Potential Effects of Suburbanization on the Water Quality and Quantity of Boiling Springs, a Sacred Area to the Shakopee Mdewakanton Dakota Community, Scott County, Minnesota

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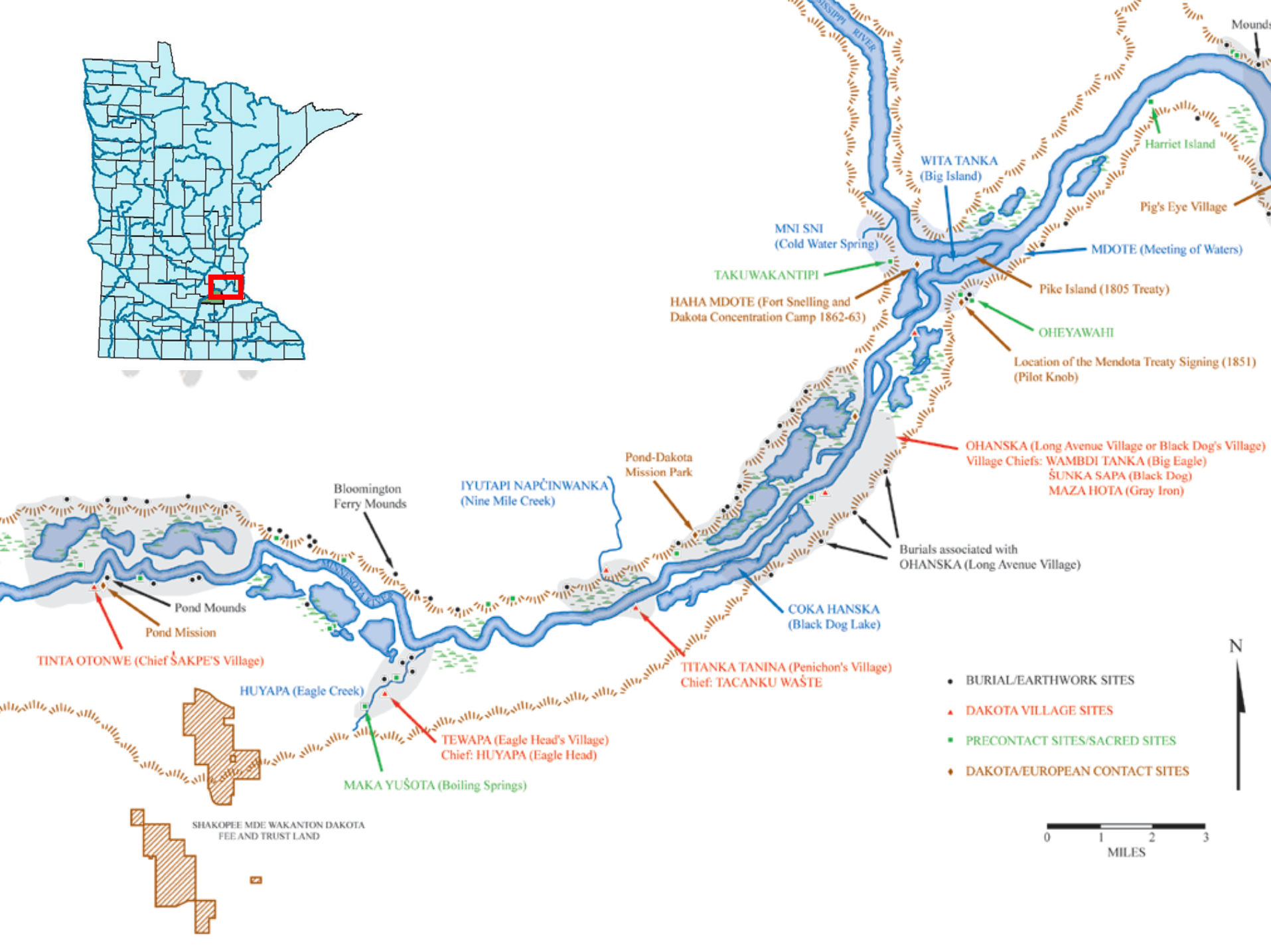
Outline

- Site Description
- Study Objectives
- Methods
- Results
- Conclusions
- Future Work
- Community Perspective


MISSISSIPPI RIVER
Mounds
Harriet Island
WITA TANKA
(Big Island)
Pig's Eye Village
MNI SNI
(Cold Water Spring)
MDOTE (Meeting of Waters)
TAKUWAKANTIPI
Pike Island (1805 Treaty)
HAHA MDOTE (Fort Snelling and
Dakota Concentration Camp 1862-63)
OHEYAWAHI
Location of the Mendota Treaty Signing (1851)
(Pilot Knob)
OHANSKA (Long Avenue Village or Black Dog's Village)
Village Chiefs: WAMBDI TANKA (Big Eagle)
ŠUNKA SAPA (Black Dog)
MAZA HOTA (Gray Iron)
Pond-Dakota
Mission Park
Bloomington
Ferry Mounds
IYUTAPI NAPČINWANKA
(Nine Mile Creek)
Burials associated with
OHANSKA (Long Avenue Village)
MINNESOTA RIVER
Pond Mounds
Pond Mission
COKA HANSKA
(Black Dog Lake)
TINTA OTONWE (Chief ŠAKPE'S Village)
TITANKA TANINA (Penichon's Village)
Chief: TACANKU WAŠTE
HUYAPA (Eagle Creek)
TEWAPA (Eagle Head's Village)
Chief: HUYAPA (Eagle Head)
MAKA YUŠOTA (Boiling Springs)
SHAKOPEE MDE WAKANTON DAKOTA
FEE AND TRUST LAND
BURIAL/EARTHWORK SITES
DAKOTA VILLAGE SITES
PRECONTACT SITES/SACRED SITES
DAKOTA/EUROPEAN CONTACT SITES
N
0
1
2
3
MILES

Boiling Springs

Largest Sand-boil spring in upper Midwest.

Never freezes or dries out.

Headwaters of last brown trout stream in Metropolitan area.

Cleanest Minnesota River tributary.

"Like my Grandmother told me, 'It is the center, the place where you come from'."

-- Joseph Brewer, in a 1994 letter to the City of Savage City Planner.

Photo of Boiling Springs (circa 1940) courtesy of Lucille Hirscher.

Eagle Creek Aquatic Management Area

Established in 1995

Goal

"To restore pre-settlement conditions in an area [Eagle Creek] bounded by residential and commercial development."

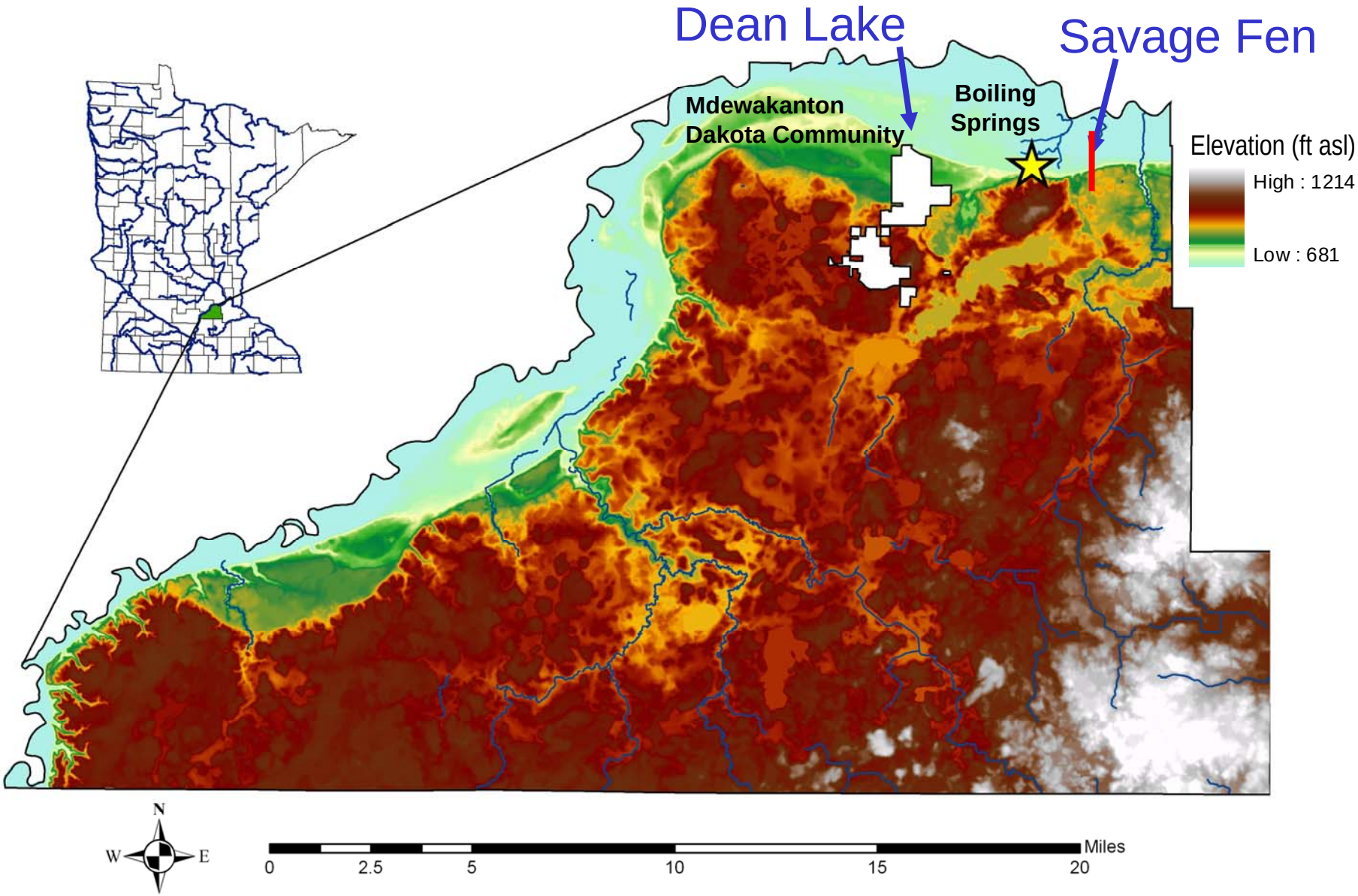
Management Objectives

- Filter runoff
- Maintain streamside plant & animal habitat
- Provide public with traditional, spiritual and recreational opportunities

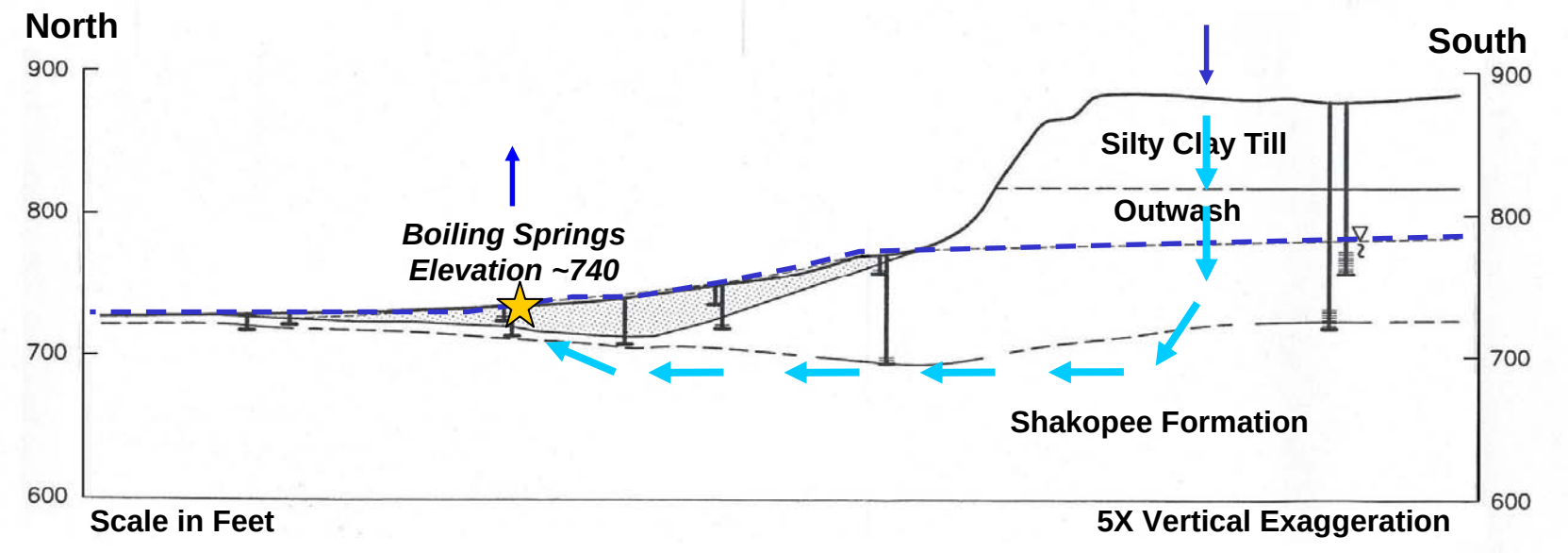
Partners

- Local Residents
- Trout Unlimited
- Trust for Public Land
- SMDC
- Cities of Savage & Shakopee
- Scott County
- U.S. Fish & Wildlife Services
- MN Valley National Wildlife Refuge
- Klass & Mary Van Zee
- Department of Natural Resources
- Friends of the Minnesota River Valley
- Sierra Club
- Lower MN River Valley Watershed

Site Location in Scott County, MN



Hydro-Geologic Setting



Piezometric Surface

Well

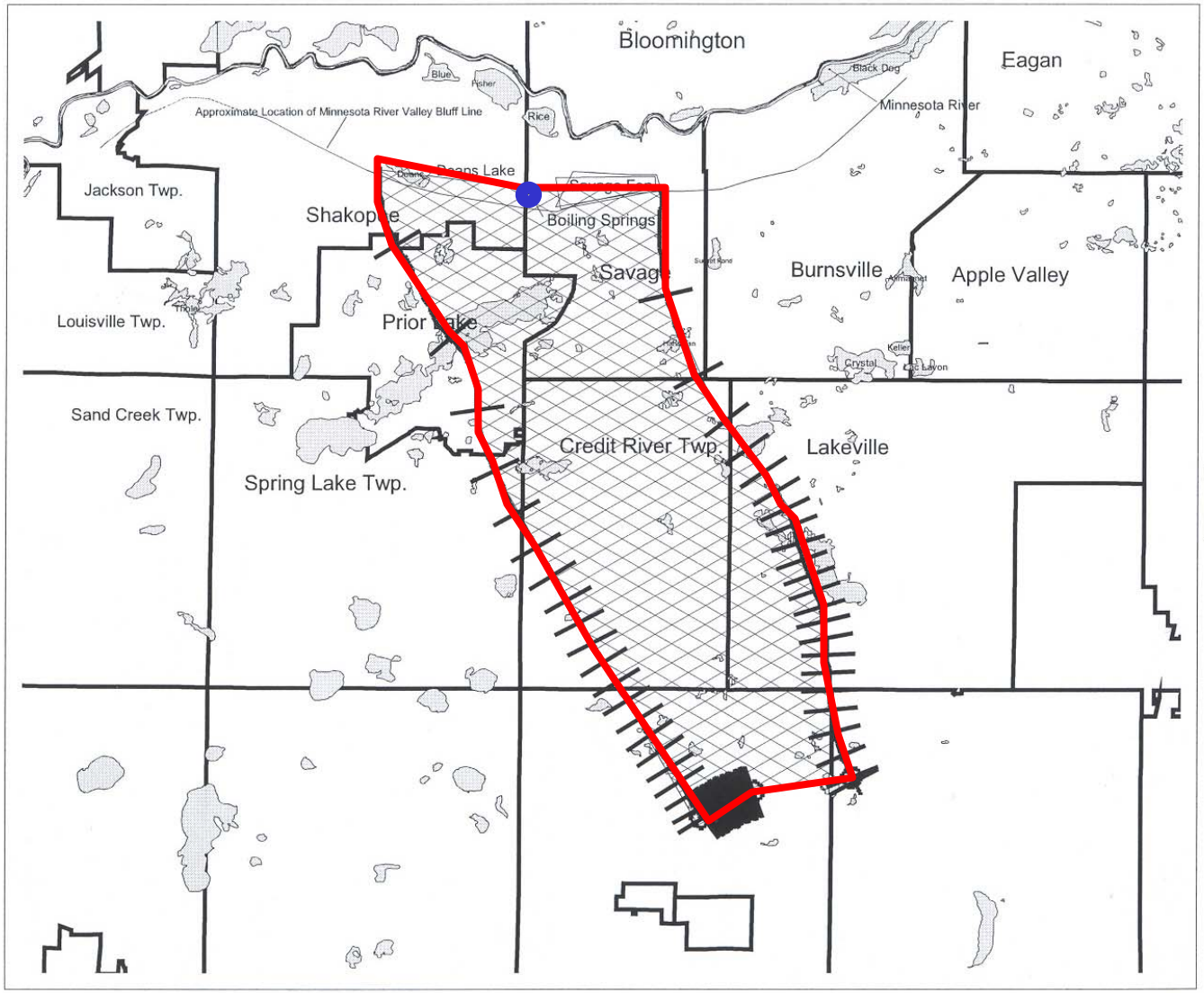
Peat, Clay, and Clay with Peat

Geologic Contact – Dashed Where Inferred

Direction of Groundwater Flow

Hydrogeologic cross-section modified from “Savage Fen Management Plan”, prepared by Barr Engineering Company, September 1994

Recharge Area



Area where groundwater in the Prairie duChien/Jordan aquifer flows to Deans Lake, Boiling Springs, and Savage Fen. Tick marks represent 10 year time of travel.

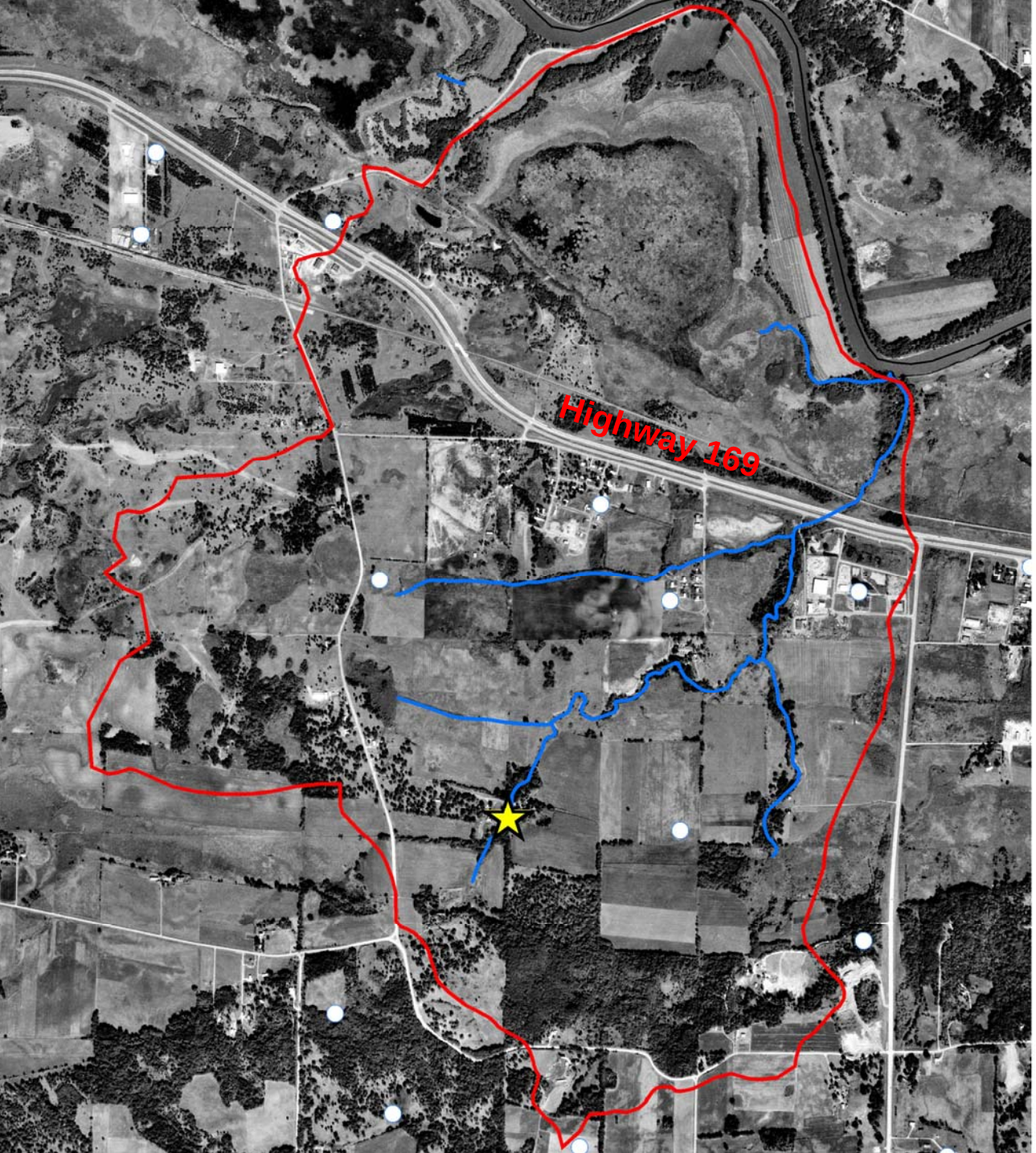
Source: Metropolitan Council revision of MPCA Metro Model 08/01

7 0 7 14 Miles

N W E S

Study Objectives

- Collect discharge and water quality data at Boiling Springs
  - Water quality analyses were determined based on expected impacts from nearby land use
- Compare data to existing datasets
  - No datasets prior to 1990
- Determine if Boiling Springs is being negatively impacted by adjacent suburban development



1970

Contamination

- Ag Chemicals
- Soil Erosion
- Road Maintenance

Reduced Discharge

- Wells (3)

Boiling Springs

Well

Stream

Eagle Creek Watershed Boundary

2000

Contamination

- Lawn Chemicals
- Soil Erosion
- Road Maintenance

Reduced Discharge

- Wells (36)
- Impervious Surface

Boiling Springs

Well

Stream

Eagle Creek Watershed Boundary

2004

Contamination

- Lawn Chemicals
- Soil Erosion
- Road Maintenance

Reduced Discharge

- Wells (40)
- Impervious Surface

Boiling Springs

Well

Stream

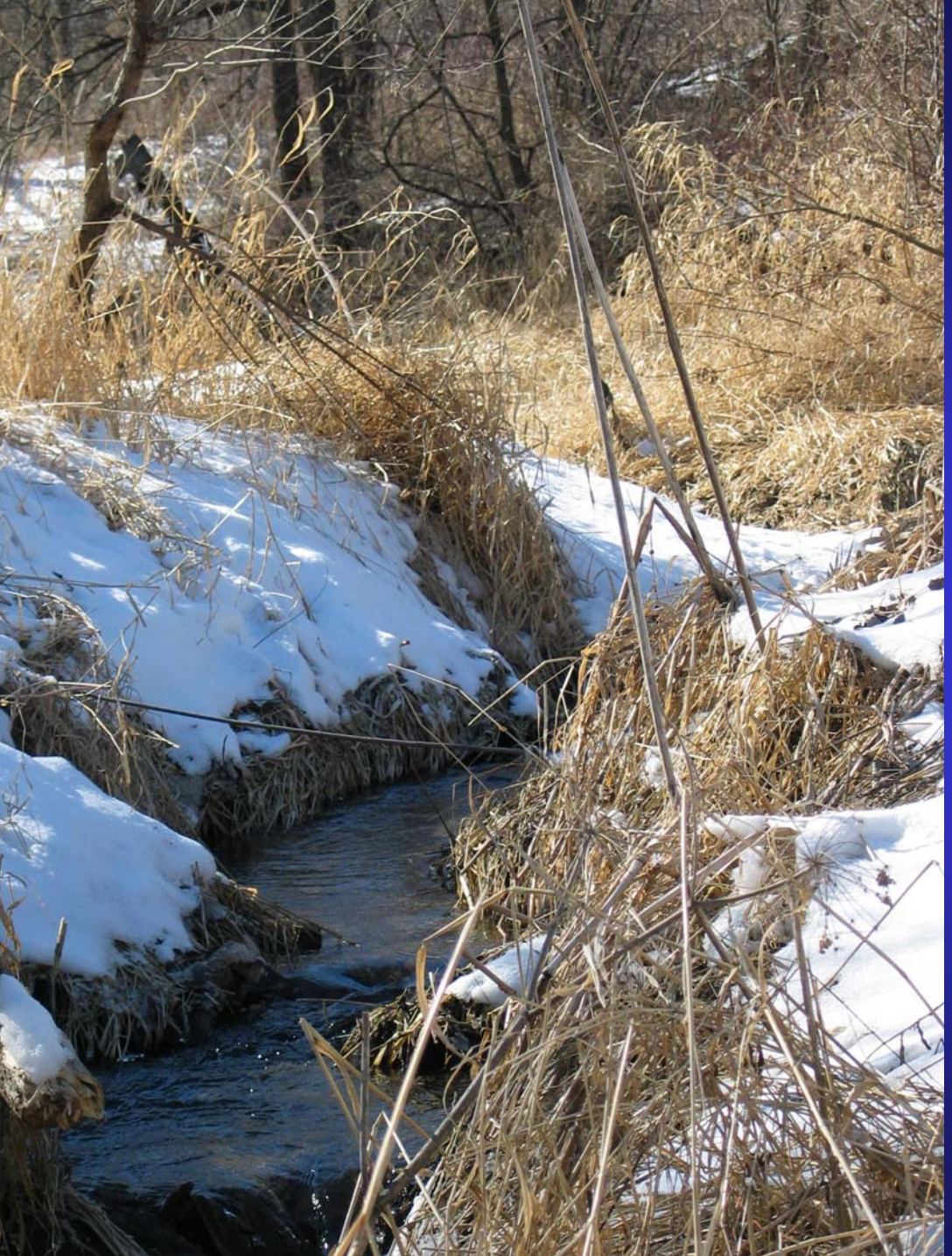
Eagle Creek Watershed Boundary

Methods

Monitoring Physical & Chemical Parameters

Physical Parameters	
Stream Stage	Spring Discharge
Dissolved Oxygen	pH
Reduction-Oxidation Potential	Specific Conductivity
Temperature	Total Dissolved Solids
Chemical Parameters	
Ammonia	Chlorophyll A
Nitrate & Nitrite	Orthophosphate
Total Calcium	Total Chloride
Total Kjeldahl Nitrogen	Total Magnesium
Total Phosphorus	Total Suspended Solids

Upstream 1
Staff Gage
Upstream 2
Down-
stream



Upstream 1

Fed by innumerable small seeps that coalesce into a small stream >100m in length.

Water affected by exposure to atmosphere and input from surface runoff.

Upstream 2

Fed by several seeps that coalesce into a diffuse stream <30m in length.

Water affected by exposure to the atmosphere and limited input from surface runoff.

Downstream

Fed by tributaries ‘Up Stream 1’ and ‘Upstream 2’, as well as through several large springs in Boiling Springs pool.

Water affected by limited exposure to the atmosphere and limited input from surface runoff.

Equipment

Stage & Discharge

- Discharge measured using a Sontek® FlowTracker
- Stage measured using a staff gage installed at the location of downstream discharge measurements

Water Chemistry

- Hydrolab ® water quality probe
- Sample analyses by the state-certified lab, Braun Intertec (Bloomington, MN)

Data Collection Schedule

Program began March 18, 2004

Water quality samples collected quarterly: March, June, September and December

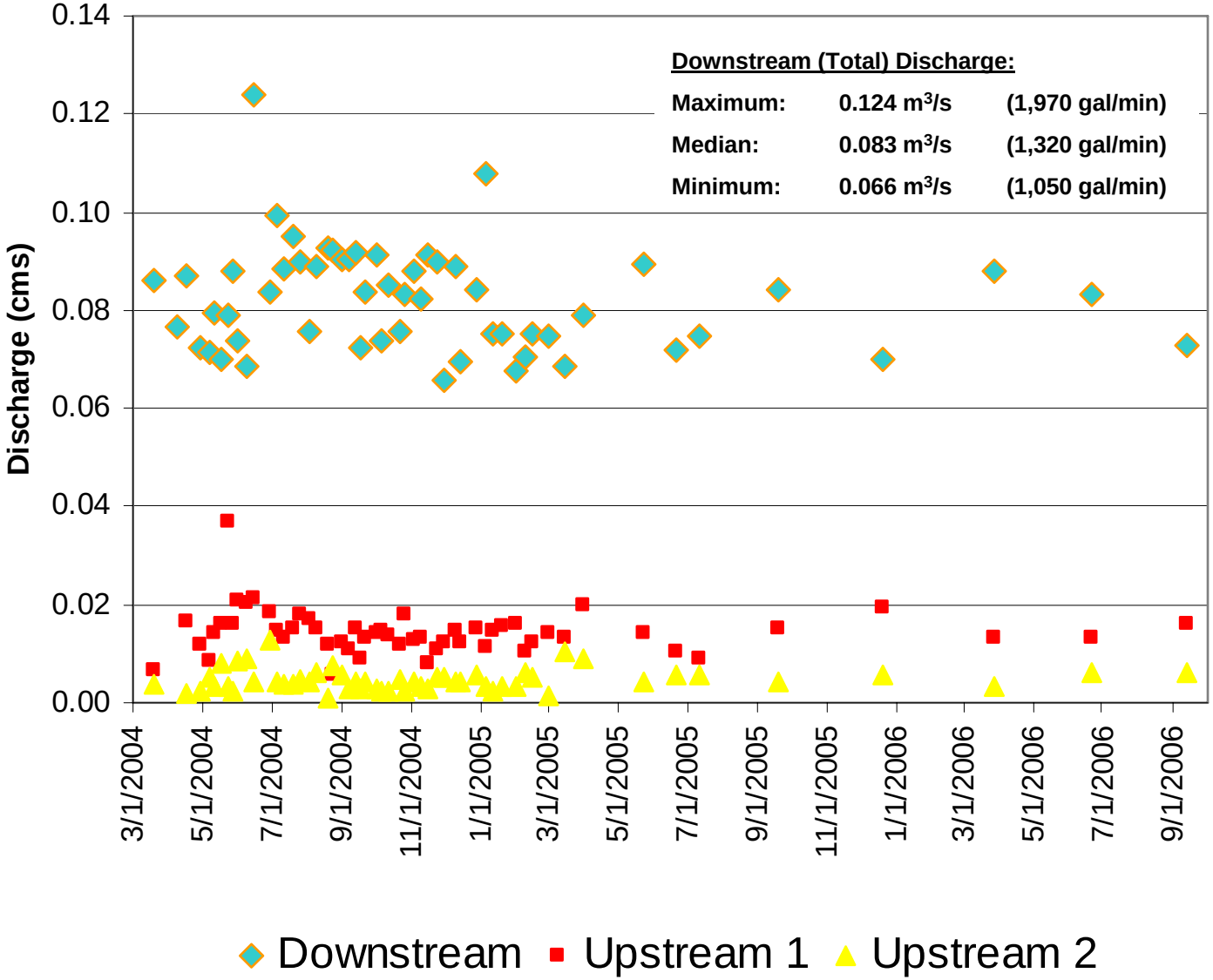
Discharge, Stage and Hydrolab® measurements made quarterly with water sample collection

Additional Discharge, Stage and Hydrolab® measurements made:

- Weekly between April and November 2004
- Every other week between December 2004 and April 2005

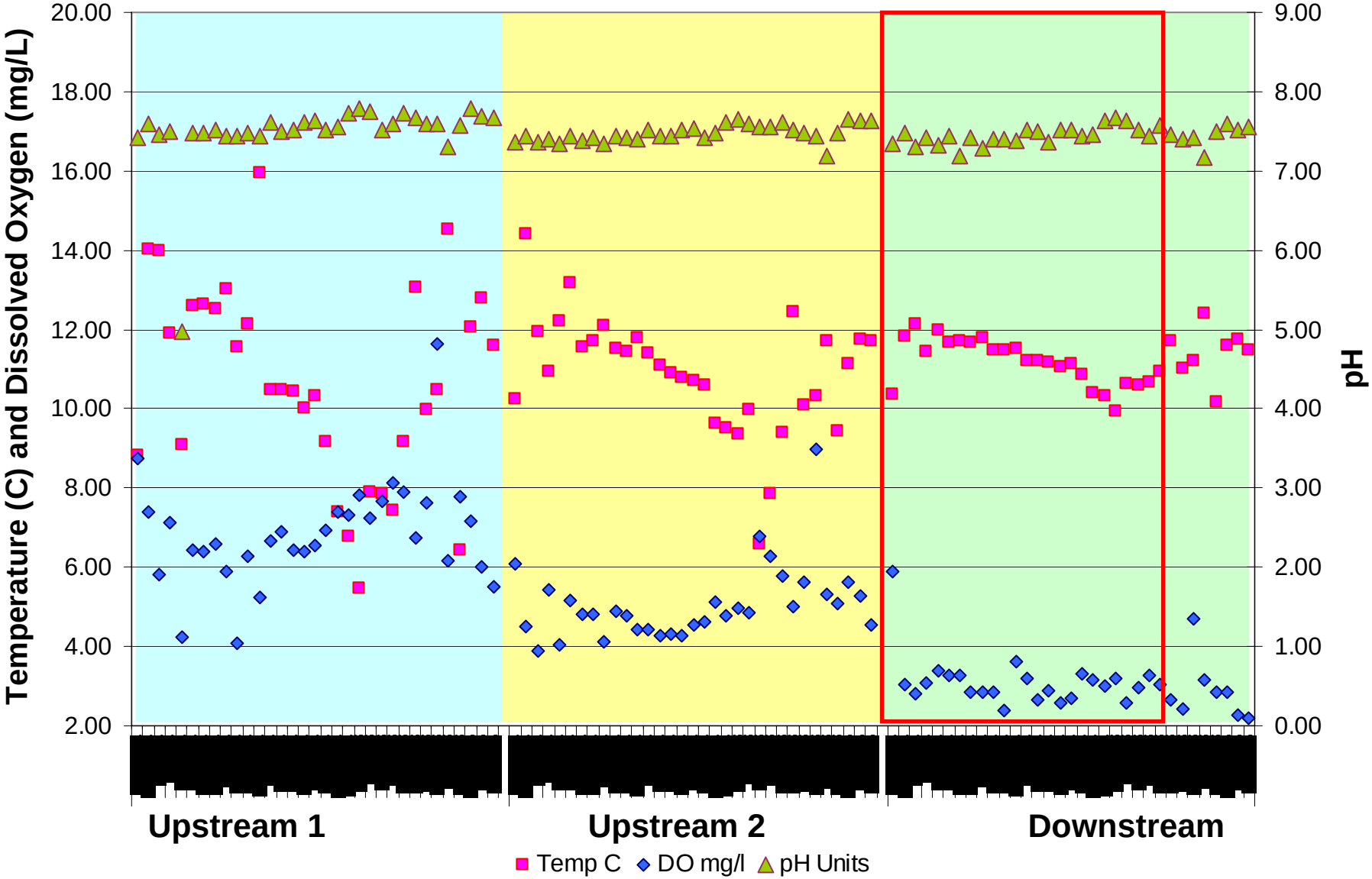
Discharge Results 2004-2006

Discharge

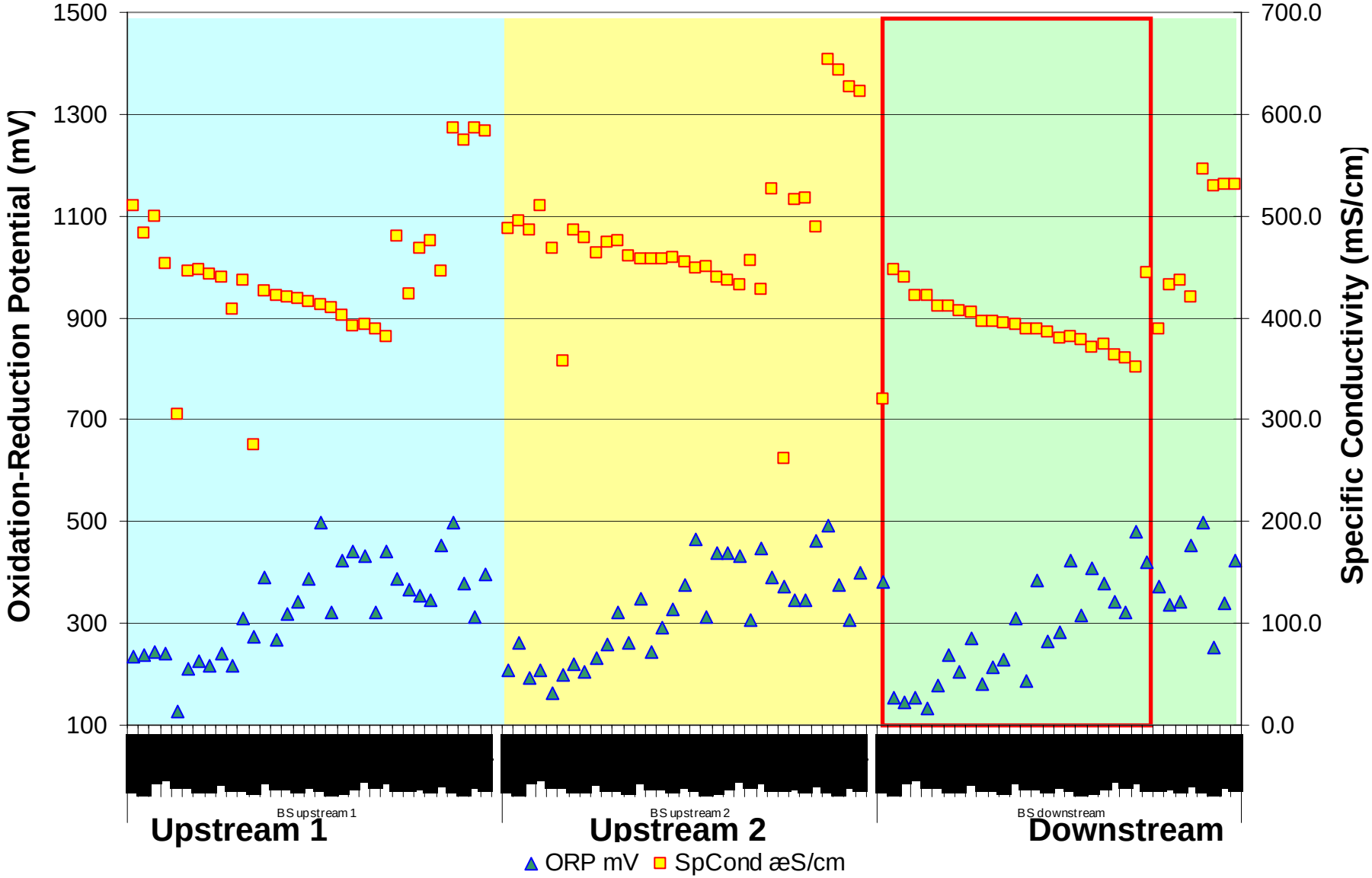

Downstream (Total) Discharge:
Maximum: 0.124 m3/s (1,970 gal/min)
Median: 0.083 m3/s (1,320 gal/min)
Minimum: 0.066 m3/s (1,050 gal/min)
Discharge (cms)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
3/1/2004
5/1/2004
7/1/2004
9/1/2004
11/1/2004
1/1/2005
3/1/2005
5/1/2005
7/1/2005
9/1/2005
11/1/2005
1/1/2006
3/1/2006
5/1/2006
7/1/2006
9/1/2006
Downstream
Upstream 1
Upstream 2

Hydrolab ® Data Collection Results 2004-2006

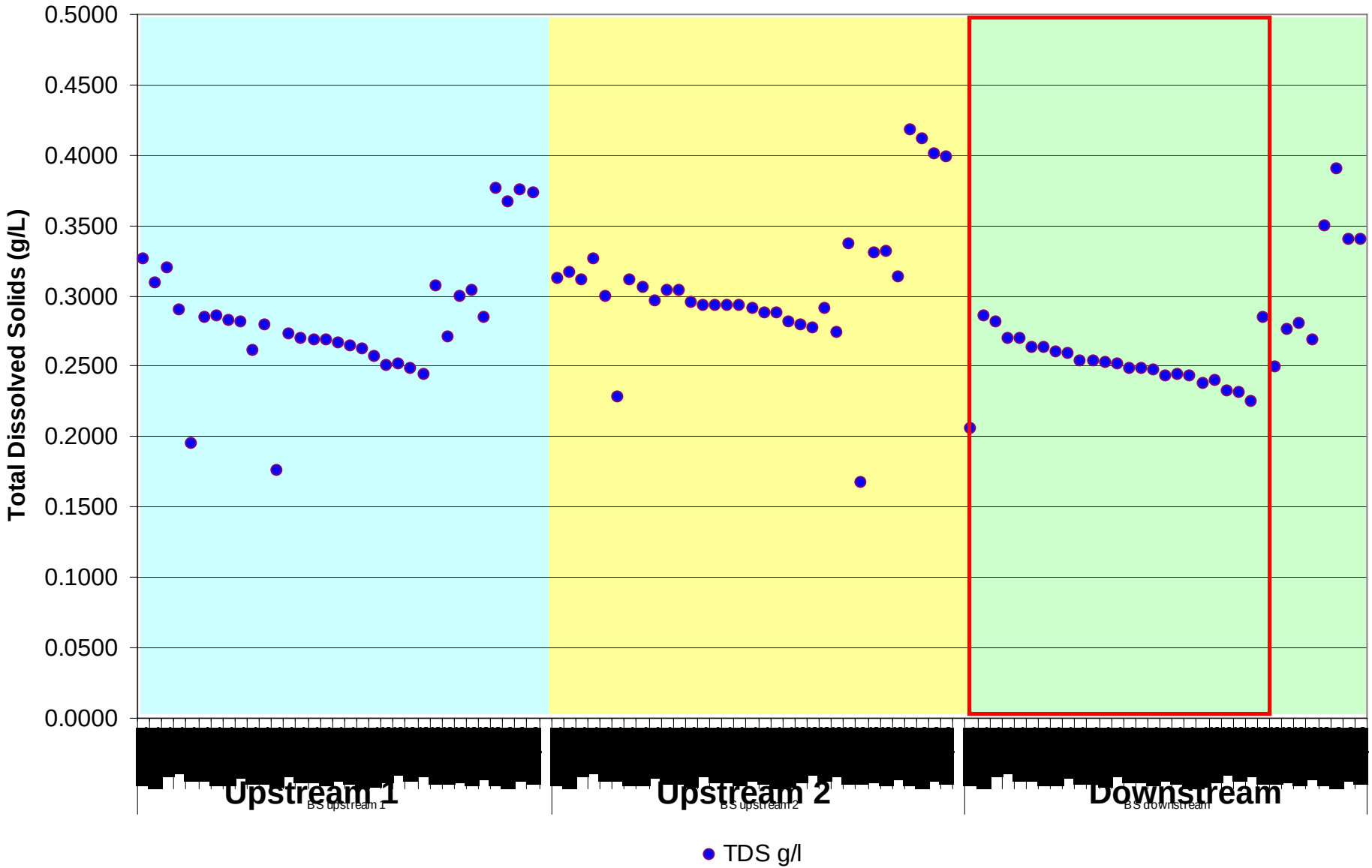
Temperature, pH, and Dissolved Oxygen



Specific Conductivity & Oxidation-Reduction Potential

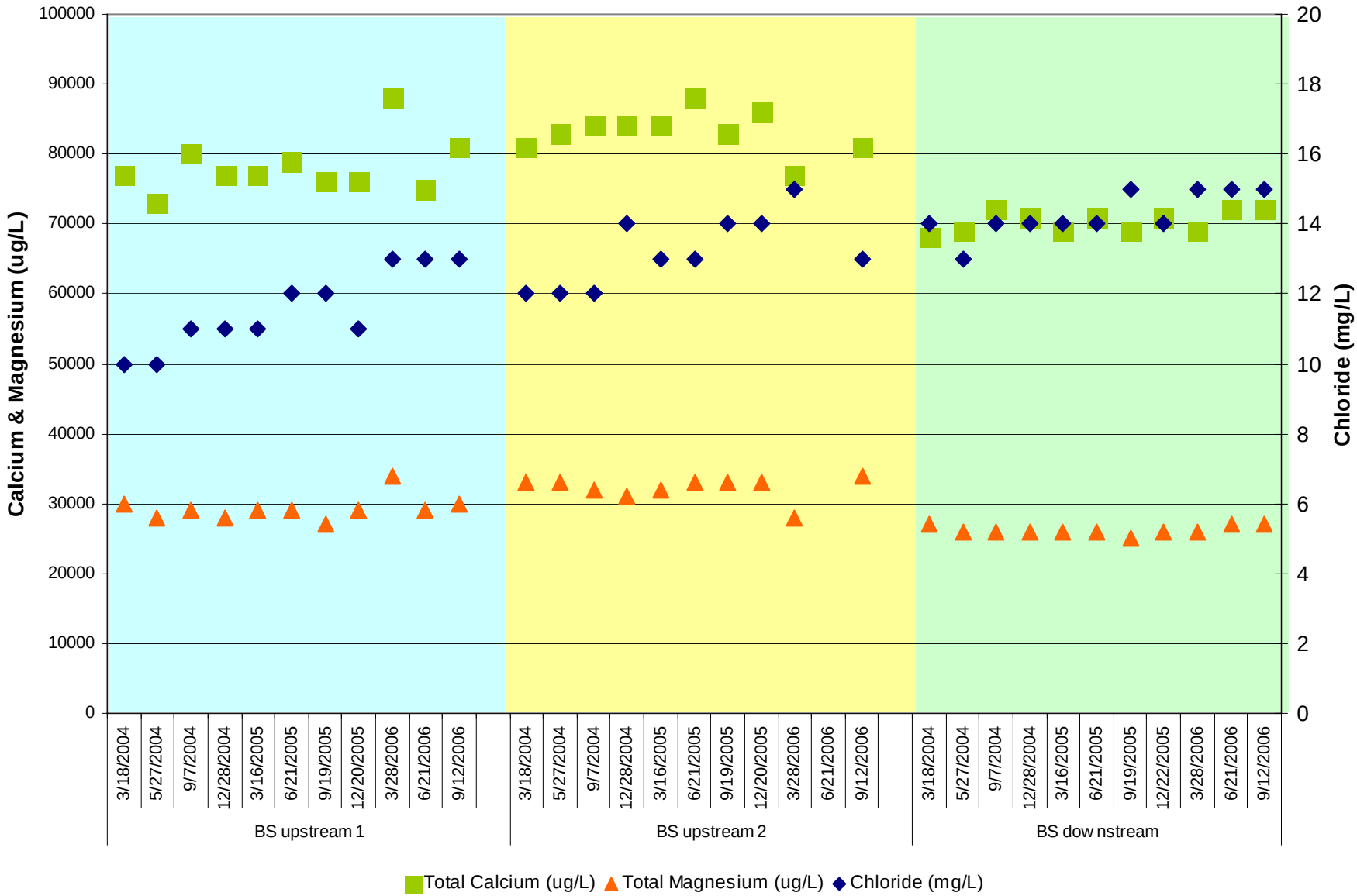


Total Dissolved Solids

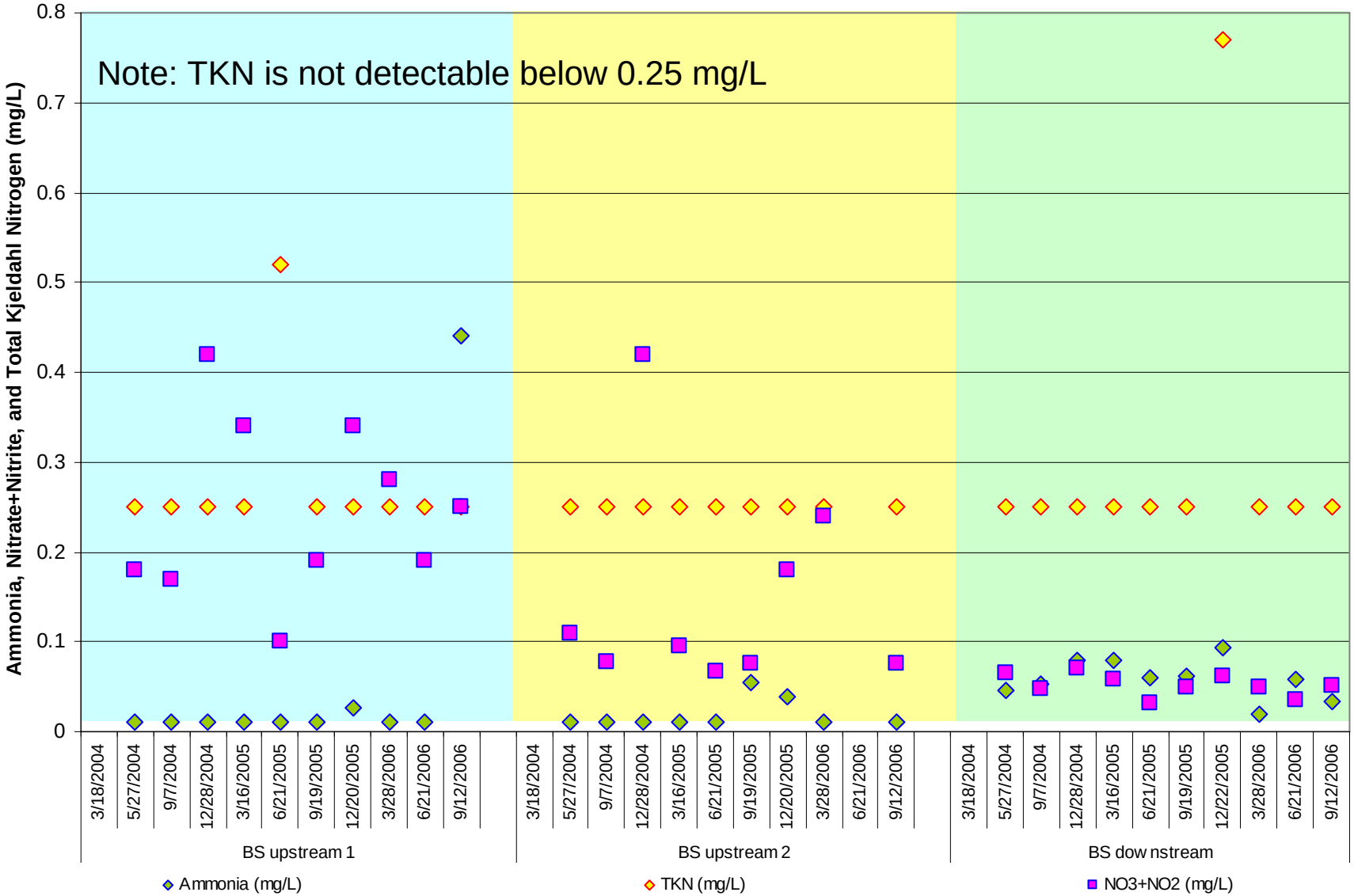


Water Sample Analyses Results 2004-2006

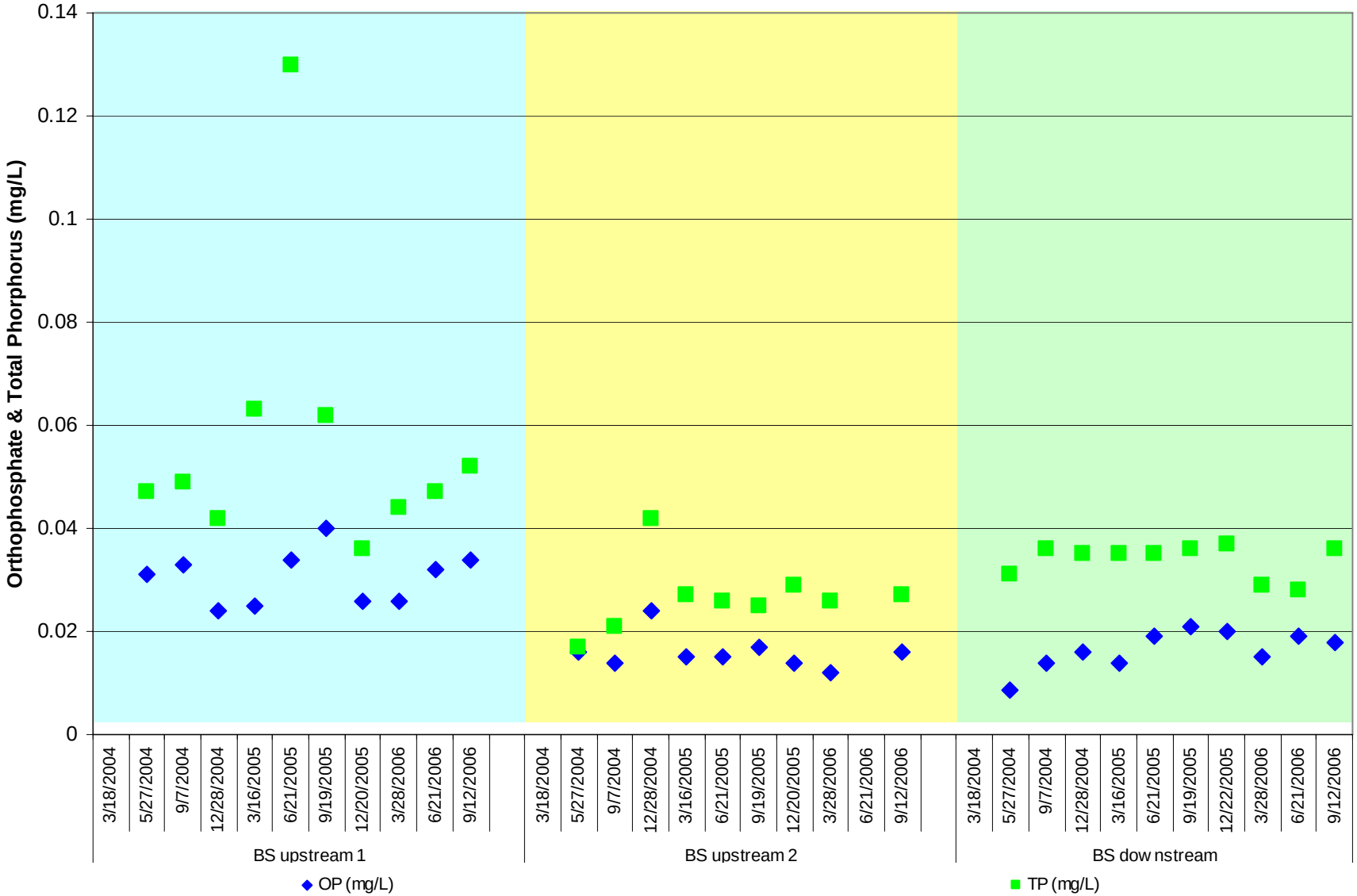
Metals


Calcium & Magnesium (ug/L)
Chloride (mg/L)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
20
18
16
14
12
10
8
6
4
2
0
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/20/2005
3/28/2006
6/21/2006
9/12/2006
BS upstream 1
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/20/2005
3/28/2006
6/21/2006
9/12/2006
BS upstream 2
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/22/2005
3/28/2006
6/21/2006
9/12/2006
BS dow nstream
Total Calcium (ug/L)
Total Magnesium (ug/L)
Chloride (mg/L)

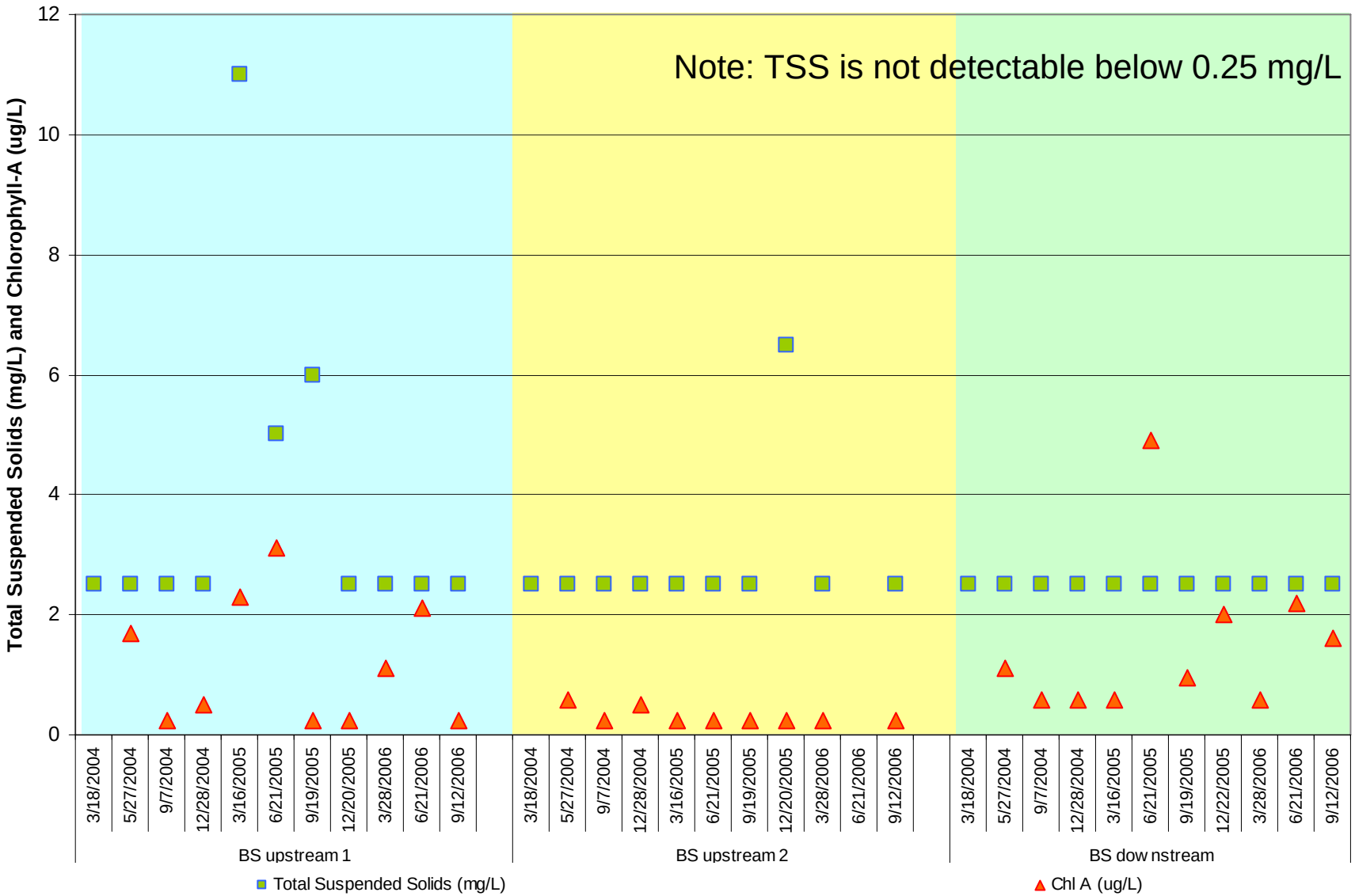
Nitrogen


Note: TKN is not detectable below 0.25 mg/L
Ammonia, Nitrate+Nitrite, and Total Kjeldahl Nitrogen (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/20/2005
3/28/2006
6/21/2006
9/12/2006
BS upstream 1
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/20/2005
3/28/2006
6/21/2006
9/12/2006
BS upstream 2
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/22/2005
3/28/2006
6/21/2006
9/12/2006
BS dow nstream
Ammonia (mg/L)
TKN (mg/L)
NO3+NO2 (mg/L)

Phosphorus


Orthophosphate & Total Phorphorus (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/20/2005
3/28/2006
6/21/2006
9/12/2006
BS upstream 1
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/20/2005
3/28/2006
6/21/2006
9/12/2006
BS upstream 2
3/18/2004
5/27/2004
9/7/2004
12/28/2004
3/16/2005
6/21/2005
9/19/2005
12/22/2005
3/28/2006
6/21/2006
9/12/2006
BS dow nstream
OP (mg/L)
TP (mg/L)

Total Suspended Solids & Chlorophyll-A



Conclusions

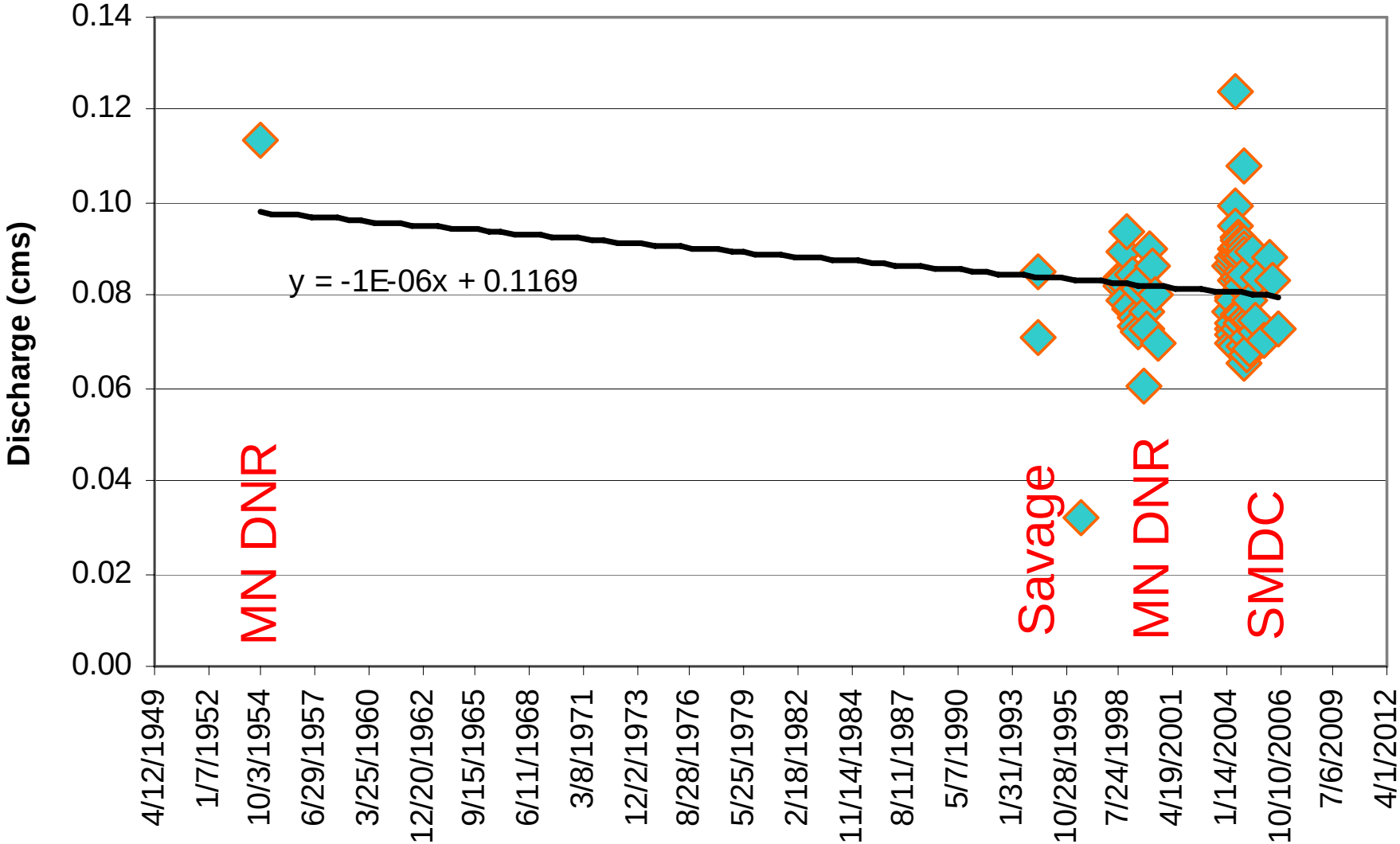
Increasing

Discharge
Chloride
Specific Conductivity
Oxidation-Reduction Potential
Total Dissolved Solids

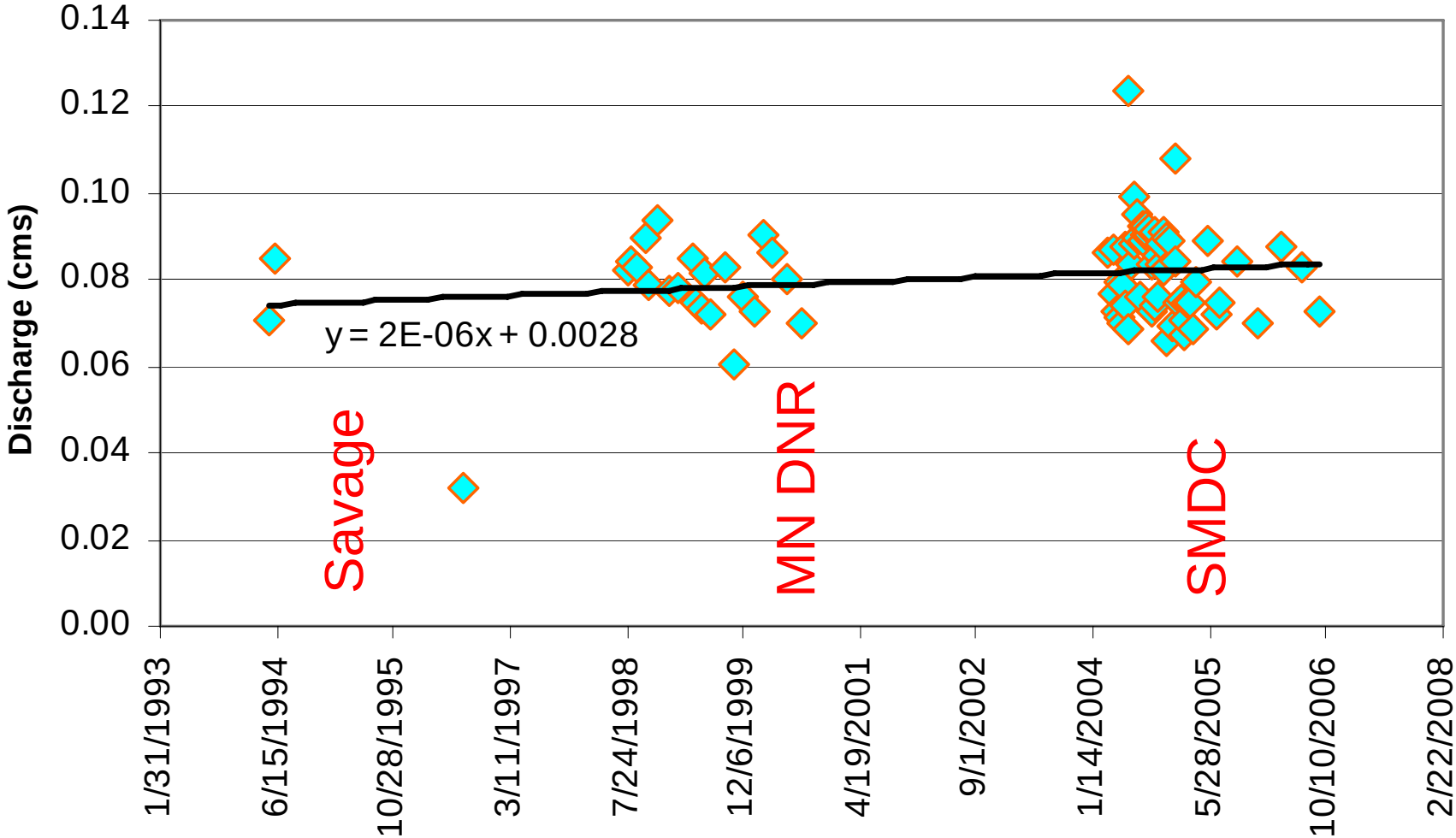
No Change

Temperature
pH
Dissolved Oxygen
Calcium
Magnesium
Nitrogen
Phosphorus
Total Suspended Solids
Chlorophyll A

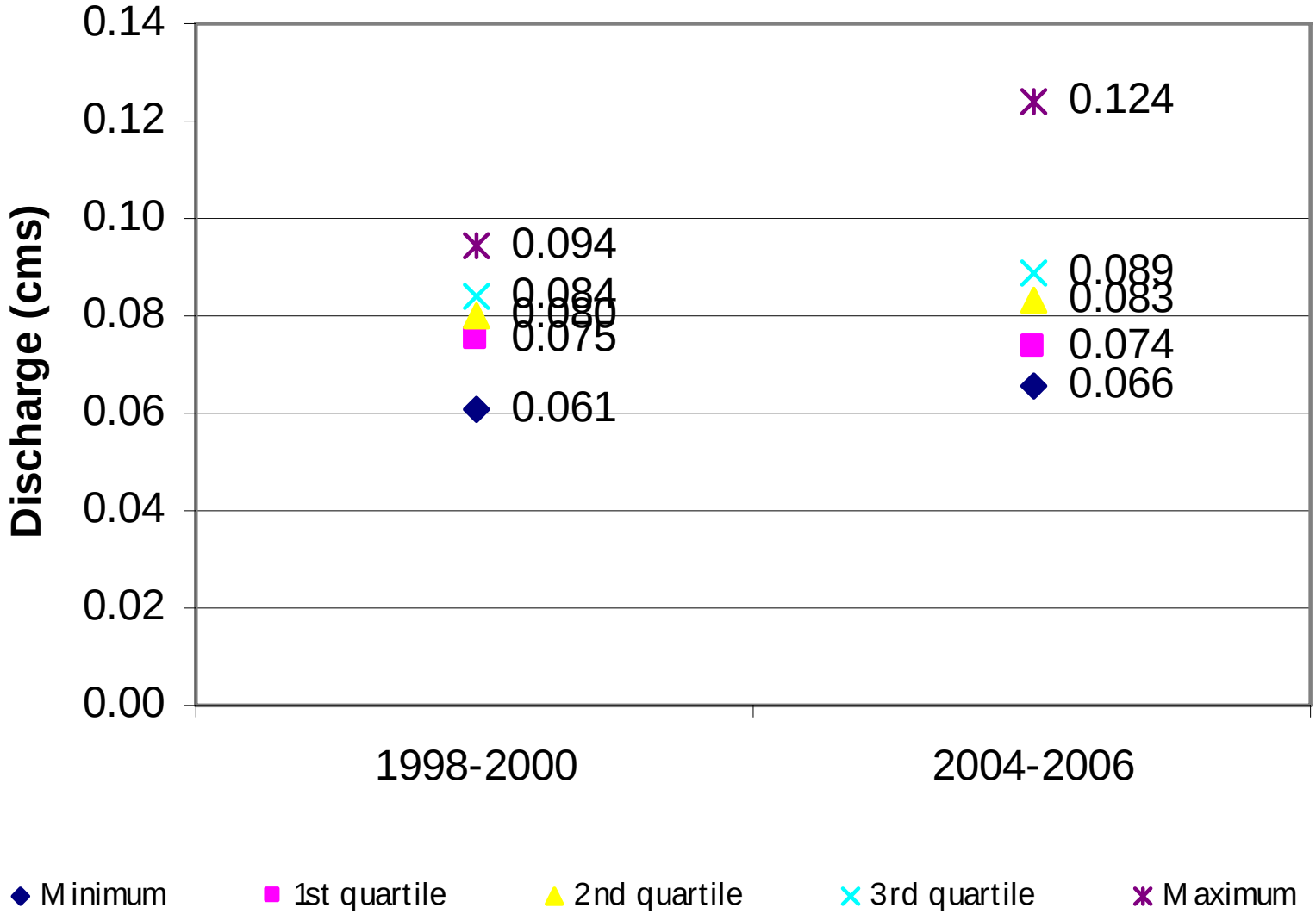
Boiling Springs Downstream Discharge



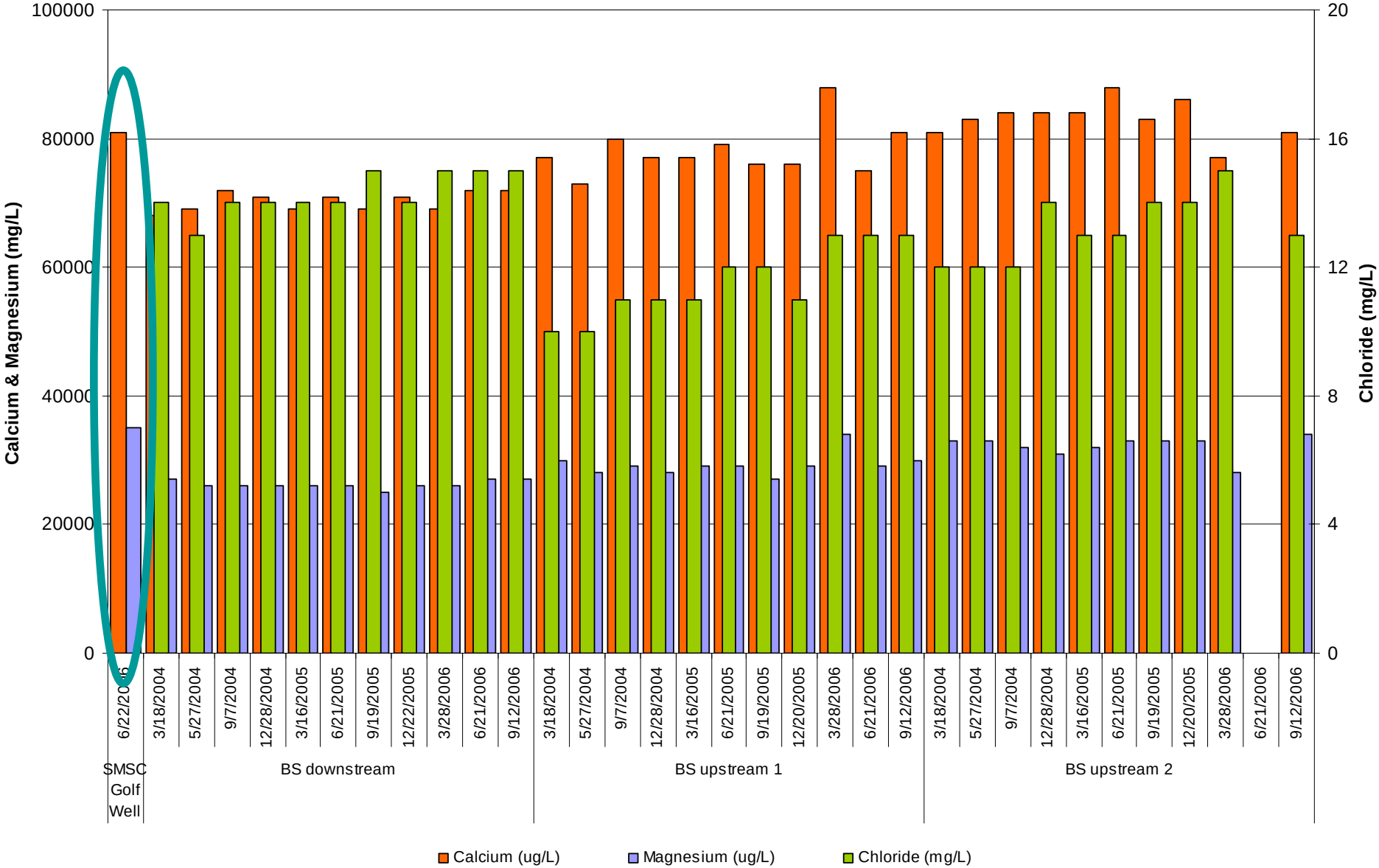
Boiling Springs Downstream Discharge



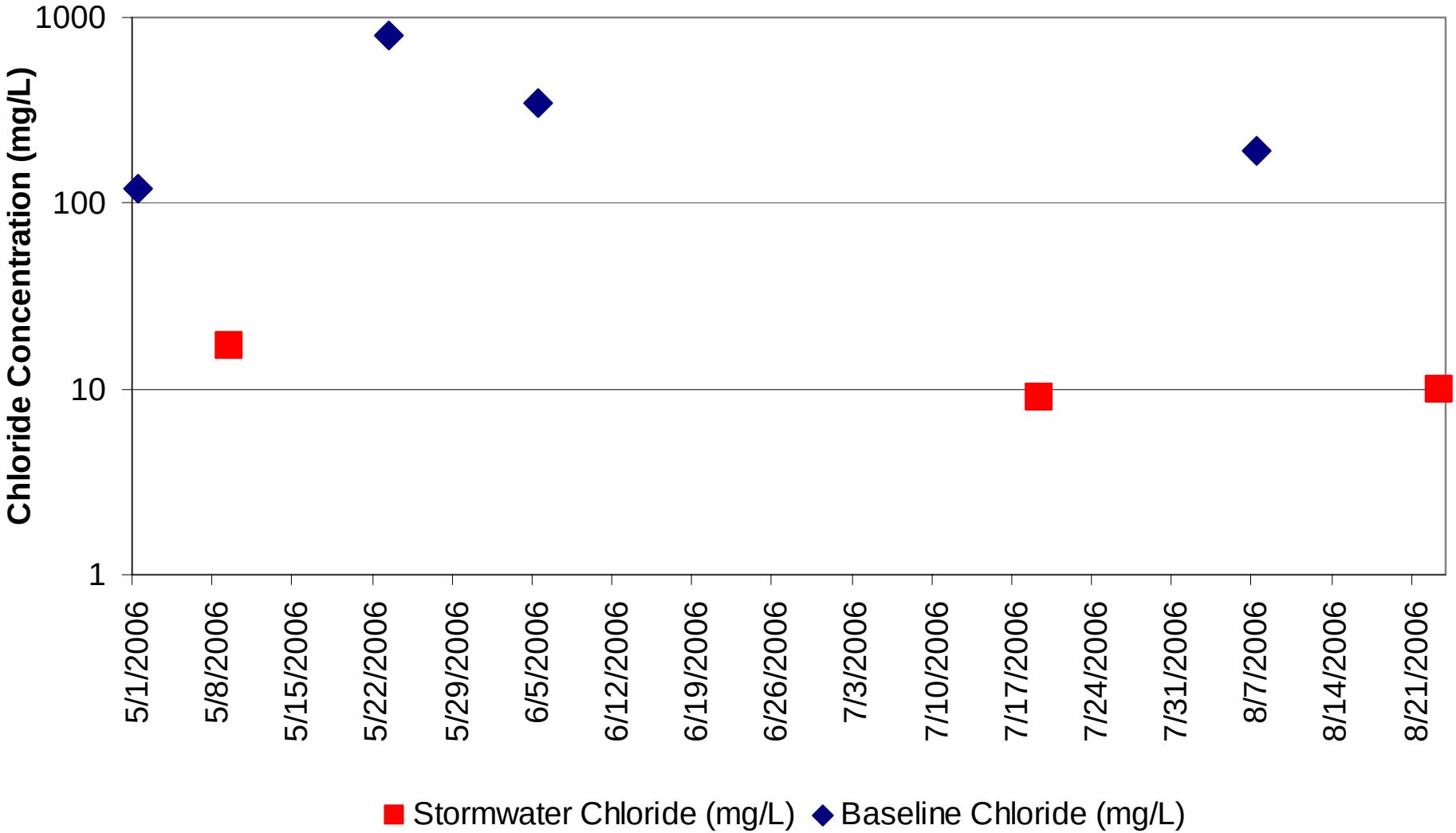
Boiling Springs Downstream Discharge



Boiling Springs Metals



Stormwater Runoff Impacts on Chloride Concentration in SMDC Wetland C1L (near Boiling Springs Recharge Area)



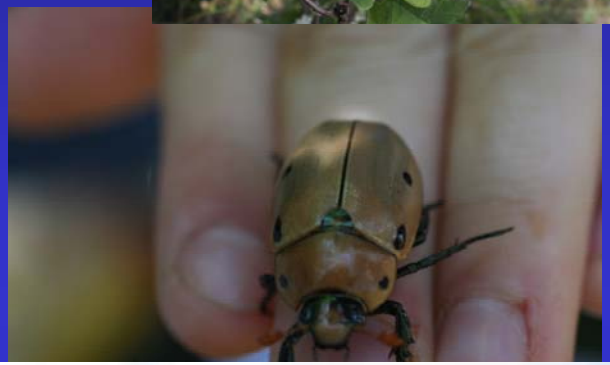
Anecdotal Information

- Newspaper articles describe Boiling Springs since late 1800's
  - Height of boils used to be 4 feet
  - Up to 7 boils would occur simultaneously
  - Pool was 20 feet deep
- Informal correspondence about Boiling Springs
  - Spring was lower than ever in 2005
  - Spring is fed by "tubes" created by iron-oxide cement; these tubes were cut during construction nearby of housing subdivision

Community Perspective

Map Making & Note Taking

Site Description



Invertebrate Sampling

Trash Pick-Up

Future Work

- High-frequency spring discharge measurements
- Age-dating spring water
- Monitoring high-frequency water pressure changes

Challenging Questions

How can we protect the cultural value of a ‘moving target’ like a water resource?

How do we approach the problem of maintaining water pressure (boiling action) vs. spring discharge?

Miscellaneous Photos

September 2006: Lowest the main pool has ever looked, although discharge was within ‘normal’ range.