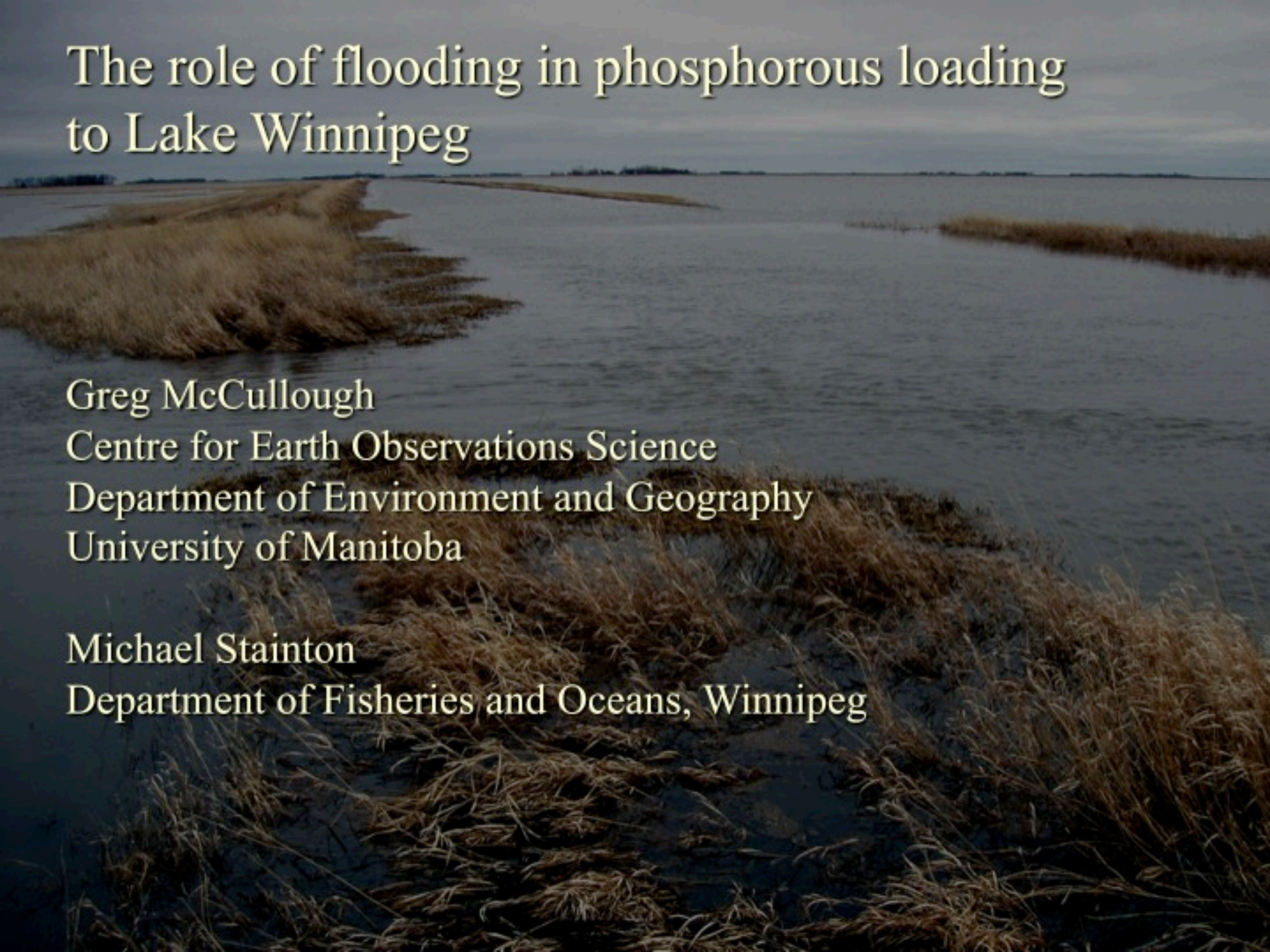


# The role of flooding in phosphorous loading to Lake Winnipeg

The background image shows a vast, calm body of water, possibly a lake or a wide river, under a grey, overcast sky. In the foreground, there are patches of tall, dry, brown grasses growing in shallow water or mudflats. The horizon is flat and distant, with some faint silhouettes of land or structures. The overall tone is somber and naturalistic.

Greg McCullough

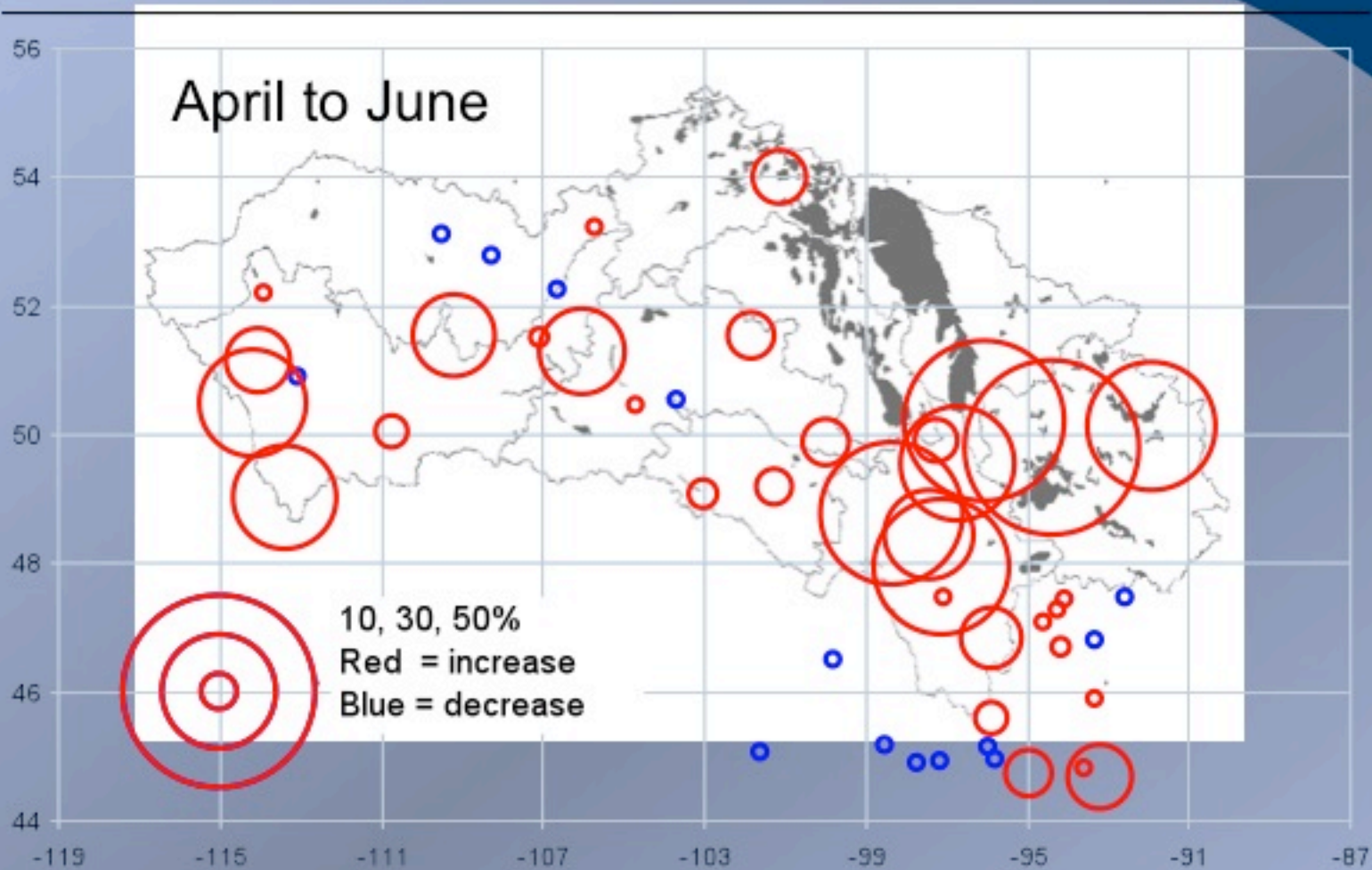
Centre for Earth Observations Science

Department of Environment and Geography

University of Manitoba

Michael Stainton

Department of Fisheries and Oceans, Winnipeg

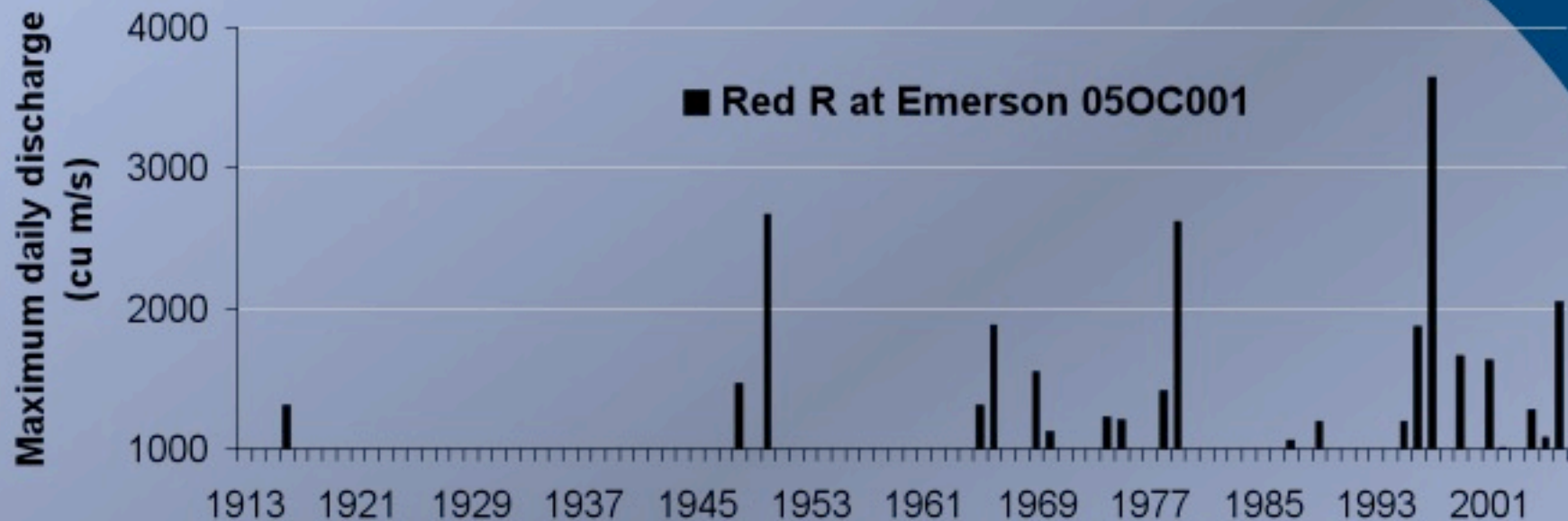


## Precipitation change in the upper Nelson watershed.

1996-2005 compared to 1946-1995 (difference / base period).

Sources: Adjusted Historical Canadian Climate Data (AHCCD, <http://www.cccma.ec.gc.ca/hccd/>) and U.S. Historical Climatology Network (USHCN, <http://cdiac.ornl.gov/epubs/ndp/usncn/monthly.html>)

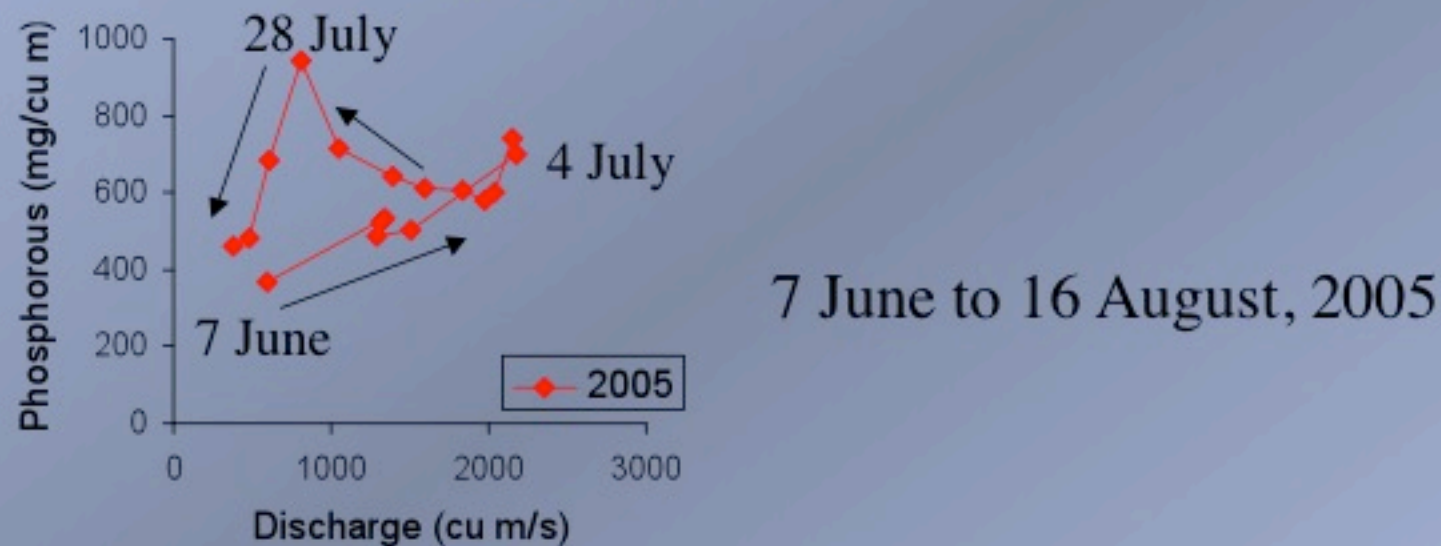
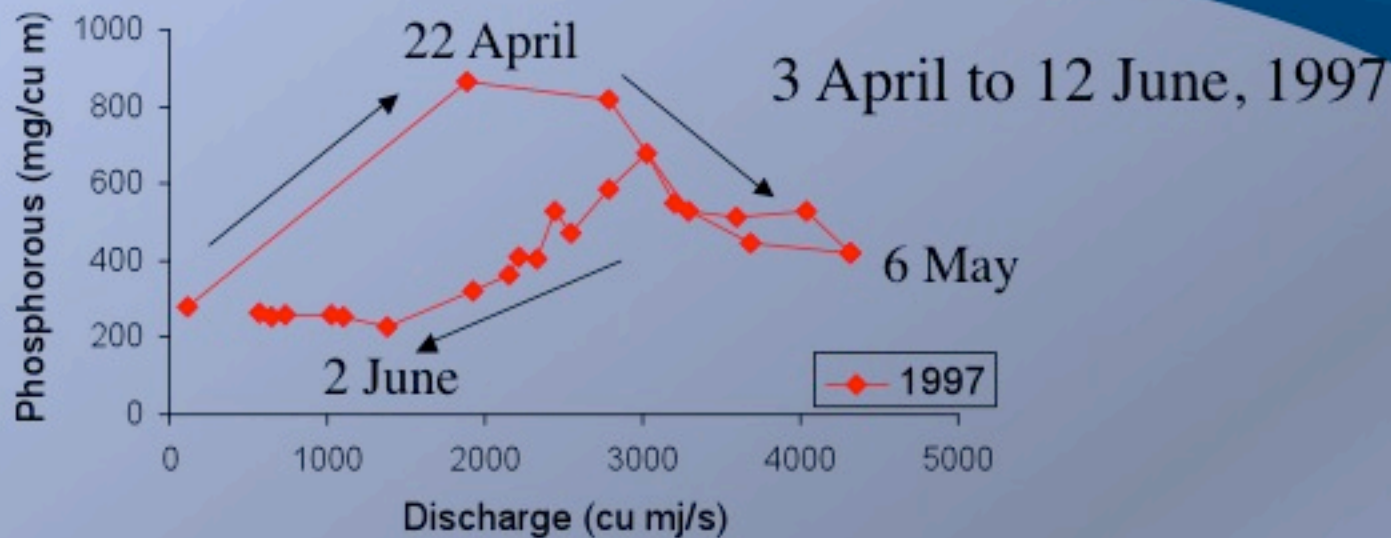




## Historic floods on the Red River

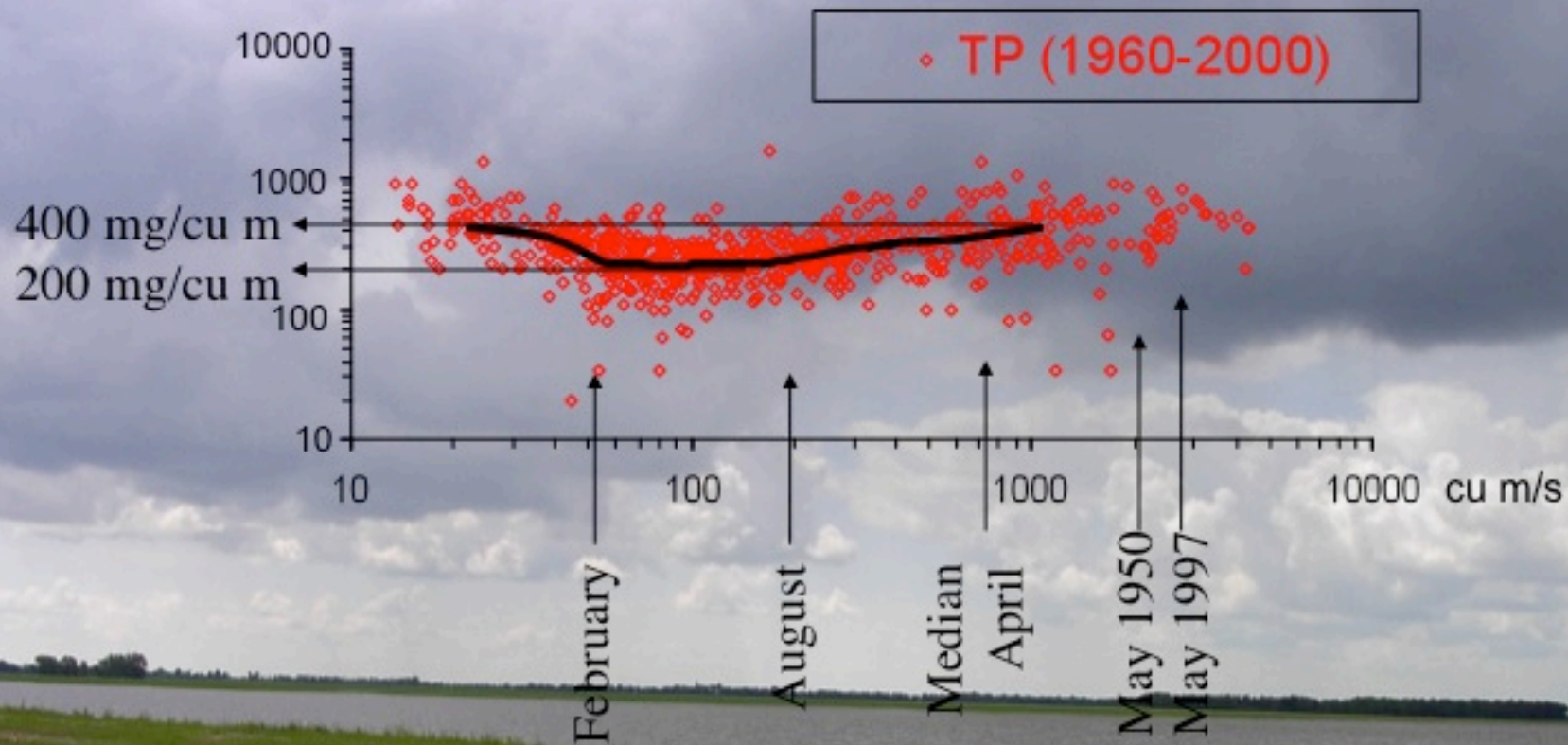
Bankfull stage at Emerson is ~1000 cu m/s



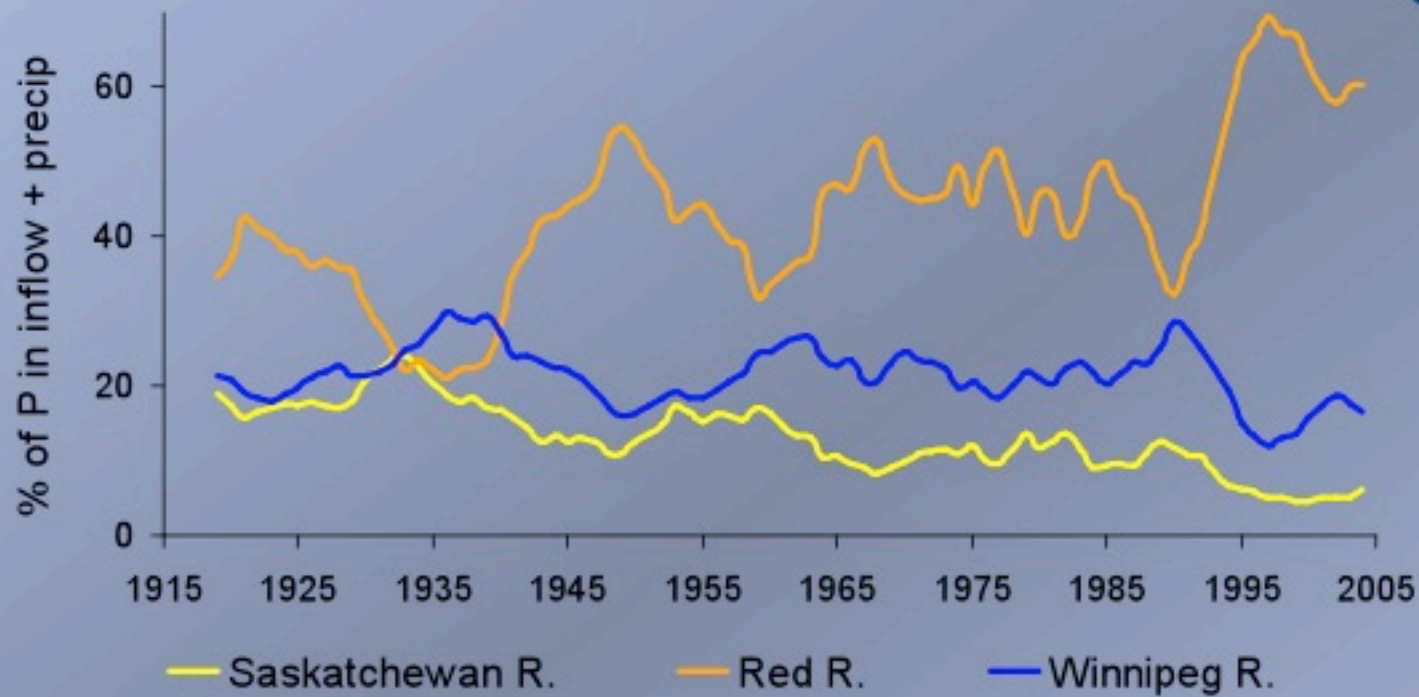


Phosphorous concentrations during two Red River floods. Arrows follow time series from early to late in flood period.





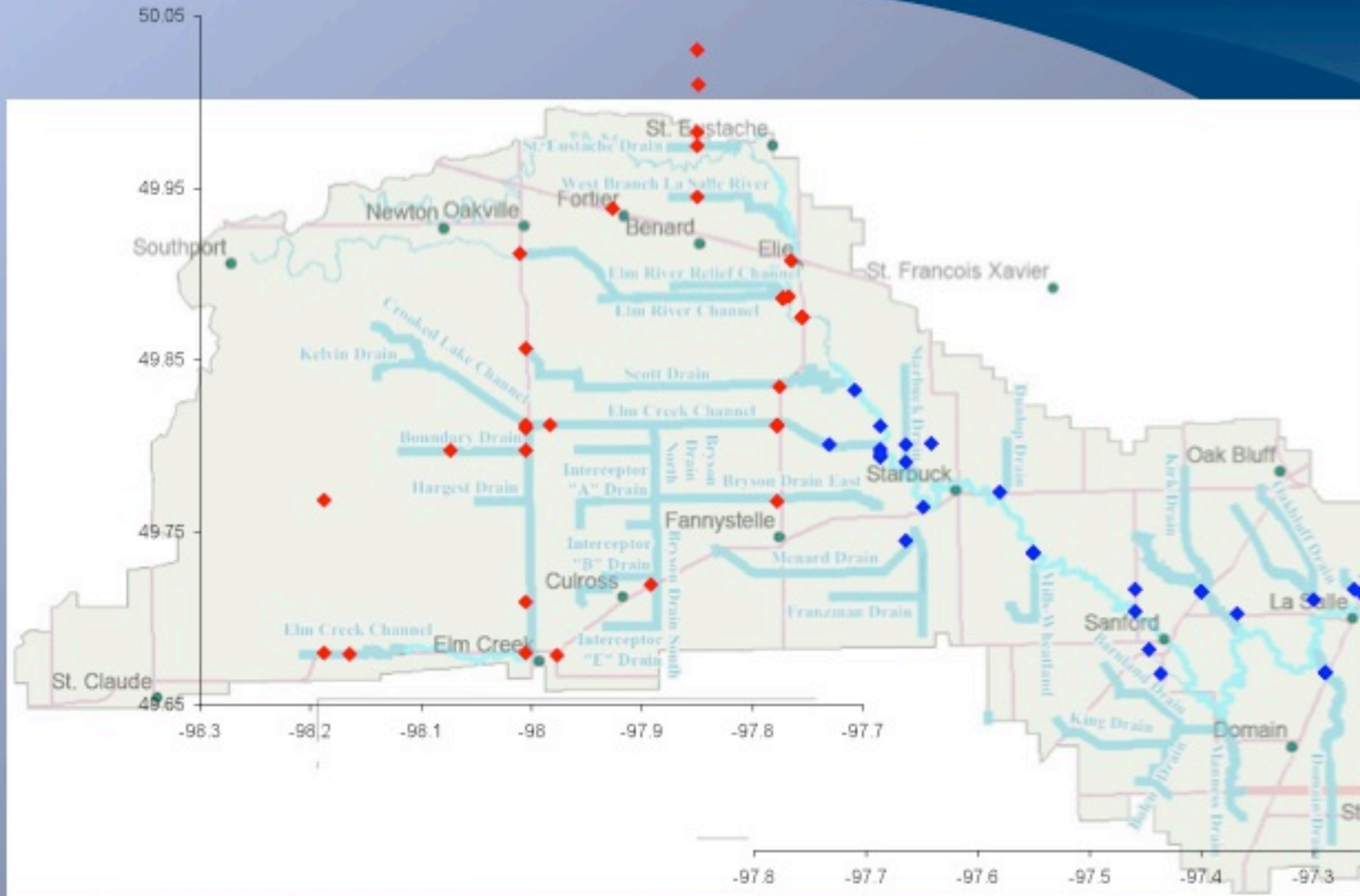
Median total phosphorous concentration in Red River during the spring flood is twice the median concentration in normal summer and fall flows.



## Relative historic phosphorous fluxes via the Saskatchewan, Red and Winnipeg Rivers

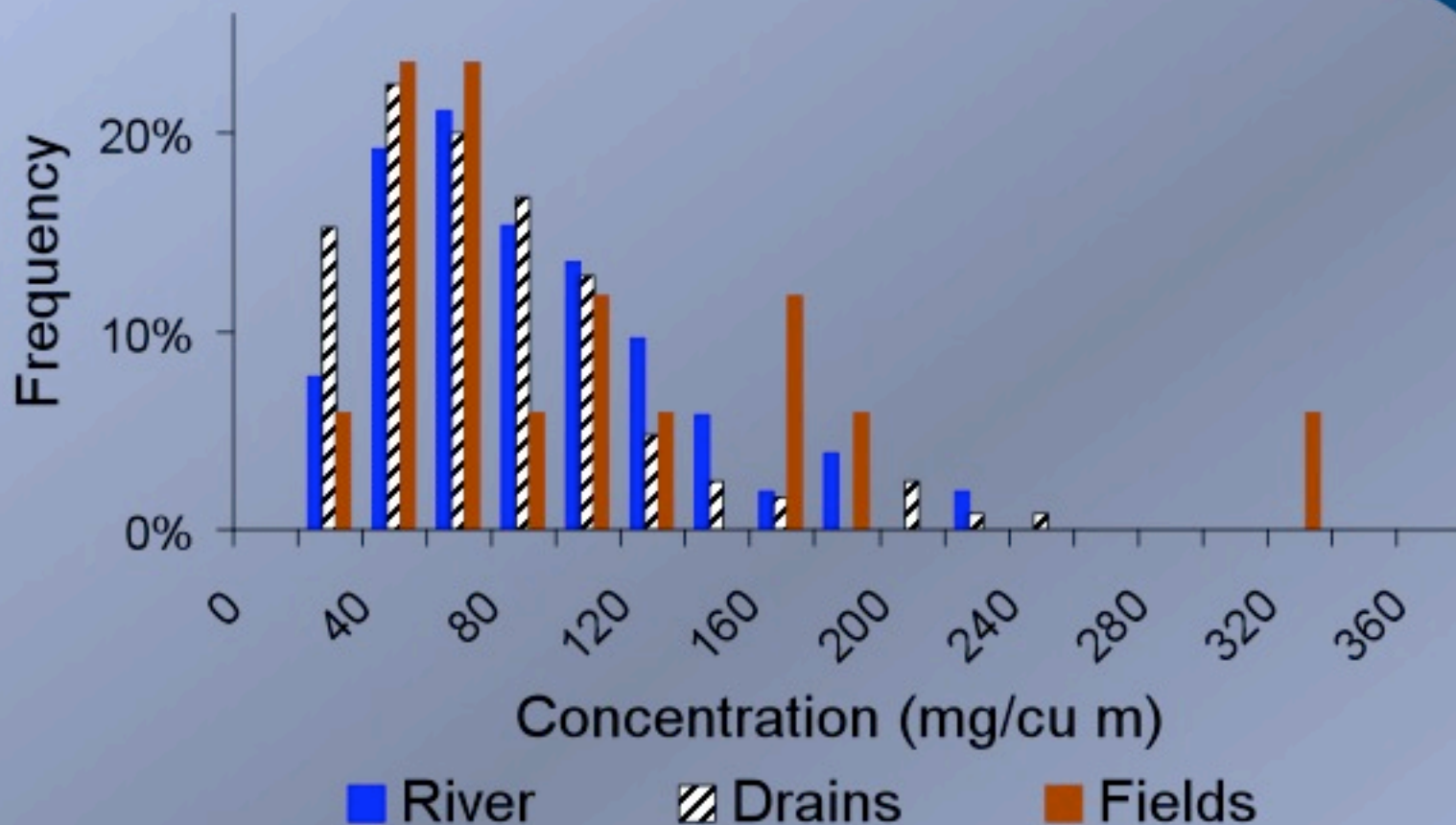
% of total inputs including TP in other metered and estimated unmetered discharge + precipitation.





Spring 2009 water quality station in the La Salle River basin

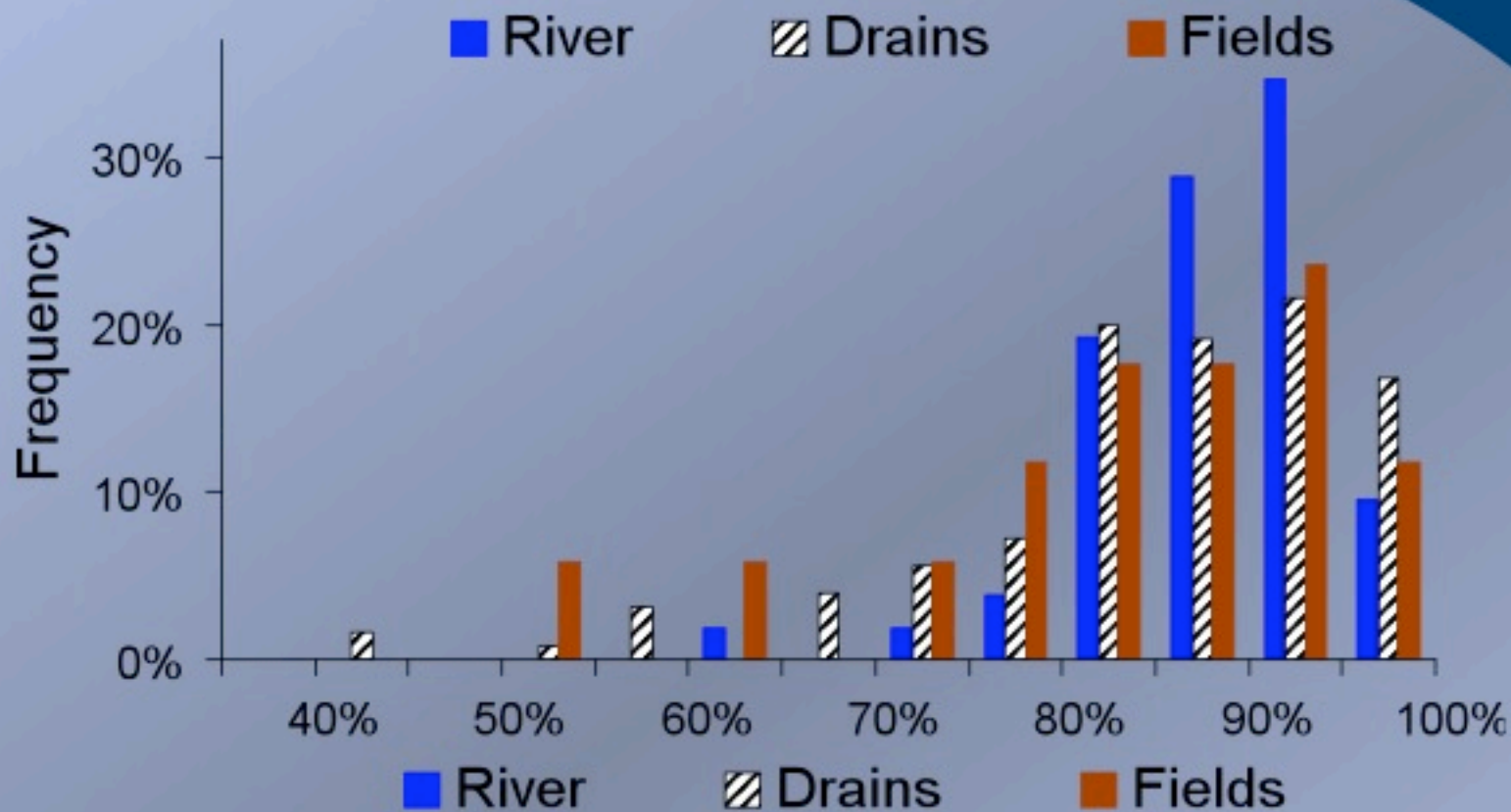




## Particulate phosphorous

in the La Salle River and subsidiary drains, and in direct runoff from fields, April – May 2009

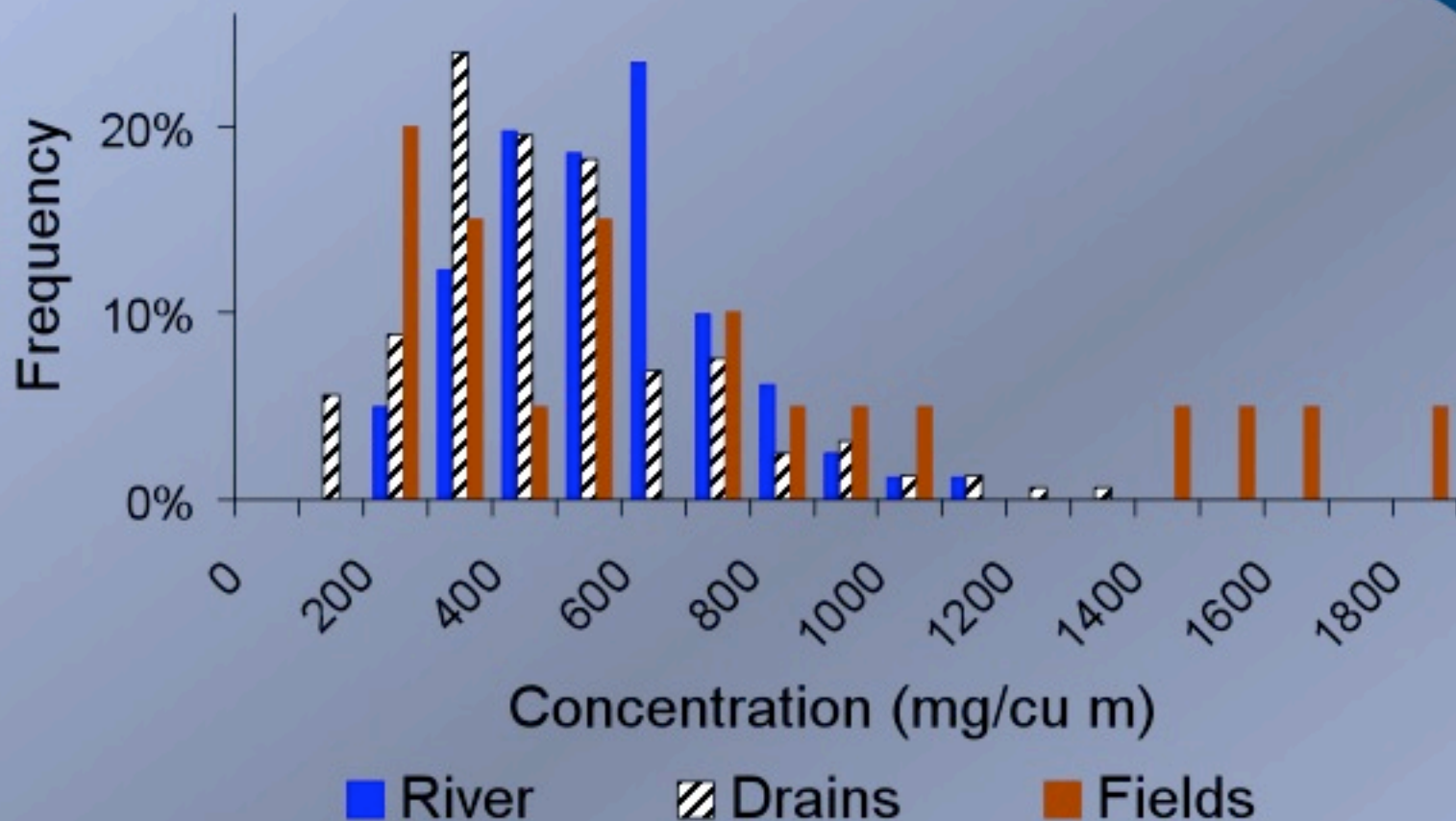




## Dissolved P as % of total P

in the La Salle River and subsidiary drains, and in direct runoff from fields, April – May 2009

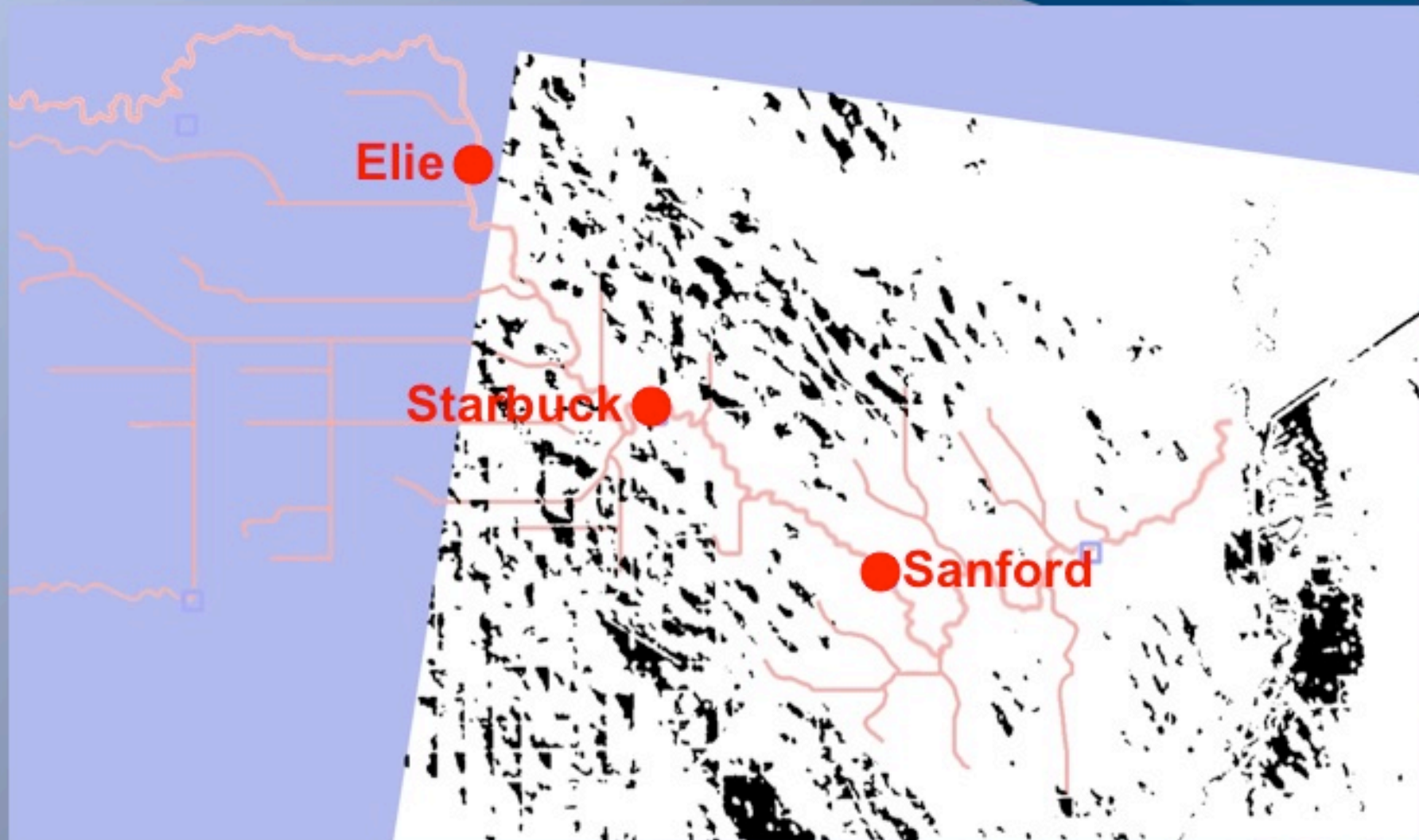




## Dissolved Phosphorous

in the La Salle River and subsidiary drains, and in direct runoff from fields, April – May 2009

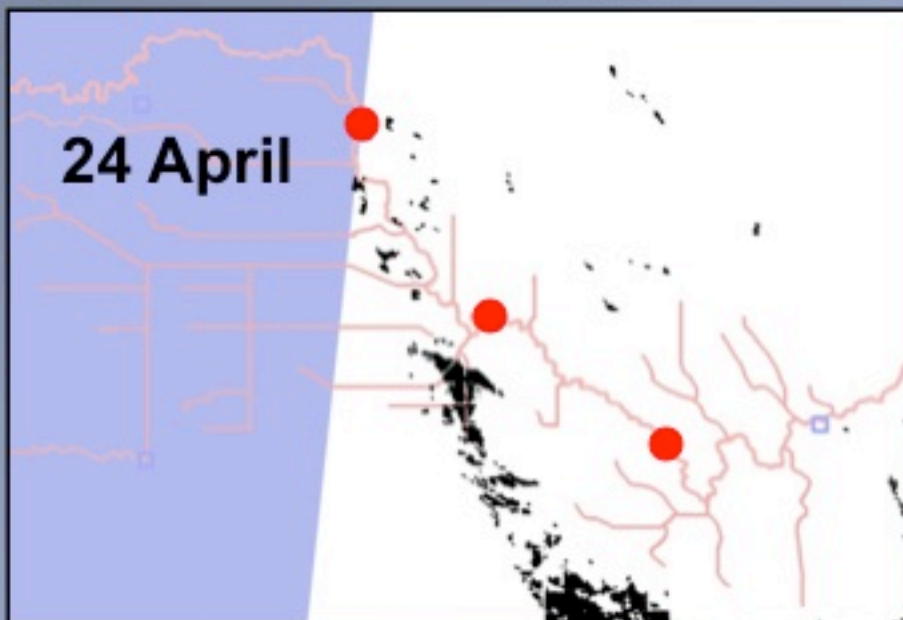
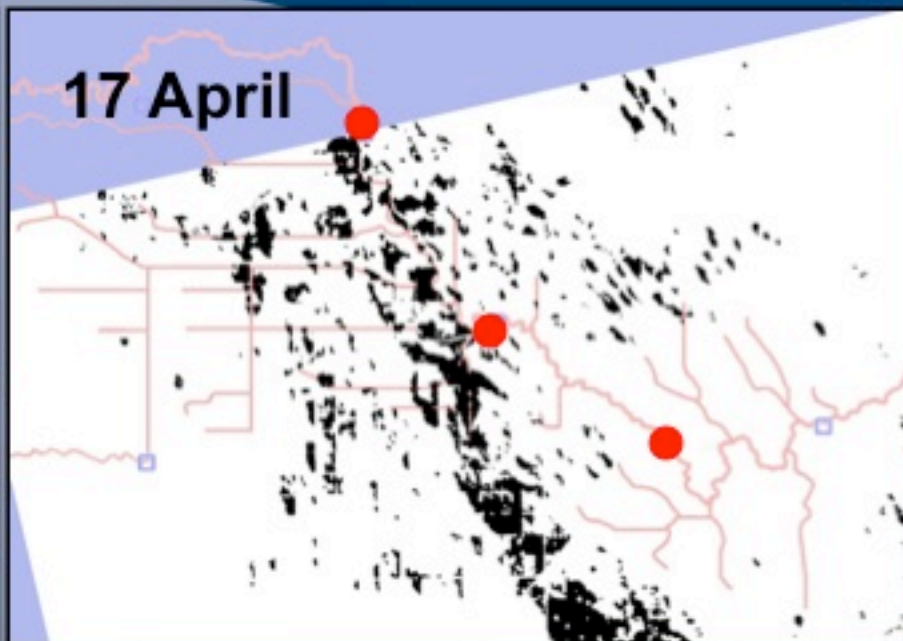
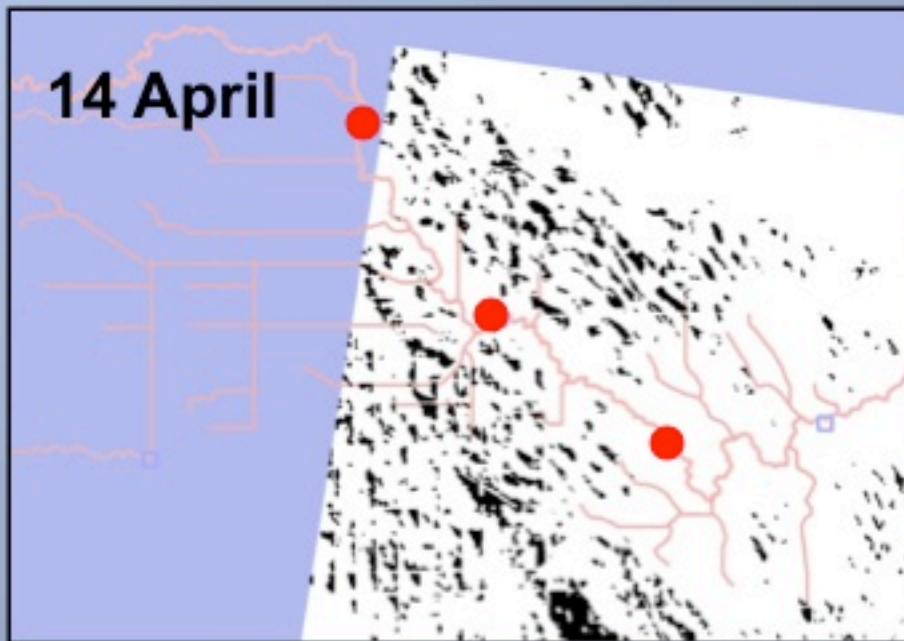




Inundated land, 14 April 2009

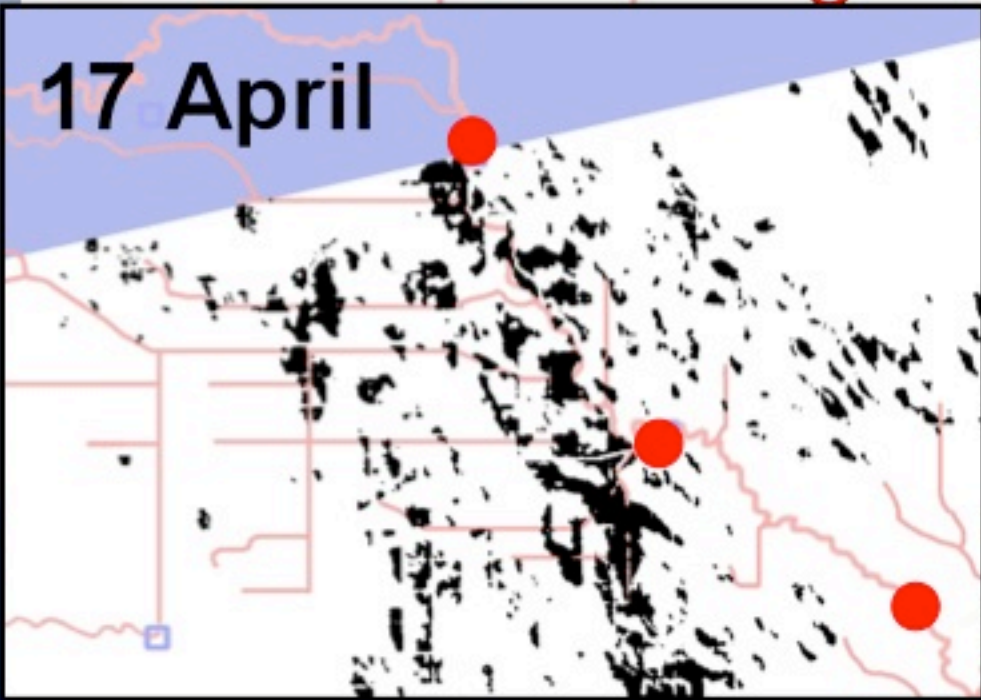
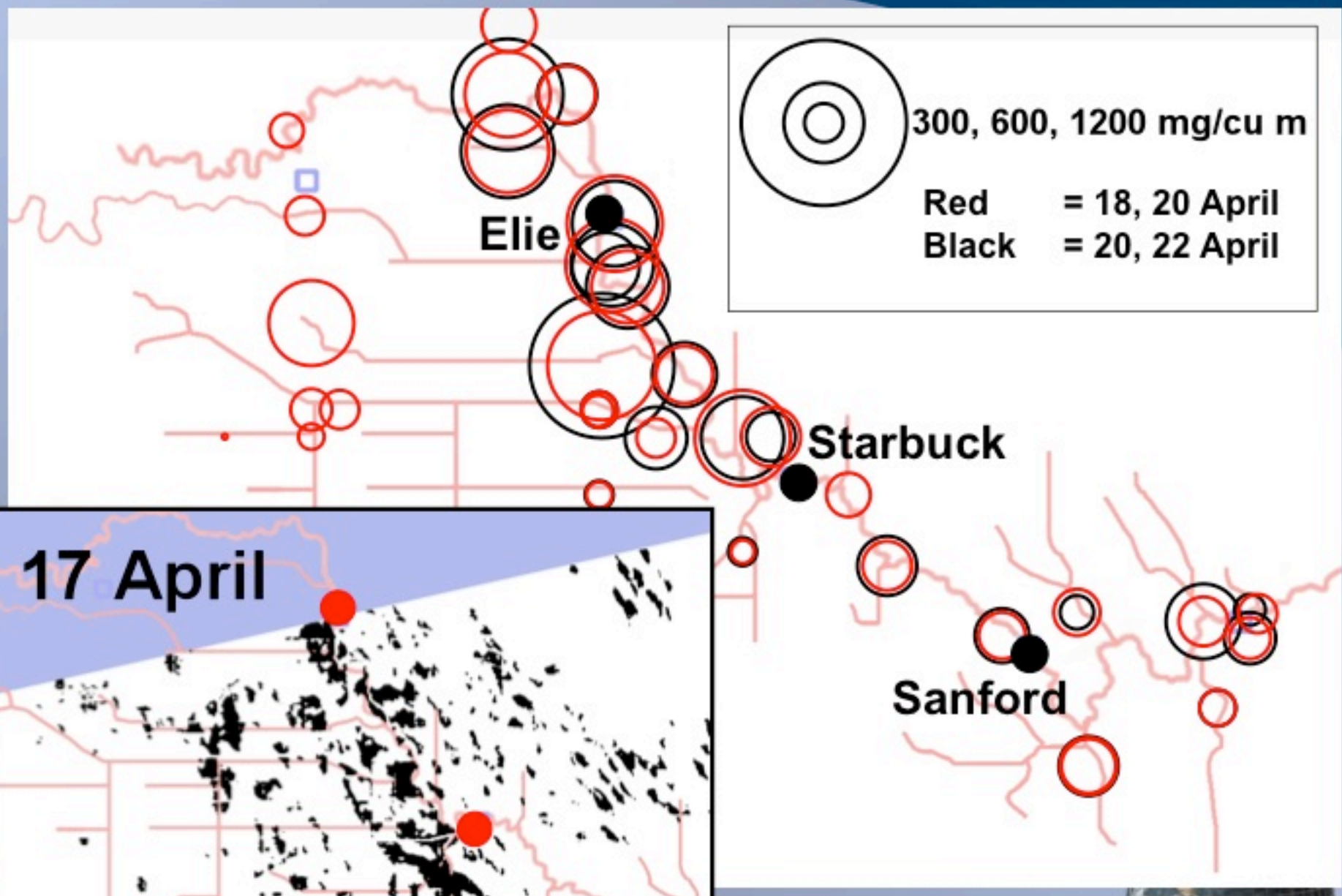
Derived from RADARSat-2 data processed by R. Landry, NRCAN-CCRS



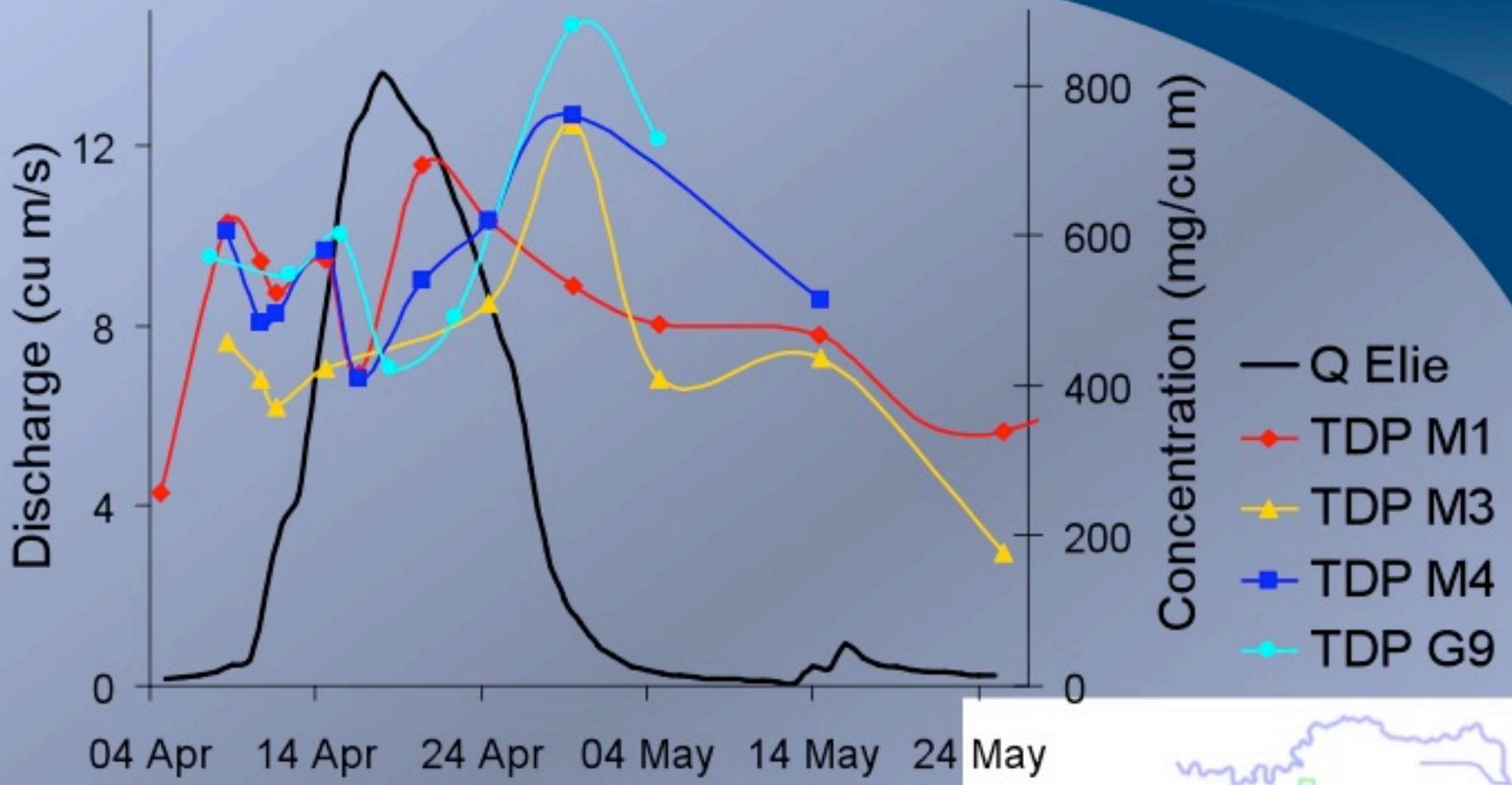


## Inundated land, spring 2009

Derived from RadarSat-2 data  
processed by R. Landry,  
NRCAN-CCRS

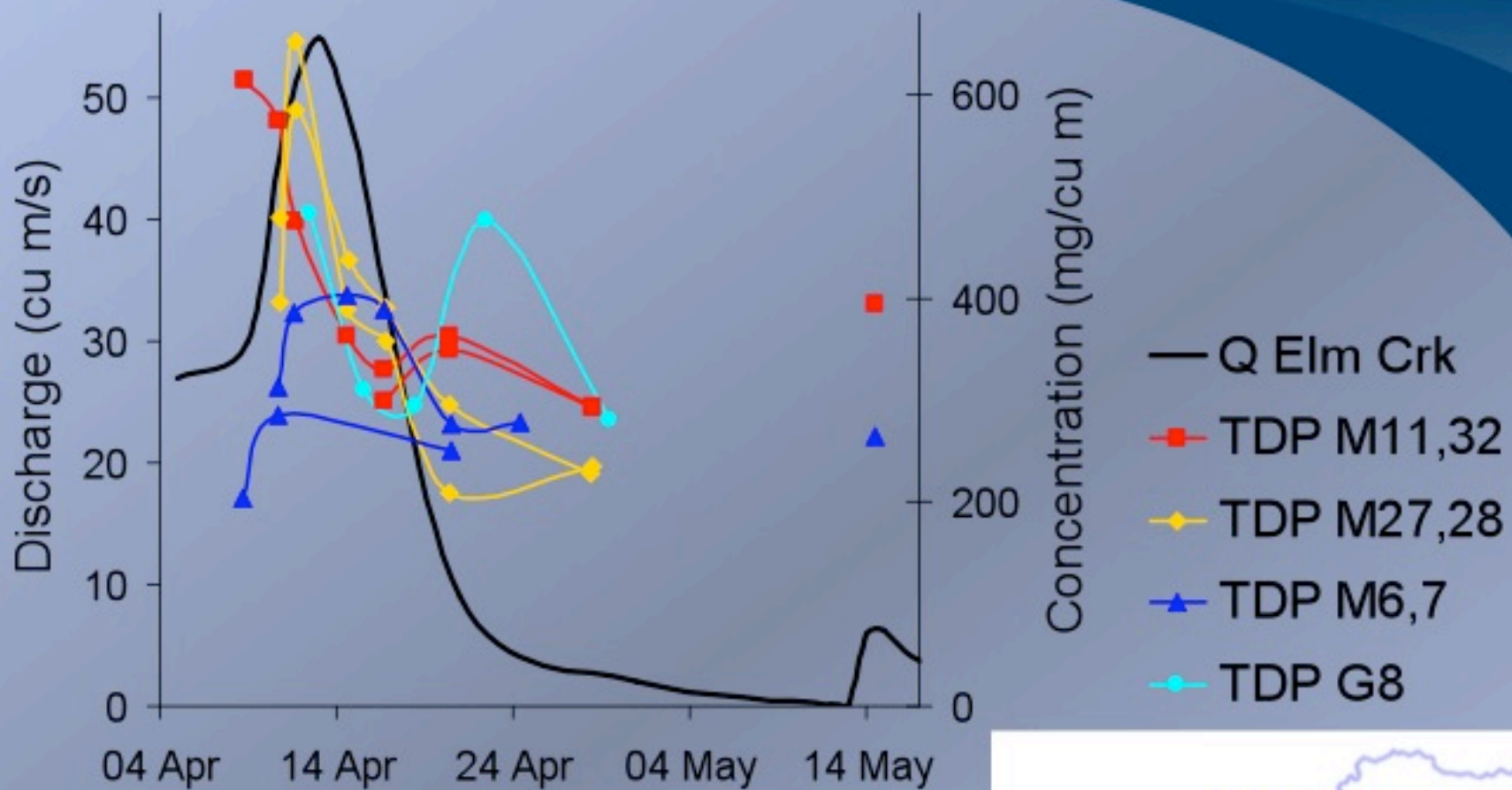


**ssolved phosphorus**

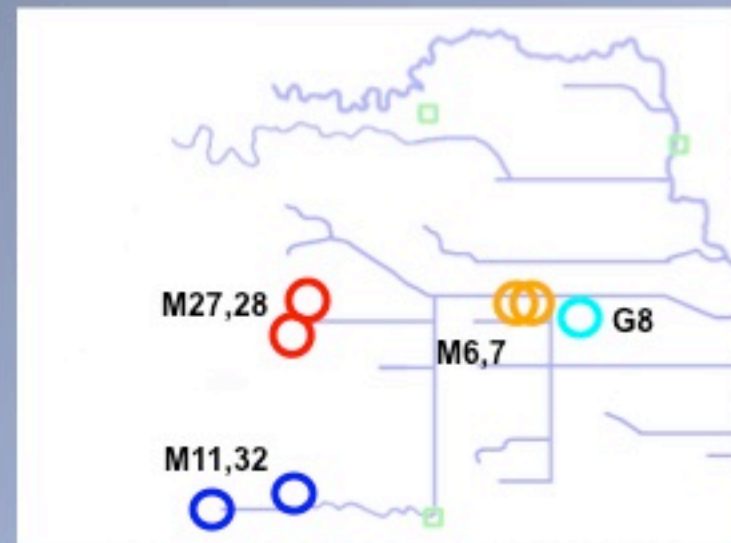


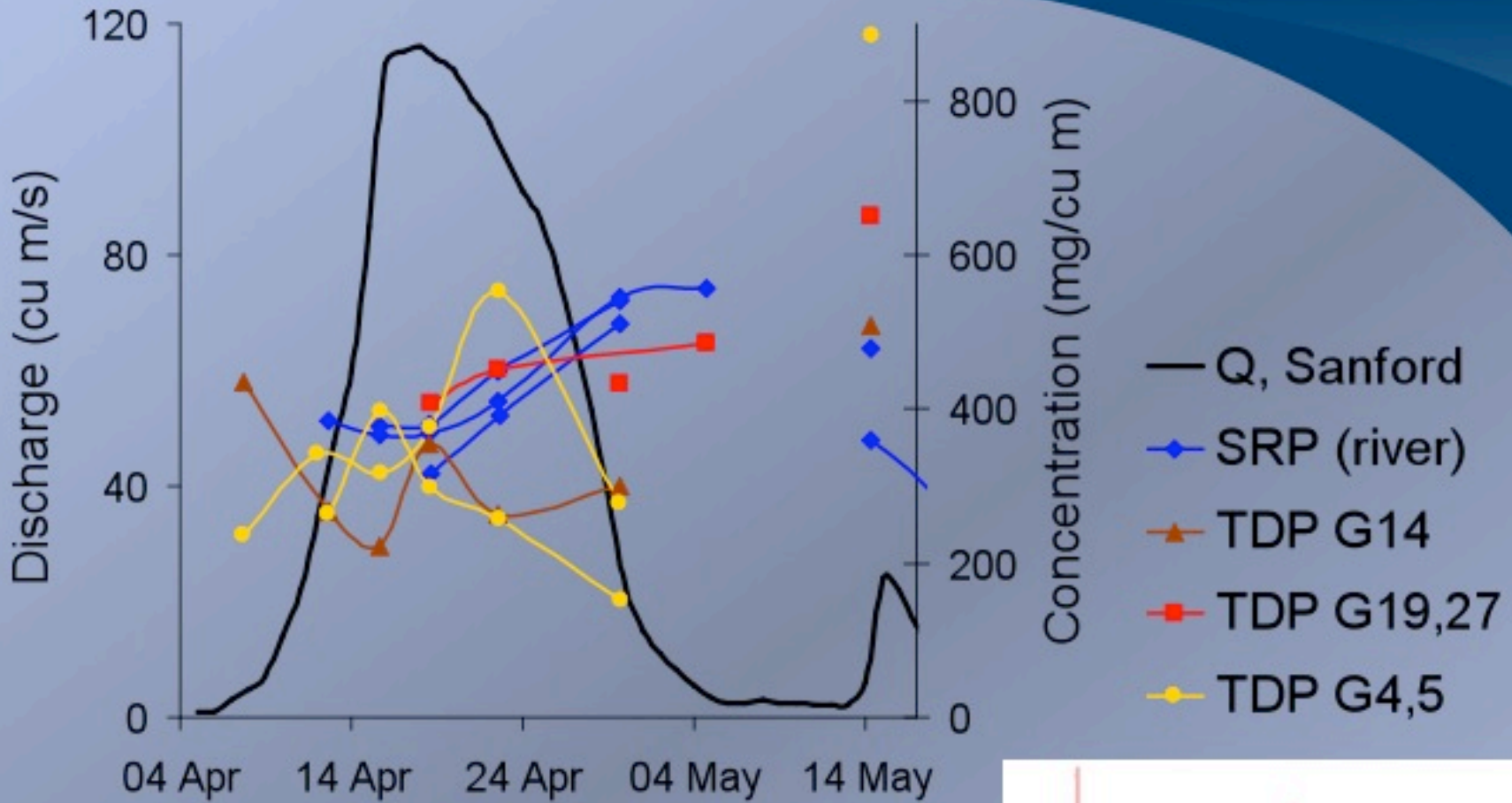
# La Salle River at Elie



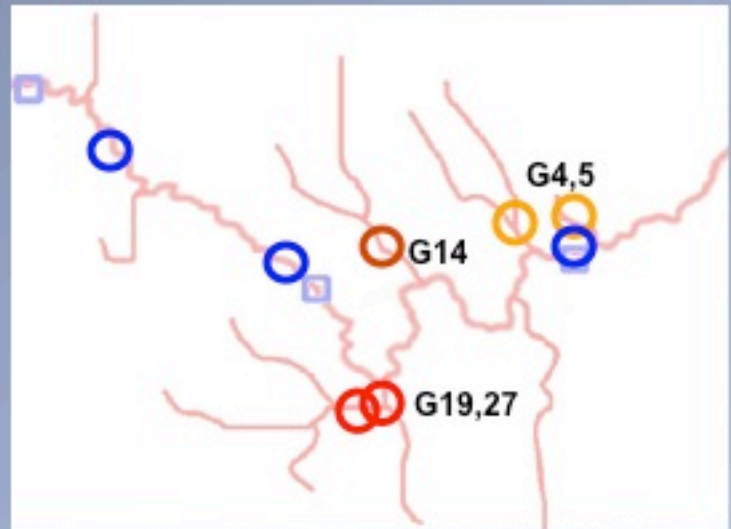


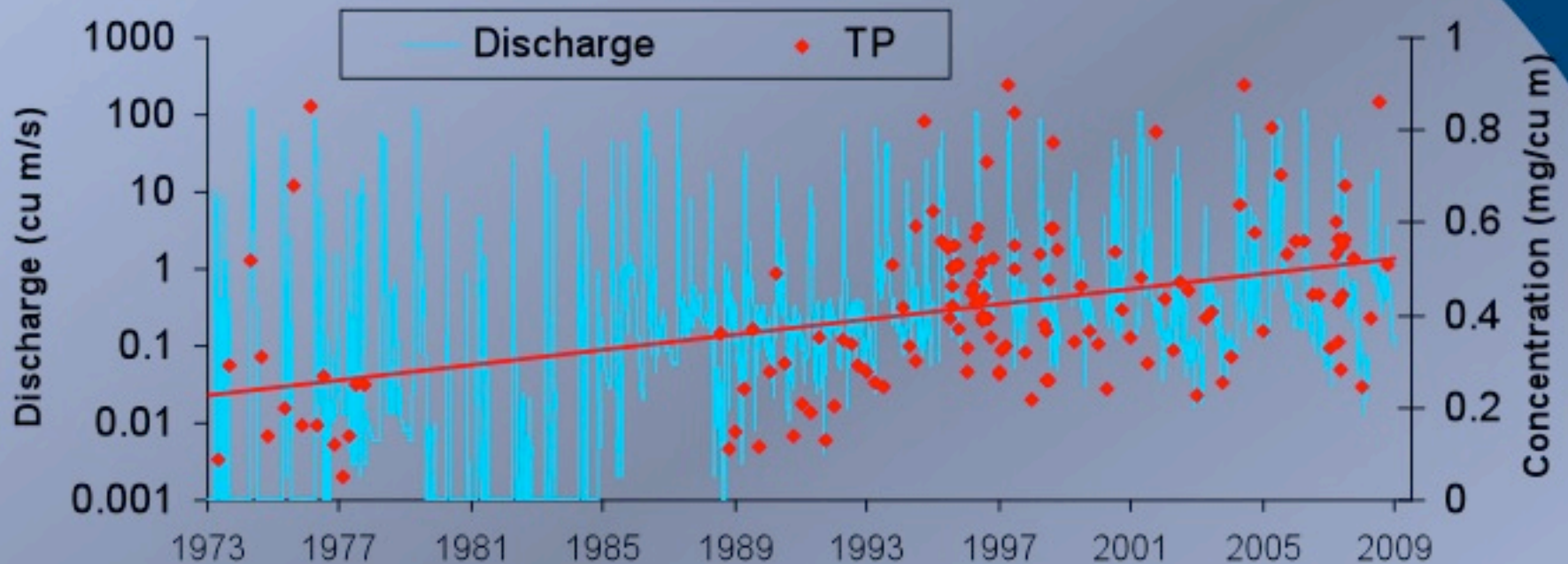
## Elm Creek drain at Hwy# 13





## La Salle River at Sanford

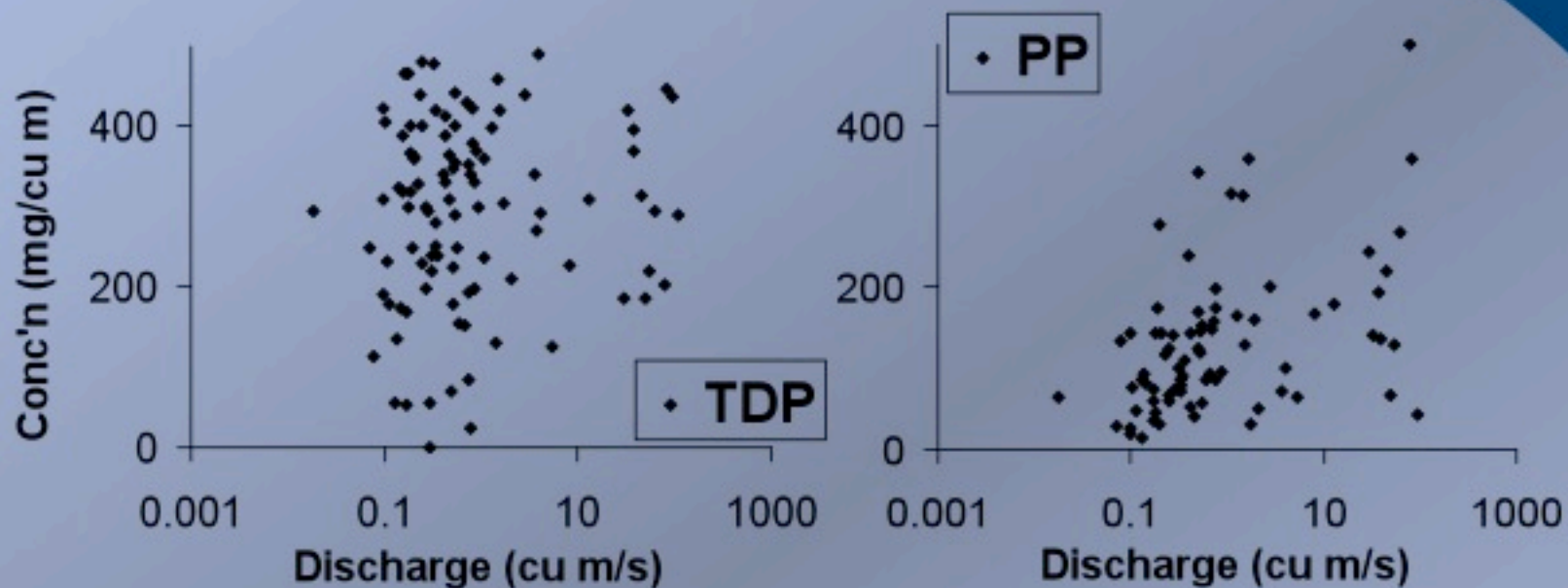




## Discharge and phosphorous concentration La Salle R., 1973 – 2009.

Data supplied by Manitoba Water Stewardship.

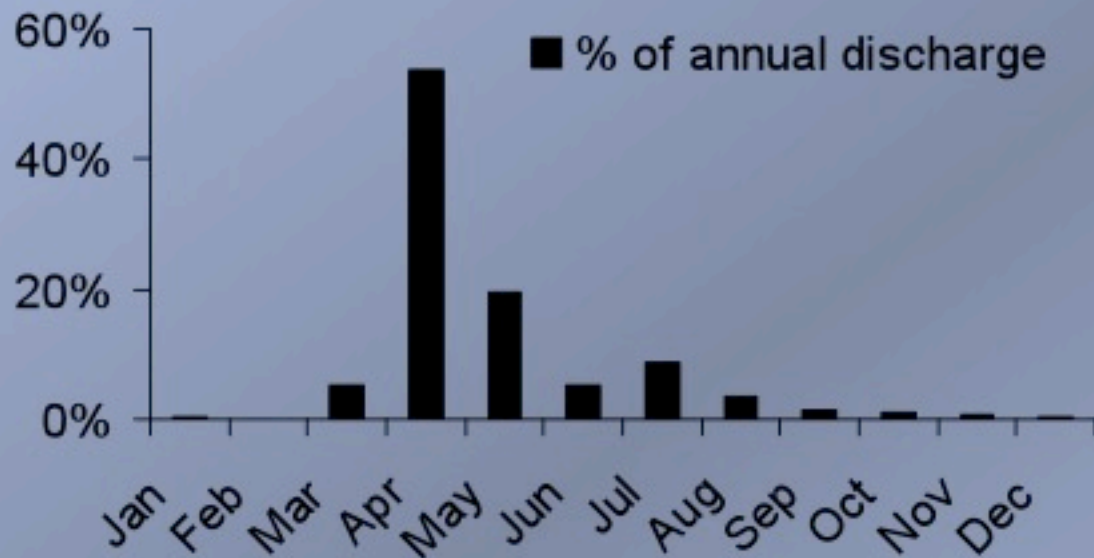




Outflow P concentration vs. discharge for the La Salle R.  
 Period = 1988 – 2007.

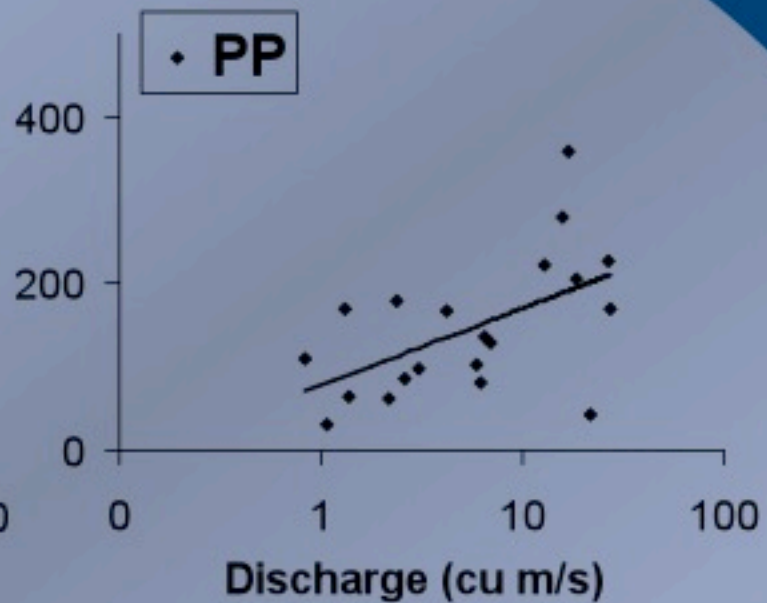
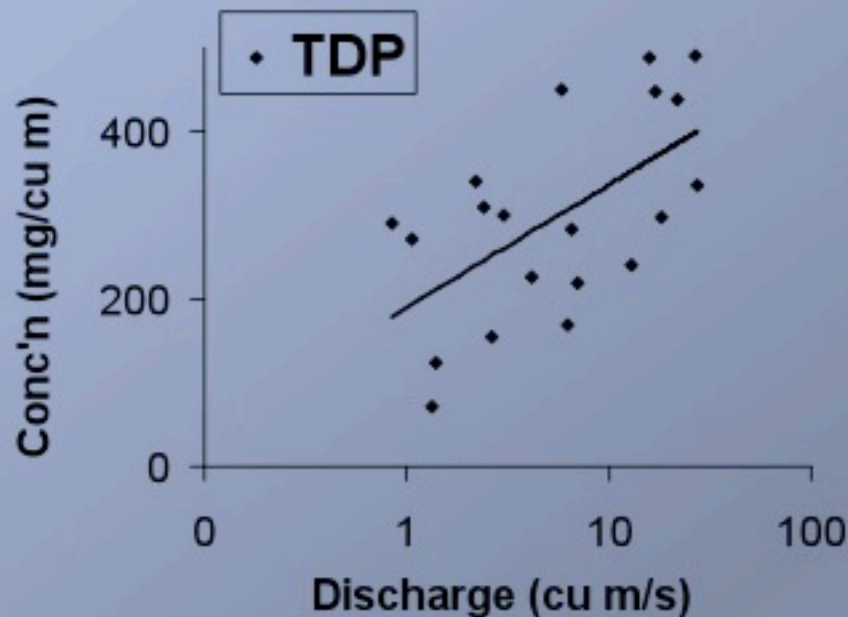
Data supplied by Manitoba Water Stewardship.





79% of La Salle River annual discharge occurs between 1 April – 30 June





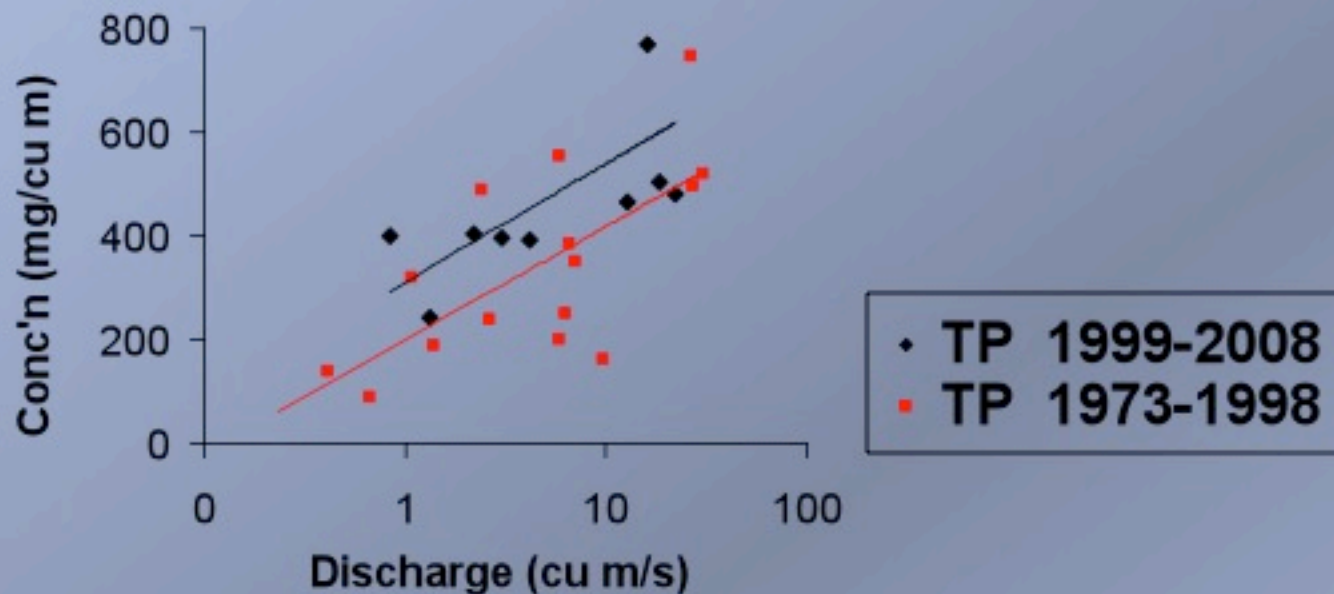
## Outflow P concentration vs. discharge for the La Salle R.

Data are means for the period 1 April – 30 June,  
where for P,  $n = 1 - 8$  in each year.

Period = 1988 – 2007.

Data supplied by Manitoba Water Stewardship.





Outflow P concentration vs. discharge for the La Salle R.  
 Data are means for the period 1 April – 30 June,  
 where for P, n = 1 – 8 in each year.

Data supplied by Manitoba Water Stewardship.





Questions?