

Forestville North Dye Trace

September 5, 2008 to November 12, 2008

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Introduction

A dye trace was conducted in an area near Forestville State Park in Minnesota from September 5, 2008 to November 12, 2008 (Figure 1). Numerous dye traces have been completed in this area in the past and this effort was made in order to better delineate the springsheds in this area due to the close proximity of numerous State of Minnesota designated trout streams. Achieving a better understanding of the connection of these sinkholes receiving surface water flow and their connectivity to springs that provide a cold water source for the designated trout streams in the area was the goal of this trace.

However, the goal of this trace was two-fold, one sinkhole that received dye, Minnesota Karst Feature Database number 23:D2474, had previously been studied and was shown to be connected to cold water sources for two trout streams. The previous dye trace was completed during wet, spring conditions and this trace was completed during a much drier time in the late fall. Completing the trace during these differing conditions may help to better understand the seasonal changes of the subsurface flow of groundwater.

Dye tracing entails using fluorescent dyes to track groundwater flow directions and travel times. The dye is poured into a sinkhole or sinking stream; from there, it flows through the karst conduit system until it re-emerges at a spring or springs. For this project, the dyes used were Eosine and Rhodamine WT. Both direct water samples and passive dye detectors were used and all the samples were analyzed at the University of Minnesota Geology Department using a scanning spectrofluorophotometer. The traces were designed and executed by Jeff Green and Andrew Peters of MNDNR Waters. E. Calvin Alexander, Jr., Andrew Luhmann, and Scott Alexander of the University of Minnesota Geology Department performed the sample analysis and interpretation.

Results

The MNDNR Waters and the Fillmore County SWCD had previously contacted the landowners who owned the relevant sinkholes and springs. Prior to dye injection, bugs had been placed at all the sampling points to determine background levels of dyes. The dye trace began on September 5, 2008, using water provided by MNDNR. Table 1 summarizes the dye input information.

Dye Inputs				
Dye Input Point	Dye (type, quantity)	Time	Water Input (Est.)	Dye Detection Point
Sinkhole 23:D2474	Eosine, 1,090 grams	1423 hrs.	500 Gallons	Springs 23:A002 and 23:A003
Sinkhole 23:D2140	Rhodamine WT, 632 grams	1529 hrs.	500 Gallons	Springs 23:A002 and 23:A003

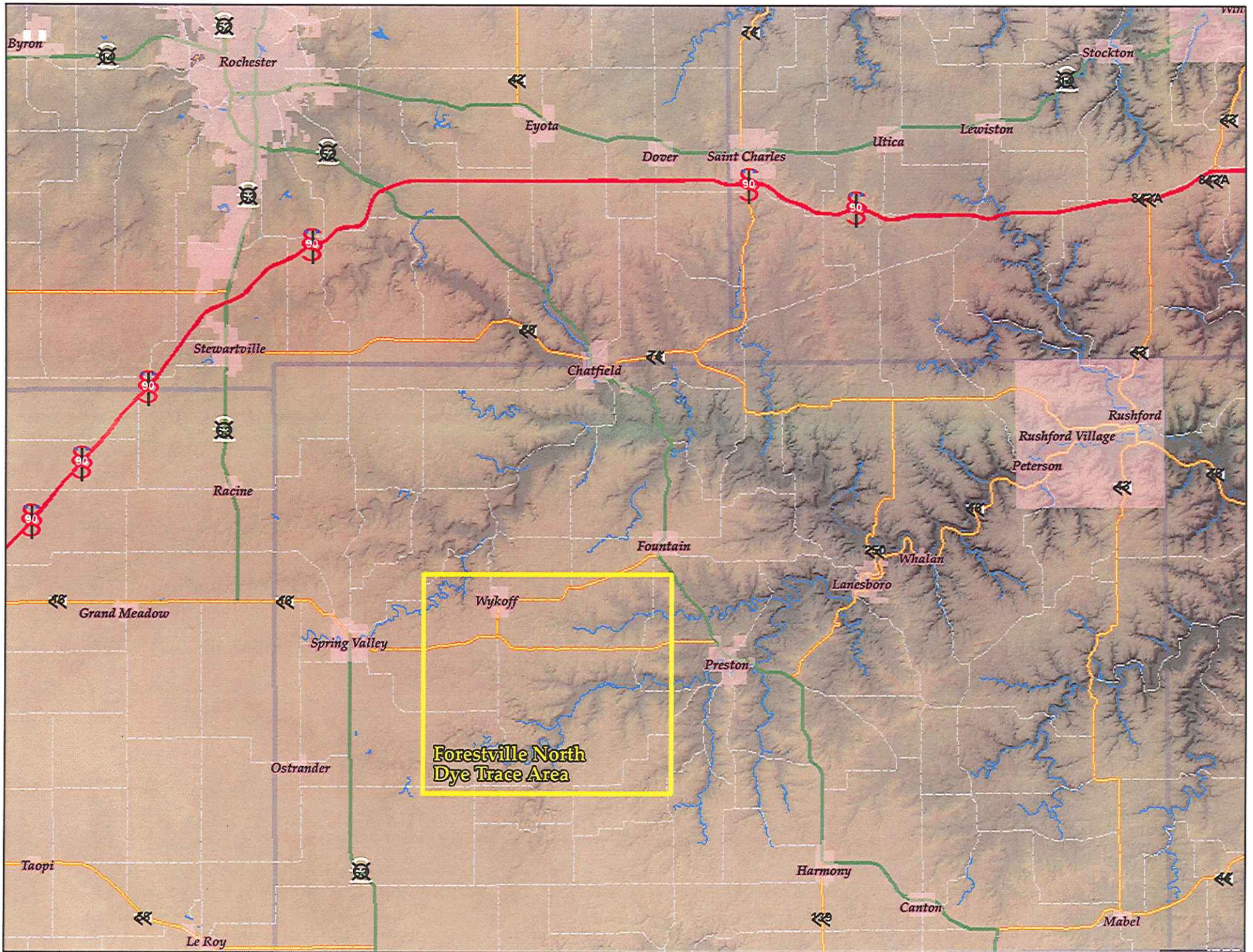
Table 1: Dye Inputs, Forestville North Dye Trace, Minnesota

Direct water samples were collected and charcoal dye detectors were in placed at all sampling locations from the start of the trace until mid-November. Both dyes were detected at levels high enough for positive identification. The dyes, Rhodamine WT and Eosine, were detected in the charcoal detectors no more than 18 days later. This translates to a groundwater flow rate of no greater than approximately 0.20 to 0.25-mile per day. This is consistent with previous traces in this geologic setting (Ordovician Galena limestone).

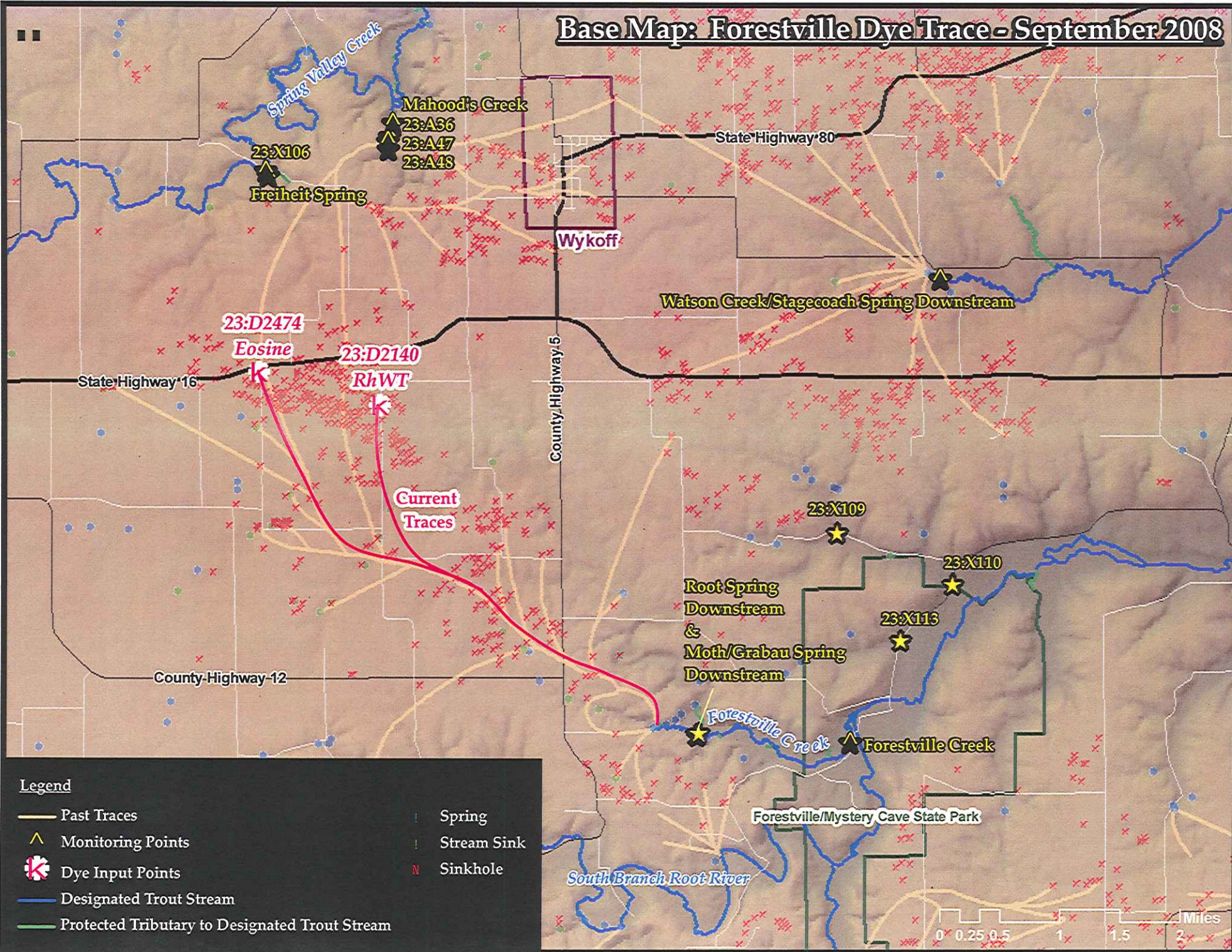
The dye input points and their known connections from this dye trace in addition to previously completed traces are shown in Figure 2. Through this double trace, we have further delineated the springshed feeding springs 23:A002 & 23:A003. This new trace has expanded the known boundaries of that springshed. In addition, sinkhole 23:D2474 was shown in this trace to be connected only to springs 23:A002 & 23:A003 that are a cold water source for Forestville Creek. Previously this sinkhole was thought to be connected to two separate springs and respective trout streams. This trace has shown that the connection of subsurface water flows from sinkholes to springs in this area may be governed by seasonal fluctuations and the respective amount of subsurface waters during times of drought or, conversely, wet periods.

Appendix 1

Figures



Base Map: Forestville Dye Trace - September 2008



- Legend**
- Past Traces
 - ▲ Monitoring Points
 - ✕ Dye Input Points
 - Designated Trout Stream
 - Protected Tributary to Designated Trout Stream
 - | Spring
 - | Stream Sink
 - | Sinkhole



Appendix 2

Dye Input

Forestville North Dye Trace: September 5, 2008 to November 12, 2008

Dye Input Points:

Input Point #1:

Sinkhole D2474:

Minnesota Karst Feature Database Number - MN23:D2474

UTM:

554,847 E, 4,836,815 N

Township, Range, Section:

SE ¼ of the NW ¼ of Section 31, T103N, R12W

Elevation:

~1330 feet

At 1423 CDT on 5 September 2008, approximately 1,090 grams of Eosine dye solution was introduced into an open swallow hole in D2474 with approximately 500 gallons of water.

Input Point #2:

Sinkhole D2140:

Minnesota Karst Feature Database Number - MN23:D2140

UTM:

556,472 E, 4,836,376 N

Township, Range, Section:

NE ¼ of the SW ¼ of Section 32, T103N, R12W

Elevation:

~1345 feet

At 1529 CDT on 5 September 2008, approximately 632 grams of Rhodamine WT dye solution was introduced into an open swallow hole in D2140 with approximately 500 gallons of water.

Forest North Trace 5 Sept 2008
Sunny, 70°F 5:6 / A.P.

Sinkhole 554847 / 4836815 ± 197 ft

Chromatant Red Eosin 0.143

Lot 020706 Chromatant

500 gal DNR tank 1.09 Kg

Dye @ 1423, Water start @
1419, end @ ≈ 1428

Water sinking in 3 small
swallets, no ponding

Sinkhole was traced from drain
1993-94. Fillmore Blue Atlas
Sprinkled Map tracing

Sinkhole 556472 / 4836376 ± 30 ft.

Rhodamine WT Chromatant

Chromatant Lot # 041807E

0.529.5 gm

Crompton & Knowles Rh WT 102.8 gm

Water start 1529, end 1536 ≈ 500 gal

from DNR tank

Dye @ 1531, no ponding

sinkhole has a 1m wide & 1m deep
collapse in bottom - water sprayed
in that, drained into a 10 cm hole.