

South Fork Root River Dye Tracing Report

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Introduction

The South Fork Root River watershed is composed of a number of springsheds (karst groundwater basins). The boundaries of some of them were shown on the Springshed plate of the Fillmore County Geologic Atlas, published by DNR Waters in 1995. That map, while useful, was not complete. In order to continue the mapping process and provide more information for local land and water managers, a triple dye trace was conducted for this project under a contract between the Fillmore SWCD and DNR Waters. The site selection process for the traces was coordinated between the Fillmore SWCD and DNR Waters and focused on areas with feedlots and manure application north of Canton, MN in the South Fork Root watershed. A better understanding of the springshed boundaries in the area will assist the SWCD to target its efforts to work with landowners in those critical areas.

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. For this project, the dyes used were Uranine C (fluorescein), Eosine, and Rhodamine WT. Both direct water samples and passive dye detectors (packets of coconut charcoal also known as “bugs”) 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, DNR Waters. E. Calvin Alexander, Jr., and Scott Alexander of the University of Minnesota Geology Department performed the sample analysis and interpretation.

Results

The Fillmore 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 fluorescence. The dye trace was run on 13 March 2007 using runoff from melting snow. Table 1 summarizes the dye input information.

| Dye Input Point | Dye (type, quantity) | Time | Runoff (Est.) | Detect point |
|-------------------|-------------------------|-----------|----------------|---------------------|
| Sinkhole 23:D7513 | Rhodamine WT 1009.3 gm. | 1430 hrs. | 20-30 G.P.M. | Spring A445 (A632) |
| Sinkhole 23:D7285 | Uranine C 1165 gm. | 1500 hrs. | 450-900 G.P.M. | Spring A445 (A632) |
| Sinkhole 23:D7450 | Eosine 1090.2 gm. | 1530 hrs. | 10+ G.P.M. | X111- (Spring A434) |

Table 1

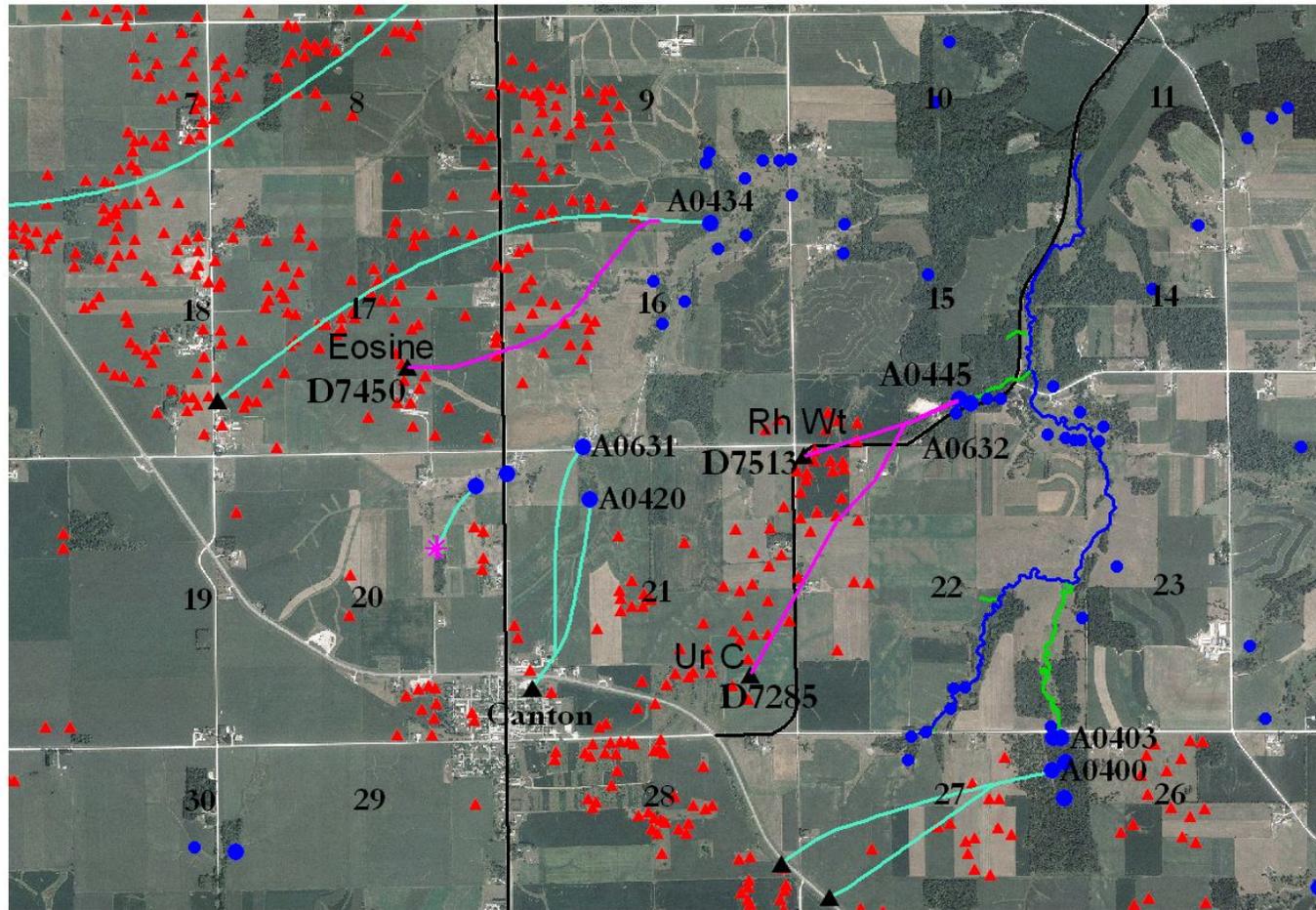
Direct water samples were taken at all the sampling sites on 14 & 15 March 2007. The charcoal detectors were changed on 20 & 30 March 2007. All three dyes were detected at levels high enough for positive identification. Two of the dyes, Rhodamine WT and Uranine C, were detected in the direct water samples approximately 28 hours later. This translates to a groundwater flow rate of over one mile per day. This is consistent with previous traces in this geologic setting (Ordovician Galena limestone).

The dye points and connections are shown in Figure 1. Through this triple trace, we have identified a previously unmapped springshed feeding Spring A632 (traces from sinkholes D7285 and D7513). There are several springs visible in the immediate area of A632 but they all feed the same coldwater tributary to Frego Creek. The trace from sinkhole D7450 that was detected in the flow from spring A434 expanded the known boundaries of that springshed.

Conclusion

This work represents an important step forward in our knowledge of the karst groundwater flow systems in the South Fork Root River watershed. As a result, more accurate monitoring can be done of local springs, conservation practices can be targeted for specific spring basins, and better land use management decisions can be made. In the event of a manure or agricultural chemical spill, we now have a better understanding of groundwater flow directions and travel times to help local and state authorities deal with this type of event.

South Fork Root River Dye Trace- March 2007



Dye trace points

- ▲ Sinkhole
- Spring
- * Stream sink
- Atlas trace
- Project trace

Karst Feature

- Spring
- * Stream Sink
- ▲ Sinkhole

Trout Stream

- Trout Stream
- Protected Tributary
- County Road

