Changes to River Baseflow Across Minnesota

Midwest Ground Water Conference
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Introduction

- Describe baseflow study.
- Share results of analytic review of flow data.
- Review complicating issues.
- Provide update on recently completed, integrated SWAT/MODFLOW models for the Little Rock Creek Watershed.

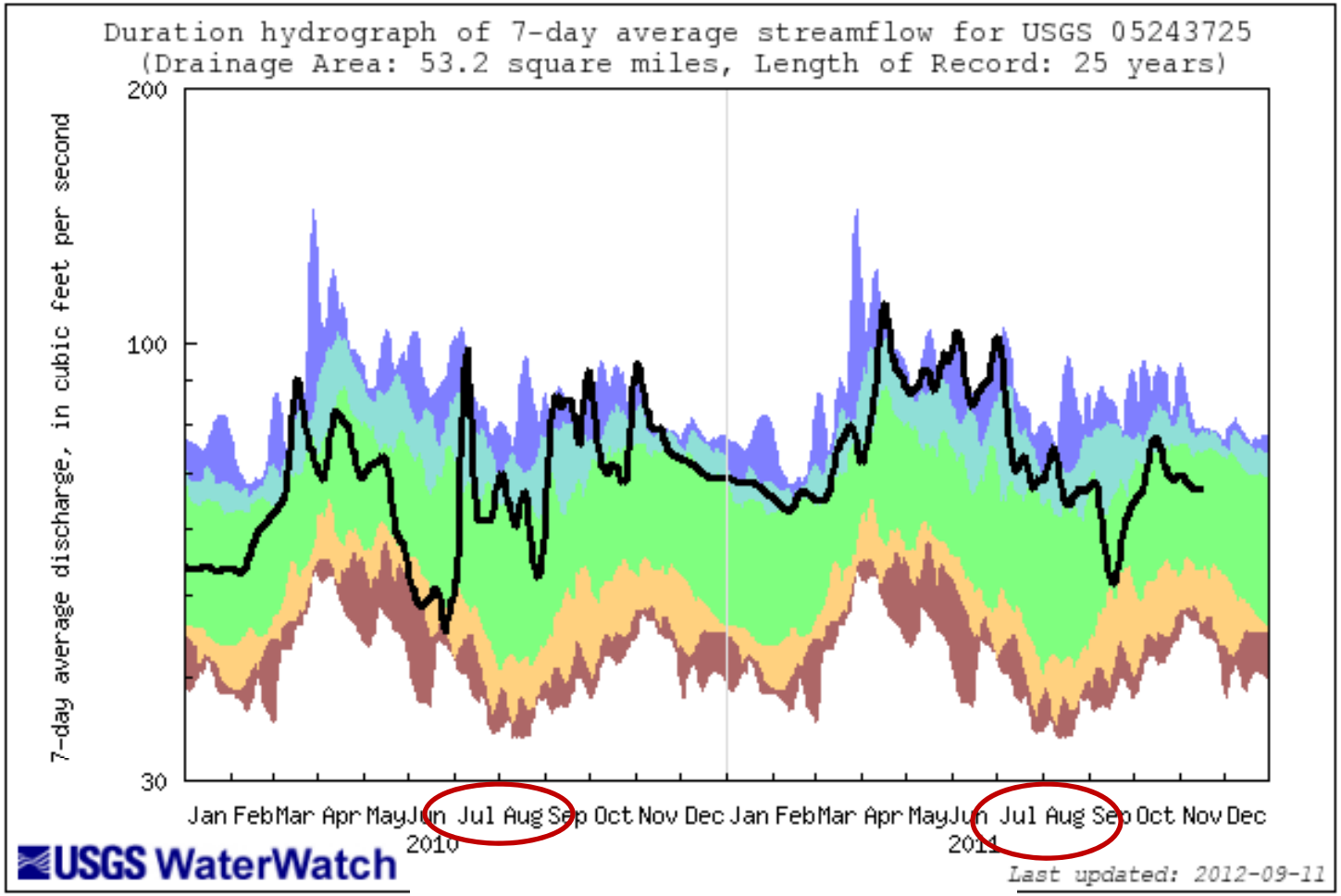
Baseflow

- Definition from the USGS: baseflow is that part of streamflow that is sustained primarily by groundwater discharge. It is not attributable to direct runoff from precipitation or melting snow.

Flow-duration hydrographs

- A cumulative frequency curve that shows the percentage of time that specified discharges are equaled or exceeded.

Straight River



Explanation - Percentile classes					
lowest-10th percentile	10-24	25-75	76-90	90th percentile -highest	Flow
Much below normal	Below normal	Normal	Above normal	Much above normal	

Gaging station dataset

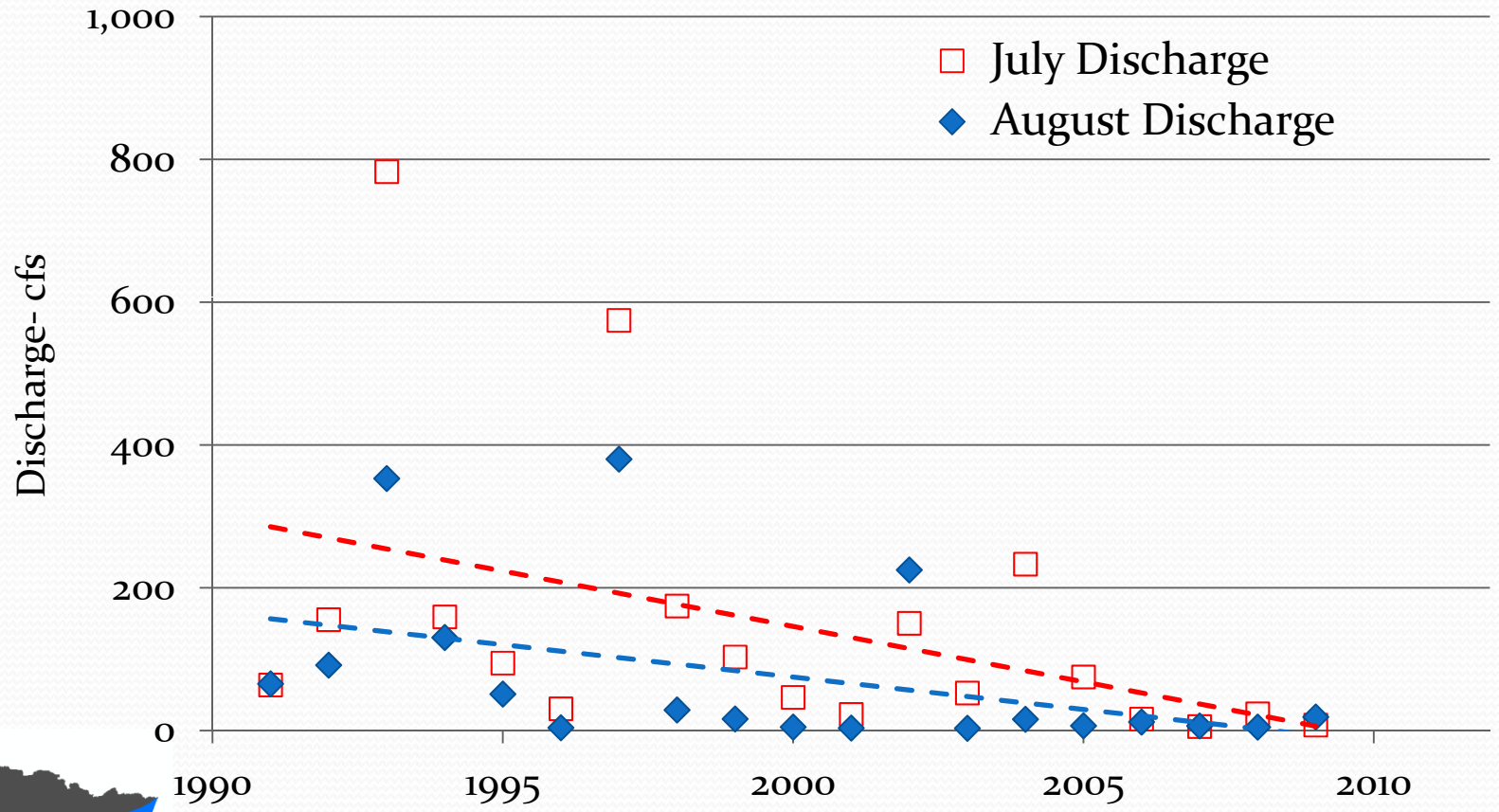
Determining trends in flow.

Two measures

1) Statistically significant trends via Mann-Kendall non-parametric trend tests; and

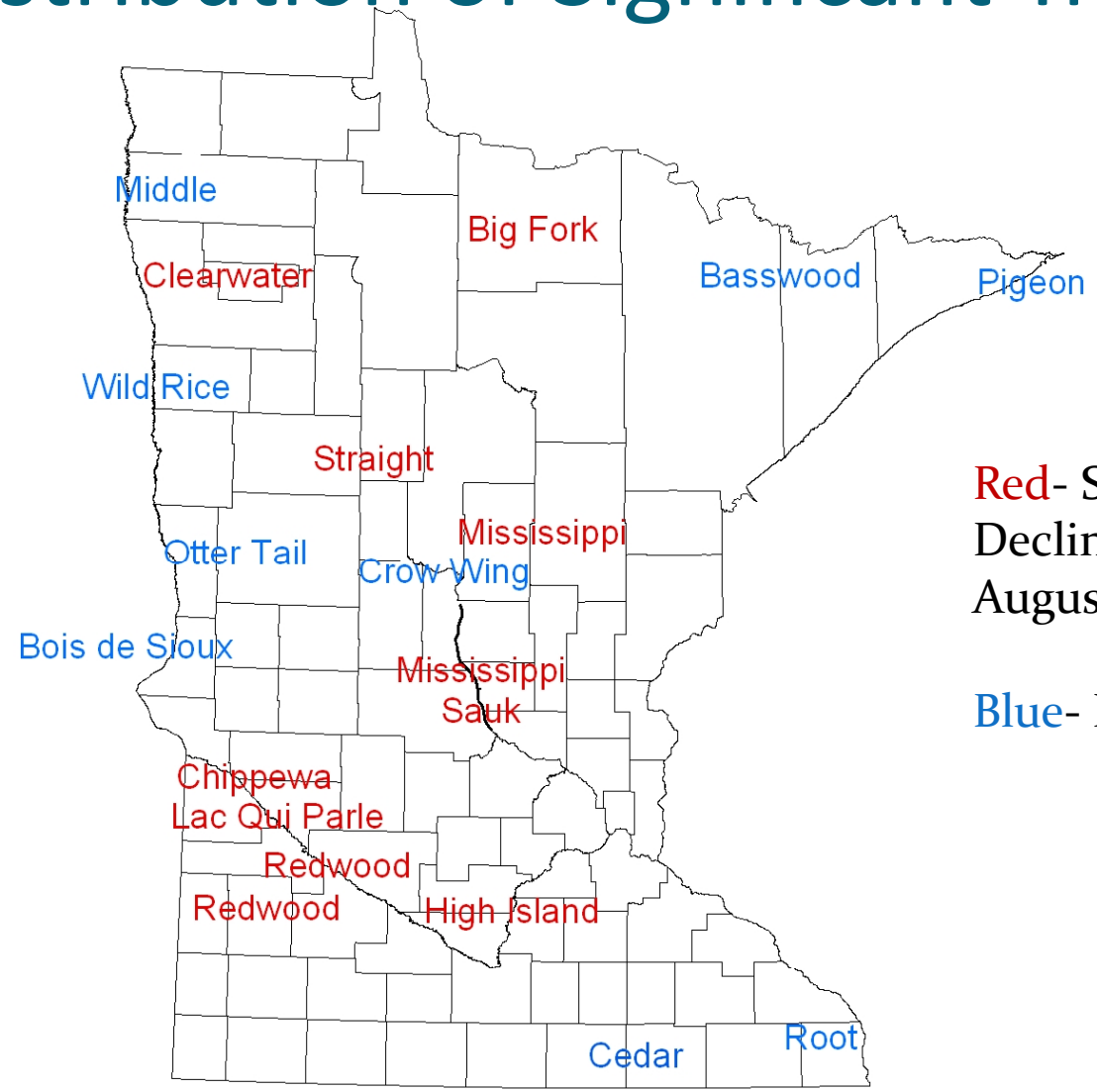
2) Sign test analysis of all trends.

High Island Creek- Summer flow



Statistically Significant Discharge Trends

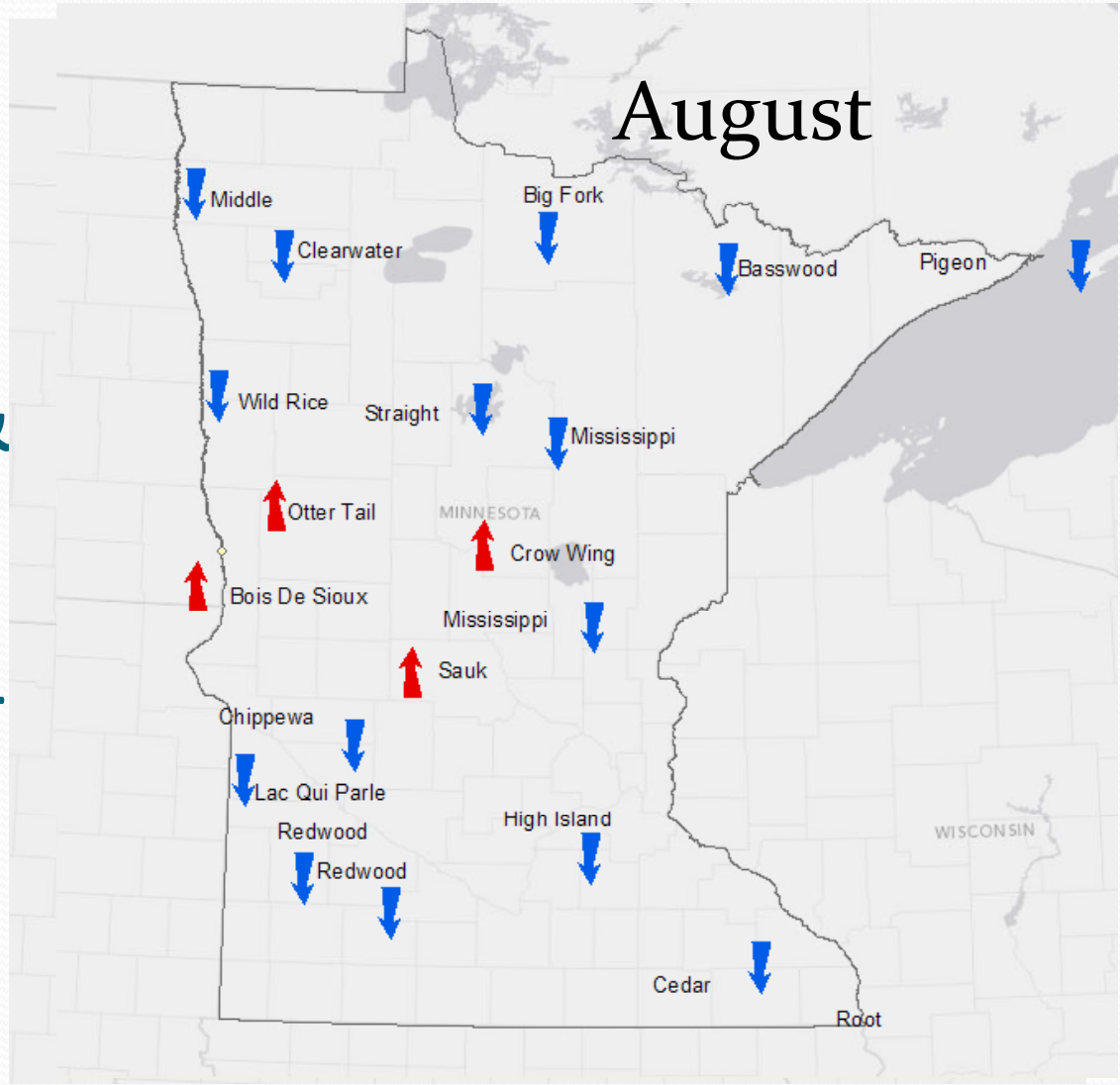
Distribution of Significant Trends



Red- Statistically Significant Decline in July and August Flows

Blue- No significant trend

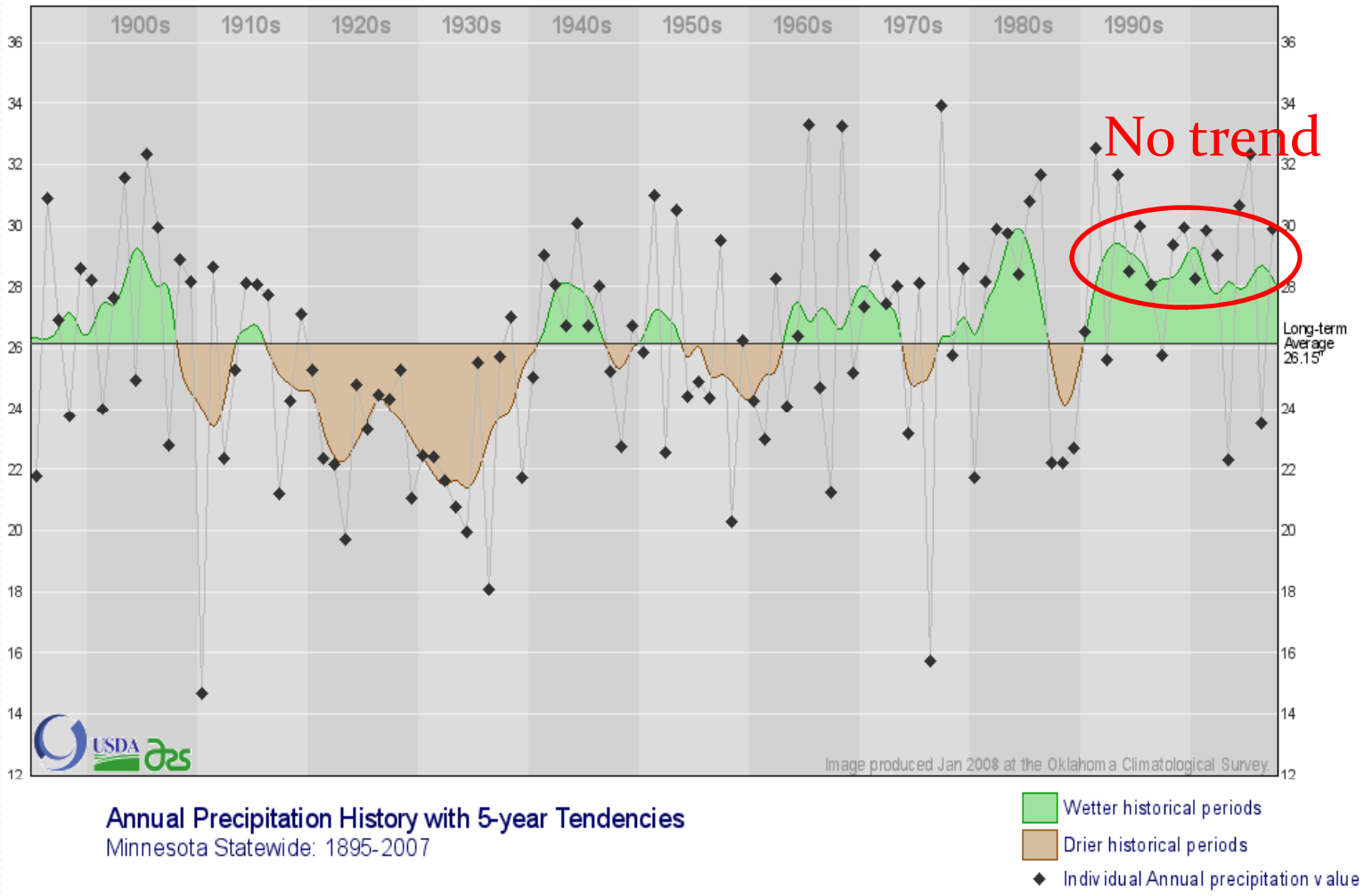
Summer Trends in Flow: July & August 1991 - 2011



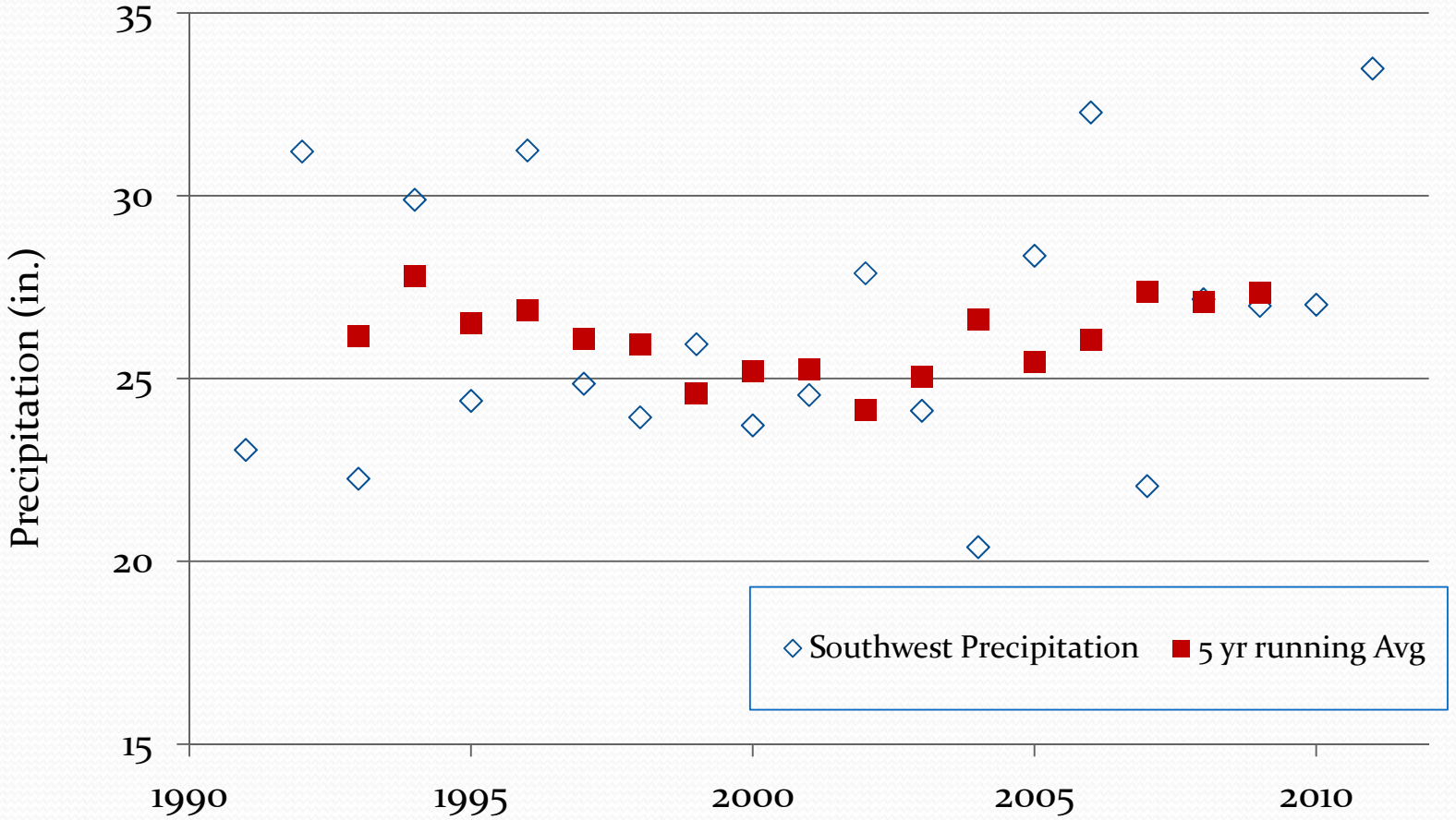
Hydrologic Context

- Precipitation
- Annual mean flow
- High capacity water withdrawals
- Field tiling

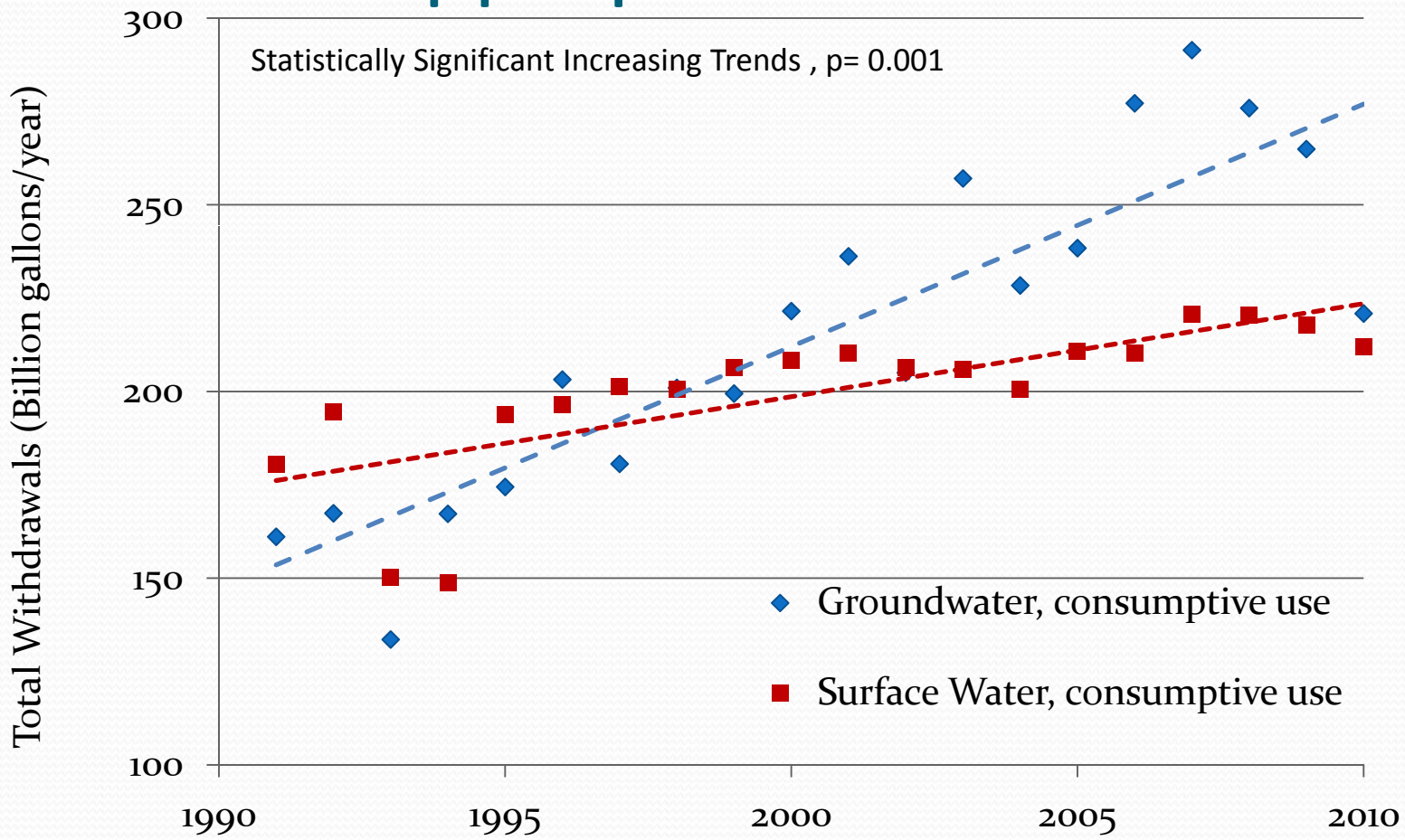
MN Annual Precipitation



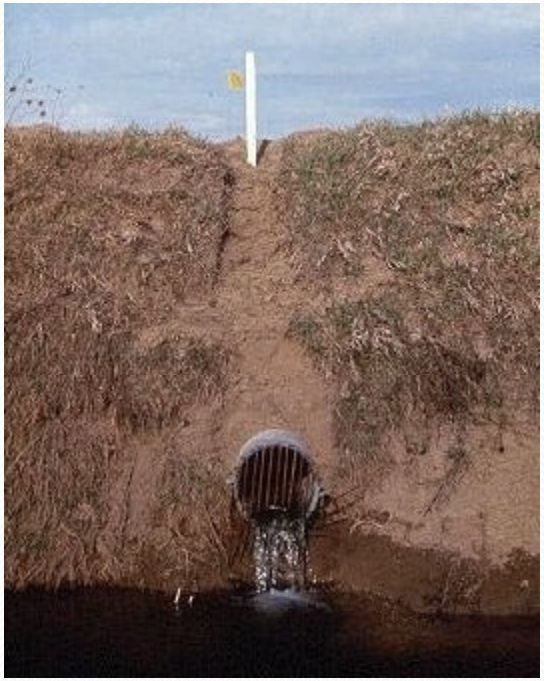
Southwest MN Precipitation Data: 1991 - 2010



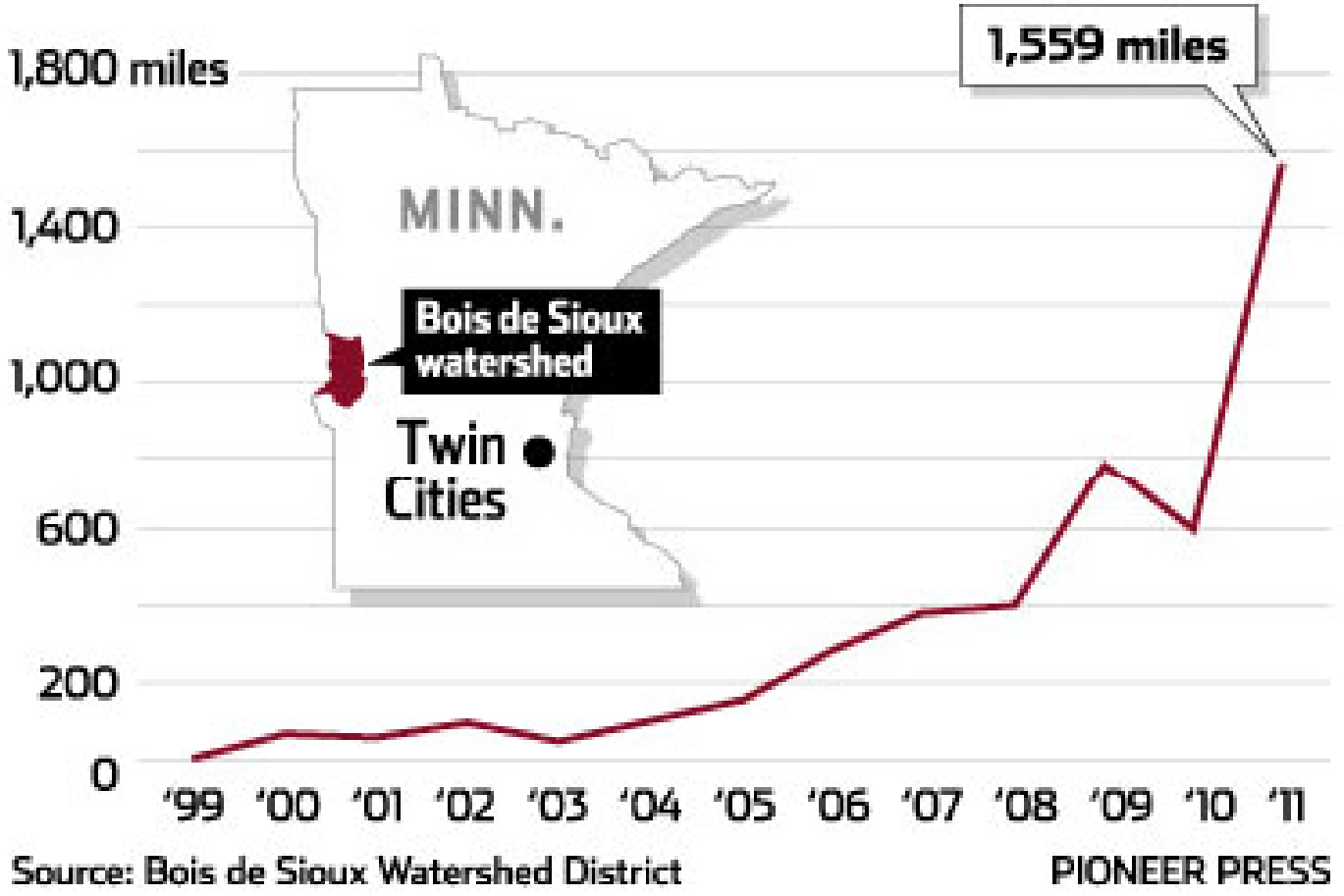
Minnesota Statewide Water Appropriations Data



Field Tiling



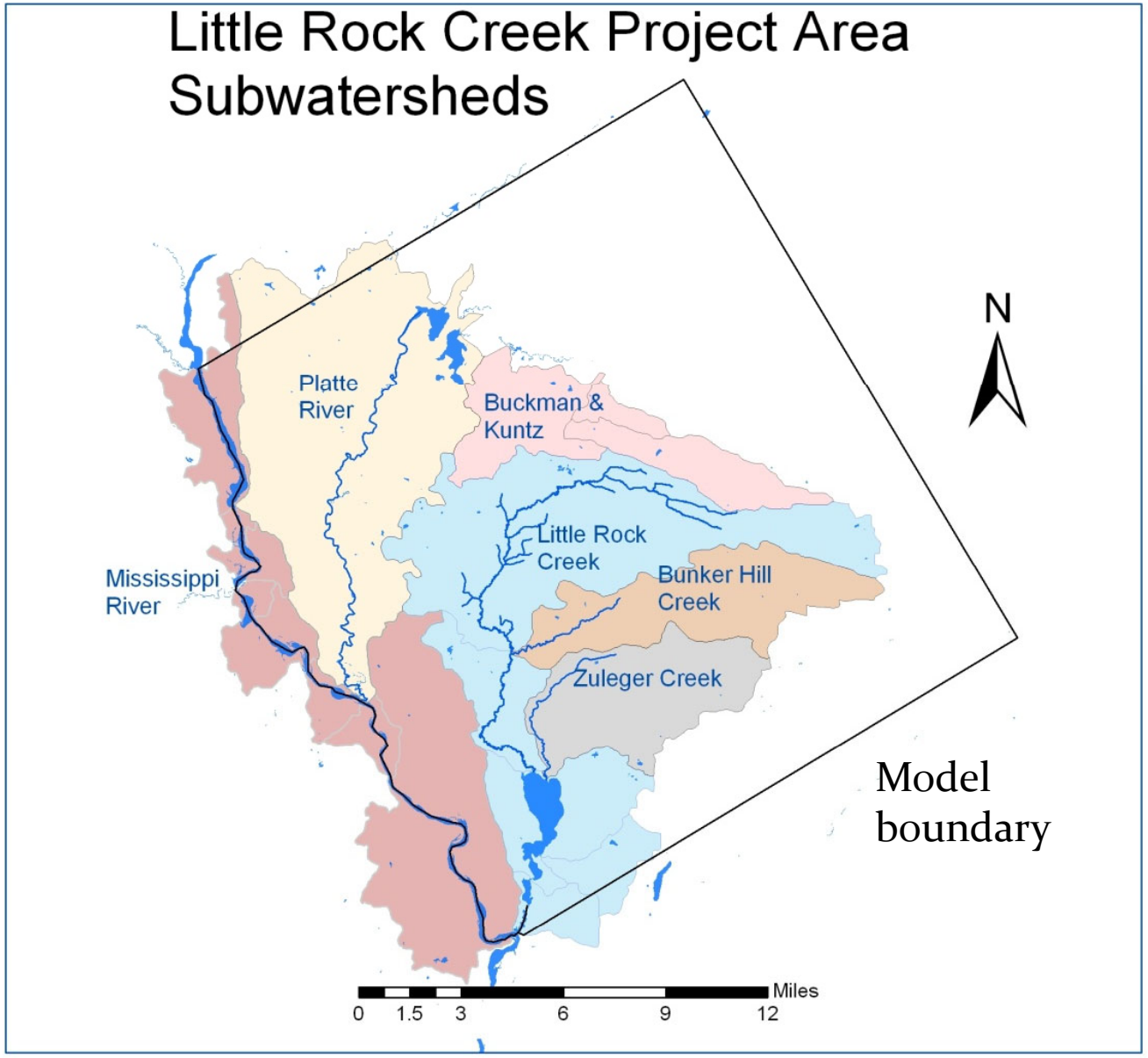
Bois de Sioux watershed



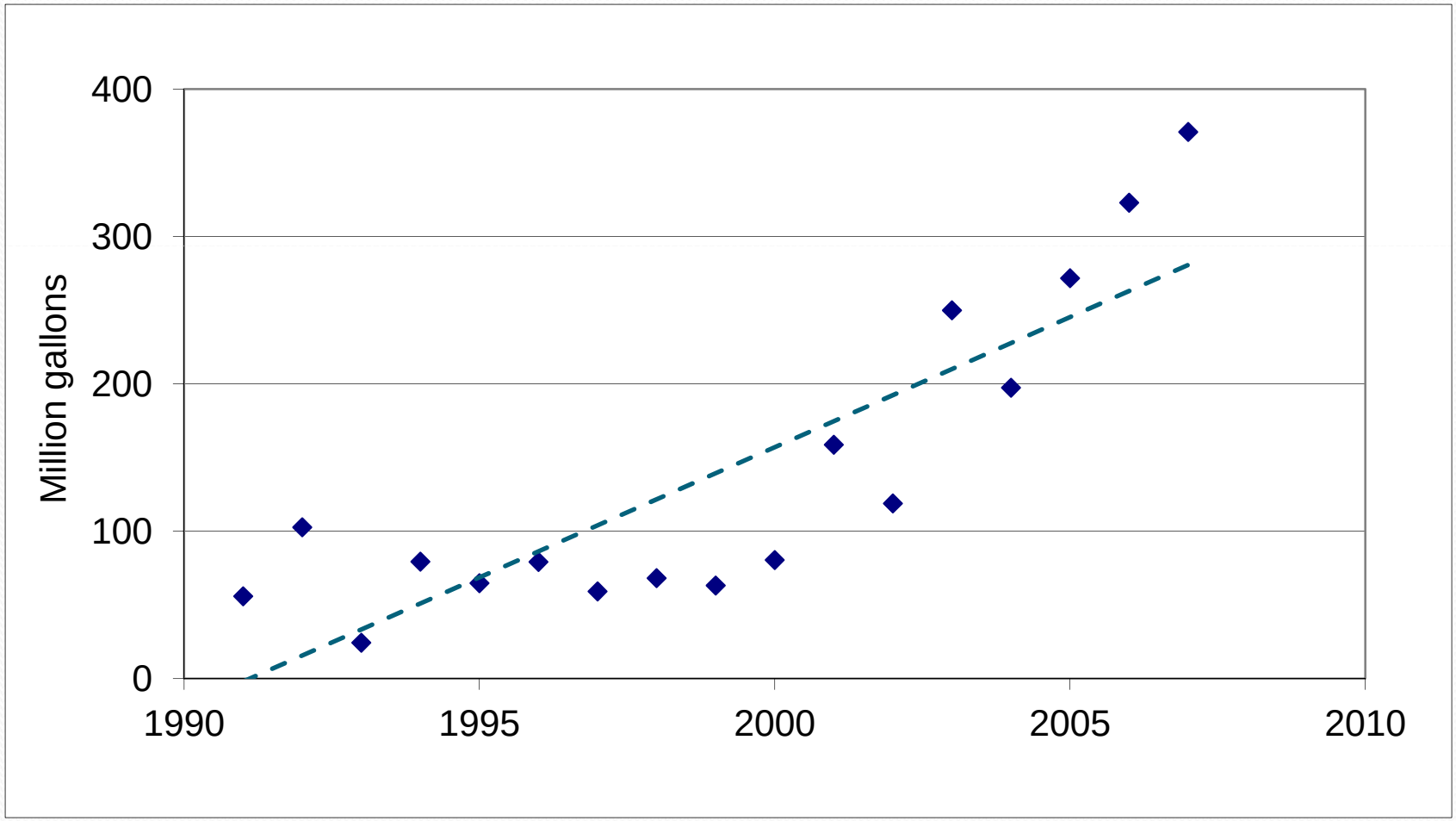
Little Rock Creek Watershed

Minnesota Test Case for Groundwater Management?

Little Rock Creek Study Area

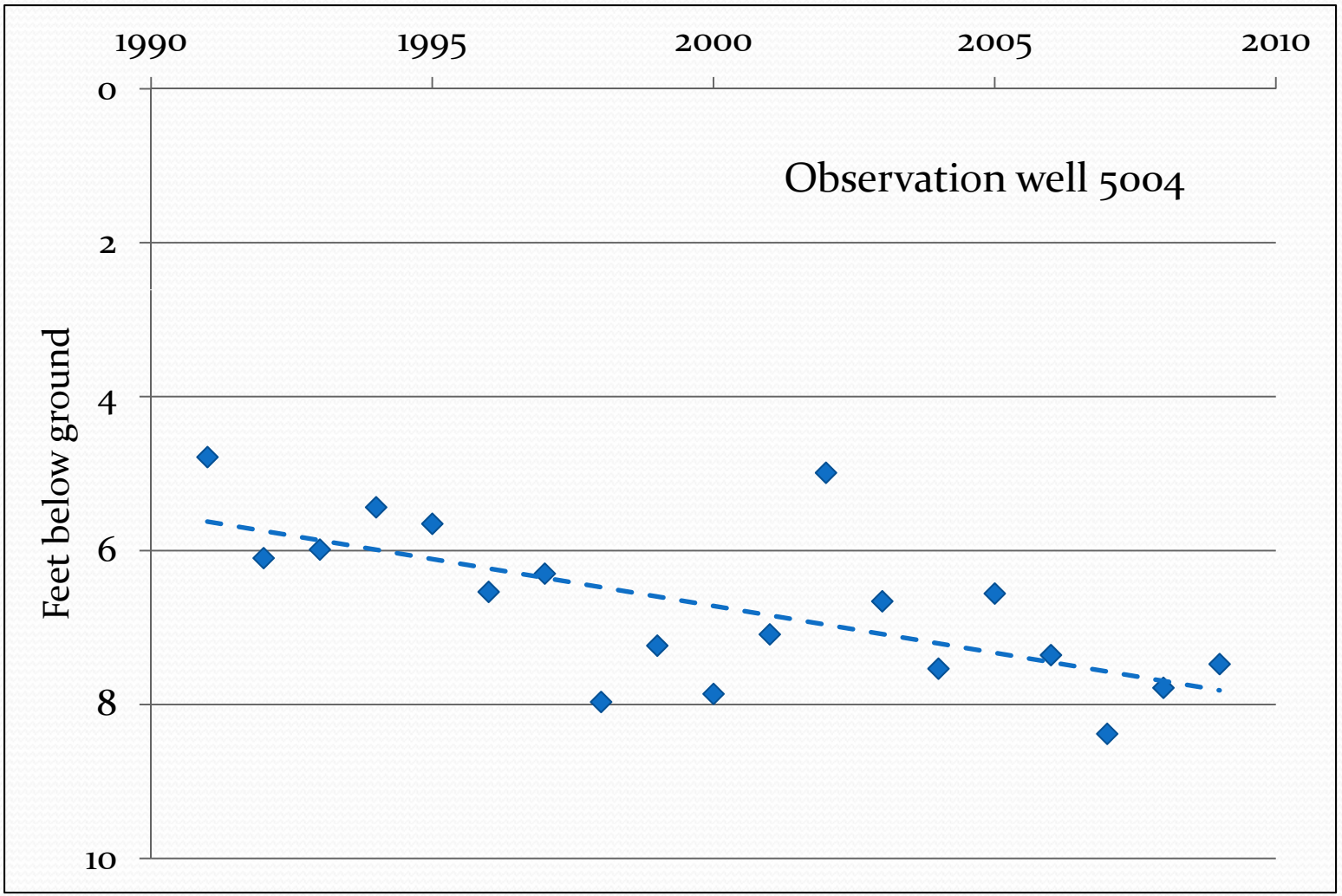


Groundwater Pumping in the Watershed



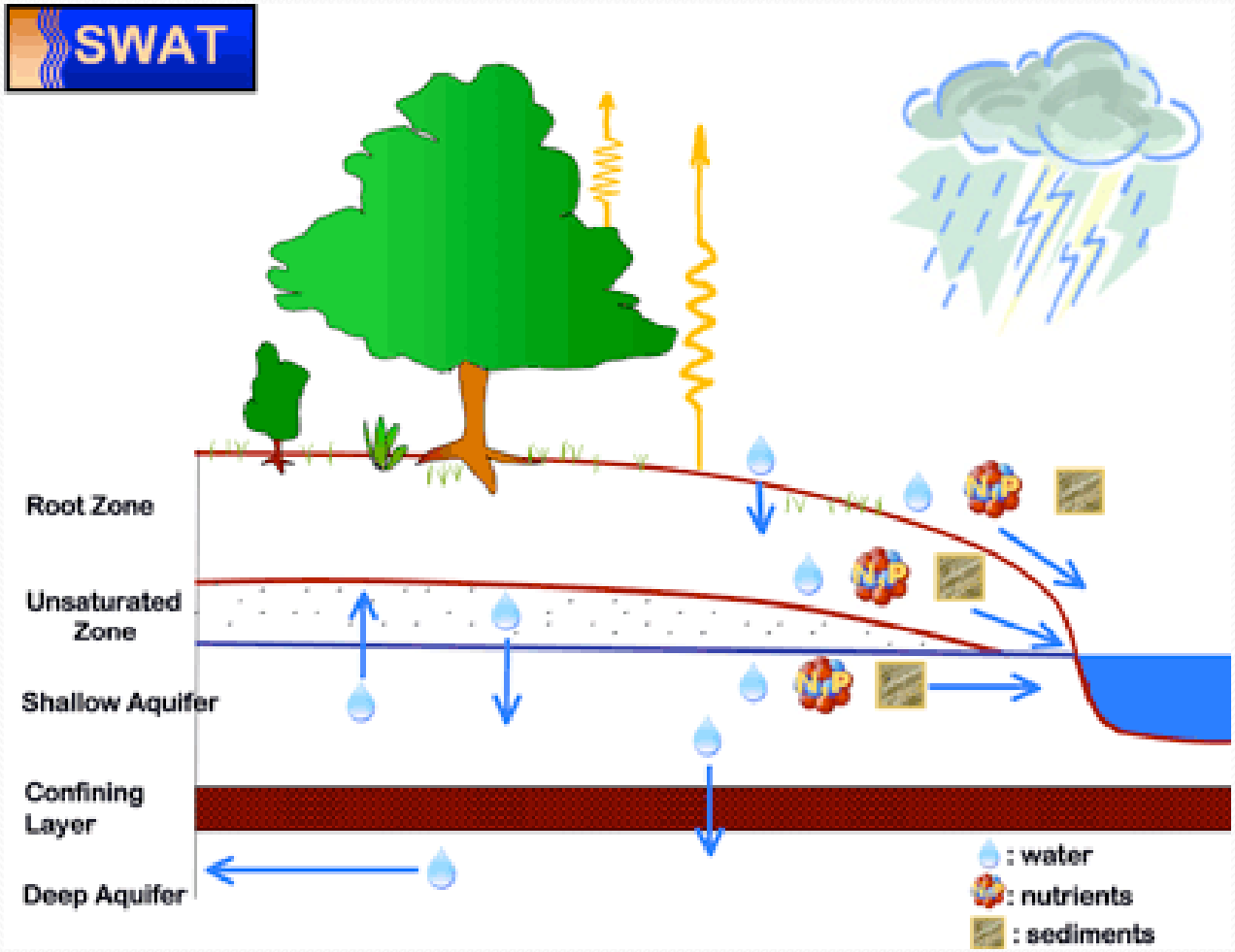
Statistically significant to p= 0.01

Groundwater Levels



Statistically significant decline, p= 0.01

Phase 2- Coupled Surface Water & Groundwater models



Baseflow Conclusions

- Baseflow in Minnesota streams is undergoing statistically significant declining trends;
- Precipitation does not appear to be responsible;
- Groundwater & surface water withdrawals do appear to be partially responsible, and the increased installation of field tiling may be a factor;
- Detailed groundwater/surface water modeling at a pilot watershed provides us with tools to manage the use of water resources while protecting stream ecology.

The End