

Minnesota River Basin Turbidity TMDL

Hydrological Simulation
Program/FORTRAN

Modeling Results: Scenario 4

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Scenario 4: Key Elements

- Perennial Vegetation
 - Increase in the Chippewa Watershed
 - Redistribution to lower reaches (except in Yellow Medicine and Hawk Creek)
- Controlled Drainage: <1% slope
- Water Storage
 - On-field storage of runoff
 - About half of the first 2 inches

Scenario 4: Runoff Relationships

Non-Infiltrating Runoff	Routed to Surface Storage	Routed to Receiving Water
1 inch	$\frac{1}{2}$ inch	$\frac{1}{2}$ inch
1.5 inches	$\frac{3}{4}$ inch	$\frac{3}{4}$ inch
2 inches	1 inch	1 inch
3 inches	1 inch	2 inches

Scenario 4: Modeling Results

- Measurements of Reduction
 - Loads (tons of sediment)
 - Concentrations
 - milligrams of sediment/liter of water
 - Tons of sediment/millions of gallons of water
 - Flows
 - Gallons
 - Cubic feet
 - Acre-feet

Relationships

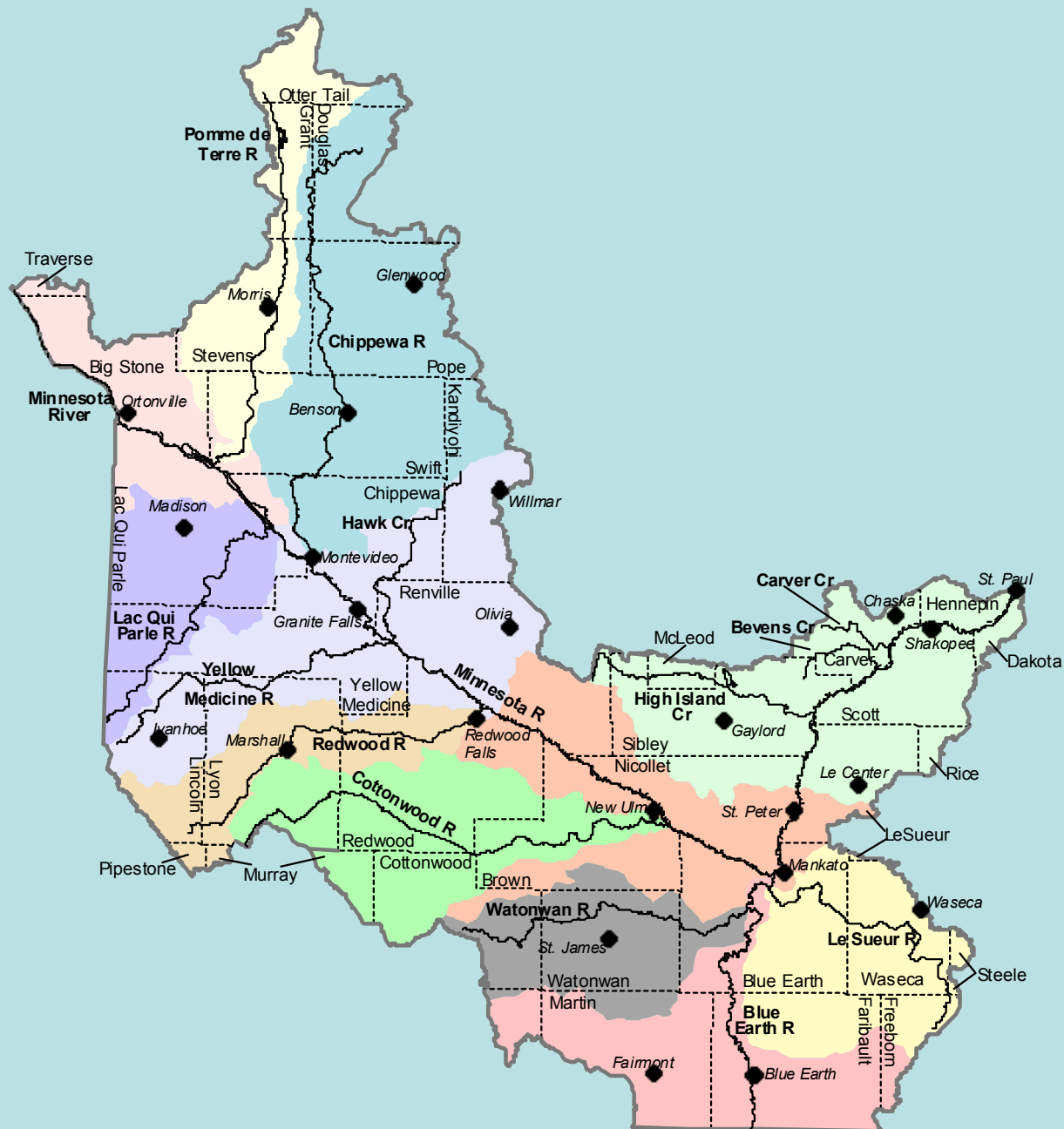
- Total Maximum Daily Load
- Concentration based standard

$$\text{Concentration} = \text{Load/Flow}$$

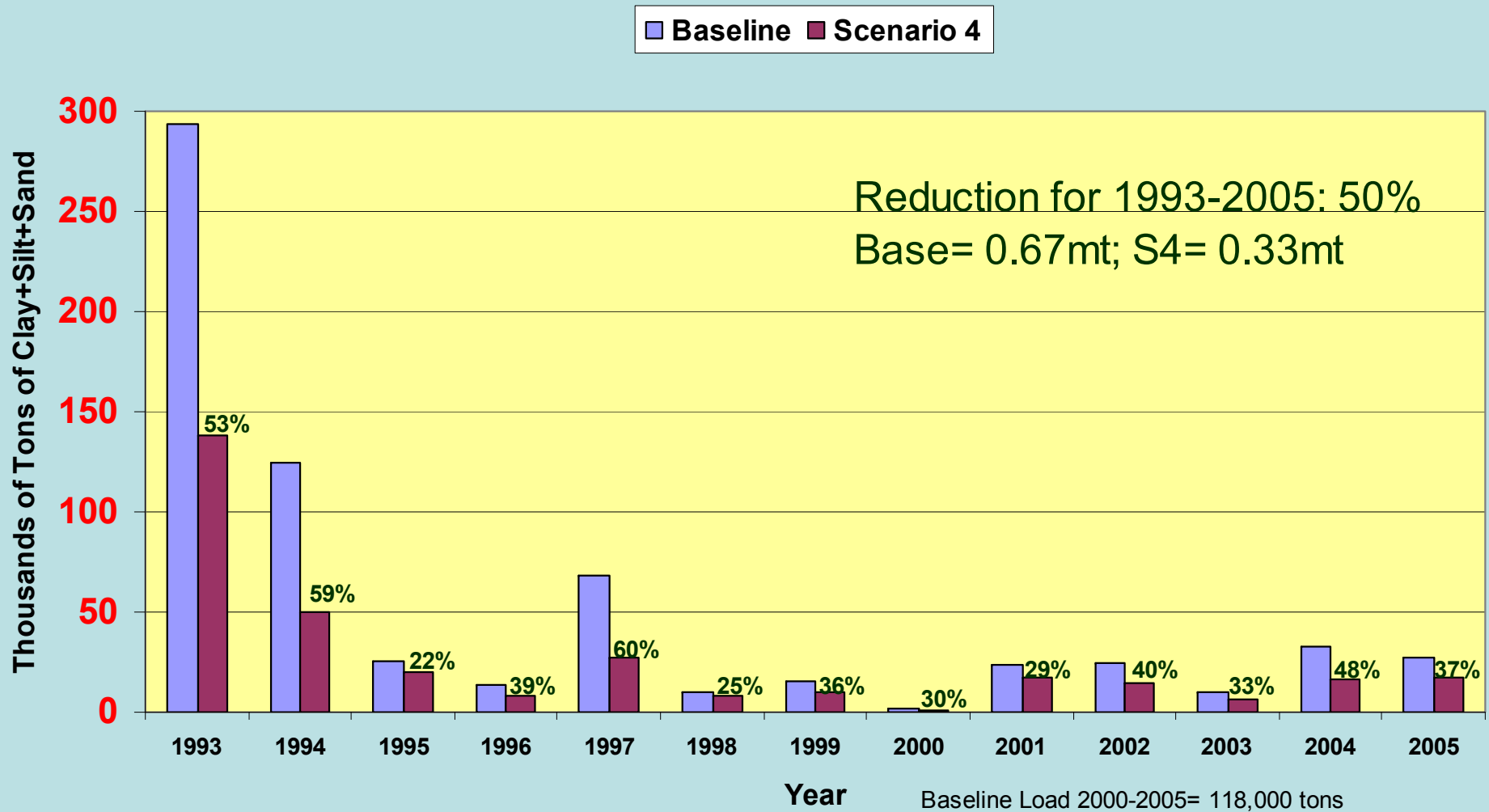
or

$$\text{Concentration} \times \text{flow} = \text{Load}$$

- TSS (mg/l) is used as a surrogate for turbidity (NTUs)

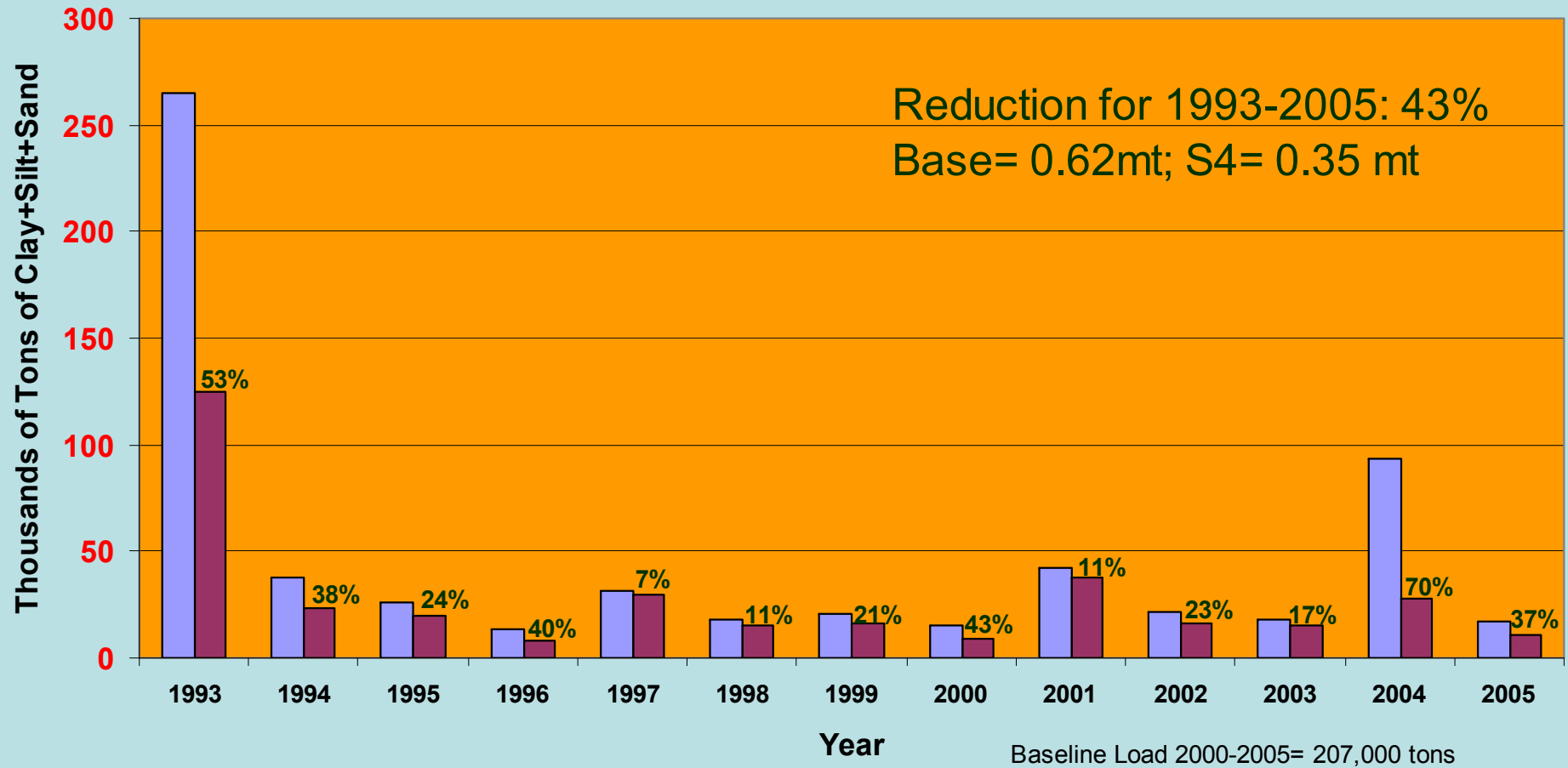


Comparison of Simulated Annual Loads: Yellow Medicine River Outlet

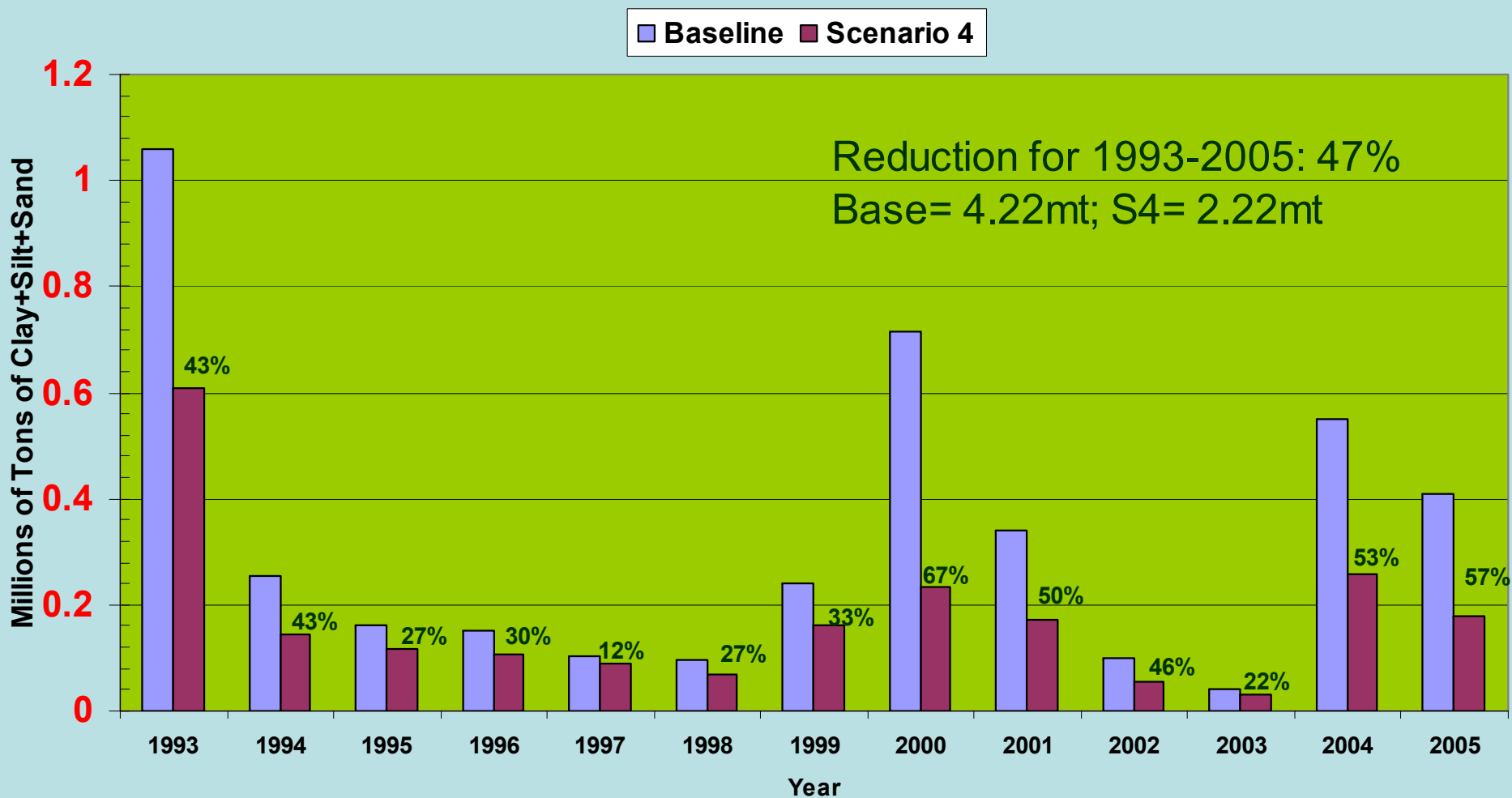


Comparison of Simulated Annual Loads: Redwood River Outlet

Baseline Scenario 4

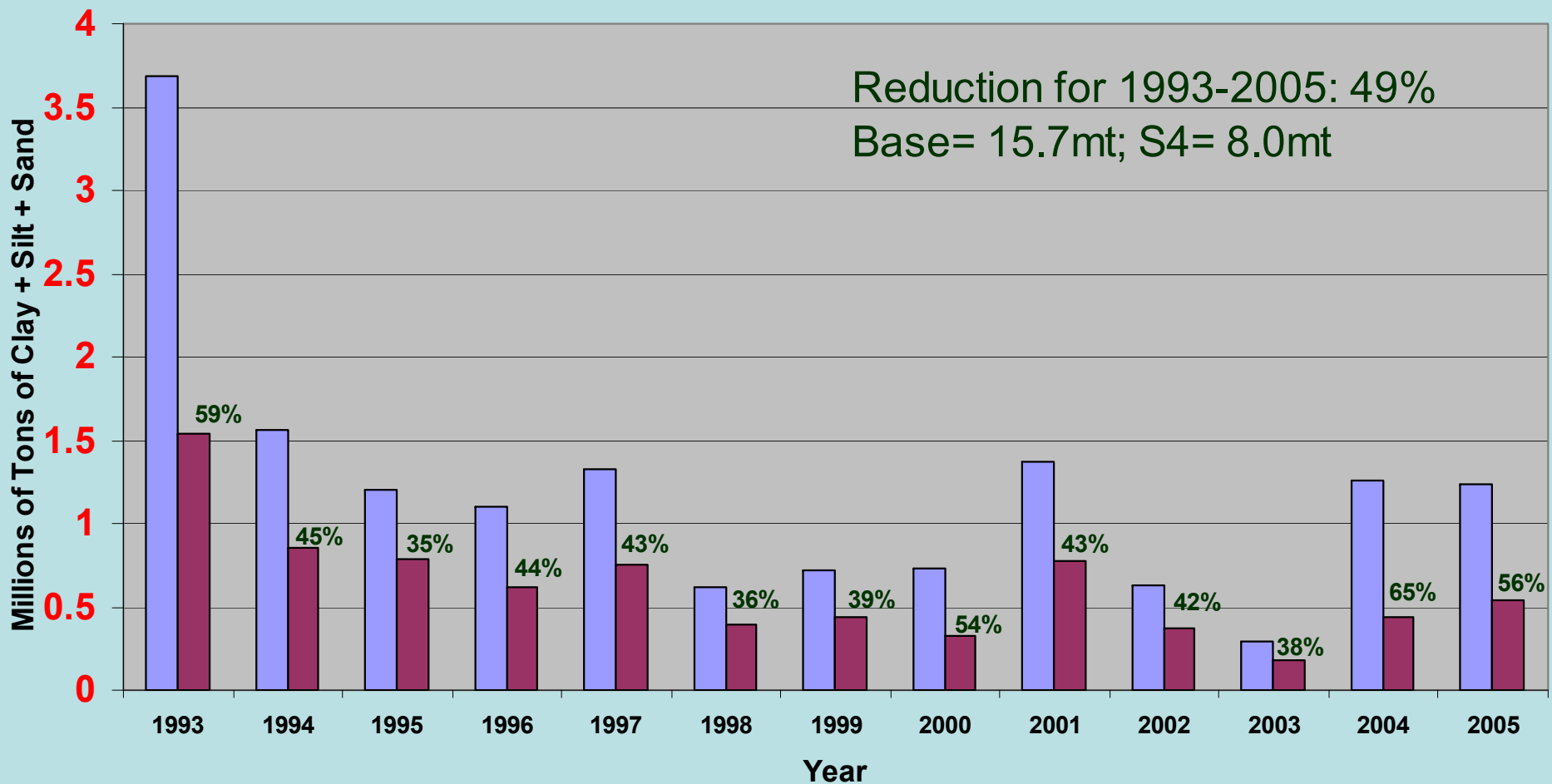


Comparison of Simulated Annual Sediment Loads: Le Sueur River Outlet



Comparison of Simulated Annual Sediment Loads: Minnesota River at Jordan

Baseline Scenario 4



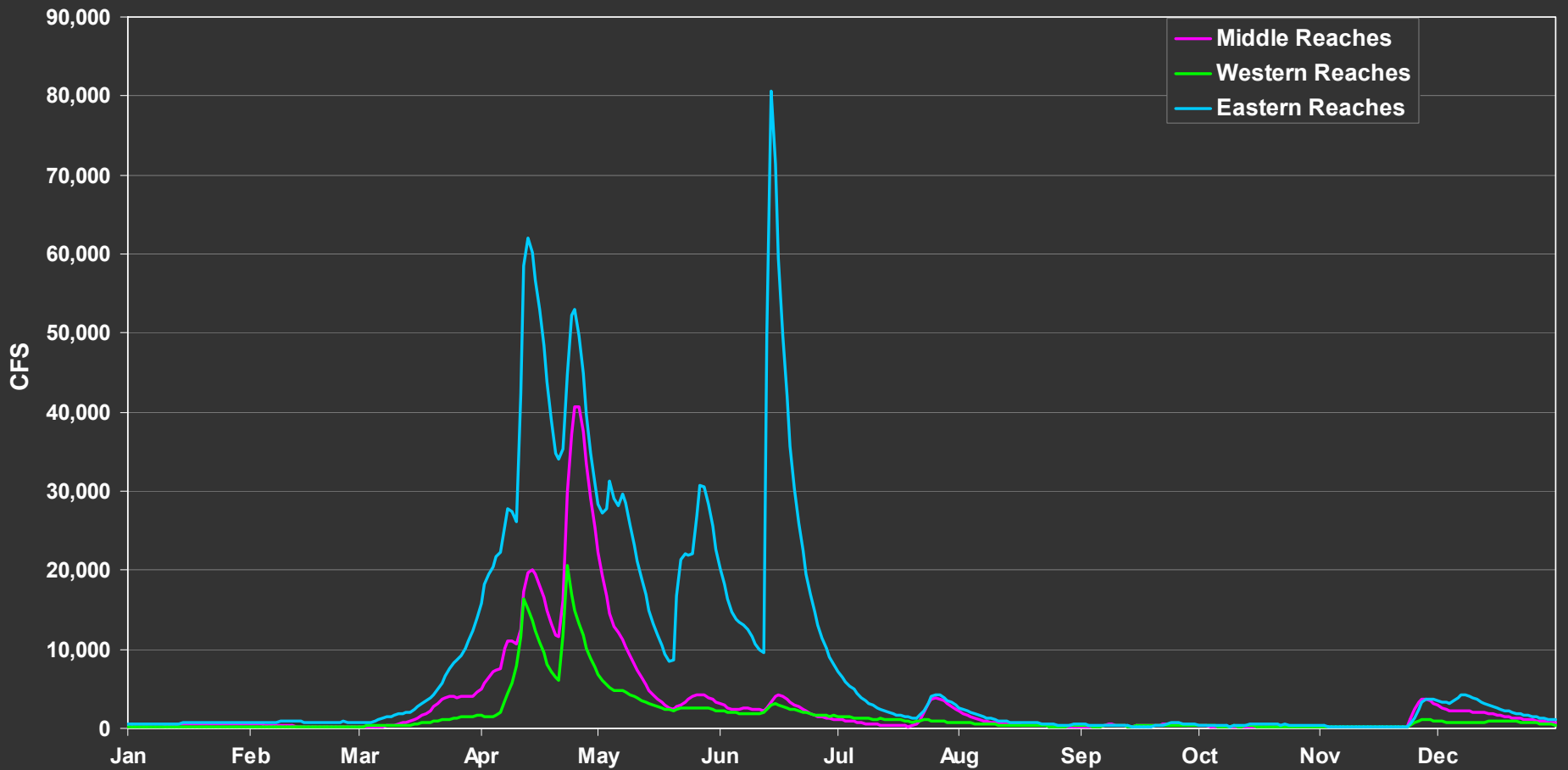
Load Analysis Summary

- Scenario 4 results in a ~50% reduction in sediment loads for most watersheds
 - Reductions vary year to year
 - Generally higher in wetter years
- Le Sueur River delivers ~25% of the load observed at Jordan
- Yellow Medicine and Redwood Rivers deliver ~5% of the load

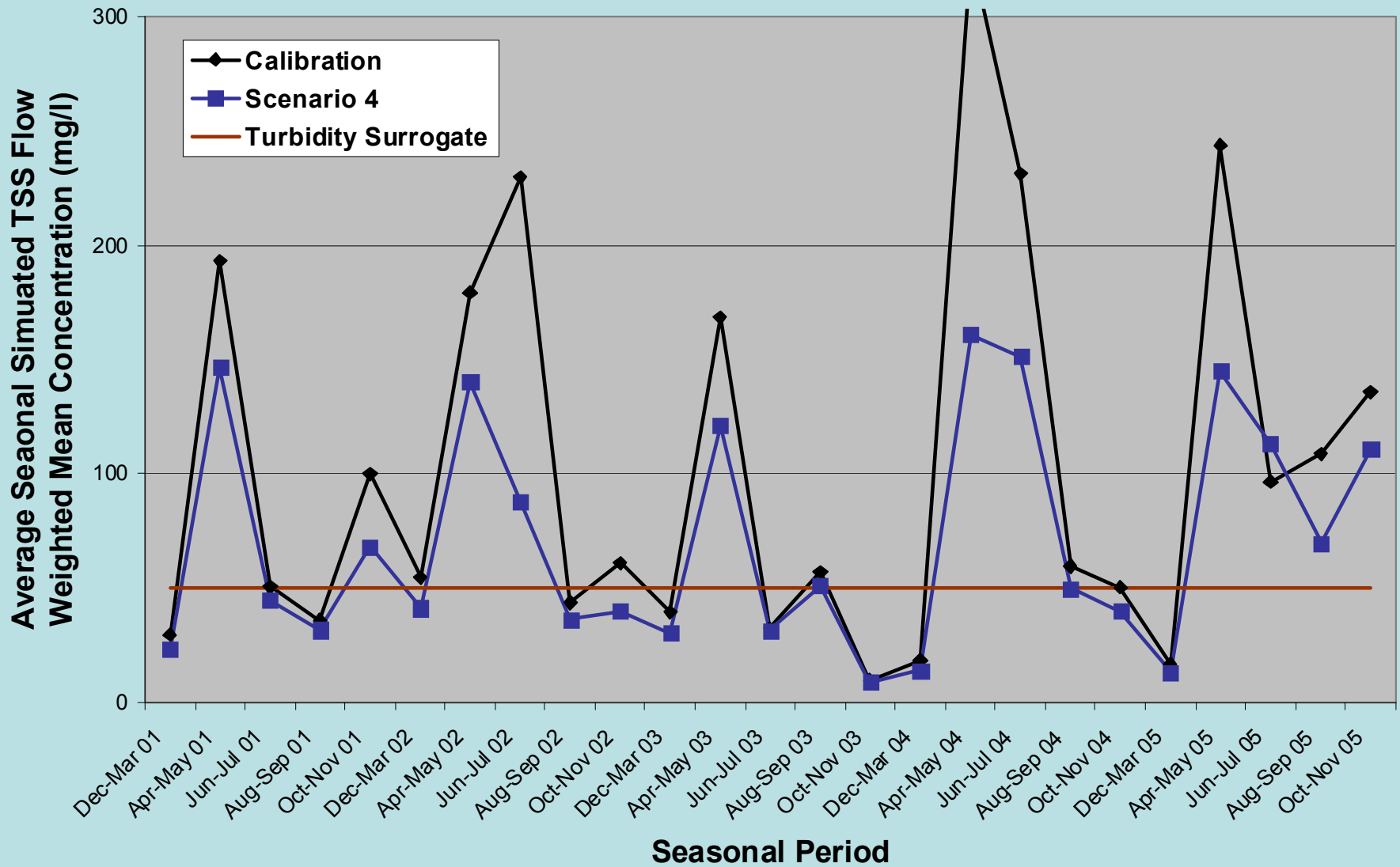
Concentration Based Standard

- Must account for variability in flow
- Total Suspended Solids is used as a surrogate for 25 NTUs
 - Western watersheds: 50 mg/l
 - Redwood and Cottonwood: 70 mg/l
 - Southern Watersheds: 90 mg/l
 - Mainstem Minnesota River: 100 mg/l

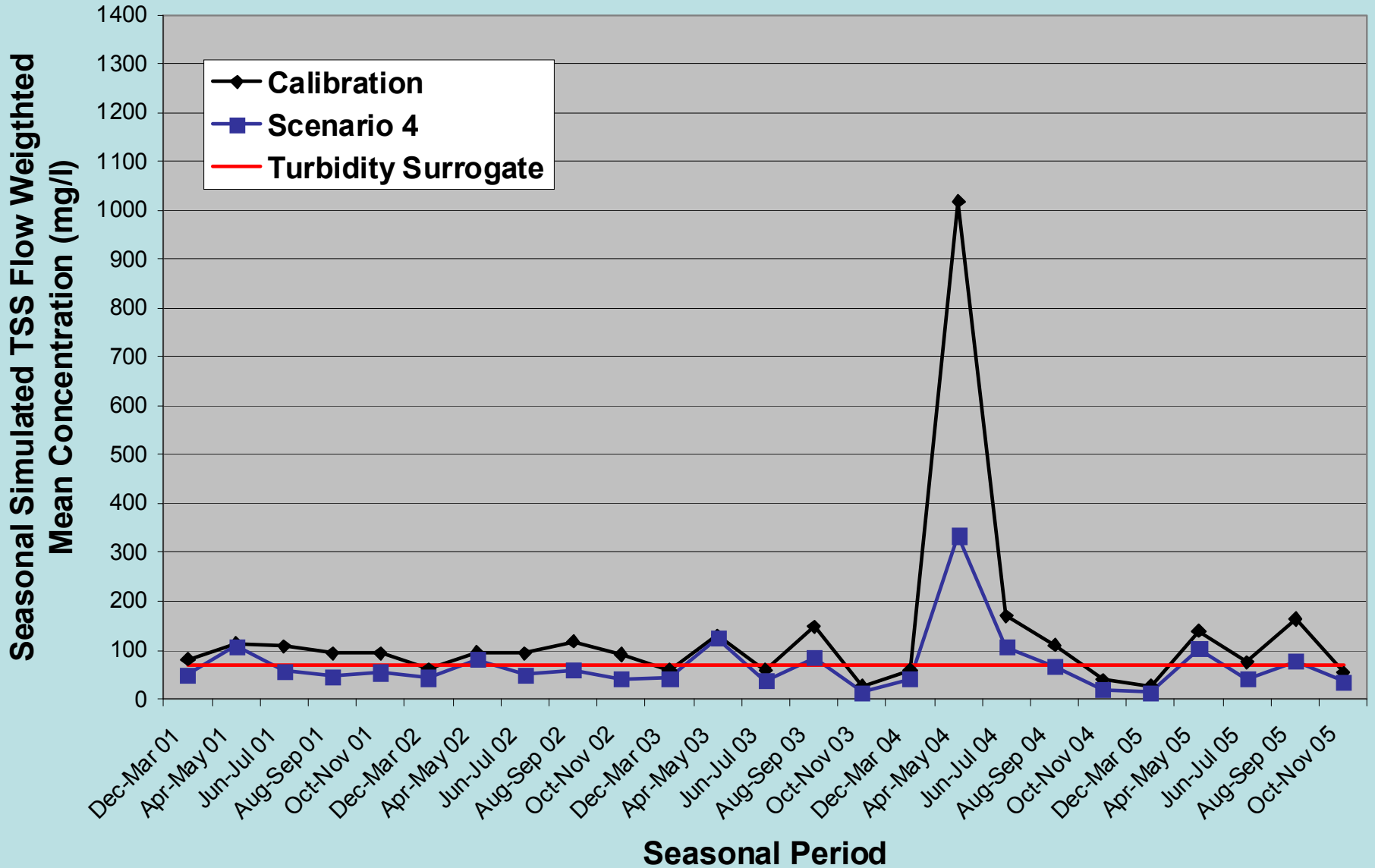
Major Reaches of the Minnesota River Flows by Source (2001)



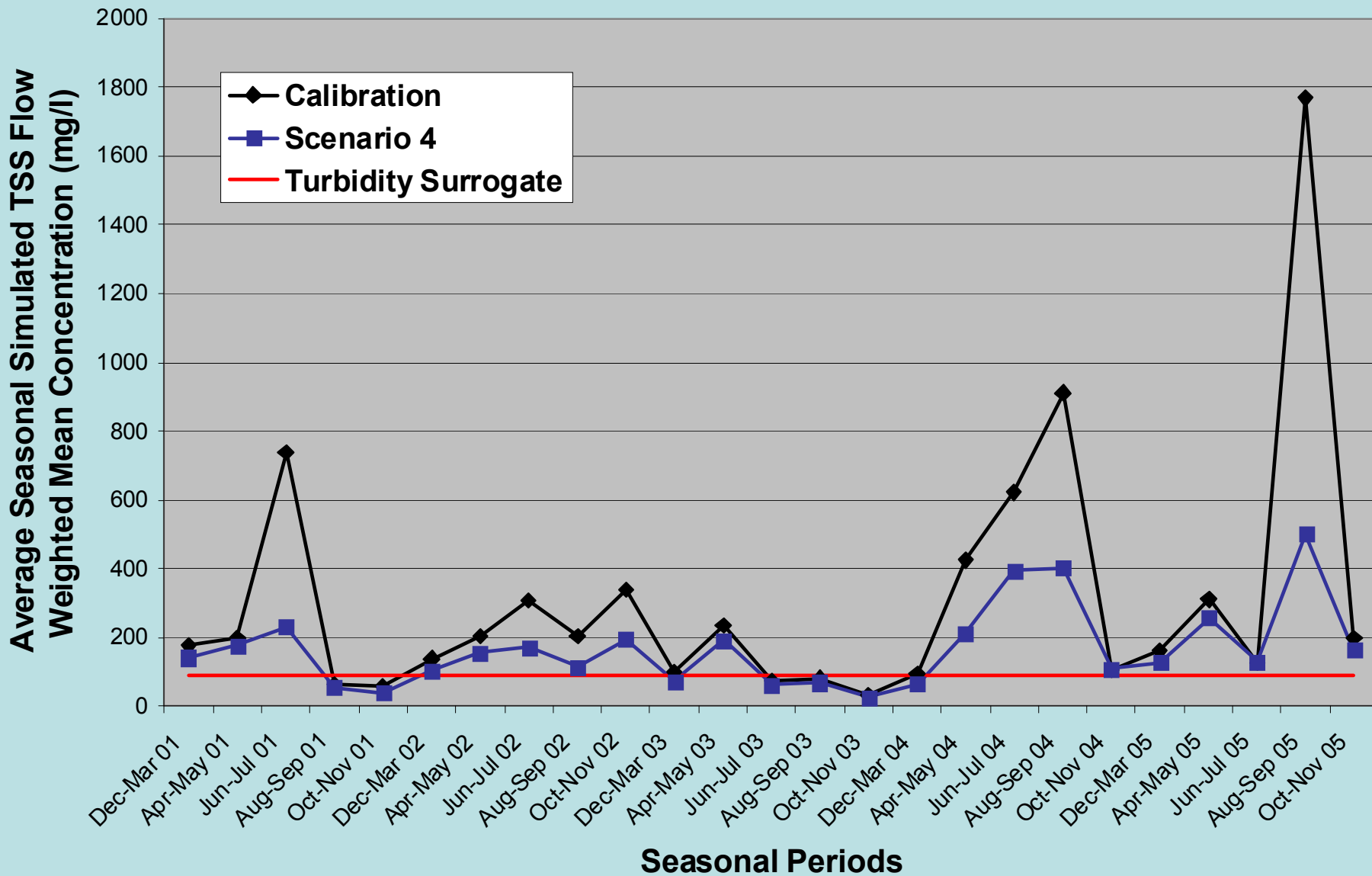
Yellow Medicine at Granite Falls



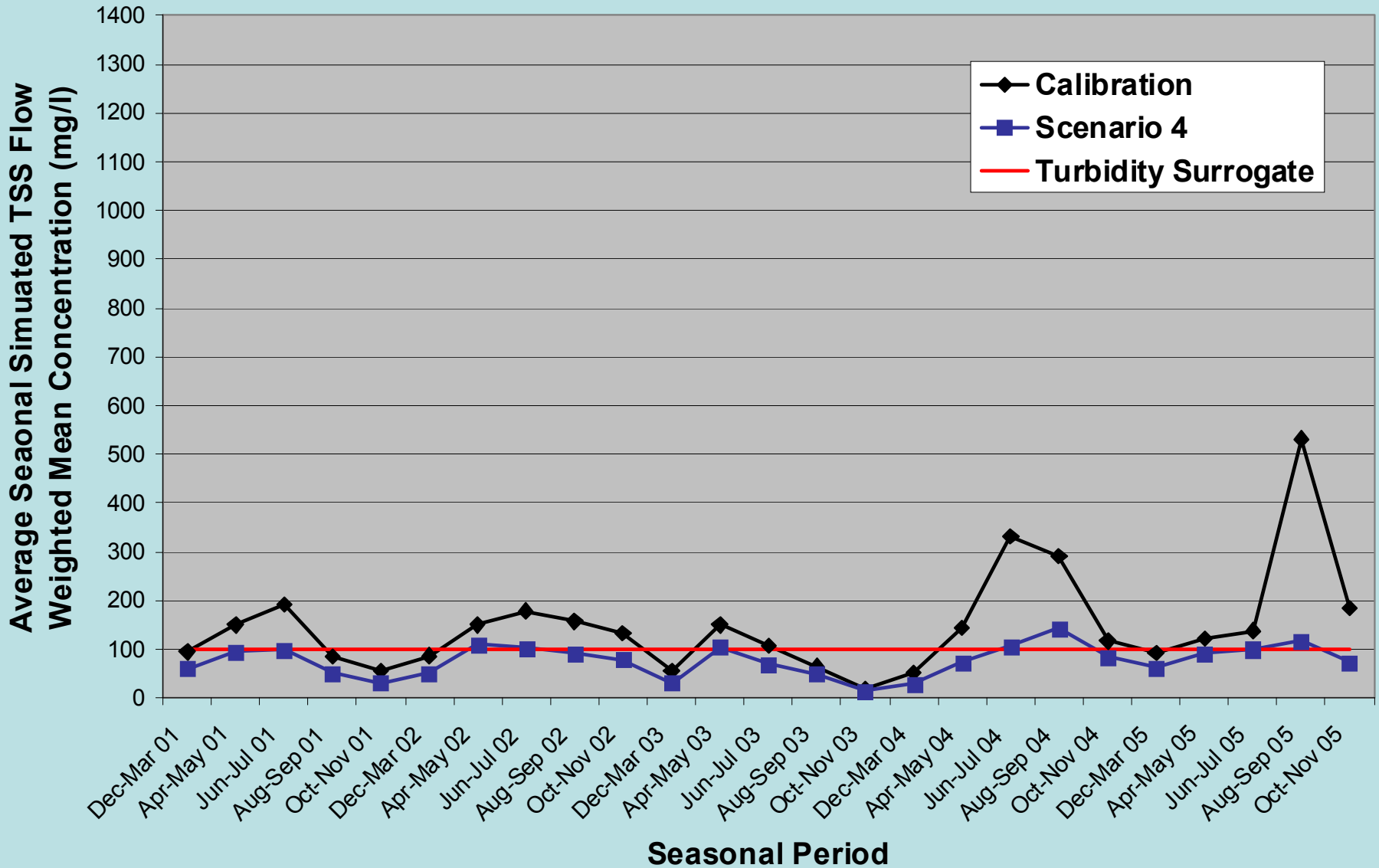
Redwood at Redwood Falls



Le Sueur at Rapidan



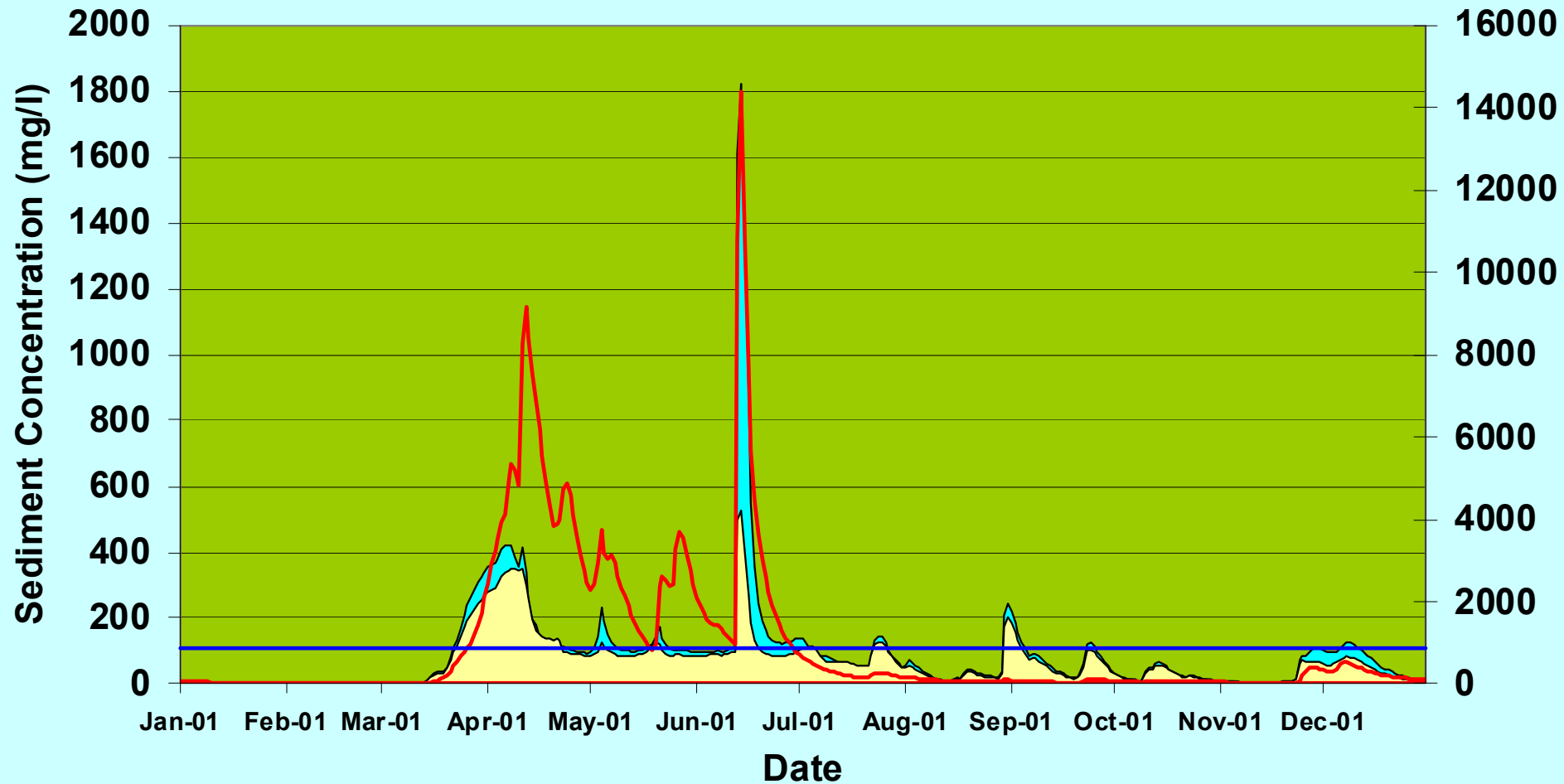
Mn River at Jordan



Le Sueur River Outlet

Sediment Concentration Comparision: 2001

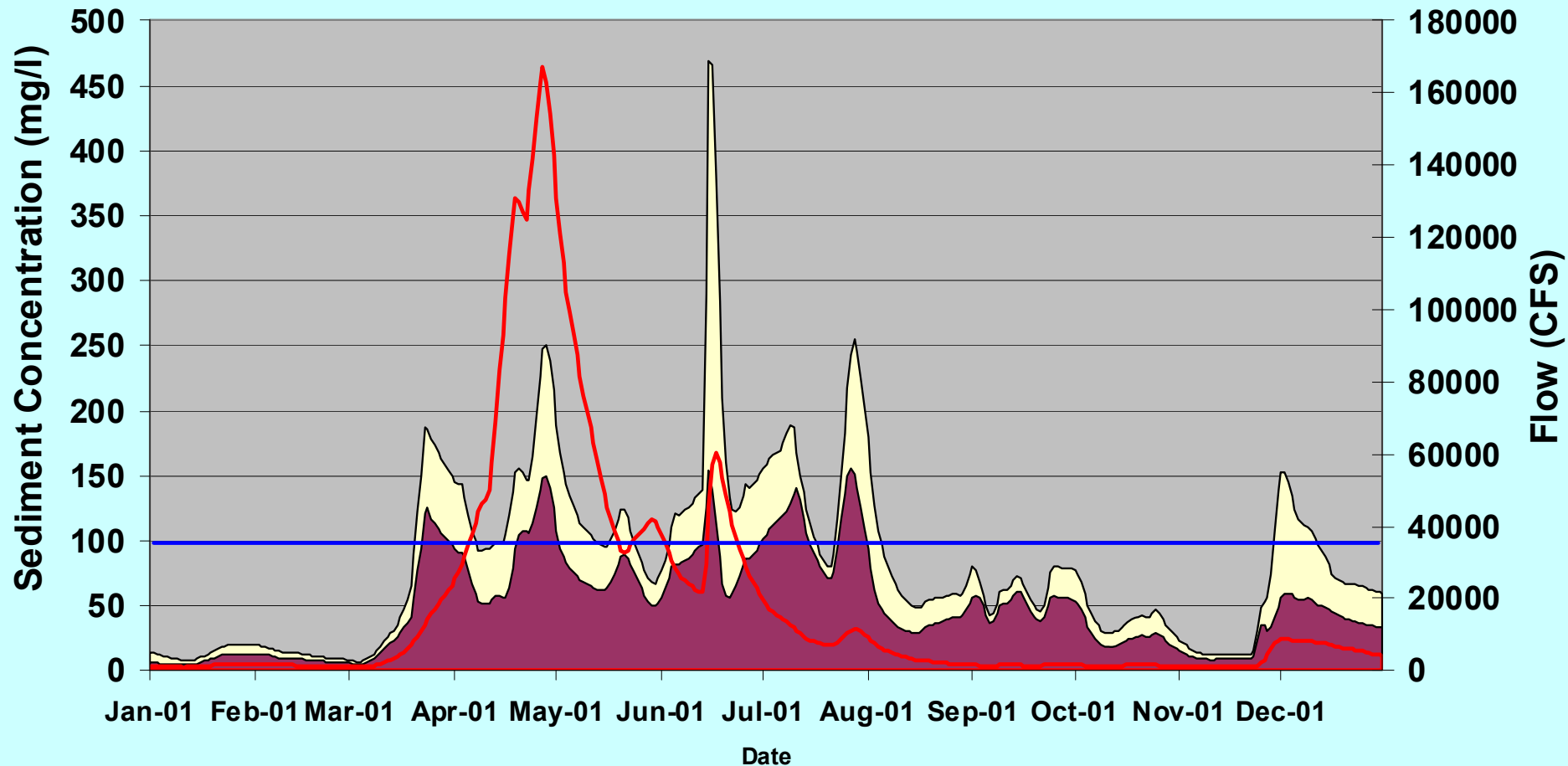
Baseline Sediment Concentration Scenario 4 Sediment Concentration Baseline Flow



Minnesota River at Jordan

Sediment Concentration Comparision: 2001

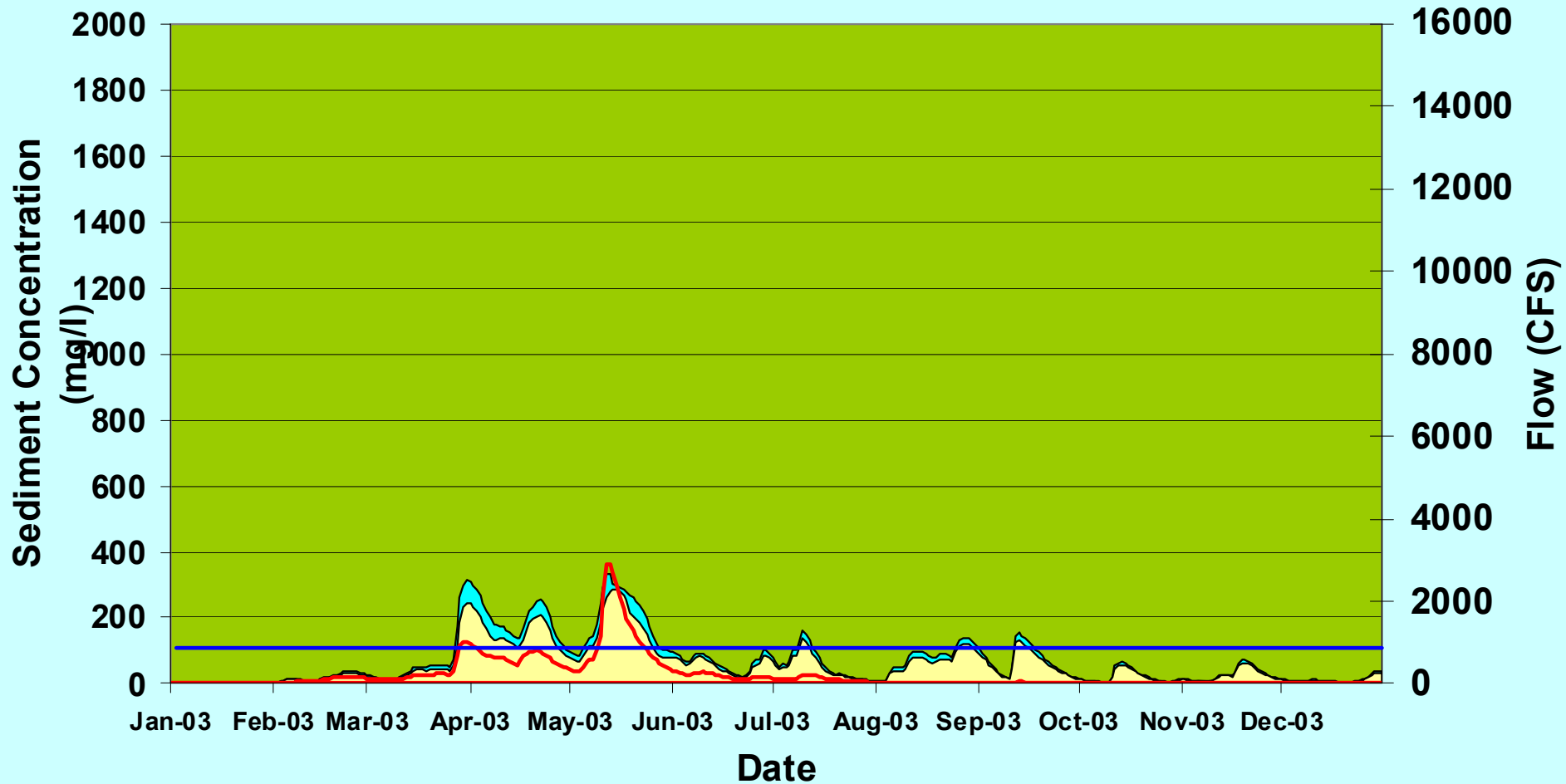
Baseline Sediment Concentration Scenario 4 Sediment Concentration Baseline Flow



Le Sueur River Outlet

Sediment Concentration Comparision: 2003

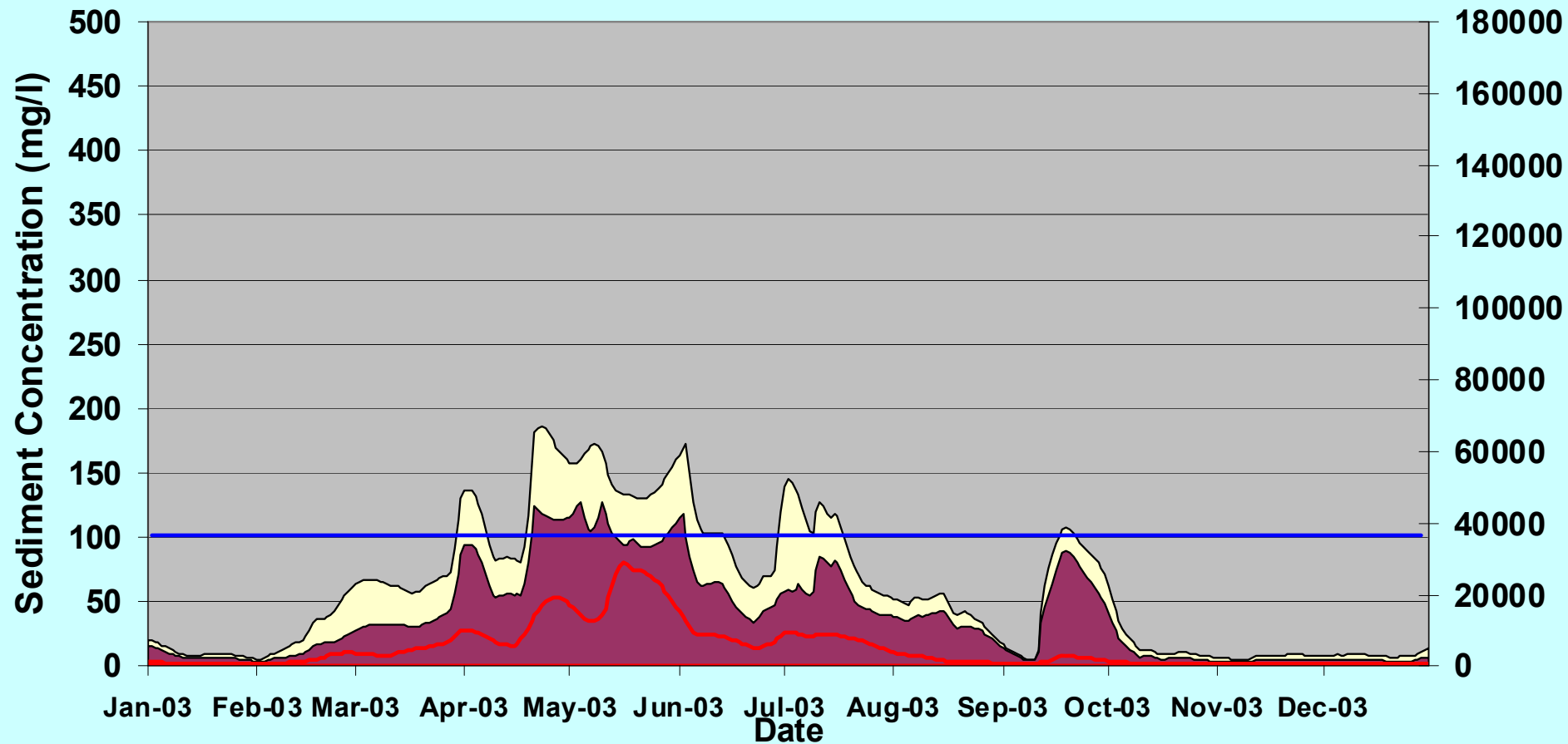
■ Baseline Sediment Concentration ■ Scenario 4 Sediment Concentration ■ Baseline Flow



Minnesota River at Jordan

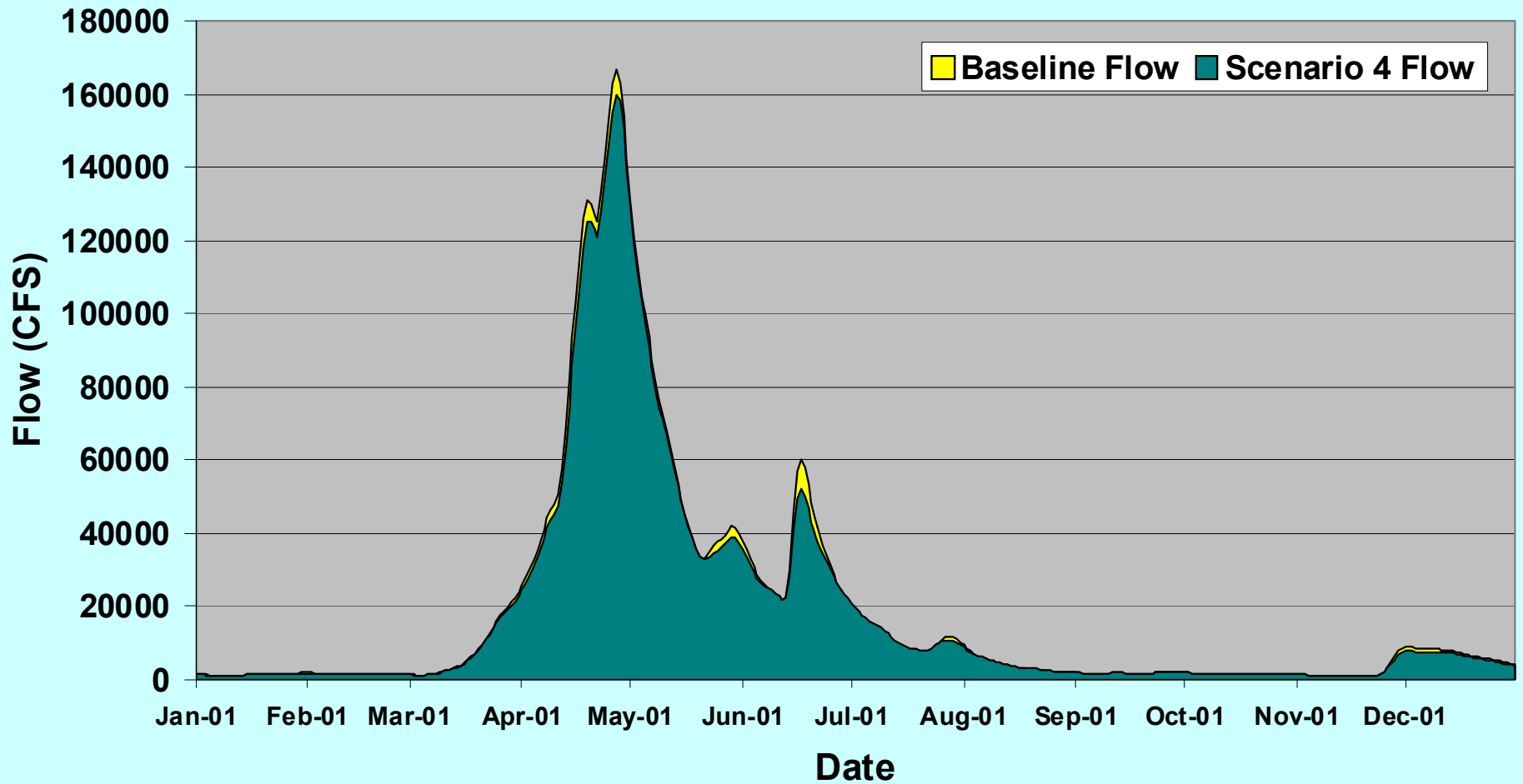
Sediment Concentration Comparision: 2003

Baseline Sediment Concentration Scenario 4 Sediment Concentration Baseline Flow



Minnesota River at Jordan

Flow Comparision: 2001



Summary

- Scenario 4 results in a ~50% reduction in sediment loads for most watersheds
 - Reductions vary year to year
 - Generally higher in wetter years
- Sediment loading is dominated by episodic events, usually in the spring (summer, fall)
- BMPs usually provide bigger reductions during events
- The watershed outlets and mainstem Minnesota would meet the turbidity standard most of the time, under Scenario 4 conditions.