PE 3-8

Y/SUB/93-99928c/Y10/1

FR033040

Y-12

ER DMC Central

OAK RIDGE Y-12 PLANT

LOCKHEED MARTIN

FINAL REPORT OF THE SECOND DYE-TRACER TEST AT THE CHESTNUT RIDGE SECURITY PITS, Y-12 PLANT, OAK RIDGE, TENNESSEE

NOVEMBER 1992

Environmental Management Department

Health, Safety, and
Environment Organization

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Prepared By

Science Applications International Corporation
for the
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
managed by
Martin Marietta Energy Systems, Inc.
for the
U.S. Department of Energy
under Contract Number DE-AC05-84OR21400

[redacted]

MANAGED BY
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

UCN-13672 (26 6-95)

Y/SUB/93-99928c/Y10/1

FINAL REPORT OF THE SECOND DYE-TRACER TEST AT THE CHESTNUT RIDGE SECURITY PITS, Y-12 PLANT, OAK RIDGE, TENNESSEE

NOVEMBER 1992

Environmental Management Department

Health, Safety, and Environment Oganization

Prepared By

Science Applications International Corporation
for the
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
managed by
Martin Marietta Energy Systems, Inc.
for the
U.S. Department of Energy
under Contract Number DE-AC05-84OR21400

CONTENTS

CONTENTS (Continued)

FIGURES

TABLES

ACRONYMS

CRHR	Chestnut Ridge Hydrogeologic Regime
CRSP	Chestnut Ridge Security Pits
DOE	U.S. Department of Energy
Energy Systems	Martin Marietta Energy Systems, Inc.
FB28	Fluorescent Brightener 28
gpm	gallons per minute
HSEA	Health, Safety, Environment, and Accountability Division
msl	mean sea level
MUD	Y-12 Maintenance and Utilities Division
nm	nanometer
ORNL	Oak Ridge National Laboratory
ppb	parts per billion
ppt	parts per trillion
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RWT	Rhodamine WT
TDEC	Tennessee Department of Environment and Conservation
UEFPC	Upper East Fork Poplar Creek

EXECUTIVE SUMMARY

Martin Marietta Energy Systems, Inc. (Energy Systems) manages a closed hazardous waste disposal unit, Chestnut Ridge Security Pits (CRSP), in the form of two trenches and several auger-holes, located on top of the eastern portion of Chestnut Ridge at the Department of Energy (DOE) Oak Ridge Y-12 Plant in Tennessee. The groundwater monitoring system for the unit presently consists of a network of upgradient and downgradient monitor wells. To investigate the discharge of groundwater to springs and streams, Energy Systems, through Geraghty and Miller, Inc., conducted an initial dye-tracer study during the driest part of 1990. The dye was detected at some of the monitoring sites, but verification was necessary due to the proximity of some sites to extraneous dye sources.

Based on the results of the initial study, Energy Systems recommended to the Tennessee Department of Environment and Conservation (TDEC) in the 1990 *Groundwater Quality Assessment Report* (GWQAR) (HSW 1991) for the CRSP that a second dye-tracer study be conducted during the wet weather season. The procedures and materials were reviewed, and a field inspection of the monitoring sites was performed in the fall of 1991. The actual test commenced during the first week of February 1992 with a 4-week baseline monitoring period to determine the inherent variability of the emission spectra within the wavelength range characteristic of Rhodamine WT (RWT) and Fluorescent Brightener 28 (FB28) or similar naturally occuring compounds within in the aquifer. This is commonly referred as *background* in discussion of minimum detectable levels of dyes. On March 13, RWT and FB28 were injected; weekly monitoring began with the collection of the first set of detectors on March 19. The test was originally scheduled to conclude after 12 weeks but was extended to 18 weeks when no definitive results were obtained.

Because two monitoring stations produced dye/optical brightener emission spectra during the baseline period, no results could be characterized on a quantitative or qualitative basis as positively indicating the detection of RWT or FB28 at these monitoring locations. The remaining monitoring produced no results which could be positively characterized as a detection of RWT or FB28. At no time was a characteristic dye spectrum that could be resolved from the background levels or interfering peaks recorded for any sample, nor could any of the results be qualitatively characterized as dye detection. A difference of opinion may arise with respect to the qualitative interpretation of some monitoring curves, but no irrefutable indications that RWT or FB28 placed into GW 178 was ever detected at any of the monitoring sites were obtained during the second test.

1. INTRODUCTION

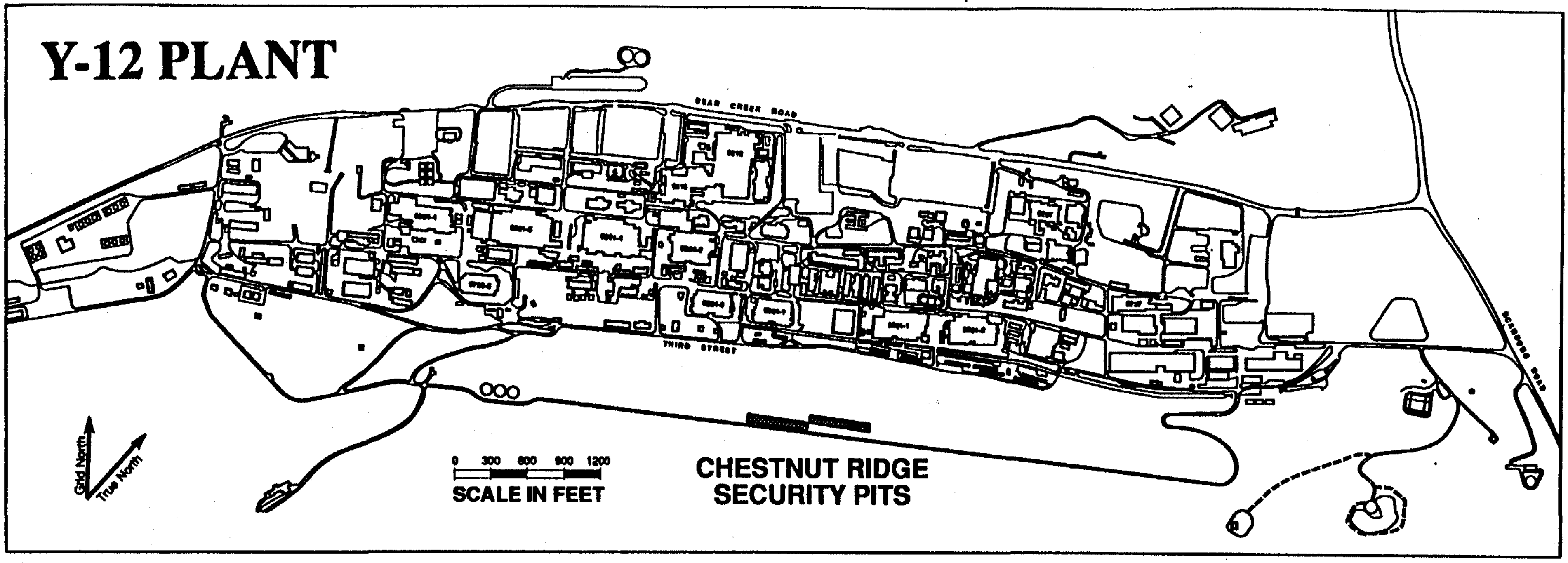
Martin Marietta Energy Systems, Inc. (Energy Systems) has completed a second dye-tracer study at the Chestnut Ridge Security Pits (CRSP) hazardous waste disposal unit at the Department of Energy (DOE) Y-12 Plant (Fig. 1.1). The initial dye-tracer study was performed from June 1990 to October 1990. Based on the results of that study, Energy Systems recommended to the Tennessee Department of Environment and Conservation (TDEC) in the *1990 Groundwater Quality Assessment Report* (HSW 1991) for the CRSP that a second dye-tracer study be conducted during the wet weather season to confirm the results of the first study.

The second dye-tracer test was designed to delineate the general groundwater flow direction as a comparison against the results of the initial study, to compare results during wet weather conditions, and to obtain qualitative data such as minimum travel times and net flowpaths. The test began with a 4-week period of baseline measurements beginning in the week of February 3, 1992. Dye was injected on March 13, 1992 and was followed by 18 weeks of monitoring activities that ended on July 17, 1992. This report details the results of the second investigation and contrasts these results with those achieved during the initial test.

1.1 CHESTNUT RIDGE SECURITY PITS FACILITY DESCRIPTION

The CRSP are a series of subsurface landfills used from 1973 to 1988 for the disposal of solid and liquid wastes associated with the fabrication and production processes at the Y-12 Plant. The CRSP consist of two waste disposal trench areas located along the crest of Chestnut Ridge, south of the Y-12 Plant. The eastern trench area has three separate disposal trenches; each individual trench is roughly 700 ft long, 10 ft wide, and 12 ft deep (Energy Systems 1988a). The western trench area includes four trenches, each roughly 750 ft long, 14 ft wide, and 16 ft deep. Both hazardous and nonhazardous wastes have been disposed of at the CRSP. Hazardous waste disposal ceased in 1984 and the facility was certified as closed in accordance with an approved Resource Conservation and Recovery Act (RCRA) Closure Plan in June 1989 (Dames and Moore 1989).

Because of the origin of the waste received at the CRSP, detailed waste inventories are classified. An unclassified inventory of materials buried in the pits lists 10 major categories of waste: acids, fiberglass, beryllium, biological waste, debris, heavy metals, inorganics, organics, thorium, and uranium (Energy Systems 1984). In addition, minor amounts of reactive materials, such as lithium hydride, deuteride, and zirconium; ignitable materials, such as alcohol; and chlorinated solvents, such as 1,1,1-trichloroethane, are present (Energy Systems 1988a). Of the estimated 3950 tons of materials disposed of at the CRSP, uranium represents 44%, ferrous materials 13%, thorium 11%, debris 10%, and other inorganics 10%.



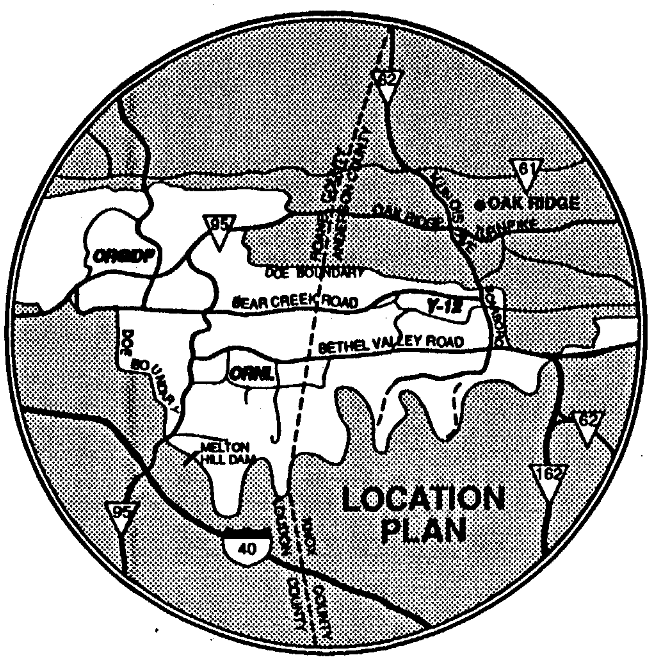


Fig. 1.1. Location map of Chestnut Ridge Security Pits.

CR-001-8/91

1.2 SITE GEOLOGY/HYDROGEOLOGY

The CRSP lie between Bethel and Bear Creek valleys on the crest of Chestnut Ridge at an elevation of 1150 ft above mean sea level (msl). The CRSP are situated in the soil overlying the Copper Ridge Dolomite, which is the basal formation within the Cambro-Ordovician Knox Group. As observed from a cored interval, the Copper Ridge Dolomite is composed of tan to medium gray, massive to thinly bedded, locally chert-rich dolostone containing abundant stylolites (King and Haase 1987). Strike of bedding within the Y-12 Plant area may range from N 55-65°E, and dip is to the southeast from 30° to nearly vertical.

The Chestnut Ridge Hydrogeologic Regime (CRHR) is composed of an upper zone of unconsolidated soils and weathered bedrock overlying a zone of Knox Group bedrock (Geraghty and Miller 1990a). Based on in-situ tests, hydraulic conductivities of the unconsolidated zone ranged between 0.8 to 745 ft/yr (average 141 ft/yr) (Mishu 1982); hydraulic conductivities of the bedrock zone ranged between 0.08 to 1345 ft/yr (average 213 ft/yr) (Golder and Associates 1987a and 1987b). While the potentiometric surface most often lies at or within the bedrock, no distinct discontinuity of permeability exists between the zones and both respond in the same general way in terms of water level fluctuations and groundwater flow directions (Geraghty and Miller 1990a).

The potentiometric surface (Fig 1.2) reflects surface topography with a groundwater divide approximately underlying the vicinity of CRSP. To the north (Figs. 1.3 - 1.5), this surface exhibits a steep hydraulic gradient in response to the topographic slope of the Chestnut Ridge face and the gradient slopes in accordance with the gentle dip of the underlying strata to the south.

Since carbonate rocks within this area have a very low primary porosity, the magnitude and direction of flow within the bedrock are controlled by structural and secondary alterations of the strata (Geraghty and Miller 1990a). Two types of flow systems, conduit/fracture and diffuse, are most likely in the CRHR within the Y-12 Plant boundaries. Conduit/fracture flow can be described as flow through a developed and integrated system of solution enlarged fractures or channels with flow rates on the order of tens or hundreds of feet per hour. Diffuse flow commonly develops in dolomitic rocks or shaley limestones where enlargement has been restricted due to lithology (Mull, Smoot, and Lieberman 1988). Diffuse flow occurs when groundwater moves through small openings and tubes, which are less well integrated and anastomosing in nature, thereby producing a reduced rate of flow from that observed in conduit/fracture dominated systems.

A degree of uncertainty exists in this study due to the poorly defined nature of the flow systems present within the Chestnut Ridge area. While numerous cavities and voids have been encountered during well installations, it is unknown if these voids are interconnected and whether they produce conduit flow conditions or are isolated and produce a more diffuse flow system over the scale of the regional aquifer. This uncertainty affects decisions regarding the length and frequency of monitoring, the choice and amounts of dyes incorporated into the test, and the sensitivity requirements of analytical instrumentation. The design of the test reflects the best effort to achieve a balance between efficient monitoring for the occurrence of dyes while conserving limited resources.

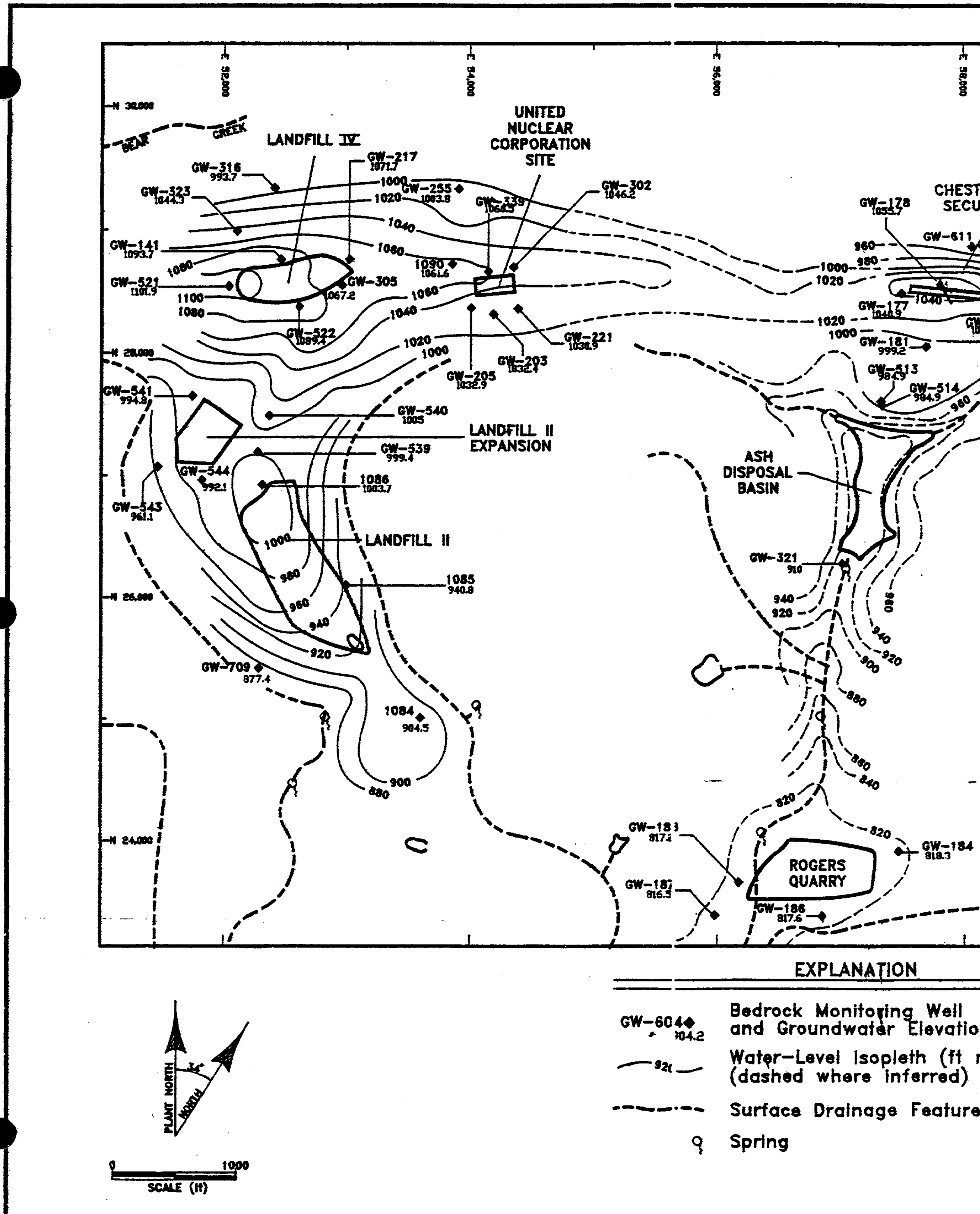
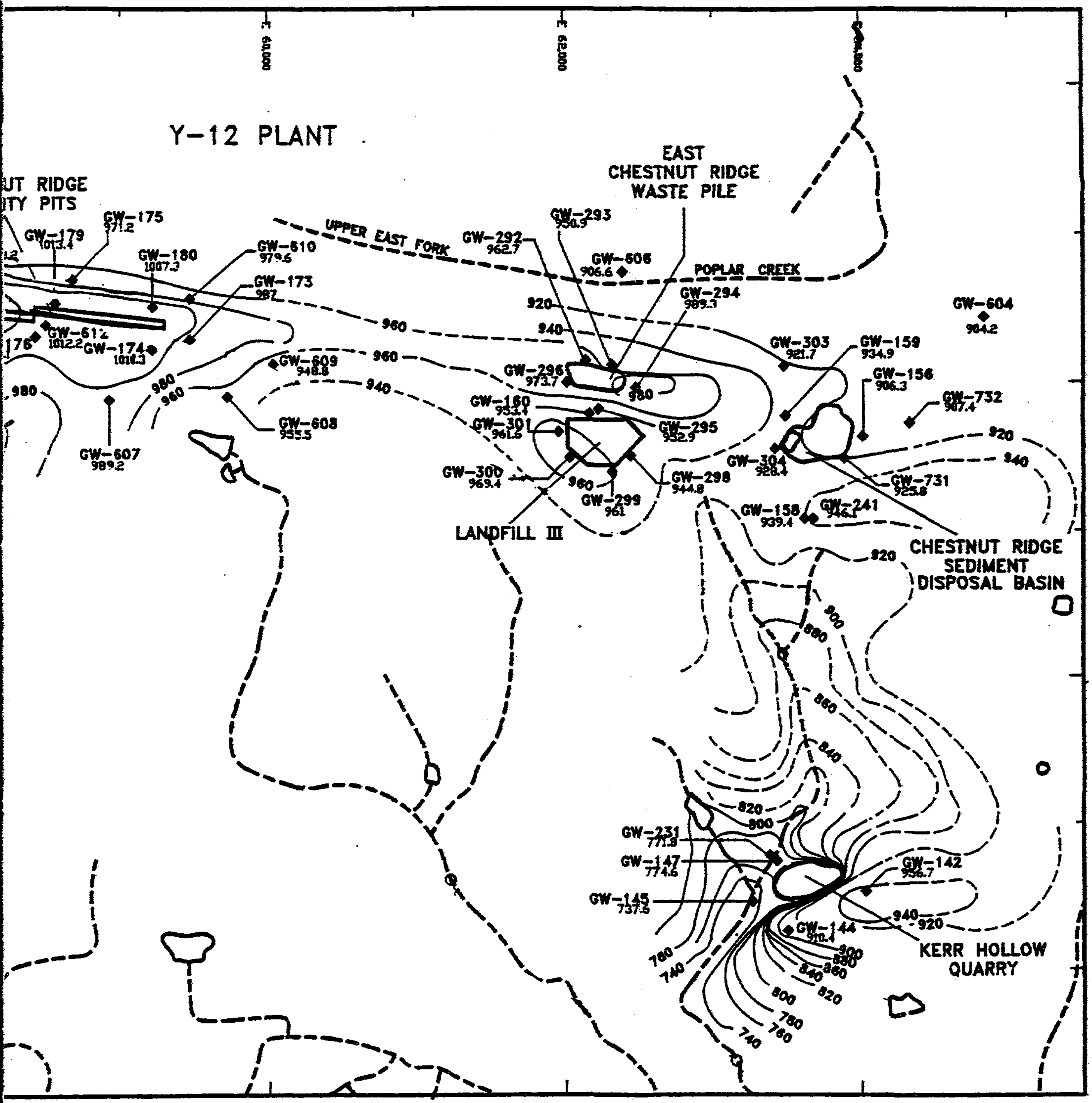


Fig. 1.2. Groundwater elevations in the Chestnut Ri



(ft msl)

sl)

ge Hydrogeologic Regime, January 16-17, 1992. Modified from: HSW, 1992a.

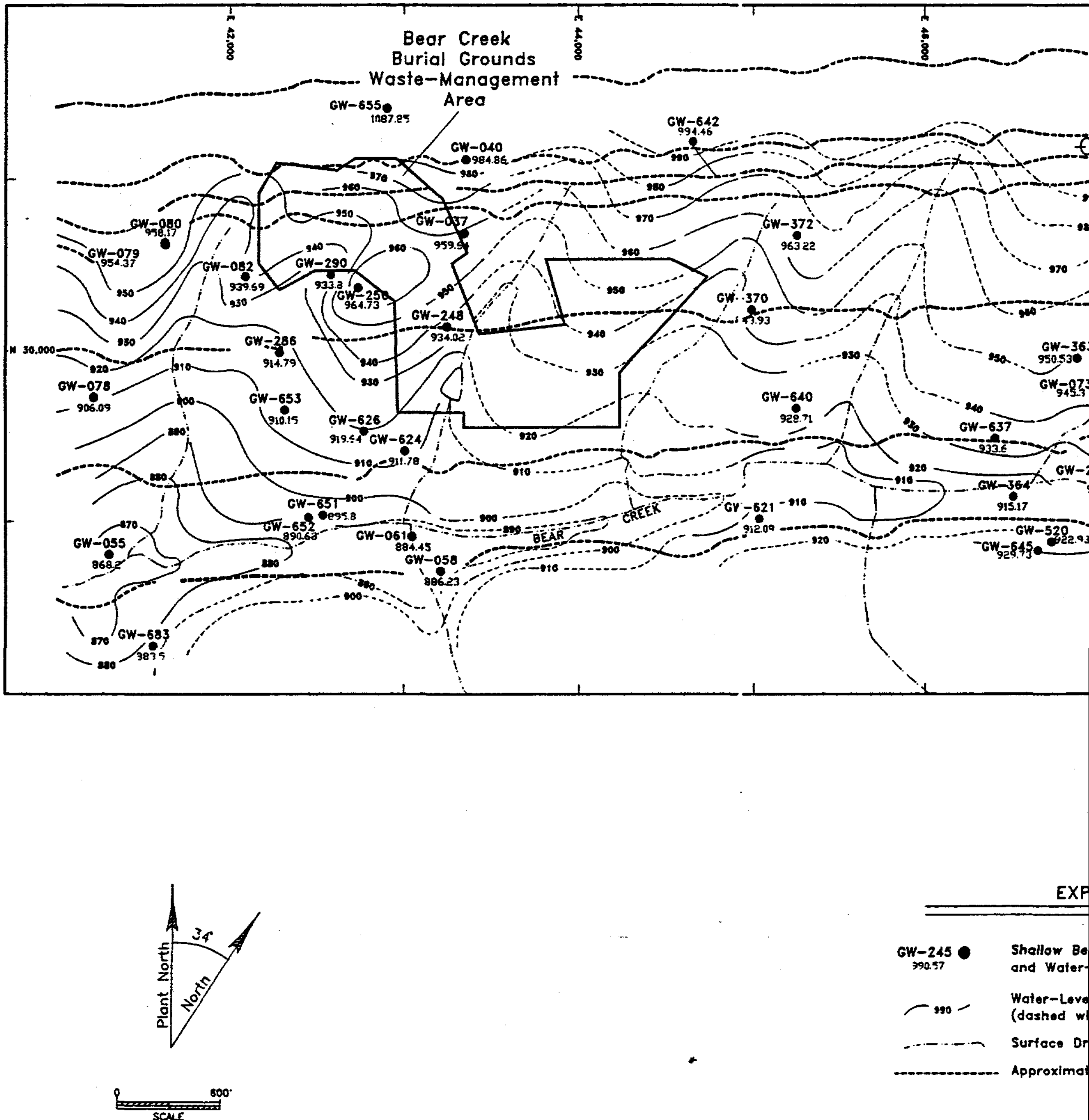
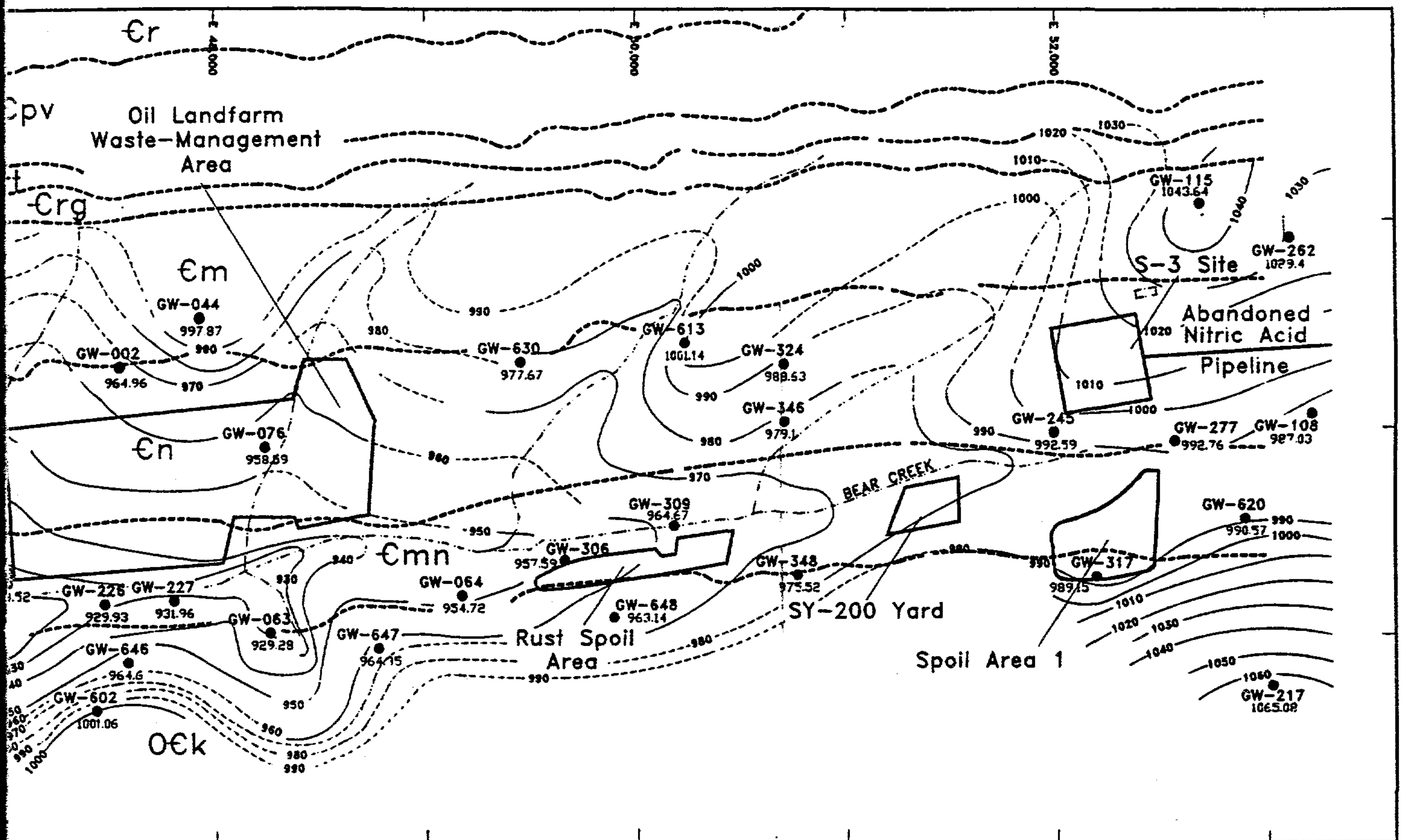


Fig. 1.3. Groundwat r elevations in the unconsolidated zon
to May 3, 1991. Modified from: HSW, 1992b.



ANATION

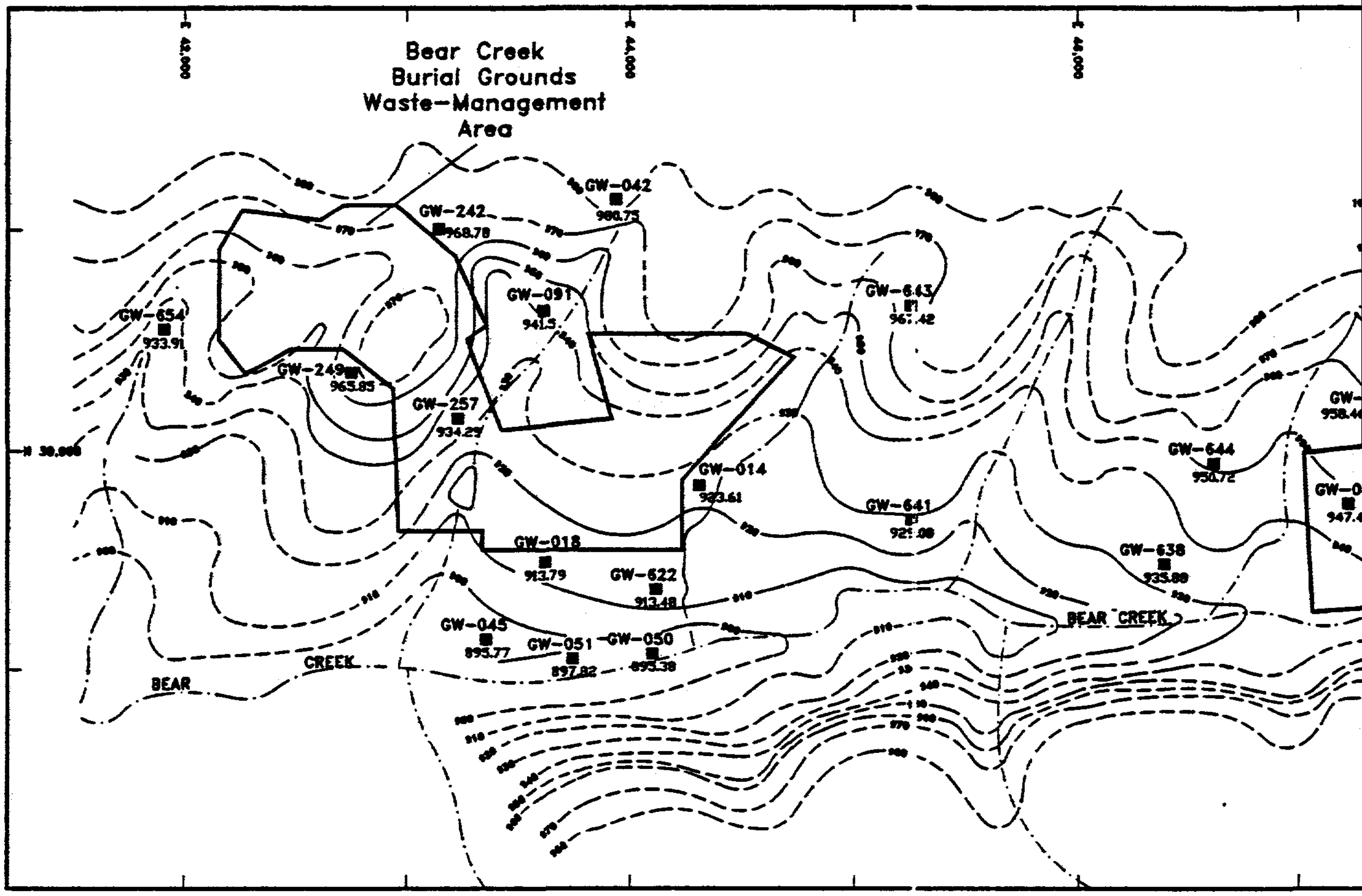
ock Monitoring Well
evel Elevation (ft msl)

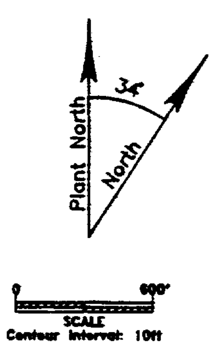
Isopleth (ft msl)
re approximate)

nage Feature

Location of Geologic Contact

from the Bear Creek Burial Grounds to the Bear Creek S.3 Site. April 29





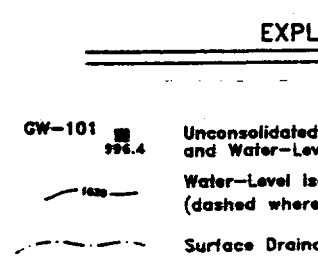
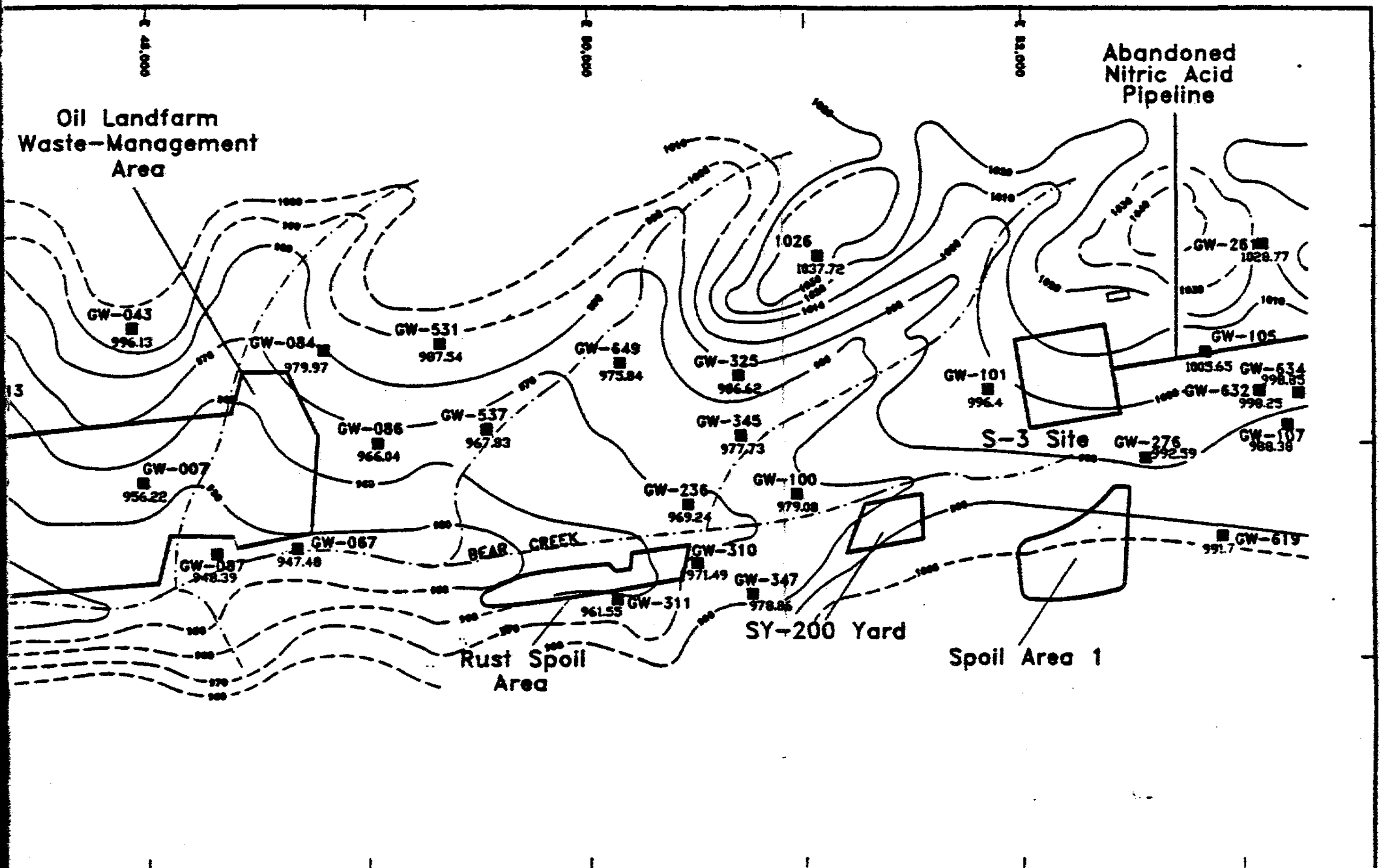


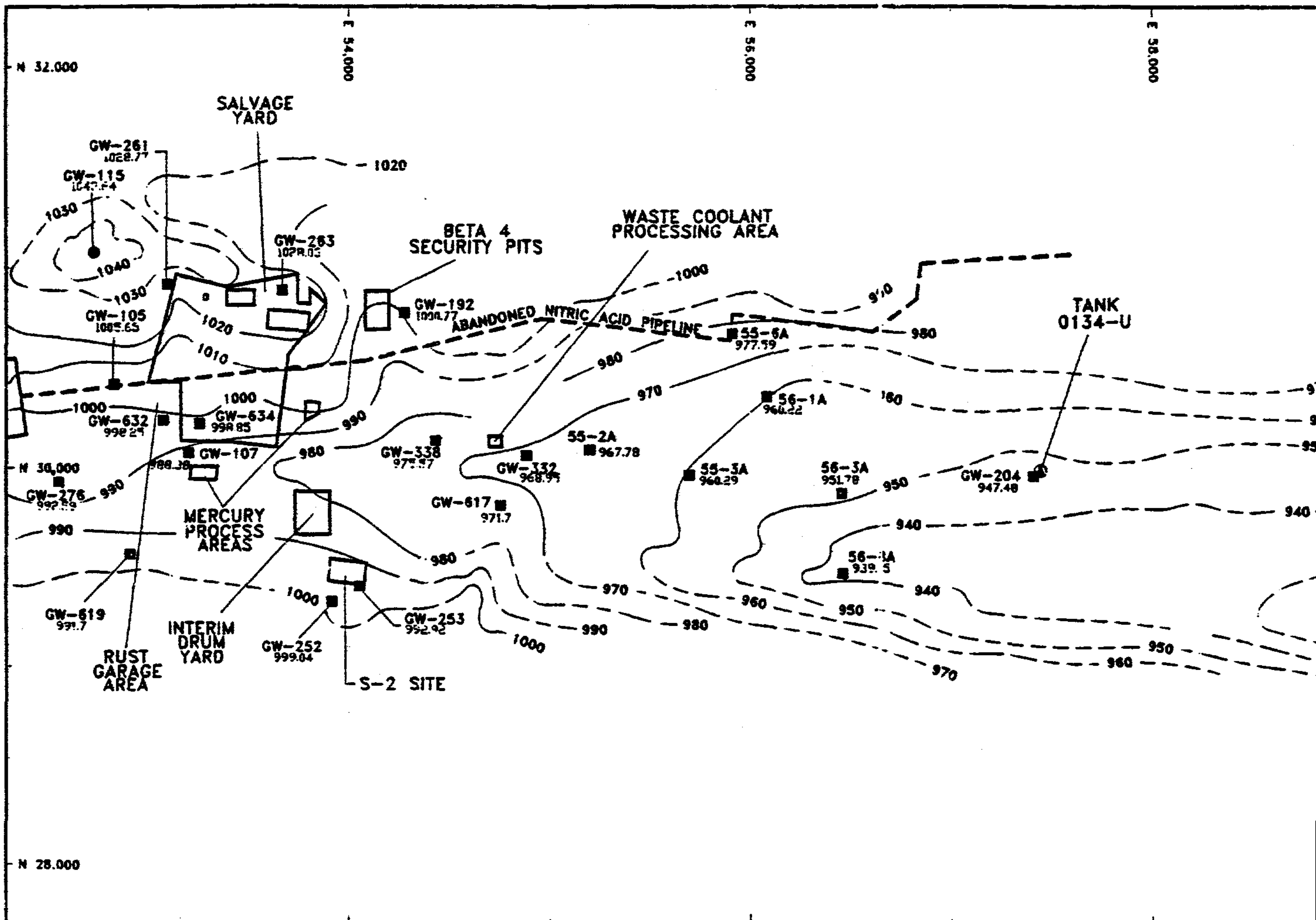
Fig. 1.4. Groundwater elevations in the shallow bedrock fro
to May 3, 1991. Modified from: HSW, 1992b.



NATION

one Monitoring Well
Elevation (ft msl)
ieth (ft msl)
nferred)
Feature

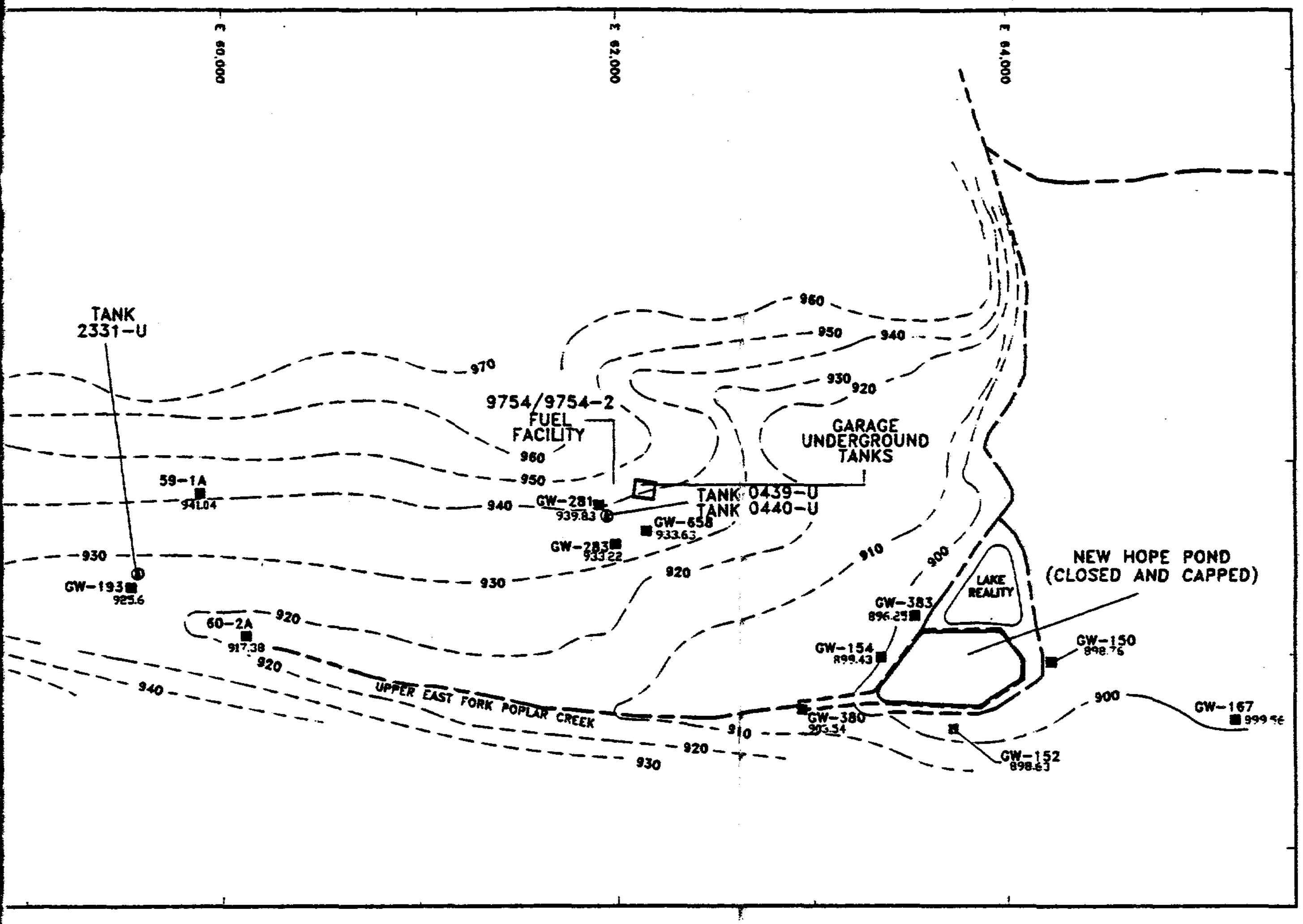
the Bear Creek Burial Grounds to the Bear Creek S.3 Site. April 29



EXPL

GW-150	Unconsolid and Water
GW-115 1043.64	Shallow B and Water
960	Water Lev (dashed w
	Surface D

Fig. 1.5. **Groundwater elevations in the unconsolidated zone and s Poplar Creek. Modified from: HSW, 1992c.**



NATION

ed Zone Monitoring Well
Level Elevation (ft msl)

rock Monitoring Well
Level Elevation (ft msl)

Isopleth (ft msl)
ere Inferred)

inage Feature

llow bedrock at the base of Chestnut Ridge at the headwaters of East Fork

1.3 SCOPE OF THE DYE-TRACER TEST

1.3.1 Initial Test History

The initial dye-tracer test was designed to delineate the general groundwater flow directions in CRHR and the discharge points originating from the CRSP area. The test was performed from July 1990 to October 1990 (Geraghty and Miller Inc. 1990b). Eighteen springs, 14 surface water sites, and 8 groundwater monitoring wells were monitored for the presence of the dyes (Fig. 1.6). Five weeks before the dye injection, charcoal detectors were installed at each monitoring site to assess the natural background fluorescence. Two weeks of background analytical data was collected during this 5-week period for measurement of background fluorescence. All but three sites had background fluorescence below the analytical detection limit of 1 part per billion (ppb) [BCK 10.14 SP-1.1ppb, UEFPC 17 SP-1.3ppb, WS 7.5 SW-2.6 ppb]. A slurry of 10 kg of sodium fluorescein dye and 20 gal of water was injected into well GW-178 on July 11, 1990, preceded and followed by a 1,000 gal. slug of potable water.

During the first dye-tracer test, a *positive* result or the *inferred* presence of dye was considered to be any concentration above the analytical detection limit of 1 ppb at those localities where no previous fluorescence baseline (background) was observed. A *possible* detection result was based on a concentration at sites above the observed background fluorescence. Positive detection results were identified at eight sites and were assumed to be in hydraulic connection with the source well, GW-178 (Geraghty and Miller, Inc. 1990b). These sites are: SCR-5.4SP, SCR-5.1SP, SCR-7.1SP, UEFPC-113, UEFPC-62, UEFPC-29, UEFPC-12/13, and GW-175. Possible connection was inferred to exist between GW-178 and sites BCK-10.14SP, BCK-9.00 SW, UEFPC-SP17, and WS 7.5 SW.

1.3.2 Objectives and Scope of the Second Dye-Tracer Test

The primary objective of the second test was to verify hydraulic continuity between the source well and groundwater discharge points identified as containing dye during the initial test. Corroboration of dye at selected sites common to both the initial test and the second test was intended to confirm point-to-point flow paths between the CRSP as a recharge area and the monitoring locations as discharge points. Minimum travel times and groundwater velocities were to be calculated from the results of the second test as well.

The design and methods for the second tracer test were analogous with the initial study, except as noted. The fundamental concern in test design was to substantiate the point-to-point contacts defined in the first study; therefore, the same monitoring well, GW-178, was used as an injection well and the majority of the same springs and surface water sites were incorporated as monitoring locations.

Variations from the initial study included the combined use of a fluorescent dye and an optical brightener, the conducting of the test under wet weather flow conditions, and the use of improved analytical instrumentation with lower detection limits. These variations were intended to optimize the success of the test by increasing the likelihood of dye transport and the probability of detection.

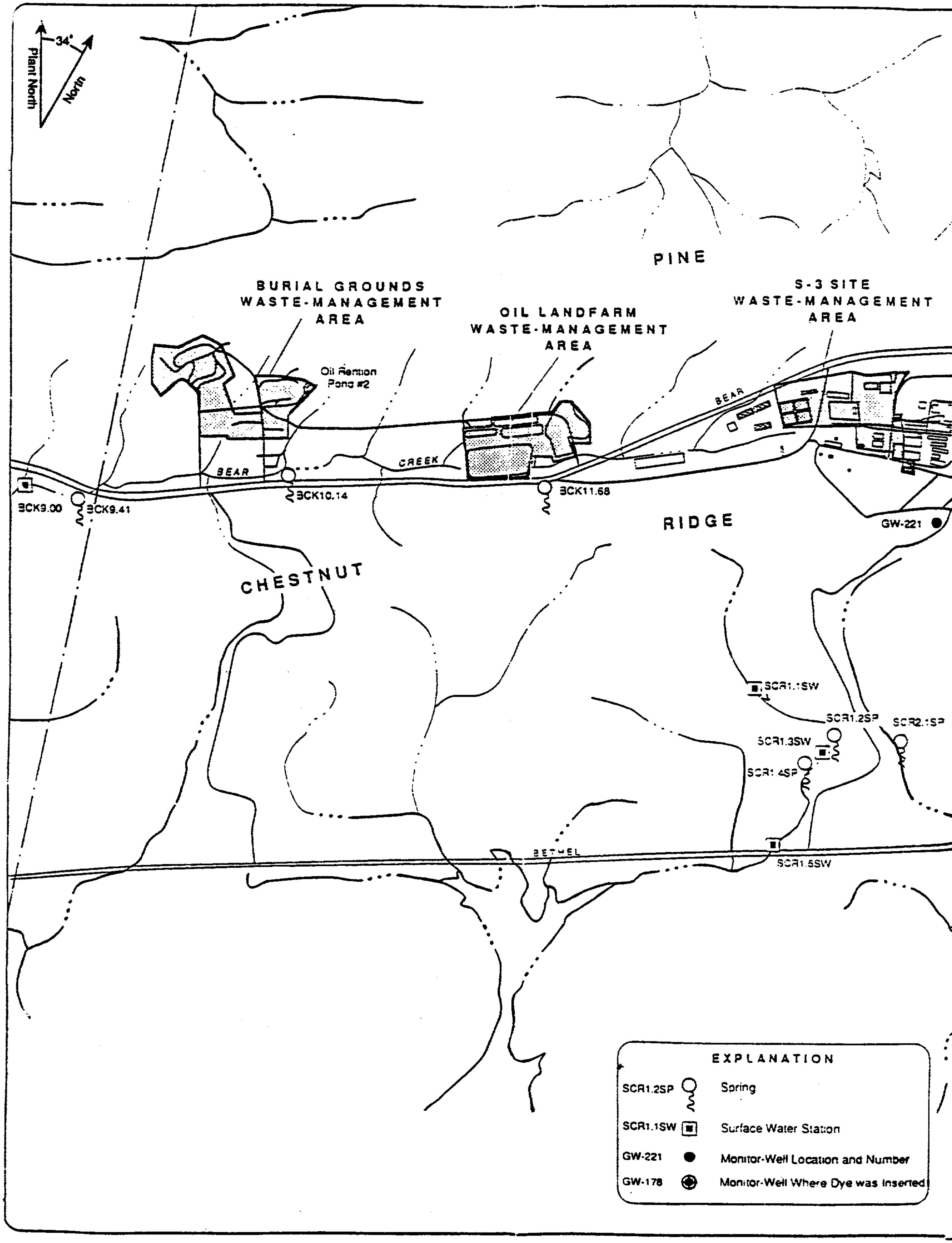
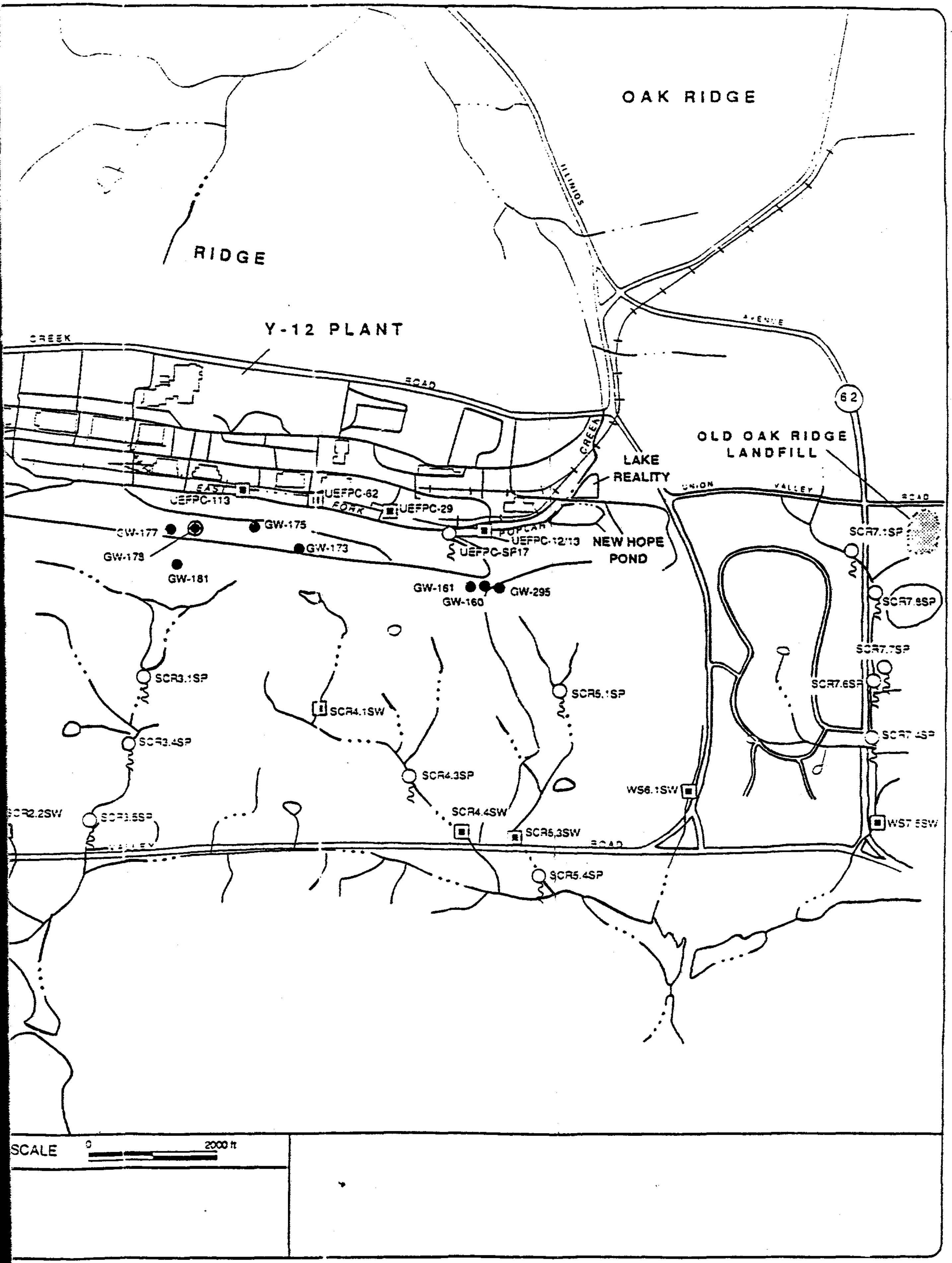


Fig. 1.6. Monitoring stations for initial dye-trac



r study. Source: Geraghty and M ller, Inc. 1989.

1.4 SUMMARY OF EVENTS

Evaluation of the results from the initial dye-tracer test, which ended in July 1991, indicated possible off-site occurrences of dye injected at the CRSP. A recommendation was made to TDEC to perform a second tracer test to confirm these results. The procedures and materials were reviewed and a field inspection of the monitoring sites was performed in the fall of 1991. Following discussion among Energy Systems, SAIC, and Quinlan and Associates, Energy Systems developed a work plan (Energy Systems, 1992). This plan was submitted in January 1992 to both DOE Oak Ridge Field Office and TDEC. Procurement of materials for the second dye-tracer test took place between the latter part of 1991 and February 1992.

The actual test commenced during the first week of February with a 4-week monitoring period to determine the baseline variability of Rhodamine WT (RWT) and Fluorescent Brightener 28 (FB28) or similar naturally occurring compounds. The first set of detectors was deployed on February 3 and collected on February 10 after a 1-week residence time at the monitoring sites. New detectors were exchanged for exposed detectors on a weekly basis thereafter. RWT and FB28 were injected on March 13. Problems with the post-injection water slug extended the recharge period to several days to complete the dye flushing. Weekly monitoring began with the collection of the first set of detectors on March 19. Minor problems occurred during the test. During the baseline period detectors were found missing. Extraneous dye sources at two locations, and interference caused by extraneous optical brightener on threads from the cotton detector packets (bugs) also occurred. More significant were the persistently high natural *background* levels of RWT throughout the test and the dry weather conditions encountered early in the test period. *Background* is defined for the purpose of this report as the inherent variability of the emission spectra within the wavelength range characteristic of RWT & FB28. The test was extended from its original length of 12 weeks to 18 weeks after reduced flow conditions and a lack of decisive results were recorded. The final period of monitoring ended July 17 with the retrieval of the final set of detectors.

2. INVESTIGATION METHODS

2.1 DYE-TRACER TEST DESIGN

The design of the second dye-tracer test was developed to address and overcome problems encountered during the first study. The test was timed to coincide with the wet weather season in order to have high flow conditions. The source well and monitoring sites were selected to provide data comparable with the first study while eliminating groundwater well sites that would only provide redundant data. Two dyes were chosen for the test to enhance discrimination and analysis during monitoring, and dye amounts were increased to provide greater detectability.

2.1.1 Seasonal Timing of the Dye-Tracer Test

The second dye-tracer test was planned to coincide with the historical wet season for the study area. Higher groundwater flow conditions associated with increased average rainfall potentially could provide for increased transport and alleviate low detection concentrations encountered during the first dye-tracer test. The optimum timing for the second test would be between December and March, which corresponds to the 30-year peak in average annual precipitation for Oak Ridge, Tennessee (NOAA, 1991).

The dyes were injected on March 13, 1992, just before the end of the historical wet season. The resulting monitoring period, between April and the end of July, corresponds to a historic period of normal rainfall, which should have produced adequate baseline flow to satisfy requisite test conditions. However, rainfall during May and June was well below historic averages (Fig. 2.1). Rainfall during June was less than one-third of normal, and dry monitoring locations were common (SCR 2.2 SW, SCR 4.1 SW, SCR 4.4 SW, GW 561).

2.1.2 Monitoring Site and Source Well Selection

The selection of the source well and monitoring sites for the second dye-tracer test (Fig. 2.2) was controlled by the requirement to assess the results from the first study. A principal objective of this dye-tracer study was to confirm the inferred hydraulic connections between the source well and the following sites: SCR-5.4SP, SCR-5.1SP, SCR-7.1SP and UEFPC-29. These inferred connections are based on the presence of dye above the analytical detection limit at these localities during the first dye-tracer test. Some monitoring locations from the first study were eliminated as redundant, in particular those immediately adjacent to CRSP and several surface water monitoring stations along Upper East Fork Poplar Creek (UEFPC). Two additional wells, GW-232 and GW-561, (Table 2.1) were included for monitoring due to their probable intersection with the karst groundwater system. Monitoring well GW-734, completed in a large void downgradient of CRSP, was added to the monitoring routine *after* injection of the dye.

Table 2.1 Monitor wells used in second dye-tracer study

WELL	GW160	GW178*	GW221	GW232	GW561	GW734
Northing	27803	28552	28359	28546	27811	28682
Easting	62165	57808	54389	66863	59323	64943
ELEV-TOC	1093.09	1143.49	1106.00	931.22	1033.35	939.93
TD	235	133	158	411.7	91	unknown
Screen:						
Top	205 (open)	122	148	401 (open)	79.9	59 (open)
Bottom	235	132	158	411.7	89.9	unknown
CSG OD	6.62	4.5	4.5	4.38	4.0	7.0

*Source well for dye.

The source well, GW-178, was the same for both tests in order to provide directly comparable data for both studies. The initial selection of GW-178 was based on the spatial proximity of the well to CRSP. The drilling log for GW-178 indicates that numerous cavities were encountered between 43 and 83 ft, and that fractures were noted from 74 ft to total depth (Energy Systems 1991). However, the screened interval in this well, from 122 to 132 ft within the Cambrian Copper Ridge Dolomite, only intersects two noted fractures. During the first dye-tracer test, a single well volume (29.6 gal) of

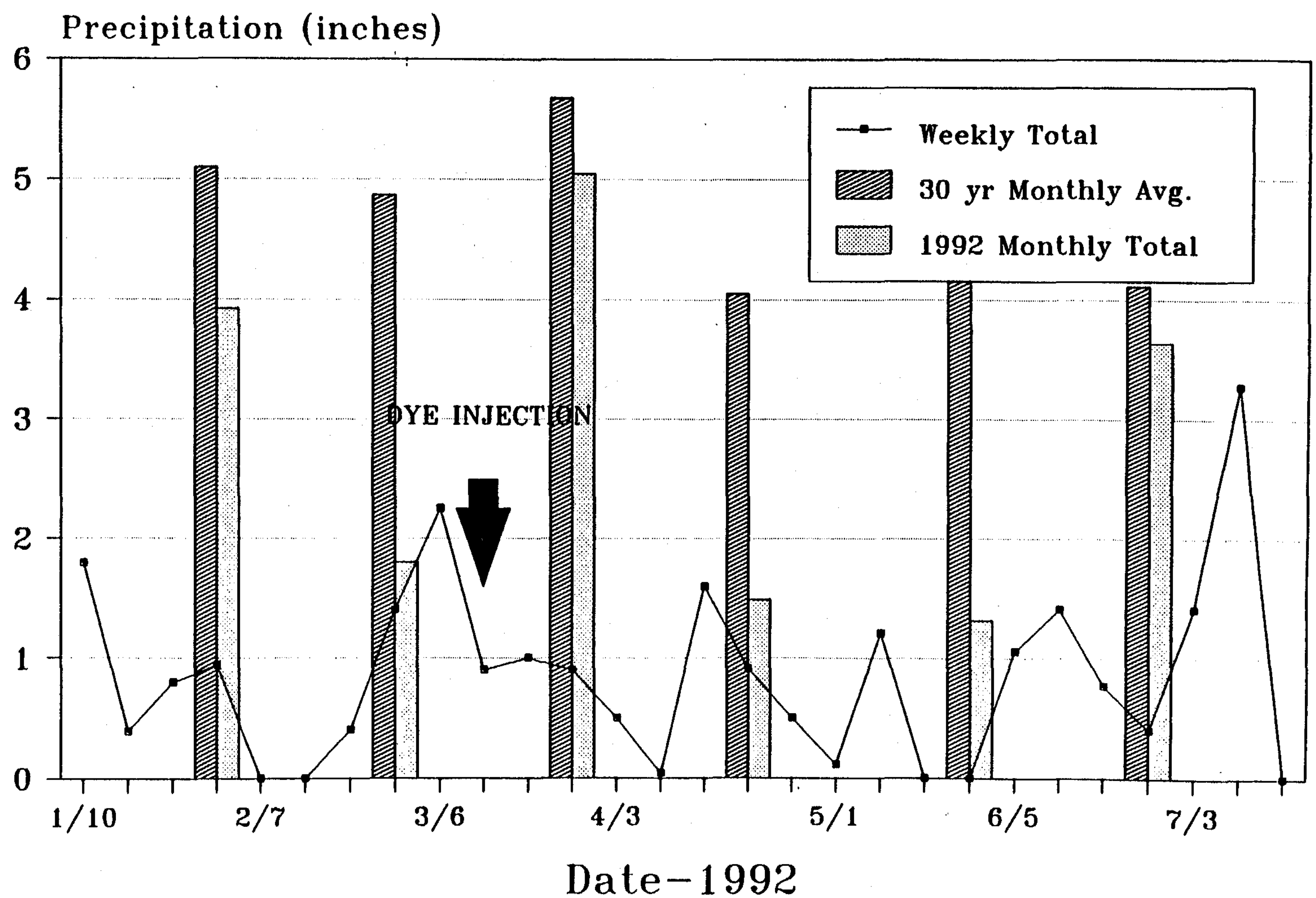


Fig. 2.1. Comparison of rainfall between test period and 30-year average.

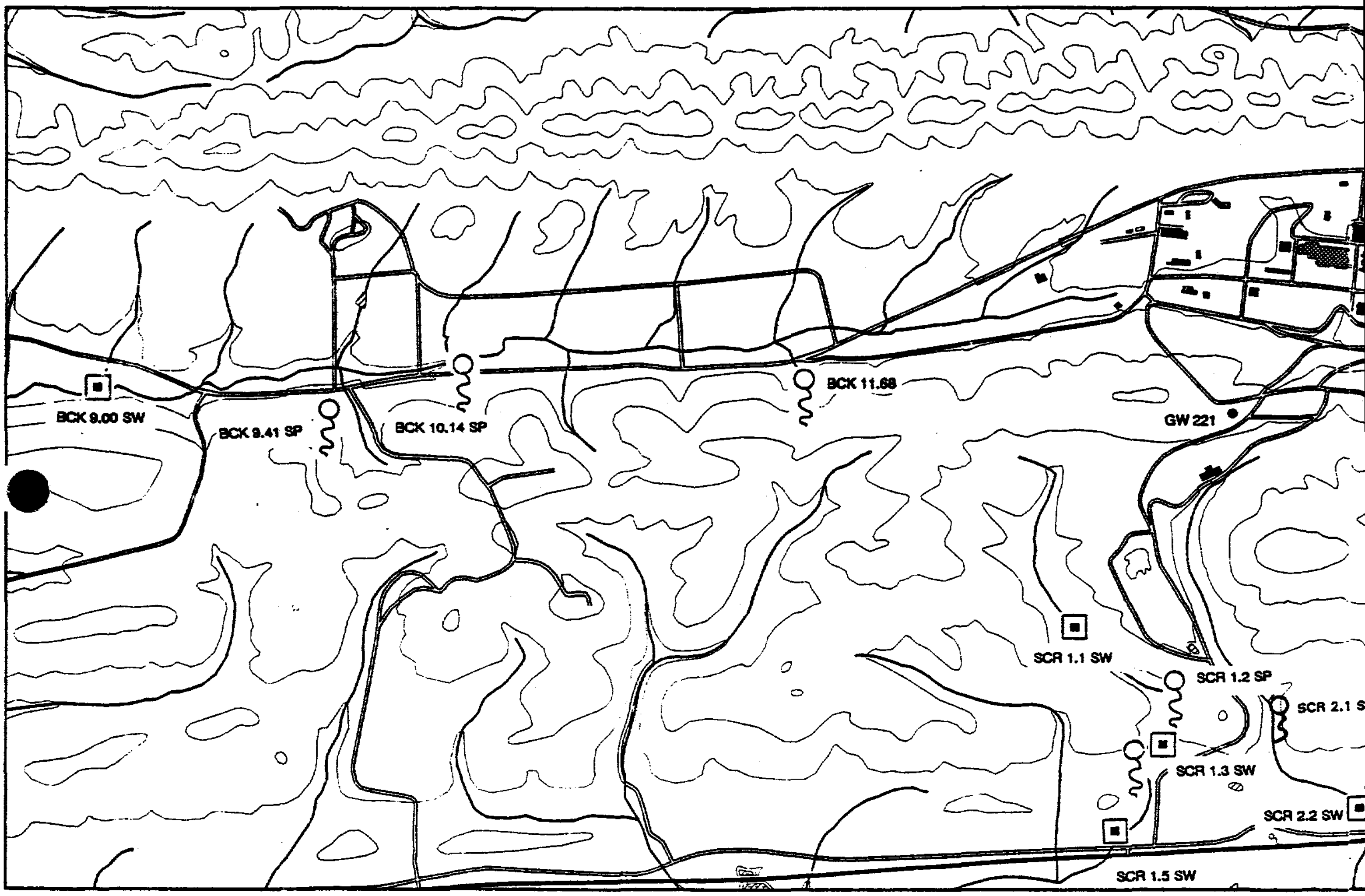
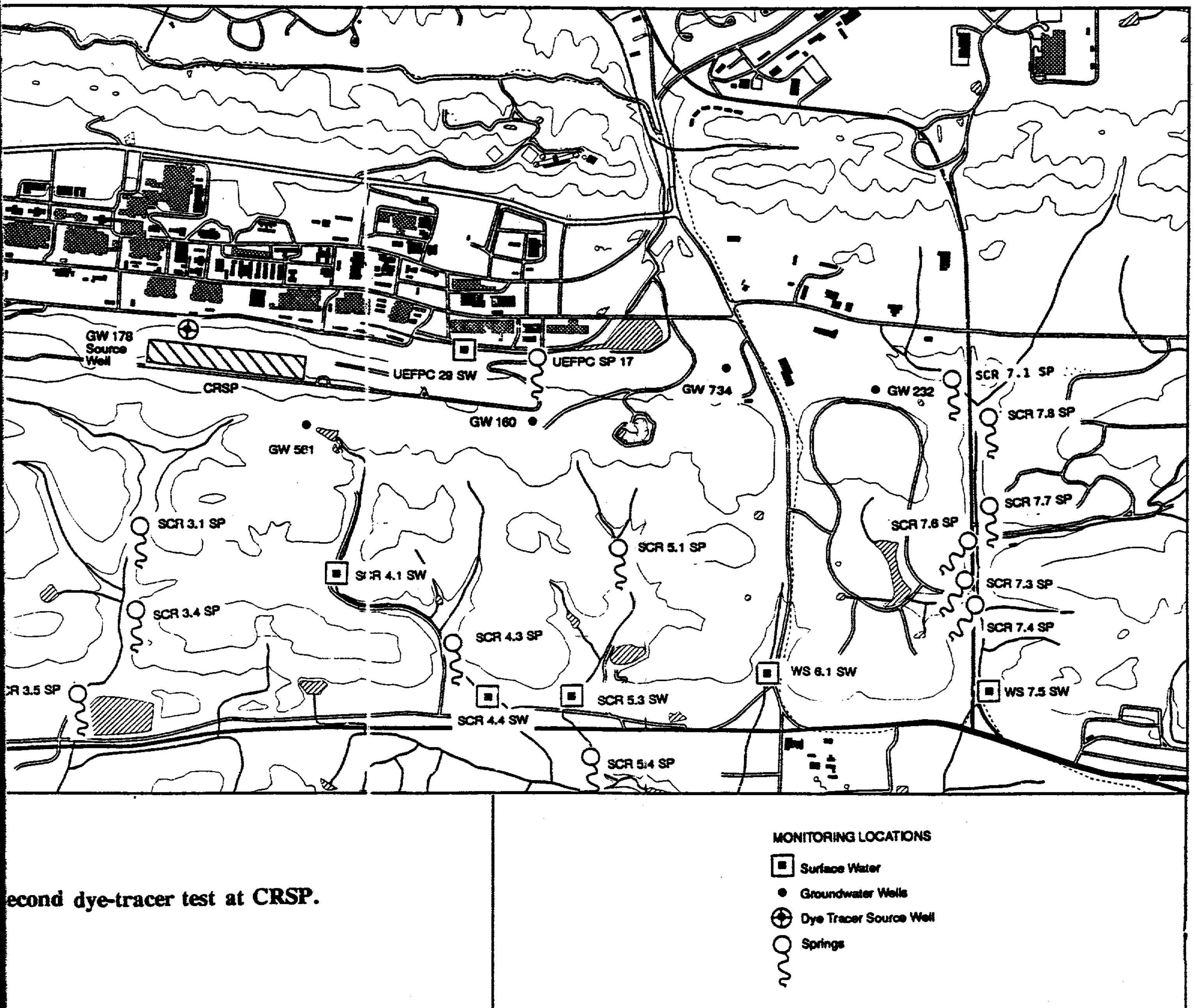


Fig. 2.2. Monitoring stations for the



econd dye-tracer test at CRSP.

potable water was introduced to the source well to assess transmissivity. The well volume discharged to the surrounding aquifer within several hours (Geraghty & Miller 1990), indicating some degree of hydraulic interconnection between the source well and the surrounding aquifer.

2.1.3 Tracer Dye Selection

An evaluation of tracer dyes commonly used for monitoring groundwater flow was conducted during development of the work plan for the second dye-tracer test [The reader is referred to the work plan for a detailed discussion of the selection process. (Energy Systems 1992)]. Since sodium fluorescein was used during the first dye-tracer test, this dye was eliminated from consideration due to the possibility of extraneous dye sources and the potential for confusion of temporal interpretations of test results. The results of the dye evaluation indicated that a relatively small number of dyes were available with the necessary properties to be used as groundwater tracers. For a tracer to be useful in monitoring groundwater flow, it must meet several requirements:

- The tracer must be conservative within the environment used.
- The tracer should have no other potential sources within the study area.
- The tracer must have a very low toxicity.
- The tracer must have a very low detection limit and high recovery rate.
- The tracer must be cost effective.

The dyes chosen to provide the best combination of key properties were RWT and FB28. The use of two simultaneous dyes was recommended to provide enhanced detection and evaluation of dye presence/absence and to produce higher resolution breakthrough curves. Since groundwater flow paths for both dyes should be the same, the use of two dyes also provides a means to distinguish *background* noise from a positive detection at very low concentrations.

The volume of dye to be injected into the source well was determined based on the results of the first dye-tracer test, analytical detection limits, estimated aquifer volume, and toxicity limits. Since no large quantities of dye were detected at monitoring points during the first test, an increase in the amount of dye used was indicated. Prior to the test, the minimum detection limits for RWT and FB28 were thought to be 50 parts per trillion (ppt) and 1000 ppt, respectively. To achieve these concentrations over the relevant portions of the various groundwater basins, an increase of several orders of magnitude in the amount of dye used during the first test would be required. Since effective aquifer volumes in karst/fracture dominated flow systems are typically much lower than those in granular aquifers (but volumetric estimates are unreliable), the dye concentrations incorporated into the first test were doubled for both RWT and FB28.

The actual amount of dye used was 225 lbs of 20% Rhodamine WT solution (lot #49) from Chem Central Dye Stuffs, Romulus, Michigan, and 246 lbs of Burco Fluor AR solution (lot B5-21892), optical brightener equivalent to FB28, from Burlington Chemical Company, Burlington, North Carolina. Based on toxicity, carcinogenicity, and mutagenicity data (Energy Systems 1992) for these dyes and the expected dispersion of the dyes within the groundwater aquifer, these dye amounts posed a negligible hazard to human health and the environment.

2.2 FIELD METHODS

2.2.1 Field Monitoring Activities

Field monitoring activities included the deploying, recovering, handling, screening, and transporting dye detectors. Unbleached cotton and activated charcoal dye detectors were deployed to monitoring sites (springs, wells, and streams) on a weekly basis, and, after the first week, exposed detectors were recovered at the same time. Detectors were handled in a way that minimized the possibility of cross-contamination between detectors and between sites. Detectors were isolated during transport, and field screened for the presence of optical brightener. All data associated with these activities was recorded in the field and reported on a weekly basis.

Both cotton and charcoal detectors placed in springs and streams were initially suspended from wire loops embedded in a 6-inch diameter concrete block or attached to reinforcement bar that was hand-driven into the stream bed. A number of detectors were lost to wildlife predation, so the detector stands were modified to include a stainless steel cage around the detectors. Detectors in monitoring wells were suspended from string at the mid-point between observed water level and the base of the well. The elevation of the detectors in wells was adjusted on a weekly basis to reflect changes in water level.

Retrieval and replacement of exposed detectors was performed on a weekly basis over the duration of the test. Field teams collected the detectors from distal monitoring points, and sampling proceeded upgradient toward the source well. At each station, the exposed detectors were removed by a technician wearing clean disposable gloves, placed in a prelabeled plastic bag, and stored in a cooler for transport to the laboratory. The technician donned fresh gloves and deployed the replacement detector at the site. Due to the low flow conditions during most of the test, field team members rarely had to enter the water at a monitoring site. When surface waters were entered, pre-cleaned boots and equipment were used. After exposure to the water, boots and equipment were bagged for later decontamination to prevent cross-contamination in the next use.

After completing deployment and recovery of detectors, the field teams transported the detectors to Oak Ridge National Laboratory (ORNL) for field screening and laboratory analysis. Cotton detectors were field screened for the presence of optical brightener by placing them on a clean surface and scanning with a long-wave ultraviolet lamp. Custody of the exposed detectors was then transferred to ORNL in accordance with Method ESP-500 Manual Chain-of-Custody Procedures (Energy Systems 1988b), where they were stored under refrigeration pending analysis.

Records of field notes, screening results, analytical services requests, and chain-of-custody forms were maintained on a continuing basis. These records are included as part of the dye-tracer study project file. The results of these activities were summarized and included in weekly progress reports.

2.2.2 Field Measurement of Physical Properties

During weekly deployment and collection of detectors, the discharging groundwater was monitored for temperature, pH, and specific conductivity immediately downstream of the detector. These measurements were taken after detector replacement to minimize handling of detectors after contact with the water. The results of these measurements were recorded for each site during each week of monitoring and are provided in Appendix A.

Temperature measurements were taken in accordance with Method ESP-307-1 *Field Measurement Procedures: Temperature* (Energy Systems 1988b). Method ESP-307-2 *Field Measurement Procedures: pH* (Energy Systems 1988b)was used to measure pH. Specific conductivity was measured following Method ESP-307-8 *Field Measurement Procedures: Conductivity* (Energy Systems 1988b). Each instrument was calibrated in accordance with manufacturer's specifications on a daily basis prior to departing for the field. The instruments were decontaminated between monitoring stations with a 5% bleach solution and clean water rinse. The results of these measurements were recorded with the field notes for each site and were tabulated in weekly reports. These data are included in Appendixes A and B.

2.2.3 Field Quality Assurance Practices

Quality Assurance (QA) during all phases of the field effort was ensured by following guidelines of DOE Quality Assurance (DOE Order 5700.6c) and the Y-12 Quality Assurance Program Plan (Energy Systems 1988). Field activities were performed in accordance with approved practices as specified in *Environmental Surveillance Procedures Quality Control Program* (Energy Systems 1988b) and the TDEC-approved *Work Plan for the Second Dye-Tracer Test at the Chestnut Ridge Security Pits, Y-12 Plant, Oak Ridge, Tennessee* (Energy Systems 1992).

Field QA during the second dye-tracer test was checked through the use of field blanks from the same numbered batch of detectors during detector collection. The exposed detectors collected by the field teams were stored in a cooler (maintained at approximately 4°C) during collection and during transport to the laboratory. An unexposed charcoal detector (trip blank) was included with each cooler as a field blank to monitor the integrity of the detector containers (zip-sealed plastic storage bags) and as a check for potential cross-contamination. The field blanks were eluted and analyzed by the laboratory, and results were reported on a weekly basis.

The results of field blank analyses during the dye-tracer test are presented in Fig. 2.3. These results indicate a relatively high variability (±1 ppb) in field blank *background* which is temporally associated with the beginning (weeks -4 to 3) and end (weeks 14 to 18) of the test. This variation also corresponds to changes in the batch of detectors used and probably reflects inherent differences in the spectral fluorescence of the charcoal in the detector packets (Sect. 2.3). In general, the field blank analytical data indicate that no discernable cross-contamination of the detectors occurred during collection or transport. However, the high variability of the *background* set a minimum detection limit for the test.

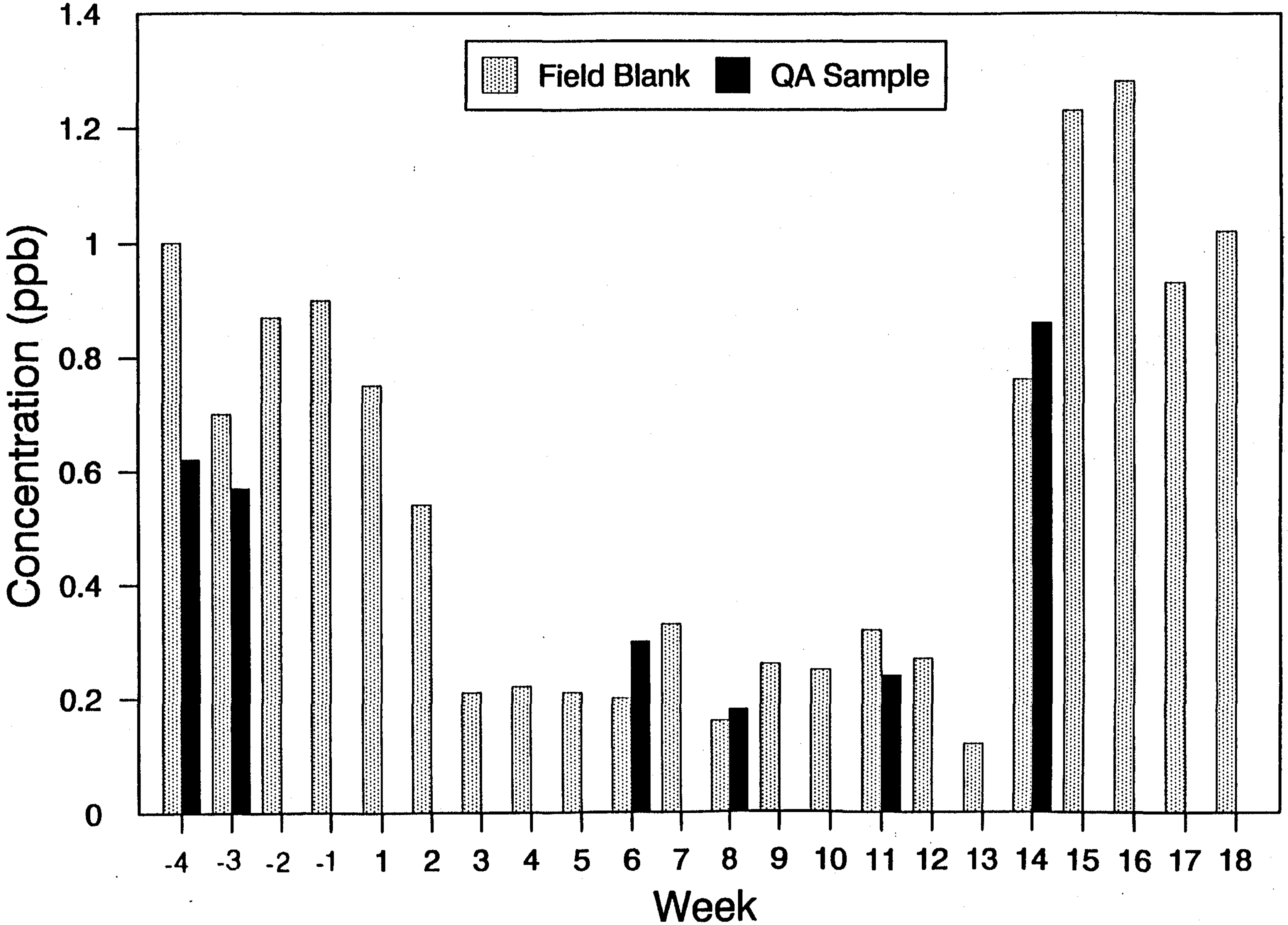


Fig. 2.3. Charcoal detector field blank results during the second dye-tracer test at CRSP.

2.3 ANALYTICAL METHODS

2.3.1 Laboratory Methods

Upon receipt, each cotton detector was removed from its mesh bag and rinsed in a jet stream of distilled, deionized water for several minutes. Rinsing was stopped when all visible signs of mud, silt, algae or other materials were gone. Excess water was squeezed from the detector and it was viewed under a long-wave UV lamp in a light box. A blue-white fluorescence was considered to be a positive indication of dye (FB-28) presence. The intensity of fluorescence was qualitatively ranked based on the intensity observed for detectors exposed to known quantities of FB-28. Rankings were established as "very weak," "weak," "medium," "strong," and "very strong" based on observations of detectors exposed to 150mL of 2 ppb, 20 ppb, 200 ppb, 1 ppm, and 8 ppm concentrations of FD-28 for 24 hr.

Individual detectors were then sandwiched between two pieces of glass microscope slide and placed in the front surface accessory of a Perkin-Elmer LS-50 luminescence spectrometer. Fluorescence emission spectra were collected under the following conditions:

- Excitation wavelength: 343 nanometer (nm)
- Excitation bandpass: 6 nm
- Emission wavelengths: 375-475 nm
- Emission bandpass: 5 nm
- Scan Speed: 20 nm/min

To account for the variable physical nature of the samples (i.e., some detectors scattered most of the incident light, whereas others were highly absorbing), the fluorescence emission intensity at 431 nm was compared to the scatter at 375 nm. Quantitative results were obtained by comparison with an external standard calibration curve obtained for detectors exposed to known quantities of FB-28.

Charcoal detectors were refrigerated until the day of analysis. Individual detectors were first rinsed for 3-5 minutes under a jet of distilled, deionized water until visibly clean. Because of frequent rusting, paper clips were removed from the detectors prior to rinsing. Excess water was then shaken from the detector, and the detector was placed in a 100 mL beaker. A 30 mL aliquot of "Smart" solution (50% n-propanol, 30% water, and 20% concentrated ammonium hydroxide) was added immediately to the beaker to elute the dye. Immediate addition of the "Smart" solution was important because if the charcoal was allowed to dry, many carbon "fines" were produced. [Charcoal fines are difficult to remove from samples and produce elevated *backgrounds*]. A watch glass was placed over the beaker to prevent evaporation during extraction. After 16 hr, 10 mL of the "Smart" extract was decanted into a centrifuge tube. The remaining extract was saved and archived (refrigerated). Samples for fluorescence analysis were centrifuged for 10 min at 3000 rpm (45,000G) and then transferred into a quartz cuvette. The cuvette was placed in the cuvette sample holder of the LS-50 luminescence spectrometer and analyzed by synchronous fluorescence under the following conditions:

- Wavelength range: 500-600 nm
- Wavelength difference: 16 nm
- Excitation bandpass: 5 nm

- Emission bandpass: 5 nm
- Scan speed: 20 nm/min

Quantitative results were obtained by comparing fluorescence intensity at 551 nm against an external calibration for RWT in "Smart" solution.

2.3.2 Analytical Interferences and Detection Limits

Fluorescence spectra were obtained using a research quality Perkin-Elmer Model LS50 luminescence spectrometer. The instrument can be configured to collect excitation, emission, or synchronously scanned spectra. Early in the project, optimum operating conditions for the analysis of FB-28 on cotton and Rhodamine WT in "Smart" solution were determined and are listed above. In "Smart" solution, Rhodamine WT could be detected in the linear dynamic range 10 parts-per-trillion (ppt) to 1 part-per-million (ppm). However, extraction of undeployed charcoal "bugs" produced a considerable analytical *background* attributable to carbon "fines" and extractable organic compounds. This *background* was observed in QA and field blank samples. Figure 2.3 is a summary of the charcoal field blank and QA sample results. The concentration is reported in "apparent" parts-per-billion Rhodamine WT. There was considerable variability in the field blanks. This wide variation can be attributed to the charcoal because the field blank concentrations (spanning several weeks per batch of charcoal) followed closely the batch-to-batch variation in QA samples. These eluant *backgrounds* also established the true minimum detectable concentration for each week's samples (in every case the apparent concentrations of the extracts were above the 10 ppt minimum detectable level obtained in pure "Smart" solution). For example, during week 16 of the test only concentrations considerably above 1.3 ppb could be considered as "detects." This does not imply that field detectors cannot exhibit concentrations lower than the blanks but the effective detection level must be determined by the blanks.

In addition to charcoal interference, materials in the samples also can contribute to the spectral *backgrounds*. Humic acids, fulvic acids, and other natural compounds can appear in the spectra as well as different dyes arising from anthropogenic sources. For example, Rhodamine WT is spectrally indistinguishable from Rhodamine B under normal fluorescence conditions. In fact, many of the samples in the study contained multiple spectral peaks, most of which were distinguished from the Rhodamine WT but elevated the *background* in the region of the Rhodamine WT. Thus, samples with large *background* peaks in the spectra could result in artificially high apparent Rhodamine WT concentrations. An example of a frequently encountered large peak at about 500 nm with a shoulder at about 550 nm is compared with a 2 ppb Rhodamine Wt sample in Fig. 2.4 clearly demonstrating the potential for *background* interference. In contrast to the charcoal interferences, the cotton sample interferences were not systematic. Frequently, large *background* peaks would appear one week and be gone the next only to return several weeks later. Samples with *background* peaks were scrutinized closely to ensure that dye was not present.

Fluorescence measurements of the cotton samples were made difficult by large, sample-to-sample variations in light scattering. Although some samples were visibly white, they absorbed UV light strongly. Others scattered most of the UV light. The difference can be attributed to irreversibly adsorbed, non-dye sample components. The minimum detectable concentration was established at 200 ppt for calibration standards. Many samples had even lower apparent concentrations because of the aforementioned light scattering variation; however, the practical limit of 200 ppt was used to evaluate

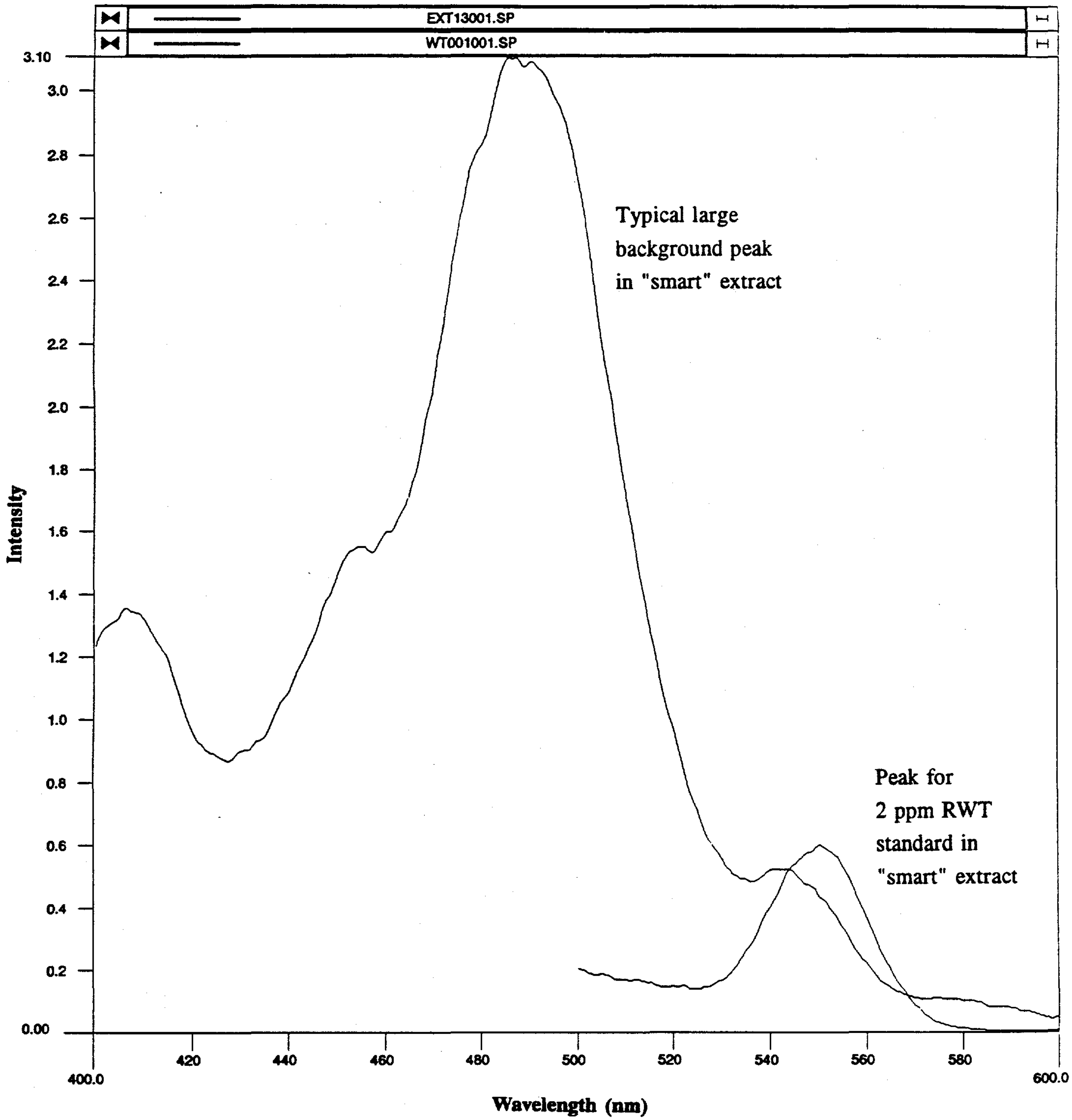


Fig. 2.4. Characteristic emission spectra for Rhodamine WT during the second dye-tracer test at CRSP.

dye presence in all of the samples. Similar to the charcoal samples, peaks from additional sample components appeared in some of the spectra. In addition to the principal peak at 431 nm, a characteristic secondary peak at 411 nm was used to confirm the presence of FB-28.

2.3.3 Laboratory Quality Assurance

Quality assurance and control measures were used throughout the study. "Smart" solution was prepared fresh daily and analyzed at the beginning and end of each day to check for contamination. A full set of calibration standards was analyzed at the start of each week. Three standards were analyzed at the beginning of each day to confirm that the calibration remained valid. To establish reproducibility, one in every 15 cotton samples was run in triplicate and one in every 15 charcoal extracts was split and analyzed. In addition, random samples from each batch of cotton bugs were checked for *background* fluorescence under long-wave UV irradiation. Two charcoal bugs from each batch were also tested. One was extracted with "Smart" solution to test for *background* fluorescence. The other was exposed to 100 mL of 50 ppb Rhodamine WT in a 150 mL beaker for 24 hr and then extracted with "Smart" solution. The presence of dye in the extract was used to confirm charcoal capacity.

2.4 DYE-TRACER TEST PROBLEMS

Several problems were encountered during the performance of the second dye-tracer test. The most significant of these problems was unseasonably low rainfall, which reduced baseline flow conditions during much of the study. The low transmissivity of the source well after dye injection produced difficulties during injection of the following slug. The source well was purged accidently several weeks after dye injection, also demonstrating that an observable quantity of dye remained near the source well. Extraneous dye sources and the variability of baseline dye concentrations degraded the effective detection limits and produced uncertainty in the interpretation of monitoring results.

A weekly description of flow conditions is provided under comments for each site in Appendix A. In several locations, dry or low flow conditions were observed throughout the test period. Dry to low flow periods are summarized in Table 2.2. During weeks 4 through 18, the stream at station SCR 2.2 SW was dry. Station SCR 4.4 SW had low flow conditions in weeks 5 and 6, and was dry in weeks 8 through 18. Station BCK 10.14SP, BCK 11.68SP, SCR 3.1SP, and SCR 3.45SP had low flow conditions from week 5 to week 7. Flow at SCR 4.1SW was described as low to almost dry during weeks 5 through 15. SCR 7.1SP was low to stagnant during weeks 5 through 9. During weeks 8 through 13 low or low to medium flow was observed at station BCK 9.00SW. Monitoring well GW-561 was dry during weeks 13 through 18.

Table 2.2 Dry to low flow conditions during the second dye tracer study

Station	Flow Trend	Weeks
GW-561	Well Dry	13-18
BCK 9.00 SW	Low or low to medium flow	8-13
BCK 10.14 SP	Low flow	5-7
BCK 11.68 SP	Low flow	5-7
SCR 2.1 SP	Intermittent low flow	5-17
SCR 2.2 SW	Dry	4-18
SCR 3.1 SP	Little to low flow	5-7
SCR 3.4 SP	Low flow	5-7
SCR 4.1 SW	Low flow to almost dry	5-15
SCR 4.4 SW	Low flow	5-6
SCR 4.4 SW	Dry	8-18
SCR 7.1 SP	Low to stagnant	5-9

2.4.1 Low Seasonal Rainfall

Rainfall during the second dye-tracer test was exceptionally low over much of the monitoring period. Measured precipitation was approximately 25% lower during the test than the 30-year average for rainfall. Significantly, nearly half of the measured rainfall occurred during the last 6 weeks of the monitoring period. The low rainfall affected baseflow conditions in the underlying karst aquifer throughout the study area. Thirty-two samples were collected at various monitoring stations over the duration of the study during dry conditions; thus, they yielded the expected *background* results.

The planned monitoring duration for the second dye-tracer test was 12 weeks; this was extended to 18 weeks due to the low rainfall and negative detection results. Near the end of the monitoring period (June and July), rainfall events increased in number and total precipitation increased significantly. A general increase in base flow conditions occurred in response to the increased rainfall.

The impact of reduced rainfall and low baseline flow conditions on the transport and detection of tracer dyes is difficult to fully assess. However, it is well established that karst aquifers may have multiple flow paths which are, at least in part, dependent on baseline flow conditions. For this reason, the first 10 to 14 weeks of the monitoring period may be considered to represent low flow/dry season baseline flow conditions. Under these conditions, groundwater within the aquifer beneath CRSP may be either following an alternate, and deeper, pathway to intersect the surface water system, or groundwater may remain in storage until an increase in baseline flow conditions. The last 4 to 8 weeks of the monitoring period reflect an increase in baseline flow conditions to normal or high flow conditions.

2.4.2 Dye Injection

Dye injection at the source well (GW-178) was performed on March 13, 1992, after 4 weeks of baseline monitoring. Preparation for dye injection began on March 12, 1992, when the introduction of an initial 1000 gal slug of potable water was started by gravity-flow into GW-178. In the morning of March 13, 1992, the wellhead area was diked and covered with plastic sheeting. At approximately 0930 pumping of dye into the well was started, and injection of both dyes was completed by 1150. Introduction of a 1000 gal slug (following the injection of the dyes) began immediately after site cleanup. Transmissivity of the well was substantially reduced after dye injection, and introduction of the following slug was not completed until March 18, 1992.

Before beginning the initial 1000 gal slug of potable water, a depth-to-water measurement taken from the top of the well casing was 87.5 ft. The initial slug was begun at 1750 on March 12, 1992, at an initial flow rate of 1.25 gal per minute (gpm) and was checked periodically to prevent overfilling. Water flow for the initial slug was stopped at 0930 on March 13, 1992, with a total of 836.6 gal placed in the well over 15.5 hours, which implies an overall flow rate of 0.89 gpm.

After completing the initial slug, the site was prepared for dye injection. Portable berms were placed around the wellhead and plastic sheeting was taped down surrounding the well. Dye canisters were shaken, placed in a lined trash can within the diked area, opened, and a pump tube was inserted. The dye was pumped with an ISCO peristaltic pump by personnel dressed in disposable protective clothing and gloves. A semi-solid dye precipitate noted in the bottom of RWT canisters was subsequently mixed with potable water and pumped into the well. A total of 25 gal of each dye, in 5 gal canisters, was pumped into the source well. After dye injection, the site was cleaned up to ensure no dye was lost to the environment, and all trash was properly disposed of outside the dye-tracer test watershed.

Introduction of the following 1000 gal slug was begun after cleanup from the dye injection and after clean plastic sheeting was laid out in the diked area surrounding the wellhead. At 12:03 on March 13, 1992, the following slug was started and the water level in the well was continually monitored to prevent overfilling. The transmissivity of the well was substantially reduced, and after several attempts, the only sustainable flow rate achieved for the following slug was 0.1 gpm. Potable water was added to the well intermittently over the next 5 days and the flow rate gradually improved a small amount. An estimate of the average effective flow rate for the following slug is 0.13 gpm. It was assumed that some of the semi-solid RWT precipitate fouled the well screen and that transmissivity would improve as the precipitate dissolved.

2.4.3 Accidental Purging of GW-178

On April 8, 1992, samplers from K-25 Sampling and Environmental Support Department prepared to sample GW-178 as part of quarterly compliance monitoring. The well had not been included in the initial list of dye-tracer monitoring wells, which had special sampling requirements. After taking a water level measurement to determine purge volume (29.6 gal X 3), the samplers began pumping the well to a poly-tank. After the first well volume was removed, the pump tube clogged and had to be shaken to resume pumping. At this point the samplers noted that the purge water was black to deep purple in color, presumably from the tracer dye, and they immediately stopped purging and contacted Y-12 Health, Safety, Environment, and Accountability Division (HSEA).

The sampling equipment used for purging GW-178 was decontaminated and checked with an equipment rinsate prior to continued use. The purged water volume was 40 gal which was sealed in a poly-tank with approximately 75 gal of other purge water. On April 10, 1992, an additional 200 gal of purge water from another well was inadvertently pumped into this same poly-tank before it was taken out of service. Y-12 Waste Management agreed to hold the purge water in 55 gal drums until after completion of the dye-tracer test. Disposal of this water occurred after the conclusion of the dye-tracer test.

HSEA concluded that no significant loss of dye volume had occurred as a result of this purging, and subsequent calculations of the amount of dye in the poly-tank (11g RWT and 28g FB28) supported this conclusion. It was also concluded that the screen in GW-178 was probably clogged and that steps should be taken to clear it. A wire brush attached to 1-in. PVC pipe was lowered into the well to scrub the screen, and then the well was flushed with potable water. Three attempts to clear the well screen by this method were made from April 15–April 20, 1992. In addition, surging of the well was performed by pressuring up a water tank and lowering tubing with an elbow to the screened interval. In each case the rate of fall in water level was recorded to provide a measure of transmissivity. A total of 292.4 gal of potable water was flushed through the well producing an average rate of fall of 0.39 ft/min. The scrubbing and flushing resulted in a small general increase in transmissivity. All cleaning equipment was sealed in plastic for subsequent off-site decontamination.

2.4.4 Extraneous Sources of Dye

Two areas within the monitored groundwater basin for the second dye-tracer study indicated the presence of extraneous sources of dye. Monitoring station UEFPC-29-SW, along UEFPC within the Y-12 Plant, consistently demonstrated elevated levels of a Rhodamine dye, which is probably related to pipe-tracing with Rhodamine B performed by Y-12 Maintenance and Utilities Division (MUD). The use of Rhodamine B by MUD was known to be ongoing when RWT was selected for the dye-tracer study, but the two dyes were considered analytically distinguishable. In practice, Rhodamine B produces a broad spectral peak that could mask the occurrence of RWT in small concentrations.

A persistent FB28 anomaly was present at monitoring station BCK 10.14 which lies along the former course of Bear Creek. The origin of this extraneous dye source is unknown, however FB28 is a common constituent in detergents, textiles, and some chemical wastes. The presence of hazardous waste and sanitary landfills (Fig. 1.3) within the Bear Creek watershed suggests the possibility of a proximal source for extraneous optical brightener. In a previous dye-tracer study (Geraghty and Miller, 1989), it was shown that Station BCK 10.14 and Bear Creek are in direct hydraulic connection and that BCK 10.14 would reflect the geochemistry of contaminants found within Bear Creek.

The old Oak Ridge Landfill located upgradient and slightly east of Area SCR 7 might also represent an extraneous source of dye.

3. TEST RESULTS

3.1 CRITERIA FOR POSITIVE DYE DETECTION

3.1.1 Idealized Dye Monitoring Results

As has been discussed in Sects. 2.1.3 and 2.2.2, several parameters were measured during the second dye-tracer test. The focus of the investigation is directed at the concentration levels of RWT and FB28, but weekly field measurements were also made of specific conductivity (uS/cm), pH, water temperature (°C) and precipitation. Only these six parameters are available to determine if the injected dyes occur at the monitoring sites. An ideal scenario is that weekly baseline measurements of dye concentrations initially would demonstrate uniformity in the emission spectra across the characteristic wavelength of the injected dyes. At some time after injection (as a function of flow path lengths), characteristic emission spectra would be detected for both FB28 and RWT at one or more monitoring sites. Probably, the first sites to display characteristic spectra would be the springs closest to the injection well. These would represent the nearest groundwater discharge points from the recharge area surrounding CRSP with hydraulic continuity to the source well. If flow patterns were controlled by diffuse flow they may demonstrate a radial migration in which monitoring locations progressively farther from the injection well show the presence of dyes. From an understanding of the karst system, flow patterns are conduit or fracture controlled and not radial. For this reason, flow paths are unpredictable and those spring locations which might have elevated dye concentrations may not be directly related to spatial proximity. Nonetheless, once dyes are present in the surface water system, they should be detected at downstream monitoring sites.

If uniform precipitation were to occur groundwater flow would be relatively constant. The temporal distribution of dye concentrations at any location should form a "breakthrough" curve (see Freeze and Cherry 1979, p.391 for complete discussion). This curve would take the form of a sharp increase from a relatively flat baseline then decrease asymptotically to the previous baseline. Assuming that RWT and FB28 are similarly conservative with respect to dispersion, adsorption, and degradation, then breakthrough curves should occur within the same time interval for a given locality (considering that this test integrates concentrations over a weekly period). Other physical-chemical properties of groundwater (e.g., pH, temperature, and specific conductivity) should reflect rainfall induced flux within a given groundwater sub-basin.

3.1.2 Quantitative Criteria for Establishing Hydraulic Continuity

By its nature, quantitative criteria cannot be easily set to define the occurrence of dyes at a monitoring site and support an inference of hydraulic continuity between the injection point and the site. A comparative measure of three standard deviations (3 sigma) from the mean concentration measured during the baseline period was drawn on the individual graphs (Appendix B). No effort is made to defend the choice of 3 standards deviations as the absolute level at which a detection can be defined. The obvious problem with this approach is that a site can have a small variation in measured values during the baseline period but demonstrate great variability during the test (such as RWT at SCR 3.5 SP). The opposite can occur when the baseline period is relatively noisy resulting in a large range defined by $\pm 3\sigma$ but the test period is flat (such as with FB28 at SCR 1.4 SP). The advantage of the latter example is that it precludes the presence of dyes at the site given the analytical capability.

The most reliable quantitative indicator of the presence of dye is when characteristic spectra occur at the correct wavelength in the fluorometric scan at levels that can be distinguished above *background* or interfering peaks. This was the case for optical brightener (in 10-40 ppb range) at BCK 10.14 SP and for Rhodamine (in the 1-10 ppb range) at UEFPC 29 SW observed during the pre-injection monitoring period and during the test period. At levels below ~ 100 ppt for FB28 and the weekly *background* for RWT (0.2-1.5ppb), it becomes a matter of opinion whether a prominent peak can be characterized as a positive detection or analytical noise.

3.1.3 Qualitative Criteria for Establishing Hydraulic Continuity

With the low range of values encountered during the test period, qualitative criteria must be relied on to infer the detection of dye. As outlined in the idealized scenario above, it is anticipated that a relatively flat curve would be observed over the baseline period and immediately following the injection. Definable increase in the levels of both RWT and FB28 (even in the low range of concentrations) should be observed together on a temporal basis and within a watershed at one or more points. Observed variances can be discounted or adjusted according to the rainfall, and attention can be paid to variances in the conductivity. However, conductivity and pH were of negligible help with interpreting the final results. To make a reasonable interpretation of dye detection, the increases should occur for a short period but return to the baseline level. Frequent increases and fall-off of RWT and FB28 levels can be attributed only to statistical noise. Likewise, very low levels of RWT and FB28 accompanied by sporadic high levels of RWT and FB28 should only be considered as variances.

3.2 TEST BACKGROUND AND MONITORING RESULTS

3.2.1 Test Results

As previously discussed, one location consistently displayed FB28 concentrations (or at least an optical brightener that could not be distinguished from FB28) and another contained Rhodamine concentrations (probably Rhodamine B) that could not be distinguished from RWT. With these two exceptions, no results could be characterized on a quantitative or qualitative basis as positively indicating the detection of RWT or FB28 at any location. At no time was a characteristic spectrum resolved from the *background* levels or interfering peaks nor were there results that could be qualitatively characterized as dye detection for any sample. A difference of opinions may arise on the qualitative interpretation of some curves but no irrefutable indications were obtained during the second test that RWT or FB28 placed into GW 178 were ever detected at any of the monitoring sites.

3.2.2 Individual Monitoring Station Results

Results for individual monitoring stations are contained in Appendix A. The Appendix contains a tabular listing, by week, for the values of each of the six parameters measured during the baseline and test periods. In addition, the field screening results for the presence or absence of optical brightener and the QA data are included. A comments column contains data such as duplicates, flow conditions, interfering peaks, and any miscellaneous comments. For each monitoring site, four graphs are also compiled onto a single page that show (by week): FB28, RWT, conductivity and precipitation, and water temperature and pH. The RWT and FB28 graphs also display a solid line for the mean concentration of the dye during the baseline period and upper and lower boundaries representing 3 standard deviations (3σ) of the mean. The concentration axes on these graphs have been scaled to accentuate the relative difference between weeks at an individual site but are different for each site (for inter-site comparison with the same scaling see Appendix B).

RWT Field Blank —The RWT concentrations displayed unexpected high concentrations during the majority of the baseline period and through week 3 of the test period. The level again rose during week 14 and remained high until the end of the test. These levels define the minimum detectable level for RWT. A discussion of the suspected systemic cause is included in Sect. 2.3.2.

GW-160 —None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test.

GW-221 —An anomalous FB28 peak appears to be present at week 1, however, this concentration of 40 ppt is well below the effective detection limit and only 10 ppt higher than many of the later weeks. Nothing is observed in the RWT curve or field measurements to support a detection.

GW-232 —A non-RWT peak was present at 600 nm which elevated week 18 to an anomalous level.

GW-561—RWT highly variable. Increasing levels of FB28 noted here during week 18 similar to other sites. The well was found to be dry from week 8 to end of test.

GW-734—This well was included at the start of the test without the benefit of baseline measurements. The two strong peaks at weeks 6 and 8 cannot be characterized properly but appear suspect with the intervening low level displayed in week 7. The RWT peak at week 17 appears anomalously strong at 42 ppt but is far below the field blank concentration of 93 ppt.

BCK 9.00 SW—None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test. Large interfering peaks noted for weeks 13 and 18.

BCK 9.41 SP—This spring contains an anomalously high FB28 at week 17, which is twice the prevailing level. A similar RWT peak does not coincide and confirm a detect during this time.

BCK 10.14 SP —An optical brightener has been positively identified (8-47 ppb) throughout the baseline and test periods. RWT displays a large amount of noise from week 10 to the end of the test. Large interfering peaks at 500 NM were noted for weeks 10-15, 17, and 18.

BCK 11.68 SP —Week 15 for FB28 was reviewed as a possible hit but found to be a highly absorbing sample that gave elevated values. RWT is noisy throughout the test with valves fall below the 30 line as well as above it.

SCR 1.1 SW —Week 13 for FB28 was reviewed and found to be a highly absorbing sample. RWT displays increasing concentrations throughout the test. The high levels noted during weeks 11, 13, and 16-18 are a result of large *background* peaks.

SCR 1.2 SP —Increases are observed during weeks 11 and 12 for FB28 and RWT, respectively, but the general level of noise in the curves makes interpretation difficult. Large *background* peaks are present for RWT during weeks 12, 13, 15, and 18.

SCR 1.3 SW —This station is very similar to SCR 1.2 SP. Large *background* peaks are noted for RWT during weeks 13, 15, and 18.

SCR 1.4 SP —Only weeks 17 and 18 for RWT are slightly anomalous but correspond to high *background* levels in the field blanks.

SCR 1.5 SW —Weeks 17 and 18 for RWT are elevated due to high *background* peaks at 500 nm.

SCR 2.1 SP —A high *background* peak at 460 nm is present at week 2 for FB28. A large peak for RWT at week 9 is problematic and cannot be resolved; however, confirmation is not obtained at the same time interval with FB28. Week 15 for RWT is affected by a large peak at 503 nm. This spring displays low flow conditions throughout much of the test.

SCR 2.2 SW—Week 3 for FB28 was a strongly absorbing sample. Large *background* peak at 500 nm is present at week 18 for RWT. The stream was dry from week 4 to the end of the test.

SCR 3.1 SP—A strongly absorbing sample was obtained for FB28 at week 17. Week 1 for RWT contained an anomalously high level at 840 ppt but not significantly higher than the field blank at 750 ppt.

SCR 3.4 SP—None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test.

SCR 3.5 SP—Week 17 for FB28 was a highly absorbing sample. RWT was noisy.

SCR 4.1—SW None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test. Weeks 5-15 had low or dry flow conditions at this site.

SCR 4.3 SP—A non-FB28 *background* peak at 460 nm at week 1 was present and low flow conditions were noted during the middle part of the test where a minor peak was observed during week 7. RWT is noisy with large sloping *background* peak at 500 nm during week 15.

SCR 4.4 SW—A large interfering peak at 503 nm for RWT at week 15 displays an anomalous peak. The stream was dry from week 8 to the end of the test.

SCR 5.1 SP—FB28 contains insignificant increases. RWT displays increasing levels in the later week much as the blanks display.

SCR 5.3 SW—Week 11 for FB28 is elevated due to an absorbing sample but the other weeks display a generally noisy variance at this level compared to a 0.200 ppb detection limit. Week 17 for RWT is inflated by a large peak at 500 nm.

SCR 5.4 SW—Week 17 for FB28 was a strongly absorbing sample and the levels observed during the other weeks were far below the .2 ppb limit. *Background* levels of RWT were elevated due to a large peak at 500 nm during weeks 9, 12-14, and 16-18.

SCR 7.1 SP—None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test. FB28 levels were far below the detection limit .200 ppb and RWT displayed noise variation similar to RWT.

SCR 7.3 SP—None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test. The increased level of RWT during week 15 is a result of a large interfering peak at 505 nm.

SCR 7.4 SP—FB28 from weeks 10 to the end of the test were noisy. Week 13 for RWT was elevated due to a peak at 503 nm. Week 15 was reviewed and found to be elevated also due to a peak at 500 nm.

SCR 7.6 SP—Week 17 for FB28 was found to be a very strongly absorbing sample. The dark color could not be removed by washing.

SCR 7.7 SP—Weeks 3 and 18 for FB28 are strongly absorbing in addition to the presence of a broad peak at 460 nm during week 3. RWT is very noisy.

SCR 7.8 SP—None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test.

UEFPC 29 SW—FB28 is very noisy. Rhodamine-like peaks consistently found in the 1-10 ppb range throughout the test.

UEFPC SP 17—None of the weekly results for either RWT or FB28 could be characterized as anomalous with respect to the baseline period or relative level observed during the test. Large *background* peaks were observed for RWT during weeks 12-14, 17, and 18.

WS 6.1 SW—FB28 appears very noisy and far below practical detection limits of .200 ppb. RWT is quiet throughout test.

WS 7.5 SW—Weeks 17 and 18 for FB28 have highly absorbing samples. RWT elevated at week 17 and 18 by giant peak at 500 nm.

3.2.3 Watershed and Monitoring Group Quality Assurance/Quality Control Results

Appendix B displays the individual RWT and FB28 weekly curves grouped by watershed or monitoring station type. This allows a spatial as well as a temporal comparison of the results and makes the identification and confirmation of trends more apparent. The inference of dye detection can be contrasted against not only the baseline and earlier weeks of the same monitoring station but against each of the other baseline and test results for the other stations within the watershed. The concentration axis is identical for all the graphs (with one exception) having the RWT scale range from 0-3 ppb and the FB28 scale range from 0-0.25 ppb. The weekly axis is also comparable. The first graph contains the weekly results for the field blanks for RWT to compare as the minimum detection limit and the weekly precipitation to use in interpretation dye concentrations between weeks.

Monitoring Wells—Only GW-734 appears to have anomalous FB28 peaks (weeks 6 and 8) that cannot be explained by high *background*, noise or overall trends. Unfortunately, no baseline measurements are available to contrast against a pre-injection period. RWT does not confirm the detection of dyes, however.

BCK Area—FB28 detection at BCK 10.14 SP (log scale to provide relative comparison). RWT highly variable at BCK 9.0 SW and BCK 10.14 SP.

SCR 1 Area—While no characteristic spectra were observed for monitoring sites within this watershed, an increase or high *background* was observed at most sites during week 13, prior to the general increase of RWT levels in the field banks.

SCR 2 Area—Neither of the two stations in the SCR 2 watershed indicate a potential detection.

SCR 3 Area—None of the three stations in the SCR 3 watershed indicate a potential detection.

SCR 4 Area—The three monitoring stations in the SCR 4 watershed appear very noisy in the baseline period as well as the test period and 2 of the 3 have high *background* peaks. No indication of dye detection can be inferred.

SCR 5 Area—The same conclusion can be drawn for SCR 5 watershed as for SCR 4.

SCR 7 Area—RWT in this watershed cannot be resolved from the high field blank levels. FB28 curves demonstrate the problem of highly absorbing samples with increases observed at week 17 with the large rainfall.

UEFPC & WS Areas—UEFPC SP 29 displays high levels of RWT but not other general trends or anomalous hits are observed.

3.3 INTERPRETATION OF TEST RESULTS

3.3.1 Delineation of Groundwater Sub-Basins

The other measured physical parameters assist in interpreting the results of the dye monitoring curves but are not reliable indicators of hydraulic continuity. Precipitation provides the most directly correlatable parameter in interpreting the dye monitoring curves. The noncharacteristic dye monitoring curves are positively correlatable to unseasonable rainfall patterns. Large precipitation events induce large groundwater flux and presumably dye migration, whereas low rainfall stagnates groundwater flow. Conductivity and pH provide useful data for discriminating groundwater sub-basins from a spatial perspective and in the contrasting of monitoring locations and types (i.e., springs, surface water, or groundwater) but have remained relatively constant at any given monitoring location.

3.4 INITIAL AND SECOND TEST COMPARISON

A detailed comparison of the methods and results for the first and second dye-tracer tests is beyond the scope of this report and will be provided in a follow-up report. However, because of the disparate conclusions of the two tests, a summary comparison of the results and interpretations is provided below. Data provided above from the second dye-tracer test, indicate that, except for the two locations where dye was present during the baseline monitoring, no dye was definitively detected during the second dye-tracer test. In contrast, the conclusions of the first dye-tracer test suggest dye detection in at least eight locations. Because both the first and second test used the same injection well, monitored approximately the same locations, and had collected data for approximately the same amount of time, other factors such as field or analytical methods may be responsible for the discrepancy between the two tests..

3.4.1 Comparison of Test Methodologies

Field methods, measurements, and quality control were generally the same for the first test as those outlined above for the second dye-tracer test and are not considered factors in the difference between the two tests. Several of the sampling locations used during the first test were considered redundant and were eliminated including three locations in UEFPC and six wells on Chestnut Ridge. During the second test, three additional wells were included: GW-232 to detect possible eastward groundwater flow; GW-561, downgradient from CRSP and situated in a possible cavity to provide data on southerly flow; and GW-734, which monitors a large cavity in the Maynardville Limestone and could provide information of possible eastward flow. One spring discharge site was added from along Scarboro Creek (SCR-7.3SP).

Analytical methods and quality assurance for the first dye-tracer test (Geraghty and Miller, Inc. 1990b) were similar to those of the second test. For the initial tracer test, the dye was eluted from the activated charcoal using a standard 100 mL aliquot of "Smart solution" consisting of a 1:1:2 mixture of distilled water, NH_4OH, and 1-propanol. During the second test, the charcoal detectors were eluted in 30 ml of a 3:2:5 mixture of distilled water, NH_4OH, and 1-propanol. The higher concentration of eluant solution used during the second test should have allowed better detection if dye were present.

Elevated and interfering *background* levels were not anticipated prior to the first test. Experiments run after the second test on washing times of the charcoal detectors indicate that a 2-hr wash under tap water prior to the extraction procedure significantly reduced *background* interference. During the second test, detectors were washed for 5 minutes. Geraghty and Miller, Inc. (1990b) do not note whether the samples of the first test were washed prior to elution.

During the first test, two aliquots of the supernatant solution were decanted into a cuvette and analyzed in a Perkin Elmer 650-S scanning spectrofluorometer. One aliquot of supernatant solution was analyzed after 1 hr of elution, another analyzed after 24 hrs of elution. Concentrations above *background* levels or detection limits were reported for samples eluted in the "Smart" solution for 1 hr or 24 hrs. Spectrographs (for weeks 2 to 9 after dye insertion) show that some samples had an increase in fluorescence between the 1-hr and 24-hr analyses, whereas several other samples show the opposite effect. Some samples show no fluorescence for one analysis, yet show fluorescence in another. Geraghty and Miller, Inc. (1990b) suggest this is probably due to an undefined "matrix effect."

The first dye-tracer test used Sodium Fluorescein (Acid Yellow 73), a green fluorescence dye. A disadvantage of this dye is that natural *background* fluorescence (from fulvic acid extracted from the soil) in the green region of spectrum can mask the fluorescein emission peak (Smart and Laidlaw, 1977). Thus, because of natural *background* fluorescence, in the green part of the spectrum, difficulties may arise in discriminating the presence of low concentrations of fluorescein or discerning a *background* peak from a dye peak.

The relatively high analytical detection limit (1 ppb) of the first test makes it difficult to distinguish between the actual presence of dye and the detection of high *background* interferences. During the second test large interference peaks occurred in several locations. These interference peaks occurred at about 500 nm and the tails of these broad peaks gave anomalously high spectral intensity in the fluorescence range for Rhodamine WT (550 nm). The presence of elevated natural *background* peaks at 500 nm also could have affected the spectra in the range of sodium fluorescein, with excitation and emission peaks at 490 and 520 nm during the first test.

3.4.2 Comparison of Test Results

A comparison of those locations considered to have had *positive* and *possible* dye detection during the first test and those locations with high interference *background* noted during the second test suggests that *background* interference may have affected some results of the first test at these sites. Table 3.1 shows those locations and concentrations that exceeded the analytical detection limit of 1 ppb during the initial test. Locations UEFPC-113, UEFPC-62, UEFPC-12/13, and GW-175 from the first test were not monitored during the second test. During the second test, locations BCK-9.00 and BCK-10.14 had as much as 4 weeks during which elevated *background* peaks gave anomalously high apparent RWT concentrations between 1.07 and 2.61 ppb. It is conceivable that high *background* peaks in the 500 nm range gave anomalously high concentrations during the first test. Also, throughout the second tracer test, UEFPC-29 had Rhodamine detection that was probably related to Rhodamine B dye use at the Y-12 Plant. Thus, it is uncertain if natural/*background* interference has affected the results of the initial test at that site.

Baseline monitoring of site UEFPC-SP17 for the second test had 2 weeks of high *background* interference with elevated RWT concentrations between 1.41 and 2.21 ppb. As with the Bear Creek monitoring sites, the reported fluorescence concentrations at UEFPC-SP17 during the first test could be a result of high *background* levels. Both SCR-5.1SP and SCR-7.1SP had no detected interference peaks during the second test, but SCR-5.4SP had 4 weeks of detection above *background* with an apparent RWT concentration between 1.16 and 2.38 ppb. The apparent fluorescein during the first test noted at station SCR-5.5SP could, likewise, be an artifact of high *background* fluorescence in the 500 nm range. Station WS-7.5SW did have two interference peaks during the second test but at much lower

Table 3.1. Locations exceeding detection analytical limit during first test

MONITORING STATIONS

week	BCK9.00	BCK10.14	UEFPC-113	UEFPC-62	UEFPC-29	UEFPC-SP17	UEFPC-12/13	SCR5.1SP	SCR5.4SP	SCR7.1SP	WS7.5SW	GW-175
2						1.58					3.32	
3		1.21									1.92	
4			1.55	3.02	1.85		5.5		1.13		3.54	
5									1.17			
6		1.43				1.73				1.43	4.52	1.28
7		1.09							1.51		7.09	
8	1.09	2.64			1.09	2.68		1.21	1.32		12.82	
9		1.13				2.6			2.45		9.05	
10		1.66										
11		1.55										
12		2.26		1.4	1.47	1.51	1.28					
13		1.66			1.21		1.09				2.71	
14		1.96		1.13	1.43		1.06				2.19	
15		3.24									1.36	

apparent concentrations than those reported during the first test. A closed municipal landfill, upgradient of SCR-7.1SP and WS-7.5SW, may be a possible source of the fluorescein detected at these sites.

In summary, due to the relatively high analytical detection limit of the first dye-tracer test and the high interfering *background* peaks observed during the second test, it is possible that fluorescein dye was not actually detected during the initial test. High natural *background* in the range of the fluorescein spectra may have caused the apparently high reported concentrations of this dye. However, one monitoring site during the first test (WS-7.5SW) appears to have had dye present, but it is unclear if this indicates a hydraulic connection with CRSP or is derived from an extraneous source upgradient of this site.

4. CONCLUSIONS

The results from this test do not conclusively demonstrate whether dye was present at any of the monitoring sites or whether it remains in storage within the karst system yet to be transported to discharge points. The problems with injecting the dye into GW-178 suggest that the injection well is not well integrated with the karst system and that the dye may not be readily available for transport even after several months. It is possible that transport may occur and that the dyes may be observed at the monitoring sites but they will probably be highly diluted. Even with ambiguous results, several conclusions can be made with regard to the objectives of the test and about conditions encountered during the test. Such conclusions can be significant in any future attempts to define groundwater flow paths in CRHR.

4.1 FLOW PATH DETERMINATION

A limited knowledge of groundwater flow paths within and exiting from CRHR at the Y-12 Plant Site prompted the initial and second dye-tracer studies. The initial study suggested that hydraulic continuity existed between CRSP and a number of monitoring sites, including some sites located outside the DOE Reservation. The connection was inferred from the observation of dye concentrations above the analytical detection limit taken from detectors at various monitoring locations. The second test was designed to confirm those findings. No definitive occurrence of fluorescent dye or optical brightener was observed at any of the monitoring sites (with the aforementioned exception of the two sites that had consistently elevated *background* dye concentrations). A definitive occurrence of dye is a concentration that clearly distinguishes itself from *background* levels at the characteristic spectra (wavelength). No such levels were observed during the second dye-tracer test. With a lack of positive identification during the second test, it cannot be unequivocally stated that flow paths exist to any of the monitoring sites.

However, these findings neither preclude the possibility that dyes were present at some finite concentration (or will occur at the monitoring sites at a future time) nor that flowpaths do exist between the CRSP and at groundwater discharge points. Estimated concentrations of the dyes are in the range of analytical uncertainty and cannot be isolated from natural variability in *background* or uncertainty in the instrumental analysis. Interferences from nontest sources create *background* levels and elevated detection limits for analysis at many of the monitoring sites. Given the resource limitations, more accurate and sensitive means of detecting the presence of dyes and/or further extension of the monitoring period cannot be achieved.

4.2 TEST METHODS

Since the primary objective of the second dye-tracer test was to confirm the results of the initial study, test methods and conditions were simulated as closely as possible. The planned deviations included the combined use of one dye and one optical brightener in greater concentrations and to conduct the test during the characteristically wet weather season.

Following the same test methods as the initial dye-tracer study did not optimize the chances of success for the second test. The source well, GW-178, was inadequate as an injection well despite its close proximity to CRSP. The screened interval in GW-178 does not include a significant void, fracture, or karst-solution feature, and therefore, the well is probably not well integrated with the karst flow system of CRHR. Injection of the dye and the difficulty of injecting the subsequent slug was, in part, due to low transmissivity of the aquifer in the screened interval. The optimal source well would provide for an "instantaneous" slug of dye entering the groundwater and dispersing through the karst flow system. Instead, complete injection was accomplished over several days; diluting the instantaneous dye concentration at any point within the aquifer.

Scheduling for the test was done to coincide with the historically highest precipitation and highest groundwater flow rate did not anticipate a period of below average rainfall. The test began during February 1992 and was followed by dye injection the second week of March. While this normally would have provided sufficient time for the test to encounter high flows during the wet season, the weather patterns were atypical and dry conditions in May prevailed early in the test. Several discharge points and surface water monitoring sites displayed low flow conditions, which probably reflected similar conditions in the subsurface. Dye transport and dispersion were retarded to an unknown extent.

5. RECOMMENDATIONS FOR FUTURE TEST METHODS

This section has been included to provide suggestions for any subsequent dye-tracer tests that may be considered by Energy Systems at CRSP or within the Oak Ridge Reservation. The following points should be considered:

1) A baseline monitoring period should be conducted for at least twice as long as the 4-week period used during this test. Natural variability and extraneous sources must be identified prior to the start of the test.

2) The baseline monitoring should be performed and a thorough evaluation made before the selecting the dye(s). Interfering peaks in the spectrographs and broad peaks from natural *backgrounds* should be characterized and a dye selected (if possible) which has its emission peak in other regions of

the spectrum. Analytical testing of potential dyes by charcoal adsorption and elution should be conducted, and the resulting spectrographs should be compared to those from this study to evaluate natural interferences.

3) An injection well should be chosen that intersects conduits of the karst aquifer; that is one that has large voids or many fractures within it monitoring interval and is noted to have taken drilling fluid or grout. A test for specific capacity of the well is also suggested.

4) A pilot study of multiple samples from the baseline period should be tested on various models/versions of synchronous scanning spectrofluorometers. Quinlan (personal communication 1992) reported that a Shimadzu spectrofluorometer was able to minimize background interferences in an independent assessment.

5) It is critical that the majority of the test be conducted during high flow conditions. Any future test should begin no later than the December-January time frame and should have a flexible monitoring schedule so that atypical seasonal variations in precipitation will not adversely impact the overall test.

6) Further consider use of inorganic tracers (Br^-, I^-) but note that the range of detection for inorganic tracers is less than fluorescent dyes.

7) QA assessment of analytical method should be done to: minimize interferences by optimizing washing time of detectors, check integrity of detectors as received from the manufacturer (lab blank), optimize elution times.

6. REFERENCES

Dames and Moore. 1989. *Closure Certification Report for Chestnut Ridge Security Pits*. Prepared for DOE/ORO ERP.

Freeze, R.A., and Cherry, J.A. 1979. *Groundwater*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Geraghty and Miller, Inc. 1989. *Tracer Study of the Hydrologic System of Upper Bear Creek, Y-12 Facility, Oak Ridge, Tennessee*. Y/SUB/89-00206C-4.

Geraghty and Miller, Inc. 1990a. *Comprehensive Groundwater Monitoring Plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee*. Prepared for Martin Marietta Energy Systems, Inc. (Y/SUB/90-00206C/5).

Geraghty and Miller, Inc. 1990b. *A Study of Groundwater Flow From Chestnut Ridge Security Pits Using a Fluorescent Dye Tracer: Preliminary Results*. Prepared for Martin Marietta Energy Systems, Inc. (Y/SUB/90-00206C/6).

Golder and Associates. 1987a. *Geohydrologic Packer Testing GW-132, GW-133, GW-134, and GW-135 at the Y-12 Plant Area, Oak Ridge, Tennessee*. Prepared for Martin Marietta Energy Systems, Inc. (Y/TS-497).

Golder and Associates. 1987b. *Geohydrologic Packer Testing GW-131 and CH-157 at the Y-12 Plant Area, Oak Ridge, Tennessee*. Prepared for Martin Marietta Energy Systems, Inc. (Y/TS-496).

HSW Environmental Consultants. 1992a. *Groundwater Quality Assessment for the Chestnut Ridge Hydrogeologocic Regime at the Y-12 Plant; 1991*. Prepared for Martin Marietta Energy Systems, Inc. (Y/SUB/92-YP507C/3/P1).

HSW Environmental Consultants. 1992b. *Groundwater Quality Assessment for the Bear Creek Hydrogeologocic Regime at the Y-12 Plant; 1991*. Prepared for Martin Marietta Energy Systems, Inc. (Y/SUB/92-YP507C/1/P1).

HSW Environmental Consultants. 1992c. *Groundwater Quality Assessment for the Upper East Fork Poplar Creek Hydrogeologocic Regime at the Y-12 Plant; 1991*. Prepared for Martin Marietta Energy Systems, Inc. (Y/SUB/92-YP507C/2/P1)

King, H.L., and Haase, C.S. 1987. *Subsurface-controlled Geologic Maps for the Y-12 Plant and Adjacent Areas of Bear Creek Valley* (ORNL/TM-10112).

Mishu, L. 1982. *Subsurface Analyses of Waste Disposal Facilities at the Y-12 Plant*, 81-1020P. Prepared for Martin Marietta Energy Systems, Inc. (Y/SUB/82-24700/2).

Martin Marietta Energy Systems, Inc. (Energy Systems). 1984. *Inventory of Disposals Conducted in the Chestnut Ridge Security Pits, Y-12 Plant, Oak Ridge, Tennessee* (Y/TS-191).

Martin Marietta Energy Systems, Inc. (Energy Systems). 1988a. *Revised RCRA Closure Plan for the Chestnut Ridge Security Pits, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (Y/TS-391).

Martin Marietta Energy Systems, Inc. (Energy Systems). 1988b. *Environmental Surveillance Procedures Quality Control Program.*

Martin Marietta Energy Systems, Inc. 1991. *Updated Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy Oak Ridge Reservation.* Y/TS-735.

Martin Marietta Energy Systems, Inc. (Energy Systems). 1992. *Work Plan for the Second Dye-Tracer Test at the Chestnut Ridge Security Pits, Y-12 Plant, Oak Ridge, Tennessee.*

Mull, D.S., Smoot, J.L., and Lieberman, T.D. 1988. *Dye Tracing Techniques Used to Determine Groundwater Flow in a Carbonate Aquifer System.* Near Investigations Report 87-4174.

NOAA. 1992. *Local Climatological Data-Monthly Summary.* Department of Commerce, ISSN 0198-487X.

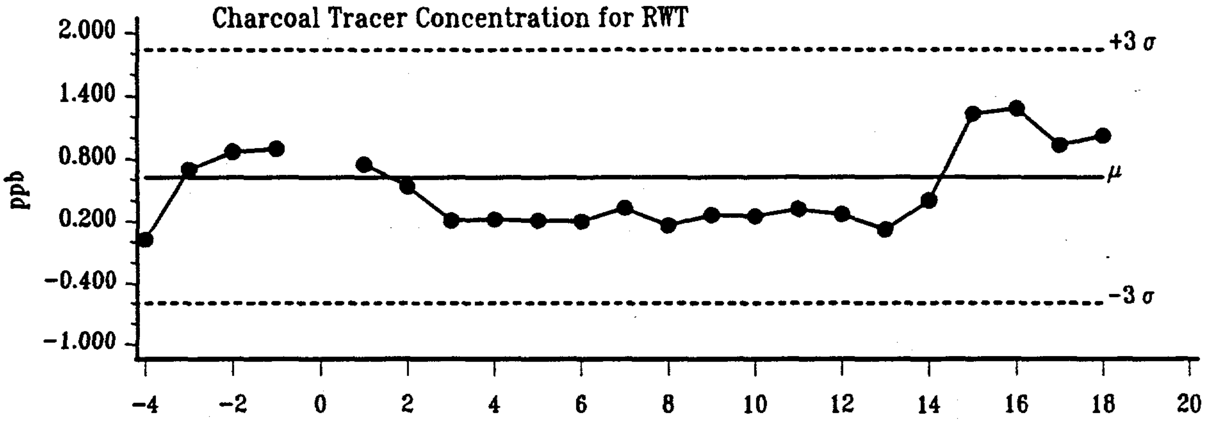
Quinlan, J.F. 1992. Personal Communication (teleconference call w/SAIC and Energy Systems personnel, Aug 6, 1992).

Smart, P.L. and Laidlaw, I.M.S. 1977. *An Evaluation of Some Fluorescent Dyes for Water Tracing,* Water Resources Research, Vol. 13, No. 1, p. 15-33.

APPENDIX A

INDIVIDUAL MONITORING STATION RESULTS

CRSP Dye Tracer Study
Station FIELD BLANK



17SEP

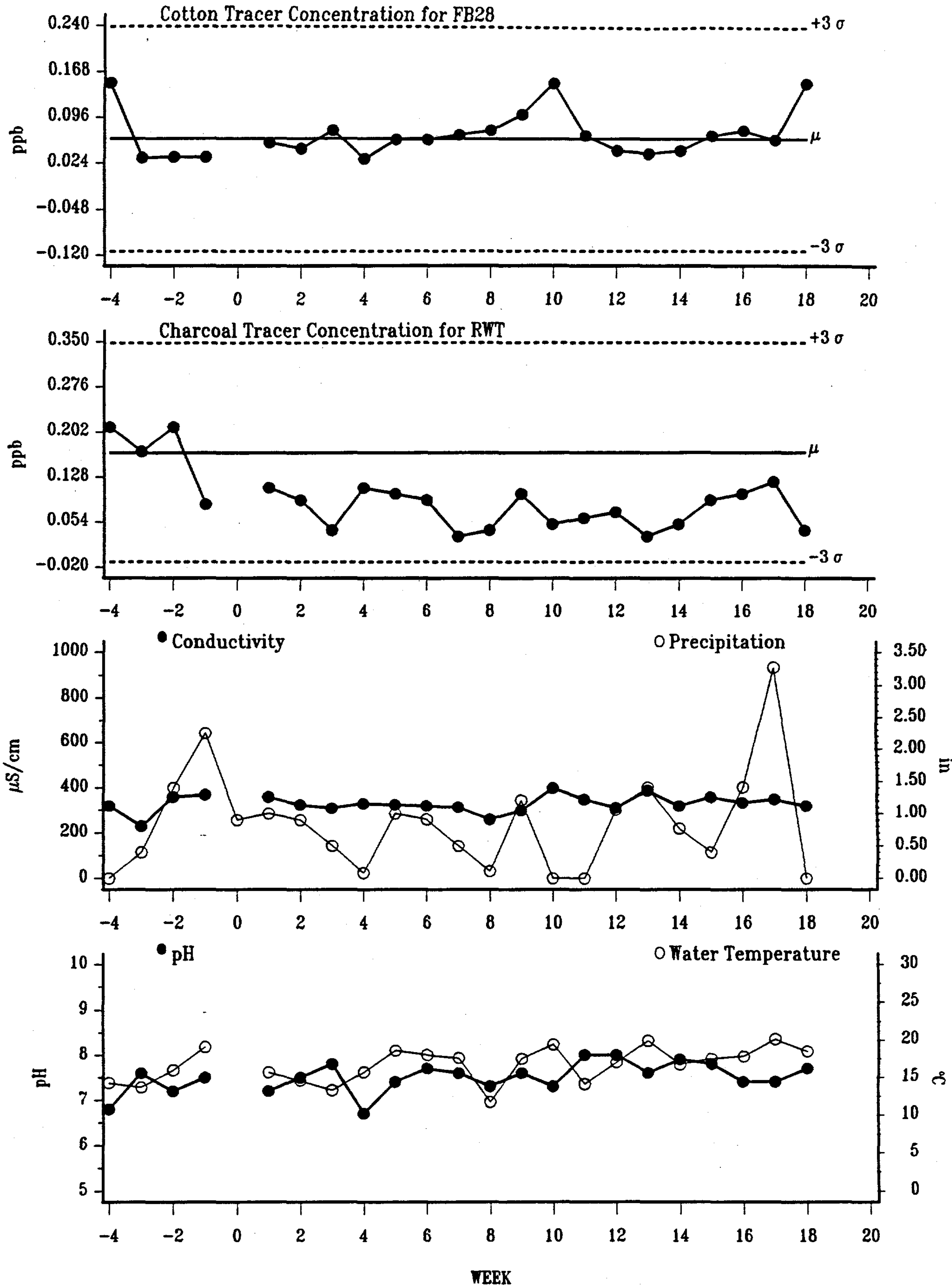
Chestnut Ridge Dye Study

Station: FIELD BLANK

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92				0.030		A	1	N/A
-3	02/17/92				0.700		A	1	N/A
-2	02/24/92				0.870		A	1	N/A
-1	03/02/92				0.900		A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92				0.750		A	1	N/A
2	03/26/92				0.540		A	1	N/A
3	04/02/92				0.210		A	1	N/A
4	04/09/92				0.220		A	1	N/A
5	04/16/92				0.210		A	1	N/A
6	04/23/92				0.200		A	1	N/A
7	04/30/92				0.330		A	1	N/A
8	05/07/92				0.160		A	1	N/A
9	05/14/92				0.260		A	1	N/A
10	05/21/92				0.250		A	1	N/A
11	05/28/92				0.320		A	1	N/A
12	06/04/92				0.270		A	1	N/A
13	06/11/92				0.120		A	1	N/A
14	06/18/92				0.400		A	1	N/A
15	06/25/92				1.230		A	1	N/A
16	07/01/92				1.280		A	1	N/A
17	07/10/92				0.930		A	1	DETECTORS COLLECTED ON FRI. DUE TO OTHER REQUIREMENTS.
18	07/17/92				1.020		A	1	HIGH BACKGROUND. DETECTORS COLLECTED ON FRI. TO ALLOW THEM TO SIT FOR FULL WEEK

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station GW 160



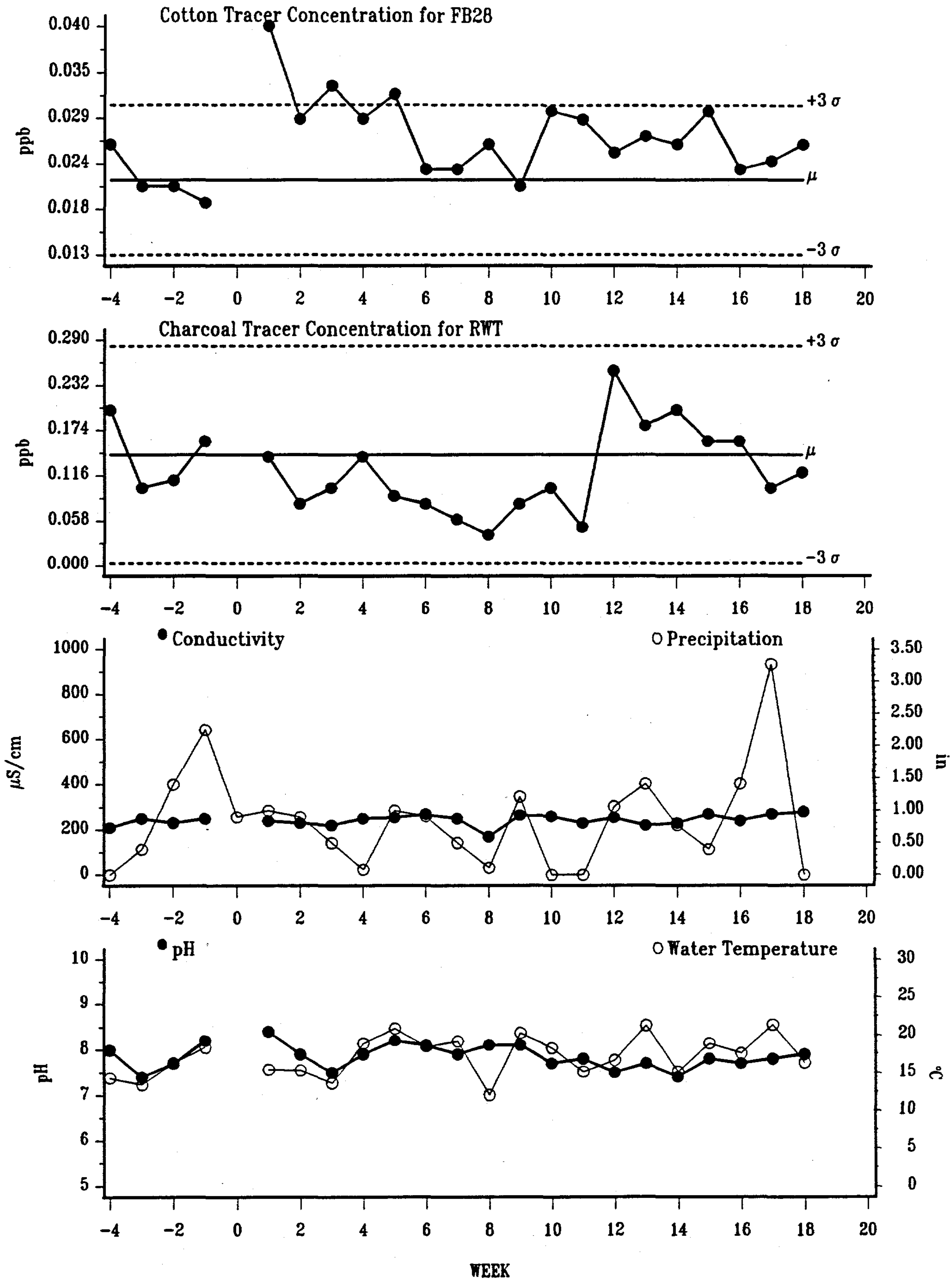
17SEP9

Station: GW 160

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	6.8	320	14.3	0.210	0.150	A	1	N/A
-3	02/17/92	7.6	230	13.7	0.170	0.032	A	1	SMALL PKS @ 538nm (SF) & @ 560nm (EM)
-2	02/24/92	7.2	360	16.0	0.210	0.033	A	1	N/A
-1	03/02/92	7.5	370	19.1	0.083	0.033	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.2	360	15.7	0.110	0.055	A	1	N/A
2	03/26/92	7.5	325	14.6	0.090	0.046	A	1	CHARCOAL .10
2	03/26/92				0.100		A	2	N/A
3	04/02/92	7.8	310	13.3	0.040	0.075	A	1	PUT STAINLESS STEEL STRAINER ON AS WEIGHT.
4	04/09/92	6.7	330	15.7	0.110	0.030	A	1	N/A
5	04/16/92	7.4	325	18.6	0.100	0.060	A	1	N/A
6	04/23/92	7.7	320	18.0	0.090	0.060	A	1	N/A
7	04/30/92	7.6	315	17.6	0.030	0.068	A	1	N/A
8	05/07/92	7.3	260	11.7	0.040	0.075	A	1	N/A
9	05/14/92	7.6	300	17.5	0.100	0.100	A	1	N/A
10	05/21/92	7.3	400	19.4	0.050	0.150	A	1	DETECTOR WAS REMOVED ON 5/20 FOR WELL TO BE SAMPLED
11	05/28/92	8.0	350	14.1	0.060	0.067	A	1	N/A
12	06/04/92	8.0	312	17.0	0.070	0.043	A	1	N/A
13	06/11/92	7.6	390	19.9	0.030	0.038	A	1	N/A
14	06/18/92	7.9	320	16.7	0.050	0.043	A	1	N/A
15	06/25/92	7.8	360	17.5	0.090	0.067	A	1	N/A
16	07/01/92	7.4	335	17.8	0.100	0.075	A	1	N/A
17	07/10/92	7.4	350	20.1	0.120	0.060	A	1	N/A
18	07/17/92	7.7	320	18.5	0.040	0.150	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station GW 221



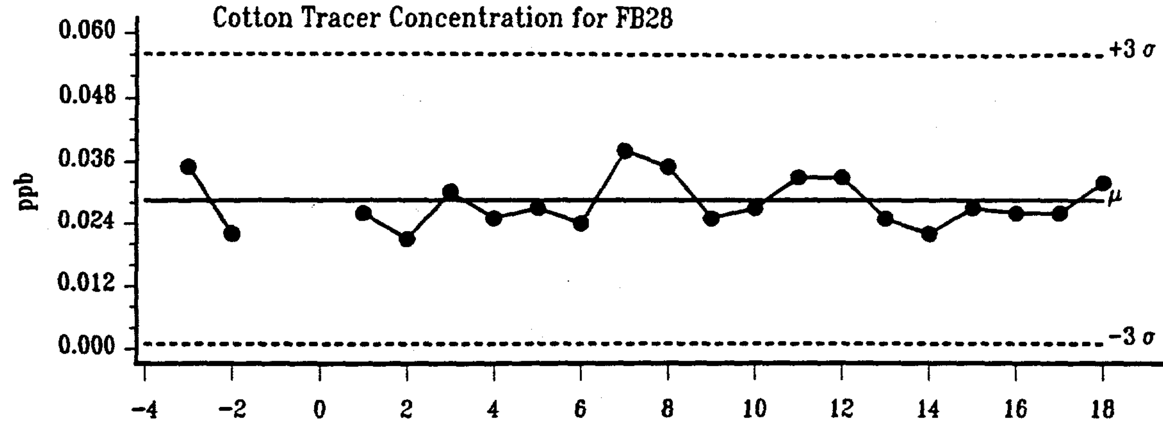
17SEP92

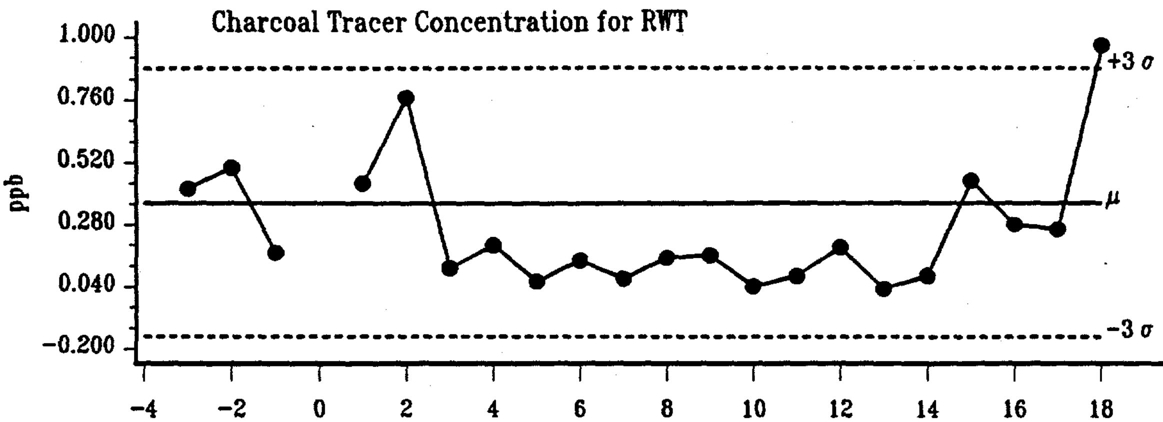
Station: GW 221

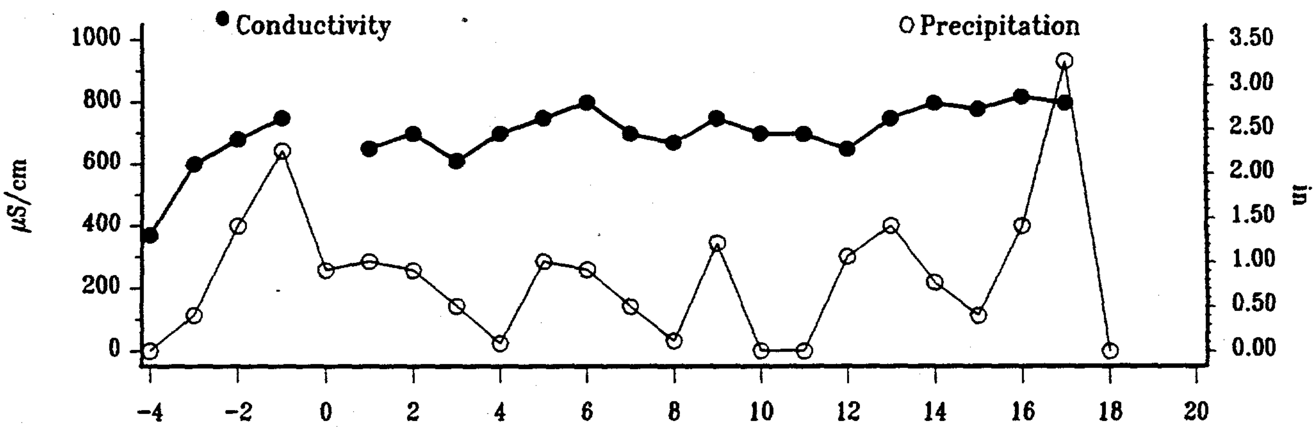
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.0	210	14.3	0.200	0.026	A	1	N/A
-3	02/17/92	7.4	250	13.4	0.100	0.021	A	1	PK @ 600nm (SF)
-2	02/24/92	7.7	231	16.3	0.110	0.021	A	1	N/A
-1	03/02/92	8.2	250	18.3	0.160	0.019	A	1	PK @ 590nm (EM)
0	03/09/92						A	1	N/A
1	03/19/92	8.4	240	15.4	0.140	0.040	A	1	N/A
2	03/26/92	7.9	230	15.3	0.080	0.029	A	1	N/A
3	04/02/92	7.5	220	13.6	0.100	0.033	A	1	CLEAR
4	04/09/92	7.9	250	18.8	0.140	0.029	A	1	N/A
5	04/16/92	8.2	255	20.8	0.090	0.032	A	1	N/A
6	04/23/92	8.1	270	18.4	0.080	0.023	A	1	N/A
7	04/30/92	7.9	250	19.1	0.060	0.023	A	1	N/A
8	05/07/92	8.1	170	12.0	0.040	0.026	A	1	DETECTOR WAS REMOVED FROM WELL FOR APPROX.24 HRS IN ORDER FOR WELL TO BE SAMPLED.
9	05/14/92	8.1	265	20.2	0.080	0.021	A	1	N/A
10	05/21/92	7.7	260	18.2	0.100	0.030	A	1	N/A
11	05/28/92	7.8	230	15.1	0.050	0.029	A	1	N/A
12	06/04/92	7.5	255	16.6	0.250	0.025	A	1	N/A
13	06/11/92	7.7	220	21.2	0.180	0.027	A	1	N/A
14	06/18/92	7.4	230	15.1	0.200	0.026	A	1	N/A
15	06/25/92	7.8	270	18.8	0.160	0.030	A	1	N/A
16	07/01/92	7.7	240	17.5	0.160	0.023	A	1	N/A
17	07/10/92	7.8	270	21.3	0.100	0.024	A	1	N/A
18	07/17/92	7.9	280	16.3	0.120	0.026	A	1	N/A

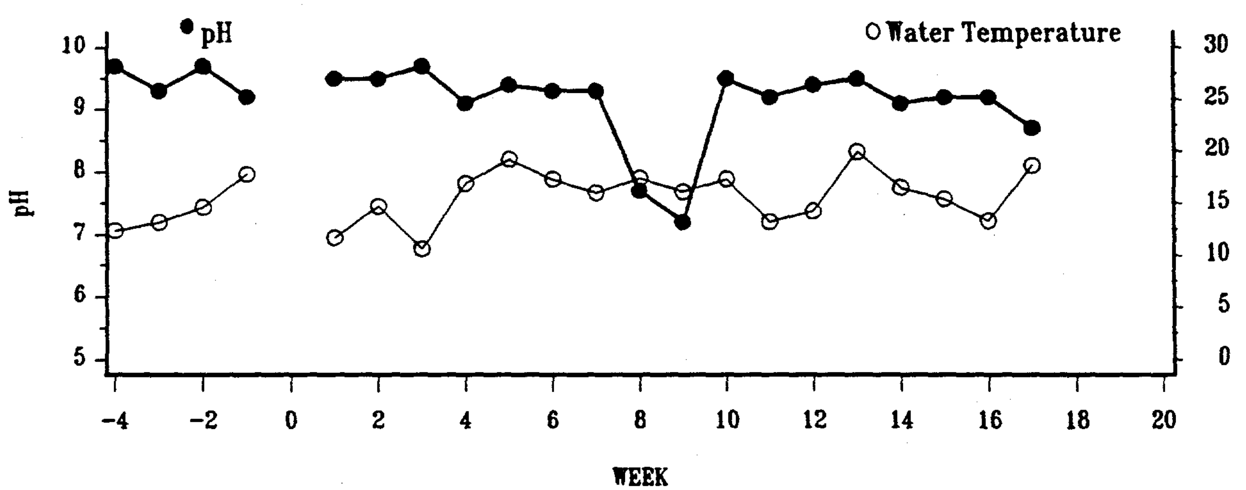
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station GW 232







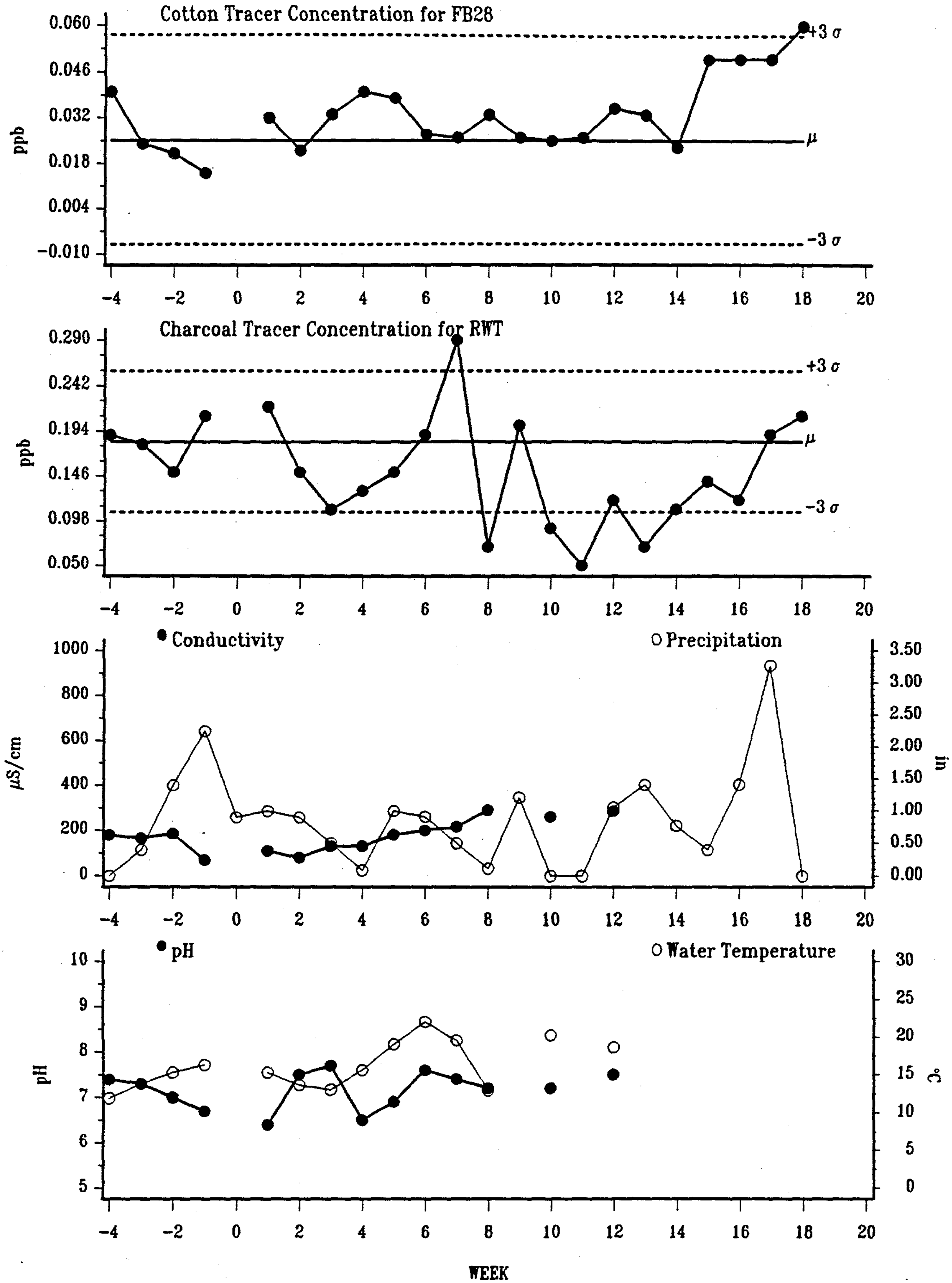


Station: GW 232

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	9.7	370	12.4			A	1	NO DETECTOR IN WELL!!!
-3	02/17/92	9.3	600	13.2	0.420	0.035	A	1	VERY CLEAN SAMPLE
-2	02/24/92	9.7	680	14.6	0.500	0.022	A	1	SMALL PK @ 542nm (SF)
-1	03/02/92	9.2	750	17.8	0.170		A	1	COTTON BUG MISSING
0	03/09/92						A	1	N/A
1	03/19/92	9.5	650	11.7	0.440	0.026	A	1	N/A
2	03/26/92	9.5	700	14.7	0.770	0.021	A	1	N/A
3	04/02/92	9.7	610	10.6	0.110	0.030	A	1	COTTON .029,.029
3	04/02/92					0.029	A	2	N/A
3	04/02/92					0.029	A	3	N/A
4	04/09/92	9.1	700	16.9	0.200	0.025	A	1	N/A
5	04/16/92	9.4	750	19.2	0.060	0.027	A	1	N/A
6	04/23/92	9.3	800	17.3	0.140	0.024	A	1	N/A
7	04/30/92	9.3	700	16.0	0.070	0.038	A	1	DETECTOR WAS REMOVED FROM WELL (APPROX. 48 HRS) IN ORDER FOR THE WELL TO BE SAMPLED.
8	05/07/92	7.7	670	17.4	0.150	0.035	A	1	N/A
9	05/14/92	7.2	750	16.1	0.160	0.025	A	1	N/A
10	05/21/92	9.5	700	17.3	0.040	0.027	A	1	N/A
11	05/28/92	9.2	700	13.2	0.080	0.033	A	1	N/A
12	06/04/92	9.4	650	14.2	0.190	0.033	A	1	N/A
13	06/11/92	9.5	750	19.9	0.030	0.025	A	1	SPLIT: 0.04
13	06/11/92				0.040		A	2	N/A
14	06/18/92	9.1	800	16.5	0.080	0.022	A	1	DETECTORS WERE REPLACED ON 06/19/92
15	06/25/92	9.2	780	15.4	0.450	0.027	A	1	N/A
16	07/01/92	9.2	820	13.3	0.280	0.026	A	1	N/A
17	07/10/92	8.7	800	18.6	0.260	0.026	A	1	N/A
18	07/17/92				0.970	0.032	A	1	CH: PEAK AT 600nm. BAILER WAS LOST IN THE WELL. DECTECTOR RECOVERED.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station GW 561



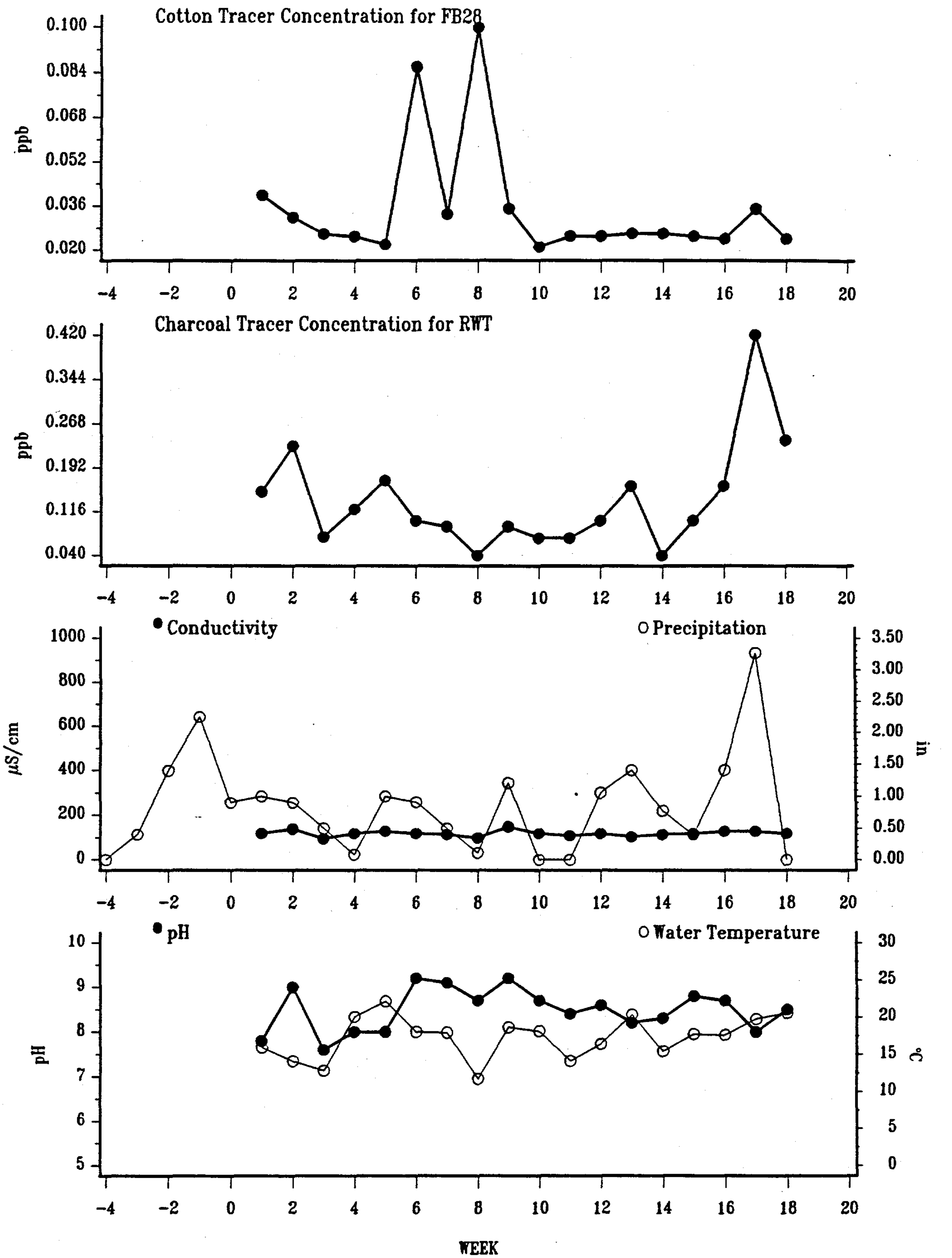
23SEP92

Station: GW 561

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.4	180	11.9	0.190	0.040	A	1	N/A
-3	02/17/92	7.3	165	13.8	0.180	0.024	4	1	VERY CLEAN SAMPLE, SMALL PK @ 595nm
-2	02/24/92	7.0	185	15.3	0.150	0.021	A	1	COTTON .019,.020 75.7,93.4,92.9=92.9 MEAN REMOVED SAMPLE AND REPLACE IT
-2	02/24/92					0.019	A	2	N/A
-2	02/24/92					0.020	A	3	N/A
-1	03/02/92	6.7	70	16.3	0.210	0.015	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.4	110	15.3	0.220	0.032	A	1	RWT ORIGINALLY REPORTED AS 0.33.
2	03/26/92	7.5	80	13.6	0.150	0.022	A	1	N/A
3	04/02/92	7.7	130	13.0	0.110	0.033	A	1	PUT STAINLESS STEEL STRAINER ON AS WEIGHT.
4	04/09/92	6.5	130	15.6	0.130	0.040	A	1	N/A
5	04/16/92	6.9	180	19.0	0.150	0.038	A	1	N/A
6	04/23/92	7.6	200	22.0	0.190	0.027	A	1	N/A
7	04/30/92	7.4	215	19.5	0.290	0.026	A	1	N/A
8	05/07/92	7.2	290	12.9	0.070	0.033	A	1	N/A
9	05/14/92				0.200	0.026	A	1	WELL DRY; DETECTOR REPLACED.
10	05/21/92	7.2	260	20.2	0.090	0.025	A	1	N/A
11	05/28/92				0.050	0.026	A	1	WELL DRY
12	06/04/92	7.5	285	18.6	0.120	0.035	A	1	N/A
13	06/11/92				0.070	0.033	A	1	WELL DRY STRING WAS WET, BUT NO WATER
14	06/18/92				0.110	0.023	A	1	STRING WAS WET, BUT NO WATER WAS OBTAINED.
15	06/25/92				0.140	0.050	A	1	WELL DRY! DETECTOR REPLACED.
16	07/01/92				0.120	0.050	A	1	WELL DRY! DETECTOR REPLACED.
17	07/10/92				0.190	0.050	A	1	WELL DRY!
18	07/17/92				0.210	0.060	A	1	CH: DETECTOR REPLACED. WEL DRY!

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station GW 734



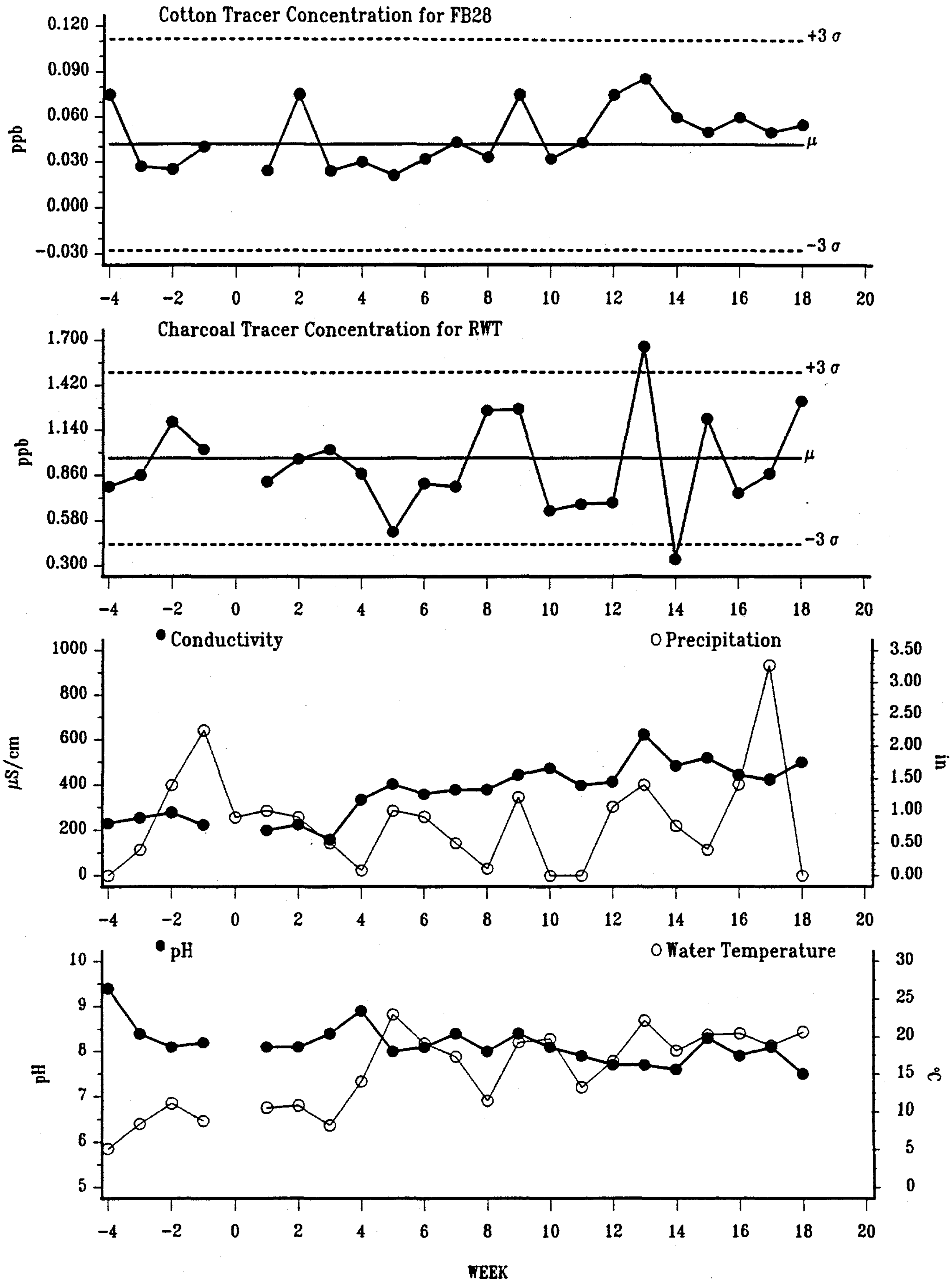
17SEP92

Station: GW 734

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	-	-	-	-	-	-	-	NO BACKGROUND MONITORING
-3	02/17/92	-	-	-	-	-	-	-	NO BACKGROUND MONITORING
-2	02/24/92	-	-	-	-	-	-	-	NO BACKGROUND MONITORING
-1	03/02/92	-	-	-	-	-	-	-	NO BACKGROUND MONITORING
0	03/09/92	-	-	-	-	-	-	-	NO BACKGROUND MONITORING
1	03/19/92	7.8	120	15.9	0.150	0.040	A	1	N/A
2	03/26/92	9.0	140	14.1	0.230	0.032	A	1	N/A
3	04/02/92	7.6	95	12.8	0.072	0.026	A	1	CLEAR
4	04/09/92	8.0	120	20.0	0.120	0.025	A	1	N/A
5	04/16/92	8.0	130	22.1	0.170	0.022	A	1	N/A
6	04/23/92	9.2	120	18.0	0.100	0.086	A	1	N/A
7	04/30/92	9.1	115	17.9	0.090	0.033	A	1	N/A
8	05/07/92	8.7	100	11.7	0.040	0.100	A	1	COTTON SPLIT: 0.086, 0.075
8	05/07/92					0.086	A	2	N/A
8	05/07/92					0.075	A	3	N/A
9	05/14/92	9.2	150	18.6	0.090	0.035	A	1	N/A
10	05/21/92	8.7	120	18.1	0.070	0.021	A	1	N/A
11	05/28/92	8.4	110	14.1	0.070	0.025	A	1	N/A
12	06/04/92	8.6	120	16.4	0.100	0.025	A	1	N/A
13	06/11/92	8.2	105	20.3	0.160	0.026	A	1	N/A
14	06/18/92	8.3	115	15.4	0.040	0.026	A	1	N/A
15	06/25/92	8.8	120	17.7	0.100	0.025	A	1	N/A
16	07/01/92	8.7	130	17.6	0.160	0.024	A	1	N/A
17	07/10/92	8.0	130	19.7	0.420	0.035	A	1	N/A
18	07/17/92	8.5	120	20.5	0.240	0.024	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station BCK 9.00 SW



Station: BCK 9.00 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	9.4	230	5.1	0.790	0.075	A	1	N/A
-3	02/17/92	8.4	255	8.4	0.860	0.027	A	1	CHARCOAL 1.07
-3	02/17/92				1.070		A	2	N/A
-2	02/24/92	8.1	278	11.1	1.190	0.025	A	1	N/A
-1	03/02/92	8.2	225	8.8	1.020	0.040	A	1	HEAVY FLOW
0	03/09/92						A	1	N/A
1	03/19/92	8.1	200	10.5	0.820	0.024	A	1	SPRING FLOW CONDITIONS ABOUT MEDIUM, SPRINGS SHOW NO INCREASE IN FLOW.
2	03/26/92	8.1	225	10.8	0.960	0.075	A	1	MEDIUM FLOW
3	04/02/92	8.4	160	8.2	1.020	0.024	A	1	STREAMS SHOWED LOW FLOW CONDITIONS. SPRINGS STAYE THE SAME.
4	04/09/92	8.9	335	14.0	0.870	0.030	A	1	N/A
5	04/16/92	8.0	405	22.9	0.510	0.021	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.1	360	19.1	0.810	0.032	A	1	N/A
7	04/30/92	8.4	380	17.3	0.790	0.043	A	1	N/A
8	05/07/92	8.0	380	11.4	1.260	0.033	A	1	LOW FLOW CONDITIONS WERE SEEN AT ALL DYE TRACER SITES. THOSE WITH NO FLOW, LOW FLOW OR JUST STAGNANT WATER ARE MARKED.
9	05/14/92	8.4	445	19.2	1.270	0.075	A	1	LOW FLOW CONDITIONS SEEN A ALL OF THE STREAMS AND SPRINGS.
10	05/21/92	8.1	475	19.7	0.640	0.032	A	1	LOW FLOW CONDITIONS WERESEEN AT ALL OF THE STREAMS AND SPRINGS.
11	05/28/92	7.9	400	13.2	0.680	0.043	A	1	CHARCOAL: .73
11	05/28/92				0.730		A	2	N/A
12	06/04/92	7.7	415	16.7	0.690	0.075	A	1	LOW TO MEDIUM FLOW CONDITIONS SEEN AT MOST OF THE SITES. HEAVY, STEADY RAIN THE NIGHT BEFORE.
13	06/11/92	7.7	625	22.1	1.660	0.086	A	1	LOW - MEDIUM FLOW CONDITIONS SEEN AT ALL SITES. CONDITIONS ARE IMPROVING BUT SOME SITES ARE STILL DRY. COTTON: HUG PEAK AT 500 NM
14	06/18/92	7.6	485	18.1	0.340	0.060	A	1	GOOD FLOW CONDITIONS SEEN AT ALL SITES.
15	06/25/92	8.3	520	20.2	1.210	0.050	A	1	LOW-MEDIUM FLOW CONDITIONS WERE SEEN AT ALL SITES
15	06/25/92				1.290		A	2	N/A
16	07/01/92	7.9	445	20.4	0.750	0.060	A	1	DETECTORS COLLECTED ONE DA EARLIER THAN USUAL DUE TO

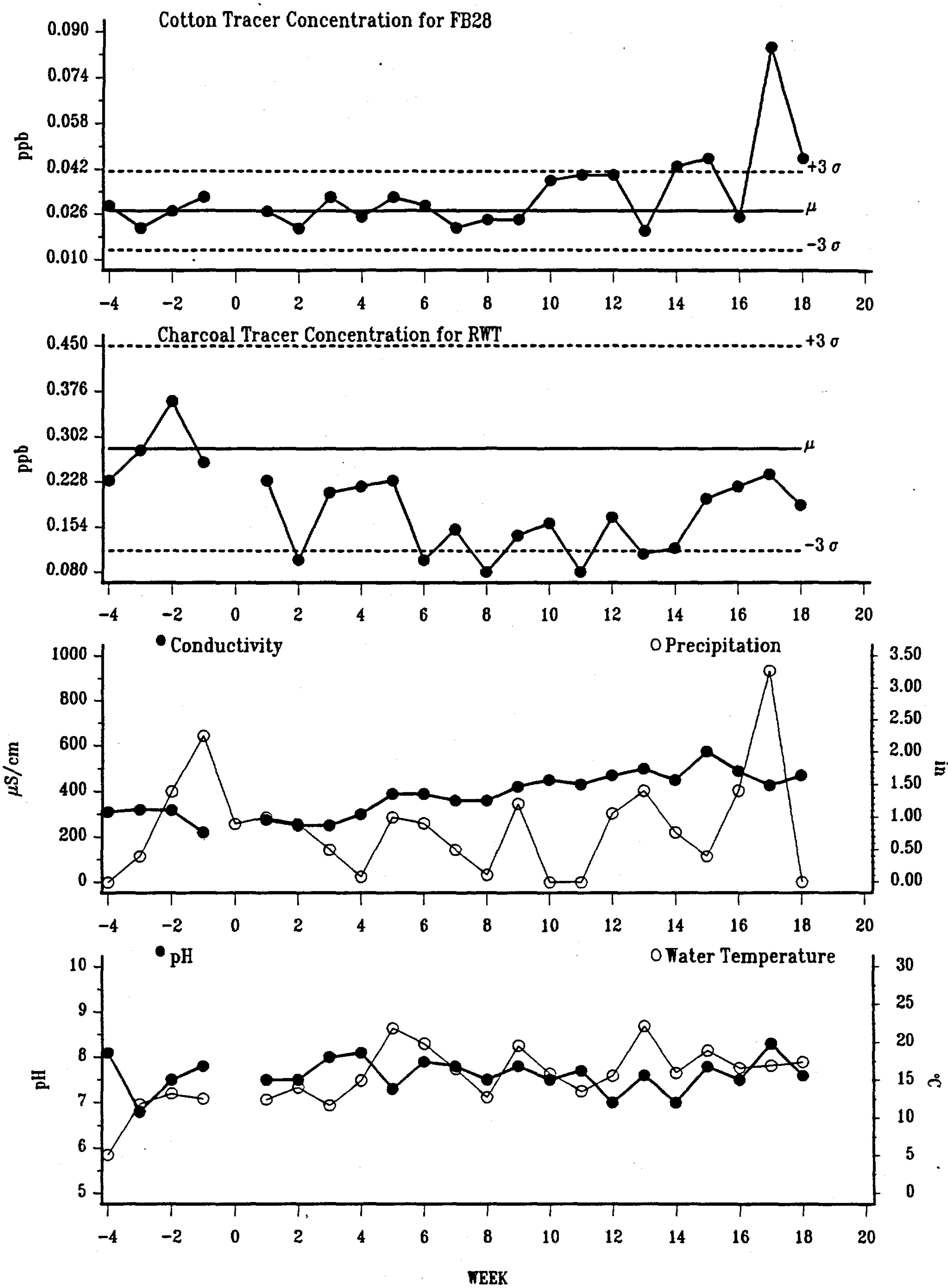
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

Station: BCK 9.00 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
17	07/10/92	8.1	425	18.8	0.870	0.050	A	1	HOLIDAY; GOOD FLOW Good flow conditions seen at all sites. Spring wate levels were elevated.
18	07/17/92	7.5	500	20.6	1.320	0.055	A	1	CH: PEAK AT 500nm. FINAL WEEK OF DYE TRACER II. PICKED UP DETECTORS ONLY.N REPLACEMENTS. FLOW CONDITIONS WERE DECENT, BU STILL LOW.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station BCK 9.41 SP

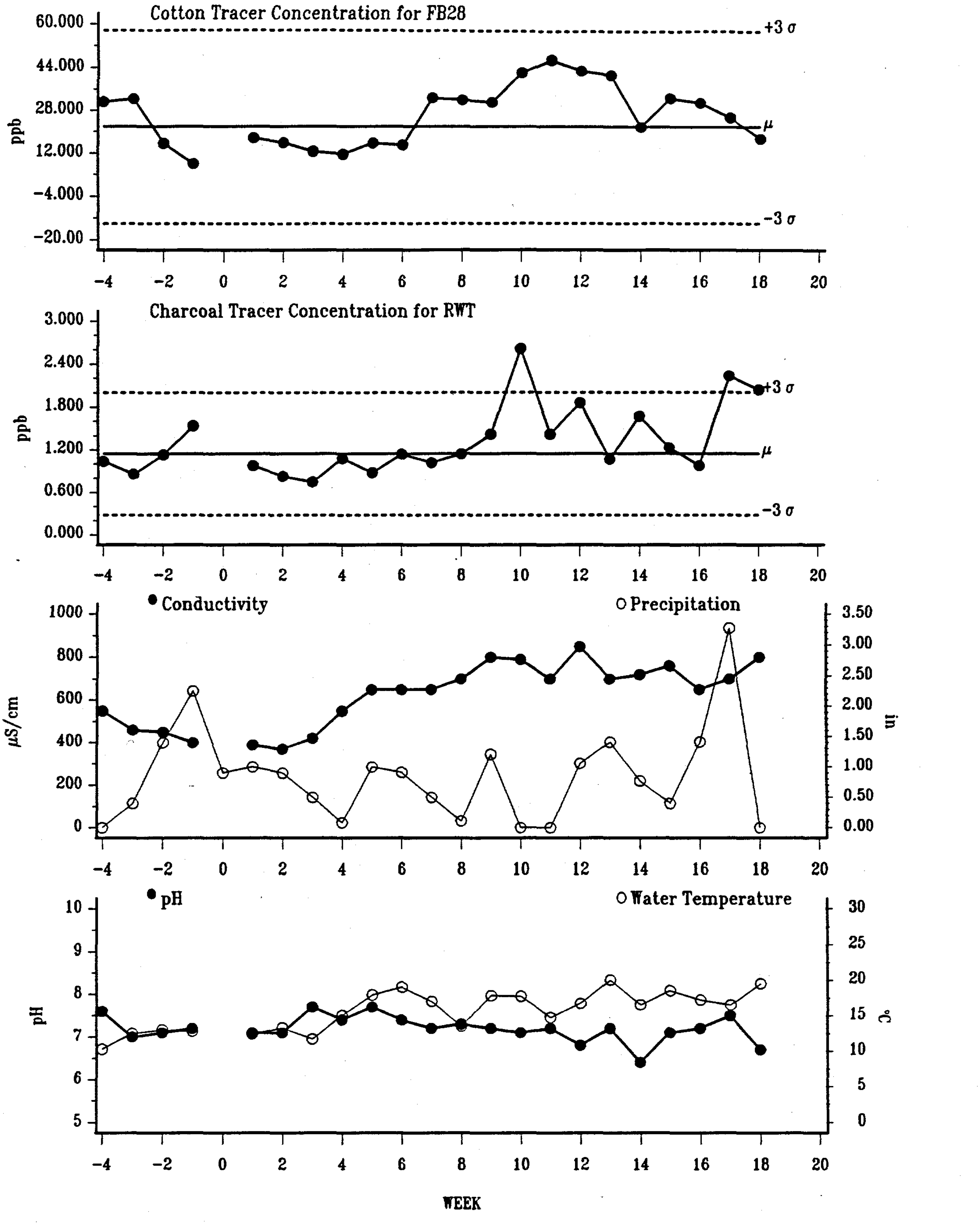


Station: BCK 9.41 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.1	310	5.1	0.230	0.029	A	1	N/A
-3	02/17/92	6.8	320	11.8	0.280	0.021	A	1	N/A
-2	02/24/92	7.5	318	13.2	0.360	0.027	A	1	N/A
-1	03/02/92	7.8	220	12.5	0.260	0.032	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.5	275	12.4	0.230	0.027	A	1	N/A
2	03/26/92	7.5	250	14.0	0.100	0.021	A	1	N/A
3	04/02/92	8.0	250	11.6	0.210	0.032	A	1	N/A
4	04/09/92	8.1	300	14.9	0.220	0.025	A	1	N/A
5	04/16/92	7.3	390	21.8	0.230	0.032	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.9	390	19.8	0.100	0.029	A	1	N/A
7	04/30/92	7.8	360	16.4	0.150	0.021	A	1	N/A
8	05/07/92	7.5	360	12.7	0.080	0.024	A	1	N/A
9	05/14/92	7.8	420	19.5	0.140	0.024	A	1	N/A
10	05/21/92	7.5	450	15.8	0.160	0.038	A	1	N/A
11	05/28/92	7.7	430	13.5	0.080	0.040	A	1	N/A
12	06/04/92	7.0	470	15.5	0.170	0.040	A	1	N/A
13	06/11/92	7.6	500	22.1	0.110	0.020	A	1	N/A
14	06/18/92	7.0	450	15.9	0.120	0.043	A	1	FULL.
15	06/25/92	7.8	575	18.9	0.200	0.046	A	1	N/A
16	07/01/92	7.5	490	16.6	0.220	0.025	A	1	MOST SITES HAD GOOD FLOW CONDITIONS.
17	07/10/92	8.3	425	16.9	0.240	0.085	A	1	FB28 CONC RECALCULATED, ORIGINALLY REPORTED AS 0.12.
18	07/17/92	7.6	470	17.4	0.190	0.046	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station BCK 10.14 SP



Station: BCK 10.14 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.6	550	10.3	1.040	31.200	P	1	COTTON: DYE(WK) 78.1-49.7=29.6
-3	02/17/92	7.0	460	12.5	0.860	32.300	P	1	COTTON: DYE PRESENT, 82.2-47.6=34.6; CHARCOAL: 1.91
-3	02/17/92				1.910		P	2	N/A
-2	02/24/92	7.1	450	13.0	1.130	15.600	P	1	DYE PRESENT! 127.6-98.1=29.5
-1	03/02/92	7.2	400	12.8	1.540	8.000	P	1	DYE PRESENT!
0	03/09/92						P	1	N/A
1	03/19/92	7.1	390	12.4	0.980	17.600	P	1	COTTON 17.6,17.6 DYE PRESENT
1	03/19/92					17.600	P	2	N/A
1	03/19/92					17.600	P	3	N/A
2	03/26/92	7.1	370	13.3	0.830	15.800	P	1	DYE PRESENT!
3	04/02/92	7.7	421	11.7	0.750	12.600	P	1	DYE PRESENT
4	04/09/92	7.4	550	15.0	1.080	11.500	P	1	DYE PRESENT! COTTON: 11.5, 11.6
4	04/09/92					11.500	P	2	N/A
4	04/09/92					11.600	P	3	N/A
5	04/16/92	7.7	650	17.9	0.880	15.600	P	1	DYE COTTON 15.8,15.8 LOW FLOW CONDITIONS
5	04/16/92					15.800	P	2	N/A
5	04/16/92					15.800	P	3	N/A
6	04/23/92	7.4	650	19.0	1.140	14.900	P	1	COTTON SPLIT: 13.9, 13.1; VERY WEAK; LOW FLOW
6	04/23/92					13.900	P	2	N/A
6	04/23/92					13.100	P	3	N/A
7	04/30/92	7.2	650	17.0	1.020	32.700	P	1	COTTON: DYE! SPLIT: 32.3, 32.7; LOW FLOW
7	04/30/92					32.300	P	2	N/A
7	04/30/92					32.700	P	3	N/A
8	05/07/92	7.3	700	13.5	1.140	31.900	P	1	COTTON: DYE! VERY WEAK, SPLIT 32.3, 32.3
8	05/07/92					32.300	P	2	N/A
8	05/07/92					32.300	P	3	N/A
9	05/14/92	7.2	800	17.8	1.420	31.000	P	1	COTTON: DYE!! VERY WEAK. SPLIT: 30.9, 30.1.
9	05/14/92					30.900	P	2	N/A
9	05/14/92					30.100	P	3	N/A
10	05/21/92	7.1	790	17.7	2.610	42.200	P	1	COTTON: 40.8, 40.8; ELEVATED BACKGROUND, LARGE PEAK AT 500nm/CANNOT CONFIRM DYE.
10	05/21/92					40.800	P	2	N/A
10	05/21/92					40.800	P	3	N/A
11	05/28/92	7.2	700	14.7	1.420	46.900	P	1	COTTON: 45.2, 45.2;

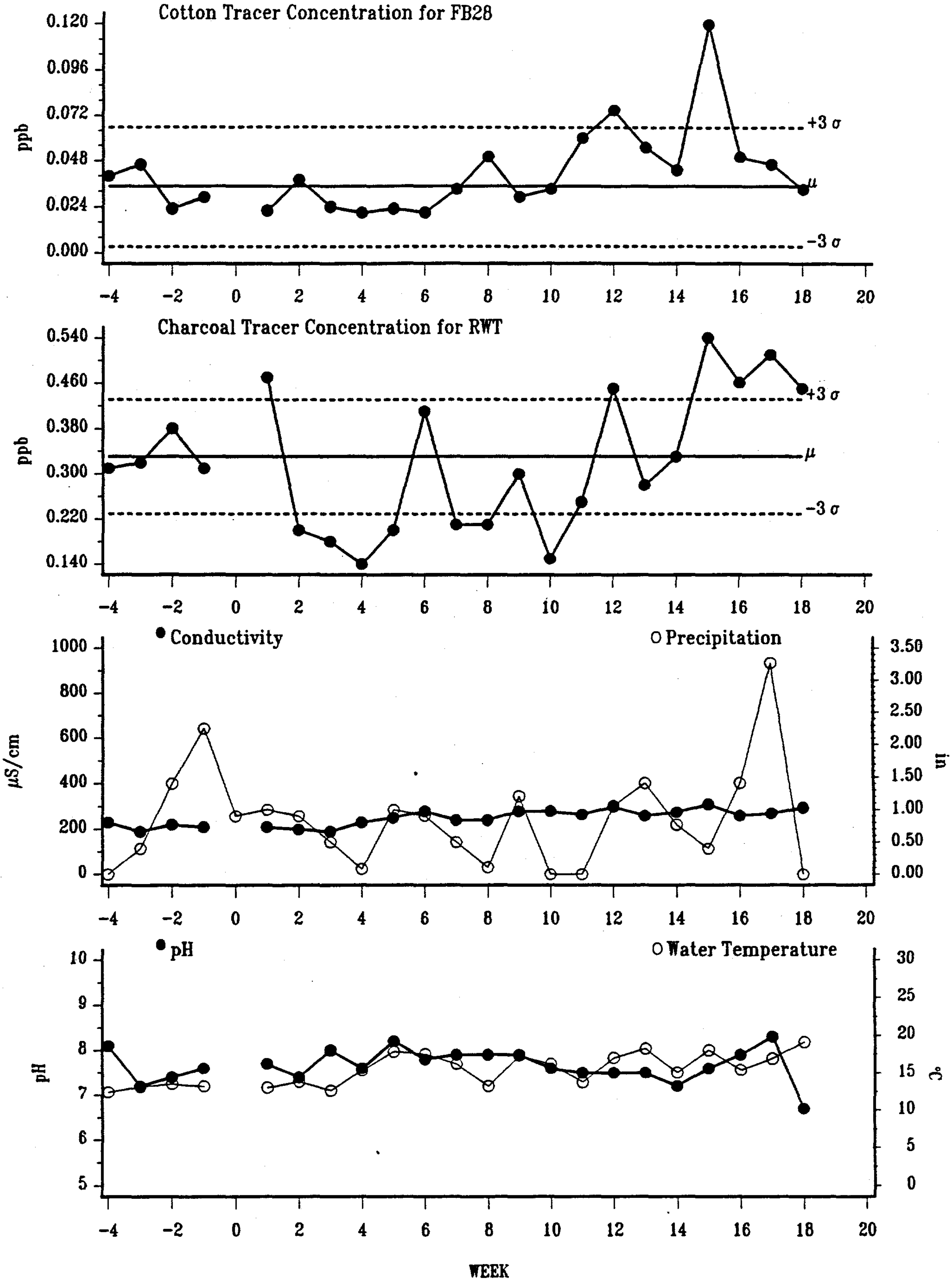
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

Station: BCK 10.14 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
									ELEVATED BACKGROUND, DYE NOT CONFIRMED.
11	05/28/92					45.200	P	2	N/A
11	05/28/92					45.200	P	3	N/A
12	06/04/92	6.8	850	16.7	1.860	42.900	P	1	CHARCOAL: MUTIPLE BCKGND PEAKS, DYE NOT CONFIRMED!
12	06/04/92					42.900	P	2	N/A
13	06/11/92	7.2	700	20.0	1.070	41.300	P	1	LARGE BKGD. PEAK AT 500 NM SPLIT: 39.9, 39.9
13	06/11/92					39.900	P	2	N/A
13	06/11/92					39.900	P	3	N/A
14	06/18/92	6.4	720	16.5	1.670	21.700	P	1	CHARCOAL: LARGE BACKGROUND PEAK AT 500nm. REALLY FLOWING.
14	06/18/92					21.700	P	2	N/A
14	06/18/92					21.700	P	3	N/A
15	06/25/92	7.1	760	18.5	1.230	32.700	P	1	CH: LARGE PEAK AT 500nm
15	06/25/92					38.500	P	2	N/A
15	06/25/92					32.700	P	3	N/A
16	07/01/92	7.2	650	17.2	0.980	31.000	P	1	N/A
16	07/01/92					32.100	P	2	N/A
16	07/01/92					30.900	P	3	N/A
17	07/10/92	7.5	700	16.5	2.230	25.400	P	1	DYE PRESENT! CH:HUGE PEAK AT 500nm
17	07/10/92					22.200	P	2	N/A
17	07/10/92					22.200	P	3	N/A
18	07/17/92	6.7	800	19.5	2.040	17.300	P	1	CH: HUGE PEAK AT 500nm. CO SPLIT!
18	07/17/92					15.700	P	2	N/A
18	07/17/92					15.700	P	3	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station BCK 11.68 SP

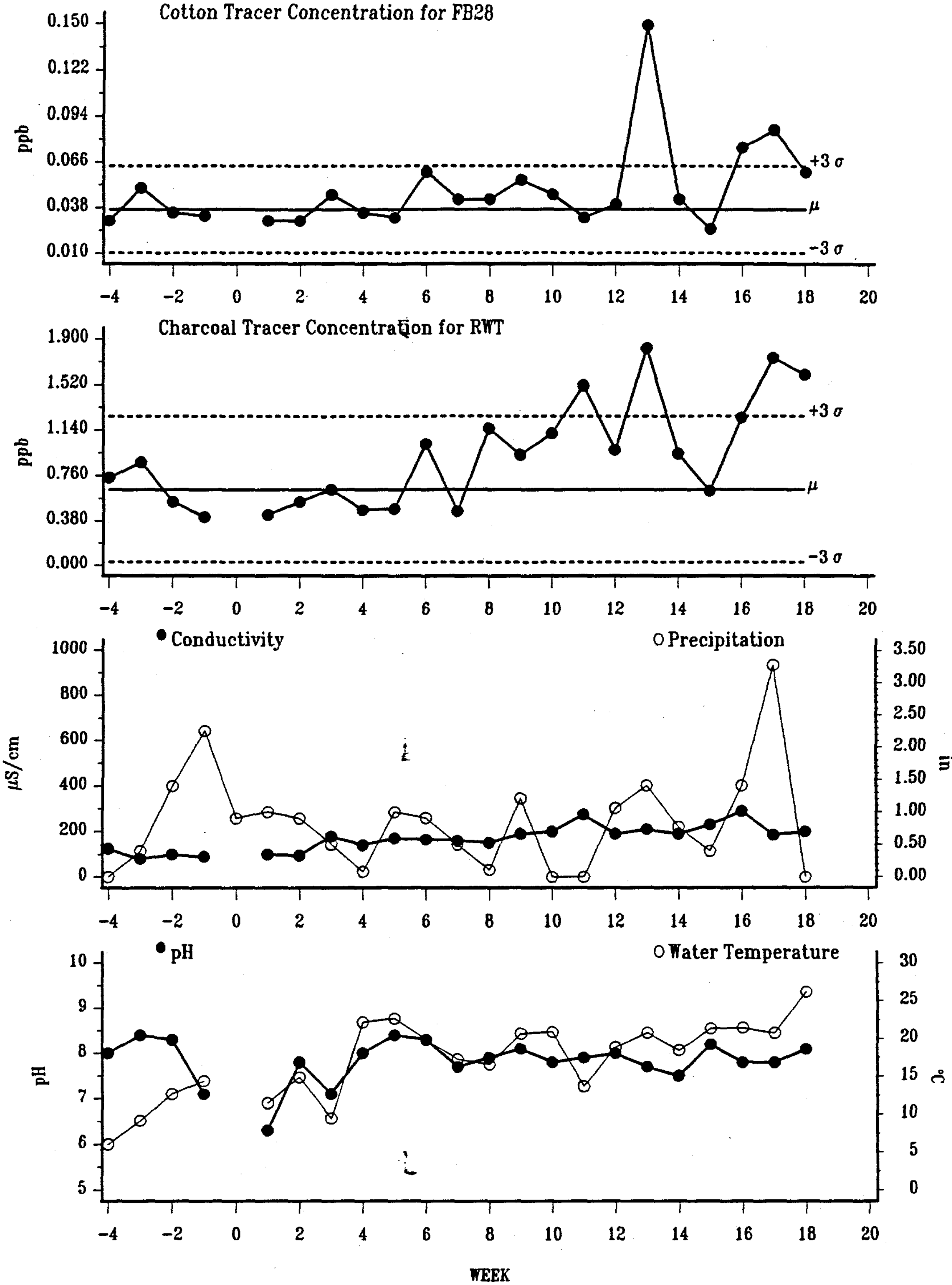


Station: BCK 11.68 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.1	230	12.4	0.310	0.040	A	1	N/A
-3	02/17/92	7.2	190	13.1	0.320	0.046	A	1	N/A
-2	02/24/92	7.4	220	13.5	0.380	0.023	A	1	N/A
-1	03/02/92	7.6	210	13.2	0.310	0.029	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.7	210	13.0	0.470	0.022	A	1	N/A
2	03/26/92	7.4	200	13.8	0.200	0.038	A	1	N/A
3	04/02/92	8.0	190	12.6	0.180	0.024	A	1	N/A
4	04/09/92	7.6	230	15.3	0.140	0.021	A	1	N/A
4	04/09/92				0.180		A	2	N/A
5	04/16/92	8.2	250	17.8	0.200	0.023	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.8	280	17.5	0.410	0.021	A	1	LOW FLOW
7	04/30/92	7.9	240	16.2	0.210	0.033	A	1	LOW FLOW
8	05/07/92	7.9	240	13.2	0.210	0.050	A	1	CHARCOAL SPLIT: 0.18
9	05/14/92	7.9	280	17.3	0.300	0.029	A	1	N/A
10	05/21/92	7.6	280	16.2	0.150	0.033	A	1	N/A
11	05/28/92	7.5	265	13.7	0.250	0.060	A	1	N/A
12	06/04/92	7.5	300	17.0	0.450	0.075	A	1	N/A
13	06/11/92	7.5	260	18.2	0.280	0.055	A	1	N/A
14	06/18/92	7.2	275	15.0	0.330	0.043	A	1	LOW
15	06/25/92	7.6	310	18.0	0.540	0.120	A	1	LOW
16	07/01/92	7.9	260	15.4	0.460	0.050	A	1	N/A
17	07/10/92	8.3	270	16.9	0.510	0.046	A	1	N/A
18	07/17/92	6.7	295	19.1	0.450	0.033	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 1.1 SW



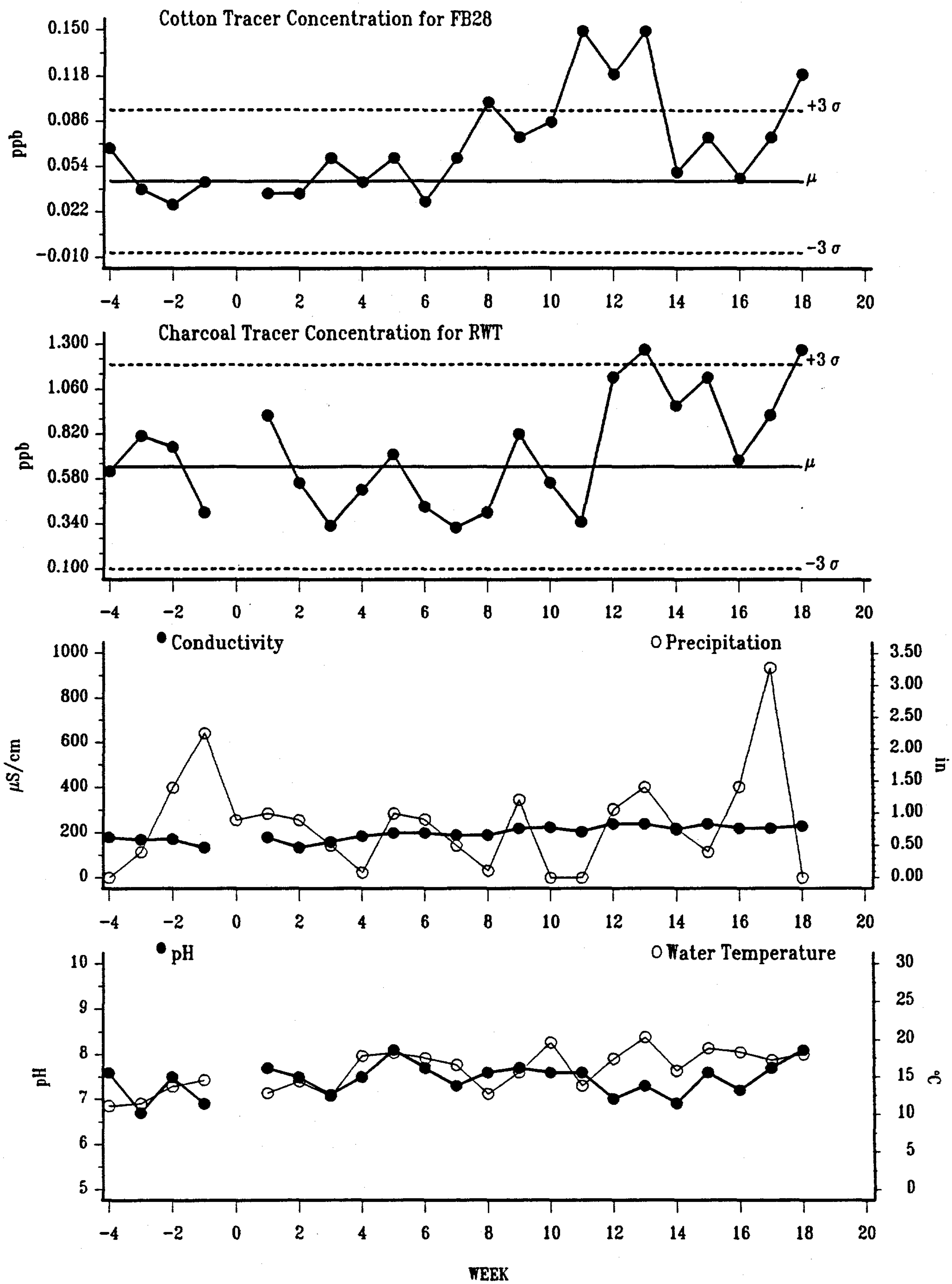
17SEP

Station: SCR 1.1 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.0	125	6.0	0.740	0.030	A	1	N/A
-3	02/17/92	8.4	80	9.1	0.870	0.050	A	1	N/A
-2	02/24/92	8.3	100	12.6	0.540	0.035	A	1	N/A
-1	03/02/92	7.1	90	14.3	0.410	0.033	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.3	100	11.4	0.430	0.030	A	1	N/A
2	03/26/92	7.8	95	14.8	0.540	0.030	A	1	N/A
3	04/02/92	7.1	178	9.4	0.640	0.046	A	1	N/A
4	04/09/92	8.0	140	22.1	0.470	0.035	A	1	N/A
5	04/16/92	8.4	170	22.6	0.480	0.032	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.3	165	19.8	1.020	0.060	A	1	COTTON SPLIT: 0.060, 0.050 ;LOW
6	04/23/92					0.060	A	2	N/A
6	04/23/92					0.050	A	3	N/A
7	04/30/92	7.7	160	17.2	0.460	0.043	A	1	N/A
8	05/07/92	7.9	150	16.5	1.150	0.043	A	1	LOW
9	05/14/92	8.1	190	20.6	0.930	0.055	A	1	N/A
10	05/21/92	7.8	200	20.8	1.110	0.046	A	1	N/A
11	05/28/92	7.9	275	13.6	1.510	0.032	A	1	CHARCOAL;ELEVATED BACKGROUND DYE NOT CONFIRMABLE
12	06/04/92	8.0	190	18.8	0.970	0.040	A	1	N/A
13	06/11/92	7.7	210	20.7	1.820	0.150	A	1	LARGE BACKGROUND
14	06/18/92	7.5	190	18.4	0.940	0.043	A	1	MEDIUM FLOW
15	06/25/92	8.2	230	21.3	0.630	0.025	A	1	GOOD FLOW
16	07/01/92	7.8	290	21.4	1.240	0.075	A	1	CH: BACKGROUND PEAK AT 500nm
17	07/10/92	7.8	185	20.7	1.740	0.086	A	1	CH: LARGE PEAK AT 500nm
18	07/17/92	8.1	200	26.2	1.600	0.060	A	1	CH: LARGE PEAK AT 500nm.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 1.2 SP

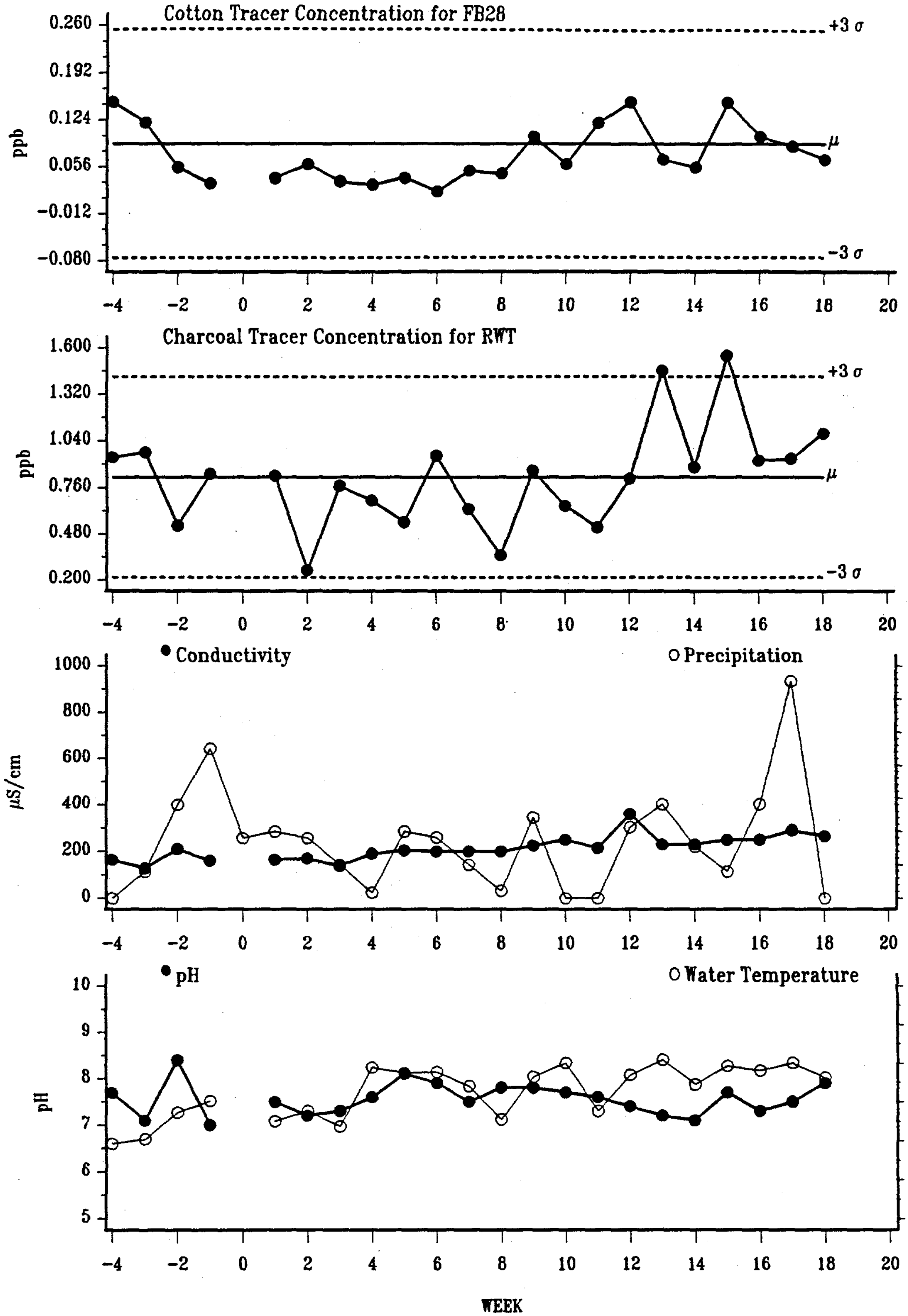


Station: SCR 1.2 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.6	180	11.1	0.620	0.067	A	1	N/A
-3	02/17/92	6.7	170	11.4	0.810	0.038	A	1	N/A
-2	02/24/92	7.5	172	13.7	0.750	0.027	A	1	N/A
-1	03/02/92	6.9	135	14.6	0.400	0.043	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.7	180	12.8	0.920	0.035	A	1	N/A
2	03/26/92	7.5	135	14.4	0.560	0.035	A	1	N/A
3	04/02/92	7.1	160	12.4	0.330	0.060	A	1	N/A
4	04/09/92	7.5	185	17.8	0.520	0.043	A	1	N/A
5	04/16/92	8.1	200	18.2	0.710	0.060	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.7	200	17.5	0.430	0.029	A	1	N/A
7	04/30/92	7.3	190	16.6	0.320	0.060	A	1	CHARCOAL SPLIT: 0.35
7	04/30/92				0.350		A	2	N/A
8	05/07/92	7.6	190	12.7	0.400	0.100	A	1	N/A
9	05/14/92	7.7	220	15.6	0.820	0.075	A	1	N/A
10	05/21/92	7.6	225	19.6	0.560	0.086	A	1	N/A
11	05/28/92	7.6	205	13.8	0.350	0.150	A	1	N/A
12	06/04/92	7.0	240	17.4	1.120	0.120	A	1	CHARCOAL: LARGE BCKGND
12	06/04/92				1.110		A	2	N/A
13	06/11/92	7.3	240	20.3	1.270	0.150	A	1	LARGE BACKGROUND
14	06/18/92	6.9	215	15.8	0.970	0.050	A	1	GOOD FLOW
15	06/25/92	7.6	240	18.8	1.120	0.075	A	1	CH: LARGE SLOPING BACKGROUND PEAK <500nm
16	07/01/92	7.2	220	18.3	0.680	0.046	A	1	N/A
17	07/10/92	7.7	220	17.2	0.920	0.075	A	1	SPLIT: COTTON
17	07/10/92					0.075	A	2	N/A
17	07/10/92					0.100	A	3	N/A
18	07/17/92	8.1	230	18.0	1.270	0.120	A	1	CH: PEAK AT 500nm.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 1.3 SW

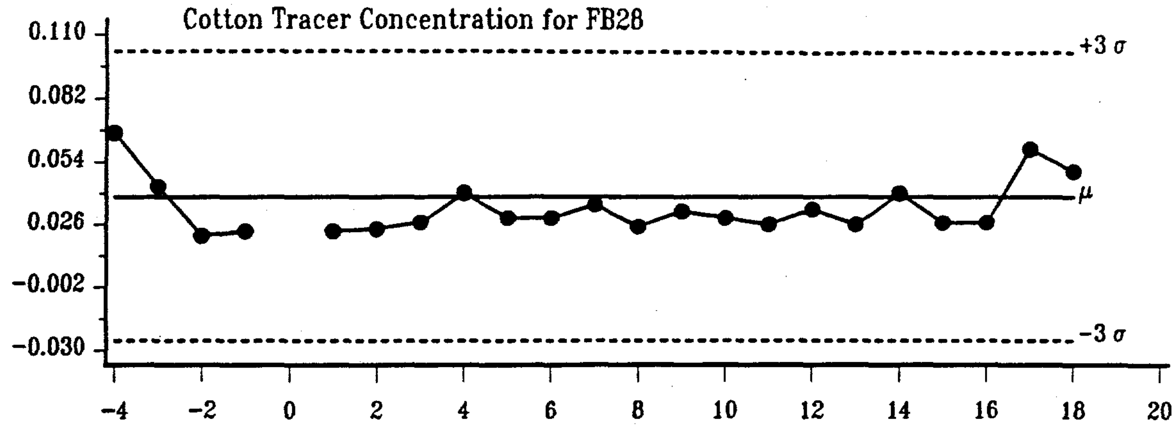


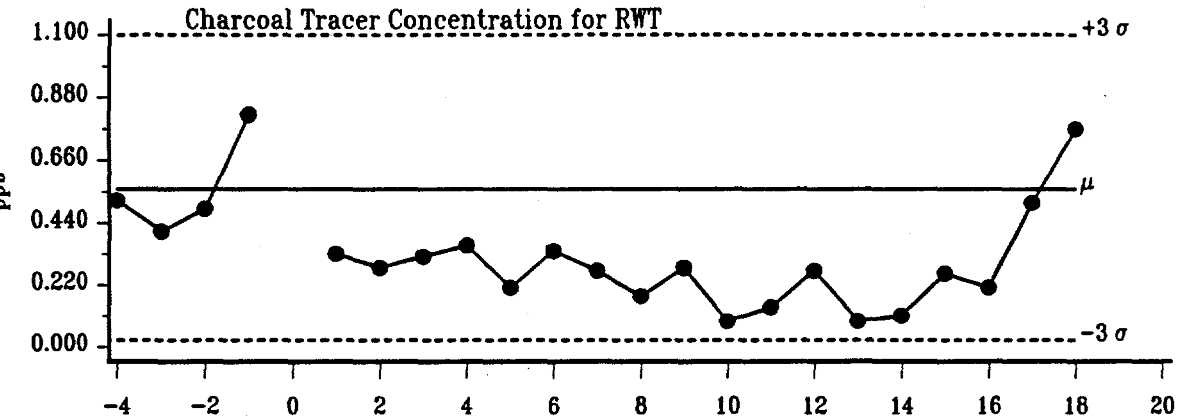
Station: SCR 1.3 SW

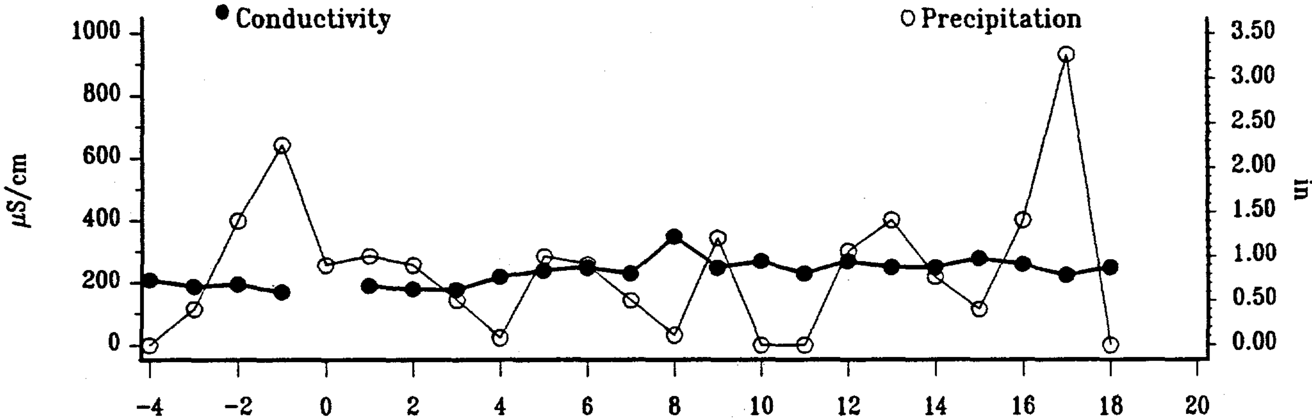
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.7	165	9.6	0.940	0.150	A	1	COTTON .152,.145
-4	02/10/92					0.152	A	2	N/A
-4	02/10/92					0.145	A	3	N/A
-3	02/17/92	7.1	128	10.2	0.970	0.120	A	1	N/A
-2	02/24/92	8.4	210	13.6	0.530	0.055	A	1	N/A
-1	03/02/92	7.0	160	15.1	0.840	0.032	A	1	COTTON .032, .031 MEDIUM FLOW
-1	03/02/92					0.032	A	2	N/A
-1	03/02/92					0.031	A	3	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.5	165	12.5	0.830	0.040	A	1	N/A
2	03/26/92	7.2	170	13.8	0.260	0.060	A	1	N/A
3	04/02/92	7.3	138	11.8	0.770	0.035	A	1	N/A
4	04/09/92	7.6	190	19.4	0.680	0.030	A	1	N/A
5	04/16/92	8.1	205	18.7	0.550	0.040	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.9	200	18.8	0.950	0.020	A	1	N/A
7	04/30/92	7.5	200	17.0	0.630	0.050	A	1	N/A
8	05/07/92	7.8	200	12.7	0.350	0.046	A	1	N/A
9	05/14/92	7.8	225	18.2	0.860	0.100	A	1	N/A
10	05/21/92	7.7	251	20.0	0.650	0.060	A	1	CHARCOAL; .70
10	05/21/92				0.700		A	2	N/A
11	05/28/92	7.6	215	13.8	0.520	0.120	A	1	LOW
12	06/04/92	7.4	360	18.4	0.810	0.150	A	1	MEDIUM FLOW
13	06/11/92	7.2	230	20.4	1.460	0.067	A	1	LARGE BACKGROUND
14	06/18/92	7.1	230	17.2	0.880	0.055	A	1	GOOD FLOW
15	06/25/92	7.7	250	19.6	1.550	0.150	A	1	CH: LARGE SLOPING BACKGROUND PEAK <500nm
16	07/01/92	7.3	250	19.0	0.920	0.100	A	1	N/A
17	07/10/92	7.5	290	20.0	0.930	0.086	A	1	N/A
18	07/17/92	7.9	265	18.1	1.080	0.067	A	1	CH: PEAK AT 500nm.

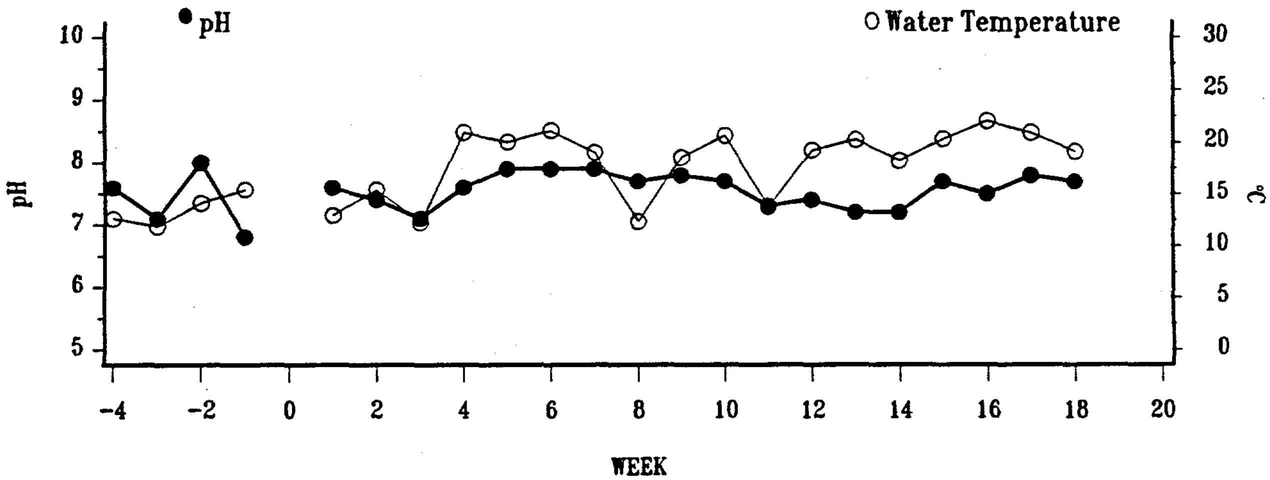
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 1.4 SP









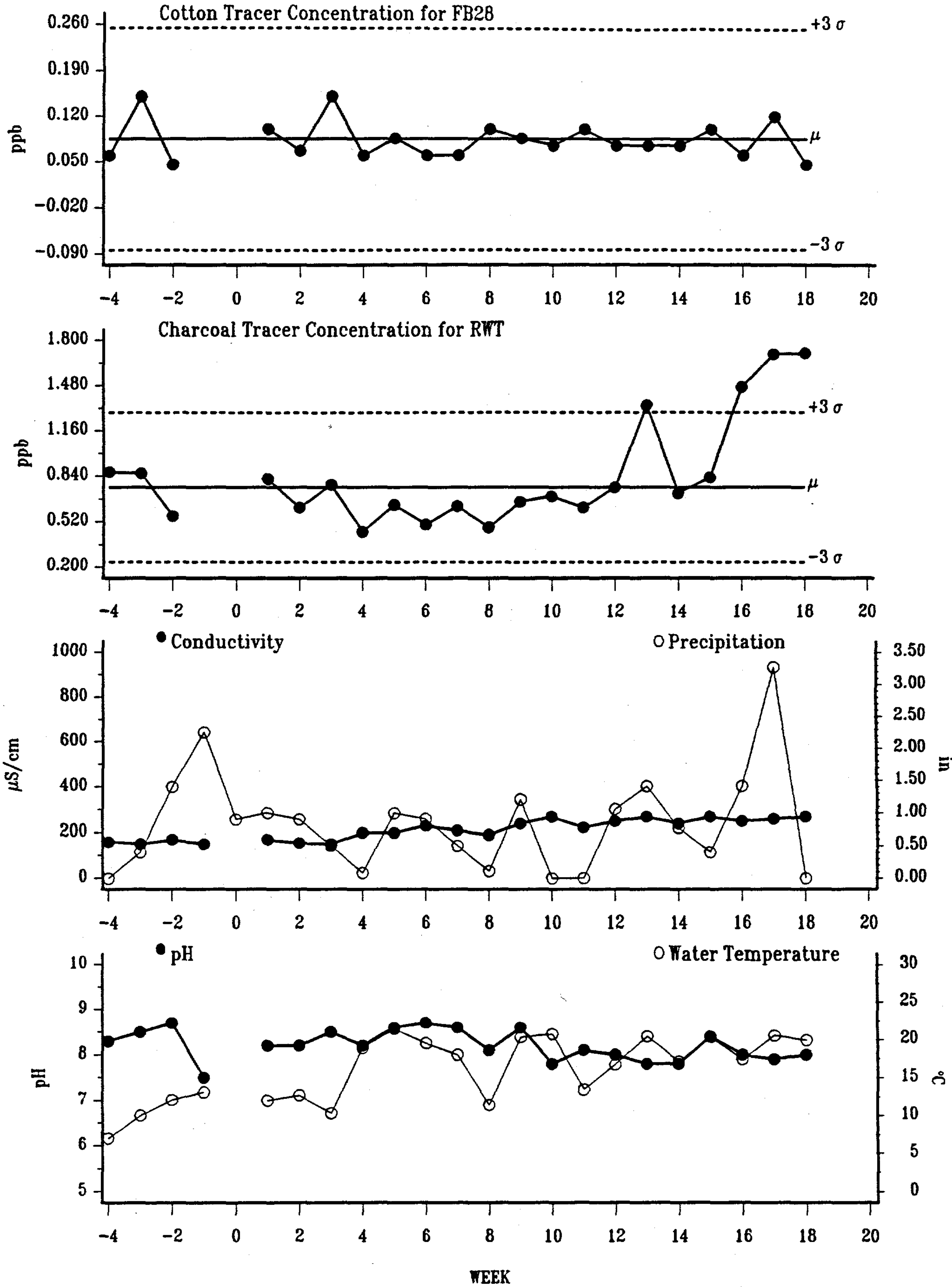
17SEP

Station: SCR 1.4 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.6	210	12.6	0.520	0.067	A	1	N/A
-3	02/17/92	7.1	188	11.8	0.410	0.043	A	1	COTTON .041,.041 75.1, 75.0=75.3 MEAN
-3	02/17/92					0.041	A	2	N/A
-3	02/17/92					0.041	A	3	N/A
-2	02/24/92	8.0	195	14.1	0.490	0.021	A	1	N/A
-1	03/02/92	6.8	170	15.4	0.820	0.023	A	1	CHARCOAL .81
-1	03/02/92				0.810		A	2	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.6	190	12.9	0.330	0.023	A	1	N/A
2	03/26/92	7.4	180	15.4	0.280	0.024	A	1	N/A
3	04/02/92	7.1	178	12.2	0.320	0.027	A	1	CHARCOAL: .33
3	04/02/92				0.330		A	2	N/A
4	04/09/92	7.6	220	20.9	0.360	0.040	A	1	N/A
5	04/16/92	7.9	240	20.0	0.210	0.029	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.9	250	21.1	0.340	0.029	A	1	N/A
7	04/30/92	7.9	230	19.0	0.270	0.035	A	1	N/A
8	05/07/92	7.7	350	12.3	0.180	0.025	A	1	N/A
9	05/14/92	7.8	250	18.5	0.280	0.032	A	1	N/A
10	05/21/92	7.7	270	20.6	0.090	0.029	A	1	N/A
11	05/28/92	7.3	230	13.7	0.140	0.026	A	1	N/A
12	06/04/92	7.4	270	19.2	0.270	0.033	A	1	N/A
13	06/11/92	7.2	250	20.2	0.090	0.026	A	1	N/A
14	06/18/92	7.2	250	18.2	0.110	0.040	A	1	GOOD FLOW
15	06/25/92	7.7	280	20.3	0.260	0.027	A	1	N/A
16	07/01/92	7.5	260	22.0	0.210	0.027	A	1	N/A
17	07/10/92	7.8	225	20.9	0.510	0.060	A	1	N/A
18	07/17/92	7.7	250	19.1	0.770	0.050	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 1.5 SW



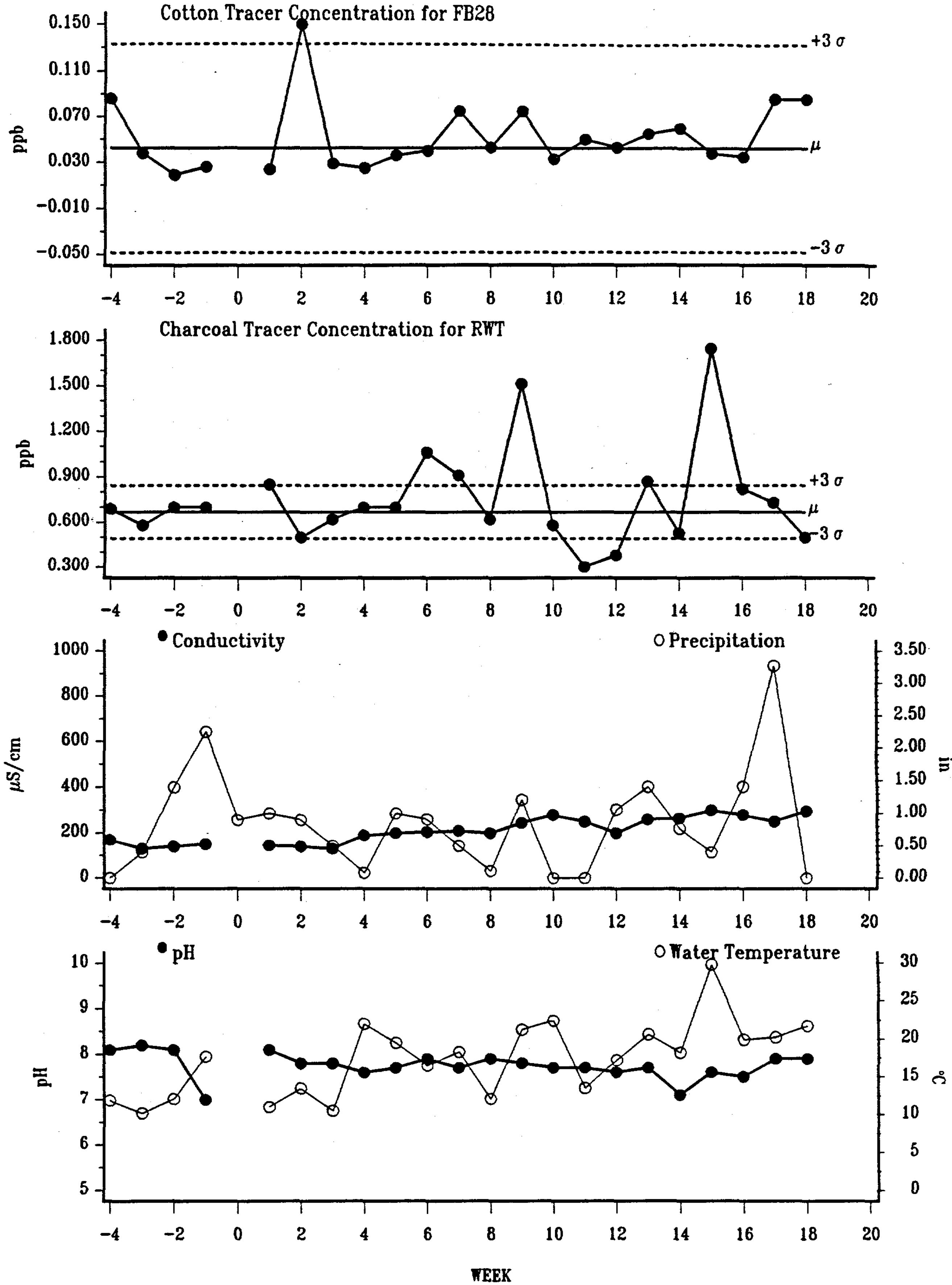
17SEP9

Station: SCR 1.5 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.3	160	7.0	0.870	0.060	A	1	N/A
-3	02/17/92	8.5	150	10.0	0.860	0.150	A	1	N/A
-2	02/24/92	8.7	170	12.1	0.560	0.046	A	1	N/A
-1	03/02/92	7.5	150	13.1			A	1	DETECTOR MISSING!!! HEAVY FLOW
0	03/09/92						A	1	N/A
1	03/19/92	8.2	170	12.0	0.820	0.100	A	1	N/A
2	03/26/92	8.2	155	12.7	0.620	0.067	A	1	COTTON .065, .065
2	03/26/92					0.065	A	2	N/A
2	03/26/92					0.065	A	3	N/A
3	04/02/92	8.5	150	10.3	0.780	0.150	A	1	N/A
4	04/09/92	8.2	200	18.9	0.450	0.060	A	1	N/A
5	04/16/92	8.6	200	21.4	0.640	0.086	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.7	230	19.5	0.500	0.060	A	1	N/A
7	04/30/92	8.6	210	18.0	0.630	0.060	A	1	N/A
8	05/07/92	8.1	190	11.4	0.480	0.100	A	1	N/A
9	05/14/92	8.6	240	20.3	0.660	0.086	A	1	N/A
10	05/21/92	7.8	270	20.7	0.700	0.075	A	1	N/A
11	05/28/92	8.1	222	13.4	0.620	0.100	A	1	LOW
12	06/04/92	8.0	250	16.7	0.760	0.075	A	1	N/A
13	06/11/92	7.8	270	20.4	1.340	0.075	A	1	LARGE BACKGROUND
14	06/18/92	7.8	240	17.1	0.720	0.075	A	1	N/A
15	06/25/92	8.4	270	20.3	0.830	0.100	A	1	N/A
16	07/01/92	8.0	250	17.4	1.470	0.060	A	1	CH: BACKGROUND PEAK AT 500nm
17	07/10/92	7.9	260	20.5	1.700	0.120	A	1	CH: LARGE PEAK AT 500nm
18	07/17/92	8.0	270	19.9	1.710	0.046	A	1	CH: LARGE PEAK AT 500nm.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 2.1 SP



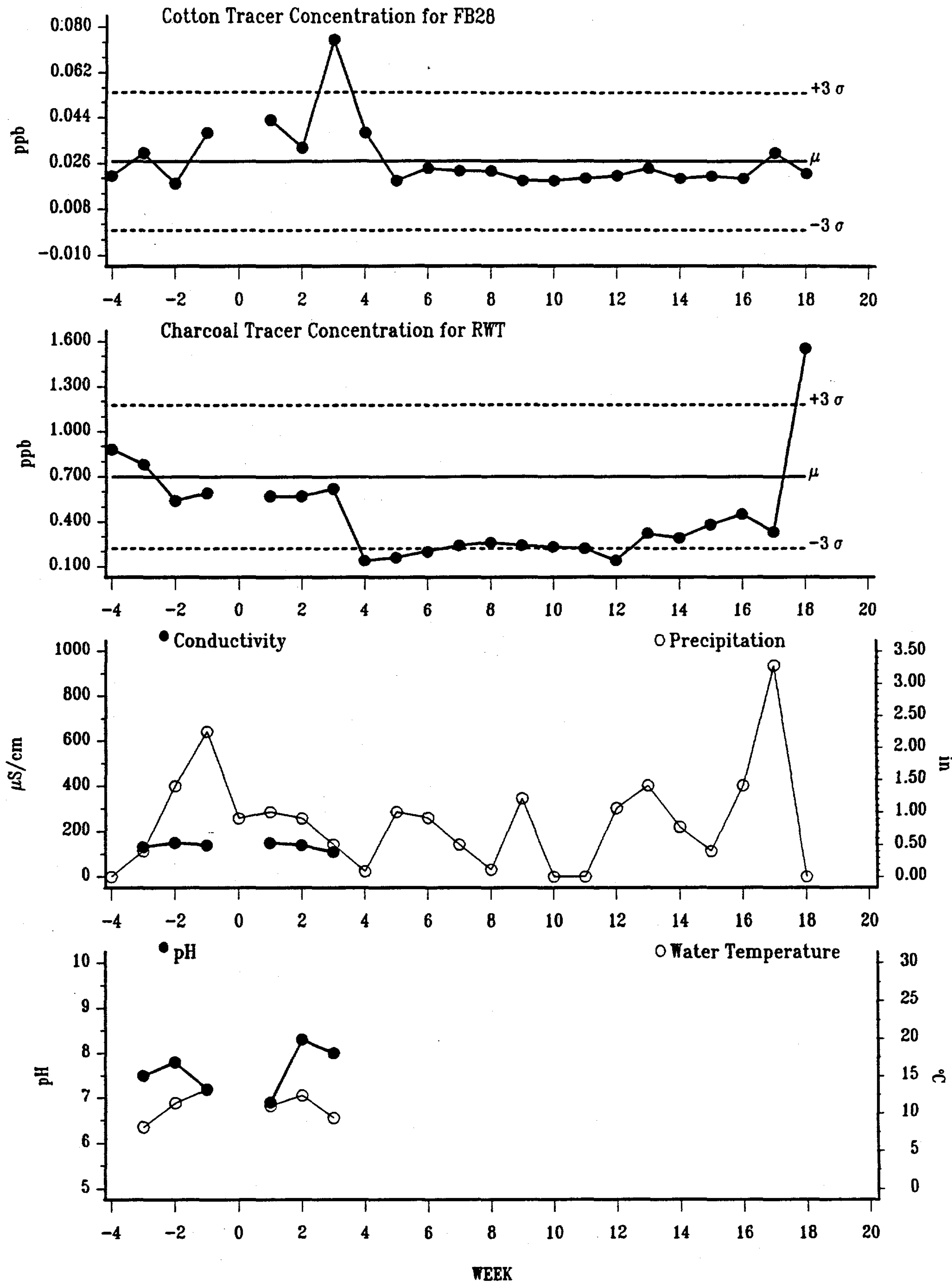
17SEP9

Station: SCR 2.1 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.1	170	11.9	0.690	0.086	A	1	N/A
-3	02/17/92	8.2	130	10.2	0.580	0.038	A	1	N/A
-2	02/24/92	8.1	140	12.1	0.700	0.019	A	1	N/A
-1	03/02/92	7.0	150	17.7	0.700	0.026	A	1	MEDIUM TO HIGH FLOW
0	03/09/92						A	1	N/A
1	03/19/92	8.1	145	11.0	0.850	0.024	A	1	N/A
2	03/26/92	7.8	140	13.5	0.500	0.150	A	1	COTTON: BACKGROUND PEAK AT 460nm (NOT FB28)
3	04/02/92	7.8	130	10.5	0.620	0.029	A	1	N/A
4	04/09/92	7.6	190	22.0	0.700	0.025	A	1	N/A
5	04/16/92	7.7	200	19.5	0.700	0.036	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.9	205	16.5	1.060	0.040	A	1	LOW
7	04/30/92	7.7	210	18.3	0.910	0.075	A	1	LOW FLOW
8	05/07/92	7.9	200	12.1	0.620	0.043	A	1	N/A
9	05/14/92	7.8	245	21.2	1.510	0.075	A	1	N/A
10	05/21/92	7.7	280	22.4	0.580	0.033	A	1	N/A
11	05/28/92	7.7	250	13.5	0.300	0.050	A	1	LOW
12	06/04/92	7.6	200	17.2	0.380	0.043	A	1	N/A
13	06/11/92	7.7	260	20.6	0.870	0.055	A	1	N/A
14	06/18/92	7.1	265	18.2	0.530	0.060	A	1	LOW
15	06/25/92	7.6	300	29.8	1.740	0.038	A	1	CH: LARGE PEAK AT 503nm; STREAM ALMOST DRY
16	07/01/92	7.5	280	19.9	0.820	0.035	A	1	N/A
17	07/10/92	7.9	250	20.2	0.730	0.086	A	1	STILL A LITTLE LOW.
18	07/17/92	7.9	295	21.7	0.500	0.086	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 2.2 SW



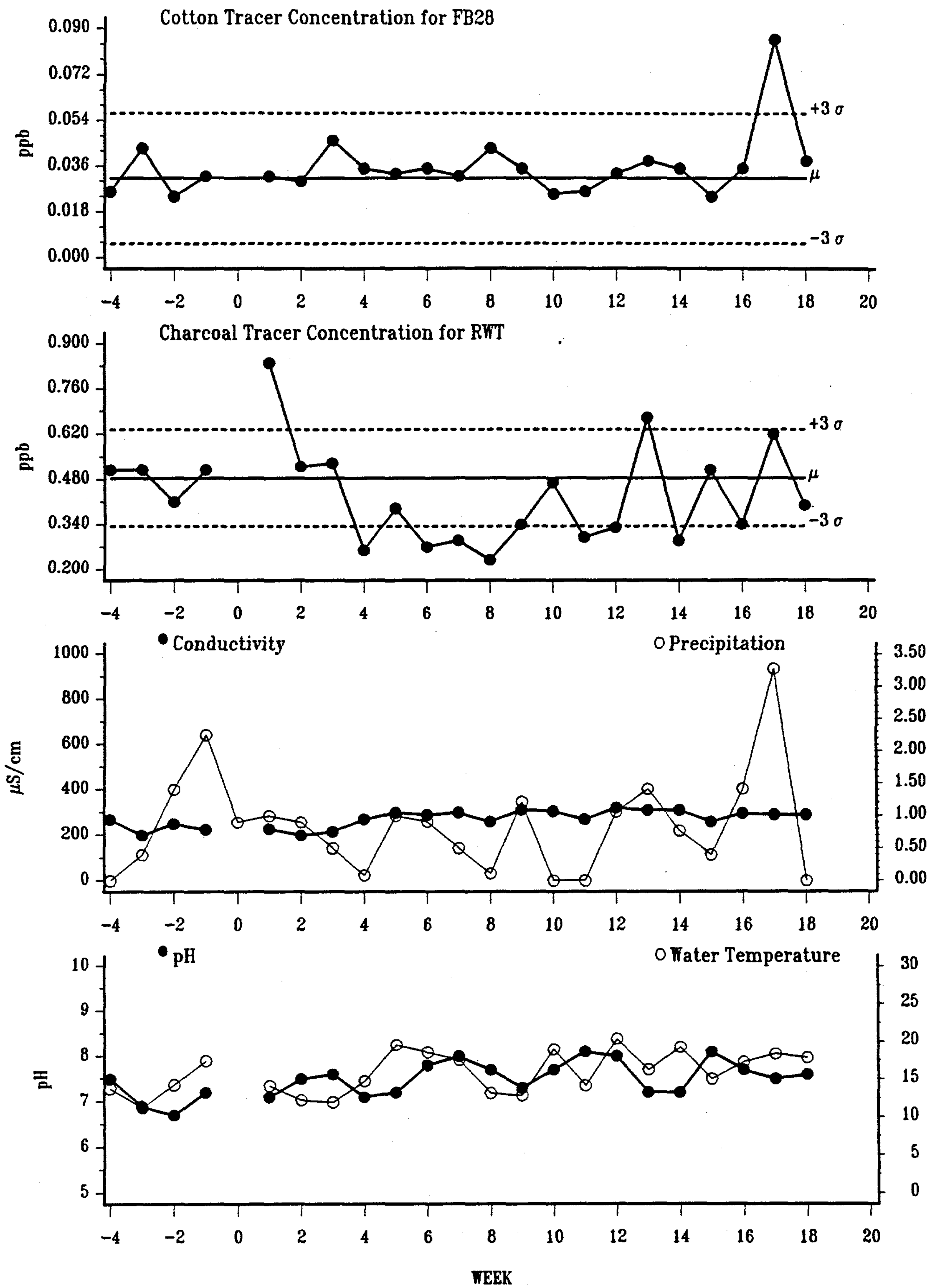
17SEP9

Station: SCR 2.2 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92				0.880	0.021	A	1	REQ INCORRECT SHOWS PK OF DYE STUSTURE STREAM DRY
-3	02/17/92	7.5	132	8.1	0.780	0.030	A	1	COTTON .030,.030 MED. SCATTERING @ 500nm (SF)
-3	02/17/92					0.030	A	2	N/A
-3	02/17/92					0.030	A	3	N/A
-2	02/24/92	7.8	150	11.3	0.540	0.018	A	1	N/A
-1	03/02/92	7.2	140	13.1	0.590	0.038	A	1	WATER PRESENT BUT MOVING SLOWLY
0	03/09/92						A	1	N/A
1	03/19/92	6.9	150	10.9	0.570	0.043	A	1	COTTON .042, .043
1	03/19/92					0.042	A	2	N/A
1	03/19/92					0.043	A	3	N/A
2	03/26/92	8.3	140	12.3	0.570	0.032	A	1	N/A
3	04/02/92	8.0	110	9.3	0.620	0.075	A	1	N/A
4	04/09/92				0.140	0.038	A	1	STREAM DRY, DETECTOR REPLACED
5	04/16/92				0.160	0.019	A	1	STREAM DRY; DETECTOR REPLACED.
6	04/23/92				0.200	0.024	A	1	STREAM DRY; DETECTOR REPLACED
7	04/30/92				0.240	0.023	A	1	NO WATER, STREAM DRY
8	05/07/92				0.260	0.023	A	1	STREAM DRY, REPLACED DETECTOR
9	05/14/92				0.240	0.019	A	1	STREAM DRY: NO WATER; DETECTOR REPLACED.
10	05/21/92				0.230	0.019	A	1	STREAM DRY; NO WATER; DETECTOR REPLACED
11	05/28/92				0.220	0.020	A	1	STREAM DRY; NO WATER; DETECTOR REPLACED
12	06/04/92				0.140	0.021	A	1	STREAM DRY. NO WATER! DETECTOR REPLACED.
13	06/11/92				0.320	0.024	A	1	STREAM DRY; NO WATER DETECTOR REPLACED
14	06/18/92				0.290	0.020	A	1	STREAM DRY, NO WATER! DETECTOR REPLACED.
15	06/25/92				0.380	0.021	A	1	STREAM DRY! DETECTOR REPLACED.
16	07/01/92				0.450	0.020	A	1	STREAM DRY! DETECTOR REPLACED.
17	07/10/92				0.330	0.030	A	1	STREAM DRY! SMALL POOL.
18	07/17/92				1.550	0.022	A	1	CH: LARGE PEAK AT 500nm.STREAM DRY! DETECTO REPLACED!

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 3.1 SP



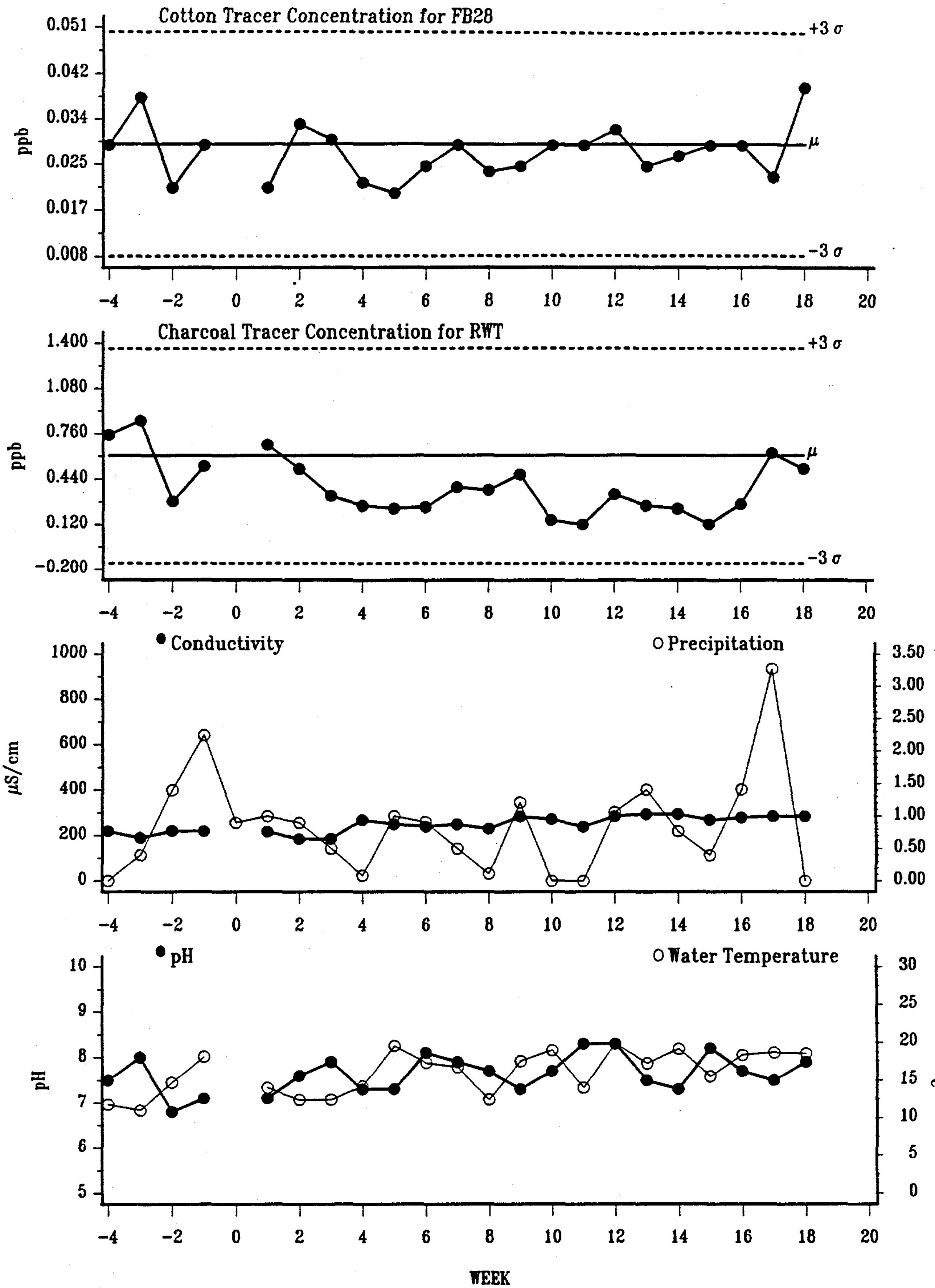
17SEP9

Station: SCR 3.1 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.5	270	13.7	0.510	0.026	A	1	N/A
-3	02/17/92	6.9	200	11.2	0.510	0.043	A	1	N/A
-2	02/24/92	6.7	250	14.2	0.410	0.024	A	1	13.1,73.0,71.3=71.3 MEAN
-1	03/02/92	7.2	225	17.4	0.510	0.032	A	1	MEDIUM TO HIGH FLOW
0	03/09/92						A	1	N/A
1	03/19/92	7.1	228	14.1	0.840	0.032	A	1	N/A
2	03/26/92	7.5	200	12.2	0.520	0.030	A	1	N/A
3	04/02/92	7.6	215	11.9	0.530	0.046	A	1	COTTON .046, .045
3	04/02/92					0.046	A	2	N/A
3	04/02/92					0.045	A	3	N/A
4	04/09/92	7.1	270	14.7	0.260	0.035	A	1	COTTON .035, .035
4	04/09/92					0.035	A	2	N/A
4	04/09/92					0.035	A	3	N/A
5	04/16/92	7.2	300	19.5	0.390	0.033	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.8	290	18.5	0.270	0.035	A	1	LITTLE FLOW
7	04/30/92	8.0	300	17.5	0.290	0.032	A	1	LOW FLOW
8	05/07/92	7.7	260	13.1	0.230	0.043	A	1	N/A
9	05/14/92	7.3	312	12.8	0.340	0.035	A	1	N/A
10	05/21/92	7.7	305	18.9	0.470	0.025	A	1	N/A
11	05/28/92	8.1	270	14.1	0.300	0.026	A	1	N/A
12	06/04/92	8.0	320	20.3	0.330	0.033	A	1	N/A
13	06/11/92	7.2	310	16.2	0.670	0.038	A	1	N/A
14	06/18/92	7.2	310	19.2	0.290	0.035	A	1	N/A
15	06/25/92	8.1	260	15.0	0.510	0.024	A	1	N/A
15	06/25/92					0.022	A	2	N/A
15	06/25/92					0.021	A	3	N/A
16	07/01/92	7.7	295	17.2	0.340	0.035	A	1	N/A
17	07/10/92	7.5	290	18.3	0.620	0.086	A	1	GOOD FLOW.
18	07/17/92	7.6	290	17.8	0.400	0.038	A	1	CH: PEAK AT 540nm

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 3.4 SP

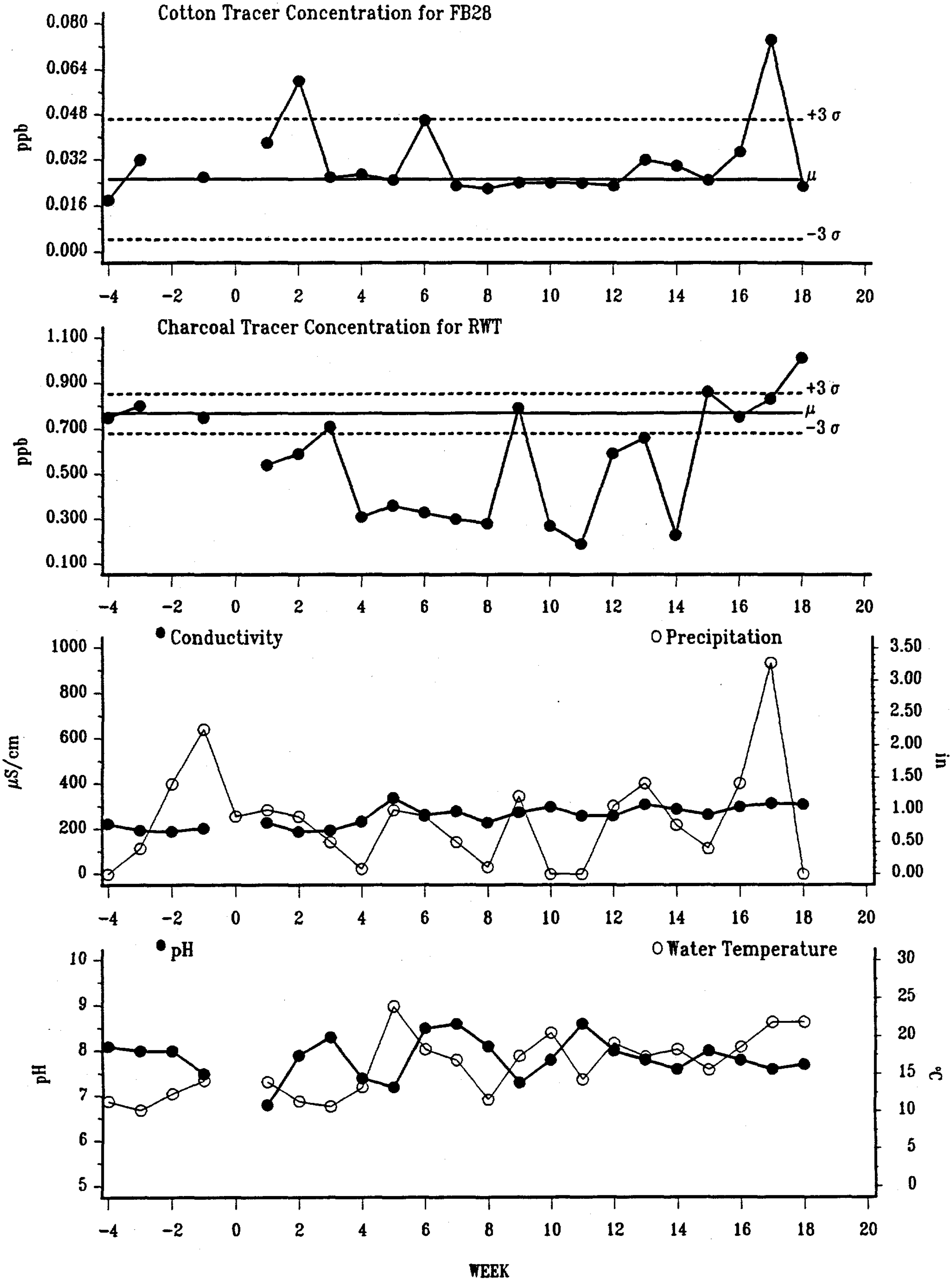


Station: SCR 3.4 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.5	220	11.8	0.750	0.029	A	1	N/A
-3	02/17/92	8.0	190	11.0	0.850	0.038	A	1	N/A
-2	02/24/92	6.8	221	14.7	0.280	0.021	A	1	N/A
-1	03/02/92	7.1	220	18.1	0.530	0.029	A	1	POOL
0	03/09/92						A	1	N/A
1	03/19/92	7.1	218	14.0	0.680	0.021	A	1	N/A
2	03/26/92	7.6	185	12.4	0.510	0.033	A	1	N/A
3	04/02/92	7.9	185	12.4	0.320	0.030	A	1	FB28 ORIGINALLY CALCULATED AS 0.06.
4	04/09/92	7.3	269	14.2	0.250	0.022	A	1	N/A
5	04/16/92	7.3	250	19.5	0.230	0.020	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.1	240	17.3	0.240	0.025	A	1	LOW
7	04/30/92	7.9	250	16.7	0.380	0.029	A	1	LOW FLOW
8	05/07/92	7.7	230	12.4	0.360	0.024	A	1	N/A
9	05/14/92	7.3	285	17.5	0.470	0.025	A	1	N/A
10	05/21/92	7.7	273	18.9	0.150	0.029	A	1	N/A
11	05/28/92	8.3	240	14.0	0.120	0.029	A	1	N/A
12	06/04/92	8.3	285	19.8	0.330	0.032	A	1	N/A
13	06/11/92	7.5	295	17.2	0.250	0.025	A	1	N/A
14	06/18/92	7.3	295	19.1	0.230	0.027	A	1	N/A
15	06/25/92	8.2	270	15.5	0.120	0.029	A	1	N/A
16	07/01/92	7.7	280	18.3	0.260	0.029	A	1	N/A
16	07/01/92				0.260		A	2	N/A
17	07/10/92	7.5	285	18.6	0.620	0.023	A	1	DETECTOR OUT OF WATER.
18	07/17/92	7.9	285	18.5	0.510	0.040	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 3.5 SP



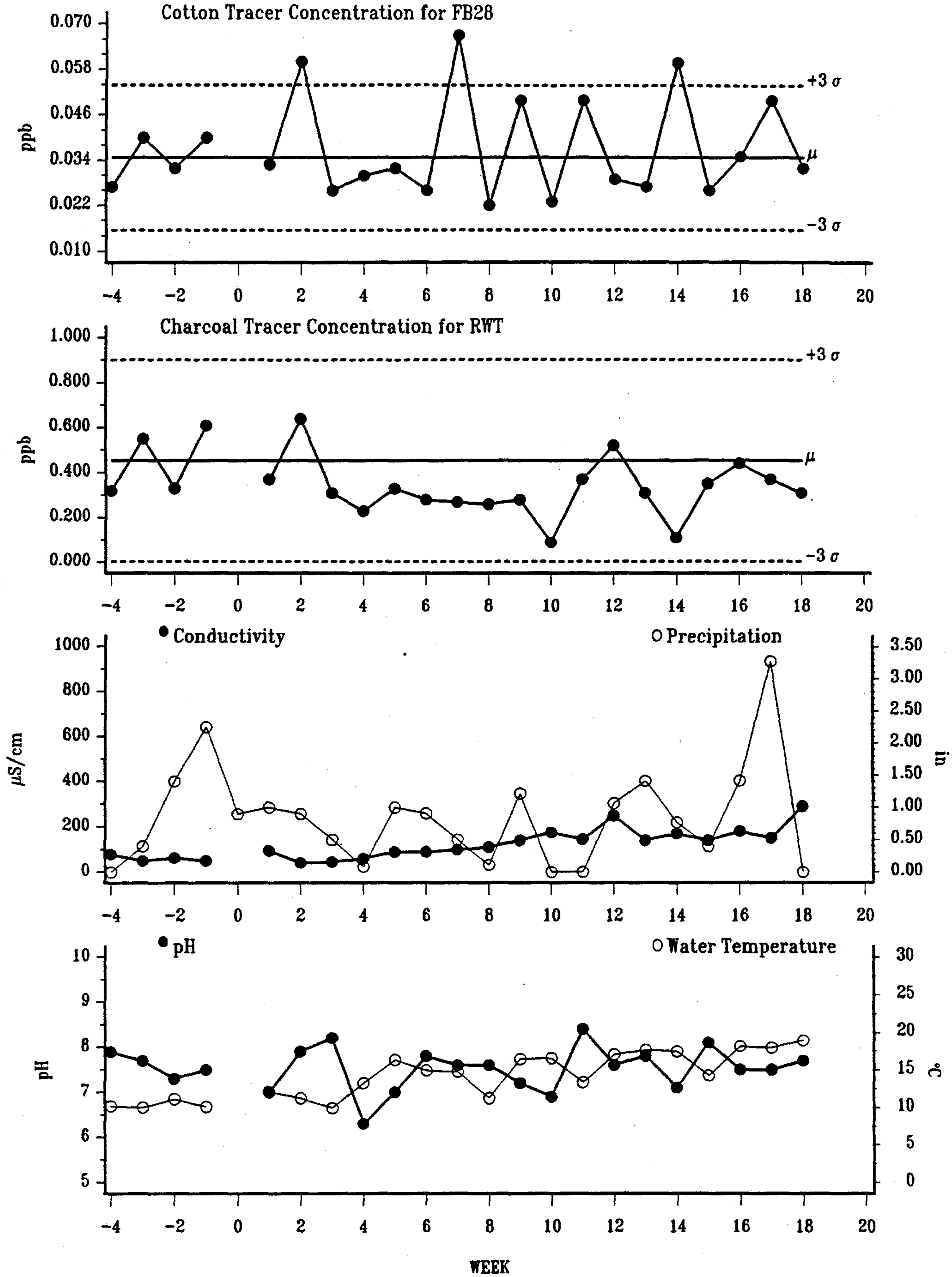
17SEP92

Station: SCR 3.5 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.1	225	11.3	0.750	0.018	A	1	N/A
-3	02/17/92	8.0	195	10.1	0.800	0.032	A	1	Lg PK @ 505nm (SF)
-2	02/24/92	8.0	190	12.3			A	1	DETECTOR MISSING!!!
-1	03/02/92	7.5	205	14.1	0.750	0.026	A	1	MEDIUM TO HIGH FLOW
0	03/09/92						A	1	N/A
1	03/19/92	6.8	230	13.9	0.540	0.038	A	1	N/A
2	03/26/92	7.9	190	11.3	0.590	0.060	A	1	N/A
3	04/02/92	8.3	195	10.6	0.710	0.026	A	1	N/A
4	04/09/92	7.4	235	13.2	0.310	0.027	A	1	N/A
5	04/16/92	7.2	340	23.9	0.360	0.025	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.5	265	18.2	0.330	0.046	A	1	N/A
7	04/30/92	8.6	280	16.8	0.300	0.023	A	1	N/A
8	05/07/92	8.1	230	11.5	0.280	0.022	A	1	LOW
9	05/14/92	7.3	275	17.3	0.790	0.024	A	1	N/A
10	05/21/92	7.8	300	20.4	0.270	0.024	A	1	N/A
11	05/28/92	8.6	260	14.2	0.190	0.024	A	1	N/A
12	06/04/92	8.0	260	19.0	0.590	0.023	A	1	N/A
13	06/11/92	7.8	310	17.2	0.660	0.032	A	1	N/A
14	06/18/92	7.6	290	18.2	0.230	0.030	A	1	GOOD FLOW
15	06/25/92	8.0	265	15.5	0.860	0.025	A	1	N/A
16	07/01/92	7.8	300	18.5	0.750	0.035	A	1	N/A
17	07/10/92	7.6	315	21.8	0.830	0.075	A	1	N/A
18	07/17/92	7.7	310	21.8	1.010	0.023	A	1	CH: SPLIT
18	07/17/92				0.990		A	2	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 4.1 SW



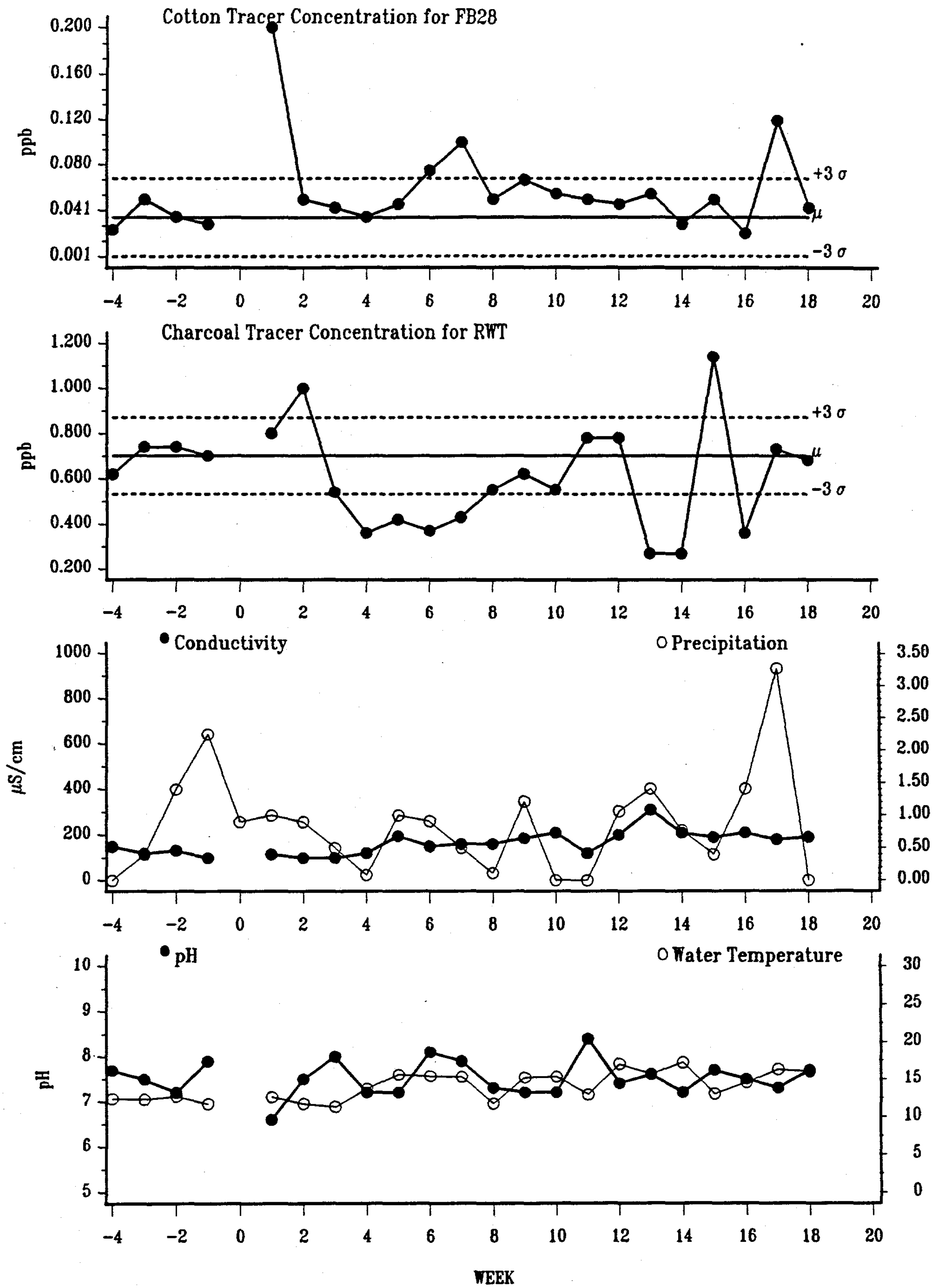
17SEP92

Station: SCR 4.1 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.9	80	10.2	0.320	0.027	A	1	N/A
-3	02/17/92	7.7	50	10.0	0.550	0.040	A	1	N/A
-2	02/24/92	7.3	63	11.1	0.330	0.032	A	1	N/A
-1	03/02/92	7.5	50	10.1	0.610	0.040	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.0	95	12.1	0.370	0.033	A	1	N/A
2	03/26/92	7.9	40	11.2	0.640	0.060	A	1	N/A
3	04/02/92	8.2	45	9.9	0.310	0.026	A	1	N/A
4	04/09/92	6.3	60	13.2	0.230	0.030	A	1	N/A
5	04/16/92	7.0	90	16.3	0.330	0.032	A	1	ALMOST DRY!
6	04/23/92	7.8	90	14.9	0.280	0.026	A	1	N/A
7	04/30/92	7.6	100	14.7	0.270	0.067	A	1	VERY LITTLE FLOW
8	05/07/92	7.6	110	11.2	0.260	0.022	A	1	ALMOST DRY!
9	05/14/92	7.2	140	16.4	0.280	0.050	A	1	N/A
10	05/21/92	6.9	175	16.5	0.090	0.023	A	1	LOW FLOW
11	05/28/92	8.4	145	13.3	0.370	0.050	A	1	ALMOST DRY!
12	06/04/92	7.6	250	17.0	0.520	0.029	A	1	N/A
13	06/11/92	7.8	140	17.6	0.310	0.027	A	1	VERY LITTLE WATER
14	06/18/92	7.1	170	17.4	0.110	0.060	A	1	ALMOST DRY, DETECTOR IN SMALL POOL.
15	06/25/92	8.1	140	14.2	0.350	0.026	A	1	LOW FLOW
16	07/01/92	7.5	180	18.1	0.440	0.035	A	1	N/A
17	07/10/92	7.5	150	17.9	0.370	0.050	A	1	N/A
18	07/18/92	7.7	290	18.9	0.310	0.032	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 4.3 SP



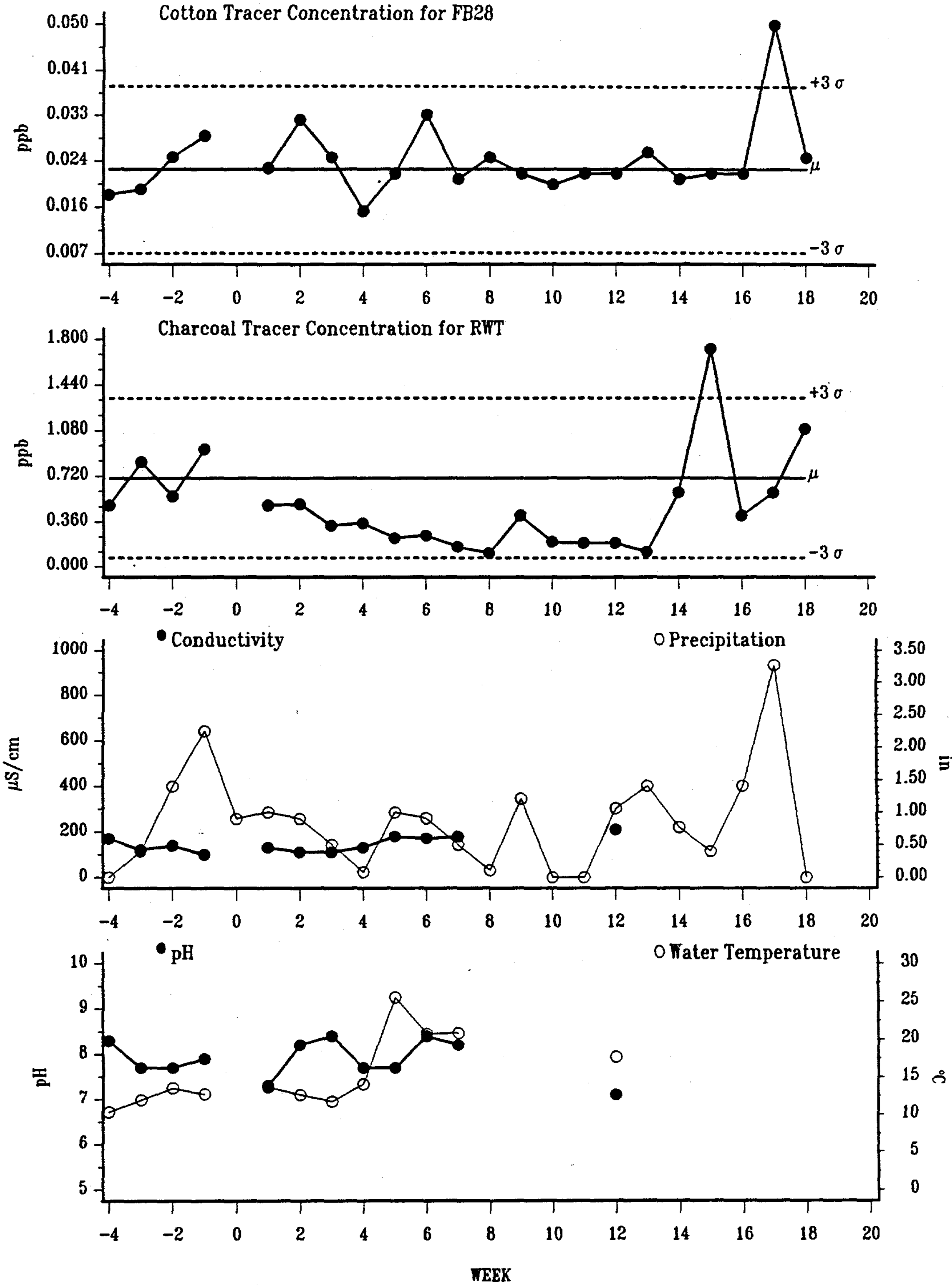
17SEP9

Station: SCR 4.3 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.7	150	12.4	0.620	0.024	A	1	N/A
-3	02/17/92	7.5	120	12.3	0.740	0.050	A	1	N/A
-2	02/24/92	7.2	132	12.7	0.740	0.035	A	1	COTTON .034,.034
-2	02/24/92					0.034	A	2	N/A
-2	02/24/92					0.034	A	3	N/A
-1	03/02/92	7.9	100	11.7	0.700	0.029	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.6	115	12.6	0.800	0.200	A	1	COTTON BKGND PK @ 460nm (NOT FB28)
2	03/26/92	7.5	100	11.7	1.000	0.050	A	1	N/A
3	04/02/92	8.0	100	11.3	0.540	0.043	A	1	N/A
4	04/09/92	7.2	120	13.7	0.360	0.035	A	1	N/A
5	04/16/92	7.2	195	15.6	0.420	0.046	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.1	150	15.4	0.370	0.075	A	1	VERY LITTLE FLOW
7	04/30/92	7.9	160	15.3	0.430	0.100	A	1	N/A
8	05/07/92	7.3	160	11.7	0.550	0.050	A	1	N/A
9	05/14/92	7.2	185	15.2	0.620	0.067	A	1	N/A
10	05/21/92	7.2	210	15.3	0.550	0.055	A	1	N/A
11	05/28/92	8.4	120	12.9	0.780	0.050	A	1	LOW
12	06/04/92	7.4	200	17.0	0.780	0.046	A	1	N/A
13	06/11/92	7.6	310	15.7	0.270	0.055	A	1	N/A
14	06/18/92	7.2	210	17.2	0.270	0.029	A	1	N/A
15	06/25/92	7.7	190	13.0	1.140	0.050	A	1	CH: LARGE SLOPING BACKGROUND PEAK <500nm
16	07/01/92	7.5	210	14.5	0.360	0.021	A	1	N/A
17	07/10/92	7.3	180	16.3	0.730	0.120	A	1	CH: PEAK AT 573nm
18	07/17/92	7.7	190	16.0	0.680	0.043	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 4.4 SW



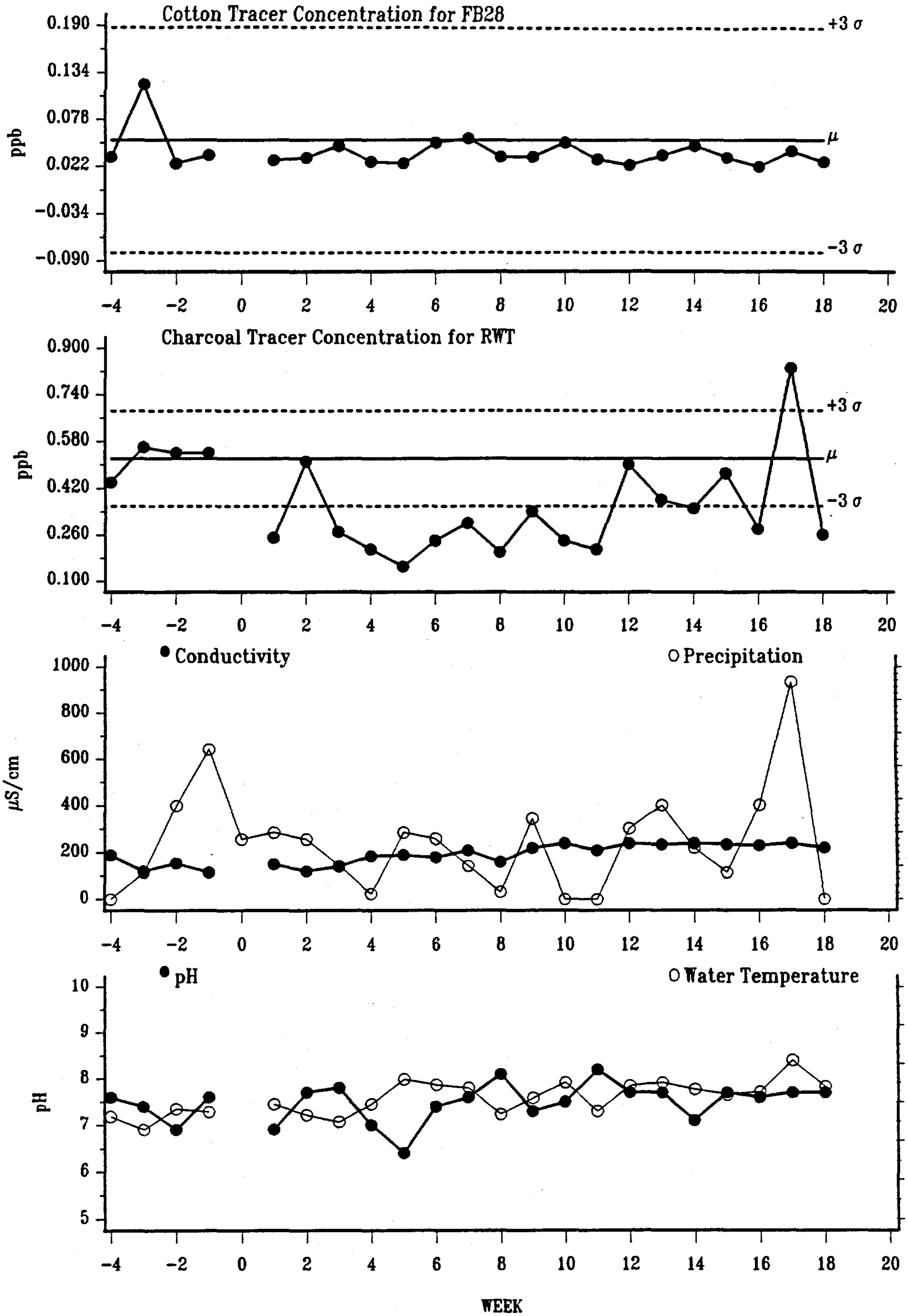
23SEP

Station: SCR 4.4 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.3	170	10.3	0.490	0.018	A	1	N/A
-3	02/17/92	7.7	120	11.9	0.830	0.019	A	1	PKS @ 561 & 587nm (EM)
-2	02/24/92	7.7	139	13.5	0.560	0.025	A	1	COTTON .025,.025 87.3, 87.3=87.4 MEAN
-2	02/24/92					0.025	A	2	N/A
-2	02/24/92					0.025	A	3	N/A
-1	03/02/92	7.9	100	12.7	0.930	0.029	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.3	130	13.6	0.490	0.023	A	1	N/A
2	03/26/92	8.2	110	12.6	0.500	0.032	A	1	N/A
3	04/02/92	8.4	110	11.7	0.330	0.025	A	1	FB28 ORIGINALLY REPORTED 0.075.
4	04/09/92	7.7	130	14.0	0.350	0.015	A	1	CHARCOAL .36
4	04/09/92				0.360		A	2	N/A
5	04/16/92	7.7	180	25.5	0.230	0.022	A	1	CHARCOAL .23 LOW FLOW CONDITIONS
5	04/16/92				0.230		A	2	N/A
6	04/23/92	8.4	172	20.7	0.250	0.033	A	1	CHARCOAL SPLIT: 0.26;
6	04/23/92				0.260		A	2	N/A
7	04/30/92	8.2	180	20.8	0.160	0.021	A	1	VERY LITTLE FLOW
8	05/07/92				0.110	0.025	A	1	NO WATER: STREAM DRY, REPLACED DETECTOR.
9	05/14/92				0.410	0.022	A	1	STREAM DRY: NO WATER; DETECTOR REPLACED. CHARCOAL: SPLIT 0.43
9	05/14/92				0.430		A	2	N/A
10	05/21/92				0.200	0.020	A	1	STREAM DRY; NO WATER; DETECTOR REPLACED
11	05/28/92				0.190	0.022	A	1	STREAM DRY; NO WATER; DETECTOR REPLACED
12	06/04/92	7.1	210	17.6	0.190	0.022	A	1	N/A
13	06/11/92				0.120	0.026	A	1	STREAM DRY; NO WATER DETECTOR REPLACED
14	06/18/92				0.590	0.021	A	1	STREAM DRY, NOT ENOUGH WATER! DETECTOR REPLACED.
15	06/25/92				1.720	0.022	A	1	CH: LARGE PEAK AT 503nm; STREAM DRY! DETECTOR REPLACED.
16	07/01/92				0.410	0.022	A	1	STREAM DRY! DETECTOR REPLACED.
17	07/10/92				0.590	0.050	A	1	STREAM DRY! NO WATER!
18	07/17/92				1.090	0.025	A	1	STREAM DRY! DETECTOR REPLACED!

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 5.1 SP



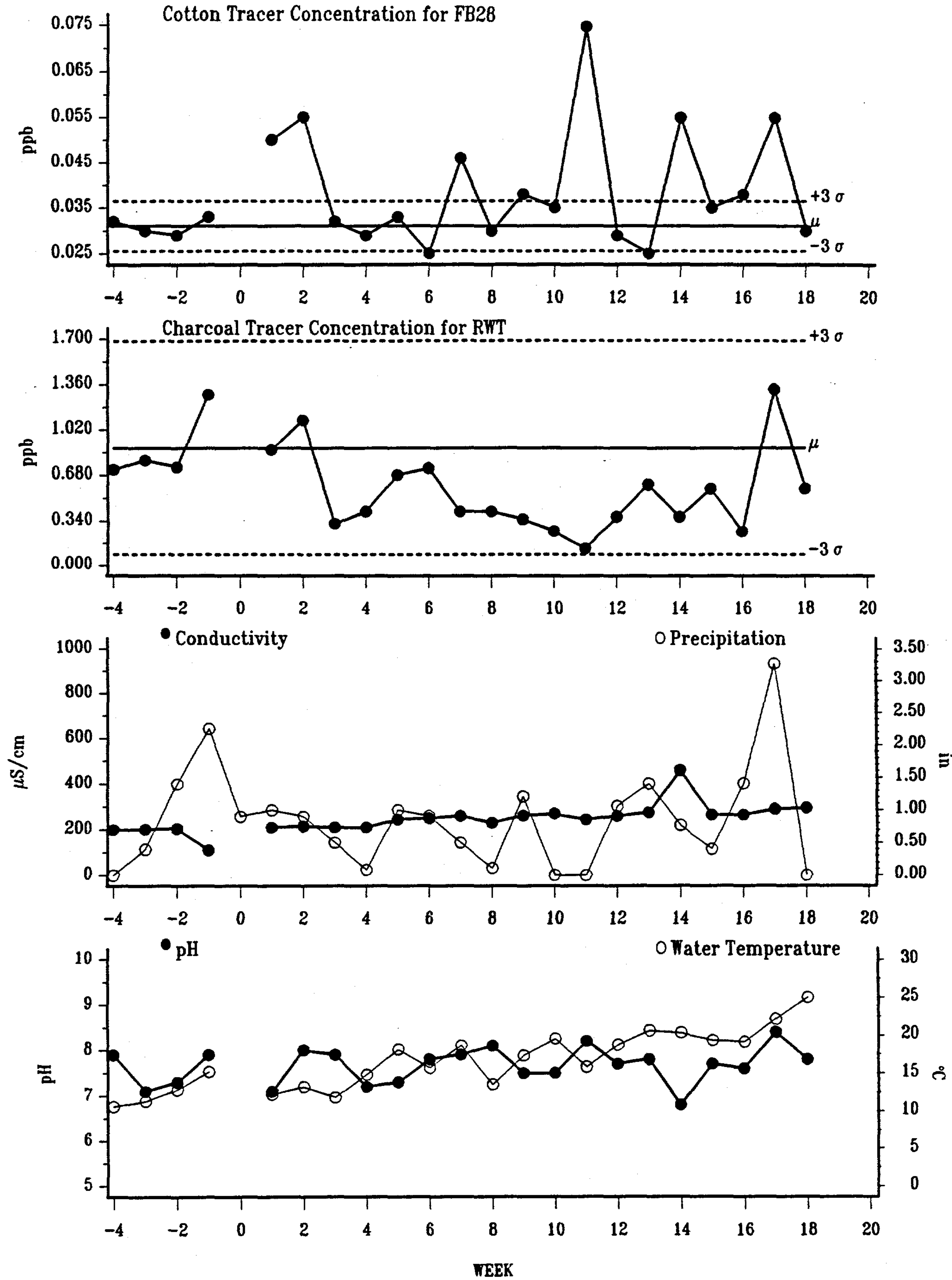
17SEP9

Station: SCR 5.1 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.6	190	13.1	0.440	0.033	A	1	COTTON .033,.033
-4	02/10/92					0.033	A	2	N/A
-4	02/10/92					0.033	A	3	N/A
-3	02/17/92	7.4	120	11.4	0.560	0.120	A	1	N/A
-2	02/24/92	6.9	155	14.1	0.540	0.025	A	1	N/A
-1	03/02/92	7.6	115	13.7	0.540	0.035	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.9	150	14.7	0.250	0.029	A	1	N/A
2	03/26/92	7.7	120	13.3	0.510	0.032	A	1	COTTON: .032, .032
2	03/26/92					0.032	A	2	N/A
2	03/26/92					0.032	A	3	N/A
3	04/02/92	7.8	140	12.4	0.270	0.046	A	1	N/A
4	04/09/92	7.0	185	14.7	0.210	0.027	A	1	N/A
5	04/16/92	6.4	190	17.9	0.150	0.025	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.4	180	17.2	0.240	0.050	A	1	N/A
7	04/30/92	7.6	210	16.8	0.300	0.055	A	1	LOW FLOW
8	05/07/92	8.1	160	13.4	0.200	0.033	A	1	N/A
9	05/14/92	7.3	220	15.5	0.340	0.033	A	1	N/A
10	05/21/92	7.5	240	17.5	0.240	0.050	A	1	N/A
11	05/28/92	8.2	210	13.8	0.210	0.030	A	1	N/A
12	06/04/92	7.7	240	17.1	0.500	0.023	A	1	N/A
13	06/11/92	7.7	235	17.5	0.380	0.035	A	1	N/A
14	06/18/92	7.1	240	16.6	0.350	0.046	A	1	N/A
15	06/25/92	7.7	235	15.9	0.470	0.032	A	1	N/A
16	07/01/92	7.6	230	16.3	0.280	0.021	A	1	N/A
17	07/10/92	7.7	240	20.4	0.830	0.040	A	1	N/A
18	07/17/92	7.7	220	17.0	0.260	0.027	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 5.3 SW

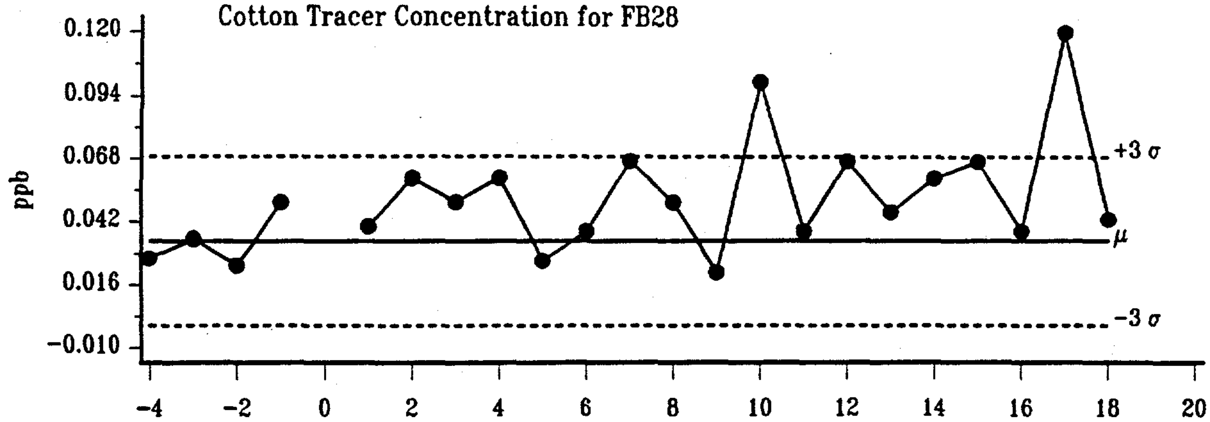


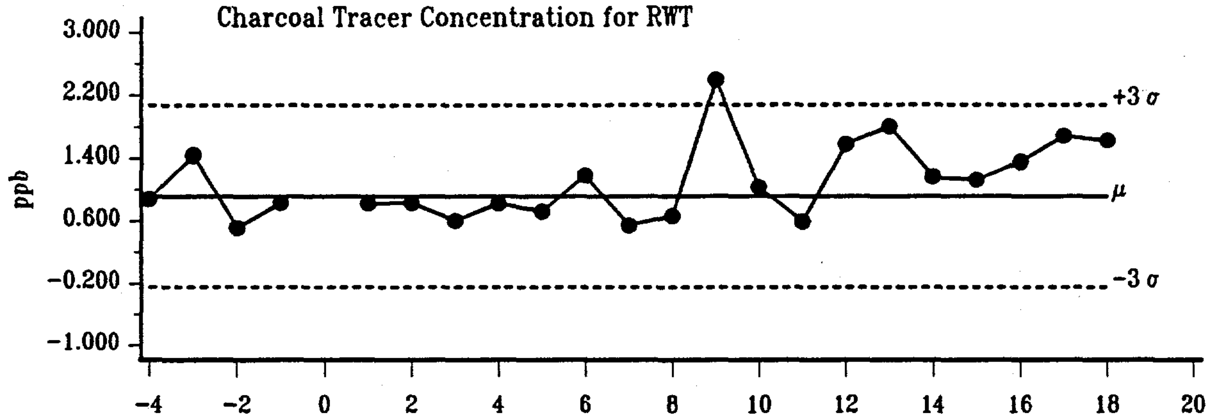
Station: SCR 5.3 SW

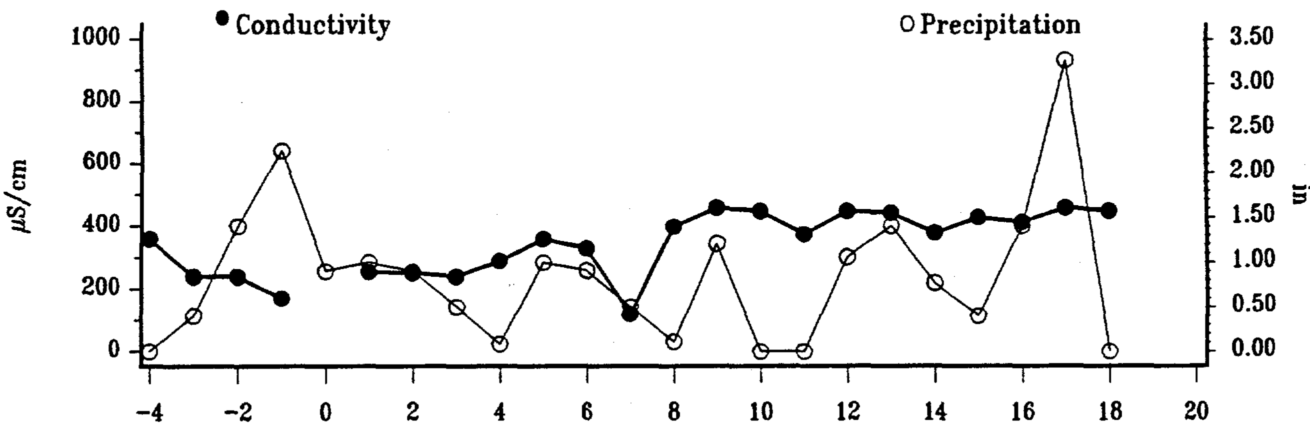
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.9	200	10.6	0.720	0.032	A	1	N/A
-3	02/17/92	7.1	202	11.3	0.790	0.030	A	1	N/A
-2	02/24/92	7.3	205	12.8	0.740	0.029	A	1	N/A
-1	03/02/92	7.9	110	15.2	1.280	0.033	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.1	210	12.2	0.870	0.050	A	1	N/A
2	03/26/92	8.0	215	13.2	1.090	0.055	A	1	N/A
3	04/02/92	7.9	210	11.8	0.320	0.032	A	1	N/A
4	04/09/92	7.2	210	14.8	0.410	0.029	A	1	N/A
5	04/16/92	7.3	245	18.1	0.680	0.033	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.8	250	15.7	0.730	0.025	A	1	N/A
7	04/30/92	7.9	260	18.6	0.410	0.046	A	1	N/A
8	05/07/92	8.1	230	13.5	0.410	0.030	A	1	N/A
9	05/14/92	7.5	262	17.3	0.350	0.038	A	1	N/A
10	05/21/92	7.5	270	19.5	0.260	0.035	A	1	N/A
11	05/28/92	8.2	245	15.8	0.130	0.075	A	1	N/A
12	06/04/92	7.7	260	18.7	0.370	0.029	A	1	N/A
13	06/11/92	7.8	275	20.6	0.610	0.025	A	1	N/A
14	06/18/92	6.8	460	20.3	0.370	0.055	A	1	N/A
15	06/25/92	7.7	265	19.3	0.580	0.035	A	1	N/A
16	07/01/92	7.6	265	19.1	0.260	0.038	A	1	N/A
17	07/10/92	8.4	290	22.1	1.320	0.055	A	1	CH: LARGE PEAK AT 500nm.
18	07/17/92	7.8	295	25.0	0.580	0.030	A	1	N/A

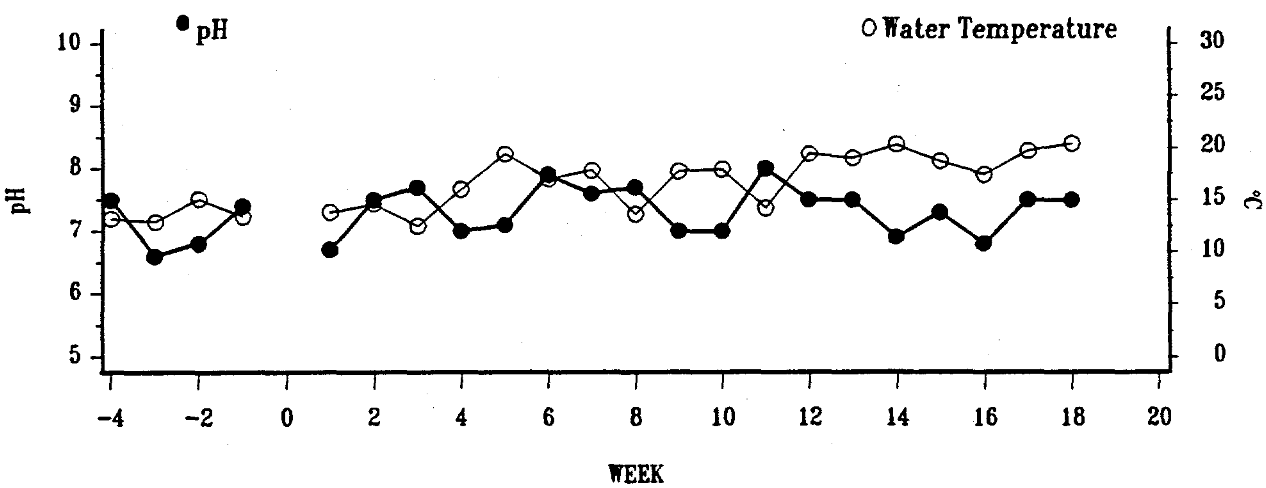
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 5.4 SP









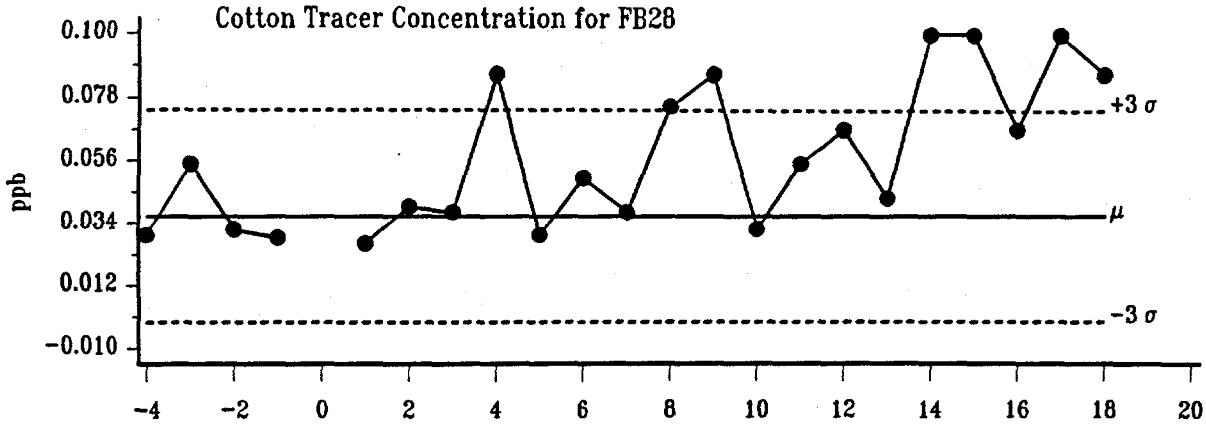
17SEP9

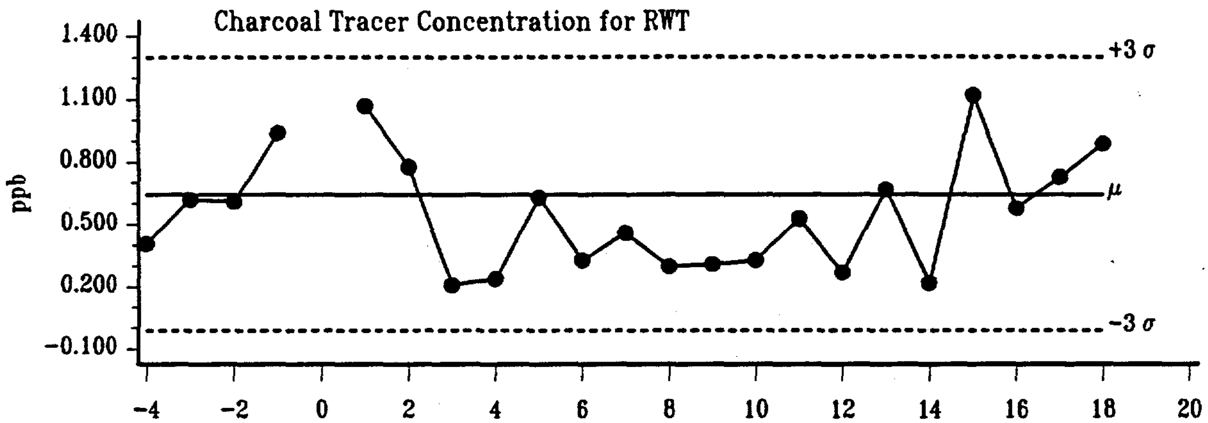
Station: SCR 5.4 SP

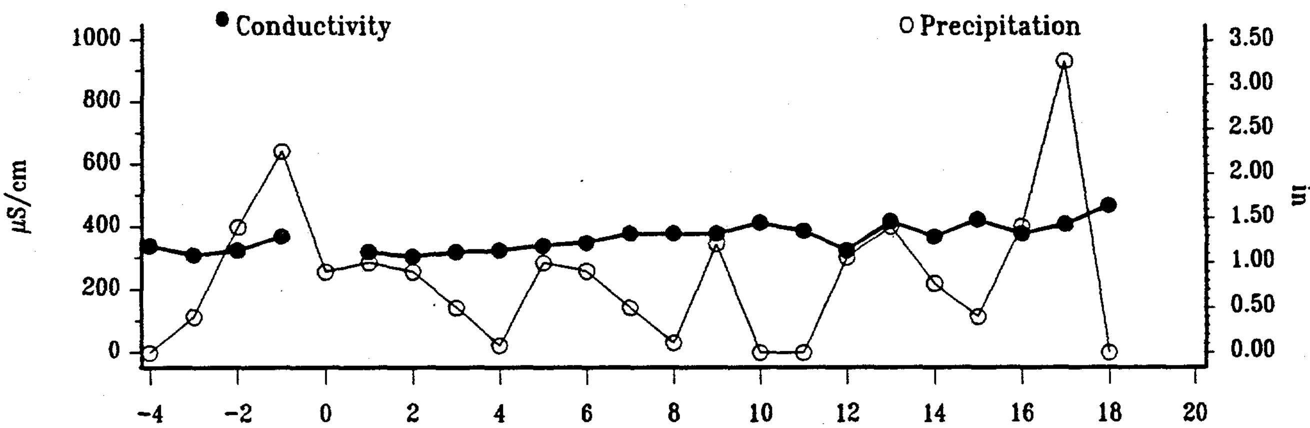
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.5	360	13.2	0.880	0.027	A	1	N/A
-3	02/17/92	6.6	240	12.9	1.440	0.035	A	1	N/A
-2	02/24/92	6.8	240	15.1	0.510	0.024	A	1	CHARCOAL .46 SPLIT SAMPLE
-2	02/24/92				0.460		A	2	N/A
-1	03/02/92	7.4	170	13.4	0.830	0.050	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.7	255	13.8	0.820	0.040	A	1	N/A
2	03/26/92	7.5	252	14.6	0.830	0.060	A	1	N/A
3	04/02/92	7.7	240	12.5	0.600	0.050	A	1	N/A
4	04/09/92	7.0	290	16.0	0.820	0.060	A	1	N/A
5	04/16/92	7.1	360	19.4	0.720	0.026	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.9	330	17.0	1.180	0.038	A	1	N/A
7	04/30/92	7.6	120	17.8	0.540	0.067	A	1	LOW FLOW
8	05/07/92	7.7	400	13.6	0.660	0.050	A	1	N/A
9	05/14/92	7.0	460	17.7	2.380	0.021	A	1	CHARCOAL: ELEVATED BKGD DUE TO LARGE PEAK AT 500 NM (NOT DYE).
10	05/21/92	7.0	450	17.9	1.030	0.100	A	1	N/A
11	05/28/92	8.0	375	14.2	0.590	0.038	A	1	LOW
12	06/04/92	7.5	450	19.4	1.570	0.067	A	1	CHARCOAL: LARGE PEAK AT 500nm
13	06/11/92	7.5	445	19.0	1.800	0.046	A	1	LARGE BKGD. PEAK AT 500 NM
14	06/18/92	6.9	380	20.3	1.160	0.060	A	1	BACKGROUND PEAK AT 500nm.
14	06/18/92				1.160		A	2	N/A
15	06/25/92	7.3	430	18.7	1.120	0.067	A	1	N/A
16	07/01/92	6.8	415	17.4	1.350	0.038	A	1	CH: BACKGROUND PEAK AT 503nm
17	07/10/92	7.5	460	19.7	1.680	0.120	A	1	CH: LARGE PEAK AT 500nm.
18	07/17/92	7.5	450	20.4	1.620	0.043	A	1	CH: LARGE PEAK AT 500nm.

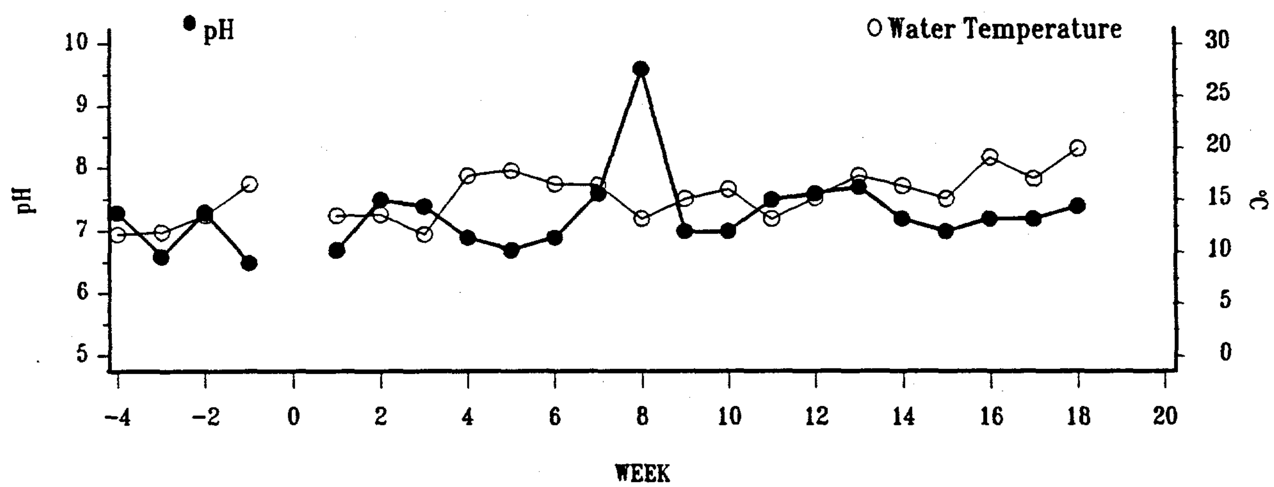
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 7.1 SP









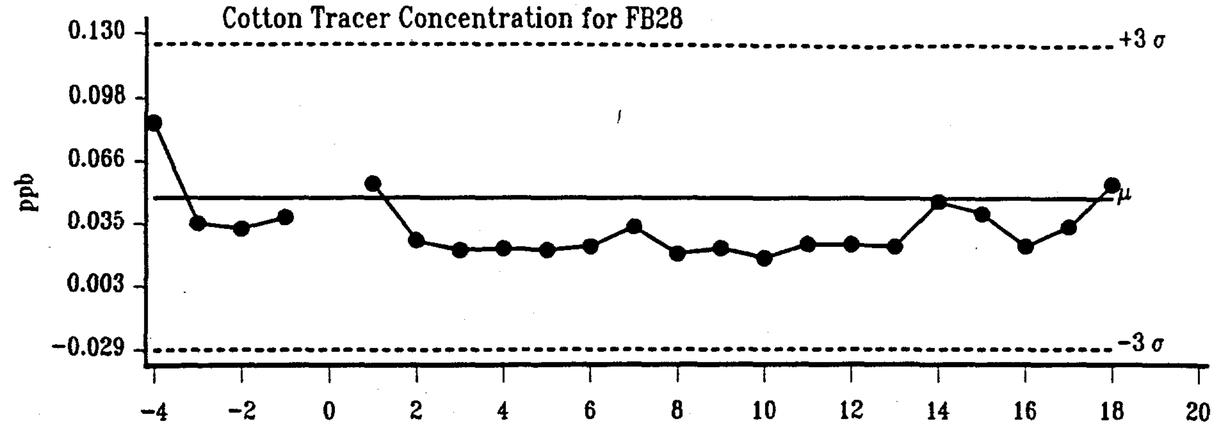
17SEP

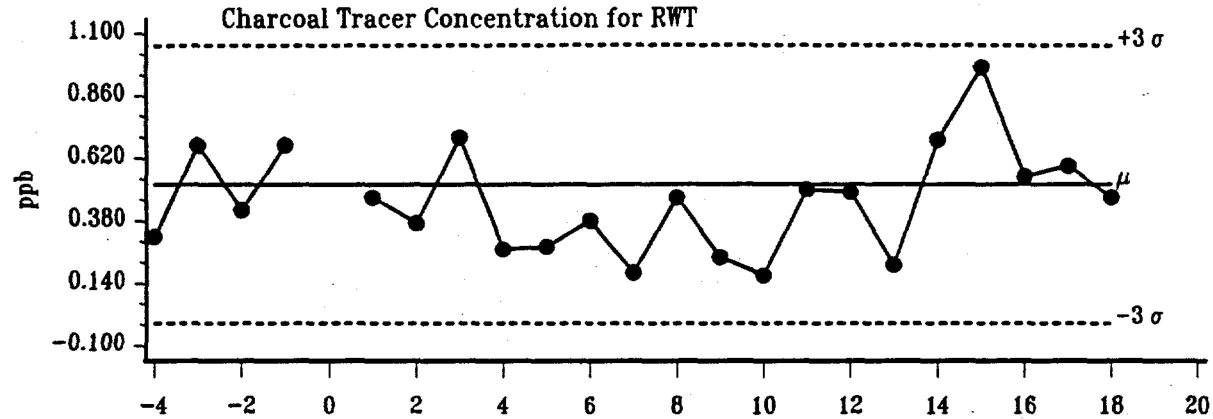
Station: SCR 7.1 SP

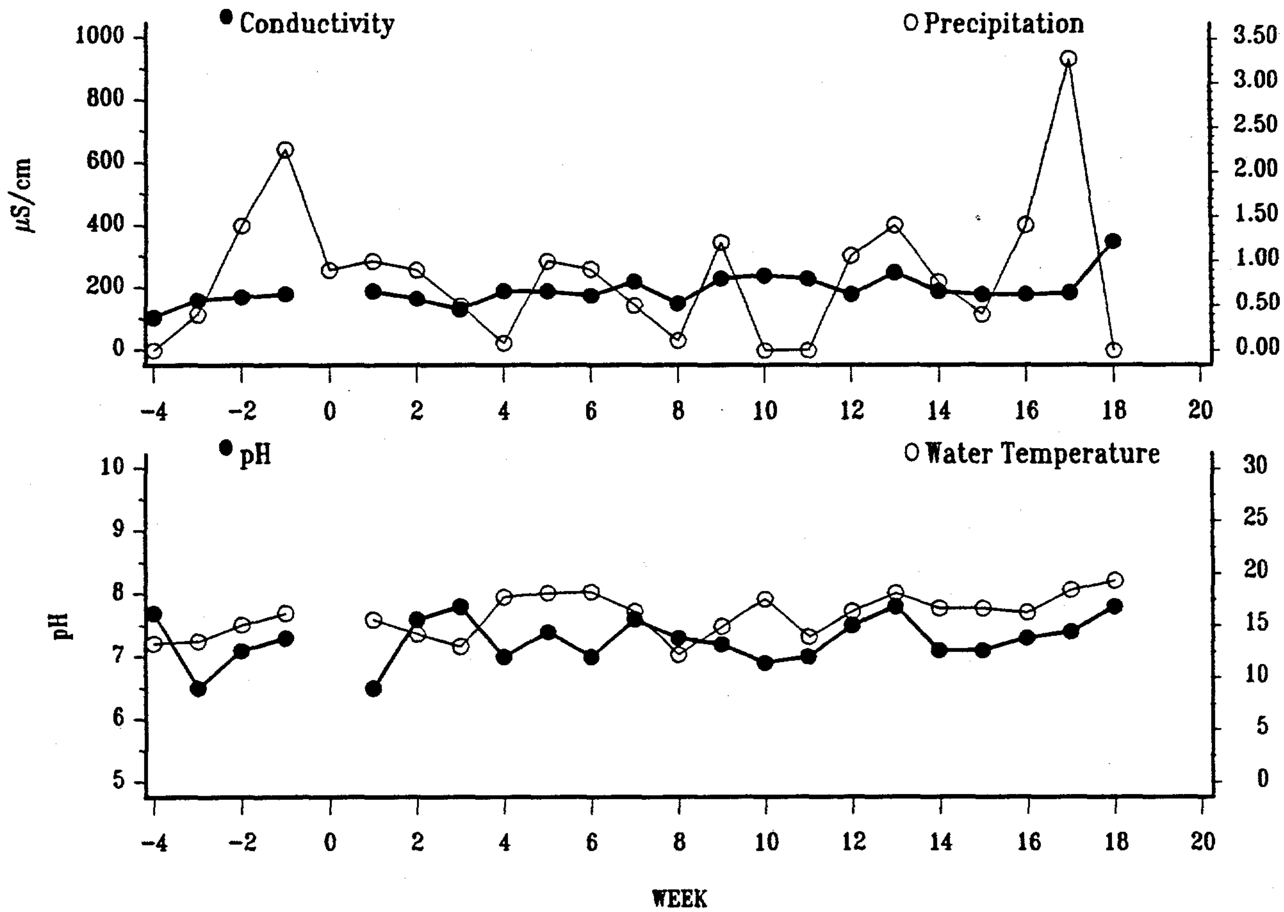
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.3	340	11.7	0.410	0.030	A	1	N/A
-3	02/17/92	6.6	310	11.9	0.620	0.055	A	1	DID NOT HAVE DETECTOR IN PLACE UNTIL 48 HRS (ON 2/29) AFTER THE FIRST ONES WERE IN PLACE. WAITING FOR A SECOND SHIPMENT OF DETECTORS
-2	02/24/92	7.3	325	13.5	0.610	0.032	A	1	N/A
-1	03/02/92	6.5	370	16.5	0.940	0.029	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.7	320	13.5	1.070	0.027	A	1	N/A
2	03/26/92	7.5	305	13.6	0.780	0.040	A	1	N/A
3	04/02/92	7.4	320	11.7	0.210	0.038	A	1	N/A
4	04/09/92	6.9	325	17.3	0.240	0.086	A	1	N/A
5	04/16/92	6.7	340	17.8	0.630	0.030	A	1	LOW; ALMOST STAGNANT
6	04/23/92	6.9	350	16.5	0.330	0.050	A	1	LOW
7	04/30/92	7.6	380	16.4	0.460	0.038	A	1	N/A
8	05/07/92	9.6	380	13.2	0.300	0.075	A	1	STAGNANT
9	05/14/92	7.0	380	15.1	0.310	0.086	A	1	STAGNANT
10	05/21/92	7.0	415	16.0	0.330	0.032	A	1	N/A
11	05/28/92	7.5	390	13.2	0.530	0.055	A	1	N/A
12	06/04/92	7.6	325	15.2	0.270	0.067	A	1	N/A
13	06/11/92	7.7	420	17.3	0.670	0.043	A	1	N/A
14	06/18/92	7.2	370	16.3	0.220	0.100	A	1	DETECTORS REPLACED ON 06/19/92
14	06/18/92					0.067	A	2	N/A
14	06/18/92					0.075	A	3	N/A
15	06/25/92	7.0	425	15.1	1.120	0.100	A	1	N/A
16	07/01/92	7.2	380	19.1	0.580	0.067	A	1	N/A
17	07/10/92	7.2	410	17.0	0.730	0.100	A	1	FLOWING
18	07/17/92	7.4	470	19.9	0.890	0.086	A	1	CO: SPLIT
18	07/17/92					0.120	A	2	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 7.3 SP







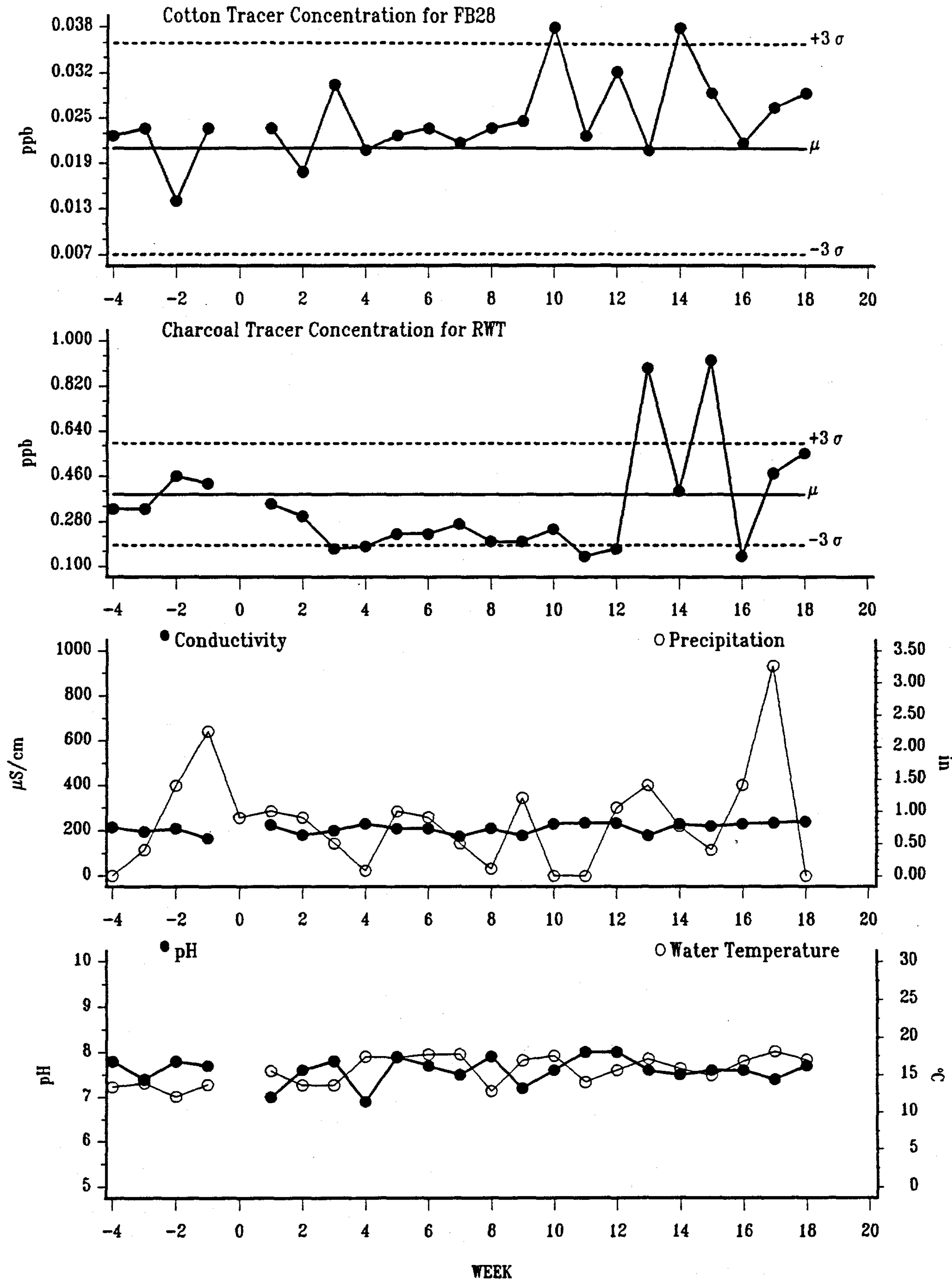
17SEP

Station: SCR 7.3 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.7	105	13.3	0.320	0.086	A	1	STRANG SHAPE SF @ 510 nm
-3	02/17/92	6.5	160	13.5	0.670	0.035	A	1	COTTON .033,.032 WIDE PI (SF) @ 500-510 nm
-3	02/17/92					0.033	A	2	N/A
-3	02/17/92					0.032	A	3	N/A
-2	02/24/92	7.1	170	15.1	0.420	0.032	A	1	NEW SPRING BROAD PK @ 510nr (SF)
-1	03/02/92	7.3	180	16.2	0.670	0.038	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.5	190	15.6	0.470	0.055	A	1	CHARCOAL .49
1	03/19/92				0.490		A	2	N/A
2	03/26/92	7.6	165	14.2	0.370	0.026	A	1	N/A
3	04/02/92	7.8	130	13.0	0.700	0.021	A	1	N/A
4	04/09/92	7.0	190	17.7	0.270	0.022	A	1	N/A
5	04/16/92	7.4	190	18.1	0.280	0.021	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.0	175	18.2	0.380	0.023	A	1	N/A
7	04/30/92	7.6	220	16.3	0.180	0.033	A	1	N/A
8	05/07/92	7.3	150	12.2	0.470	0.019	A	1	N/A
9	05/14/92	7.2	230	14.9	0.240	0.022	A	1	LOW
10	05/21/92	6.9	240	17.5	0.170	0.017	A	1	N/A
11	05/28/92	7.0	230	13.9	0.500	0.024	A	1	N/A
12	06/04/92	7.5	180	16.3	0.490	0.024	A	1	N/A
13	06/11/92	7.8	250	18.1	0.210	0.023	A	1	N/A
14	06/18/92	7.1	190	16.6	0.690	0.046	A	1	DETECTORS REPLACED ON 06/19/92.
15	06/25/92	7.1	180	16.6	0.970	0.040	A	1	CH: LARGE PEAK AT 505nm
16	07/01/92	7.3	180	16.2	0.550	0.023	A	1	N/A
17	07/10/92	7.4	185	18.4	0.590	0.033	A	1	N/A
18	07/17/92	7.8	350	19.3	0.470	0.055	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 7.4 SP

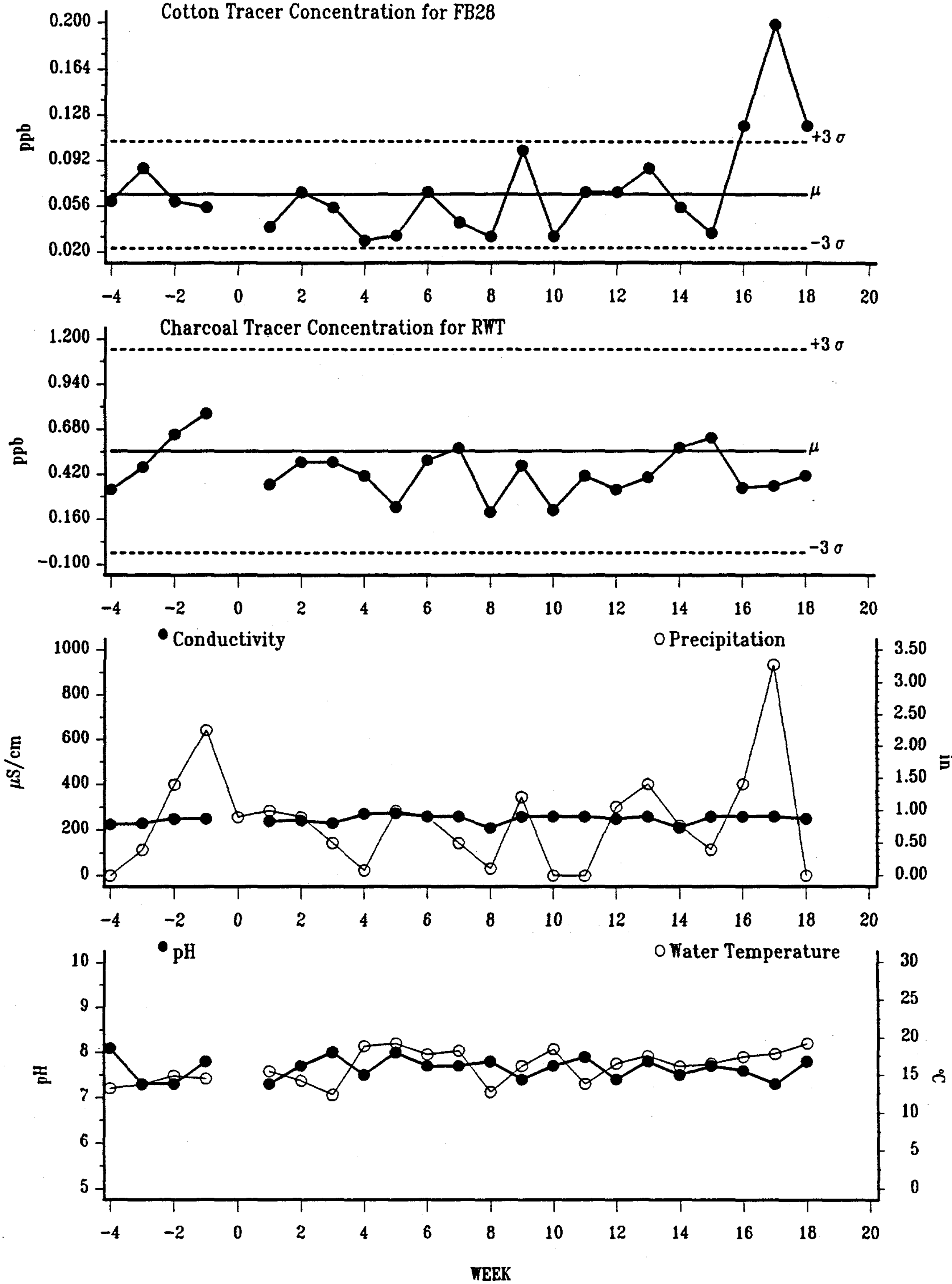


Station: SCR 7.4 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.8	215	13.4	0.330	0.023	A	1	CHARCOAL .45 SPLIT SAMPLE
-4	02/10/92				0.450		A	2	N/A
-3	02/17/92	7.4	195	13.9	0.330	0.024	A	1	DID NOT HAVE DETECTORS IN PLACE UNTIL 48hrs (ON 2/29) AFTER THE FIRST ONES WERE IN PLACE. WE WERE WAITING ON A SECOND SHIPMENT OF DETECTORS.
-2	02/24/92	7.8	210	12.1	0.460	0.014	A	1	BROAD PK @ 510 nm (SF)
-1	03/02/92	7.7	165	13.7	0.430	0.024	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.0	225	15.5	0.350	0.024	A	1	COTTON .026, .026
1	03/19/92					0.026	A	2	N/A
1	03/19/92					0.026	A	3	N/A
2	03/26/92	7.6	180	13.6	0.300	0.018	A	1	N/A
3	04/02/92	7.8	200	13.6	0.170	0.030	A	1	N/A
4	04/09/92	6.9	230	17.4	0.180	0.021	A	1	N/A
5	04/16/92	7.9	210	17.3	0.230	0.023	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.7	210	17.7	0.230	0.024	A	1	N/A
7	04/30/92	7.5	175	17.7	0.270	0.022	A	1	N/A
8	05/07/92	7.9	210	12.8	0.200	0.024	A	1	N/A
9	05/14/92	7.2	179	16.9	0.200	0.025	A	1	N/A
10	05/21/92	7.6	230	17.5	0.250	0.038	A	1	N/A
11	05/28/92	8.0	235	14.0	0.140	0.023	A	1	N/A
12	06/04/92	8.0	235	15.6	0.170	0.032	A	1	N/A
13	06/11/92	7.6	180	17.1	0.890	0.021	A	1	BKGD. PEAK AT 503 NM
14	06/18/92	7.5	230	15.8	0.400	0.038	A	1	HEAVY THUNDERSTORMS INTERRUPTED SAMPLING.
15	06/25/92	7.6	220	14.9	0.920	0.029	A	1	CH:PEAK AT 500 nm
16	07/01/92	7.6	230	16.8	0.140	0.022	A	1	N/A
17	07/10/92	7.4	235	18.1	0.470	0.027	A	1	N/A
18	07/17/92	7.7	240	17.0	0.550	0.029	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 7.6 SP



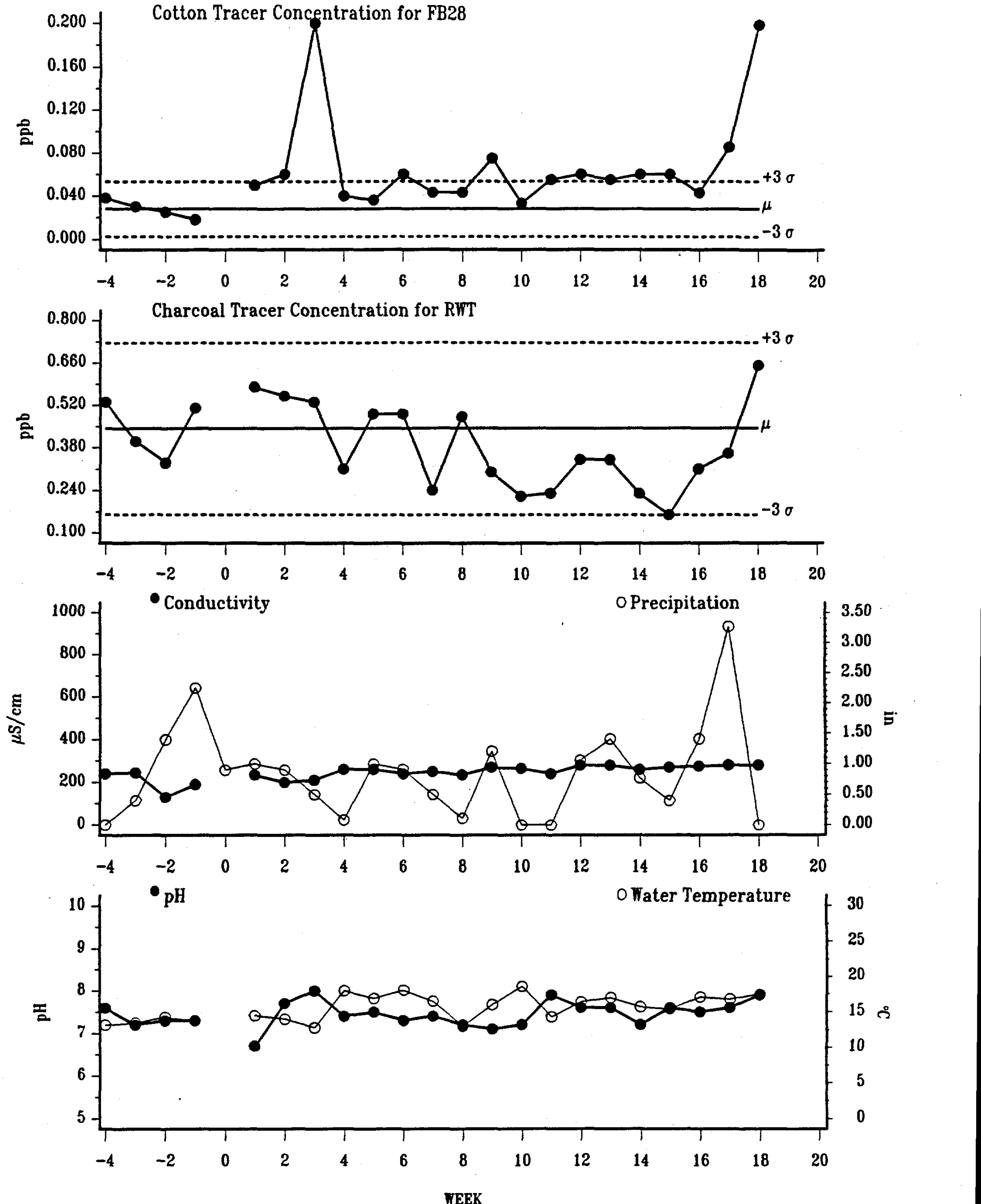
17SEP92

Station: SCR 7.6 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.1	225	13.2	0.330	0.060	A	1	N/A
-3	02/17/92	7.3	230	13.7	0.460	0.086	A	1	N/A
-2	02/24/92	7.3	250	14.9	0.650	0.060	A	1	CHARCOAL .68 ONE SMALL SPT, SPLIT SAMPLE
-2	02/24/92				0.680		A	2	N/A
-1	03/02/92	7.8	250	14.5	0.770	0.055	A	1	Lg PK @ 500 nm (SF)
0	03/09/92						A	1	N/A
1	03/19/92	7.3	240	15.5	0.360	0.040	A	1	CHARCOAL .35
1	03/19/92				0.350		A	2	N/A
2	03/26/92	7.7	243	14.2	0.490	0.067	A	1	N/A
3	04/02/92	8.0	230	12.3	0.490	0.055	A	1	N/A
4	04/09/92	7.5	272	18.8	0.410	0.029	A	1	N/A
5	04/16/92	8.0	275	19.2	0.230	0.033	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.7	260	17.7	0.500	0.067	A	1	N/A
7	04/30/92	7.7	260	18.2	0.570	0.043	A	1	N/A
8	05/07/92	7.8	210	12.7	0.200	0.032	A	1	N/A
9	05/14/92	7.4	260	16.2	0.470	0.100	A	1	N/A
10	05/21/92	7.7	260	18.4	0.210	0.032	A	1	N/A
11	05/28/92	7.9	260	13.8	0.410	0.067	A	1	N/A
12	06/04/92	7.4	250	16.5	0.330	0.067	A	1	N/A
13	06/11/92	7.8	260	17.5	0.400	0.086	A	1	VERY LOW
14	06/18/92	7.5	210	16.1	0.570	0.055	A	1	DETECTORS REPLACED ON 06/19/92.
15	06/25/92	7.7	260	16.5	0.630	0.035	A	1	N/A
16	07/01/92	7.6	260	17.4	0.340	0.120	A	1	N/A
17	07/10/92	7.3	260	17.8	0.350	0.200	A	1	N/A
18	07/17/92	7.8	250	19.2	0.410	0.120	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 7.7 SP

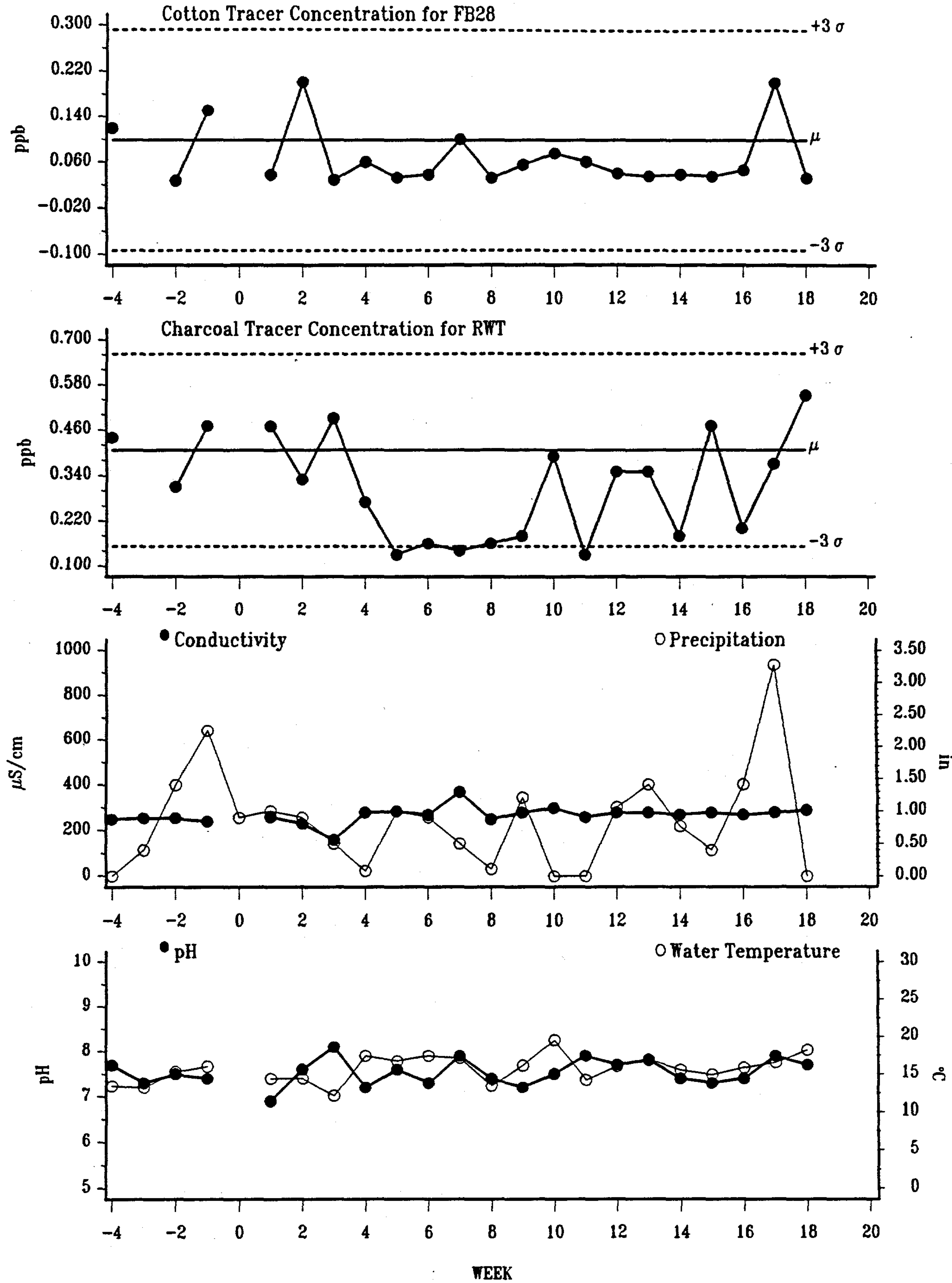


Station: SCR 7.7 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.6	240	13.2	0.530	0.038	A	1	COTTON .037,.037;DID NOT HAVE DETECTORS IN PLACE UNTIL 48 HRS (ON 2/29) AFTER THE FIRST ONES. WAITING FOR A SECOND SHIPMENT OF DETECTORS.
-4	02/10/92					0.037	A	2	N/A
-4	02/10/92					0.037	A	3	N/A
-3	02/17/92	7.2	245	13.5	0.400	0.030	A	1	N/A
-2	02/24/92	7.3	130	14.3	0.330	0.025	A	1	N/A
-1	03/02/92	7.3	190	13.8	0.510	0.018	A	1	COTTON .018, .017
-1	03/02/92					0.018	A	2	N/A
-1	03/02/92					0.017	A	3	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.7	235	14.5	0.580	0.050	A	1	N/A
2	03/26/92	7.7	200	14.0	0.550	0.060	A	1	N/A
3	04/02/92	8.0	210	12.8	0.530	0.200	A	1	COTTON: BKGND PK @ 460 nm (NOT FB28)
4	04/09/92	7.4	260	18.0	0.310	0.040	A	1	N/A
5	04/16/92	7.5	260	16.9	0.490	0.036	A	1	COTTON .033, .035
5	04/16/92					0.033	A	2	N/A
5	04/16/92					0.035	A	3	N/A
6	04/23/92	7.3	240	18.1	0.490	0.060	A	1	LOW
7	04/30/92	7.4	250	16.5	0.240	0.043	A	1	N/A
8	05/07/92	7.2	235	13.0	0.480	0.043	A	1	N/A
9	05/14/92	7.1	270	16.0	0.300	0.075	A	1	LOW, STAGNANT. COTTON: SPLIT 0.055, 0.060
9	05/14/92					0.055	A	2	N/A
9	05/14/92					0.060	A	3	N/A
10	05/21/92	7.2	265	18.6	0.220	0.033	A	1	N/A
11	05/28/92	7.9	240	14.3	0.230	0.055	A	1	N/A
12	06/04/92	7.6	280	16.4	0.340	0.060	A	1	N/A
13	06/11/92	7.6	280	17.0	0.340	0.055	A	1	N/A
14	06/18/92	7.2	260	15.7	0.230	0.060	A	1	DETECTORS REPLACED ON 06/19/92
15	06/25/92	7.6	270	15.4	0.160	0.060	A	1	N/A
16	07/01/92	7.5	275	17.1	0.310	0.043	A	1	N/A
17	07/10/92	7.6	280	16.8	0.360	0.086	A	1	N/A
18	07/17/92	7.9	280	17.5	0.650	0.200	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station SCR 7.8 SP

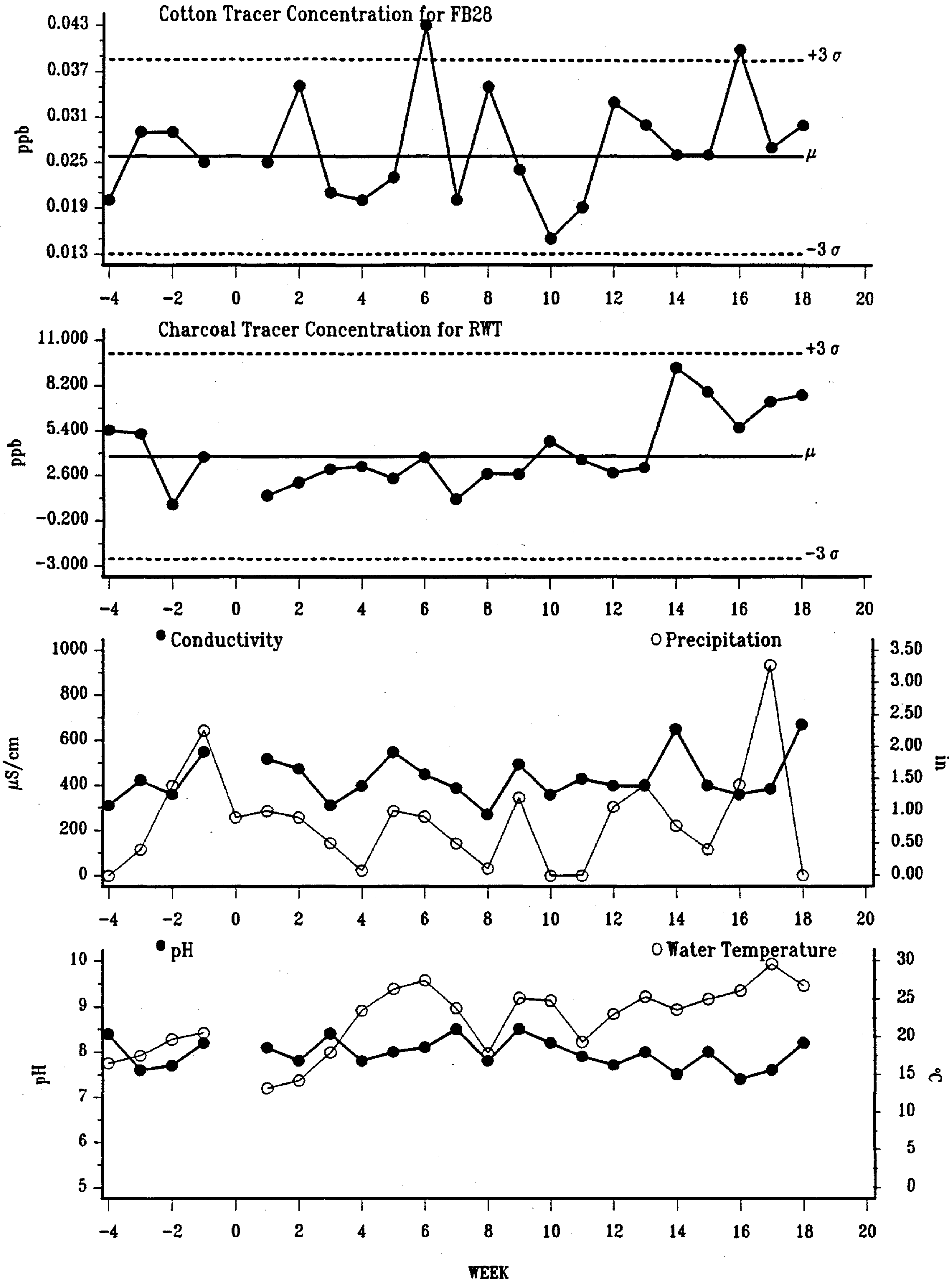


Station: SCR 7.8 SP

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.7	250	13.4	0.440	0.120	A	1	N/A
-3	02/17/92	7.3	255	13.2			A	1	DETECTOR MISSING!!!
-2	02/24/92	7.5	255	15.3	0.310	0.027	A	1	N/A
-1	03/02/92	7.4	240	16.0	0.470	0.150	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	6.9	260	14.4	0.470	0.038	A	1	N/A
2	03/26/92	7.6	230	14.4	0.330	0.200	A	1	COTTON: BACKGROUND PEAK AT 460nm (NOT FB28)
3	04/02/92	8.1	160	12.1	0.490	0.029	A	1	N/A
4	04/09/92	7.2	280	17.4	0.270	0.060	A	1	N/A
5	04/16/92	7.6	285	16.7	0.130	0.033	A	1	LOW FLOW CONDITIONS, COTTON: .033, .035
5	04/16/92					0.033	A	2	N/A
5	04/16/92					0.035	A	3	N/A
6	04/23/92	7.3	270	17.4	0.160	0.038	A	1	N/A
7	04/30/92	7.9	370	17.1	0.140	0.100	A	1	COTTON SPLIT: 0.060, 0.075
7	04/30/92					0.060	A	2	N/A
7	04/30/92					0.075	A	3	N/A
8	05/07/92	7.4	250	13.4	0.160	0.032	A	1	N/A
9	05/14/92	7.2	280	16.1	0.180	0.055	A	1	LOW
10	05/21/92	7.5	300	19.5	0.390	0.075	A	1	STAGNANT
11	05/28/92	7.9	260	14.2	0.130	0.060	A	1	N/A
12	06/04/92	7.7	280	16.0	0.350	0.040	A	1	N/A
13	06/11/92	7.8	280	16.9	0.350	0.035	A	1	N/A
14	06/18/92	7.4	271	15.5	0.180	0.038	A	1	DETECTORS REPLACED ON 06/19/92; GOOD FLOW
15	06/25/92	7.3	280	14.9	0.470	0.035	A	1	N/A
16	07/01/92	7.4	270	15.8	0.200	0.046	A	1	N/A
17	07/10/92	7.9	280	16.5	0.370	0.200	A	1	N/A
18	07/17/92	7.7	290	18.2	0.550	0.032	A	1	N/A

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station UEFPC 29 SW



18SEP92

Station: UEFPC 29 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.4	310	16.5	5.440	0.020	A	1	CHARCOAL DYE PRESENT!
-3	02/17/92	7.6	423	17.5	5.200	0.029	A	1	CHARCOAL DYE PRESENT! PK @ 511 & 550 (SF)/PK @ 568nm (EM)
-2	02/24/92	7.7	361	19.7	0.820	0.029	A	1	N/A
-1	03/02/92	8.2	550	20.5	3.760	0.025	A	1	CH=DYE PRESENT!
0	03/09/92						A	1	N/A
1	03/19/92	8.1	520	13.2	1.360	0.025	A	1	N/A
2	03/26/92	7.8	475	14.2	2.160	0.035	A	1	CHARCOAL: DYE! 3.26 COTTON .034, .034
2	03/26/92				3.260		A	2	N/A
2	03/26/92					0.034	A	2	N/A
2	03/26/92					0.034	A	3	N/A
3	04/02/92	8.4	310	17.9	2.970	0.021	A	1	CHARCOAL 2.98 DYE PRESENT!
3	04/02/92				2.980		A	2	N/A
4	04/09/92	7.8	400	23.5	3.180	0.020	A	1	CHARCOAL 3.08 DYE PRESENT!
4	04/09/92				3.080		A	2	N/A
5	04/16/92	8.0	550	26.3	2.400	0.023	A	1	CHARCOAL 2.36 DYE PRESENT!
5	04/16/92				2.360		A	2	N/A
6	04/23/92	8.1	450	27.4	3.730	0.043	A	1	CHARCOAL SPLIT: 3.78; DYE PRESENT!
6	04/23/92				3.780		A	2	N/A
7	04/30/92	8.5	390	23.8	1.140	0.020	A	1	CHARCOAL SPLIT: 1.15; LOW FLOW
7	04/30/92				1.150		A	2	N/A
8	05/07/92	7.8	270	17.8	2.690	0.035	A	1	CHARCOAL SPLIT: 2.71, DYE!
8	05/07/92				2.710		A	2	N/A
9	05/14/92	8.5	495	25.1	2.650	0.024	A	1	CHARCOAL: DYE PRESENCE DIFFICULT TO CONFIRM. SPLIT: 2.79.
9	05/14/92				2.790		A	2	N/A
10	05/21/92	8.2	360	24.8	4.740	0.015	A	1	CHARCOAL: 5.39 DYE PRESENT BUT PEAK AT 500nm ALSO
10	05/21/92				5.390		A	2	N/A
11	05/28/92	7.9	430	19.3	3.580	0.019	A	1	CHARCOAL: 3.95; DYE PRESEN
11	05/28/92				3.950		A	2	N/A
12	06/04/92	7.7	400	23.0	2.740	0.033	A	1	DYE PRESENT!!
12	06/04/92				3.420		A	2	N/A
13	06/11/92	8.0	400	25.3	3.090	0.030	A	1	LOW
13	06/11/92				3.060		A	2	SPLIT: 3.06
14	06/18/92	7.5	650	23.6	9.300	0.026	A	1	CHARCOAL: THIS POSITIVE HI IS THOUGHT TO BE THE RHODAMINE DYE USED IN THE SINK TESTING OPERATIONS AT THE Y-12 PLANT. THE ENTIRE UPPER EAST FORK POPLAR CREEK (UEFPC) WAS TURNED

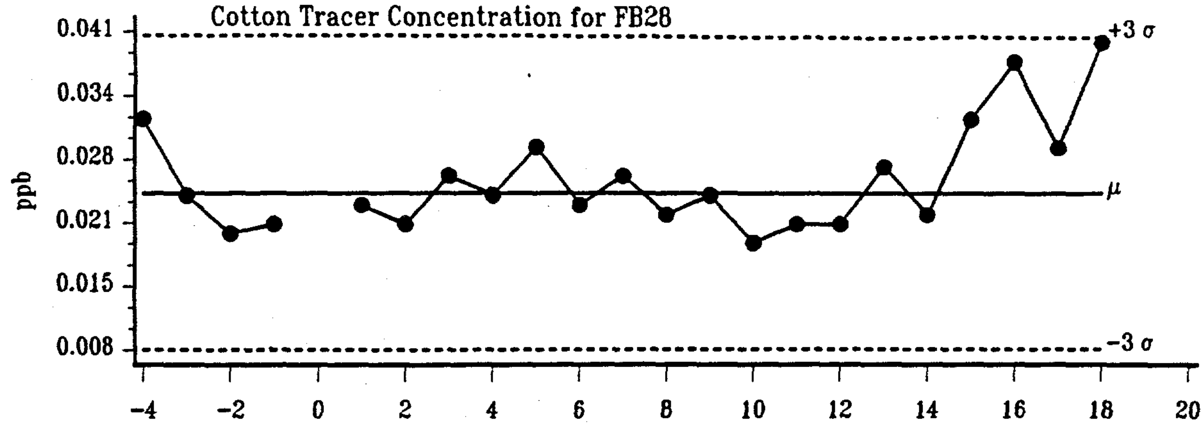
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

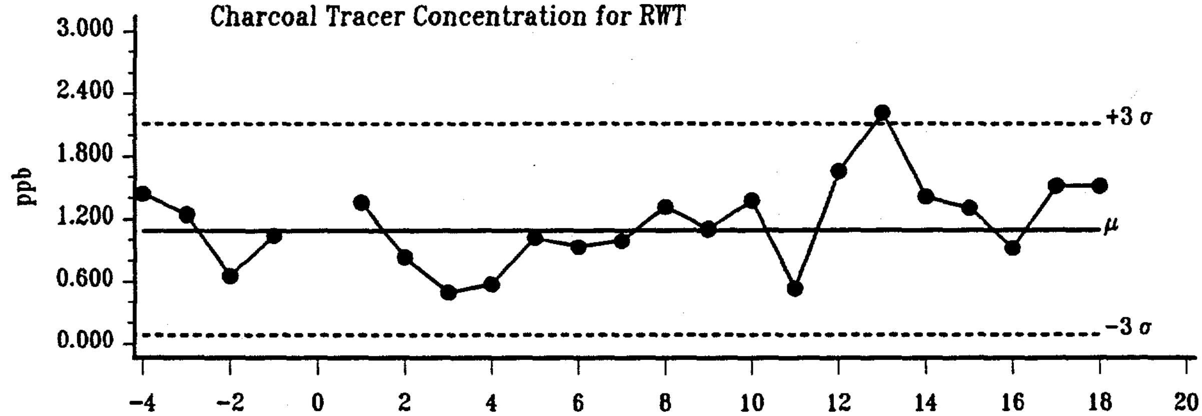
Station: UEFPC 29 SW

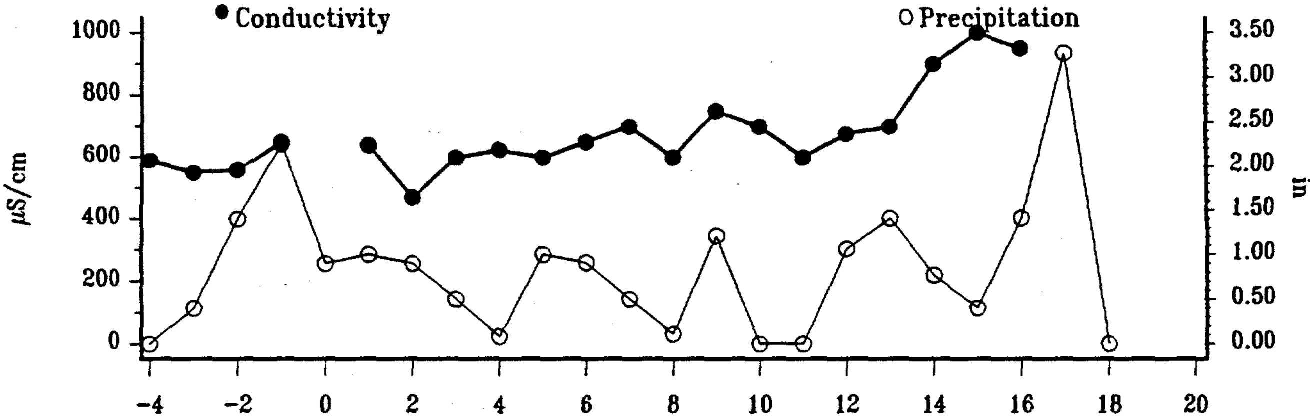
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
									VISIBLY RED ON 06/16/92
14	06/18/92				9.600		A	2	N/A
15	06/25/92	8.0	400	25.0	7.800	0.026	A	1	CH: DYE PRESENT!
15	06/25/92				8.000		A	2	N/A
16	07/01/92	7.4	360	26.1	5.610	0.040	A	1	CH: DYE PRESENT! CO: TRIPLICATE NOTED(NO OTHER DATA)
16	07/01/92				5.770		A	2	N/A
17	07/10/92	7.6	385	29.6	7.200	0.027	A	1	CH: DYE PRESENT! SPLIT!
17	07/10/92				7.170		A	2	N/A
18	07/17/92	8.2	670	26.7	7.610	0.030	A	1	CH: SPLIT DYE PRESENT! PEA AT 508nm.
18	07/17/92				7.420		A	2	N/A

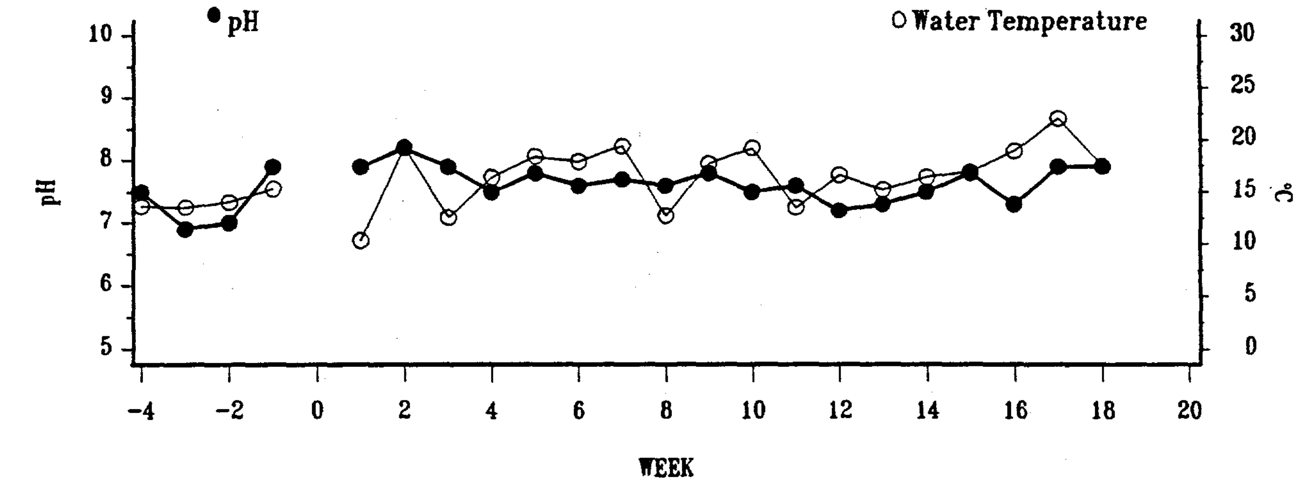
* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station UEFPC SP-17







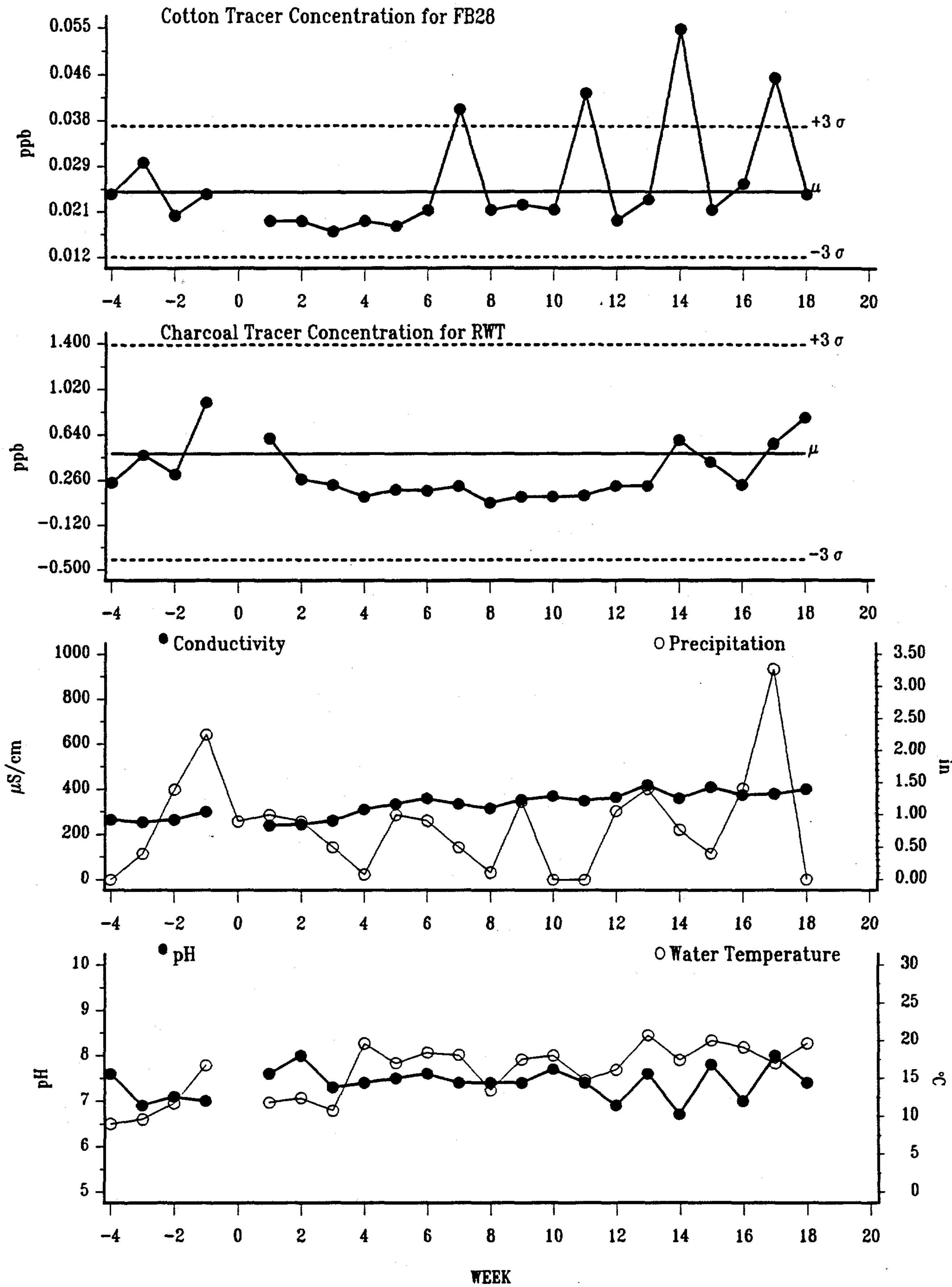


Station: UEFPC SP-17

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.5	590	13.6	1.440	0.032	A	1	N/A
-3	02/17/92	6.9	550	13.5	1.240	0.024	A	1	EXTRA SCATTERING EM BCKGD
-2	02/24/92	7.0	558	14.0	0.650	0.020	A	1	N/A
-1	03/02/92	7.9	650	15.3	1.040	0.021	A	1	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.9	640	10.3	1.350	0.023	A	1	N/A
2	03/26/92	8.2	470	19.3	0.830	0.021	A	1	N/A
3	04/02/92	7.9	600	12.5	0.490	0.026	A	1	N/A
4	04/09/92	7.5	625	16.4	0.570	0.024	A	1	N/A
5	04/16/92	7.8	600	18.4	1.020	0.029	A	1	N/A
6	04/23/92	7.6	650	17.9	0.930	0.023	A	1	LOW FLOW
7	04/30/92	7.7	700	19.4	0.990	0.026	A	1	LOW FLOW
8	05/07/92	7.6	600	12.7	1.310	0.022	A	1	N/A
9	05/14/92	7.8	750	17.7	1.100	0.024	A	1	N/A
10	05/21/92	7.5	700	19.2	1.370	0.019	A	1	N/A
11	05/28/92	7.6	600	13.5	0.530	0.021	A	1	N/A
12	06/04/92	7.2	675	16.6	1.650	0.021	A	1	CHARCOAL: LARGE PEAK AT 500nm
13	06/11/92	7.3	700	15.2	2.210	0.027	A	1	HUGE BKGD. PEAK AT 503 NM
14	06/18/92	7.5	900	16.4	1.410	0.022	A	1	CHARCOAL:SEVERAL BACKGROUND PEAKS.
15	06/25/92	7.8	1000	16.9	1.300	0.032	A	1	N/A
16	07/01/92	7.3	950	18.9	0.920	0.038	A	1	N/A
17	07/10/92	7.9	1450	22.0	1.510	0.029	A	1	CH: PEAK AT 500nm.
17	07/10/92				1.470		A	2	N/A
18	07/17/92	7.9	1200	17.5	1.510	0.040	A	1	CH: LARGE PEAK AT 500nm.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station WS 6.1 SW

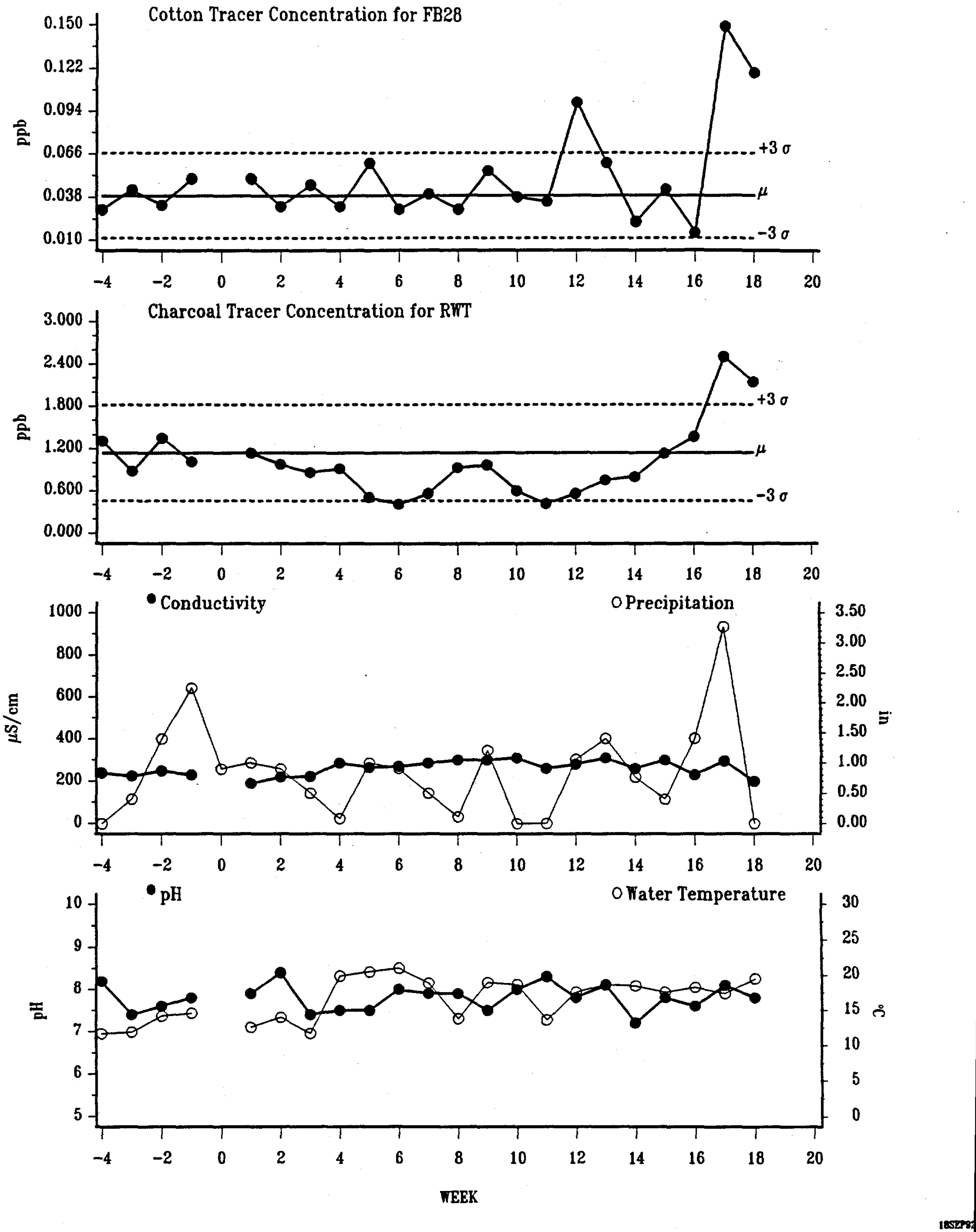


Station: WS 6.1 SW

Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	7.6	265	9.0	0.240	0.024	A	1	N/A
-3	02/17/92	6.9	255	9.6	0.470	0.030	A	1	N/A
-2	02/24/92	7.1	265	11.7	0.310	0.020	A	1	N/A
-1	03/02/92	7.0	300	16.7	0.910	0.024	A	1	CHARCOAL .89
-1	03/02/92				0.890		A	2	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.6	240	11.8	0.610	0.019	A	1	HIGH FLOW AND MUDDY
2	03/26/92	8.0	245	12.4	0.270	0.019	A	1	N/A
3	04/02/92	7.3	260	10.7	0.220	0.017	A	1	N/A
4	04/09/92	7.4	310	19.6	0.120	0.019	A	1	N/A
5	04/16/92	7.5	335	17.0	0.180	0.018	A	1	LOW FLOW CONDITIONS
6	04/23/92	7.6	360	18.4	0.170	0.021	A	1	N/A
7	04/30/92	7.4	335	18.1	0.210	0.040	A	1	VERY LITTLE FLOW
8	05/07/92	7.4	315	13.4	0.070	0.021	A	1	ALMOST STAGNANT.
9	05/14/92	7.4	355	17.5	0.120	0.022	A	1	N/A
10	05/21/92	7.7	370	18.0	0.120	0.021	A	1	COTTON: 0.019, 0.019; LOW FLOW CONDITIONS WERE SEEN AT ALL DYE TRACER SITES.
10	05/21/92					0.019	A	2	N/A
10	05/21/92					0.019	A	3	N/A
11	05/28/92	7.4	350	14.7	0.130	0.043	A	1	N/A
12	06/04/92	6.9	365	16.1	0.210	0.019	A	1	WATER PRESENT
12	06/04/92					0.019	A	2	N/A
12	06/04/92					0.019	A	3	N/A
13	06/11/92	7.6	420	20.7	0.210	0.023	A	1	N/A
14	06/18/92	6.7	360	17.4	0.590	0.055	A	1	GOOD FLOW.
15	06/25/92	7.8	410	20.0	0.410	0.021	A	1	N/A
16	07/01/92	7.0	375	19.1	0.220	0.026	A	1	GOOD FLOW
17	07/10/92	8.0	380	17.0	0.560	0.046	A	1	N/A
18	07/17/92	7.4	400	19.6	0.780	0.024	A	1	CH: PEAK AT 541nm.

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

CRSP Dye Tracer Study
Station WS 7.5 SW



Station: WS 7.5 SW

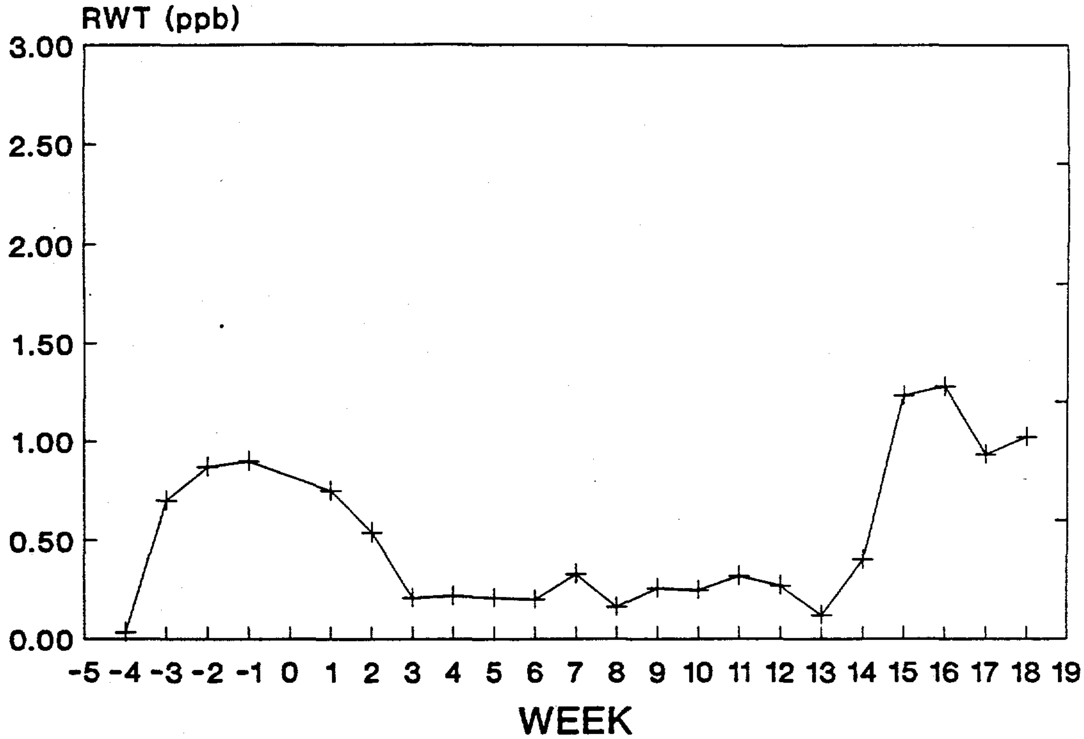
Week	Date	pH	Cond.	Temp (°C)	Charcoal (ppb)	Cotton (ppb)	Absence/ Presence	Split*	Comments
-4	02/10/92	8.2	240	11.7	1.310	0.030	A	1	Lg SF PK @ 500 nm
-3	02/17/92	7.4	225	11.9	0.880	0.043	A	1	Lg SF PK @ 500 nm
-2	02/24/92	7.6	249	14.2	1.350	0.033	A	1	Lg SF PK @ 500 nm
-1	03/02/92	7.8	230	14.6	1.020	0.050	A	1	Lg SF PK @ 500 nm COTTON: .050, .048
-1	03/02/92					0.050	A	2	N/A
-1	03/02/92					0.048	A	3	N/A
0	03/09/92						A	1	N/A
1	03/19/92	7.9	190	12.6	1.140	0.050	A	1	HIGH FLOW AND MUDDY
2	03/26/92	8.4	220	14.0	0.980	0.032	A	1	N/A
3	04/02/92	7.4	222	11.7	0.860	0.046	A	1	COTTON .046, .045
3	04/02/92					0.046	A	2	N/A
3	04/02/92					0.045	A	3	N/A
4	04/09/92	7.5	285	19.9	0.920	0.032	A	1	N/A
5	04/16/92	7.5	265	20.5	0.510	0.060	A	1	LOW FLOW CONDITIONS
6	04/23/92	8.0	270	21.0	0.410	0.030	A	1	N/A
7	04/30/92	7.9	285	18.9	0.560	0.040	A	1	N/A
8	05/07/92	7.9	300	13.8	0.930	0.030	A	1	N/A
9	05/14/92	7.5	300	19.0	0.970	0.055	A	1	N/A
10	05/21/92	8.0	310	18.7	0.600	0.038	A	1	N/A
11	05/28/92	8.3	260	13.6	0.420	0.035	A	1	LOW; COTTON: 0.035, 0.035
11	05/28/92					0.035	A	2	N/A
11	05/28/92					0.035	A	3	N/A
12	06/04/92	7.8	280	17.6	0.560	0.100	A	1	N/A
13	06/11/92	8.1	310	18.7	0.750	0.060	A	1	BKGD. PEAK AT 500 NM
14	06/18/92	7.2	260	18.5	0.800	0.022	A	1	WATER VERY MUDDY.
15	06/25/92	7.8	300	17.6	1.130	0.043	A	1	CH: LARGE PEAK AT 500nm
16	07/01/92	7.6	230	18.3	1.370	0.015	A	1	N/A
17	07/10/92	8.1	295	17.4	2.500	0.150	A	1	CH: HUGE PEAK AT 500nm.
18	07/17/92	7.8	200	19.5	2.140	0.120	A	1	CH: HUGE PEAK AT 500nm

* Split Definition: 1 - original entry, 2 - duplicate, 3 - triplicate

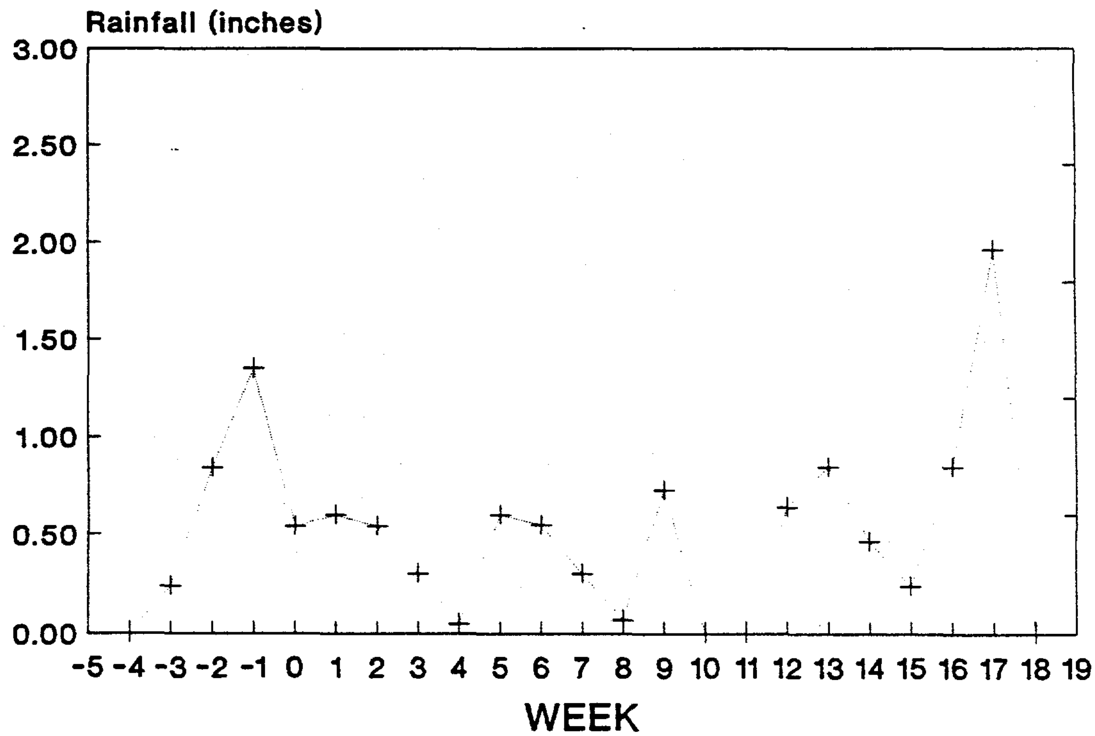
APPENDIX B

MONITORING RESULTS BY AREA

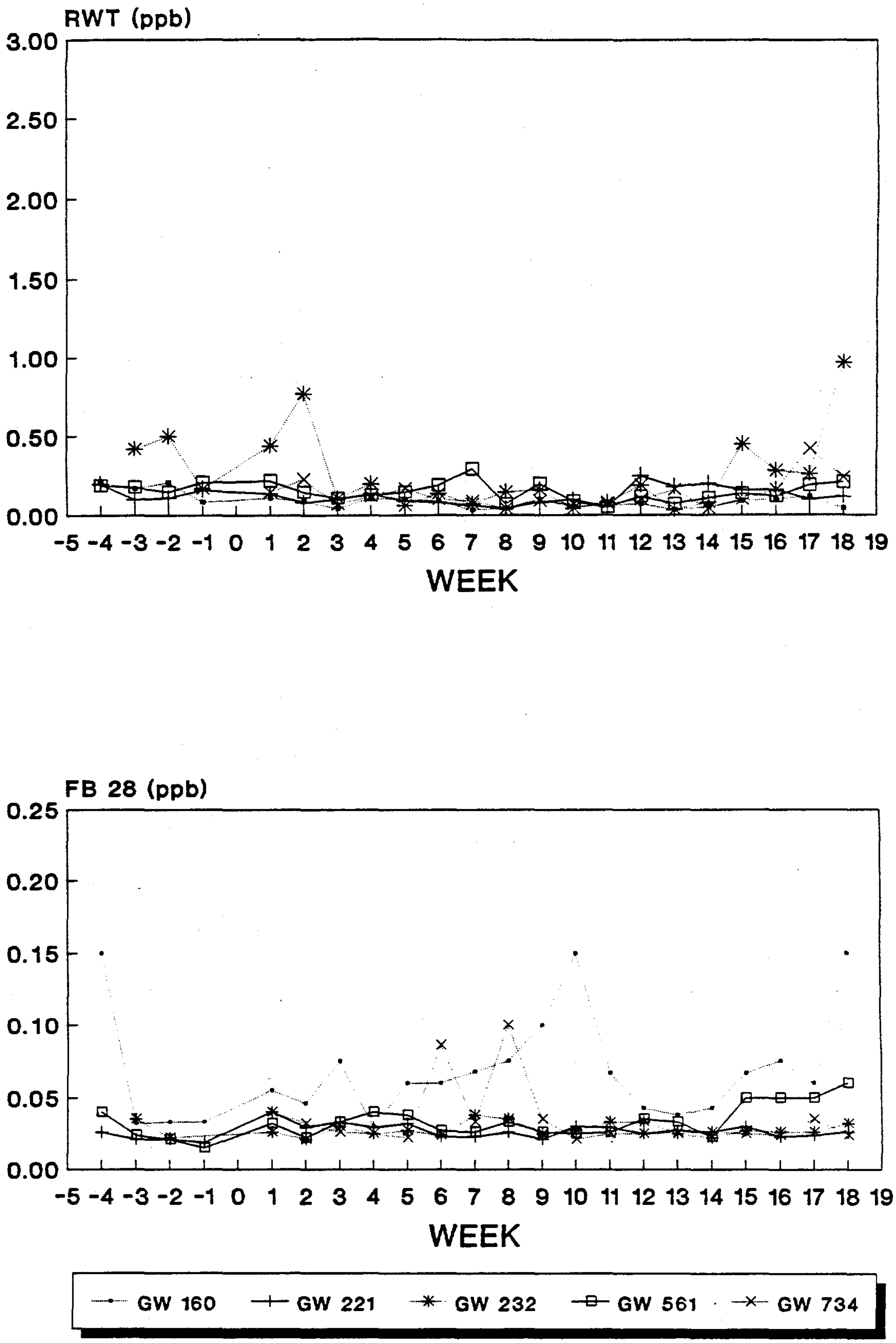
FIELD BLANK - RWT



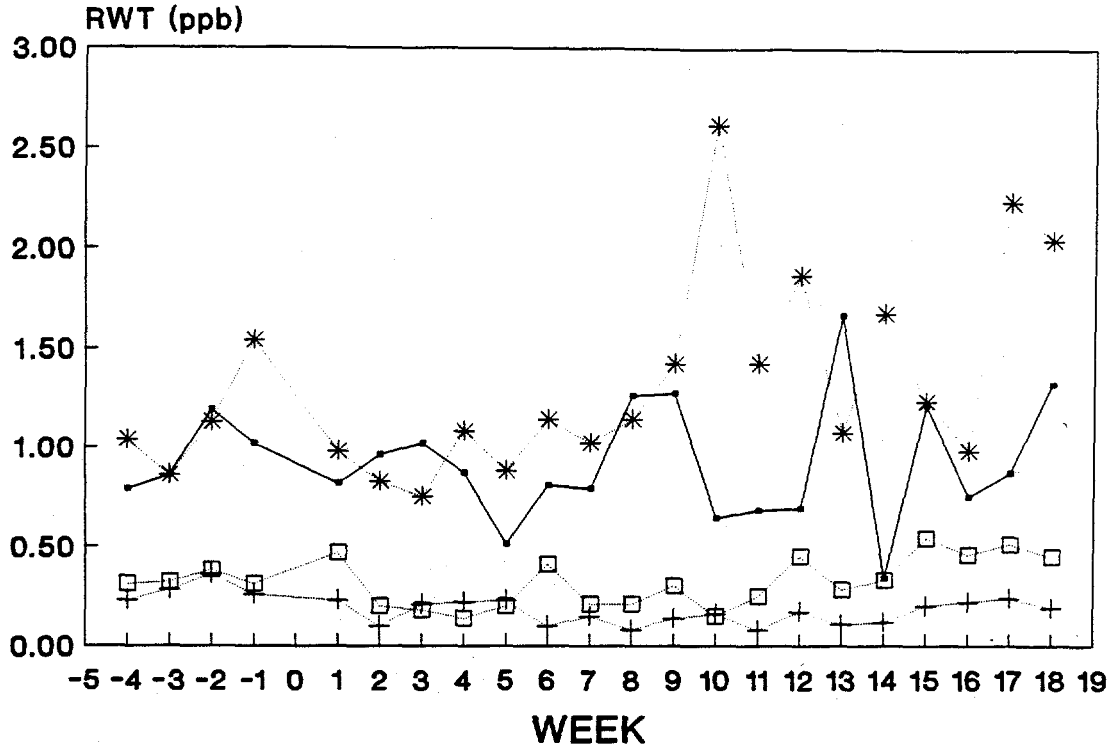
PRECIPITATION

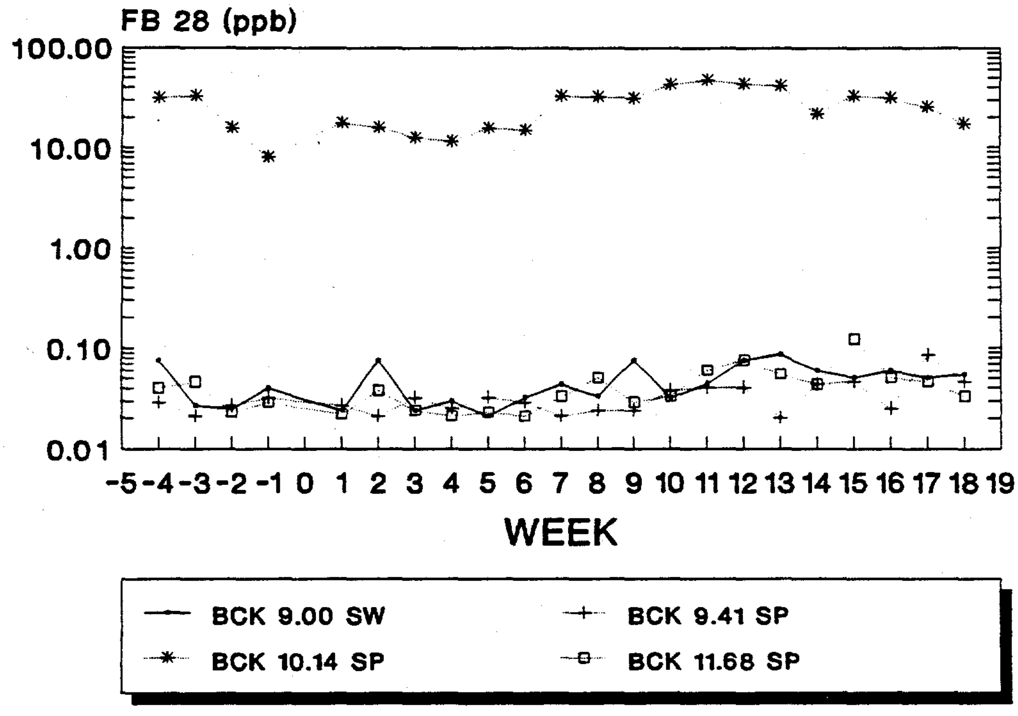


MONITORING WELLS



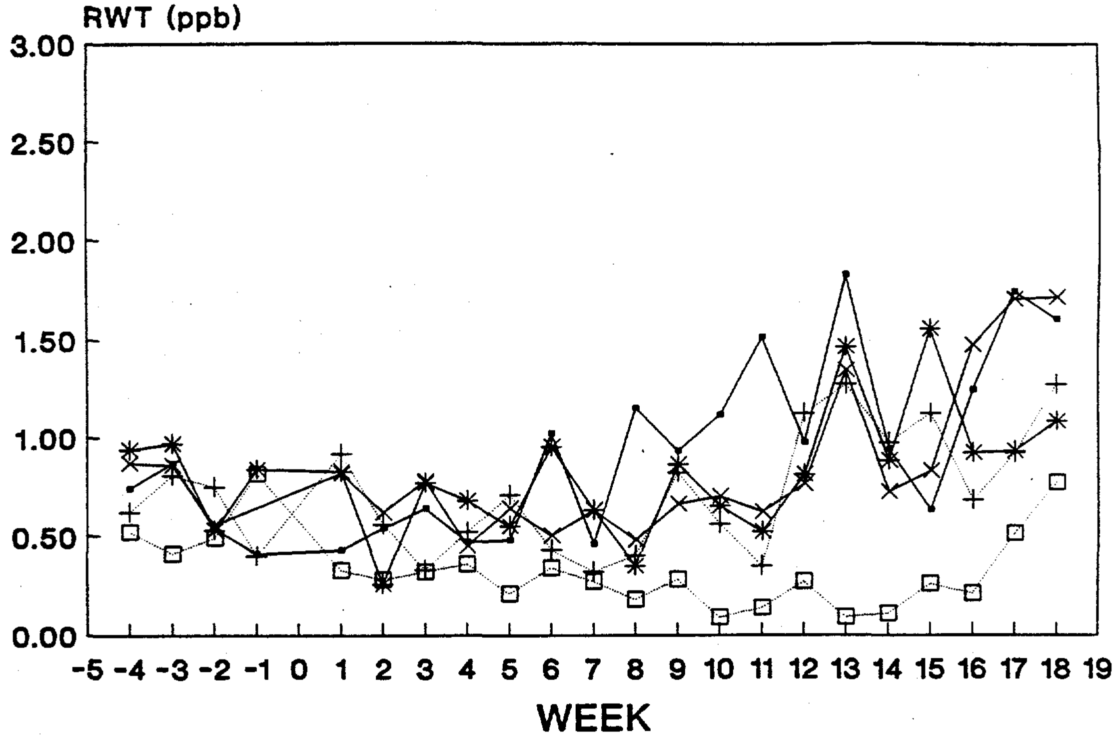
BCK AREA



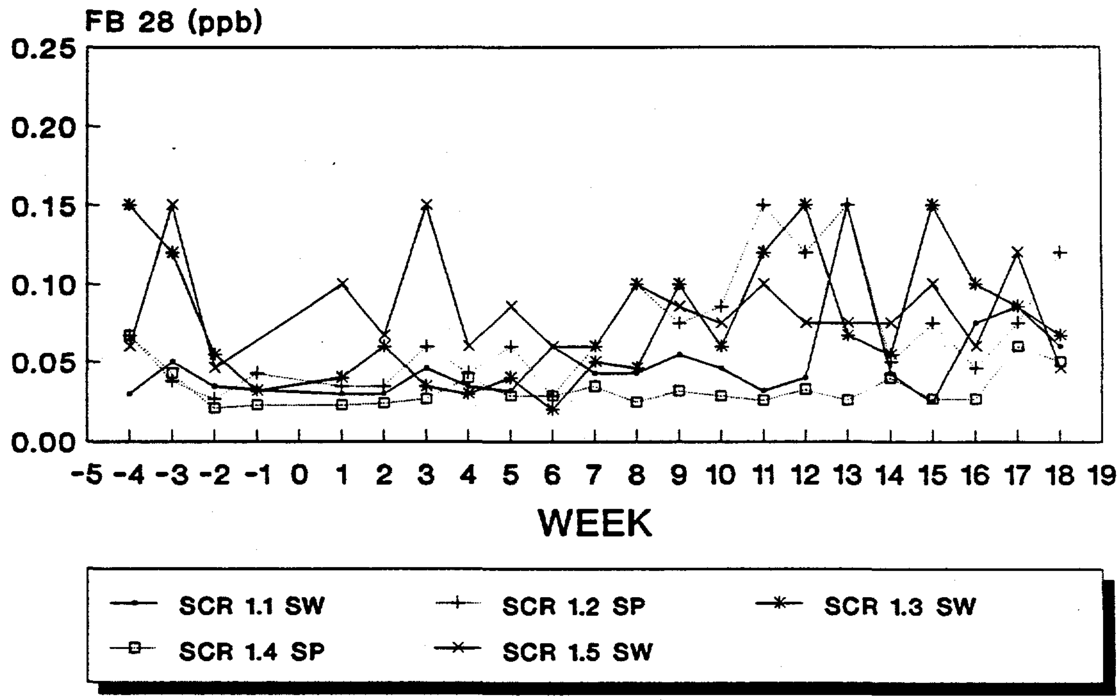


Note log scale of FB28 concentrations

SCR 1 AREA

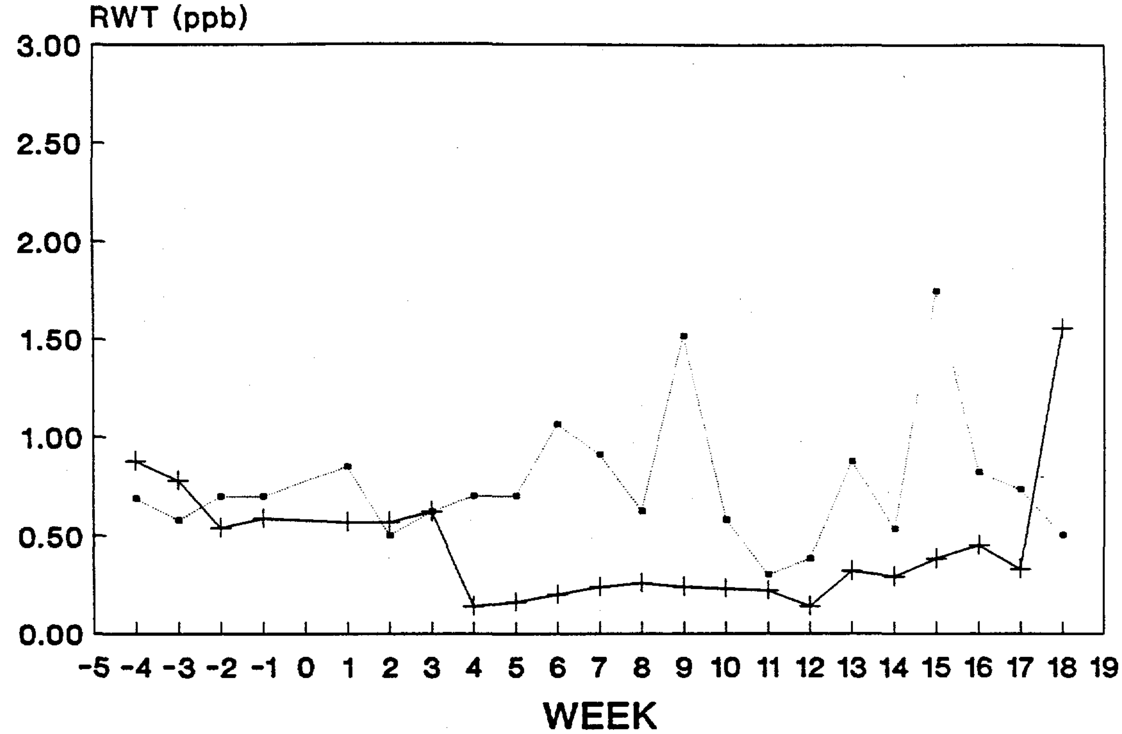


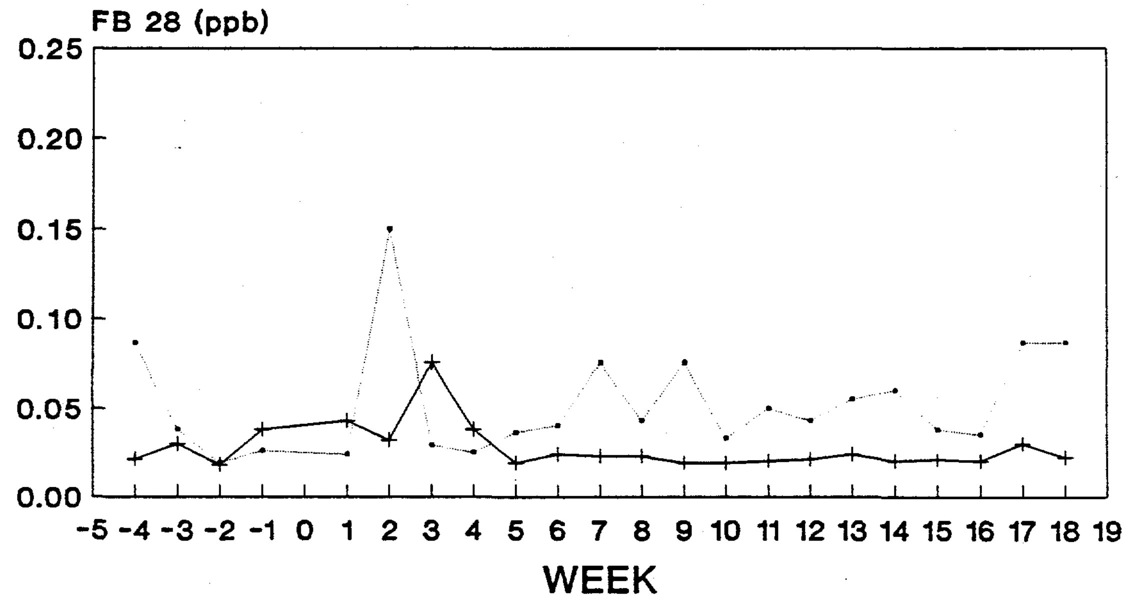
RWT (ppb)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK



FB 28 (ppb)
0.25
0.20
0.15
0.10
0.05
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK
SCR 1.1 SW
SCR 1.2 SP
SCR 1.3 SW
SCR 1.4 SP
SCR 1.5 SW

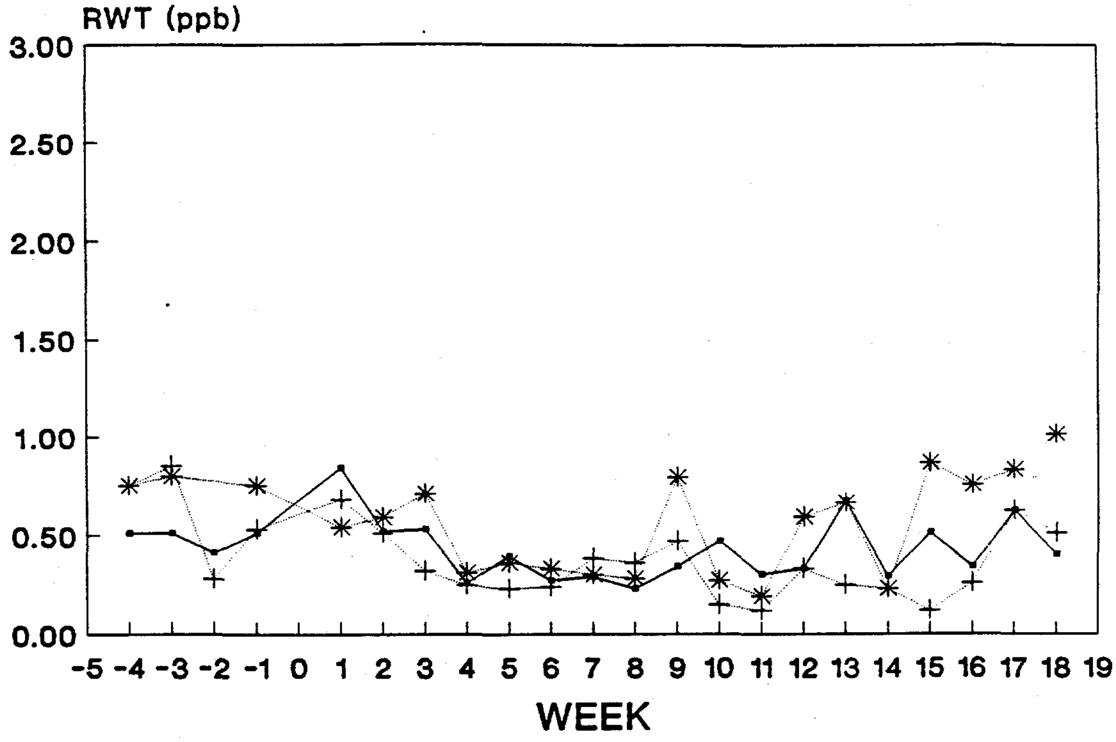
SCR 2 AREA

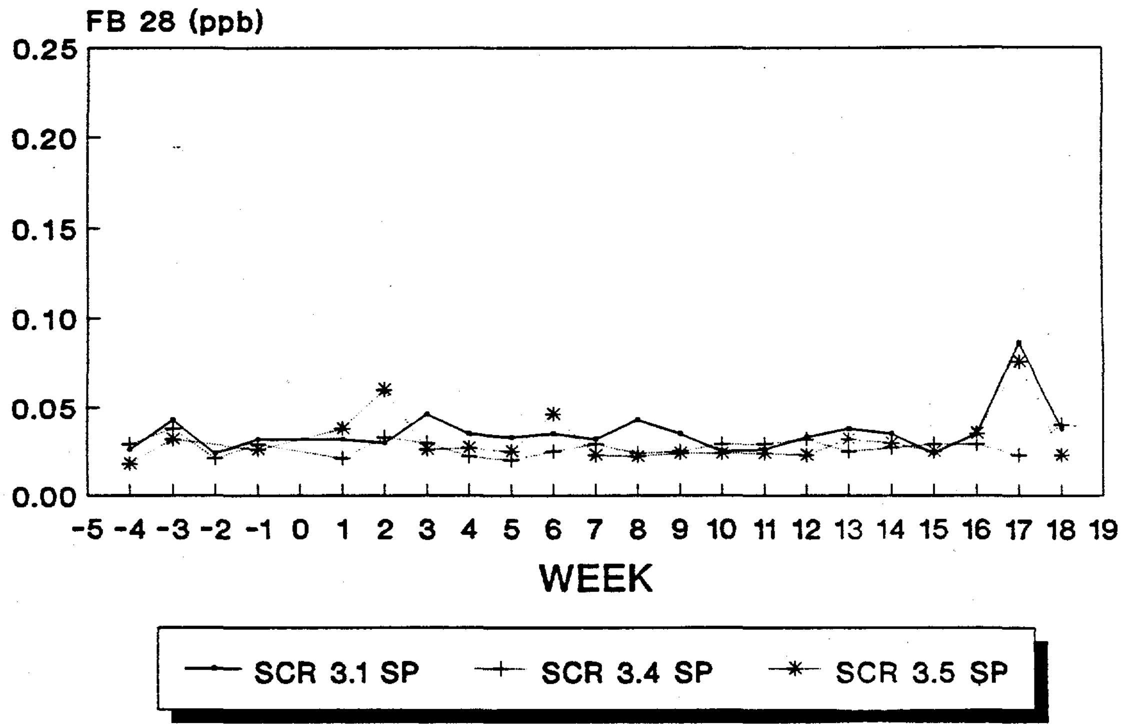




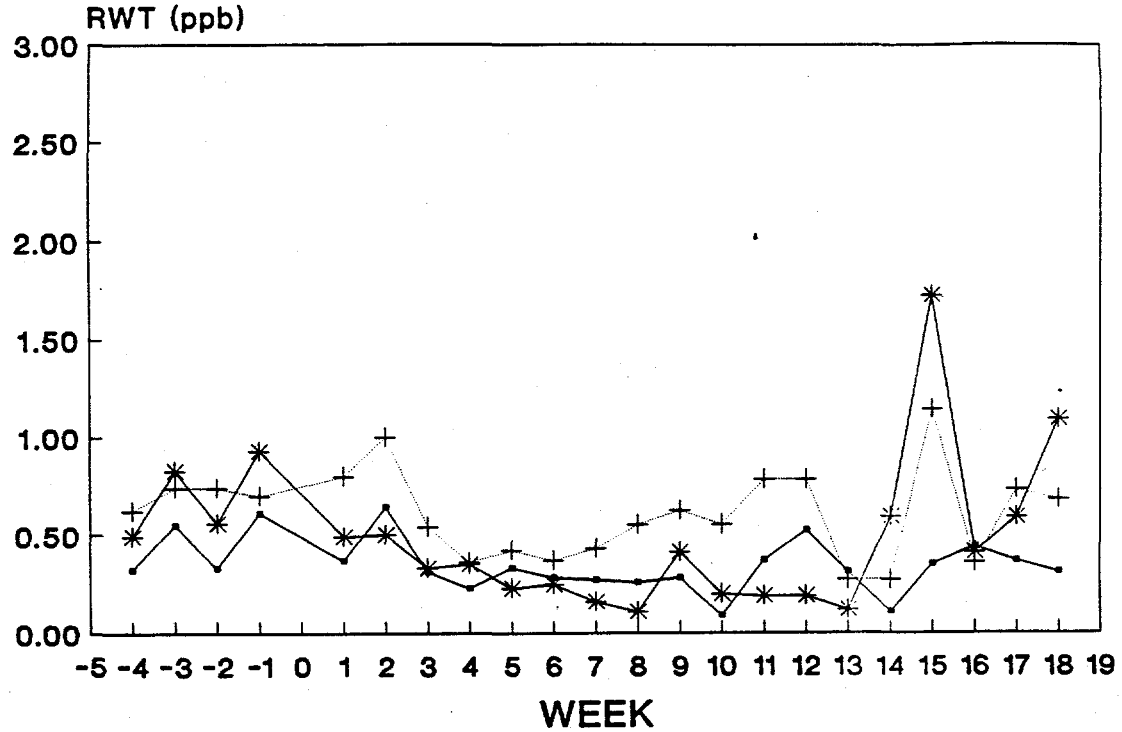
SCR 2.1 SP — SCR 2.2 SW

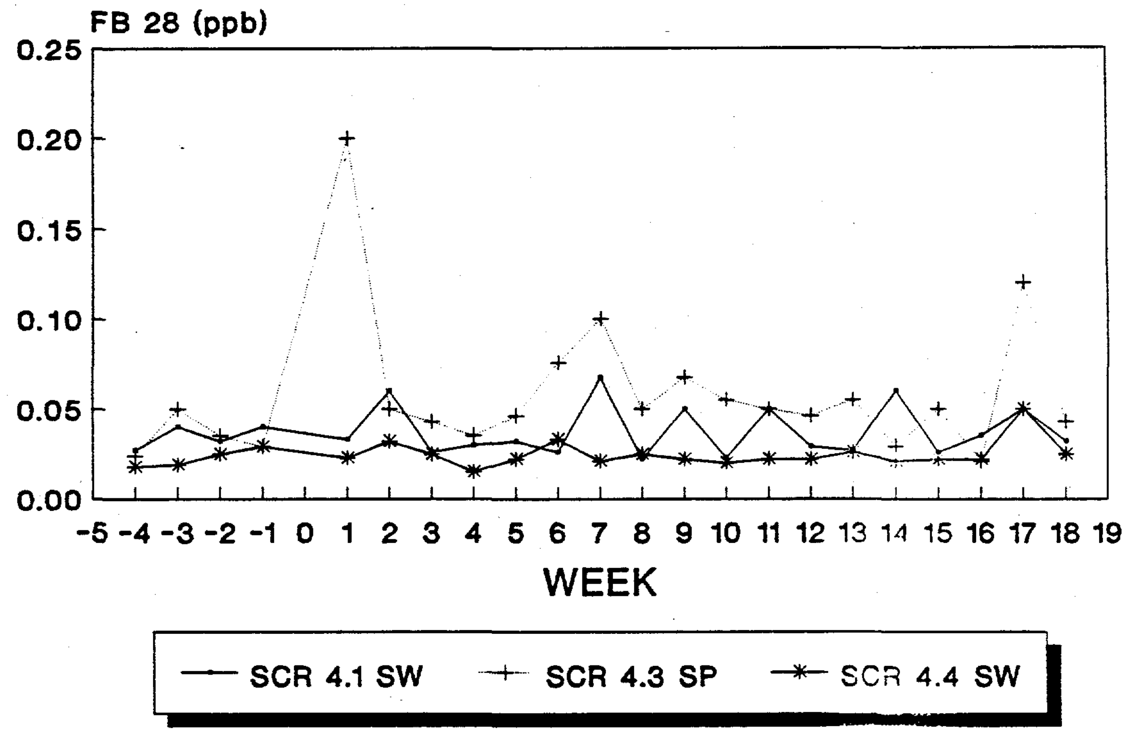
SCR 3 AREA


RWT (ppb)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK

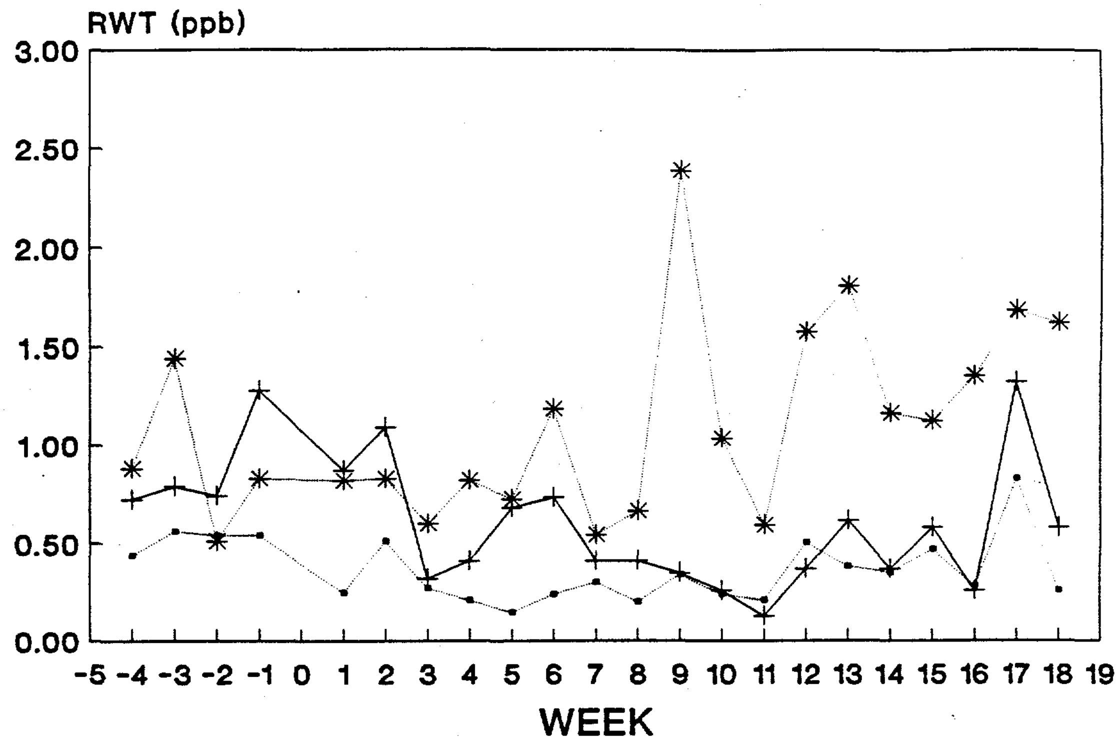

FB 28 (ppb)
0.25
0.20
0.15
0.10
0.05
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK
SCR 3.1 SP
SCR 3.4 SP
SCR 3.5 SP

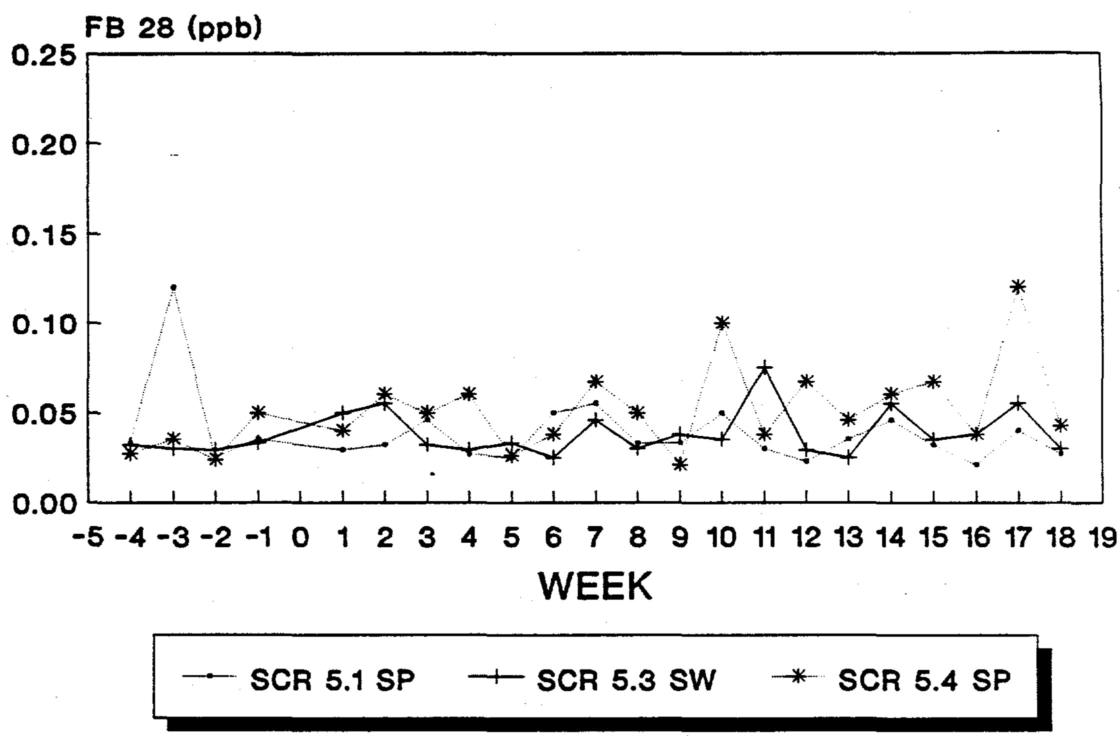
SCR 4 AREA


RWT (ppb)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK

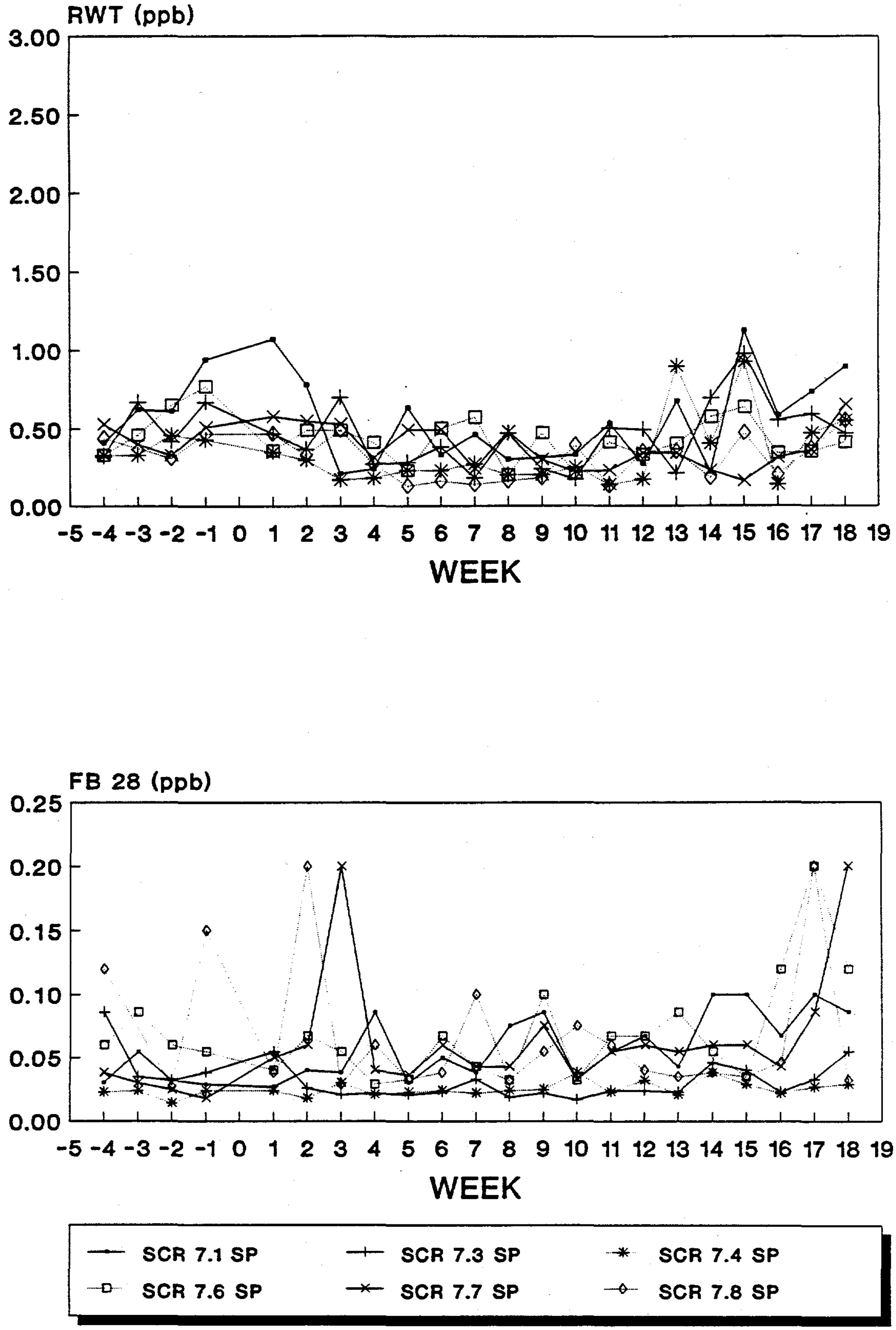

FB 28 (ppb)
0.25
0.20
0.15
0.10
0.05
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK
SCR 4.1 SW
SCR 4.3 SP
SCR 4.4 SW

SCR 5 AREA

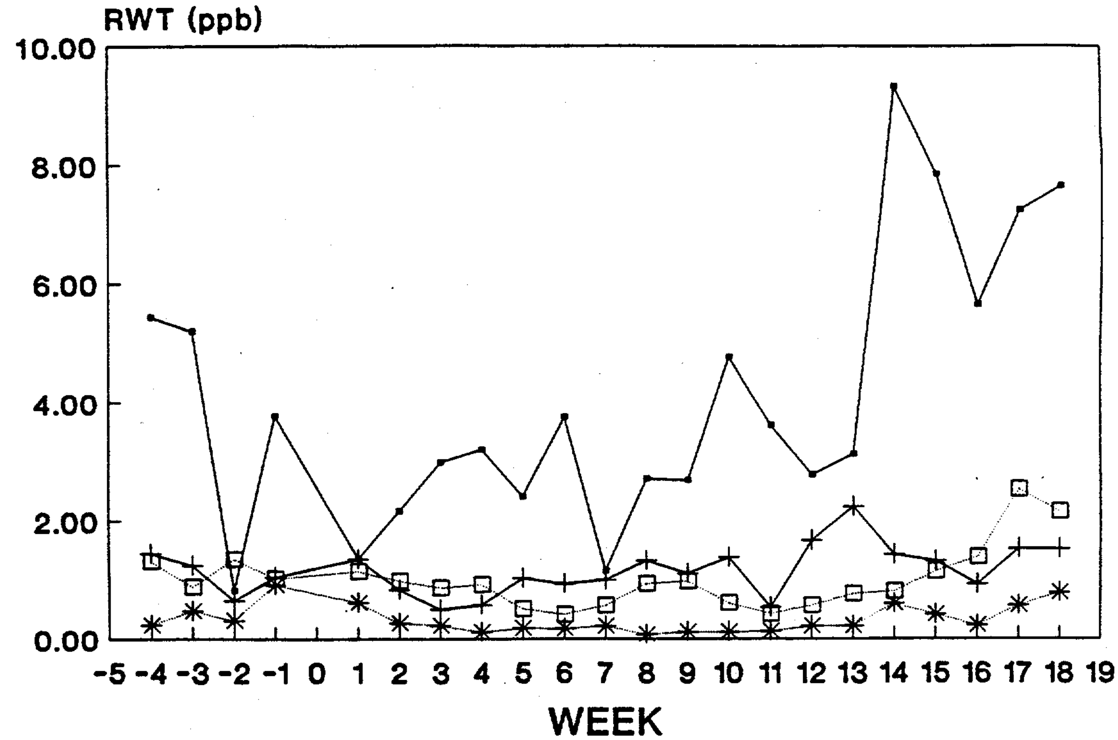

RWT (ppb)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK

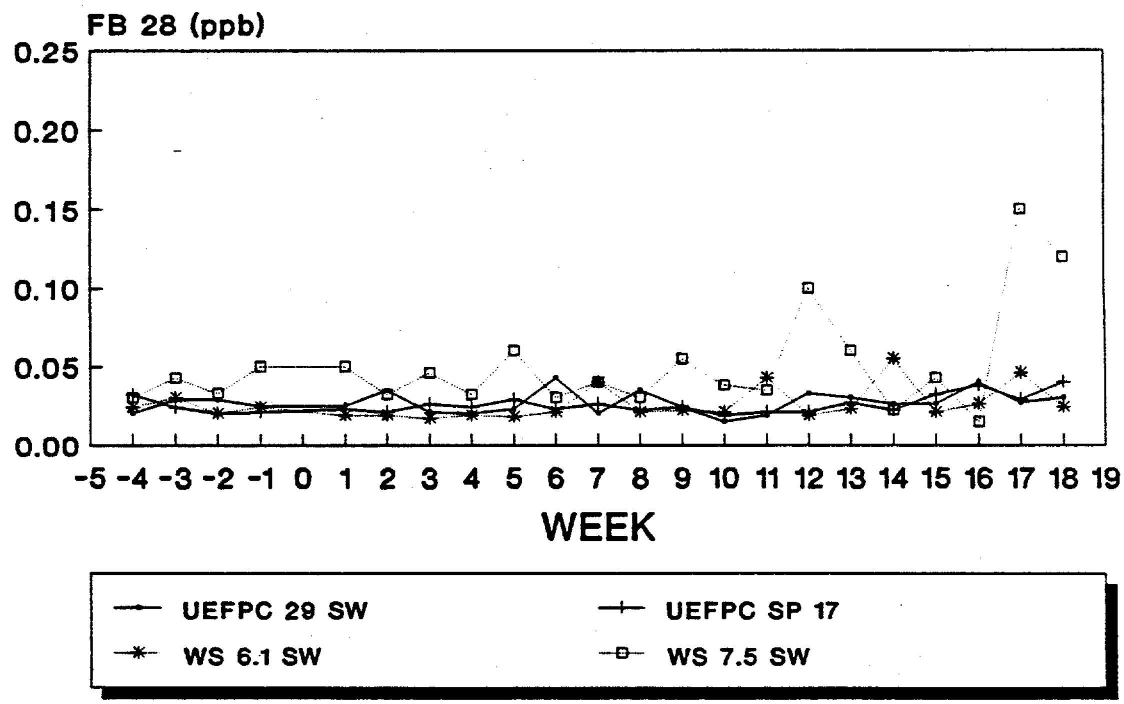

FB 28 (ppb)
0.25
0.20
0.15
0.10
0.05
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK
SCR 5.1 SP
SCR 5.3 SW
SCR 5.4 SP

SCR 7 AREA


RWT (ppb)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK
FB 28 (ppb)
0.25
0.20
0.15
0.10
0.05
0.00
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
WEEK
SCR 7.1 SP
SCR 7.3 SP
SCR 7.4 SP
SCR 7.6 SP
SCR 7.7 SP
SCR 7.8 SP

UEFPC & WS AREAS





DISTRIBUTION

DEPARTMENT OF ENERGY

G. W. Bodenstein (2)
W. G. McMillan

HEALTH, SAFETY, AND ENVIRONMENT DIVISION

E. R. Beauchamp (3)
D. E. Bohrman
W. K. Jago
S. B. Jones (5)
L. W. McMahon
E. B. Rundle
File - EMD - RC

ENVIRONMENTAL RESTORATION DIVISION

M. J. Norris
G. L. Underburg (3)
J. A. Hodgins

UNIVERSITY OF TENNESSEE

R. M. Evans
P. M. Goldstrand
B. W. McMaster
L. A. Shevenell

QUINLAN AND ASSOCIATES

J. F. Quinlan

ENVIRONMENTAL SCIENCES DIVISION

R. B. Clapp
R. B. Dreier
T. O. Early
D. D. Huff
J. M. Loar
C. T. Rightmire
R. R. Turner

ENERGY DIVISION

R. H. Ketelle
R. R. Lee

PRODUCTION SUPPORT MAINTENANCE DIVISION

K. D. Delius

ORISE

S. M. Field

SAIC

D. Combs
D. Keefer
M. A. Klidzejs

HSW

J. Walker

A. K. Lee/DOE-OSTI (2)
Y-12 Central Files