# Groundwater, Streams, Lakes and Pumping in the Central Sands

George J. Kraft, David J. Mechenich,
Jessica Haucke, Katherine Clancy

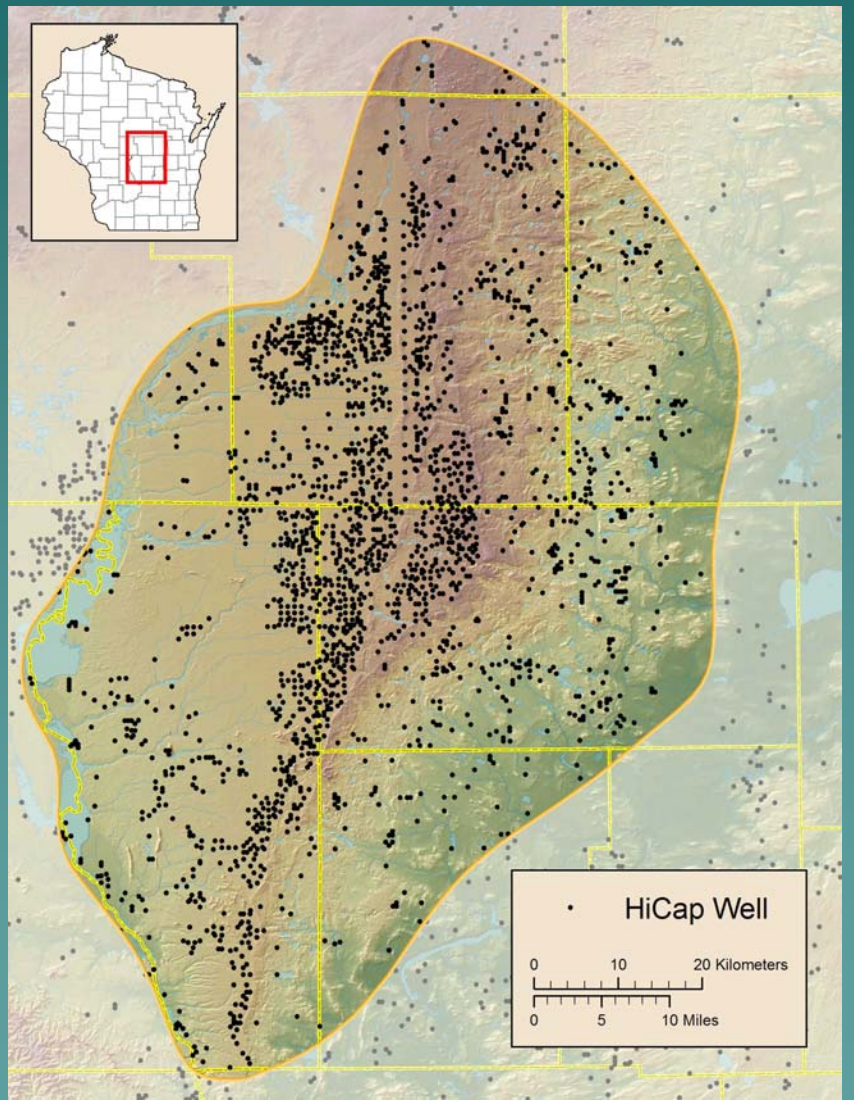

Little Plover


Long Lake


Pickerel Lake


Stoltenberg Cr.

# A Little History



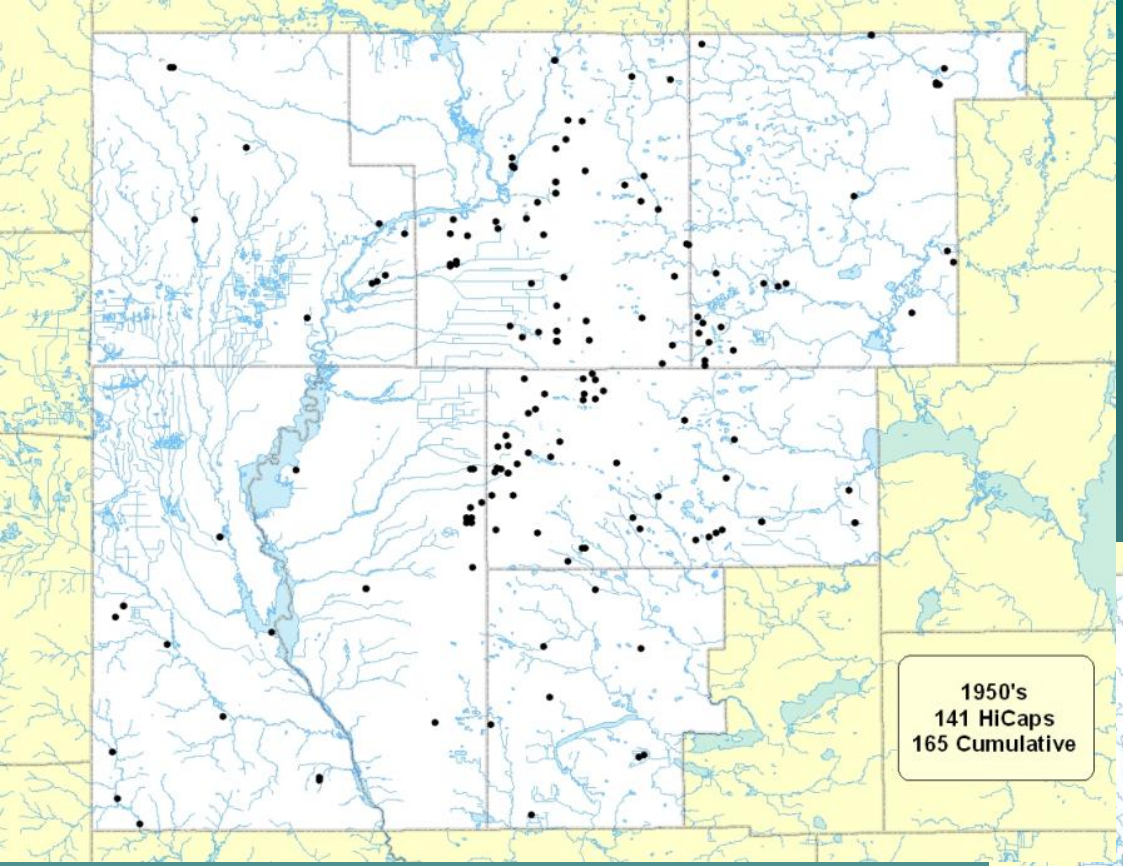
“The public will not stand for the destruction of streams... We have the water now, but what will we have if we pump it out at a faster rate?”

- V.J. Muench, Isaac Walton League, 1950

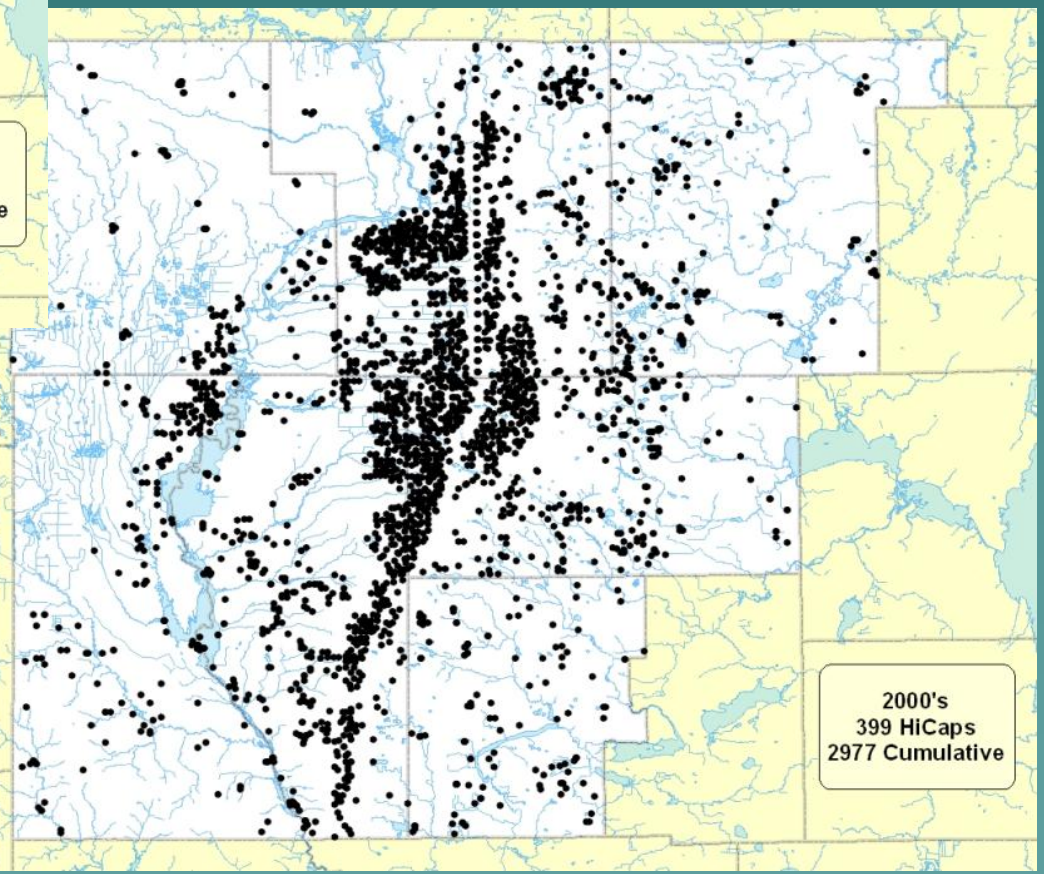
“Wisconsin has vast water resources... Irrigation ... has no permanent effect on the ground or surface water levels.... No reasonable person is concerned about this....”

- Wisconsin Agricultural Water Conservation Committee, 1959

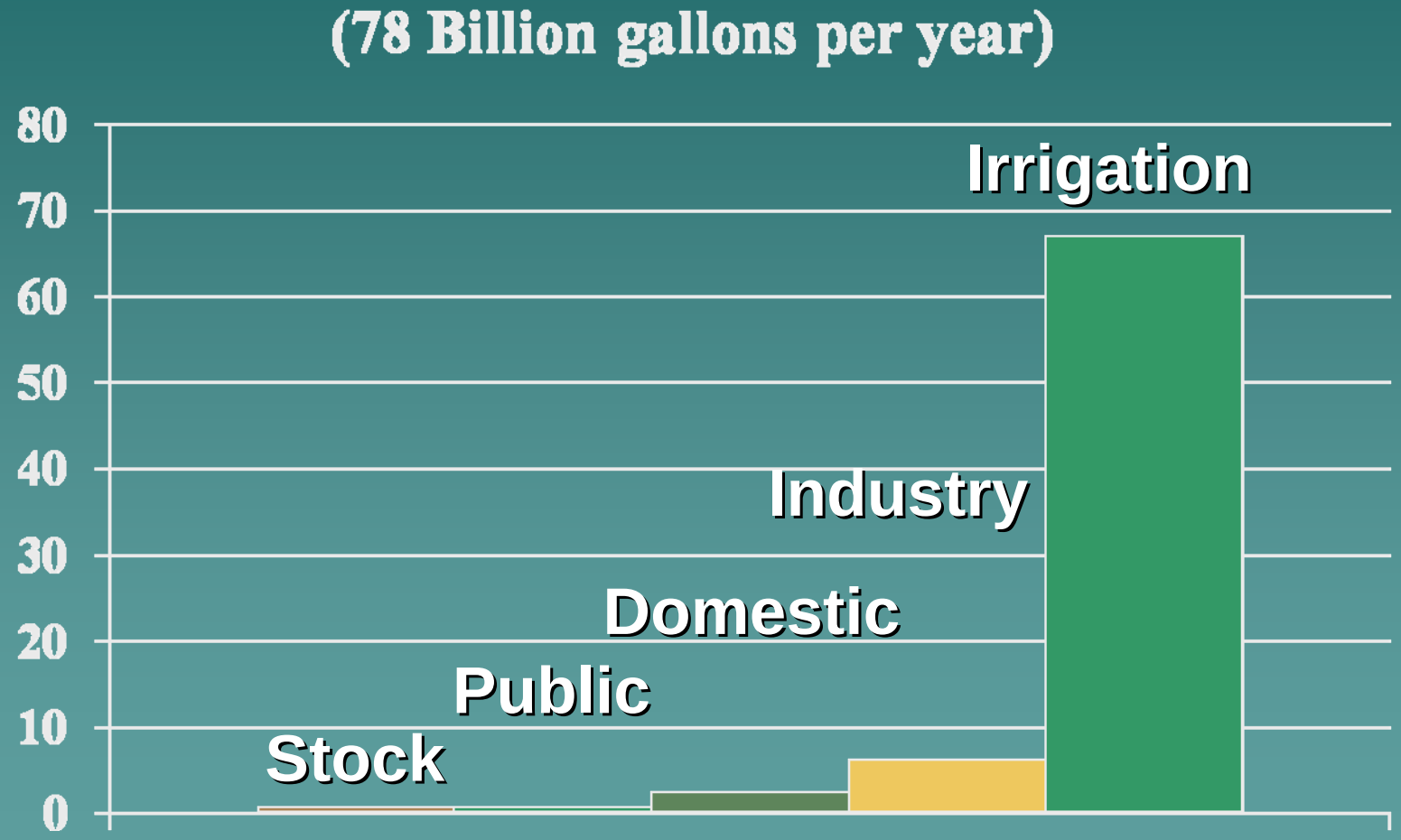
# 1960 – 165 High Capacity Wells




# 2003 – ~3000 High Capacity Wells



# Three Central Counties Groundwater Use (Buchwald, 2009)



Ed L. Avery

D. Krug

# WATER ON THE LAND

Depart
Madis

197

Watershed Center 6.

# Hydrology of the Little Plover River Basin Portage County, Wisconsin And the Effects of Water Resource Development

GEOLOGICAL SURVEY WATER-SUPPLY PA

*Prepared in cooperation with the Wisconsin Conservation Department and the University of Wisconsin Geological and Natural History Survey*

6.1.3

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

# EFFECTS OF IRRIGATION ON STREAM

# IN THE CENTRAL SAND PLAIN OF WISCONSI

By
E. P. Weeks and H. G. Stangland

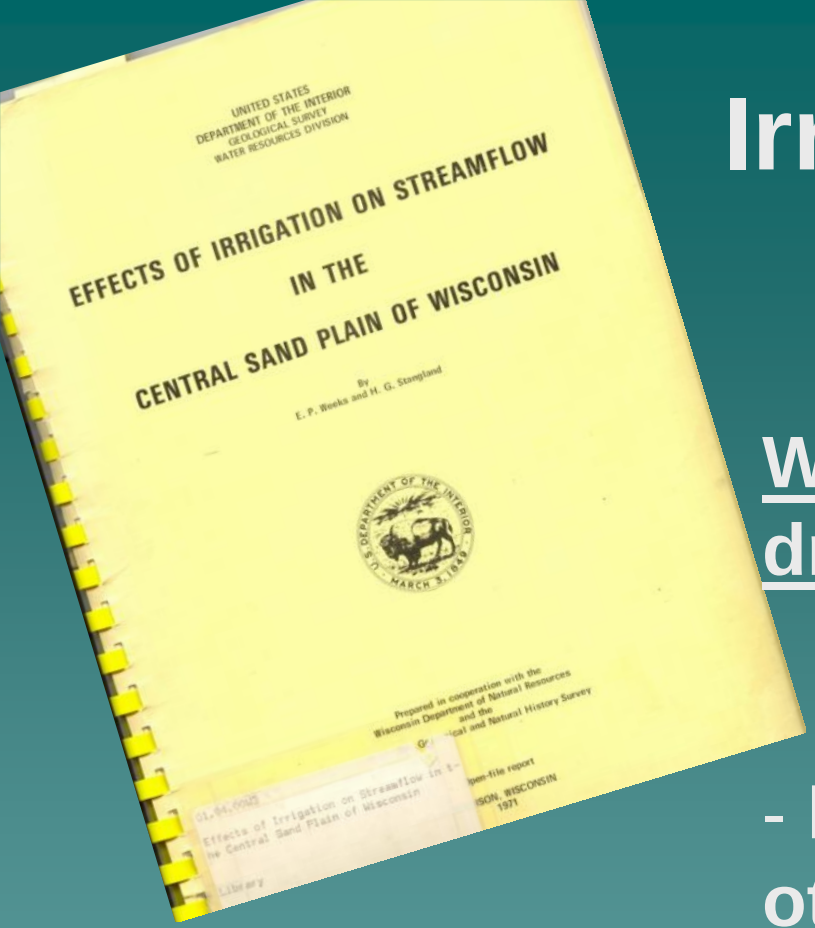
U.S. DEPARTMENT OF THE INTERIOR · MARCH 3, 1849 ·

01.04.0003
Effects of Irrigation on Streamflow in t-
he Central Sand Plain of Wisconsin
Library

Prepared in cooperation with the
Wisconsin Department of Natural Resources
and the
Gi ical and Natural History Survey

pen-file report

ISON, WISCONSIN
1971




# Irrigation Pumping Impacts

**<u>With ½ the land area irrigated, during drought:</u>**

- **headwaters streams that would otherwise flow will dry up**

- **water levels will decline an extra 4 - 5 feet on top of “natural” decline**

# Is it Pumping or Weather???

# Indicators of Weather and Dry Conditions

1. Precipitation:
   Hancock – average to slightly above
   Stevens Point - slightly below average

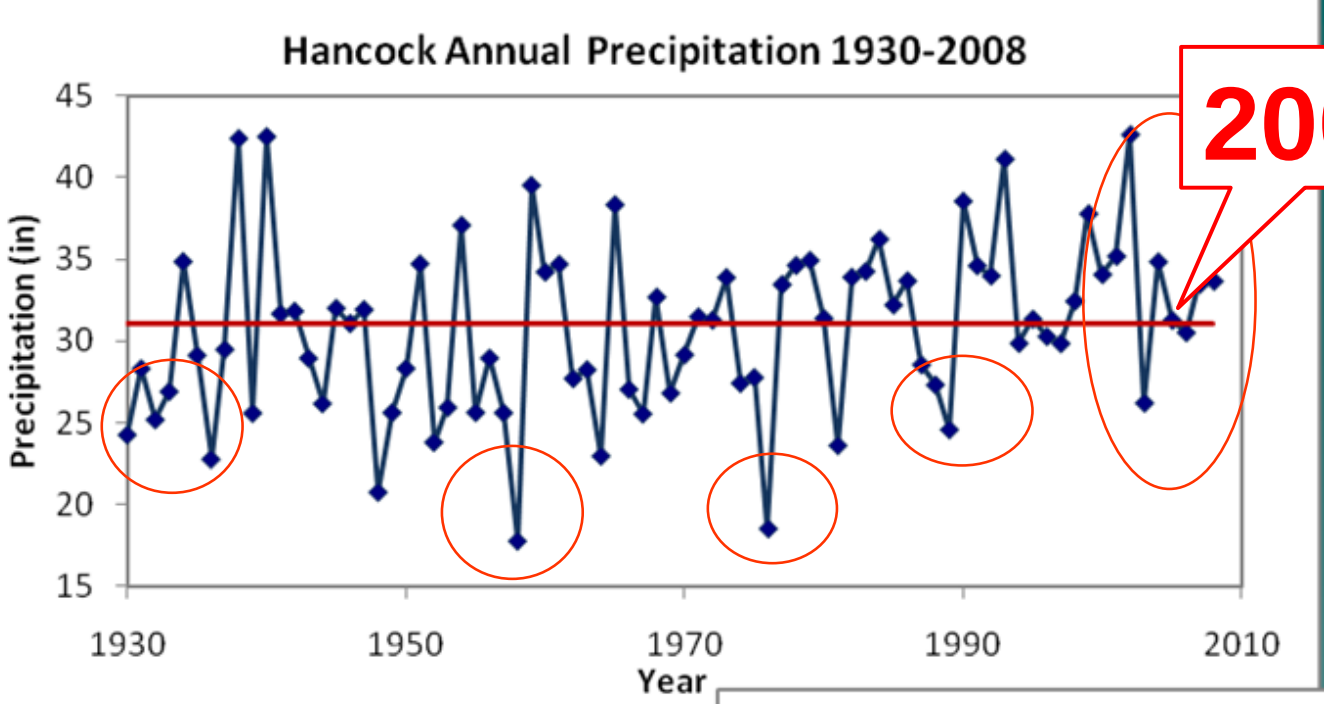
2. Drought index since 2000: Near normal

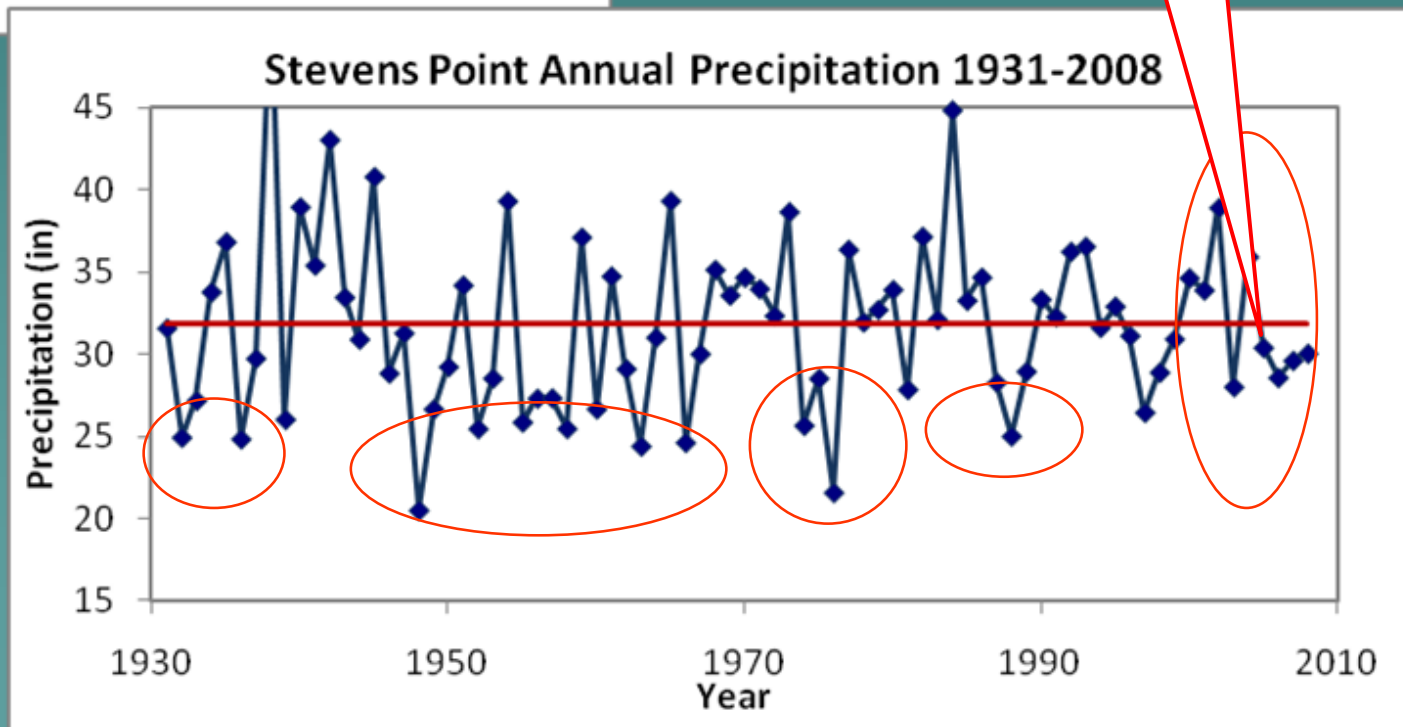
3. Reference streams (not too affected by pumping): A little low (10-50 percentile); 2007 lowest

4. Reference groundwater levels (wells not too affected by pumping): Somewhat low (10-20 percentile), not record low.

5. Reference lake levels: Lower than average, but not close to record low.

# Precipitation



# Other commentary on stressed water

1. Impervious surface reduced infiltration.
2. Dewatering for the Plover water main drained the aquifer.
3. Lake Michigan is down – St. Clair River connection.
4. The Little Plover didn't exist until the farmers dynamited it in.
5. Record drought.
6. Some ponds got filled at the head of x river.
7. Dams used to compress water in the aquifer and cause more groundwater storage.
8. Dredging in the Buena Vista Marsh.
9. Low water in the Wisconsin River.
10. Pumping in the Fox Valley.
11. Pumping by cranberry producers in Wood / Jackson Counties.
12. Some gullies around lakes were filled.
13. Lake Superior is down.
14. People living on lakes pump lots of water.
15. Springville pond was drained.
16. McDill Pond was drained.
17. Water is being pumped into the deep subsurface for oil production in Texas.
18. Irrigation doesn't use water – it all goes back into the ground.
19. Lawn sprinkling uses more water than crop irrigation.
20. There were no trout in central Wisconsin until the farmers put them there.

# Is it Pumping or Weather???

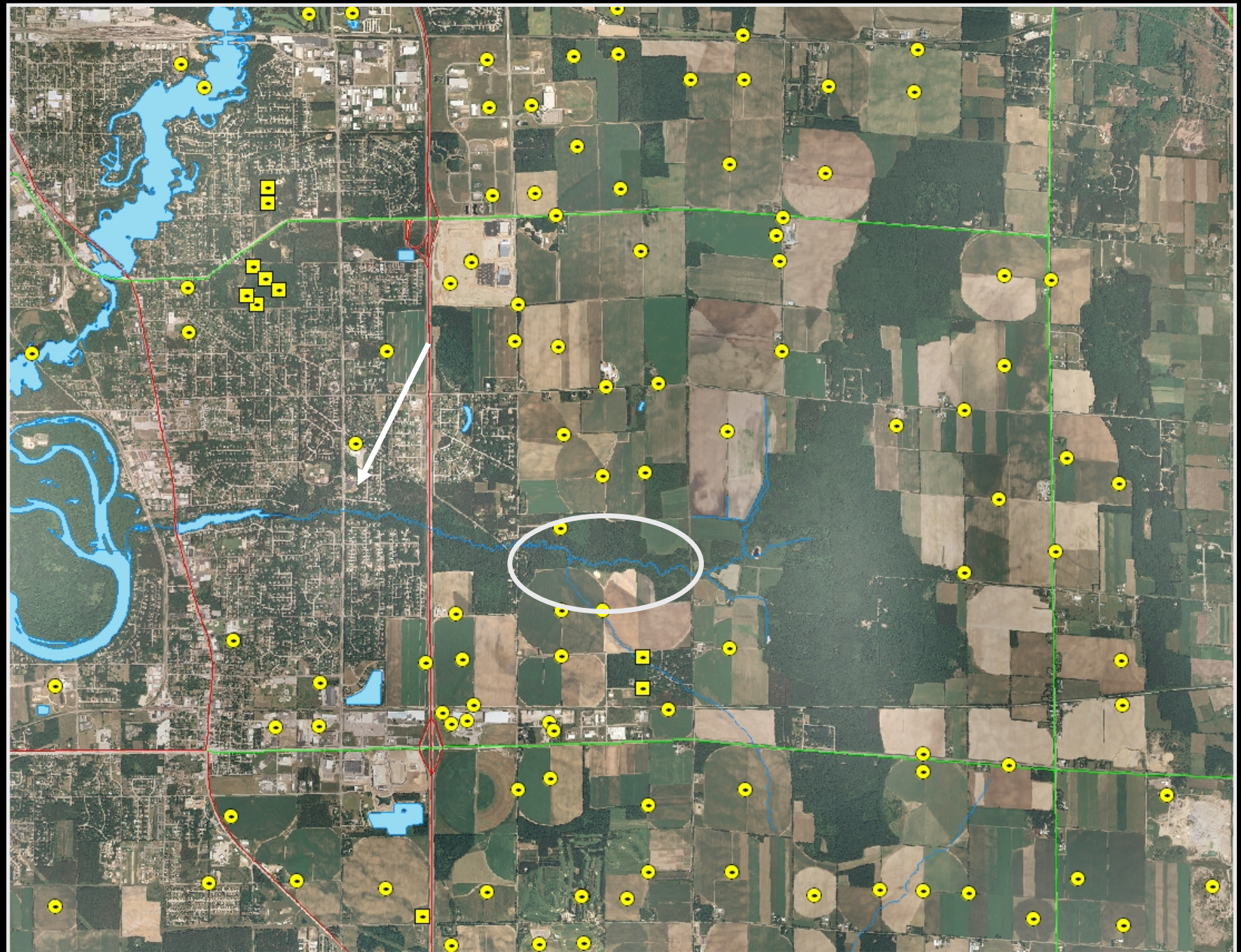
A little to middling dry??

# Is There “Missing” Water ?

## (Can’t be Explained by Weather Alone)

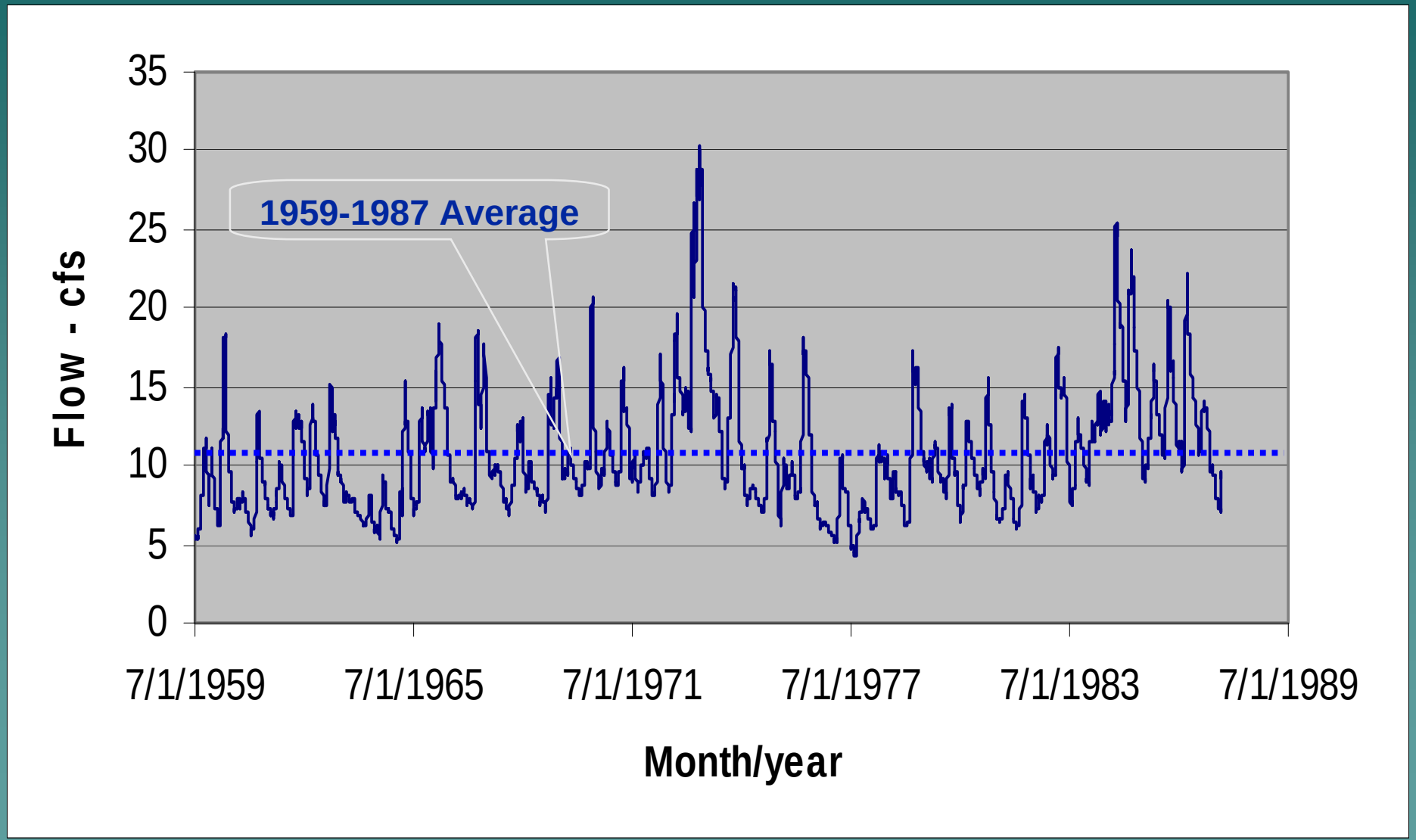
## Little Plover

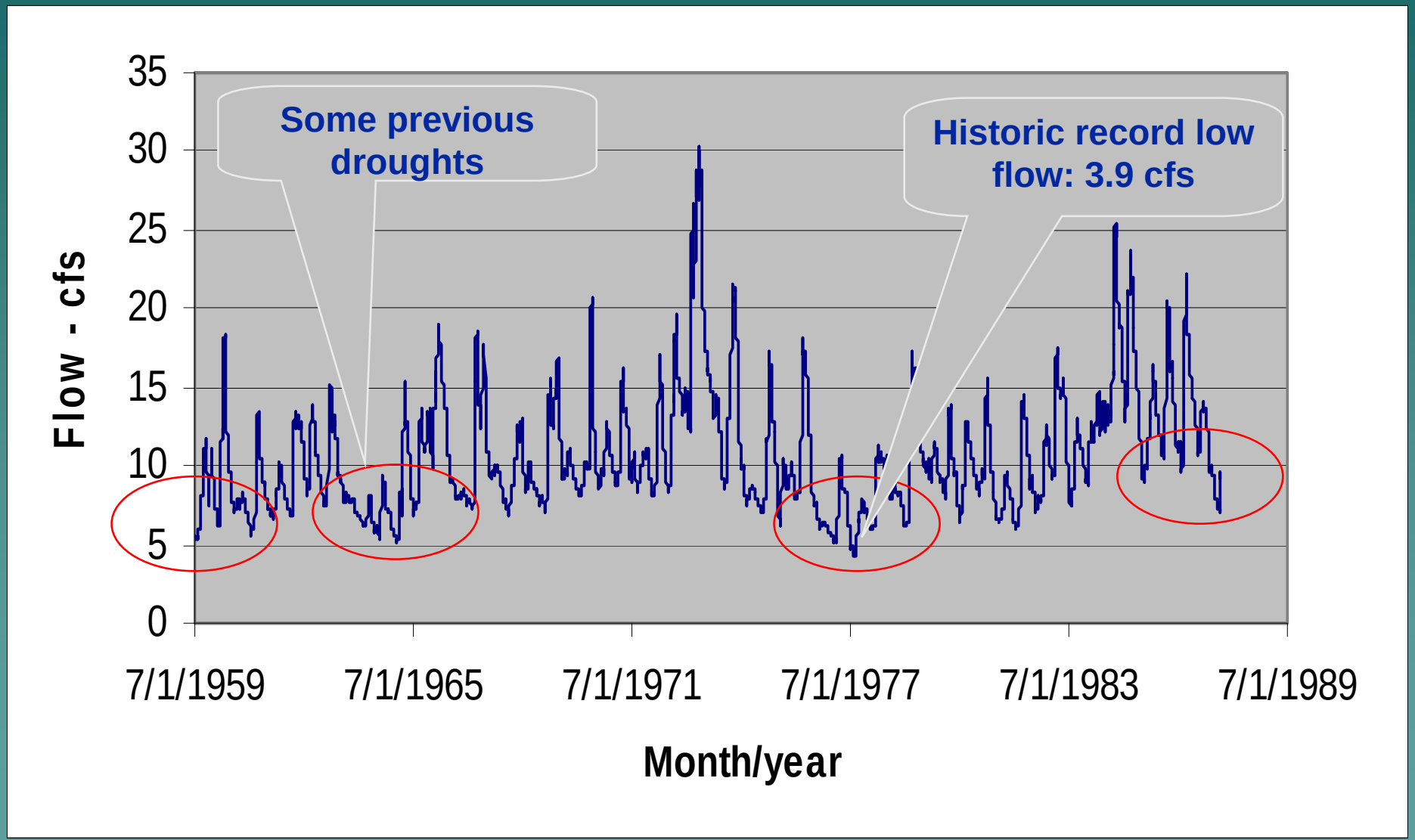

Little Plover River – 1980s

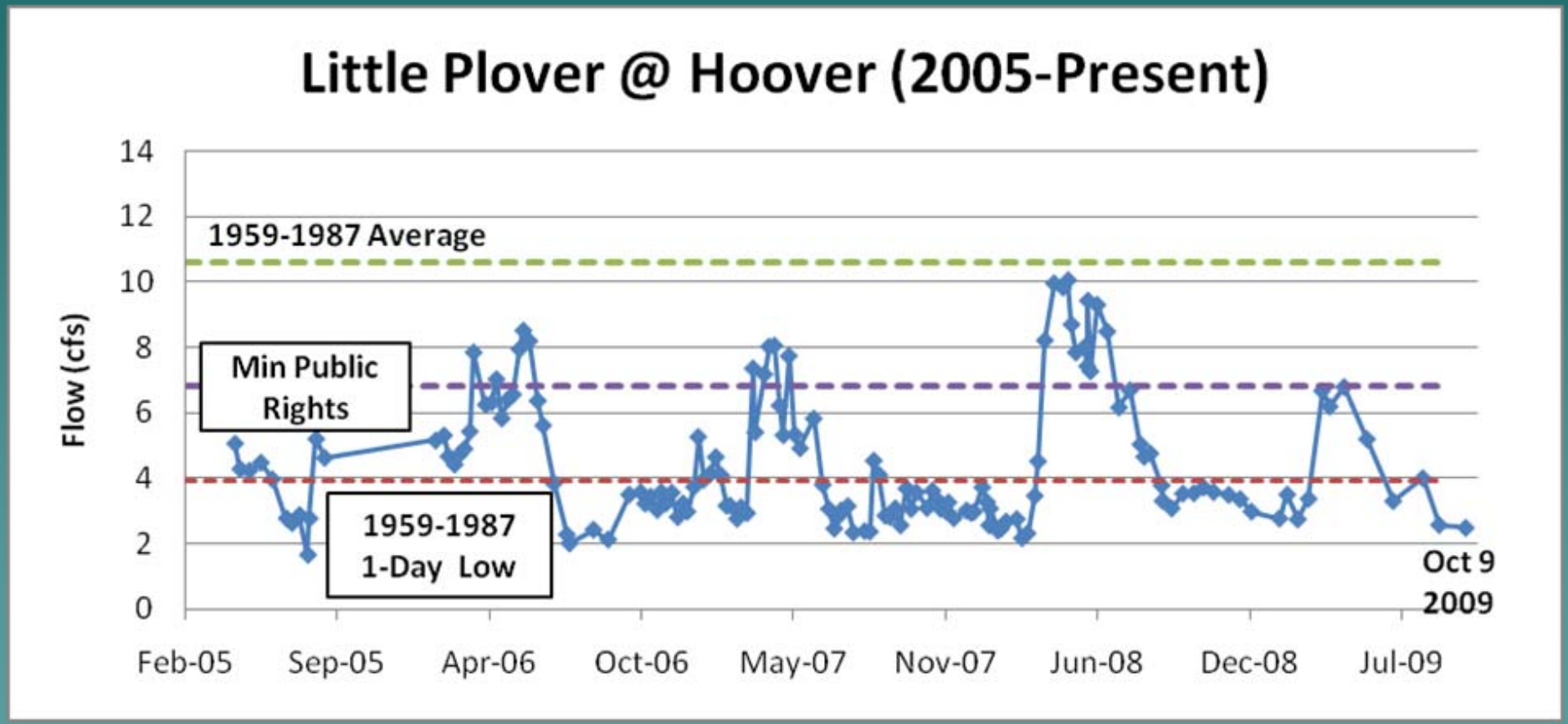


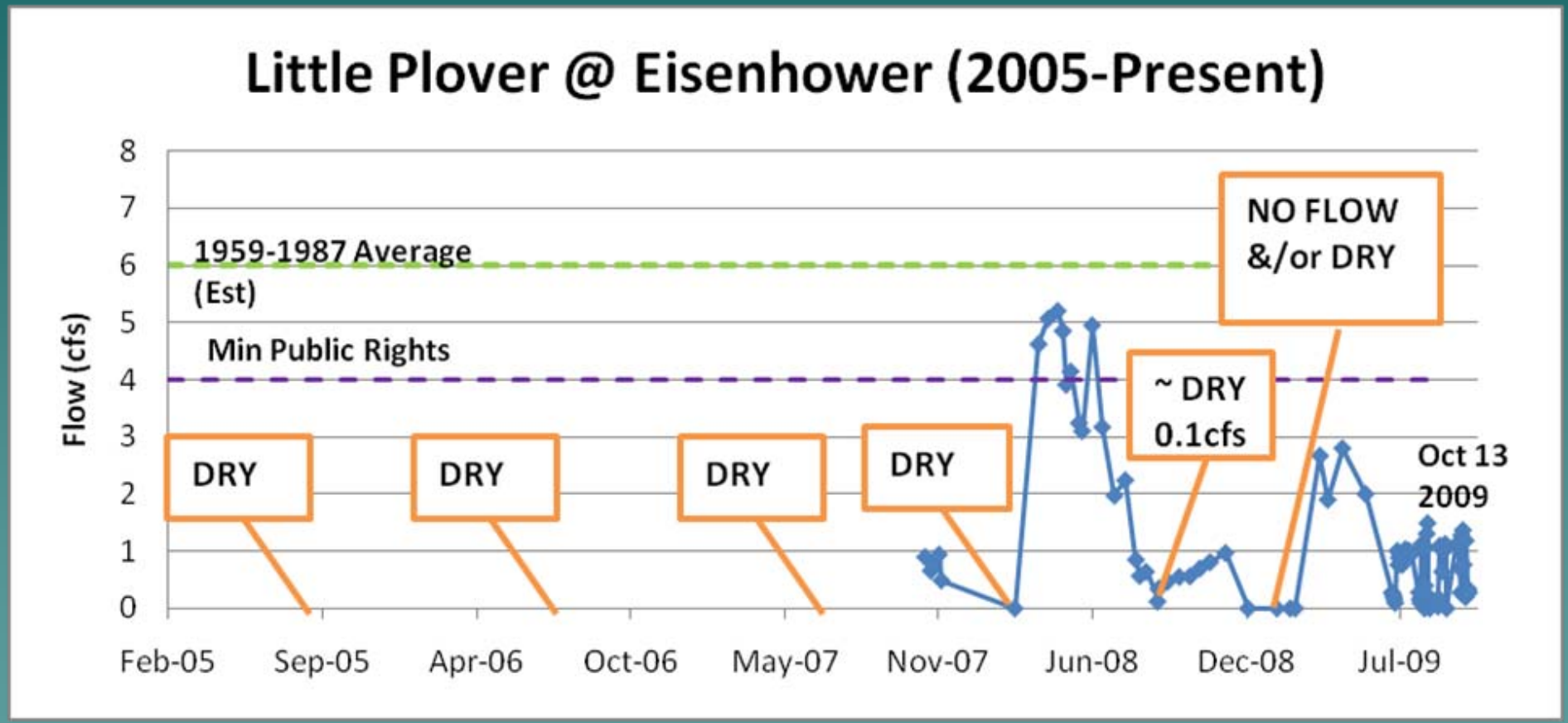
# Little Plover – (Dry stretches 2005-2009)

# Little Plover @ Hoover: 1959-1987




Some previous droughts
Historic record low flow: 3.9 cfs
Flow - cfs
35
30
25
20
15
10
5
0
7/1/1959
7/1/1965
7/1/1971
7/1/1977
7/1/1983
7/1/1989
Month/year


Little Plover @ Hoover (2005-Present)
Flow (cfs)
14
12
10
8
6
4
2
0
1959-1987 Average
Min Public Rights
1959-1987 1-Day Low
Oct 9 2009
Feb-05
Sep-05
Apr-06
Oct-06
May-07
Nov-07
Jun-08
Dec-08
Jul-09


Little Plover @ Eisenhower (2005-Present)
Flow (cfs)
8
7
6
5
4
3
2
1
0
1959-1987 Average
(Est)
Min Public Rights
DRY
DRY
DRY
DRY
~ DRY
0.1cfs
NO FLOW
&/or DRY
Oct 13
2009
Feb-05
Sep-05
Apr-06
Oct-06
May-07
Nov-07
Jun-08
Dec-08
Jul-09

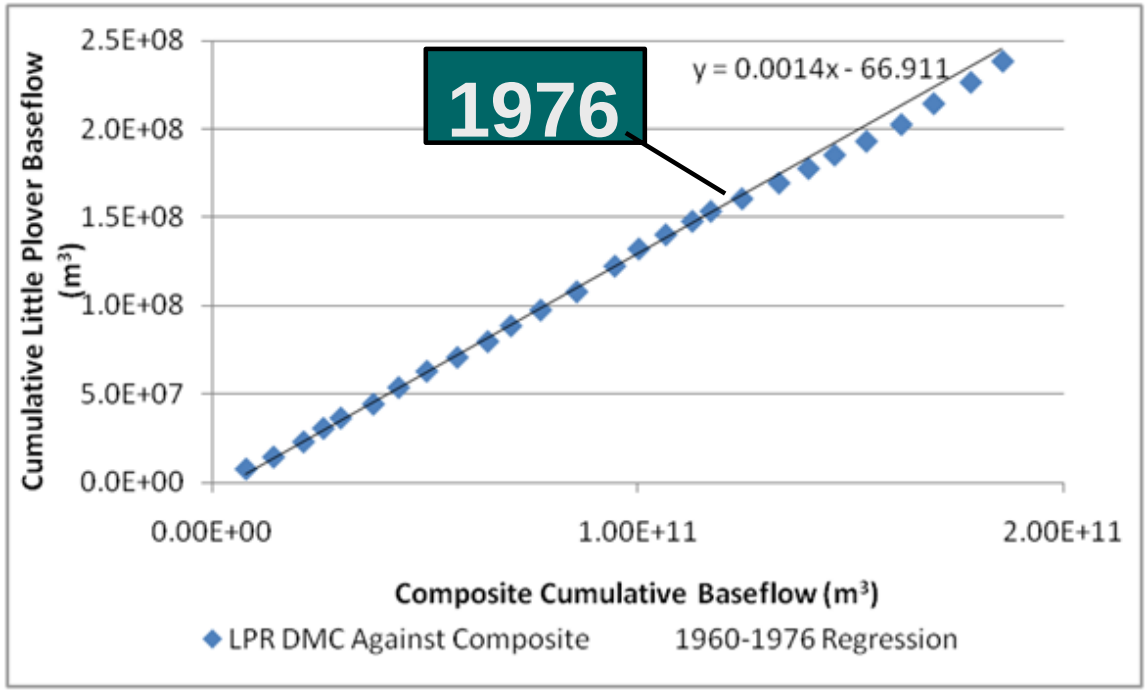
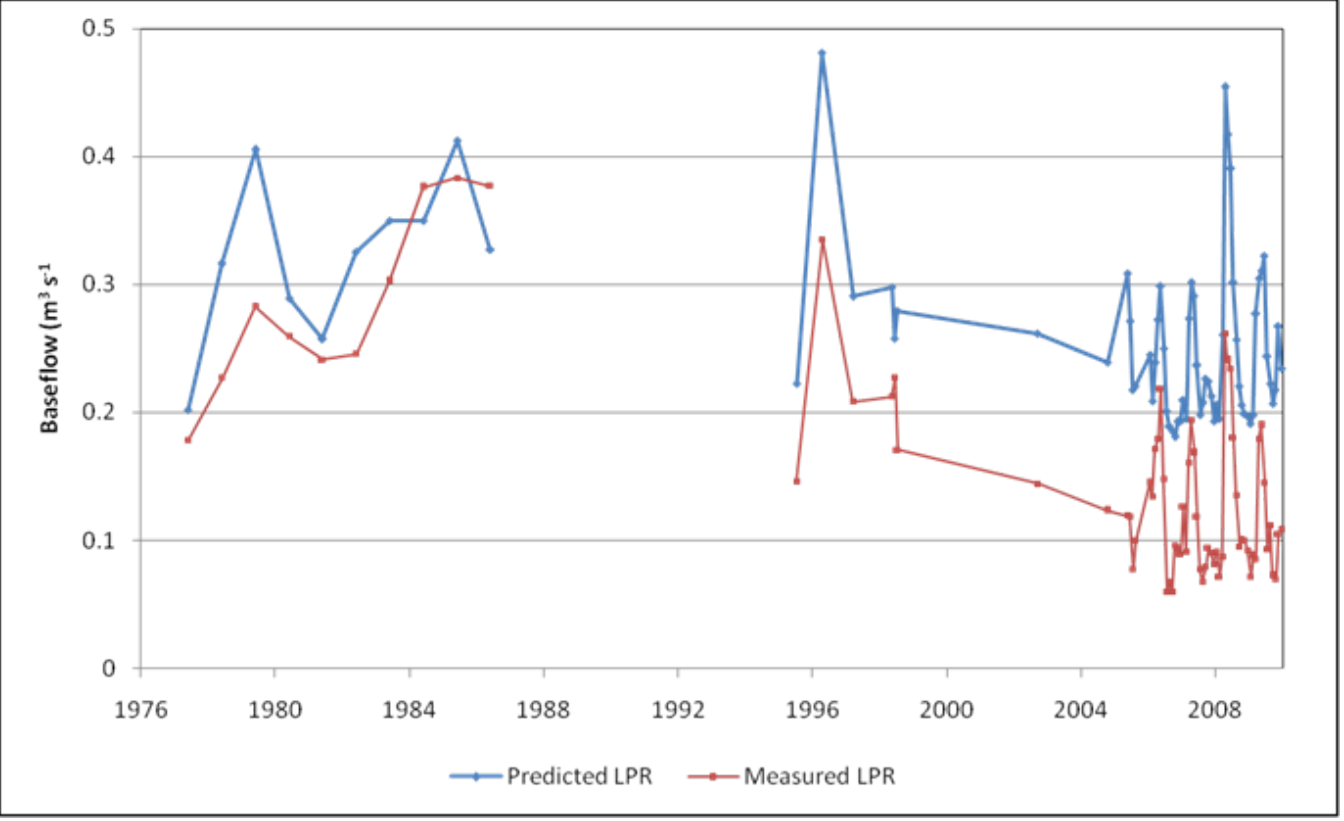
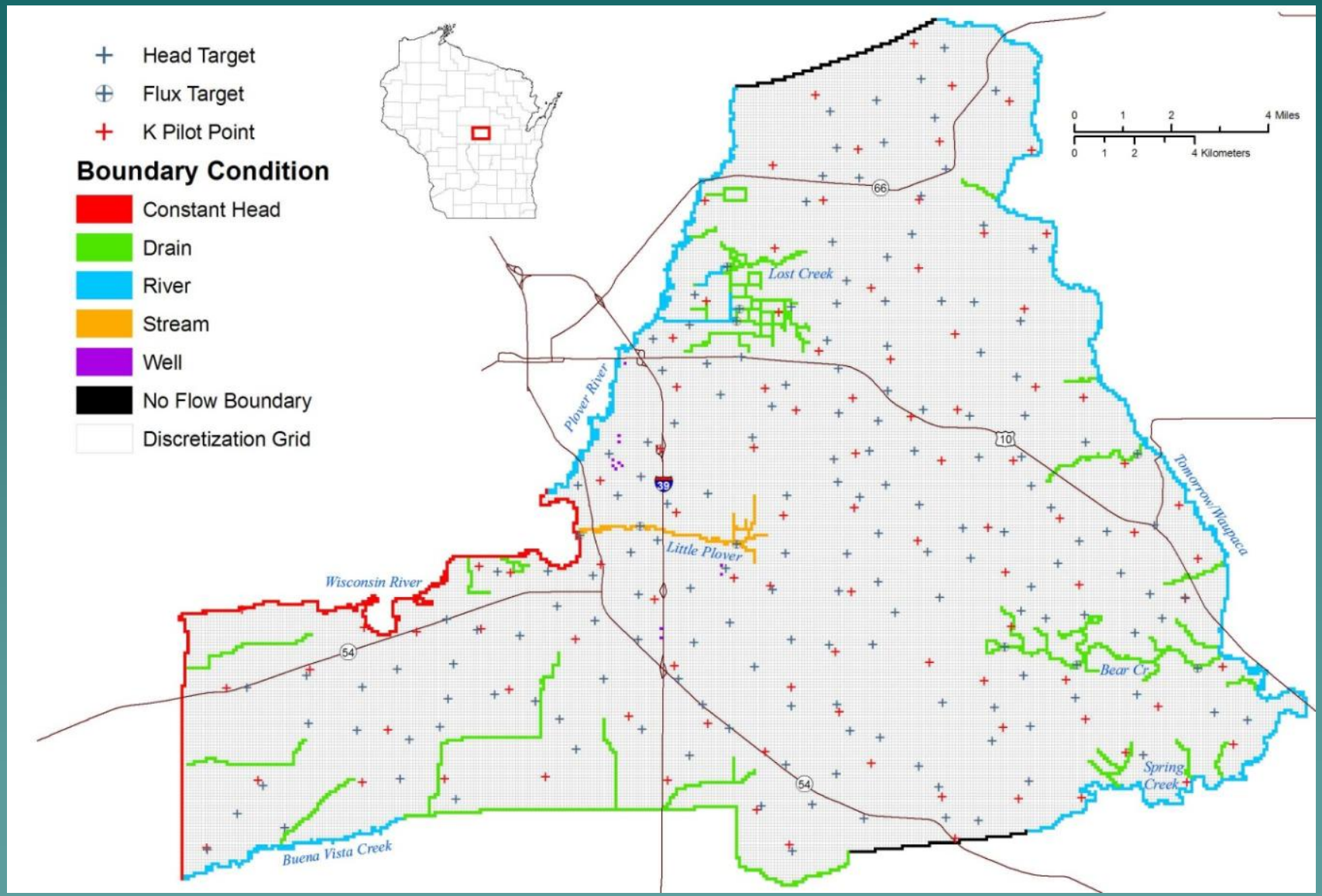


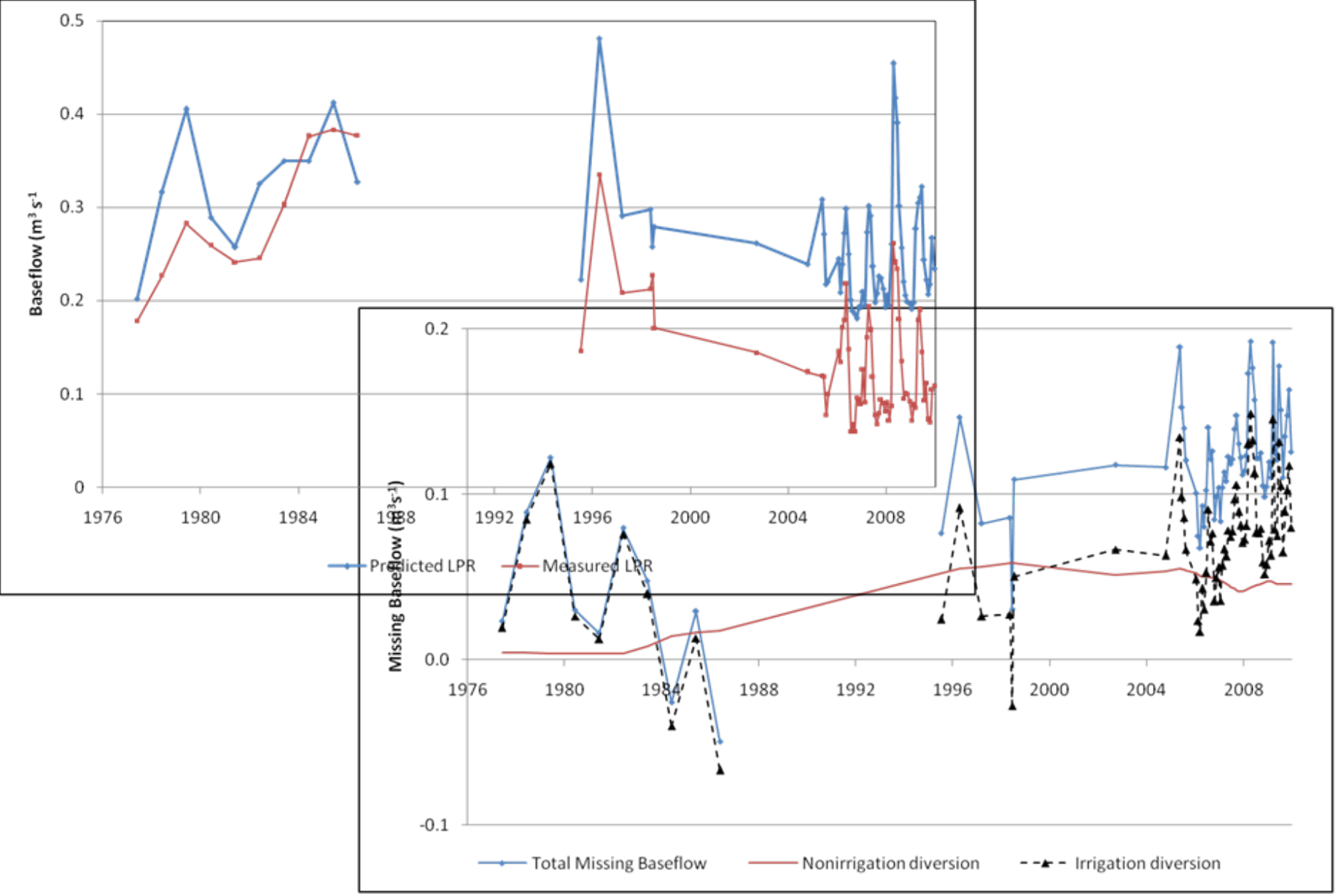

**Table 11. Regression equations to predict Little Plover baseflow (cfs) developed from binned data as shown in Table 10.**

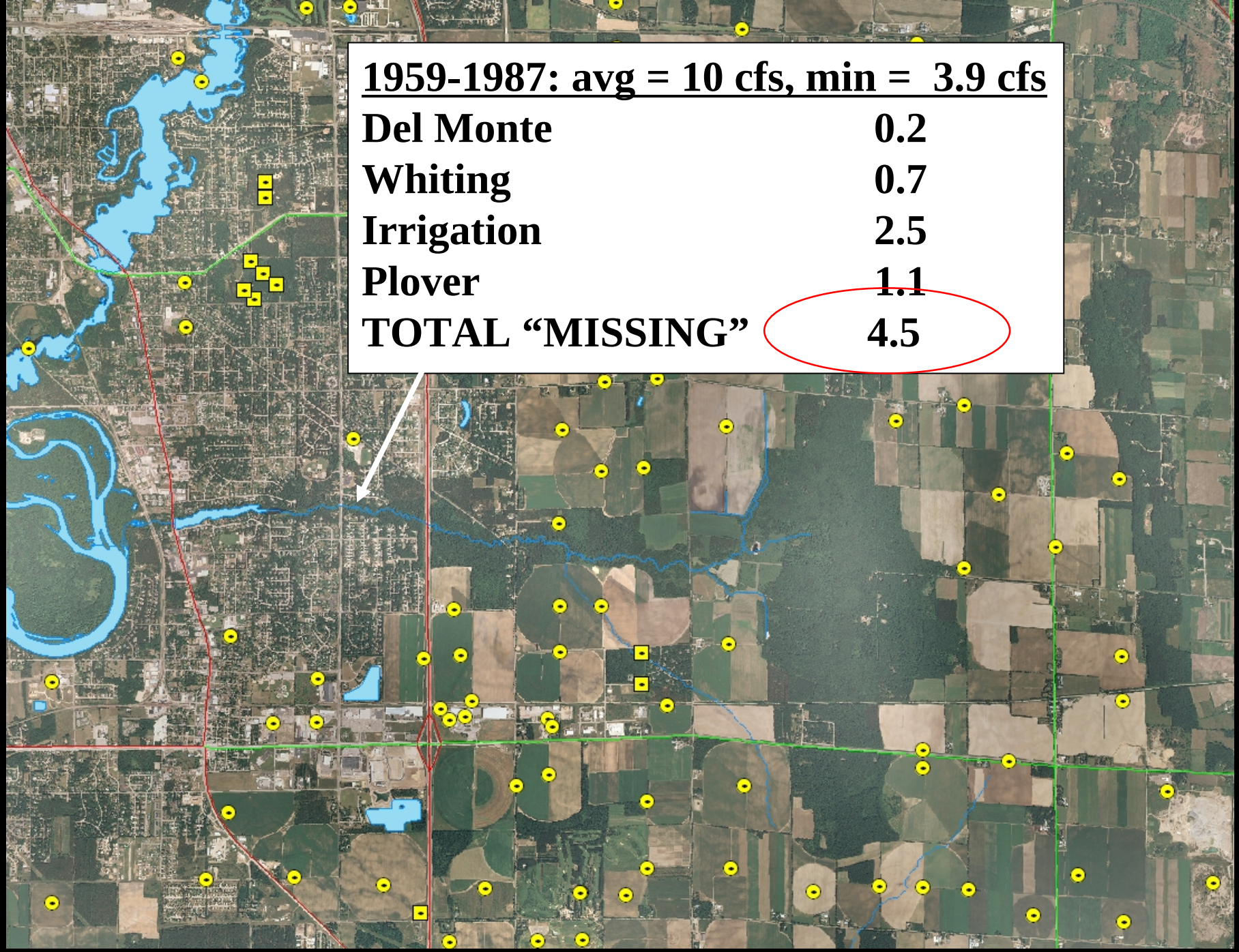
| Station | Regression | $R^2$ |
|---|---|---|
| WI Dell | y = 0.0010x + 2.93 | $R^2$ = 0.95 |
| Fox R. at Berlin | y = 0.0064x + 3.37 | $R^2$ = 0.89 |
| Eau Claire R. @Kelly | y = 0.0156x + 6.76 | $R^2$ = 0.72 |
| Wolf at New London | y = 0.0042x + 2.86 | $R^2$ = 0.89 |
| Embarrass at Embarrass | y = 0.0275x + 3.31 | $R^2$ = 0.85 |
| Tenmile Ck nr Nekoosa* | y = 0.0845x + 5.40 | $R^2$ = 0.70 |

*Tenmile Creek uses unbinned data


0.5
0.4
0.3
0.2
0.1
0
Baseflow (m³ s⁻¹)
1976
1980
1984
1988
1992
1996
2000
2004
2008
Predicted LPR
Measured LPR


Head Target
Flux Target
K Pilot Point
Boundary Condition
Constant Head
Drain
River
Stream
Well
No Flow Boundary
Discretization Grid
0 1 2 4 Miles
0 1 2 4 Kilometers
Lost Creek
Plover River
Little Plover
Tomorrow/Waupaca
Wisconsin River
Bear Cr
Spring Creek
Buena Vista Creek
66
10
39
54
54

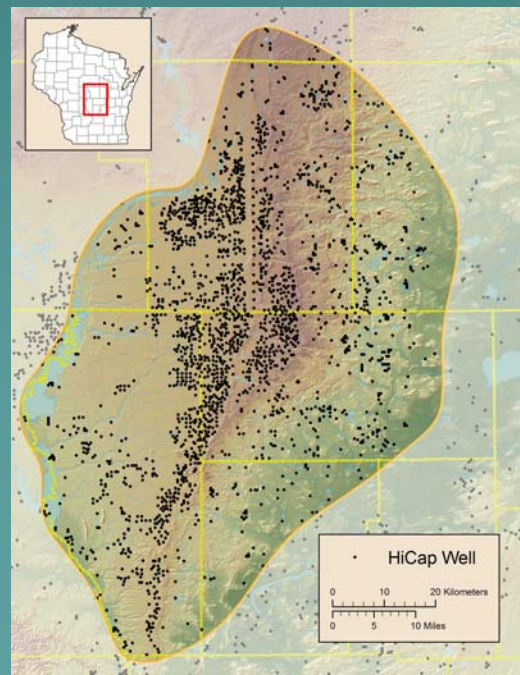

0.5
0.4
0.3
0.2
0.1
0
Baseflow (m³ s⁻¹)
1976
1980
1984
1988
1992
1996
2000
2004
2008
Predicted LPR
Measured LPR
0.2
0.1
0.0
-0.1
Missing Baseflow (m³s⁻¹)
Total Missing Baseflow
Nonirrigation diversion
Irrigation diversion

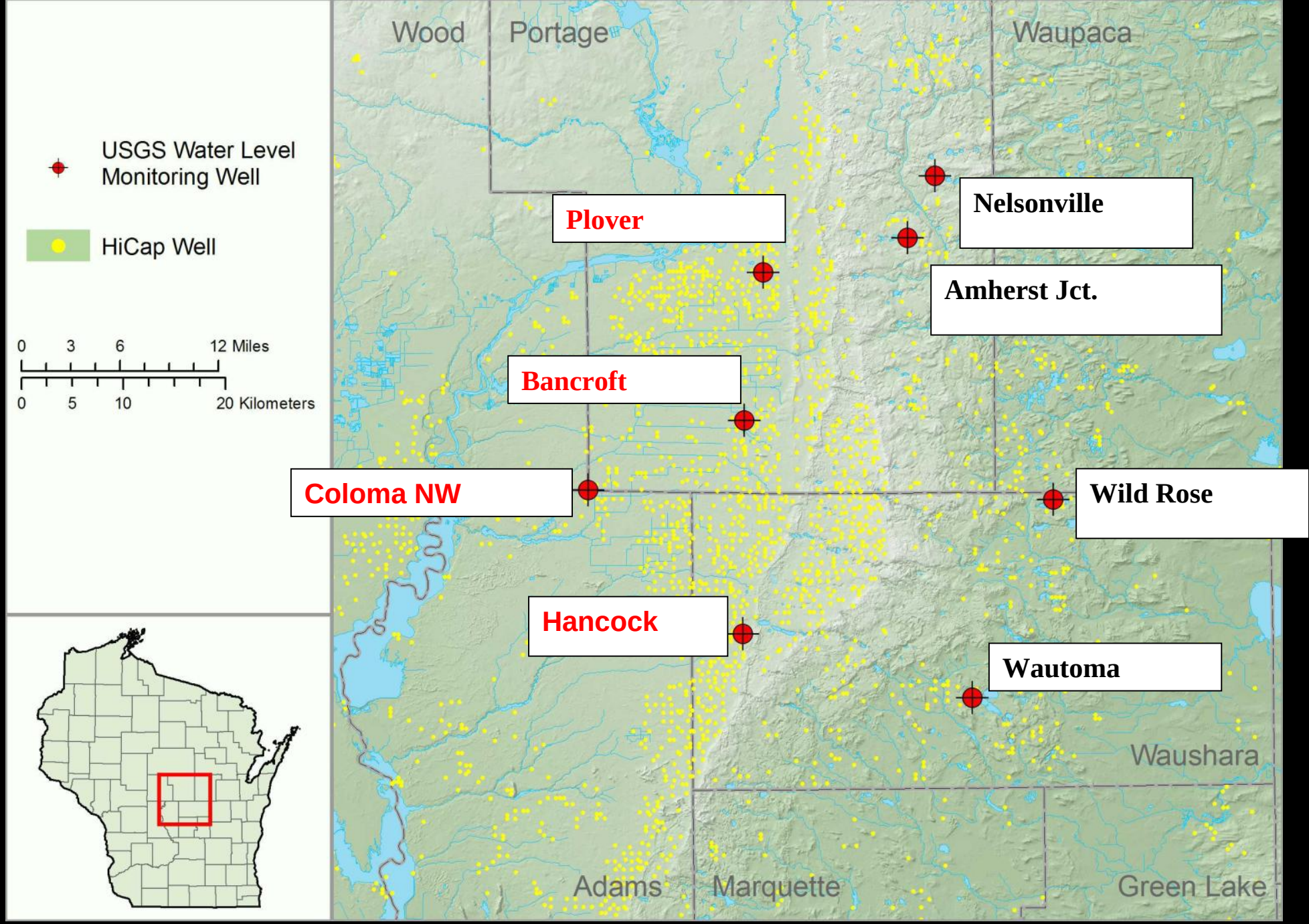

1959-1987: avg = 10 cfs, min = 3.9 cfs
Del Monte 0.2
Whiting 0.7
Irrigation 2.5
Plover 1.1
TOTAL "MISSING" 4.5

# Is There “Missing” Water?

## (Can’t be Explained by Weather Alone)

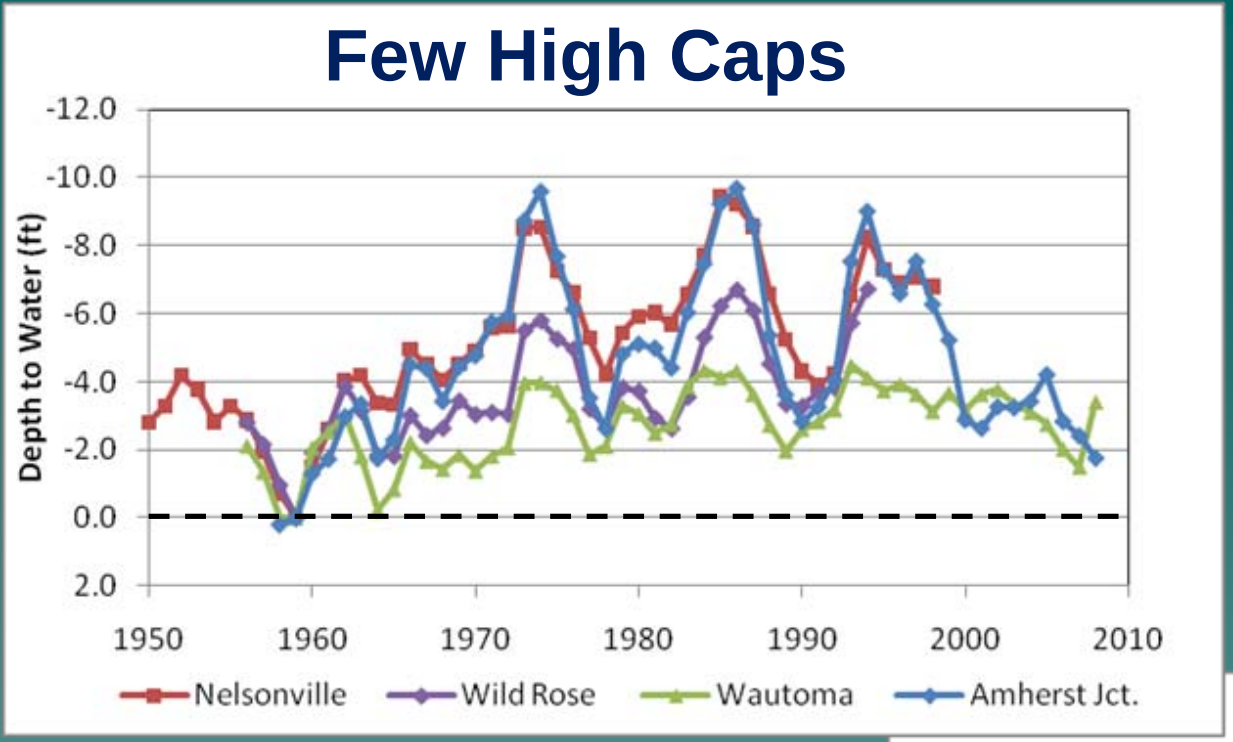
# Water Levels in Monitoring Wells & Lakes Over Whole Central Sands



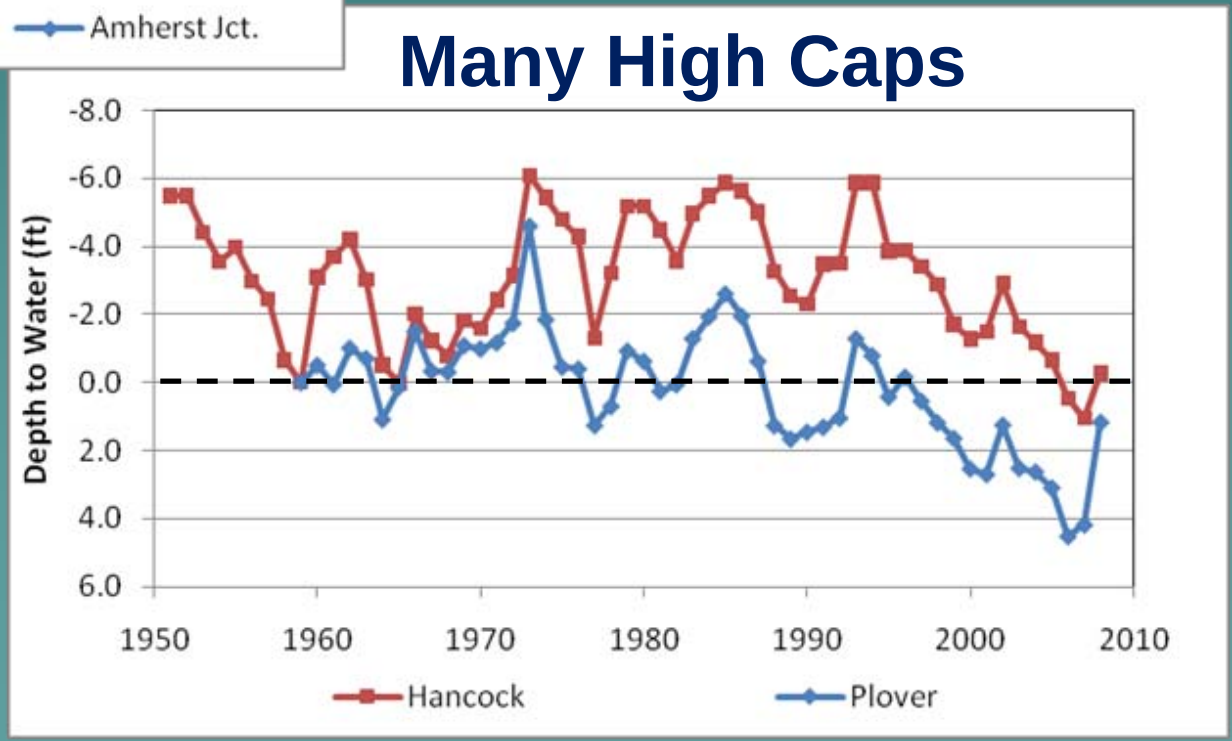

USGS Water Level Monitoring Well
HiCap Well
0 3 6 12 Miles
0 5 10 20 Kilometers
Wood
Portage
Waupaca
Plover
Nelsonville
Amherst Jct.
Bancroft
Coloma NW
Wild Rose
Hancock
Wautoma
Waushara
Adams
Marquette
Green Lake

# Water Levels in Areas with Few and Many High Capacity Wells

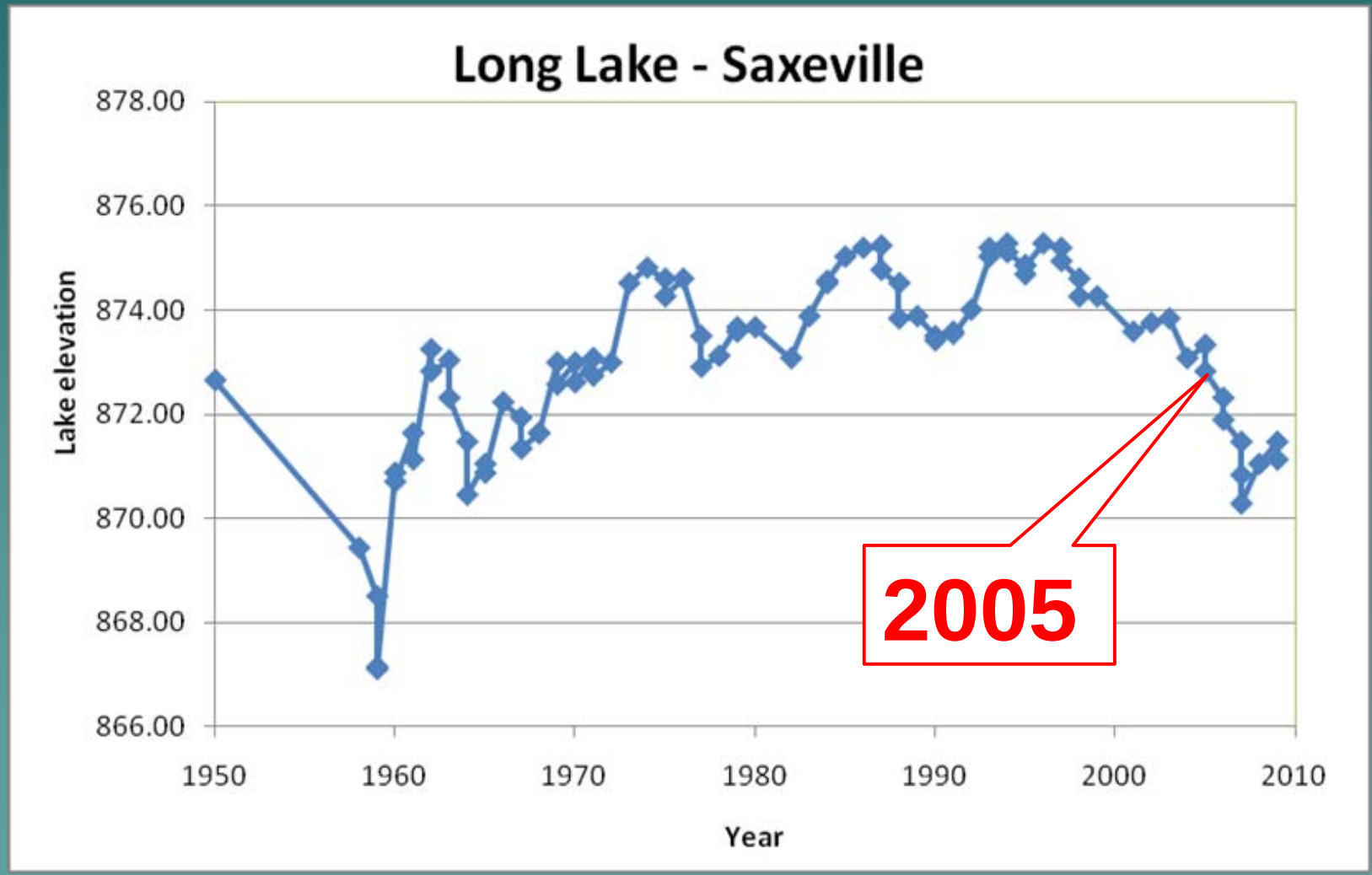
## Few High Caps



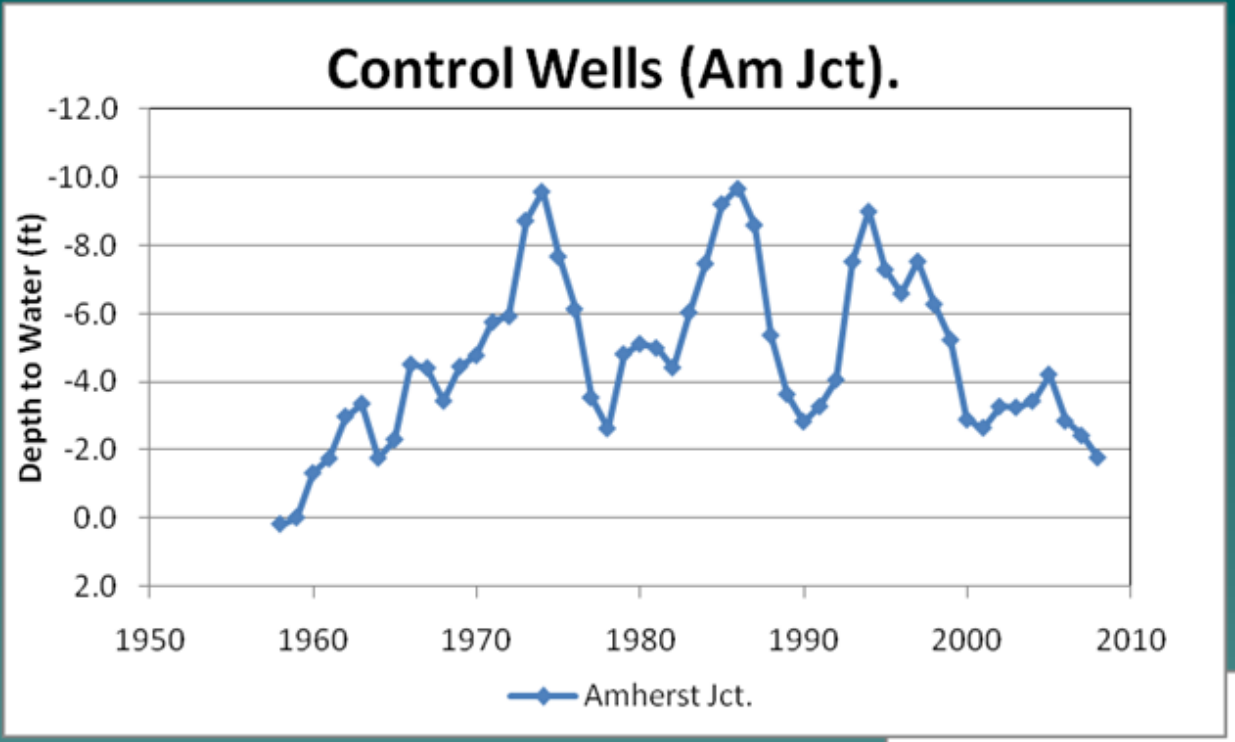

## Many High Caps

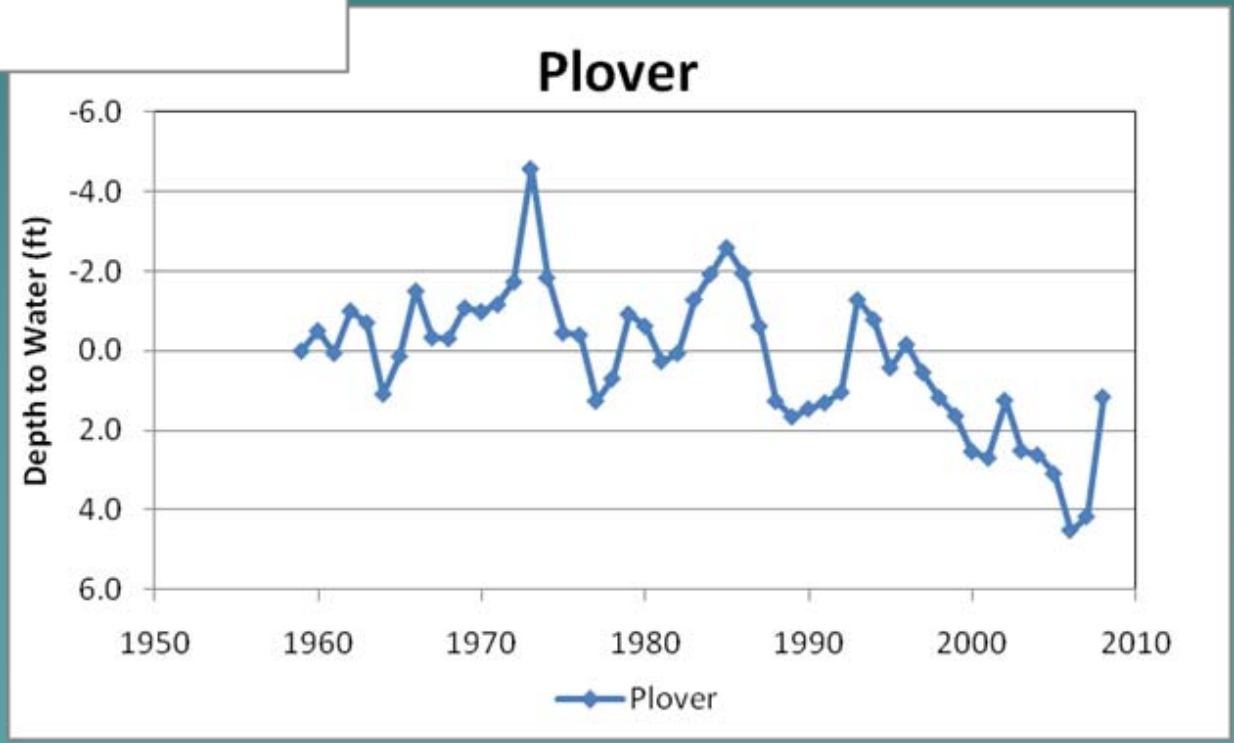


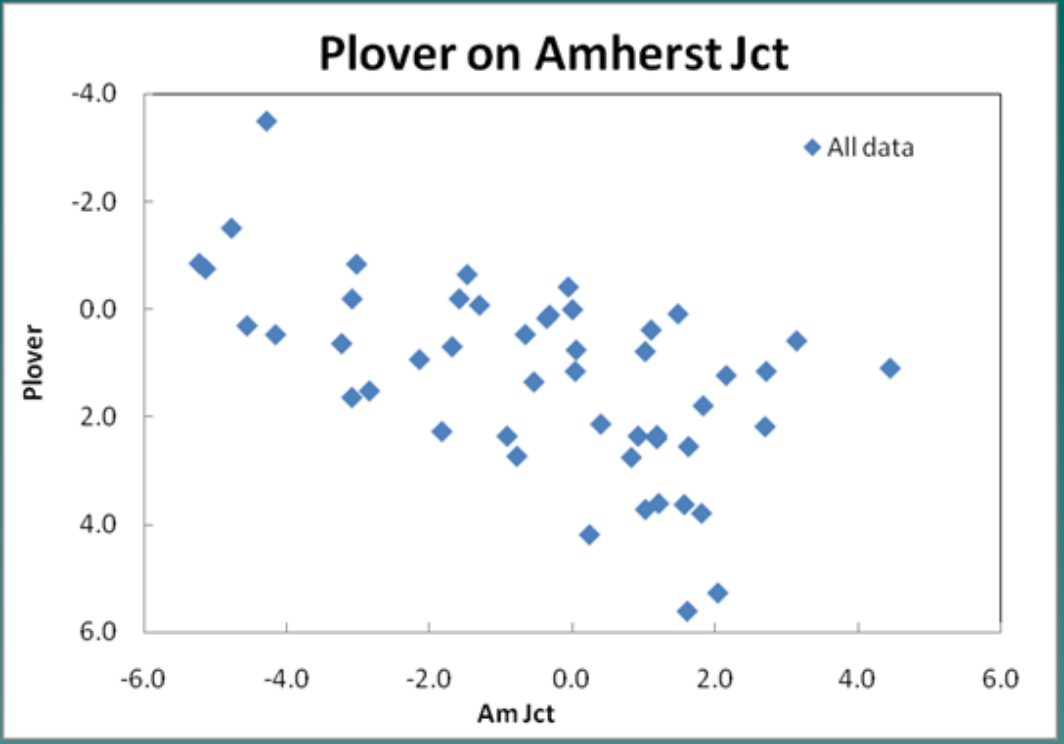
# Reference Lake Level
# Long Lake - Saxeville



# Factor out the weather: Compare a “Control Well” with one near Many High Capacity Wells

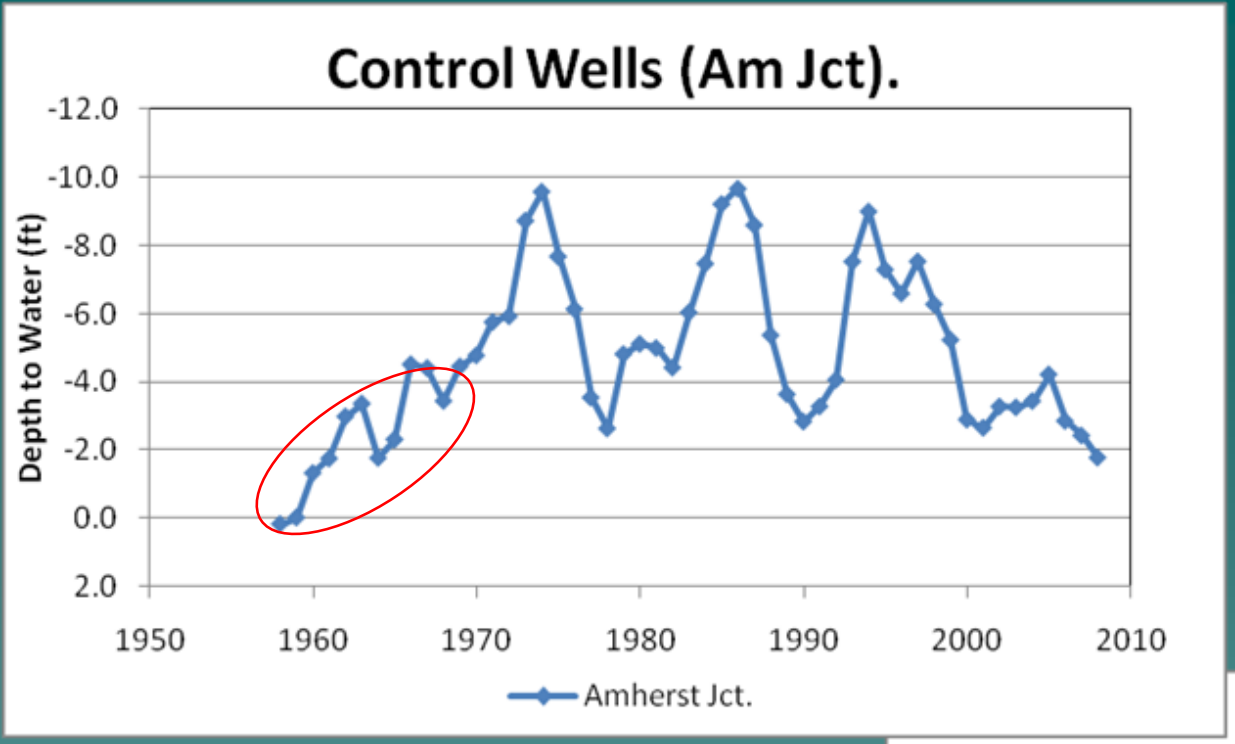


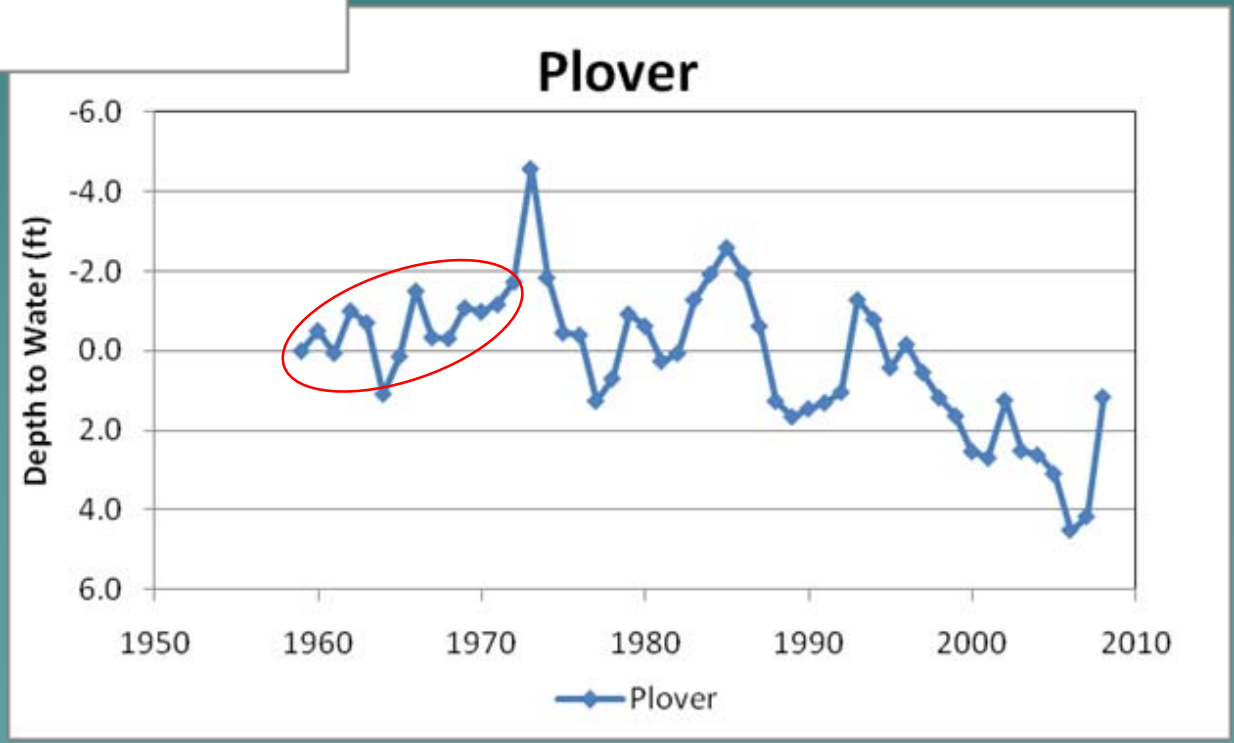



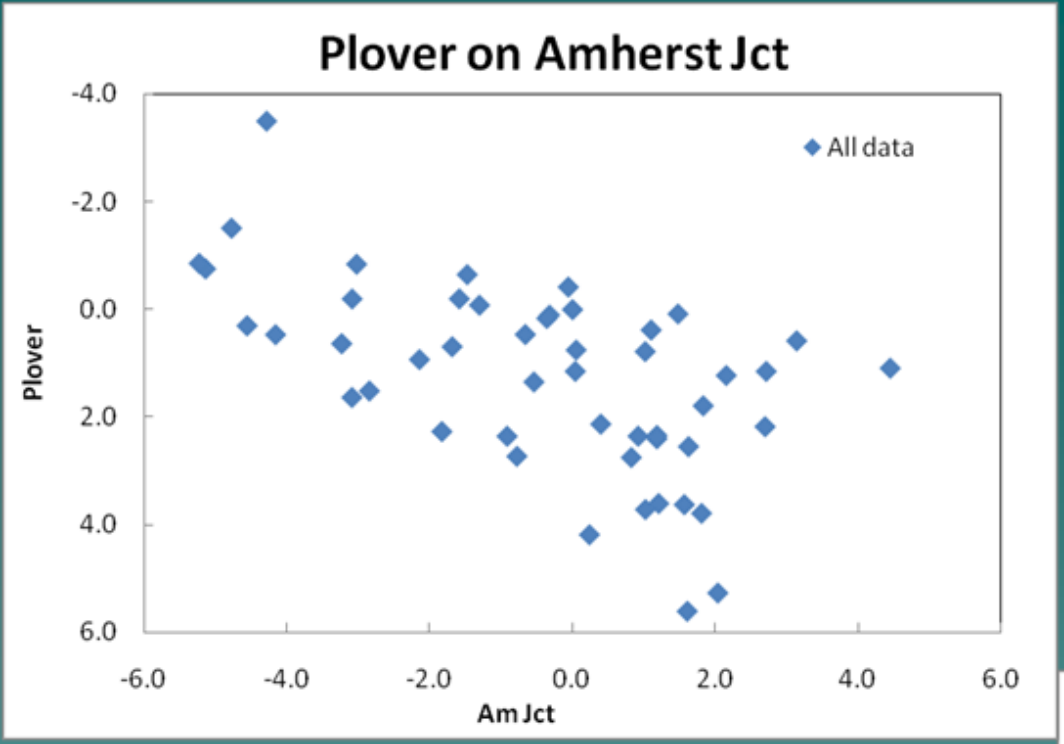



# Plover (Many High Caps) Compared with Amherst Junction (Few High Caps) 1959-2007

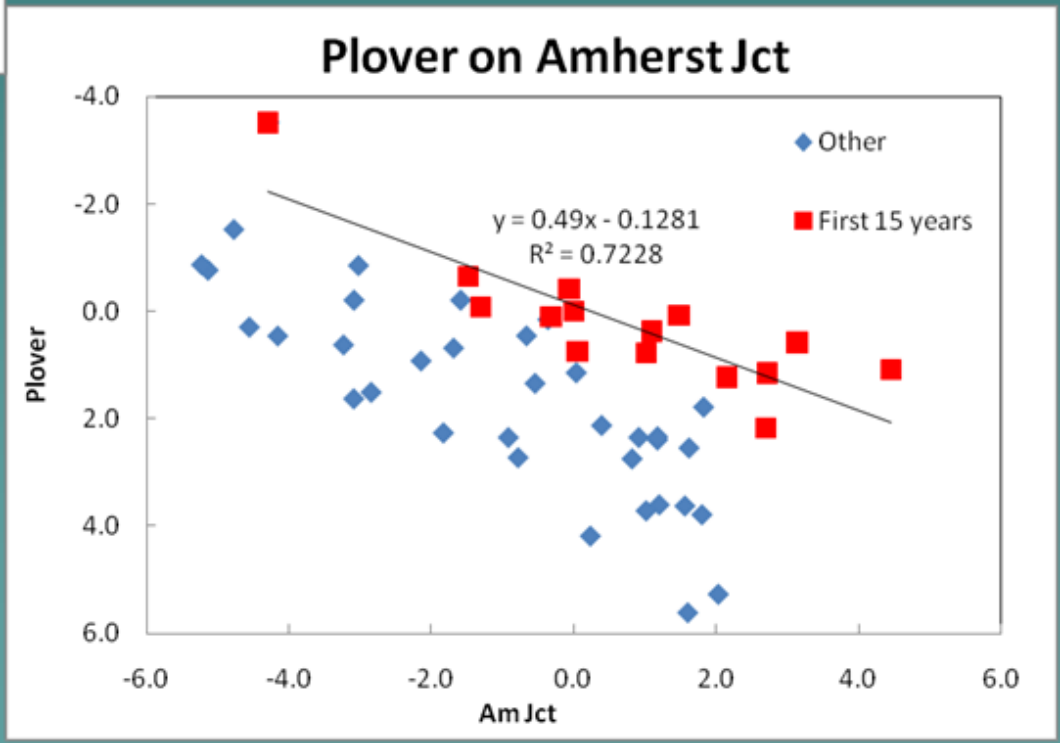
# Early History – Pumping Is Less Developed



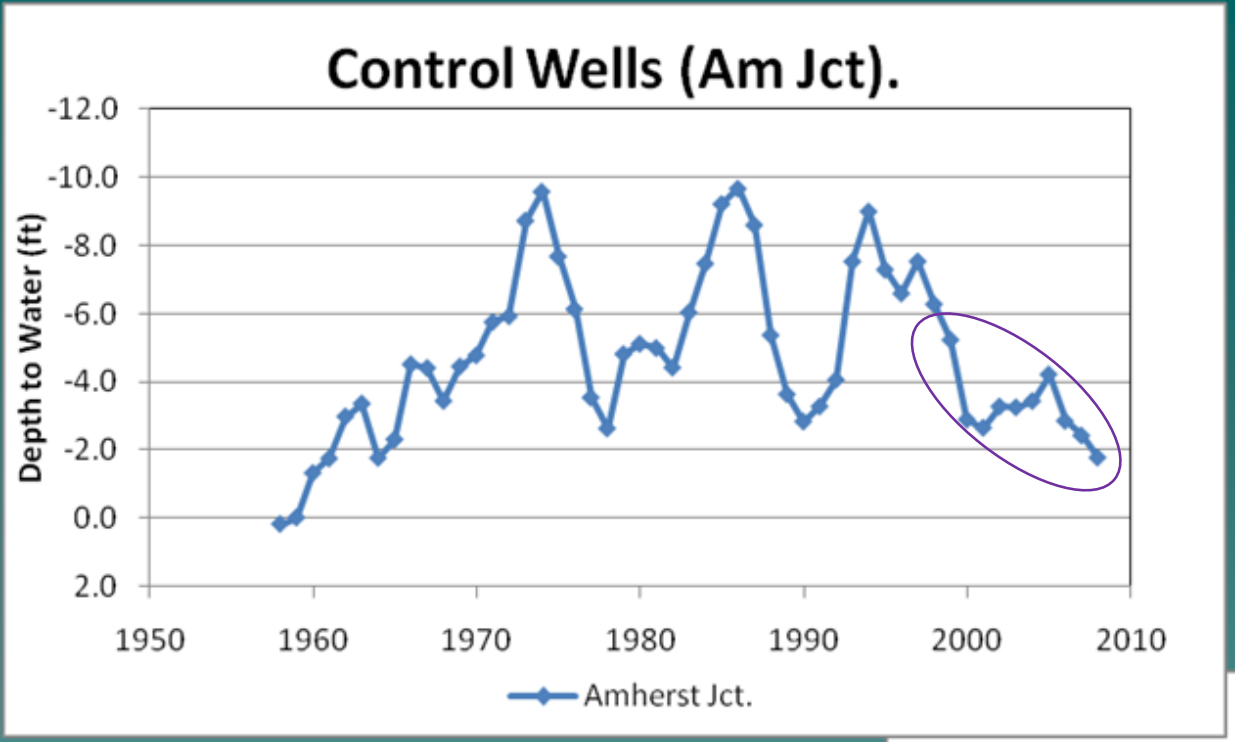



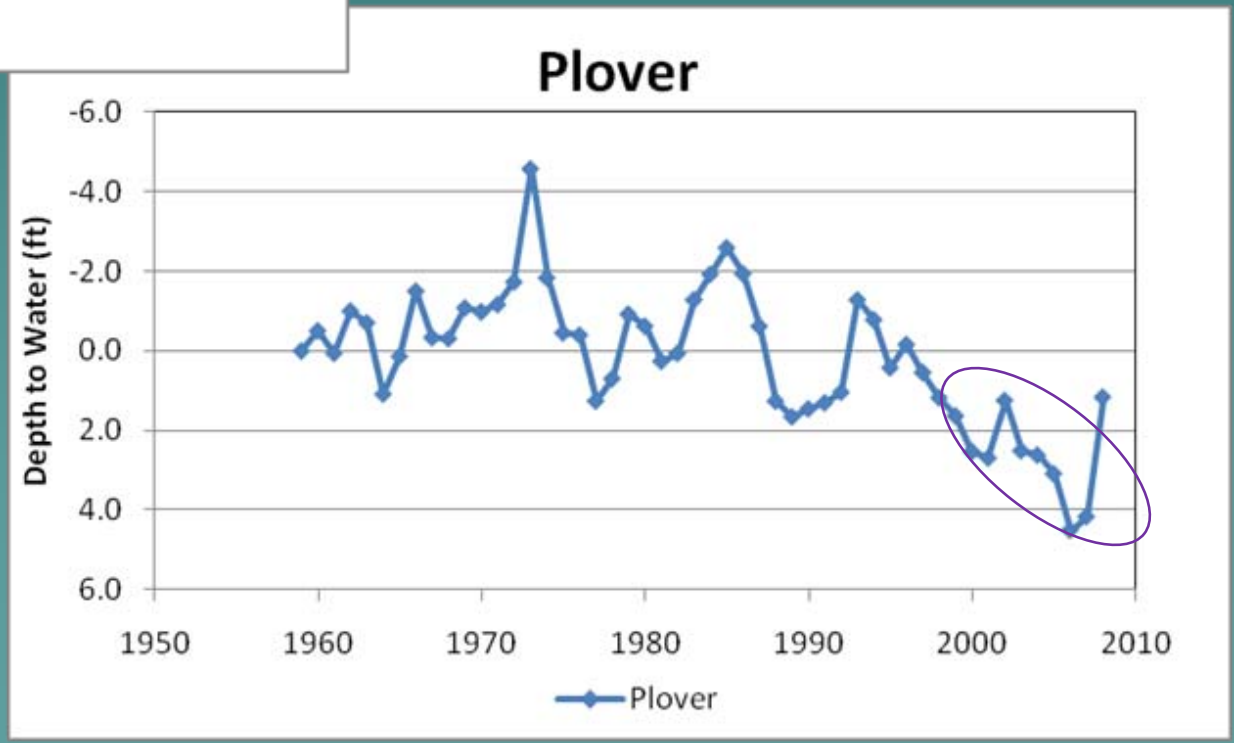


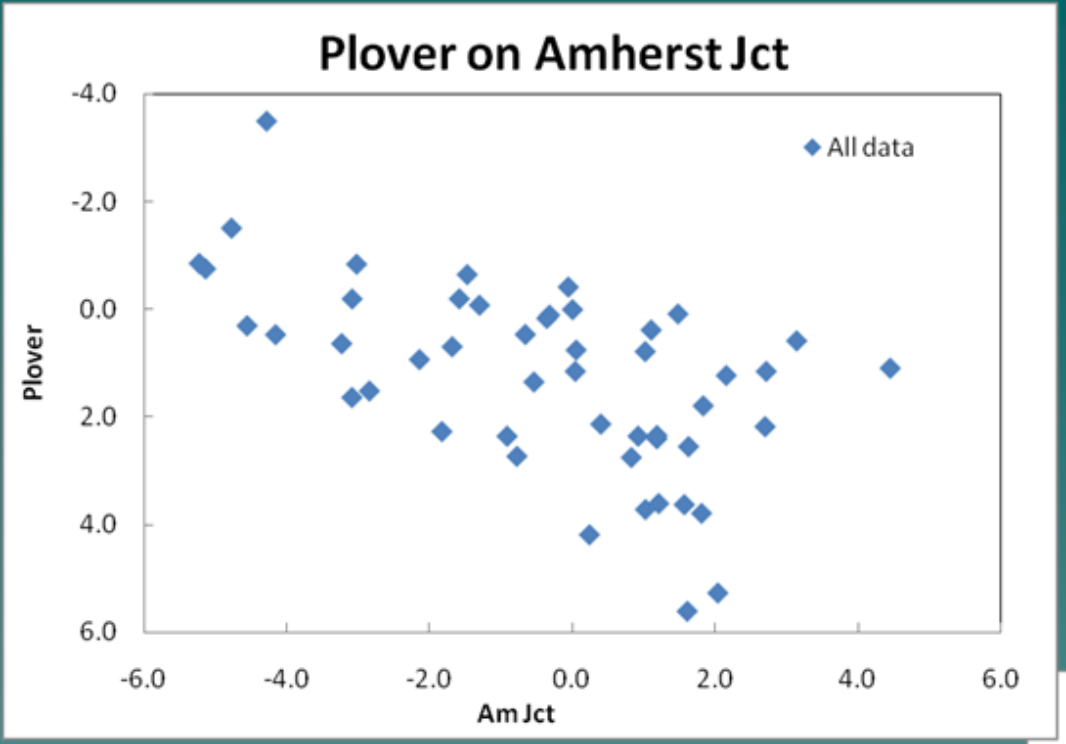

# Early History Shown



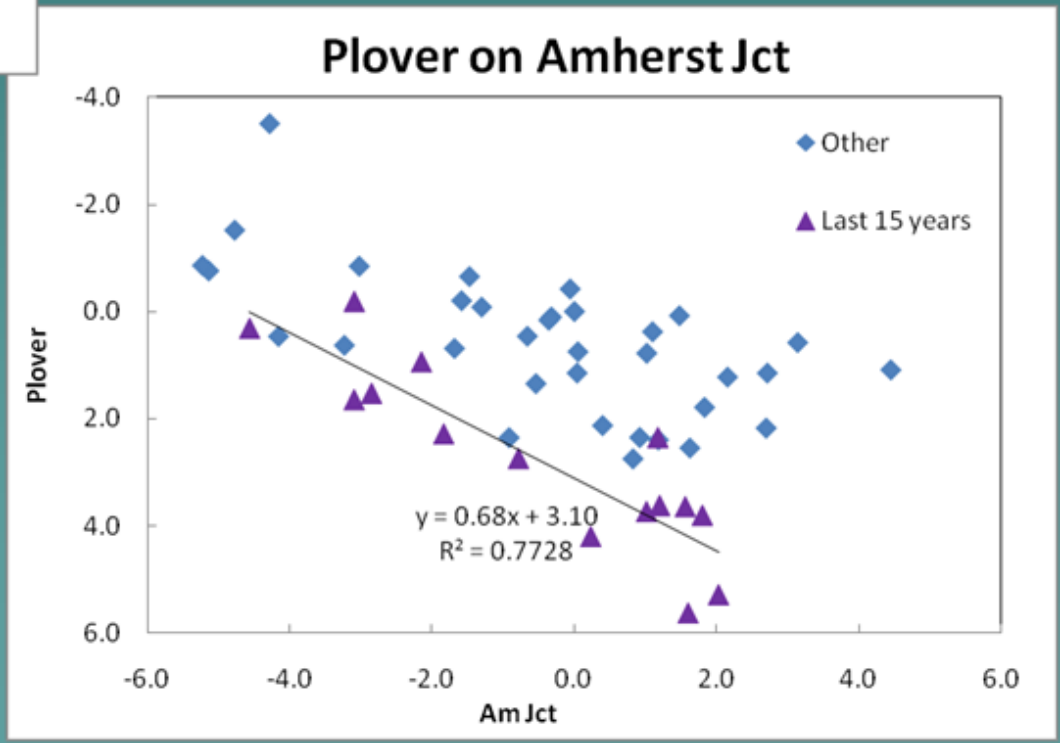
# Late History – Pumping More Developed

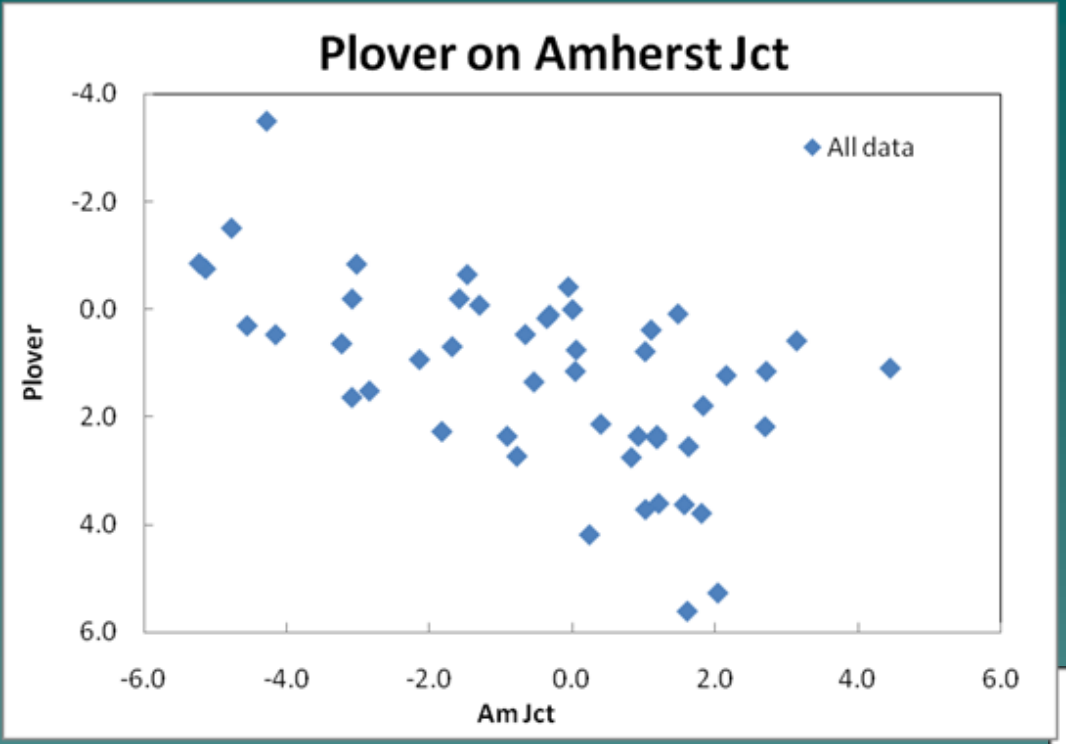


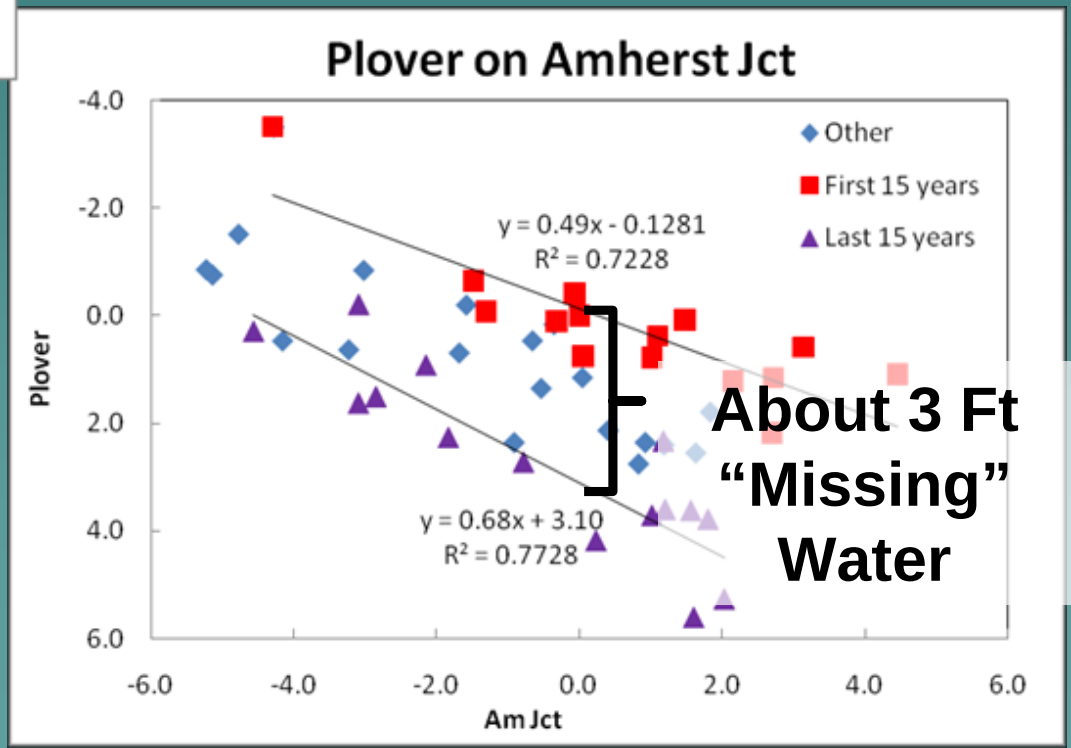



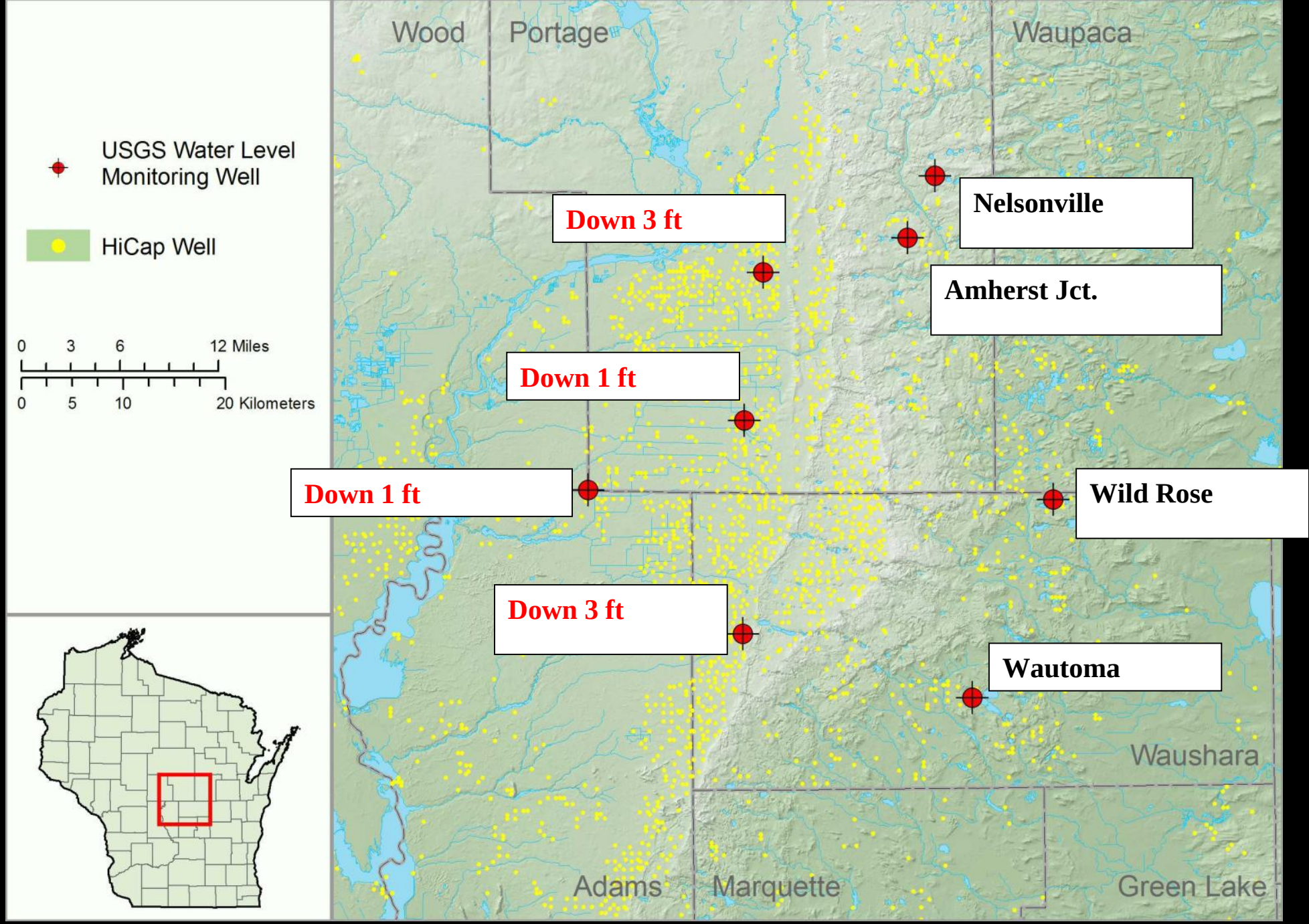



# Late History Shown



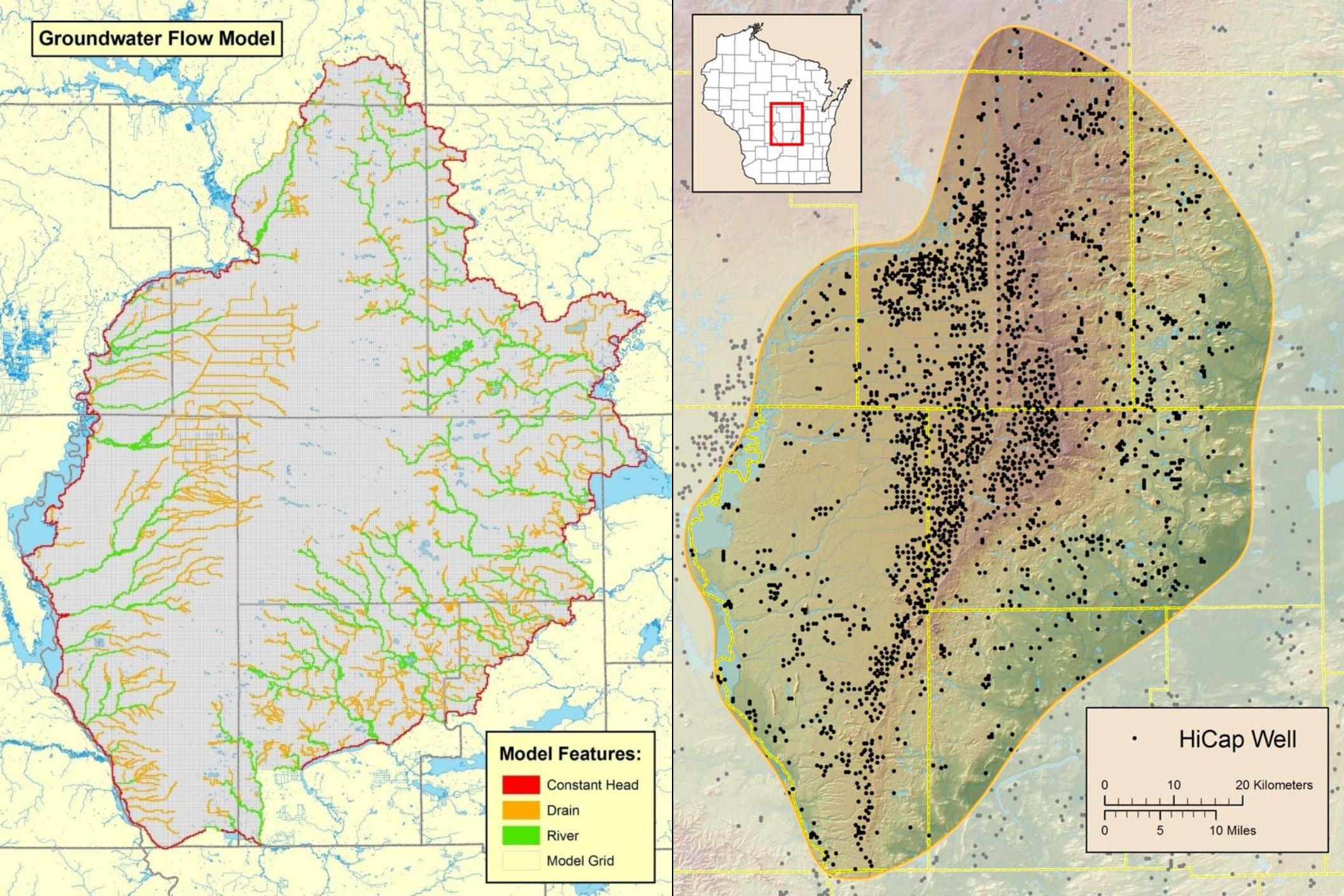

Plover on Amherst Jct
All data
Plover
Am Jct
-4.0
-2.0
0.0
2.0
4.0
6.0
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0


Plover on Amherst Jct
Other
First 15 years
Last 15 years
y = 0.49x - 0.1281
R² = 0.7228
y = 0.68x + 3.10
R² = 0.7728
About 3 Ft
"Missing"
Water
Plover
Am Jct
-4.0
-2.0
0.0
2.0
4.0
6.0
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0


USGS Water Level Monitoring Well
HiCap Well
0 3 6 12 Miles
0 5 10 20 Kilometers
Wood
Portage
Waupaca
Down 3 ft
Nelsonville
Amherst Jct.
Down 1 ft
Down 1 ft
Wild Rose
Down 3 ft
Wautoma
Waushara
Adams
Marquette
Green Lake

# “Missing Water” in Waushara County Lakes

| | |
|---|---|
| Huron Lake | **3.6 ft** |
| Pine Lake (Hancock) | **3.2** |
| Fish Lake | **2.7** |
| Pleasant Lake | **1.5** |
| Burghs | **0.9** |
| Pine (Springville) | **0.8** |


Groundwater Flow Model
Model Features:
Constant Head
Drain
River
Model Grid
HiCap Well
0
10
20 Kilometers
0
5
10 Miles

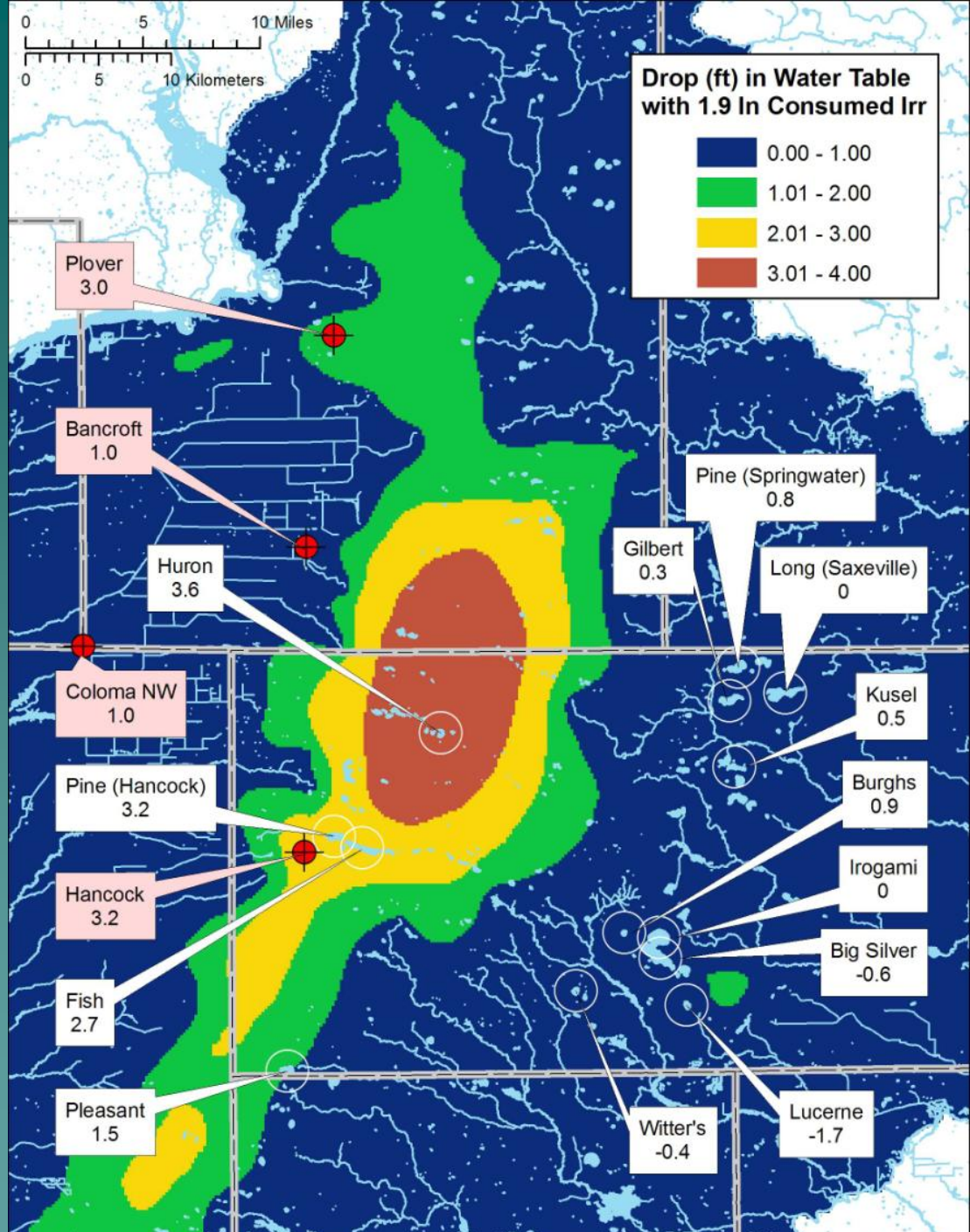
# MISSING WATER

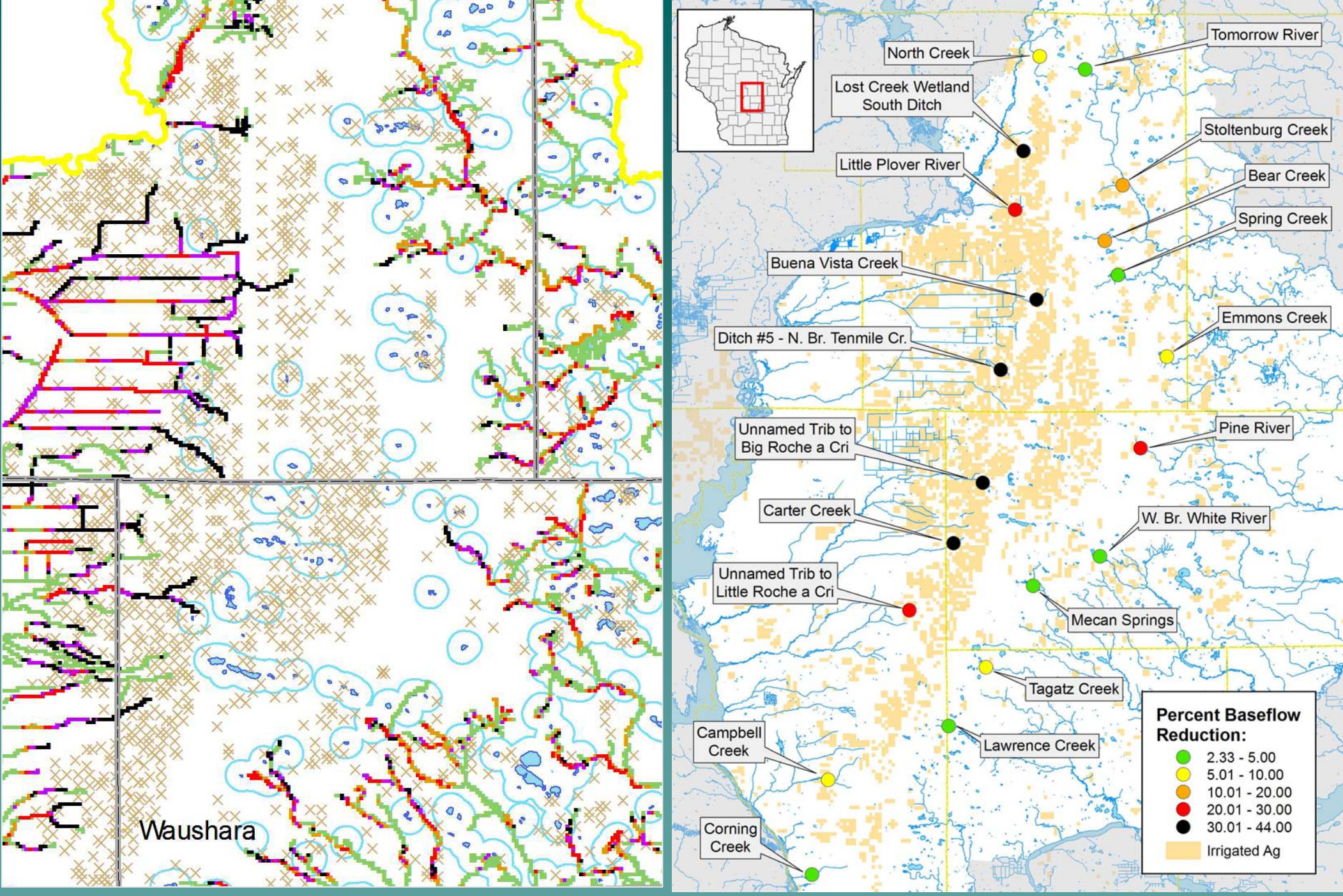
## Colors:

**Groundwater Model - With 1.9” average recharge reduction on Irrigated land**

## Boxes:

**Statistically estimated**

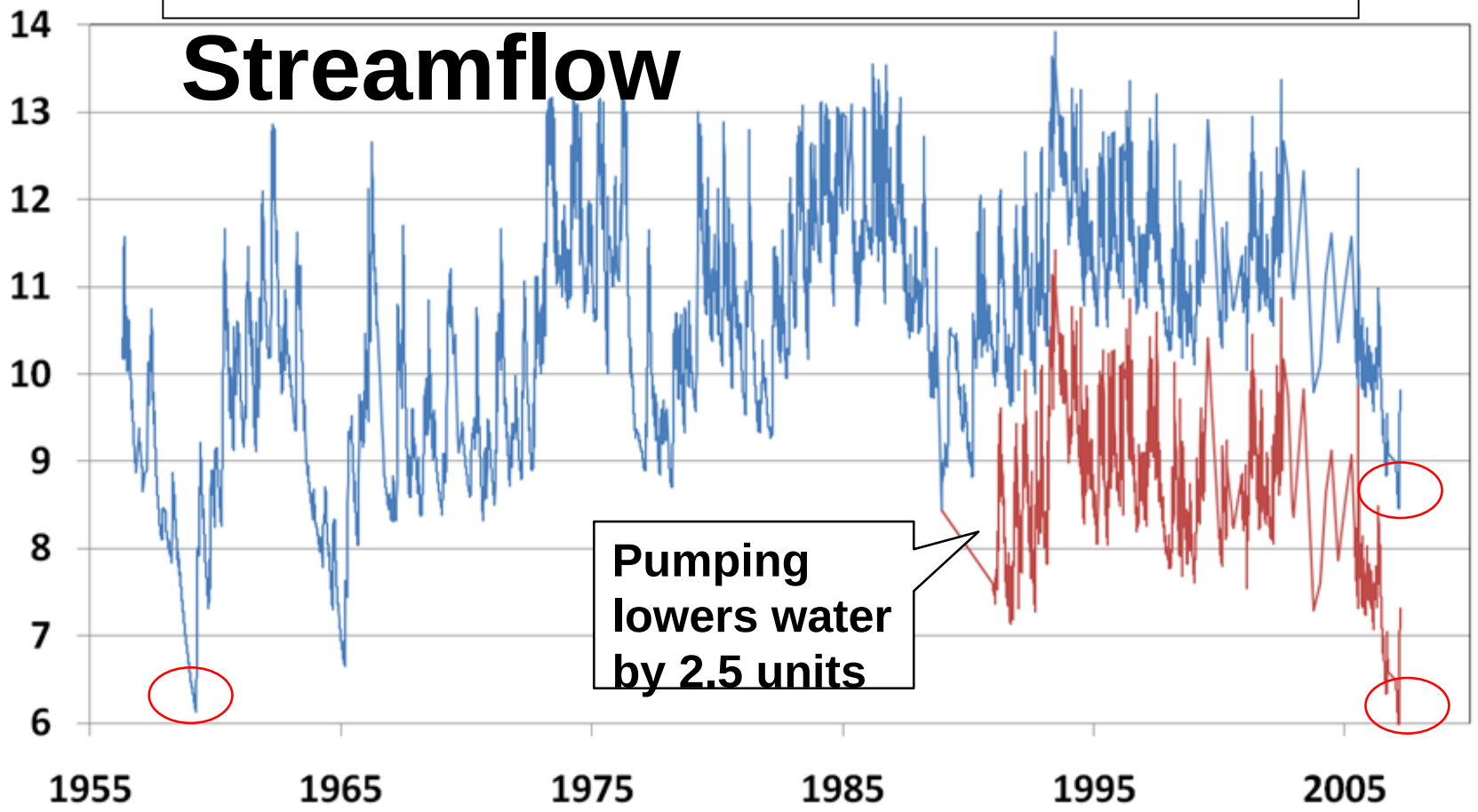



Waushara
North Creek
Tomorrow River
Lost Creek Wetland South Ditch
Stoltenburg Creek
Little Plover River
Bear Creek
Spring Creek
Buena Vista Creek
Emmons Creek
Ditch #5 - N. Br. Tenmile Cr.
Pine River
Unnamed Trib to Big Roche a Cri
Carter Creek
W. Br. White River
Unnamed Trib to Little Roche a Cri
Mecan Springs
Tagatz Creek
Campbell Creek
Lawrence Creek
Corning Creek
Percent Baseflow Reduction:
2.33 - 5.00
5.01 - 10.00
10.01 - 20.00
20.01 - 30.00
30.01 - 44.00
Irrigated Ag

# Conclusions for Central Sands

- Present “dry” weather is not that unusual
- Water is “missing” from lakes, streams, and groundwater
- Recharge reduction on irrigated land (due to increased ET) averaging ~ 2” explains missing water in Waushara County
- Recharge reduction on irrigated land averaging 5.5” explains LPR missing water

# Water Level or Streamflow



# Water Level or Streamflow