Protecting Manoomin (wild rice) through Modern Science and Traditional Ecological Knowledge

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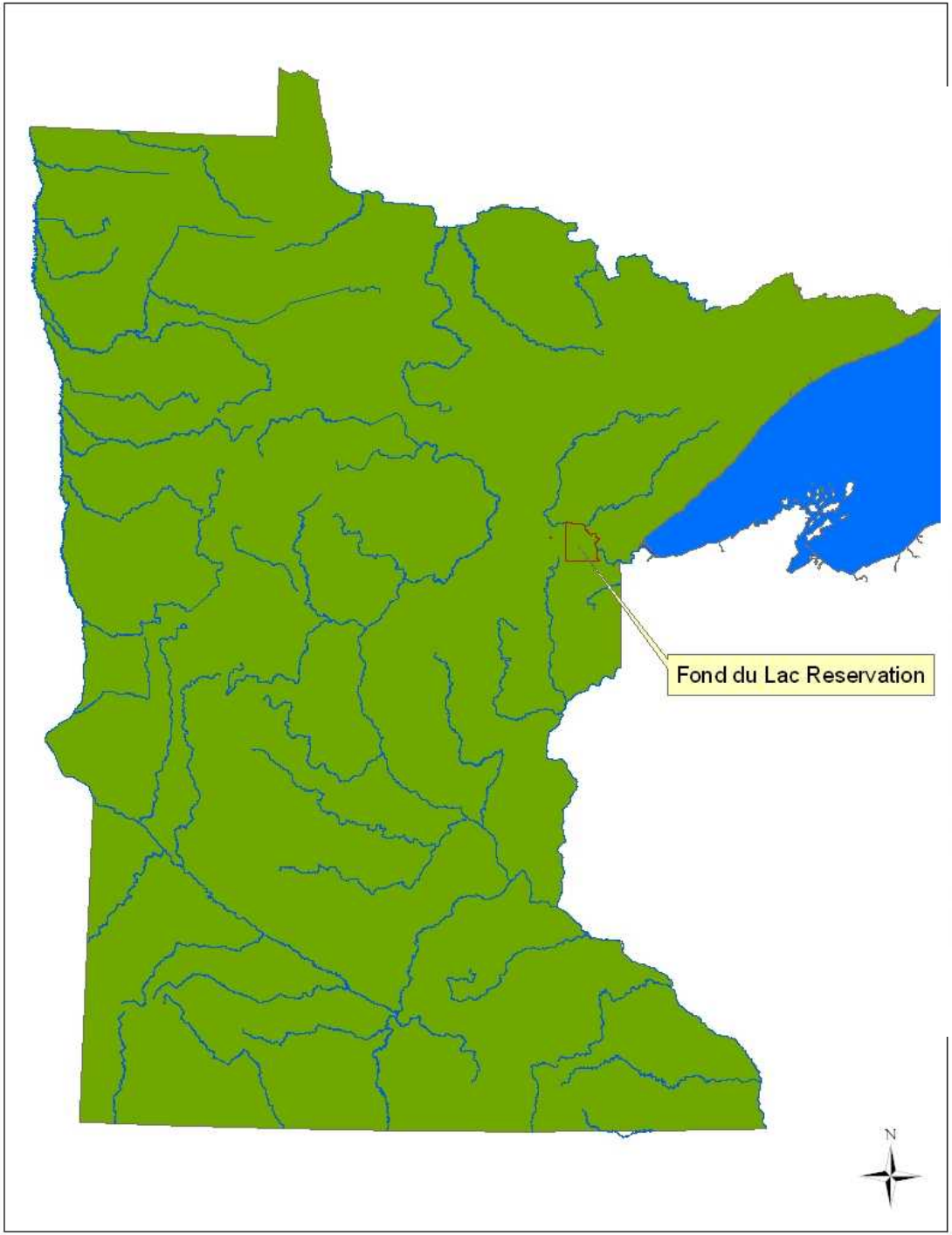
National Water Quality Monitoring Conference 2012

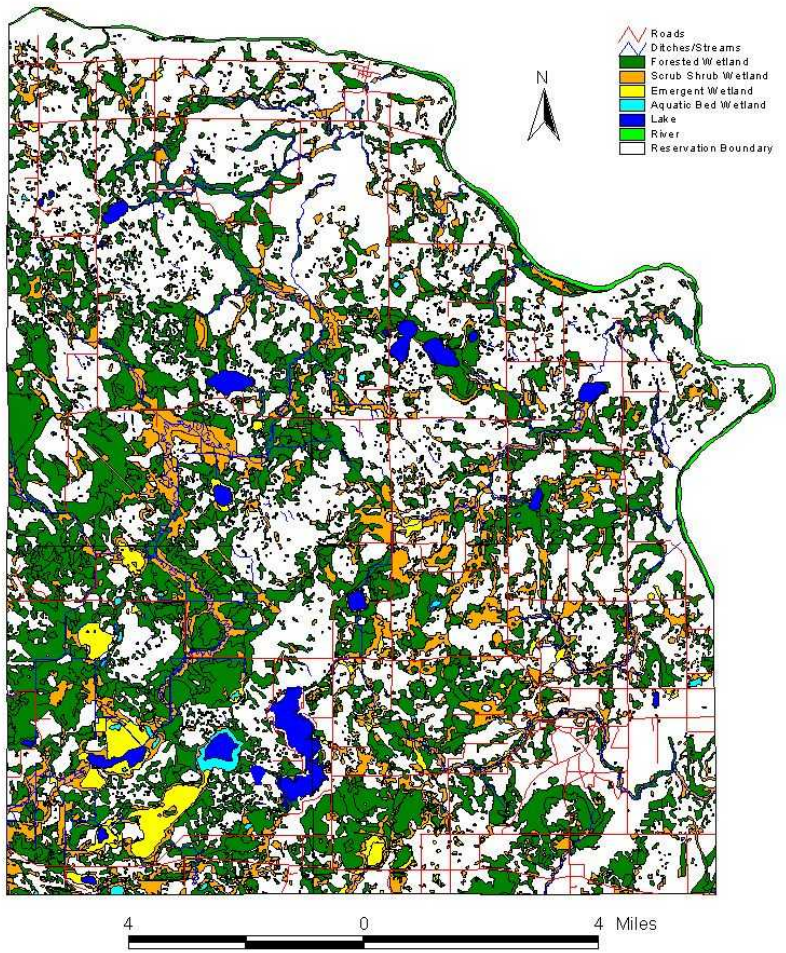
In cooperation with

Pete Cooper, USDA – NRCS, St. Paul, MN

Perry Jones, USGS, Minnesota Water Science Center

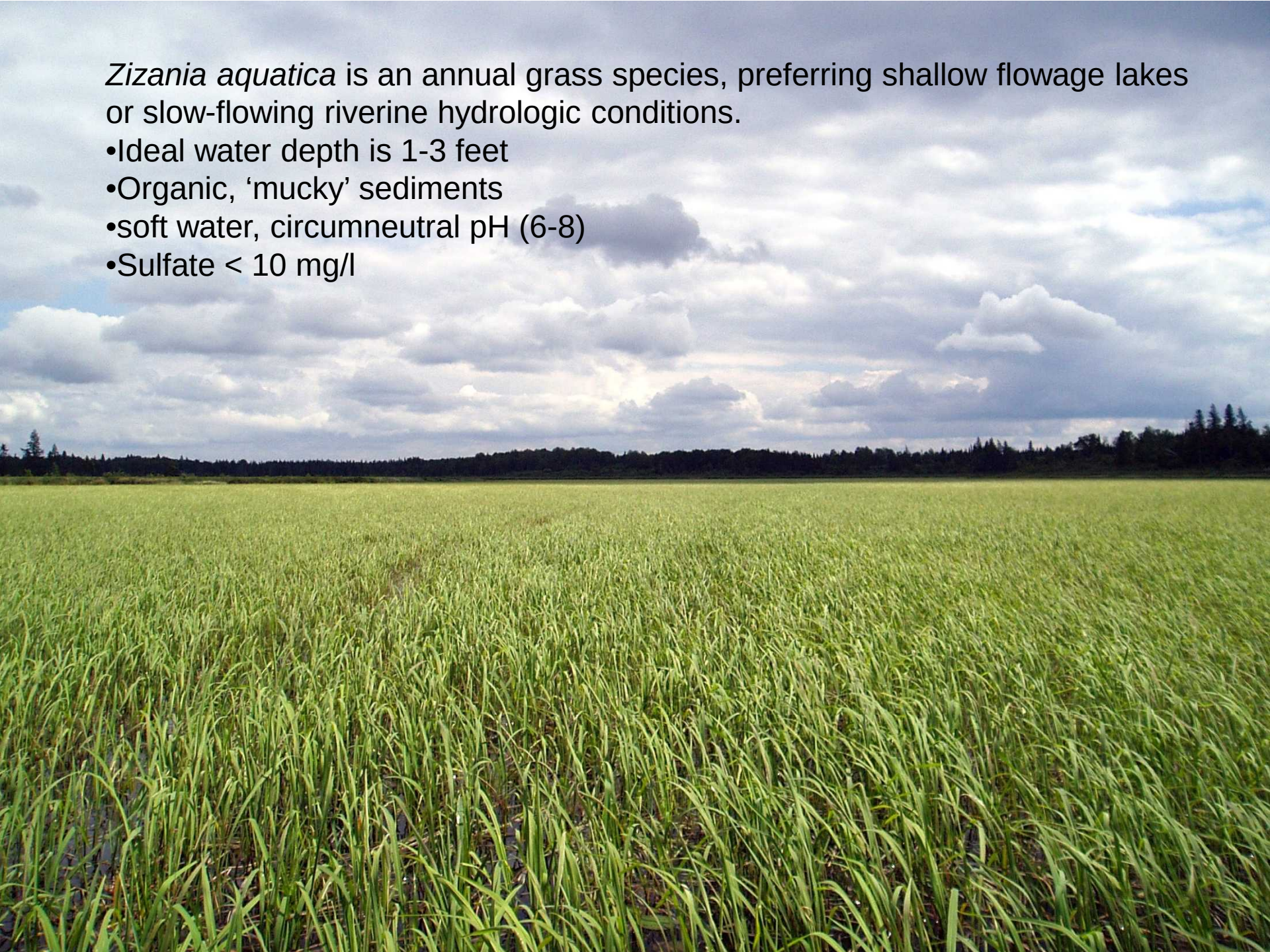


Map 5 - Fond du Lac Wetland Types



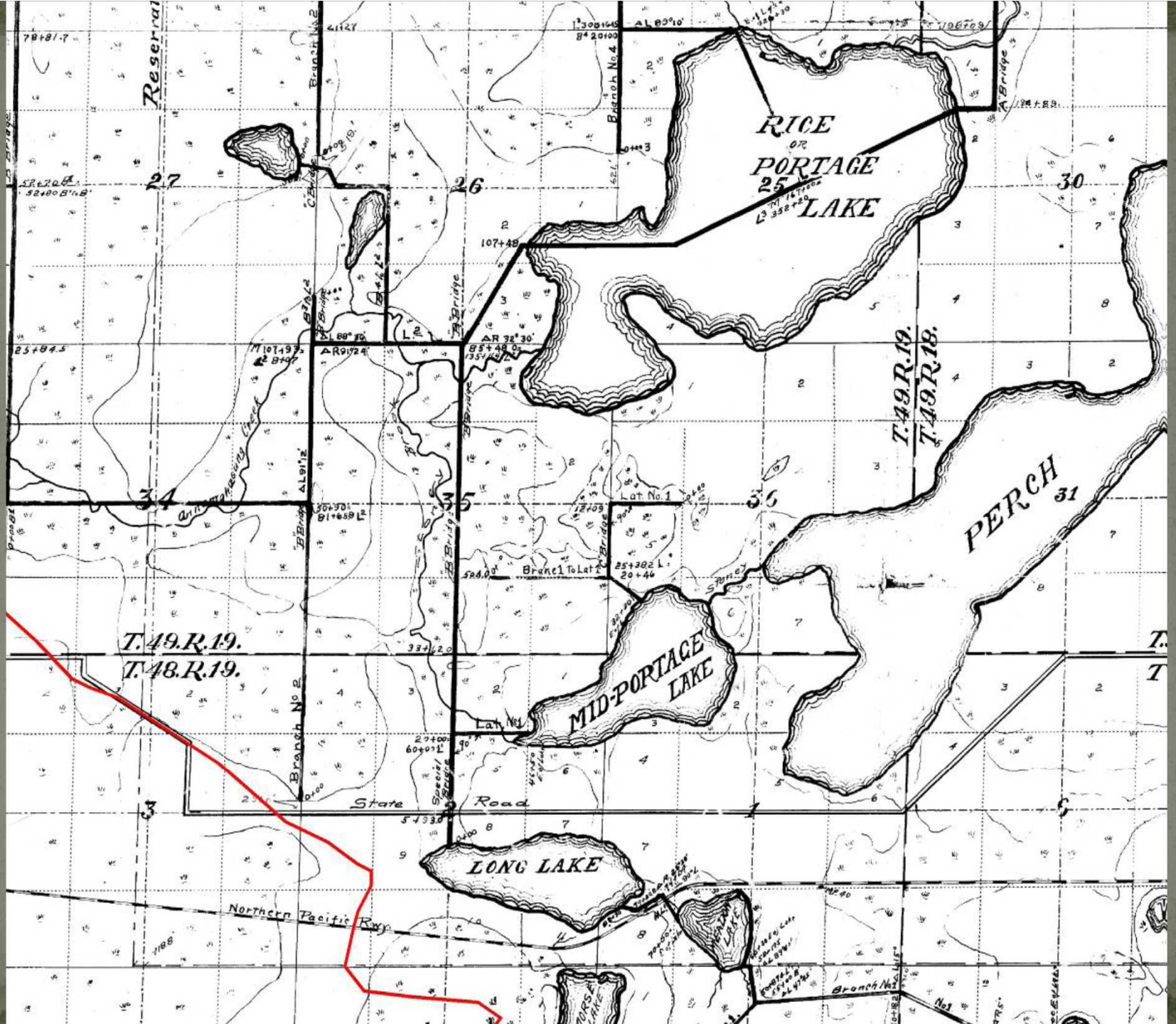
Manoomin, a gift from the creator….central element in the traditional Anishinaabe or Ojibwe migration story. Over centuries, the Ojibwe moved westward through the Great Lakes basin to the final stopping place, where “food grows on the water”.

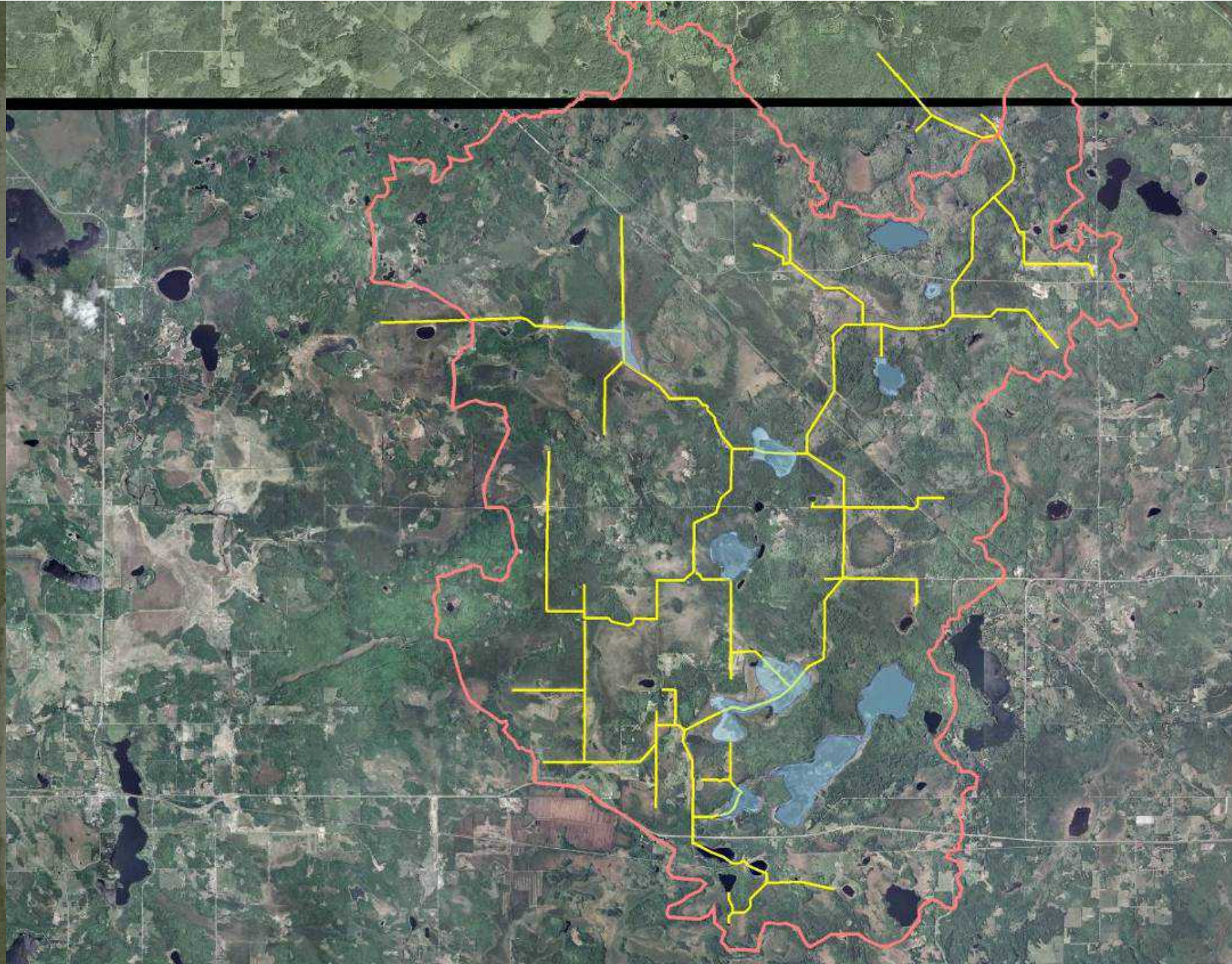

Rogue River



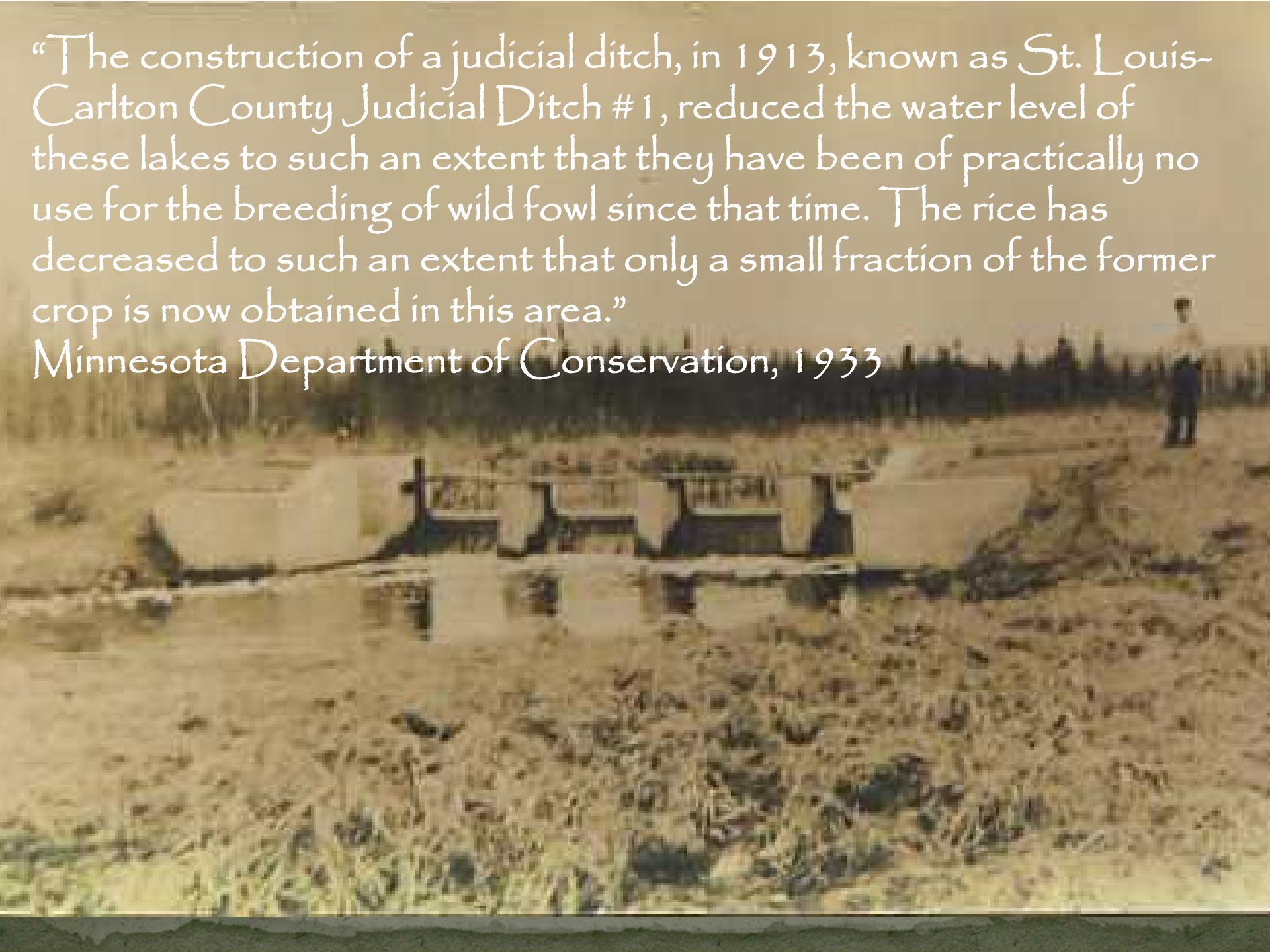
Zizania aquatica is an annual grass species, preferring shallow flowage lakes or slow-flowing riverine hydrologic conditions.

- Ideal water depth is 1-3 feet
- Organic, ‘mucky’ sediments
- soft water, circumneutral pH (6-8)
- Sulfate < 10 mg/l


RICE
OR
PORTAGE
LAKE
PERCH
MID-PORTAGE
LAKE
LONG LAKE
T.49.R.19.
T.48.R.19.
T.49.R.18.
State Road
Northern Pacific Ry.
Branch No 2
Branch No 4
Lat No 1
Lat No 2
Branch To Lat 1
27
26
25
30
31
34
35
36

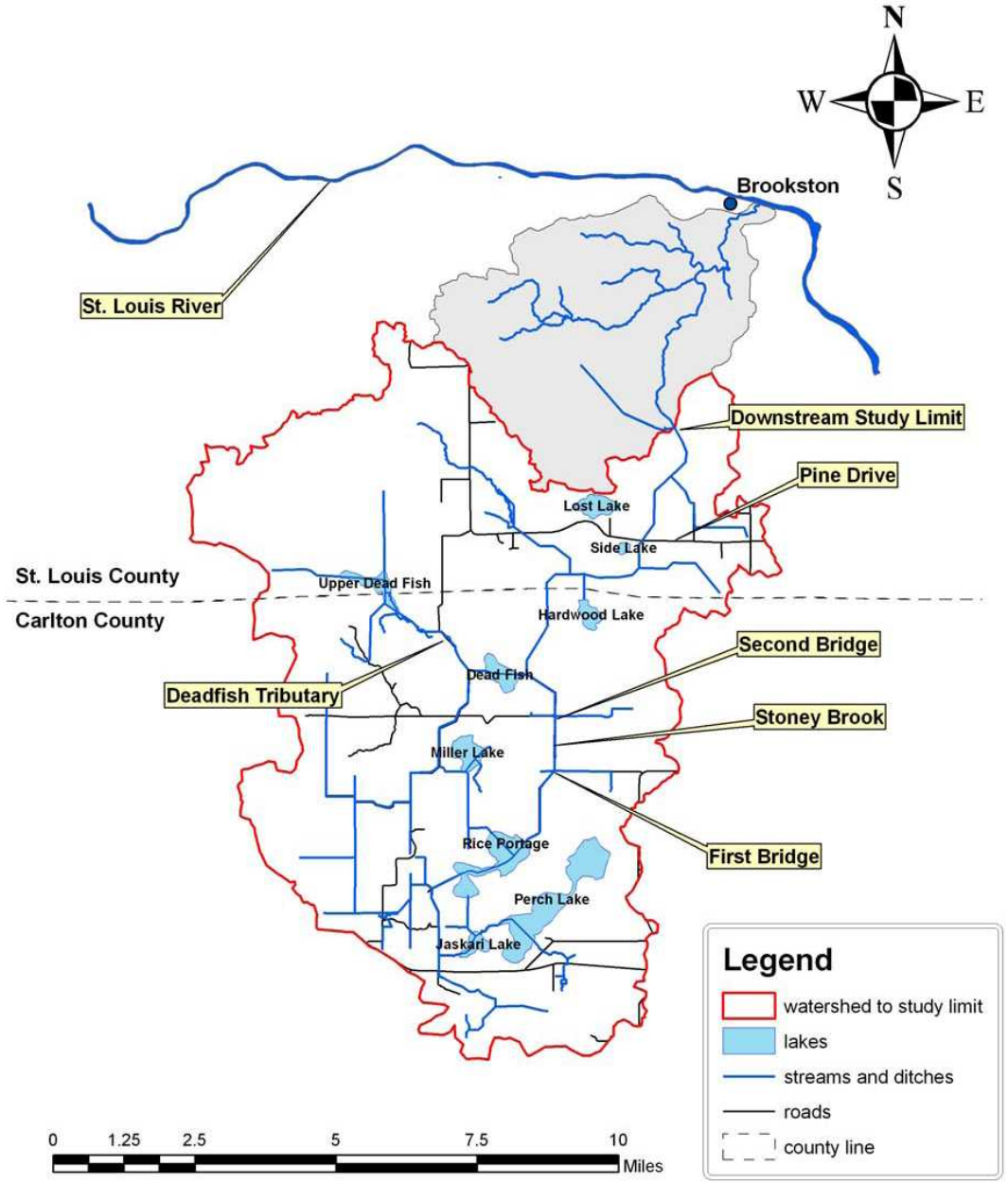


"The construction of a judicial ditch, in 1913, known as St. Louis-Carlton County Judicial Ditch #1, reduced the water level of these lakes to such an extent that they have been of practically no use for the breeding of wild fowl since that time. The rice has decreased to such an extent that only a small fraction of the former crop is now obtained in this area."
Minnesota Department of Conservation, 1933




Stoney Brook Watershed Hydrologic Study

Stoney Brook Watershed Project Map

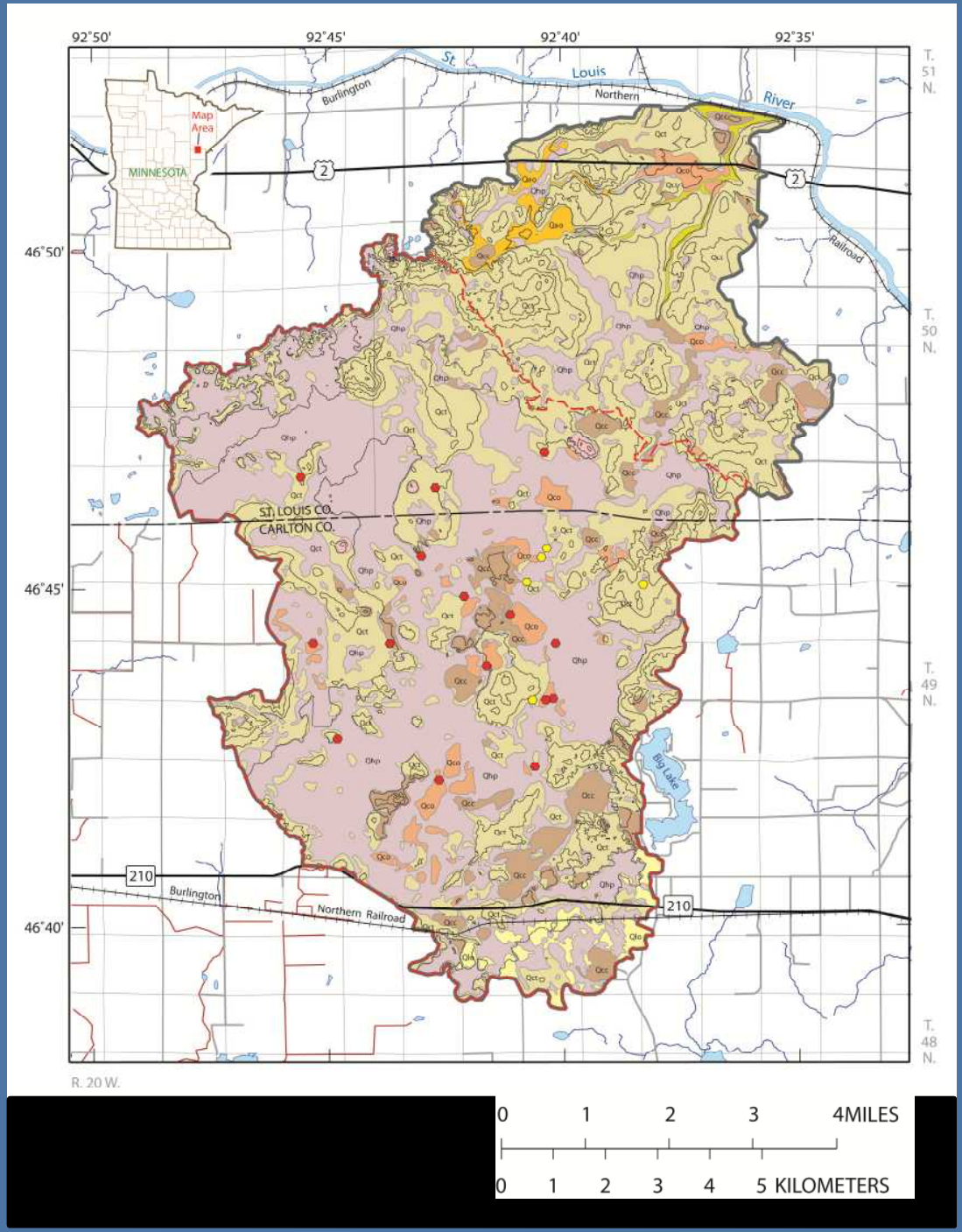


NRCS provided basic hydrologic assessment of watershed; used both hydrologic (HEC-HMS) and hydraulic (HEC-RAS) models to simulate:

- Channel modifications
- Existing lake outlet structure gate/stop log management options
- Diversion of some channel flows from one sub basin to another
- Additional storage options
- Modification of existing outlet structures

USGS summarized ground water resources, relationship between ground water and existing surface drainage system

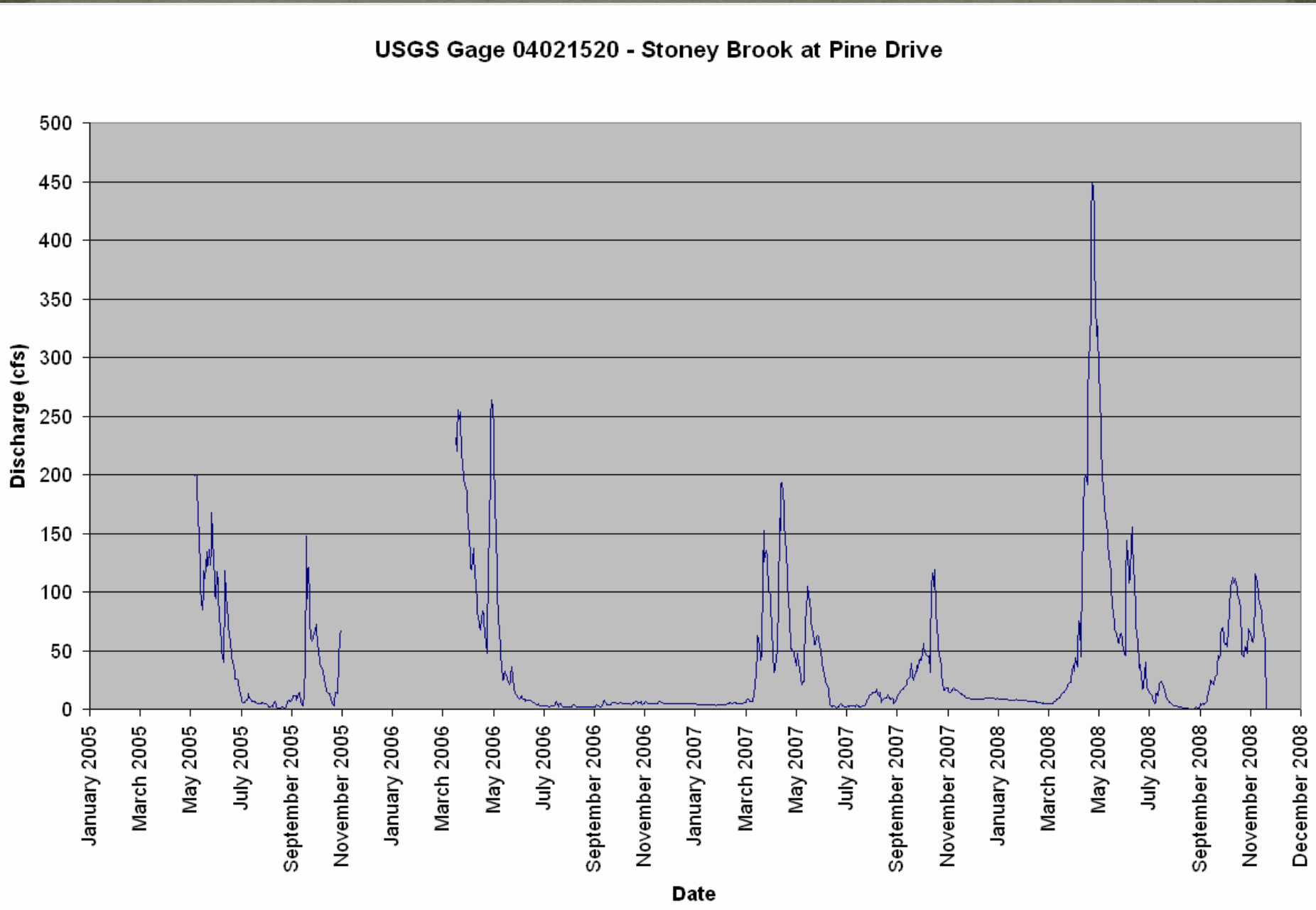
- Installed network of precipitation gages, shallow wells, continuous stream gage
- Data was used to calibrate the NRCS surface water models
- Baseflow analysis, recharge estimates
- Calculate evapotranspiration rate



Surficial Geology – Stoney Brook Watershed

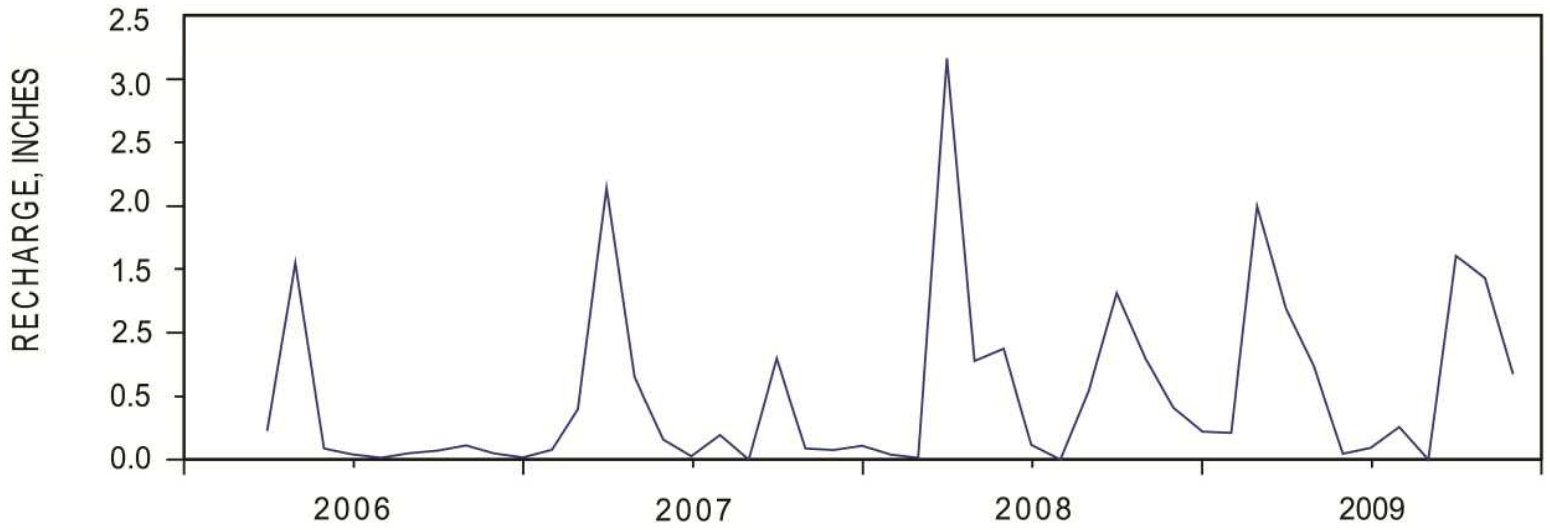
Minnesota Geological Survey (Boerboom, 2009)

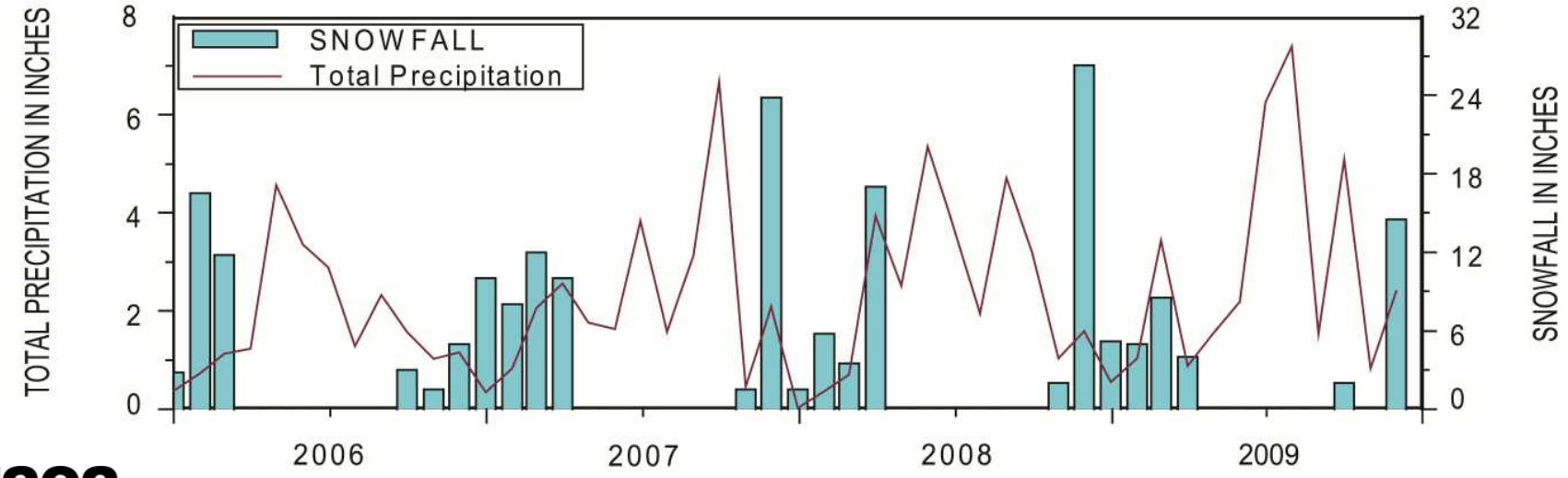
- Qhp - Peat/organic sediments
- Qha – Floodplain Alluvium
- Qlo – Outwash deposits
- Qco – Outwash deposits
- Qci – Ice-contact deposits
- Qcc – Till, sand/gravel complex
- Qct – Till deposits


USGS Gage 04021520 - Stoney Brook at Pine Drive
Discharge (cfs)
500
450
400
350
300
250
200
150
100
50
0
January 2005
March 2005
May 2005
July 2005
September 2005
November 2005
January 2006
March 2006
May 2006
July 2006
September 2006
November 2006
January 2007
March 2007
May 2007
July 2007
September 2007
November 2007
January 2008
March 2008
May 2008
July 2008
September 2008
November 2008
December 2008
Date

Stoney Brook Watershed – Monthly Recharge Estimates and Precipitation

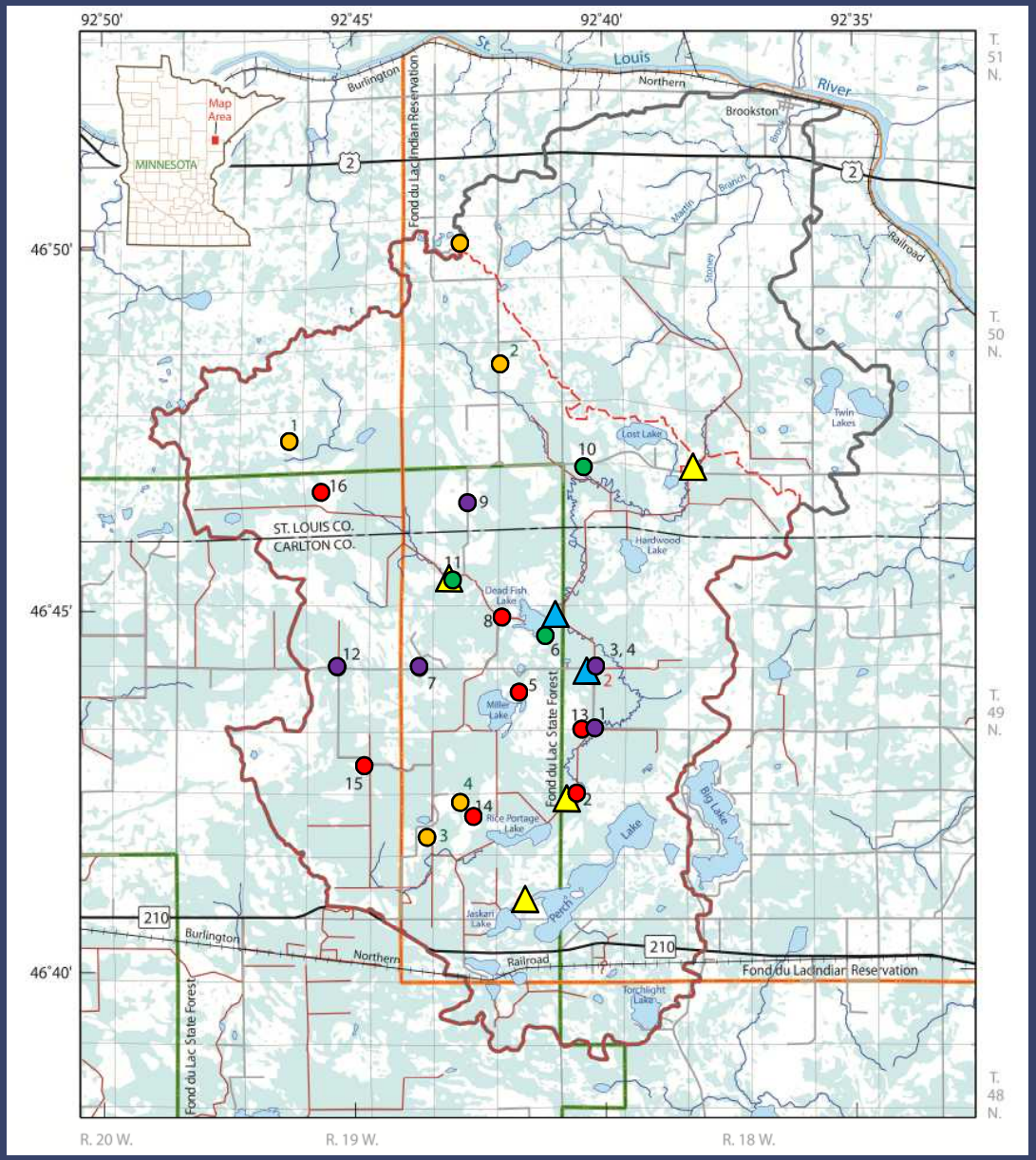
Recharge Estimates from Baseflow Analysis of Streamflow





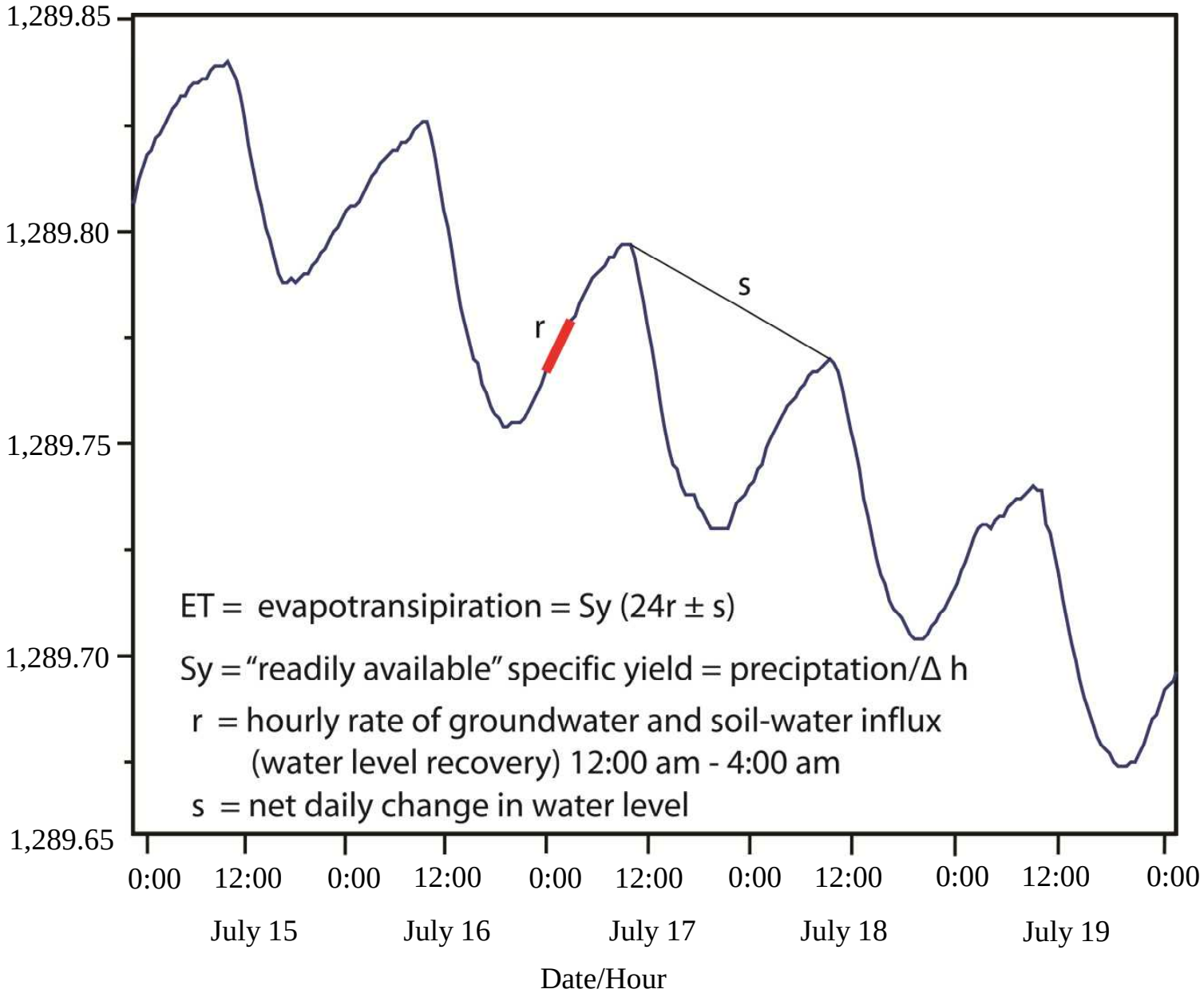
USGS

USGS/FDL Groundwater Study – Stoney Brook Watershed



- Monitoring Well - Continuous Water Levels
- Monitoring Well and Precipitation Gage
- Monitoring Well
- Precipitation Gage
- Open-Channel Flow /Precipitation gage
- Open-Channel Flow Gage
- Wetlands

Estimating Evapotranspiration from Groundwater levels - Monitoring Well 1

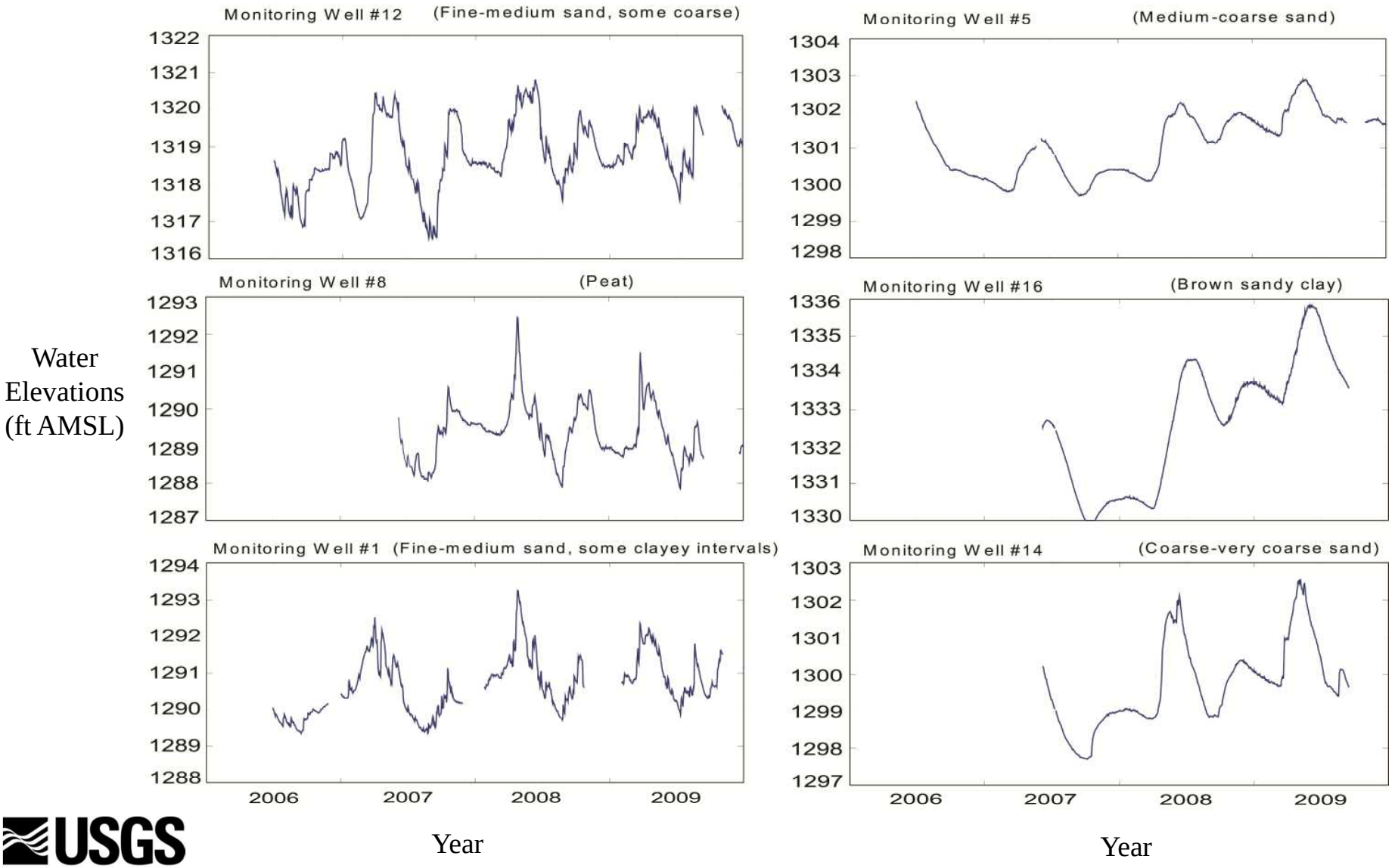


USGS

Stoney Brook Watershed - Groundwater levels, 2006-2009

Wells close to ditches
Abrupt response to rain

Wells further from ditches
Gradual response to rain



USGS

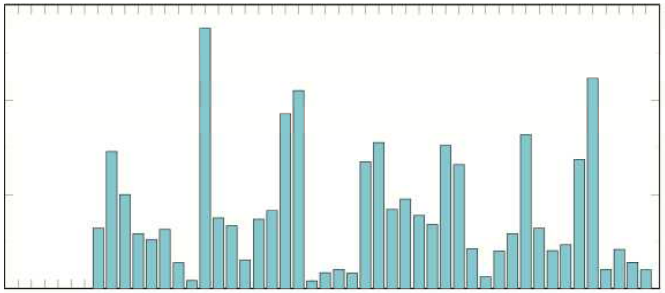
Stoney Brook Watershed – Monthly "Recharge" Estimates, 2006-2009

Wells close to ditches
Recharge + GW interaction with Ditch

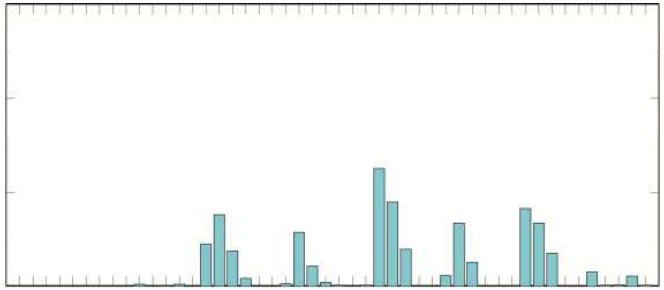
Wells further from ditches
Recharge

Monthly "Recharge" Estimates (inches)

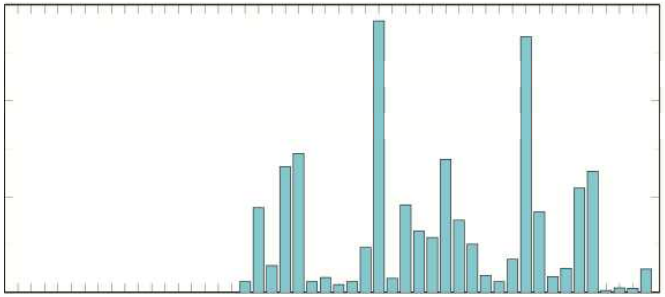
Monitoring Well #12 Estimated Spec. Yield = 0.18



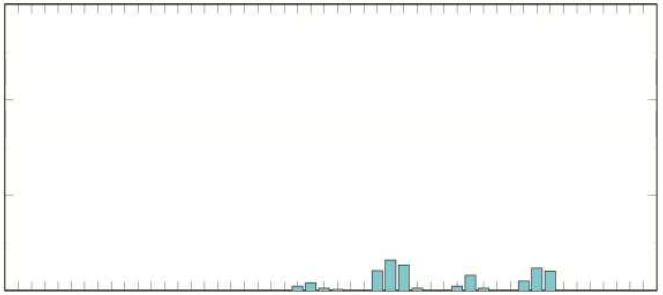
Monitoring Well #5 Estimated Spec. Yield = 0.24



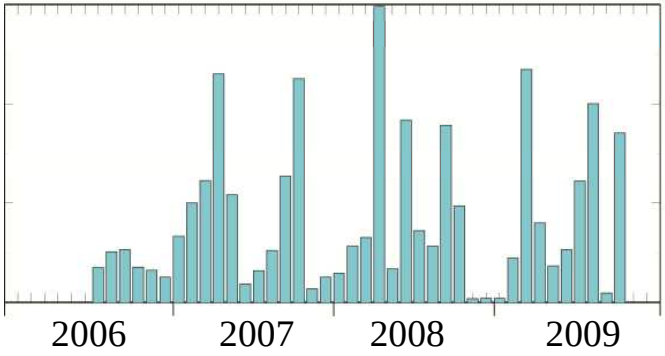
Monitoring Well #8 Estimated Spec. Yield = 0.19



Monitoring Well #16 Estimated Spec. Yield = 0.04

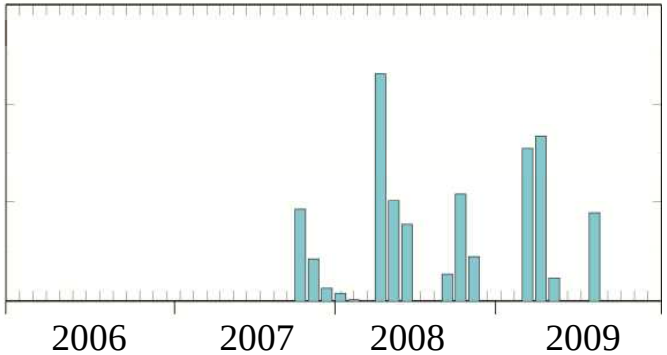


Monitoring Well #1 Estimated Spec. Yield = 0.23



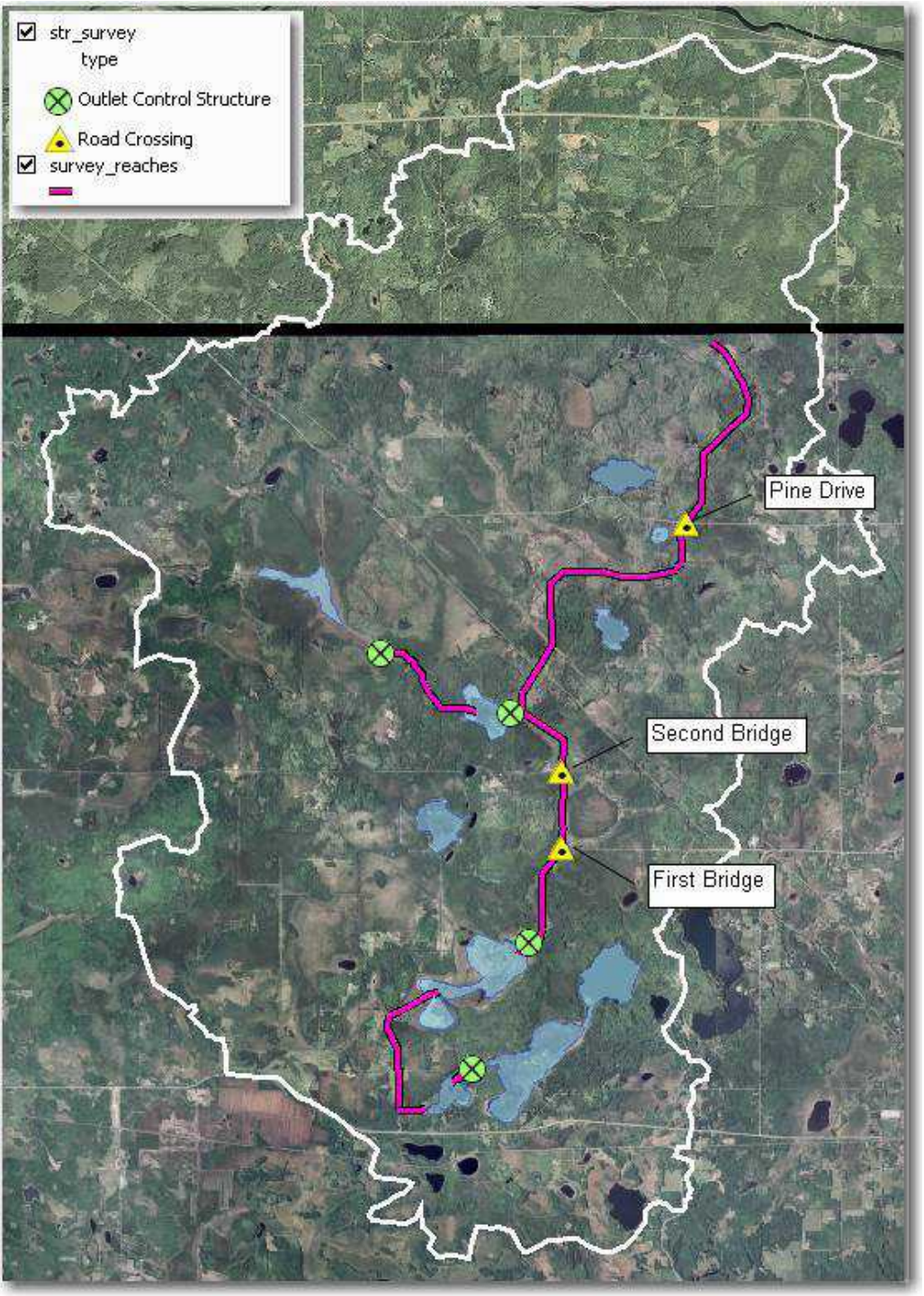
Year

Monitoring Well #14 Estimated Spec. Yield = 0.23



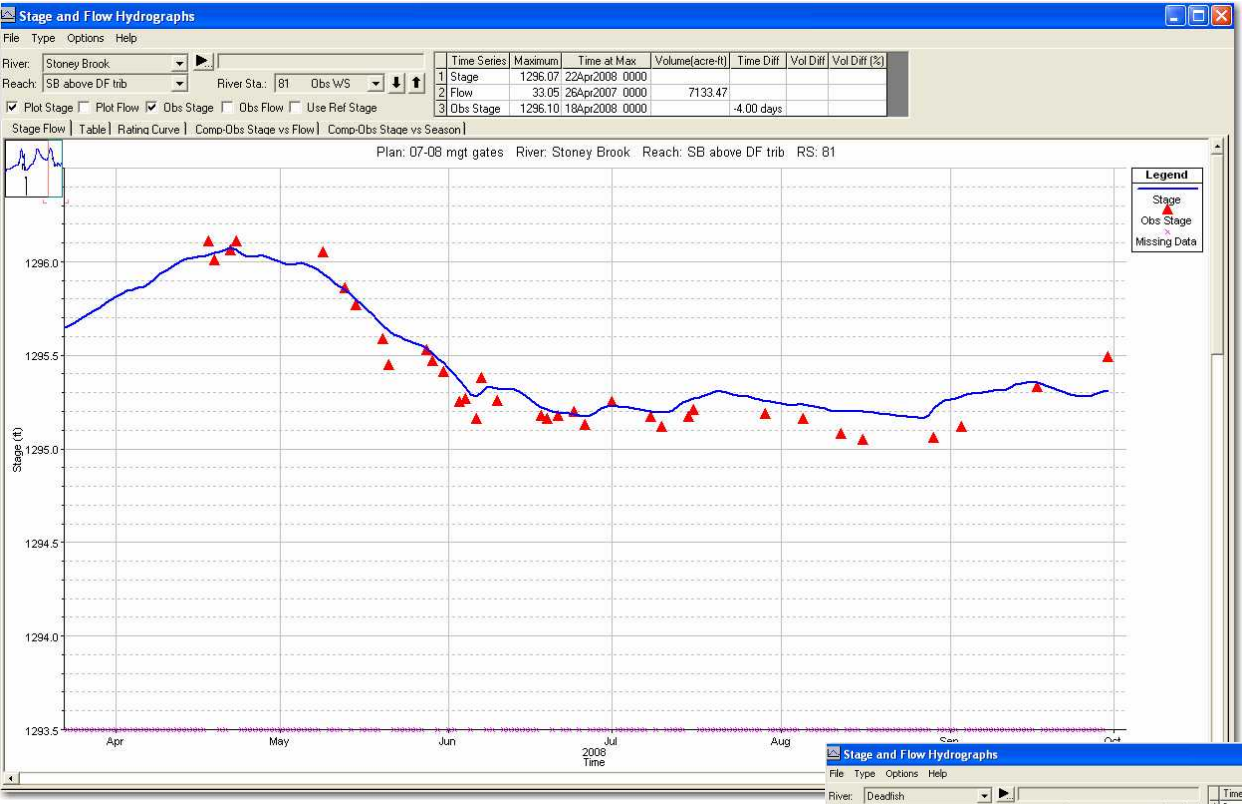
Year

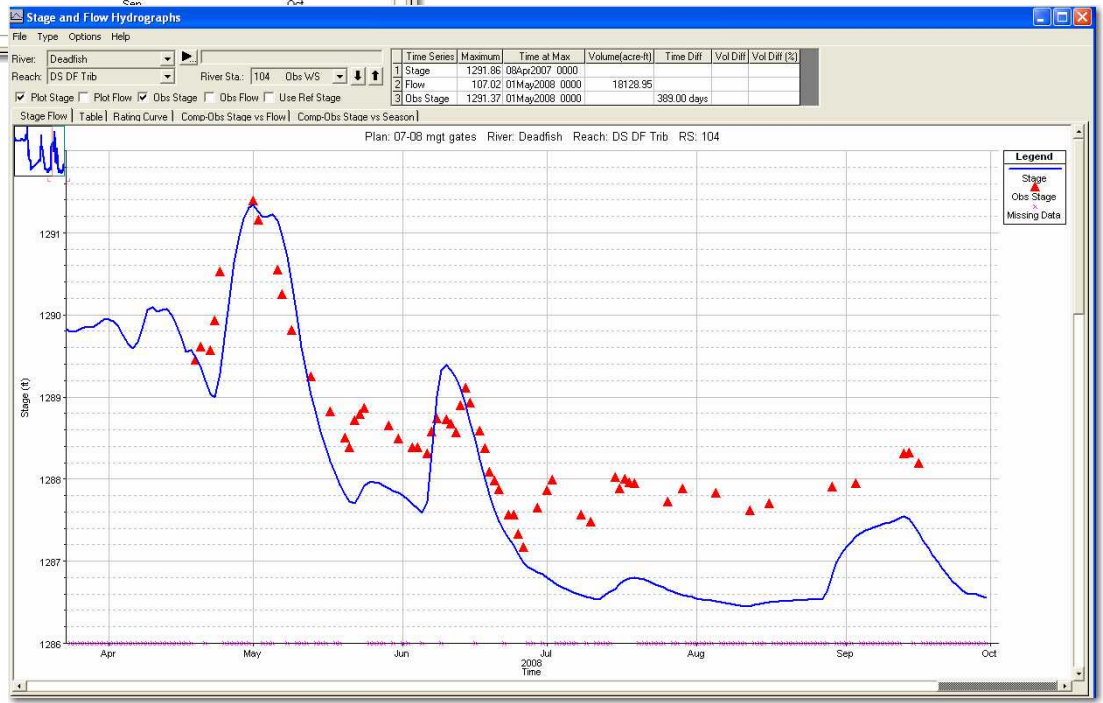
USGS


str_survey
type
Outlet Control Structure
Road Crossing
survey_reaches
Pine Drive
Second Bridge
First Bridge

HEC-HMS estimates stream flow (surface and baseflow hydrographs), lake levels throughout watershed

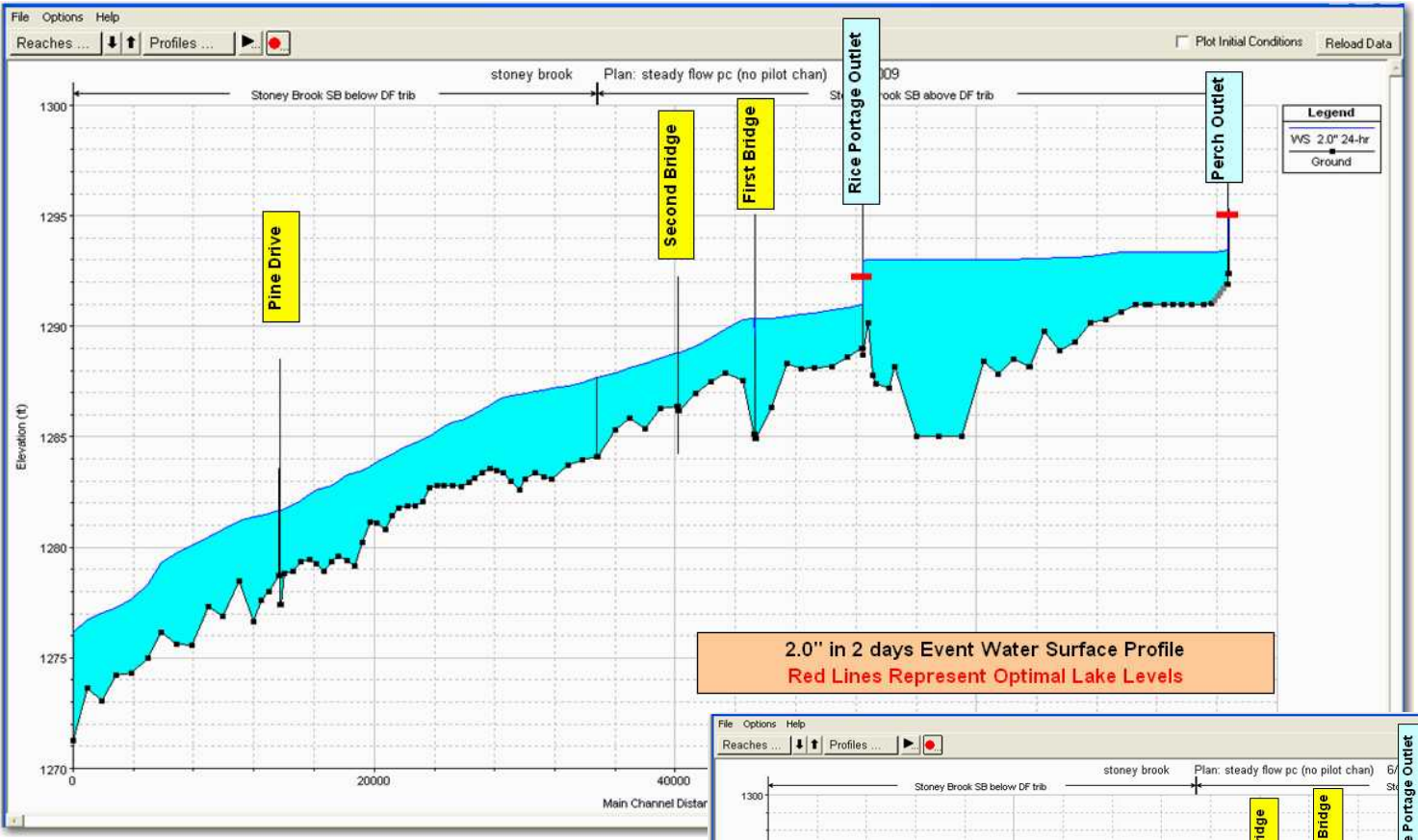
- Canopy and surface storage interception
- Evapotranspiration from plants
- Evaporation from lake surfaces
- Storage of water within the soil
- Movement of surface water to the subwatershed outlet
- Percolation of soil water into groundwater
- Lateral movement of groundwater to adjacent channels

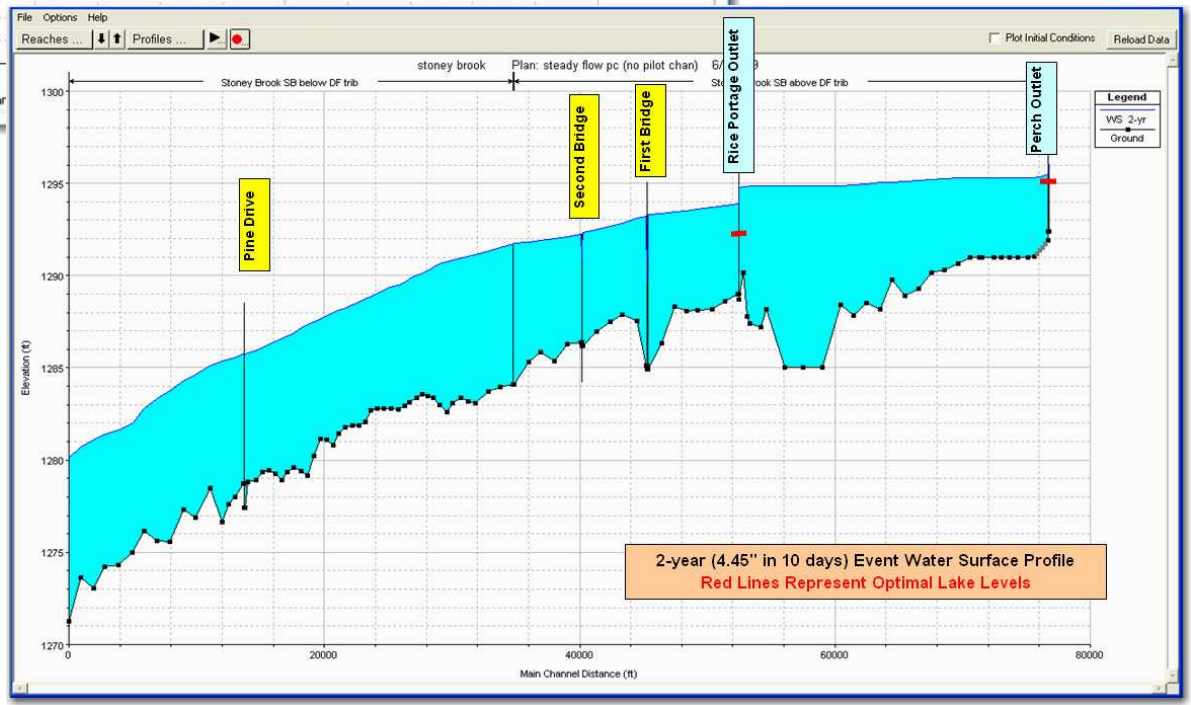

Stage and Flow Hydrographs
File Type Options Help
River: Stoney Brook
Reach: SB above DF trib
River Sta.: 81 Obs WS
Plot Stage Plot Flow Obs Stage Obs Flow Use Ref Stage
Time Series | Maximum | Time at Max | Volume(acre-ft) | Time Diff | Vol Diff | Vol Diff (%)
1 Stage | 1296.07 | 22Apr2008 0000
2 Flow | 33.05 | 26Apr2007 0000 | 7133.47
3 Obs Stage | 1296.10 | 18Apr2008 0000 | -4.00 days
Stage Flow | Table | Rating Curve | Comp-Obs Stage vs Flow | Comp-Obs Stage vs Season
Plan: 07-08 mgt gates River: Stoney Brook Reach: SB above DF trib RS: 81
Legend
Stage
Obs Stage
Missing Data
Stage (ft)
1296.0
1295.5
1295.0
1294.5
1294.0
1293.5
Apr
May
Jun
Jul
Aug
2008
Time

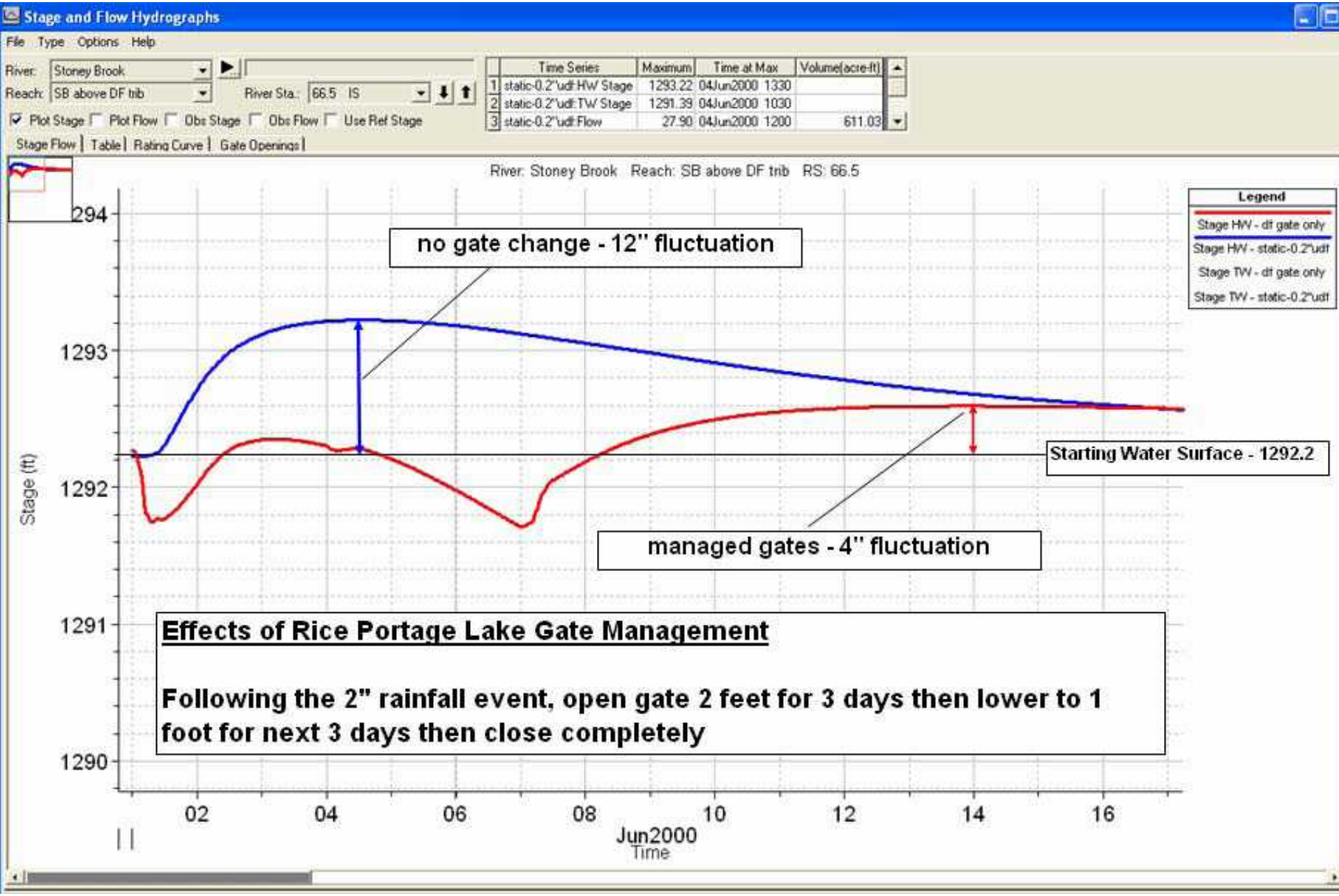

Stage and Flow Hydrographs
File Type Options Help
River: Deadfish
Reach: DS DF Trib
River Sta.: 104 Obs WS
Plot Stage Plot Flow Obs Stage Obs Flow Use Ref Stage
Time Series | Maximum | Time at Max | Volume(acre-ft) | Time Diff | Vol Diff | Vol Diff (%)
1 Stage | 1291.86 | 08Apr2007 0000
2 Flow | 107.02 | 01May2008 0000 | 18128.95
3 Obs Stage | 1291.37 | 01May2008 0000 | 389.00 days
Stage Flow | Table | Rating Curve | Comp-Obs Stage vs Flow | Comp-Obs Stage vs Season
Plan: 07-08 mgt gates River: Deadfish Reach: DS DF Trib RS: 104
Legend
Stage
Obs Stage
Missing Data
Stage (ft)
1291
1290
1289
1288
1287
1286
Apr
May
Jun
Jul
Aug
Sep
Oct
2008
Time

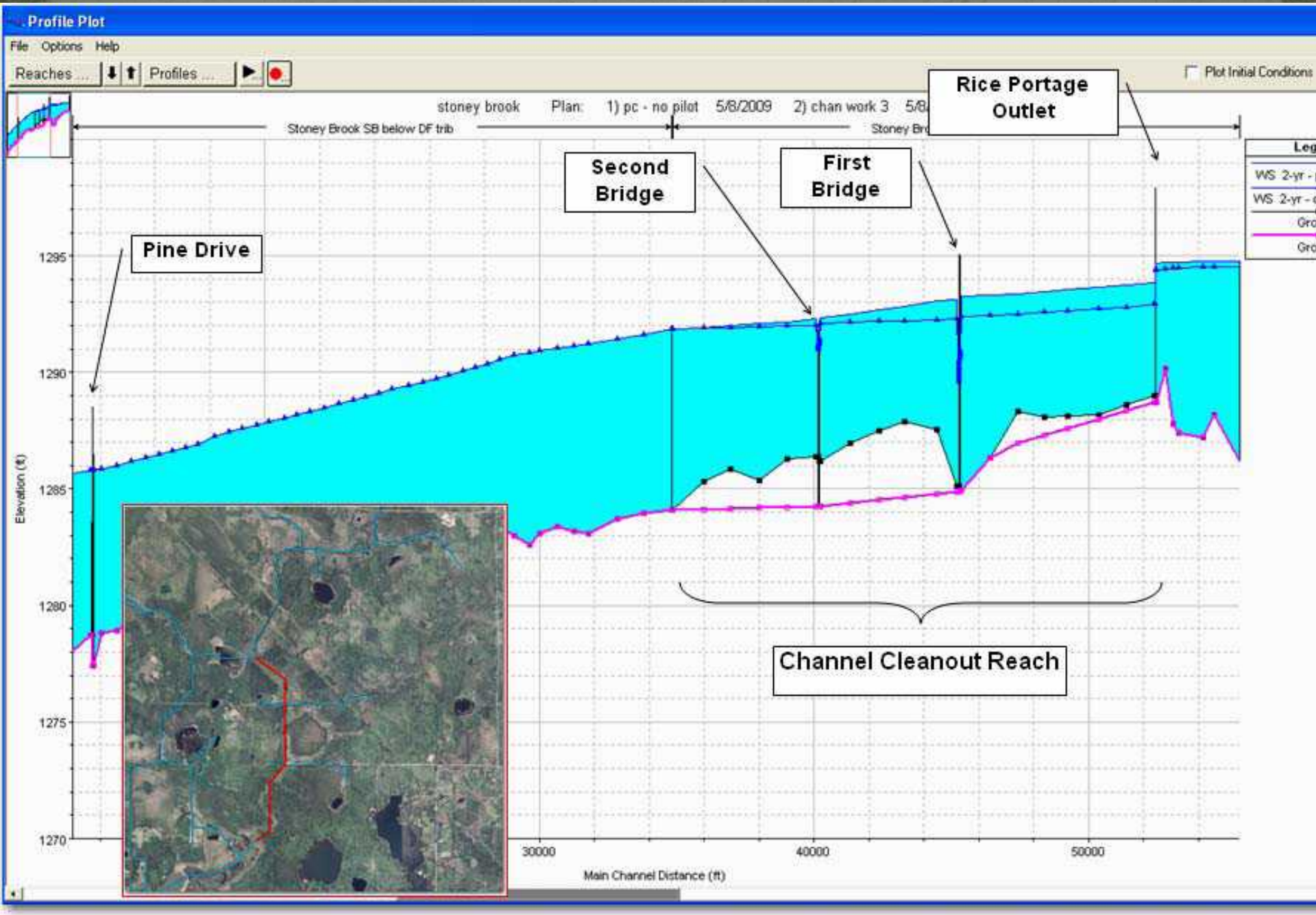
HEC–RAS estimates water elevations and velocity in channel/floodplain system for a given discharge

- Accounts for channel geometry, roughness
- Road crossings, lake level control structures
- Simulate current condition tailwater effects (downstream of the control structures)
- Simulate effects of channel modifications on water levels in the main ditch system
- Unsteady flow option used to simulate spoil/levee breaching, and gate stop log management scenarios


File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
stoney brook
Plan: steady flow pc (no pilot chan)
Stoney Brook SB below DF trib
Pine Drive
Second Bridge
First Bridge
Rice Portage Outlet
Perch Outlet
Legend
WS 2.0" 24-hr
Ground
Elevation (ft)
1300
1295
1290
1285
1280
1275
1270
0
20000
40000
Main Channel Distar
2.0" in 2 days Event Water Surface Profile
Red Lines Represent Optimal Lake Levels


File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
stoney brook
Plan: steady flow pc (no pilot chan)
Stoney Brook SB below DF trib
Pine Drive
Second Bridge
First Bridge
Rice Portage Outlet
Perch Outlet
Legend
WS 2-yr
Ground
Elevation (ft)
1300
1295
1290
1285
1280
1275
1270
0
20000
40000
60000
80000
Main Channel Distance (ft)
2-year (4.45" in 10 days) Event Water Surface Profile
Red Lines Represent Optimal Lake Levels


Stage and Flow Hydrographs
File Type Options Help
River: Stoney Brook
Reach: SB above DF trib
River Sta.: 66.5 IS
Plot Stage Plot Flow Obs Stage Obs Flow Use Ref Stage
Stage Flow | Table | Rating Curve | Gate Openings
Time Series | Maximum | Time at Max | Volume(acre-ft)
1 static-0.2"udf:HW Stage | 1293.22 | 04Jun2000 1330 |
2 static-0.2"udf:TW Stage | 1291.39 | 04Jun2000 1030 |
3 static-0.2"udf:Flow | 27.90 | 04Jun2000 1200 | 611.03
River: Stoney Brook Reach: SB above DF trib RS: 66.5
Legend
Stage HW - dt gate only
Stage HW - static-0.2"udf
Stage TW - dt gate only
Stage TW - static-0.2"udf
no gate change - 12" fluctuation
Starting Water Surface - 1292.2
managed gates - 4" fluctuation
Effects of Rice Portage Lake Gate Management
Following the 2" rainfall event, open gate 2 feet for 3 days then lower to 1 foot for next 3 days then close completely
Stage (ft)
1294
1293
1292
1291
1290
02
04
06
08
10
12
14
16
Jun2000
Time


Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
stoney brook Plan: 1) pc - no pilot 5/8/2009 2) chan work 3 5/8
Stoney Brook SB below DF trib
Rice Portage Outlet
Second Bridge
First Bridge
Pine Drive
Channel Cleanout Reach
Elevation (ft)
1295
1290
1285
1280
1275
1270
30000
40000
50000
Main Channel Distance (ft)


04/07/2

Migwiitch!

Cooperative funding agreements with NRCS, USGS
USGS tribal internship program
EPA 319 Base Program grant
Great Lakes Restoration Initiative tribal capacity grant
BIA Water Resources grant

Fond du Lac Resource Management