Clean Water Partnership Diagnostic Study 1998-2002

- Water quality monitoring
  - Water chemistry
  - Biological monitoring – fish, mussels and other invertebrates
  - Physical stream characteristics
- Karst studies – dye tracing and spring monitoring
- Watershed assessments – land use, feedlots, wetlands, etc.

South Branch Root River
3-Year Goals for Implementation

- Reduce fecal coliform numbers to meet state water quality standard
- Reduce pollutant loading for sediment, nitrogen and phosphorus

Governor's 10-year Clean Water Initiative

Goals for SE MN Streams

- Reduce harmful bacteria entering rivers and streams, specifically a 65% reduction by 2013
- Reduce sediment loading to rivers and streams, specifically a 30% reduction by 2013

Water Quality Monitoring 2004-2005

- Grab samples twice a month from April to October at Historic Forestville bridge
  - Fecal coliform bacteria/E. coli
  - Nitrogen and phosphorus
- Plus runoff events
  - Total suspended solids
- Permanent monitoring station at Forestville bridge
  - Probes: stage, pH, dissolved oxygen, turbidity, temperature, conductivity
  - Automated datalogger records measurements every 15 minutes

Fecal Coliform Bacteria

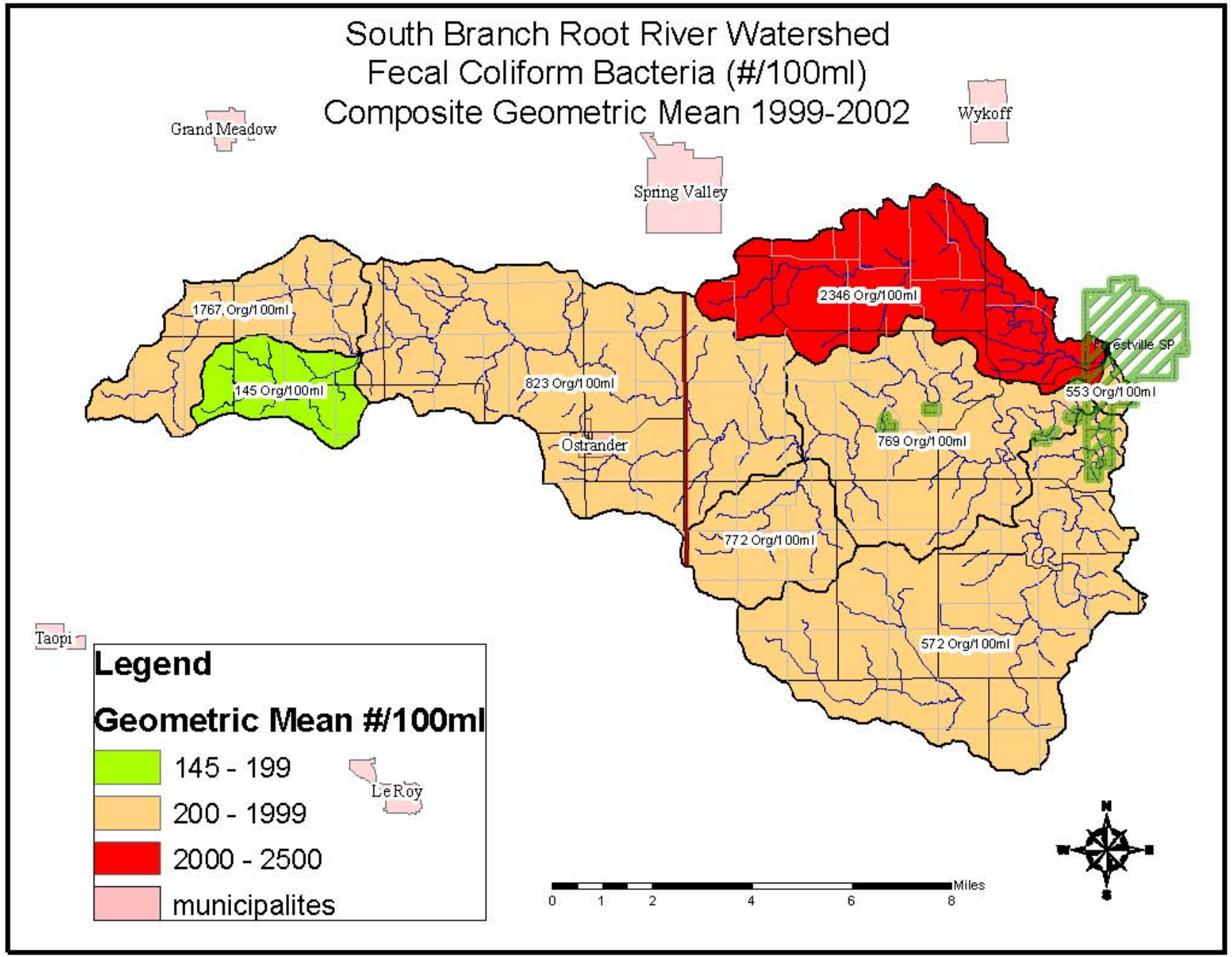
- 83 grab samples collected between 1999 and 2002
  - Overall geometric mean at Forestville

    = 553 orgs/100 mL

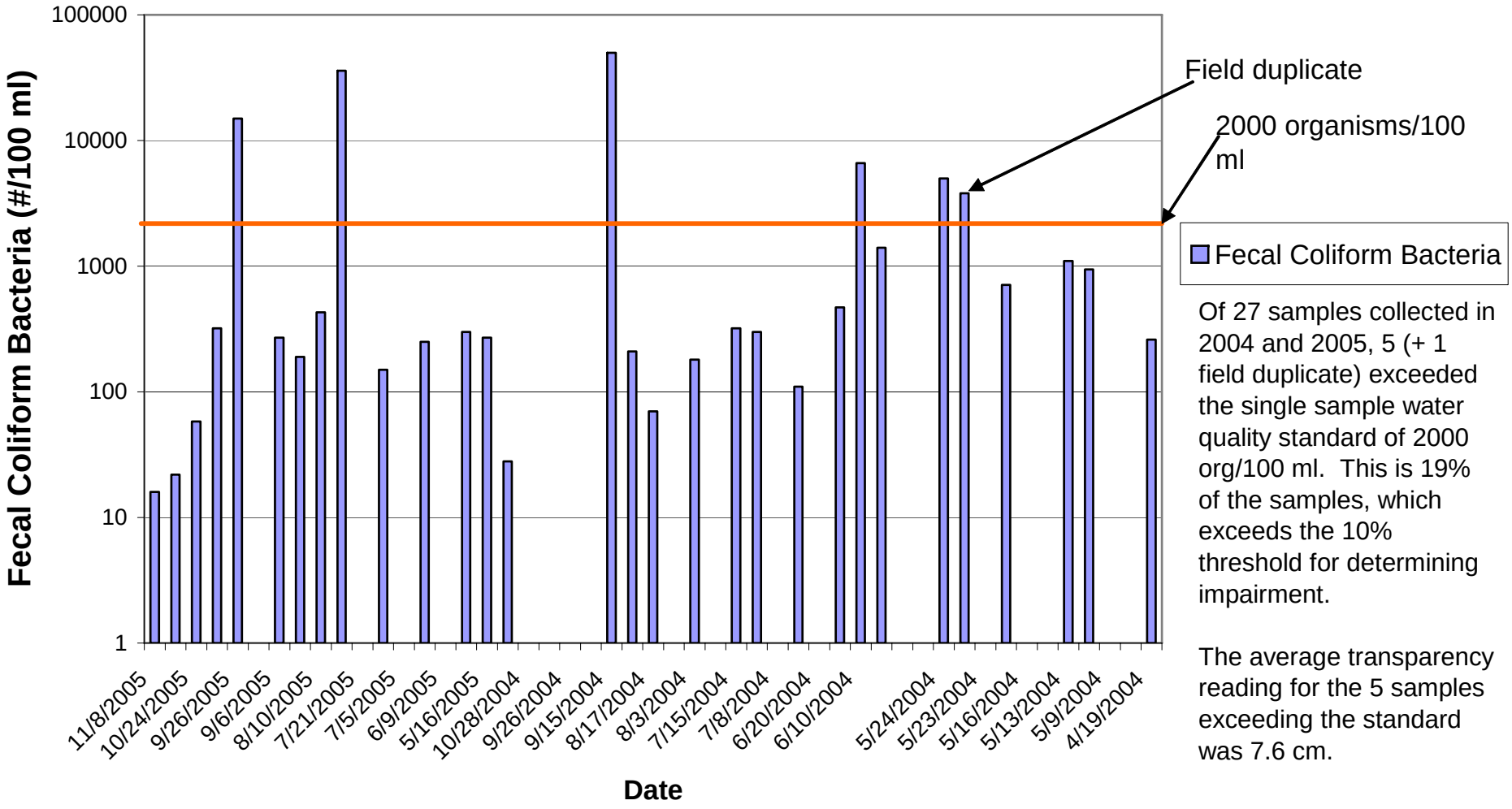
    more than 2 times the water quality standard of 200 org/100 ml (for multiple samples)
  - 24 exceeded 2000 org/100 mL

    (the water quality standard for individual samples)

The major sources of Fecal Coliform Bacteria are mismanaged livestock manure and malfunctioning septic systems.


South Branch Root River Watershed
Fecal Coliform Bacteria (#/100ml)
Composite Geometric Mean 1999-2002
Grand Meadow
Wykoff
Spring Valley
1767 Org/100ml
2346 Org/100ml
Forestville SP
145 Org/100ml
823 Org/100ml
553 Org/100ml
Ostrander
769 Org/100ml
772 Org/100ml
572 Org/100ml
Taopi
LeRoy
Legend
Geometric Mean #/100ml
145 - 199
200 - 1999
2000 - 2500
municipalites
0 1 2 4 6 8
Miles
N

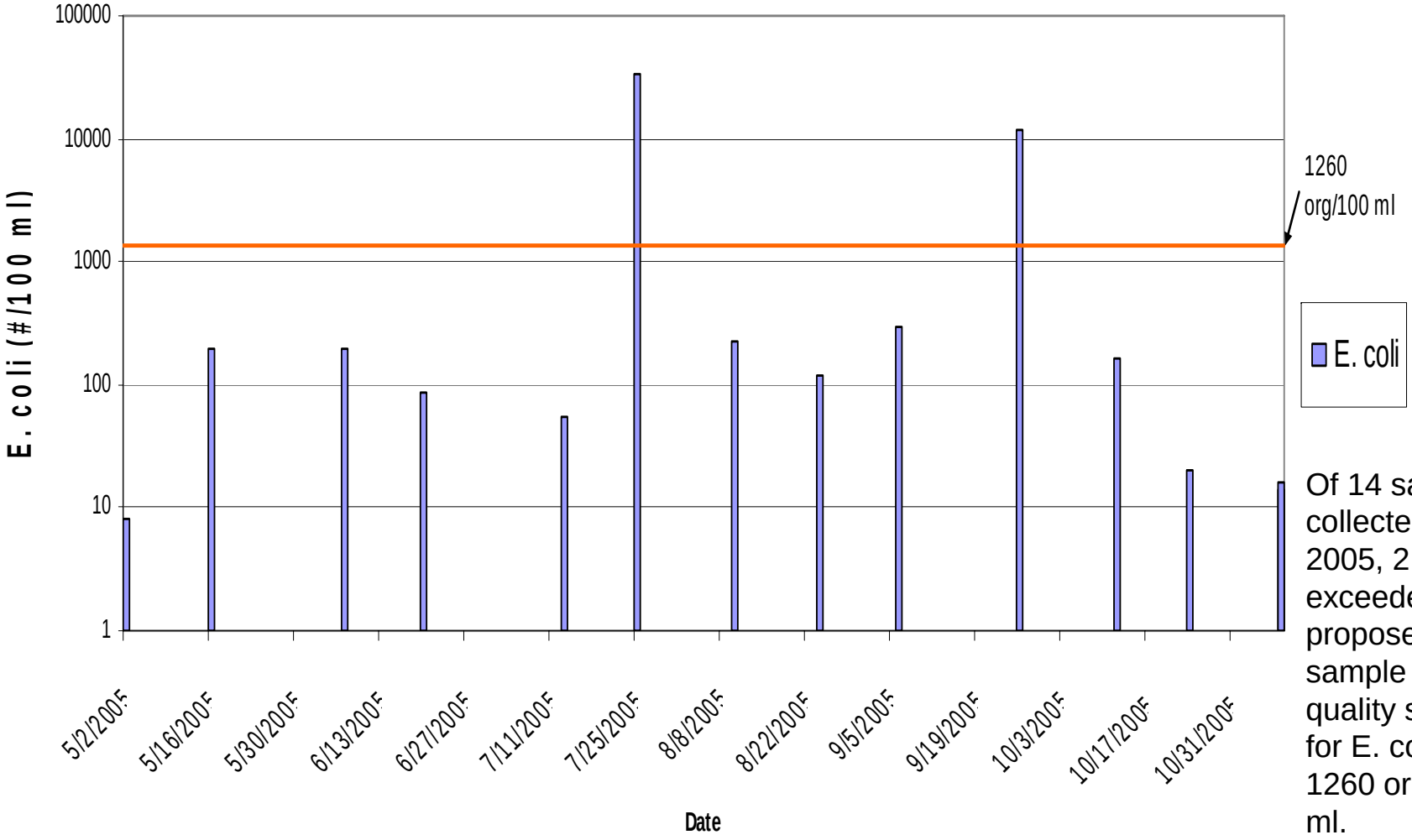
Fecal Coliform Bacteria 2004 - 2005
South Branch Root River



Of 27 samples collected in 2004 and 2005, 5 (+ 1 field duplicate) exceeded the single sample water quality standard of 2000 org/100 ml. This is 19% of the samples, which exceeds the 10% threshold for determining impairment.

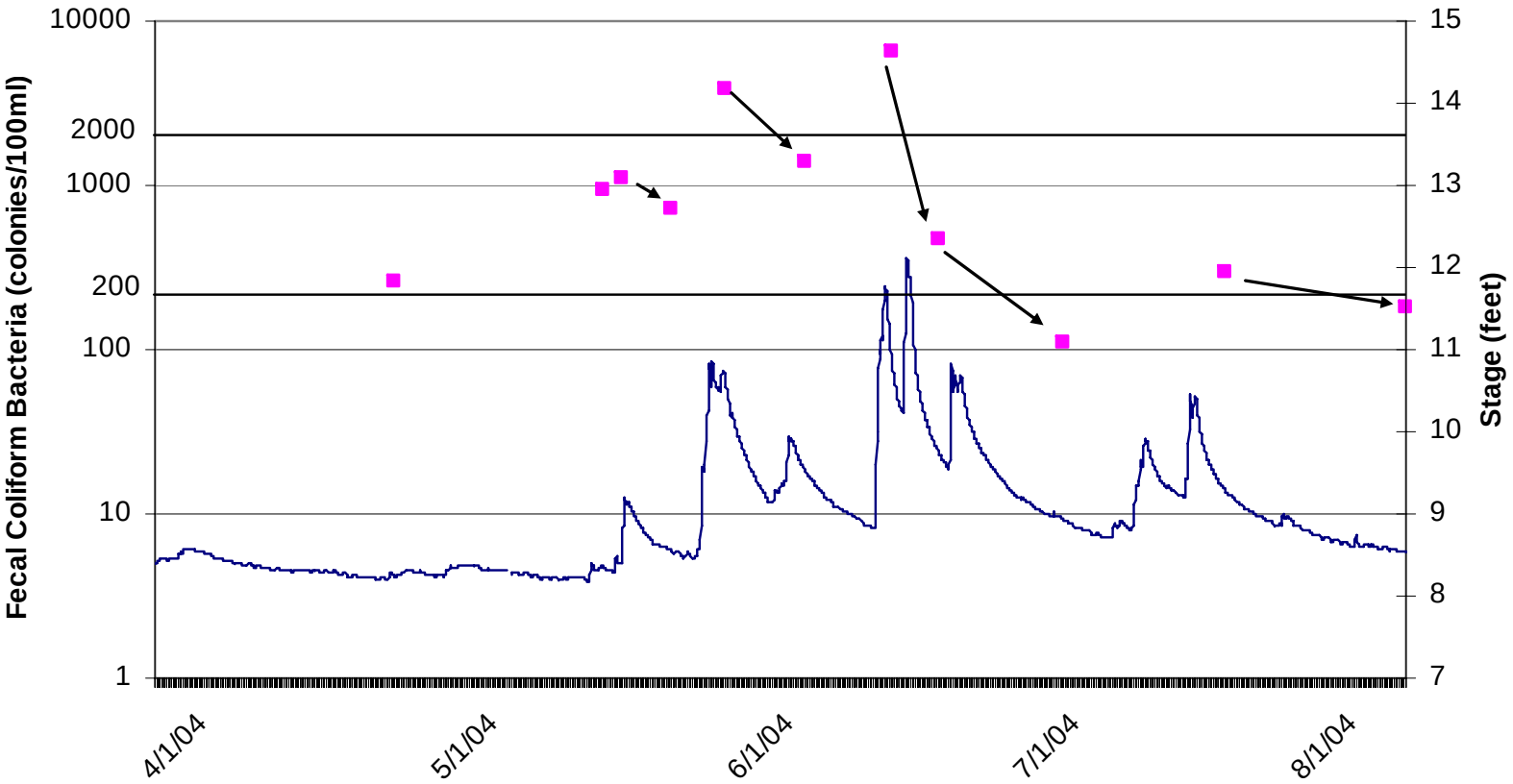
The average transparency reading for the 5 samples exceeding the standard was 7.6 cm.

E. coli 2005
South Branch Root River Watershed Project



Of 14 samples collected in 2005, 2 (14%) exceeded the proposed single sample water quality standard for E. coli of 1260 org/100 ml.

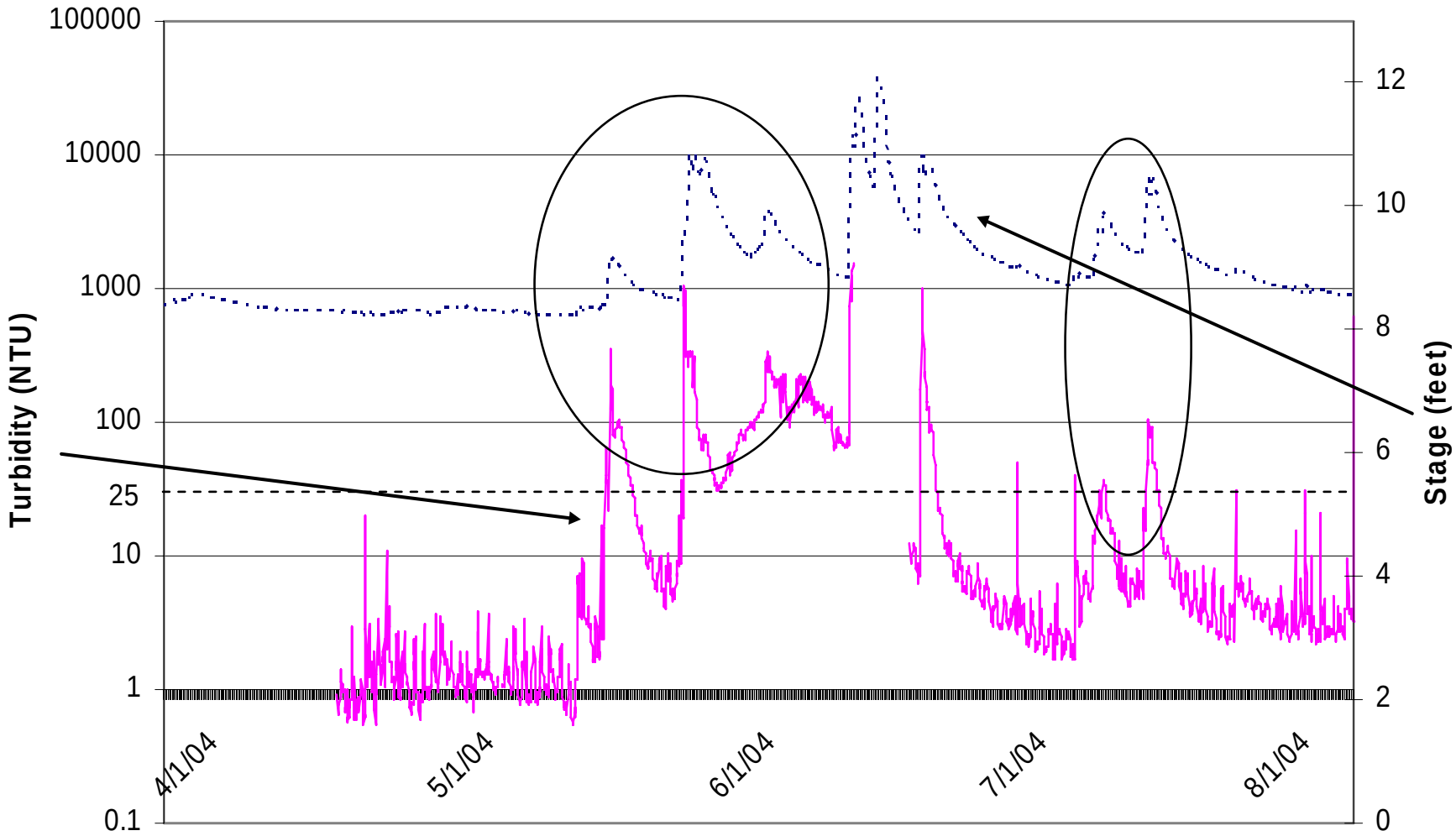
South Branch Root River - Forestville



Turbidity

- The average turbidity of 80 water samples collected between 1999 and 2002 was about 85 NTUs (nephelometric turbidity units)
  - **Over 8 times the water quality standard for coldwater trout streams (10 NTUs)**
  - **Over 3 times the warm water stream standard (25 NTUs)**
- Turbidities over 1000 NTUs were observed during several runoff events

South Branch Root River - Forestville



25% of obs. > 25 ntu (data shown on this chart)

30% of obs. > 25 ntu (Root River at Mouth 1993-2002)

Note: 10 NTU is the trout stream standard

Turbidity and Transparency

- Transparency of 20 cm = turbidity of 25 NTUs, the warm water stream standard
- Transparency of 5 cm = total suspended solids of 250 mg/l
  - 58 mg/l is the threshold for Western Corn Belt Plains streams
- Transparency of 5 cm = about ½ tsp. of sediment in 1 gallon of water

How To Measure Transparency

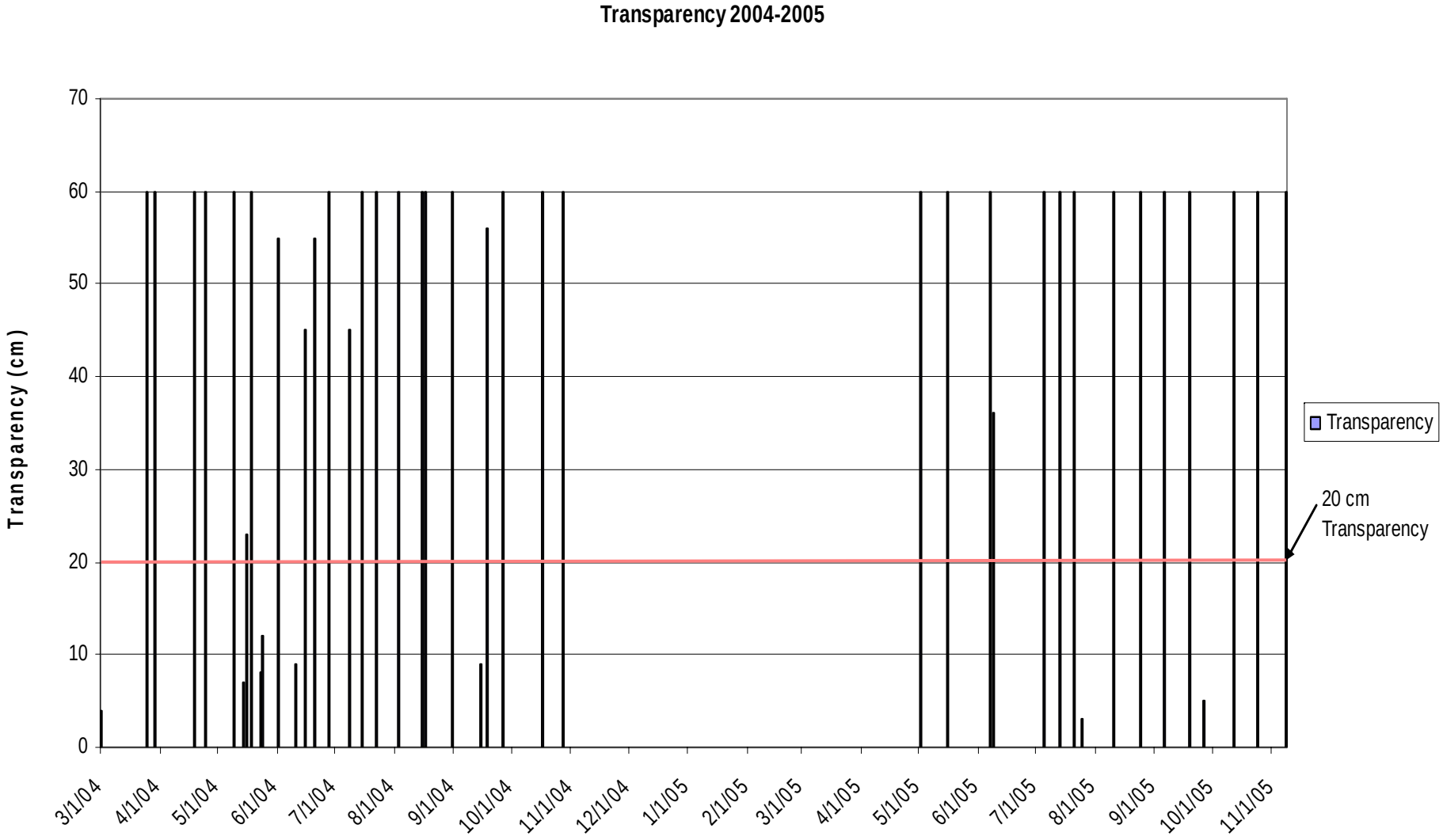
Fill transparency tube with water from stream.

Look down into the tube while releasing water through the clamped outlet tube until the black and white symbol in the bottom is just visible.

Take an initial reading measured in centimeters.

Let out more water until the symbol is clearly visible and take a second reading. Average the 1st and 2nd reading and record.

Transparency 2004 - 2005

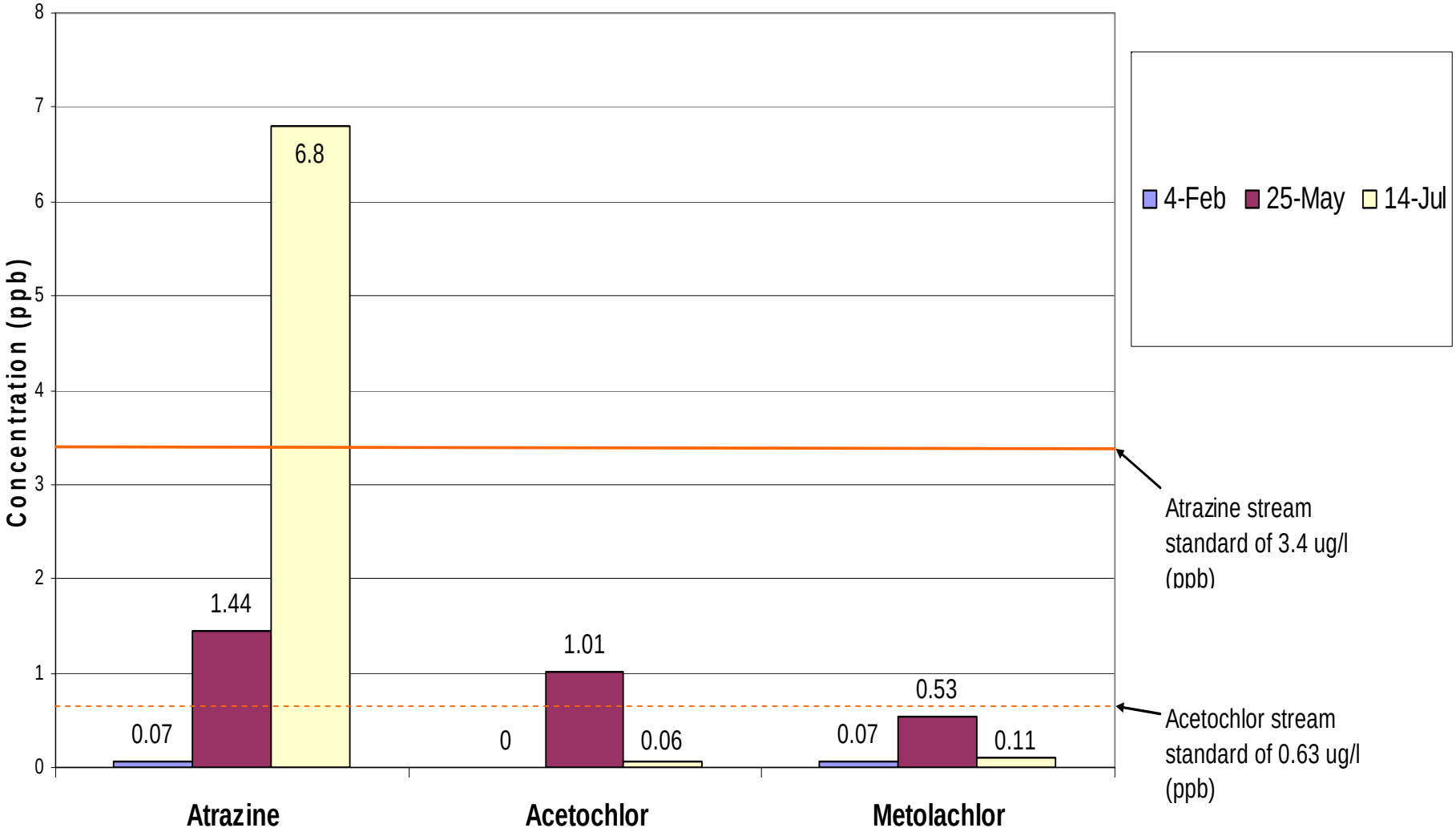


44 observations; 8 in violation of the 20 cm criterion, which meets the impairment requirement of 3 observations below 20 cm AND 10% (4 - 5) of observations under 20 cm.

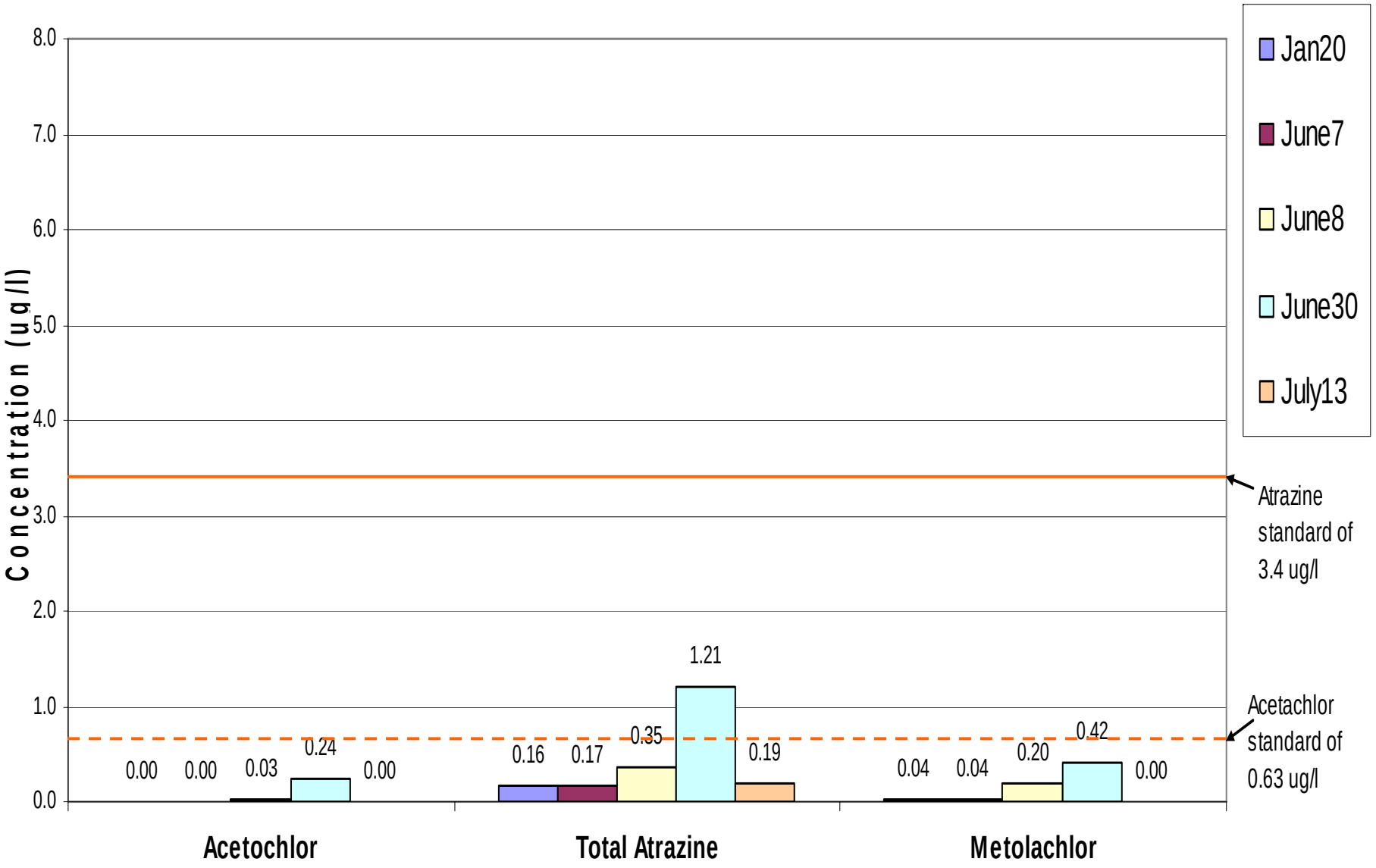
Pesticide Monitoring

- In cooperation with the MN Department of Agriculture, pesticide samples have been collected at the Historic Forestville Bridge during two time periods during the year since 2002:
  - Winter baseflow (Jan.-Feb.)
  - Spring/summer runoff (May 15 – July 15)
- A series of about 20 pesticide compounds are analyzed in each sample.
- At least one spring runoff sample from the South Branch has exceeded the water quality for atrazine every year since 2002 except 2005 when no runoff events occurred between May 15 and July 15.

South Branch Root River Pesticide Monitoring 2004



Pesticide samples 2005



Phosphorus

July 25, 2005 event

- 4.9” of precipitation recorded that day
- Total amount of runoff from 74,000 acres = 0.2 inches
- Mean flow of 570 cubic feet/second (cfs)
- Estimated 3000 lbs of phosphorus passed that site that day
- Flow peaked on July 26th and remained high for 2-3 days

Phosphorus

- Phosphorus attaches to soil particles.
- Phosphorus concentrations are highest in the streams during runoff events when soil is also being transported.
- In 1999 and 2000, which were years of extreme flooding, an estimated 57,000 pounds and 100,000 pounds of phosphorus, respectively, were transported by the South Branch.
- This calculates to 2.08 lbs/acre and 3.65 lbs/acre lost in the watershed.
- Normalized for rainfall, these amounts are 0.175 lbs/acre/inch of rainfall and 0.244 lbs/acre/inch of rainfall, respectively.

Station Name

Phosphorus 2005

s001-320

S BR ROOT R AT CR-118 IN FORESTVILLE ST PK

Sample Date	CSMP Transparenc Tube,	Dissolved oxygen	Nitrate and Nitrite Nitrogen, Total	Field pH	Phosphorus
Units of Measure	cm	mg/L	mg/L		mg/L
11/8/2005			9		0.024
11/8/2005	> 60	16.16	9		0.022
10/24/2005	> 60	14.92	9.5		0.031
10/12/2005	> 60	12.62	9.8		0.042
9/26/2005	5	9.03	4.2		0.407
9/19/2005	> 60	10.73	8.5		0.054
9/6/2005	> 60	10.61	8.2		0.045
8/24/2005	> 60	13.21	9.9		0.044
8/10/2005	> 60	13.84	9.5		0.044
7/25/2005	3	9.46	5.2		1.09
7/21/2005	60	12.43	7		0.193
7/13/2005	> 60	12.08	9		0.033
7/5/2005	> 60	11.91	9.7		0.048
6/20/2005			10		0.052
6/9/2005	36	11.09	8.7		
6/7/2005	> 60	11.9	8.7		0.051
5/16/2005	> 60	10.86	10		0.038

Nitrogen

- High flows have the effect of diluting nitrogen concentrations.
- There is no water quality standard for streams for nitrogen. However,
  - The South Branch of the Root River and some tributaries are losing streams, which means water is lost to the subsurface ground water through cracks and sinkholes in the streambed. Since ground water is the sole source of drinking water for watershed residents, and there is a drinking water standard of 10 ppm, nitrate levels above 10 ppm have the potential to impact drinking water supplies.
  - Nitrogen transport to the Gulf of Mexico is linked to the Dead Zone where oxygen levels drop below the level necessary to sustain aquatic life, which has greatly harmed the fishing industry in the Gulf.

Nitrogen

- The nitrogen yields for the years 1999 and 2000 were 84.7 lbs/acre and 105.1 lbs/acre, respectively.
- Normalized for rainfall, these amounts are 6.2 lbs/acre/inch of rainfall and 5.5 lbs/acre/inch of rainfall, respectively.
- Economic losses due to lost nitrogen are significant, especially in the upper reaches of the watershed where tile drainage speeds the loss of nitrogen into waterways.

Nitrogen 2005

Station Name s001-320

S BR ROOT R AT CR-118 IN FORESTVILLE ST PK

Sample Date	Nitrate and Nitrite Nitrogen, Total mg/L	
11/8/2005	*9*	
11/8/2005	*9*	
10/24/2005	*9.5*	
10/12/2005	*9.8*	
9/26/2005	*4.2*	
9/19/2005	*8.5*	
9/6/2005	*8.2*	
8/24/2005	*9.9*	
8/10/2005	*9.5*	
7/25/2005	*5.2*	
7/21/2005	*7*	
7/13/2005	*9*	
7/5/2005	*9.7*	
6/20/2005	*10*	
6/9/2005	*8.7*	
6/7/2005	*8.7*	
5/16/2005	*10*	
5/2/2005	*9.1*	