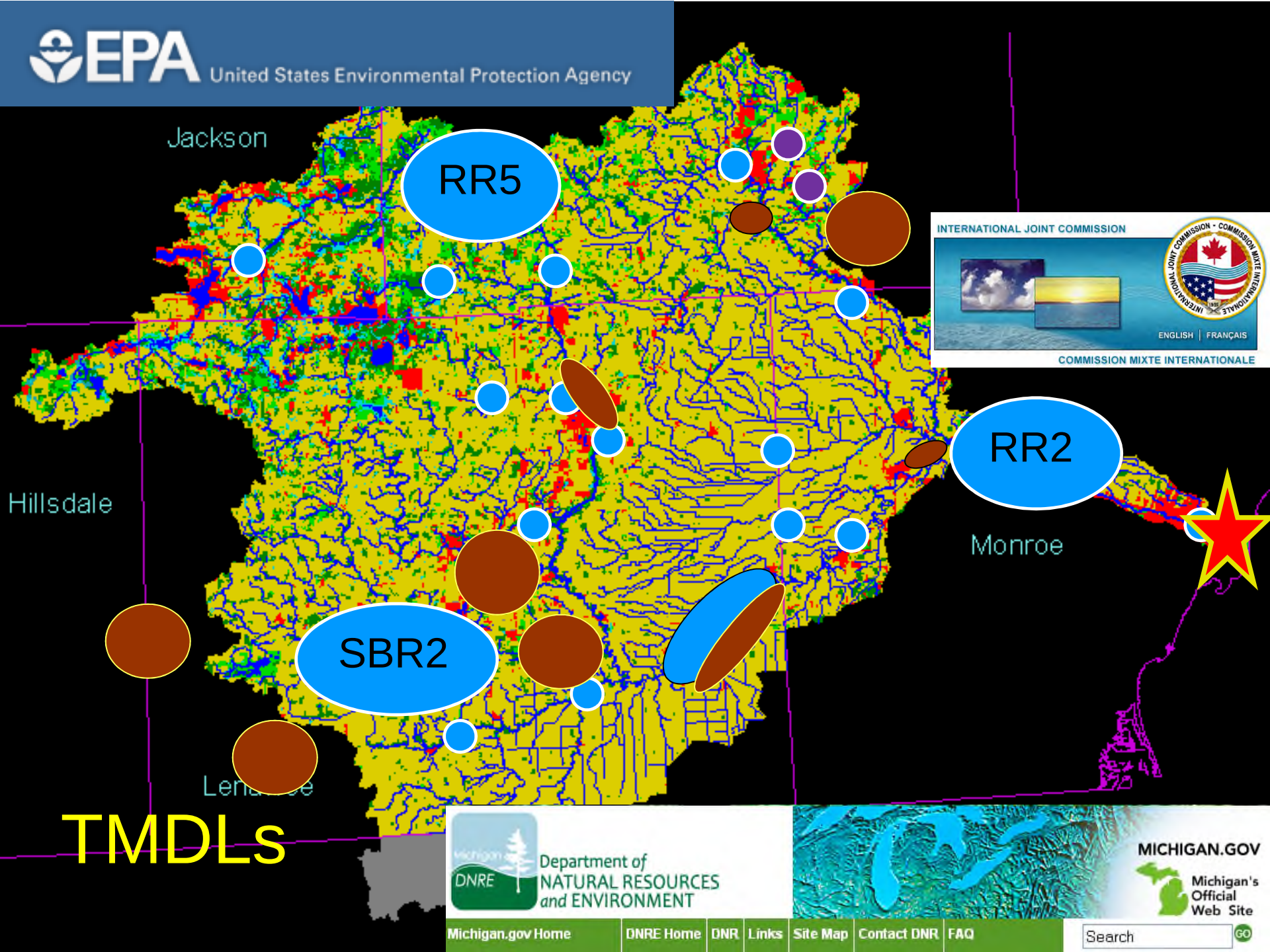


from: DEQ, River Raisin Watershed Hydrologic Study, 2006


Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
from: DEQ, River Raisin Watershed Hydrologic Study, 2006
~1,072 square miles


1800
Land Use
Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Open Land
Forest
Wetland
Water

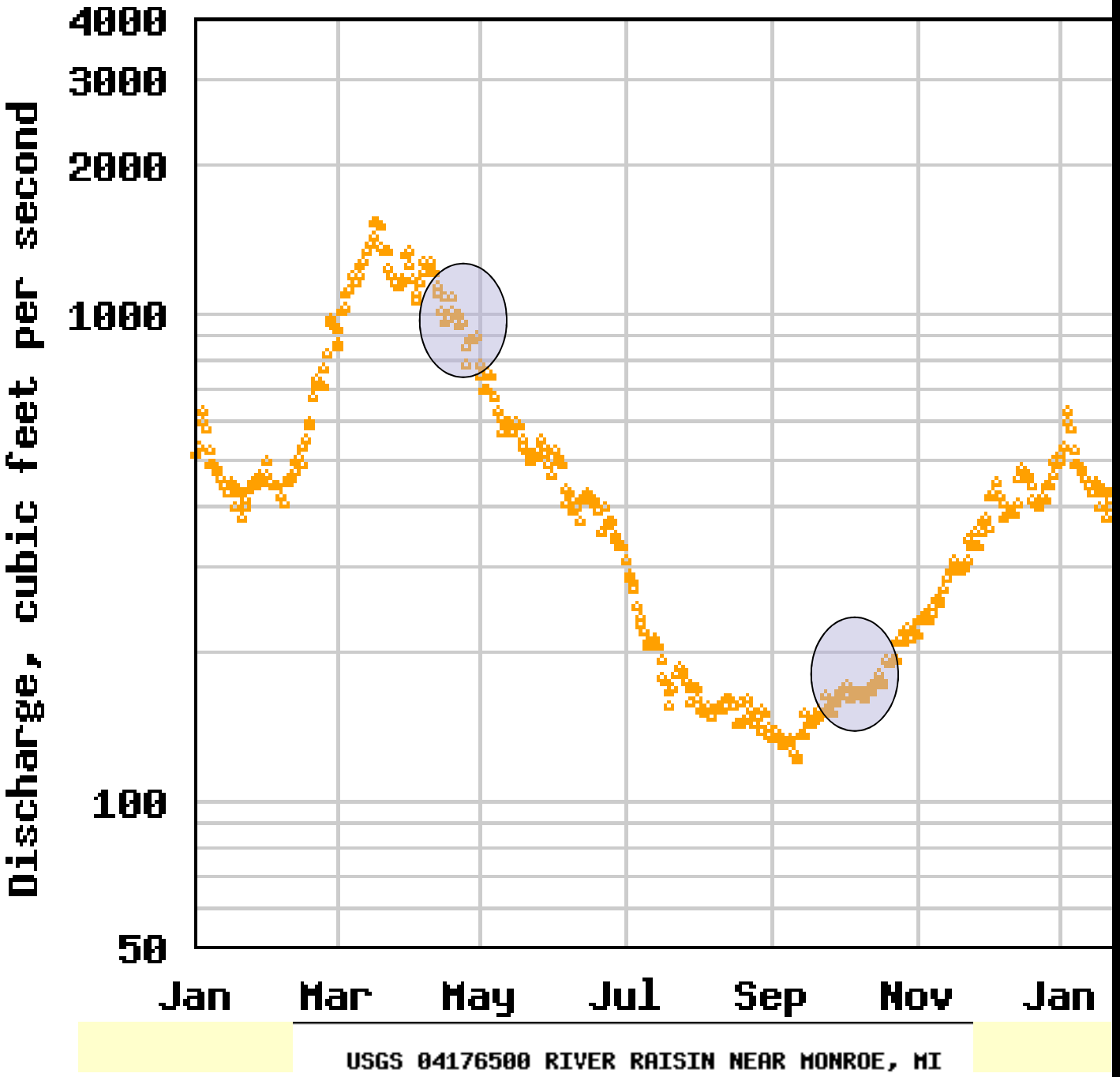

1978
Land Use
Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Urban
Cropland
Open Land
Forest
Wetland
Water


EPA United States Environmental Protection Agency
Jackson
RR5
Hillsdale
RR2
Monroe
SBR2
INTERNATIONAL JOINT COMMISSION
ENGLISH | FRANÇAIS
COMMISSION MIXTE INTERNATIONALE
Department of NATURAL RESOURCES and ENVIRONMENT
MICHIGAN.GOV
Michigan's Official Web Site
Michigan.gov Home
DNRE Home
DNR
Links
Site Map
Contact DNR
FAQ
Search
GO

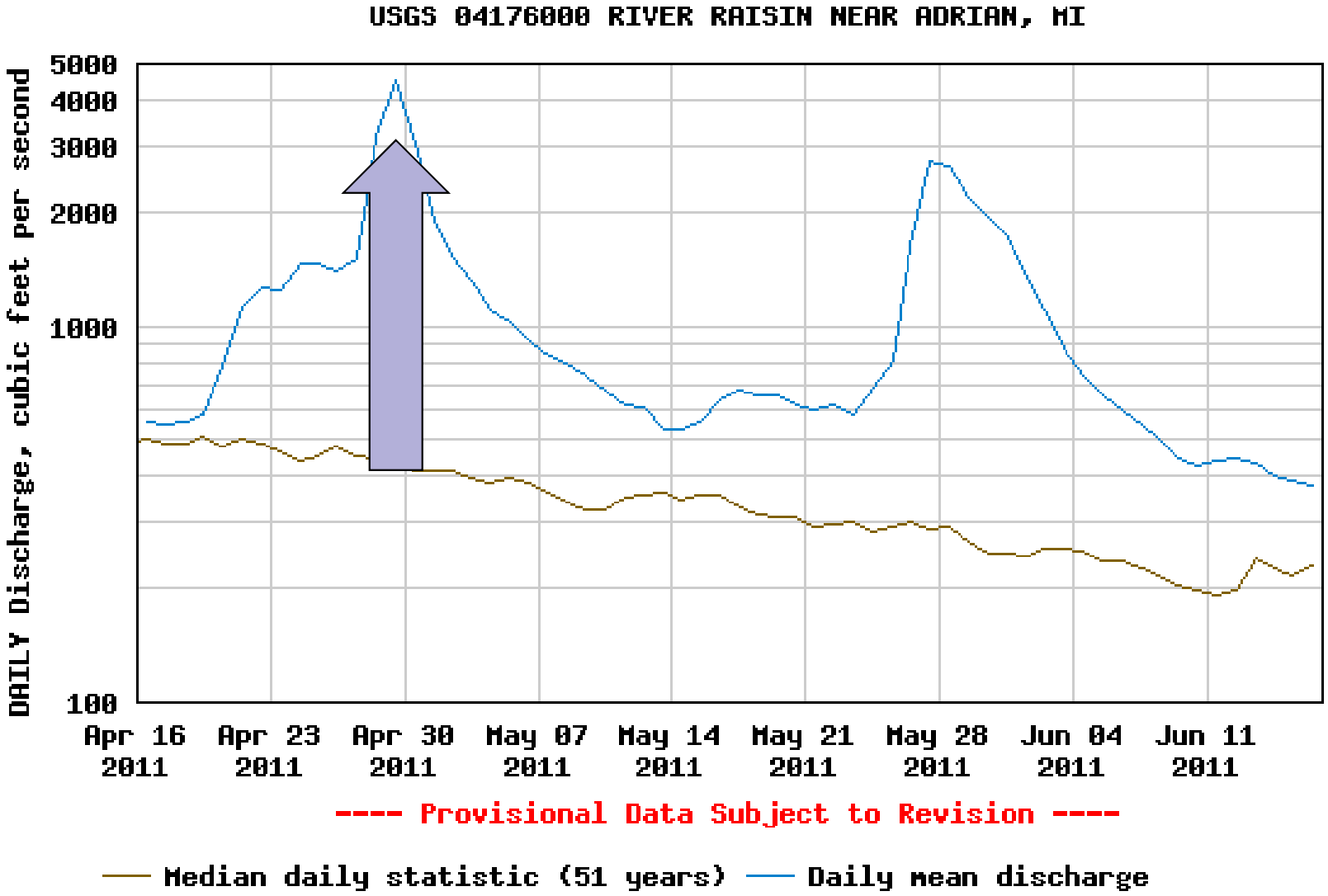
TMDLs

Problems of collection heterogeneity

1) Proficiency of collection
    1) Habitat survey – 300’ of stream
    2) Number of searchers
    3) Training level
2) Sample size
3) River depth
    1) Seasonality
    2) Aberrations (the weather)
4) Real things


Discharge, cubic feet per second
4000
3000
2000
1000
100
50
Jan
Mar
May
Jul
Sep
Nov
Jan
USGS 04176500 RIVER RAISIN NEAR MONROE, MI

Discharge, cubic feet per second



ERDC/CHL CHETN-VIII-4
December 2000

US Army Corps of Engineers®

Effective Discharge Calculation

by D. S. Biedenharn and R. R. Copeland

PURPOSE: The purpose of this Technical Note is to describe the methodology known as the effective discharge approach for estimating channel-forming discharge in stable alluvial streams.

INTRODUCTION: While channel-forming discharge presented by ERDC/CHL CHETN-VIII-5 can be estimated by two other methodologies (the bankfull discharge and the specified recurrence interval discharge, only the effective discharge approach is discussed here. The effective discharge transports the largest fraction of the bed-material load and, hence, can be a good estimator for channel-forming discharge. However, the effective discharge should not be assumed to be the channel-forming discharge a priori without confirmation using field indicators of geomorphic significance. This procedure for effective discharge calculations has been developed for a range of river types. It is a systematic method designed to have general applicability. The effective discharge procedure requires both hydrological and sediment data.

COMPUTATIONAL PROCEDURE: The procedure to determine the effective discharge is executed in three major steps which are as follows: (a) the flow-frequency distribution is determined from available flow-duration data, (b) sediment data are used to construct a bed-material-load rating curve, and (c) the flow-frequency distribution and bed-material-load rating

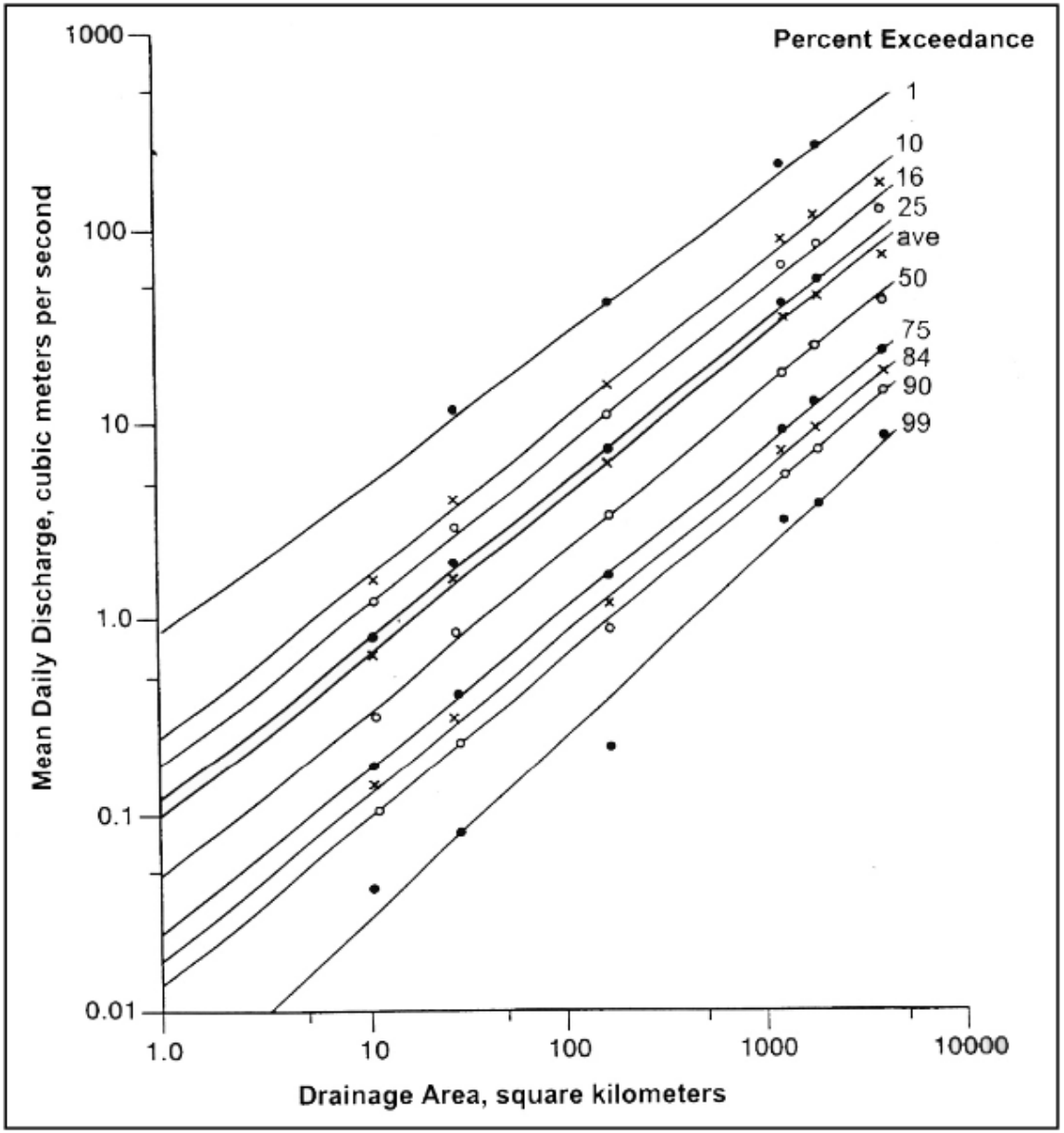
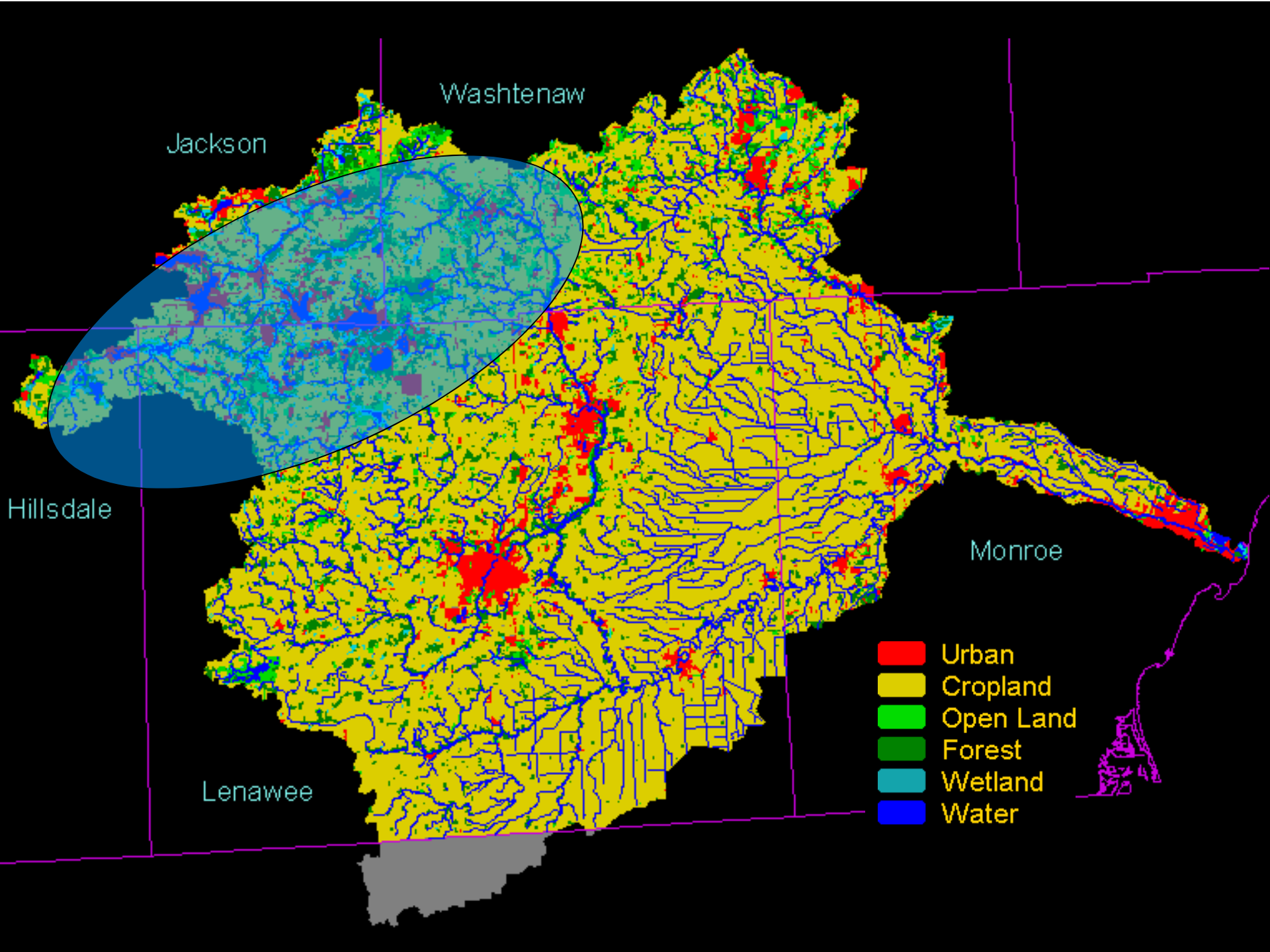


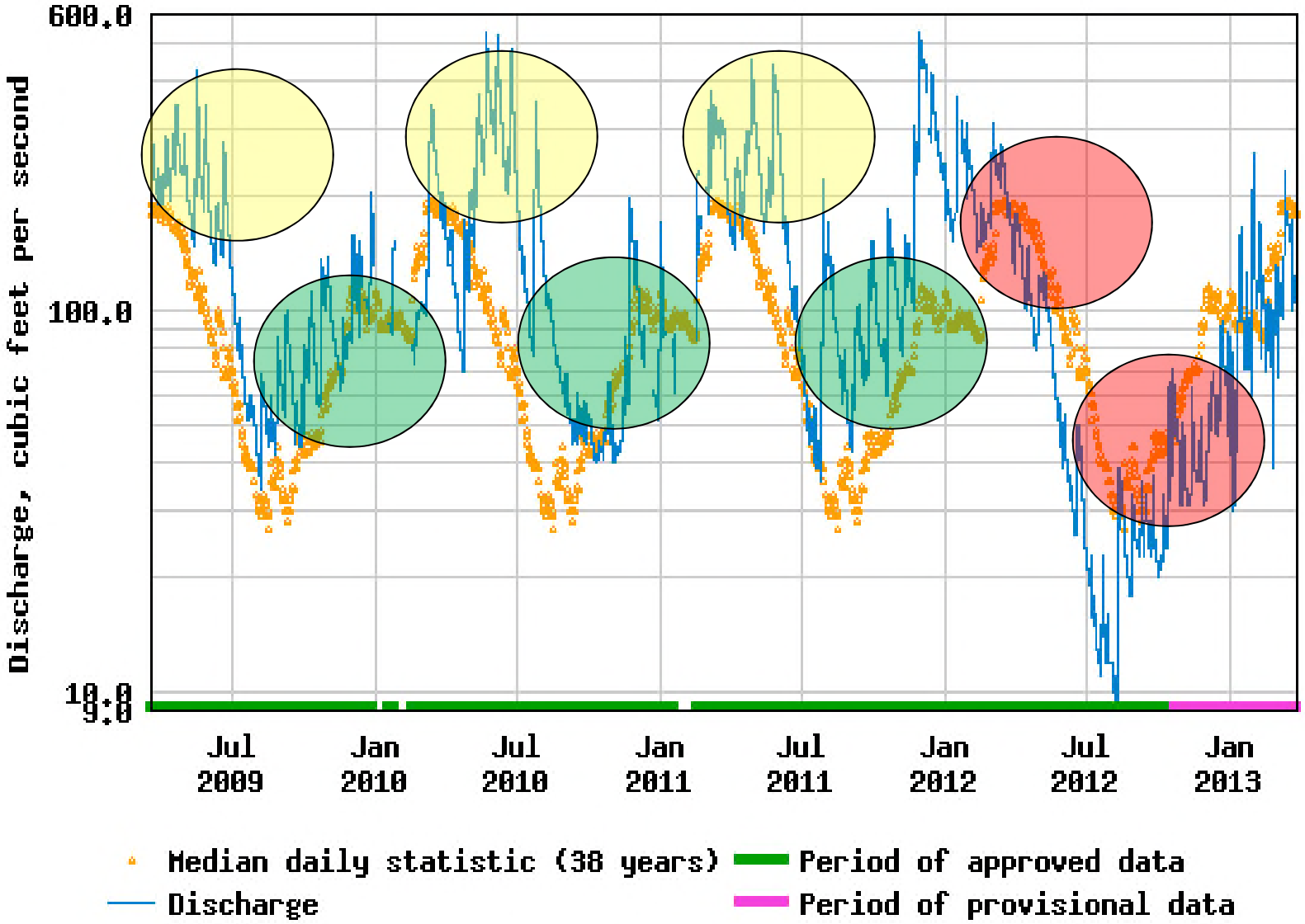
Figure 2. Downstream daily flow-duration curve, River Wye, UK 1937-1962 (Hey 1975)

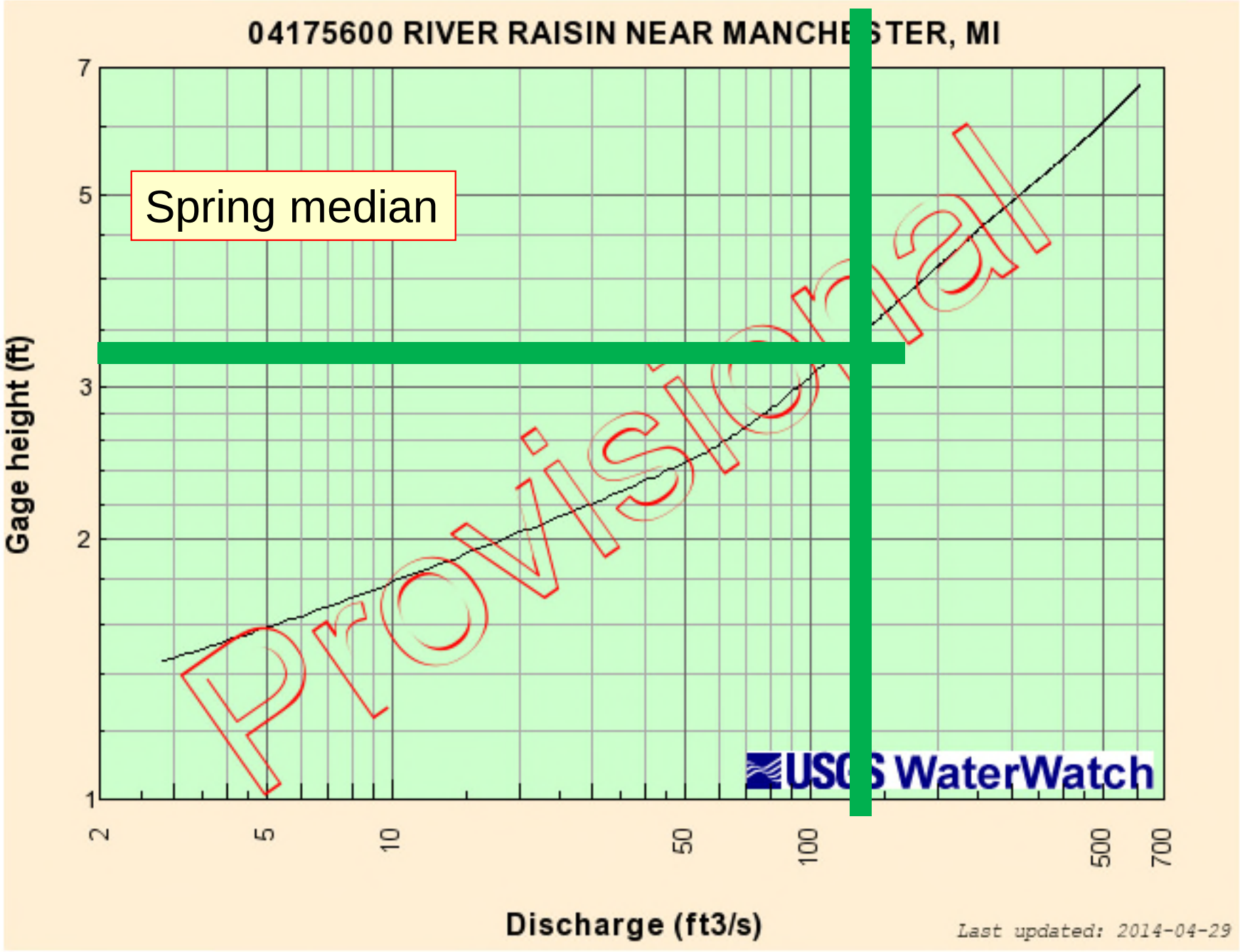

Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Urban
Cropland
Open Land
Forest
Wetland
Water

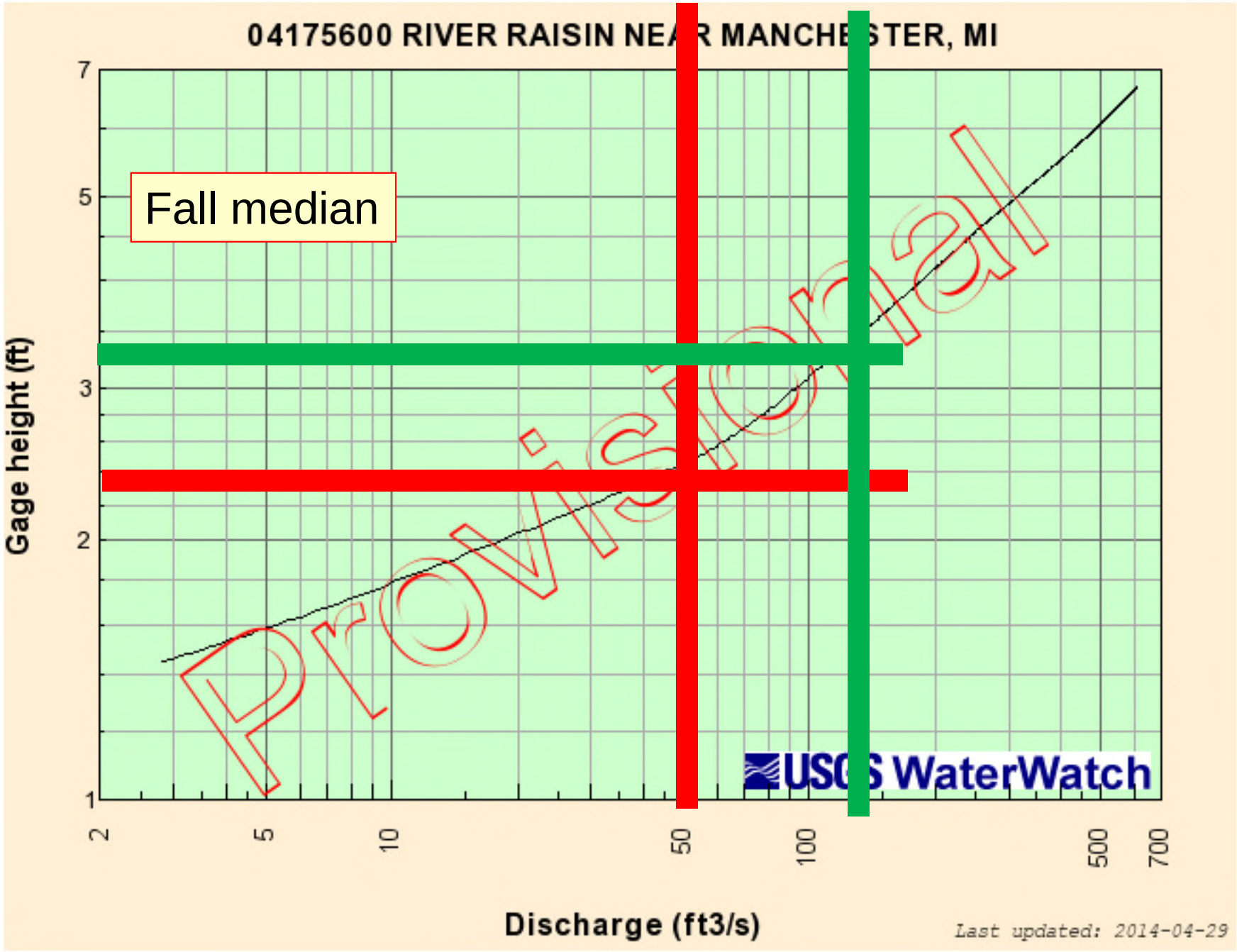
RR5 – Upper River Raisin (above Manchester)

USGS

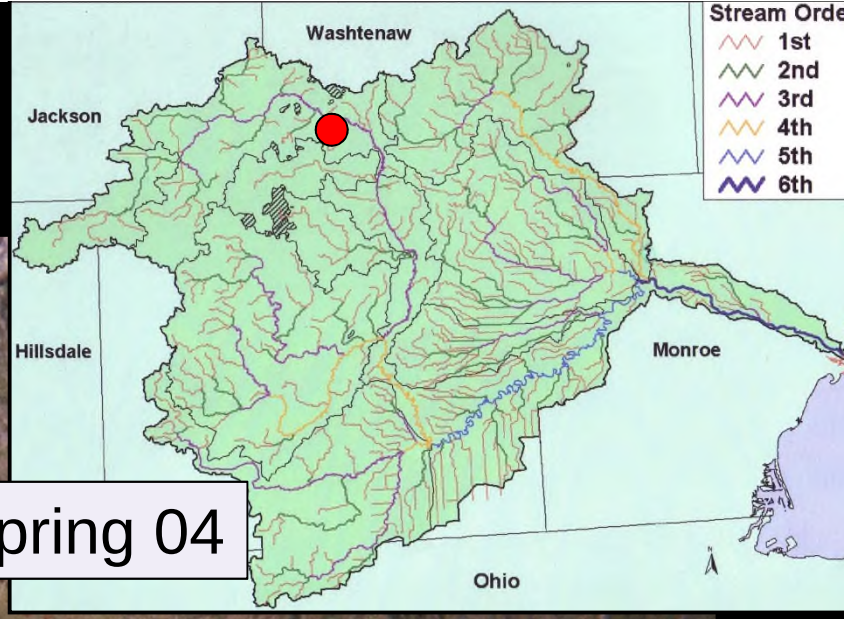
USGS 04175600 RIVER RAISIN NEAR MANCHESTER, MI




04175600 RIVER RAISIN NEAR MANCHESTER, MI
Spring median
Provisional
USGS WaterWatch
Gage height (ft)
7
5
3
2
1
2
5
10
50
100
500
700
Discharge (ft3/s)
Last updated: 2014-04-29


04175600 RIVER RAISIN NEAR MANCHESTER, MI
Fall median
Provisional
USGS WaterWatch
Gage height (ft)
7
5
3
2
1
2
5
10
50
100
500
700
Discharge (ft3/s)
Last updated: 2014-04-29

RR5 – Upper River Raisin (above Manchester)



Spring 02

8:20

85

Spring 03

7:20

41

Spring 04

4:12

22

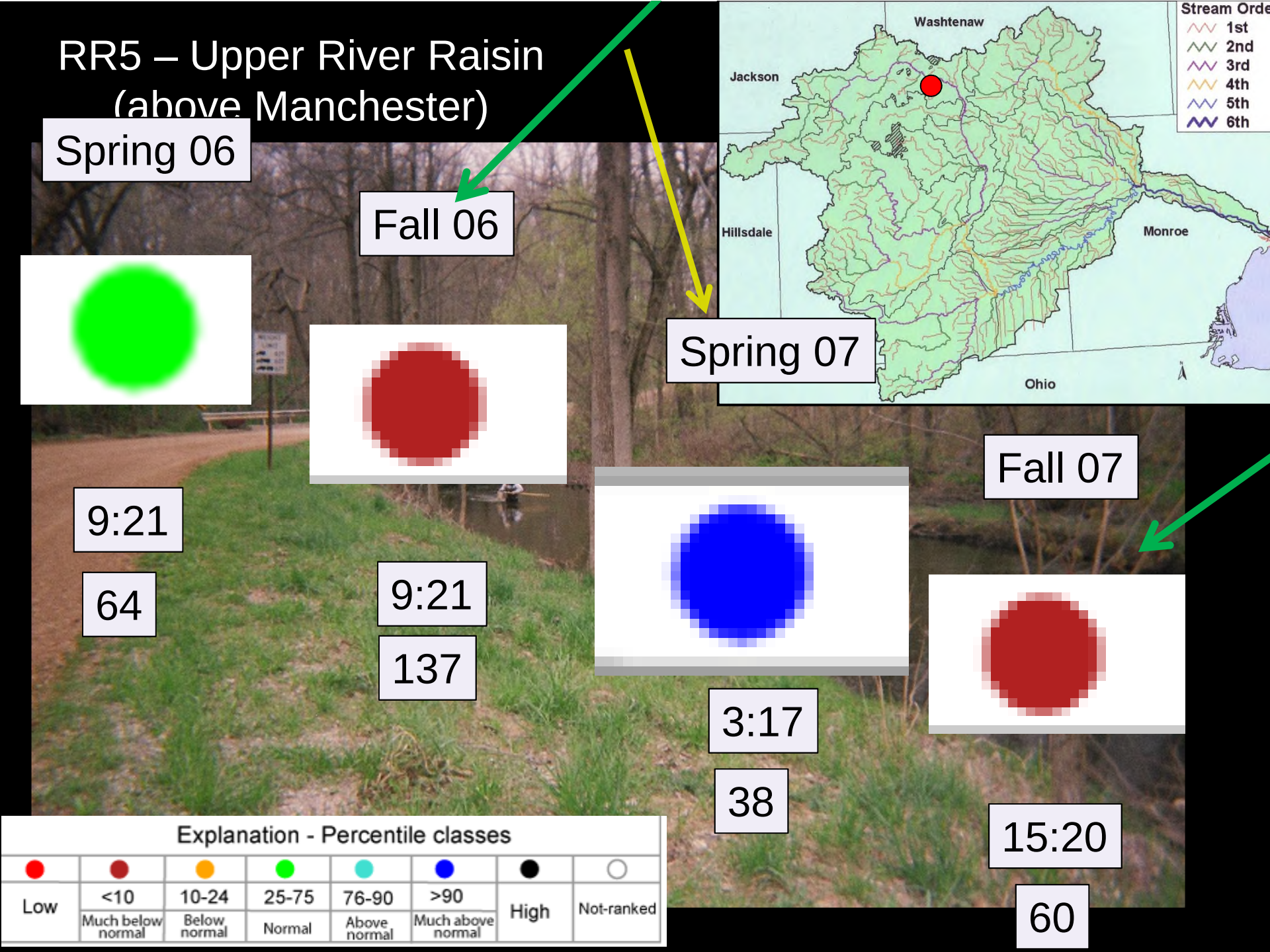
Spring 05

8:16

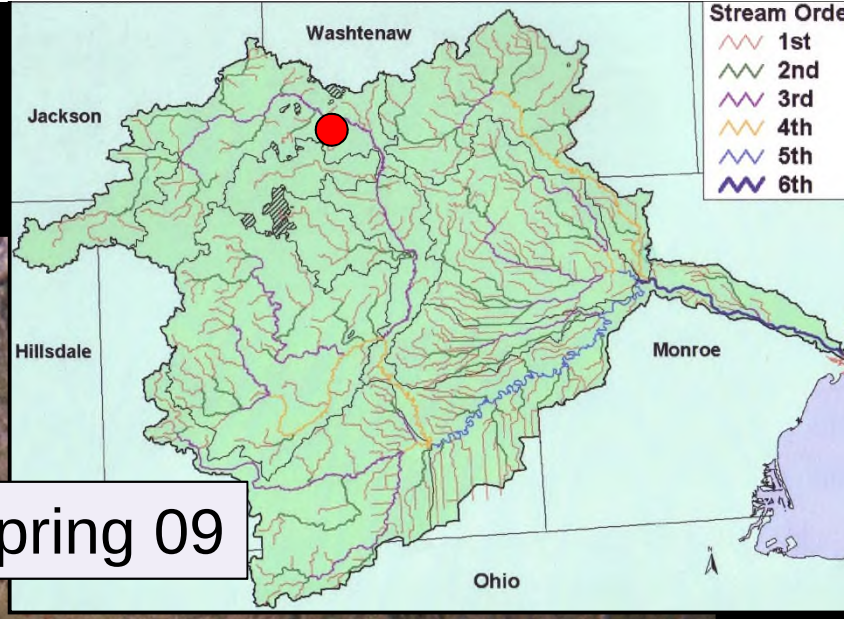
49

Explanation - Percentile classes							
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked

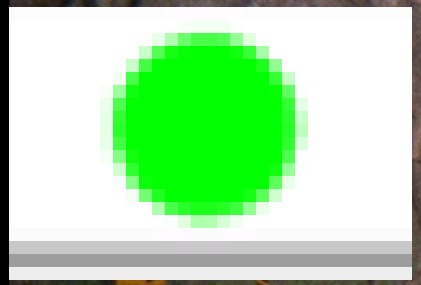
RR5 – Upper River Raisin (above Manchester)



RR5 – Upper River Raisin (above Manchester)



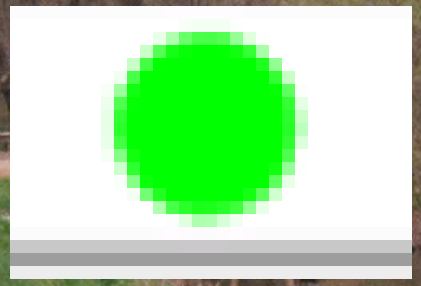
Spring 08



8:23

149

Fall 08



9:29

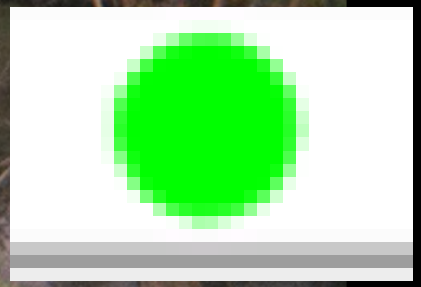
188

Spring 09

12:29

367

Fall 09



9:16

276

Explanation - Percentile classes

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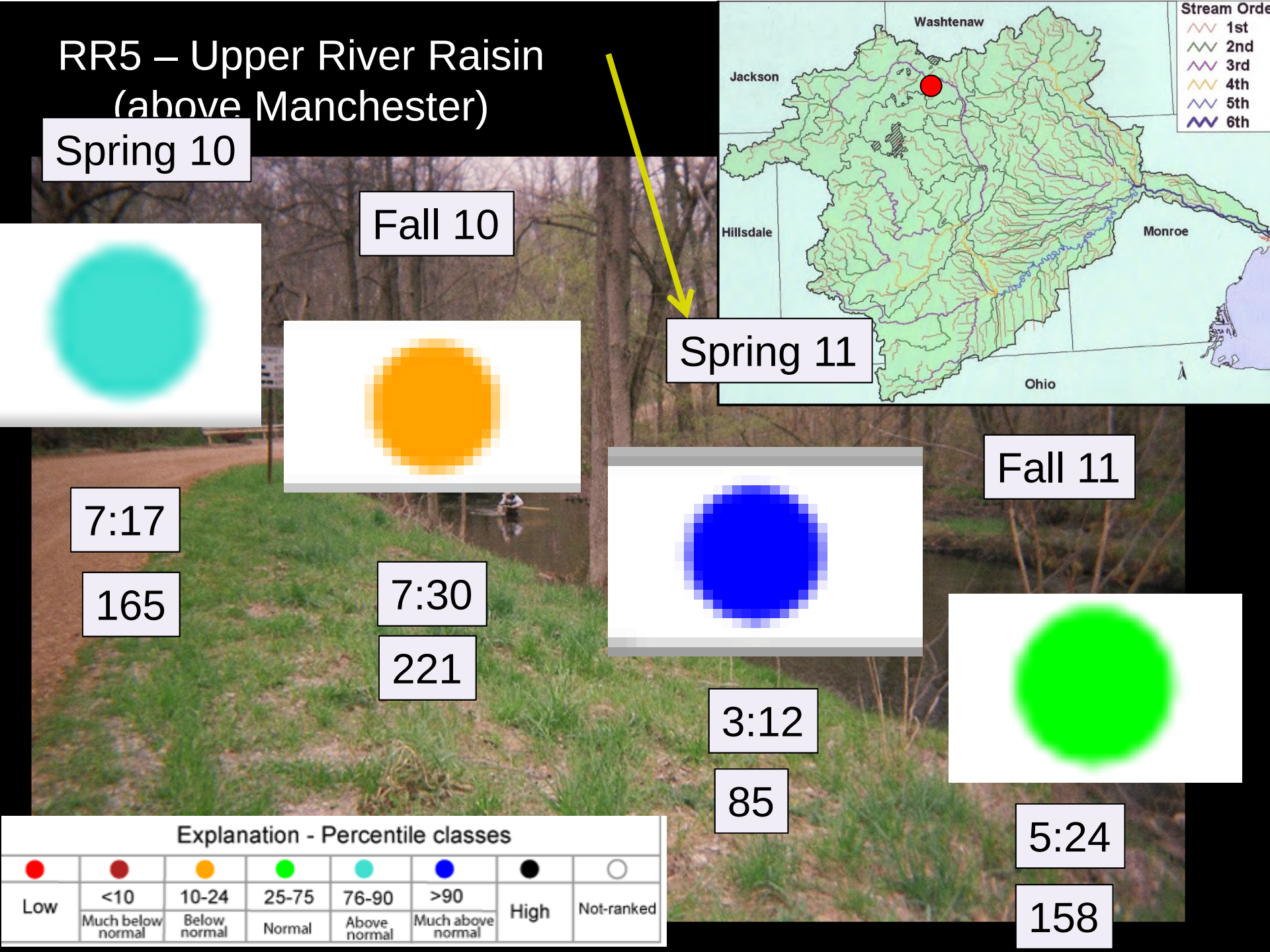
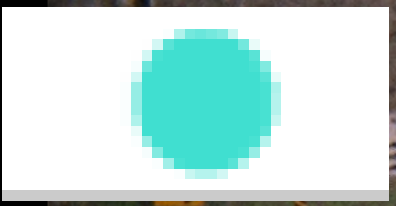
RR5 – Upper River Raisin (above Manchester)

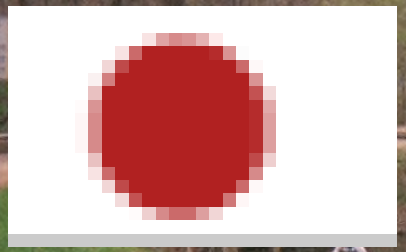


RR5 – Upper River Raisin (above Manchester)

Spring 12

Fall 12



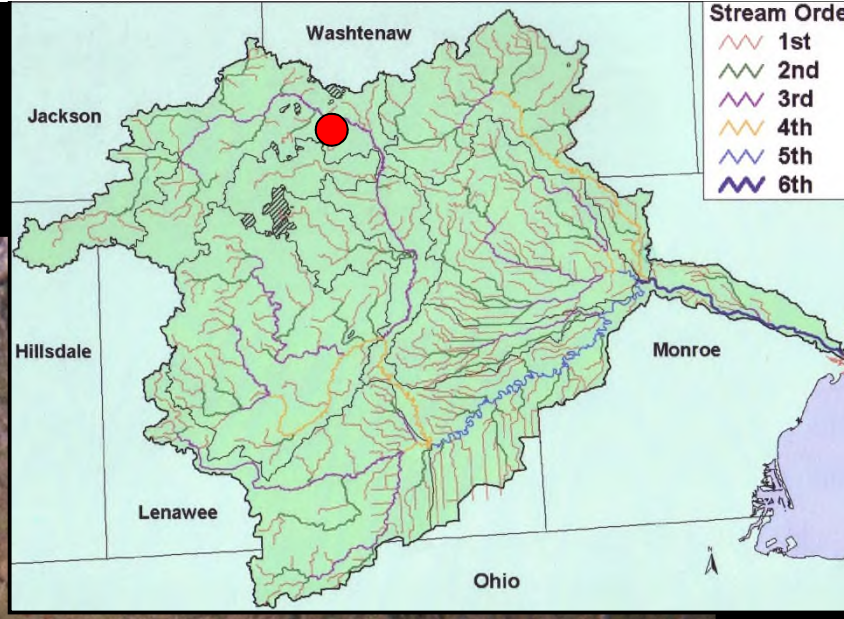


11:24

226

6:24

160



Explanation - Percentile classes

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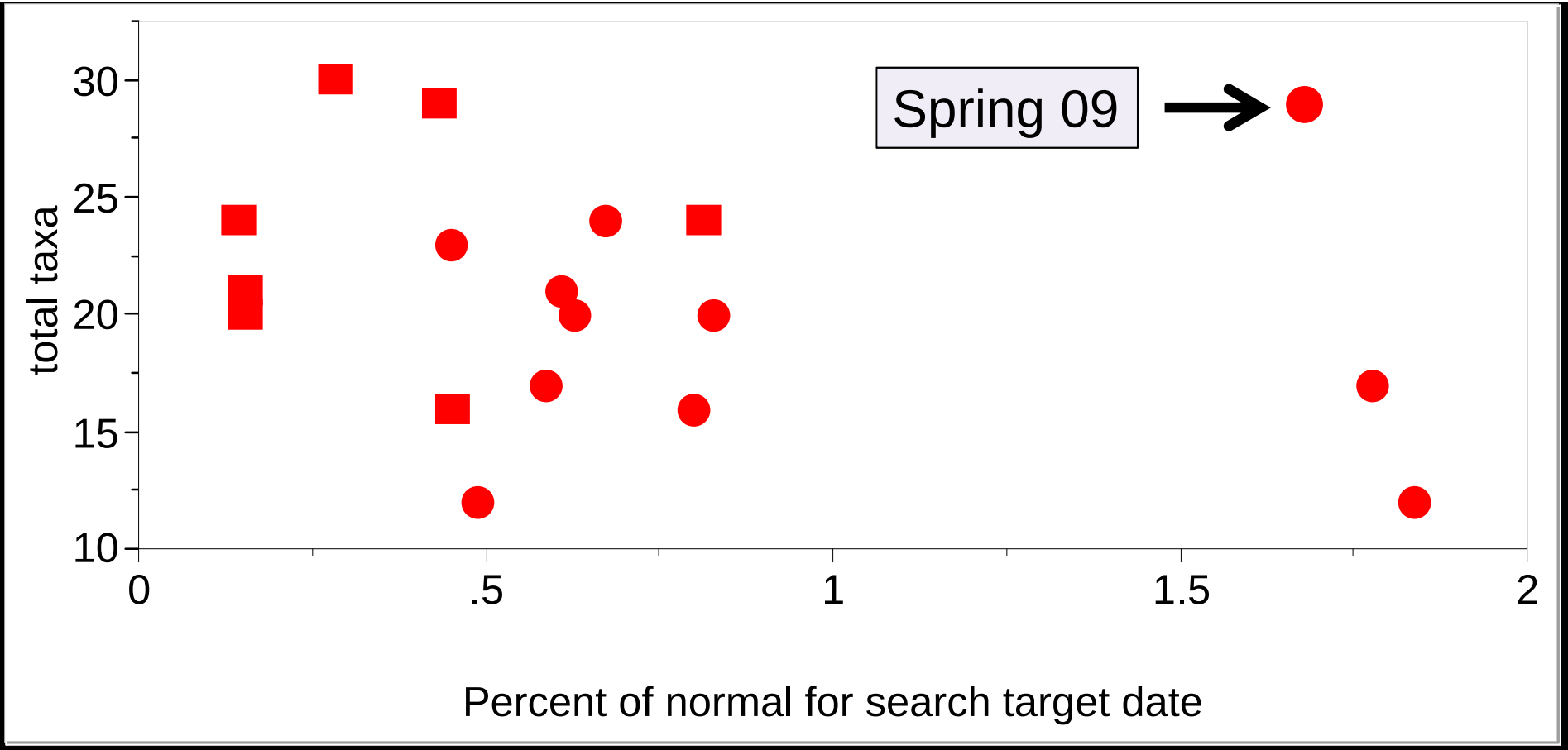
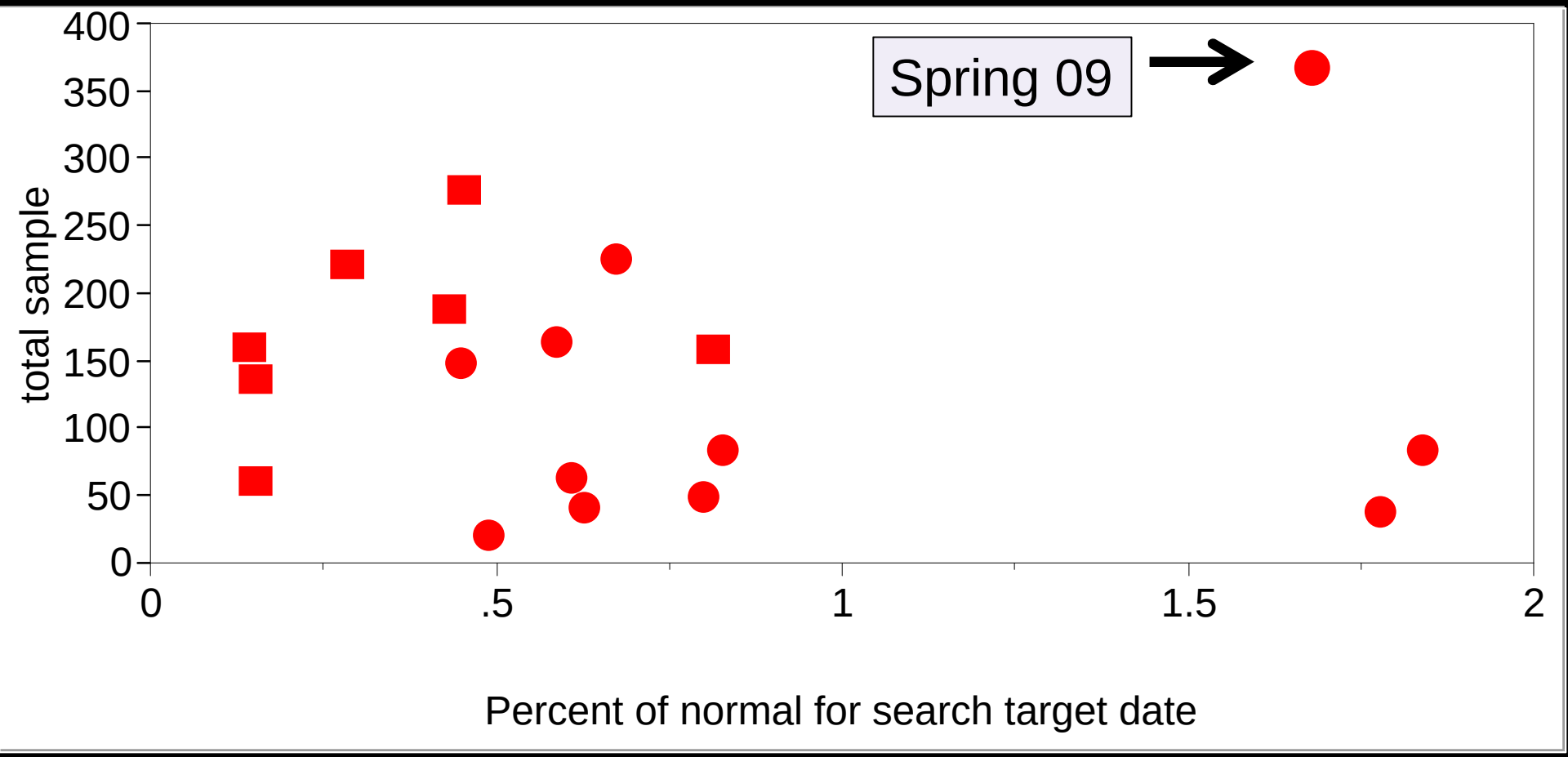


RR5 – Upper River Raisin
(above Manchester)

Fall collection

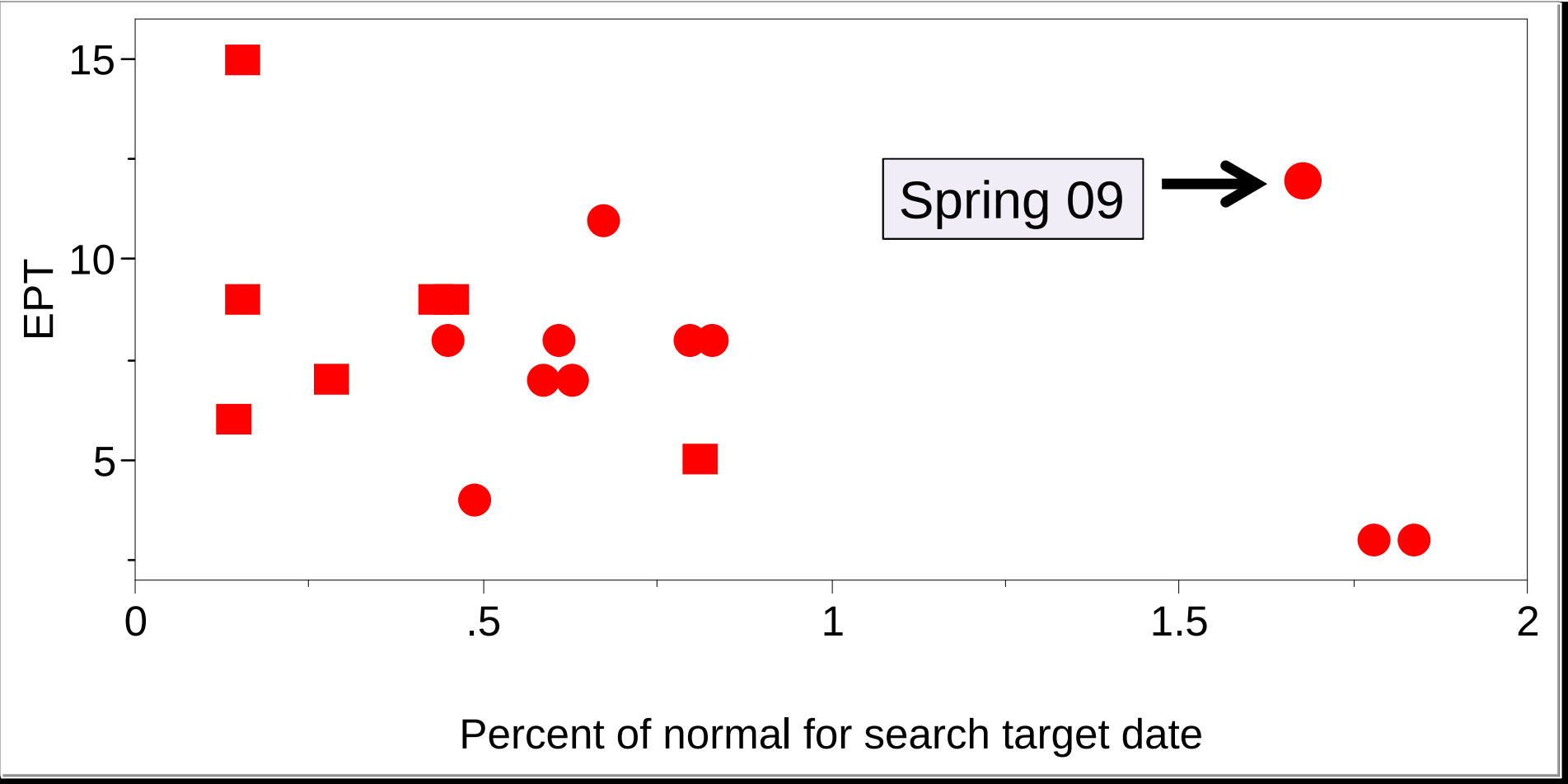
Spring collection



RR5 – Upper River Raisin
(above Manchester)

Fall collection

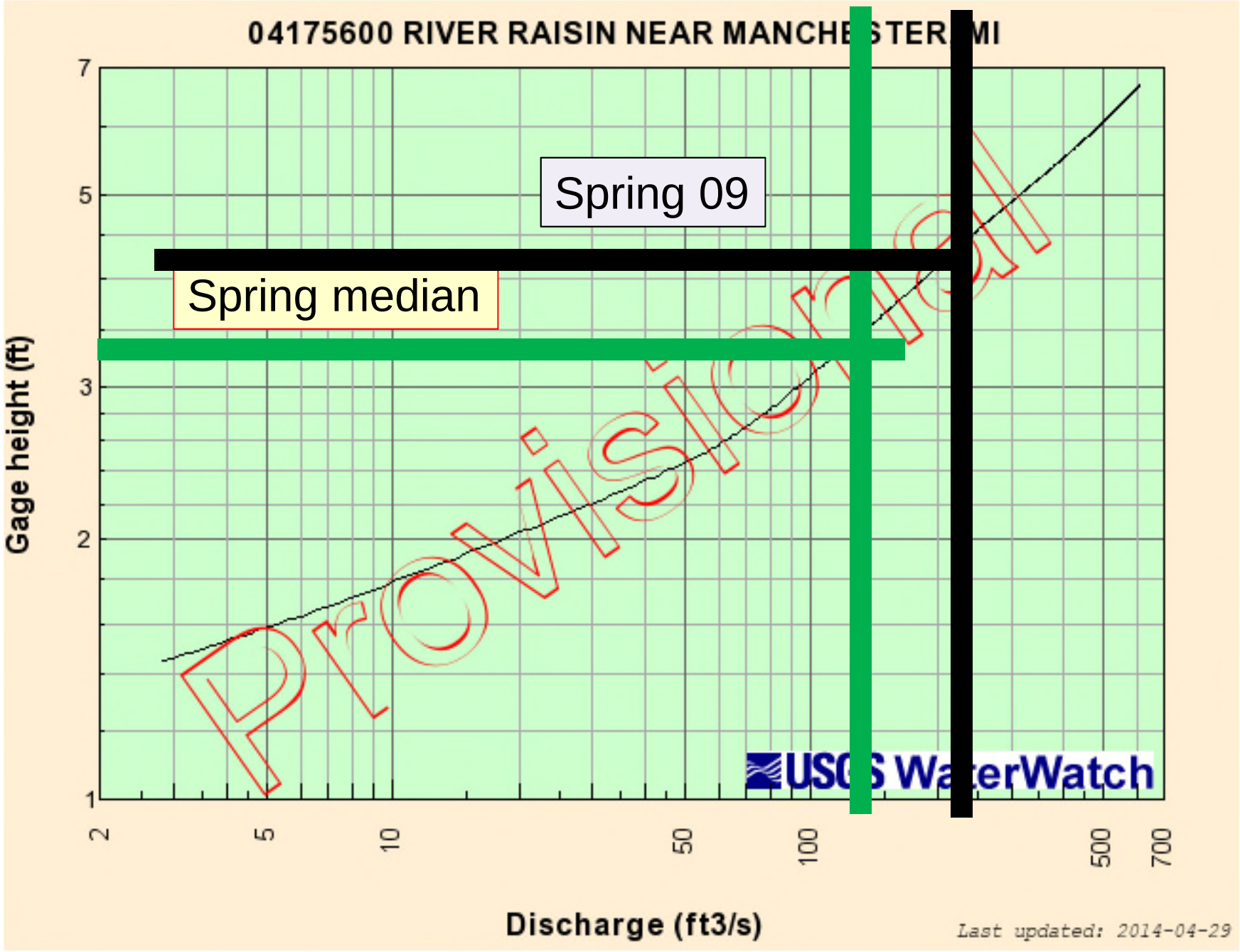
Spring collection

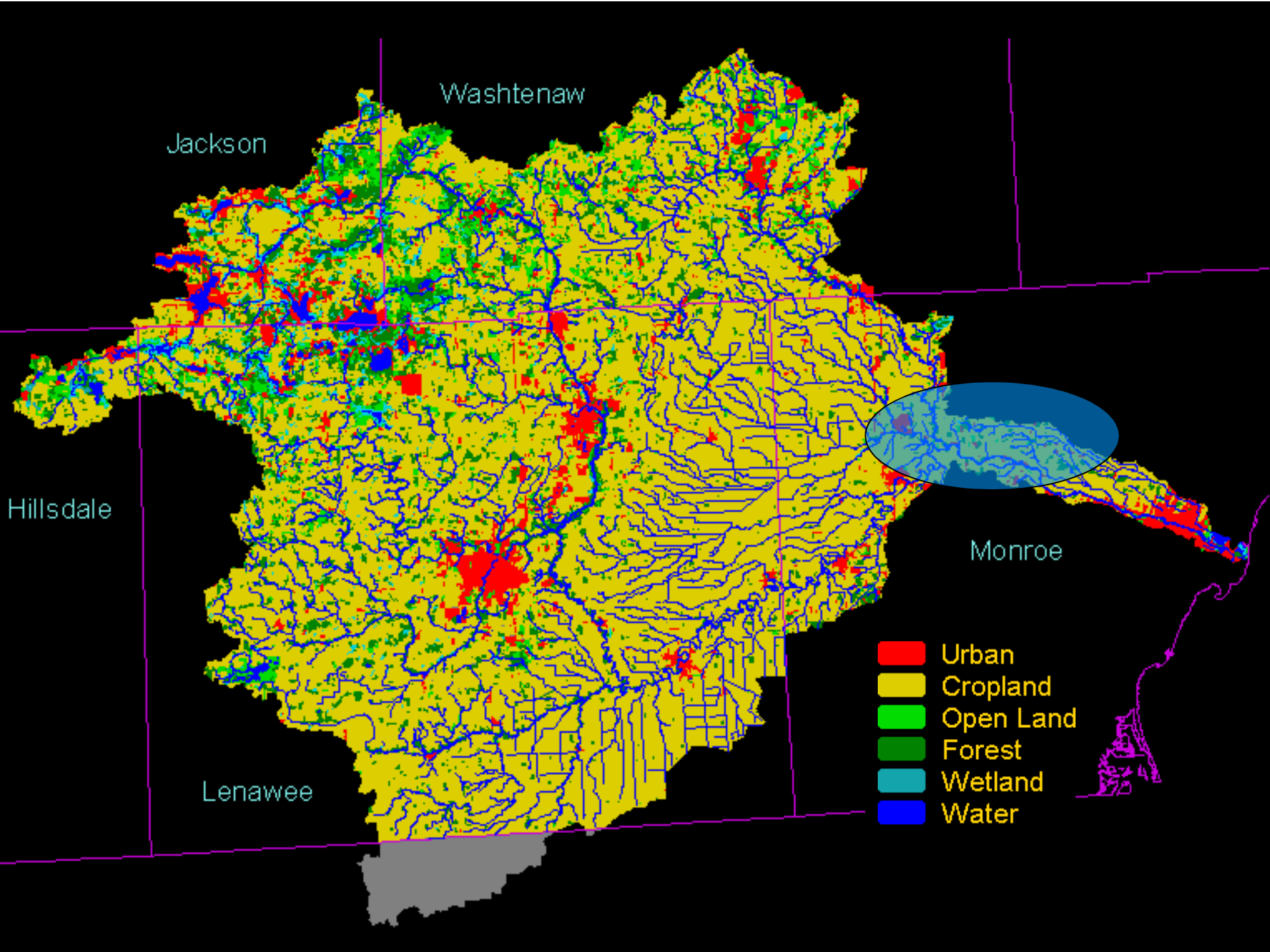


RR5 – Upper River Raisin
(above Manchester)

Fall collection

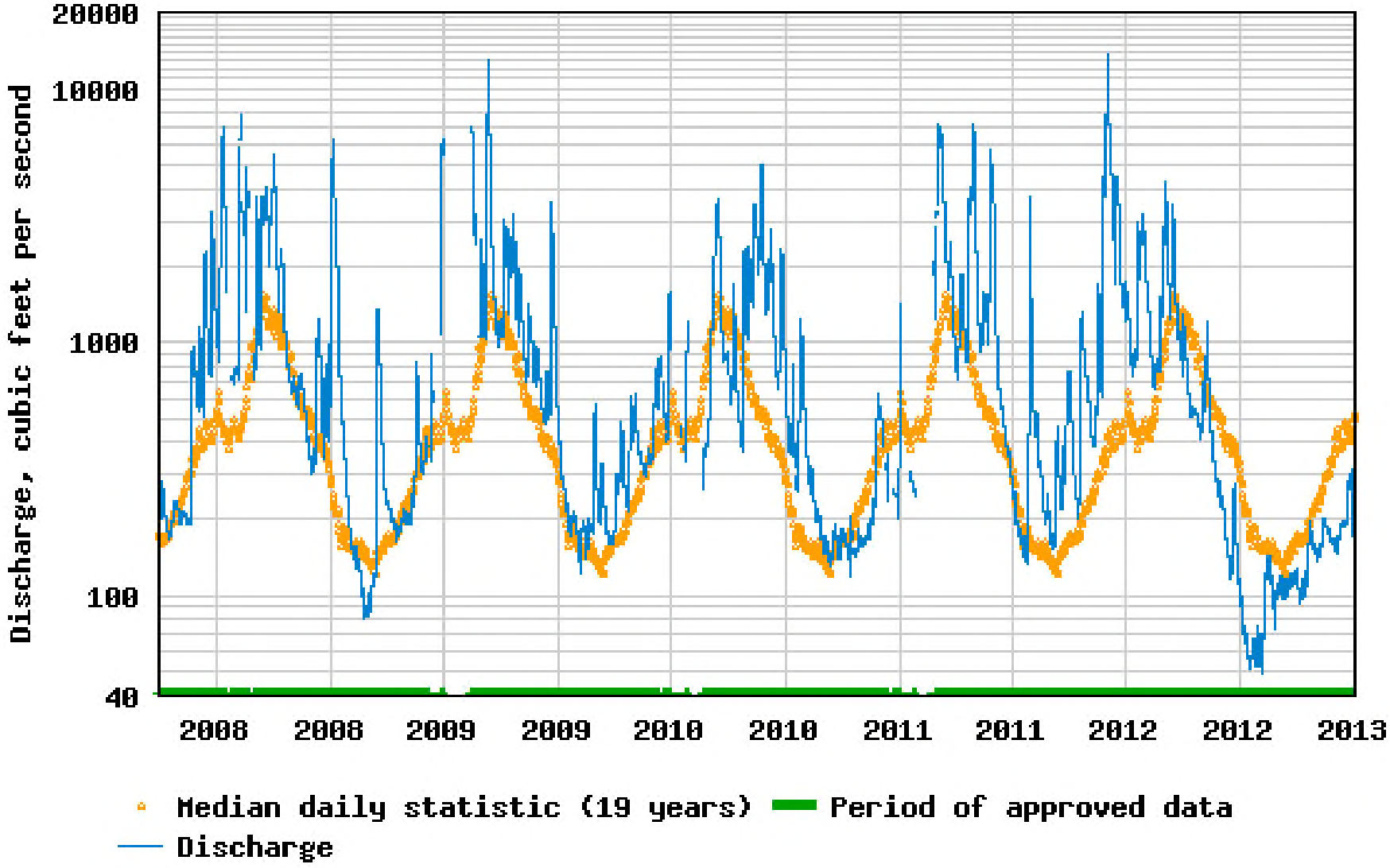
Spring collection

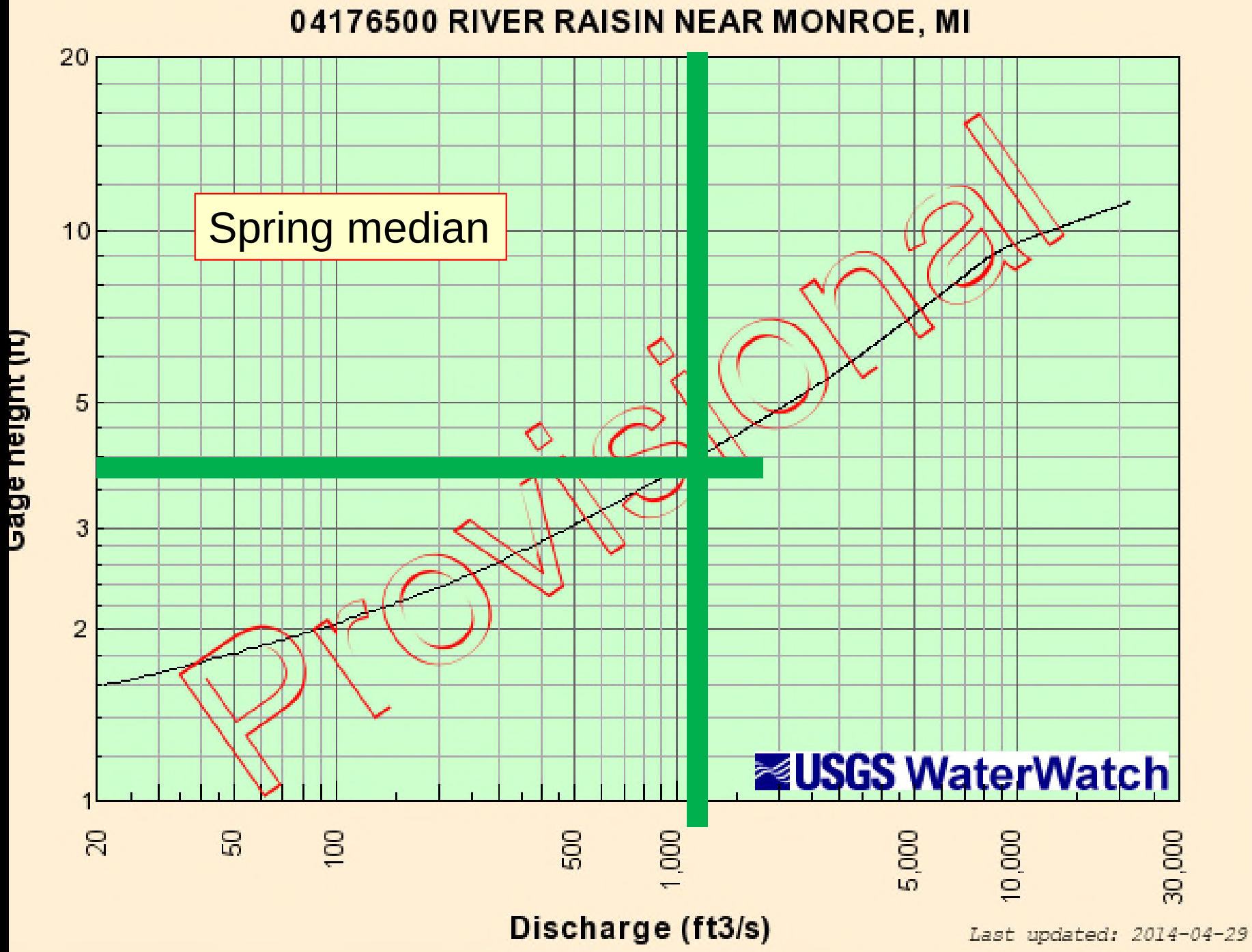

04175600 RIVER RAISIN NEAR MANCHESTER, MI
Spring 09
Spring median
Provisional
USGS WaterWatch
Gage height (ft)
7
5
3
2
1
2
5
10
50
100
500
700
Discharge (ft3/s)
Last updated: 2014-04-29


Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Urban
Cropland
Open Land
Forest
Wetland
Water

USGS

USGS 04176500 RIVER RAISIN NEAR MONROE, MI




04176500 RIVER RAISIN NEAR MONROE, MI
Spring median
Provisional
USGS WaterWatch
Gage height (ft)
20
10
5
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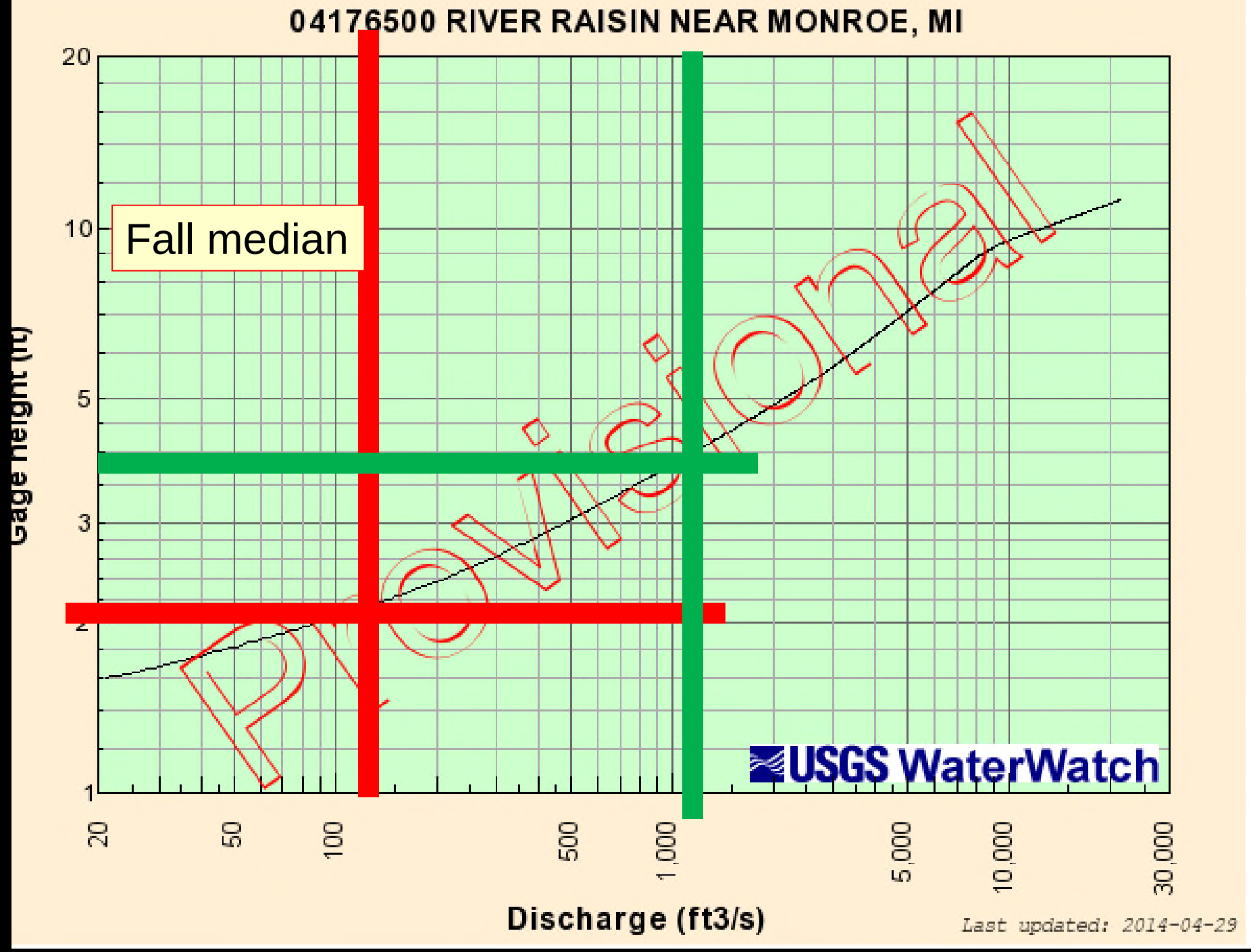
1
20
50
100
500
1,000
5,000
10,000
30,000
Discharge (ft3/s)
Last updated: 2014-04-29


04176500 RIVER RAISIN NEAR MONROE, MI
Fall median
Provisional
USGS WaterWatch
Gage height (ft)
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10
5
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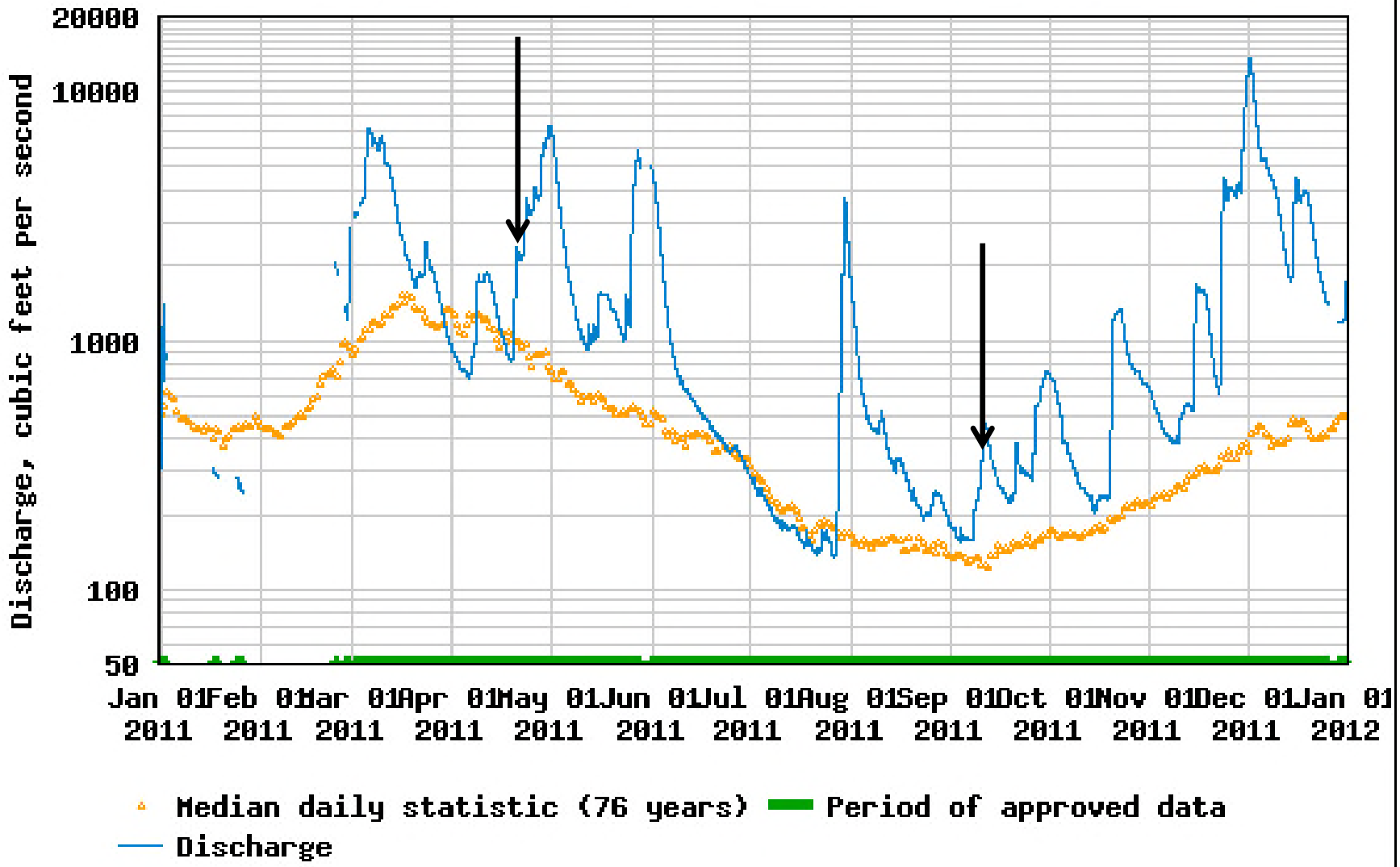
20
50
100
500
1,000
5,000
10,000
30,000
Discharge (ft3/s)
Last updated: 2014-04-29

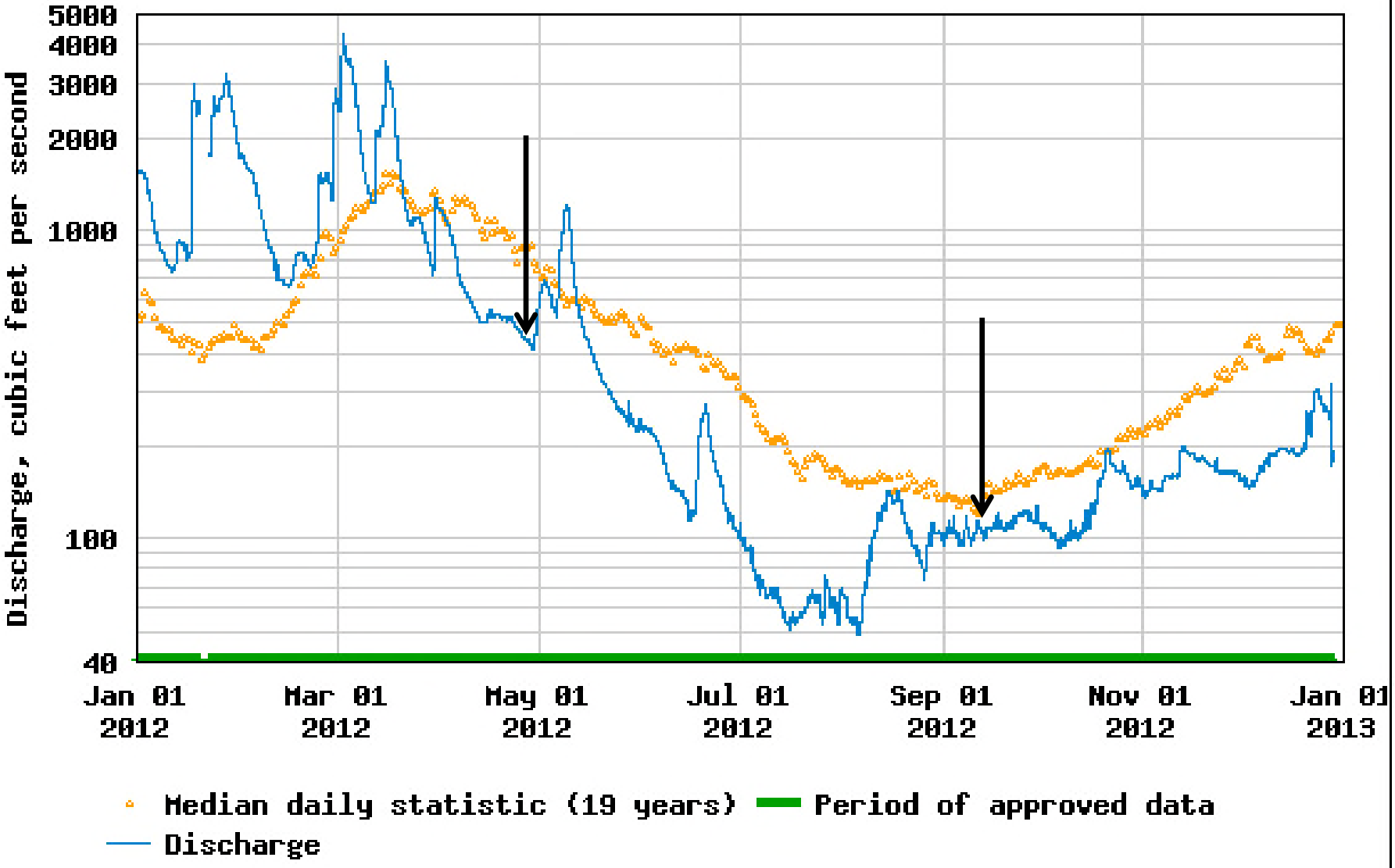
USGS

USGS 04176500 RIVER RAISIN NEAR MONROE, MI



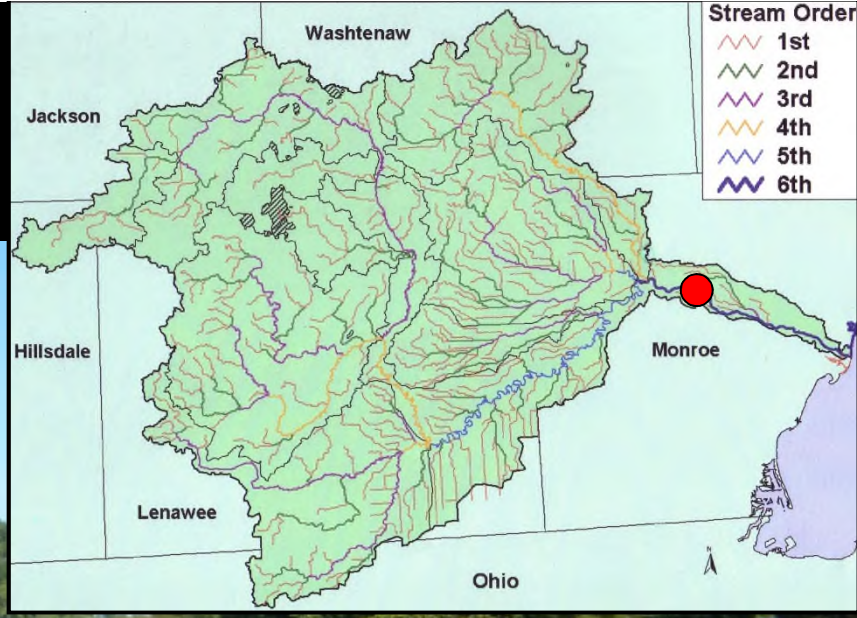
USGS

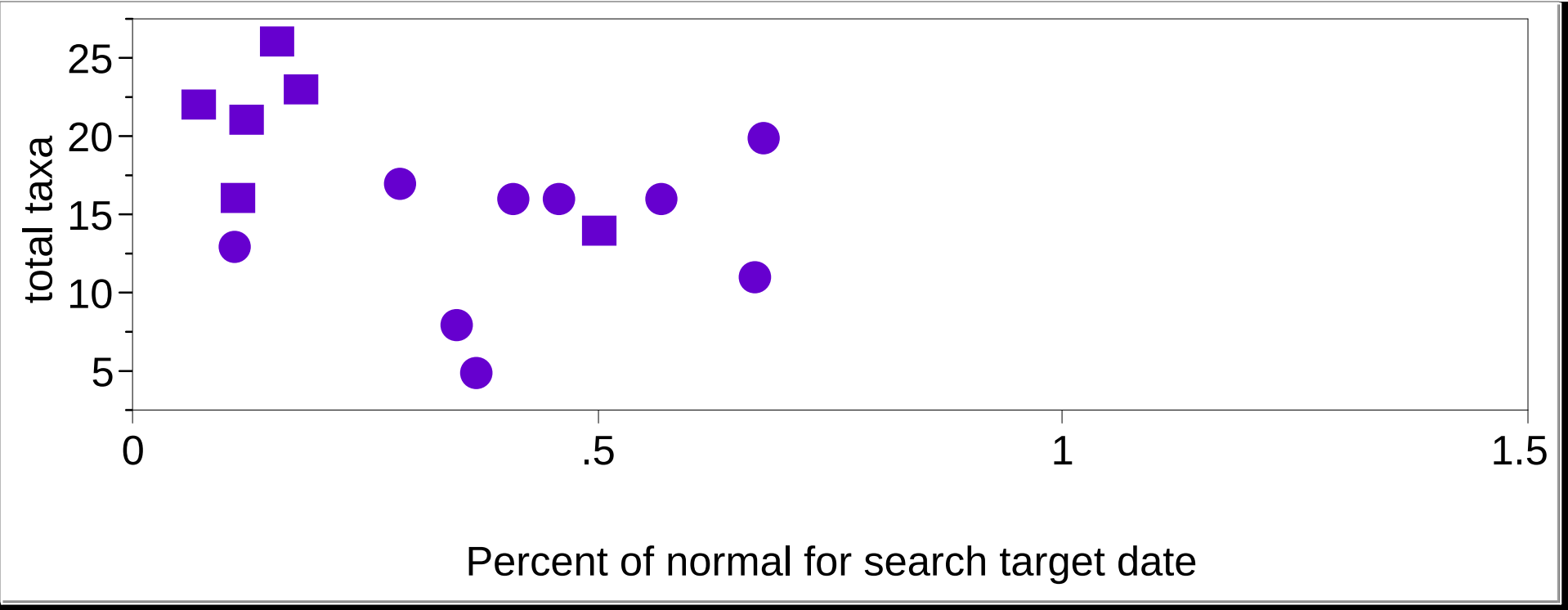
USGS 04176500 RIVER RAISIN NEAR MONROE, MI



RR2 – Lower River Raisin
(Ida-Maybe Road)

RR2 – Lower River Raisin (Ida-Maybe Road)



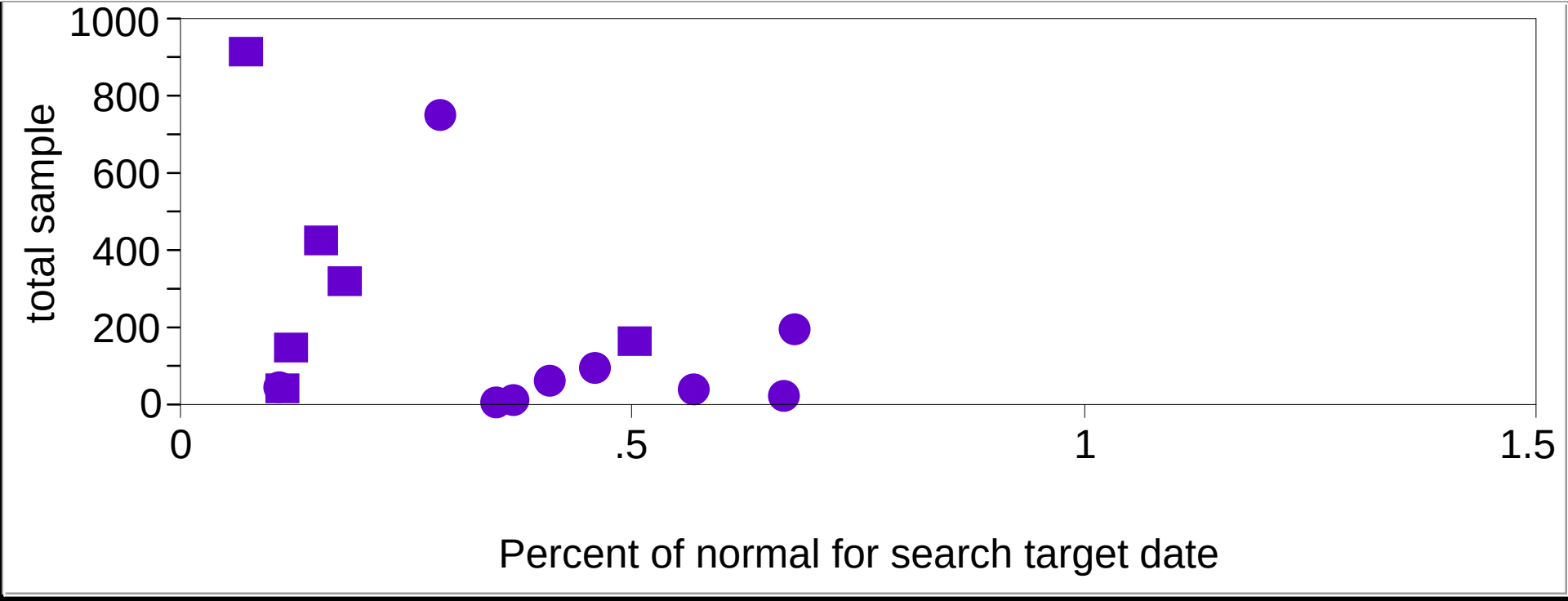


RR2 – Lower River Raisin
(Ida-Maybe Road)

Trend for more taxa in fall

Fall collection

Spring collection

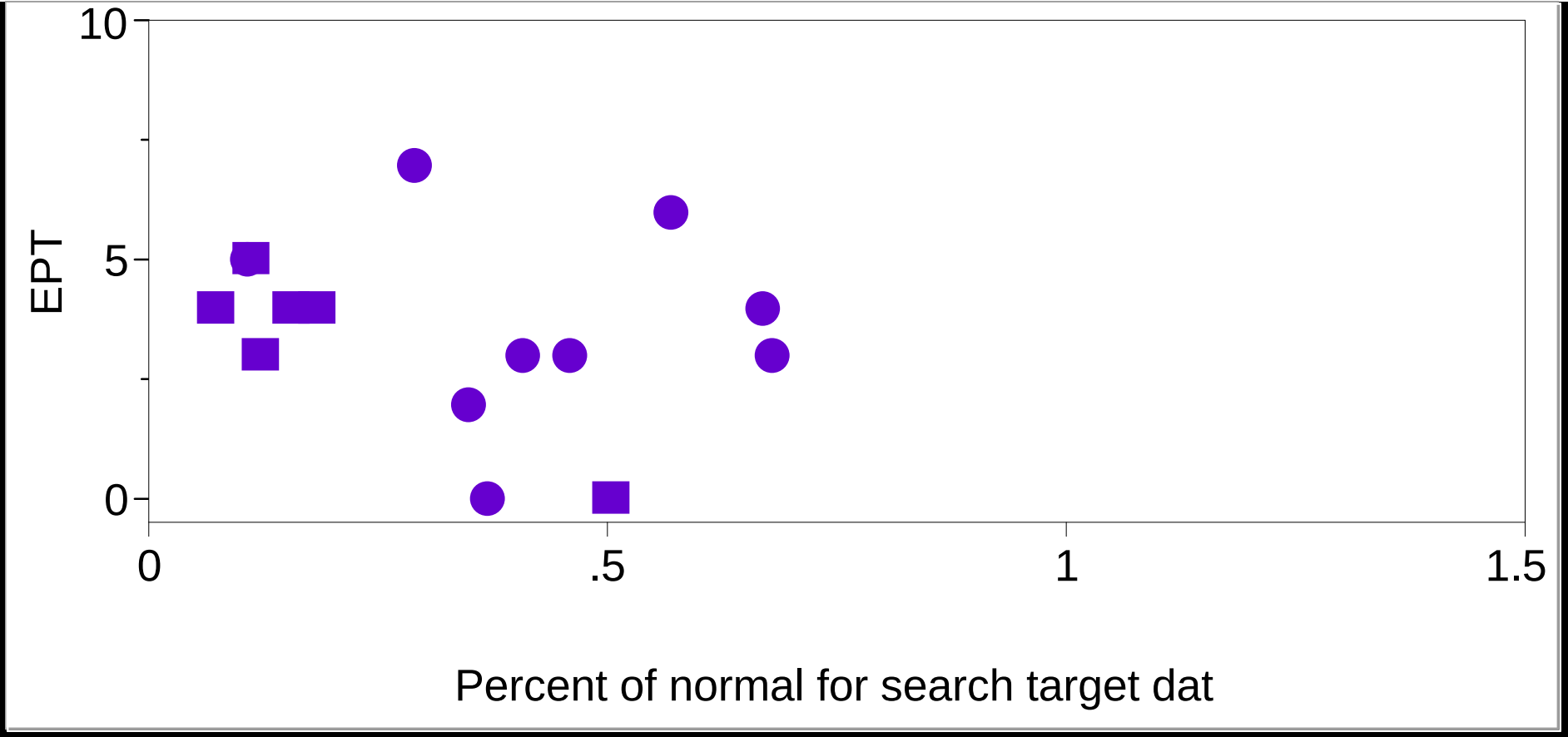


RR2 – Lower River Raisin
(Ida-Maybe Road)

Recently, larger sample size in fall
Usually significantly shallower in fall

Fall collection

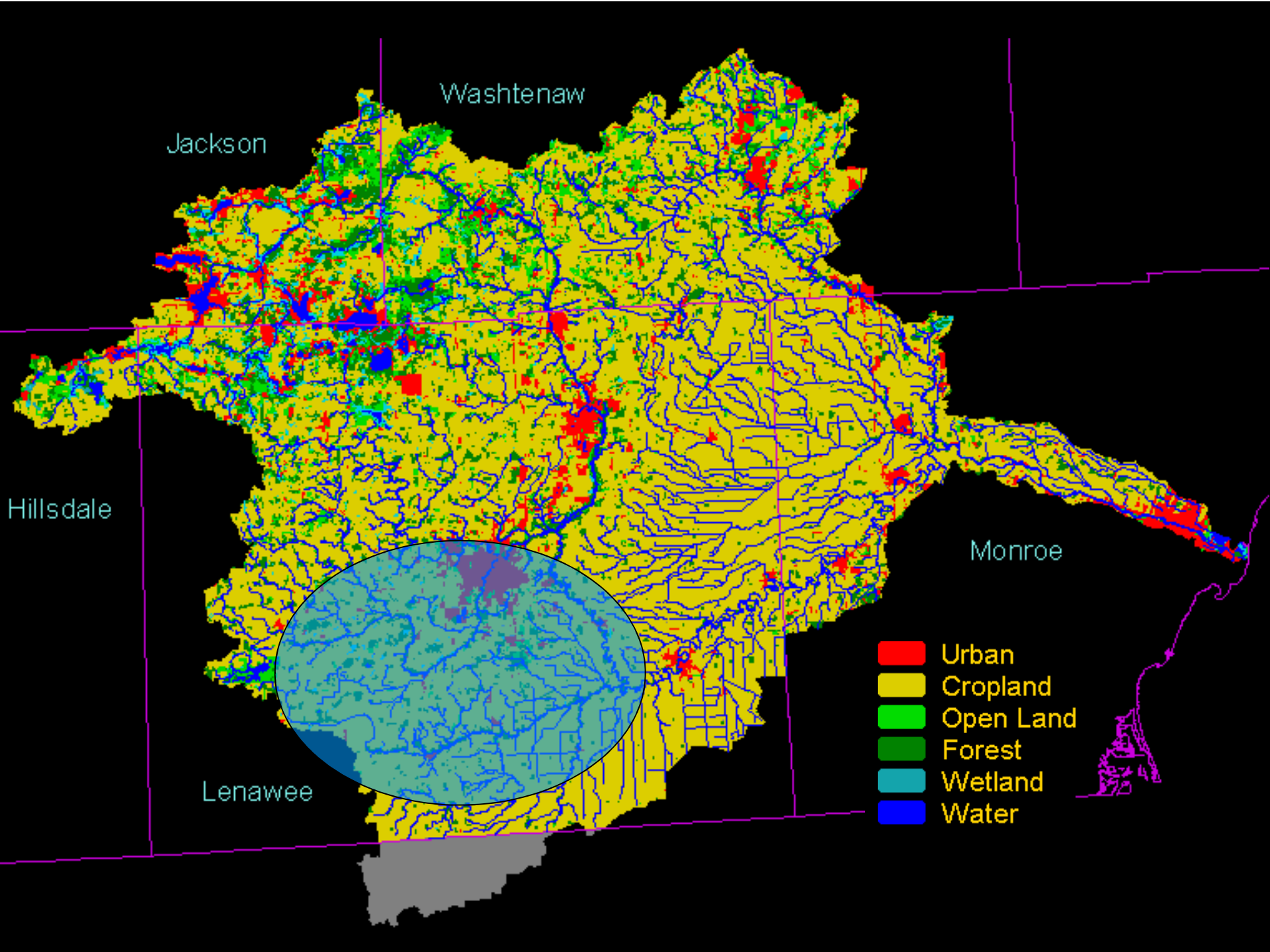
Spring collection



RR2 – Lower River Raisin
(Ida-Maybe Road)

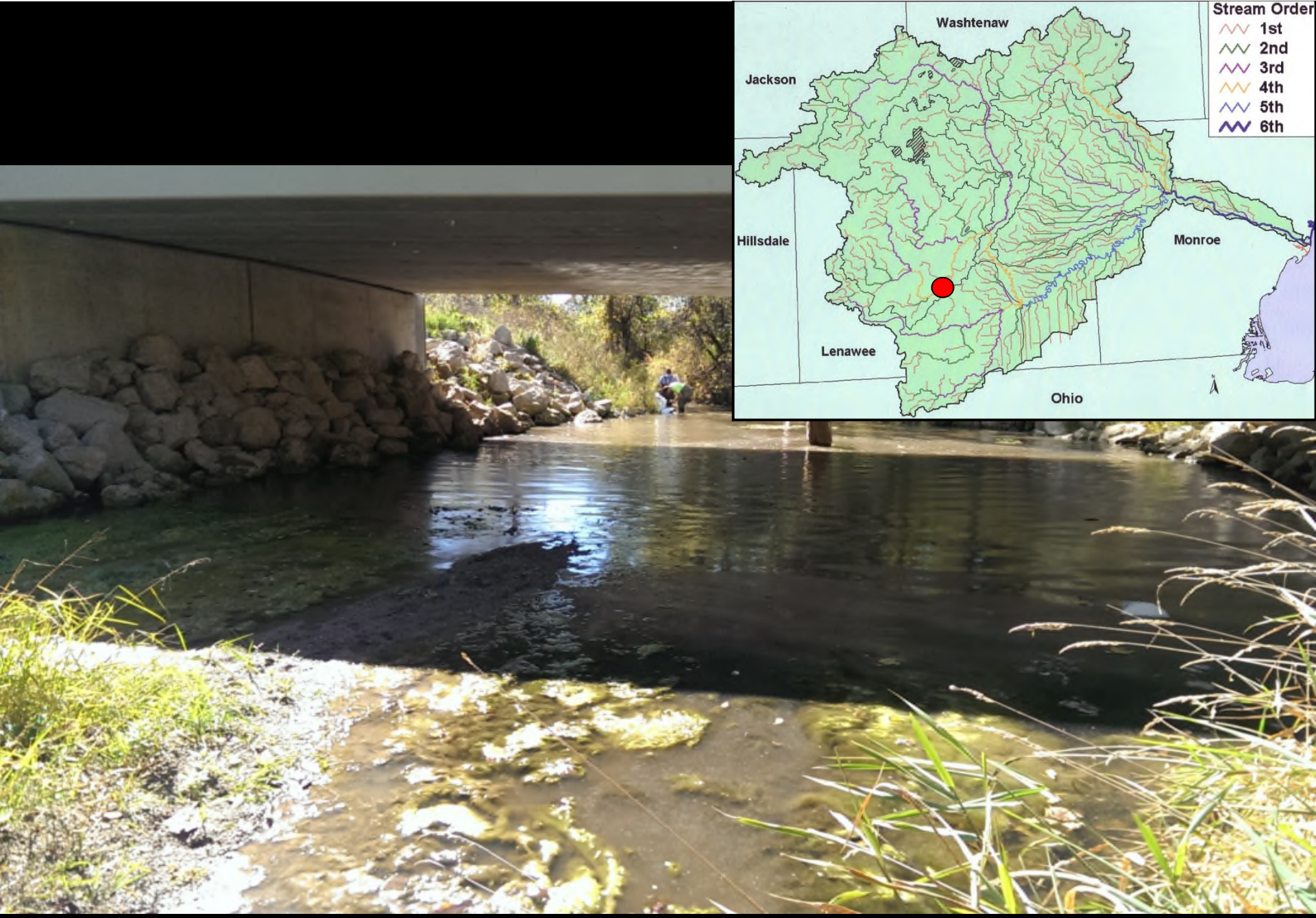
Fall collection

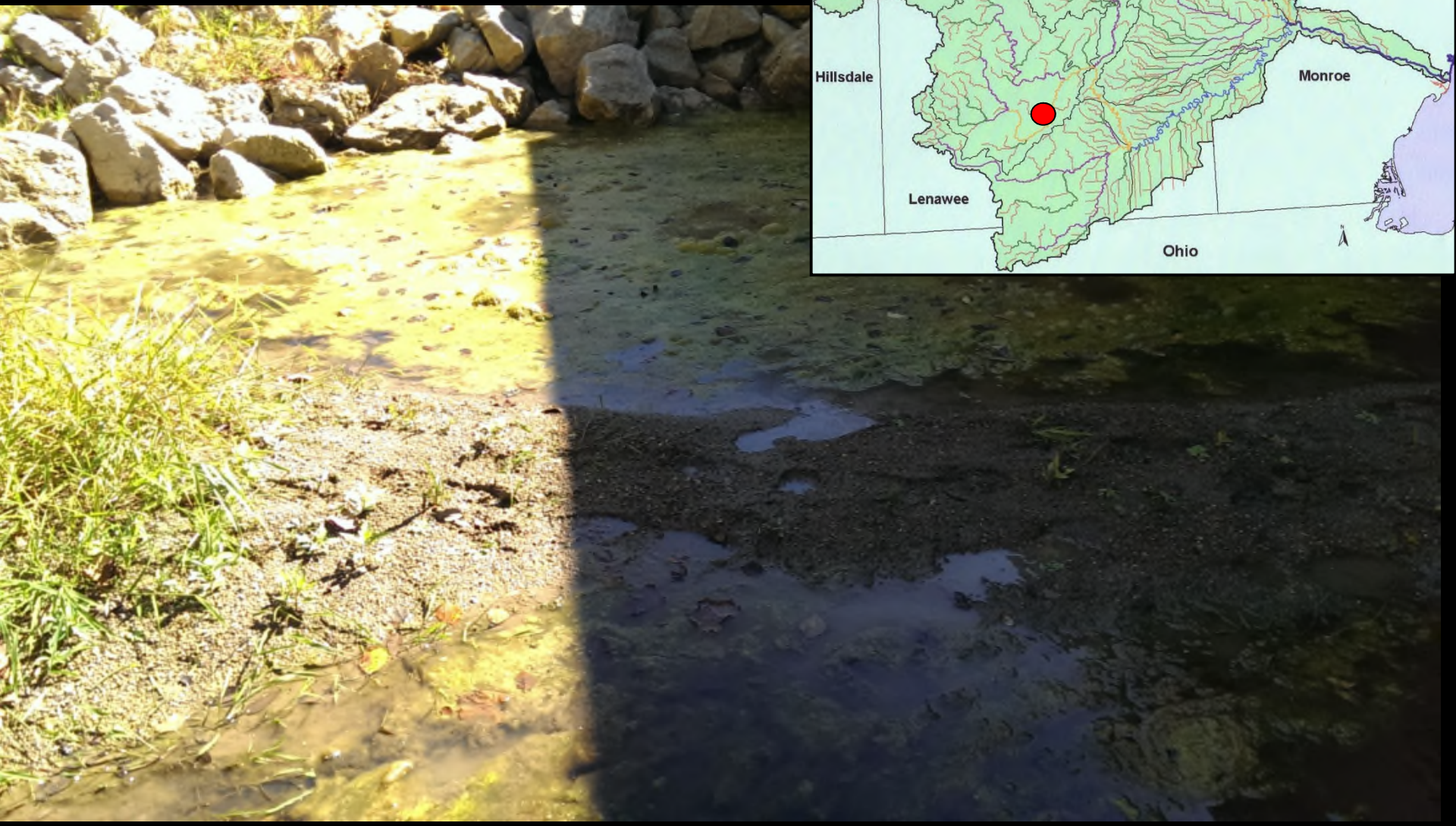
Spring collection

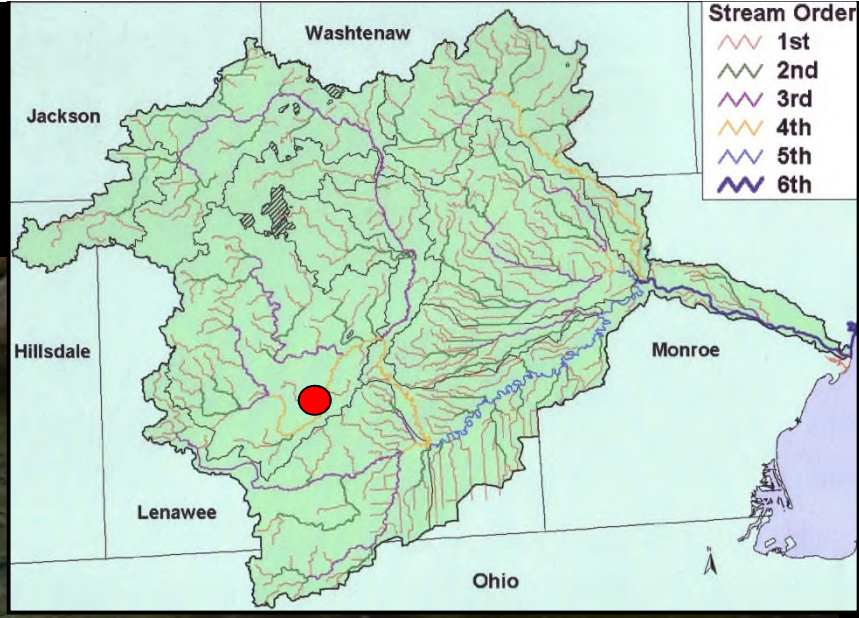

Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Urban
Cropland
Open Land
Forest
Wetland
Water

SBR2 – South Branch River Raisin (above Adrian)

Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Ohio
Stream Order
1st
2nd
3rd
4th
5th
6th


Washtenaw
Jackson
Hillsdale
Monroe
Lenawee
Ohio
Stream Order
1st
2nd
3rd
4th
5th
6th




Washtenaw
Jackson
Hillsdale
Lenawee
Monroe
Ohio
Stream Order
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3rd
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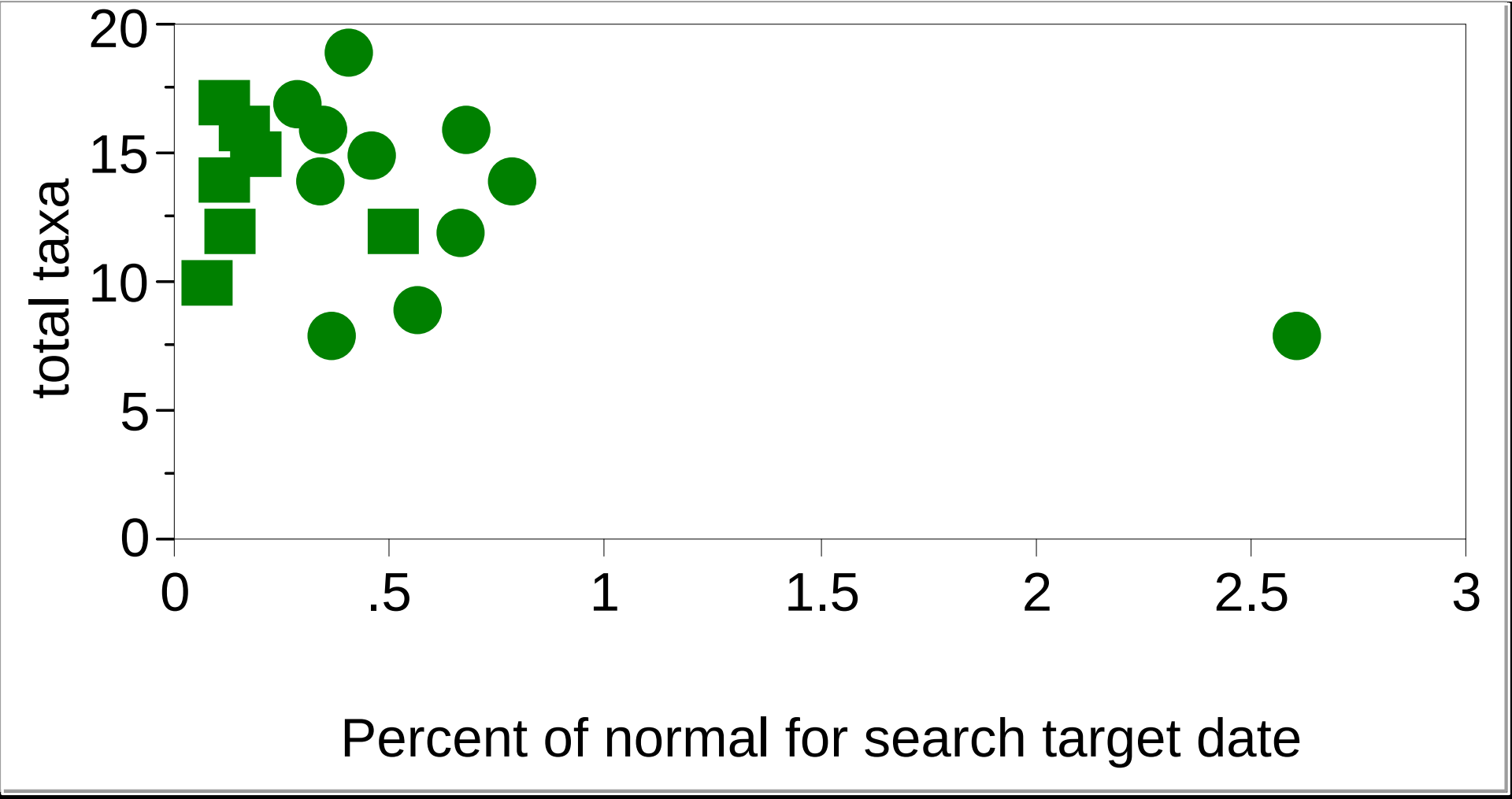
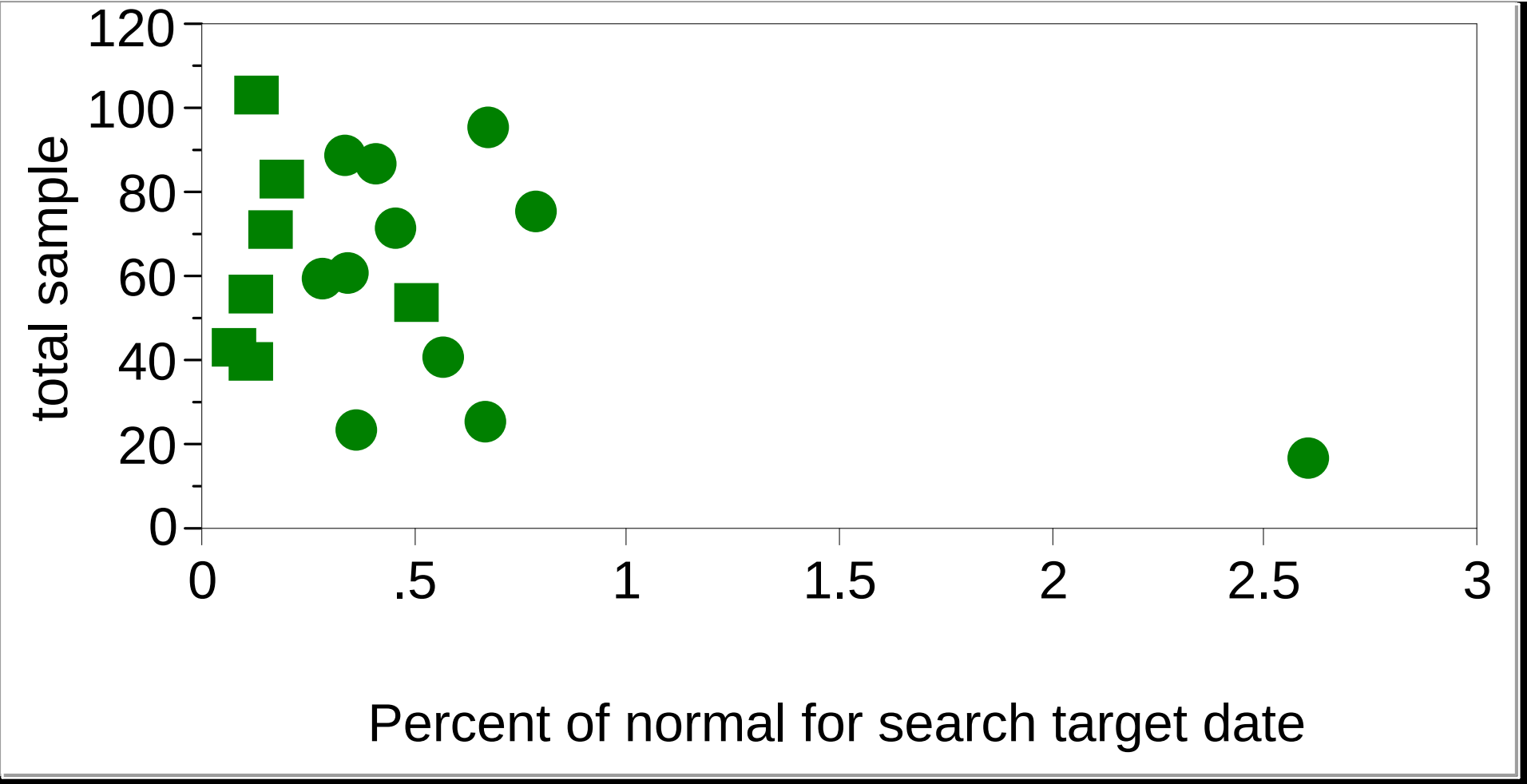
5th
6th



SBR2 – South Branch River Raisin
(above Adrian)

Fall collection

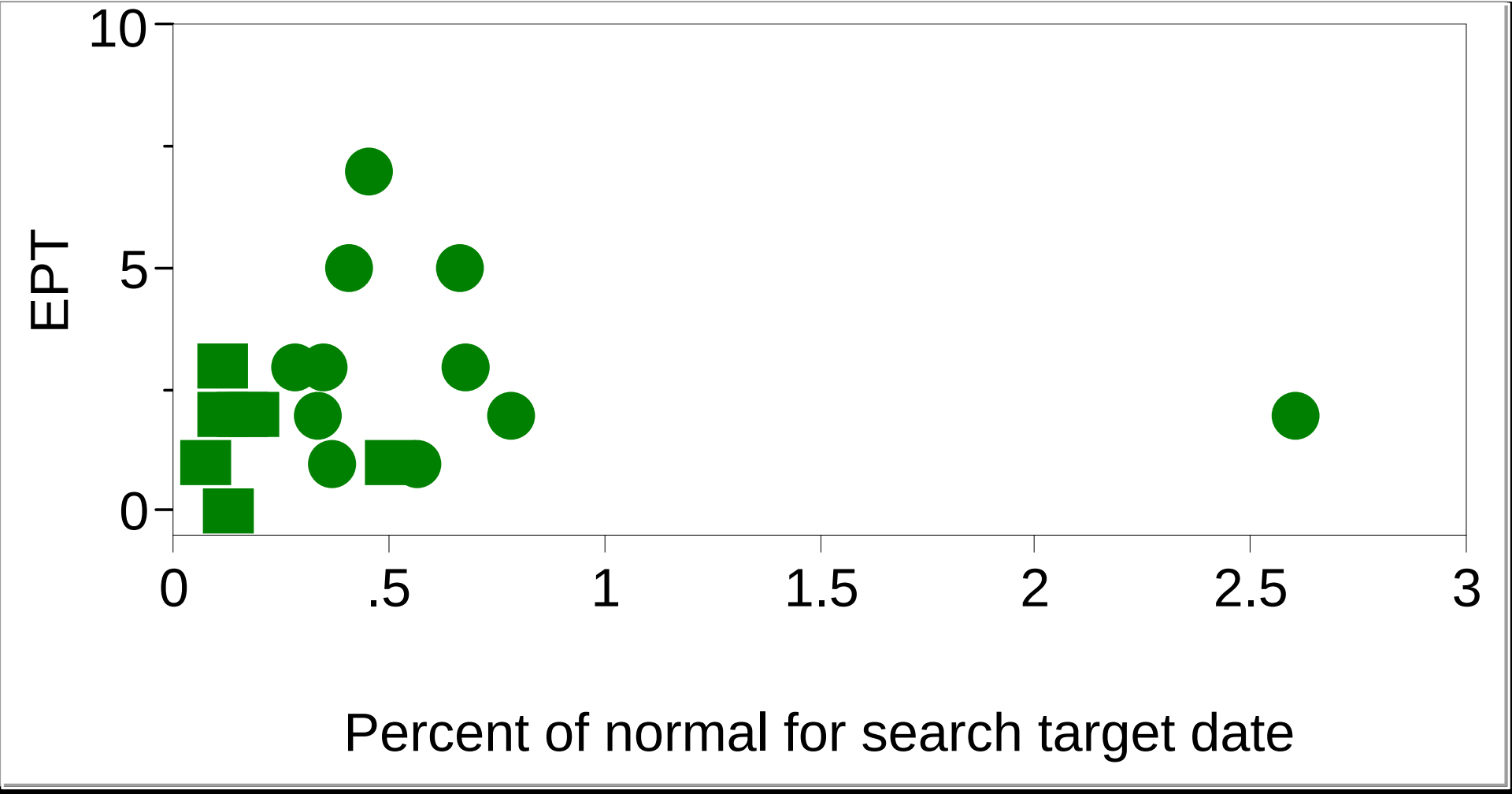
Spring collection



SBR2 – South Branch River Raisin
(above Adrian)

Fall collection

Spring collection



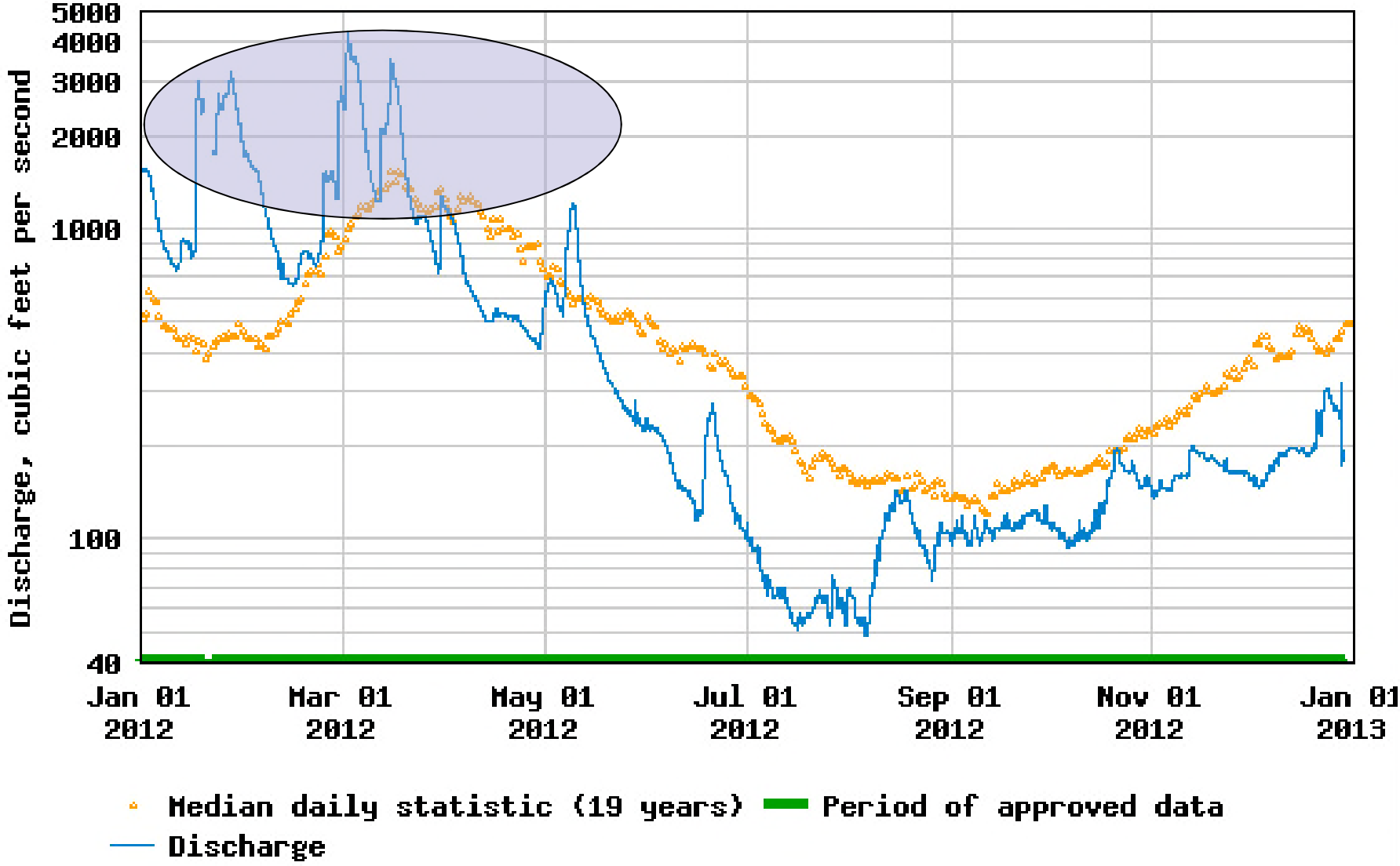
SBR2 – South Branch River Raisin
(above Adrian)

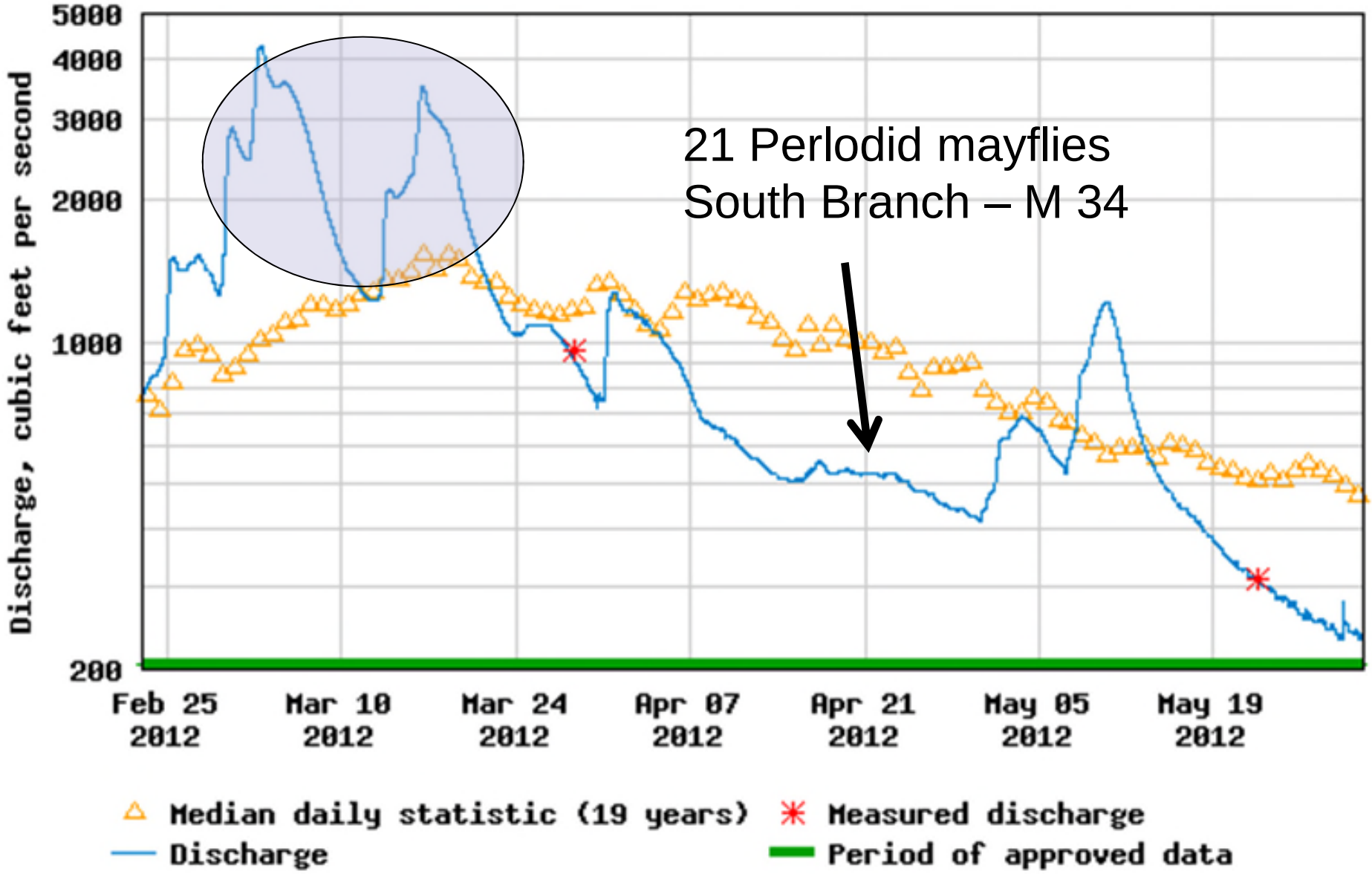
Fall collection

Spring collection

USGS

USGS 04176500 RIVER RAISIN NEAR MONROE, MI




21 Perlodid mayflies
South Branch – M 34
Discharge, cubic feet per second
5000
4000
3000
2000
1000
200
Feb 25 2012
Mar 10 2012
Mar 24 2012
Apr 07 2012
Apr 21 2012
May 05 2012
May 19 2012
Median daily statistic (19 years)
Measured discharge
Discharge
Period of approved data

Lenawee
ba Hoff Dairy
Raymond and St
teline Farm (swine)
Image © 2008 D
20.9 km
Bruinsma Dairy
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BIOLOGICAL SURVEY OF THE RAISIN RIVER AT ADRIAN
February 9, 1955

Bottom samples were collected with a stream square foot bottom sampler in the South Branch of the Raisin River above and below Adrian; in the North Branch of the Raisin River at Comfort Road below Tecumseh; and in the Raisin River below the junction of the two branches. The results of the sampling are given in Table I.

Highway M-34 crosses the South Branch of the Raisin River before it is polluted with industrial wastes and domestic sewage (or sewage plant effluents) originating in Adrian. A bottom sample was collected below the M-34 bridge in moss-covered rubble and coarse gravel in a shallow riffle. In collecting the sample, it was obvious that the clean-water groups of fish food animals were well represented.

latworms		
Dugesia	C	
quatic Earthworms		
Limnodrilus	P	
Tubifex	P	
Peloscolex	P	
Dero	P	
Stylaria	F	
ollusca(Clams and Snails)		
Sphaerium	P	
Pisidium	P	
rustacea(shrimp&crayfish)		
Cambarus sp.	C	
Hyalella azteca	C	
ayflies (nymphs)		
Stenonema fuscum	C	
Stenonema sp.	C	
Stenonema heterotarsale	C	
Caenis	C	
toneflies(nymphs)		
Taeniopteryx maura	C	
Brachyptera fasciata	C	
addisflies (larvae)		
Hydropsychidae larvae	C	
Hydropsyche bifida	C	
Hydropsyche sp.	C	
Cheumatopsyche sp.	C	
rlflies (larvae)		
Sialis infumata	C	
obsonflies (larvae)		
Corydalus cornutus	C	
iptera:(Midgeflies,Blackflies,etc. larvae)		
Calopsectra dives(midge)	F	
Pentaneura flavifrons(midge)	C	
Cricotopus bicinctus(midge)	F	
Tanytarsus jucundus(midge)	C	
Microtendipes pedellus(midge)	C	
Glyptotendipes senilis(midge)	C	
Glyptotendipes lobiferus(midge)	P	
Cryptochironomus digitatus(midge)	C	
Tendipes decorus(midge)	P	
Spaniotoma sp. (midge)	F	
Palpomyia (punkies)	F	
Simulidae (blackflies)	F	
Atherix(snipeflies)	C	
Limnophora sp.(anthomyiids)	C	
Eriocera(push ring larvae)	F	
Atocha (cranefly)	C	
etles		
Stenelmis larvae	C	
Parnid beetles	C	
Berosus larvae	C	
Helichus larvae	C	

otal number of animals per square foot
ercent pollutional
ercent facultative

ayflies (nymphs)		
Stenonema fuscum	C	5
Stenonema sp.	C	5
Stenonema heterotarsale	C	1
Caenis	C	- -
toneflies(nymphs)		
Taeniopteryx maura	C	6
Brachyptera fasciata	C	8
addisflies (larvae)		
Hydropsychidae larvae	C	81*
Hydropsyche bifida	C	3+
Hydropsyche sp.	C	4
Cheumatopsyche sp.	C	44+
rlflies (larvae)		
Sialis infumata	C	1
obsonflies (larvae)		
Corydalus cornutus	C	- -
iptera:(Midgeflies,Blackflies,etc. larvae)		
Calopsectra dives(midge)	F	12
Pentaneura flavifrons(midge)	C	19
Cricotopus bicinctus(midge)	F	395
Tanytarsus jucundus(midge)	C	27
Microtendipes pedellus(midge)	C	1
Glyptotendipes senilis(midge)	C	1
Glyptotendipes lobiferus(midge)	P	- -
Cryptochironomus digitatus(midge)	C	- -
Tendipes decorus(midge)	P	2
Spaniotoma sp. (midge)	F	3
Palpomyia (punkies)	F	- -
Simulidae (blackflies)	F	88

USGS

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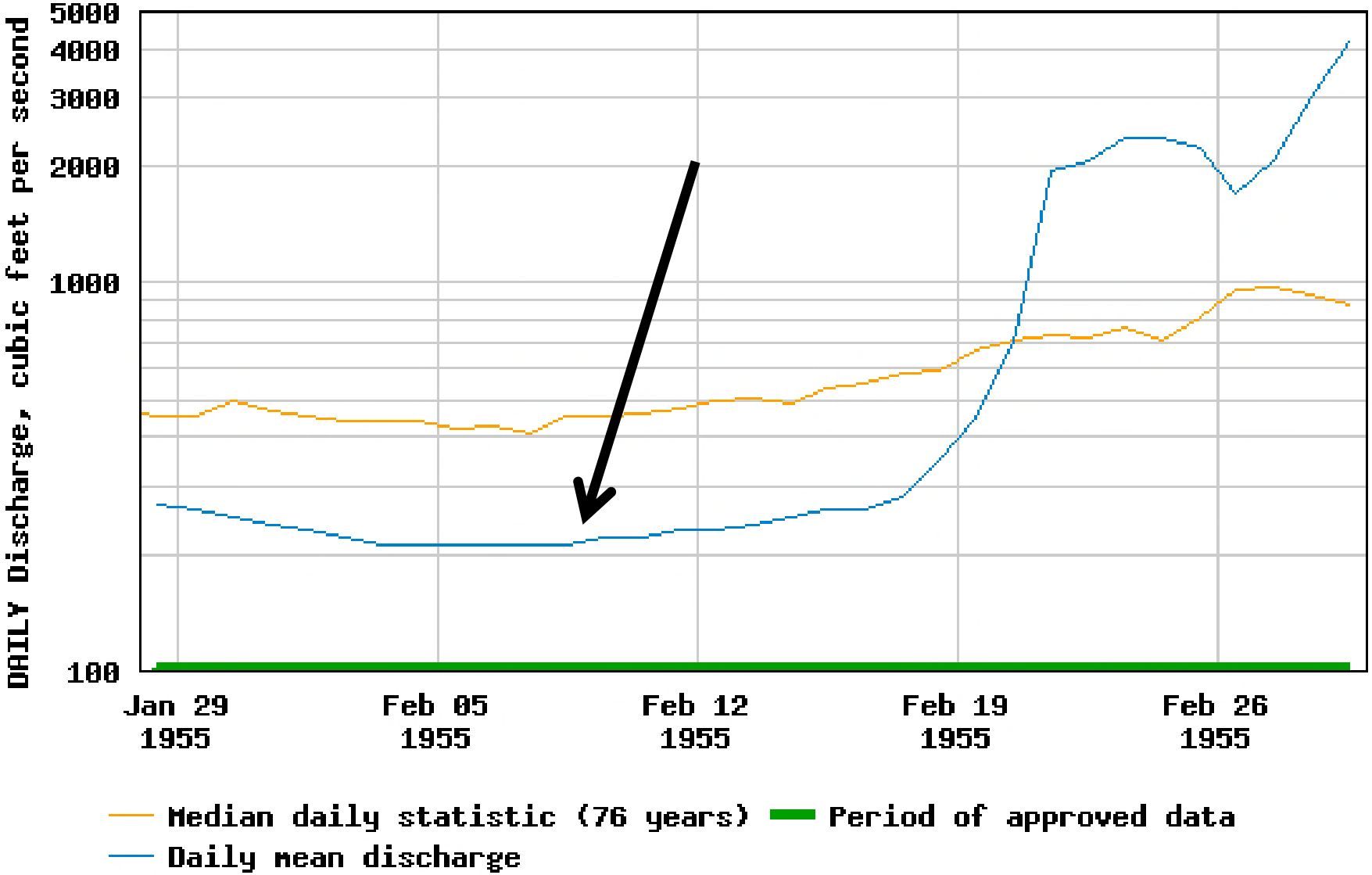
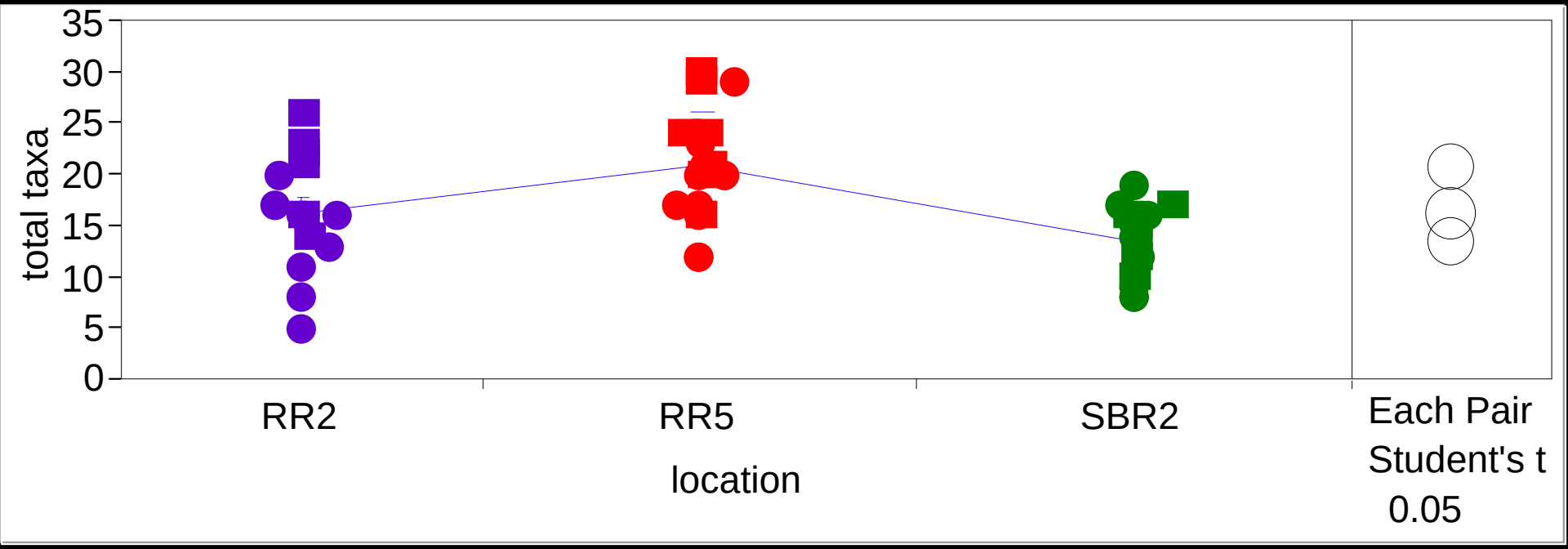


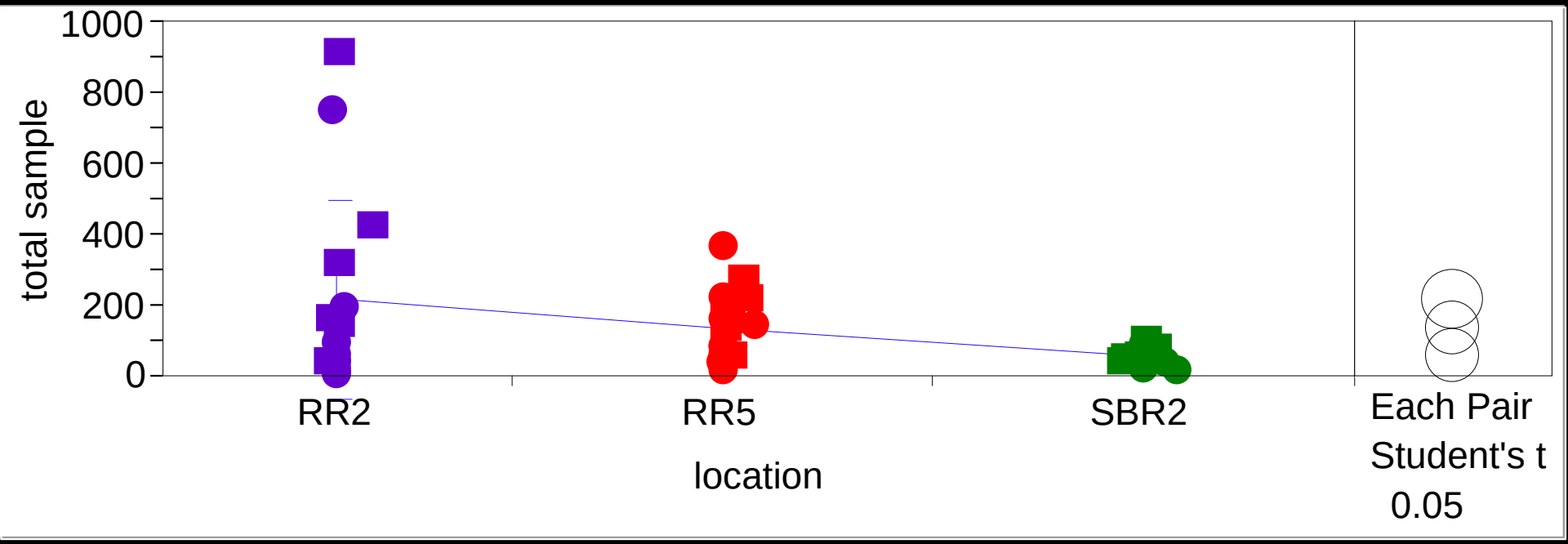
TABLE 2. Results of Water Analyses, South Branch[1] Raisin River in parts per million.

	Buckeye Products				Hurd Lock
Date	2/8/55	2/8/55	2/9/55	2/9/55	2/9/55
Time	9:15 am	1:15 pm	8:40 am	2:45 pm	2:55 pm
Cyanides	7.5	7.0	12.5	11.0	0.03
Copper	8.0	6.6	8.0	5.7	trace
Hexavalent Chromium	4.7	2.4	0.0	2.8	0.09
Zinc	4.0	- -	8.0	- -	- -



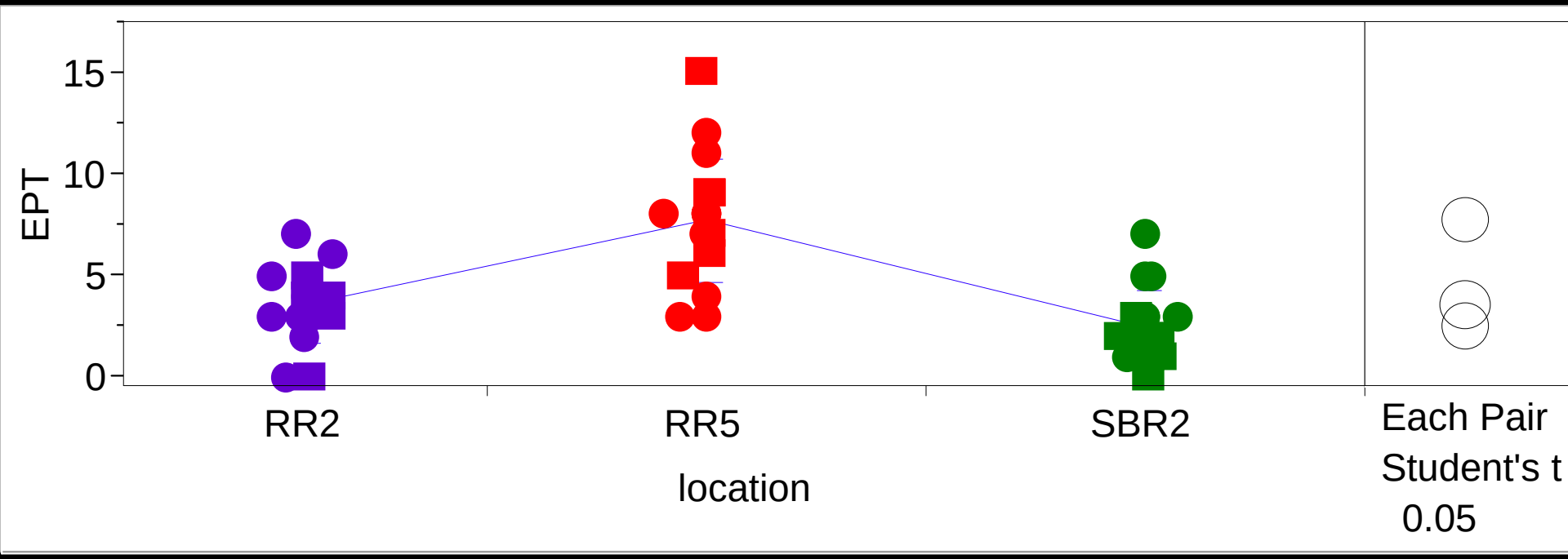
Means and Std Deviations

Level	Number	Mean	Std Dev
RR2	15	16.2667	5.66274
RR5	18	20.8333	5.34955
SBR2	18	13.5556	3.23987



Means and Std Deviations

Level	Number	Mean	Std Dev
RR2	15	217.067	278.493
RR5	18	138.389	93.404
SBR2	18	61.056	25.609



Means and Std Deviations

Level	Number	Mean	Std Dev
RR2	15	3.53333	1.92230
RR5	18	7.72222	3.04487
SBR2	18	2.50000	1.72354

Conclusions

1) **Proficiency of collection**
    1) **Habitat survey – 300’ of stream**
    2) **Number of searchers**
    3) **Training level**
2) **Sample size – All possible habitats searched**
3) **River depth**
    1) **Seasonality**
    2) **Aberrations (the weather)**
4) **Real things**
    1) **Cyanide**
    2) **Nutrients**

Notes

1) Perhaps April is too early to routinely safely monitor this river, particularly downstream

2) SBR2 has some interesting dynamics with surrounding land use interacting with stream flow as evidenced by rare appearances of stoneflies

RR7

The New York Times

Coated With Algae

The satellite images show Lake Erie at two different times in 2011, when the lake suffered the worst algae bloom in decades. The first image shows the lake before the bloom started; the second shows the bloom at its greatest extent, covering much of the lake's western basin. Related Article »

The New York Times

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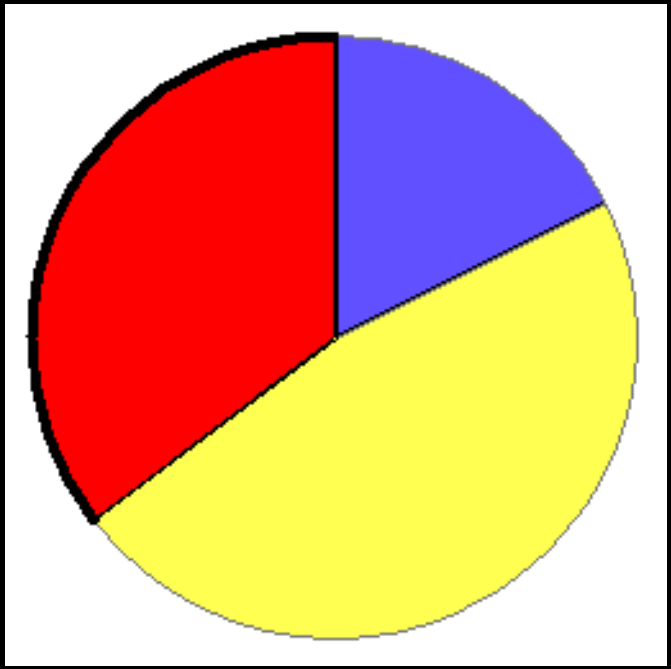
Upper River Raisin Austin Road



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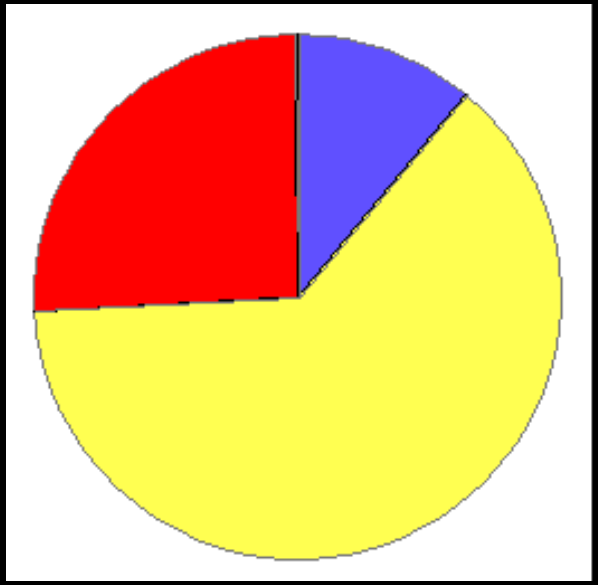
384

STATION S
River Raisin
Austin Road
7/29/2008

METRIC	Value	Score
TOTAL NUMBER OF TAXA	44	1
NUMBER OF MAYFLY TAXA	6	1
NUMBER OF CADDISFLY TAXA	10	1
NUMBER OF STONEFLY TAXA	1	1
PERCENT MAYFLY COMP.	29.39	1
PERCENT CADDISFLY COMP.	24.85	1
PERCENT DOMINANT TAXON	15.76	1
PERCENT ISOPOD, SNAIL, LEECH	2.42	1
PERCENT SURF. AIR BREATHERS	4.24	1
TOTAL SCORE		9
MACROINV. COMMUNITY RATING		EXCELLENT

Michigan DNRE Department of NATURAL RESOURCES and ENVIRONMENT

Ida-Maybee Rd.



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496

STATION 2
River Raisin
Ida Maybee Road
7/30/2008

METRIC	Value	Score
TOTAL NUMBER OF TAXA	30	0
NUMBER OF MAYFLY TAXA	5	1
NUMBER OF CADDISFLY TAXA	5	1
NUMBER OF STONEFLY TAXA	0	-1
PERCENT MAYFLY COMP.	40.73	1
PERCENT CADDISFLY COMP.	8.47	0
PERCENT DOMINANT TAXON	30.65	-1
PERCENT ISOPOD, SNAIL, LEECH	1.41	1
PERCENT SURF. AIR BREATHERS	1.01	1
TOTAL SCORE		3
MACROINV. COMMUNITY RATING		ACCEPTABLE

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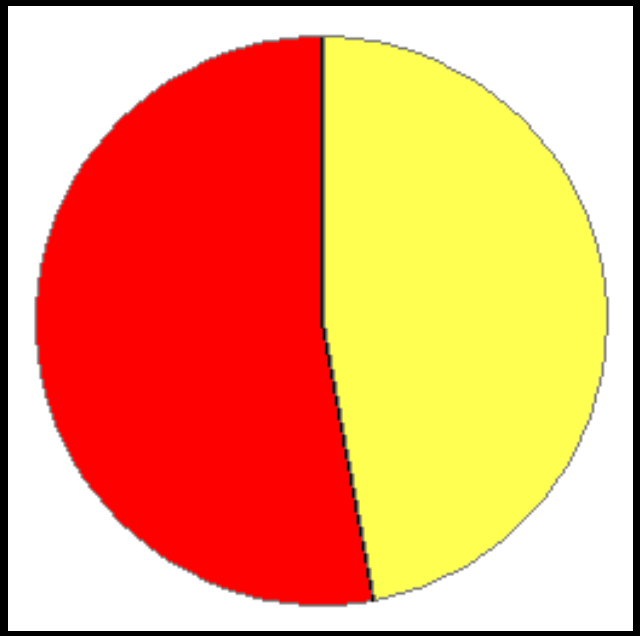
South Branch River Raisin Benner/Carleton Hwy



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300

STATION 27
South Branch Raisin River
Carleton Hwy/Benner Hwy
7/22/2008

METRIC	Value	Score
TOTAL NUMBER OF TAXA	18	0
NUMBER OF MAYFLY TAXA	2	1
NUMBER OF CADDISFLY TAXA	1	0
NUMBER OF STONEFLY TAXA	0	-1
PERCENT MAYFLY COMP.	3.00	0
PERCENT CADDISFLY COMP.	27.67	1
PERCENT DOMINANT TAXON	32.67	1
PERCENT ISOPOD, SNAIL, LEECH	4.33	0
PERCENT SURF. AIR BREATHERS	2.33	1
TOTAL SCORE		3
MACROINV. COMMUNITY RATING		ACCEPTABLE