STATE COLLEGE BOROUGH WATER AUTHORITY

SLAB CABIN RUN DYE TRACE STUDY

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Section 1
Introduction

1.1 Purpose and Objectives

The purpose of this dye trace study program was to provide College Township Water Authority (CTWA), State College Borough Water Authority (SCBWA), and The Pennsylvania State University (PSU) a better understanding of the origin of recharge to each of their respective wellfields. The major objectives of the dye trace study program include:

1. Determining if hydraulic connections exist between the region's major public groundwater suppliers and Slab Cabin Run and Spring Creek,
2. Determining the degree of hydraulic connections between wellfields and streams where they exist, and
3. Determining the travel time of dye through the aquifer system from various points at low and average stream flows.

1.2 Background Information

This dye trace study program was initiated as part of the SCBWA's Source Water Protection Program. Initially, a dye trace study was conducted during November 2005 while Slab Cabin Run's flow was relatively low to see if a hydraulic connection exists between the stream, its tributaries, and SCBWA Wellfields 1 and 3. A second dye trace event was subsequently conducted during December 2006 to determine how the results may differ during higher stream flow in Slab Cabin Run. During the second dye trace event, CTWA and PSU participated through monitoring CTWA's Spring Creek Park and Shiloh Road Wells, and PSU's Well 33. The dyes had the potential to be detected in CTWA's and PSU's wells and it provided a unique opportunity to understand the recharge characteristics of these wells. A brief discussion of the area's hydrogeology is provided in the next section followed by the methods and results of both dye trace events.

1.2.1 Hydrogeologic Setting

The CTWA, SCBWA, and PSU Wellfields are all situated in Nittany Valley, in the Valley and Ridge physiographic province. Nittany Valley is underlain by folded and faulted carbonate bedrock bounded by Tussey Ridge to the southeast and Bald Eagle Ridge to the northwest. Waters entering the aquifer ultimately drain to Spring Creek and leave the basin through Milesburg Gap in Bald Eagle Ridge. The carbonate bedrock in Nittany Valley is characterized as karst terrain. Most of the water in the aquifer is stored and transmitted through dissolution openings caused by

the migration of slightly acidic waters through bedrock fractures. Typically the limestone is very dense and mostly impermeable, except where solution processes have enlarged the bedrock fractures. The dissolving of bedrock is characterized by both small features (e.g., fractures and fissures) and large features (e.g., caves, sinkholes, springs, and underdrained streams).

The aquifers in Nittany Valley are anisotropic and heterogeneous, in that groundwater flows preferentially in certain directions, generally from southwest to northeast, due to geologic structure (i.e. bedrock strike). Bedding plane partings separate rock layers that parallel the valley, and can be inclined at various angles. The bedding plane partings are preferential dissolution features and therefore can become widened by solution processes and provide enhanced groundwater flow paths. In addition, nearly vertical zones of fracture concentration (visible as fracture traces on aerial photography) can provide avenues for significant groundwater flow. In some locations, faults have placed rock layers with different hydraulic properties adjacent to one another which can either act as a groundwater flow barrier or as a zone of enhanced groundwater flow, depending on the nature of the faulting, weathering and dissolution of the bedrock.

SCBWA Wellfields 1 and 3 are located in the upper Slab Cabin Run Basin as shown in Figure 1. Roaring Run, a tributary of Slab Cabin Run, which is fed by mountain springs and recharge that originates from the sandstones that form the ridges and the colluvium that blankets the mountain slopes. Both upper Slab Cabin Run and Roaring Run's flow decreases significantly during dry times of the year as they become underdrained and lose flow into Nittany Valley's carbonate bedrock floor. Roaring Run typically flows after the spring snowmelt and then goes dry in late spring to early summer except after significant precipitation events. CTWA's Spring Creek Park Well is very near the confluence of Slab Cabin Run and Spring Creek near Houserville, while their Shiloh Road Well is relatively distant from any surface streams. PSU's Well 33 is near Spring Creek, approximately one-quarter mile downstream from where Slab Cabin Run joins Spring Creek. The lower section of Slab Cabin Run and the portion of Spring Creek in proximity to the CTWA and PSU wellfields are perennial sections of these streams, however prolonged dry periods cause significant reduction of flow in both streams.

Slab Cabin Run Dye Trace Study Report
Section 2
Low Stream Flow Dye Trace Study

This section of the report describes the methods utilized to conduct the low stream flow dye trace testing and the study's results.

2.1 Methods

The Crawford Hydrology Laboratory at Western Kentucky University was utilized for analysis of samples collected from monitoring points for the various dyes used in the project. The first step in the dye tracing study was to determine if any background concentrations of fluorescent dyes exist in surface water or groundwater. The presence of background concentrations of each type of dye to be used at each monitoring location was assessed by collection of samples from each monitoring point approximately 2 weeks before initiation of the dye trace study. Activated charcoal receptors were placed in the flow at each monitoring point for approximately one week to verify the absence or presence of background dye concentrations. The receptors were analyzed prior to initiation of the dye trace study so that the presence of any background concentrations of dye could be verified prior to the dye trace test and the testing protocol could be modified if necessary. The dye trace study was conducted once the background fluorescence results were determined to be satisfactory. A different type of dye was injected at each location so multiple dyes could be detected at each monitoring point and traced back to the associated source. The methodologies used for the low flow dye trace test are described in detail below.

The locations listed below were used for injection of the dyes during the low stream flow dye trace test as shown in Figure 1:

1. Slab Cabin Run at Pine Grove Mills-Sulphorhodamine B (SRB) dye.
2. Musser Gap tributary stream at Route 45-Fluorescein dye.
3. Roaring Run below Shingletown Reservoir-Tinopal CBS-X (optical brightener).

These points were selected based on the known hydrology of the stream, the potential for dye interaction with the wellfields and monitoring points, and accessibility. The dyes used in this study (sulphorhodamine B, fluorescein, tinopal CBS-X) are among the most commonly used tracers and are safe for human and aquatic exposure at the concentrations to be used for this study. Five pounds of each dye was dissolved into five gallons of water and was directly poured into sinking streams (Slab Cabin Run and Roaring Run), and direct injection into the dry stream bed of ephemeral streams (Musser Gap tributary) followed by sufficient flushing (approximately 1000 gallons) for introduction into the watershed. Extreme caution was used to avoid any cross contamination of dyes at the different sampling points

while also making sure that personnel who added the dyes did not come in contact with any sampling equipment.

The locations and sampling interval for dye detection at each monitoring point is summarized below with time related to dye injection time. In addition a brief rationale for selection of each monitoring point is provided.

- Spring pool behind Watkins Dariette on Route 26/45 - Samples for sulphorhodamine B were collected every four hours for 24 hours and daily thereafter until dye concentration had dissipated. This location was selected to verify that the sinking portion of Slab Cabin Run in Pine Grove Mills does re-emerge here to ultimately provide most of Slab Cabin Run's flow.
- Slab Cabin Run near former Ferguson Township wastewater treatment plant - Samples for sulphorhodamine B were collected every four hours for 24 hours and daily thereafter until dye concentration had dissipated. This location was selected to verify that the sinking portion of Slab Cabin Run in Pine Grove Mills and behind Watkins Dariette does ultimately provide most of Slab Cabin Run's flow.
- Destiny Farm Spring (at junction of Routes 26 and 45) - Samples for sulphorhodamine B were collected every two days for eight days and weekly until the dye concentration had dissipated. This location was selected to determine if this spring emanates from where Slab Cabin Run sinks in Pine Grove Mills or is the groundwater discharge point for the portion of the groundwater basin that extends southwest, beyond Slab Cabin Run's surface drainage. If no dye was detected then it could be assumed that this water is from the extended groundwater basin, which does also provide significant perennial flow to Slab Cabin Run.
- Slab Cabin Run at Scott Road - Samples for sulphorhodamine B were collected every four hours for 24 hours and daily thereafter until dye concentration had dissipated. This location was selected to simulate the addition of Beneficial Reuse water to Slab Cabin Run via a wetland, which is proposed to occur in this general vicinity. Once sulphorhodamine B was detected from this location, the travel time to down stream receptors could be estimated.
- Well 11 in SCBWA Wellfield 1 (Thomas Wellfield) - Samples for sulphorhodamine B, fluorescein, and tinopal CBS-X were collected daily until dye was detected and daily thereafter until dye concentrations had dissipated. This location was selected to determine the travel time to Wellfield 1 from each of the dye injection points to better define the recharge area.
- Wellfield 25 in SCBWA Wellfield 3 (Harter Wellfield) - Samples for sulphorhodamine B, fluorescein, and tinopal CBS-X were collected daily until dye was detected and daily thereafter until dye concentrations had dissipated. This location was selected to determine the travel time to Wellfield 3 from each of the dye injection points to better define the recharge area.

- Slab Cabin Run across from the SCBWA Building - Samples for sulphorhodamine B, fluorescein, and tinopal CBS-X were collected daily until dye was detected and daily thereafter until dye concentrations had dissipated. This location was selected to determine the travel time from injection points to Slab Cabin Run in the vicinity of the wellfields.
- Slab Cabin Run at Atherton Street - Samples for sulphorhodamine B, fluorescein, and tinopal CBS-X were collected daily until dye was detected and daily thereafter until dye concentrations had dissipated. This location was selected to determine the travel time from injection points to Slab Cabin Run and if groundwater baseflow input occurs. This monitoring point went dry during the testing period and therefore was moved downstream to Slab Cabin Run Park.

In addition, samples were collected after the first significant rainfall that occurred once the dye concentration had significantly dissipated to determine if there was a spike in concentrations due to flushing of the aquifer system from rain.

2.2 Results

The low flow test commenced on November 9, 2005, when Slab Cabin Run was in a losing stream stage where it had a flow of approximately 300 gpm in Pine Grove Mills to almost no flow where it crosses under Atherton Street.

Sulphorhodamine B

Sulphorhodamine B had the most widespread occurrence of detections in the study, which was expected since it had been added to the uppermost portion of Slab Cabin Run. Figure 2 shows the concentration of sulphorhodamine B at each of the stream receptor locations in Slab Cabin Run and Figure 3 shows the concentration of sulphorhodamine B in Wells 11 and 25. Appendix A contains all of the dye trace data analytical results. Based on dye analytical results the following arrival times and estimated travel rates are provided for each location:

- Watkins Dariette: 20 hour dye arrival over a subsurface distance of 2600 feet (0.6 mi/day or 130 ft/hr),
- Slab Cabin Run near former Ferguson Twp. wastewater treatment plant: 24 hour dye arrival through combined subsurface and surface flow distance of 4,375 feet (0.83 mi/day or 182 ft/hr),
- Scott Road: 48 hour dye arrival primarily through surface flow distance of 7,900 feet (0.75 mi/day or 164 ft/hr),
- Slab Cabin Run across from SCBWA Building: 5-day dye arrival primarily through surface flow distance of 21,500 feet (0.81 mi/day or 180 ft/hr).

- SCBWA Wells 11 and 25 each had sulphorhodamine B detections after 5 days, indicating that the dye migrated to these wells at a rate similar to its arrival at Slab Cabin Run across from SCBWA Building.

The presence of sulphorhodamine B in Wells 11 and 25 indicates that both wells are under the influence of surface water from Slab Cabin Run. Well 25's maximum sulphorhodamine B concentrations were significantly higher than Well 11's (82 ppb/day compared to 1 ppb/day), suggesting that Well 25 has an enhanced surface connection to Slab Cabin Run during lower stream stages. The sulphorhodamine B travel time to Wellfields 1 and 3 from the proposed Beneficial Reuse recharge area near Rt. 26/45 junction is approximately 3 days based on the dye trace study results at this low stream stage. No dye was detected in the spring on the Destiny Farm, indicating that this spring is likely recharged from the portion of the groundwater basin that extends beyond the Slab Cabin Run surface water basin. The dye trace results indicate the rapidity with which surface contaminants such as fuel or chemical spills, fertilizers, road salts, etc., can move through the aquifer into the drinking water supply. The dye also moved though the system quite rapidly, flushing out to negligible levels within approximately four weeks. It should be noted that the amount of sulphorhodamine B used during this test (five pounds) caused Slab Cabin Run's to be red for approximately four days until the dye flushed through the system.

Fluorescein

Fluorescein was added to the Slab Cabin Run watershed via flushing five gallons of the dye into the dry streambed of Musser Gap with approximately 1,000 gallons of water. This dye arrived in Wells 11 and 25 between days 20 and 28 at similar concentrations (0.76 ppb/day and 0.56 ppb/day), but was detected in Slab Cabin after 13 days at a concentration of 1 ppb/day. The approximate travel rate of fluorescein to Slab Cabin Run in the vicinity of the wellfields was 675 ft/day via a combination of subsurface and surface flow. Figure 4 shows the fluorescein concentrations for Wells 11 and 25 and Slab Cabin Run. It is suspected that the fluorescein emanated from a series of springs on the Windy Hill Farm property, which flow directly to Slab Cabin Run. It is also possible that a portion of the fluorescein remained underground and was then intercepted by Wells 11 and 25, which could explain the delayed detection in these wells along with their similar dye concentrations. The travel rate of the fluorescein to Wells 11 and 25 is approximately 315 ft/day, assuming that it took 28 days to reach these wells.

Tinopal CBS-X

Tinopal CBS-X (a.k.a. optical brightener) was added to Roaring Run just upstream from where this stream typically sinks, approximately 1,800 feet upstream (south) from where Roaring Run crosses under Route 45. Roaring Run flows adjacent to Wellfield 3, therefore it was suspected that this dye would show up in Well 25

relatively rapidly. Surprisingly, the tinopal CBS-X did not show up in Well 25 until 128 days after it had been added to the watershed, for a calculated travel rate of 33 ft/day. Tinopal CBS-X concentrations in Well 25 had dissipated to background concentrations after 142 days, therefore taking approximately two weeks to move through the aquifer in the vicinity of Well 25. Blue Spring in Boalsburg had low concentrations (0.55-0.65 ppb/day) of tinopal CBS-X after 84 days, for an estimated travel rate of 108 ft/day. Figure 5 shows the tinopal CBS-X concentrations for Well 25 and Blue Spring. Based on the known direction of bedrock strike and the aquifer's strike parallel anisotropy, it is feasible that the tinopal CBS-X could have moved along bedrock strike to reach Blue Spring. Tinopal CBS-X does appear to have a detection lag time compared to other dyes, which could be attributed to it's affinity to adsorb to the aquifer matrix based on personal communication with Adam Coffman, Lab Manager, Crawford Hydrology Lab. Therefore, some of the dye arrival delay could be attributed to this, however the dye arrivals are still relatively slow as compared to the travel rates of the other dyes. One complicating factor is the potential background concentrations of tinopal CBS-X, because it is found in many laundry detergents and therefore could originate from the on-lot septic systems that exist in the Shingletown/Roaring Run area and in the residential area upgradient from Blue Spring in Boalsburg.

Slab Cabin Run Dye Trace Study Report
Section 3
Average Stream Flow Dye Trace Study

This section of the report describes the methods utilized to conduct the average stream flow dye trace testing. As previously stated, there were two dye trace studies conducted by introducing dyes into the headwaters of Slab Cabin Run and its tributaries. Similar methods were used during each test, with the only modifications including the location of dye injection and monitoring points. The average stream flow dye trace study commenced on December 7, 2006, and was conducted when Slab Cabin Run was at average stream flow levels under gaining stream conditions with 900 gpm of flow in Pine Grove Mills and 3,450 gpm where it crosses under Atherton Street. Roaring Run was also flowing during this test with measured flows of 1,850 gpm where the dye was added (see Figure 6 for location), 950 gpm where it crosses under Route 45, and 650 gpm at its confluence with Slab Cabin Run, indicating that it was under losing stream conditions during the initiation of the test.

3.1 Methods

The Crawford Hydrology Laboratory at Western Kentucky University was utilized for the second dye trace test and background testing was conducted using the same methods and analyses as the initial dye tracing test. The same three dyes were used during this average stream flow dye test, however the dyes were switched around at each injection location as shown on Figure 6 and described below:

1. Slab Cabin Run at Pine Grove Mills- Tinopal CBS-X (optical brightener).
2. Musser Gap tributary stream at Route 45- Sulphorhodamine B (SRB) dye.
3. Roaring Run below Shingletown Reservoir- Fluorescein dye.

Less dye was used during this test to minimize any stream discoloration impacts. Approximately 2.5 pounds of tinopal CBS-X and sulphorhodamine B dye were dissolved into 2.5 gallons of water and were directly poured into sinking streams at each location on December 7, 2006. Approximately 1.75 pounds of fluorescein dye were dissolved in 1.75 gallons of water and slowly released via drip flow during December 7-11, 2006, in an effort to minimize stream discoloration. The locations and sampling intervals for dye detection at each monitoring point is summarized below. In addition a brief rationale for selection of each monitoring point is provided.

- Slab Cabin Run at Scott Road: Samples were collected daily and analyzed for tinopal CBS-X for one week, and then weekly until the dye concentration had dissipated. This location was selected to simulate the addition of Beneficial Reuse water to Slab Cabin Run via a wetland, which is proposed to occur in this

general vicinity. Once tinopal CBS-X is detected from this location, the travel time to downstream receptors can be estimated.

- Two Springs at Windy Hill Farm (along Route 45): Samples were collected weekly for fluorescein and tinopal CBS-X for four weeks. Thereafter, monthly sampling and analysis was conducted until the dye concentration had dissipated. These locations were selected to determine if these springs are recharged from Musser Gap.
- Well 11 in SCBWA Wellfield 1 (Thomas Wellfield): Samples were collected daily and analyzed for sulphurhodamine B, fluorescein, and tinopal CBS-X until dye was detected, and sampling and analysis continued weekly thereafter until the dye concentrations had significantly dissipated. This location was selected to determine the travel time to SCBWA Well 11 from each of the dye injection points.
- Wellfield 25 in SCBWA Wellfield 3 (Harter Wellfield): Samples were collected daily and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X until dye was detected, and sampling and analysis continued weekly thereafter until the dye concentrations had significantly dissipated. This location was selected to determine the travel time to SCBWA Well 25 from each of the dye injection points.
- Slab Cabin Run across from SCWA Building: Samples were collected daily and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X until dye was detected, and sampling and analysis continued weekly thereafter until dye concentrations had significantly dissipated. This location was selected to determine the travel time from injection points to Slab Cabin Run in the vicinity of the wellfields.
- Slab Cabin Run near Centre Hills Country Club: Samples were collected daily and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X until dye was detected, and sampling and analysis continued weekly thereafter until dye concentrations had significantly dissipated. This location was selected to determine the travel time from injection points to Slab Cabin Run in the vicinity of proposed Beneficial Reuse wetland and irrigation areas.
- Blue Spring in Boalsburg: Samples were collected monthly and analyzed for fluorescein until dye concentrations had dissipated. This location was selected to determine if Blue Spring receives any recharge from Roaring Run.
- Slab Cabin Run at Spring Creek Park: Samples were collected every two days for one week and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X, and sampling and analysis continued weekly thereafter until dye concentrations had dissipated. This location was selected to determine if dye in Slab Cabin Run would be detected in CTWA and PSU Wells.
- CTWA Spring Creek Park Well: Samples were collected every two days for two weeks and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X, and sampling and analysis continued weekly thereafter until dye concentrations had

dissipated. This location was selected to determine if dye in Slab Cabin Run is found in the CTWA Well.

- CTWA Shiloh Road Well: Samples were collected monthly and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X. This location was selected to determine if dye in Slab Cabin Run and Spring Creek is found in this well.
- Spring Creek near PSU Well 33: Samples were collected every two days for two weeks and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X, and sampling and analysis continued weekly thereafter until dye concentrations had dissipated. This location was selected to determine the travel time of dye to this section of Spring Creek and to determine if the dye was detected in PSU Well 33.
- PSU Well 33 (Houserville): Samples were collected every two days for two weeks and analyzed for sulphorhodamine B, fluorescein, and tinopal CBS-X, and sampling and analysis continued weekly thereafter until dye concentrations had dissipated. This location was selected to determine if dye in this section of Spring Creek could be detected in PSU Well 33.

3.2 Results

Sulphorhodamine B

Sulphorhodamine B had widespread detections in all surface water monitoring points on Slab Cabin Run and Spring Creek downstream from Musser Gap. The only groundwater monitoring point with sulphorhodamine B detections was SCBWA Well 11. Figure 7 shows the concentration of sulphorhodamine B at each of the stream and spring receptor locations and Figure 8 shows the concentration of sulphorhodamine B in Well 11. Appendix B contains all of the dye trace data analytical results. Based on dye analytical results the following arrival times and estimated travel rates are provided for each location:

- Windy Hill Springs 1 and 2: Both of these springs had strong sulphorhodamine B detections after one week, however it is apparent that the dye was present in one day or less since it was detected in downstream locations within one day. The estimated rate of travel through the subsurface to these springs is on the order of 1,000 feet per day (0.19 mi/day or 40 ft/hr) assuming a travel time of 1 day.
- Slab Cabin Run across from SCBWA Building: Sulphorhodamine B detection after 1-day through both subsurface and surface flow distance of 8,800 feet (1.6 mi/day or 370 ft/hr).
- SCBWA Well 11: Sulphorhodamine B detection after 2 days through both subsurface and surface flow distance of 6,750 feet (0.64 mi/day or 140 ft/hr).
- Slab Cabin Run at Centre Hills County Club: Sulphorhodamine B detection after 1 day through both subsurface and surface flow distance of 15,300 feet (2.89 mi/day or 640 ft/hr).

- Slab Cabin Run in Spring Creek Park: Sulphorhodamine B detection after 2 days through both subsurface and surface flow distance of 23,400 feet (2.2 mi/day or 490 ft/hr).
- Spring Creek: Sulphorhodamine B detection after 2 days through both subsurface and surface flow distance of 24,750 feet (2.3 mi/day or 515 ft/hr).

The presence of sulphorhodamine B in Well 11 indicates this well is under the influence of surface water from Slab Cabin Run, which is consistent with the previous dye trace testing results. No other monitored wells, including SCBWA Well 25, PSU Well 33, nor either of the CTWA wells had any detections of sulphorhodamine B concentrations above background levels, indicating they are not being recharged from surface water at average stream flow levels. This indicates that SCBWA Well 25 does not receive recharge from Slab Cabin Run at average stream flow levels, however it did during the low stream flow dye trace test when it induced flow from Slab Cabin Run. One domestic well adjacent to Musser Gap (Tennis residence) reported red water from their well for several days. This well was several hundred feet southwest (upgradient) from where the dye was injected, but could have been drawn to the well via pumping or from advection of the dye. The dye trace results indicate the rapidity with which surface contaminants such as fuel or chemical spills, fertilizers, road salts, etc., can move through the aquifer into the drinking water supply. The dye was still detectable in trace concentrations after nearly 90 days in many locations, indicating that residual concentrations of contaminants may persist for long periods of time in the aquifer. This is further corroborated by the presence of fluorescein in the background samples from Windy Hill Springs from the initial dye trace test 13 months ago.

Fluorescein

Fluorescein was added to Roaring Run in an area where the stream was losing flow to the subsurface, as a means to introduce the dye to the aquifer. Figure 9 shows the concentration of fluorescein in Roaring Run near Well 25 and Figure 10 shows the concentration of fluorescein at all other detected locations. Based on dye analytical results the following arrival times and estimated travel rates are provided for each location:

- Roaring Run near Well 25 across from SCBWA Building: Fluorescein detection after 1-day through surface flow distance of 5,800 feet (1.1 mi/day or 240 ft/hr).
- SCBWA Well 25: Fluorescein detection after 1 day through both subsurface and surface flow distance of 5,800 feet (1.1 mi/day or 240 ft/hr).
- Slab Cabin Run at Centre Hills County Club: Fluorescein detection after 1 day through surface flow distance of 13,500 feet (2.55 mi/day or 560 ft/hr).
- Slab Cabin Run in Spring Creek Park: Fluorescein detection after 2 days through surface flow distance of 22,500 feet (2.1 mi/day or 470 ft/hr).

- Spring Creek: Fluorescein detection after 2 days through surface flow distance of 24,300 feet (2.3 mi/day or 510 ft/hr).
- Blue Spring: Fluorescein detection after 29 days primarily through subsurface flow distance of 8,300 feet (0.05 mi/day or 12 ft/hr). In this case the dye likely showed up sooner than 29 days, so these are low estimates of the actual rate of dye flow.

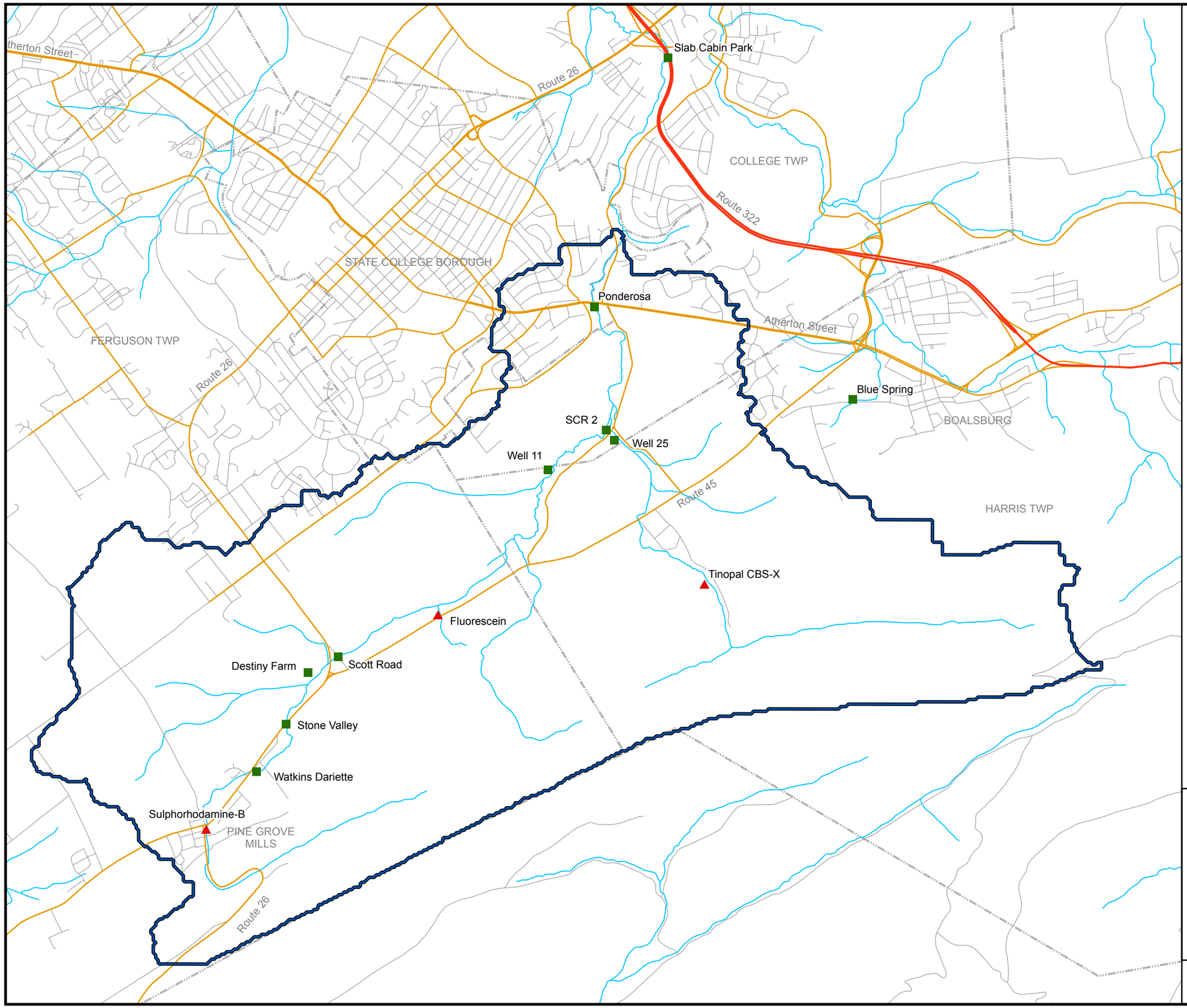
The presence of fluorescein in Well 25 indicates this well is under the influence of surface water from Roaring Run and induces recharge from Roaring Run to the well under these flow conditions. No other monitored wells, including SCBWA Well 11, PSU Well 33, nor either of the CTWA wells had any detections of fluorescein concentrations above background levels, again indicating they are not being recharged from surface water at average stream flow levels. The presence of fluorescein in Blue Spring confirms the previous Tinopal CBS-X detection in the spring during the low flow test and also demonstrates the significance of strike-parallel groundwater flow, where groundwater flow is regionally from southwest to northeast.

Tinopal CBS-X

Tinopal CBS-X (a.k.a. optical brightener) was added to Slab Cabin in Pine Grove Mills just upstream from where this stream typically sinks, approximately 200 feet downstream from where it crosses under Route 45. Figure 10 shows the tinopal CBS-X concentrations in the monitoring points where it was detected, which were all surface water monitoring points as summarized below.

- Slab Cabin Run at Scott Road: Tinopal CBS-X detection after 1 day through both subsurface and surface flow distance of 7,650 feet (1.4 mi/day or 320 ft/hr).
- Slab Cabin Run across from SCBWA Building: Tinopal CBS-X detection after 2 days through both subsurface and surface flow distance of 19,800 feet (1.9 mi/day or 410 ft/hr).
- Slab Cabin Run at Centre Hills County Club: Tinopal CBS-X detection after 2 days through both subsurface and surface flow distance of 25,650 feet (2.4 mi/day or 530 ft/hr).
- Slab Cabin Run in Spring Creek Park: Tinopal CBS-X detection after 4 days primarily through surface flow distance of 33,300 feet (1.6 mi/day or 350 ft/hr).

The fact that tinopal CBS-X did not appear in Well 11 may be due to its affinity to adsorb to the aquifer matrix based on personal communication with Adam Coffman, Lab Manager, Crawford Hydrology Lab. This is consistent with the significant decrease in concentrations as is moved downstream through the watershed to the point that low concentrations were detected at the lower end of Slab Cabin Run and it was not detectable in Spring Creek. Tinopal CBS-X was not detected in any other wells.



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Dye Test Location

- Injection
- Receptor
- Upper Slab Cabin Watershed
- Highway
- State Road
- Local Road
- Municipality Boundary
- Stream

Notes:

1. Map displayed in the Pennsylvania State Plane North Coordinate System, US Survey Feet, North American Datum of 1983 (NAD83).
2. Road data and municipality boundaries derived from shapefiles created by the Pennsylvania Department of Transportation, Harrisburg, PA, 2006.

0 1,750 3,500 7,000

Feet

FIGURE 1

Dye Trace Study Injection and Monitoring Point Map During the Low Stream Flow Test

State College Borough Water Authority,
State College, Pennsylvania

N.A. Water Systems

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Figure 2-Sulphorhodamine B Concentrations in Slab Cabin Run Stream Receptors During the Low Stream Flow Test

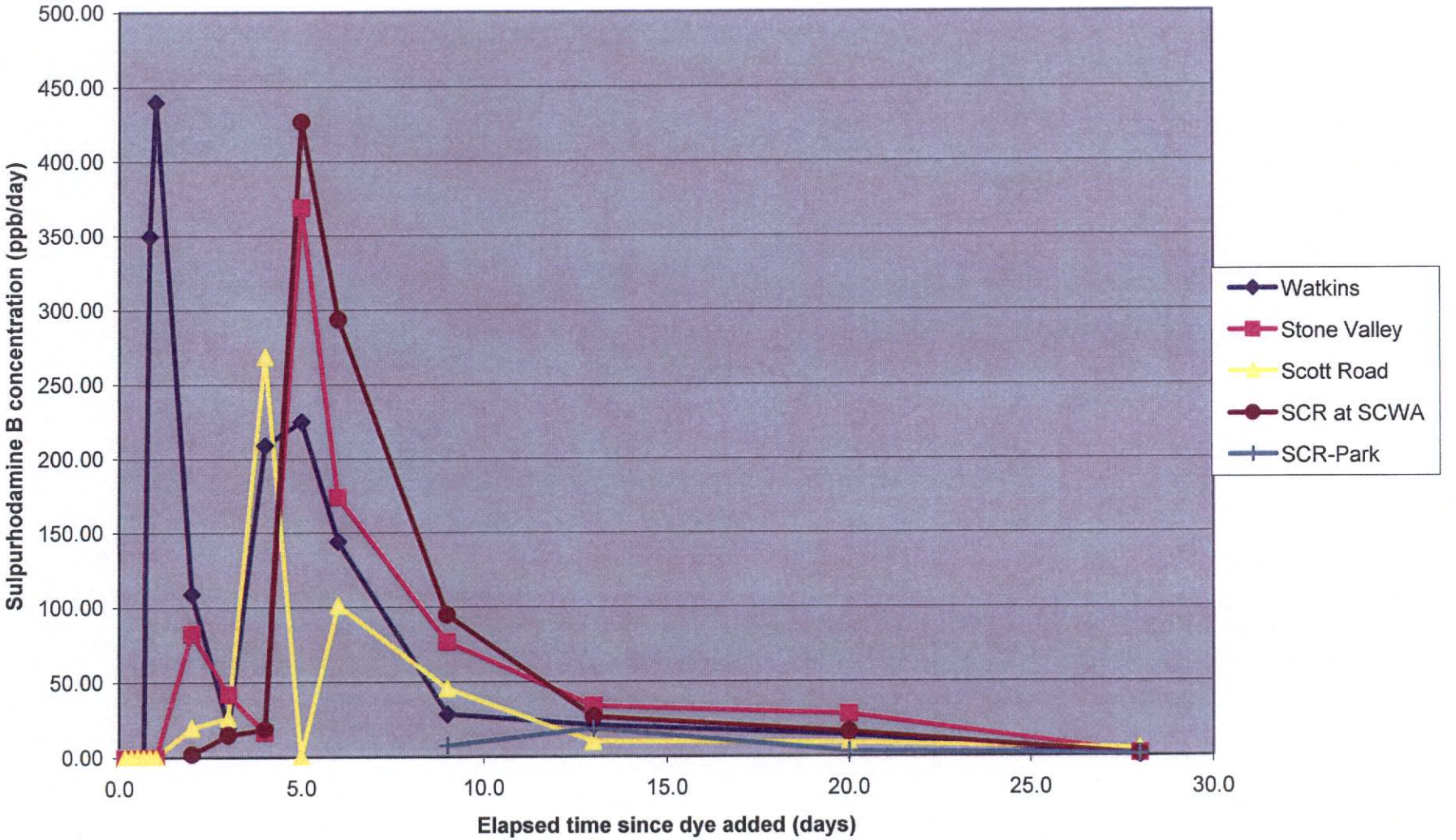


Figure 3-Sulphorhodamine B Concentrations in Wells 11, 25 and Adjacent Slab Cabin Run Receptor Locations During the Low Stream Flow Test

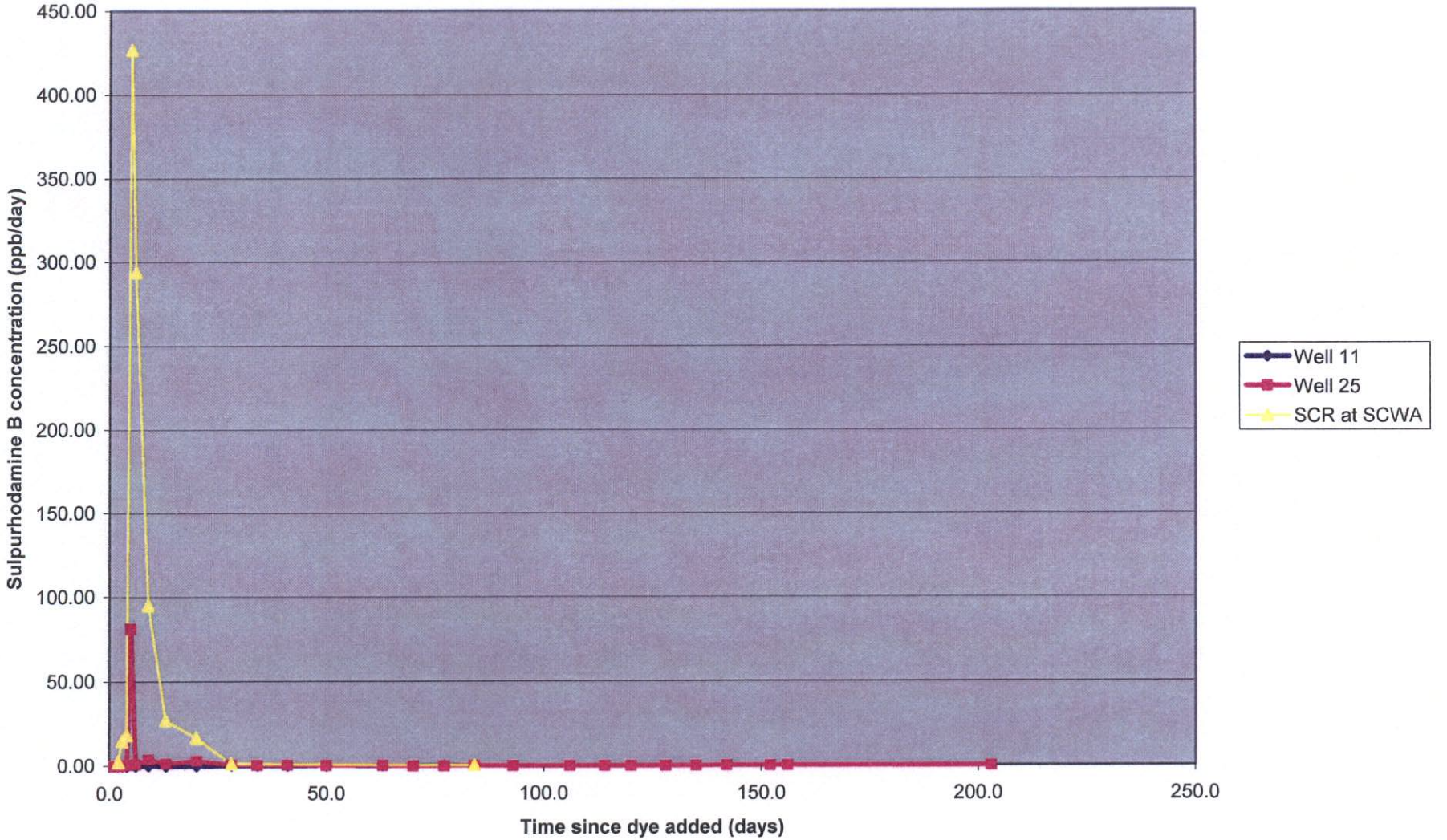


Figure 4-Fluorescein Concentrations in Wells 11, 25 and Adjacent Slab Cabin Run Receptor Locations During the Low Stream Flow Test

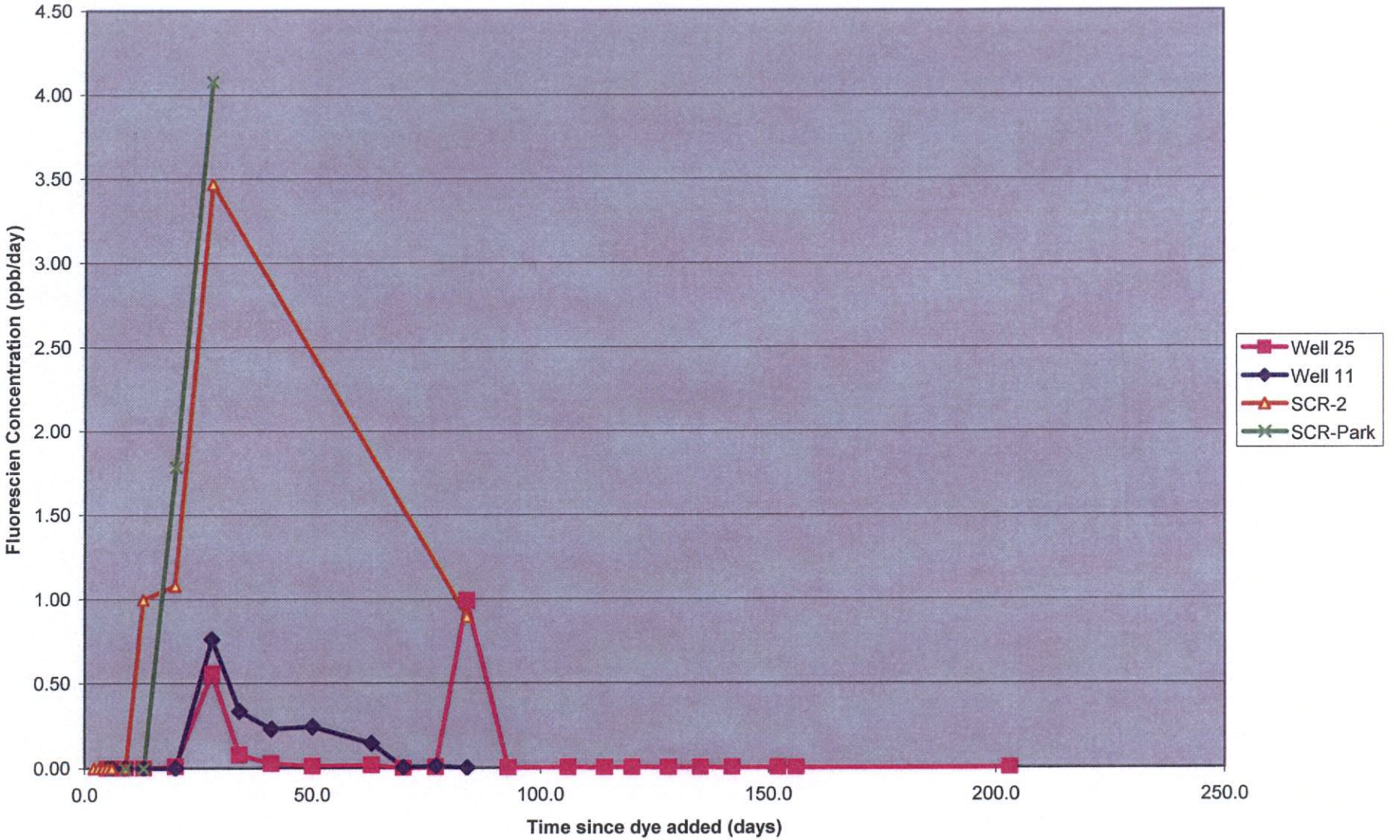
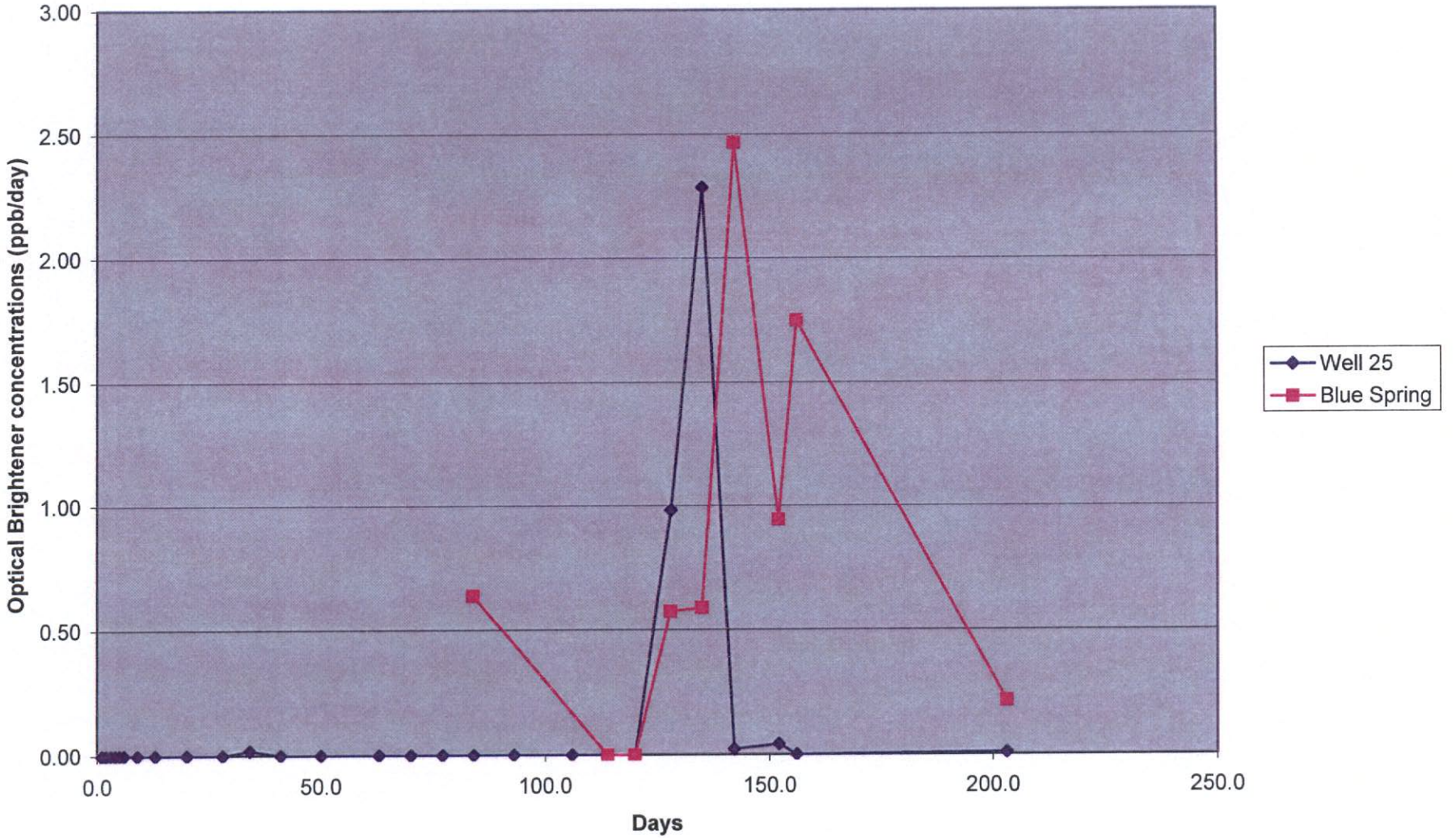
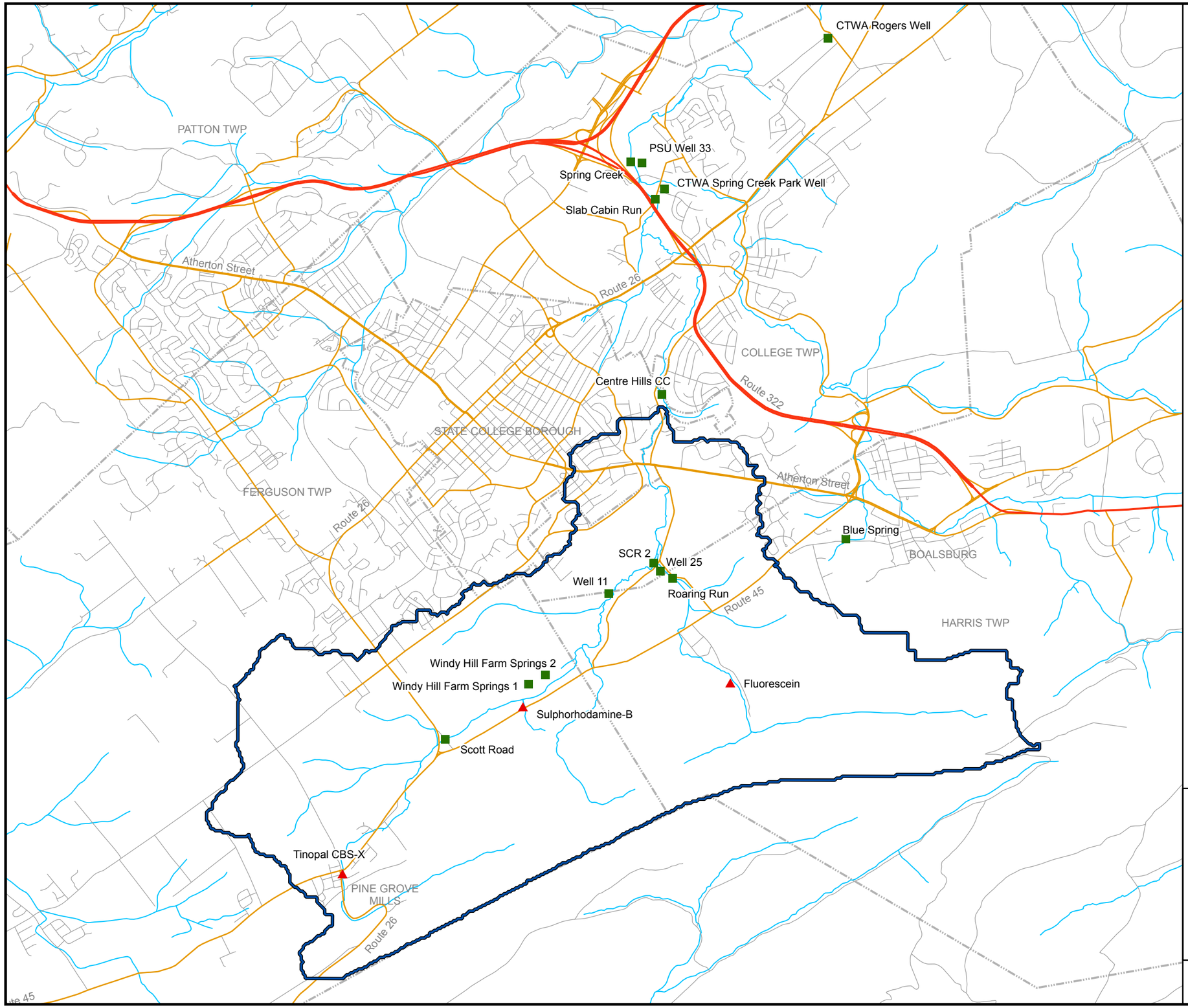


Figure 5-Tinopal CBS-X in Well 25 and Blue Spring During the Low Stream Flow Test





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Dye Test Location

- Injection
- Receptor
- Upper Slab Cabin Watershed
- Highway
- State Road
- Local Road
- Municipality Boundary
- Stream

Notes:

1. Map displayed in the Pennsylvania State Plane North Coordinate System, US Survey Feet, North American Datum of 1983 (NAD83).
2. Road data and municipality boundaries derived from shapefiles created by the Pennsylvania Department of Transportation, Harrisburg, PA, 2006.

0 2,250 4,500 9,000

Feet

FIGURE 6

Dye Trace Study Injection and Monitoring Point Map During the Average Stream Flow Test

State College Borough Water Authority, State College, Pennsylvania

N.A. Water Systems

Z:\databases\scwa\gisdata\arcmap_doc\2006\56002690-047.mxd; June 14, 2007

Figure 7-Sulphorhodamine B Concentrations in Slab Cabin Run Stream Receptors During the Average Stream Flow Test

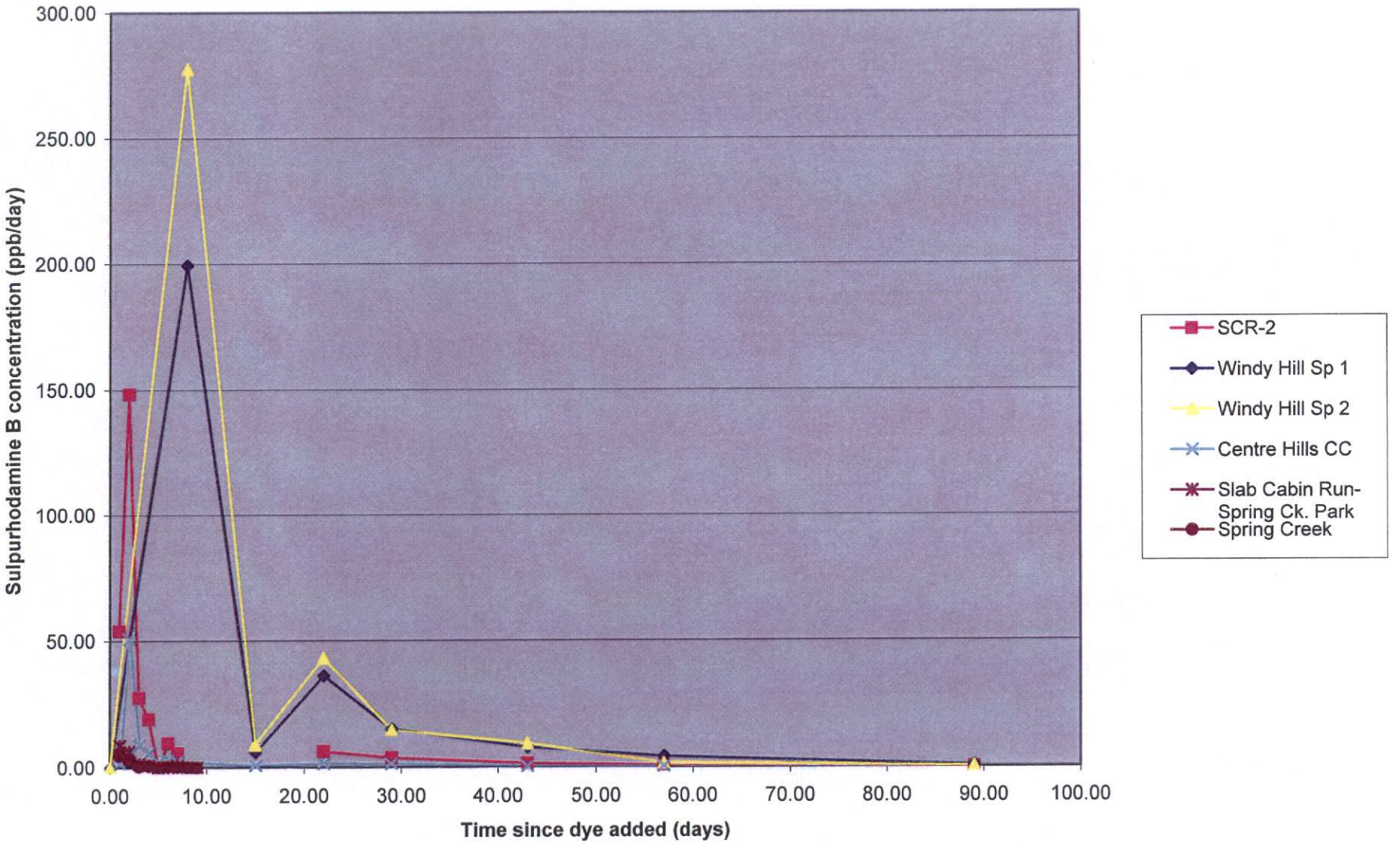


Figure 8-Sulphorhodamine B Concentrations in Well 11 During the Average Stream Flow Test

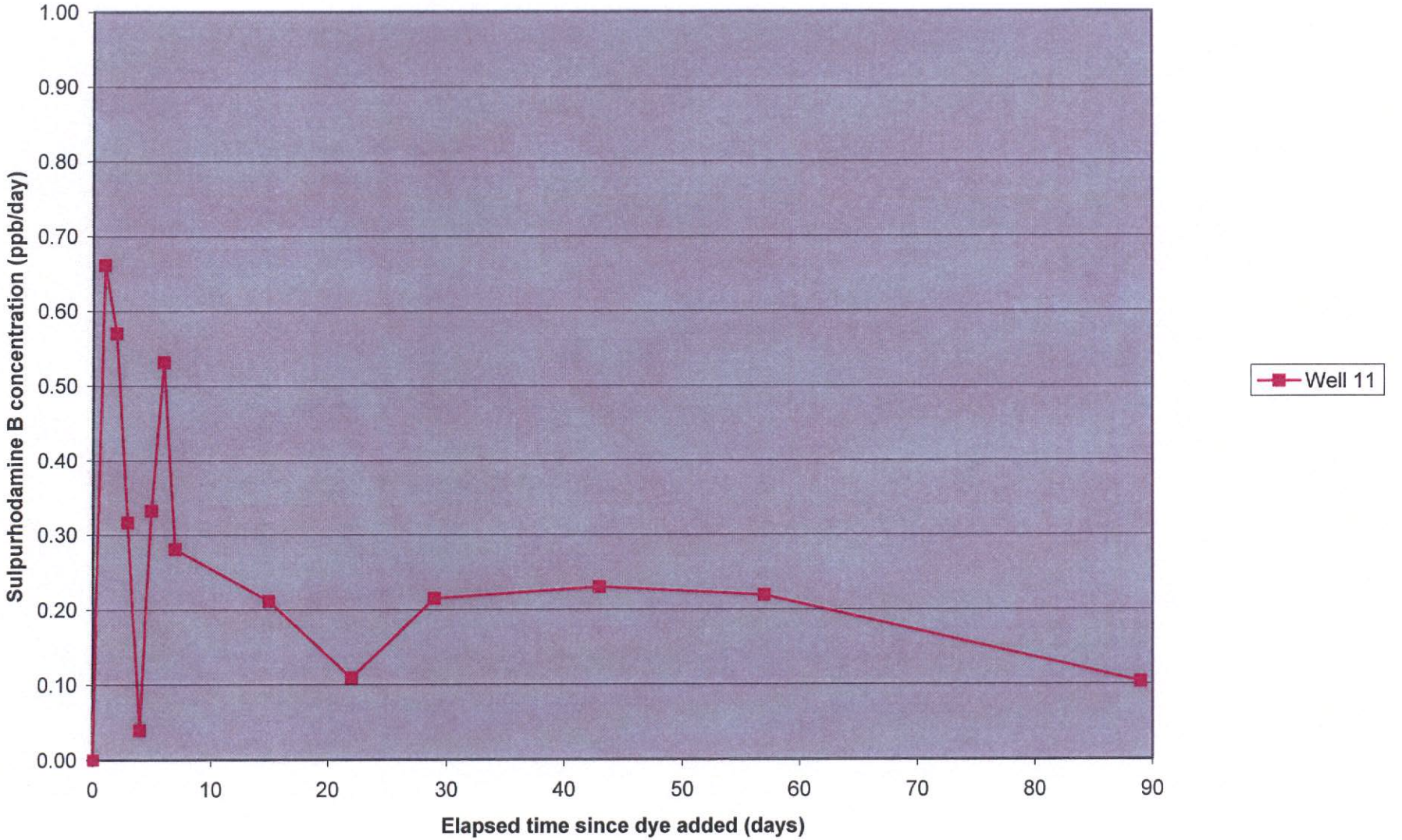


Figure 9-Fluorescein Concentrations in Roaring Run Adjacent to Well 25 During the Average Stream Flow Test

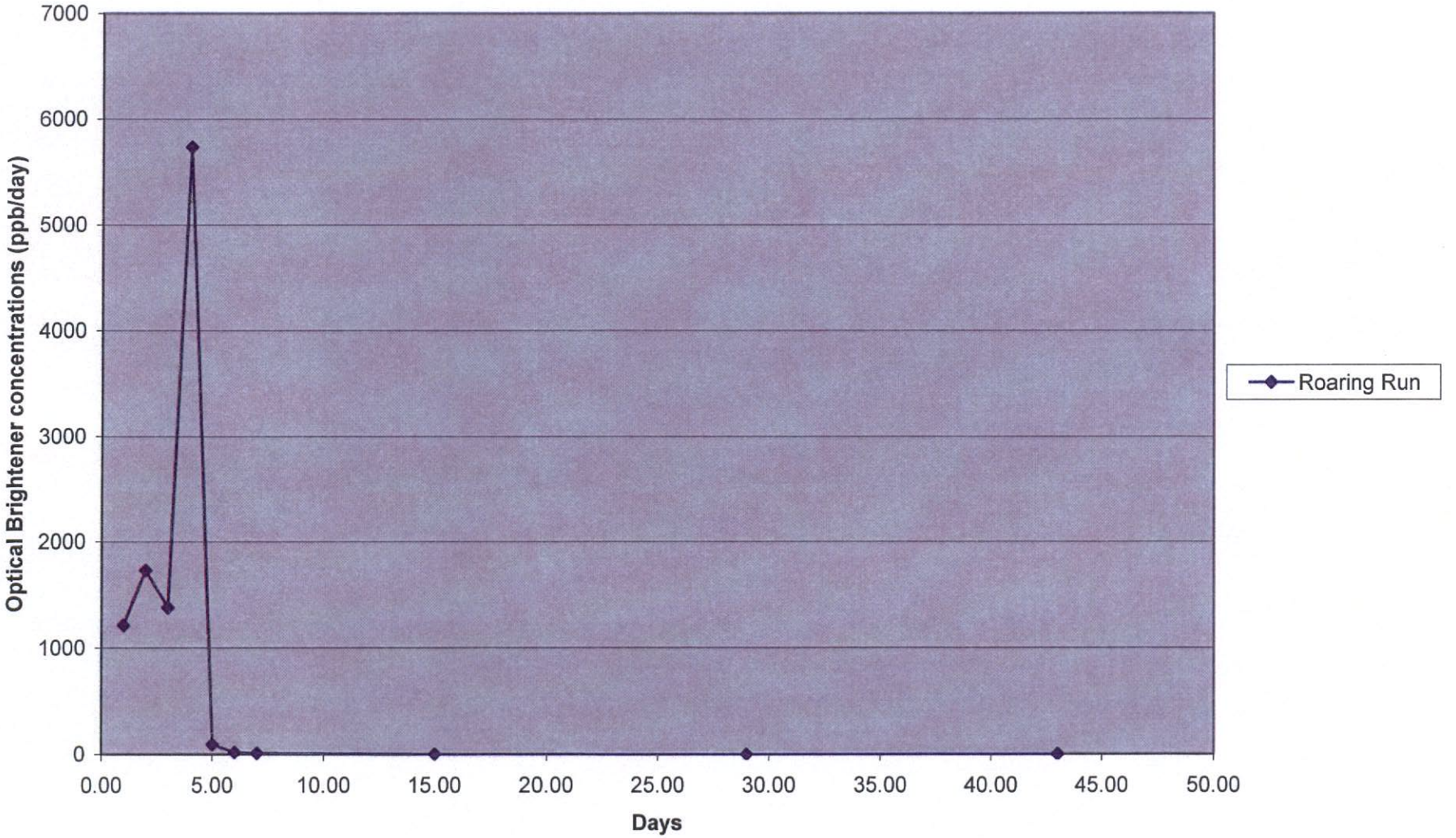


Figure 10-Tinopal CBS-X Concentrations in Monitoring Point Locations During the Average Stream Flow Test

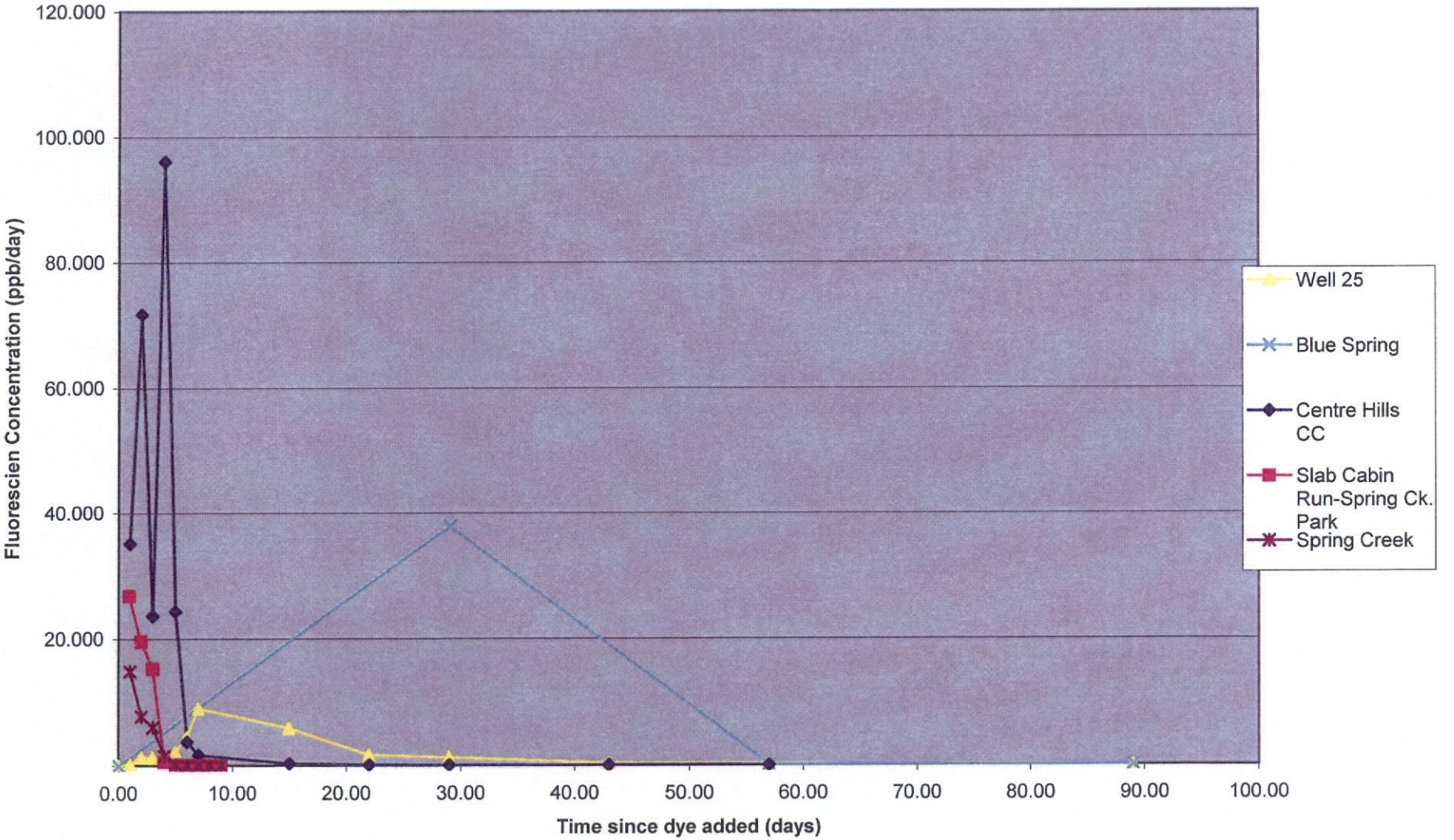
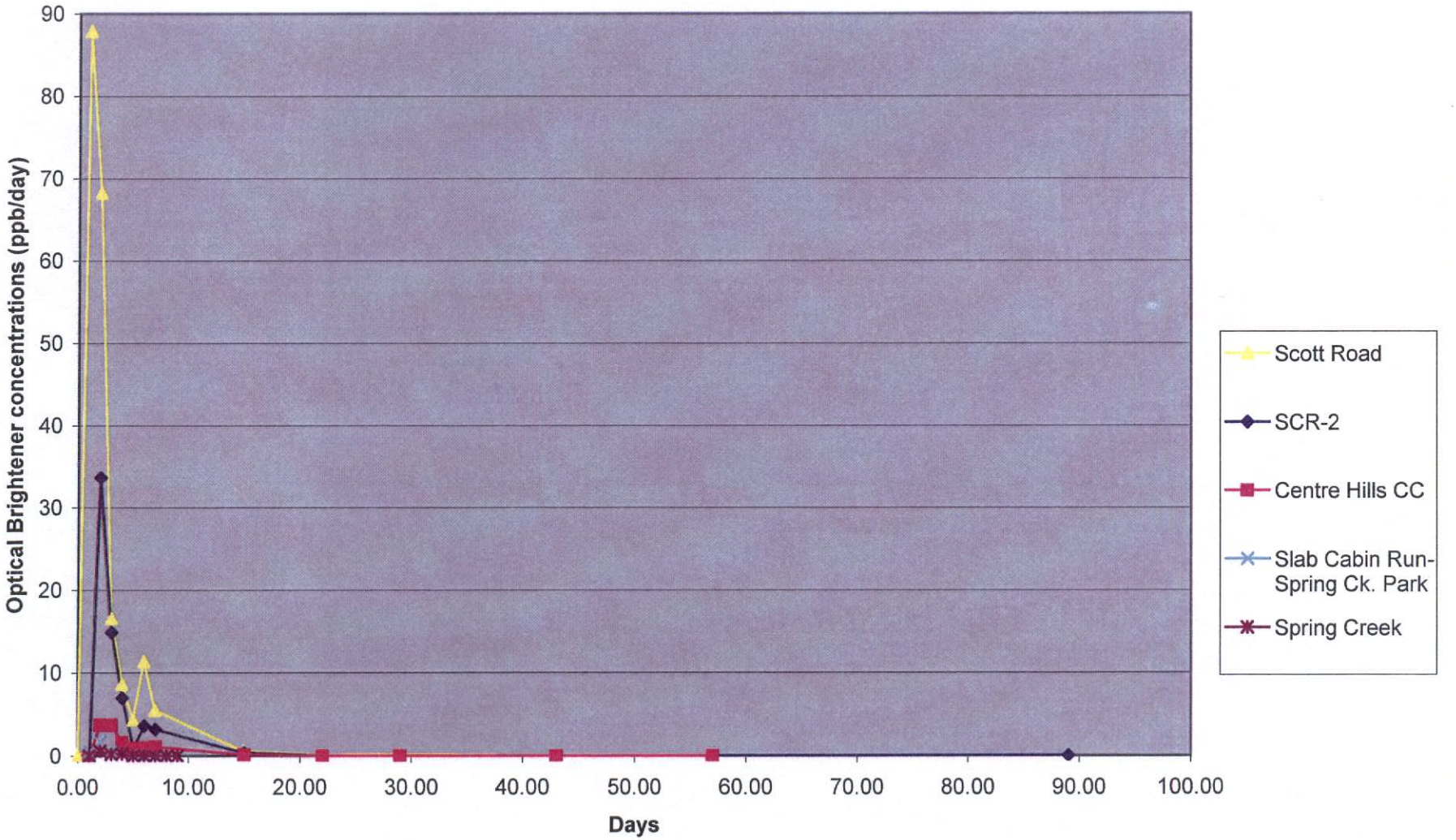


Figure 11. Optical Brightener Concentrations in Monitoring Points



Appendix A
Dye Trace Laboratory Reports and Normalized Dye Trace Data for the Low Stream Flow Dye Trace Test

Crawford Hydrology Lab * Center for Cave and Karst Studies

Western Kentucky University
Bowling Green, KY 42101
(270) 745-9224
E-mail: caveandkarst@wku.edu

* *Hydrogeologists, Geologists, Environmental Scientists* * *Karst Geophysical Subsurface Investigations*
* *Karst Groundwater Investigations* * *Fluorescent Dye Analysis*

LABORATORY REPORT SHEET

FLUORIMETRIC ANALYSIS RESULTS

Slab Cabin Run

Analysis requested by:

David Yoxtheimer @ N.A. Water Systems

TINOPAL CBS-X	FLUORESCEIN	EOSINE	FD&C Red #3	D&C Red #28	SULPHORHODAMINE B
Fabric Brightening Agent 351	Color Index: Acid Yellow 73	Color Index: Acid Red 87	Color Index: Food Red 14	Color Index: Acid Red 92	Color Index: Acid Red 52
Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal
Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer

CHARCOAL AND WATER SAMPLES

Code Number	Event	Date Collected	Feature Name	Peakfit	Comment	TINOPAL CBS-X Results	TINOPAL CBS-X Conc in ppb	FLUORESCEIN Results	FLUORESCEIN Conc in ppb	EOSINE Results	EOSINE Conc in ppb	FD&C RED #3 Results	FD&C RED #3 Conc in ppb	D&C Red #28 Results	D&C Red #28 Conc in ppb	SULPHORHODAMINE B Results	SULPHORHODAMINE B Conc in ppb
001-0	01	10/26/2005	WATKINS			ND		ND								ND	
001-0	02	11/2/2005	WATKINS			ND			0.011							ND	
001-0	03	11/9/2005	WATKINS													ND	
001-0	04	11/9/2005	WATKINS													ND	
001-0	05	11/9/2005	WATKINS													B	0.005
001-0	06	11/10/2005	WATKINS													+++	58.307
001-0	07	11/10/2005	WATKINS													+++	440.073
001-0	08	11/10/2005	WATKINS													+++	109.138
001-0	09	11/11/2005	WATKINS		DL											+++	20.381
001-0	10	11/12/2005	WATKINS		DL											+++	209.338
001-0	11	11/13/2005	WATKINS													+++	225.322
001-0	12	11/14/2005	WATKINS													+++	144.346
001-0	13	11/15/2005	WATKINS													+++	86.386
001-0	14	11/18/2005	WATKINS													+++	85.688
001-0	15	11/22/2005	WATKINS													+++	101.333
001-0	16	12/5/2005	WATKINS													++	4.680
001-0	17	12/7/2005	WATKINS														
001-0	18	12/13/2005	WATKINS		ns												
001-0	19	12/20/2005	WATKINS		ns												
001-0	20	12/29/2005	WATKINS		ns												
001-0	21	1/11/2006	WATKINS		ns												
002-0	01	10/26/2005	STONE VALLEY				0.564		0.036							ND	
002-0	02	11/2/2005	STONE VALLEY			ND			0.011							ND	

ND Below Quantitation Limit
B Background
NS No Sample

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/11/2007

CHARCOAL AND WATER SAMPLES

Code Number	Event	Date Collected	Feature Name	Peakfit	Comment	TINOPAL CBS-X		FLUORESCEIN		EOSINE		FD&C RED #3		D&C Red #28		SULPHORHODAMINE B	
						Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb
002-0	03	11/9/2005	STONE VALLEY													ND	
002-0	04	11/9/2005	STONE VALLEY													ND	
002-0	05	11/9/2005	STONE VALLEY													ND	
002-0	06	11/10/2005	STONE VALLEY													ND	
002-0	07	11/10/2005	STONE VALLEY													ND	
002-0	08	11/10/2005	STONE VALLEY													+	0.117
002-0	09	11/11/2005	STONE VALLEY		DL											+++	82.658
002-0	10	11/12/2005	STONE VALLEY		DL											+++	42.088
002-0	11	11/13/2005	STONE VALLEY		DL											+++	16.976
002-0	12	11/14/2005	STONE VALLEY													+++	369.253
002-0	13	11/15/2005	STONE VALLEY													+++	174.235
002-0	14	11/18/2005	STONE VALLEY													+++	230.491
002-0	15	11/22/2005	STONE VALLEY													+++	137.066
002-0	16	12/5/2005	STONE VALLEY													+++	199.769
002-0	17	12/7/2005	STONE VALLEY													+++	16.079
002-0	18	12/13/2005	STONE VALLEY		ns												
002-0	19	12/20/2005	STONE VALLEY		ns												
002-0	20	12/29/2005	STONE VALLEY		ns												
002-0	21	1/11/2006	STONE VALLEY		ns												
003-0	01	10/26/2005	DESTINY FARM			ND			0.017							ND	
003-0	02	11/2/2005	DESTINY FARM			ND			0.011							ND	
003-0	09	11/11/2005	DESTINY FARM													ND	
003-0	11	11/13/2005	DESTINY FARM													+?	268.399
003-0	13	11/15/2005	DESTINY FARM													ND	
003-0	14	11/18/2005	DESTINY FARM													ND	
003-0	15	11/22/2005	DR.002.0.SS													ND	
003-0	16	12/5/2005	DR.002.0.SS			ND		ND								ND	
003-0	17	12/7/2005	DR.002.0.SS			B	0.256									ND	
003-0	18	12/13/2005	DR.002.0.SS		ns												
003-0	19	12/20/2005	DR.002.0.SS		ns												
003-0	20	12/29/2005	DR.002.0.SS		ns												
003-0	21	1/11/2006	DR.002.0.SS		ns												
004-0	01	10/26/2005	SCOTT ROAD			ND		ND								ND	
004-0	02	11/2/2005	SCOTT ROAD			ND										ND	
004-0	03	11/10/2005	SCOTT ROAD													ND	

ND Below Quantitation Limit
B Background
NS No Sample

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/11/2007

CHARCOAL AND WATER SAMPLES

Code Number	Event	Date Collected	Feature Name	Peakfit	Comment	TINOPAL CBS-X		FLUORESCEIN		EOSINE		FD&C RED #3		D&C Red #28		SULPHORHODAMINE B	
						Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb
004-0	04	11/10/2005	SCOTT ROAD													ND	
004-0	05	11/10/2005	SCOTT ROAD													ND	
004-0	06	11/10/2005	SCOTT ROAD													ND	
004-0	07	11/10/2005	SCOTT ROAD													ND	
004-0	08	11/10/2005	SCOTT ROAD													ND	
004-0	09	11/11/2005	SCOTT ROAD		DL											+++	19.461
004-0	10	11/12/2005	SCOTT ROAD		DL											+++	26.162
004-0	11	11/13/2005	SCOTT ROAD													ND	
004-0	12	11/14/2005	SCOTT ROAD													B	0.046
004-0	13	11/15/2005	SCOTT ROAD													+++	101.068
004-0	14	11/18/2005	SCOTT ROAD													+++	136.046
004-0	15	11/22/2005	SCOTT ROAD													+++	40.156
004-0	16	12/5/2005	SCOTT ROAD			ND		ND								+++	62.606
004-0	17	12/7/2005	SCOTT ROAD		ns											+++	40.156
004-0	18	12/13/2005	SCOTT ROAD		ns												
004-0	19	12/20/2005	SCOTT ROAD		ns												
004-0	20	12/29/2005	SCOTT ROAD		ns												
004-0	21	1/11/2006	SCOTT ROAD		ns												
005-0	01	10/26/2005	WELL 11			ND			0.026							ND	
005-0	02	11/2/2005	WELL 11			ND			0.023							ND	
005-0	08	11/10/2005	WELL 11			ND		ND								ND	
005-0	09	11/11/2005	WELL 11			ND		ND								ND	
005-0	10	11/12/2005	WELL 11			ND		B	0.008							ND	
005-0	11	11/13/2005	WELL 11			ND		ND								B	0.011
005-0	12	11/14/2005	WELL 11			ND		ND								+?	0.989
005-0	13	11/15/2005	WELL 11			ND		ND								B	0.026
005-0	14	11/18/2005	WELL 11			ND		ND								+	0.369
005-0	15	11/22/2005	WELL 11			ND		ND								+	0.246
005-0	16	12/5/2005	WELL 11			ND		ND								+	0.465
005-0	17	12/7/2005	WELL 11			B	0.152	++	6.080							++	1.357
005-0	18	12/13/2005	WELL 11			ND		+	2.012							++	1.276
005-0	19	12/20/2005	WELL 11			ND		+	1.623							++	1.541
005-0	20	12/29/2005	WELL 11			ND		+	2.204							++	2.792
005-0	21	1/11/2006	WELL 11			ND		+	1.919							++	2.079
005-0	23	1/18/2006	WELL 11			ND		B	0.036							++	1.235
005-0	24	1/25/2006	WELL 11			ND		B	0.085							++	1.724

ND Below Quantitation Limit
B Background
NS No Sample

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/11/2007

CHARCOAL AND WATER SAMPLES

Code Number	Event	Date Collected	Feature Name	Peakfit	Comment	TINOPAL CBS-X		FLUORESCEIN		EOSINE		FD&C RED #3		D&C Red #28		SULPHORHODAMINE B	
						Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb
005-0	25	2/1/2006	WELL 11			ND		B	0.006							++	0.694
006-0	01	10/26/2005	WELL 25			ND		ND								ND	
006-0	02	11/2/2005	WELL 25			ND			0.030							ND	
006-0	08	11/10/2005	WELL 25			ND		B	0.005							ND	
006-0	09	11/11/2005	WELL 25			ND		B	0.009							ND	
006-0	10	11/12/2005	WELL 25			ND		B	0.010							+	0.315
006-0	11	11/13/2005	WELL 25			ND		B	0.010							++	0.720
006-0	12	11/14/2005	WELL 25			ND		ND								+++	81.290
006-0	13	11/15/2005	WELL 25			ND		ND								++	1.309
006-0	14	11/18/2005	WELL 25			ND		ND								+++	12.444
006-0	15	11/22/2005	WELL 25			ND		ND								+++	5.937
006-0	16	12/5/2005	WELL 25			B	0.168	+	0.085							+++	21.746
006-0	17	12/7/2005	WELL 25			ND		++	4.451							+++	6.124
006-0	18	12/13/2005	WELL 25			B	0.117	+	0.481							++	3.215
006-0	19	12/20/2005	WELL 25			ND		B	0.195							++	4.120
006-0	20	12/29/2005	WELL 25			ND		B	0.119							++	3.364
006-0	21	1/11/2006	WELL 25			ND		B	0.257							++	3.852
006-0	23	1/18/2006	WELL 25			ND		ND								ND	
006-0	24	1/25/2006	WELL 25			ND		B	0.056							+	0.312
006-0	25	2/1/2006	WELL 25			ND		+?	6.943							++	1.942
006-0	26	2/10/2006	WELL 25			ND		B	0.022							+	0.558
006-0	27	2/23/2006	WELL 25			ND		B	0.063							+?	0.906
006-0	28	3/3/2006	WELL 25			ND		B	0.027							+?	0.458
006-0	29	3/9/2006	WELL 25			ND		B	0.025							+?	0.464
006-0	30	3/17/2006	WELL 25			+	7.862	B	0.020							ND	
006-0	31	3/24/2006	WELL 25			++	16.013	B	0.016							ND	
007-0	01	10/26/2005	SLAB CABIN AT SCBWA			ND			0.021							ND	
007-0	02	11/2/2005	SLAB CABIN AT SCBWA			ND			0.011							ND	
007-0	08	11/10/2005	SLAB CABIN AT SCBWA			ND		B	0.011							ND	
007-0	09	11/11/2005	SLAB CABIN AT SCBWA			ND		ND								++	2.514
007-0	10	11/12/2005	SLAB CABIN AT SCBWA		DL	ND		ND								+++	15.083
007-0	11	11/13/2005	SLAB CABIN AT SCBWA		DL	ND		ND								+++	18.615
007-0	12	11/14/2005	SLAB CABIN AT SCBWA			ND		ND								+++	426.704
007-0	13	11/15/2005	SLAB CABIN AT SCBWA			ND		ND								+++	293.793
007-0	14	11/18/2005	SLAB CABIN AT SCBWA			ND		ND								+++	285.335
007-0	15	11/22/2005	SLAB CABIN AT SCBWA			ND		++	3.981							+++	108.099

ND Below Quantitation Limit
B Background
NS No Sample

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/11/2007

CHARCOAL AND WATER SAMPLES

Code Number	Event	Date Collected	Feature Name	Peakfit	Comment	TINOPAL CBS-X		FLUORESCEIN		EOSINE		FD&C RED #3		D&C Red #28		SULPHORHODAMINE B	
						Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb	Results	Conc in ppb
007-0	16	12/5/2005	SLAB CABIN AT SCBWA			ND		++	7.545							+++	116.473
007-0	17	12/7/2005	SLAB CABIN AT SCBWA			B	0.100	+++	27.756							+++	10.157
007-0	18	12/13/2005	SLAB CABIN AT SCBWA		ns												
007-0	19	12/20/2005	SLAB CABIN AT SCBWA		ns												
007-0	20	12/29/2005	SLAB CABIN AT SCBWA		ns												
007-0	21	1/11/2006	SLAB CABIN AT SCBWA		ns												
007-0	25	2/1/2006	SLAB CABIN AT SCBWA			ND		+?	6.248							+?	1.730
008-0	08	11/10/2005	SLAB CABIN AT PONDEROSA			ND		B	0.008							ND	
008-0	09	11/11/2005	SLAB CABIN AT PONDEROSA			ND		ND								ND	
008-0	10	11/12/2005	SLAB CABIN AT PONDEROSA			ND		ND								ND	
008-0	11	11/13/2005	SLAB CABIN AT PONDEROSA			ND		ND								ND	
009-0	14	11/18/2005	SLAB CABIN RUN PARK			ND		ND								+++	23.218
009-0	15	11/22/2005	SLAB CABIN RUN PARK			ND		ND								+++	75.145
009-0	16	12/5/2005	SLAB CABIN RUN PARK			ND		+++	12.516							+++	24.957
009-0	19	12/20/2005	SLAB CABIN RUN PARK		ns												
009-0	20	12/29/2005	SLAB CABIN RUN PARK		ns												
009-0	21	1/11/2006	SLAB CABIN RUN PARK		ns												
010-0	22	1/12/2006	BLUE SPRING			ND		+?	0.063							+?	0.208
011-0	25	2/1/2006	BLUE SPRING			+?	4.467	ND								ND	
011-0	28	3/3/2006	BLUE SPRING			ND											
011-0	29	3/9/2006	BLUE SPRING			ND											
011-0	30	3/17/2006	BLUE SPRING				4.596										
011-0	31	3/24/2006	BLUE SPRING				4.124										

Project:	Slab Cabin Run Dye Trace
Contact:	Dave Yoxtheimer @ N.A. Water Systems

Lab Manager	Approval Date
Adam Coffman	

Comments: COMBINED ALL SITES GS = Grab (Water) Sample IB = Initial Background Dup. = Duplicate

+? = Crawford Protocol - a True Positive (+) only after two consecutive hits over ten times the initial background levels.

ND Below Quantitation Limit
B Background
NS No Sample

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/11/2007

Normalized Dye Trace Concentration Data During the Low Stream Flow Dye Trace Test

Code Number	01 02	Date Collected		Feature Name	Elapsed Time (Days)	Sample period	TINOPAL CBS-X Results	TINOPAL CBS-X Conc in ppb	FLUORESCEIN Results	FLUORESCEIN Conc in ppb	Normalized Fl Conc (ppb/day)	SULPHORHODAMINE B Results	SULPHORHODAMINE B Conc in ppb	Normalized SRB Conc (ppb/day)
001-0	01	10/26/2005	Watkins	DR.001.0.SS			ND		ND			ND		
001-0	02	11/2/2005		DR.001.0.SS			ND			0.01		ND		
001-0	03	11/9/2005		DR.001.0.SS	0.2	0.17						ND		0.00
001-0	04	11/9/2005		DR.001.0.SS	0.3	0.17						ND		0.00
001-0	05	11/9/2005		DR.001.0.SS	0.5	0.17						ND		0.00
001-0	06	11/10/2005		DR.001.0.SS	0.7	0.17						B	0.01	0.03
001-0	07	11/10/2005		DR.001.0.SS	0.8	0.17						+++	58.31	349.84
001-0	08	11/10/2005		DR.001.0.SS	1.0	1.00						+++	440.07	440.07
001-0	09	11/11/2005		DR.001.0.SS	2.0	1.00						+++	109.14	109.14
001-0	10	11/12/2005		DR.001.0.SS	3.0	1.00						+++	20.38	20.38
001-0	11	11/13/2005		DR.001.0.SS	4.0	1.00						+++	209.34	209.34
001-0	12	11/14/2005		DR.001.0.SS	5.0	1.00						+++	225.32	225.32
001-0	13	11/15/2005		DR.001.0.SS	6.0	1.00						+++	144.345	144.35
001-0	14	11/18/2005		DR.001.0.SS	9.0	3.00						+++	86.306	28.80
001-0	15	11/22/2005		DR.001.0.SS	13.0	4.00						+++	85.688	21.42
001-0	16	11/29/2005		DR.001.0.SS	20.0	7.00						+++	101.333	14.48
001-0	17	12/7/2005		DR.001.0.SS	28.0	8.00						++	4.680	0.59
002-0	01	10/26/2005	Stone Valley	DR.002.0.SS				0.56		0.04		ND		
002-0	02	11/2/2005		DR.002.0.SS			ND			0.01		ND		
002-0	03	11/9/2005		DR.002.0.SS	0.2	0.17						ND		0.00
002-0	04	11/9/2005		DR.002.0.SS	0.3	0.17						ND		0.00
002-0	05	11/9/2005		DR.002.0.SS	0.5	0.17						ND		0.00
002-0	06	11/10/2005		DR.002.0.SS	0.7	0.17						ND		0.00
002-0	07	11/10/2005		DR.002.0.SS	0.8	0.17						ND		0.00
002-0	08	11/10/2005		DR.002.0.SS	1.0	1.00						+	0.12	0.12
002-0	09	11/11/2005		DR.002.0.SS	2.0	1.00						+++	82.66	82.66
002-0	10	11/12/2005		DR.002.0.SS	3.0	1.00						+++	42.09	42.09
002-0	11	11/13/2005		DR.002.0.SS	4.0	1.00						+++	16.98	16.98
002-0	12	11/14/2005		DR.002.0.SS	5.0	1.00						+++	369.25	369.25
002-0	13	11/15/2005		DR.002.0.SS	6.0	1.00						+++	174.235	174.24
002-0	14	11/18/2005		DR.002.0.SS	9.0	3.00						+++	230.481	76.83
002-0	15	11/22/2005		DR.002.0.SS	13.0	4.00						+++	137.066	34.27
002-0	16	11/29/2005		DR.002.0.SS	20.0	7.00						+++	199.789	28.54
002-0	17	12/7/2005		DR.002.0.SS	28.0	8.00						+++	16.079	2.01
003-0	01	10/26/2005	Destiny Farm	DR.003.0.SS			ND			0.02		ND		
003-0	02	11/2/2005		DR.003.0.SS			ND			0.01		ND		
003-0	09	11/11/2005		DR.003.0.SS								ND		
003-0	11	11/13/2005		DR.003.0.SS								ND	0.00	
004-0	01	10/26/2005	Scott Rd	DR.004.0.SP			ND		ND			ND		
004-0	02	11/2/2005		DR.004.0.SP			ND					ND		
004-0	03	11/10/2005		DR.004.0.SS	0.2	0.17						ND		0.00
004-0	04	11/10/2005		DR.004.0.SS	0.3	0.17						ND		0.00
004-0	05	11/10/2005		DR.004.0.SS	0.5	0.17						ND		0.00
004-0	06	11/10/2005		DR.004.0.SS	0.7	0.17						ND		0.00
004-0	07	11/10/2005		DR.004.0.SS	0.8	0.17						ND		0.00
004-0	08	11/10/2005		DR.004.0.SS	1.0	1.00						ND		0.00
004-0	09	11/11/2005		DR.004.0.SS	2.0	1.00						+++	19.48	19.48
004-0	10	11/12/2005		DR.004.0.SS	3.0	1.00						+++	26.16	26.16
004-0	11	11/13/2005		DR.004.0.SS	4.0	1.00						+++	268.40	268.40
004-0	12	11/14/2005		DR.004.0.SS	5.0	1.00						B	0.05	0.05
004-0	13	11/15/2005		DR.004.0.SS	6.0	1.00						+++	101.066	101.07
004-0	14	11/18/2005		DR.004.0.SS	9.0	3.00						+++	136.046	45.35
004-0	15	11/22/2005		DR.004.0.SS	13.0	4.00						+++	40.156	10.04
004-0	16	11/29/2005		DR.004.0.SS	20.0	7.00						+++	62.606	8.94
004-0	17	12/7/2005		DR.004.0.SS	28.0	8.00						+++	40.156	5.02
005-0	01	10/26/2005	Well 11	DR.005.0.SS			ND		ND	0.03		ND		
005-0	02	11/2/2005		DR.005.0.SS			ND			0.02		ND		
005-0	08	11/10/2005		DR.005.0.SS	1.0	1.00	ND		ND		0.00	ND		0.00
005-0	09	11/11/2005		DR.005.0.SS	2.0	1.00	ND		ND		0.00	ND		0.00
005-0	10	11/12/2005		DR.005.0.SS	3.0	1.00	ND		B	0.008	0.01	ND		0.00
005-0	11	11/13/2005		DR.005.0.SS	4.0	1.00	ND		ND		0.00	B	0.01	0.01
005-0	12	11/14/2005		DR.005.0.SS	5.0	1.00	ND		ND		0.00	B	0.99	0.99
005-0	13	11/15/2005		DR.005.0.SS	6.0	1.00			ND		0.00	B	0.029	0.03
005-0	14	11/18/2005		DR.005.0.SS	9.0	3.00			ND		0.00	+	0.369	0.12
005-0	15	11/22/2005		DR.005.0.SS	13.0	4.00			ND		0.00	+	0.246	0.06
005-0	16	11/29/2005		DR.005.0.SS	20.0	7.00					0.00	+	0.465	0.07
005-0	17	12/7/2005		DR.005.0.SS	28.0	8.00			+?	6.080	0.76	++	1.357	0.17
005-0	18	12/13/2005		DR.005.0.SS	34.0	6.00			+	2.012	0.34	++	1.276	0.21
005-0	19	12/20/2005		DR.005.0.SS	41.0	7.00			+	1.623	0.23	++	1.541	0.22
005-0	20	12/29/2005		DR.005.0.SS	50.0	9.00			+	2.204	0.24	++	2.792	0.31
005-0	21	1/11/2006		DR.005.0.SS	63.0	13.00			+	1.919	0.15	++	2.079	0.16
005-0	23	1/18/2006		DR.005.0.WE.23	70.0	7.00			B	0.036	0.01	++	1.235	0.18
005-0	24	1/25/2006		DR.005.0.WE.23	77.0	7.00			B	0.085	0.01	++	1.724	0.25
005-0	25	2/1/2006		DR.005.0.WE.23	84.0	7.00			B	0.006	0.00	++	0.894	0.10
006-0	01	10/26/2005	Well 25	DR.006.0.WE			ND		ND			ND		
006-0	02	11/2/2005		DR.006.0.WE			ND			0.030		ND		
006-0	08	11/10/2005		DR.006.0.SS	1.0	1.00	ND	0.00	B	0.005	0.01	ND		0.00
006-0	09	11/11/2005		DR.006.0.SS	2.0	1.00	ND	0.00	B	0.009	0.01	ND		0.00
006-0	10	11/12/2005		DR.006.0.SS	3.0	1.00	ND	0.00	B	0.010	0.01	+	0.32	0.32
006-0	11	11/13/2005		DR.006.0.SS	4.0	1.00	ND	0.00	B	0.010	0.01	++	0.72	0.72
006-0	12	11/14/2005		DR.006.0.SS	5.0	1.00	ND	0.00	ND		0.00	+++	81.29	81.29
006-0	13	11/15/2005		DR.006.0.SS	6.0	1.00	ND	0.00	ND		0.00	++	1.309	1.31
006-0	14	11/18/2005		DR.006.0.SS	9.0	3.00	ND	0.00	ND		0.00	+++	12.444	4.15
006-0	15	11/22/2005		DR.006.0.SS	13.0	4.00	ND	0.00	ND		0.00	+++	5.937	1.48
006-0	16	11/29/2005		DR.006.0.SS	20.0	7.00	ND	0.00	+	0.085	0.01	+++	21.746	3.11
006-0	17	12/7/2005		DR.006.0.SS	28.0	8.00	ND	0.00	++	4.451	0.56	+++	6.124	0.77
006-0	18	12/13/2005		DR.006.0.SS	34.0	6.00	B	0.117	+	0.481	0.08	++	3.215	0.54
006-0	19	12/20/2005		DR.006.0.SS	41.0	7.00	ND	0.00	B	0.195	0.03	++	4.129	0.59
006-0	20	12/29/2005		DR.006.0.SS	50.0	9.00	ND	0.00	B	0.119	0.01	++	3.364	0.37
006-0	21	1/11/2006		DR.006.0.SS	63.0	13.00	ND	0.00	B	0.267	0.02	++	3.852	0.30
006-0	23	1/18/2006		DR.006.0.WE.23	70.0	7.00	ND	0.00	ND		0.00	ND		0.00

006-0	24	1/25/2006		DR.006.0.WE.23	77.0	7.00	ND		0.00	B	0.056	0.01	+	0.312	0.04
006-0	25	2/1/2006		DR.006.0.WE.23	84.0	7.00	ND		0.00	+?	6.943	0.99	++	1.942	0.28
006-0	26	2/10/2006		DR.006.0.WE.26	93	9	ND		0.00	B	0.022	0.00	+	0.558	0.06
006-0	27	2/23/2006		DR.006.0.WE.27	106	13	ND		0.00	B	0.063	0.00	+?	0.986	0.07
006-0	28	3/3/2006		DR.006.0.WE.28	114	8	ND		0.00	B	0.027	0.00	+?	0.458	0.06
006-0	29	3/9/2006		DR.006.0.WE.29	120	6	ND		0.00	B	0.025	0.00	+?	0.464	0.08
006-0	30	3/17/2006		DR.006.0.WE.30	128	8	+	7.862	0.98	B	0.020	0.00	ND		0.00
006-0	31	3/24/2006		DR.006.0.WE.31	135	7	++	15.013	2.29	B	0.016	0.00	ND		0.00
006-0	32	3/31/2006		DR.006.0.WE.32	142	7	B	0.153	0.02	B	0.007	0.00	++	1.339	0.19
006-0	33	4/10/2006		DR.006.0.WE.33	152	10	B	0.420	0.04	B	0.016	0.00	++	1.672	0.17
006-0	34	4/14/2006		DR.006.0.WE.34	156	4	ND		0.00	ND		0.00	++	0.577	0.17
006-0	35	5/31/2006		DR.006.0.WE.35	203	47	B	0.372	0.01	ND		0.00	++	1.988	0.04
007-0	01	10/26/2005	SCR at SCWA	DR.007.0.WE			ND				0.021		ND		
007-0	02	11/2/2005		DR.007.0.WE			ND				0.011		ND		
				DR.007.0.WE	1.00	1.00	ND			B	0.011	0.01	ND		
007-0	09	11/11/2005		DR.007.0.SS	2.0	1.00	ND			ND		0.00	++	2.51	2.51
007-0	10	11/12/2005		DR.007.0.SS	3.0	1.00	ND			ND		0.00	+++	15.08	15.08
007-0	11	11/13/2005		DR.007.0.SS	4.0	1.00	ND			ND		0.00	+++	18.62	18.62
007-0	12	11/14/2005		DR.007.0.SS	5.0	1.00				ND		0.00	+++	426.70	426.70
007-0	13	11/15/2005		DR.007.0.SS	6.0	1.00				ND		0.00	+++	293.793	293.79
007-0	14	11/18/2005		DR.007.0.SS	9.0	3.00				ND		0.00	+++	285.335	95.11
007-0	15	11/22/2005		DR.007.0.SS	13.0	4.00				++	3.981	1.00	+++	108.099	27.02
007-0	16	11/29/2005		DR.007.0.SS	20.0	7.00				++	7.545	1.08	+++	118.473	16.64
007-0	17	12/7/2005		DR.007.0.SS	28.0	8.00				+++	27.756	3.47	+++	10.157	1.27
007-0	25	2/1/2006		DR.007.0.SS.23	84.0	7.00	ND			+?	6.248	0.893	+?	1.730	0.25
008-0	08	11/10/2005	SCR at Ponderosa	DR.008.0.SS			ND			B	0.01		ND		
008-0	09	11/10/2005		DR.008.0.SS			ND			B	0.01		ND		
008-0	09	11/11/2005		DR.008.0.SS			ND			ND			ND		
008-0	10	11/12/2005		DR.008.0.SS			ND			ND			ND		
008-0	11	11/13/2005		DR.008.0.SS			ND			ND			ND		
009-0	14	11/18/2005	SCR-Park	DR.009.0.SS	9.0	3.00				ND		0.00	+++	23.218	7.74
009-0	15	11/22/2005		DR.009.0.SS	13.0	4.00				ND		0.00	+++	75.145	18.79
009-0	16	11/29/2005		DR.009.0.SS	20.0	7.00				+++	12.516	1.79	+++	24.857	3.57
009-0	17	12/7/2005		DR.009.0.SS	28.0	8.00				+++	32.615	4.08	+++	9.515	1.19
011-0	25	2/1/2006	Blue Spring	DR.011.0.SP.25	84	7	+?	4.467	0.638143						
011-0	28	3/3/2006		DR.011.0.SP.28	114	30	ND	0	0						
011-0	29	3/9/2006		DR.011.0.SP.29	120	6	ND	0	0						
011-0	30	3/17/2006		DR.011.0.SP.30	128	8		4.596	0.5745						
011-0	31	3/24/2006		DR.011.0.SP.31	135	7		4.124	0.589143						
011-0	32	3/31/2006		DR.011.0.SP.32	142	7	+	17.374	2.467714						
011-0	33	4/10/2006		DR.011.0.SP.33	152	10	+	9.450	0.945						
011-0	34	4/14/2006		DR.011.0.SP.34	156	4	+	7.005	1.75125						
011-0	35	5/31/2006		DR.011.0.SP.31	203	47	+	10.125	0.215426						

Appendix B
Dye Trace Laboratory Reports and Normalized Dye Trace Data for the Average Stream Flow Dye Trace Test

Crawford Hydrology Lab * Center for Cave and Karst Studies

Western Kentucky University

* Hydrogeologists, Geologists, Environmental Scientists * Karst Geophysical Subsurface Investigations

* Karst Groundwater Investigations * Fluorescent Dye Analysis

Bowling Green, KY 42101

Lab 270-745-9224 Office 270-745-3252

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LABORATORY REPORT SHEET

FLUORIMETRIC ANALYSIS RESULTS

SCR/Test #2

Analysis requested by:

N.A. WATER SYSTEMS

TINOPAL CBS-X	FLUORESCEIN	EOSINE OJ	SULPHORHODAMINE B
Fabric Brightening Agent 351	Color Index: Acid Yellow 73	Color Index: Acid Red 87	Color Index: Acid Red 52
Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal	Dye Receptor: Activated Charcoal
Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer	Analysis by: Spectrofluorophotometer

						CHARCOAL AND WATER SAMPLES											
						TINOPAL CBS-X			FLUORESCEIN			EOSINE OJ			SULPHORHODAMINE B		
LAB ID	Event	Date Collected	Feature Name/Description	Peakfit	Comment	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)
001-0	01	11/28/2006	SCOTT RD.			ND			IB						IB	0.085	NPI
001-0	02	12/7/2007	SCOTT RD.			B	0.126	389.2									
001-0	03	12/8/2007	SCOTT RD.			++	87.881	396.8									
001-0	04	12/9/2007	SCOTT RD.			++	66.204	396.6									
001-0	05	12/10/2007	SCOTT RD.			++	16.576	396.4									
001-0	06	12/11/2007	SCOTT RD.			+	8.663	397.4									
001-0	07	12/12/2007	SCOTT RD.			+	4.388	396.2									
001-0	08	12/13/2007	SCOTT RD.			++	11.347	397.4									
001-0	09	12/14/2006	SCOTT RD.			+	5.507	397.4									
001-0	11	12/22/2006	SCOTT RD.			+	4.273	397.4									
001-0	12	12/29/2006	SCOTT RD.			B	0.528	NPI									
001-0	13	1/5/2007	SCOTT RD.			B	0.928	NPI									
001-0	14	1/19/2007	SCOTT RD.			ND											
001-0	15	2/2/2007	SCOTT RD.			ND											
002-0	01	11/28/2006	WINDY HILL SPRING 1			ND			IB	6.910	516.6				ND		
002-0	10	12/15/2006	WINDY HILL SPRING 1			ND			ND						+++	1597.500	576.2
002-0	11	12/22/2006	WINDY HILL SPRING 1			ND			B	6.225	516.4				+++	44.095	576.0
002-0	12	12/29/2006	WINDY HILL SPRING 1			ND			B	5.221	516.8				+++	253.869	576.2
002-0	13	1/5/2007	WINDY HILL SPRING 1			ND			B	5.002	517.0				+++	106.608	575.4
002-0	14	1/19/2007	WINDY HILL SPRING 1			ND			B	5.756	517.4				+++	112.172	575.2
002-0	15	2/2/2007	WINDY HILL SPRING 1			ND			B	8.381	517.2				+++	60.586	574.4
002-0	16	3/6/2007	WINDY HILL SPRING 1			ND			B	12.128	516.8				+++	18.672	572.8
003-0	01	11/28/2006	WINDY HILL SPRING 2			ND			IB	0.744	515.8				ND		
003-0	10	12/15/2006	WINDY HILL SPRING 2			B	0.109	NPI	B	4.989	516.4				+++	2220.600	576.2
003-0	11	12/22/2006	WINDY HILL SPRING 2			ND			ND						+++	63.142	576.0
003-0	12	12/29/2006	WINDY HILL SPRING 2			ND			ND						+++	301.260	576.2
003-0	13	1/5/2007	WINDY HILL SPRING 2			ND			ND						+++	103.614	575.4

\+ Positive

++ Very Positive

+++ Extremely Positive

Created 7/12/2007

CHARCOAL AND WATER SAMPLES

LAB ID	Event	Date Collected	Feature Name/Description	Peakfit	Comment	TINOPAL CBS-X Results	TINOPAL CBS-X Conc in ppb	TINOPAL CBS-X Peak Center (nm)	FLUORESCEIN Results	FLUORESCEIN Conc in ppb	FLUORESCEIN Peak Center (nm)	EOSINE OJ Results	EOSINE OJ Conc in ppb	EOSINE OJ Peak Center (nm)	SULPHORHODAMINE B Results	SULPHORHODAMINE B Conc in ppb	SULPHORHODAMINE B Peak Center (nm)
003-0	14	1/19/2007	WINDY HILL SPRING 2			ND			B						+++	130.739	575.2
003-0	15	2/2/2007	WINDY HILL SPRING 2			ND			ND						+++	21.310	574.8
003-0	16	3/6/2007	WINDY HILL SPRING 2			ND			B	0.109	516.8				+++	11.094	574.6
004-0	01	11/28/2006	WELL 11			IB	0.528	390.0	IB	0.608	NPI				ND		
004-0	03	12/8/2007	WELL 11			B	0.039	381.6	ND						ND		
004-0	04	12/9/2007	WELL 11			B	0.328	386.6	+?	1.508	515.6				++	0.662	576.4
004-0	05	12/10/2007	WELL 11			B	0.124	381.6	B	0.008	513.6				++	0.571	576.4
004-0	06	12/11/2007	WELL 11			B	0.081	385.6	B	0.013	515.4				+	0.317	576.0
004-0	06	12/11/2007	WELL 11		GS	ND			ND						B	0.040	586.0
004-0	07	12/12/2007	WELL 11			B	0.400	387.4	B	0.014	514.6				+	0.333	576.2
004-0	08	12/13/2007	WELL 11			B	0.255	386.2	B	0.041	515.4				++	0.532	576.0
004-0	09	12/14/2006	WELL 11			B	0.327	385.8	B	0.032	515.2				+	0.281	575.4
004-0	11	12/22/2006	WELL 11			B	0.121	382.4	B	0.099	515.8				++	1.691	575.4
004-0	12	12/29/2006	WELL 11			ND			B	0.010	511.2				++	0.762	575.0
004-0	13	1/5/2007	WELL 11			ND			ND						++	1.505	575.0
004-0	14	1/19/2007	WELL 11			B	0.661	390.8	B						++	3.226	574.6
004-0	15	2/2/2007	WELL 11			B	0.967	NPI	ND						++	3.073	573.4
004-0	16	3/6/2007	WELL 11			B	0.356	NPI	ND						++	3.291	572.2
005-0	01	11/28/2006	SCR 2			ND			IB	0.526	518.2				IB	0.007	NPI
005-0	03	12/8/2007	SCR 2			B	0.121	418.6							+++	54.154	576.4
005-0	04	12/9/2007	SCR 2			++	33.727	397.0							+++	148.658	576.6
005-0	05	12/10/2007	SCR 2			++	14.894	396.6							+++	27.766	576.4
005-0	06	12/11/2007	SCR 2			+	6.992	396.6							+++	19.300	576.4
005-0	06	12/11/2007	SCR 2		GS	B	0.947	395.6							+	0.455	580.8
005-0	07	12/12/2007	SCR 2			+	3.673	397.2							+++	9.908	576.2
005-0	08	12/13/2007	SCR 2			+	3.264	397.4							++	5.900	576.2
005-0	09	12/14/2006	SCR 2			+	3.100	400.6							+++	9.236	576.0
005-0	11	12/22/2006	SCR 2		NS												
005-0	12	12/29/2006	SCR 2			ND									+++	45.320	575.8
005-0	13	1/5/2007	SCR 2			ND									+++	27.727	575.2
005-0	14	1/19/2007	SCR 2			ND									+++	23.676	574.8
005-0	15	2/2/2007	SCR 2			ND									+++	11.822	574.0
005-0	16	3/6/2007	SCR 2			ND									++	4.188	572.2
006-0	01	11/28/2006	WELL 25			IB	0.579	NPI	IB	0.012	507.8				ND		
006-0	03	12/8/2007	WELL 25			B	0.174	386.4	+	0.172	515.6				B	0.007	560.4
006-0	04	12/9/2007	WELL 25			B	0.227	387.2	++	1.306	515.6				B	0.060	571.8
006-0	05	12/10/2007	WELL 25			B	0.126	385.8	++	1.262	515.6				B	0.029	570.8
006-0	06	12/11/2007	WELL 25			B	0.124	386.4	+	0.959	515.6				B	0.027	572.4
006-0	06	12/11/2007	WELL 25		GS	ND			+	0.185	510.0				ND		

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/12/2007

						CHARCOAL AND WATER SAMPLES											
						TINOPAL CBS-X			FLUORESCEIN			EOSINE OJ			SULPHORHODAMINE B		
LAB ID	Event	Date Collected	Feature Name/Description	Peaksfit	Comment	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)
006-0	07	12/12/2007	WELL 25			B	0.353	386.8	++	2.109	515.6				B	0.033	570.8
006-0	08	12/13/2007	WELL 25			B	0.123	397.8	++	4.483	515.6				+?	0.053	574.8
006-0	09	12/14/2006	WELL 25			B	0.352	386.8	++	8.973	516.0				+?	0.118	579.0
006-0	11	12/22/2006	WELL 25			B	0.466	386.0	+++	46.842	516.0				B	0.320	569.0
006-0	12	12/29/2006	WELL 25			ND			++	11.150	516.0				B	0.199	567.2
006-0	13	1/5/2007	WELL 25			ND			++	8.008	516.0				B	0.308	570.2
006-0	14	1/19/2007	WELL 25			B	0.365	404.8	++	3.490	516.0				B	0.353	569.0
006-0	15	2/2/2007	WELL 25			B	0.171	NPI	++	1.827	516.0				B	0.310	NPI
006-0	16	3/6/2007	WELL 25			B	0.674	388.6	+	0.381	515.8				B	0.249	560.4
007-0	01	11/28/2006	CENTRE HILLS CC			ND			IB	0.088	513.0				IB	0.008	NPI
007-0	03	12/8/2007	CENTRE HILLS CC			ND			++	35.196	515.8				++	1.900	576.4
007-0	04	12/9/2007	CENTRE HILLS CC			+	3.800	395.6	++	71.768	515.8				+++	51.068	576.4
007-0	05	12/10/2007	CENTRE HILLS CC			+	3.773	396.2	++	23.664	515.8				+++	9.176	576.4
007-0	06	12/11/2007	CENTRE HILLS CC			+	1.658	394.8	+++	96.122	515.8				++	5.964	576.4
007-0	07	12/12/2007	CENTRE HILLS CC			B	0.956	393.2	++	24.359	515.8				++	2.488	576.2
007-0	08	12/13/2007	CENTRE HILLS CC			B	0.974	397.6	+	3.781	515.8				++	3.059	576.0
007-0	09	12/14/2006	CENTRE HILLS CC			+?	1.136	392.8	+	1.676	516.0				++	2.494	575.8
007-0	11	12/22/2006	CENTRE HILLS CC			B	1.211	NPI	+	2.739	516.0				++	6.901	575.8
007-0	12	12/29/2006	CENTRE HILLS CC			B	0.108	NPI	B	0.457	516.4				+++	10.911	575.8
007-0	13	1/5/2007	CENTRE HILLS CC			ND			B	0.180	517.8				+++	10.376	575.2
007-0	14	1/19/2007	CENTRE HILLS CC			ND			B	0.164	515.2				+++	6.007	574.8
007-0	15	2/2/2007	CENTRE HILLS CC			ND			B	0.149	518.2				++	4.142	574.0
008-0	01	11/28/2006	SLAB CABIN-SPRING CREEK PARK			ND			IB	0.092	514.8				ND		
008-0	04	12/9/2007	SLAB CABIN-SPRING CREEK PARK			B	0.997	393.0	++	53.721	515.8				+++	18.058	576.4
008-0	06	12/11/2007	SLAB CABIN-SPRING CREEK PARK			+	3.513	395.6	++	39.201	515.8				+++	13.496	576.4
008-0	08	12/13/2007	SLAB CABIN-SPRING CREEK PARK			+	1.067	395.0	++	30.528	515.8				++	3.360	576.2
008-0	10	12/15/2006	SLAB CABIN-SPRING CREEK PARK			B	0.719	389.6	+	1.264	516.0				++	2.413	575.6
008-0	11	12/22/2006	SLAB CABIN-SPRING CREEK PARK			B	0.971	393.8	+	1.276	516.2				++	2.706	575.4
008-0	12	12/29/2006	SLAB CABIN-SPRING CREEK PARK			B	0.459	NPI	B	0.396	516.2				++	1.808	575.0
008-0	13	1/5/2007	SLAB CABIN-SPRING CREEK PARK			B	0.261	NPI	B	0.167	516.8				+++	6.309	575.0
008-0	14	1/19/2007	SLAB CABIN-SPRING CREEK PARK			ND			B	0.422	516.0				+++	5.435	574.4
008-0	15	2/2/2007	SLAB CABIN-SPRING CREEK PARK			ND			B	0.198	517.2				++	3.796	573.6
009-0	01	11/28/2006	CTWA-SPRING CK PARK WELL			IB	0.622	388.2	ND						ND		
009-0	04	12/9/2007	CTWA-SPRING CK PARK WELL			B	0.030	379.6	B	0.005	NPI				ND		
009-0	06	12/11/2007	CTWA-SPRING CK PARK WELL			B	0.185	386.0	B	0.009	511.8				B	0.009	566.6
009-0	08	12/13/2007	CTWA-SPRING CK PARK WELL			B	0.466	386.6	ND						ND		
009-0	10	12/15/2006	CTWA-SPRING CK PARK WELL			B	0.530	386.6	B	0.006	504.8				ND		
009-0	11	12/22/2006	CTWA-SPRING CK PARK WELL			B	0.736	386.0	B	0.012	NPI				ND		

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CHARCOAL AND WATER SAMPLES

LAB ID	Event	Date Collected	Feature Name/Description	Peakfit	Comment	TINOPAL CBS-X Results	TINOPAL CBS-X Conc in ppb	TINOPAL CBS-X Peak Center (nm)	FLUORESCEIN Results	FLUORESCEIN Conc in ppb	FLUORESCEIN Peak Center (nm)	EOSINE OJ Results	EOSINE OJ Conc in ppb	EOSINE OJ Peak Center (nm)	SULPHORHODAMINE B Results	SULPHORHODAMINE B Conc in ppb	SULPHORHODAMINE B Peak Center (nm)
009-0	12	12/29/2006	CTWA-SPRING CK PARK WELL			ND			B	0.006	NPI				ND		
009-0	13	1/5/2007	CTWA-SPRING CK PARK WELL			ND			ND						ND		
009-0	14	1/19/2007	CTWA-SPRING CK PARK WELL			B	0.688	NPI	B	0.015	NPI				ND		
009-0	15	2/2/2007	CTWA-SPRING CK PARK WELL			B	0.953	386.2	ND						ND		
010-0	01	11/28/2006	PSU-SPRING CREEK			ND			IB	0.082	NPI				ND		
010-0	04	12/9/2007	PSU-SPRING CREEK			B	0.151	393.0	++	29.802	515.8				+++	9.952	576.4
010-0	06	12/11/2007	PSU-SPRING CREEK			+?	1.286	400.4	++	15.594	515.8				+++	5.801	576.4
010-0	08	12/13/2007	PSU-SPRING CREEK			B	0.438	392.6	++	12.210	515.8				++	1.212	576.0
010-0	10	12/15/2006	PSU-SPRING CREEK			B	0.553	NPI	+	3.048	516.0				++	1.690	575.2
010-0	11	12/22/2006	PSU-SPRING CREEK			B	0.167	NPI	+	1.730	516.0				++	1.624	574.4
010-0	12	12/29/2006	PSU-SPRING CREEK			ND			B	0.314	515.4				++	2.972	575.0
010-0	13	1/5/2007	PSU-SPRING CREEK			ND			B	0.140	513.2				++	2.798	574.4
010-0	14	1/19/2007	PSU-SPRING CREEK			B			B	0.348	514.8				++	2.942	573.2
010-0	15	2/2/2007	PSU-SPRING CREEK			ND			B	0.151	512.4				++	1.581	571.4
011-0	01	11/28/2006	PSU-WELL 33			IB	1.102	388.0	ND						ND		
011-0	06	12/11/2007	PSU-WELL 33			B	0.372	387.0	+?	0.058	515.6				ND		
011-0	08	12/13/2007	PSU-WELL 33			B	0.400	387.0	B	0.005	510.4				ND		
011-0	10	12/15/2006	PSU-WELL 33			B	0.763	386.8	ND						ND		
011-0	11	12/22/2006	PSU-WELL 33			B	1.274	387.8	B	0.005	510.4				ND		
011-0	12	12/29/2006	PSU-WELL 33			B	0.945	387.4	B	0.019	514.8				B	0.015	576.6
011-0	13	1/5/2007	PSU-WELL 33			B	0.759	387.2	ND						ND		
011-0	14	1/19/2007	PSU-WELL 33			B	0.238		B	0.005	508.8				ND		
011-0	15	2/2/2007	PSU-WELL 33			B	0.479	386.0	ND						ND		
012-0	01	11/28/2006	CTWA-SHILOH ROAD WELL			IB	0.956	391.0	IB	0.013	NPI				ND		
012-0	04	11/28/2006	CTWA-SHILOH ROAD WELL			B	0.031	381.0	ND						ND		
012-0	13	1/5/2007	CTWA-SHILOH ROAD WELL			B	0.546	387.4	ND						ND		
012-0	15	2/2/2007	CTWA-SHILOH ROAD WELL			B	0.616	390.0	ND						ND		
013-0	01	11/29/2006	BLUE SPRING			ND			IB	0.011	NPI				ND		
013-0	13	1/5/2007	BLUE SPRING						+++	1100.500	515.6						
013-0	15	2/2/2007	BLUE SPRING			ND			++	1.334	515.4				ND		
013-0	16	3/6/2007	BLUE SPRING						+	0.316	513.6						
014-0	03	12/8/2007	ROARING RUN						+++	1214.600	515.8						
014-0	04	12/9/2007	ROARING RUN						+++	1732.300	515.8						
014-0	05	12/10/2007	ROARING RUN						+++	1381.800	515.8						
014-0	06	12/11/2007	ROARING RUN		GS					0.487	508.8						
014-0	06	12/11/2007	ROARING RUN						+++	5738.100	515.8						
014-0	07	12/12/2007	ROARING RUN						+++	97.530	515.8						
014-0	08	12/13/2007	ROARING RUN						+++	21.441	515.8						
014-0	09	12/14/2006	ROARING RUN						+++	12.278	516.0						

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Created 7/12/2007

						CHARCOAL AND WATER SAMPLES											
						TINOPAL CBS-X			FLUORESCEIN			EOSINE OJ			SULPHORHODAMINE B		
LAB ID	Event	Date Collected	Feature Name/Description	Peakfit	Comment	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)	Results	Conc in ppb	Peak Center (nm)
014-0	11	12/22/2006	ROARING RUN						+++	19.446	515.2						
014-0	13	1/5/2007	ROARING RUN						++	1.965	515.6						
014-0	14	1/19/2007	ROARING RUN						++	1.046	515.2						

Project	Contact
SCR/Test #2	DAVID YOXTHEIMER

Lab Manager	Approval Date
Adam Coffman	

Comments: All Sheets, Fluorescent Dye Analysis for Tinopal CBS-X, Fluorescein and Sulphorhodamine B

NPI = No Peak Identified GS = Grab Sample NS = No Sample IB = Initial Background ND = Non Detect B = Background Concentration

+? = Crawford Protocol Possible Positive - a True Positive (+) only after two consecutive hits over ten times the initial background levels.

\+ Positive
++ Very Positive
+++ Extremely Positive

Created 7/12/2007

Normalized Dye Tracing Data For Average Stream Flow Dye Trace Study

Date Collected	Scott Rd	Elapsed Time (Days)	Sample period	TINOPAL CBS-X Conc in ppb	TINOPAL CBS-X ppb/day	FLUORESCEIN Results	FLUORESCEIN Conc in ppt	Normalized Fl Conc. (ppb/day)	SULPHORHODAMINE B Results	SULPHORHODAMINE B Conc in ppb	Normalized SRB Conc. (ppb/day)
11/28/2006			07	0	0.00						
12/7/2007		0.00	9.00	0.13	0.01	ND					
12/8/2007		1.00	1.00	87.88	87.88						
12/9/2007		2.0	1.00	68.20	68.20						
12/10/2007		3.0	1.00	16.58	16.58						
12/11/2007		4.0	1.00	8.66	8.66						
12/12/2007		5.0	1.00	4.39	4.39						
12/13/2007		6.0	1.00	11.35	11.35						
12/14/2006		7.0	1.00	5.51	5.51						
12/22/2006		15.0	8.00	4.27	0.53						
12/29/2006		22.0	7.00	0.53	0.08						
1/5/2007		29.0	7.00	0.93	0.13						
1/19/2007		43.0	14.00	0.00	0.00						
2/2/2007		57.0	14.00	0.00	0.00						
	SCR 2										
11/28/2006		0	07	0.12	0.02				0.01	0.00	
12/8/2007		1	1.00	0.12	0.12				54.15	54.15	
12/9/2007		2	1.00	33.73	33.73				148.66	148.66	
12/10/2007		3	1.00	14.89	14.89				27.77	27.77	
12/11/2007		4	1.00	6.99	6.99				19.30	19.30	
12/12/2007		5	1.00	0.95	0.95				0.455	0.46	
12/13/2007		6	1.00	3.67	3.67				9.908	9.91	
12/14/2006		7	1.00	3.26	3.26				5.9	5.90	
12/22/2006		15	8.00	3.10	0.39						
12/29/2006		22	7.00	0.00	0.00				45.32	6.47	
1/5/2007		29	7.00	0.00	0.00				27.727	3.96	
1/19/2007		43	14.00	0.00	0.00				23.676	1.69	
2/2/2007		57	14.00	0.00	0.00				11.822	0.84	
3/6/2007		89	32.00	0.00	0.00				4.188	0.13	
	WH Spring 1										
11/28/2006		0	7				6.91	0.987142857		0.00	0
12/15/2006		8	8.00				0.00	0		1597.50	199.6875
12/22/2006		15	7.00				6.23	0.889285714		44.10	6.299285714
12/29/2006		22	7.00				5.22	0.745857143		253.87	36.267
1/5/2007		29	7.00				5.00	0.714571429		106.61	15.22971429
1/19/2007		43	14.00				5.76	0.411142857		112.17	8.012285714
2/2/2007		57	14.00				8.38	0.598642857		60.59	4.327571429
3/6/2007		89	32.00				12.13	0.379		18.67	0.5835
	WH Spring 2										
11/28/2006		0	7				0.74	0.106285714		0.00	0
12/15/2006		8	8.00				4.99	0.623625		2220.60	277.575
12/22/2006		15	7.00				0.00	0		63.14	9.020285714
12/29/2006		22	7.00				0.00	0		301.25	43.03714286
1/5/2007		29	7.00				0.00	0		103.61	14.802
1/19/2007		43	14.00				0.00	0		130.74	9.3385
2/2/2007		57	14.00				0.00	0		21.31	1.522142857
3/6/2007		89	32.00				0.11	0.00340625		11.09	0.3466875
	Well 11										

11/28/2006			07	0.53	0.08	0.008	0.001	0.00	0.00	
12/7/2007		0.00	9.00	0.04	0.00	0			0.00	0.00
12/8/2007		1.00	1.00	0.33	0.33	1.508	1.508	0.66	0.66	0.66
12/9/2007		2.00	1.00	0.12	0.12	0.008	0.008	0.57	0.57	0.57
12/10/2007		3.00	1.00	0.08	0.08	0.013	0.013	0.32	0.32	0.32
12/11/2007		4.00	1.00	0.00	0.00	0		0.04	0.04	0.04
12/12/2007		5.00	1.00	0.40	0.40	0.014	0.014	0.333	0.33	0.33
12/13/2007		6.00	1.00	0.26	0.26	0.041	0.041	0.532	0.53	0.53
12/14/2006		7.00	1.00	0.33	0.33	0.032	0.032	0.281	0.28	0.28
12/22/2006		15.00	8.00	0.12	0.02	0.099	0.012	1.691	0.21	0.03
12/29/2006		22.00	7.00	0.00	0.00	0.01	0.001	0.762	0.11	0.02
1/5/2007		29.00	7.00	0.00	0.00	0		1.505	0.22	0.03
1/19/2007		43.00	14.00	0.66	0.05	0		3.226	0.23	0.02
2/2/2007		57.00	14.00	0.97	0.07	0		3.073	0.22	0.02
3/6/2007		89.0	32.00	0.36	0.01	0		3.291	0.10	0.00
	Well 25									
11/28/2006			07	0.58	0.08	0.012	0.002	0.00	0.00	
12/7/2007		0.00	9.00	0.17	0.02				0.00	0.00
12/8/2007		1.00	1.00	0.23	0.23	0.172	0.172	0.66	0.66	0.66
12/9/2007		2.00	1.00	0.13	0.13	1.306	1.306	0.57	0.57	0.57
12/10/2007		3.00	1.00	0.12	0.12	1.262	1.262	0.32	0.32	0.32
12/11/2007		4.00	1.00	0.00	0.00	0.959	0.959	0.04	0.04	0.04
12/12/2007		5.00	1.00	0.35	0.35	2.109	2.109	0.333	0.33	0.33
12/13/2007		6.00	1.00	0.12	0.12	4.483	4.483	0.532	0.53	0.53
12/14/2006		7.00	1.00	0.35	0.35	8.973	8.973	0.281	0.28	0.28
12/22/2006		15.00	8.00	0.47	0.06	46.842	5.855	1.691	0.21	0.03
12/29/2006		22.00	7.00	0.00	0.00	11.150	1.593	0.762	0.11	0.02
1/5/2007		29.00	7.00	0.00	0.00	8.008	1.144	1.505	0.22	0.03
1/19/2007		43.00	14.00	0.37	0.03	3.490	0.249	3.226	0.23	0.02
2/2/2007		57.00	14.00	0.17	0.01	1.827	0.131	3.073	0.22	0.02
3/6/2007		89.0	32.00	0.67	0.02	0.381	0.012	3.291	0.10	0.00
	Roaring Run									
12/8/2007		1.00	1.00			1214.60	1214.600			
12/9/2007		2.00	1.00			1732.30	1732.300			
12/10/2007		3.00	1.00			1381.80	1381.800			
12/11/2007		4.00	1.00			5738.10	5738.100			
12/12/2007		5.00	1.00			97.53	97.530			
12/13/2007		6.00	1.00			21.44	21.441			
12/14/2006		7.00	1.00			12.28	12.278			
12/22/2006		15.00	8.00			19.45	2.431			
1/5/2007		29.00	14.00			1.97	0.140			
1/19/2007		43.00	14.00			1.05	0.075			
	Blue Spring									
11/28/2006		0	7			0.01	0.00		0.00	0.00
1/5/2007		29	29.00			1100.50	37.95		106.61	3.68
2/2/2007		57	28.00			1.33	0.05		60.59	2.16
3/6/2007		89	32.00			0.32	0.01		18.67	0.58
	Centre Hills									
11/28/2006				0.00		0.09			0.01	
12/7/2007		0.00								
12/8/2007		1.00	1.00	0.00	0.00	35.20	35.20		1.90	1.90
12/9/2007		2.00	1.00	3.80	3.80	71.77	71.77		51.07	51.07
12/10/2007		3.00	1.00	3.77	3.77	23.66	23.66		9.16	9.16

12/11/2007		4.00	1.00	1.66	1.66	96.12	96.12		5.96	5.96	
12/12/2007		5.00	1.00	0.96	0.96	24.36	24.36		2.49	2.49	
12/13/2007		6.00	1.00	0.97	0.97	3.78	3.78		3.06	3.06	
12/14/2006		7.00	1.00	1.14	1.14	1.68	1.68		2.49	2.49	
12/22/2006		15.00	8.00	1.21	0.15	2.74	0.34		6.90	0.86	
12/29/2006		22.00	7.00	0.11	0.02	0.46	0.07		10.91	1.56	
1/5/2007		29.00	7.00	0.00	0.00	0.18	0.03		10.38	1.48	
1/19/2007		43.00	14.00	0.00	0.00	0.15	0.01		6.01	0.43	
2/2/2007		57.00	14.00	0.00	0.00	0.15	0.01		4.14	0.30	

Slab Cabin Run-Spring Ck Park.

11/28/2006						0.092					
12/9/2007		2	2.00	1.00	0.50	53.72	26.86		18.06	9.03	
12/11/2007		4	2.00	3.51	1.76	39.20	19.60		13.50	6.75	
12/13/2007		6	2.00	1.07	0.53	30.53	15.26		3.36	1.68	
12/15/2006		8	2.00	0.72	0.36	1.26	0.63		2.41	1.21	
12/22/2006		16	8.00	0.97	0.12	1.28	0.16		2.71	0.34	
12/29/2006		22	6.00	0.46	0.08	0.40	0.07		1.61	0.30	
1/5/2007		29	7.00	0.26	0.04	0.17	0.02		6.31	0.90	
1/19/2007		43	14.00	0	0.00	0.42	0.03		5.44	0.39	
2/2/2007		57	14.00	0	0.00	0.20	0.01		3.60	0.27	

PSU-SPRING CREEK

11/28/2006						0.082					
12/9/2007		2	2.00	0.15	0.08	29.80	14.90		9.95	4.98	
12/11/2007		4	2.00	1.29	0.64	15.59	7.80		5.80	2.90	
12/13/2007		6	2.00	0.44	0.22	12.21	6.11		1.21	0.61	
12/15/2006		8	2.00	0.55	0.28	3.05	1.52		1.69	0.85	
12/22/2006		16	8.00	0.17	0.02	1.73	0.22		1.62	0.20	
12/29/2006		22	6.00	0	0.00	0.31	0.05		2.97	0.50	
1/5/2007		29	7.00	0	0.00	0.14	0.02		2.80	0.40	
1/19/2007		43	14.00	0	0.00	0.35	0.02		2.94	0.21	
2/2/2007		57	14.00	0	0.00	0.15	0.01		1.58	0.11	