Creating an ArcGIS Online Web Mapping Application from Discharge Monitoring Reports

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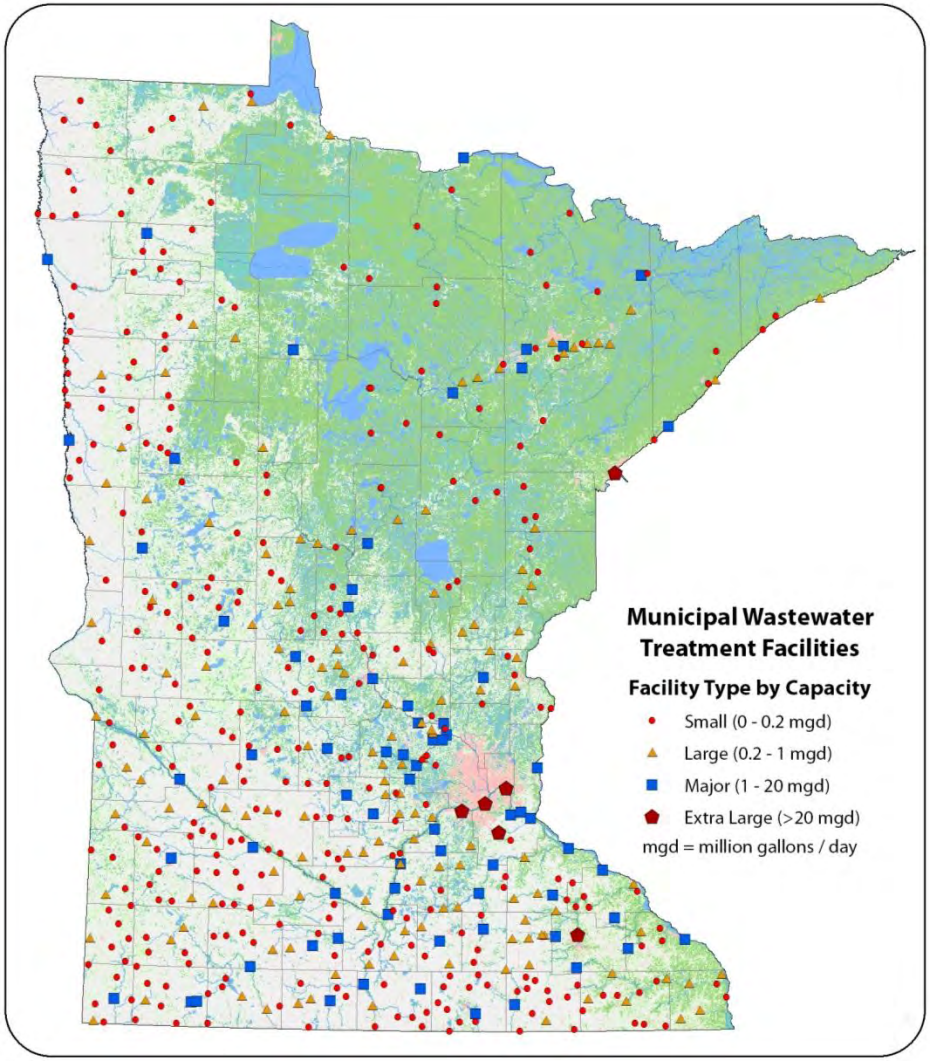
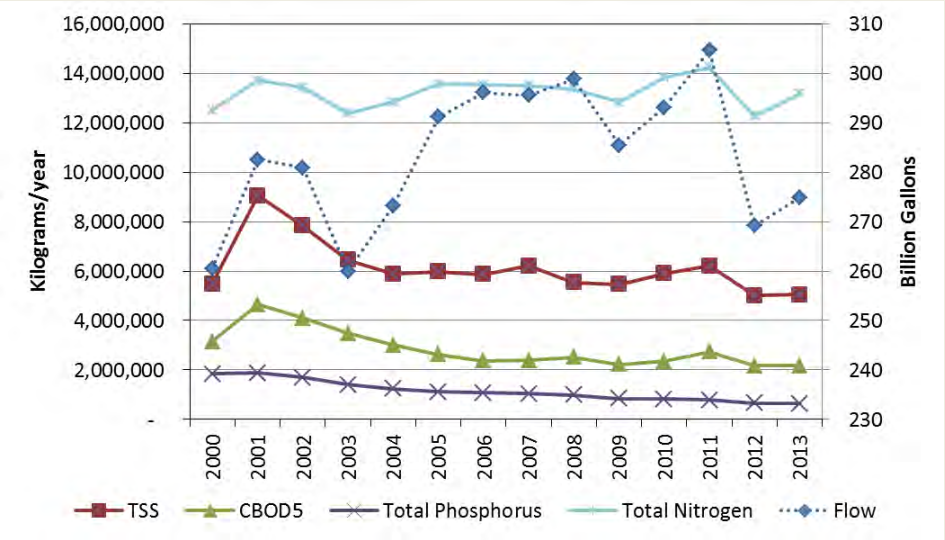
Uses and Needs for Wastewater Data (DMRs)

- 15 years' worth of wastewater records from ~1,000 facilities.
- Data need to be accessible.
  - Effectively leveraging DMR records to make informed decisions can be difficult.
- Data need to be flexible.
  - An efficient process for estimating missing data and revising inconsistent values is needed.



Uses and Needs for Wastewater Data (DMRs)

- Flow data are critical because they affect all pollutant loading estimates
  - Individual pollutant concentration assumptions can made if site or category specific data are missing.
  - Categorical concentration assumptions can be updated as data become available.



Data Process for Discharge Monitoring

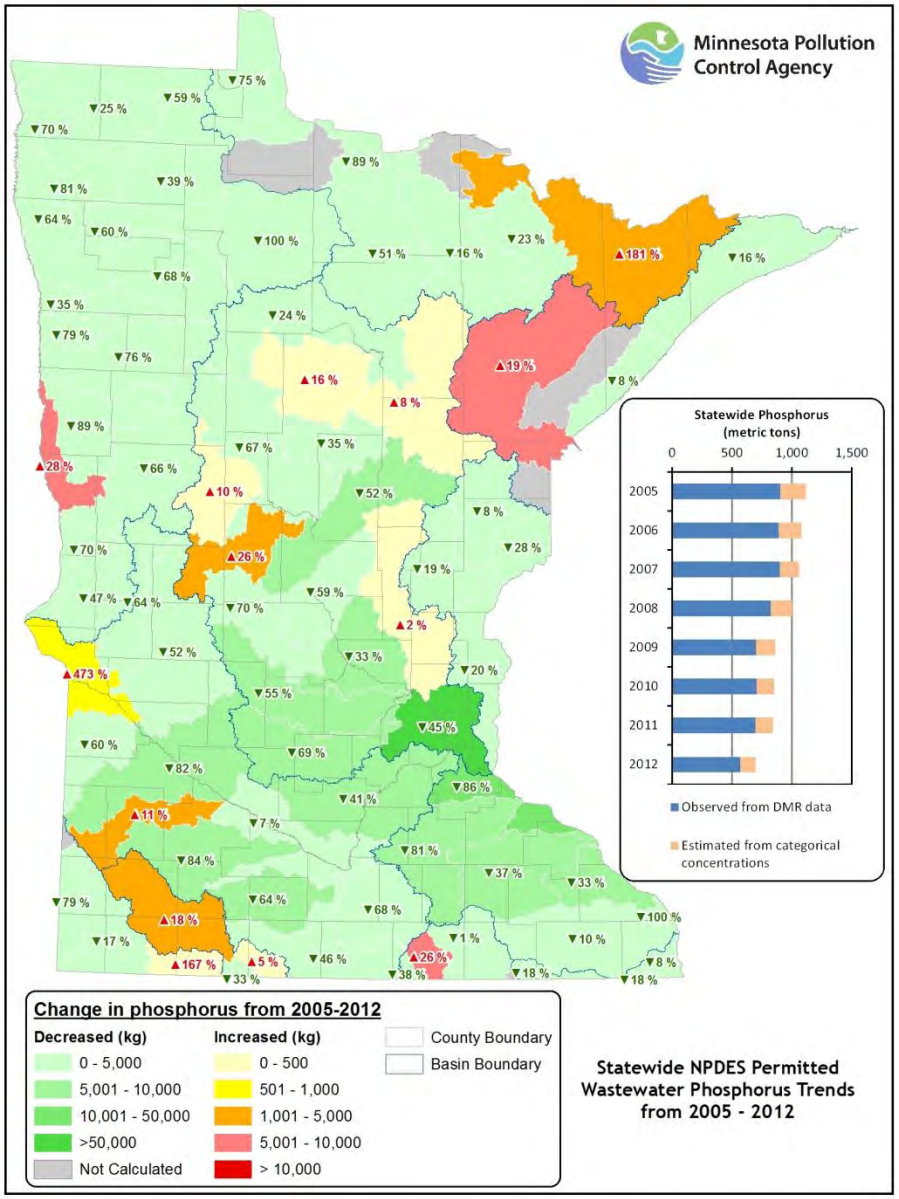
- DMR reports are submitted to the MPCA and stored in an enterprise database.
- Access database pairs monthly flow/pollutant records.
- Monthly loads are summarized to annual values for each facility.
- Annual facility loads are converted to a data service for online mapping applications.

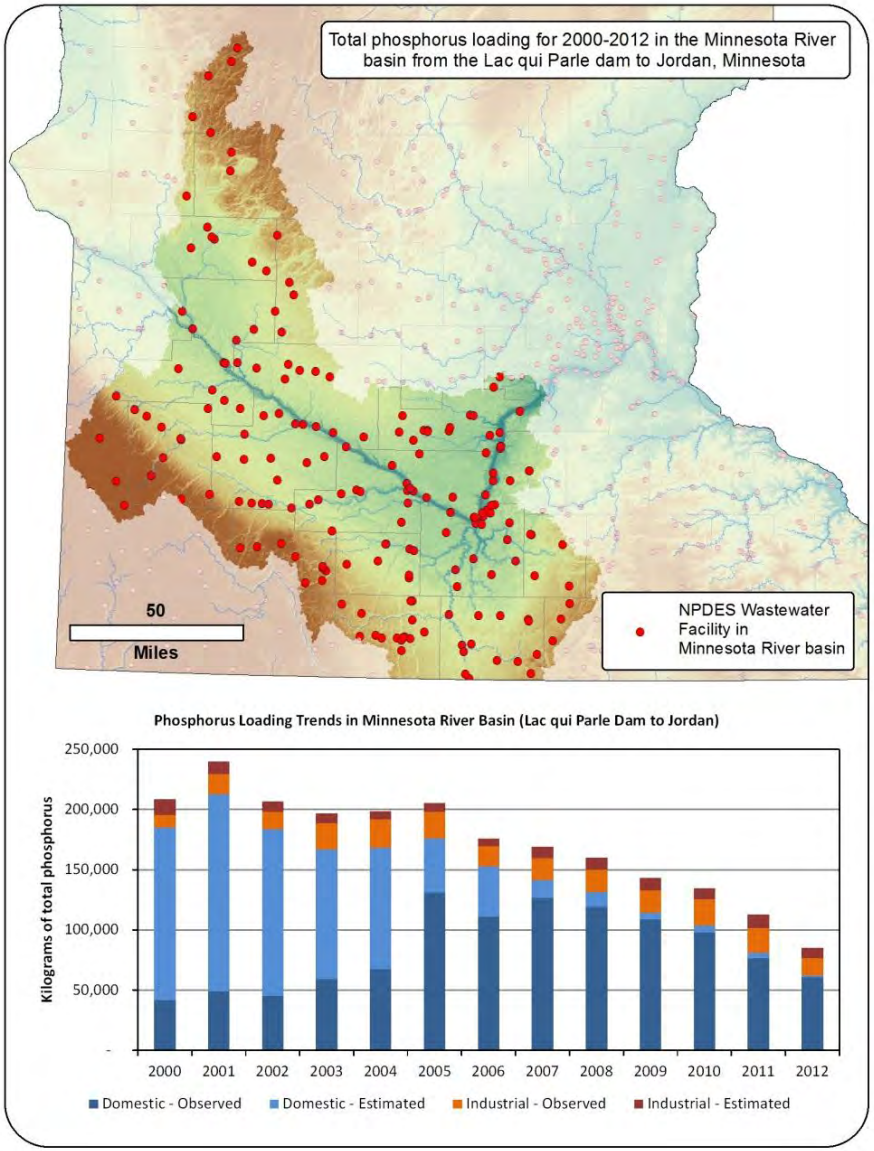
Surface Discharge Station SD001 (Main Facility Discharge)

Parameter Name	Limit and Units	Limit Type	1/13
Bicarbonates (HCO3)	mg/L	CalMoMax	220
BOD, Carbonaceous 05 Day (20 Deg C) Percent Removal	85 %	MnCalMoAvg	99
BOD, Carbonaceous 05 Day (20 Deg C)	1352 kg/day	CalMoAvg	145
BOD, Carbonaceous 05 Day (20 Deg C)	2254 kg/day	MxCalWkAvg	151
BOD, Carbonaceous 05 Day (20 Deg C)	15 mg/L	CalMoAvg	3
BOD, Carbonaceous 05 Day (20 Deg C)	25 mg/L	MxCalWkAvg	3
Cadmium, Total (as Cd)	ug/L	SingleVal	<.2
Calcium, Total (as Ca)	mg/L	CalMoMax	88
Chloride, Total	mg/L	CalMoMax	360
Chlorine, Total Residual	0.038 mg/L	DailyMax	
Chromium, Total (as Cr)	ug/L	SingleVal	<.5
Copper, Total (as Cu)	ug/L	SingleVal	21
Fecal Coliform, MPN or Membrane Filter 44.5C	200 #100ml	CalMoGeoMn	
Flow	MG	CalMoTot	388.19
Flow	mgd	CalMoAvg	121.52
Flow	mgd	CalMoMax	13.76
Hardness, Calcium & Magnesium, Calculated (as CaCO3)	mg/L	CalMoMax	330
Lead, Total (as Pb)	ug/L	SingleVal	<.6
Magnesium, Total (as Mg)	mg/L	CalMoMax	26
Mercury, Total (as Hg)	10 ng/L	CalMoAvg	
Mercury, Total (as Hg)	17 ng/L	DailyMax	
Nickel, Total (as Ni)	ug/L	SingleVal	8.4
Nickel, Total (as Ni)	ug/L	SingleVal	8.4
Nitrite Plus Nitrate, Total (as N)	mg/L	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	1172 kg/day	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	270 kg/day	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	451 kg/day	CalMoAvg	4
Nitrogen, Ammonia, Total (as N)	902 kg/day	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	10 mg/L	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	13 mg/L	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	3 mg/L	CalMoAvg	
Nitrogen, Ammonia, Total (as N)	5 mg/L	CalMoAvg	.09
Nitrogen, Kjeldahl, Total	mg/L	CalMoAvg	
Oxygen, Dissolved	5.0 mg/L	CalMoMin	7.2

Calculating Phosphorus Loads

- Enterprise database currently contains 700,000 flow and total phosphorus records.
- Access database pairs relevant surface discharge flow and phosphorus values by month.
- Resulting dataset contains ~50,000 phosphorus and ~100,000 flow observations.
- Categorical concentrations based on facility size and type used to fill missing values.
- Inaccurate values are corrected with a patch file.

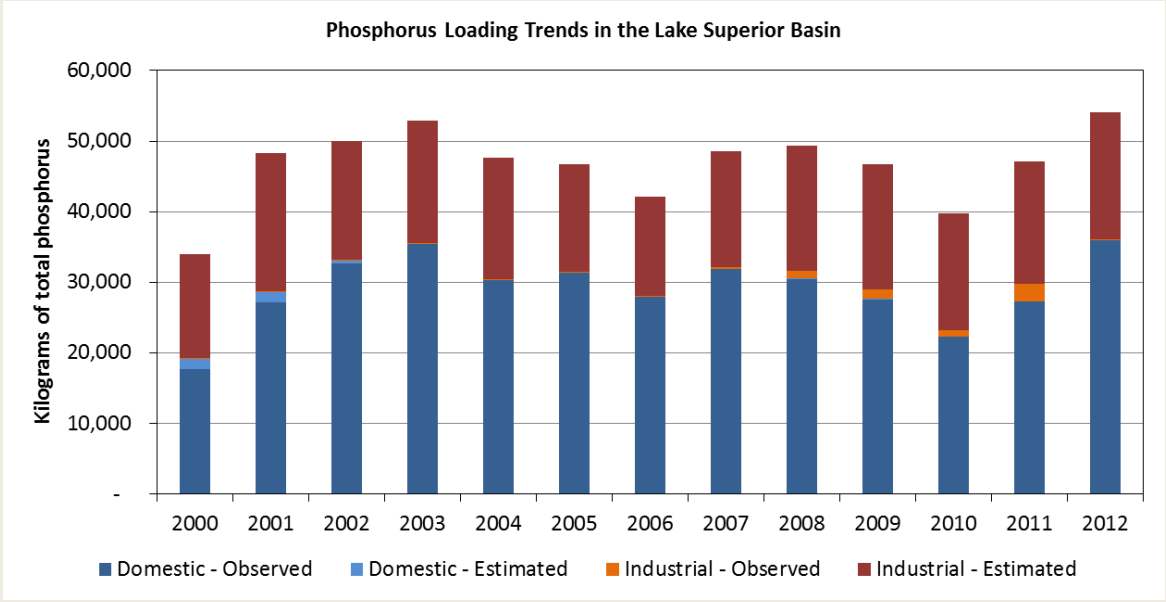

Minnesota Pollution Control Agency
Statewide Phosphorus (metric tons)
0
500
1,000
1,500
2005
2006
2007
2008
2009
2010
2011
2012
Observed from DMR data
Estimated from categorical concentrations
Change in phosphorus from 2005-2012
Decreased (kg)
0 - 5,000
5,001 - 10,000
10,001 - 50,000
>50,000
Not Calculated
Increased (kg)
0 - 500
501 - 1,000
1,001 - 5,000
5,001 - 10,000
> 10,000
County Boundary
Basin Boundary
Statewide NPDES Permitted Wastewater Phosphorus Trends from 2005 - 2012

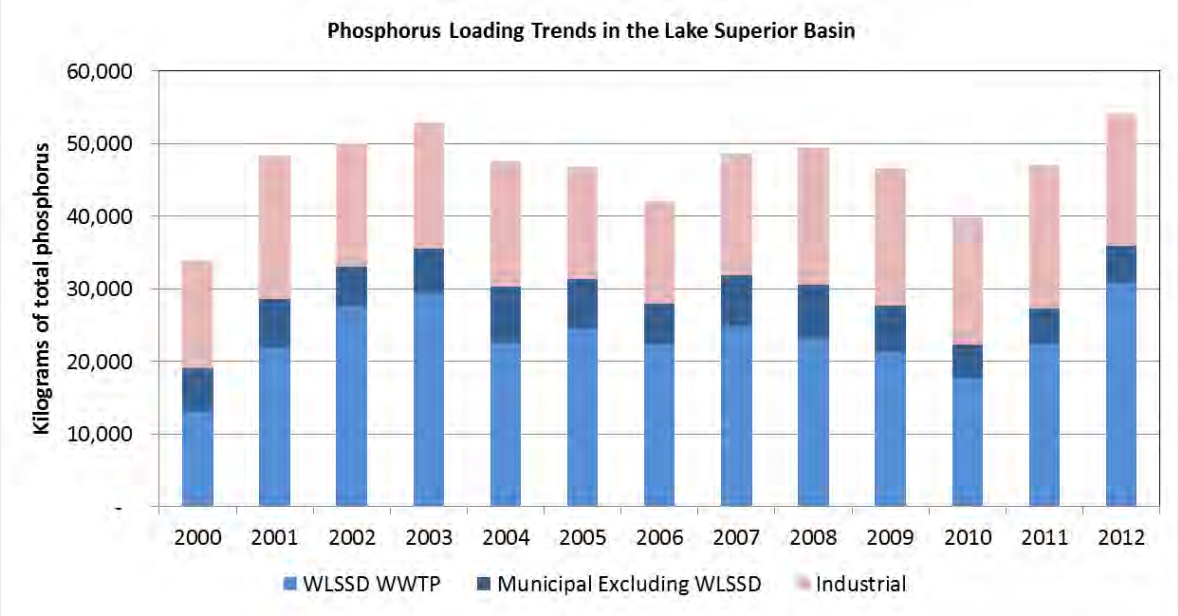

Total phosphorus loading for 2000-2012 in the Minnesota River basin from the Lac qui Parle dam to Jordan, Minnesota
50
Miles
NPDES Wastewater Facility in Minnesota River basin
Phosphorus Loading Trends in Minnesota River Basin (Lac qui Parle Dam to Jordan)
Kilograms of total phosphorus
250,000
200,000
150,000
100,000
50,000
-
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Domestic - Observed
Domestic - Estimated
Industrial - Observed
Industrial - Estimated

Most industrial phosphorus loading values in the Lake Superior basin are estimated.

Accessible data means less time is needed for preparation and more time can be used to indicate patterns.

The Western Lake Superior Sanitary District accounts for about 80% of Minnesota's municipal phosphorus load to Lake Superior.





MPCA phosphorus strategy

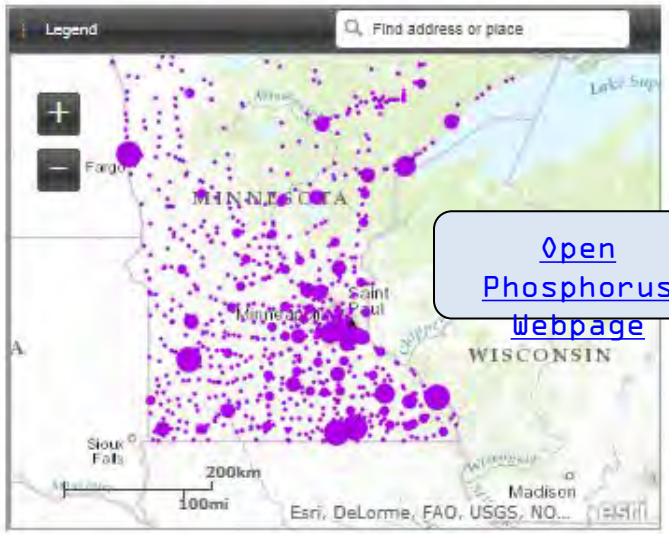
Under natural conditions phosphorus (P) is typically scarce in lakes and streams. The past 100 years of human activities have resulted in excessive loading of phosphorus into many freshwater systems. This can cause water pollution by promoting excessive growth of algae, particularly in lakes, turning them green and suffocating fish and other aquatic life in serious cases. Phosphorus is released from both point and nonpoint sources of pollution. Minnesota has had point source effluent limitations for phosphorus since the early 1970s.

Controlling phosphorus is an important part of protecting Minnesota's water resources. Considera reductions in phosphorus from wastewater treatment facilities have been achieved since the MPC Citizens Board adopted a strategy for addressing phosphorus in National Pollutant Discharge Elimination System (NPDES) permits several years ago.

Phosphorus loads were reduced by 50 percent from 2000-09 and have continued to decline since 2009. The 2013 total phosphorus load for the state was 633,000 kilograms, down 12 percent from the 2011-12 average of 717,000 kilograms. The annual phosphorus load has been reduced by 66 percent from the 2000-01 baseline of 1,855,000 kilogram per year.

Typically phosphorus limits are required for new or expanding discharges or for facilities discharg directly to lakes or within specific regions of the state (Minn. R. 7053.0255). Limits have also increasingly been established to meet specific water quality targets in waterbodies as defined in state numeric eutrophication standards (Minn. R. 7050.0222).

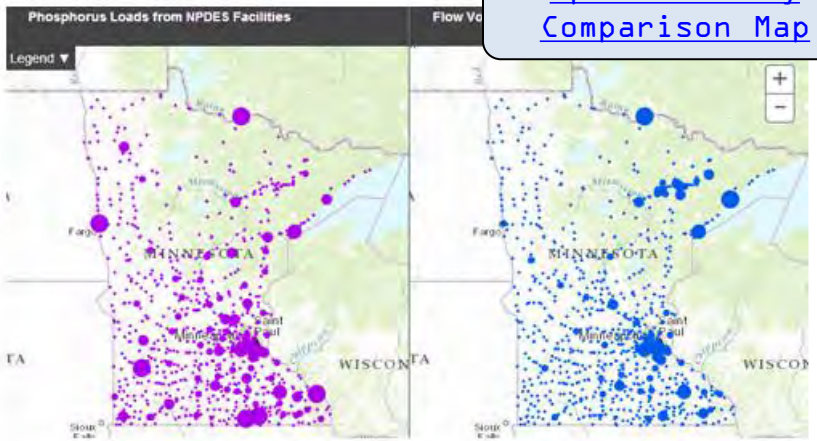
The map and links below provide summaries of annual phosphorus loads and flow volumes discharged from wastewater facilities since 2005. Click on a facility for more detail.



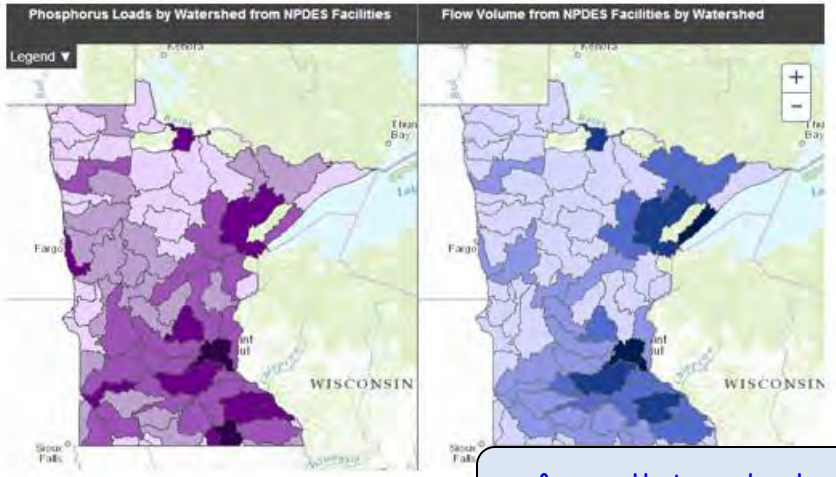
Open Phosphorus Webpage

Maps comparing flow and phosphorus by facility (go to i

Open Facility Comparison Map



Maps comparing flow and phosphorus loads summarized by watershed (go to interactive map)

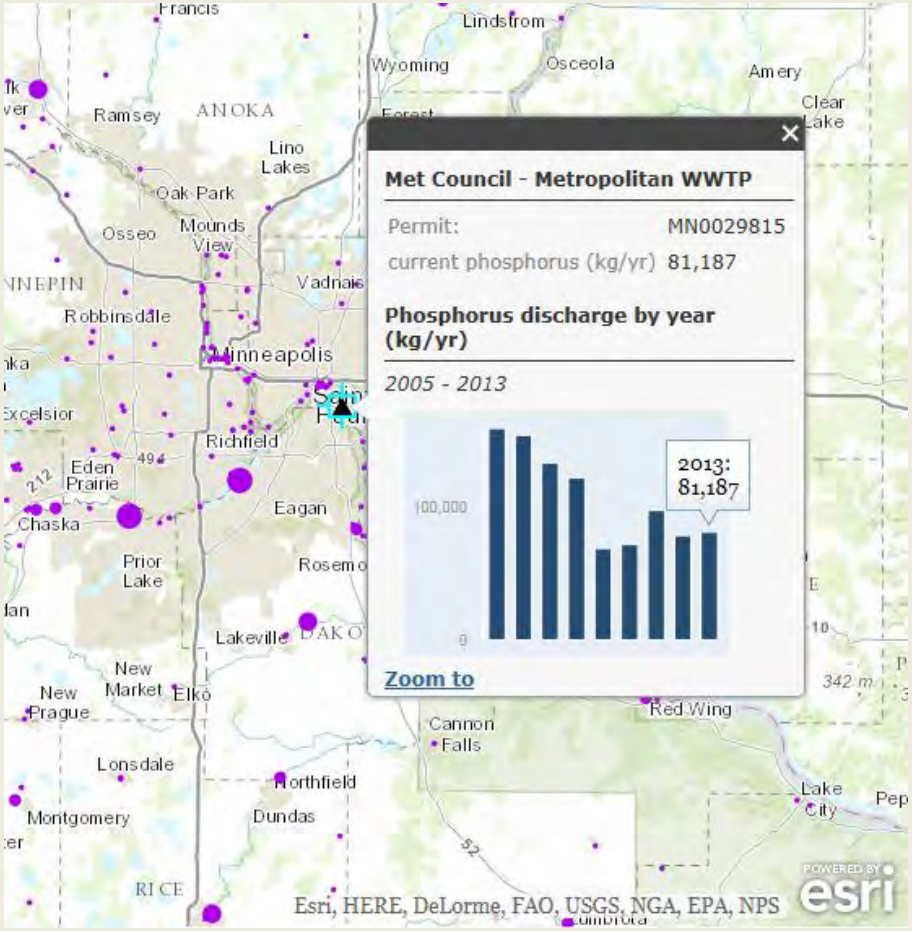


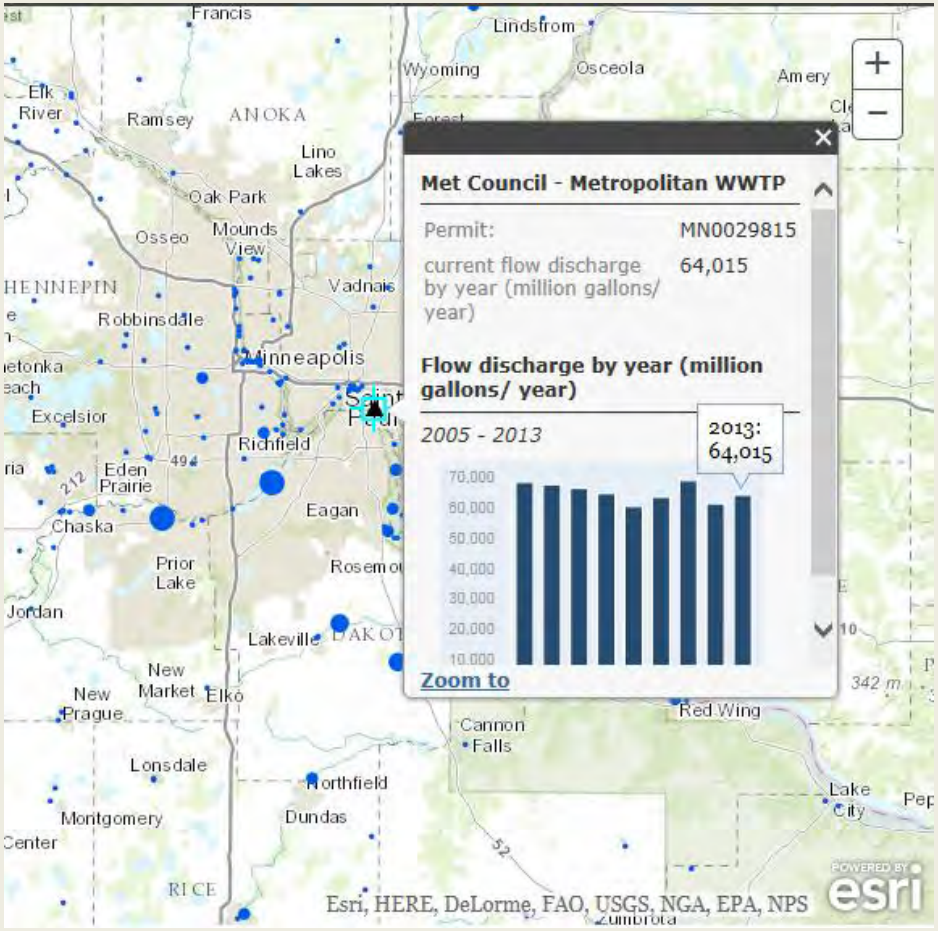
Open Watershed Comparison Map

For more information

For more information about the MPCA phosphorus strategy, contact Steve Weiss at the MPCA: 651-757-2814 or 1-800-657-3864.

Loading and Flow Comparison



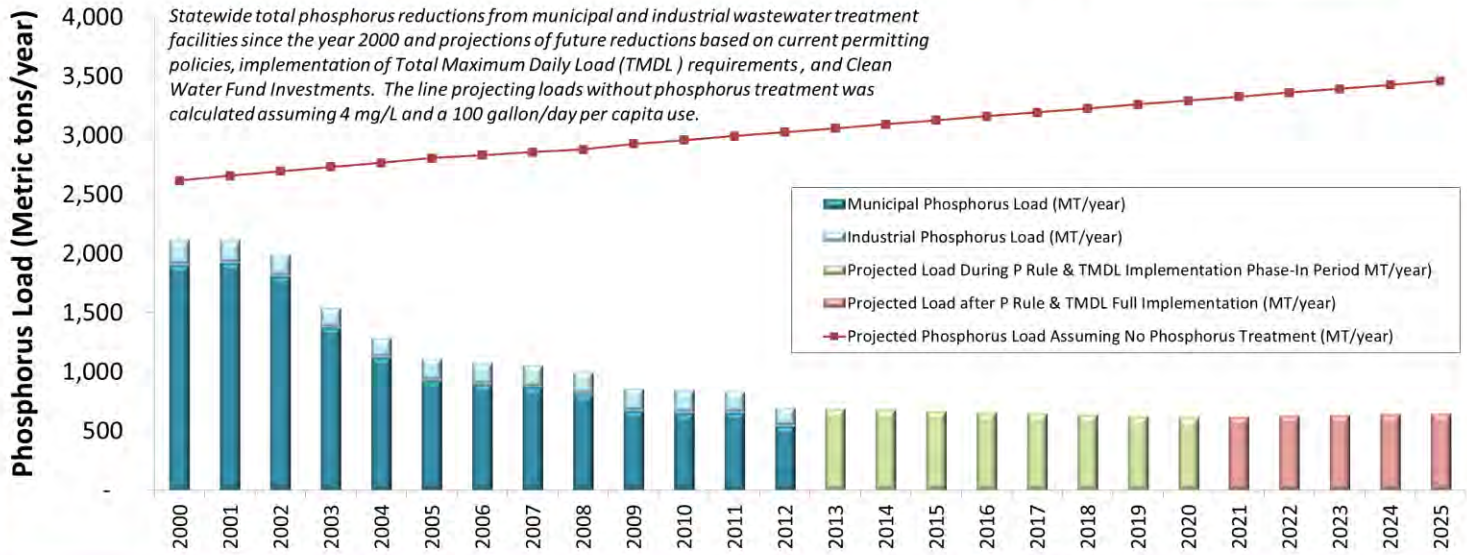


Applicability to Other Pollutants

- Most work to date has focused on phosphorus trends.
- Flow data are the common factor for calculating loading trends for other pollutants.
- Loading values calculated for other parameters.
- Confidence in load values varies by parameter due to monitoring requirements and data availability.

Phosphorus Trends, Projections, and Milestones for Municipal and Industrial Wastewater

Statewide total phosphorus reductions from municipal and industrial wastewater treatment facilities since the year 2000 and projections of future reductions based on current permitting policies, implementation of Total Maximum Daily Load (TMDL) requirements , and Clean Water Fund Investments. The line projecting loads without phosphorus treatment was calculated assuming 4 mg/L and a 100 gallon/day per capita use.



2000: Phosphorus Strategy Adopted.
MPCA Board approved strategy for the development of 1 mg/L phosphorus limits for new and expanding wastewater treatment plants (WWTPs) that had potential to discharge phosphorus in excess of 1,800 lbs/year and established requirements for other WWTPs to develop and implement Phosphorus Management Plans (PMPs).

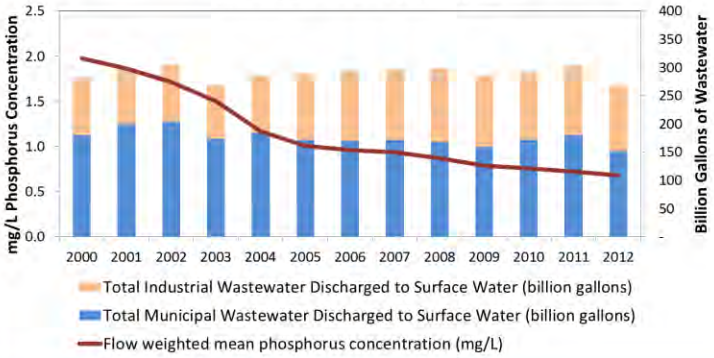
2005: MN River Basin General Phosphorus Permit
Wastewater implementation plan for the Lower Minnesota River Low Dissolved Oxygen TMDL. Established total phosphorus effluent limits for the 39 largest WWTPs upstream of Jordan, MN.

2006: Metropolitan WWTP 1 mg/L Effluent Limit
The Metro Plant serves 1.8 million people and can treat up to 251 million gallons of wastewater per day.

2008: Phosphorus Rule
The Phosphorus Strategy created in 2000 was formally adopted as Minnesota Rule 7053.0255.

2010: Clean Water Fund Investments
The Clean Water, Land and Legacy Amendment passed Nov. 4, 2008 begins funding projects.

Municipal and Industrial Wastewater Flow and Phosphorus Concentration Trends (2000-2012)



Growth Projections for Municipal Wastewater Flow and Minnesota Households (2005-2035)