South Branch Root 319 DNR Waters Final Report

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Introduction

The South Branch 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. Since the publication of the geologic atlas, DNR Waters, Fillmore County SWCD, and the University of Minnesota have done an additional 24 dye traces in the South Branch Root area. These traces helped to refine existing springshed boundaries and identified several previously unmapped springsheds. In order to continue this process, dye tracing was included in the work plan of the South Branch Root Clean Water Partnership 319 project for the Governor's Root River Initiative. The goal was to conduct three triple traces to further refine the known springshed boundaries in the watershed area.

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

Ten separate traces were done for this project. The specifics of each trace are presented in Table 1. Two traces were run from B123 (Freeman swallet), a stream sink on the Warren Freeman farm in Section 35 Spring Valley Township. This stream sink receives runoff and contaminant pump-out water from the BP-Amoco oil terminal east of Spring Valley. This stream sink is 4800 ft. to the northwest of a stream sink that feeds into the Moth and Grabau (headwater springs of Forestville Creek) system. Both traces were run with natural runoff. Neither dye was detected despite our wide spread of sampling points. We made many repeat trips to the sink in the hope of running the trace a third time. Flow conditions were never suitable for a third attempt. Due to the importance of this trace, we will try to repeat it as part of the U of M & DNR LCCMR-Springshed mapping project.

Three traces were run from the Joe & Bonnie Austin farm in Section 4 of Forestville Township. Two were injected in a sinkhole, D2205 on the west part of the Austin farm.

One trace was run with 500 gallons of water from a DNR tank, the second with snowmelt runoff. The third trace was from a previously unmapped stream sink and was run with snowmelt runoff. None of the three dyes were detected. A fourth trace was run from a stream sink on the east part of the Austin farm prior to this project. That dye was also not detected.

DATE	TIME	WATER_SOURCE	NAME	Detection Point	MSS_ID	EASTING	NORTHING
2 April 2006	1400	Waiting for runoff	Mystery hole	No detect	D2646	560403	4835963
4 April 2006	1415	Snowmelt 20-40 gpm	Freeman swallet	No detect	B123	551371	4837147
26 Oct. 2006	923	500 gal. DNR tank	Mystery hole	Forestville Creek	D2646	560398	4835963
23 Oct. 2007	1412	400 gal. DNR tank	Austin west sink	No detect	D2205	557343	4835707
23 Oct 2007	1525	900 gal. DNR tank	Mystery hole	Moth/Grabau springs	D2646	560398	4835963
23 Oct. 2007	1731	2-3 gpm tile flow	Freeman swallet	No detect	B123	551475	4837104
13 March 2008	1820	1-3 gpm snowmelt	Austin West sink	No detect	D2205	557346	4835695
7 April 2006	1127	Snowmelt	Austin stream sink	No detect		557784	4835487
5 Sept. 2008	1423	500 Gal. DNR tank	Elm Sink	Moth/Grabau springs	D2474	554847	4836815
5 Sept. 2008	1531	500 Gal. DNR tank	Schmidt II sink	Moth/Grabau springs	D2140	556472	4836376

Table 1. **Dye Trace Details**

The repeat tracing for the Freeman sink and Austin farm meant that bugs were out in the streams and springs north of Forestville for over one year. The springs on the east side of Mahoods Valley west of Wykoff consistently had elevated levels of the green dye Uranine C (fluorescein). This dye is commonly used to color automotive antifreeze. The springshed for the east springs includes the City of Wykoff. The elevated Uranine C levels indicate that there is a direct connection into the conduit system in the springshed that is receiving Uranine C-enriched water.

Three traces were run from sinkhole D2646, the “Mystery Hole”, in Section 34 of Fillmore Township. This trace was run to help locate the boundary between the Forlorn River springshed (Moth and Grabau springs) and the Stagecoach springshed which is the headwaters of Watson Creek. The first trace was not detected. The second trace was detected in Forestville Creek. Subsequently, fieldwork determined that Root Spring, a tributary to Forestville Creek, emanates directly from a joint in the bedrock. This suggests that it is a karst conduit spring. Therefore, a third trace was run from the Mystery Hole and bugs were placed to allow us to determine if the connection was to Moth/Grabau, Root, or both. The dye from the third trace was only detected at Moth/Grabau. This expands the boundary of the Forlorn River springshed and implies that the springshed feeding Root Spring lies further to the east (Figure 1).

In September of 2008, a dual trace was run from sinkhole D2474 (Elm sink) Section 31 Fillmore Township and D2140 (Schmidt II sink) Section 32 Fillmore Township. The Elm

sink trace was a repeat of a trace done in 1993 for the county geologic atlas springshed plate. That trace has dye go north to Mahoods Valley and southeast to Moth/Grabau. Conditions this year were quite dry, so we determined that repeating the trace would be valuable. The September 2008 trace was only found in Moth/Grabau, indicating that the springshed boundary moves north from this sink under low flow conditions. The D2140 (Schmidt II) trace was run to further refine the known springshed boundaries. This trace was also detected only in Moth/Grabau. This trace thus expanded the boundaries of the Forlorn River springshed.

Summary

Despite the unusually low success rate of these dye traces, several important results were obtained. First, we significantly expanded the boundaries of the Forlorn River springshed which is the basin that feeds Moth/Grabau springs. Second, the trace from D2474 demonstrated that the boundary between the Mahoods Valley springshed and the Forlorn River springshed moves north under low flow conditions. Third, the morphology of Root spring indicates that it is fed by karst conduits which makes it a potential target for future dye traces. Last, although it is not in the SBRR watershed, the consistent presence of Uranine C in the east springs in Mahoods Valley indicates that there is a direct discharge of Uranine C-enriched waters into the conduit system.

This work represents an important step forward in our knowledge of the karst groundwater flow systems in the South Branch 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. The springsheds that we have identified are critical areas for trout stream spring water supply. The expanded information base can be applied to water and land use decisions in the South Branch Root watershed.

Acknowledgements

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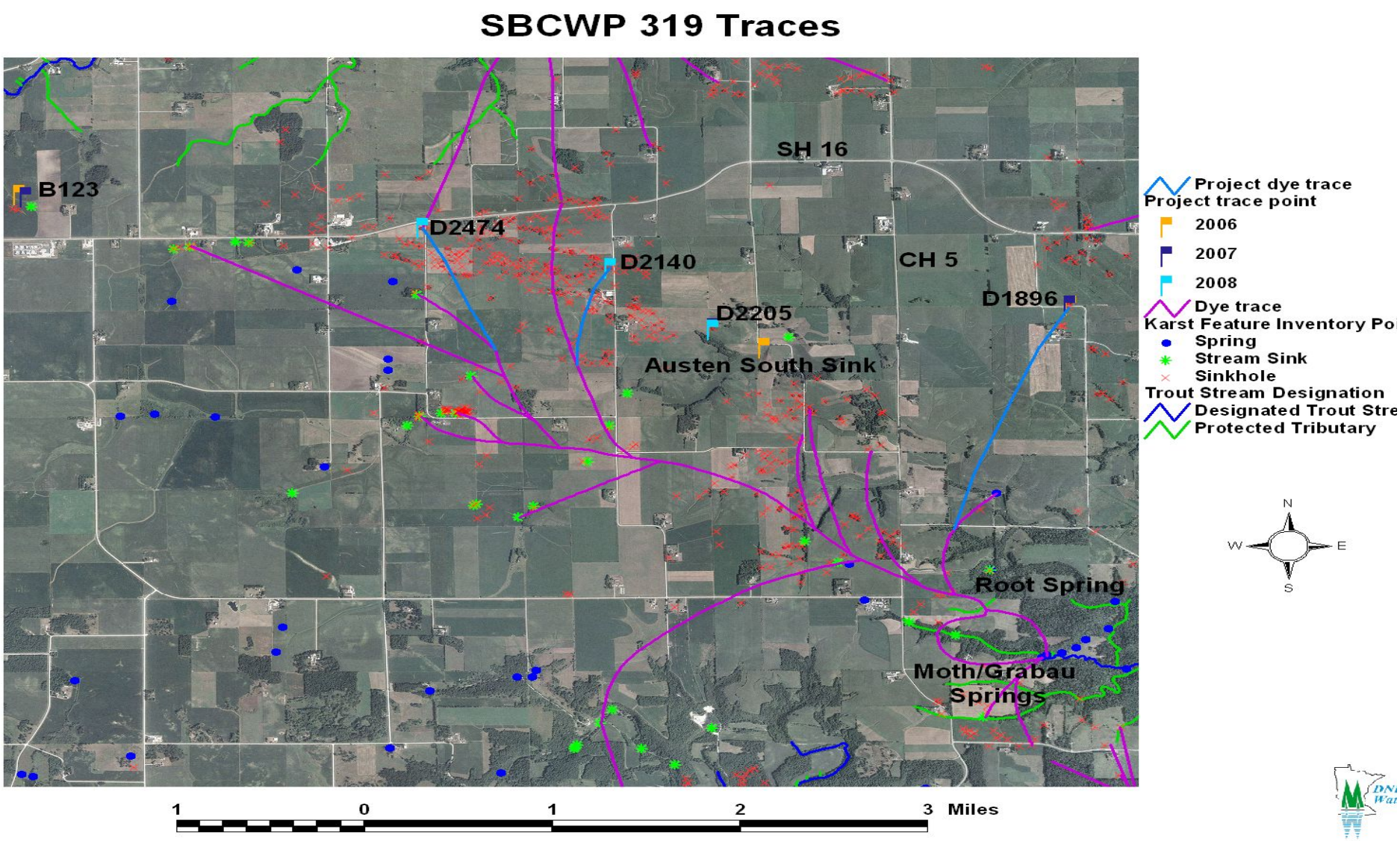

Figure 1. SBCWP Dye Traces 2006-2008