NON-POINT SOURCE ASSESSMENT AND STORM-SEWER INFILTRATION/INFLOW AND EXFILTRATION STUDY ROCKY FLATS PLANT SITE

Tasks 2 and 3
of the
Zero-Offsite Water-Discharge Study

Prepared For:

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Transmittal

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NON-POINT SOURCE ASSESSMENT AND STORM-SEWER INFILTRATION/INFLOW AND EXFILTRATION STUDY ROCKY FLATS PLANT

EXECUTIVE SUMMARY

This constitutes the final report for two of the numerous studies being conducted for, and in the development of, a Zero-Offsite Water-Discharge Plan for the Rocky Flats Plant (RFP) in response to Item C.7 of the Agreement in Principle (AIP) between the Colorado Department of Health (CDH) and the U.S. Department of Energy (DOE) (DOE and State of Colorado, 1989). The CDH/DOE Agreement Item C.7 states the following: "Source Reduction and Zero Discharges Study: Conduct a study of all available methods to eliminate Rocky Flats discharges to the environment including surface waters and ground water. This review should include a source reduction review." The consolidation of the various studies is discussed in ASI (1991e).

Specifically, this report describes preliminary results of two interrelated studies involving quantity and quality analyses of storm-sewer inflow/infiltration and exfiltration (Task 2, ASI, 1990c) and of a non-point source assessment (Task 3, ASI, 1990d). These analyses included review of relevant data and technical reports providing information on both ambient conditions and economic-development activities affecting regional water quality.

Another study aspect involved several monitoring components: (1) design and implementation of field instrumentation to record continuous flows and to collect water-quality samples during storm-runoff or high-flow events at selected sites for characterizing runoff quantity and quality involving the RFP storm-sewer system; (2) installation of bulk-precipitation sample collectors and an evaporation pan, and proposed installation suspended-sediment (MISSISSIPPI) samplers (the latter still await approval through the "environmental-checklist" [EC] system); and (3) approximately weekly surveys of water levels and indicator water-quality variables through field measurements at eight shallow alluvial wells located throughout the RFP site. A total of 77

measurements at eight shallow alluvial wells located throughout the RFP site. A total of 77 samples have been collected and submitted for selective laboratory chemical analyses for 41 events (storms or otherwise high recorded flows). Laboratory results are available to date for some of these samples. High concentrations in unfiltered samples (that is, exceedances relative to CDH stream standards) were noted of gross alpha, gross beta, and several trace metals (chromium, iron, lead, and manganese) for several of the storm-runoff/high-flow samples.

Based upon the preliminary results of field investigations and data-analysis studies, the following conclusions and recommendations are made:

1) Infiltration into the storm-sewer system has been identified at monitoring sites SW023 and SW093. Preliminary estimates of annual infiltration at these two sites indicate an average of about 0.072 MGD, or about 26.2 million gallons per year.

2) External (that is, non-RFP related) influences by both natural conditions and human-induced activities are affecting regional water quality in and around the RFP area.

3) Collected available data for storm-runoff/high-flow events point toward some close-in (within the confines of the RFP Controlled Area) contributions to radionuclides and perhaps several trace metals. The highest indicator-radionuclide (gross-alpha and gross-beta) concentrations were obtained in a sample collected at site SW118 draining the northwest part of the RFP area. The sample results are reported for total (unfiltered) concentrations and, in several instances, could be compared to earlier data reported for both total or dissolved (filtered-sample) concentrations. Concentrations of a few trace-metal species (aluminum and iron) exhibit substantial differences between total and dissolved concentrations, possibly due to increased solubility of certain mineral facies caused by acidifying samples.

4) Continued monitoring of storm-runoff events at installed non-point source (NPS) sites has been recommended and has been approved. The network may be modified in terms of constituents and locations beginning about October 1991 in response to newly-identified objectives or data needs involving stormwater-NPDES regulatory requirements.

5) When additional resultant data become available, further data analyses and investigations using historical and recent surface-water and ground-water data are recommended to develop a better understanding of regional water-quality impacts.

6) Several previous studies have documented physical characteristics and ambient chemical conditions in stream and impoundment sediments in and around the RFP area. Implementation of the proposed suspended-sediment samplers and additional more-detailed characterization of bottom-sediment chemistry of stream channels and of reservoirs (both on-site and offsite) may be useful in expanding upon available historical data and in refining the assessment of non-point source contributions.

7) The recording rain gage located in the West Buffer Zone of the RFP may not be representative of rainfall at other locations of the RFP site. Data from a recently installed (August 1991) precipitation gage located near site SW022 will aid in this concern. Measured storm runoff at several different locations in the RFP site for a single-storm rainfall indicated that the runoff may exceed the measured storm rainfall at the rain-gage location. Therefore, additional recording or bulk rain gages should be installed on selected watersheds on the RFP. In this way, areal variations in the rainfall patterns at the RFP could be analyzed. This is especially important for high-intensity convective storms typical of the RFP area during the late spring and summer.

8) Stream standards for Woman Creek and its tributaries upstream from Standley Lake, and for Walnut Creek and its tributaries upstream from Great Western Reservoir, have been promulgated by the State of Colorado Water Quality Control Commission. These stream standards designate that all surface water in the Woman Creek and Walnut Creek basins is classified as Domestic Water Supply. The corresponding numeric stream standards for this classification generally follow State of Colorado and EPA guidelines for primary and secondary drinking-water standards, except for radionuclides and selected trace-metals concentrations. The exceptions to EPA drinking-water numeric standards for Woman Creek and Walnut Creek are as follows (Appendix F):

		CDH-WQCC Stream Standard	
Constituent	EPA Drinking-Water Standard	Woman Creek Standard	Walnut Creek Standard
Mercury (ug/L)	2.0	0.01	0.01
Gross Alpha (pCi/L)	15	7	11
Gross Beta (pCi/L)	50	5	19
Tritium (pCi/L)	20,000	500	500

Several exceedances of the gross-alpha and gross-beta standards have been noted, based upon the available storm water and ambient data for the non-point source monitoring sites (Section 3.2 and Appendix A). However, no exceedances of the tritium stream standards were noted, based upon data compiled for this study.

Selected trace metals have numeric stream standards which have been exceeded occasionally in the storm-runoff/high-flow event samples for total concentrations of cadmium, chromium, iron, lead, and manganese. Recently-proposed table-value standards have yet to be implemented by the CHD-WQCC for application to the RFP's stream segments. These are based upon critical low-streamflow levels and the hardness of the water and are judged to be limiting for aquatic life.

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER INFILTRATION/INFLOW AND EXFILTRATION STUDY ROCKY FLATS PLANT

1.0 INTRODUCTION

1.1 BACKGROUND

As part of the various ongoing studies associated with the Zero-Offsite Water-Discharge Study conducted by Advanced Sciences, Inc. (ASI) on behalf of EG&G Rocky Flats, Inc., certain aspects of assessing and managing non-point source runoff at and around the Rocky Flats Plant (RFP) site are of concern. The various component studies of the Zero-Offsite Water-Discharge Study are described in ASI (1990b), and the consolidation of these studies is outlined in ASI (1991e). This overall Study was developed in response to an Agreement in Principal (AIP) between the Colorado Department of Health (CDH) and the U.S. Department of Energy (DOE) (DOE and State of Colorado, 1989). The DOE/CDH Agreement Item C.7 states the following: "Source Reduction and Zero Discharges Study: Conduct a study of all available methods to eliminate Rocky Flats discharges to the environment including surface waters and ground water. This review should include a source reduction review." This report documents our field and data-analysis investigations for evaluating the relative contribution of the RFP storm-sewer system in this effort and also for putting into perspective this system relative to other factors affecting regional water-quality conditions.

1.2 SCOPE AND OBJECTIVES

The quantity and quality aspects of these studies involving non-point source runoff monitoring and assessment are described in the two associated Project Management Plans (PMPs) (ASI, 1990c; 1990d). Data and information relevant to identifying and quantifying non-point sources and of characterizing associated water-quality runoff conditions provide the focus of these studies. Particular emphasis was placed upon design and implementation of a Plant-wide storm-sewer monitoring program that could characterize effectively flows and indicator water quality. The initial work schedule addressed by these studies and incorporated into an interim report (ASI, 1990m) included a component of field-monitoring investigations, with data collected and reported therein through about September 1990. Data collection has continued, and this final report includes available (retrieved through EG&G's RFEDS) water-quality data collected through about July 1991, selective ground-water data collected through April 1991, and streamflow and precipitation data collected through mid-September, 1991.

Also, this continuing effort will interact with several other ongoing investigations at the RFP. These investigations could include the studies of Water-Yield and Water-Quality of Walnut Creek and Woman Creek Watersheds (Task 4) (ASI, 1990g; 1990j), Confirmation of Rainfall/Runoff Relationships (Task 5) (ASI, 1990h; 1991d), Treated Sewage/Process-Wastewater Recycle (Task 13) (ASI, 1990i; 1991c), Water-Yield and Water-Quality of Other Sources Tributary to Standley Lake and Great Western Reservoir (Task 16) (ASI, 1990f; 1990k), Bypass Upstream Flows around Rocky Flats Plant (Task 24) (ASI, 1991a; 1991b), and Consolidation and Zero Discharge Plan (Task 30) (ASI, 1990b; 1991e).

The primary objectives of these studies are: (1) identification and quantification of infiltration/inflow or exfiltration into the storm-sewer and storm-runoff collection system within the controlled area at the RFP, and (2) identification of parts of the controlled area at the RFP which contribute the largest non-point source (NPS) loads of contaminants to the existing stream systems potentially impacted by the RFP. By fulfilling these two objectives, a better understanding of the potential for contaminant transport off-site by surface waters (especially during storm events or snowmelt) and the potential for release of storm runoff from the controlled area of the RFP without detention/retention or treatment can be assessed. The storm-sewer inflow/infiltration and exfiltration (I/I & E) study is assessing the quantities of water potentially entering the drainage system during dry weather conditions which might have to be treated or stored under a "zero-discharge" scenario. The non-point source runoff quantity and quality data will serve as a useful basis for future planning of zero-discharge water-management alternatives related to storm runoff and snowmelt from the controlled area and perhaps other parts of the RFP.

This report includes a summary of field data-collection results for a 15-month period from July 1990 through mid-September 1991. During this monitoring period, a total of 76 storm-runoff/high-flow events samples and 51 bulk-precipitation samples were collected. Resultant chemical analyses were available for most samples only through about July 1991, based upon recent EG&G's Rocky Flats Environmental Database System (RFEDS) retrievals. A preliminary evaluation of these data is included in this report, along with selective comparisions with applicable stream standards.

2.0 APPROACHES

2.1 LITERATURE REVIEW AND EXISTING-DATA EVALUATION

Relevant data and information on the RFP's storm-sewer system were collected at the outset of these studies (ASI, 1990c; 1990d). The storm-sewer and storm-runoff collection-system plan and the profile "as-builts" within the RFP controlled area were reviewed and spot checked in the field to see if they represented the storm-runoff collection system as it currently exists. Cognizant EG&G personnel were interviewed to obtain data on past problems with the storm-sewer system and known footing- and building-drain connections to the storm-sewer system. This led to an inventory of the existing storm-runoff system, including the type of storm-sewer system and pipe materials used for the storm sewers. Most of the storm sewer system at the RFP consists of open channels and culverts. Figure 1 shows the extent of the storm sewer system. Interviews with EG&G personnel indicated that, during heavy rainfall, the existing open channel-culvert storm sewer system cannot always handle the resulting runoff without overtopping roads within the controlled area or causing ponding upstream from culverts for short periods.

As part of the assessment for a supplemental water-quality and flow monitoring-network design, the existing surface-water data-collection efforts were reviewed and coordinated with the existing fixed-interval sampling program in cooperation with personnel of the EG&G subcontractor, Woodward-Clyde (WC, 1990). The following data were reviewed as a part of this study: short-term (recent) daily rainfall records obtained from EG&G's Environmental Restoration (ER) Department's former Environmental Monitoring and Assessment Division (EMAD), selected data on ground-water levels in relatively shallow, alluvial wells, and comparative historical water-quality analyses at selected onsite as well as offsite locations. However, because no concurrent storm-flow and water-quality data are known to be available, the historical data cannot be fully used to augment this study.

2.2 WATER-QUALITY STREAM STANDARDS

The RFP is subject to the regulatory requirements of the CDH's Water Quality Control Division. Because the RFP is a Federal facility, point-source permits to discharge are written by the U. S. Environmental Protection Agency (EPA) rather than the State of Colorado, however, the State certifies the discharge permit. Water-quality regulation at the RFP also is affected by the AIP in that the DOE must notify the State prior to releases of water from impoundments on the RFP to downstream waters. The AIP also serves as a vehicle through which the State may cause the DOE to conduct surface-water sampling programs that are not mandated by existing water-quality standards (EG&G, 1991e).

During the period from December 1989 through February 1990, the State of Colorado's Water Quality Control Commission (CWQCC) conducted hearings on the water-quality standards for surface waters draining into Standley Lake and Great Western Reservoir. These waters include Woman Creek, which discharges to Standley Lake, and Walnut Creek, which discharges to Great Western Reservoir (Figure 2). The segmentation of Woman Creek and Walnut Creek upstream from Standley Lake and Great Western Reservoir, as a result of the 1989-90 Commission hearings and deliberations, is delineated on Figure 2. Stream Segment 2 and Stream Segment 3 consist of Standley Lake and Great Western Reservoir, respectively; these segments are classified as Domestic Water Supply. Stream Segment 4 includes all of Woman Creek upstream from Standley Lake and that part of Walnut Creek and its tributaries upstream from Great Western Reservoir but below the A- and B-series ponds on the RFP (Figure 2). All of Stream Segment 4 is classified as Domestic Water Supply by the Colorado Water Quality Control Commission. North Walnut Creek and South Walnut Creek, along with Pond C-2, have been designated as Stream Segment 5 by the Commission and given a classification of Domestic Water Supply. This classification for Stream Segment 5 was adopted by the Commission as a goal, rather than as an existing use of Stream Segment 5. Because the ambient conditions of Stream Segment 5 generally were undocumented at the time of steam-classification deliberations (EG&G, 1991e), the Commission agreed to reconsider the actual numeric standards for Stream Segment

5 within three years. DOE (through its subcontractors) currently is monitoring several sites along Stream Segment 5 as well as Stream Segment 4 to establish baseline (ambient) water-quality conditions (EG&G, 1991a; 1991f).

Numeric standards are associated with each stream segment. The numeric standards for Domestic Water Supply for Stream Segments 2, 3, 4, and 5 at and near the RFP generally coincide with EPA primary and secondary drinking-water standards (EPA, 1989) as summarized in Appendix F (Table F-1). Notable exceptions between the EPA drinking-water standards and the CDH numeric standards for the stream segments are those for mercury (2.0 ug/L for the EPA drinking-water standard and 0.01 ug/l for the stream standard) and concentrations of radionuclides (Appendix F). Generally, radionuclide concentrations under the CDH-specified stream standards range from 0 to 98 percent lower than the EPA drinking-water standards. The water-quality data collected during this study have been compared to EPA drinking-water standards as well as to the CDH stream standards. It is understood, for purposes of the concept of zero discharge, that storm runoff leaving the RFP site would have to meet applicable stream standards. However, if storm-runoff/high-flow quality meets the EPA drinking-water standards, it also should be considered acceptable for downstream release with a small (acceptable) risk to public health.

2.3 SUPPLEMENTAL MONITORING-NETWORK DESIGN

Ongoing surface-water monitoring activities (Rockwell International, 1988b; 1989b; EG&G Rocky Flats, Inc., 1991a) were reviewed to minimize the overlap in the proposed monitoring-program efforts and to promote interfacing of the results of these studies with those of similar efforts throughout the RFP site and adjacent area. Based upon review of information and data needs and with collaboration with cognizant EG&G personnel, the following design components for a combined storm-sewer I/I/E and non-point source water-quantity and water-quality monitoring program were implemented. Four monitoring sites (SW022, SW023, SW027, and SW093, Figure 1) included in the EG&G's (1991a) surface-water monitoring plan were upgraded with field instrumentation for recording continuous flow stage and automatic sampling of storm events (Figure 2). A fifth monitoring site (SW118, Figure 1) was instrumented in a manner identical to the four upgraded sites and was included in order to obtain better definition of non-point source runoff in the northern and western parts of the RFP Controlled Area and in limited parts of the Buffer Zone. Two of these sites (SW027 and SW093) are included in EG&G's current surface-water monitoring program (WC, 1990; EG&G, 1991a). The specific descriptions of the field instrumentation are included in the following sections. A separate event-related surface-water monitoring and sediment characterization program involving sites at greater distances from the RFP Controlled Area is given in EG&G (1991f).

2.3.1 Storm-Sewer Infiltration/Inflow and Exfiltration Study

During closure plan studies for the Pad 904 and Pad 750 at the RFP (Rockwell International; 1989d and 1989e), it was noted that water quantity and water quality in selected parts of the storm-sewer system at the RFP were in excess of what normally would be expected for such a system. For example, some areas of the storm-sewer system had water flowing even during non-rainfall periods. Additionally, data for the Pad 750 closure plan indicated that the gross-alpha, gross-beta, and nitrate-nitrogen concentrations of the discharges from a continuously flowing culvert to South Walnut Creek, during the period October 1986 through August 1989, were often higher than EPA primary drinking-water standards, even during periods of no rainfall. These perennial flows and water-quality concentrations exceeding drinking-water standards in the storm-sewer and storm-runoff collection systems indicate that these systems were receiving water from unknown sources not related to storm runoff.

The original intent of the Storm-Sewer I/I & E Study was to identify the quantity and source, if possible, of the unknown water in the storm sewer for non-rainfall days (ASI, 1990c). Because the storm-sewer system is made up of swales, short culverts under roadways, and four long storm sewers (the longest is over 2,400 feet; see Appendix G), it was concluded by EG&G and ASI personnel that the Storm-Sewer I/I & E Study (Task 2) and the Non-Point Source Assessment

(Task 3) should be combined to avoid duplication of effort in field data collection and analyses of water-quantity and water-quality data.

An inventory of the storm-sewer system at the RFP was conducted using "as-built" drawings provided by EG&G. A summary of the storm-sewer pipe inventory is given in Appendix G (Table G-1). As indicated in this inventory, about 33,580 feet (ft) of storm drain exist in the RFP Controlled Area. About 19,900 ft, or 59 percent, of the storm-sewer system consists of corrugated metal pipe (CMP) culverts of varying length. Much of the storm-sewer system consists of unlined open channels along roadways and other plant facilities such as buildings. The remainder of the system consists of reinforced concrete pipe (RCP), polyvinyl chloride pipe (PVC), cast iron pipe (CI), steel pipe (STL) and about 150 ft of asbestos-concrete (AC) pipe. The four longest sections of storm sewer (Figure 1) provide drainage from the Protected Area (PA) (formerly called the Perimeter Security Zone, PSZ) to monitoring site SW093, from the PA to monitoring site SW023, from the southern part of the RFP Controlled Area to monitoring site SW022, and from a part of the 400-area in the southwestern part of the Controlled Area to the South Interceptor Canal ultimately discharging to monitoring site SW027. The capacities of the major storm-sewer pipes in the system have been estimated by EG&G (1991e). The smaller pipe diameters shown in Appendix Table G-1 (from 2-inches to about 6-inches) are primarily building and footing drains which discharge to the storm-sewer system. The water source for some of these drains originates in sumps and in water pumped to the storm-sewer system. This could account for the perennial flows noted in some of the storm drains (ASI, 1990b). According to the "as-builts", many of the building drains discharge to the ground surface and then are collected in the storm-drain system of open channels and culverts and discharged offsite. To the extent that some of the shallow ground water in the RFP Controlled Area may have relatively high concentrations of contaminants, the storm runoff or "perennial" flows in the storm sewer also may have high concentrations of contaminants.

Field-monitoring components of the Storm-Sewer I/I & E Study (ASI, 1990c) are described as follows. The five monitoring sites, selected jointly by EG&G and ASI personnel, are given in

Table 1 and are located on Figure 1. The flow-monitoring efforts proposed for the five selected storm-discharge sites are located at points conducive for inclusion in the water-quality characterization objectives of the Storm-Sewer I/I & E Study and of the Non-Point Source Assessment. Water quantity as well as water quality are being monitored by these studies in order to assess the infiltration to the storm-sewer system as well as the quality of water associated with both storm runoff and infiltration.

To allow for collection of flow data at these sites, pressure transducers were placed in the channels, or in primary flow-measuring devices, and linked through cables to data loggers which were placed nearby in locked storage boxes located above the channel at each site (Figure 3). This flow-measurement equipment also is used to activate automatic water-sampling equipment at preset water levels recorded by each data logger, which reflected our best estimates of the stormflow stages to sample (Table B-11). Stage values have been recorded continuously at 10-minute, 15-minute, or 20-minute intervals throughout the course of this study (Table B-11). Configurations and inventory of flow-measurement equipment are summarized in Table 2.

Existing hydraulic structures (weirs, culverts, or diversion boxes) are used as channel control and primary flow-measuring devices wherever possible. At site SW022, the existing concrete diversion box inlet serves as a "free overfall" (a special case of the hydraulic drop) with limits imposed by two pipe culverts that exit the diversion box. At site SW023, an existing 45-degree V-notch weir, a broad-crested weir, and the two 30-in diameter reinforced concrete pipes (RCP's) serve as the channel control and primary flow-measuring devices. At both sites SW022 and SW023, the pipes downstream from the monitoring location are controlled by hand-operated gates. The operation of these gates is controlled by unknown personnel at the RFP, most likely security personnel. The gates do not appear to be operated based upon anticipated flow events, but rather the upon risk of spills or possibility of access to secure areas through the culverts. The opening of the gates is measured during routine maintenance checks of each site. It is possible, however, for the gates to change position between intermittent site visits which would impact the accuracy of the rating curves assumed to apply at these sites.

Table 1
Description of Monitoring Sites

Location Designation[1)]	Description	Approximate Drainage Area (ac)
SW022	Concrete Diversion Box at East Patrol Road	75
SW023	South Walnut Creek at Sewage Treatment Plant	89
SW027	South Interceptor Canal at Woman Creek	±205
SW093	North Walnut Creek downstream from 72-in CMP	245
SW118[2)]	North Walnut Creek upstream from 72-in CMP at Drop Structure	51

1) See Figure 1 for monitoring-site locations.
2) Previously referred to as site SW999 (ASI, 1990c; 1990d; 1990e).

Table 2
Inventory of Flow-Measurement and Automatic-Sampling Instrumentation

Item[1]	Serial No.	Remarks	Began Operations[2]
Site SW022			
Pressure-Transducer	20134	PXD260, 10-psi	7/26
Hermit Data Logger	1KB-923-32		7/26
ISCO Sampler	07228-019		7/20,(9/05)
Site SW023			
Pressure-Transducer	20089	PXD260, 10-psi	7/26
Hermit Data Logger	1KB-922-32		7/26
ISCO Sampler	07063-049		7/20,7/26
Site SW027			
Pressure-Transducer	6709	50-psi	6/27
Hermit Data Logger	1KB-921-32		6/27
ISCO Sampler	07063-054		7/20,7/20
Site SW093			
Pressure-Transducer	20088	PXD260, 10-psi	7/26
Hermit Data Logger	1KB-924-32		7/26
Parshall Flume	--	36-in	(7/24)
ISCO Sampler	07063-081		7/20,(7/26)
Site SW118			
Pressure-Transducer[3]	259259	50-psi	6/27
Hermit Data Logger	1KB-1006-32		6/27
ISCO Sampler	07228-055		7/20,(7/20)

1) See Figure 1 for monitoring-site locations. Status of September 30, 1991.
2) Dates signify fully-operational startup, except for ISCO samplers, where the 7/20 date indicates manual setting for storms during 7/20-21, and the second date (estimated) indicates the time of linkage with stage-recording equipment (Hermit data logger/ pressure transducer). All start-up dates indicated are for the year 1990 (as documented in ASI (1990m), see also Table B-11).
3) Equipment on loan from EG&G-EM (formerly ER/EMAD).

At site SW027, the two existing 66-in diameter corrugated metal pipes (CMPs) are used as the channel control and primary flow-measuring devices. Because no artificial channel control or primary flow-measuring device was available at site SW093, a 36-in throat Parshall flume was installed as the primary flow-measuring device (Figure 3A). At site SW118, the channel control and primary flow-measuring device is a concrete drop-structure which serves as a "free overfall." Theoretical stage-discharge rating curves for these five site locations are given in Appendix B (Figures B-1 through B-5) along with rating tables for each site (Tables B-6 through B-10). Each rating table provides the relationship of the staff-gage stage to the flow at a given site. Each rating curve provides a graphical depiction of the paired values in the associated rating table.

At all sites, the existing flow-measuring device (hydraulic structure or flume) has a limited capacity and may be overtopped or bypassed during extremely high flows. The existing primary flow-measuring device at each of the five sites was surveyed and measured in the field in order to develop the theoretical stage-flow rating curves given in Appendix B (Figures B-1 through B-5 and Tables B-6 through B-10). These rating curves can be extended above the normal capacity of the device so that extreme events may be measured or estimated even if the structure is overtopped. The theoretical rating curves usually are confirmed in the field using direct measurements of discharge from current-meter measurements of flow velocity and cross-sectional area of flow. Our site-reconnaissance surveys of the five monitoring locations conducted during the spring and summer of 1990 indicated that relatively small, or no, flows at the five sites occurred at most times under non-rainfall conditions (exceptions to this involving observed high flows not associated with precipitation are discussed below). Therefore, only a limited number of direct-flow measurements (using a current meter) were collected to verify the theoretical flow-rating curves. If a site was visited when the channel was flowing, an attempt was made to make current-meter measurements. To date, however, no current-meter measurements have been made at any of the five sites to check the accuracy of the theoretical stage-flow rating curves.

Rainfall and other hydrologic data, such as ground-water elevations, also were collected to support this study. Rainfall data from the EG&G-operated meteorological station in the West

Rainfall and other hydrologic data, such as ground-water elevations, also were collected to support this study. Rainfall data from the EG&G-operated meteorological station in the West Buffer Zone were available for concurrent time periods with the measured flows in the storm-sewer system. The relationship of rainfall data to the measured storm runoff at the five monitoring sites should give an indication of whether and when significant non-rainfall water may be entering the storm-sewer system. The relationship of ground-water elevation data to the depth of the storm-sewer system would yield an indication of whether the water in the perennial flow sections of the storm sewer is from ground water or another source such as a leaking water line. Ground-water elevations in eight alluvial wells (Figure 1) were monitored weekly during the period between late May 1990 and the end of April 1991 (ASI, 1991f). These alluvial wells include 3586, 4486, PZ 0789, PZ 2389, PZ 4289, PZ 4589, PZ 5589, and PZ 6189. A summary of the weekly ground-water elevations in these wells, along with selected field water-quality data from the wells, is given later in Table 9. Because the "as-built" drawings of the storm-sewer system do not always indicate the invert elevations of the pipes, it is often difficult to conclude if the storm-sewer pipe inverts themselves are below the water table, or if the perennial flows are due to building footing drains which are known to be at or below the ground-water table in various parts of the RFP. A detailed analysis of the ground-water elevations from the eight wells monitored monthly for this study is presented in the Sanitary Sewer Infiltration/Inflow and Exfiltration Study (Task 1) (ASI, 1990k; 1991f). Data for the same alluvial wells were used for the Task 1 study as well as for these studies.

2.3.2 Non-Point Source Assessment

This study component of the combined Storm-Sewer I/I & E Study and Non-Point Source Assessment includes field investigations collecting water-quality data for storm-runoff/high-flow events and data analyses for evaluating contributions from non-point (diffuse) sources in and around the RFP area (ASI, 1990d). The overall study objective is to attempt to delineate which areas, if any, of the RFP Controlled Area may exhibit ambient water-quality conditions from flows which are impacted significantly by development within the Controlled Area. The original goal of the Non-Point Source Assessment (Task 2) (ASI, 1990b) was to identify individual drainage basins within the RFP Controlled Area which contribute the largest loads of contaminants to the existing stream systems, based upon such factors as storm size and areal land use. The Non-Point Source Assessment would identify and assess those areas which may or may not require runoff collection and treatment systems. Of particular importance, at the RFP, are contaminants which may be adsorbed onto sediment particles and transported as suspended or bed material during a storm runoff event. Special sampling methods, as discussed below, would be used to obtain a suspended-sediment sample.

To meet the goals and objectives of the Non-Point Source Assessment, the same five monitoring site locations as those for the Storm-Sewer I/I & E Study were used. The reason for using this same monitoring network for the initial non-point source data collection was to reduce duplication of effort in characterizing the runoff from the RFP Controlled Area. Future expansion of the non-point source monitoring network into the Buffer Zone, or even off-site, may include different monitoring sites. The monitoring sites were selected jointly by EG&G and ASI personnel after review of existing data or literature related to storm runoff from the RFP Controlled Area. As shown on Figure 1, the five monitoring sites measure runoff from about 580 acres of the 610 acres (or about 95 percent) of the developed part of the Controlled Area and part of the East Buffer Zone.

The field aspects of the Non-Point Source Assessment component were comprised of installation and operation of automatic-samplers, triggered by a data-logger at a pre-specified water depth, at each of the five monitoring sites (Figure 1). A typical installation is presented on Figure 3. The samples collected in these samplers are hand-composited, based upon the actual flow during the storm, for chemical analyses; these hand-composited samples are not filtered, and hence the analytical results represent total (dissolved plus suspended) concentrations for the various water-quality constituents of interest.

In addition, supplemental field monitoring has been implemented or proposed, using bulk-precipitation (wetfall/dryfall) samplers, an evaporation pan, and suspended-sediment (MISSISSIPPI) samplers (ASI, 1990d, as amended). Schematics of these supplemental monitoring components are shown on Figures 4, 5 and 6, respectively. As required by EG&G and DOE, environmental checklists (ECs) were prepared for the proposed installation of these components. Authorization to proceed with installations of the bulk-precipitation and evaporation-pan equipment was received on September 27, 1990, and these installations have been made. However, authorization to proceed with the MISSISSIPPI installations has never been received.

The purpose of the bulk-precipitation samplers (Figure 4) is to sample both wetfall and dryfall. Dryfall consists of suspended particulates carried by the wind. These particulates are deposited in the funnel of the bulk-precipitation sampler and then are "washed" into the sampler by wetfall (precipitation). Because some contaminants are adsorbed onto particulates, the bulk-precipitation sampler should give an indication of wind-blow transport of contaminants settling out of the air column at a specific point. The data collected by the bulk-precipitation samplers should give an indication of the transport of contaminants downwind at the RFP. These bulk-precipitation samplers are located at the existing EG&G meteorological station in the West Buffer Zone (usually upwind of the RFP Controlled Area) and at sites SW022, SW027 and SW118 (all generally downwind of the RFP Controlled Area) (Figure 1).

The evaporation pan (Figure 5) is located at the existing EG&G-operated meteorological station. The purpose of the evaporation pan is to collect site-specific evaporation data for other zero-discharge study tasks. The site-specific evaporation data were used in the Surface-Water Evaporation Study (Task 15) and also in other tasks, such as Confirmation of Rainfall/Runoff Relationships (Task 5), Solar Pond Interceptor Trench System Ground-Water Management Study (Task 7), Present Landfill Area Ground-Water/Surface-Water Collection Study (Task 8), Treated-Sewage/Process-Wastewater Recycle Study (Task 13), Temporary Water Storage Capabilities Study (Task 21), and Consolidation and Zero-Discharge Plan (Task 30) (ASI, 1990b; 1991e).

The purpose of the proposed MISSISSIPPI devices (Figure 6) would be to collect a suspended-sediment sample during a storm event. The automatic samplers are not designed to collect a representative sample of the sediments suspended in storm runoff. The importance of collecting a representative sample of suspended sediment during a storm has to do with the fact that certain contaminants, such as trace metals, radionuclides, and pesticides, typically are found adsorbed to suspended-sediment particles. The transport of contaminants offsite in suspended sediment may account for a large percentage of the mass loadings of certain contaminants. The MISSISSIPPI devices are proposed to be installed at each of the five non-point source monitoring sites. To date, the DOE has not approved the installation of the MISSISSIPPI samplers. When these devices are installed and available to collect samples, the physical and chemical analyses of the suspended-sediment samples will enable the assessment of the percentage of dissolved-versus-suspended contaminant transport from selected land uses within the RFP Controlled Area. Also, the resultant data will indicate the potential for transport of contaminants offsite during storm events.

2.4 FIELD INVESTIGATIONS - AN OVERVIEW

Procedures to be followed during installation of field-monitoring equipment, as well as operation and maintenance of such equipment, and servicing following storm events is covered in a site-specific health-and-safety plan (ASI, 1990e). The operation of the five-site monitoring system is designed to collect both continuous discharge and storm-related runoff and water-quality data which are representative of a given storm. The concept of "event mean concentration" during a storm is used to collect and composite the water-quality samples during a storm-runoff event.

Storm-event sampling is done by connecting the HERMIT data logger to the ISCO automatic water sampler. The "alarm" feature of the HERMIT is used to actuate the automatic sampler. The flow at actuation is pre-determined, based upon engineering judgement and is that stage above which the automatic sampler will take samples. Flows less than the pre-set actuation stage will not set off the automatic sampler, and no samples are collected during these low flows. The data logger continues to record continuous stage (converted to flow rate by the rating curve) even though the sampler is not operating. Originally, two of the five monitoring sites (SW093 and SW118) had actuation flows set at event stages assumed to be in the range of 4 to 7 cubic feet per second (cfs); event stages at the other three sites were set between about 0.8 and 1.8 cfs (Table B-11). Later during the monitoring period, actuation flows at some sites were shifted downward to stages judged to be associated with flows generally less than or equal to about 1 cfs (Table B-11). These flow-sampling thresholds were set relatively low for this study and generally all storms should trigger collection of discrete samples by the automatic samplers. As time-duration and associated water-quality data become available on the smaller storms, the actuation flow on occassion were increased so that only the larger events were sampled (Table B-11).

After actuation, the automatic samplers begin sampling at pre-determined time intervals between samples (initially set at one hour during the July 20-24 period and at 15 minutes starting July 26, 1990). These sampling intervals were adjusted in accordance with anticipated sampling needs (Table B-11). These frequency-sampling rates provided for sample collection over the expected duration of storm hydrographs for a given time of year while improving the chances of obtaining sample close to their associated peak discharges. Examples of typical sampling intervals over storm hydrographs produced over the 15-month period are shown in Figures 7 and 8. The automatic samplers, once actuated, sample up to 24 times at the pre-specified time interval whenever the flow rate is at, or above, the set actuation level for a given time at each site (Table B-11). Stage data records then are collected from the data loggers at intervals not exceeding every two weeks or immediately following a storm.

Following the occurrence of storm events, stage data and water samples are collected from the HERMIT data logger and ISCO water-quality sampler. The stage data for a given site are converted to instantaneous discharges (set at 10-minute, 15-minute, or 20-minute intervals) using the appropriate rating table as given in Appendix B. These instantaneous discharges then are used to calculate the volume of sample from each sample bottle which then is used to give a flow-composited sample representative of the event mean concentration (Table A-4). Finally, each composite sample is transferred, under chain-of-custody, to Woodward-Clyde (WC) personnel for shipment to the designated EG&G contract laboratory for chemical analyses.

Due to limited sample volumes obtained from these field investigations, emphasis has been placed on analyzing for indicator variables (ASI, 1990d, as amended) (see Appendix A): gross alpha, gross beta, and tritium (Table A-1); several trace metals (Table A-2); and major ions and selected nutrients (when sample holding-time limits can be met (Table A-3). Sample volumes generally associated with the non-point source assessment program generally have been too small for analyses of specific radionuclides, and the field procedures for sample collection, handling, and processing are not conducive for analyses of volatile organic compounds (VOCs) of possible general interest. However, for future storm events for more detailed chemical characterization, an attempt will be made to obtain manual grab samples, if possible, resulting in large enough sample volumes to analyze for an expanded list of water-quality constituents. The general prioritization protocol for sample analyses for this program has been as follows: (a) less than 100 mL of sample volume - tritium; (b) less than 500 mL of sample volume - tritium plus trace metals; (c) less than 1 L of sample volume - tritium, trace metals and gross alpha/beta; and (d) greater than 1 L of sample volume (1,250 mL) - (a), (b), and (c) plus major ions, dissolved solids, and total suspended solids. An inventory of project-related samples is given in Table 9; other non-project related samples for which data were available are tabulated in Table A-5. Selective resultant data from RFEDS retrievals available to date are given in Appendix A (Tables A-1 through A-3); detailed data are available from EG&G personnel upon formal request (Annette Primrose, EG&G, written commun., April 9 and September 18, 1991).

Over the 15-month period of operation of this supplemental monitoring program, 76 stream samples and 51 bulk-precipitation samples have been collected for 43 storm-runoff/high-flow events that occurred during the period (Figures 7 and 8 and Appendix B). Selective water-quality data obtained to date as a result of this program are given in Appendix A (Tables A-1, A-2, and A-3) and, when possible, are compared with other data collected at a given site (Table A-5).

2.5 TECHNICAL-SUPPORT SERVICES

Assistance was given to EG&G staff in an evaluation of a regional (offsite) surface-water monitoring program for indicator chemical constituents. Also, technical inputs and relevant report sections were provided by ASI professionals to EG&G for its Surface-Water Management Plan (EG&G, 1991e). About October 1991, this data-collection program is to be transformed into field investigations and related reports addressing information requirements for EPA's stormwater NPDES regulatory program.

3.0 RESULTS

3.1 EVALUATION OF PREVIOUS DATA AND STUDIES

3.1.1 Storm-Sewer System

Documentation of historical quantitative flow and water-quality conditions within the RFP storm-sewer system is essentially non-existent. To provide a preliminary assessment of the water quantity and quality conditions in the storm-sewer system, the following documents were reviewed:

(1) a site drainage computer model (Lee Wan and Associates, 1987);

(2) RFP utility drawings showing the locations of storm sewers;

(3) Storage Pad 750 Interim Status Closure Plan containing water-quality data on "perennial" flow in that part of the storm sewer discharging to South Walnut Creek (Rockwell International, 1989e); and

(4) Storage Pad 904 Interim Status Closure Plan containing water-quality data on storm runoff to the storm-sewer system (Rockwell International, 1989d).

Discussion of these data historical data/information sources are discussed in the following paragraphs.

As described above and shown on Figure 1 and summarized in Appendix Table G-1, the storm-sewer system within the RFP Controlled Area consists of over 33,000 lineal ft of pipe ranging in size from about 3 inches in diameter to 6 ft in diameter. It is estimated that open channels, as part of the storm-sewer system, may include an additional 33,000 lineal ft. Existing information and data indicate that no discharge measurements have historically been made within the storm sewer system. EG&G employees have observed that there is constant flow at several locations within the storm sewer system. At monitoring site SW093 (North Walnut Creek downstream from the existing 72-inch diameter culvert), flow has been observed to occur throughout the year. At site SW023 (South Walnut Creek at the Sewage Treatment Plant), flow also has been observed to occur year round. The existing 45° V-notch weir at SW023 is evidence that flow rates were of historical interest at this location. However, to date, no historical flow data records have been found for site SW023.

Upstream from site SW023 on South Walnut Creek and west of Building 991 (Figure 1), two storm sewer culverts discharge to a relatively undeveloped area of the RFP downstream from the Pad 750 (located at the northwest corner of Sage Avenue and Tenth Street) and upstream from monitoring site SW122 (EG&G Rocky Flats, Inc., 1990b). The culvert discharging from beneath the Pad 750 flows continuously east as South Walnut Creek (Rockwell International, 1989e). Water-quality grab samples have been collected weekly from the culvert discharge since October 15, 1986. These grab samples are analyzed for gross-alpha, gross-beta, nitrate-nitrogen and dissolved solids concentrations.

Water-quality data related to samples collected at the Pad 750 culvert, which discharges to South Walnut Creek, are plotted with respect to time for gross-alpha, gross-beta, and nitrate concentrations on Figure 9. Analysis of the historical data at the Pad 750 culvert shows considerable variation with no specific trends observable. In the Pad 750 Interim Status Closure Plan (Rockwell International, 1989e), the water-quality data at the Pad 750 culvert were correlated with precipitation at the RFP. No strong correlation was found. Also, saltcrete spills at the Pad 750 were observed on 11/1/88, 4/8/89, 5/22-6/25/89, 6/26-7/17/89, and 7/17-8/20/89 (Rockwell International, 1989e). No observable changes in the concentrations of the culvert discharge water related to these saltcrete spills on the Pad 750 were noted. It is, therefore, believed that the culvert water is not significantly impacted by the waste-storage activities at the Pad 750 (Rockwell International, 1989e). The maximum contaminant levels identified in samples of the Pad 750 culvert water for the period October 15, 1986 through August 31, 1989 (Figure 9), were 164 $\pm$ 9 pCi/L for gross-alpha activity, 63 $\pm$ 2 pCi/L for gross-beta activity and 4.5 mg/L for nitrate-nitrogen. As shown on Figure 9, the concentration of gross alpha was often above the EPA recommended drinking-water standard of 15 pCi/L. The gross-alpha numeric stream standard for South Walnut Creek is 11 pCi/L. Therefore, the frequency of stream-standard exceedances for gross alpha at the Pad 750 culvert would be higher for the numeric stream standard than for the drinking-water standard. The Pad 750 Interim Status Closure Plan indicated that about 47 percent of the samples collected at the Pad 750 culvert had concentrations equal to or greater than the drinking-water standard. Based upon the probability curve for gross-alpha samples from the Pad 750 culvert, about 58 percent of the samples would cause an exceedance of the 11 pCi/L stream-standard concentration. Similar analyses of the data for gross beta (drinking-water standard of 50 pCi/L and numeric stream standard of 19 pCi/L) shows that about 13 percent of the historical data would be equal to or greater than the drinking-water standard, and about 43 percent would be equal to or greater than the stream standard. Therefore, the gross-beta stream standard could be expected to be exceeded more frequently in South Walnut Creek. Nitrate-nitrogen values at the Pad 750 culvert were always below the drinking-water and stream standard (both 10 mg/L).

The exact source of the continuously-flowing water from the Pad 750 culvert is unknown at this time. The natural drainage basin for South Walnut Creek includes areas where monitoring wells indicate ground levels about 6 to 10 feet below the existing land surface. Because the headwaters of South Walnut Creek were filled to construct parts of the 100-, 400-, and 700-series buildings, water may be moving along preferential pathways in the area. Observations by EG&G personnel and their contractors, as well as the review of the utility drawing "as-builts", indicate that building footing drains discharge into the Pad 750 culvert (ASI, 1990b). Therefore, one possible source of the continuous flow from the Pad 750 culvert is building footing drains, some of which are pumped to the storm-sewer system discharging at the Pad 750 culvert.

The other continuously flowing monitoring location is site SW093, located at the outlet of the 72-inch diameter CMP culvert draining the PA (Figure 1). This site is located on North Walnut Creek. A monitoring site upstream from the inlet of this 72-inch CMP indicates that North Walnut Creek upstream is an ephemeral stream consistent with similar streams in the area.

Therefore, the source of continuous flow at site SW093 is judged to be derived from that part of the storm-sewer system within the PA. The quantity of flow measured during non-rainfall periods at SW093 is discussed in Section 3.2 below.

Site SW093 is located at the end of the longest of the storm-sewer subsystems at the RFP. This subsystem consists of about 1,625 ft of 72-in diameter CMP, about 300 ft of 60-in diameter CMP, about 700 ft of 48-in diameter CMP, and other miscellaneous smaller pipes coming from building drains of the 700-series buildings in the PA. As with the Pad 750 culvert, it is suspected that the continuous flows at site SW093 are the result of ground water being collected by drains and discharged to the storm-sewer system. No known historical water-quality data are available on the continuous flows at site SW093. Tables A-1 and A-2 (Appendix A) show historical water-quality data for eight samples collected at site SW093 during the period July 1988 through October 1989. The gross-alpha concentrations were greater than or equal to the drinking-water standard (15 pCi/L) in one of the eight samples, and greater than or equal to the stream standard (11 pCi/L) in three of the eight samples (Table A-1). Gross-beta activity was less than the drinking-water standard (50 pCi/l) for all eight samples but was greater than or equal to the stream standard (19 pCi/L) in two of the eight samples. Historical tritium concentrations in the eight samples were less than the stream standard (500 pCi/L) as well as the proposed drinking-water standard (20,000 pCi/L). Other water-quality constituents for the eight samples collected prior to this study showed concentrations generally less than or equal to both drinking-water and stream standards.

Runoff water-quality data are available at the Pad 904 for the period February 12 through June 6, 1989 (Rockwell International, 1989d). As indicated on Figure 1, runoff overtopping the existing berms at the Pad 904 would be intercepted by a ditch running along the east side of the Pad and then intercepted by a ditch running along the north side of the Pad. Once in the northern ditch, the water is collected in a 24-in diameter CMP culvert and routed under Central Avenue. As the water exists the culvert, it is routed east through a ditch running north of Central Avenue. Water in this ditch is then measured at monitoring site SW022. If both of the gates in the site SW022 diversion box are open, water may be discharged either to site SW023 or continue on to Pond B-4 for detention.

The water-quality data given in this study were obtained from the Pad 904 Interim Status Closure Plan (Rockwell International, 1989d). The water-quality data are from samples collected from ponded areas behind the asphalt berm around the Pad 904. Therefore, the water-quality data may not represent water which actually ran off the pad and entered the storm-sewer system. However, it is judged that the concentration data presented in the Pad 904 Interim Status Closure Plan provide one possible set of storm runoff water-quality data which could represent certain areas of the RFP Controlled Area. Gross-alpha, gross-beta and nitrate-nitrogen concentrations for grab samples of Pad 904 runoff for the period February 12, 1988, through June 6, 1989, are presented on Figure 10 (Rockwell International, 1989d). Interpretation of the analytical results of the grab samples shown on Figure 10 is difficult because of the uncertainties in the relationship between the quantity of runoff water and the concentration values of the sample. Runoff concentrations could be underestimated by dilution of the runoff from subsequent precipitation. Overestimation of runoff concentrations could occur, due to the runoff volume insufficient to overtop the berm followed by a time lag before sample collection allowing evaporation of a portion of the ponded water on the Pad 904. Pondcrete and Saltcrete spills occurred on the Pad 904 on 5/23/88, 7/22/88, 9/19/88, 6/26-7/1/89 and 7/17-8/20/89 (Rockwell International, 1989d). These spills may have impacted the concentration of runoff even though the spills were contained on the Pad, and water used in Pad decontamination was contained on the Pad until removed by pumping. Leakage of runoff under the asphalt berm has been routinely observed by RFP personnel. The Pad 904 currently has been covered with protective structures to keep precipitation from falling on the pondcrete and saltcrete stored at the site. On the basis of the information presented above, the interpretations given below are generalizations based upon uncertainty as to peak concentrations and average storm-related concentrations.

The maximum gross-alpha concentration (Figure 10) of runoff from the Pad 904 was about 53 pCi/L. The maximum gross-beta activity concentration was about 150 pCi/L, and the maximum nitrate-nitrogen concentration was about 178 mg/L. Isotope-specific analyses (Pu-238, Pu-239, Am-241, U-234, U-235, and U-238) also are available for two runoff samples: one collected prior to the July 22, 1988 spill (June 26, 1988), and one immediately after the July 22, 1988 spill (July 22, 1988). Isotope concentrations of runoff prior to the July 22 pondcrete spill indicated that plutonium 238+239 concentrations (0.52 $\pm$ 0.1 pCi/L) were greater than the stream standard (0.05 pCi/L) for Walnut Creek. Uranium 234+235 concentrations in runoff (1.7 $\pm$ 0.4 pCi/L) were less than the stream standard of 10 pCi/L for Walnut Creek. The americium 241 concentration in runoff of 0.83 $\pm$ 0.13 pCi/L was greater than the stream standard of 0.05 pCi/L for Walnut Creek (Rockwell International, 1989d).

Based upon probability plots for gross-alpha, gross-beta and nitrate-nitrogen concentrations of storm runoff from the Pad 904, about 41 percent of the runoff samples had concentrations equal to or greater than the drinking-water standard (15 pCi/L). About 50 percent of the samples had a gross-alpha concentration equal to or greater than the Walnut Creek stream standard (11 pCi/L). About 37 percent of the Pad 904 runoff samples had a gross-beta concentration equal to or greater than the drinking-water standard (50 pCi/L); whereas, about 87 percent of the samples had concentrations equal to or greater than the stream standard (19 pCi/L). About 48 percent of the runoff samples at the Pad 904 had a nitrate-nitrogen concentration equal to or greater than the drinking-water and stream standards (both 10 mg/L). These historic data indicate that storm runoff from selected parts of the RFP may have concentrations of radionuclides and other water-quality constituent concentrations which are greater than both State and Federal recommended standards.

3.1.2 Non-Point Source Runoff

In order to provide a broader assessment of historical non-point source water-quality conditions in and around the RFP, the following documents were reviewed:

(1) RFP annual monitoring reports (Rockwell International, 1988a; 1989b; EG&G Rocky Flats, Inc., 1990a; 1991f (draft), as well as preceding reports for the monitoring years 1971 through 1986);

(2) a USGS hydrologic study (Hurr, 1976);

(3) two recent compilations of water-yields and water-quality conditions for several tributaries draining parts of the RFP (ASI, 1990g; 1990j) and for inflows to Standley Lake and Great Western Reservoir (ASI, 1990f; 1990k);

(4) an ASI subcontractor report describing other non-RFP impacts upon the area's water quality (Moran, 1990; see Appendix E),

(5) several reports and publications dealing with stream-channel and impoundment bottom-sediment chemistry, and

Discussion of relevant aspects of each of these data/information sources is given in the following paragraphs.

Regarding the RFP annual monitoring results, our evaluation focused upon review and assessment of aspects of past regional monitoring programs. Of particular interest was the availability of long-term (approximately 20 years) monitoring data on average concentrations of selective radionuclides in selected reservoirs. These data were collected for impoundments potentially impacted by the RFP (Standley Lake and Great Western Reservoir) as well as for Ralston Reservoir and Lake Dillon, located some distance offsite. Available annual-mean data for plutonium (Pu), uranium (U), americium (Am), and tritium (H^3) for these four impoundments have been compiled in Tables 3 through 6, respectively. Noteworthy observations based upon these data include the following:

(1) Analytical methods and associated precision levels have varied considerably over time, making a statistically rigorous treatment of the data for assessment of long-term trends unrealistic.

(2) Based upon visual inspection of the annual time series, the following time trends were observed: (a) a trend of declining levels of tritium (H^3) in Great Western Reservoir since the mid-1970s (no pre-1980 annual averages were available for the

Table 3
Annual-Mean Concentrations of Selected Indicator Radionuclides -- Standley Lake

	Annual Mean Concentrations (pCi/L)			
Year	Pu	U(+Pu)[1]	Am	H^3
1971	0.16	3.44	0.06	--
1972	<0.34±40%	4.76±33%	<0.16±92%	--
1973	<0.04±69%	3.63±48%	--	--
1974	<0.02±98%	<1.09±132%	--	--
1975	<0.036±23%	2.746±29%	<0.027±119%	--
1976	<0.045±87%	1.849±38%	<0.051±78%	--
1977	<0.1	2.3	<0.1	--
1978A[2]	<0.1	5.2	<0.1	--
1978B[2]	<0.012	--	<0.013	--
1979	<0.007±52%	3.3±11%	<0.016±11%	--
1980	<0.01	<4	<0.03	<500
1981	0.002±0.002	2.6±0.1	0.004±0.004	<300
1982	0.000±0.002	2.3±0.1	0.008±0.004	200±100
1983	<0.002±0.002	1.7±0.1	<0.004±0.005	200±100
1984	0.005±0.002	1.6±0.1	0.002±0.006	200±100
1985	0.004±0.004	1.6±0.06	0.006±0.006	200±100
1986	0.002±0.001	1.8±0.1	<0.001±0.008	100±100
1987	0.004±0.006	1.7±0.1	0.002±0.002	100±60
1988	0.005±0.016	1.8±0.2	<0.007±0.01	10±130
1989	0.000±0.002	1.72±0.34	0.005±0.005	0±150
1990	0.004±0.008	0.90±0.38[3] 0.71±0.12[4]	0.002±0.003	20±10

1) Combined analyses for 1971 through 1974.
2) A equals first half of year; B equals second half of year.
3) Radiochemically determined as Uranium-233 and -234.
4) Radiochemically determined as Uranium-238.

Notes: ± means plus or minus
< means less-than indicated value
-- means no data available

Source: Data through 1989 are included in EG&G (1990a) and preceding annual monitoring reports (reported in units of 10^{-9} uCi/mL). The 1990 data are provisional and are included in the 1990 draft report (EG&G, 1991h).

Table 4
Annual-Mean Concentrations of Selected Indicator Radionuclides -- Great Western Reservoir

	Annual Mean Concentrations (pCi/L)			
Year	Pu	U(+Pu)[1]	Am	H^3
1971	0.24	3.05	0.32	--
1972	<0.67±88%	4.29±23%	<0.38±59%	--
1973	<0.08±59%	3.00±49%	--	8221±9%
1974	<0.002±55%	<0.55±105%	--	--
1975	<0.099±58%	1.983±25%	<0.033±20%	2300±14%
1976	<0.061±38%	0.877±50%	<0.025±32%	953±14%
1977	<0.1	1.9	<0.1	--
1978A[2]	<0.1	3.2	<0.1	--
1978B[2]	<0.012	--	<0.013	--
1979	<0.009±59%	2.7±17%	<0.017±65%	--
1980	<0.02	<3	<0.03	<500
1981	0.011±0.004	3.1±0.1	0.000±0.003	<300
1982	0.002±0.005	2.9±0.1	0.007±0.003	200±100
1983	0.005±0.004	2.2±0.1	0.003±0.005	100±100
1984	0.005±0.003	2.3±0.1	0.002±0.003	100±100
1985	0.009±0.002	2.35±0.0	0.012±0.004	100±100
1986	0.008±0.002	2.1±0.1	0.006±0.008	100±100
1987	0.007±0.01	2.5±0.1	0.002±0.003	100±60
1988	0.004±0.003	2.05±0.22	0.003±0.008	<30±120
1989	0.006±0.010	1.37±0.23	0.005±0.005	10±30
1990	0.004±0.004	0.56±0.12[3] 0.55±0.10[4]	<0.001±0.001	20±20

1) Combined for 1971 through 1974.
2) A equals first half of year; B equals second half of year.
3) Radiochemically determined as Uranium-233 and -234.
4) Radiochemically determined as Uranium-238.

Notes: ± means plus or minus
< means less-than indicated value
-- means no data available

Source: Data through 1989 are included in EG&G (1990a) and preceding annual monitoring reports (reported in units of 10^{-9} uCi/mL). The 1990 data are provisional and are included in the 1989 draft report (EG&G, 1991h).

Table 5
Annual-Mean Concentrations of Selected Indicator Radionuclides -- Ralston Reservoir

Year	Pu	U(+Pu)[1]	Am	H^3
		Annual Mean Concentrations (pCi/L)		
1971	0.04	15.62	--	--
1972	<0.44±71%	7.43±36%	--	--
1973	--	--	--	--
1974	--	--	--	--
1975	--	--	--	--
1976	--	--	--	--
1977	--	--	--	--
1978	--	--	--	--
1979	<0.004	11.9	<0.010	--
1980	<0.004	11.4±0.3	<0.03	<500
1981	<0.001±0.004	33.±1	<0.004±0.007	<500
1982	0.003±0.006	22.±1	<0.01±0.01	500±400
1983	0.004±0.005	2.1±0.2	<0.003±0.006	400±600
1984	<0.003±0.004	1.4±0.2	<0.008±0.005	200±800
1985	0.01±0.02	2.0±0.2	0.04±0.06	<300±600
1986	0.01±0.02	1.4±0.2	<0.02±0.06	0±400
1987	<0.001±0.03	1.7±0.1	0.01±0.02	200±400
1988	0.026±0.033	0.9±0.1	0.002±0.025	--
1989	0.002±0.030	2.75±0.16	0.023±0.032	40±150
1990	0.011±0.037	0.65±0.30[2] 0.53±0.16[3]	<0.014±0.039	190±120

1) Combined analyses for 1971 and 1972.
2) Radiochemically determined as Uranium-233 and -234.
3) Radiochemically determined as Uranium-238.

Notes: ± means plus or minus
< means less-than indicated value
-- means no data available

Source: Data through 1989 are included in EG&G (1990a) and preceding annual monitoring reports (reported in units of 10^{-9} uCi/mL). The 1990 data are provisional and are included in the 1990 draft report (EG&G, 1991h).

Table 6
Annual-Mean Concentrations of Selected Indicator Radionuclides -- Dillon Reservoir

Year	Annual Mean Concentrations (pCi/L) Pu	U	Am	H^3
1971	--	--	--	--
1972	--	--	--	--
1973	--	--	--	--
1974	--	--	--	--
1975	--	--	--	--
1976	--	--	--	--
1977	--	--	--	--
1978	--	--	--	--
1979	<0.004	1.4	<0.010	--
1980	<0.006	<0.9	<0.03	<500
1981	<0.002±0.004	0.6±0.1	0.00±0.01	600±500
1982	0.000±0.007	0.9±0.1	0.00±0.01	400±500
1983	0.012±0.006	2.0±0.1	<0.006±0.007	300±800
1984	0.00±0.02	0.9±0.2	<0.001±0.004	200±400
1985	0.04±0.02	1.8±0.2	0.05±0.06	<200±600
1986	0.02±0.03	0.9±0.2	<0.01±0.07	0±400
1987	<0.01±0.02	1.0±0.1	0.00±0.02	700±400
1988	<0.005±0.028	0.5±0.1	<0.005±0.026	227±521
1989	<0.007±0.029	0.65±0.09	<0.012±0.029	0±290
1990	<0.002±0.033	0.41±0.34[1)] 0.31±0.17[2)]	0.031±0.049	<10±110

1) Radiochemically determined as Uranium-233 and -234.
2) Radiochemically determined as Uranium-238.

Notes:
± means plus or minus
< means less-than indicated value
-- means no data available

Source: Data through 1989 are included in EG&G (1990a) and preceding annual monitoring reports (reported in units of 10^{-9} uCi/mL). The 1990 data are provisional and are included in the 1990 draft report (EG&G, 1991h).

other three sites) (Otto, 1985); and (b) an order-of-magnitude decrease in uranium (U) concentrations in the offsite Ralston Reservoir between 1982 and 1983 (Setlock, 1983).

(3) Detectible amounts of plutonium are being reported in annual water samples from both Ralston Reservoir and Dillon Reservoir. At present, no explanation can readily be given for the possible sources or cause for detection of this radionuclide at these locations. However, atmospheric fallout from past nuclear testing generally is more prevalent over mountainous regions, or areas of relatively greater precipitation.

It should be kept in mind that all these noted data are for the water column of these reservoirs. At least the more recently reported data results are for unfiltered samples. As suggested by Moran (1990) (see Appendix E) as well as earlier by other studies (see, for example, Steele and Coughlin, 1982; Steele and Doerfer, 1983), samples for bottom-sediment chemistry may provide considerable supplemental information regarding water-quality characterization.

A hydrologic study was conducted at the RFP site during the mid-1970s (Hurr, 1976). The streamflow data generated as a result of this study were incorporated into the analyses of watershed water yields (Task 4 - Water-Yield and Water-Quality Study of Walnut Creek and Woman Creek Watersheds, ASI, 1990g; 1990j). The Task 4 subordinate study also characterized water-quality conditions in the Walnut Creek and Woman Creek watersheds (ASI, 1990g; 1990j), and available historical as well as recent data were collected and evaluated at sampling locations upgradient as well as downgradient from the RFP site. At a natural-seep monitoring site (SW104) located in the upper part of the Woman Creek basin, occasional elevated concentrations of radionuclides as well as selected trace metals have been noted (ASI, 1990j, Appendix Table E-1). Similar data were compiled and evaluated in Task 16 - Water-Yield and Water-Quality of Other Sources Tributary to Standley Lake and Great Western Reservoir (ASI, 1990f; 1990k) for inflow quantity and quality contributions to Standley Lake and Great Western Reservoir.

Moran's (1990) analysis (Appendix E), performed as part of the Non-Point Source Assessment, suggests that surface and ground waters and associated sediments in general proximity to the RFP have been affected by both natural and non-RFP-related impacts (for example, mining and other economic activities), and such considerations should be included in characterizing the regional water quality of the area. Specific sources and activities affecting water quality are cited in Moran's (1990) report as well as in Rockwell International (1989c) and EG&G (1990c; 1991b; 1991c; 1991e). Also discussed are possible sources contributing ambient radioactivity besides RFP activities.

A number of sediment-chemistry surveys have been conducted for direct assessment of RFP-affected conditions or for offsite comparisons of these conditions. More definitive conclusions are planned for inclusion in the final study report. Frequently, sampling and analytical methods have differed; however, a general depiction of the presence of certain radionuclides in bottom sediments has been obtained. An initial assessment of the radionuclide indicator variable Pu-239 in soils samples was reported by Poet and Martell (1972). Another field investigation was conducted by the U.S. Environmental Protection Agency (EPA, 1975); certain documented results for Great Western Reservoir and Standley Lake were compared with composite sediment samples for Ralston Reservoir, Cherry Creek Reservoir, and Marston Lake. Paine (1974) analyzed for Pu-239 in several surface-sediment cores in the B-series ponds as well as Pond C-1; these then were compared to values obtained for Walnut Creek near the RFP eastern boundary along Indiana Avenue. Setlock (1983) outlined a more detailed sediment sampling program for Great Western Reservoir and Standley Lake; the resultant data were reported in memoranda prepared by the City of Broomfield (1984, 1985). Sampling investigations reported by Thomas and Robertson (1981) covered both waters and sediments near the RFP. Offsite sediment surveys for comparison of the above investigations were conducted on Halligan Reservoir and Wellington Reservoir to the north and south, respectively, of the RFP area (Cohen and others, 1990).

3.2 DISCUSSION OF RECENTLY-COLLECTED DATA

3.2.1 Storm-Sewer I/I & E

A modified analysis of infiltration/inflow and exfiltration (I/I & E) was performed on the storm-sewer system at the RFP. Because the storm-sewer system is designed to have inflow, estimates of theoretical inflow compared to actual inflow were not made. Additionally, because upstream flows are generally not measured in the storm-sewer system, exfiltration was not estimated. Infiltration in the storm-sewer system was estimated by the following procedure similar to that for a sanitary-sewer system (EPA, 1975):

(1) The average daily storm-sewer flows for the period of record were calculated and plotted versus time.

(2) On the plot from (a) above, the total area above zero flow on non-rainfall days was measured. This area represents **total** infiltration.

(3) The curves for measured storm sewer flow, ground water elevations and rainfall were compared to assess their inter-relationships.

As indicated above, only two (SW023 and SW093) of the five monitoring sites have exhibited continuous flows during the monitoring period documented herein. However, the daily measured flows and measured rainfall at all five sites were plotted to demonstrate that measured flows at the remaining three sites (SW022, SW027 and SW118) were in response to rainfall for the period of record (approximately June or July through September 1990, depending upon the monitoring site). These daily hydrographs of measured discharge, ground water elevations, and rainfall for the five sites are shown on Figures 11 through 15. Analysis of these figures indicates that only SW023 and SW093 have measured discharge on non-rainfall days.

A preliminary analysis of the runoff and water-quality data collected to date indicates several patterns of interest. The runoff at sites SW022, SW027 and SW118 showed intermittent characteristics, that is, the flows decreased to zero after a rainstorm. On the other hand, the runoff at sites SW023 and SW093 exhibited perennial (continuous-flow) characteristics; that is, the flows decreased after a rainstorm but did not cease entirely. This indicates that either ground water or some other discharge from the RFP (such as leaks in water lines or sanitary sewer lines) may be the primary source causing continuous flows at these two sites. Figures 12 and 14 for sites SW023 and SW093, respectively, indicate that flow continues at some low level even after many days of no rainfall. Comparison of daily precipitation data (Appendix C) with measured daily discharge data (Appendix B, Tables B-2 and B-4) indicate this occurrence of non-rainfall flows at sites SW023 and SW093.

Infiltration to the storm-sewer system at site SW023 was estimated using the three-step procedure above. The non-rainfall days used included the second day after the daily precipitation data in Appendix C indicated no precipitation up to the next rainfall day. For site SW023, this included about 200 days during the period July 26, 1990 through August 31, 1991 (402 total days with many missing days of data). The longest non-rainfall period within the period of record was 31 days from December 19, 1990 through January 18, 1991 (Appendix C).

The total measured discharge at site SW023 for the 200 no-rainfall days was about 40.1 acre-feet (ac-ft) or about 13.1 million gallons (MG). On an annualized basis, this flow volume would be about 7.4 MG, or an average of about 0.020 million gallons per day (MGD).

Infiltration to the storm sewer system at site SW093 was estimated for the same 200 non-rainfall days as for site SW023. For site SW093 the total measured discharge for these 200 days was about 101 ac-ft or about 33.1 MG. On an annualized basis, this flow volume would be about 18.8 MG or an average of about 0.052 MGD.

Based upon non-precipation flows at these two sites, these estimates of infiltration to the storm-sewer system are based upon about a one-year intermittent period of record. The total estimated quantity of infiltration at monitoring sites SW023 and SW093 is about 0.072 MGD or 26.2 MG annually. This amount of water is judged not significant. The cost of identifying the location of the sources of this infiltration would probably be much more than the cost of treating this water and reusing it at the RFP. However, it is recommended that the monitoring of streamflows at the five sites continue so that additional seasonal variability of the flows can be assessed. The high ground-water elevations in late spring at the RFP show increases in discharge on non-rainfall days, indicating that some of the infiltration is truly derived from ground water rather than leaky water or storm-sewer lines.

3.2.2 Non-Point Source Assessment

Daily-mean flow data collected since late June (at sites SW027 and SW118) or late July 1990 (at sites SW022, SW023 and SW093) through mid-September 1991 are tabulated by monitoring site in Appendix B. Selected storm-event hydrographs are given in Figure 7 for this approximately 15-month period of the non-point-source monitoring program. Figure 8 gives selected recorded non-precipation hydrographs for sites SW023 and SW093. Also shown on Figures 7 and 8 are many of the occurrences where composite samples were collected at the sites indicated for the sampled storm-runoff (Figure 7) or high-flow (Figure 8) events, as given in Tables 7 and 8. Through instrument and field-technician errors and because of increased security measures at the RFP during the Gulf War, some increments of flow data were lost or not obtained from the data loggers in the field during the 15-month monitoring period (Appendix B, Table B-12).

Not all sites were affected by runoff for a given storm rainfall or high-flow event. Also, due to the delay in obtaining and installing equipment, a few early-July 1990 storms were not sampled. Other storm events were not sampled due to field-equipment malfunctions. For the initial planning purposes (ASI, 1990d), it was anticipated that samples for up to five storm-runoff events would be collected during the period from July through September 1990. In fact, each of nine storm-runoff/high-flow events occuring during that period has resulted in collection of one or more samples, as indicated above, for a total of 11 composite, one single, and two grab samples (ASI, 1990m). A suspected manufacturing error in the sampler at site SW027 has prevented that

Table 7
EVENT-GENERATED WATER-QUALITY SAMPLING INVENTORY
July 1990 - September 1991

Pcpt. Date (1990)	Alarm Date (1990)	Depth[1] Pcpt.) (in.)	SW022[2]		SW023[2]	SW027[2]		SW093[2]	SW118[2]		MetSta[2]
			Srf	P	Srf	Srf	P	Srf	Srf	P	P
7/20	7/20	0.80	C7		C24			G1	C7		
7/21	7/21	0.43									
7/23	7/23	0.10			C24			C24			
7/30	7/30	0.12						C2			
8/22	8/22	0.00[3]			C6						
9/01	9/01	0.88						C7			
9/05	9/05	0.00[3]						S1			
9/07	9/07	0.00[3]	G1								
9/11	9/11	0.01[3]						C24			
9/18	9/18	0.61			C15	C7					
10/09	10/09	0.00[3]			S1						
10/19		0.08									
10/20	10/20	0.17		X			X			X	X
11/04	11/04	0.00[3]	C14								
11/06	11/06	0.25		X			X			X	X
11/07	11/07	0.00			C5				C2		
11/08	11/08	0.00	G1								
11/09	11/09	0.00			C23	C8					
11/10	11/10	0.00						S1			
11/27	11/27	0.00[3]			C23						
12/03	12/03	0.00[3]	S1								
12/19	12/19	0.00[3]			C10						

Codes: C = Composite; S = Single Sample; G = Grab; # = number of samples.

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Table 7
EVENT-GENERATED WATER-QUALITY SAMPLING INVENTORY
July 1990 - September 1991 (Continued)

Pcpt. Date (1991)	Alarm Date (1991)	Depth[1] Pcpt.) (in.)	SW022[2] Srf	SW022[2] P	SW023[2] Srf	SW027[2] Srf	SW027[2] P	SW093[2] Srf	SW118[2] Srf	SW118[2] P	MetSta[2] P
1/11	1/11	0.00[3]			S1						
1/16	1/16	0.00[3]			C4						
2/22	2/22	0.00[4]					X				
3/15	3/15	0.00[3]		X				S1		X	
3/29	3/29	0.10			C5					X	
4/08	4/08	0.04			C24						
4/10	4/10	0.00[4]		X							
4/11	4/11	0.35			C23						
4/12	4/12	0.22	S1								
4/15	4/15	0.00[4]		X			X			X	
4/21	4/21	0.21			C23						
4/29		0.31									
4/30	4/30	0.37	S1	X	C24	C17	X		C10	X	X
5/04	5/04	0.50		X			X			X	
5/05	5/05	0.00							S1		
5/12	5/12	0.00[3]			C14						
5/10	5/10	0.00[3]	C5								
5/15	5/15	0.68		X		C24	X	C6	C24	X	X
5/16		0.96									
5/22	5/22	0.52	C14		C19				C18		
5/23	5/23	0.15			C10	C16					
5/24		0.04									

Codes: C = Composite; S = Single Sample; G = Grab; # = number of samples.

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Table 7
EVENT-GENERATED WATER-QUALITY SAMPLING INVENTORY
July 1990 - September 1991 (Continued)

Pcpt. Date (1991)	Alarm Date (1991)	Depth[1] Pcpt.) (in.)	SW022[2] Srf	SW022[2] P	SW023[2] Srf	SW027[2] Srf	SW027[2] P	SW093[2] Srf	SW118[2] Srf	SW118[2] P	MetSta[2] P
5/31	5/31	0.85									
6/01	6/01	1.11	C24	X		C24	X		C24	X	X
6/02		0.24									
6/06		0.07									
6/07	6/07	0.41	C9			C24		C23	C10		
6/21	6/21	0.15		X			X			X	X
7/09	7/09	0.78	S1	X			X	S1		X	X
7/22	7/22	0.48		X			X	C6		X	X
7/23	7/23	0.25	G1		G1						
7/24	7/24	0.15						C2			
7/26	7/24&26	0.14	C24								
8/03	8/03	0.58	C20	X		S1	X	S1		X	X
8/04		0.04									
8/06	8/06	1.15	C18		C13	S1		C24			
8/09	8/09	0.17	C9	X	C6	C18	X	C16		X	X
8/16	8/16	0.16	C5		S1			C11			

Codes: C = Composite; S = Single Sample; G = Grab; # = number of samples.

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Table 7
EVENT-GENERATED WATER-QUALITY SAMPLING INVENTORY
July 1990 - September 1991 (Concluded)

SUMMARY

	SW022[2] Srf	SW022[2] P	SW023[2] Srf	SW027[2] Srf	SW027[2] P	SW093[2] Srf	SW118[2] Srf	SW118[2] P	MetSta[2] P
26 Precipitation Events	14	11	17	10	11	14	8	12	10
17 Non-Precip. Events	4	3	6	0	2	3	0	2	0
TOTALS (43 Events)	18	14	23	10	13	17	8	14	10
13 Major Storm Events	9		7	7		8	6		

Codes: C = Composite; S = Single Sample; G = Grab; # = Number of Samples.

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1) Depth Precipitation is provided by EG&G as recorded at the Meteorological Station (MetSta) located in the West Buffer Zone. See Table C-1.

2) "Srf" indicates a surface water sample; and "P" indicates a bulk precipitation sample. Table 8 provides a summary of samples collected for analysis.

3) Automatic sampler alarm triggered although no precipitation was recorded at the MetSta.

4) Samples were collected from the bulk-precipitation sampler although no precipitation was recorded at the MetSta site.

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Table 8
Summary of Storm-Runoff/High-Flow Samples,
July 1990 - September 1991

Sample Collected	Event Date(s)	Site Sampled	Type/# Samples	Lab Code ID
7/23/90	07/20-21	SW022	Composite - 7	SW70001WC
7/23	07/20	SW023	Composite - 24	SW70002WC
7/23	07/20	SW093	Grab - 1	SW70003WC
7/23	07/20	SW118	Composite - 7	SW70004WC
7/24	07/23-24	SW023	Composite - 24	SW70005WC
7/24	07/23-24	SW093	Composite - 24	SW70006WC
7/31	07/30	SW093	Composite - 2	SW70007WC
8/24	08/22	SW023	Composite - 6	SW70011WC
9/04	09/01	SW093	Composite - 7	SW70012WC
9/07	09/05	SW093	Single Sample - 1	SW70014WC
9/07	09/07	SW022	Grab - 1	SW70013WC
9/19	09/11	SW093	Composite - 24	SW70017WC
9/19	09/18	SW023	Composite - 15	SW70015WC
9/19	09/18-19	SW027	Composite - 7	SW70016WC
10/12	10/09	SW023	Single Sample -1	SW70018WC
10/24	10/20	SW022P	Precip. 260 mL	SW70020WC
10/24	10/20	SW027P	Precip. 400 mL	SW70021WC
10/24	10/20	SW118P	Precip. 450 mL	SW70023WC
10/24	10/20	MetSta-P	Precip. 300 mL	SW70024WC

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Table 8
Summary of Storm-Runoff/High-Flow Samples,
July 1990 - September 1991
(Continued)

Sample Collected	Event Date(s)	Site Sampled	Type/# Samples	Lab Code ID
11/07/90	11/04/90	SW022	Composite -14	SW70028WC
11/08	11/06	SW022P	Precip. 200 mL	SW70030WC
11/08	11/06	SW027P	Precip. 375 mL	SW70032WC
11/08	11/06	SW118P	Precip. 450 mL	SW70033WC
11/08	11/06	MetSta-P	Precip. 245 mL	SW70034WC
11/08	11/07	SW118	Composite - 2	SW70035WC
11/08	11/07	SW023	Composite - 5	SW70029WC
11/08	11/08	SW022	Grab - 1	SW70027WC
11/19	11/09	SW023	Composite - 23	SW70040WC
11/19	11/09	SW027	Composite - 8	SW70042WC
11/19	11/10	SW093	Single Sample - 1	SW70041WC
12/10	11/27	SW023	Composite - 23	SW70045WC
12/13	12/03	SW022	Single Sample - 1	SW70046WC
12/19	12/19	SW023	Composite - 10	SW70047WC
2/22/91	1/11/91	SW023	Single Sample - 1	SW60063WC
2/22	1/16	SW023	Composite - 4	SW60062WC
2/22	2/22	SW027P	Precip. 200 mL	SW60064WC
3/19	3/15	SW022P	Precip. 280 mL	SW60067WC*
3/19	3/15	SW093	Single Sample - 1	SW60065WC
3/19	3/15	SW118P	Precip. 320 mL	SW60066WC*

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Table 8
Summary of Storm-Runoff/High-Flow Samples,
July 1990 - September 1991
(Continued)

Sample Collected	Event Date(s)	Site Sampled	Type/# Samples	Lab Code ID
4/02/91	3/29/91	SW023	Composite - 5	SW60066WC*
4/02	3/29	SW118P	Precip. 150 mL	SW60067WC*
4/09	4/08	SW023	Composite - 24	SW60068WC
4/10	4/10	SW022P	Precip. 450 mL	SW60070WC
4/15	4/11	SW023	Composite - 23	SW60069WC
4/15	4/12	SW022	Single Sample - 1	SW60074WC
4/15	4/15	SW022P	Precip. 400 mL	SW60071WC
4/15	4/15	SW027P	Precip. 450 mL	SW60072WC
4/15	4/15	SW118P	Precip. 440 mL	SW60073WC
4/23	4/21	SW023	Composite - 23	SW60075WC
5/01	4/30	SW022	Single Sample - 1	SW60082WC
5/01	4/30	SW022P	Precip. 480 mL	SW60078WC
5/01	4/30	SW023	Composite - 24	SW60083WC
5/01	4/30	SW027	Composite - 17	SW60081WC
5/01	4/30	SW027P	Precip. 460 mL	SW60076WC
5/01	4/30	SW118	Composite - 10	SW60080WC
5/01	4/30	SW118P	Precip. 430 mL	SW60077WC
5/02	4/30	MetSta-P	Precip. 450 mL	SW60079WC
5/06	5/04	SW022P	Precip. 350 mL	SW60087WC
5/06	5/04	SW027P	Precip. 400 mL	SW60086WC
5/06	5/05	SW118	Single Sample - 1	SW60084WC
5/06	5/04	SW118P	Precip. 600 mL	SW60085WC

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Table 8
Summary of Storm-Runoff/High-Flow Samples,
July 1990 - September 1991
(Continued)

Sample Collected	Event Date(s)	Site Sampled	Type/# Samples	Lab Code ID
5/17/91	5/10/91	SW022	Composite - 5	SW60088WC
5/17	5/12	SW023	Composite - 14	SW60090WC
5/17	5/15	SW022P	Precip. 800 mL	SW60089WC
5/17	5/15	SW027	Composite - 24	SW60091WC
5/17	5/15	SW027P	Precip. 700 mL	SW60092WC
5/17	5/15	SW093	Composite - 6	SW60093WC
5/17	5/15	SW118	Composite - 24	SW60094WC
5/17	5/15	SW118P	Precip. 750 mL	SW60095WC
5/17	5/15	MetSta-P	Precip. 800 mL	SW60096WC
5/23	5/22	SW022	Composite - 14	SW60098WC
5/23	5/22-5/23	SW023	Composite - 19	SW60100WC
5/23	5/22-5/23	SW118	Composite - 18	SW60099WC
5/28	5/23-5/24	SW023	Composite - 10	SW60101WC
5/23	5/23	SW027	Composite - 16	SW60097WC
6/03	5/31-6/01	SW022	Composite - 24	SW60102WC
6/03	5/31-6/01	SW022P	Precip.1000 mL	SW60103WC
6/03	5/31-6/01	SW027	Composite - 24	SW60104WC
6/03	5/31-6/01	SW027P	Precip.1000 mL	SW60105WC
6/03	5/31-6/01	SW118	Composite - 24	SW60106WC
6/03	5/31-6/01	SW118P	Precip.1000 mL	SW60107WC
6/03	5/31-6/01	MetSta-P	Precip.1000 mL	SW60108WC
6/11	6/07	SW022	Composite - 9	SW60112WC
6/11	6/07	SW027	Composite - 24	SW60109WC
6/11	6/07	SW093	Composite - 23	SW60110WC
6/11	6/07	SW118	Composite - 10	SW60111WC

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Table 8
Summary of Storm-Runoff/High-Flow Samples,
July 1990 - September 1991
(Continued)

Sample Collected	Event Date(s)	Site Sampled	Type/# Samples	Lab Code ID
6/25/91	6/21/91	SW022P	Precip. 600 mL	SW60114WC
6/25	6/21	SW027P	Precip. 425 mL	SW60013WC
6/25	6/21	SW118P	Precip. 500 mL	SW60115WC
6/25	6/21	MetSta-P	Precip. 450 mL	SW60116WC
7/10	07/09	SW022	Single Sample -1	SW60117WC
7/10	07/09	SW022P	Precip. 250 mL	SW60120WC
7/10	07/09	SW027P	Precip. 200 mL	SW60121WC
7/10	07/09	SW093	Single Sample -1	SW60118WC
7/10	07/09	SW118	Precip. 375 mL	SW60122WC
7/10	07/09	MetSta-P	Precip. 450 mL	SW60119WC
7/23	07/23	SW022	Grab - 1	SW60125WC
7/24	07/22-23	SW022P	Precip. 500 mL	SW60129WC
7/23	07/23	SW023	Grab - 1	SW60124WC
7/24	07/22-23	SW027P	Precip. 450 mL	SW60126WC
7/23	07/22	SW093	Composite - 6	SW60123WC
7/24	07/22-23	SW118P	Precip. 400 mL	SW60128WC
7/24	07/22-23	MetSta-P	Precip. 650 mL	SW60127WC
7/29	07/24	SW093	Composite - 2	SW60131WC
7/29	07/24&26	SW022	Composite - 24	SW60130WC
08/05	08/03	SW022	Composite - 20	SW60132WC
08/05	08/03-04	SW022P	Precip. 750 ml	SW60135WC
08/05	08/03	SW027	Single Sample -1	SW60133WC
08/05	08/03-04	SW027P	Precip. 750 ml	SW60136WC
08/05	08/03	SW093	Single Sample -1	SW60134WC
08/05	08/03-04	SW118P	Precip. 750 ml	SW60137WC
08/05	08/03-04	MetStaP	Precip. 750 ml	SW60138WC

SHEET 5 OF 6

Table 8
Summary of Storm-Runoff/High-Flow Samples,
July 1990 - September 1991
(Concluded)

Sample Collected	Event Date(s)	Site Sampled	Type/# Samples	Lab Code ID
08/07	08/06	SW022	Composite - 18	SW60139WC
08/07	08/06	SW023	Composite - 13	SW60140WC
08/07	08/06	SW027	Single Sample -1	SW60141WC
08/07	08/06	SW093	Composite - 24	SW60142WC
08/12	08/09	SW022	Composite - 09	SW60148WC
08/12	08/09	SW022P	Precip. 700 ml	SW60145WC
08/12	08/09	SW023	Composite - 06	SW60149WC
08/12	08/09	SW027	Composite - 18	SW60151WC
08/12	08/09	SW027P	Precip. 500 ml	SW60146WC
08/12	08/09	SW093	Composite - 16	SW60150WC
08/12	08/09	SW118P	Precip. 600 ml	SW60147WC
08/12	08/09	MetStaP	Precip. 750 ml	SW60144WC
08/28	08/16	SW022	Composite - 05	SW60156WC
08/28	08/16	SW023	Single Sample -1	SW60157WC
08/28	08/16	SW093	Composite - 11	SW60158WC

* Duplicate Sample Lab Code ID; may undergo revision.

SHEET 6 OF 6

sampler from collecting samples over much of the period of field investigations for the early period (ASI, 1990m); this malfunctioning equipment has since been repaired. For the entire 15-month period covered by this report, a total of 43 storm-runoff/high-flow events were sampled, with a total of 76 stream and 51 bulk-precipation samples collected for water-quality characterization (Tables 7 and 8). Laboratory analytical results have been received to date for most of these samples (Appendix A, Tables A-1, A-2 and A-3); detailed basic data are available from EG&G's RFEDS retrievals (Annette Primrose, EG&G, written commun., April 9 and Spetember 18, 1991).

Field and laboratory water-quality data for low flows are collected monthly at each of these sites; resultant data for the 1989 calendar year have been included in a surface-water geochemical report prepared by EG&G (1991c). Also, an initial bachground geochemical-characterization report has been prepared by EG&G (1990c), based upon data for selected ground-water, surface-water, and stream-sediment monitoring sites. Annual monitoring reports giving data-compilation and data-analysis results are envisioned, which would summarize information provided by these data. Storm-event samples generally have not been collected in sufficient quantities to be compared to ground-water indicator-variable quality from nearby shallow alluvial wells (Appendix D). It is noteworthy that specific conductances in several of the wells have increased, occasionally substantially, during the 12-month survey period. However, no chemical-characterization evidence is available at this time to support either the ground-water or leak hypothesis at the perennial-flow sites (primarily involving sites SW023 and SW093). The results of the approximately-weekly surveys indicated overall slight decreases in water levels in six of the eight shallow alluvial wells during the 1990-91 winter period covered by the surveys (Table 9) (ASI, 1991f). The greatest decrease was observed in well PZ 5589 (a total decline of about 10.9 ft from May 1990 to January 1991). Small increases in water levels (2.5 ft and nearly 4.6 ft, respectively) were noted over this same period in wells 4486 and PZ 4289 (Table 9). Because the inverts of the storm sewer system are not known, it is difficult to assess at this time whether or not ground-water infiltration is the primary cause of perennial flows at sites SW023

Table 9
Summary of Ground-Water Elevations,
May 1990-April 1991

Alluvial-Well Identification[1)]

Date	3586	4486	PZ0789	PZ2389	PZ4289	PZ4589	PZ5589	PZ6189
	Water-Level Elevation, ft MSL							
05/15/90	--[2)]	6014.80	--	--	5996.17	6017.19	6048.87	--
05/23/90	--	6014.44	6001.92	5989.56	5995.89	6017.25	6048.27	6007.61
05/30/90	5903.51	6014.72	6001.94	5989.35	5995.74	6017.27	6048.27	6007.53
06/06/90	5903.39	6014.80	6001.63	5989.14	5995.62	6017.27	6046.87	6007.83
06/13/90	5903.07	6014.25	6001.92	5988.83	5995.62	6017.33	6047.47	6006.74
06/19/90	5902.88	6014.08	6001.02	5988.15	5994.84	6016.52	6046.81	6006.54
06/28/90	5902.76	6013.74	6001.94	5988.30	5994.99	6017.70	6044.80	6007.23
07/03/90	5902.84	6013.69	6001.79	5988.27	5994.92	6016.72	6046.25	6007.11
07/12/90	5901.98	6014.72	6001.01	5988.21	5995.14	6017.10	6045.64	6007.26
07/18/90	5902.12	6014.90	6001.11	5988.25	5995.37	6017.47	6045.44	6007.66
07/25/90	5902.37	6015.23	6001.24	5988.00	5996.08	6018.25	6048.02	6008.31
08/02/90	5902.32	6015.08	6001.04	5987.55	5995.52	6017.67	6046.72	6006.89
08/09/90	5902.12	6014.91	6000.89	5987.34	5994.56	6017.74	--	6007.51
08/15/90	5901.24	6015.01	6001.67	5987.50	5995.02	6018.77	6045.49	6007.44
08/23/90	5902.34	6014.86	6001.59	5987.35	5994.87	6018.85	6044.96	6007.26
09/14/90	5902.39	6015.13	6002.34	--	5995.12	6022.00	6044.65	6014.01
09/24/90	5901.64	6015.48	6001.30	5988.05	5995.12	6019.10	6045.77	6014.06
09/27/90	5902.64	6012.94	6002.19	5987.90	5994.92	6020.10	6045.12	6008.06
10/04/90	5902.54	6015.43	6001.89	5987.70	5994.55	6020.05	6044.52	6008.06
10/11/90	5902.49	6014.28	6000.94	5987.60	5994.47	6020.05	6044.47	6009.01
10/18/90	5901.90	6014.28	5999.98	5986.62	5993.55	6019.12	6042.52	6007.19
10/25/90	5901.78	6014.28	6000.27	5986.25	5993.68	6019.05	6043.05	6007.01
11/09/90	5901.94	6015.44	6001.12	5986.36	5993.68	6018.94	6045.32	6006.96
11/16/90	5901.79	6015.44	6003.04	5988.35	5994.80	6018.80	6045.02	6006.99
11/21/90	5901.54	6015.53	6001.29	5986.90	5995.27	6019.60	6045.57	6008.86
11/28/90	5901.84	6014.21	6001.05	5986.13	5994.21	6018.70	6044.66	6006.88
12/05/90	5901.76	6013.91	6000.82	5985.64	5993.97	6018.49	6043.70	6006.83
12/12/90	--	6014.44	6001.49	5986.42	5994.09	6018.35	6043.37	6007.61
12/27/90	5902.22	6012.30	5999.49	5985.31	5992.45	6017.82	6040.03	6006.61
01/03/91	5901.96	--	5999.71	5985.30	5991.92	6017.55	6038.75	6006.50
01/09/91	5901.98	6006.80	5999.49	5985.30	5991.56	6017.44	6037.93	6006.44
02/12/91	5902.78	6014.05	6000.61	5987.31	5993.08	6017.48	6038.77	6006.26
03/26/91	5903.02	6014.88	6000.09	5986.98	5992.25	6016.27	6039.43	6006.16
04/04/91	5902.79	6014.62	5999.89	5986.65	5992.02	6016.07	6039.22	--
04/26/91	5903.43	6015.24	6001.19	5987.01	5994.92	6016.35	6044.55	6006.35

1) See Figure 1 for locations. Source: ASI (1991f).
2) -- = no measurement.

and SW093. The most likely cause is judged to be building footing or other drains which discharge to the storm-sewer system.

In general, the observed daily-mean discharges at the five monitoring sites, given in Appendix B (Tables B-1 through B-5), appear to be in response to storms whose intensity and duration are reflected by the daily precipitation data (Appendix C, Table C-1) collected at the EG&G meteorological station located in the West Buffer Zone, approximately 1.7 miles (mi) from the nearest flow-gaging site (SW118) and 2.8 mi from the furthest flow-gaging site (SW027). Preliminary analysis of these precipitation and discharge data indicates that the largest storm for which runoff was measured occurred during May 31 through June 3, 1991; this storm had a total 3-day precipitation of 2.27 inches (in). The estimated storm runoff in each case was calculated by summing the daily mean discharges (Appendix B) from the storm (less base flow), multiplying this total daily mean discharge by 1.98 to obtain the volume of the storm runoff in ac-ft, and dividing by the drainage area at the site to obtain the depth of runoff in inches from the storm event.

Table 10 summarizes the rainfall-runoff responses for 22 storms during the period of record at the five monitoring sites. Rainfall-runoff relationships were developed for the five monitored drainage basins using the runoff volumes given in Table 10. These rainfall-runoff relationships for each drainage basin are shown on Figures C-1 through C-5 (Appendix C). The best-fit regression relationship, based upon the selected storms, showed coefficients of determination (that is, total variance explained, R^2, a measure of the goodness of fit of the regression line) ranging from nearly 0.47 at site SW093 to about 0.80 at site SW118. The storms used in the rainfall-runoff relationships were non-winter storms and included both frontal storms and thunderstorms. The total runoff at the five monitoring sites ranged from about 13 percent of rainfall at site SW027 (drainage area = 171 ac) to 82 percent of rainfall at site SW118 (drainage area = 51 ac). Hurr (1976) found, based upon limited data, that the runoff in the Woman Creek basin (drainage area = >1,000 ac) was about 1.4 percent of rainfall. One of the factors contributing to the small percentage of rainfall that ran off in the Woman Creek case by Hurr (1976) was that most of the

Table 10
Summary of Storm-Runoff Quantity,
July 1990 - September 1991

Storm Date(s)	Measured Rainfall[1)] (inches)	Storm Runoff for Monitoring Site[2)] SW022 (ac-ft)	SW022 (in)	SW023 (ac-ft)	SW023 (in)	SW027 (ac-ft)	SW027 (in)	SW093 (ac-ft)	SW093 (in)	SW118 (ac-ft)	SW118 (in)
(1990)											
7/04-06	0.63	--	--	--	--	1.01	0.07	--	--	1.72	0.40
7/08-09	0.67	--	--	--	--	2.06	0.14	--	--	1.90	0.45
7/11	0.24	--	--	--	--	0.55	0.03	--	--	0.57	0.14
7/19-23	1.37	--	--	--	--	4.83	0.34	--	--	8.24	1.94
7/29-30	0.14	0.28	0.05	0.38	0.05	0.32	0.02	0.64	0.03	0.12	0.03
9/01-02	1.02	1.37	0.22	0.22	0.03	0.00	0.00	1.94	0.10	1.68	0.40
9/17-21	0.75	4.16	0.67	14.16	1.90	1.29	0.09	1.72	0.08	2.97	0.70
10/19-20	0.25	0.00	0.00	2.16	0.29	0.00	0.00	--	--	0.83	0.20
11/02-03	0.30	0.59	0.09	1.84	0.25	--	--	1.09	0.05	1.27	0.30
11/05-07	0.26	1.74	0.28	1.44	0.19	--	--	15.52	0.76	6.17	1.45
(1991)											
4/11-12	0.57	--	--	2.10	0.28	1.18	0.08	0.59	0.03	1.64	0.39
4/29-30	0.68	2.02	0.32	6.01	0.81	1.24	0.09	0.89	0.04	0.00	0.00
5/04-05	0.50	1.72	0.28	4.26	0.57	0.75	0.05	0.06	0.00	2.34	0.55
5/15-17	1.65	6.87	1.10	--	--	--	--	30.12	1.48	11.46	2.70
5/22-25	0.72	0.91	0.15	1.46	0.20	0.87	0.06	5.86	0.29	6.20	1.45

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Table 10 (Concluded)
Summary of Storm-Runoff Quantity,
July 1990 - September 1991

Storm Date(s)	Measured Rainfall[1] (inches)	Storm Runoff for Monitoring Site[2] SW022 (ac-ft)	SW022 (in)	SW023 (ac-ft)	SW023 (in)	SW027 (ac-ft)	SW027 (in)	SW093 (ac-ft)	SW093 (in)	SW118 (ac-ft)	SW118 (in)
(1991, Continued)											
5/31-6/03	2.27	1.19	0.19	4.46	0.60	9.39	0.65	25.93	1.27	12.15	2.86
6/21	0.15	0.02	0.00	0.44	0.06	0.00	0.00	0.30	0.01	0.14	0.03
7/09-12	1.24	0.34	0.05	--	--	0.34	0.02	6.59	0.32	4.46	1.05
7/22-26	1.08	1.88	0.30	4.32	0.58	2.22	0.16	6.23	0.31	8.57	2.02
8/01-04	0.84	1.05	0.17	3.17	0.43	0.69	0.05	7.90	0.39	3.96	0.93
8/06	1.15	0.89	0.14	3.68	0.50	0.95	0.07	35.86	1.76	3.33	0.78
8/09	0.17	0.34	0.05	2.79	0.38	0.83	0.06	8.15	0.40	0.71	0.17

1) Using available data at EG&G-operated meteorological station in the West Buffer Zone or, alternatively, the National Weather Service (NWS) climatological station at Boulder, Colorado (See Appendix C, Table C-1).

2) Based on cumulative daily-mean flows given in Appendix B (Tables B-1 through B-5) adjusted for base flow.

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records that were used to develop the Woman Creek rainfall-runoff relationship resulted from frontal storms with long rainfall durations, rather than thunderstorms whose intensities are much higher. Therefore, it is concluded that the rainfall-runoff relationships presented at the five monitoring sites are reasonable.

Analyses of Table 10 and Figures C-1 through C-5 indicate that an uneven runoff responses occurred to point-measured precipitation values. This was especially evident for the thunderstorms, typical of the semi-arid environment of the area. Distance from the precipitation measuring point (EG&G's meteorological station) also affects the quality of the rainfall-runoff relationships. The amount of runoff detention also impacts the rainfall-runoff relationships. Many small detention facilities are located at the RFP, consisting of small ponds and depressions, berms around buildings and tanks, and other areas. Runoff collected in these areas is released after the storm events and distort the runoff response to rainfall. The drainage basins in which detention is judged to be largest include monitoring sites SW022, SW023, and SW093. The rainfall-runoff relationships for these drainage basins had the lowest coefficients of determination, indicating more scatter in the data relative to the regression line.

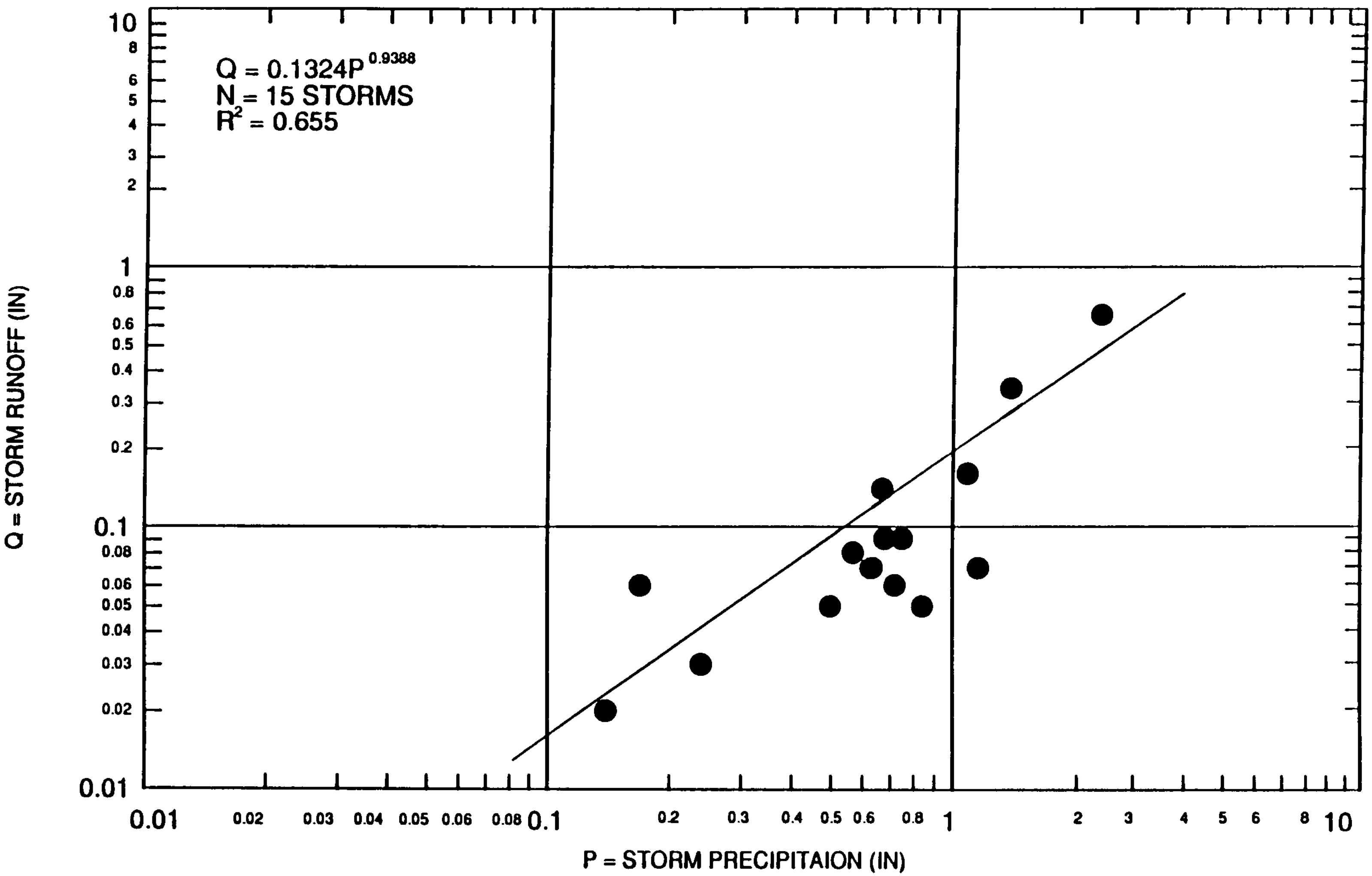
Analysis of Table 10 also indicates that runoff values (in inches) for some storms was larger than the rainfall values (in inches) measured at the EG&G meteorological station. This might be due to inaccuracies in the flow and rainfall measurements, distance of the meteorological station from the drainage basin, or differences in patterns that thunderstorms track across a given drainage basin. Of the 22 storms shown in Table 10, about half of the storms measured had runoff depths higher than rainfall depths for one or more of the drainage basins. These storms were not used in estimating the rainfall-runoff relationships shown in Figures C-1 through C-5. In general, the rainfall-runoff relationships appear reasonable for the storms events analyzed in this study. These relationships could be used to estimate the quantity of runoff from a rainfall event at the RFP (ASI, 1990h; 1991d). Runoff from snowmelt has not been included in the rainfall-runoff relationships.

For certain periods of no precipitation observed at the EG&G meteorological station during the period from late July 1990 through mid-September 1991, monitoring sites SW022, SW023, and SW093 recorded occasional flow events which substantially exceeded the expected non-rainfall flow quantities (Tables 7 and 10). These events are indicated by a footnote on Table 7; most of the recorded high flows not associated with precipitation involved high flows and correcponding samples collected at site SW023. The sources of water which caused these flows are unknown at this time. Both a grab sample and an automatic ISCO sample were collected on September 7, 1990, at site SW022 at 1630 hours. At sites SW023 and SW027, no samples were collected, either because sampler actuation levels were not reached or due to an automatic-sampler malfunction. At site SW093, the sampler actuation level was not reached and no samples were collected for the September 8 event. Relatively high mean-daily discharges at site SW023 on September 27 and 28, 1990, were attributed to temperature fluctuations in the data-logger cable and pressure transmitter which occurred before burial of the cable and pressure transmitter.

A preliminary evaluation of the event sample water-quality data tabulated in Appendix A indicates that site SW118 had the highest total (that is, unfiltered-sample) concentrations of gross alpha and gross beta of the four sites (site SW027 has no reported results to date for storm-event samples) for which runoff events were sampled (Table A-1). These analyses undoubtedly are affected by the suspended sediment transported by the storm runoff sampled, as indicated by the consistently reported lower concentrations of gross alpha and gross beta for low-flow ambient samples collected by Woodward-Clyde and analyzed for dissolved concentrations (Table A-1). Historical samples collected during low flows at some of these sites tend to exhibit consistently lower radionuclide concentrations, even for unfiltered samples (see 1986-89 as well as 1990 ambient data in Table A-1). The concentrations of gross alpha (111.4 $\pm$ 30.3 pCi/L) and gross beta (120.4 $\pm$ 11.9 pCi/L) at the site SW118 sample for July 23, 1990 (Table A-1), both exceeded the stream standard for Segment 5 of Walnut Creek of 11 and 19 pCi/L, respectively (CWQCC, 1990). Storm-runoff samples at sites SW022, SW023, SW093, and SW118 also had gross-alpha and gross-beta concentrations exceeding Walnut Creek stream standards (1 to 4 analyses in each case, Table A-1). Regarding Woman Creek stream standards, site SW027's gross-alpha and gross-beta exceedances involved only the historical (1986-87) data (Table A-1). The relatively high gross-beta concentrations (over 2.5 to nearly 5.7 pCi/L) reported for 6 bulk-precipitation samples (2 each at sites SW022P, SW027P, and SW118P) are noteworthy; one of these six values (site SW027) even exceeds the stream standard for Woman Creek.

Regarding other water-quality variables, results previously available (ASI, 1990m) were tabulated for six storm-runoff event samples with trace-metal analyses (indicating stream standards exceedances for cadmium, chromium, iron, and manganese), and for twelve samples with analyses of major anions. In particular, stream-standards (CWQCC, 1990) exceedances were noted for total-recoverable concentrations of chromium (three out of six values), iron (all six values), lead (three out of six values), and manganese (one out of six values). It should be kept in mind that these trace-metal analyses were based upon total concentrations, that is, samples have not been filtered. The high observed trace-metal concentrations again were judged to be often a result of the relatively large suspended-sediment loads during storm runoff, as reflected in concentrations of total suspended solids (TSS) during these events (ASI, 1990m). Acidification of unfiltered samples and the associated digestion process of the analytical laboratory may tend to cause significant amounts of several trace metals (namely, aluminum, iron, and manganese) to go into solution from particulate matter in these samples. The relatively high concentrations for the variables noted are apparent in several of the analytical results given in Table A-2.

The ranges of observed concentrations for numerous chemical constituents, based upon analyses of storm-runoff/high-flow as well as ambient samples, are given in Table 11 for selected variables. This more recent tabulation was based upon a recent RFEDS retrieval (Robert Fiehweg, EG&G, written commun., September 26, 1991) and confirms the observed CDH-WQCC stream standards exceedances involving cadmium, chromium, iron, and manganese as well as lead concentrations observed for the smaller data set reported previously (ASI, 1990m).

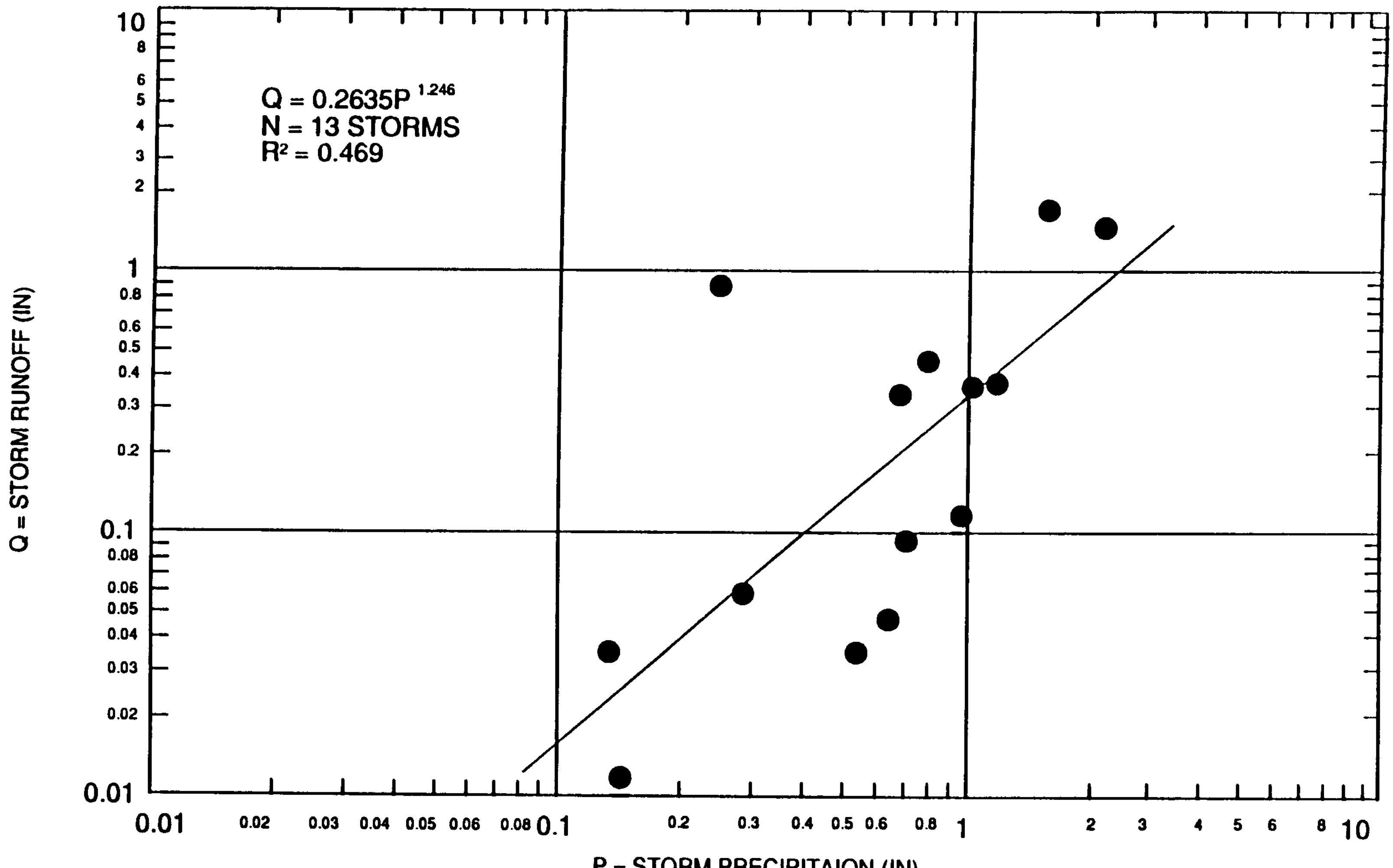


RAINFALL - RUNOFF RELATIONSHIP
SITE SW027

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

FIGURE C-3

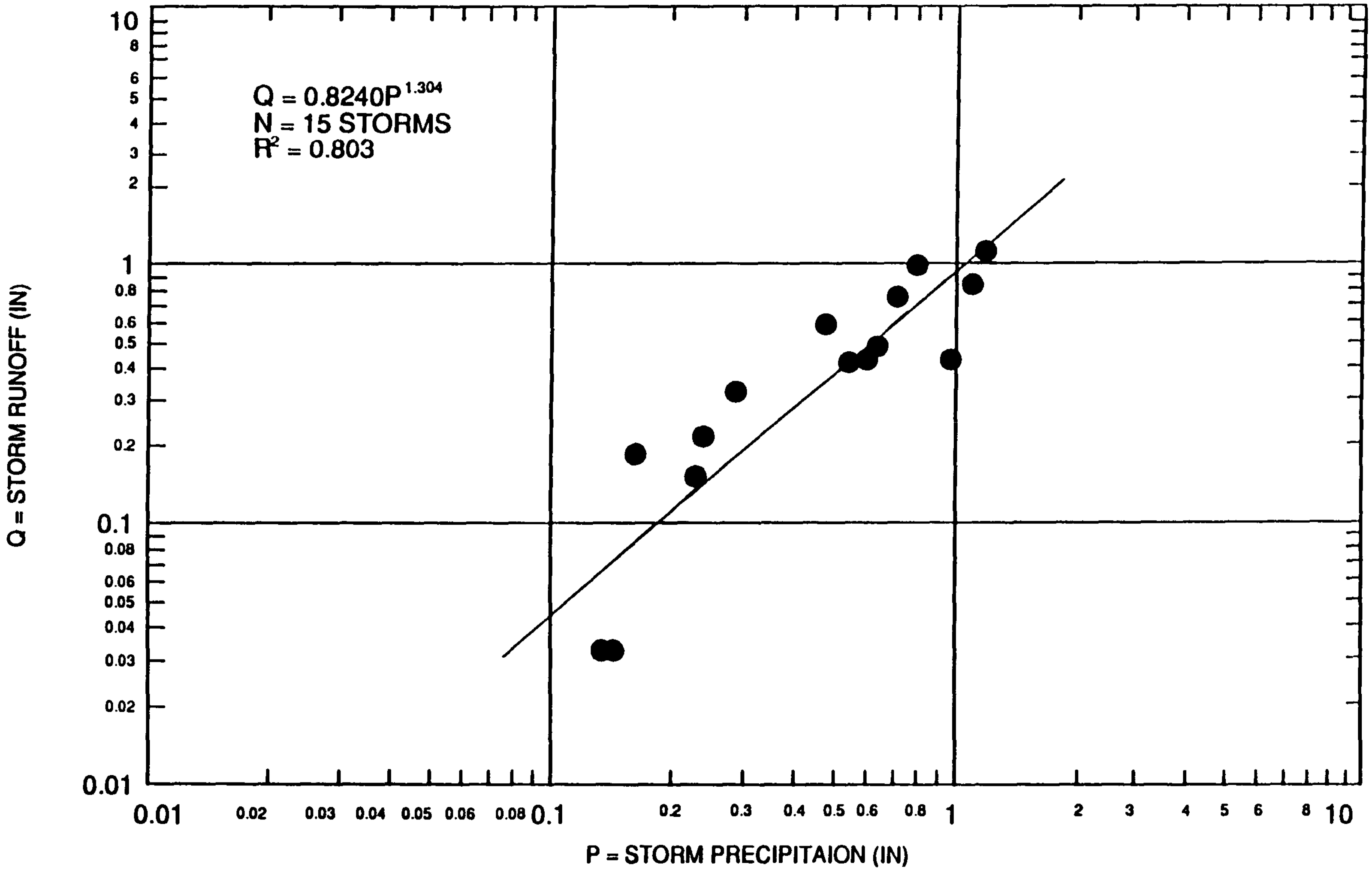


RAINFALL - RUNOFF RELATIONSHIP
SITE SW093

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

FIGURE C-4



RAINFALL - RUNOFF RELATIONSHIP
SITE SW118

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

FIGURE C-5

Table 11
Summary of Results, Recent Event and Ambient Water-Quality Data

Constituent (units)	No. of Values	Concentration Minimum	Concentration Maximum	EPA Drinking Water Standard[3]	Stream Standard[3]
Radionuclide Indicators[1]					
Gross Alpha (pCi/L)	15	2.9	111.[6]	15	11[4], 7[5]
Gross Beta (pCi/L)	15	7.48	120.[6]	50	19[4], 5[5]
Selected Trace Metals[2]					
Arsenic (As) (ug/L)	102	0.1	1.0	50	50
Cadmium (Cd) (ug/L)	102	2.	23.[6]	10	--
Chromium (Cr) (ug/L)	103	4.	95.[6]	50	50
Copper (Cu) (ug/L)	103	2.	128.	1000	--
Iron (Fe) (ug/L)	103	5.	616.[6]	1000	1000
Lead (Pb) (ug/L)	100	0.4	128.[6]	50	--
Manganese (Mn) (ug/L)	103	1.	1420.[6]	1000	1000
Nickel (Ni) (ug/L)	103	3.9	87.	--	--
Zinc (Zn) (ug/L)	103	2.	1120.	--	--
Major Ions[2]					
Calcium (Ca) (mg/L)	103	24.	112.	--	--
Magnesium (Mg) (mg/L)	103	4.9	175.	--	--
Potassium (K) (mg/L)	102	0.1	53.	--	--
Sodium (Na) (mg/L)	103	3.7	248.	--	--
Bicarbonate (HCO_3) (mg/L)	53	3.	310.	--	--
Sulfate (SO_4) (mg/L)	68	3.	120.	250	250
Chloride (Cl) (mg/L)	68	5.	580.	250	250
Fluoride (F) (mg/L)	33	0.2	0.9	2.4-4.0	--

1) See Table A-1 (only total concentrations are considered).
2) RFEDS/SAS statistics (Robert Fiehweg, EG&G, written commun. September 26, 1991).
3) See Appendix F.
4) Walnut Creek.
5) Woman Creek.
6) Noted stream-standards exceedances (see text).

4.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are made as a result of the preliminary analyses conducted for the storm-sewer study and non-point source assessment:

1) Infiltration into the storm-sewer system has been identified at monitoring sites SW023 and SW093. Preliminary estimates of annual infiltration at these two sites indicate an average of about 0.072 MGD or about 26.2 million gallons per year.

2) External (that is, non-RFP related) influences by both natural conditions and human-induced activities are affecting regional water quality in and around the RFP area. Specific factors are cited in the subcontractor report included as Appendix E.

3) Recently collected data for storm-runoff/high-flow events point toward some close-in (within the confines of the RFP) contributions to radionuclides and perhaps several trace metals. The sample results are reported for total (unfiltered) concentrations and could in several instances be compared to earlier data reported for both total or dissolved (filtered-sample) concentrations. Concentrations of a few trace-metal species (aluminum and iron) exhibit substantial differences between total and dissolved concentrations, possibly due to increased solubility of certain mineral facies caused by acidifying samples. Some comparative analyses of trace metals on filtered samples collected for storm events would be useful to compare with total (unfiltered) concentrations for the present mode of monitoring operation. Also, further review and evaluation is needed as to the analytical methods used by EG&G contract laboratories for samples collected as part of this study as well as for historical data.

4) Continued monitoring of storm-runoff events at installed non-point source (NPS) sites is recommended. The network may be modified in terms of constituents and locations on or about October 1991 in response to newly-identified objectives or data needs involving stormwater NPDES regulatory monitoring. Also, this continuing effort should interact with several other investigations currently underway at the RFP.

5) As more data results become available, further data analyses and investigation using historical as well as recent data are recommended to develop a better understanding of regional water-quality impacts.

6) Several previous studies have documented physical characteristics and ambient chemical conditions in stream and impoundment sediments in and around the RFP

area. Implementation of proposed suspended-sediment samplers and additional more-detailed characterization of bottom-sediment chemistry of stream channels and of reservoirs (both on-site and offsite) may be useful in expanding upon available historical data and in refining the assessment of non-point source contributions.

7) The recording rain gage located in the West Buffer Zone of the RFP may not be representative of rainfall at other locations of the RFP site. Measured storm runoff at several different locations in the RFP site for a single storm rainfall indicated that the runoff may exceed the measured storm rainfall at the rain-gage location. Therefore, additional recording or bulk rain gages should be installed on selected watersheds on the RFP. In this way, areal variations in the rainfall patterns at the RFP could be analyzed. This is especially important for high-intensity convective storms typical of the RFP area during the late spring and summer.

8) Stream standards for Woman Creek and its tributaries upstream from Standley Lake, and for Walnut Creek and its tributaries upstream from Great Western Reservoir have been promulgated by the State of Colorado Water Quality Control Commission. These stream standards designate that all surface water in the Woman Creek and Walnut Creek basins is classified as Domestic Water Supply. The corresponding numeric stream standards for this classification generally follow State of Colorado and EPA guidelines for primary and secondary drinking-water standards, except for radionuclides and selected trace-metals concentrations. The exceptions to EPA drinking-water numeric standards for Woman Creek and Walnut Creek are as follows:

		CDH-WQCC Stream Standard	
Constituent	EPA Drinking-Water Standard	Woman Creek Standard	Walnut Creek Standard
Mercury (ug/L)	2.0	0.01	0.01
Gross Alpha (pCi/L)	15	7	11
Gross Beta (pCi/L)	50	5	19
Tritium (pCi/L)	20,000	500	500

Several instances of gross-alpha and gross-beta stream-standards exceedances were noted in event-sample analyses. Certain trace metals have numeric stream standards which have indicated exceedances in the cases of cadium, chromium, iron, lead, and manganese concentrations.

5.0 ACKNOWLEDGMENTS

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Ralph Lindberg, EM/ER	Peter Folger, formerly with ER/EMAD
Anand Shah, DOE/E&G	Andy McLean, EM/NEPA
Kitty Woldow, EM/CWAD	Eric Mende, EM/CWAD
Russ Applehans, PFE/C	Andy Berzins, EM/CWAD
Frank Walker, FPM	James Langman, EM/ER (Appendix E only)

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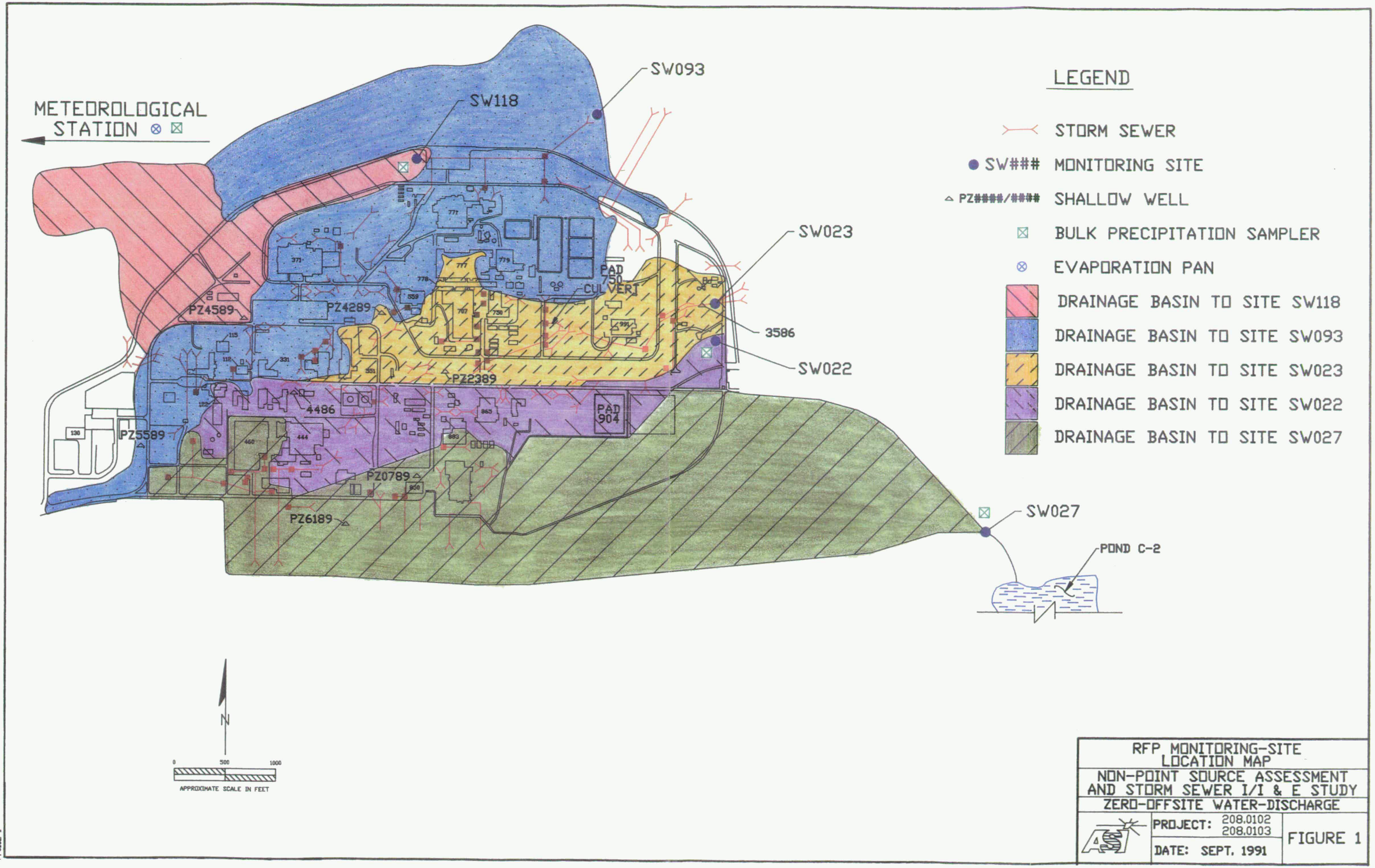
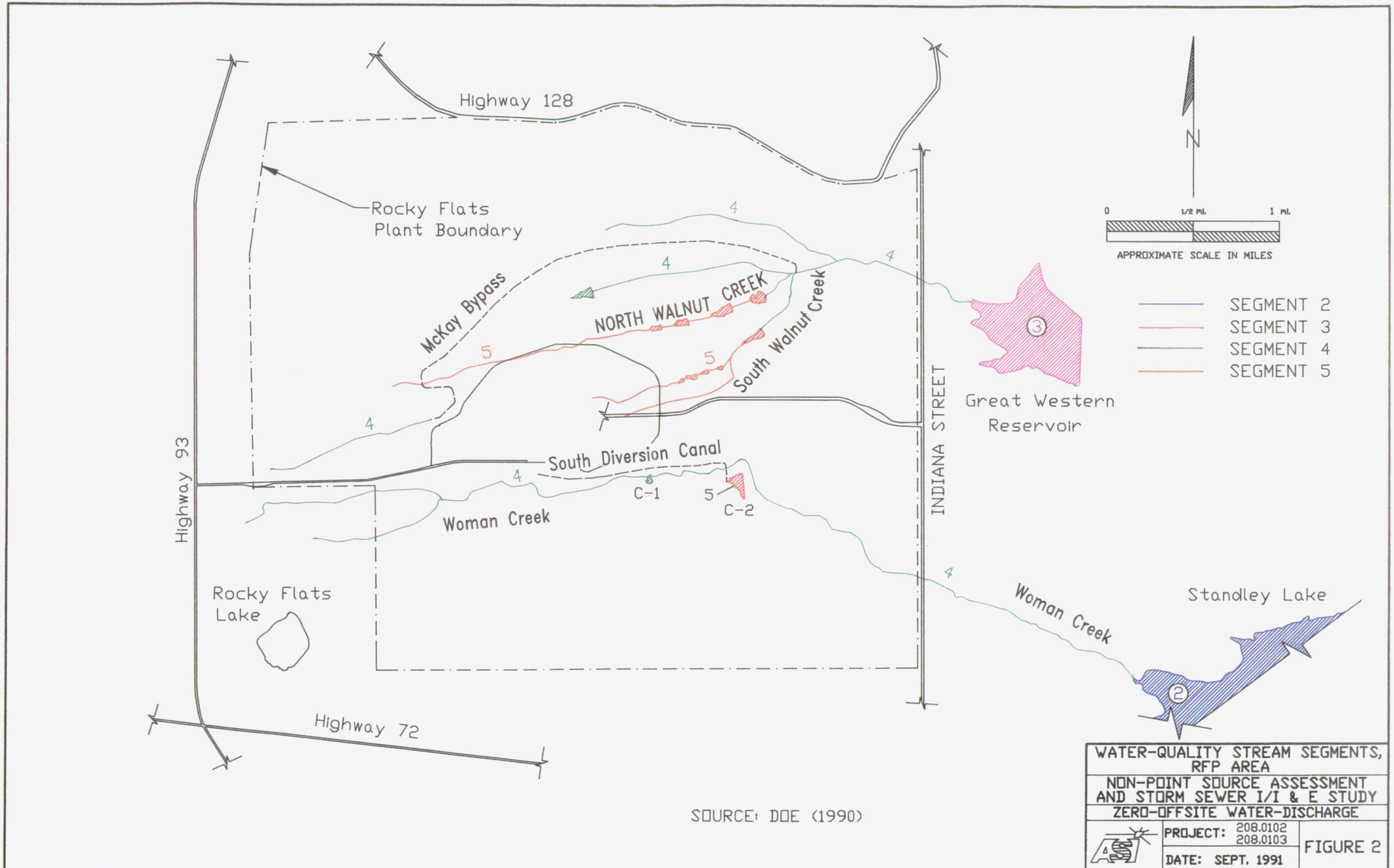
FIGURES


METEOROLOGICAL STATION
SW118
SW093
SW023
3586
SW022
SW027
POND C-2
PZ4589
PZ4289
PZ2389
PZ5589
4486
PZ0789
PZ6189
PAD 750
CULVERT
PAD 904
LEGEND
STORM SEWER
SW### MONITORING SITE
PZ####/#### SHALLOW WELL
BULK PRECIPITATION SAMPLER
EVAPORATION PAN
DRAINAGE BASIN TO SITE SW118
DRAINAGE BASIN TO SITE SW093
DRAINAGE BASIN TO SITE SW023
DRAINAGE BASIN TO SITE SW022
DRAINAGE BASIN TO SITE SW027
N
0 500 1000
APPROXIMATE SCALE IN FEET
RFP MONITORING-SITE LOCATION MAP
NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER-DISCHARGE
PROJECT: 208.0102 208.0103
DATE: SEPT. 1991
FIGURE 1
FF0102-1



WATER-QUALITY STREAM SEGMENTS, RFP AREA

NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY

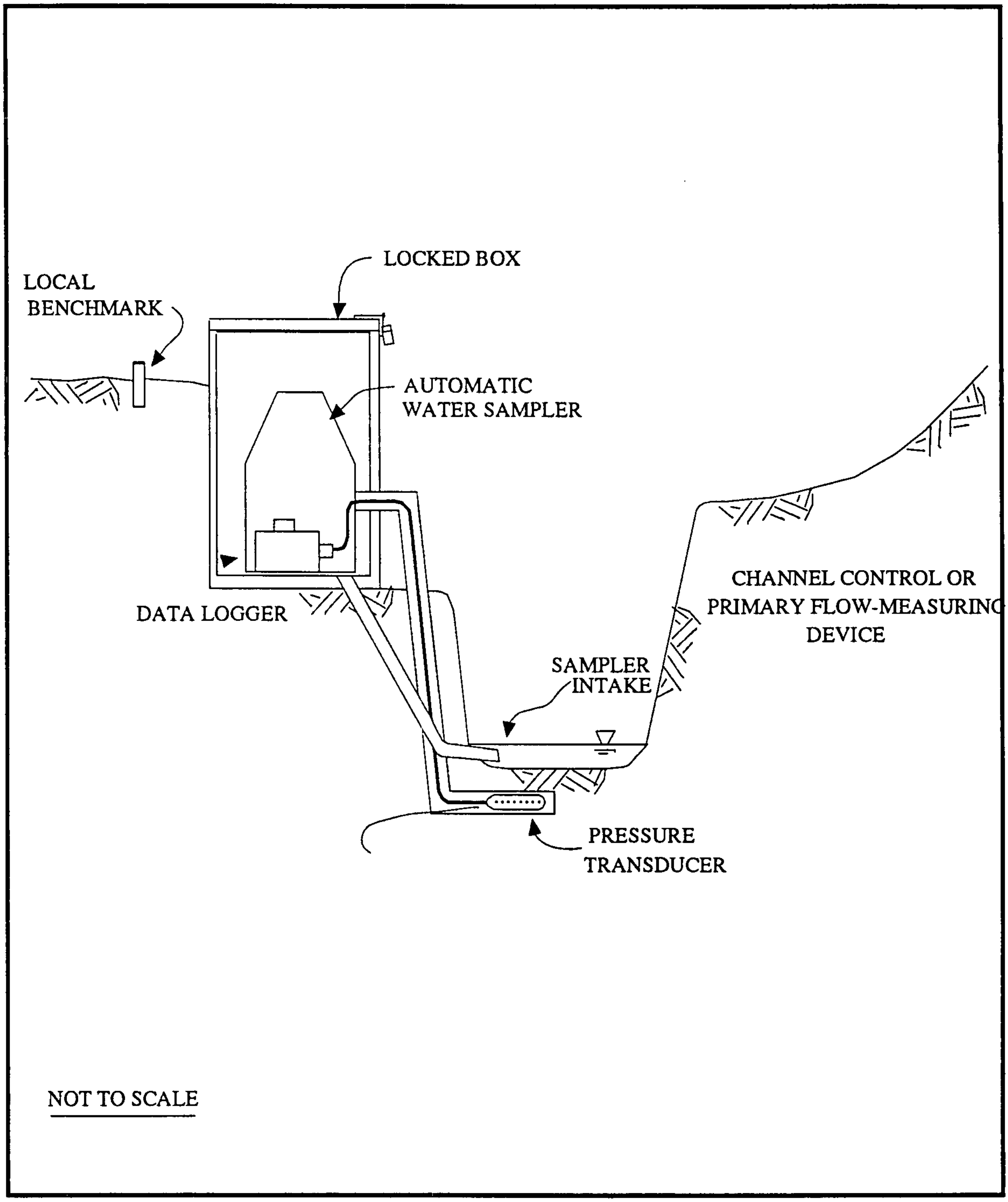
ZERO-OFFSITE WATER-DISCHARGE

PROJECT: 208.0102 208.0103

DATE: SEPT. 1991

FIGURE 2

F0102-2

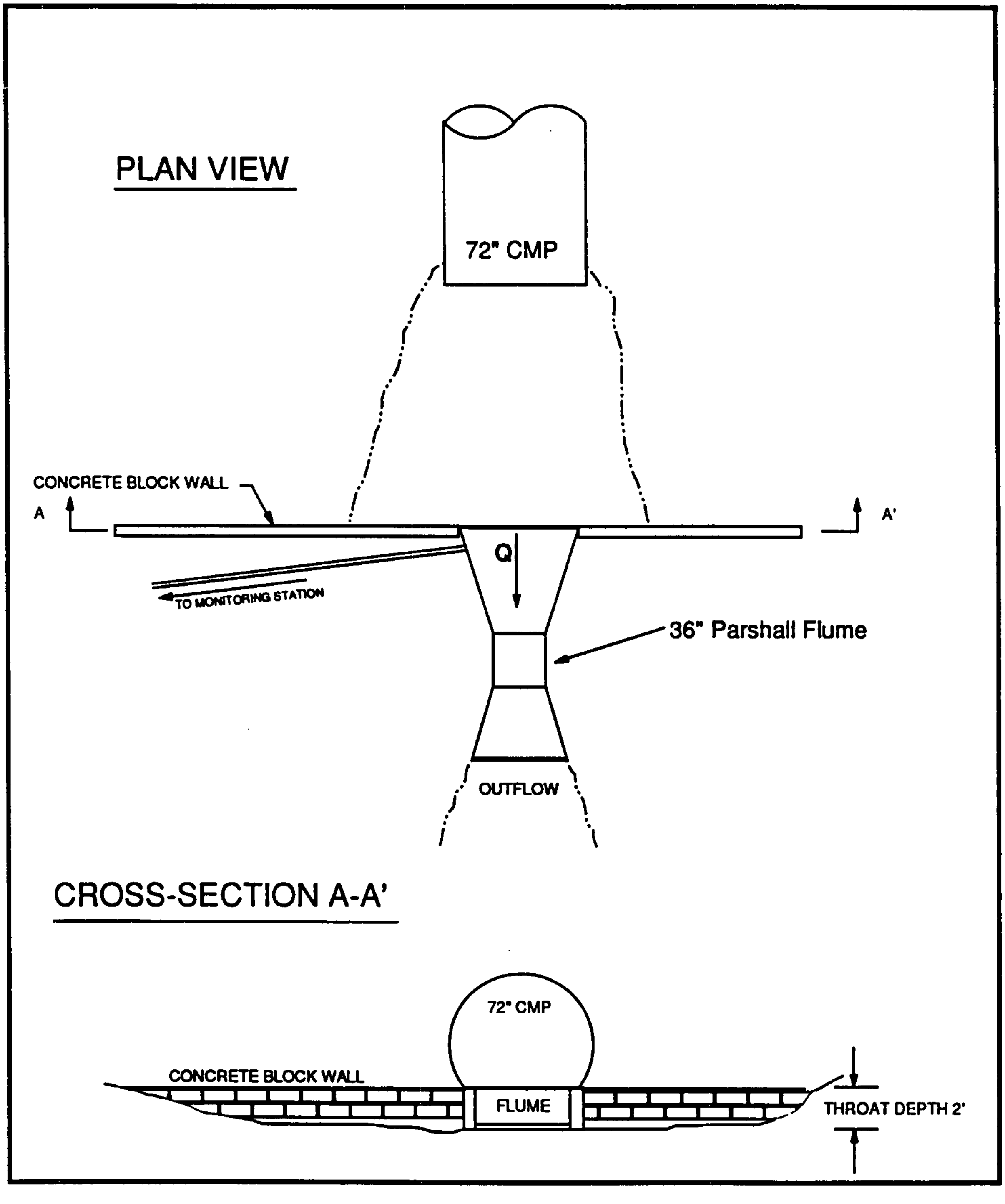


TYPICAL MONITORING STATION
FOR STREAMFLOW AND WATER QUALITY

NON-POINT SOURCE ASSESSMENT
AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
& 208.0103

Figure No. 3

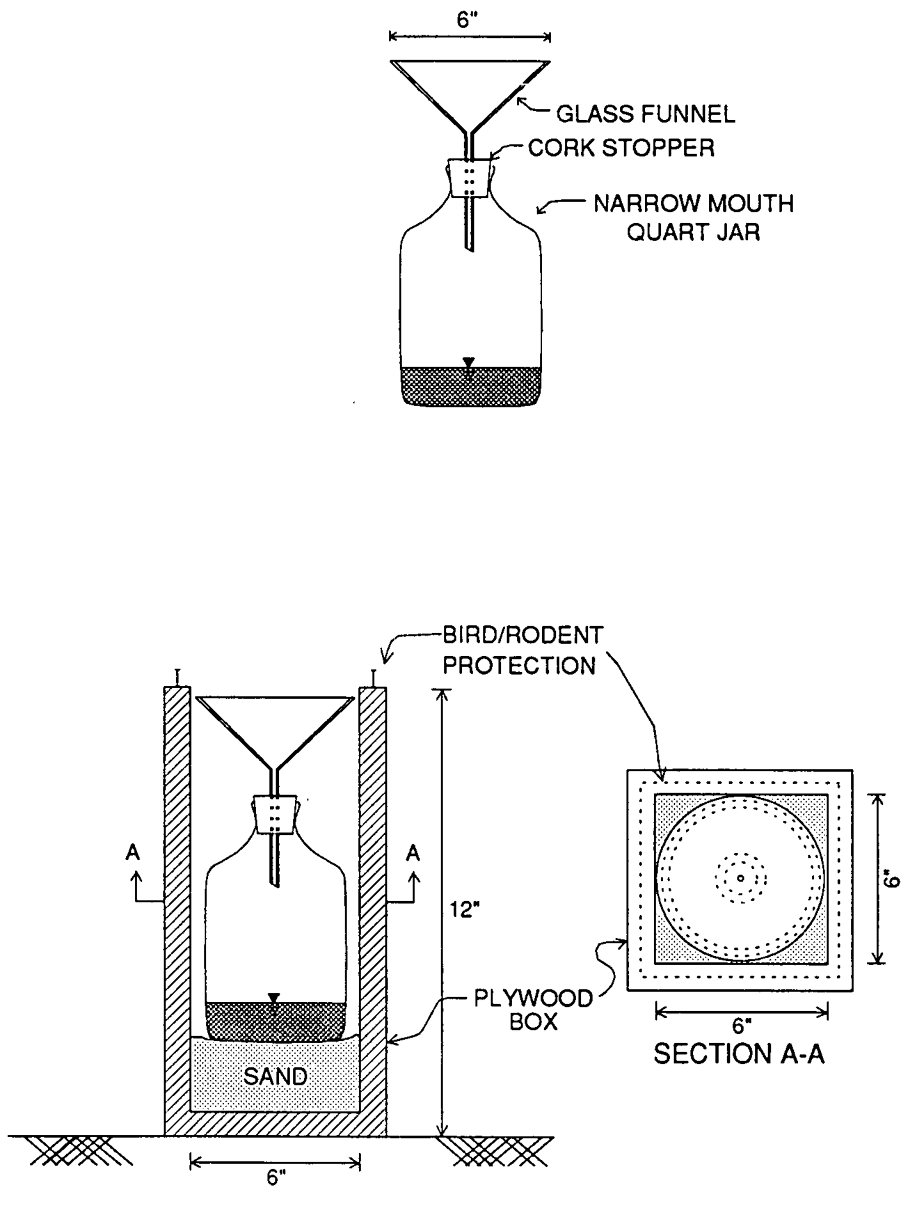


SCHEMATIC OF FLUME, SITE SW-93

Project No's: 208.0102
& 208.0103

NON-POINT SOURCE ASSESSMENT
AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Figure No. 3A

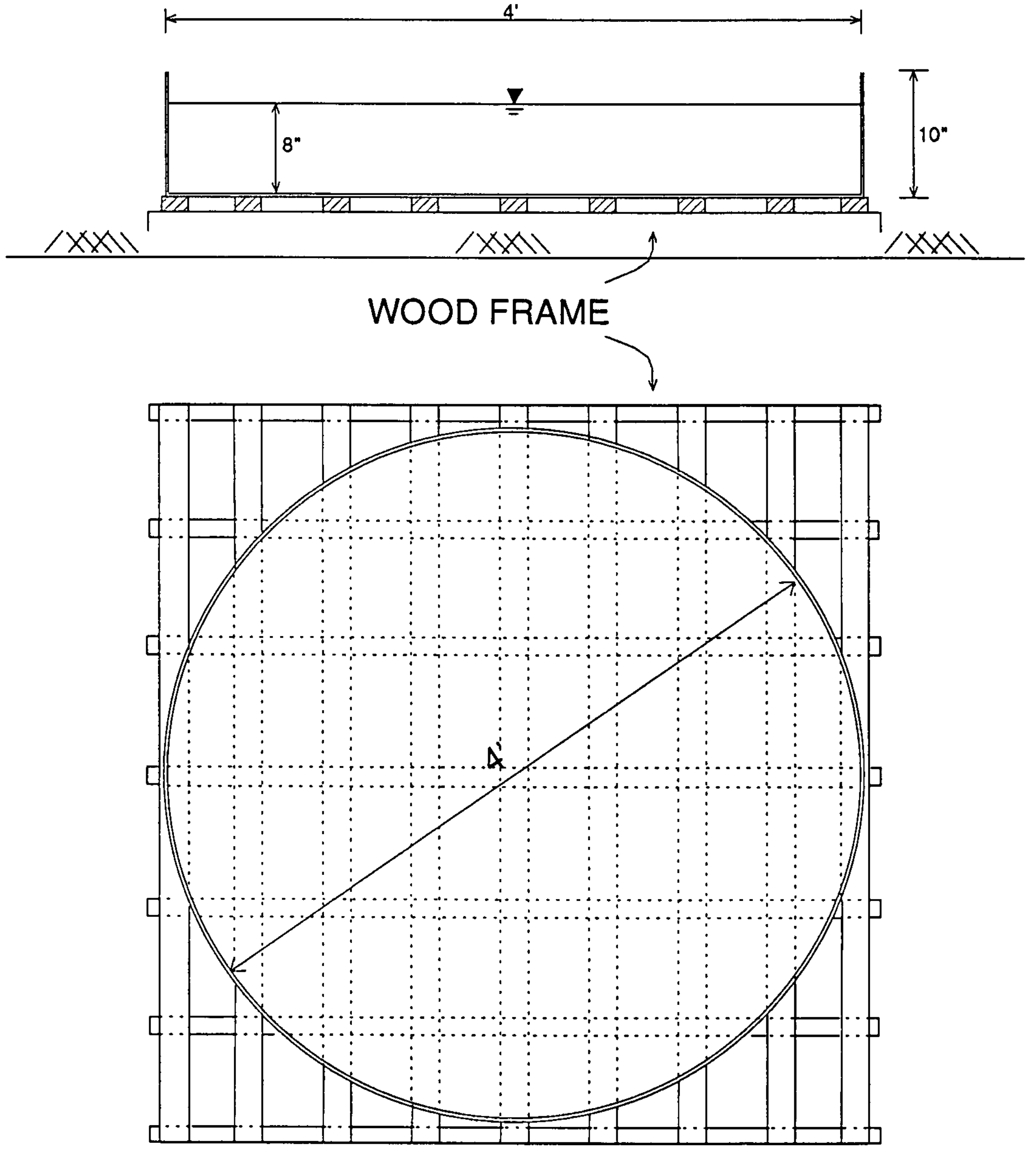


BULK (WETFALL/DRYFALL) PRECIPITATION SAMPLER

Project No's: 208.0102
& 208.0103

NON-POINT SOURCE ASSESSMENT
AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Figure No. 4



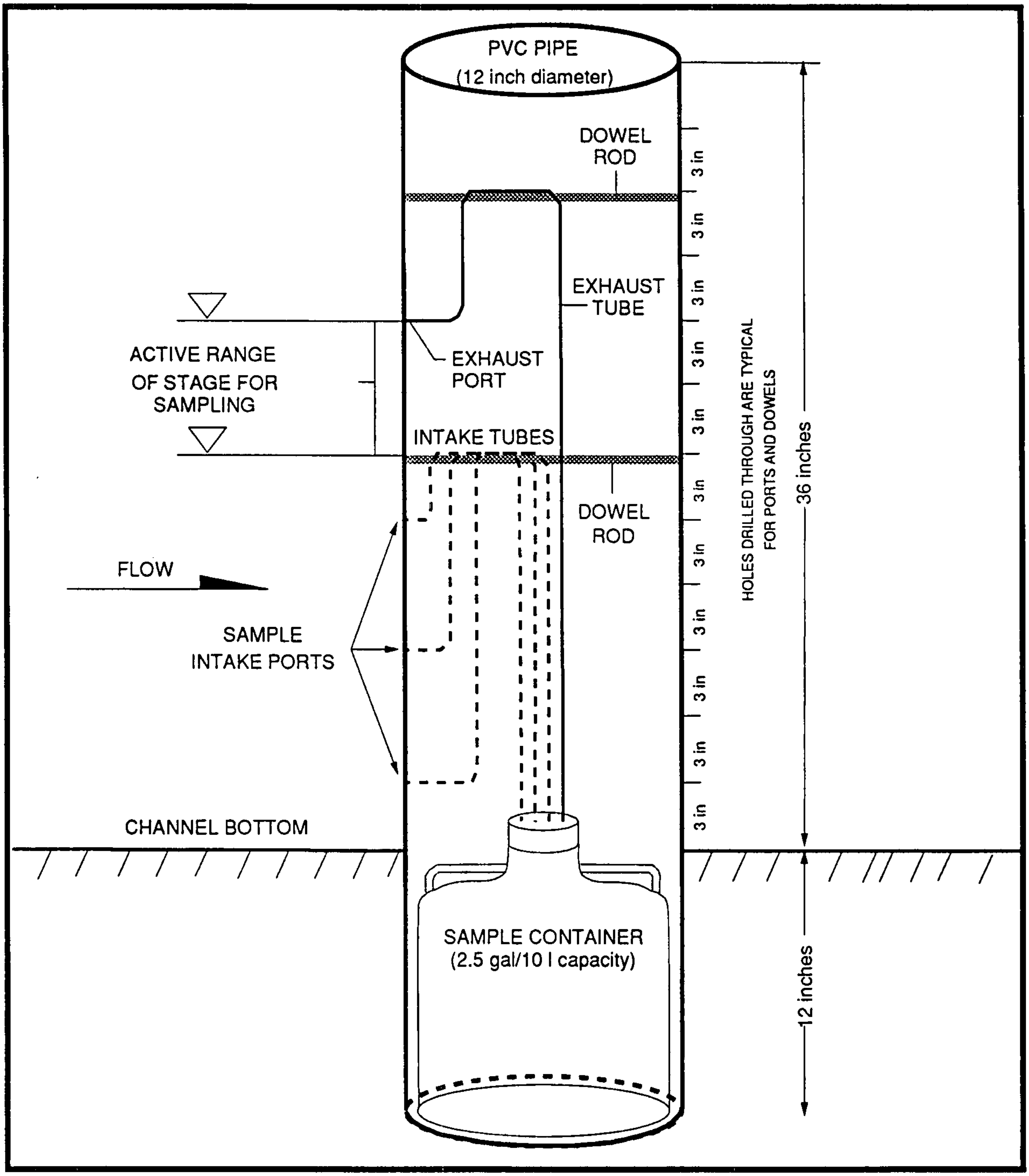
WEATHER BUREAU CLASS A EVAPORATION PAN

Project No's: 208.0102
& 208.0103

NON-POINT SOURCE ASSESSMENT
AND STORM-SEWER I/I & E STUDY

ZERO-OFFSITE WATER DISCHARGE

Figure No. 5



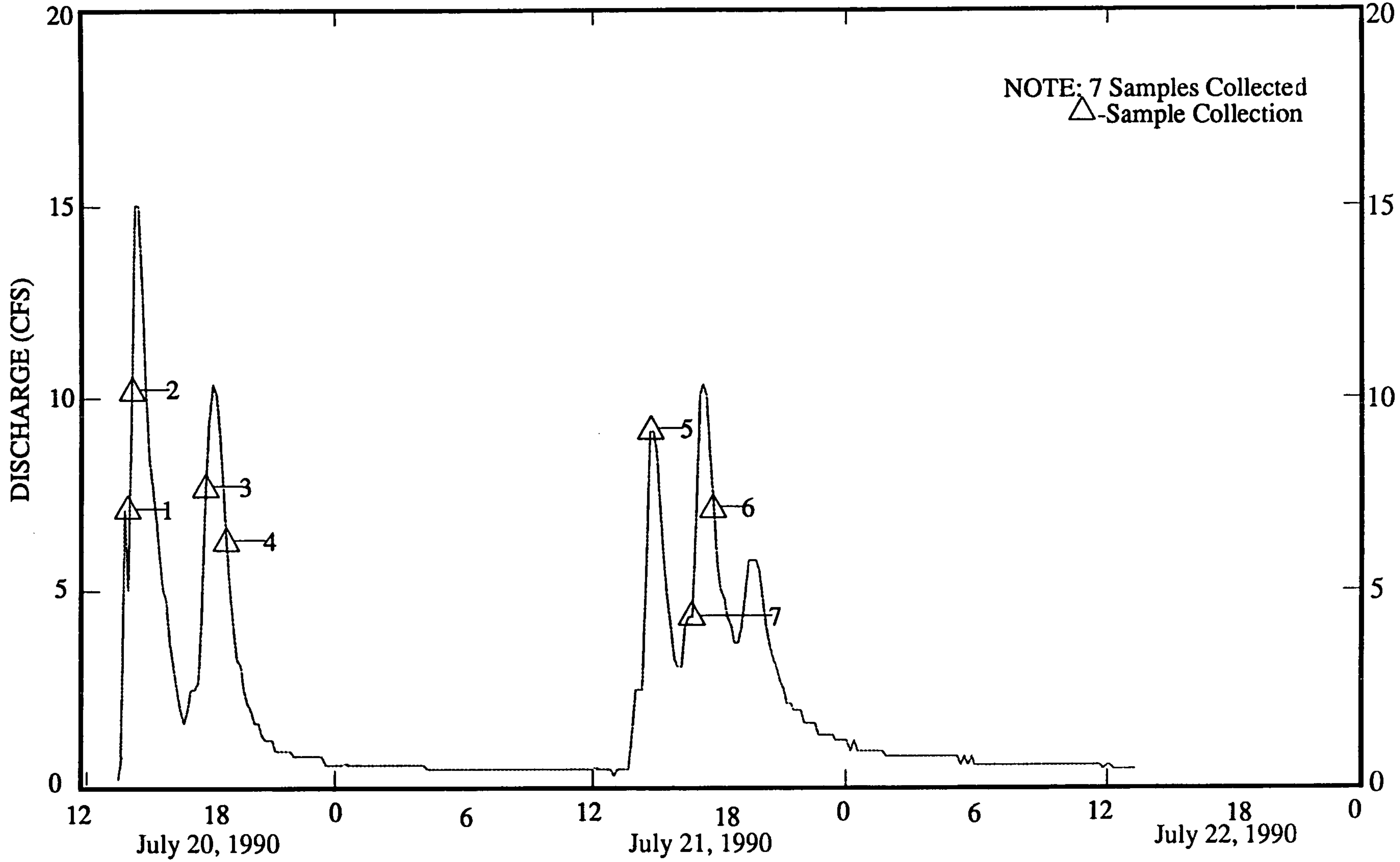
MISSISSIPPI

Mobile Integrated Sediment Sampler Involving Staggered Stage Intake Ports for Precision Investigations

Project No's: 208.0102
& 208.0103

NON-POINT SOURCE ASSESSMENT
AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Figure No. 6

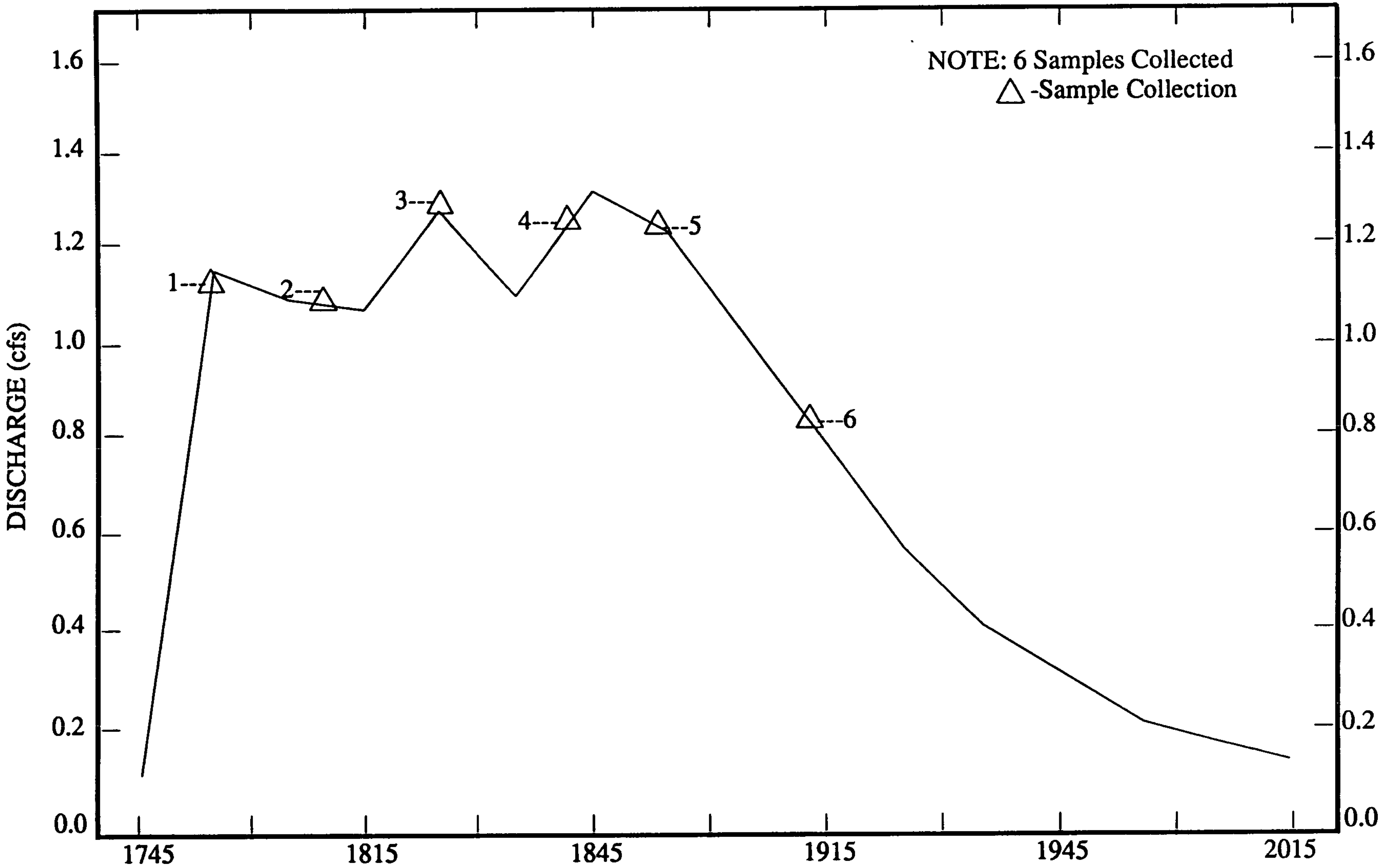


STORM HYDROGRAPH
SITE SW118 N. Walnut Creek U/S from Drop Structure
July 20-22, 1990

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102
208.0103

Figure 7 A

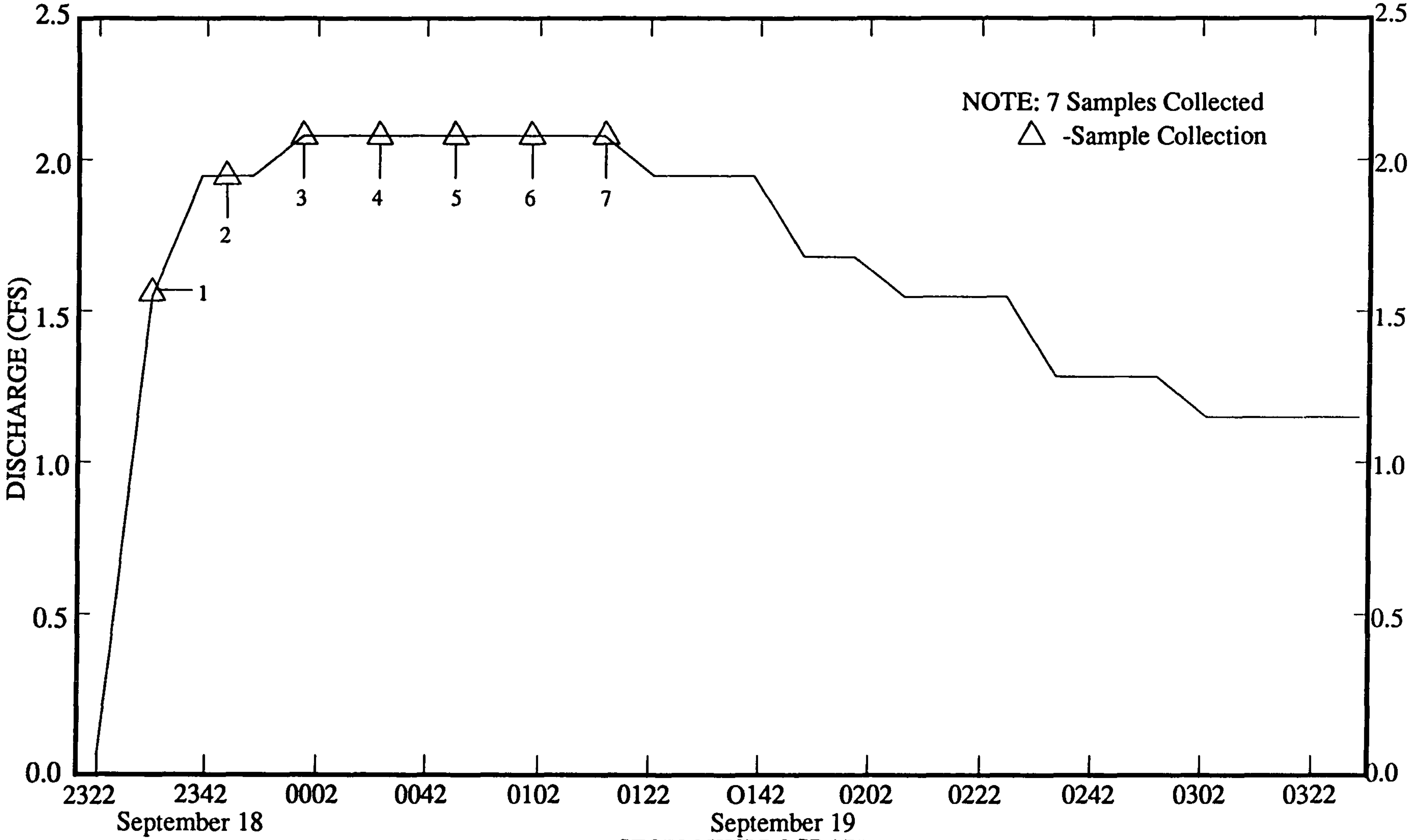


STORM HYDROGRAPH
SW023 S. Walnut Creek at STP
August 22, 1990

Project No's: 208.0102
208.0103

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Figure 7 B

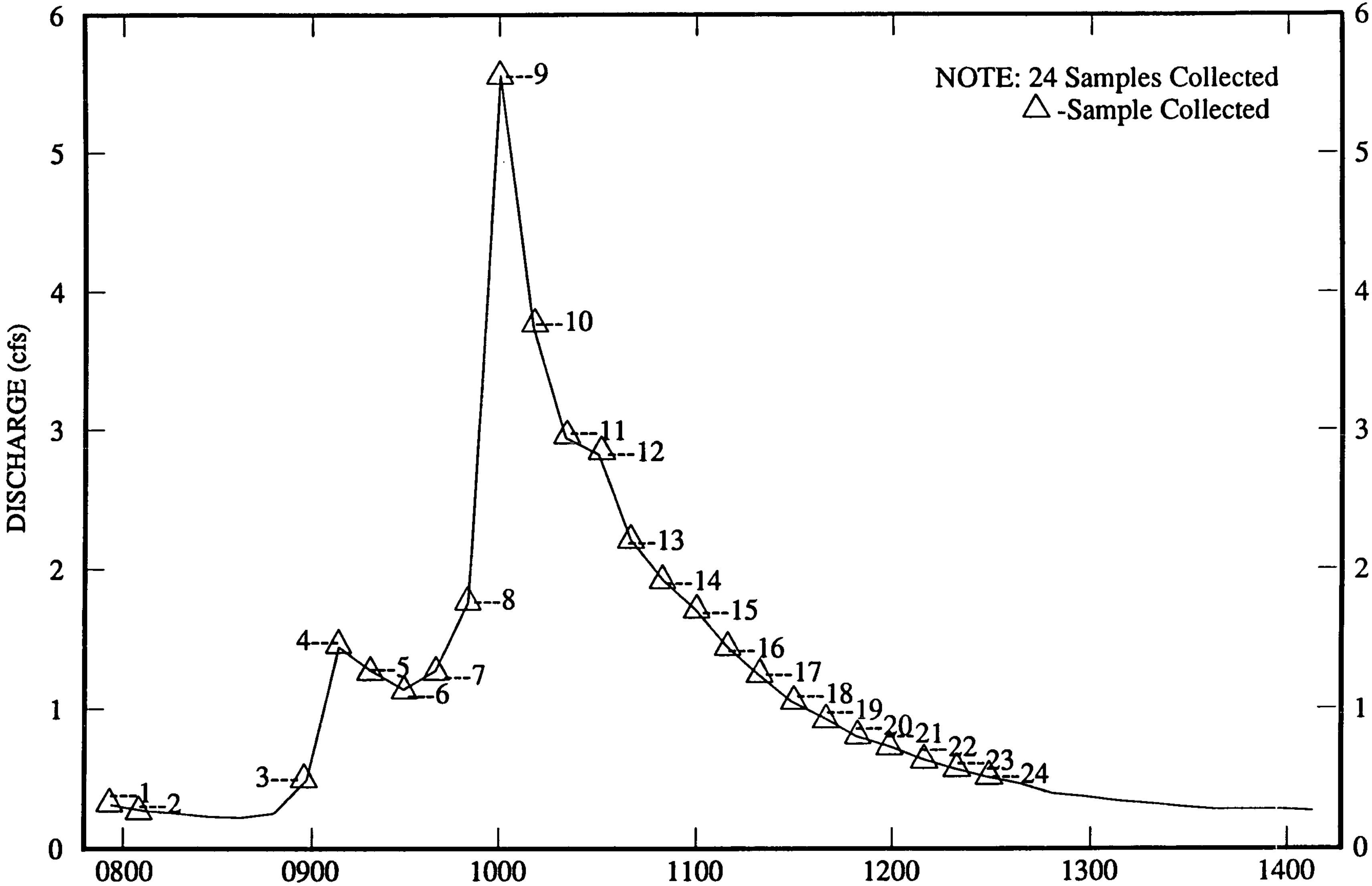


STORM HYDROGRAPH
SITE SW027 S. Diversion Channel at Woman Creek
September 18-19, 1990

NON-POINT SOURCE ASSESMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102
208.0103

Figure 7 C

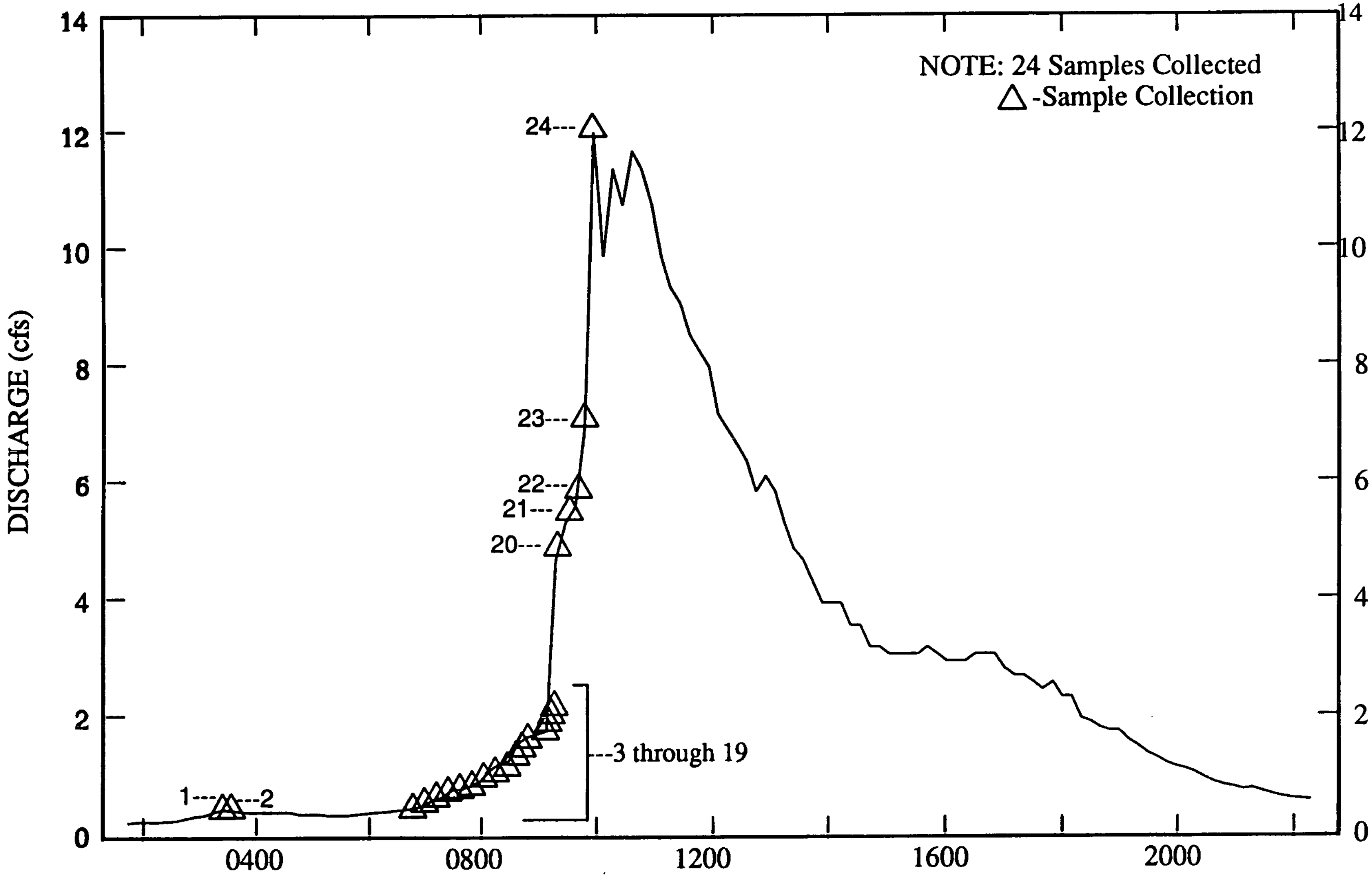


STORM HYDROGRAPH
SW023 S. Walnut Creek at STP
April 11, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 D

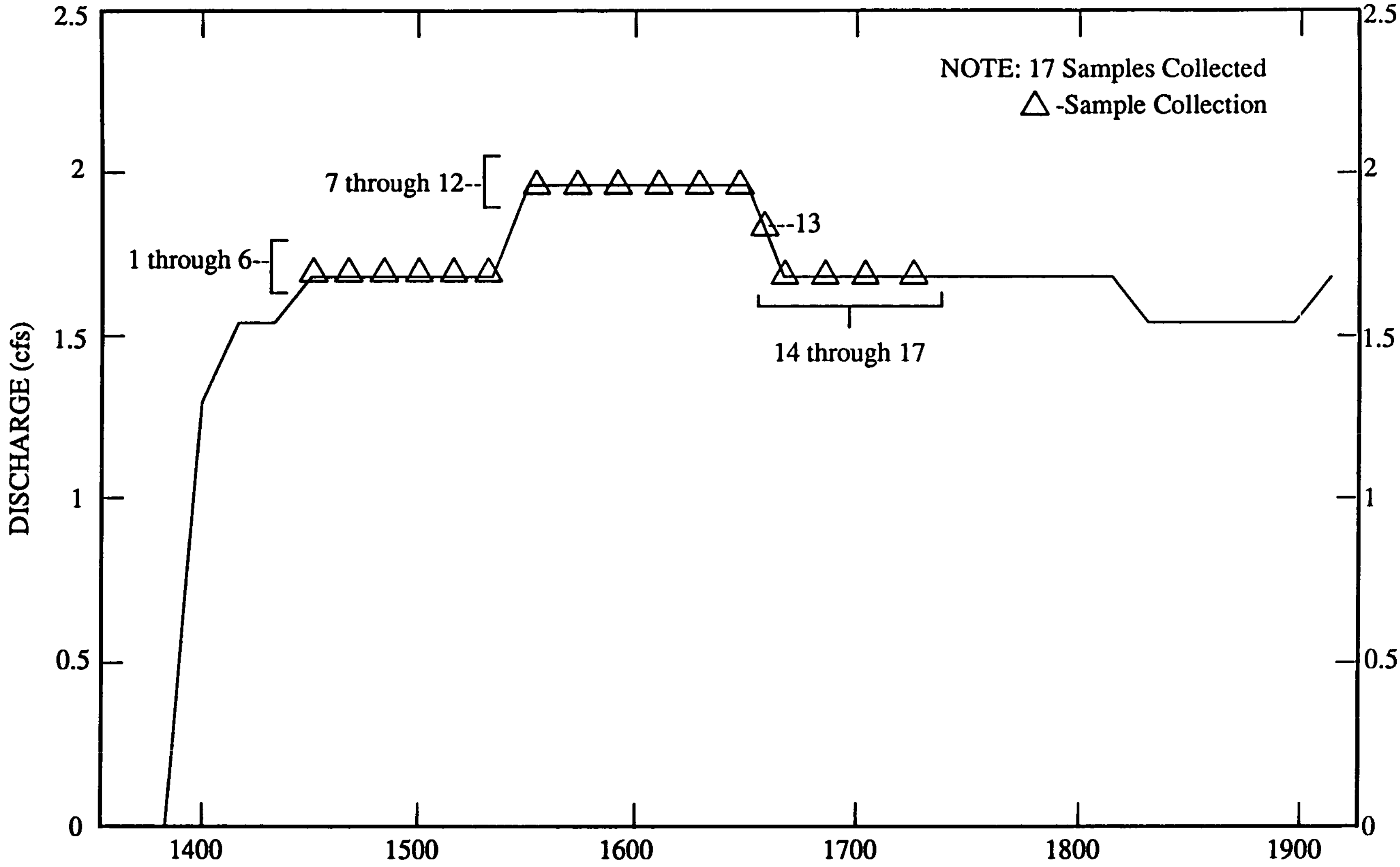


STORM HYDROGRAPH
SW023 S. Walnut Creek at STP
April 30, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 E1

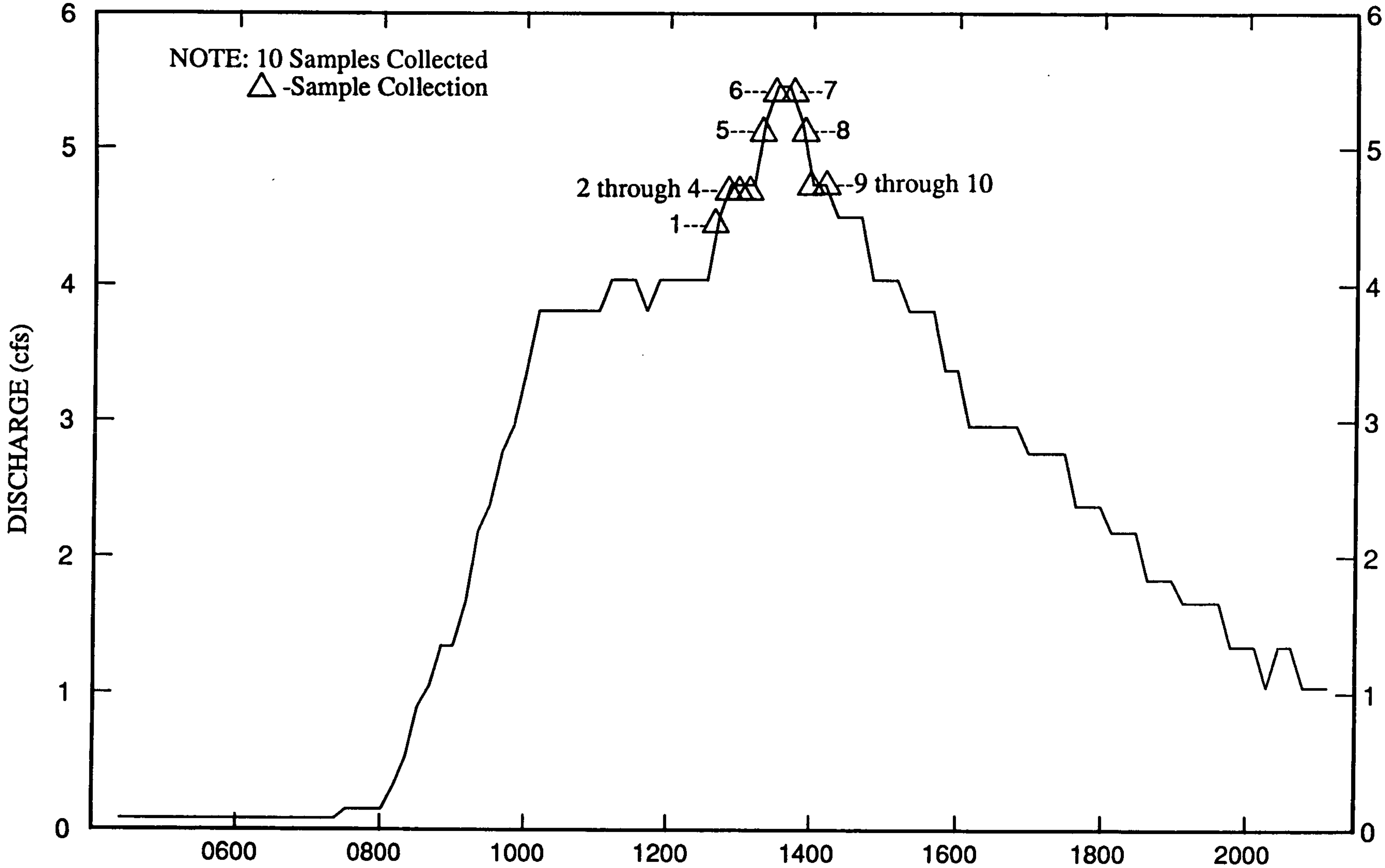


STORM HYDROGRAPH
SW027 S. Diversion Canal at Woman Creek
April 30, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 E2

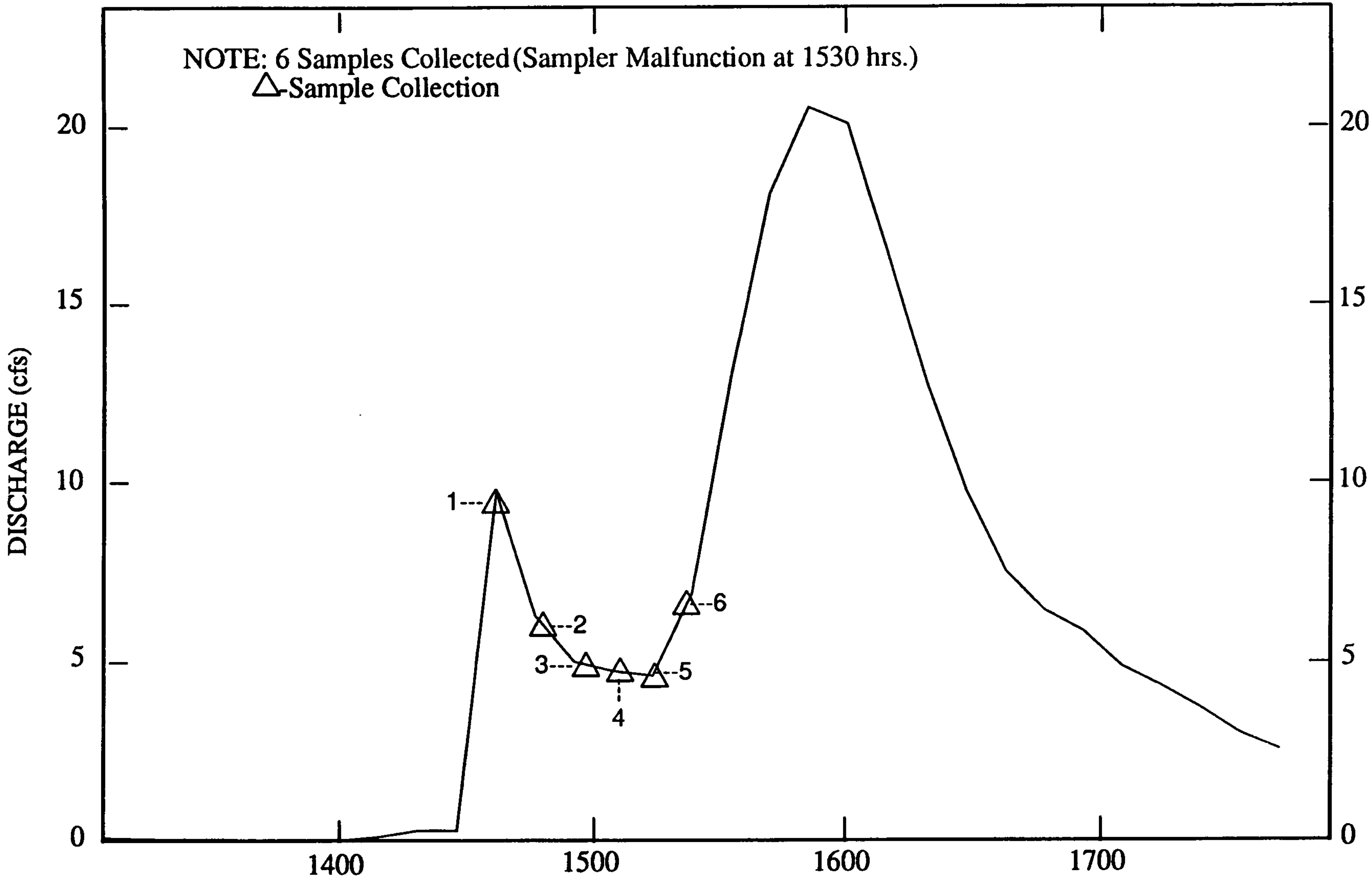


STORM HYDROGRAPH
SW118 N. Walnut Creek U/S from 72-in. CMP
April 30, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 E3

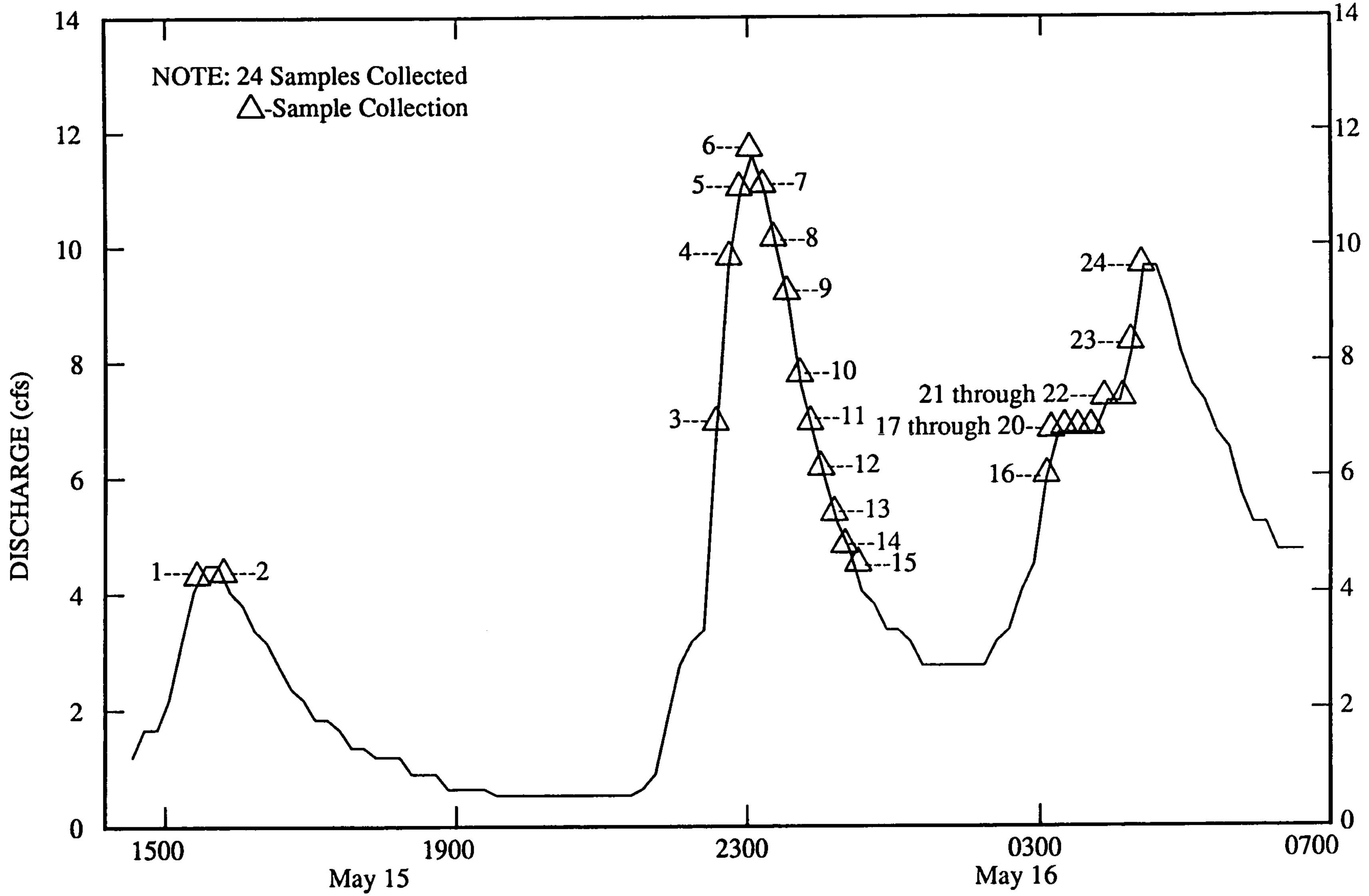


STORM HYDROGRAPH
SW093 N. Walnut Creek D/S from 72-in. CMP
May 15, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 F1

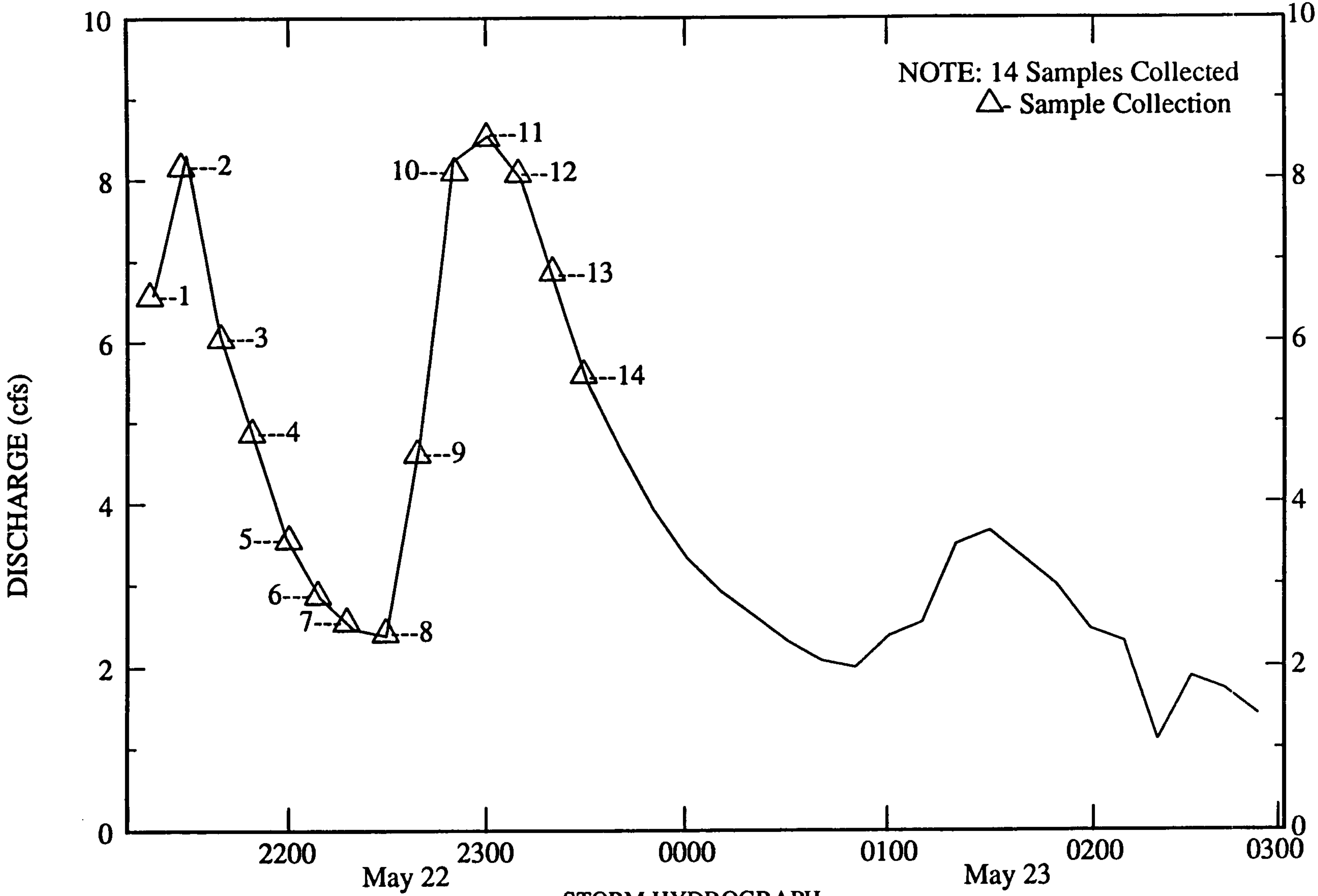


STORM HYDROGRAPH
SW118 N. Walnut Creek U/S from 72-in. CMP
May 15-16, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 F2

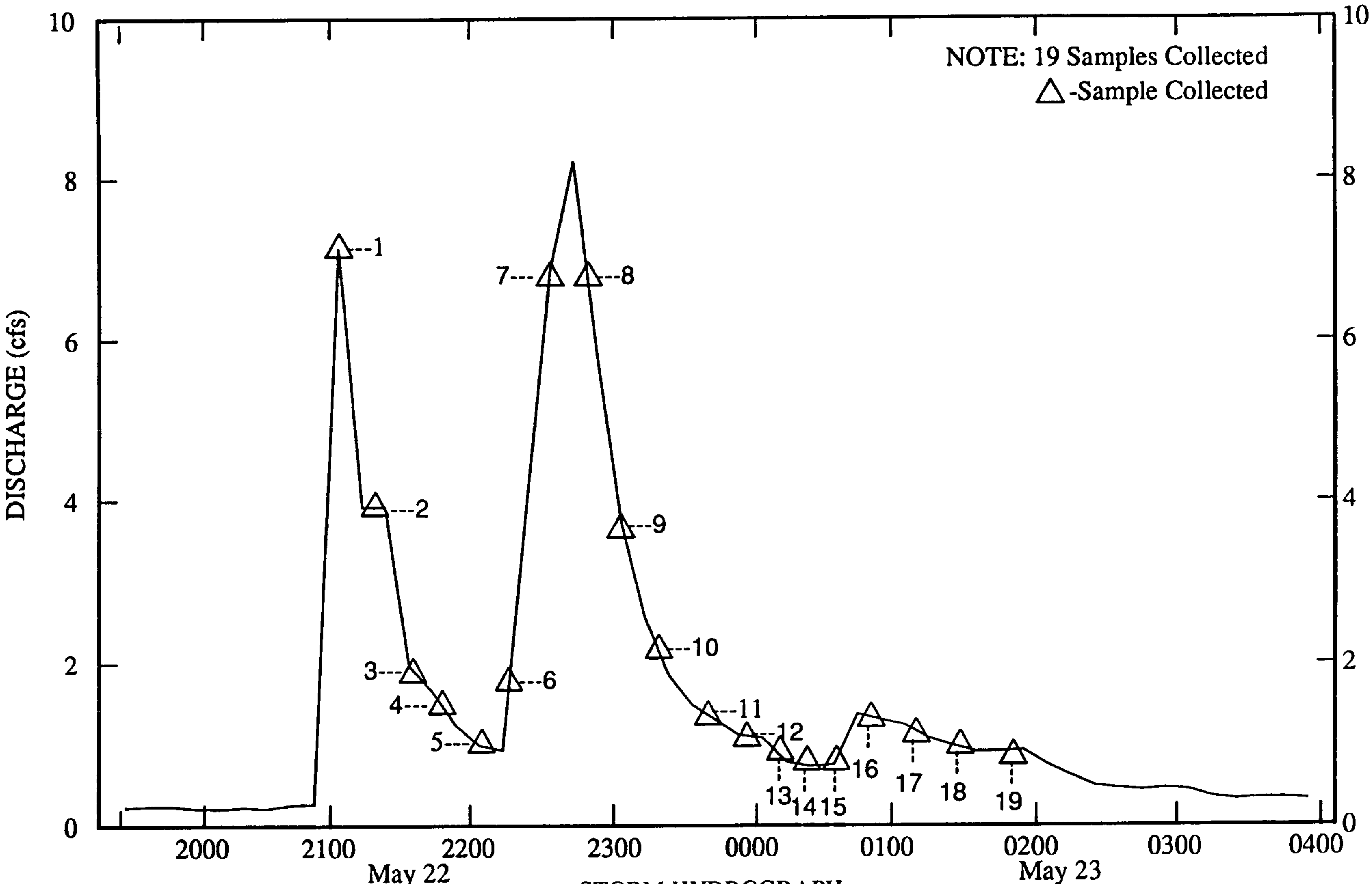


STORM HYDROGRAPH
SW022 Ditch at Concrete Diversion Box Structure
May 22-23, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 G1

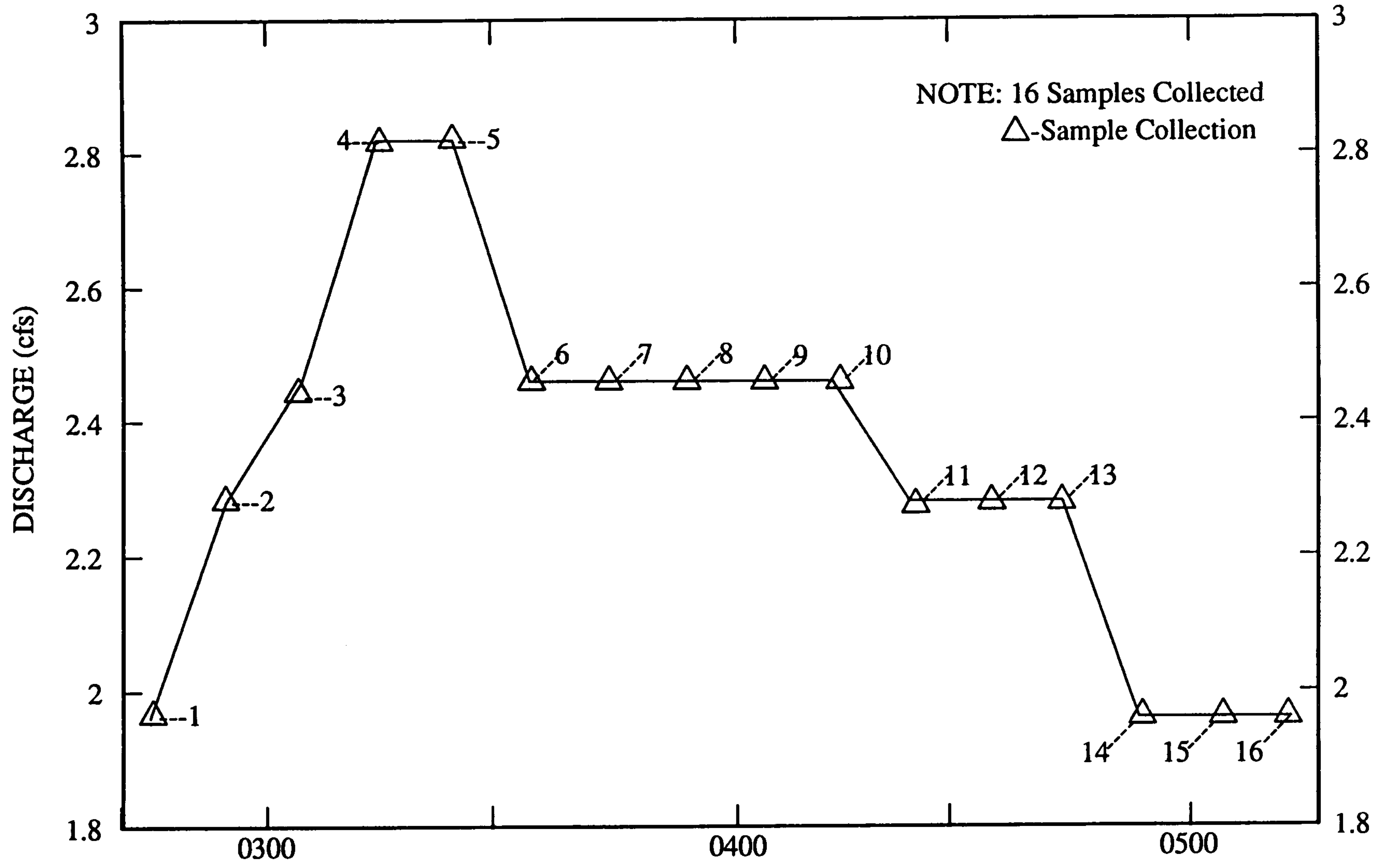


STORM HYDROGRAPH
SW023 S. Walnut Creek at STP
May 22-23, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102 & 208.0103

Figure 7 G2

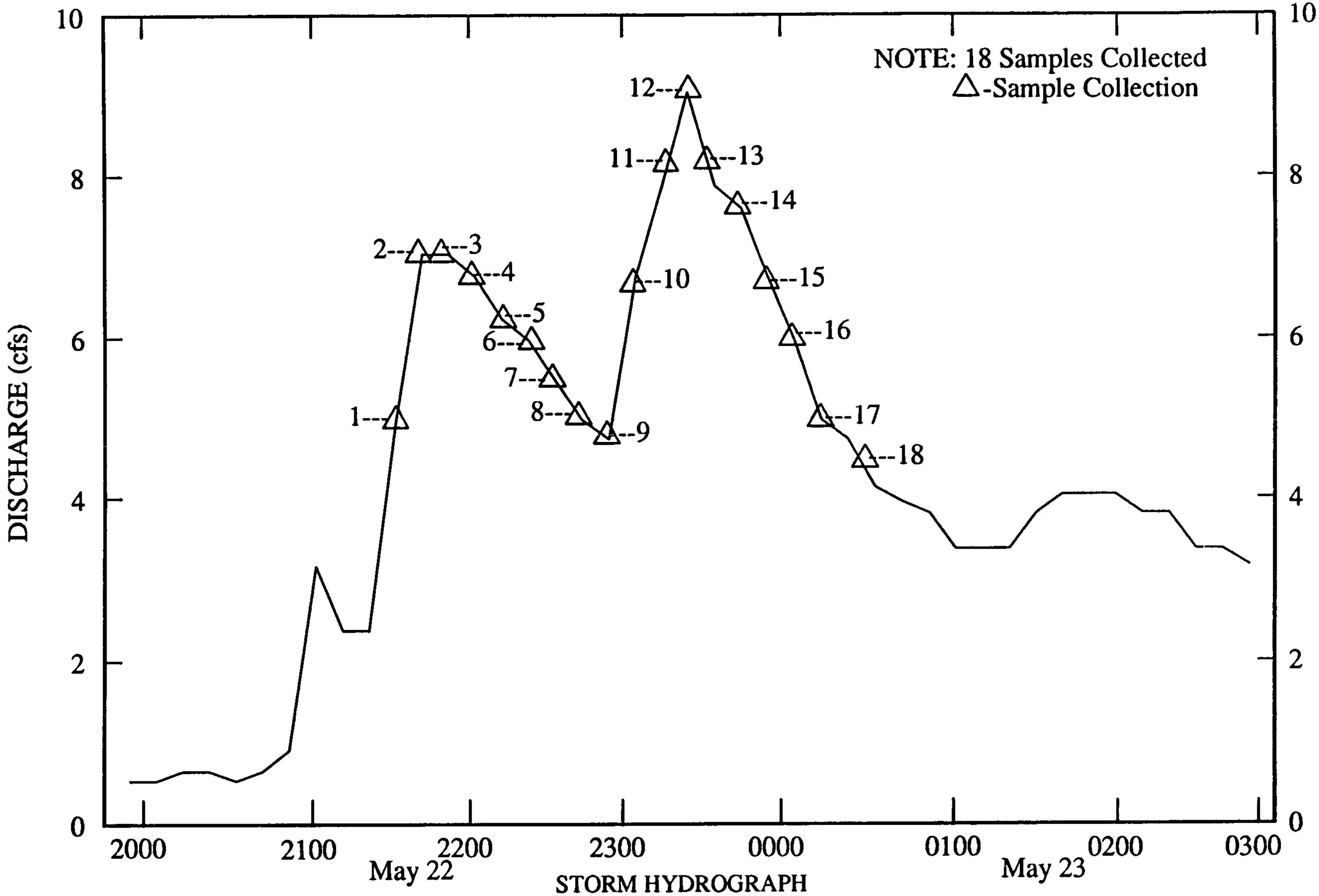


STORM HYDROGRAPH
SW027 S. Diversion Canal at Woman Creek
May 23, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102 & 208.0103

Figure 7 G3

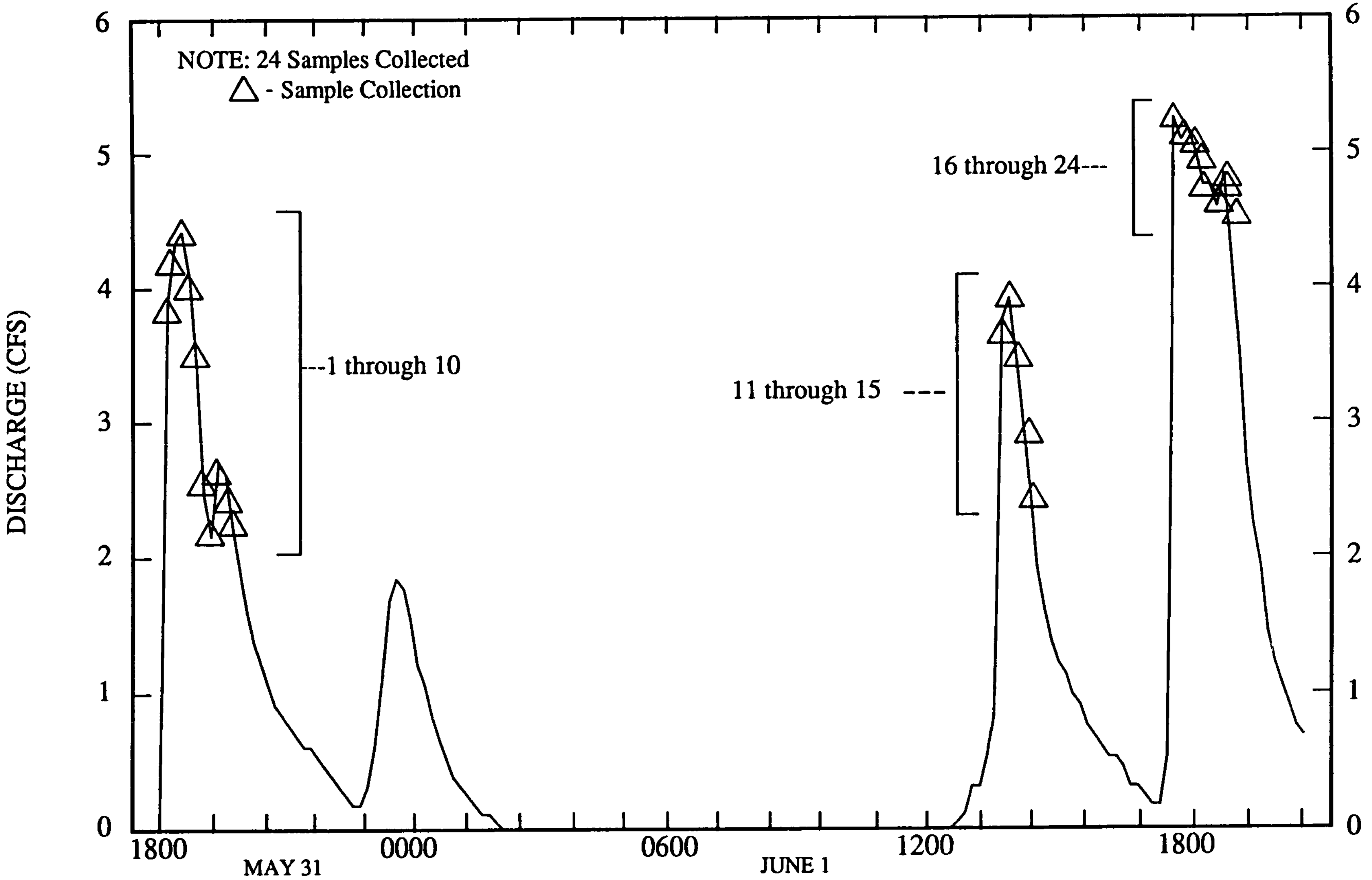


STORM HYDROGRAPH
SW118 N. Walnut Creek U/S from Drop Structure
May 22-23, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 G4

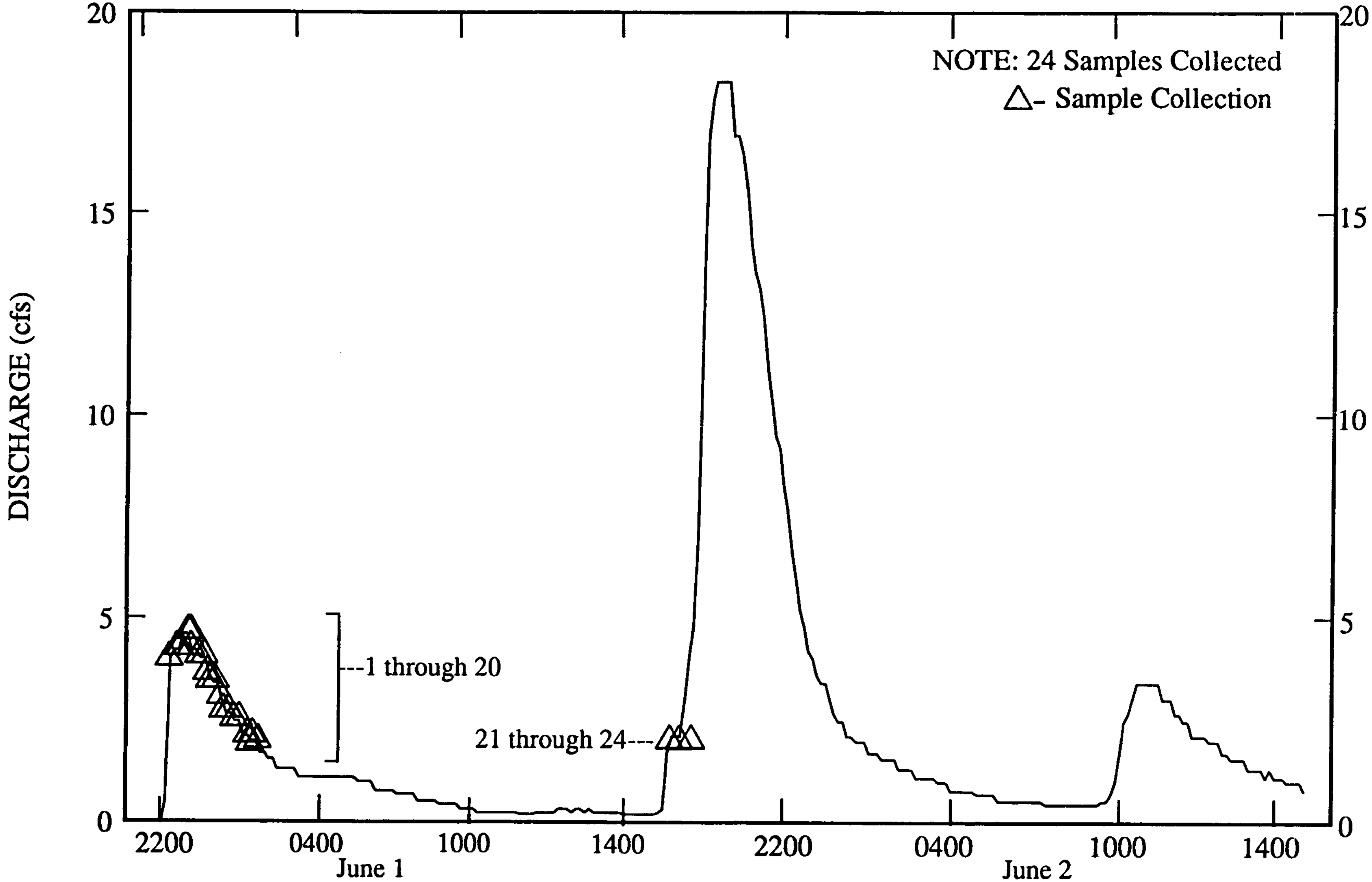


STORM HYDROGRAPH
SITE SW022 Ditch at Concrete Diversion Box Structure
May 31 - June 1, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 H1

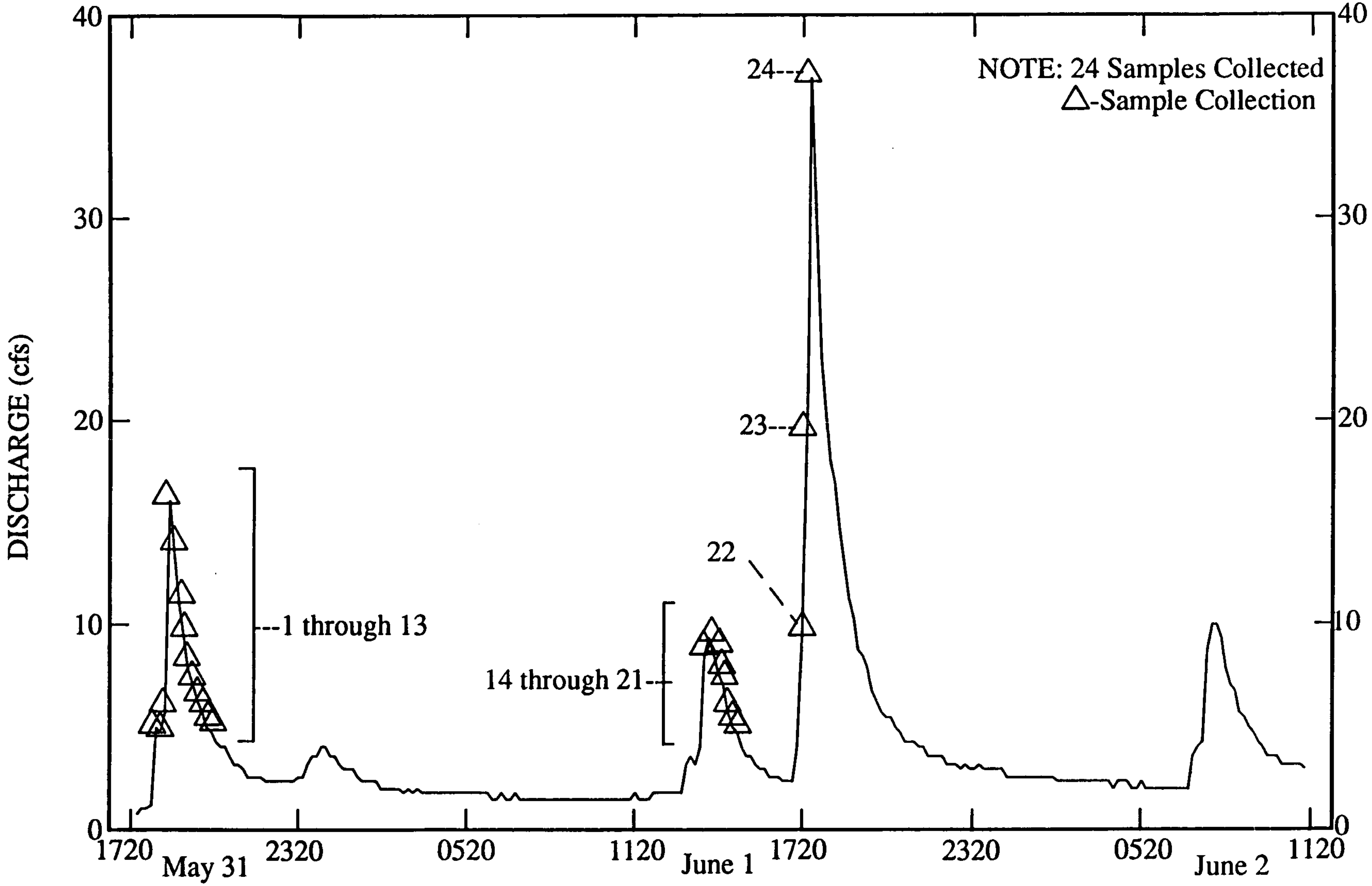


STORM HYDROGRAPH
SW027 S. Diversion Channel at Woman Creek
May 31 - June 1, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 H2

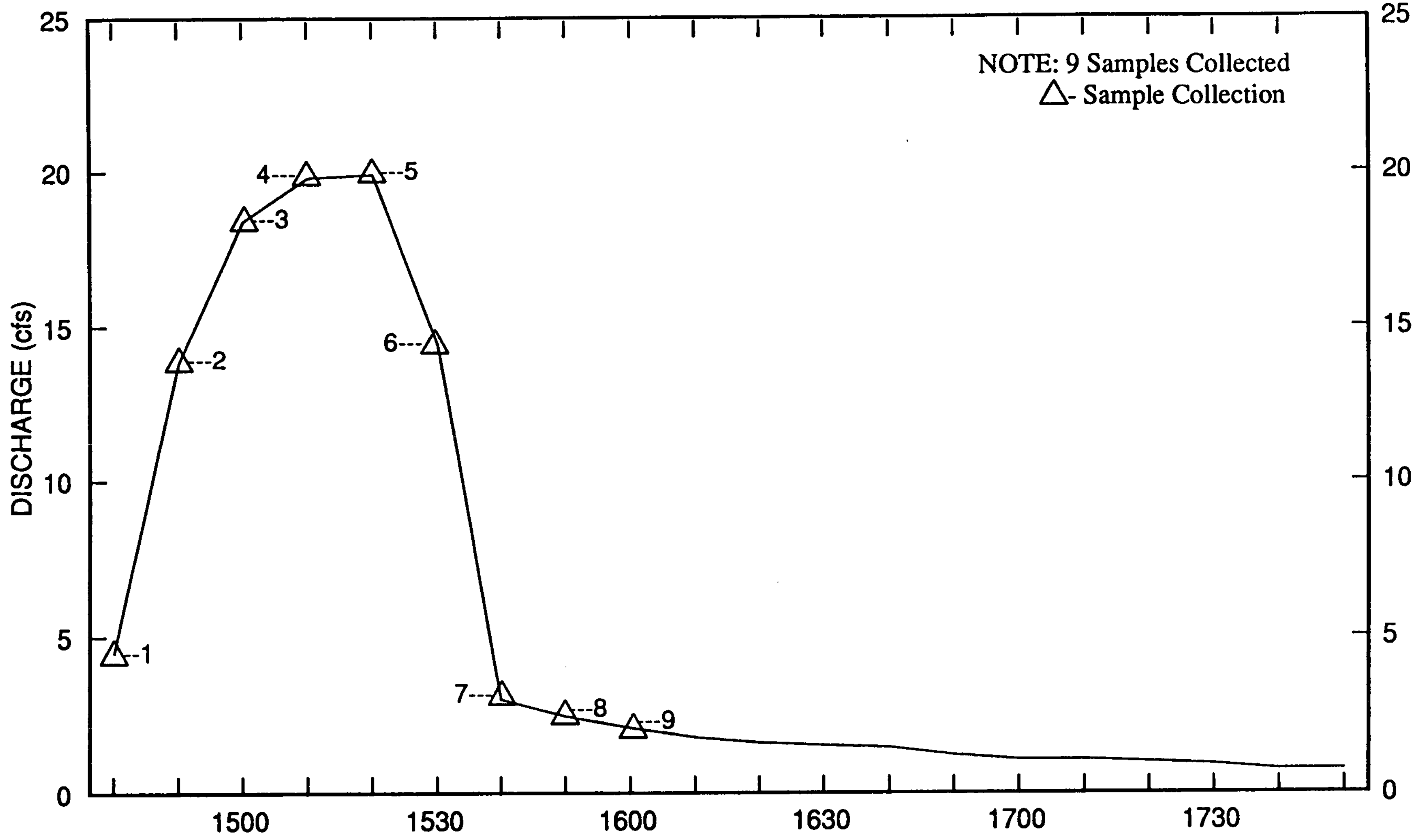


STORM HYDROGRAPH
SW118 Ditch at Concrete Diversion Box Structure
May 31 - June 2, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 H3

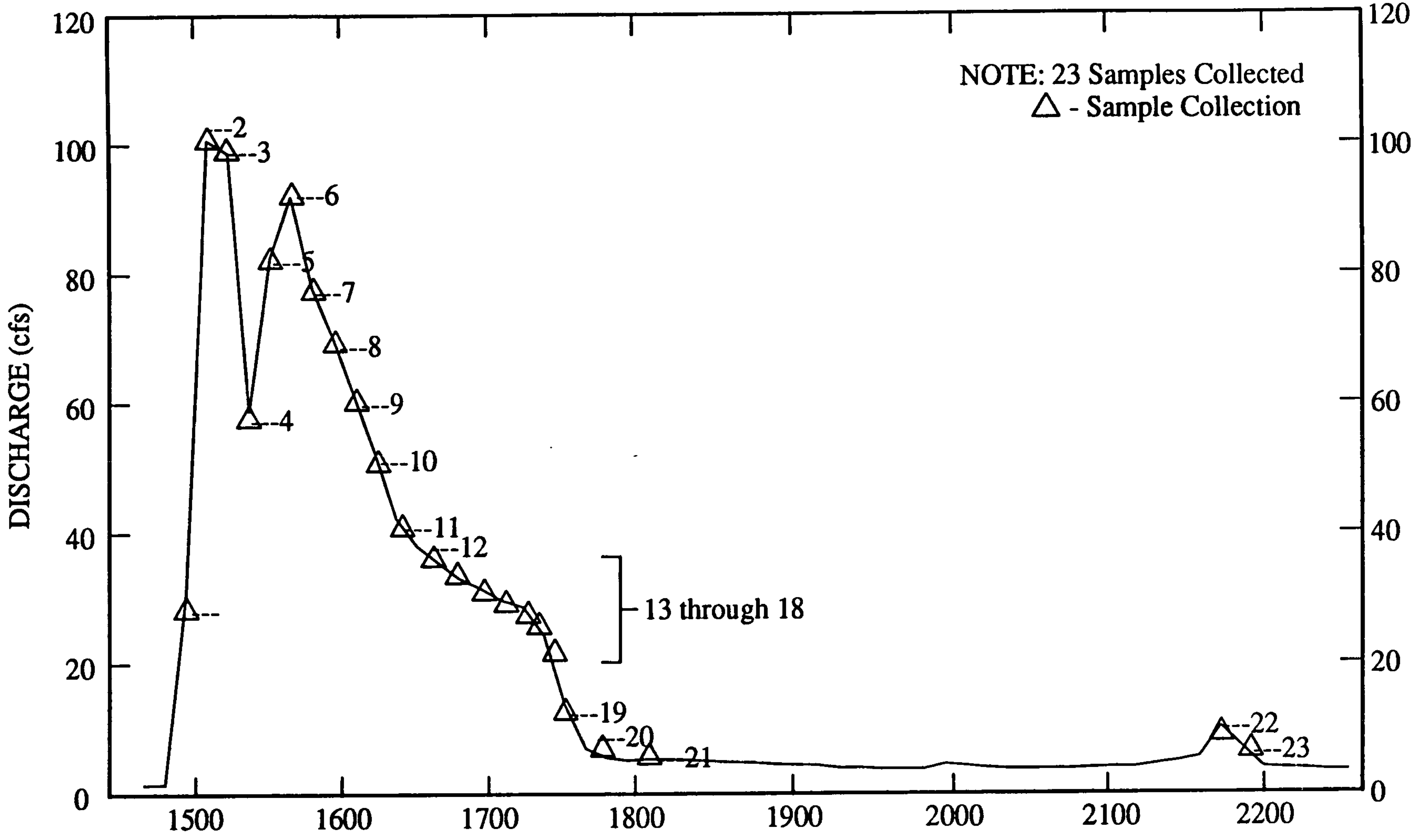


STORM HYDROGRAPH
SW022 Ditch at Concrete Diversion Box Structure
June 7, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 I1

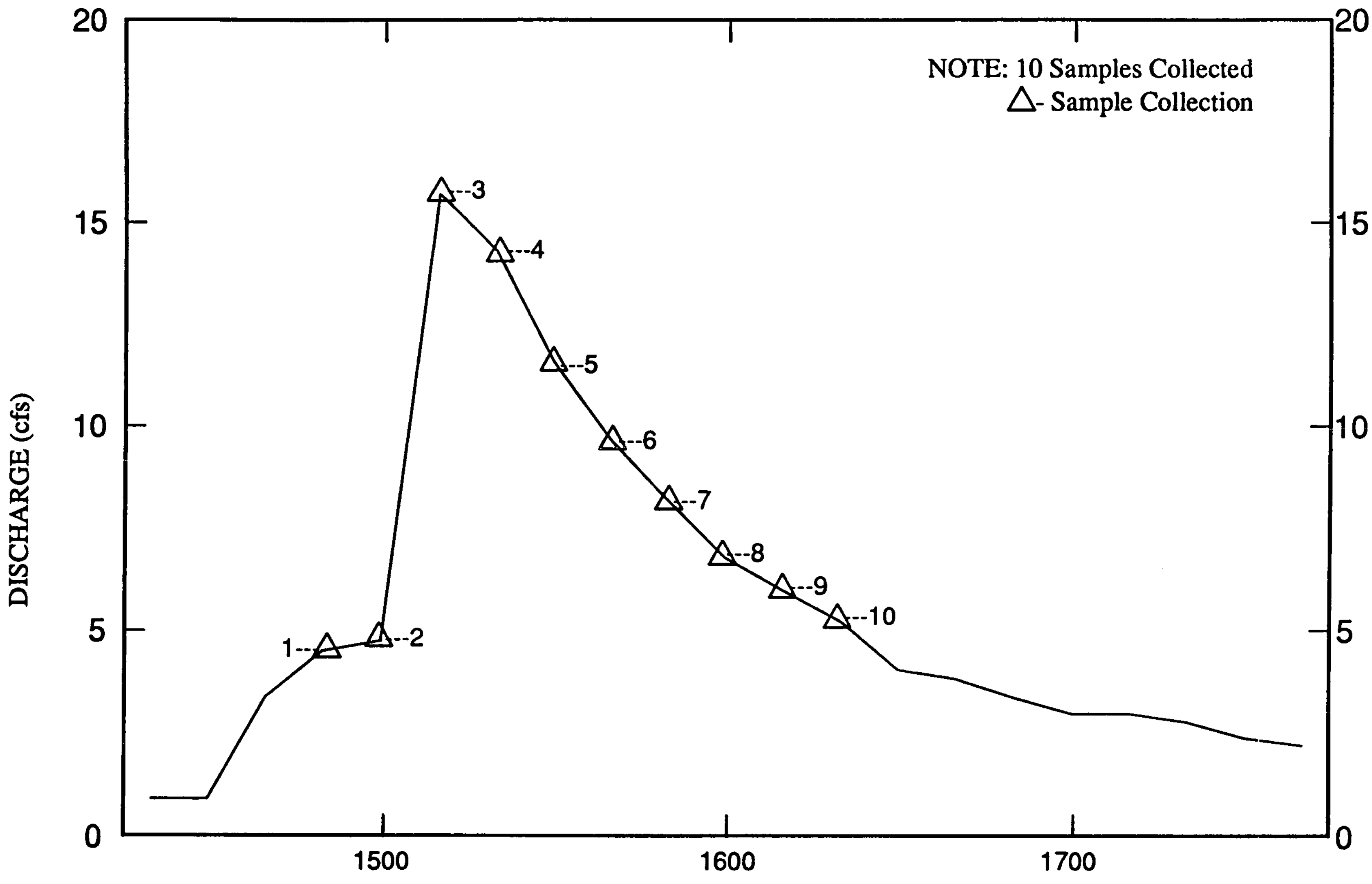


STORM HYDROGRAPH
SW093 Ditch at Concrete Diversion Box Structure
June 7, 1991

Project No's: 208.0102
208.0103

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Figure 7 I2

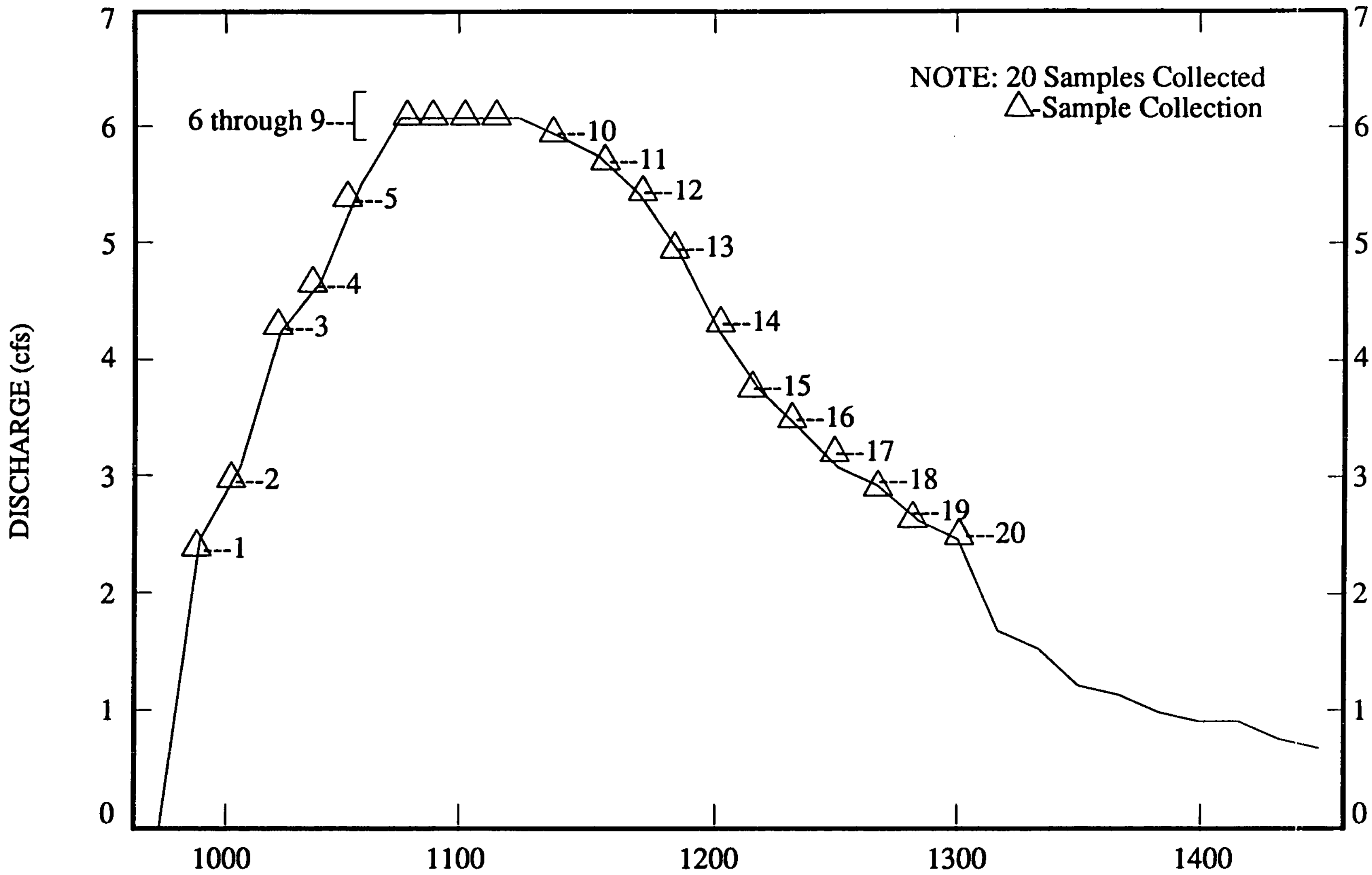


STORM HYDROGRAPH
SW118 N. Woman Creek U/S from 72-in. CMP
August 7, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 I3

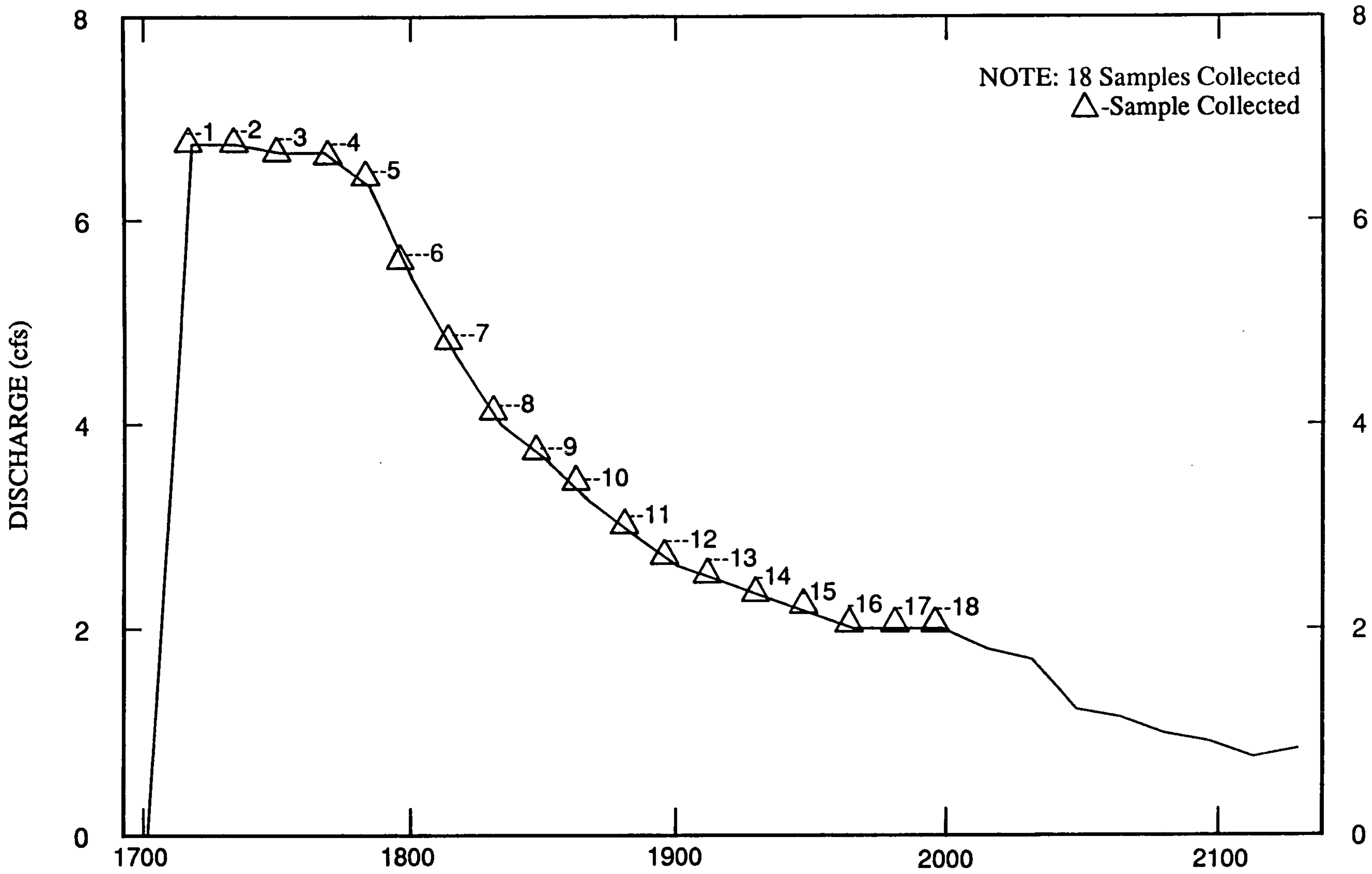


STORM HYDROGRAPH
SW022 Ditch at Concrete Diversion Box Structure
August 3-4, 1991

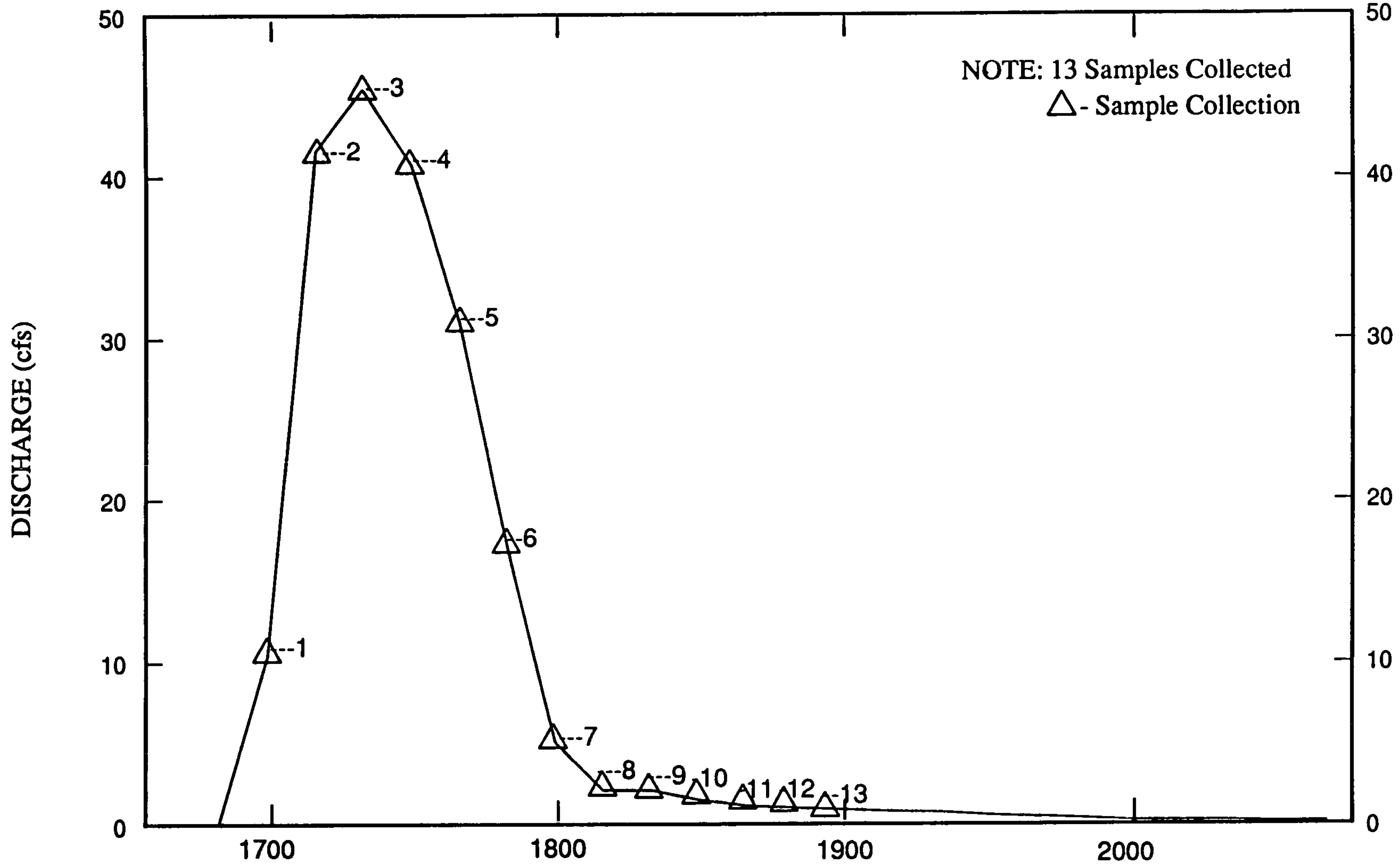
NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102
208.0103

Figure 7 J



STORM HYDROGRAPH
SW022 Ditch at Concrete Diversion Box Structure
August 6, 1991

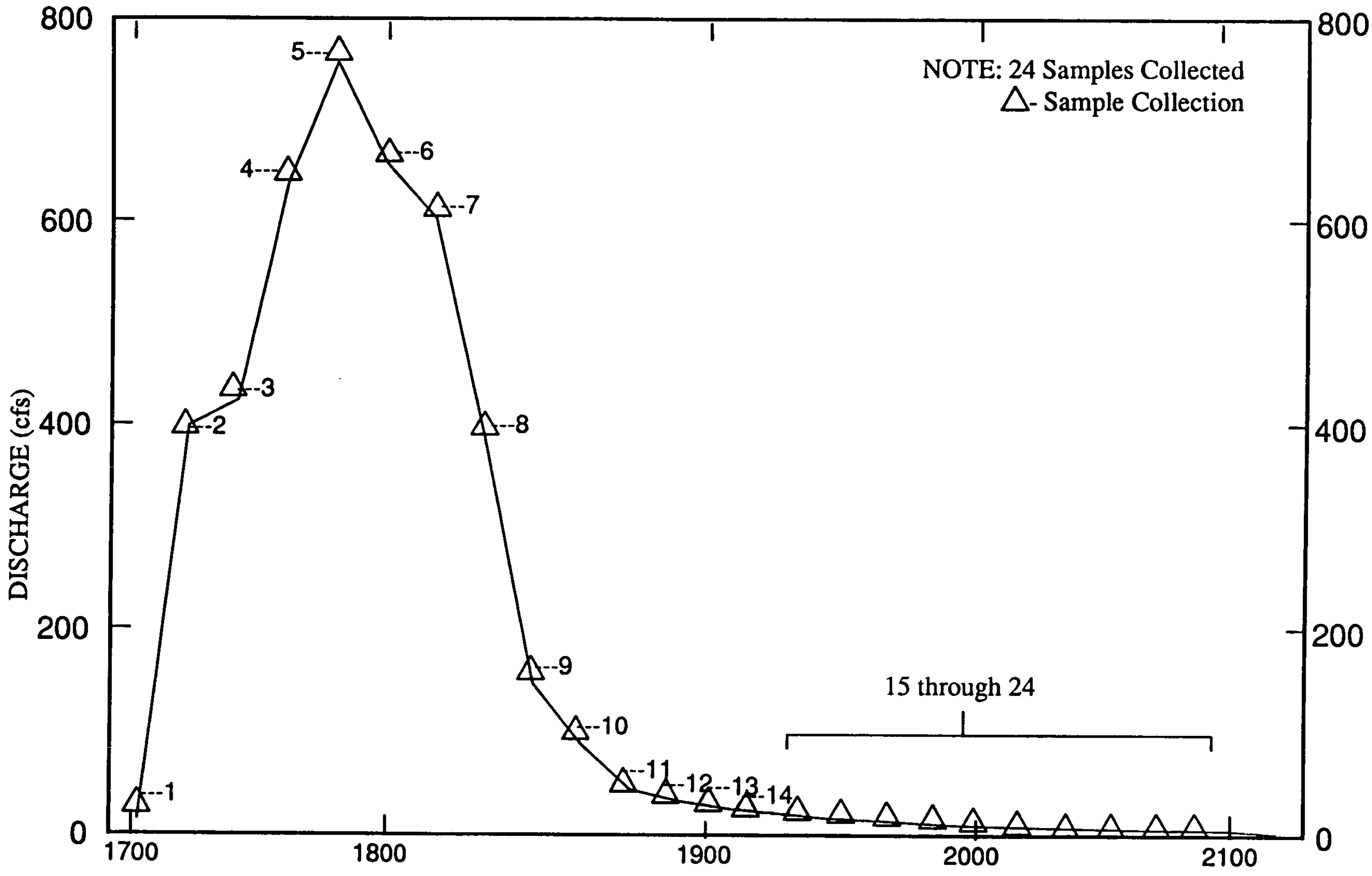


STORM HYDROGRAPH
SW023 S. Walnut Creek at STP
August 6, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102
& 208.0103

Figure 7 K2

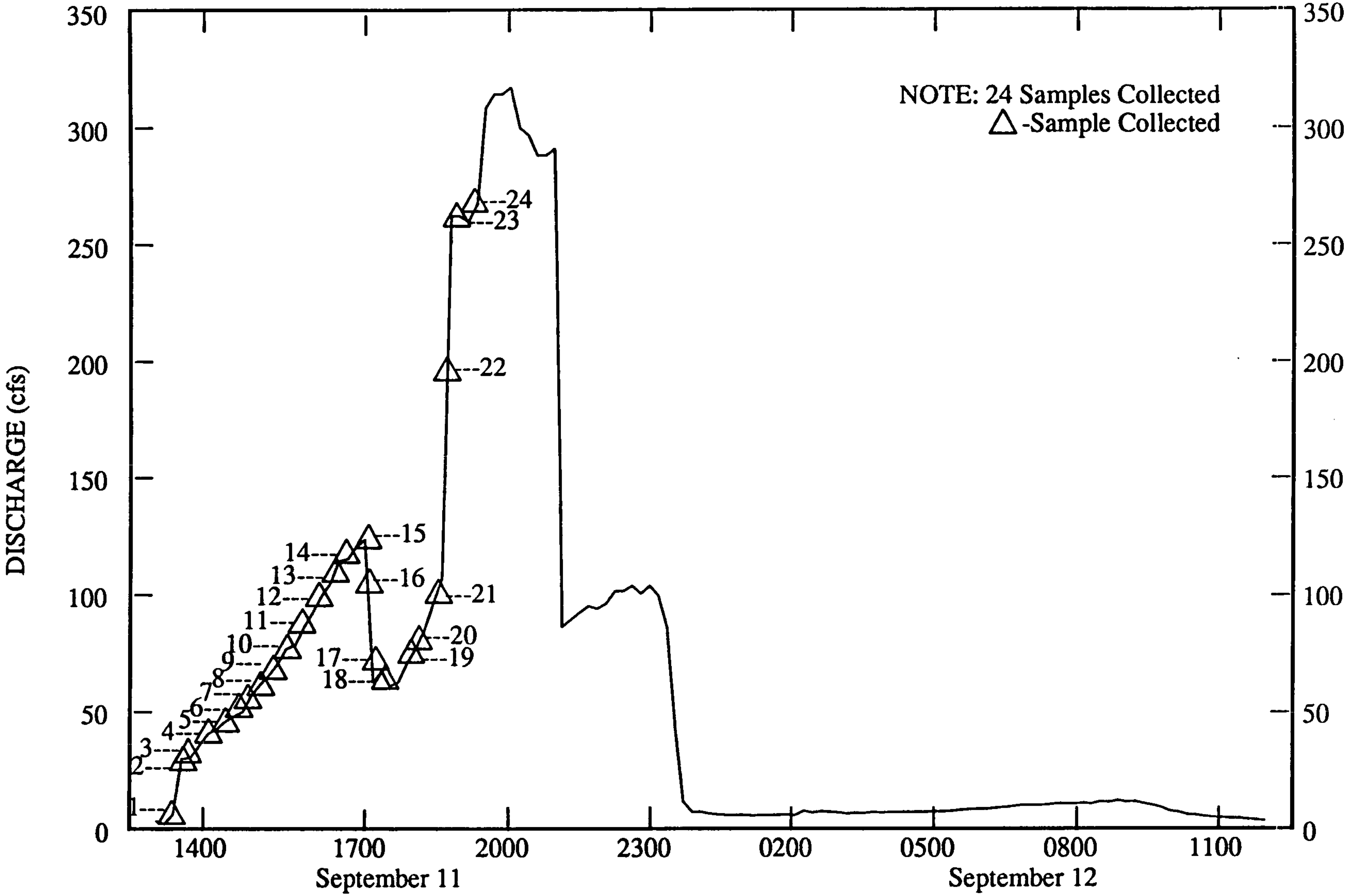


STORM HYDROGRAPH
SW093 N. Woman Creek D/S from 72-in. CMP
August 6, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 7 K3

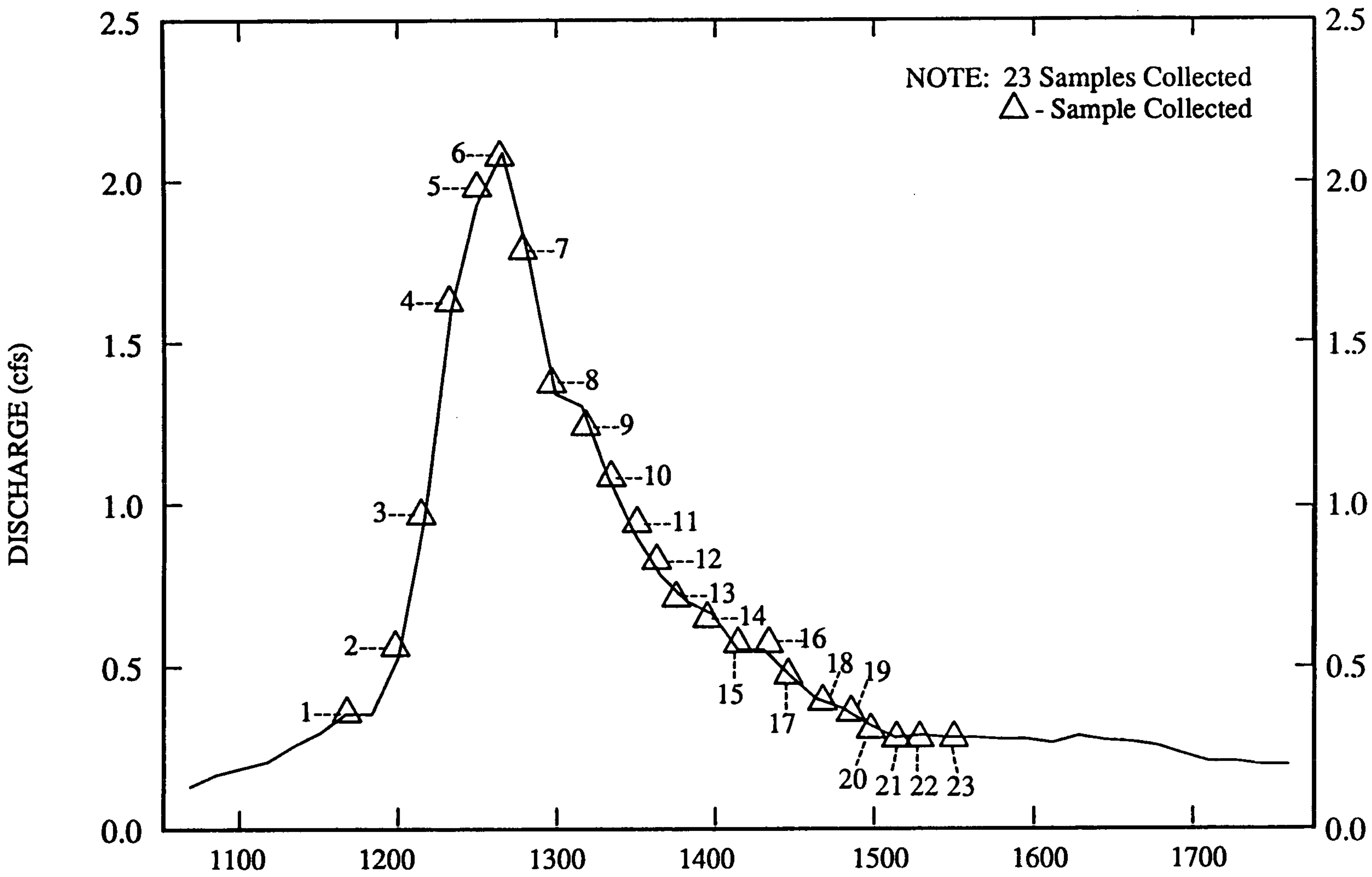


NON-PRECIPITATION EVENT HYDROGRAPH
SW093 N. Walnut Creek D/S from 72-in. CMP
September 11-12, 1990

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

Figure 8 A

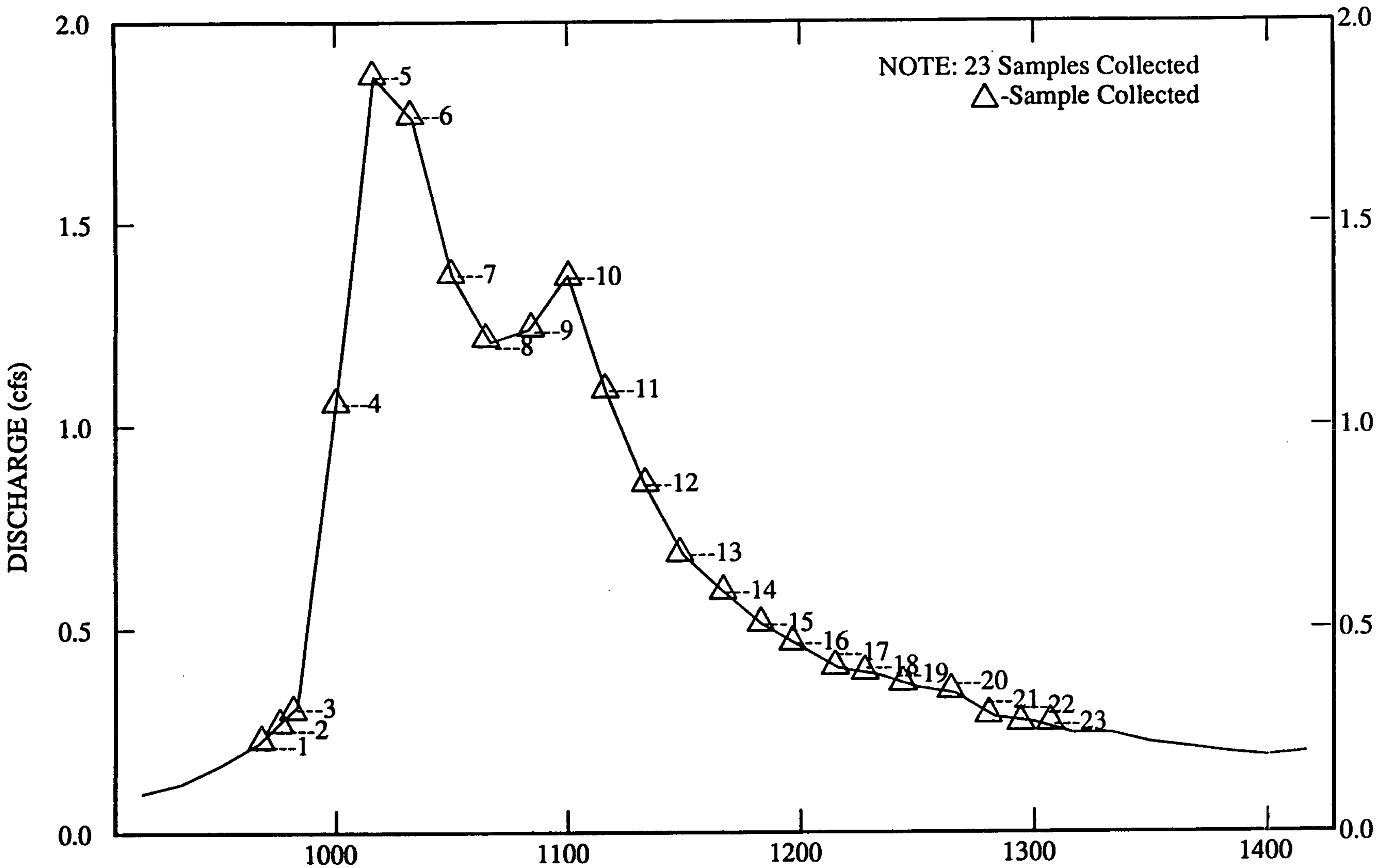


NON-PRECIPITATION EVENT HYDROGRAPH
SW023 S. Walnut Creek at STP
November 9, 1990

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's. 208.0102
& 208.0103

Figure 8B

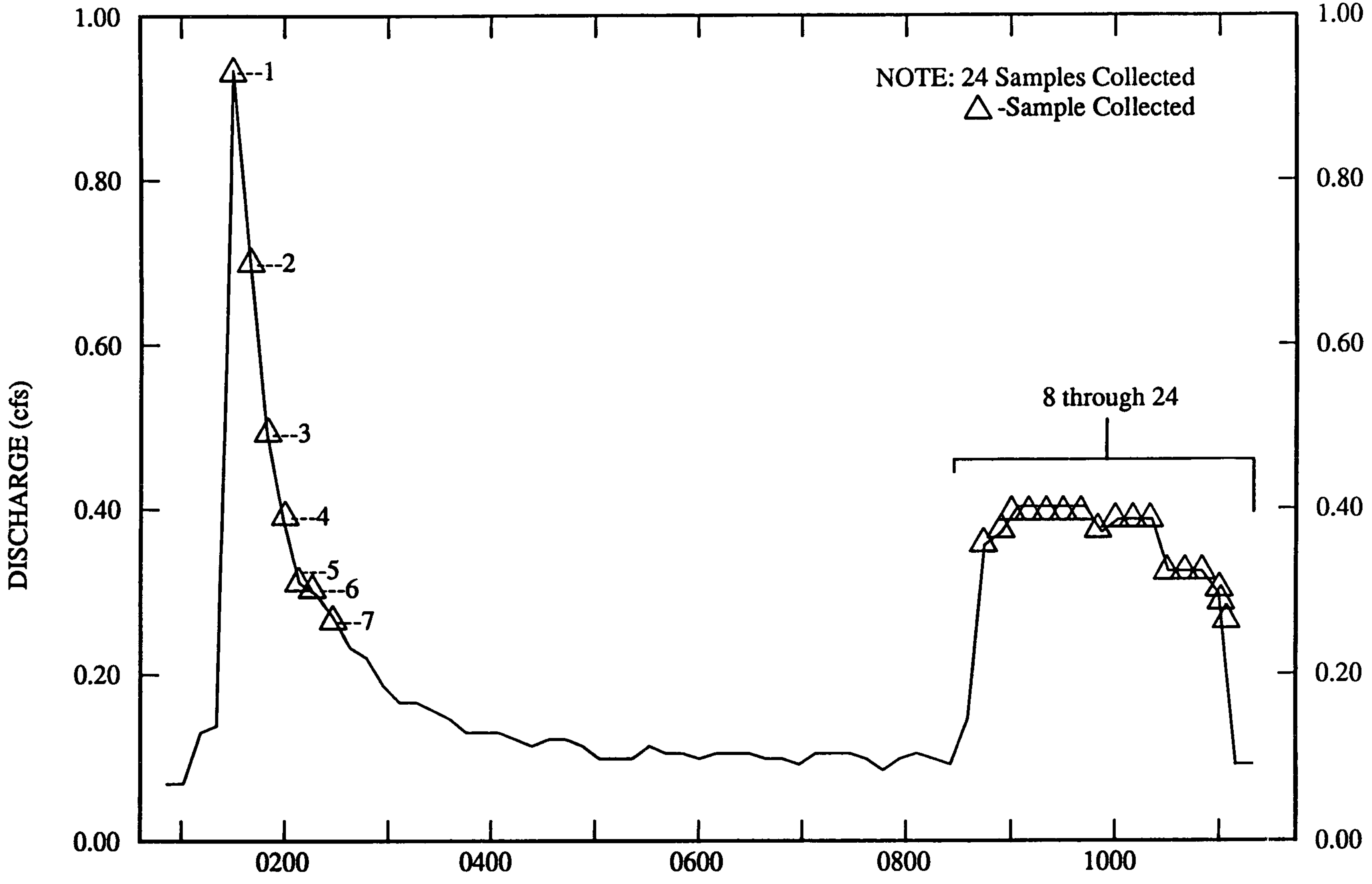


NON-PRECIPITATION EVENT HYDROGRAPH
SW023 S. Walnut Creek at STP
November 27, 1990

Project No's: 208.0102
208.0103

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Figure 8C

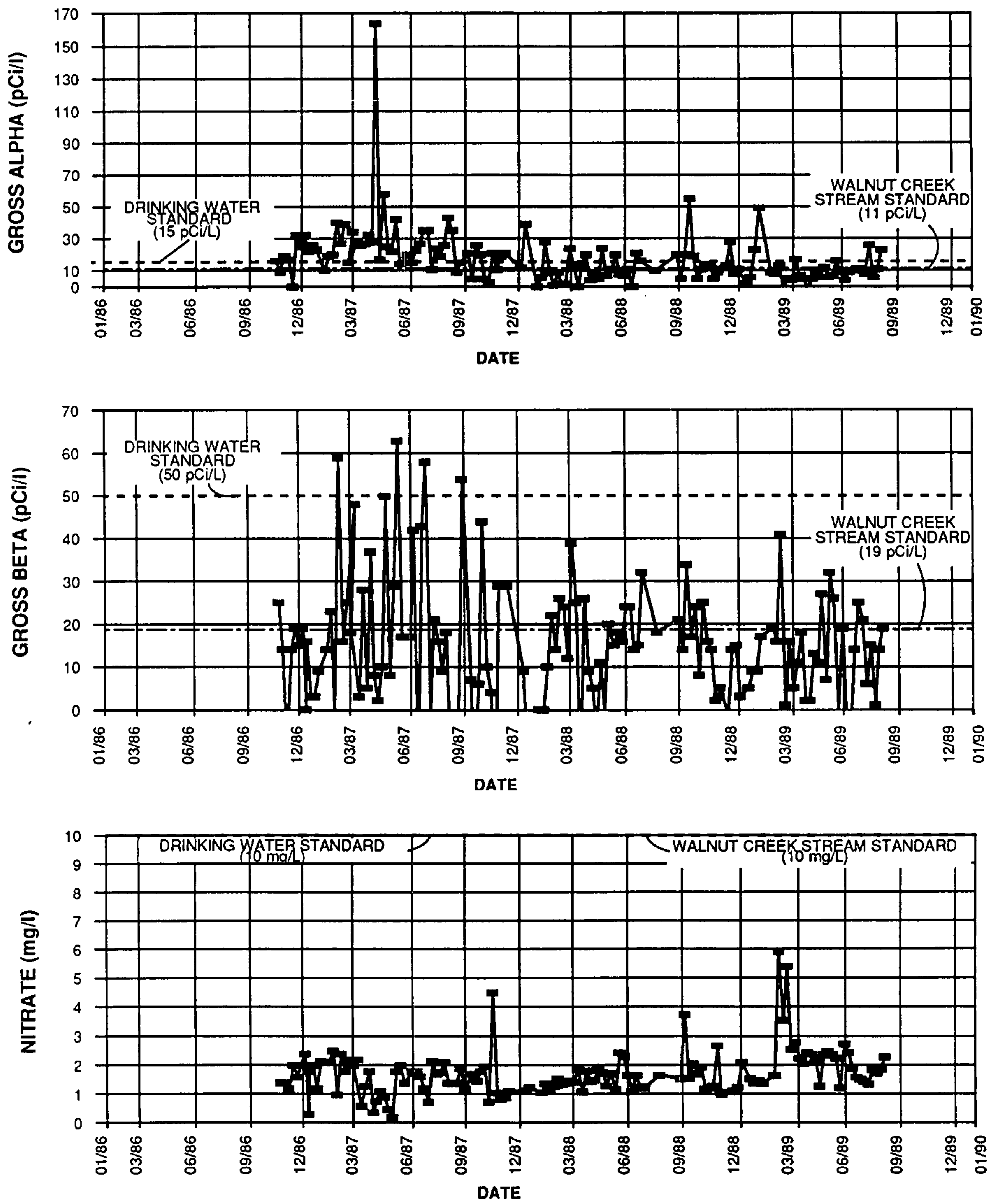


NON-PRECIPITATION EVENT HYDROGRAPH
SW023 S. Walnut Creek at STP
April 8, 1991

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

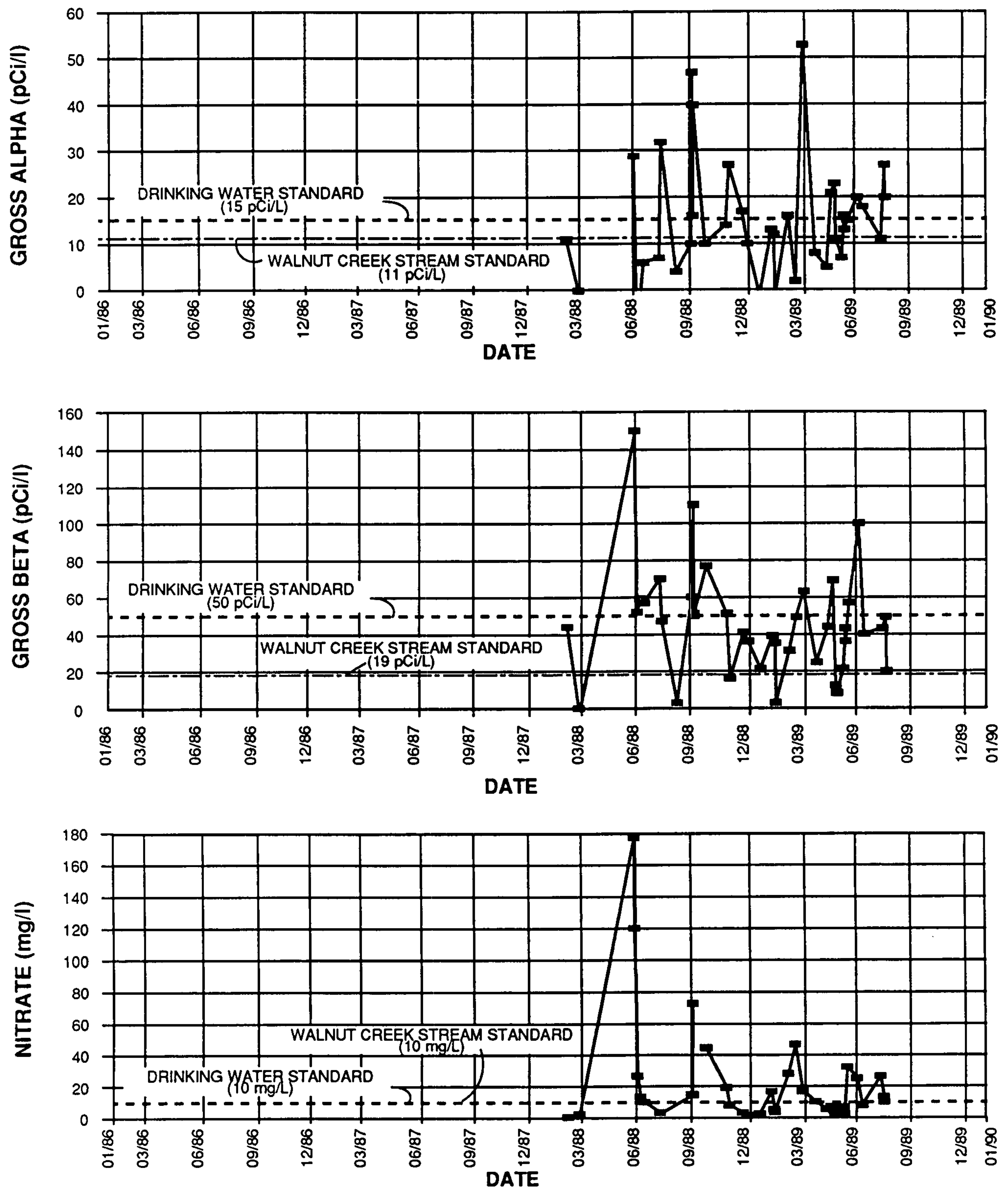
Project No's: 208.0102
208.0103

Figure 8D



SOURCE: ROCKWELL INTERNATIONAL (1989e)

GROSS ALPHA, GROSS BETA, AND NITRATE-NITROGEN CONCENTRATIONS AT PAD 750 CULVERT



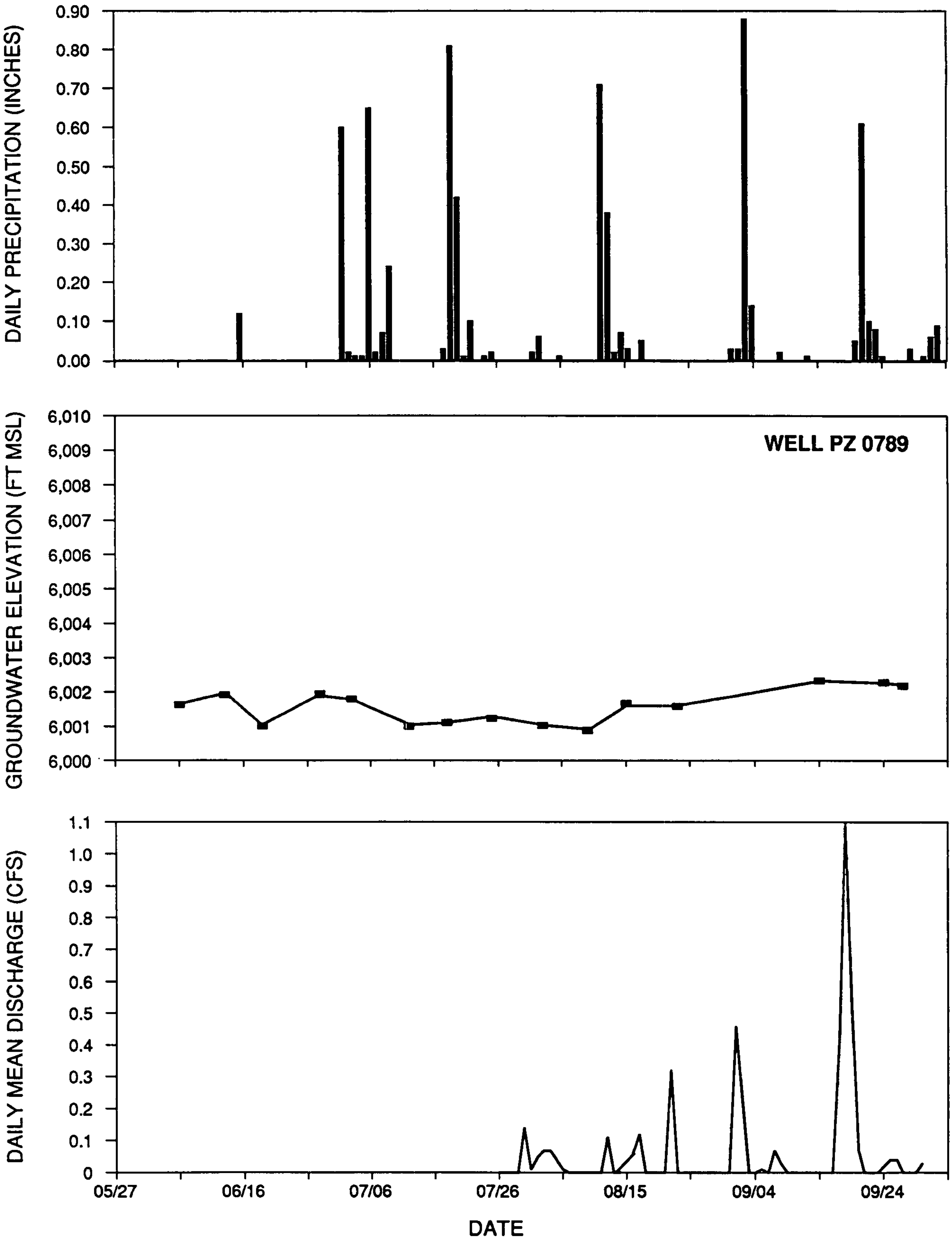
SOURCE: ROCKWELL INTERNATIONAL (1989d)

GROSS ALPHA, GROSS BETA, AND NITRATE-NITROGEN RUNOFF CONCENTRATIONS AT PAD 904 PUDDLE

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY ZERO-OFFSITE WATER DISCHARGE

PROJECT NO. 208.0102 208.0103

FIGURE NO. 10

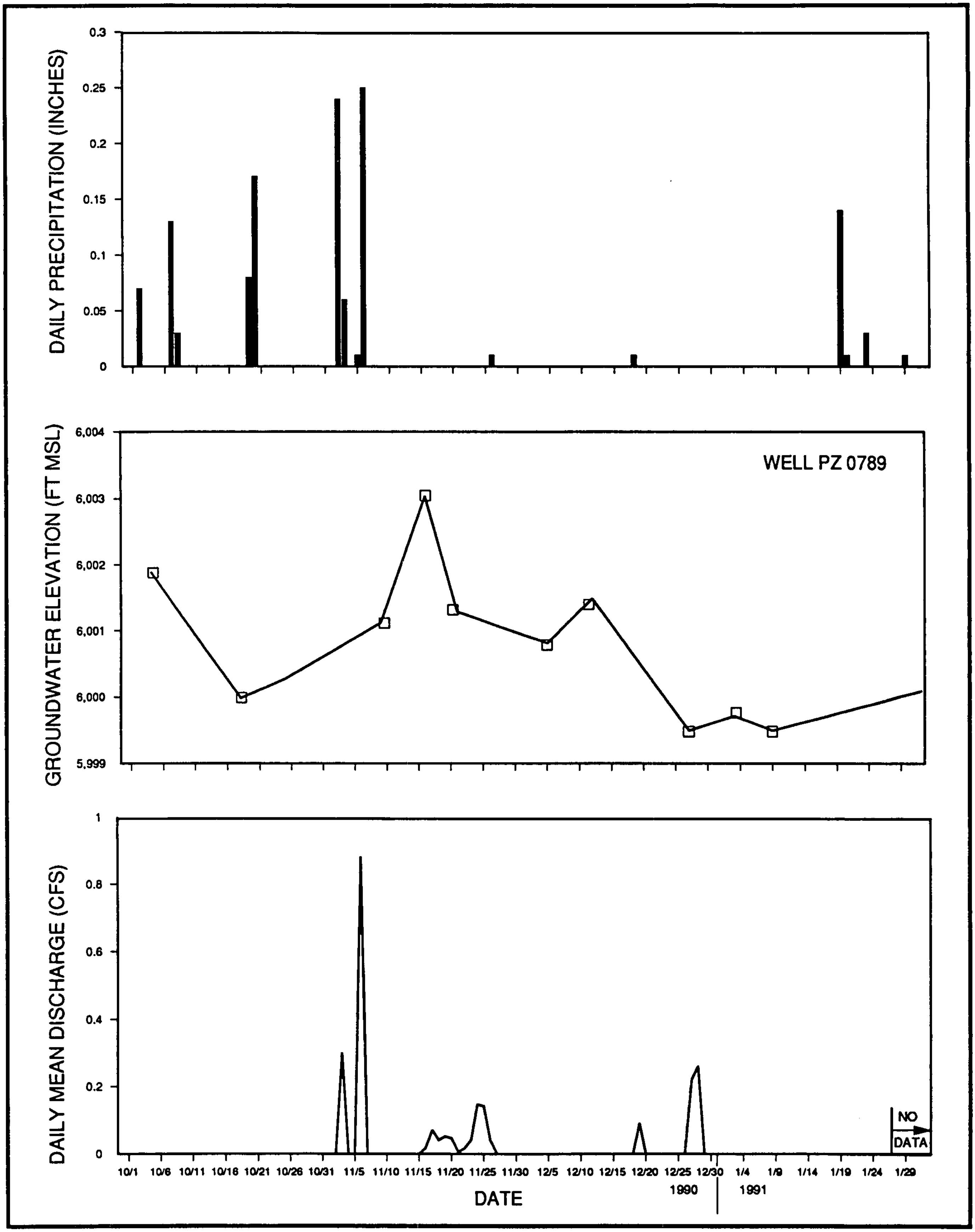


MONITORING SITE SW022 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 11A

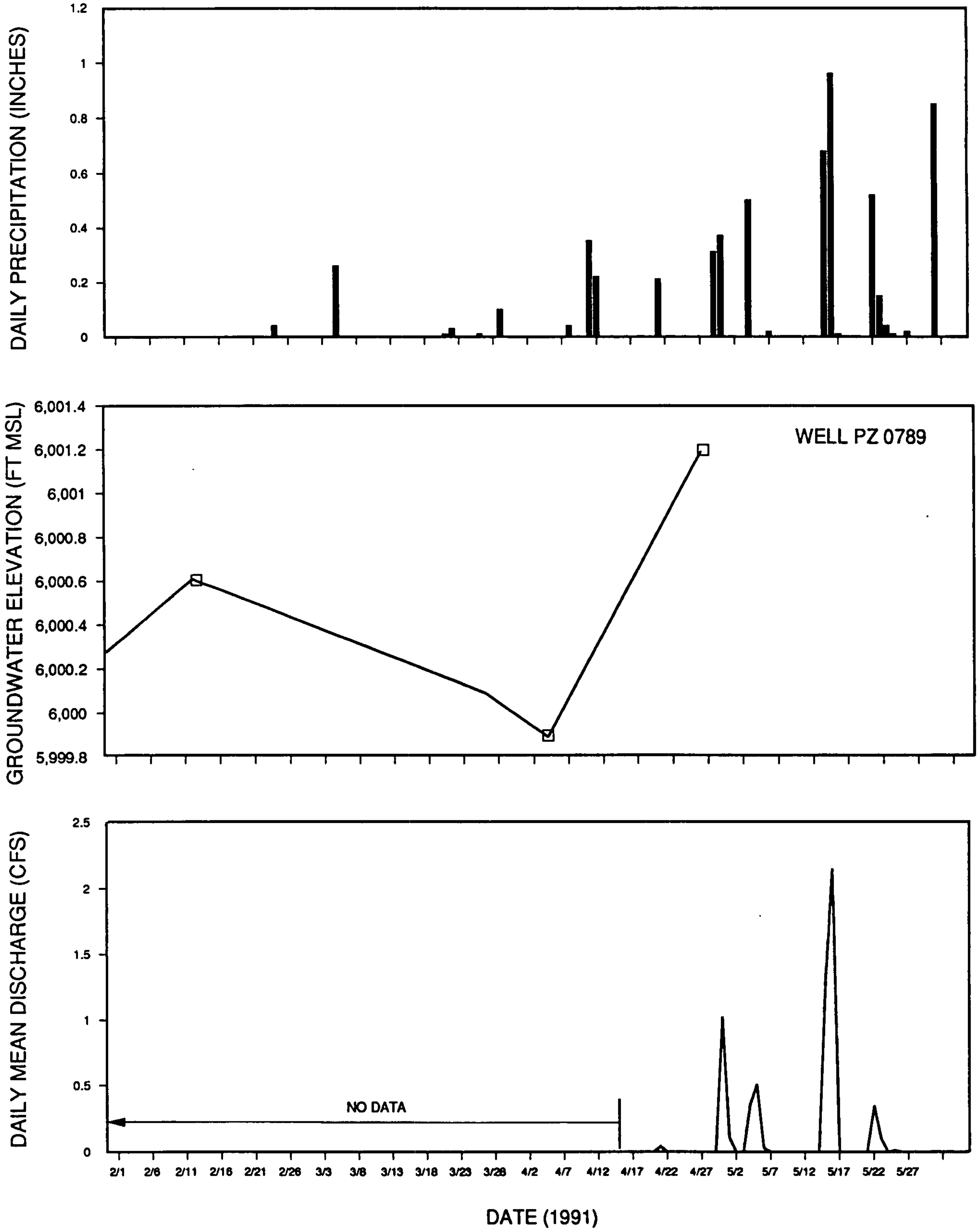


MONITORING SITE SW022 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 11B

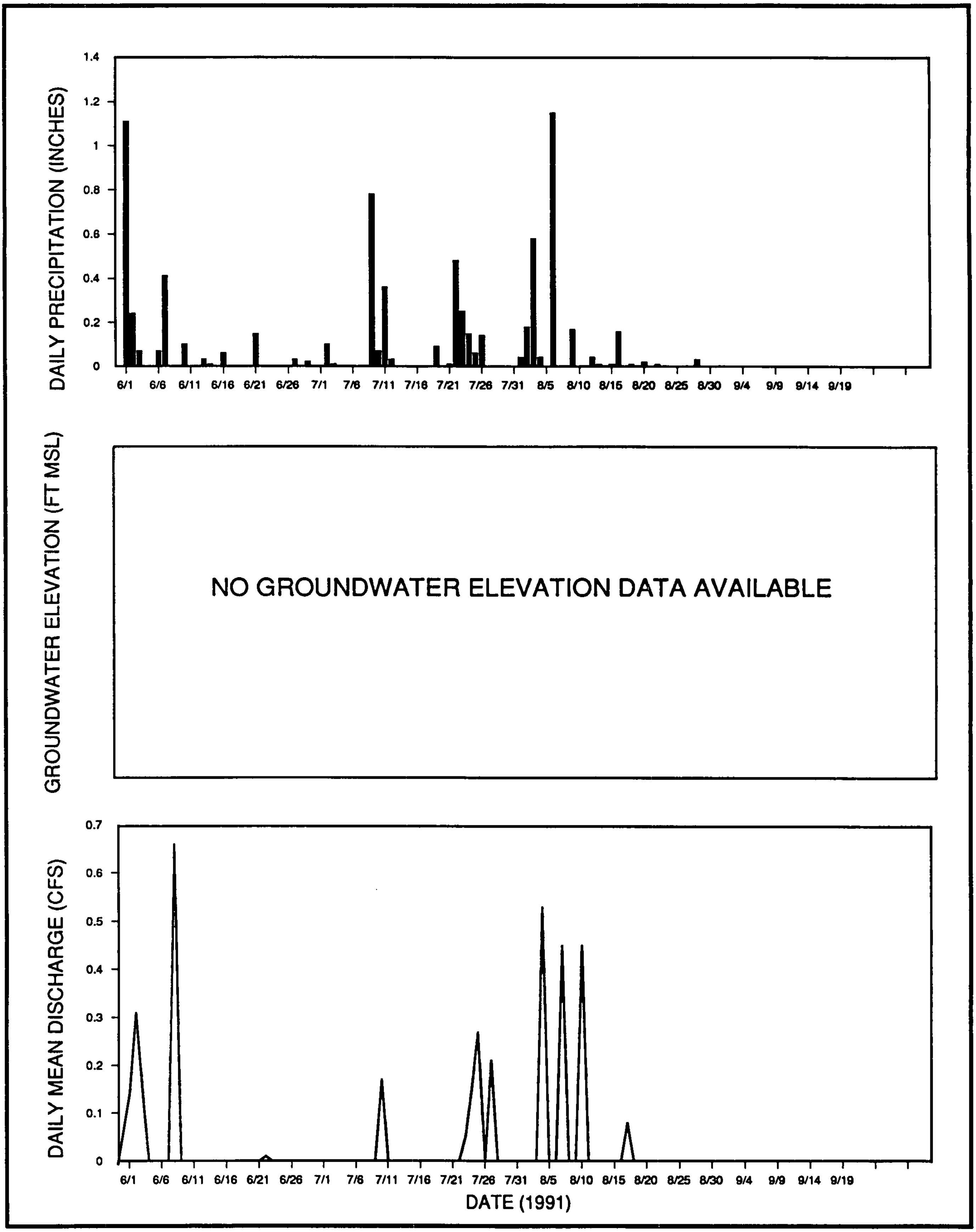


MONITORING SITE SW022 I/I & E

NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102 208.0103

FIGURE 11C

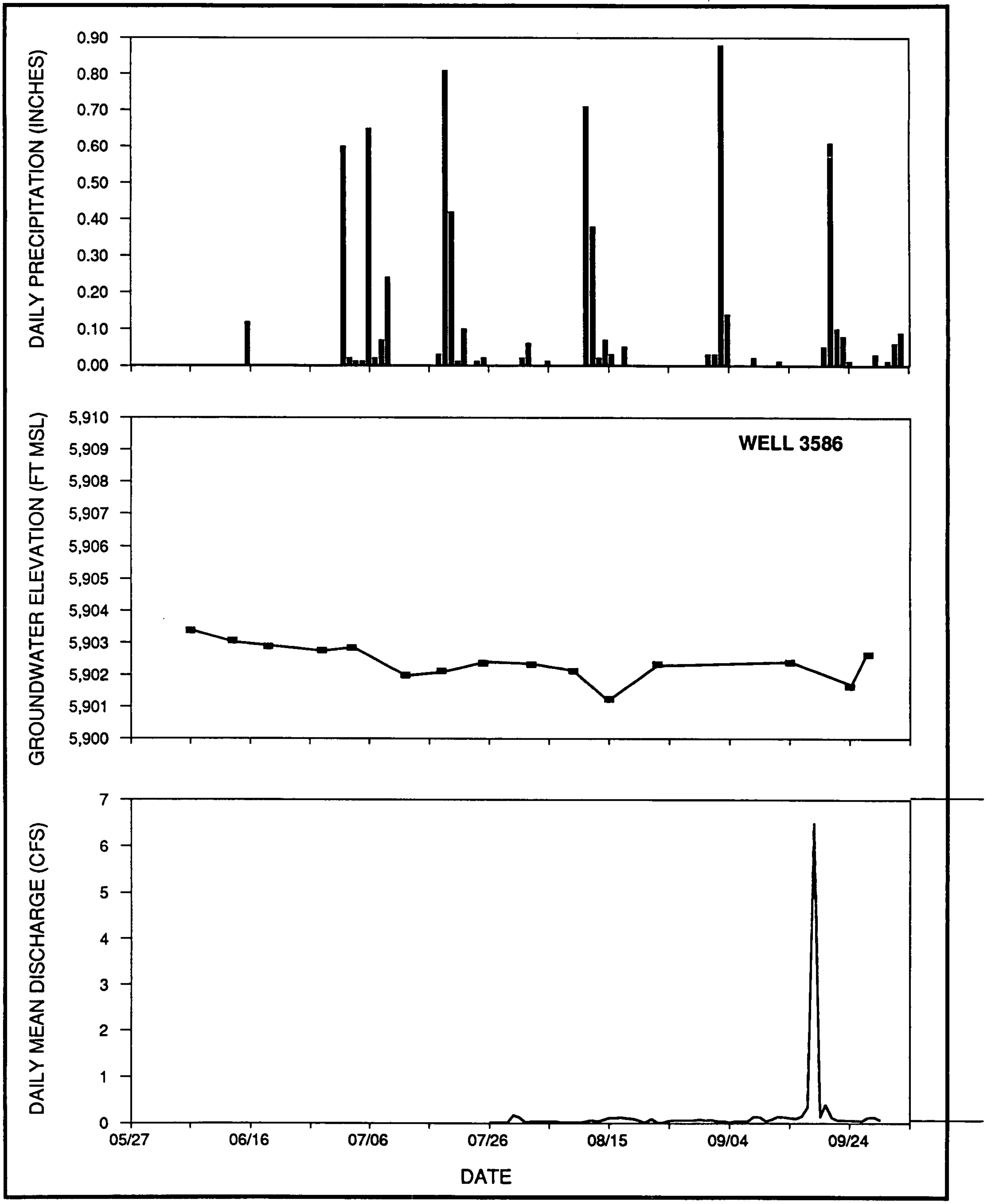


MONITORING SITE SW022 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 11D

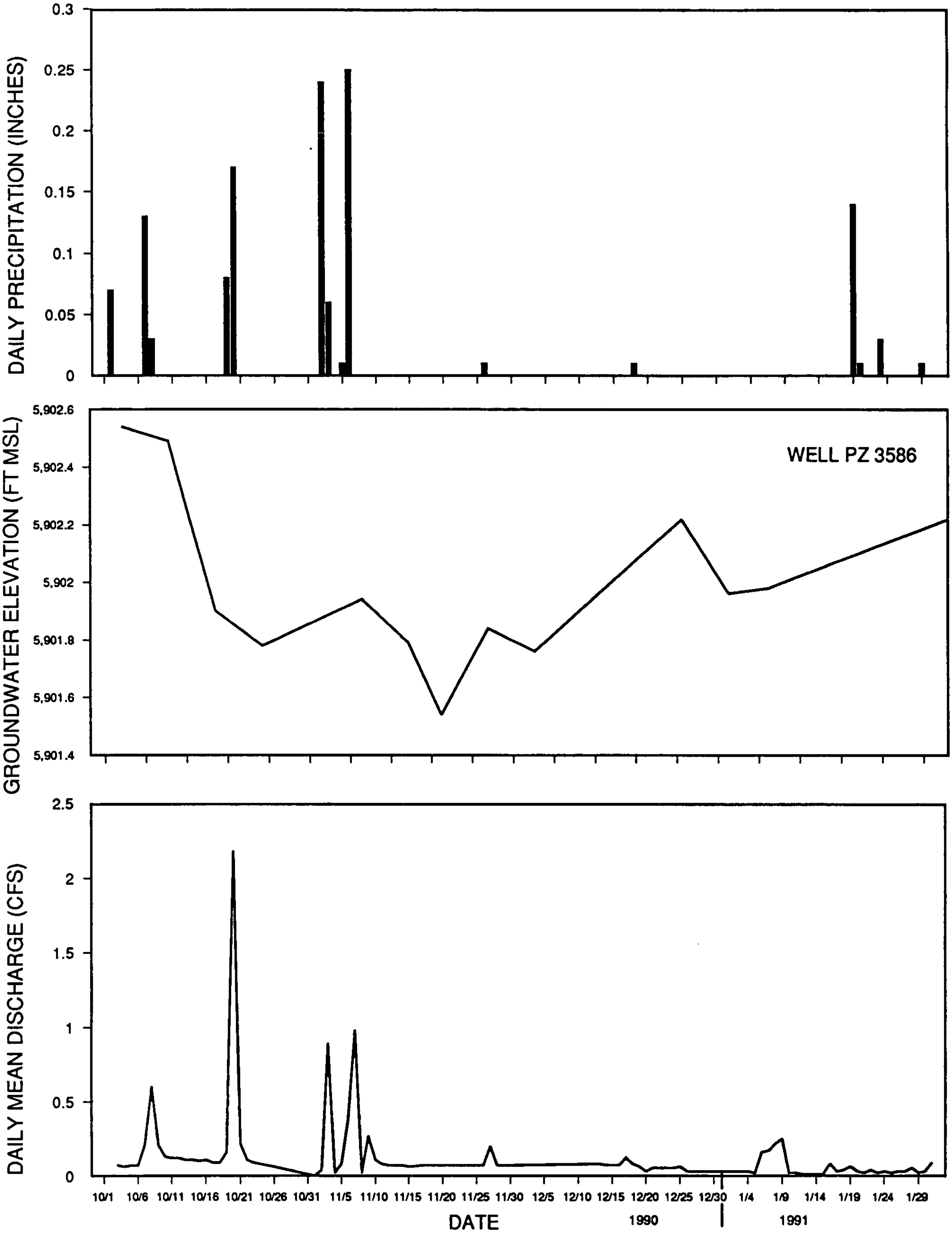


MONITORING SITE SW023 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 12A

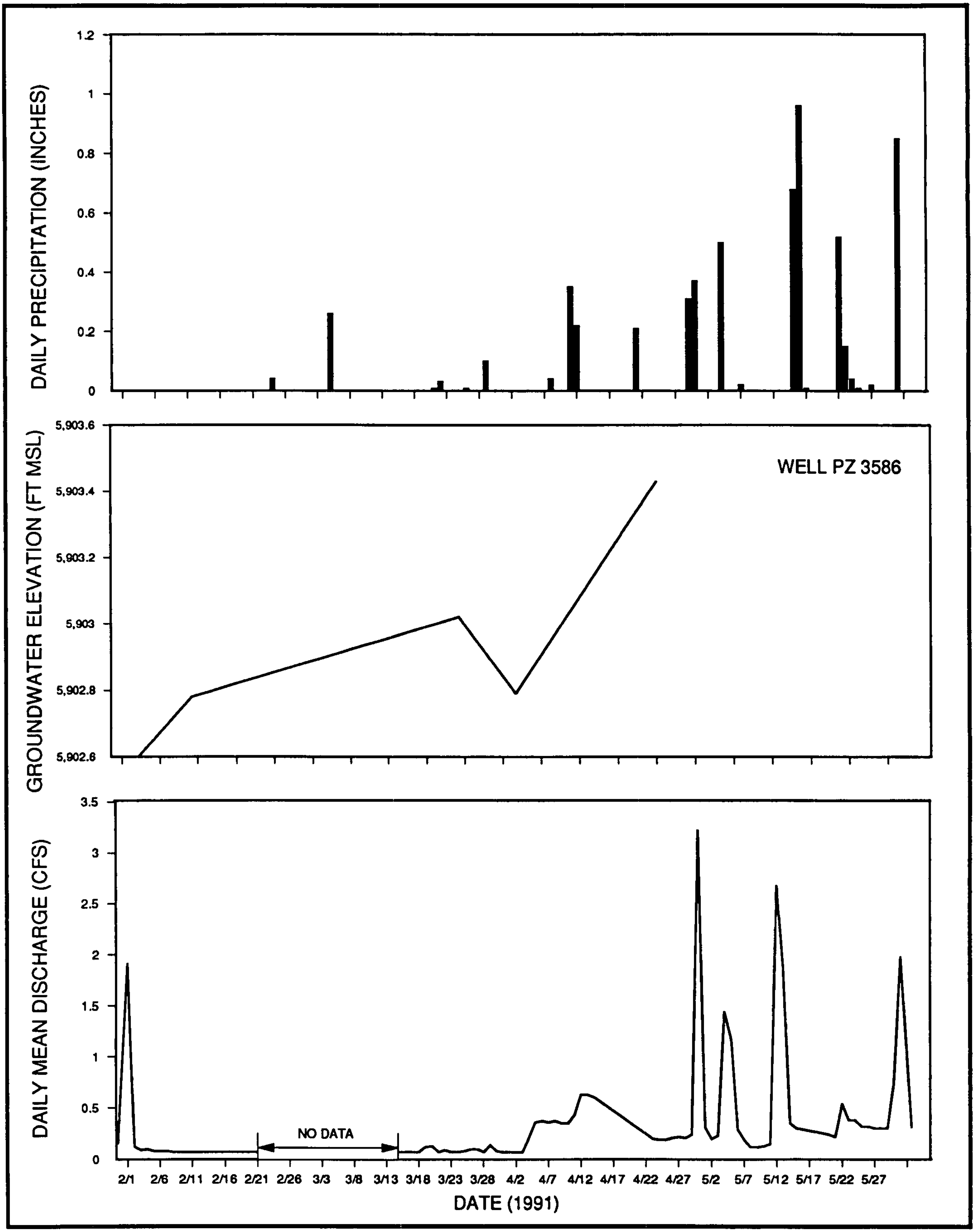


MONITORING SITE SW023 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 12B

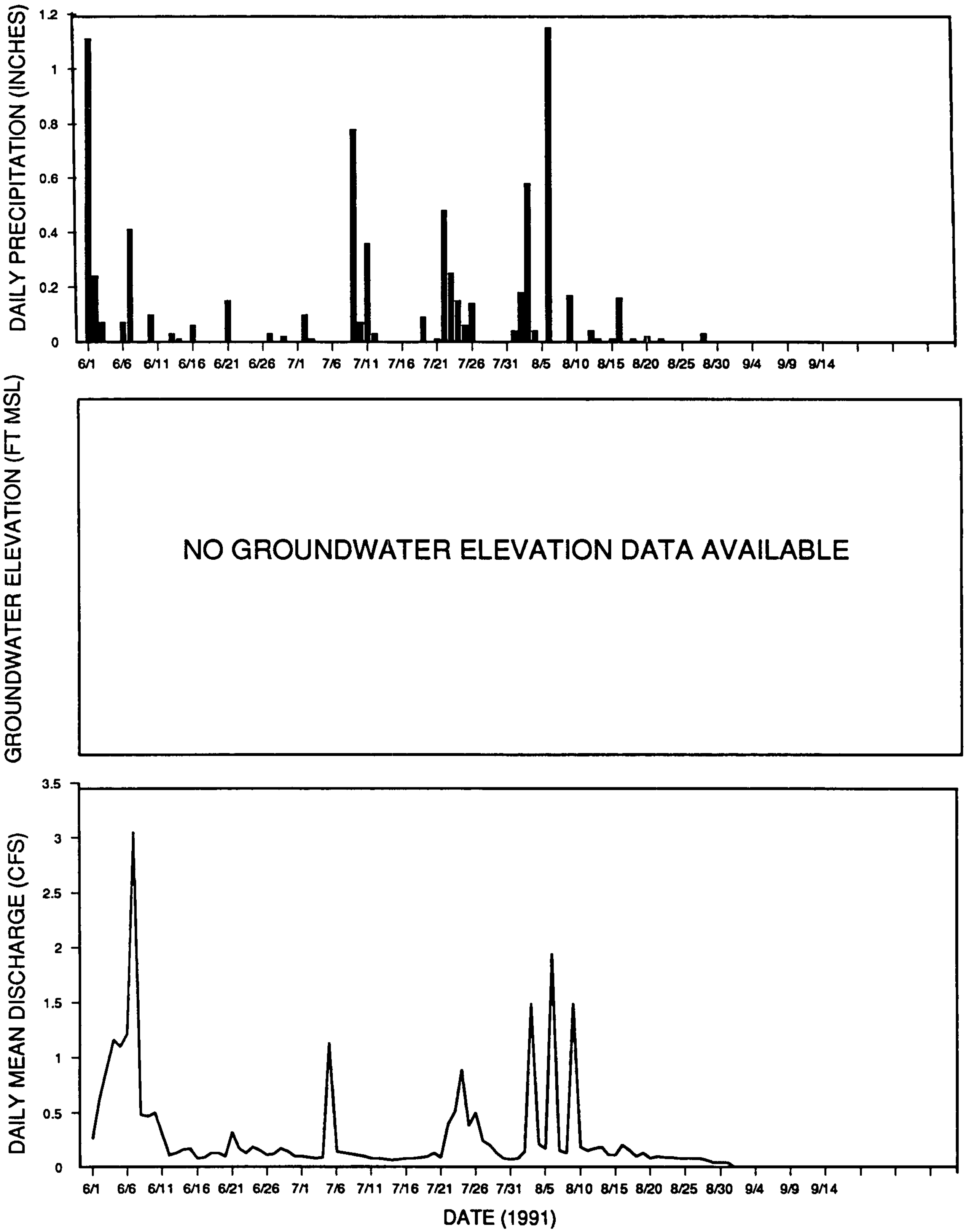


MONITORING SITE SW023 I/I & E

NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102 208.0103

FIGURE 12C

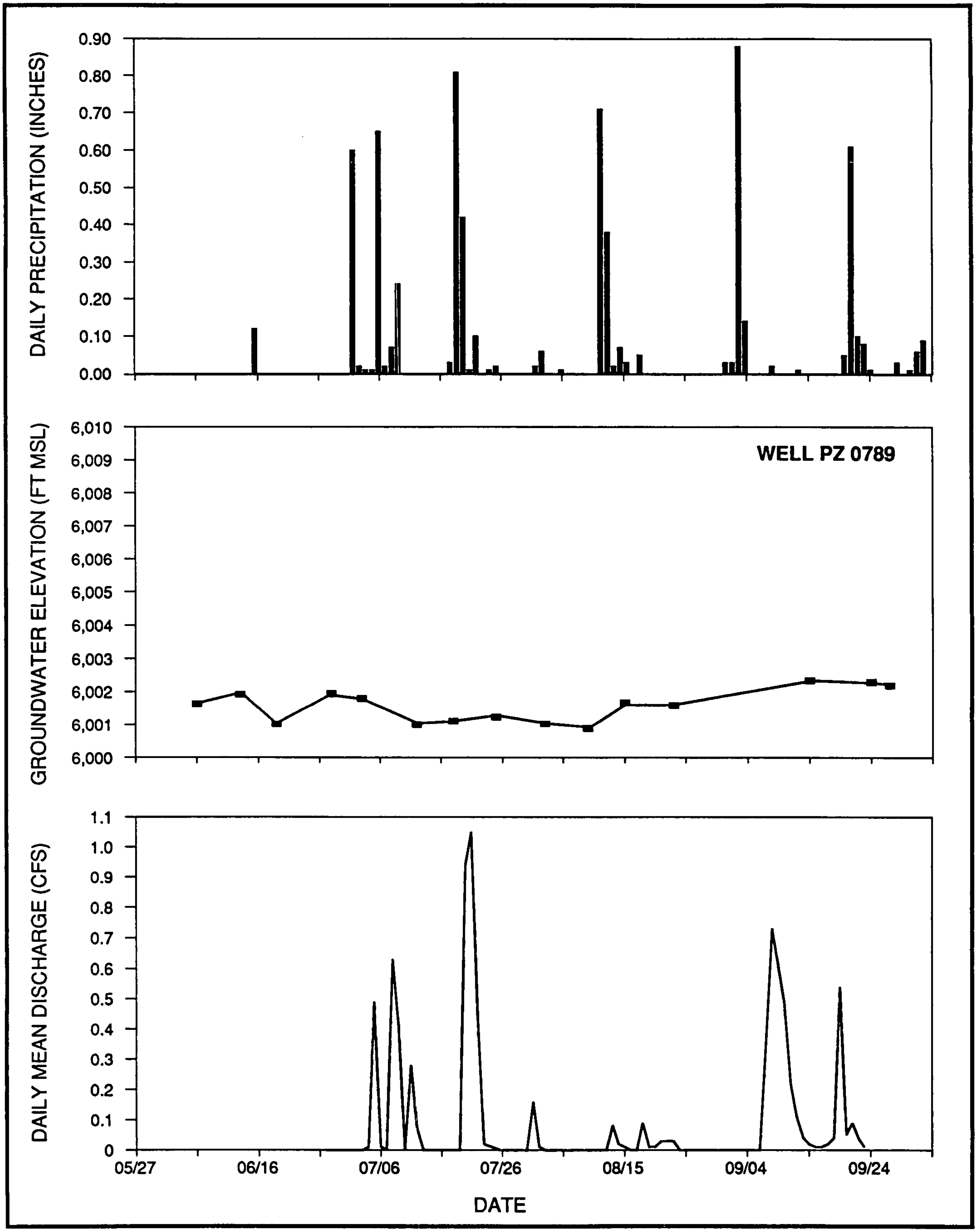


MONITORING SITE SW023 I/I & E

NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102 208.0103

FIGURE 12D

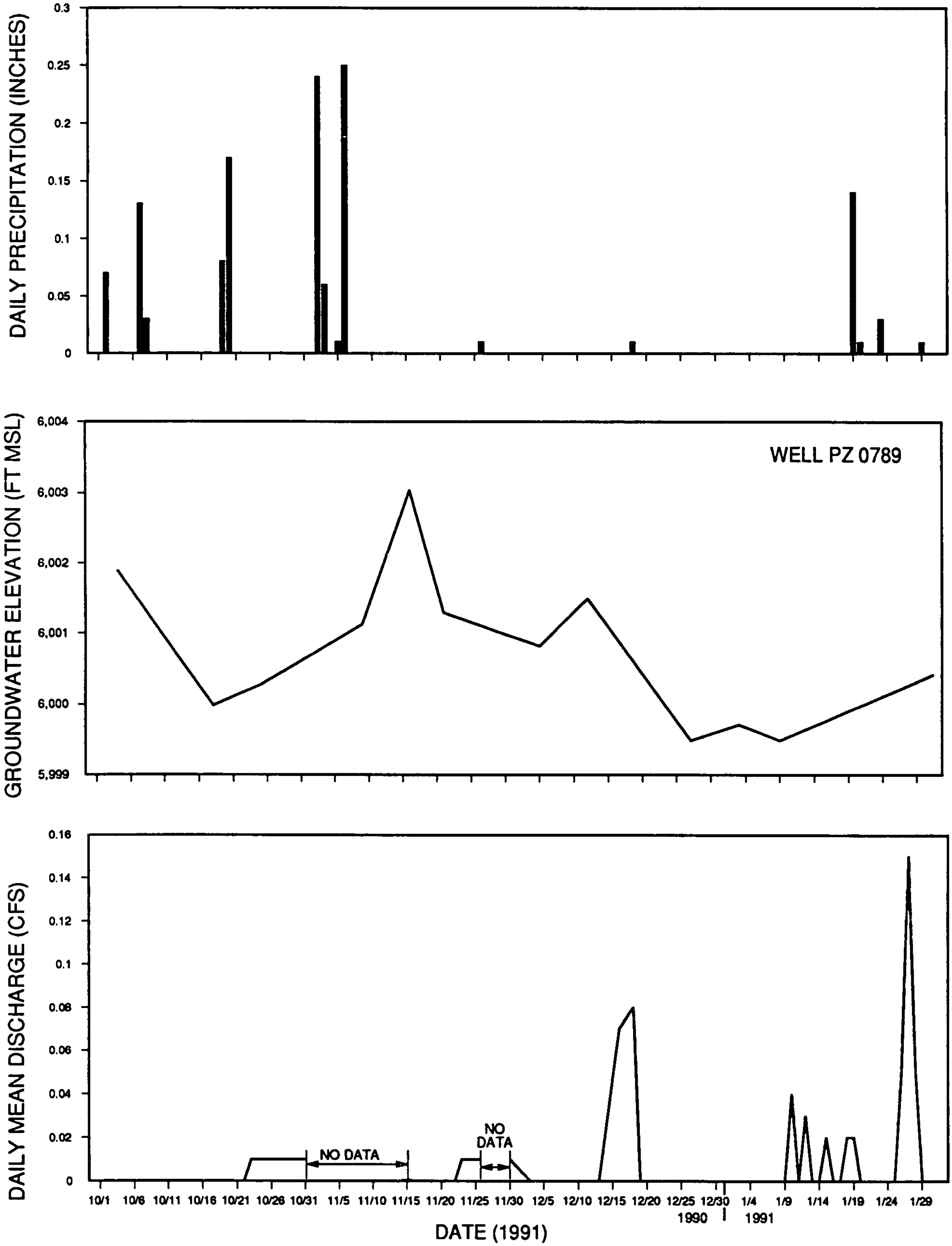


MONITORING SITE SW027 I/I & E

NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102 208.0103

FIGURE 13A

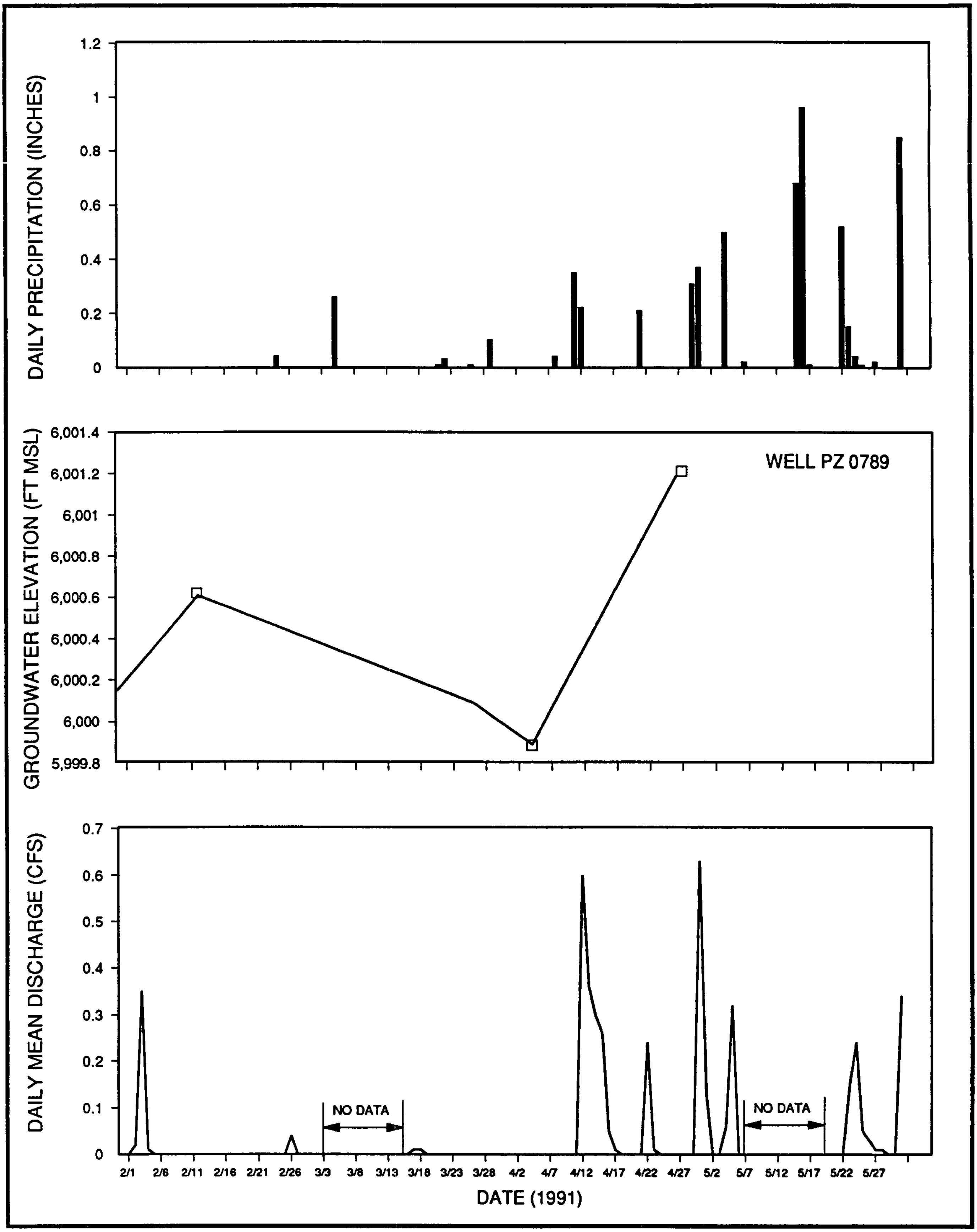


MONITORING SITE SW027 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 13B

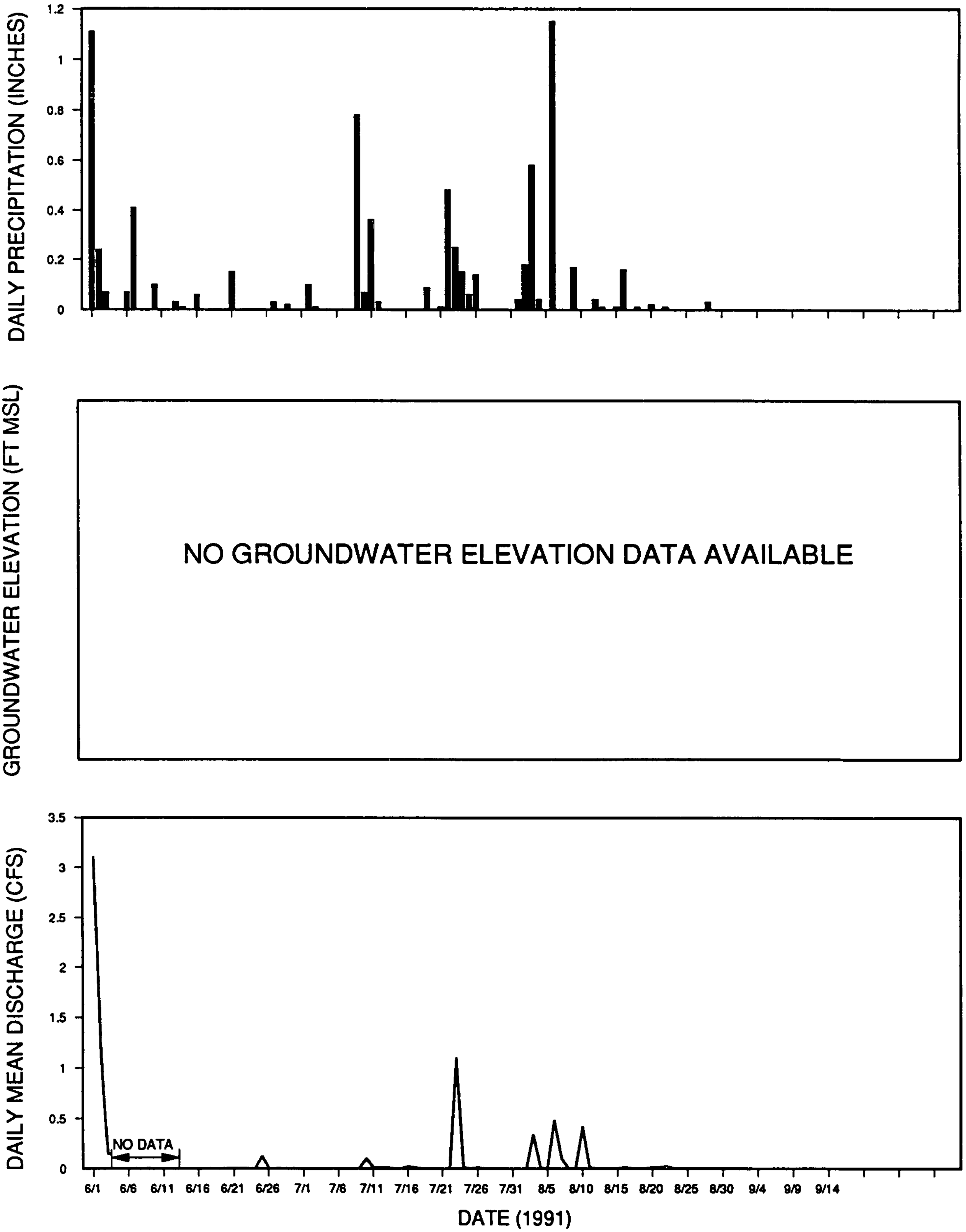


MONITORING SITE SW027 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 13C

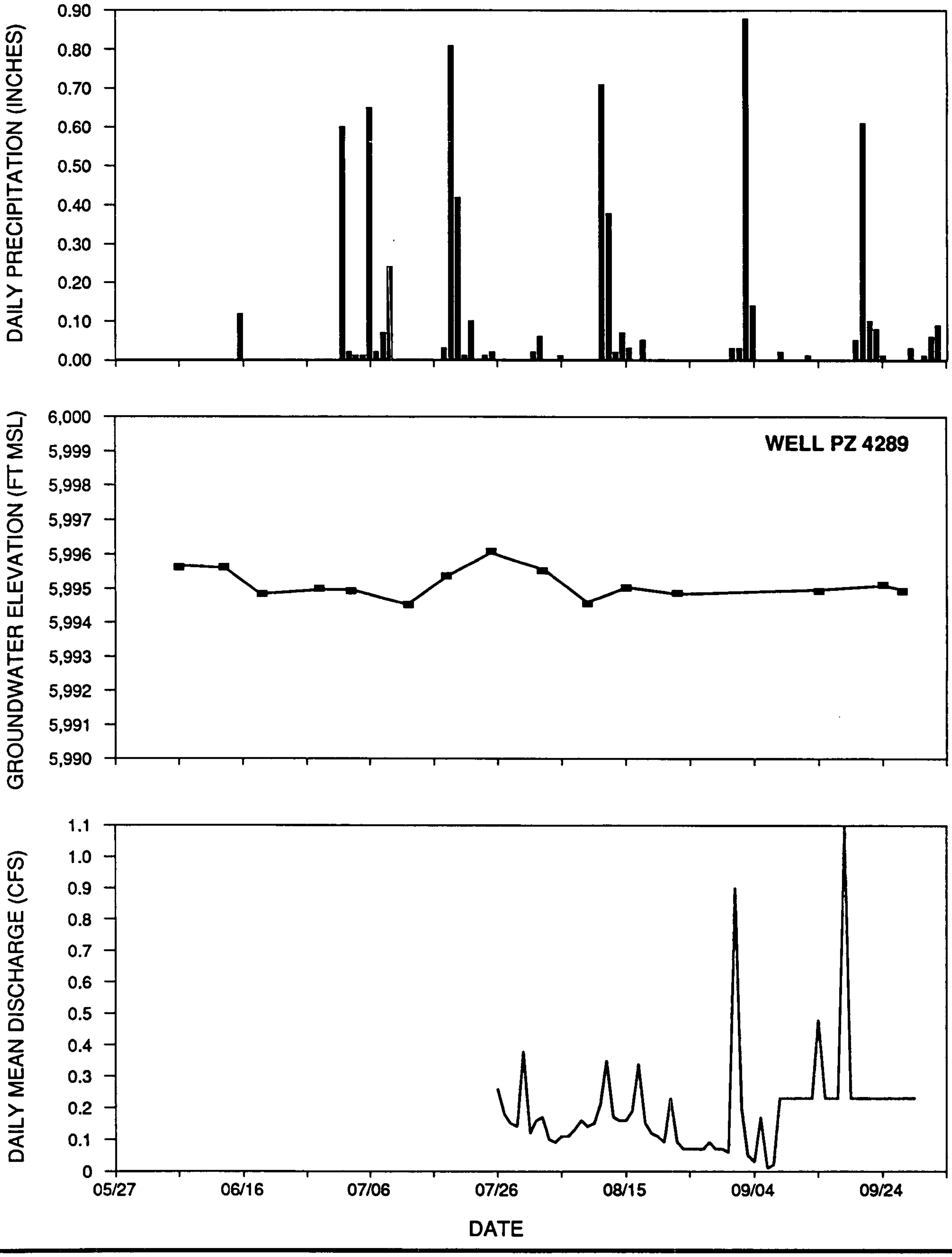


MONITORING SITE SW027 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 13D

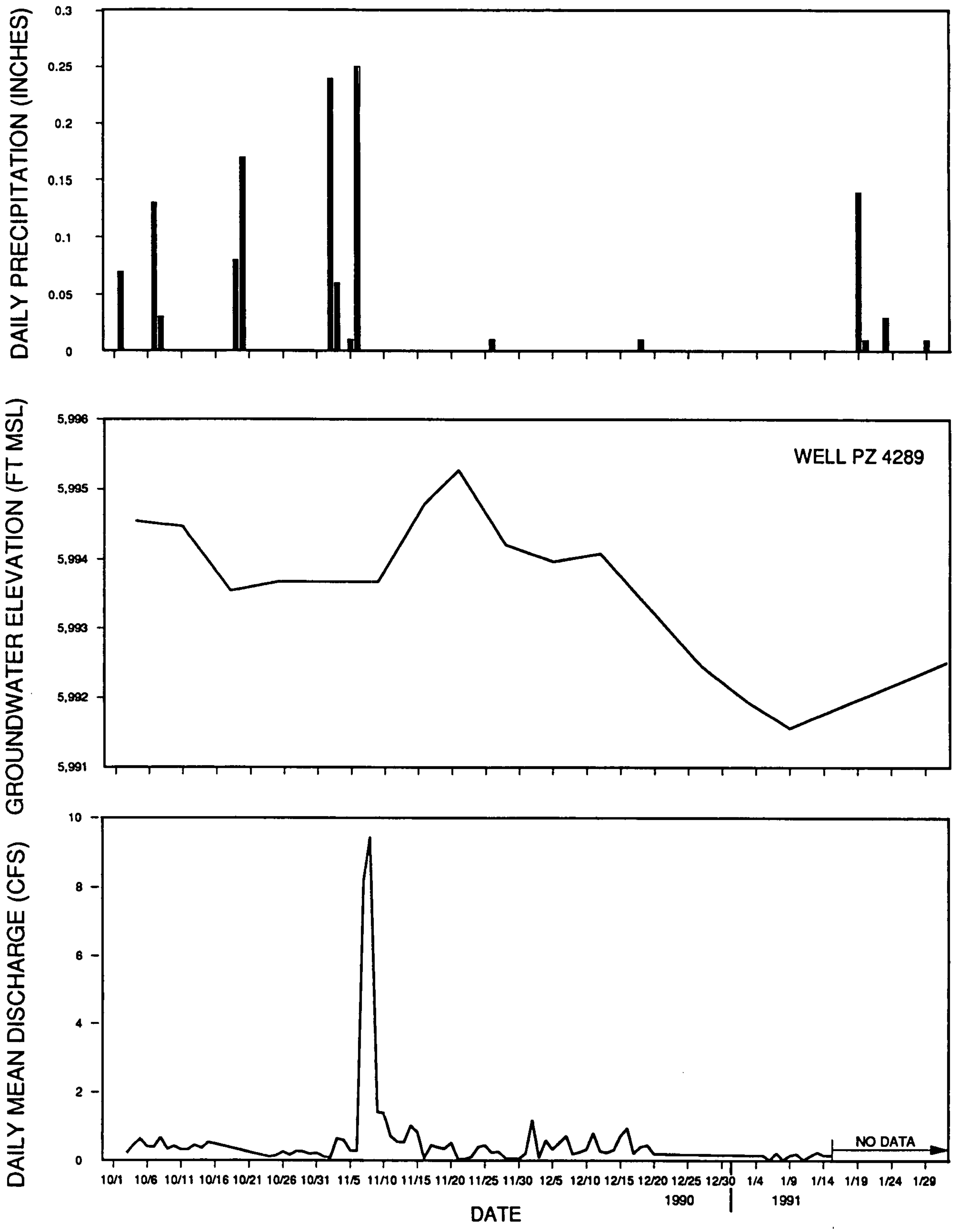


MONITORING SITE SW093 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 14A

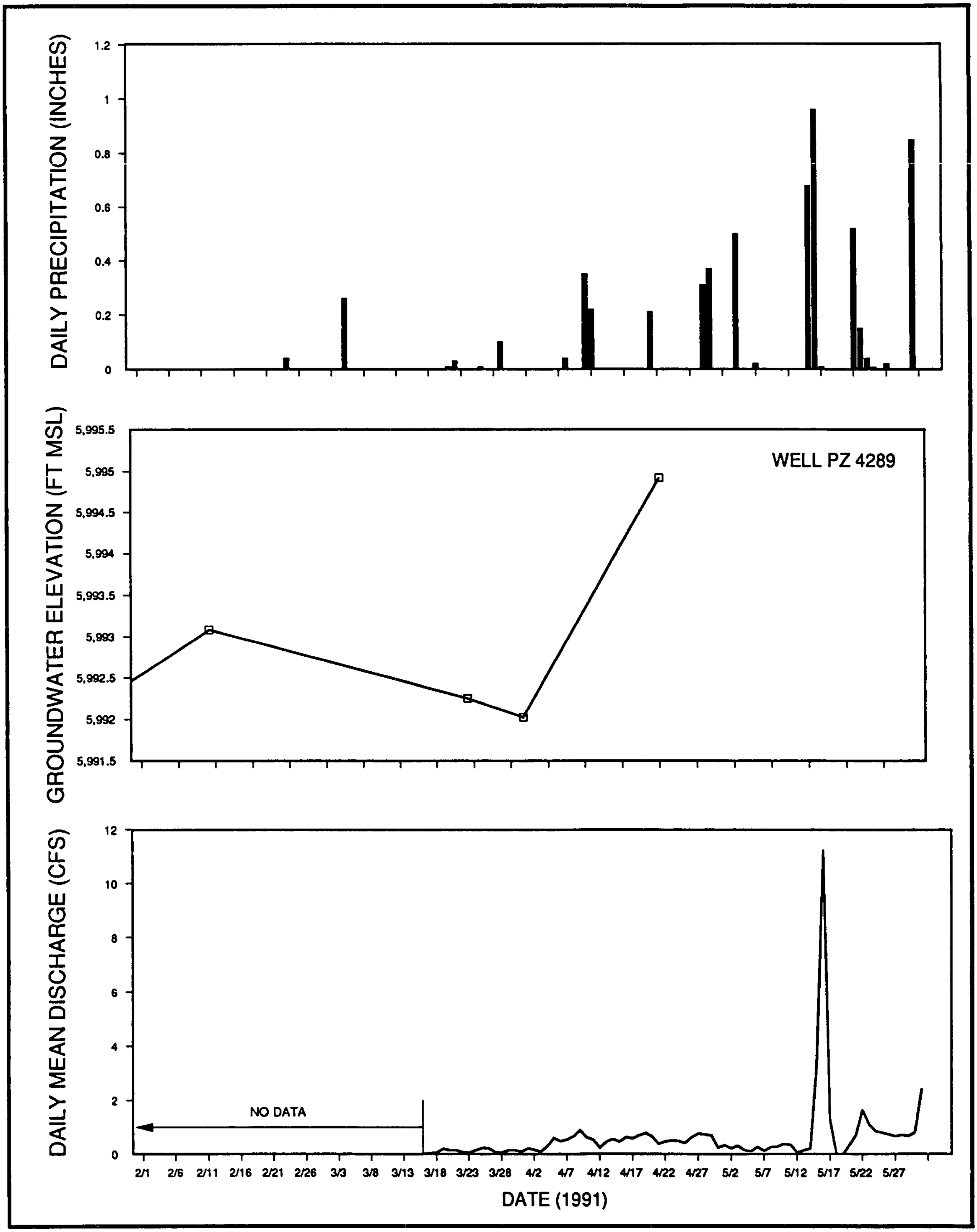


MONITORING SITE SW093 I/I & E

NON-POINT SOURCE ASSESSMENT AND STORM SEWER I/I & E STUDY ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102 208.0103

FIGURE 14B

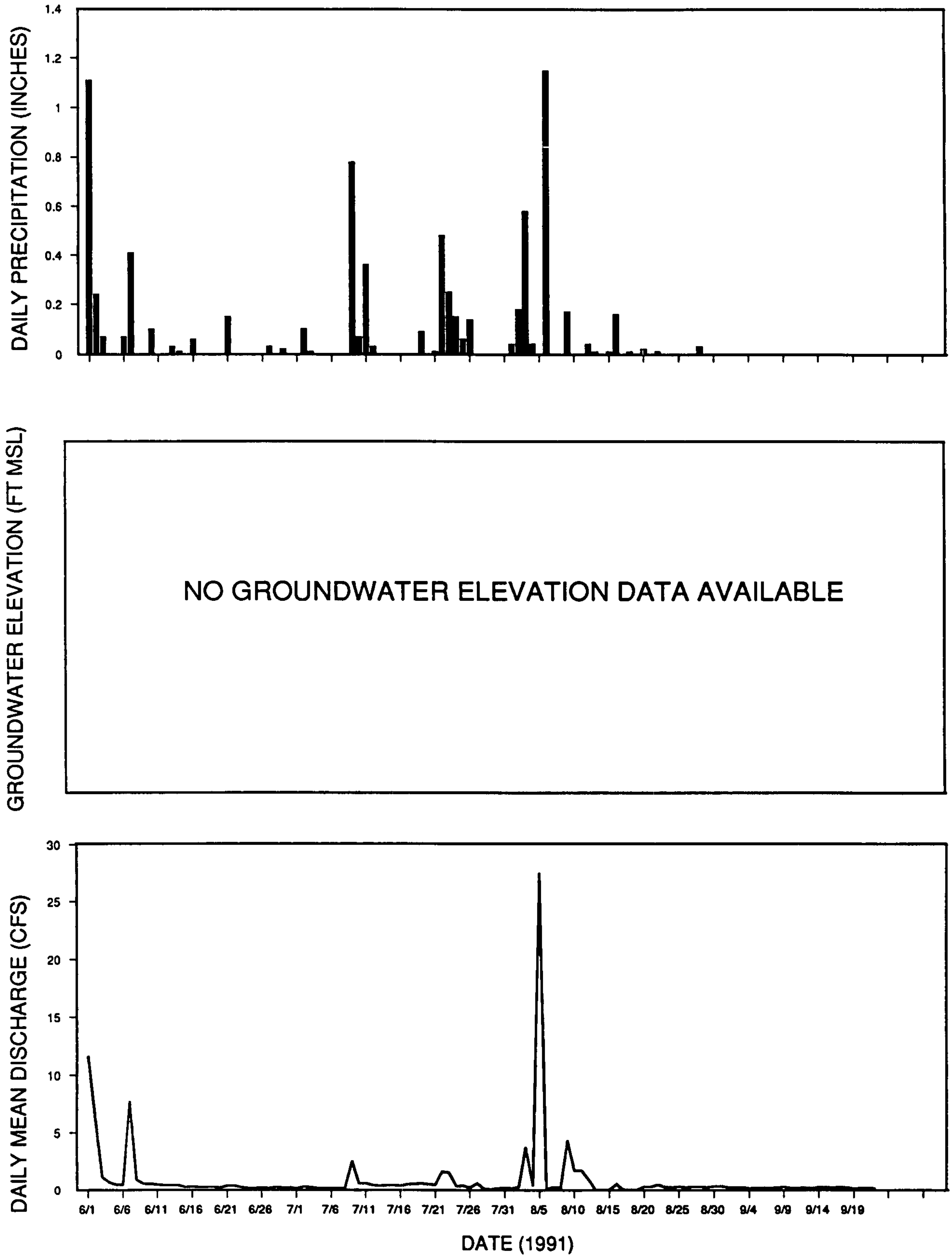


MONITORING SITE SW093 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 14C

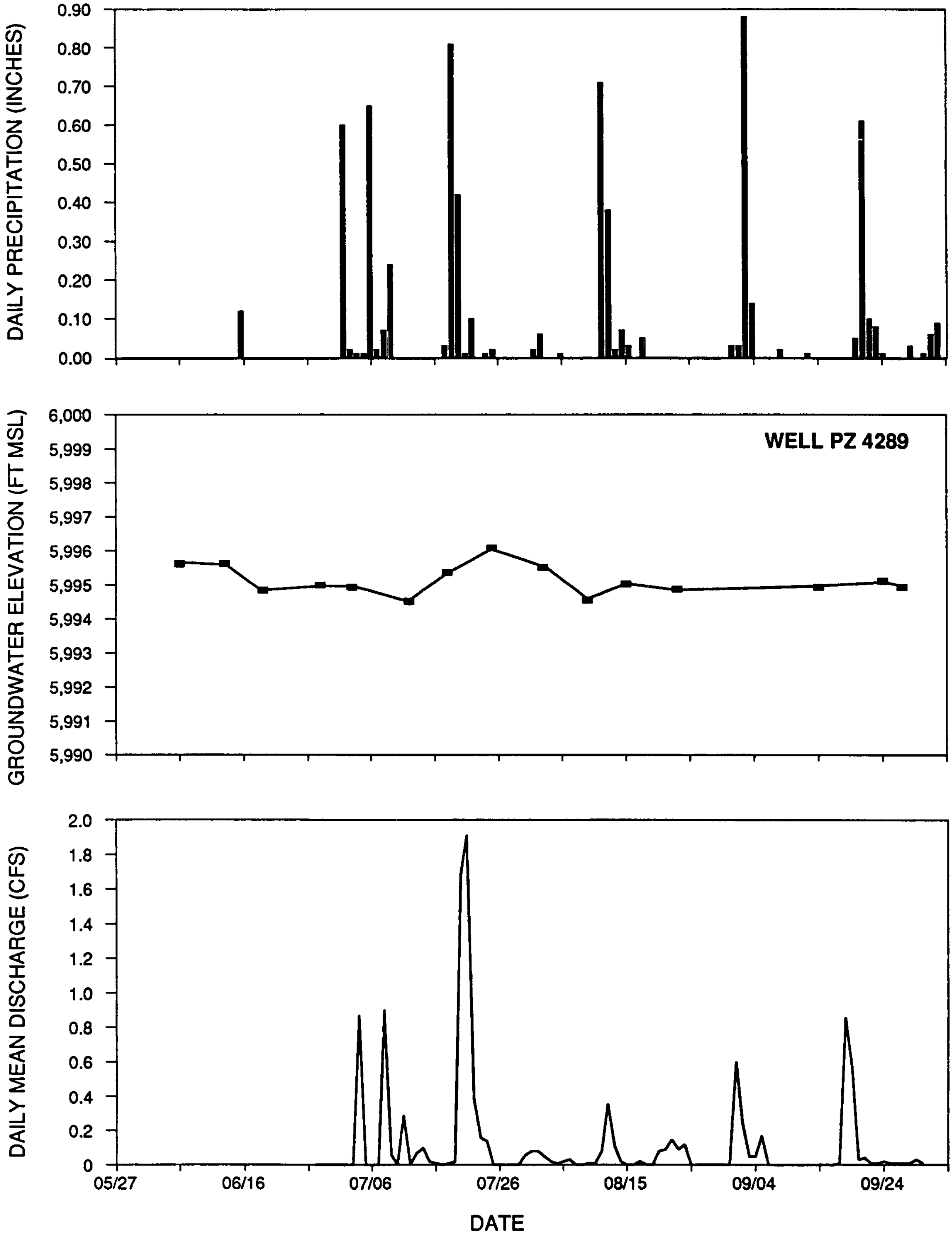


MONITORING SITE SW093 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 14D

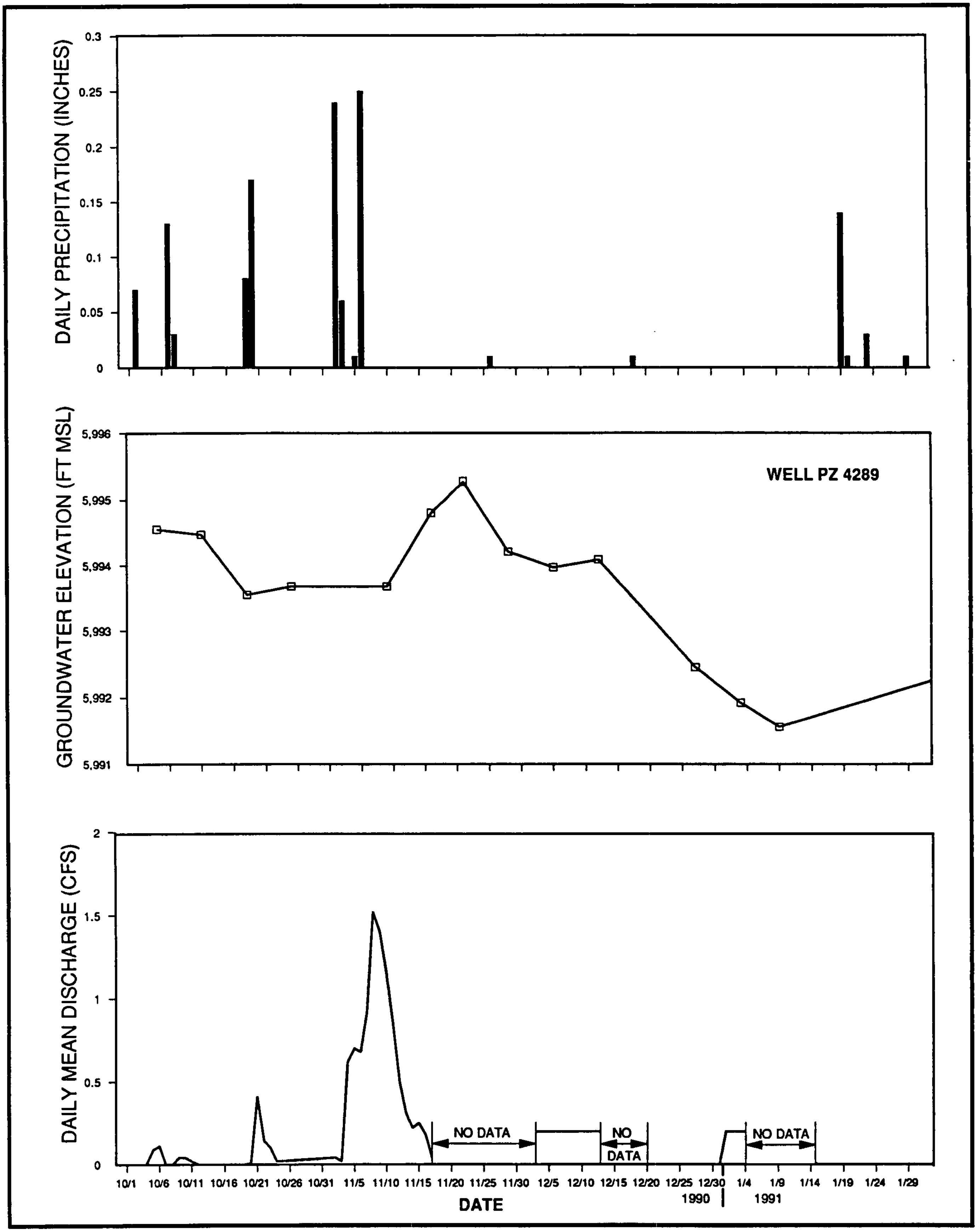


MONITORING SITE SW118 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 15A

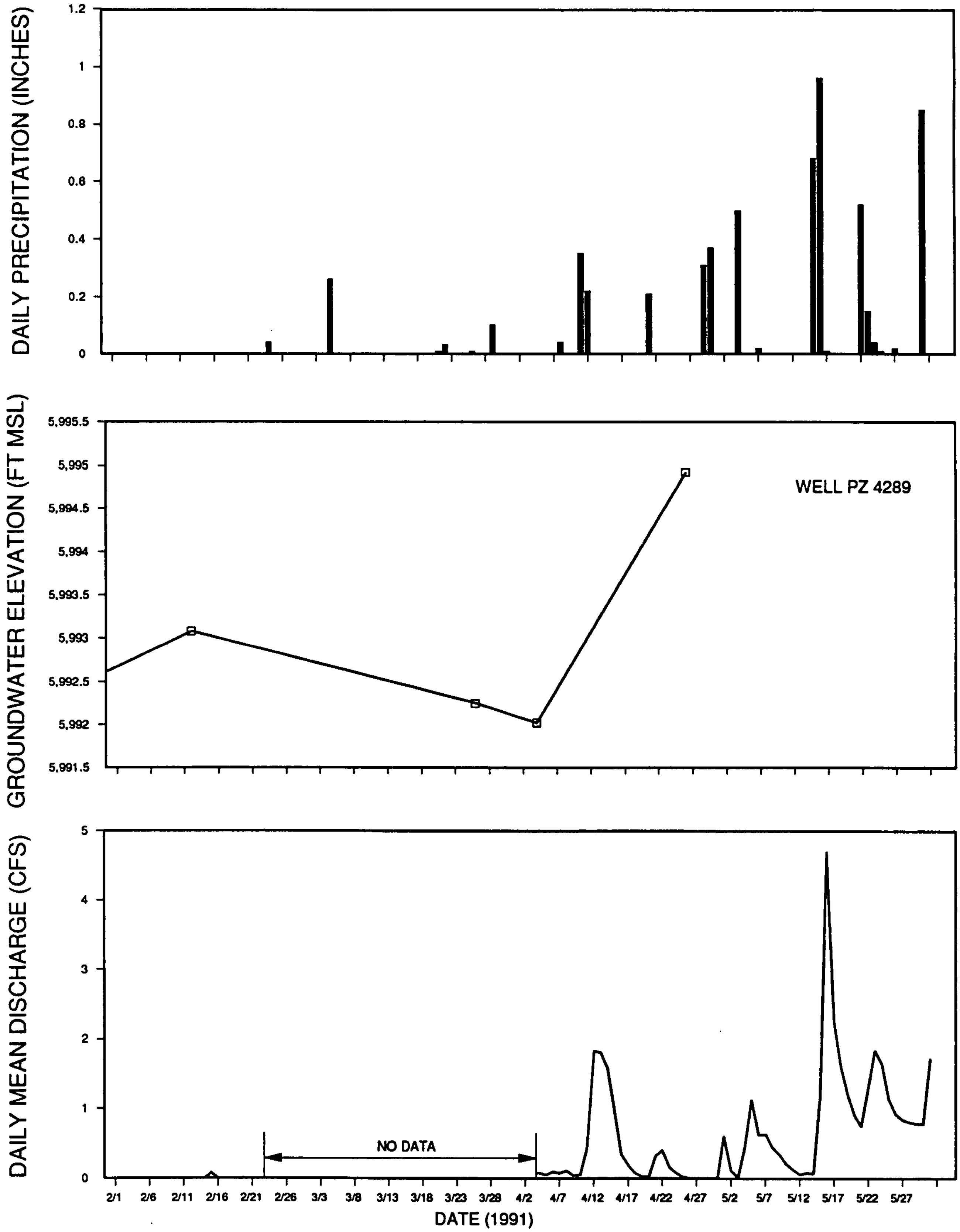


MONITORING SITE SW118 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 15B

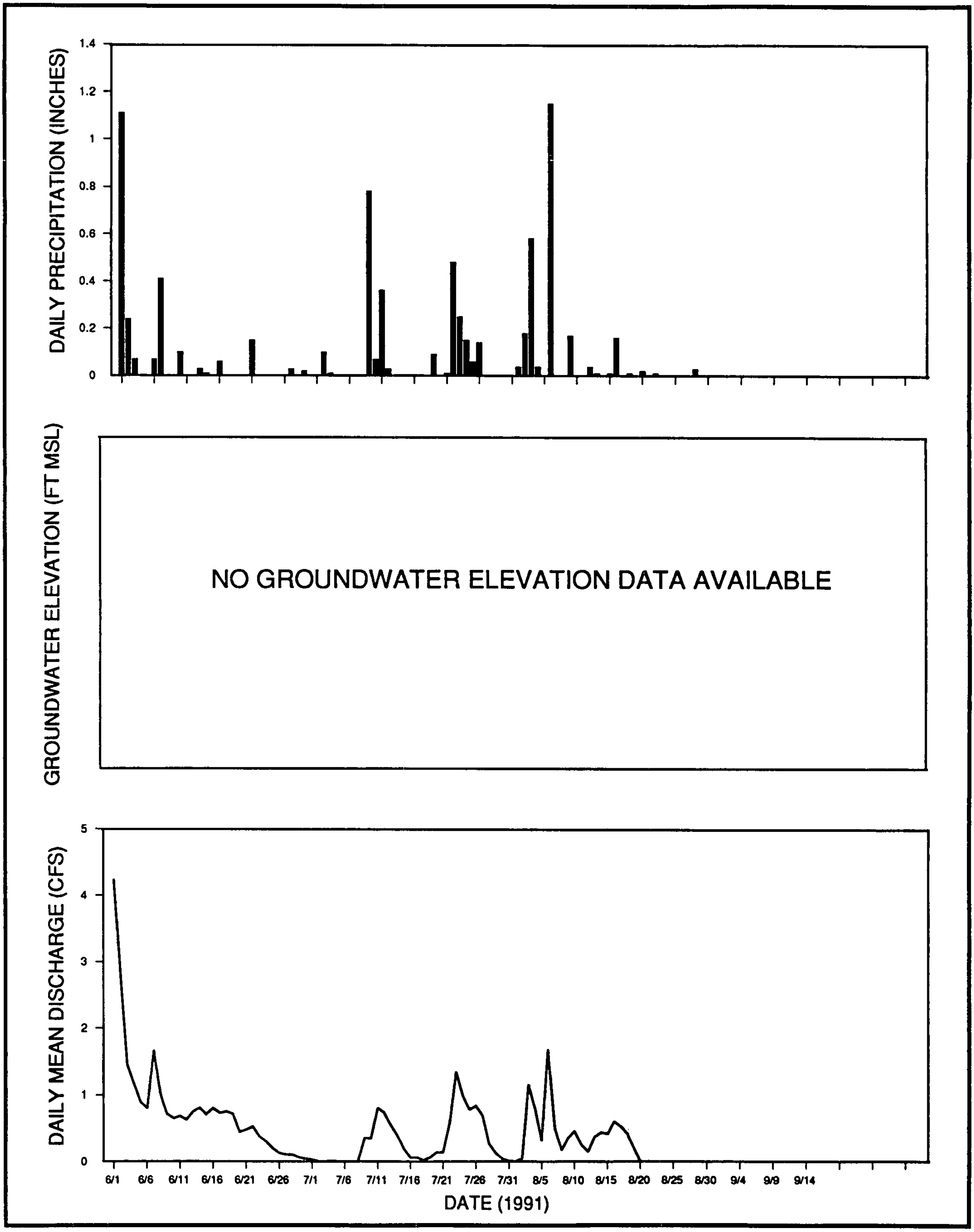


MONITORING SITE SW118 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 15C



MONITORING SITE SW118 I/I & E

NON-POINT SOURCE ASSESSMENT
AND STORM SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT NO.: 208.0102
208.0103

FIGURE 15D

A

APPENDIX A

SUPPLEMENTAL WATER-QUALITY DATA TABULATIONS

Table A-1

Comparative Radionuclide Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site[2]	Source	Date	Sample Lab Code	Radionuclide Concentration (units)[1]		
				Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)
SW022	A	07/23/90	70001	31.45 ± 9.91	36.97 ± 4.06	[3]
	A	11/07/90	70028	6.04 ± 2.56	20.81 ± 2.06	[3]
	A	11/08/90	70027	26.24 ± 8.84	55.35 ± 4.46	[3]
SW022P	A	10/24/90	70020	2.30 ± 1.60	4.04 ± 1.66	21.71 ± 148
	A	11/08/90	70030	0.36 ± 1.08	3.71 ± 1.19	[3]
SW023	E	08/19/86		0. ± 4.	5. ± 3.	0.05 ± 0.24*
	A	07/23/90	70002	40.24 ± 12.8	40.71 ± 5.06	[3]
	A	07/24/90	70005	5.03 ± 2.44	8.17 ± 1.45	[3]
	W	10/16/90	00443	2.9 ± 1.81	7.48 ± 1.05	230.07 ± 154
	A	11/08/90	70029	10.02 ± 5.51	63.07 ± 4.72	[3]
	W	11/16/90[4]	00544	<2.0	4.3 ± 1.8	<200
	W	12/04/90[4]	00648	4.0 ± 2.0	4.2 ± 1.8	<200
	W	12/04/90[4]	80074	<1.0	<2.0	<200
	W	12/04/90[4]	80075	2.8 ± 1.8	3.4 ± 1.7	<200
	A	12/10/90	70045	3.62 ± 4.13	36.16 ± 3.84	[3]
	W	01/14/91[4]	00750	<2.0	6.2 ± 1.9	<200
SW027	R	08/19/86		33. ± 12.	37. ± 0.7	<30 ± 210
	R	07/??/87		10. ± 0.	61. ± 3.	<110
	W	11/13/90[4]	00508	<2.0	5.0 ± 1.7	<200
	W	11/13/90[4]	80068	<1.0	<2.0	<200
	W	11/13/90[4]	80069	<2.0	4.9 ± 1.7	<200
	W	12/06/90[4]	00612	<2.0	5.6 ± 1.8	<200
SW027P	A	10/24/90	70021	0.03 ± 0.91	1.52 ± 1.10	65.23 ± 150
	A	11/08/90	70032	0.68 ± 1.30	5.68 ± 1.32	[3]
SW093	E	07/07/88		--	--	200 ± 307
	E	07/07/88[4]		17.9 ± 5.35	14.9 ± 5.58	--
	E	03/23/89		12. ± 8.	7. ± 3.	250 ± 160
	E	03/23/89[4]		10. ± 7.	4. ± 3.	--

SHEET 1 OF 2

Table A-1 - Continued

Comparative Radionuclide Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site[2)]	Source	Date	Sample Lab Code	Radionuclide Concentration (units)[1)] Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)
SW093	E	05/25/89		8. ± 6.	9. ± 4.	300 ± 150
(continued)		E	07/05/89	±14. 5.	20. ± 3.	90 ± 220
	E	09/07/89		8.1 ± 2.0	25.5 ± 3.0	<20 ± 240
	E	10/10/89		6.8 ± 1.5	13.7 ± 3.4	<40 ± 260
	A	07/23/90	70003	44.89 ± 13.2	44.03 ± 5.16	3)
	A	07/24/90	70006	3.52 ± 2.18	7.49 ± 1.49	3)
	A	07/31/90	70007	36.93 ± 9.63	42.96 ± 3.99	3)
	W	10/17/90	00448	9.18 ± 5.17	9.38 ± 2.67	9.38 ± 158
	A	10/24/90	70022	4.10 ± 1.86	8.83 ± 1.45	26.01 ± 153
	W	11/19/90[4)]	00549	4.5 ± 2.0	8.0 ± 1.9	<200
	W	12/06/90[4)]	00653	2.5 ± 1.8	5.8 ± 1.8	<200
SW118	A	07/23/90	70004	111.40± 30.3	120.4 ± 11.9	3)
	W	10/29/90[4)]	00458	3.30 ± 1.80	3.3 ± 2.0	220 ± 120
	A	11/08/90	70035	3.62 ± 2.18	8.32 ± 1.45	3)
	W	11/27/90[4)]	00559	<2.0	3.4 ± 1.7	<200
	W	12/13/90[4)]	00663	<2.0	4.1 ± 1.7	<200
SW118P	A	10/24/90	70023	0.26 ± 0.82	2.54 ± 1.15	76.27 ± 152
	A	11/08/90	70033	0.73 ± 1.15	4.82 ± 1.33	3)

A - ASI recently collected samples.
E - Historical EG&G data (ITEMS data base).
R - Rockwell International (1988a), Table 6-4.
W - Woodward-Clyde samples (Retrieved from the RFEDS, April 9,1991 and September 18, 1991)

1) Total concentrations (unfiltered samples) containing varying amounts of suspended sediment (or particulates), except as noted by footnote 4.
2) See Figure 1 for monitoring-site locations.
3) Laboratory results are pending.
4) Dissolved concentration (filtered sample).

* Suspected problem with reported units (pending EG&G review).

SHEET 2 OF 2

Table A-2 - Comparative Total (Dissolved) Trace-Metal Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (ug/L)						
				Al	Sb	As	Ba	Be	Cd	Cr
SW022	A	07/23/90	70001	46400 N*	37 U	5.5 B	486	3.2 B	5.5	62.2*
SW023	E	08/19/86		100 U	50 U	2 U	100 U	130	5 U	10 U
SW023	A	07/23/90	70002	73900 N*	37 U	6.1 B	742	5.2	11.3	95.0*
SW023	A	07/24/90	70005	4900 N*	37 U	2.4 B	137 B	1.0 B	11.2	9.6 B
SW023	A	08/24/90	70011	4070	46.1 B	3.6 B	94.6 B	1.0 B	3.9 B	6.8 B
SW023	A	11/08/90	70029							
SW023	A	12/10/90	70045							
SW023	A	12/19/90	70047		(see RFEDS retrievals)					
SW023	W	01/14/91	00750							
SW093	E	07/07/89		36	500 U	2 U	127	2 U	4 U	20 U
				(30 U)	(500 U)	(2 U)	(130)	(2 U)	(4 U)	(20 U)
SW093	E	03/23/89		200 U	60 U	10 U	200 U	5 U	5 U	17.3
				(200 U)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(25.0)
SW093	E	06/08/89		488	60 U	10 U	200 U	5 U	5 U	20 U
				(200 U)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(20 U)
SW093	E	07/05/89		200 U	69.2	10 U	200 U	5 U	5 U	13.5
				(200 U)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(11.7)
SW093	E	08/03/89		679	60 U	10 U	200 U	5 U	5 U	10 U
				(200 U)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(10 U)
SW093	E	10/10/89		200 U	60 U	10 U	200 U	5 U	5 U	10 U
				(200 U)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(10 U)

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported value is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
N = The Matrix Spike sample recovery is outside USEPA control limits.
S = The reported value was determined by the Method of Standard Analysis (MSA).
U = Not Detected.
W = The post-digestion (analytical) spike for GFAA is outside ISEPA control limits (85%-115%) while the sample absorbance is less than 50% of the spike absorbance.
* = Duplicate analysis is outside of USEPA control limits.

Table A-2 - Comparative Total (Dissolved) Trace-Metal Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (ug/L)						
				Al	Sb	As	Ba	Be	Cd	Cr
SW093	E	11/02/89		200 U	60 U	10 U	200 U	5 U	5 U	10 U
				(2360)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(10 U)
SW093	E	12/07/89		642	60 U	10 U	200 U	5 U	5 U	10 U
				(200 U)	(60 U)	(10 U)	(200 U)	(5 U)	(5 U)	(10 U)
SW093	A	07/23/90	70003	45600 N*	37 U	3.8 B	471	3.8 B	4.0 U	55.9*
SW093	A	07/24/90	70006	6720 N*	37	2.7	137	1	5.8	10.9*
SW093	A	10/24/90	70022							
SW093	W	11/19/90	00549							
SW118	W	10/29/90	00458	(see RFEDS retrievals)						
SW118	W	11/27/90	00559							
SW118	W	12/13/90	00663							
				Co	Cu	Fe	Pb	Mn	Hg	Ni
SW022	A	07/23/90	70001	24.4 B	109	49800	128	942	0.4 U	56.4
SW023	E	08/19/86		50 U	20 U	600	10 U	20	0.2 U	40 U
SW023	A	07/23/90	70002	36.7 B	128	77200	130	21270	0.4 U	86.6
SW023	A	07/24/90	70005	8 U	21 U	4980	14.7	94.9	0.4 U	23 U
SW023	A	08/24/90	70011	6.0 U	29.4	5220	12.4	218 E	0.2 U	12.0 U
SW023	A	11/08/90	70029							

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported value is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
N = The Matrix Spike sample recovery is outside USEPA control limits.
S = The reported value was determined by the Method of Standard Analysis (MSA).
U = Not Detected.
W = The post-digestion (analytical) spike for GFAA is outside ISEPA control limits (85%-115%) while the sample absorbance is less than 50% of the spike absorbance.
* = Duplicate analysis is outside of USEPA control limits.

Table A-2 - Comparative Total (Dissolved) Trace-Metal Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Co	Cu	Fe	Pb	Mn	Hg	Ni
				Chemical Constituent (ug/L)						
SW023	A	12/10/90	70045	(see RFEDS retrievals)						
SW023	A	12/19/90	70047							
SW023	W	01/14/91	00750							
SW093	E	07/07/88		20 U	20 U	508	4 U	383	0.2 U	20 U
				(20 U)	(20 U)	(30 U)	(4 U)	(392)	(0.2 U)	(20 U)
SW093	E	03/23/89		50 U	25 U	513	5 U	216	0.5	40 U
				(50 U)	(25 U)	(296)	(5 U)	(208)	(0.5)	(40 U)
SW093	E	06/08/89		50 U	25 U	922	5 U	273	0.2 U	40 U
				(50 U)	(25 U)	(100 U)	(5 U)	(173)	(0.2 U)	(40 4U)
SW093	E	07/05/89		50 U	25 U	1400	5 U	999	0.2 U	40 U
				(50 U)	(25 U)	(103)	(5 U)	(1020)	(0.2 U)	(40 U)
SW093	E	08/03/89		50 U	25 U	1450	5 U	443	0.2 U	40 U
				(50 U)	(25 U)	(100 U)	(5 U)	(438)	(0.2 U)	(40 U)
SW093	E	10/10/89		50 U	25 U	1220	856	847	0.2 U	40 U
				(50 U)	(25 U)	(551)	(5 U)	(870)	(0.2 U)	(40 U)
SW093	E	11/02/89		50 U	25 U	100 U	3 U	204	0.2 U	40 U
				(50 U)	(25 U)	(3510)	(3 U)	(287)	(0.2 U)	(40 U)
SW093	E	12/07/89		50 U	25 U	1810	3 U	764	0.2 U	40 U
				(50 U)	(25 U)	(290)	(3 U)	(815)	(0.2 U)	(40 U)
SW093	A	07/23/90	70003	25.3 B	86.1	55300	74.7	988	0.4 U	61.9
SW093	A	07/24/90	70006	8 U	17.5 B	6250	10.5 S	243	0.4 U	23 U

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported value is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
N = The Matrix Spike sample recovery is outside USEPA control limits.
S = The reported value was determined by the Method of Standard Analysis (MSA).
U = Not Detected.
W = The post-digestion (analytical) spike for GFAA is outside ISEPA control limits (85%-115%) while the sample absorbance is less than 50% of the spike absorbance.
* = Duplicate analysis is outside of USEPA control limits.

Table A-2 - Comparative Total (Dissolved) Trace-Metal Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (ug/L)						
				Co	Cu	Fe	Pb	Mn	Hg	Ni
SW093	A	10/24/90	70022							
SW093	W	11/19/90	00549							
						(see RFEDS retrievals)				
SW118	W	10/29/90	00458							
SW118	W	11/27/90	00559							
SW118	W	12/13/90	00663							
				Se	Ag	Th	V	Zn		
SW022	A	07/23/90	70001	1 U,W	8.2 B,N	1 U,N	124	592		
SW023	E	08/19/86		2 U	10 U	10 U	50 U	20 U		
SW023	A	07/23/90	70002	2.0 U,W	6.4 B,N	1 U,N	206	1120		
SW023	A	07/24/90	70005	1 U	6.2 B,N	1 U,W,N	17.9 B	225		
SW023	A	08/24/90	70011	3.0 B,W,U	4.0 U	1.0 U,W,N	14.5 B	355		
SW023	A	11/08/90	70029							
SW023	A	12/10/90	70045							
SW023	A	12/19/90	70047			(see RFEDS retrievals)				
SW023	W	01/14/91	00750							

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported value is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
N = The Matrix Spike sample recovery is outside USEPA control limits.
S = The reported value was determined by the Method of Standard Analysis (MSA).
U = Not Detected.
W = The post-digestion (analytical) spike for GFAA is outside ISEPA control limits (85%-115%) while the sample absorbance is less than 50% of the spike absorbance.
* = Duplicate analysis is outside of USEPA control limits.

Table A-2 - Comparative Total (Dissolved) Trace-Metal Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Se	Ag	Th	V	Zn
				Chemical Constituent (ug/L)				
SW093	E	07/07/88		5 U	30 U	300 U	10 U	88
				(5 U)	(30 U)	(300 U)	(10 U)	(63)
SW093	E	03/23/89		5 U	10 U	10 U	50 U	48.3
				(5 U)	(10 U)	(10 U)	(50 U)	(33.4)
SW093	E	06/08/89		5 U	10 U	10 U	50 U	13.5
				(5 U)	(10 U)	(10 U)	(50 U)	(36.2)
SW093	E	07/05/89		5 U	10 U	10 U	50 U	96.6
				(5 U)	(10 U)	(10 U)	(50 U)	(40)
SW093	E	08/03/89		5 U	10 U	10 U	50 U	172
				(5 U)	(10 U)	(10 U)	(50 U)	(20 U)
SW093	E	10/10/89		5 U	10 U	10 U	50 U	54.3
				(5 U)	(10 U)	(10 U)	(50 U)	(65.6)
SW093	E	11/02/89		5 U	10 U	10 U	50 U	28.5
				(5 U)	(10 U)	(10 U)	(50 U)	(123)
SW093	E	12/07/89		5 U	10 U	10 U	50 U	54.4
				(5 U)	(10 U)	(10 U)	(50 U)	(26.5)
SW093	A	07/23/90	70003	1 U,W	4.2 B,N	1 U,N	125	608
SW093	A	07/24/90	70006	1 U,W	3.7 B,N	1 8 U,N	19.8 B	162
SW093	A	10/24/90	70022					
SW093	W	11/19/90	00549					
SW118	W	10/29/90	00458	(see RFEDS retrievals)				
SW118	W	11/27/90	00559					

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported value is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
N = The Matrix Spike sample recovery is outside USEPA control limits.
S = The reported value was determined by the Method of Standard Analysis (MSA).
U = Not Detected.
W = The post-digestion (analytical) spike for GFAA is outside ISEPA control limits (85%-115%) while the sample absorbance is less than 50% of the spike absorbance.
* = Duplicate analysis is outside of USEPA control limits.

Table A-2 - Comparative Total (Dissolved) Trace-Metal Data, Non-Point Source Monitoring Sites

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (ug/L)				
				Se	Ag	Th	V	Zn
SW118	W	12/13/90	00663		(see RFEDS retrievals)			

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported value is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
N = The Matrix Spike sample recovery is outside USEPA control limits.
S = The reported value was determined by the Method of Standard Analysis (MSA).
U = Not Detected.
W = The post-digestion (analytical) spike for GFAA is outside ISEPA control limits (85%-115%) while the sample absorbance is less than 50% of the spike absorbance.
* = Duplicate analysis is outside of USEPA control limits.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1)]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	pH (Std Units)	SC (uS/cm)	Chemical Constituent (mg/L)			
						Ca	Mg	K	Na
SW022	A	07/23/90	70001	---	---	74.0	17.7	10.1	7.29
SW022	A	09/07/90	70013	7.4	162	--	--	--	--
SW023	E	08/19/86	--	--	--	(78.8)	(18.1)	(0.1U)	(235.)
SW023	A	07/23/90	70002	7.6	450	94.9	20.3	12.2	9.3
SW023	A	07/24/90	70005	7.6	380	45.8	9.8	3.67 B	31.0
SW023	A	08/24/90	70011	7.2	200	29.8	6.26	3.31	15.8
SW023	A	09/19/90	70015	7.3	120	--	--	--	--
SW023	W	10/16/90	00443						
SW023	A	11/08/90	70029						
SW023	W	11/16/90	00544						
SW023	A	11/19/90	70040						
SW023	A	12/10/90	70045	(see RFEDS retrievals)					
SW023	A	12/19/90	70047						
SW023	W	01/14/91	00750						
SW027	E	01/29/90	--	7.7	--	--	--	--	--
SW027	A	09/19/90	70016	6.4	380	--	--	--	--

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	pH (Std Units)	SC (uS/cm)	Chemical Constituent (mg/L)			
						Ca	Mg	K	Na
SW093	E	07/07/88	--	--	--	81.0 (84.8)	17.9 (18.9)	2.47 (2.64)	39.9 (41.9)
SW093	E	03/23/89	--	--	--	55.5 (56.5)	11.7 (11.8)	5.U (5.U)	27.9 (30.)
SW093	E	06/08/89	--	--	--	70.1 (60.0)	13.4 (11.8)	5.U (5.U)	26.3 (24.8)
SW093	E	07/05/89	--	--	--	101 (101.0)	23.9 (24.2)	5.U (5.U)	49.6 (51.2)
SW093	E	08/03/89	--	--	--	75.3 (75.6)	15.8 (16.1)	5.U (5.U)	36.6 (35.4)
SW093	E	10/10/89	--	--	--	109 (112.0)	29.2 (30.4)	5.U (5.U)	59.6 (61.9)
SW093	E	11/02/89	--	--	--	52.4 (50.9)	11.2 (10.6)	5.U (5.U)	47.1 (41.9)
SW093	E	12/07/89	--	--	--	77.7 (84.7)	20 (21.8)	5.U (5.U)	43.7 (49.0)
SW093	E	01/29/90	--	7.8	--	--	--	--	--
SW093	E	02/21/90	--	7.9	--	--	--	--	--
SW093	E	03/16/90	--	7.9	--	--	--	--	--

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1)]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	pH (Std Units)	SC (uS/cm)	Chemical Constituent (mg/L)			
						Ca	Mg	K	Na
SW093	A	07/23/90	70003	7.6	380	43.7	16.9	95.4	12.2
SW093	A	07/24/90	70006	--	--	54.6	10.3	43.8 B	25.6
SW093	A	07/31/90	70007	7.2	215	--	--	--	--
SW093	A	09/04/90	70012	7.2	175	--	--	--	--
SW093	A	09/19/90	70017	--	--	--	--	--	--
SW093	A	10/24/90	70022	(see RFEDS retrievals)					
SW093	W	11/19/90	00549						

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1)]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (mg/L)					
				Alk	HCO_3	CO_3	SO_4	Cl	F
SW022	A	07/23/90	70001	53	53	ND	9.1	6.8	0.3
SW022	A	09/07/90	70013	58	58	<10	11	5	<0.5
SW023	A	07/23/90	70002	69	69	ND	9.6	8	0.3
SW023	A	07/24/90	70005	120	120	ND	25	22	0.6
SW023	A	08/24/90	70011	73	73	--	11	14	0.5
SW023	A	09/19/90	70015	53	53	<10	<10	7	<0.5
SW023	A	09/19/90	70016	87	87	18	<10	34	0.6
SW023	W	10/16/90	00443						
SW023	A	11/08/90	70029						
SW023	W	11/16/90	00544			(see RFEDS retrievals)			
SW023	A	11/19/90	70040						
SW023	A	12/10/90	70045						
SW023	A	12/19/90	70047						
SW023	W	01/14/91	00750						
SW027	E	01/29/90		--	--	<5	88	52	--

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1)]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (mg/L)					
				Alk	HCO_3	CO_3	SO_4	Cl	F
SW093	E	01/29/90		--	--	<5	72	75	--
SW093	E	02/21/90		--	--	<5	47	160	--
SW093	E	03/16/90		--	--	<5	34	64	--
SW093	A	07/23/90	70003	50	50	ND	9.6	8.6	0.3
SW093	A	07/24/90	70006	130	130	ND	22	20	0.4
SW093	A	07/31/90	70007	--	81	0	15	12	0.2
SW093	A	09/04/90	70012	--	56	<10	<10	8	<0.5
SW093	A	09/19/90	70017	--	65	<10	<10	11	<0.5
SW093	A	10/24/90	70022						
SW093	W	11/19/90	00549		(see RFEDS retrievals)				

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1)]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (mg/L)						
				NH_3-N	NO_3/NO_2-N	Total P	PO_4	SiO_2	TDS	TSS
SW022	A	07/23/90	70001	--	1.8	1.8	--	--	190	2800
SW022	A	09/07/90	70013	2.5	1.3	--	--	--	100	300
SW023	A	07/23/90	70002	--	1.7	1.5	--	--	140	1600
SW023	A	07/24/90	70005	--	2.8	1.4	--	--	220	120
SW023	A	08/24/90	70011	--	1.1	--	0.21	--	140	170
SW023	A	09/19/90	70015	--	1	--	0.08	--	94	360
SW023	W	10/16/90	00443							
SW023	A	11/08/90	70029							
SW023	W	11/16/90	00544							
SW023	A	11/19/90	70040		(see RFEDS retrievals)					
SW023	A	12/10/90	70045							
SW023	A	12/19/90	70047							
SW023	W	01/14/91	00750							
SW027	E	01/29/90		--	4.6	--	--	--	470	--
SW027	A	09/19/90	70016	--	1.5	--	0.18	--	210	45

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-3 - Comparative Major-Ion Data, Non-Point Source Monitoring Sites[1]

Rocky Flats Plant

Site	Source	Date	Sample Lab Code	Chemical Constituent (mg/L)						
				NH_3-N	NO_3/NO_2-N	Total P	PO_4	SiO_2	TDS	TSS
SW027	W	11/13/90	00508	--	--	--	--	4.5	--	--
SW027	W	11/13/90	80068	--	--	--	--	0.12	--	--
SW027	W	11/13/90	80069	--	--	--	--	4.7	--	--
SW093	E	01/29/90		--	4.2	--	--	--	550	--
SW093	E	02/21/90		--	3.6	--	--	--	590	10
SW093	E	03/16/90		--	8.3	--	--	--	680	24
SW093	A	09/04/90	70012	3.4	1.8	--	--	--	110	1170
SW093	A	09/19/90	70017	--	3.1	--	0.07	--	140	810
SW093	A	10/24/90	70022	(see RFEDS retrievals)						
SW093	W	11/19/90	00549							

A = ASI recently collected samples.
E = Historical EG&G data (ITEMS data base).
B = The reported vaule is less than Contract Required Detection Limit (CRDL), but greater than or equal to Instrument Detection Limit (IDL).
ND = Not determined.

1) Total (unfiltered sample) concentrations, unless noted by values in parentheses, which are dissolved (filtered-sample) concentrations.

Table A-4 - Automatic-Sampling Storm-Event Data

Site SW022	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
SW70001WC	07/20	1352	1	--	--	235[1]
(07/23/90)	07/20	1752	2	--	--	344
	07/20	1742	3	--	--	254
	07/20	1842	4	--	--	208
	07/21	1442	5	--	--	302
	07/21	1642	6	--	--	142
	07/21	1742	7	--	--	235
SW70013WC (09/07/90)	09/07	1620	1	--	--	Grab
SW70028WC	11/04	0923	1	.28	2.00	26
(11/07/90)	11/04	0938	2	.34	2.54	107
	11/04	0953	3	.37	2.77	147
	11/04	1008	4	.41	3.08	202
	11/04	1023	5	.56	4.33	421
	11/04	1038	6	.95	7.64	1000
	11/04	1053	7	.81	6.42	786
	11/04	1108	8	.79	6.25	757
	11/04	1123	9	.70	5.50	626
	11/04	1138	10	.57	4.42	436
	11/04	1153	11	.52	4.00	363
	11/04	1208	12	.41	3.08	202
	11/04	1223	13	.37	2.77	147
	11/04	1238	14	.31	2.31	66
SW70027WC (11/08/90)	11/08	1200	1	--	--	Grab
SW70046WC (12/13/90)	12/03		1	*	--	
SW60074WC (04/15/91)	04/12	0907	1	.42	3.17	
SW60082WC (05/01/91)	04/30	0900	1	.79	6.25	

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW022 (Cont'd)						
SW60088WC	05/10	1313	1	.28	2.08	1000
(05/17/91)	05/10	1323	2	.29	2.15	1000
	05/10	1333	3	.30	2.23	1000
	05/10	1343	4	.29	2.15	1000
	05/10	1353	5	.29	2.15	1000
SW60098WC	05/22	2121	1	.83	6.58	704
(05/23/91)	05/22	2131	2	1.03	8.31	965
	05/22	2141	3	.77	6.08	628
	05/22	2151	4	.62	4.83	439
	05/22	2201	5	.47	3.58	250
	05/22	2211	6	.38	2.85	139
	05/22	2221	7	.33	2.46	80
	05/22	2231	8	.32	2.38	69
	05/22	2241	9	.61	4.75	427
	05/22	2251	10	1.02	8.23	953
	05/22	2301	11	1.06	8.54	1000
	05/22	2311	12	.99	8.00	919
	05/22	2321	13	.85	6.75	729
	05/22	2331	14	.70	5.50	540
SW60102WC	05/31	1813	1	.51	3.92	498
(06/03/91)	05/31	1823	2	.56	4.33	603
	05/31	1833	3	.57	4.42	624
	05/31	1843	4	.53	4.08	540
	05/31	1853	5	.45	3.42	373
	05/31	1903	6	.33	2.46	133
	05/31	1913	7	.29	2.15	56
	05/31	1923	8	.36	2.69	191
	05/31	1933	9	.35	2.62	172
	05/31	1943	10	.30	2.23	75
	06/01	1333	11	.49	3.75	457
	06/01	1343	12	.51	3.92	498
	06/01	1353	13	.46	3.50	394
	06/01	1403	14	.40	3.00	268
	06/01	1413	15	.33	2.46	133
	06/01	1733	16	.67	5.25	833
	06/01	1743	17	.65	5.08	791
	06/01	1753	18	.66	5.17	812
	06/01	1803	19	.64	5.00	770
	06/01	1813	20	.61	4.75	707

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW022 (Cont'd)						
	06/01	1823	21	.61	4.75	707
	06/01	1833	22	.59	4.58	666
	06/01	1843	23	.62	4.83	728
	06/01	1853	24	.54	4.17	561
SW60112WC	06/07	1439	1	.58	4.50	143
(06/11/91)	06/07	1449	2	1.45	13.80	661
	06/07	1459	3	1.91	18.40	917
	06/07	1509	4	2.05	19.80	994
	06/07	1519	5	2.06	19.90	1000
	06/07	1529	6	1.51	14.40	694
	06/07	1539	7	.40	3.00	60
	06/07	1549	8	.33	2.46	30
	06/07	1559	9	.28	2.08	8
SW60117WC (07/10/91)	07/09	1909	1	.55	4.25	
SW60125WC (07/23/91)	07/23	1150	1	--	--	Grab
SW60130WC	07/24	1443	1	.37	2.77	483
(07/29/91)	07/24	1453	2	.37	2.77	483
	07/24	1503	3	.39	2.92	572
	07/24	1513	4	.42	3.17	712
	07/24	1523	5	.46	3.50	904
	07/24	1533	6	.48	3.67	1000
	07/24	1543	7	.45	3.42	856
	07/24	1553	8	.43	3.25	760
	07/24	1603	9	.40	3.00	616
	07/24	1613	10	.40	3.00	616
	07/24	1623	11	.39	2.92	572
	07/24	1633	12	.35	2.62	395
	07/24	1643	13	.29	2.15	129
	07/24	1653	14	.27	2.00	40
	07/26	1523	15	.46	3.50	904
	07/26	1533	16	.44	3.33	808
	07/26	1543	17	.40	3.00	616
	07/26	1553	18	.36	2.69	439
	07/26	1603	19	.36	2.69	439

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW022 (Cont'd)						
	07/26	1613	20	.35	2.62	395
	07/26	1623	21	.33	2.46	306
	07/26	1633	22	.31	2.31	217
	07/26	1643	23	.29	2.15	129
	07/26	1653	24	.29	2.15	129
SW60132WC	08/03	0952	1	.33	2.46	128
(08/05/91)	08/03	1002	2	.41	3.08	278
	08/03	1012	3	.55	4.25	559
	08/03	1022	4	.60	4.67	659
	08/03	1032	5	.70	5.50	860
	08/03	1042	6	.77	6.08	1000
	08/03	1052	7	.77	6.08	1000
	08/03	1102	8	.77	6.08	1000
	08/03	1112	9	.77	6.08	1000
	08/03	1122	10	.75	5.92	960
	08/03	1132	11	.73	5.75	920
	08/03	1142	12	.69	5.42	839
	08/03	1152	13	.63	4.92	719
	08/03	1202	14	.55	4.25	559
	08/03	1212	15	.49	3.75	438
	08/03	1222	16	.45	3.42	358
	08/03	1232	17	.41	3.08	278
	08/03	1242	18	.39	2.92	239
	08/03	1252	19	.35	2.62	165
	08/03	1302	20	.33	2.46	128
SW60139WC	08/06	1710	1	.85	6.75	1000
(08/07/91)	08/06	1720	2	.85	6.75	1000
	08/06	1730	3	.84	6.67	983
	08/06	1740	4	.84	6.67	983
	08/06	1750	5	.80	6.33	914
	08/06	1800	6	.69	5.42	723
	08/06	1810	7	.60	4.67	568
	08/06	1820	8	.52	4.00	429
	08/06	1830	9	.48	3.67	360
	08/06	1840	10	.43	3.25	274
	08/06	1850	11	.39	2.92	206
	08/06	1900	12	.35	2.62	142
	08/06	1910	13	.33	2.46	110
	08/06	1920	14	.31	2.31	78
	08/06	1930	15	.29	2.15	46
	08/06	1940	16	.27	2.00	15
	08/06	1950	17	.29	2.00	15
	08/06	1960	18	.27	2.00	15

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW022 (Cont'd)						
SW60148WC	08/09	1728	1	1.52	14.50	840
(08/12/91)	08/09	1738	2	1.76	16.90	1000
	08/09	1748	3	1.63	15.60	913
	08/09	1758	4	1.42	13.50	773
	08/09	1808	5	.75	5.92	266
	08/09	1818	6	.65	5.08	211
	08/09	1828	7	.50	3.83	127
	08/09	1838	8	.37	2.77	56
	08/09	1848	9	.33	2.46	36
SW60156WC	08/16	1642	1	.41	3.08	1000
(08/16/91)	08/16	1652	2	.36	2.69	661
	08/16	1702	3	.33	2.46	461
	08/16	1712	4	.31	2.31	327
	08/16	1722	5	.28	2.08	127

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023						
SW70002WC (07/23/90)	07/20	1200	1-24	--	--	**
SW70005WC (07/24/90)	07/23-24	1530	1-24	--	--	**
SW70011WC (08/24/90)	08/22	1757	1	.91	1.1	433
	08/22	1812	2	.89	1.1	401
	08/22	1827	3	.95	1.3	486
	08/22	1842	4	.93	1.2	454
	08/22	1857	5	.93	1.2	459
	08/22	1912	6	.83	0.9	332
SW70015WC (09/19/90)	09/18		1-15	*		
SW70018WC (10/12/90)	10/09	2352	1	.60	.40	
SW70029WC (11/08/90)	11/07	1138	1	.69	.57	1000
	11/07	1153	2	.79	.80	1000
	11/07	1208	3	.73	.66	1000
	11/07	1223	4	.71	.61	1000
	11/07	1238	5	.64	.47	1000
SW70040WC (11/19/90)	11/09	1149	1	.56	.34	46
	11/09	1159	2	.67	.53	151
	11/09	1209	3	.85	.96	385
	11/09	1219	4	1.03	1.60	732
	11/09	1229	5	1.09	1.92	905
	11/09	1239	6	1.11	2.09	1000
	11/09	1249	7	1.06	1.76	819
	11/09	1259	8	.97	1.34	590
	11/09	1309	9	.96	1.30	571
	11/09	1319	10	.89	1.08	449
	11/09	1329	11	.83	.91	355
	11/09	1339	12	.78	.78	284
	11/09	1349	13	.75	.70	244
	11/09	1359	14	.73	.66	220
	11/09	1409	15	.68	.55	162
	11/09	1419	16	.68	.55	162

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023 (Cont'd)						
	11/09	1429	17	.64	.47	119
	11/09	1439	18	.60	.40	80
	11/09	1449	19	.58	.37	63
	11/09	1459	20	.55	.32	38
	11/09	1509	21	.52	.28	15
	11/09	1519	22	.52	.28	15
	11/09	1589	23	.52	.28	15
SW70045WC	11/27	0933	1	.51	.27	5
(12/10/90)	11/27	0943	2	.53	.29	28
	11/27	0953	3	.54	.31	31
	11/27	1003	4	.88	1.05	493
	11/27	1013	5	1.08	1.86	1000
	11/27	1023	6	1.06	1.76	934
	11/27	1033	7	.98	1.37	693
	11/27	1043	8	.93	1.21	590
	11/27	1053	9	.94	1.24	610
	11/27	1103	10	.98	1.37	693
	11/27	1113	11	.89	1.08	511
	11/27	1123	12	.81	.85	370
	11/27	1133	13	.74	.68	262
	11/27	1143	14	.70	.59	207
	11/27	1153	15	.66	.51	157
	11/27	1203	16	.63	.46	122
	11/27	1213	17	.60	.40	89
	11/27	1223	18	.59	.39	79
	11/27	1233	19	.57	.36	59
	11/27	1243	20	.56	.34	50
	11/27	1253	21	.52	.28	14
	11/27	1303	22	.51	.27	5
	11/27	1313	23	.51	.27	23
SW70047WC	12/19	0932	1	.60	.40	200
(12/19/90)	12/19	0947	2	.51	.27	19
	12/19	1217	3	.86	.99	1000
	12/19	1232	4	.77	.75	676
	12/19	1247	5	.71	.61	488
	12/19	1302	6	.65	.49	322
	12/19	1317	7	.59	.39	179
	12/19	1332	8	.56	.34	115
	12/19	1347	9	.52	.28	38
	12/19	1402	10	.53	.30	56

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023 (Cont'd)						
SW60063WC (02/22/91)	1/11	1552		.69	.57	530
SW60062WC (02/22/91)	1/16	1342	1	.63	.46	336
	1/16	1357	2	.81	.85	1000
	1/16	1412	3	.77	.75	831
	1/16	1427	4	.70	.59	564
SW60066WC (04/02/91)	03/29	1349	1	.66	.51	865
	03/29	1359	2	.68	.55	1000
	03/29	1409	3	.67	.53	933
	03/29	1419	4	.67	.53	933
	03/29	1429	5	.65	.49	798
SW60068WC (04/09/91)	04/08	0129	1	.84	.93	1000
	04/08	0139	2	.75	.70	660
	04/08	0149	3	.65	.49	349
	04/08	0159	4	.59	.39	194
	04/08	0209	5	.54	.31	81
	04/08	0219	6	.53	.30	61
	04/08	0229	7	.51	.27	20
	04/08	0859	8	.57	.36	148
	04/08	0909	9	.58	.37	171
	04/08	0919	10	.60	.40	216
	04/08	0929	11	.60	.40	216
	04/08	0939	12	.60	.40	216
	04/08	0949	13	.60	.40	216
	04/08	0959	14	.60	.40	216
	04/08	1009	15	.58	.37	171
	04/08	1159	16	.59	.39	194
	04/08	1209	17	.59	.39	194
	04/08	1219	18	.59	.39	194
	04/08	1229	19	.55	.32	102
	04/08	1239	20	.55	.32	102
	04/08	1249	21	.55	.32	102
	04/08	1259	22	.52	.28	61
	04/08	1309	23	.51	.27	61
	04/08	1319	24	.50	.26	61
SW60069WC (04/15/91)	04/11	0759	1	.54	.31	9
	04/11	0809	2	.51	.27	2
	04/11	0859	3	.65	.49	37
	04/11	0909	4	1.00	1.44	186

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023 (Cont'd)						
	04/11	0919	5	.95	1.27	160
	04/11	0929	6	.91	1.14	139
	04/11	0939	7	.95	1.27	160
	04/11	0949	8	1.06	1.76	236
	04/11	0959	9	1.32	5.56	834
	04/11	1009	10	1.23	3.74	547
	04/11	1019	11	1.18	2.94	422
	04/11	1029	12	1.17	2.82	403
	04/11	1039	13	1.12	2.21	308
	04/11	1049	14	1.09	1.92	261
	04/11	1059	15	1.05	1.71	228
	04/11	1109	16	1.00	1.44	186
	04/11	1119	17	.94	1.24	155
	04/11	1129	18	.88	1.05	125
	04/11	1139	19	.84	.93	107
	04/11	1149	20	.79	.80	86
	04/11	1159	21	.76	.73	74
	04/11	1209	22	.72	.64	60
	04/11	1219	23	.69	.57	50
SW60075WC	04/21	0328	1	.75	.70	81
(04/23/91)	04/21	0338	2	.93	1.21	217
	04/21	0348	3	.85	.96	151
	04/21	0358	4	.80	.83	115
	04/21	0408	5	.75	.70	81
	04/21	0418	6	.69	.57	46
	04/21	0428	7	.62	.44	10
	04/21	1748	8	.70	.59	51
	04/21	1758	9	.76	.73	88
	04/21	1808	10	1.06	1.76	366
	04/21	1818	11	1.23	3.74	900
	04/21	1828	12	1.24	3.92	950
	04/21	1838	13	1.23	3.74	900
	04/21	1848	14	1.25	4.11	1000
	04/21	1858	15	1.21	3.37	800
	04/21	1908	16	1.17	2.82	652
	04/21	1918	17	1.18	2.45	554
	04/21	1928	18	1.11	2.09	456
	04/21	1938	19	1.08	1.86	395
	04/21	1948	20	1.05	1.71	352
	04/21	1958	21	1.00	1.44	280
	04/21	2008	22	.95	1.27	234
	04/21	2018	23	.94	1.24	226

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023 (Cont'd)						
SW60083WC	04/30	0744	1	.83	.91	7
(05/01/91)	04/30	0754	2	.89	1.08	23
	04/30	0804	3	.93	1.21	34
	04/30	0814	4	.94	1.24	37
	04/30	0824	5	1.02	1.55	65
	04/30	0834	6	1.04	1.65	74
	04/30	0844	7	1.05	1.70	79
	04/30	0854	8	1.06	1.76	84
	04/30	0904	9	1.28	4.66	345
	04/30	0914	10	1.31	5.29	402
	04/30	0924	11	1.32	5.56	425
	04/30	0934	12	1.37	6.88	544
	04/30	0944	13	1.55	11.95	1000
	04/30	0954	14	1.48	9.85	812
	04/30	1004	15	1.53	11.33	944
	04/30	1014	16	1.51	10.71	889
	04/30	1024	17	1.54	11.64	972
	04/30	1034	18	1.53	11.33	944
	04/30	1044	19	1.51	10.71	889
	04/30	1054	20	1.48	9.85	812
	04/30	1104	21	1.46	9.31	762
	04/30	1114	22	1.45	9.04	738
	04/30	1124	23	1.43	8.49	689
	04/30	1134	24	1.42	8.22	664
SW60090WC	05/12	1410	1	1.18	2.94	120
(05/17/91)	05/12	1420	2	1.04	1.65	62
	05/12	1430	3	1.00	1.44	54
	05/12	1440	4	1.12	2.21	88
	05/12	1450	5	1.19	3.06	126
	05/12	1500	6	1.59	13.19	580
	05/12	1510	7	1.78	20.22	898
	05/12	1520	8	1.66	15.66	692
	05/12	1530	9	1.54	11.64	512
	05/12	1540	10	1.34	6.09	262
	05/12	1550	11	1.22	3.55	128
	05/12	1600	12	1.13	2.33	94
	05/12	1610	13	1.06	1.76	68
	05/12	1620	14	.95	1.27	46
SW6100WC	05/22	2109	1	1.38	7.14	859
(05/23/91)	05/22	2124	2	1.24	3.92	437
	05/22	2139	3	1.10	1.97	437
	05/22	2154	4	.99	1.37	181
	05/22	2209	5	.86	.99	139

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023 (Cont'd)						
	05/22	2224	6	1.04	1.65	85
	05/22	2239	7	1.37	6.88	52
	05/22	2254	8	1.37	6.88	45
	05/22	2309	9	1.23	3.73	437
	05/22	2324	10	1.11	2.02	825
	05/22	2339	11	1.01	1.49	1000
	05/22	2354	12	.93	1.19	686
	05/23	0009	13	.89	1.08	412
	05/23	0024	14	.77	.75	260
	05/23	0039	15	.77	.75	167
	05/23	0054	16	.97	1.33	118
	05/23	0109	17	.94	1.24	93
	05/23	0124	18	.86	.99	68
	05/23	0139	19	.83	.91	64
SW60101WC	05/23	2331	1	.89	1.08	1000
(06/03/91)	05/23	2341	2	.85	.96	756
	05/23	2351	3	.79	.80	429
	05/24	0001	4	.72	.64	91
	05/24	0011	5	.77	.75	328
	05/24	0021	6	.79	.80	429
	05/24	0031	7	.74	.68	182
	05/24	0041	8	.73	.66	136
	05/24	0051	9	.71	.61	45
	05/24	0101	10	.78	.78	379
SW60124WC (07/23/91)	07/23	1125	1	--	--	Grab
SW60140WC	08/06	1657	1	1.50	10.40	215
(08/07/91)	08/06	1707	2	2.44	41.56	914
	08/06	1717	3	2.77	45.39	1000
	08/06	1727	4	2.36	40.71	895
	08/06	1737	5	2.01	30.91	675
	08/06	1747	6	1.70	17.10	365
	08/06	1757	7	1.30	5.03	94
	08/06	1807	8	1.11	2.09	28
	08/06	1817	9	1.11	2.09	28
	08/06	1827	10	1.01	1.49	15
	08/06	1837	11	.90	1.11	6
	08/06	1847	12	.86	.99	4
	08/06	1857	13	.82	.88	1

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW023 (Cont'd)						
SW60149WC	08/09	1722	1	2.49	42.09	888
(08/12/91)	08/09	1732	2	2.93	47.27	1000
	08/09	1742	3	2.82	45.98	972
	08/09	1752	4	1.99	29.89	626
	08/09	1802	5	1.65	15.30	312
	08/09	1812	6	1.06	1.76	20
SW60157WC	08/16	1611	1	.94	1.24	
(08/28/91)						

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW027						
SW70016WC	09/18	2332	1	.29	1.5	440
(09/19/90)	09/18	2347	2	.32	2.0	860
	09/19	0002	3	.33	2.1	1000
	09/19	0017	4	.33	2.1	1000
	09/19	0032	5	.33	2.1	1000
	09/19	0047	6	.33	2.1	1000
	09/19	0102	7	.33	2.1	1000
SW70042WC	11/09	2015	1	.26	1.19	289
(11/19/90)	11/09	2030	2	.26	1.19	289
	11/09	2045	3	.26	1.19	289
	11/09	2100	4	.26	1.19	289
	11/09	2115	5	.28	1.40	1000
	11/09	2130	6	.26	1.19	289
	11/09	2145	7	.26	1.19	289
	11/09	2200	8	.26	1.19	289
SW60081WC	04/30	1453	1	.31	1.82	207
(05/01/91)	04/30	1503	2	.31	1.82	207
	04/30	1513	3	.32	1.96	448
	04/30	1523	4	.32	1.96	448
	04/30	1533	5	.32	1.96	448
	04/30	1543	6	.32	1.96	448
	04/30	1553	7	.32	1.96	448
	04/30	1603	8	.32	1.96	448
	04/30	1613	9	.34	2.28	1000
	04/30	1623	10	.34	2.28	1000
	04/30	1633	11	.34	2.28	1000
	04/30	1643	12	.34	2.28	1000
	04/30	1653	13	.34	2.28	1000
	04/30	1703	14	.34	2.28	1000
	04/30	1713	15	.34	2.28	1000
	04/30	1723	16	.32	1.96	448
	04/30	1843	17	.32	1.96	448
SW60091WC (05/17/91)	05/15		1-24	*		
SW60097WC	05/23	0245	1	.32	1.96	232
(05/23/91)	05/23	0255	2	.34	2.28	518
	05/23	0305	3	.35	2.46	679

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW027 (Cont'd)						
	05/23	0315	4	.37	2.82	1000
	05/23	0325	5	.37	2.82	1000
	05/23	0335	6	.35	2.46	679
	05/23	0345	7	.35	2.46	679
	05/23	0355	8	.35	2.46	679
	05/23	0405	9	.35	2.46	679
	05/23	0415	10	.35	2.46	679
	05/23	0425	11	.34	2.28	518
	05/23	0435	12	.34	2.28	518
	05/23	0445	13	.34	2.28	518
	05/23	0455	14	.32	1.96	232
	05/23	0505	15	.32	1.96	232
	05/23	0515	16	.32	1.96	232
SW60104WC	05/31	2209	1	.43	4.00	139
(06/03/91)	05/31	2219	2	.44	4.20	151
	05/31	2229	3	.44	4.20	151
	05/31	2239	4	.46	4.60	175
	05/31	2249	5	.46	4.60	175
	05/31	2259	6	.44	4.20	151
	05/31	2309	7	.44	4.20	151
	05/31	2319	8	.43	4.00	139
	05/31	2329	9	.43	4.00	139
	05/31	2339	10	.41	3.60	115
	05/31	2349	11	.40	3.40	103
	05/31	2359	12	.40	3.40	103
	06/01	0009	13	.38	3.00	78
	06/01	0019	14	.36	2.64	57
	06/01	0029	15	.36	2.64	57
	06/01	0039	16	.35	2.46	46
	06/01	0049	17	.35	2.46	46
	06/01	0059	18	.33	2.10	24
	06/01	0109	19	.33	2.10	24
	06/01	0119	20	.32	1.96	16
	06/01	0129	21	.32	1.96	16
	06/01	1739	22	.33	2.10	24
	06/01	1749	23	.33	2.10	24
	06/01	1759	24	.33	2.10	24
SW60109WC (06/11/91)	06/07		1-24	*		

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Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW027 (Cont'd)						
SW60133WC (08/05/91)	08/03	1429	1	.36	2.64	
SW60141WC (08/06/91)	08/06	1941	1	.62	9.16	
SW60151WC	08/09	1947	1	.60	8.55	816
(08/12/91)	08/09	1957	2	.65	10.09	1000
	08/09	2007	3	.65	10.09	1000
	08/09	2017	4	.62	9.16	889
	08/09	2027	5	.59	8.24	779
	08/09	2037	6	.55	7.00	632
	08/09	2047	7	.54	6.68	593
	08/09	2057	8	.51	5.72	479
	08/09	2107	9	.47	4.80	369
	08/09	2117	10	.44	4.20	298
	08/09	2127	11	.43	4.00	274
	08/09	2137	12	.41	3.60	226
	08/09	2147	13	.38	3.00	155
	08/09	2157	14	.36	2.64	112
	08/09	2207	15	.35	2.46	91
	08/09	2217	16	.33	2.10	48
	08/09	2227	17	.32	1.96	31
	08/09	2237	18	.32	1.96	31

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW093						
SW70003WC (07/23/90)	07/20	1300	1	--	--	Grab
SW70006WC (07/24/90)	07/23-24	1600	1-24	--	--	**
SW70007WC	07/30	2117	1	.81	8.6	1000
(07/31/90)	07/30	2132	2	.57	5.0	1000
SW70012WC	09/01	2033	1	.86	9.5	356[2]
(09/04/90)	09/01	2048	2	.57	5.0	458
	09/01	2103	3	.98	11.6	445
	09/01	2118	4	.97	11.5	438
	09/01	2133	5	.81	8.6	319
	09/01	2148	6	.69	6.7	239
	09/01	2203	7	.57	5.0	167
SW70014WC (09/07/90)	09/05	--	1	--	--	Grab
SW70017WC	09/11	1327	1	.66	6.26	68
(09/19/90)	09/11	1342	2	1.79	29.04	142
	09/11	1357	3	1.99	35.23	168
	09/11	1412	4	2.18	41.32	266
	09/11	1427	5	2.29	45.53	305
	09/11	1442	6	2.37	48.61	332
	09/11	1457	7	2.51	56.81	641
	09/11	1512	8	2.61	63.35	742
	09/11	1527	9	2.65	70.15	768
	09/11	1542	10	2.69	76.43	792
	09/11	1557	11	2.75	85.85	814
	09/11	1612	12	2.82	96.13	824
	09/11	1627	13	2.90	104.35	840
	09/11	1642	14	2.99	113.93	842
	09/11	1657	15	3.03	119.95	845
	09/11	1712	16	2.65	99.02	832
	09/11	1727	17	2.63	67.01	747
	09/11	1742	18	2.58	61.08	732
	09/11	1757	19	2.65	70.15	778
	09/11	1812	20	2.70	78.00	809

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW093 (Cont'd)						
	09/11	1827	21	2.82	95.83	824
	09/11	1842	22	3.43	192.10	941
	09/11	2857	23	3.73	261.50	973
	09/11	1912	24	3.73	266.50	991
SW70041WC (11/19/90)	11/10	0622	1	.85	9.30	
SW60065WC (03/19/91)	03/15		1	*		
SW60093WC (05/17/91)	05/15	1431	1	.87	9.70	1000
	05/15	1441	2	.66	6.26	1000
	05/15	1451	3	.57	4.98	1000
	05/15	1501	4	.55	4.71	1000
	05/15	1511	5	.54	4.58	1000
	05/15	1521	6	.70	6.86	1000
SW60110WC (06/11/91)	06/07	1445	1	1.79	29.84	266
	06/07	1455	2	2.87	101.15	1000
	06/07	1505	3	2.85	99.02	978
	06/07	1515	4	2.54	58.64	562
	06/07	1525	5	2.73	82.71	810
	06/07	1535	6	2.79	92.13	907
	06/07	1545	7	2.70	78.00	762
	06/07	1555	8	2.65	70.15	681
	06/07	1605	9	2.58	61.08	587
	06/07	1615	10	2.43	51.93	493
	06/07	1625	11	2.20	41.80	389
	06/07	1635	12	2.07	37.53	345
	06/07	1645	13	1.98	34.96	318
	06/07	1655	14	1.89	32.53	293
	06/07	1705	15	1.83	30.91	277
	06/07	1715	16	1.76	29.06	258
	06/07	1725	17	1.72	28.02	247
	06/07	1735	18	1.54	23.60	201
	06/07	1745	19	1.05	12.95	92
	06/07	1755	20	.64	5.97	20
	06/07	1805	21	.54	4.58	5
	06/07	2145	22	.85	9.30	54
	06/07	2155	23	.64	5.97	20
SW60118WC (07/10/91)	07/09	1857	1	.52	4.31	

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW093 (Cont'd)						
SW60123WC	07/22	1458	1	.83	8.96	970
(07/23/91)	07/22	1508	2	.77	7.97	797
	07/22	1518	3	.71	7.02	629
	07/22	1528	4	.65	6.11	469
	07/22	1538	5	.58	5.12	295
	07/22	1548	6	.54	4.58	200
SW60131WC	07/24	1432	1	.67	6.41	1000
(07/29/91)	07/24	1442	2	.63	5.82	1000
SW60134WC	08/03	1020	1	.80	8.46	1000
(08/05/91)						
SW60142WC	08/06	1702	1	1.33	18.76	20
(08/07/91)	08/06	1712	2	4.16	403.40	528
	08/06	1722	3	4.22	428.80	561
	08/06	1732	4	4.83	641.75	842
	08/06	1742	5	5.19	761.60	1000
	08/06	1752	6	4.89	661.25	868
	08/06	1802	7	4.72	606.80	796
	08/06	1812	8	4.13	390.95	511
	08/06	1822	9	3.22	151.80	196
	08/06	1832	10	2.79	92.13	117
	08/06	1842	11	2.36	48.44	59
	08/06	1852	12	2.06	37.24	45
	08/06	1902	13	1.80	30.10	35
	08/06	1912	14	1.61	25.34	29
	08/06	1922	15	1.44	21.22	23
	08/06	1932	16	1.33	18.76	20
	08/06	1942	17	1.20	16.00	17
	08/06	1952	18	1.11	14.11	14
	08/06	2002	19	1.04	12.76	12
	08/06	2012	20	.98	11.64	11
	08/06	2022	21	.93	10.78	10
	08/06	2032	22	.89	10.20	9
	08/06	2042	23	.84	9.50	8
	08/06	2052	24	.81	6.46	7
SW60150WC	08/09	1720	1	.82	8.80	89
(08/12/91)	08/09	1730	2	2.51	56.81	883
	08/09	1740	3	2.61	63.87	1000
	08/09	1750	4	2.43	51.93	802
	08/09	1800	5	2.17	40.78	618
	08/09	1810	6	1.95	34.15	508
	08/09	1820	7	1.78	29.58	433

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW093 (Cont'd)						
	08/09	1830	8	1.48	22.14	309
	08/09	1840	9	1.28	17.68	236
	08/09	1850	10	1.08	13.52	167
	08/09	1900	11	.92	10.62	119
	08/09	1910	12	.83	8.96	91
	08/09	1920	13	.73	7.33	64
	08/09	1930	14	.64	5.97	42
	08/09	1940	15	.56	4.85	23
	08/09	1950	16	.49	3.93	8
SW60158WC	08/16	1621	1	.97	11.46	1000
(08/28/91)	08/16	1631	2	.95	11.10	955
	08/16	1641	3	.77	7.97	565
	08/16	1651	4	.70	6.86	426
	08/16	1701	5	.62	5.68	279
	08/16	1711	6	.54	4.58	142
	08/16	1721	7	.63	5.82	297
	08/16	1731	8	.60	5.39	243
	08/16	1741	9	.56	4.85	175
	08/16	1751	10	.52	4.31	109
	08/16	1801	11	.46	3.56	15

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW118						
SW70004WC	07/20	1352	1	.39	7.0	235
(07/23/90)	07/20	1752	2	.50	10.3	344
	07/20	1742	3	.41	7.6	254
	07/20	1842	4	.36	6.2	208
	07/20	1442	5	.46	9.0	302
	07/20	1642	6	.28	4.3	142
	07/20	1742	7	.39	7.0	235
SW70035WC	11/07	1422	1	.91	4.50	1000
(11/08/90)	11/07	1432	2	.91	4.50	1000
SW60080WC	04/30	1240	1	.91	4.50	196
(05/01/91)	04/30	1250	2	.92	4.73	392
	04/30	1300	3	.92	4.73	392
	04/30	1310	4	.92	4.73	392
	04/30	1320	5	.94	5.21	792
	04/30	1330	6	.95	5.46	1000
	04/30	1340	7	.95	5.46	1000
	04/30	1350	8	.94	5.21	792
	04/30	1400	9	.92	4.73	392
	04/30	1410	10	.92	4.73	392
SW60084WC	05/05	1300	1	.91	4.26	
(05/06/91)						
SW60094WC	05/15	1533	1	.91	4.50	32
(05/17/91)	05/15	1543	2	.91	4.50	32
	05/15	2233	3	1.00	6.76	736
	05/15	2243	4	1.10	9.65	736
	05/15	2353	5	1.14	10.94	913
	05/15	2303	6	1.16	11.58	1000
	05/15	2313	7	1.14	10.94	913
	05/15	2323	8	1.11	9.98	781
	05/15	2333	9	1.08	9.04	653
	05/15	2343	10	1.03	7.59	455
	05/15	2353	11	1.00	6.76	342
	05/16	0003	12	.97	5.97	234
	05/16	0013	13	.94	5.21	130
	05/16	0023	14	.92	4.73	64
	05/16	0253	15	.91	4.50	32

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW118 (Cont'd)						
	05/16	3003	16	.97	5.97	234
	05/16	0313	17	1.00	6.76	342
	05/16	0323	18	1.00	6.76	342
	05/16	0333	19	1.00	6.76	342
	05/16	0343	20	1.00	6.76	342
	05/16	0353	21	1.02	7.31	417
	05/16	0403	22	1.02	7.31	417
	05/16	0413	23	1.05	8.17	534
	05/16	0423	24	1.10	9.65	736
SW60099WC	05/22	2133	1	.93	4.97	149
(05/23/91)	05/22	2143	2	1.01	7.03	581
	05/22	2153	3	1.01	7.03	581
	05/22	2203	4	1.00	6.76	523
	05/22	2213	5	.98	6.23	412
	05/22	2223	6	.97	5.97	358
	05/22	2233	7	.95	5.46	251
	05/22	2243	8	.93	4.97	149
	05/22	2253	9	.92	4.73	98
	05/22	2303	10	1.00	6.76	523
	05/22	2313	11	1.04	7.87	755
	05/22	2323	12	1.08	9.04	1000
	05/22	2333	13	1.04	7.87	755
	05/22	2343	14	1.03	7.59	697
	05/22	2353	15	1.00	6.76	523
	05/23	0003	16	.97	5.97	358
	05/23	0013	17	.93	4.97	149
	05/23	0023	18	.92	4.73	98
SW60106WC	05/31	1801	1	.93	4.97	22
(06/03/91)	05/31	1811	2	.92	4.73	14
	05/31	1821	3	.96	5.71	44
	05/31	1831	4	1.29	16.06	362
	05/31	1841	5	1.22	13.60	286
	05/31	1851	6	1.14	10.94	205
	05/31	1901	7	1.09	9.34	156
	05/31	1911	8	1.04	7.87	111
	05/31	1921	9	1.01	7.03	85
	05/31	1931	10	.98	6.23	60
	05/31	1941	11	.96	5.71	44
	05/31	1951	12	.93	4.97	22
	05/31	2001	13	.92	4.73	14

Table A-4 - Automatic-Sampling Storm-Event Data - Continued

	"Storm" Date(s)	"Storm" Time	Sample Sequence	Stage (ft)	Discharge (cfs)	Composite vol. (ml)
Site SW118 (Cont'd)						
	06/01	1351	14	1.06	8.47	129
	06/01	1401	15	1.09	9.34	156
	06/01	1411	16	1.06	8.47	129
	06/01	1421	17	1.03	7.59	102
	06/01	1431	18	1.01	7.03	85
	06/01	1441	19	.96	5.71	44
	06/01	1451	20	.93	4.97	22
	06/01	1501	21	.92	4.73	14
	06/01	1721	22	1.09	9.34	156
	06/01	1731	23	1.39	19.90	479
	06/01	1741	24	1.77	36.90	1000
SW60111WC	06/07	1448	1	.91	4.50	21
(06/11/91)	06/07	1458	2	.92	4.73	41
	06/07	1508	3	1.28	15.68	1000
	06/07	1518	4	1.24	14.28	877
	06/07	1528	5	1.16	11.58	641
	06/07	1538	6	1.10	9.65	472
	06/07	1548	7	1.05	8.17	342
	06/07	1558	8	1.00	6.76	219
	06/07	1608	9	.97	5.97	150
	06/07	1618	10	.94	5.21	83

NOTES:

1) Hermit data logger not yet installed; composite volumes determined through correlation to SW118 Hermit Flow Records.
2) Only 7 of 10 sample bottles used for composite.
* Hermit data lost for this storm-event time period.
** Sampler actuated manually. Composite sample was derived from equal volumes from each bottle.

Table A-5
Summary of Ambient Monthly and Other Miscellaneous Samples,[1)]
October 1990 - July 1991

Sample Collected (1990)	Site Sampled	Types of Samples Analysis[2)]	Lab Code ID
10/16	SW023	Rad, Org, P/A/Misc	SW00443WC
10/17	SW093	Rad, Org, P	SW00448WC
10/29	SW118	Rad, TM/C, Org, P/A/Misc	SW00458WC
11/13	SW027	Org, A/Misc	SW00508WC
		A/Misc, Org	SW80068WC
		Org, A/Misc	SW80069WC
11/16	SW023	Org, A/Misc	SW00544WC
11/19	SW093	TM/C, Org, A/Misc	SW00549WC
11/27	SW118	TM/C, Org, A/Misc	SW00559WC
12/04	SW023	Org	SW00648WC
		Org	SW80075WC
		Org	SW80074WC
	Well 3586	Org	GW00524IT
12/06	SW027	Org	SW00612WC
	SW093	Org	SW00653WC
12/11	Well 4486	TM/C, Org, A/Misc	GW00668IT
12/13	SW118	TM/C, Org, A/Misc	SW00663WC

SHEET 1 of 2

Table A-5 (Concluded)
Summary of Ambient Monthly and Other Miscellaneous Samples,[1)]
October 1990 - July 1991

Sample Collected (1991)	Site Sampled	Types of Samples Analysis[2)]	Lab Code ID
1/14	SW023	Org, A/Misc	SW00750WC
3/21	SW118	TM/C, Org, A/Misc	SW00971WC
3/28	SW023	TM/C, Org, A/Misc	SW00956WC
4/10	SW118	TM/C, Org, P/A/Misc	SW01073WC
4/15	SW027	TM/C, Org, P/A/Misc	SW01022WC
	SW093	TM/C, Org, P/A/Misc	SW01063WC
4/17	SW023	TM/C, Org, P/A/Misc	SW01058WC
		TM/C, Org, P/A/Misc	SW80112WC
		TM/C, Org, P/A/Misc	SW80113WC
5/09	SW118	TM/C, Org, P/A/Misc	SW01180WC
7/17	SW023	A/Misc	SW01371WC

1) Resultant data given in RFEDS retrievals of April 9, 1991 and of September 18, 1991 (See Table A-6).

2) Rad = radionuclides
TM/C = Trace metals and major cations
Org = Organics
P/A/Misc = Pesticides, major anions, and miscellaneous (selected nutrients, silica, etc.).

SHEET 2 of 2

B

APPENDIX B

DAILY-MEAN-DISCHARGE DATA AND CHANNEL/FLUME RATING CURVES
NON-POINT SOURCE (STORM-SEWER) MONITORING SITES

TABLE B-1

CONCRETE DIVERSION BOX AT EAST PATROL ROAD (SITE SW022) - DRAINAGE AREA = 75 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	---	---	.05	.46
2	---	---	---	---	---	---	---	---	---	---	.07	.23
3	---	---	---	---	---	---	---	---	---	---	.07	.00
4	---	---	---	---	---	---	---	---	---	---	.04	.00
5	---	---	---	---	---	---	---	---	---	---	.01	.01
6	---	---	---	---	---	---	---	---	---	---	.00	.00
7	---	---	---	---	---	---	---	---	---	---	.00	.07
8	---	---	---	---	---	---	---	---	---	---	.00	.03
9	---	---	---	---	---	---	---	---	---	---	.00	.00
10	---	---	---	---	---	---	---	---	---	---	.00	.00
11	---	---	---	---	---	---	---	---	---	---	.00	.00
12	---	---	---	---	---	---	---	---	---	---	.11	.00
13	---	---	---	---	---	---	---	---	---	---	.00	.00
14	---	---	---	---	---	---	---	---	---	---	.00	.00
15	---	---	---	---	---	---	---	---	---	---	---	.00
16	---	---	---	---	---	---	---	---	---	---	.06	.00
17	---	---	---	---	---	---	---	---	---	---	.12	.41
18	---	---	---	---	---	---	---	---	---	---	.00	1.10
19	---	---	---	---	---	---	---	---	---	---	.00	.52
20	---	---	---	---	---	---	---	---	---	---	.00	.07
21	---	---	---	---	---	---	---	---	---	---	.00	.00
22	---	---	---	---	---	---	---	---	---	---	.32	.00
23	---	---	---	---	---	---	---	---	---	---	.00	.00
24	---	---	---	---	---	---	---	---	---	---	.00	.02
25	---	---	---	---	---	---	---	---	---	---	.00	.04
26	---	---	---	---	---	---	---	---	---	.00	.00	.04
27	---	---	---	---	---	---	---	---	---	.00	.00	.00
28	---	---	---	---	---	---	---	---	---	.00	.00	.00
29	---	---	---	---	---	---	---	---	---	.00	.00	.00
30	---	---	---	---	---	---	---	---	---	.14	.00	.03
31	---	---	---	---	---	---	---	---	---	.01	.00	---
TOTAL	---	---	---	---	---	---	---	---	---	.15	.85	3.03
MEAN	---	---	---	---	---	---	---	---	---	.03	.03	.10
MAX	---	---	---	---	---	---	---	---	---	.14	.32	1.10
MIN	---	---	---	---	---	---	---	---	---	.00	.00	.00

WATER YEAR TOTAL 4.03 MEAN .06 MAX 1.10 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-1 (CONT.)

CONCRETE DIVERSION BOX AT EAST PATROL ROAD (SITE SW022) - DRAINAGE AREA = 75 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	.00	---	---	---	---	---	.11	.31	.00	.00	.00
2	---	.00	---	---	---	---	---	.00	.15	.00	.00	.00
3	.00	.30	---	---	---	---	---	.00	.00	.00	.53	.00
4	.00	.00	---	.00	---	---	---	.36	.00	.00	.00	.00
5	.00	.00	---	.00	---	---	---	.51	.00	.00	.00	.00
6	.00	.88	---	.00	---	---	---	.06	.00	.00	.45	.00
7	.00	.00	---	.00	---	---	---	.00	.77	.00	.00	.00
8	.00	.00	---	.00	---	---	---	.00	.00	.00	.00	.00
9	.00	.00	---	.00	---	---	---	.00	.00	.17	.45	.00
10	.00	.00	---	.00	---	---	---	.00	.00	.00	.00	.00
11	.00	.00	---	.00	---	---	---	.00	.00	.00	.00	.00
12	.00	.00	---	.00	---	---	---	.00	.00	.00	.00	
13	.00	.00	.00	.00	---	---	---	.00	.00	.00	.00	
14	.00	.00	.00	.00	---	---	---	.00	.00	.00	.00	
15	.00	.00	.00	.00	---	---	.00	1.32	.00	.00	.00	
16	.00	.00	.00	.00	---	---	.00	2.15	.00	.00	.08	
17	.00	.00	.00	.00	---	---	.00	.00	.00	.00	.00	
18	.00	.00	.00	.00	---	---	.00	.00	.00	.00	.00	
19	.00	.01	.18	.00	---	---	.00	.00	.00	.00	.00	
20	.00	.00	.00	.00	---	---	.00	.00	.00	.00	.00	
21	.00	.00	---	.00	---	---	.00	.00	.01	.00	.00	
22	.00	.00	---	.00	---	---	.00	.35	.00	.05	.00	
23	.00	.00	---	.00	---	---	.00	.10	.00	.15	.00	
24	---	.01	---	.00	---	---	.00	.01	.00	.54	.00	
25	---	.02	---	.00	---	---	.00	.00	.00	.00	.00	
26	---	.00	---	.00	---	---	.00	.00	.00	.21	.00	
27	---	.00	.22	---	---	---	.00	.00	.00	.00	.00	
28	---	.00	.26	---	---	---	.00	.00	.00	.00	.00	
29	---	.00	---	---		---	.00	.00	.00	.00	.00	
30	---	---	---	---		---	1.02	.00	.00	.00	.00	
31	---		---	---		---		.14		.00	.00	
TOTAL	.00	1.22	.66	.00	---	---	1.02	5.11	1.24	1.12	1.51	.00
MEAN	.00	.04	.07	.00	---	---	.06	.16	.04	.04	.05	.00
MAX	.00	.88	.26	.00	---	---	1.02	2.15	.77	.54	.53	.00
MIN	.00	.00	.00	.00	---	---	.00	.00	.00	.00	.00	.00

WATER YEAR TOTAL 11.88 MEAN .05 MAX 2.15 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-2

SOUTH WALNUT CREEK AT SEWAGE TREATMENT PLANT (SITE SW023) - DRAINAGE AREA = 89 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	---	---	.02	.07
2	---	---	---	---	---	---	---	---	---	---	.03	.04
3	---	---	---	---	---	---	---	---	---	---	.03	.04
4	---	---	---	---	---	---	---	---	---	---	.03	.01
5	---	---	---	---	---	---	---	---	---	---	.03	.04
6	---	---	---	---	---	---	---	---	---	---	.03	.04
7	---	---	---	---	---	---	---	---	---	---	.02	.04
8	---	---	---	---	---	---	---	---	---	---	.02	.14
9	---	---	---	---	---	---	---	---	---	---	.02	.13
10	---	---	---	---	---	---	---	---	---	---	.02	.04
11	---	---	---	---	---	---	---	---	---	---	.03	.08
12	---	---	---	---	---	---	---	---	---	---	.06	.14
13	---	---	---	---	---	---	---	---	---	---	.03	.13
14	---	---	---	---	---	---	---	---	---	---	.07	.11
15	---	---	---	---	---	---	---	---	---	---	.11	.10
16	---	---	---	---	---	---	---	---	---	---	.11	.15
17	---	---	---	---	---	---	---	---	---	---	.12	.35
18	---	---	---	---	---	---	---	---	---	---	.10	6.50
19	---	---	---	---	---	---	---	---	---	---	.09	.13
20	---	---	---	---	---	---	---	---	---	---	.05	.41
21	---	---	---	---	---	---	---	---	---	---	.02	.12
22	---	---	---	---	---	---	---	---	---	---	.09	.06
23	---	---	---	---	---	---	---	---	---	---	.01	.06
24	---	---	---	---	---	---	---	---	---	---	.02	.06
25	---	---	---	---	---	---	---	---	---	---	.05	.05
26	---	---	---	---	---	---	---	---	---	.02	.06	.05
27	---	---	---	---	---	---	---	---	---	.02	.06	.12
28	---	---	---	---	---	---	---	---	---	.02	.06	.13
29	---	---	---	---	---	---	---	---	---	.02	.06	.06
30	---	---	---	---	---	---	---	---	---	.17	.08	---
31	---	---	---	---	---	---	---	---	---	.12	.06	---
TOTAL	---	---	---	---	---	---	---	---	---	.37	1.59	9.40
MEAN	---	---	---	---	---	---	---	---	---	.06	.05	.32
MAX	---	---	---	---	---	---	---	---	---	.17	.12	6.50
MIN	---	---	---	---	---	---	---	---	---	.02	.01	.01

WATER YEAR TOTAL 11.36 MEAN .17 MAX 6.50 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-2 (CONT.)

SOUTH WALNUT CREEK AT SEWAGE TREATMENT PLANT (SITE SW023) - DRAINAGE AREA = 89 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	.00	---	---	1.91	---	.07	.31	.26	.10	.08	---
2	---	.04	---	---	.12	---	.07	.20	.62	.09	.14	---
3	.07	.89	---	---	.09	---	.07	.23	---	.08	1.49	---
4	.06	.02	---	.02	.10	---	.22	1.44	1.16	.09	.21	---
5	.07	.08	---	.02	.08	---	.36	1.17	1.10	1.13	.16	---
6	.07	.38	---	.16	.08	---	.37	.28	1.21	.14	1.94	---
7	.21	.98	---	.17	.08	---	.36	.19	3.05	---	.15	---
8	.60	.02	---	.22	.07	---	.37	.12	.48	---	.13	---
9	.21	.27	---	.25	.07	---	.35	.12	.47	---	1.49	---
10	.13	.11	---	.02	.07	---	.35	.13	.50	.10	.18	---
11	.12	.08	---	.02	.07	---	.43	.15	.31	.08	.15	---
12	.12	.07	---	.01	.07	---	.63	.30	.11	.08	.17	
13	.11	.07	.08	.01	.07	---	.63	.35	.13	.07	.18	
14	.11	.07	.07	.01	.07	---	.60	.35	.16	.06	.11	
15	.10	.06	.07	.01	.07	.07	.56	2.68	.17	---	.11	
16	.11	.06	.07	.08	.07	.07	---	1.87	.08	.08	.20	
17	.09	.07	.12	.03	.07	.07	---	---	.09	.08	.15	
18	.09	.07	.08	.04	.07	.07	---	---	.13	.09	.10	
19	.16	.07	.05	.06	.07	.12	---	---	.13	.10	.13	
20	2.18	.07	.03	.03	.07	.13	---	.24	.10	.13	.08	
21	.22	.07	.05	.02	.07	.07	---	.22	.32	.09	.10	
22	.11	.07	.05	.04	.07	.09	---	.54	.17	.40	.09	
23	.09	.07	.05	.02	---	.07	.20	.38	.13	.51	.09	
24	---	.07	.05	.03	---	.07	.19	.38	.18	.89	.08	
25	---	.07	.06	.02	---	.08	.19	.32	.23	.38	.08	
26	---	.07	.03	.03	---	.10	.21	.32	.11	.50	.08	
27	---	.20	---	.03	---	.10	.22	.30	.12	.24	.08	
28	---	.07	---	.05	---	.07	.21	.30	.17	.20	.06	
29	---	.07	---	.02	---	.14	.24	.30	.24	.12	.04	
30	---	---	---	.03	---	.08	3.22	.74	.10	.08	.04	
31	---	---	---	.09	---	.07	---	1.98	---	.07	.00	
TOTAL	5.03	4.24	.86	1.54	3.51	1.47	10.12	15.56	12.03	5.98	8.09	---
MEAN	.24	.15	.06	.05	.16	.09	.44	.58	.41	.22	.26	---
MAX	2.18	.98	.12	.25	1.91	.14	3.22	2.68	3.05	1.13	1.94	---
MIN	.06	.00	.03	.01	.07	.07	.07	.12	.08	.06	.00	---

WATER YEAR TOTAL 68.43 MEAN .26 MAX 3.22 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-3

SOUTH INTERCEPTOR CANAL AT WOMAN CREEK (SITE SW027) - DRAINAGE AREA = 171 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	---	.00	.01	.00
2	---	---	---	---	---	---	---	---	---	.00	.00	.00
3	---	---	---	---	---	---	---	---	---	.00	.00	.00
4	---	---	---	---	---	---	---	---	---	.01	.00	.00
5	---	---	---	---	---	---	---	---	---	.49	.00	.00
6	---	---	---	---	---	---	---	---	---	.01	.00	.00
7	---	---	---	---	---	---	---	---	---	.00	.00	.34
8	---	---	---	---	---	---	---	---	---	.63	.00	.73
9	---	---	---	---	---	---	---	---	---	.41	.00	.61
10	---	---	---	---	---	---	---	---	---	.00	.00	.49
11	---	---	---	---	---	---	---	---	---	.28	.00	.22
12	---	---	---	---	---	---	---	---	---	.07	.00	.11
13	---	---	---	---	---	---	---	---	---	.00	.08	.04
14	---	---	---	---	---	---	---	---	---	.00	.02	.02
15	---	---	---	---	---	---	---	---	---	.00	.01	.01
16	---	---	---	---	---	---	---	---	---	.00	.00	.01
17	---	---	---	---	---	---	---	---	---	.00	.00	.02
18	---	---	---	---	---	---	---	---	---	.00	.09	.04
19	---	---	---	---	---	---	---	---	---	.00	.01	.54
20	---	---	---	---	---	---	---	---	---	.94	.01	.05
21	---	---	---	---	---	---	---	---	---	1.05	.03	.09
22	---	---	---	---	---	---	---	---	---	.43	.03	.04
23	---	---	---	---	---	---	---	---	---	.02	.03	.01
24	---	---	---	---	---	---	---	---	---	---	.00	---
25	---	---	---	---	---	---	---	---	---	---	.00	---
26	---	---	---	---	---	---	---	---	---	.00	.00	---
27	---	---	---	---	---	---	---	---	.00	.00	.00	---
28	---	---	---	---	---	---	---	---	.00	.00	.00	---
29	---	---	---	---	---	---	---	---	.00	.00	.00	---
30	---	---	---	---	---	---	---	---	.00	.00	.00	---
31	---	---	---	---	---	---	---	---	---	.16	.00	---
TOTAL	---	---	---	---	---	---	---	---	.00	4.50	.32	3.37
MEAN	---	---	---	---	---	---	---	---	.00	.16	.01	.15
MAX	---	---	---	---	---	---	---	---	.00	1.05	.09	.73
MIN	---	---	---	---	---	---	---	---	.00	.00	.00	.00

WATER YEAR TOTAL 8.19 MEAN .09 MAX 1.05 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-3 (CONT.)

SOUTH INTERCEPTOR CANAL AT WOMAN CREEK (SITE SW027) - DRAINAGE AREA = 171 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	.01	---	.00	.00	.00	.00	.13	3.11	.00	.00	.00
2	---	---	---	.00	.02	---	.00	.00	1.14	.00	.00	.00
3	---	---	.00	.00	.35	---	.00	.00	.15	.00	.34	.00
4	.00	---	.00	.00	.01	---	.00	.06	---	.00	.01	.00
5	.00	---	.00	.00	.00	---	.00	.32	---	.00	.00	.00
6	.00	---	.00	.00	.00	---	.00	.00	---	.00	.48	.00
7	.00	---	.00	.00	.00	---	.00	---	---	.00	.01	.00
8	.00	---	.00	.00	.00	---	.00	---	---	.00	.00	.00
9	.00	---	.00	.00	.00	---	.00	---	---	.00	.00	.00
10	.00	---	.00	.04	.00	---	.00	---	---	.10	.42	.00
11	.00	---	.00	.00	.00	---	.00	---	.06	.06	.01	.00
12	.00	---	.00	.03	.00	---	.60	---	.01	.01	.00	
13	.00	---	.00	.00	.00	---	.36	---	.00	.01	.00	
14	.00	---	---	.00	.00	---	.30	---	.00	.00	.00	
15	.00	---	---	.02	.00	.00	.26	---	.00	.00	.00	
16	.00	.00	---	.00	.00	.00	.05	---	.00	.01	.01	
17	.00	.00	---	.00	.00	.01	.01	---	.00	.01	.02	
18	.00	.00	.00	.02	.00	.01	.00	---	.00	.00	.00	
19	.00	.00	.00	.02	.00	.00	.00	---	.00	.00	.00	
20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	
21	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	
22	.00	.00	.00	.00	.00	.00	.24	.00	.00	.00	.02	
23	.01	.00	.00	.00	.00	.00	.01	.15	.00	1.10	.00	
24	.01	.00	.00	.00	.00	.00	.00	.24	.00	.01	.00	
25	.01	---	.00	.00	.12	.00	.00	.05	.01	.00	.00	
26	.01	---	.00	.05	.04	.00	.00	.03	.00	.01	.00	
27	.01	---	.00	.15	.00	.00	.00	.01	.00	.00	.00	
28	.01	---	.00	.05	.00	.00	.00	.01	.00	.00	.00	
29	.01	---	.00	.00		.00	.00	.00	.00	.00	.00	
30	.01	---	.00	.00		.00	.63	.00	.00	.00	.00	
31	.01		.00	.00		.00		.34		.00	.00	
TOTAL	.09	.01	.00	.38	.54	.02	2.46	1.34	4.48	1.32	1.34	.00
MEAN	.00	.00	.00	.01	.02	.00	.08	.07	.19	.04	.04	.00
MAX	.01	.01	.00	.15	.35	.01	.63	.34	3.11	1.10	.48	.00
MIN	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

WATER YEAR TOTAL 11.98 MEAN .04 MAX 3.11 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-4

NORTH WALNUT CREEK AT OUTLET OF 72-IN CMP (SITE SW093) - DRAINAGE AREA = 245 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	---	---	.16	.90
2	---	---	---	---	---	---	---	---	---	---	.17	.20
3	---	---	---	---	---	---	---	---	---	---	.10	.05
4	---	---	---	---	---	---	---	---	---	---	.09	.03
5	---	---	---	---	---	---	---	---	---	---	.11	.17
6	---	---	---	---	---	---	---	---	---	---	.11	.01
7	---	---	---	---	---	---	---	---	---	---	.13	.02
8	---	---	---	---	---	---	---	---	---	---	.16	.23
9	---	---	---	---	---	---	---	---	---	---	.14	.23
10	---	---	---	---	---	---	---	---	---	---	.15	.23
11	---	---	---	---	---	---	---	---	---	---	.21	.23
12	---	---	---	---	---	---	---	---	---	---	.35	.23
13	---	---	---	---	---	---	---	---	---	---	.17	.23
14	---	---	---	---	---	---	---	---	---	---	.16	.48
15	---	---	---	---	---	---	---	---	---	---	.16	.23
16	---	---	---	---	---	---	---	---	---	---	.19	.23
17	---	---	---	---	---	---	---	---	---	---	.34	.23
18	---	---	---	---	---	---	---	---	---	---	.15	1.10
19	---	---	---	---	---	---	---	---	---	---	.12	.23
20	---	---	---	---	---	---	---	---	---	---	.11	.23
21	---	---	---	---	---	---	---	---	---	---	.09	.23
22	---	---	---	---	---	---	---	---	---	---	.23	.23
23	---	---	---	---	---	---	---	---	---	---	.09	.23
24	---	---	---	---	---	---	---	---	---	---	.07	.23
25	---	---	---	---	---	---	---	---	---	---	.07	.23
26	---	---	---	---	---	---	---	---	---	.26	.07	.23
27	---	---	---	---	---	---	---	---	---	.18	.07	.23
28	---	---	---	---	---	---	---	---	---	.15	.09	.23
29	---	---	---	---	---	---	---	---	---	.14	.07	.23
30	---	---	---	---	---	---	---	---	---	.38	.07	---
31	---	---	---	---	---	---	---	---	---	.12	.06	---
TOTAL	---	---	---	---	---	---	---	---	---	1.23	4.26	7.56
MEAN	---	---	---	---	---	---	---	---	---	.20	.14	.26
MAX	---	---	---	---	---	---	---	---	---	.38	.35	1.10
MIN	---	---	---	---	---	---	---	---	---	.12	.06	.01

WATER YEAR TOTAL 13.05 MEAN .20 MAX 1.10 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-4 (CONT.)

NORTH WALNUT CREEK AT OUTLET OF 72-IN CMP (SITE SW093) - DRAINAGE AREA = 245 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	.12	.21	---	---	---	.20	.31	11.64	.13	.14	.27
2	---	.09	1.18	---	---	---	.15	.19	---	.30	.30	.26
3	.22	.64	.08	---	---	---	.08	.29	1.13	.26	3.73	.25
4	.45	.59	.58	.15	---	---	.28	.13	.65	.15	.38	.16
5	.62	.29	.34	.15	---	---	.58	.10	.46	.15	.22	.22
6	.40	.29	.51	.01	---	---	.47	.27	.45	.15	18.33	.22
7	.39	8.13	.71	.23	---	---	.53	.11	7.74	.15	.26	.17
8	.66	9.40	.19	.01	---	---	.65	.26	.88	.18	.19	.25
9	.33	1.41	.25	.15	---	---	.86	.27	.54	2.54	4.31	.23
10	.42	1.38	.33	.20	---	---	.61	.37	.53	.51	1.70	.16
11	.32	.70	.80	.01	---	---	.52	.33	.46	.58	1.69	.18
12	.32	.54	.28	.14	---	---	.22	.06	.40	.42	.92	
13	.45	.53	.24	.25	---	---	.44	.13	.41	.39	.00	
14	.36	1.01	.32	.16	---	---	.55	.19	.42	.40	.03	
15	.52	.83	.71	.15	---	.00	.44	3.32	.25	.41	.02	
16	---	.07	.94	---	---	.00	.62	11.22	.30	.39	.50	
17	---	.44	.21	---	---	.03	.57	1.27	.26	.51	.04	
18	---	.39	.40	---	---	.06	.68	.63	.23	.54	.03	
19	---	.35	.44	---	---	.18	.77	.44	.25	.59	.02	
20	---	.51	.20	---	---	.14	.64	.34	.21	.49	.28	
21	---	.05	---	---	---	.13	.36	.70	.36	.44	.28	
22	---	.04	---	---	---	.07	.47	1.63	.36	1.61	.48	
23	---	.12	---	---	---	.05	.50	1.08	.25	1.54	.24	
24	.12	.40	---	---	---	.13	.48	.83	.18	.33	.26	
25	.16	.45	---	---	---	.22	.40	.78	.17	.39	.29	
26	.27	.24	---	---	---	.20	.61	.72	.20	.22	.23	
27	.17	.26	---	---	---	.07	.74	.65	.18	.56	.28	
28	.28	.07	---	---	---	.05	.72	.69	.24	.12	.29	
29	.26	.08	---	---		.14	.68	.67	.21	.07	.24	
30	.20	.06	---	---		.14	.23	.79	.20	.14	.32	
31	.22		---	---		.08		2.43		.20	.33	
TOTAL	7.14	29.48	8.92	1.61	---	1.69	15.05	31.20	29.56	14.86	36.33	4.65
MEAN	.34	.98	.45	.13	---	.10	.50	1.00	1.02	.48	1.17	.21
MAX	.66	9.40	1.18	.25	---	.22	.86	11.22	11.64	2.54	18.33	.27
MIN	.12	.04	.08	.01	---	.00	.08	.06	.17	.07	.00	.12

WATER YEAR TOTAL 180.49 MEAN .50 MAX 18.33 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

TABLE B-5

NORTH WALNUT CREEK AT DROP STRUCTURE UPSTREAM FROM 72-IN CMP (SITE SW118) - DRAINAGE AREA = 51 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	---	.00	.08	.60
2	---	---	---	---	---	---	---	---	---	.00	.05	.25
3	---	---	---	---	---	---	---	---	---	.00	.02	.05
4	---	---	---	---	---	---	---	---	---	.87	.01	.05
5	---	---	---	---	---	---	---	---	---	.00	.02	.17
6	---	---	---	---	---	---	---	---	---	.00	.03	.00
7	---	---	---	---	---	---	---	---	---	.00	.00	.00
8	---	---	---	---	---	---	---	---	---	.90	.00	.00
9	---	---	---	---	---	---	---	---	---	.06	.01	.00
10	---	---	---	---	---	---	---	---	---	.00	.01	.00
11	---	---	---	---	---	---	---	---	---	.29	.08	.00
12	---	---	---	---	---	---	---	---	---	.00	.36	.00
13	---	---	---	---	---	---	---	---	---	.07	.11	.00
14	---	---	---	---	---	---	---	---	---	.10	.02	.00
15	---	---	---	---	---	---	---	---	---	.02	.00	.00
16	---	---	---	---	---	---	---	---	---	.01	.00	.00
17	---	---	---	---	---	---	---	---	---	.00	.02	.01
18	---	---	---	---	---	---	---	---	---	.01	.00	.86
19	---	---	---	---	---	---	---	---	---	.02	.00	.56
20	---	---	---	---	---	---	---	---	---	1.68	.08	.03
21	---	---	---	---	---	---	---	---	---	1.91	.09	.04
22	---	---	---	---	---	---	---	---	---	.39	.15	.01
23	---	---	---	---	---	---	---	---	---	.16	.09	.01
24	---	---	---	---	---	---	---	---	---	.14	.12	.02
25	---	---	---	---	---	---	---	---	---	.00	.00	.01
26	---	---	---	---	---	---	---	---	---	.00	.00	.01
27	---	---	---	---	---	---	---	---	.00	.00	.00	.01
28	---	---	---	---	---	---	---	---	.00	.00	.00	.01
29	---	---	---	---	---	---	---	---	.00	.00	.00	.03
30	---	---	---	---	---	---	---	---	.00	.06	.00	.01
31	---	---	---	---	---	---	---	---	---	.08	.00	---
TOTAL	---	---	---	---	---	---	---	---	.00	6.77	1.35	2.74
MEAN	---	---	---	---	---	---	---	---	.00	.22	.04	.09
MAX	---	---	---	---	---	---	---	---	.00	1.91	.36	.86
MIN	---	---	---	---	---	---	---	---	.00	.00	.00	.00

WATER YEAR TOTAL 10.86 MEAN .11 MAX 1.91 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

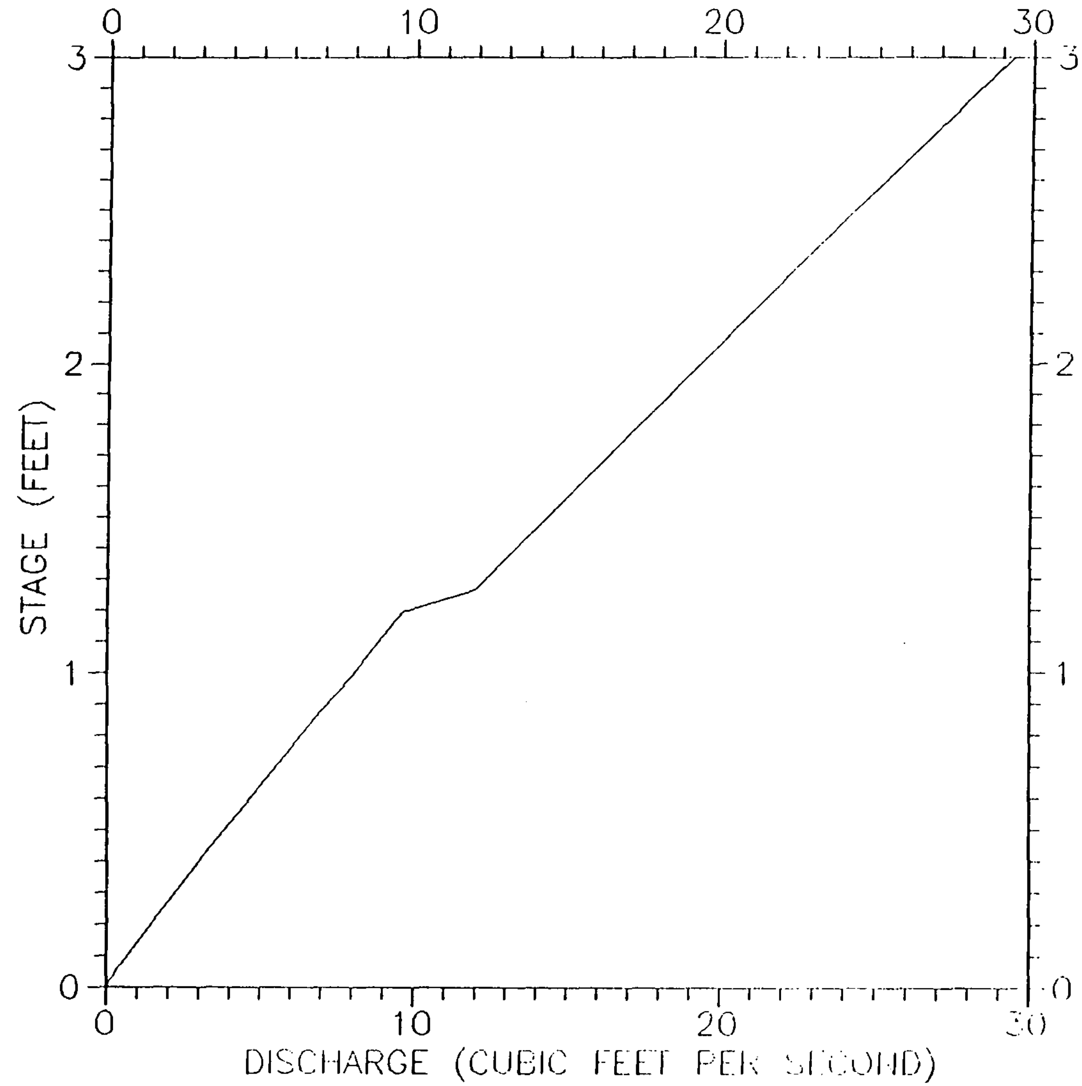
TABLE B-5 (CONT.)

NORTH WALNUT CREEK AT DROP STRUCTURE UPSTREAM FROM 72-IN CMP (SITE SW118) - DRAINAGE AREA = 51 acres
DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	.04	---	.20	.00	---	---	.29	3.25	.03	.00	---
2	---	.02	---	.20	.00	---	---	.11	1.83	.00	.05	---
3	.00	.62	.20	.20	.00	---	---	.01	.83	.00	1.16	---
4	.09	.70	.20	.20	.00	---	.00	.33	.50	.01	.79	---
5	.11	.68	.20	---	.00	---	.00	.85	.32	.00	.32	---
6	.00	.92	.20	---	.00	---	.00	.34	.25	.00	1.68	---
7	.00	1.52	.20	---	.00	---	.00	.03	.98	.00	.50	.00
8	.04	1.40	.20	---	.00	---	.00	.08	.41	.00	.18	.00
9	.04	1.16	.20	---	.00	---	.00	.02	.20	.35	.36	.00
10	.02	.86	.20	---	.00	---	.00	.01	.15	.35	.46	.00
11	.00	.50	.20	---	.00	---	.03	.00	.18	.81	.26	.00
12	.00	.31	.20	---	.00	---	.80	.00	.15	.74	.16	
13	.00	.22	.20	---	.00	---	.77	.00	.22	.55	.37	
14	.00	.25	---	---	.00	---	.60	.00	.26	.39	.44	
15	.00	.18	---	.00	.07	---	.38	.82	.19	.19	.42	
16	.00	.04	---	.00	.00	---	.34	3.57	.25	.06	.61	
17	.00	---	---	.00	.00	---	.18	1.40	.21	.06	.53	
18	.00	---	---	.00	.00	---	.07	.87	.22	.02	.43	
19	.01	---	.00	.00	.00	---	.03	.53	.21	.06	.22	
20	.41	---	.00	.00	.00	---	.02	.33	.07	.14	.00	
21	.14	---	.00	.00	.00	---	.31	.22	.07	.14	.00	
22	.10	---	.00	.00	.00	---	.40	.71	.10	.60	.00	
23	.02	---	.00	.00	---	---	.16	1.05	.04	1.11	.00	
24	---	---	.00	.00	---	---	.07	.89	.02	.99	.00	
25	---	---	.00	.00	---	---	.02	.48	.01	.79	.00	
26	---	---	.00	.00	---	---	.00	.33	.13	.84	.00	
27	---	---	.00	.00	---	---	.00	.27	.11	.70	.00	
28	---	---	.00	.00	---	---	.00	.25	.10	.27	.00	
29	---	---	.00	.00		---	.00	.24	.06	.13	.00	
30	---	---	.00	.00		---	.00	.23	.04	.04	---	
31	---		.00	.00		---		1.06		.01		
TOTAL	.98	9.42	2.20	.80	.07	---	4.66	15.32	10.52	9.38	8.94	.00
MEAN	.05	.59	.09	.04	.00	---	.15	.49	.35	.30	.31	.00
MAX	.41	1.52	.20	.20	.07	---	.80	3.57	3.25	1.11	1.68	.00
MIN	.00	.02	.00	.00	.00	---	.00	.00	.01	.00	.00	.00

WATER YEAR TOTAL 62.31 MEAN .35 MAX 3.57 MIN .00

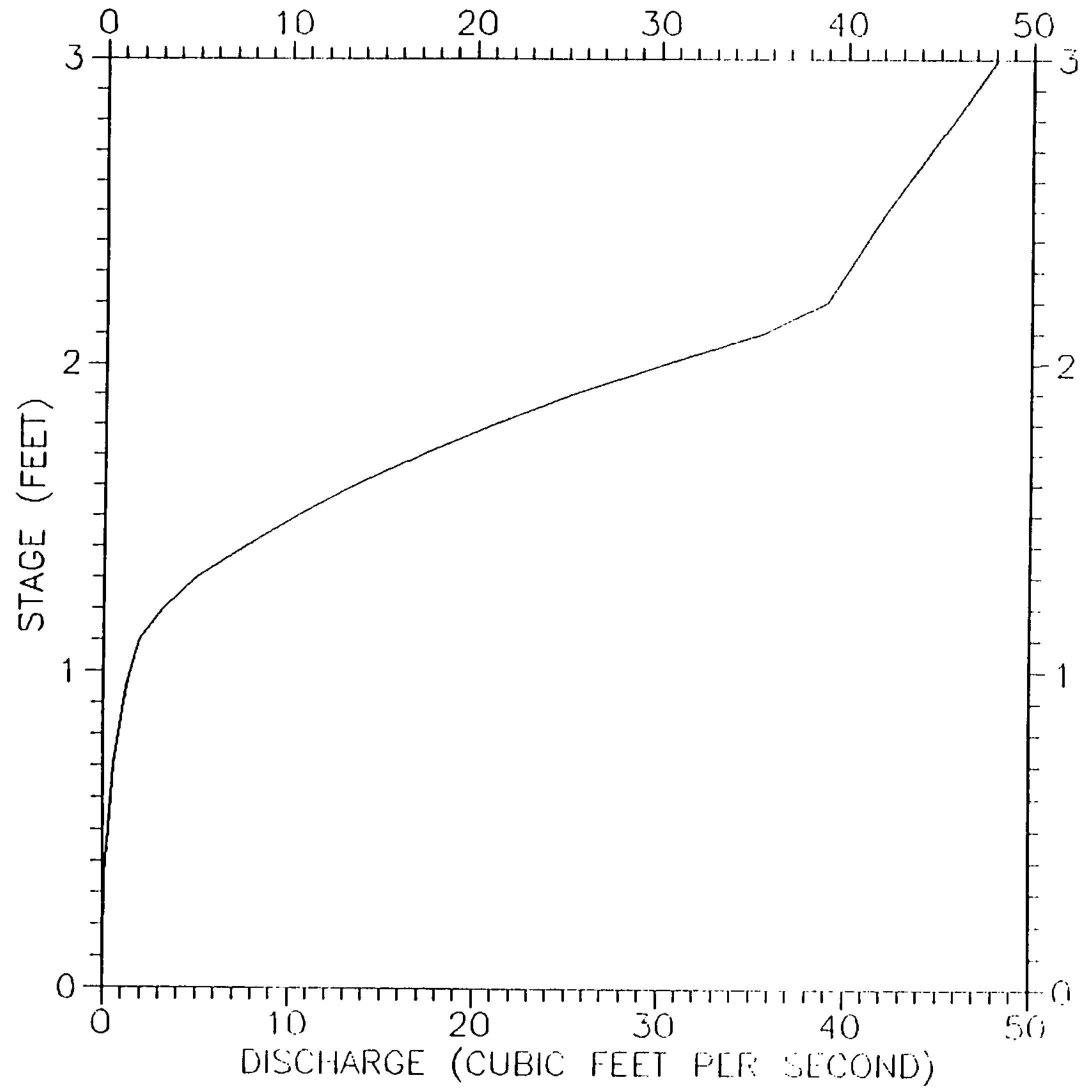
NOTE: --- INDICATES NO DATA FOR A GIVEN DAY



RATING CURVE, SITE SW022
CONCRETE DIVERSION BOX AT EAST PATROL ROAD

NON-POINT SOURCE ASSESSMENT STUDY AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

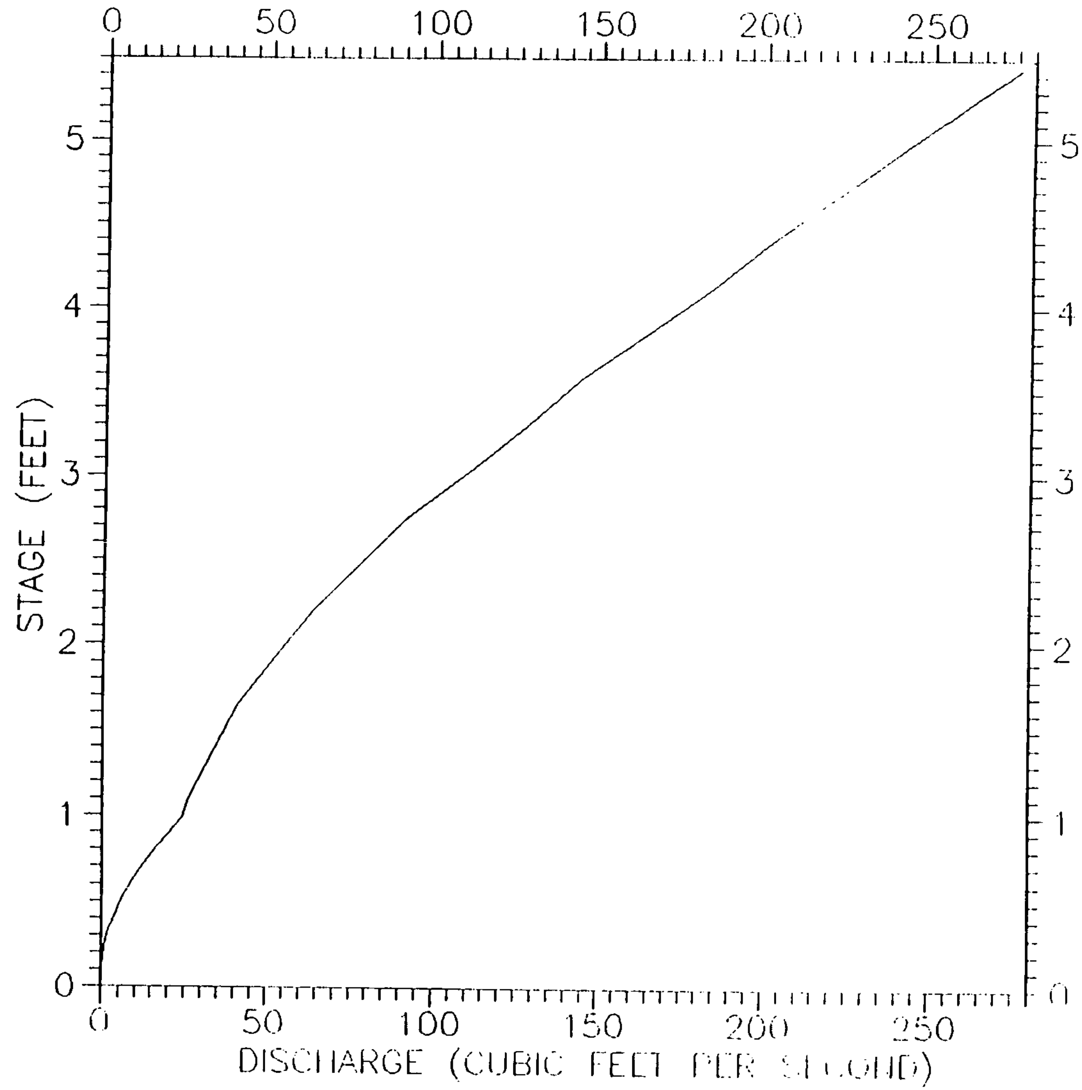
PROJECT No. 208.0102
208.0103
FIGURE No. B-1



RATING CURVE, SITE SW023
SOUTH WALNUT CREEK AT SEWAGE TREATMENT PLANT

NON-POINT SOURCE ASSESSMENT STUDY AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

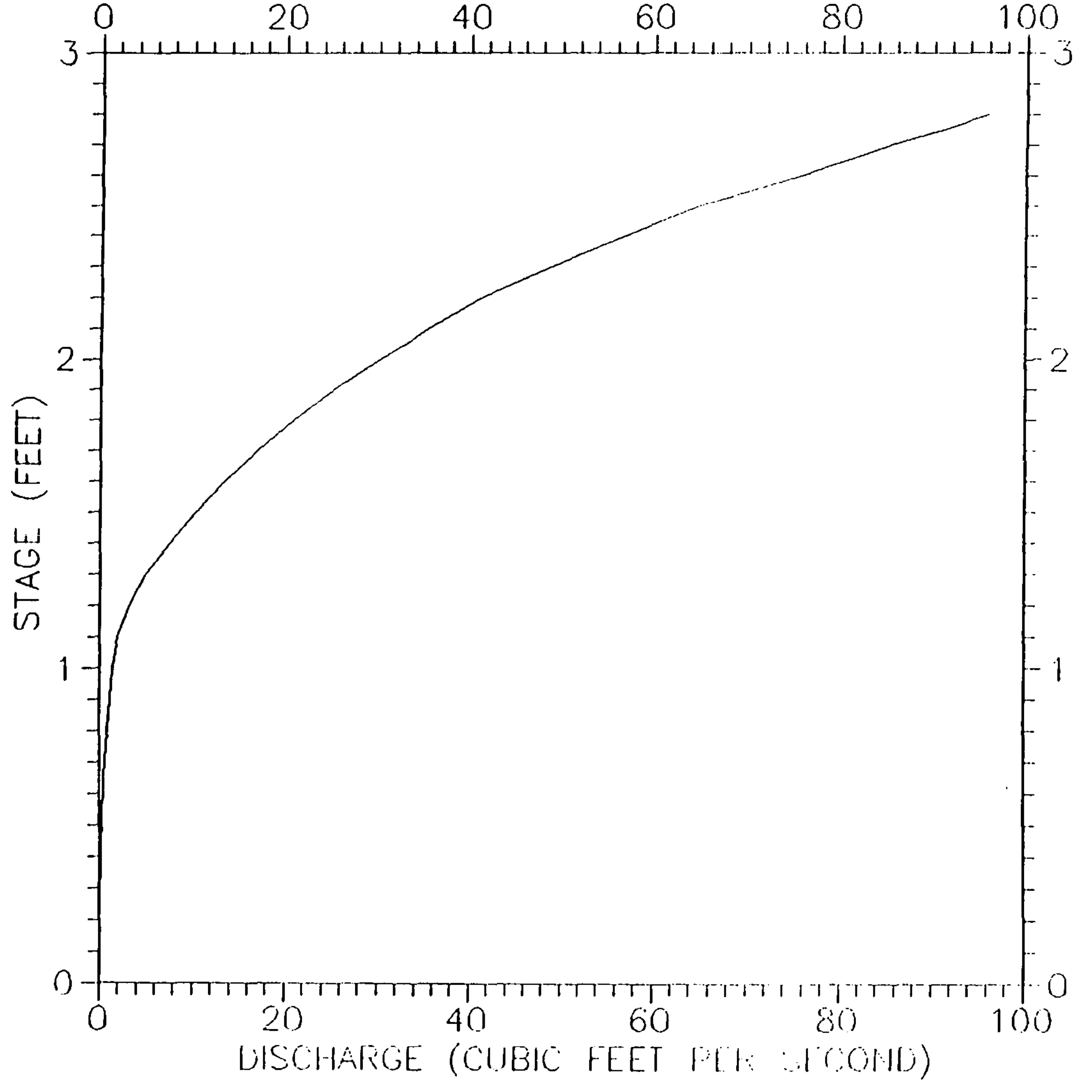
PROJECT No. 208.0102
208.0103
FIGURE No. B-2



RATING CURVE, SITE SW027
SOUTH INTERCEPTOR CANAL AT WOMAN CREEK

NON-POINT SOURCE ASSESSMENT STUDY AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

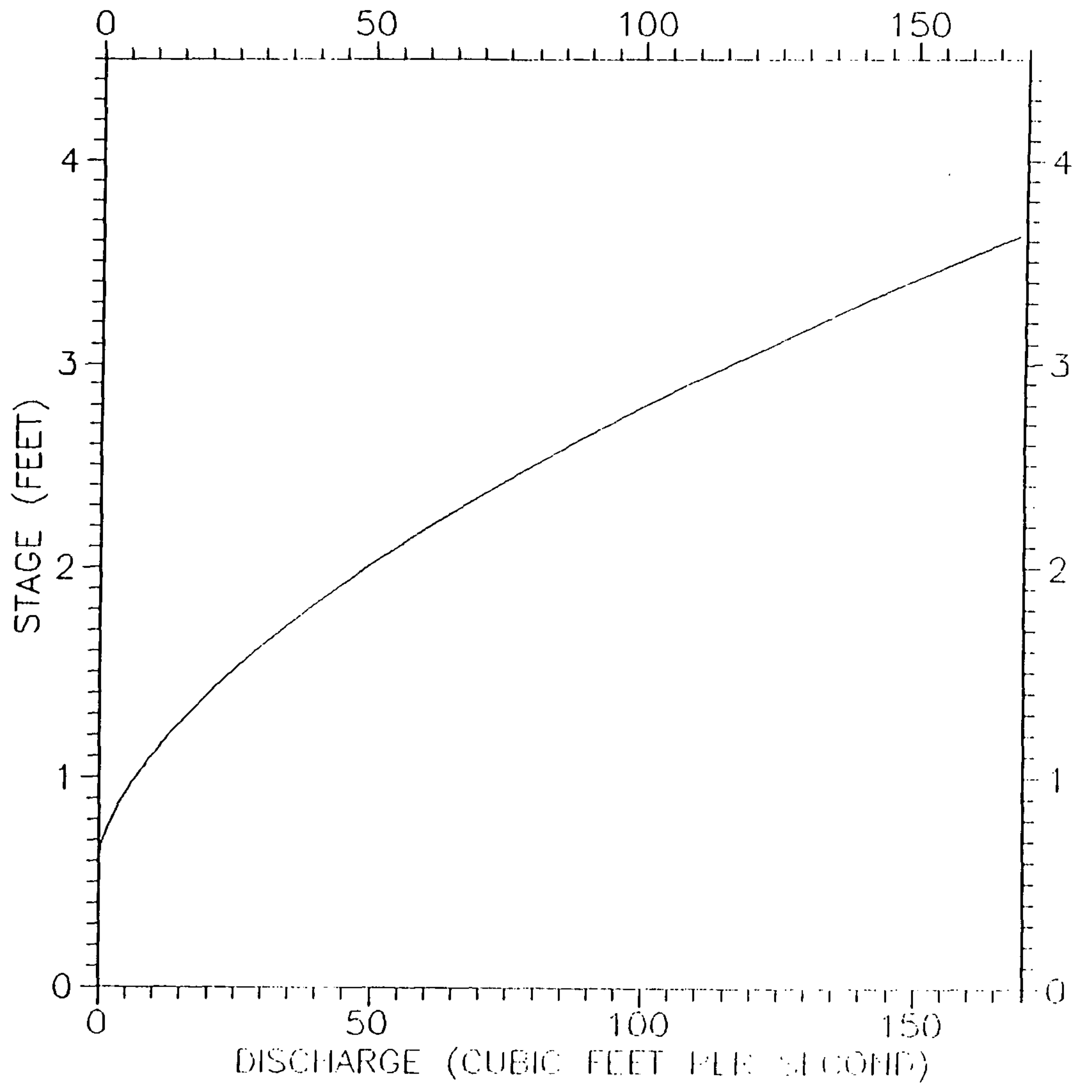
PROJECT No. 208.0102
208.0103
FIGURE No. B-3



RATING CURVE, SITE SW093
NORTH WALNUT CREEK AT OUTLET OF 72-IN CMP

NON-POINT SOURCE ASSESSMENT STUDY AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT No. 208.0102
208.0103
FIGURE No. B-4



RATING CURVE, SITE SW118
NORTH WALNUT CREEK AT DROP STRUCTURE UPSTREAM FROM 72-IN CMP

NON-POINT SOURCE ASSESSMENT STUDY AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

PROJECT No. 208.0102
208.0103
FIGURE No. B-5

TABLE B-6

Theoretical Stage - Discharge Rating Table For Monitoring Site SW022[1)]

Stage[2)] (feet)	Discharge[2),3)] (cfs)
0	0
0.01	0.05
0.02	0.10
0.03	0.18
0.04	0.25
0.05	0.30
0.06	0.40
0.08	0.50
0.11	0.75
0.14	1.0
0.21	1.5
0.27	2.0
0.40	3.0
0.52	4.0
0.64	5.0
0.76	6.0
0.88	7.0
0.99	8.0
1.12	9.0
1.20	9.7
1.27	12.0
1.47	14.0
1.67	16.0
1.87	18.0
2.07	20.0
2.27	22.0
2.47	24.0
2.67	26.0
2.87	28.0
3.00	29.4

---

1) Site located at concrete diversion box at East Patrol Road.
2) Stage = 0 ft is crest of concrete diversion box (Discharge = 0 cfs).
3) Discharge assumes that gates inside the diversion box are fully open.

TABLE B-7

Theoretical Stage - Discharge Rating Table For Monitoring Site SW023[1)]

Stage[2)] (feet)	Discharge[2),3)] (cfs)	Stage[2)] (feet)	Discharge[2),3)] (cfs)
0	0	0.75	0.703
0.01	0	0.80	0.826
0.02	0	0.85	0.961
0.03	0	0.90	1.11
0.04	0	0.95	1.27
0.05	0.001	1.00	1.44
0.06	0.001	1.10	1.97
0.08	0.002	1.20	3.18
0.10	0.005	1.30	5.03
0.15	0.013	1.40	7.67
0.20	0.026	1.50	10.4
0.25	0.045	1.60	13.5
0.30	0.071	1.70	17.1
0.35	0.105	1.80	21.0
0.40	0.146	1.90	25.3
0.45	0.196	2.00	30.4
0.50	0.255	2.10	35.5
0.55	0.324	2.15	37.2
0.60	0.402	2.20	39.0
0.65	0.492	2.50	42.2
0.70	0.592	3.00	48.1

---

1) Site located on South Walnut Creek at STP upstream from a 45° V-notch weir.
2) Stage = 0 ft is crest of 45° V-notch weir (Discharge = 0 cfs).
3) Discharge assumes that gates on 2, 30-inch RCP's are fully open.

TABLE B-8

Theoretical Stage - Discharge Rating Table
For Monitoring Site SW027[1)]

Stage[2)] (feet)	Discharge (cfs)
0	0
0.06	0.02
0.11	0.11
0.17	0.36
0.22	0.76
0.28	1.4
0.33	2.1
0.38	3.0
0.44	4.2
0.50	5.4
0.55	7.0
0.66	10.4
0.77	14.7
0.88	19.6
0.99	24.2
1.10	26.0
1.65	41.2
2.20	64.0
2.75	92.0
3.02	110
3.30	128
3.58	144
3.85	164
4.12	184
4.40	202
4.65	220
4.95	240
5.22	260
5.50	280

1) Site located in South Diversion Canal at Woman Creek Bypass.
2) Stage = 0 ft is invert of 2, 66-inch CMP's (Discharge = 0 cfs).

TABLE B-9

Theoretical Stage - Discharge Rating Table For Monitoring Site SW093[1)]

Stage[2)] (feet)	Discharge (cfs)	Stage[2)] (feet)	Discharge (cfs)
0	0	0.75	7.65
0.01	0.01	0.80	8.46
0.02	0.03	0.85	9.30
0.03	0.05	0.90	10.3
0.04	0.08	0.95	11.1
0.05	0.11	1.00	12.0
0.06	0.15	1.10	13.9
0.08	0.23	1.20	16.0
0.10	0.32	1.30	18.1
0.12	0.43	1.40	20.3
0.14	0.55	1.50	22.6
0.16	0.68	1.60	25.1
0.18	0.82	1.70	27.5
0.20	0.92	1.80	30.1
0.22	1.12	1.90	32.8
0.24	1.28	2.00	35.5
0.26	1.46	2.10	38.4
0.28	1.63	2.20	41.8
0.30	1.82	2.40	50.1
0.34	2.22	2.60	62.3
0.38	2.64	2.80	93.7
0.40	2.86	3.00	115
0.45	3.44	3.20	148
0.50	4.05	3.40	186
0.55	4.71	3.60	229
0.60	5.39	3.80	279
0.65	6.11	4.00	337
0.70	6.86	4.20	420
		4.40	508

1) Site located on North Walnut Creek downstream from 72-inch CMP.
2) Stage = 0 ft is bottom of 36-inch throat Parshall flume (Discharge = 0 cfs).

TABLE B-10

Theoretical Stage - Discharge Rating Table For Monitoring Site SW118[1]

Stage[2] (feet)	Discharge (cfs)	Stage[2] (feet)	Discharge (cfs)
0.62	0	1.12	10.3
0.63	0.03	1.17	11.9
0.64	0.08	1.22	13.6
0.65	0.15	1.27	15.3
0.66	0.23	1.32	17.2
0.67	0.32	1.37	19.1
0.68	0.42	1.42	21.1
0.69	0.53	1.47	23.1
0.70	0.64	1.52	25.3
0.71	0.77	1.57	27.5
0.72	0.90	1.62	29.7
0.74	1.19	1.72	34.4
0.76	1.50	1.82	39.4
0.78	1.83	1.92	44.7
0.80	2.18	2.02	50.1
0.82	2.56	2.12	55.8
0.84	2.96	2.22	61.8
0.86	3.37	2.32	68.0
0.88	3.81	2.42	74.4
0.90	4.26	2.52	81.0
0.92	4.73	2.62	87.9
0.94	5.21	2.72	95.0
0.96	5.71	2.82	102
0.98	6.23	2.92	110
1.00	6.76	3.02	118
1.02	7.31	3.12	126
1.04	7.87	3.22	134
1.06	8.47	3.32	142
1.08	9.04	3.42	151
1.10	9.65	3.52	160
		3.62	169

---

1) Site located on North Walnut Creek at Second Drop Structure upstream from 72-inch CMP.
2) Stage = 0.62 ft is crest of drop structure (Discharge = 0).

Table B-11

Field - Instrument Settings

Monitoring Site	Date	Alarm Setting (ft)	(cfs)	Sample-Time Increments (min)
SW022				
	7-26-90	--1)	--1)	--1)
	9-05-90	0.25	1.83	15
	9-07-90	0.30	2.83	15
	3-15-91	0.25	1.83	15
	4-15-91	0.25	1.83	10
SW023				
	7-26-91	0.80	0.83	15
	9-07-90	0.50	0.26	15
	3-15-91	0.60	0.40	15
	4-04-91	0.50	0.26	15
	4-15-91	0.60	0.40	10
	5-02-91	0.70	0.59	10
	5-06-91	0.70	0.59	20
	5-28-91	0.80	0.83	20
SW027				
	6-27-90	--2)	--2)	--2)
	7-26-90	0.25	1.09	15
	3-15-91	0.30	1.70	15
	4-15-91	0.30	1.70	10
SW093				
	7-26-90	0.50	4.05	15
	4-15-91	0.50	4.05	10
	5-06-91	0.40	2.86	10
	6-03-91	0.50	2.86	10

SHEET 1 of 2

Table B-11 (Concluded)

Field - Instrument Settings

Monitoring Site	Date	Alarm Setting (ft)	(cfs)	Sample-Time Increments (min)
	7-10-91	0.40	2.86	10
	7-23-91	0.50	4.05	10
	7-29-91	0.40	2.86	10
SW 118				
	6-27-90	--[2)]	--[2)]	--[2)]
	7-26-90	1.00	6.76	15
	9-07-90	0.90	4.26	15
	4-15-91	0.90	4.26	10

1) Sampler not fully operational; stream-stage recording began on 7-26-90; alarm cable linkage connected to automatic sampler on 9-05-90.

2) Sampler not fully operational; stream-stage recording began on 6-27-90; alarm cable linkage connected to automatic sampler on 7-26-90.

Table B-12

Summary of Streamflow-Record Losses

Monitoring Site	Date(s)	No. of Days	Explanation
SW022			
	10/01/90 - 10/02/90	2	Operational (setup) error
	10/24/90 - 10/31/90	8	Operational (retrieval) error
	11/30/90 - 12/12/90	13	Lost file (data logger)
	12/21/90 - 12/26/90	6	Data logger truncated file
	12/29/90 - 1/03/91	6	Data logger truncated file
	1/27/91 - 2/22/91	27	Data logger truncated file
	2/23/91 - 4/04/91	41	Data logger crash (CPU lockup)
	4/05/91 - 4/14/91	10	Lost file (office)
SW023			
	9/30/90 - 10/02/90	3	Operational (setup) error
	10/24/90 - 10/31/90	8	Operational (retrieval) error
	11/30/90 - 12/12/90	13	Lost file (office)
	12/27/90 - 1/03/91	8	Data logger truncated file
	2/23/91 - 3/14/91	20	Gulf war security constraints
	4/16/91 - 4/22/91	7	Lost file (office)
	5/16/91 - 5/19/91	4	Data logger (electrostatic discharge)
	6/03/91	1	Data logger flooded
	7/07/91 - 7/09/91	3	Data logger (electrostatic discharge)
	7/15/91	1	Date logger truncated file
	9/01/91 - 9/11/91	11	Computer disk with bad sectors (retrieval)

SHEET 1 of 2

Table B-12 - Concluded

Summary of Streamflow-Record Losses

Monitoring Site	Date(s)	No. of Days	Explanation
SW027			
	7/24/90 - 7/25/90	2	Operational (setup) error
	9/24/90 - 10/03/90	10	Operational (setup) error
	11/02/90 - 11/15/90	14	Lost file (office)
	11/25/90 - 12/02/90	8	Operational (retrieval) error
	12/14/90 - 12/17/90	4	Data logger truncated file
	3/02/91 - 3/14/91	13	Data disk with bad sectors (retrieval)
	5/07/91 - 5/19/91	13	Data logger (electrostatic discharge)
	6/04/91 - 6/10/91	7	Operational (retrieval) error
SW093			
	9/30/90 - 10/02/90	3	Operational (setup) error
	10/16/90 - 10/23/90	8	Lost file (office)
	12/21/90 - 1/03/91	14	Data logger truncated file
	1/16/91 - 3/01/91	45	Gulf war security contraints
	3/02/91 - 3/14/91	13	Data logger (electrostatic discharge)
	6/02/91	1	Transducer obstruction
SW118			
	10/01/90 - 10/02/90	2	Operational (setup) error
	10/24/90 - 10/31/90	8	Lost file (office)
	11/17/90 - 12/02/90	16	Operational (retrieval) error
	12/14/90 - 12/18/90	5	Data logger (electrostatic discharge)
	1/05/91 - 1/14/91	10	Lost file (data logger)
	2/23/91 - 3/15/91	21	Data logger (electrostatic discharge)
	3/16/91 - 4/03/91	19	Lost file (office)
	8/30/91 - 9/6/91	8	Computer disk with bad sectors (retrieval)

SHEET 2 of 2

C

APPENDIX C

PRECIPITATION DATA
EG&G METEOROLOGICAL STATION
IN THE WEST BUFFER ZONE
JANUARY 1990 THROUGH SEPTEMBER 1991

Table C-1

EG&G PRECIPITATION STATION IN WEST BUFFER ZONE
PRECIPITATION, IN INCHES, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.02	.00	.00	.00	.00	.00	.00	.00	.00	.02	.88
2	.00	.00	.00	.00	.10	.00	.00	.00	.00	.00	.06	.14
3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00*	.00
4	.00	.00	.00	.00	.00	.00	.05	.58	.00	.60	.00*	.00
5	.00	.00	.00	.00	.00	.18	.33	.00	.00	.02	.01*	.00
6	.00	.00	.00	.00	.00	.89	.00	.00	.00	.01	.00*	.02
7	.00	.00	.07	.00	.00	.05	.00	.00	.00	.01	.00*	.00
8	.00	.00	.00	.00	.00	.00	.04	.07	.00	.65	.00	.00
9	.00	.00	.00	.00	.00	.04	.13	.00	.00	.02	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.07	.00	.01
11	.00	.00	.00	.00	.00	.00	.00	.13	.00	.24	.71*	.00
12	.00	.00	.00	.00	.00	.00	.01	.03	.00	.00	.38*	.00
13	.00	.00	.00	.00	.01	.45	.00	.00	.00	.00	.02*	.00
14	.00	.00	.00	.00	.00	.43	.01	.00	.00	.00	.07	.00
15	.00	.00	.00	.05	.00	.03	.00	.02	.00	.00	.03	.00
16	.00	.00	.00	.00	.00	.00	.04	.14	.00	.00	.00	.00
17	.01	.01	.10	.00	.00	.00	.00	.00	.00	.00	.05*	.05
18	.00	.00	.00	.07	.00	.04	.02	.00	.00	.00	.00*	.61
19	.00	.00	.02	.15	.00	.00	.05	.00	.12	.03	.00*	.01
20	.00	.00	.00	.00	.01	.00	.00	.00	.00	.80	.00*	.08
21	.00	.00	.00	.00	.00	.00	.00	.00	.00	.43	.00*	.01
22	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00*	.00
23	.01	.00	.00	.00	.00	.03	.20	.00	.00	.10	.00	.00
24	.00	.00	.00	.01	.00	.00	.25	.00	.00	.00	.00	.00
25	.00	.03	.00	.00	.00	.00	.15	.00	.00	.01	.00	.03
26	.00	.00	.00	.00	.00	.00	.00	.05	.00	.02	.00	.00
27	.00	.04	.00	.00	.03	.21	.00	.00	.00	.00	.00	.01
28	.00	.00	.00	.00	.02	.07	.00	.14	.00	.00	.00	.06
29	.00	.00	.00	.00		.15	.05	.48	.00	.02	.00	.09
30	.00	.00	.00	.00		.02	.00	.18	.00	.12	.02	.00
31	.09		.13	.00		.00		.00		.00	.03	
TOTAL	.11	.10	.32	.28	.17	2.59	1.33	1.82	.12	3.16	1.40	2.00
MEAN	.00	.00	.01	.01	.01	.08	.04	.06	.00	.10	.05	.07
MAX	.09	.04	.13	.15	.10	.89	.33	.58	.12	.80	.71	.88
MIN	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

WATER YEAR TOTAL 13.40 MEAN .04 MAX .89 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY
* BOULDER, COLORADO DATA

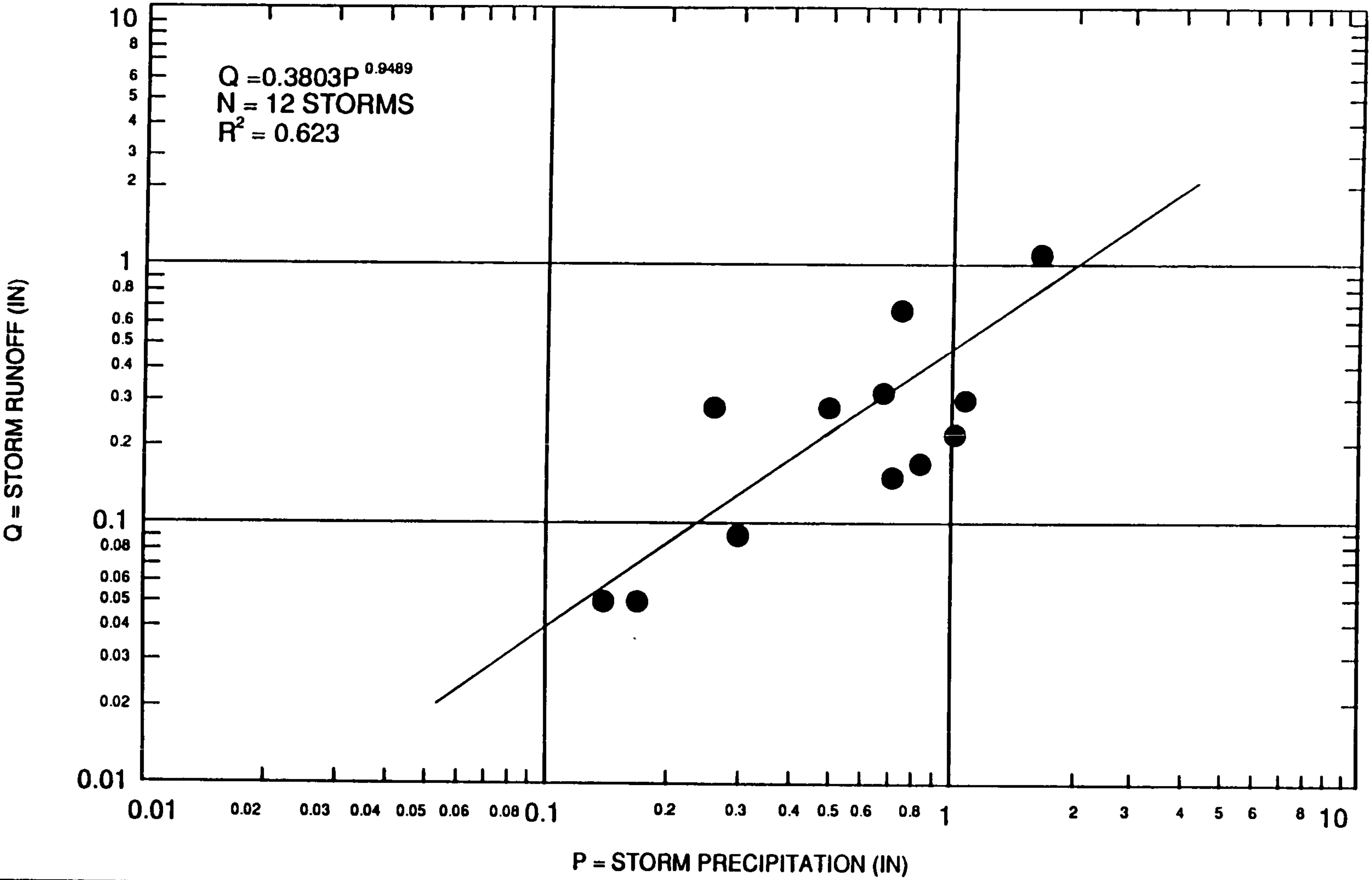
Table C-1

EG&G PRECIPITATION STATION IN WEST BUFFER ZONE
PRECIPITATION, IN INCHES, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.00	.00	.00	.00	.00	.00	.00	1.11	.00	.04	---
2	.07	.24	.00	.00	.00	.00	.00	.00	.24	.10	.18	---
3	.00	.06	.00	.00	.00	.00	.00	.00	.07	.01	.58	---
4	.00	.00	.00	.00	.00	.00	.00	.50	.00	.00	.04	---
5	.00	.01	.00	.00	.00	.26	.00	.00	.00	.00	.00	---
6	.00	.25	.00	.00	.00	.00	---	.00	.07	.00	1.15	---
7	.13	.00	.00	.00	.00	.00	---	.02	.41	.00	.00	---
8	.03	.00	.00	.00	.00	.00	.04	.00	.00	.00	.00	---
9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.78	.17	---
10	.00	.00	.00	.00	.00	.00	.00	.00	.10	.07	.00	---
11	.00	.00	.00	.00	.00	.00	.35	.00	.00	.36	.00	---
12	.00	.00	.00	.00	.00	.00	.22	.00	.00	.03	.04	---
13	.00	.00	.00	.00	.00	.00	.00	.00	.03	.00	.01	---
14	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	---
15	.00	.00	.00	.00	.00	.00	.00	.68	.00	.00	.01	---
16	.00	.00	.00	.00	.00	.00	.00	.96	.06	.00	.16	---
17	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	---
18	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.01	---
19	.08	.00	.00	.14	.00	.00	.00	.00	.00	.09	.00	---
20	.17	.00	.00	.01	.00	.00	.00	.00	.00	.00	.02	---
21	.00	.00	.00	.00	.00	.01	.21	.00	.15	.01	.00	---
22	.00	.00	.00	.00	.00	.03	.00	.52	.00	.48	.01	---
23	.00	.00	.00	.03	.00	.00	.00	.15	.00	.25	.00	---
24	.00	.00	.00	.00	.04	.00	.00	.04	.00	.15	.00	---
25	.00	.00	.00	.00	.00	.00	.00	.01	.00	.06	.00	---
26	.00	.01	.00	.00	.00	.01	.00	.00	.00	.14	.00	---
27	.00	.00	.00	.00	.00	.00	.00	.02	.03	.00	.00	---
28	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	---
29	.00	.00	.00	.01		.10	.31	.00	.02	.00	.00	---
30	.00	.00	.00	.00		.00	.37	.00	.00	.00	.00	---
31	.00		.00	.00		.00		.85		.00	.00	
TOTAL	.48	.57	.01	.19	.04	.41	1.50	3.76	2.30	2.53	2.45	---
MEAN	.02	.02	.00	.01	.00	.01	.05	.12	.08	.08	.08	---
MAX	.17	.25	.01	.14	.04	.26	.37	.96	1.11	.78	1.15	---
MIN	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	---

WATER YEAR TOTAL 14.24 MEAN .04 MAX 1.15 MIN .00

NOTE: --- INDICATES NO DATA FOR A GIVEN DAY

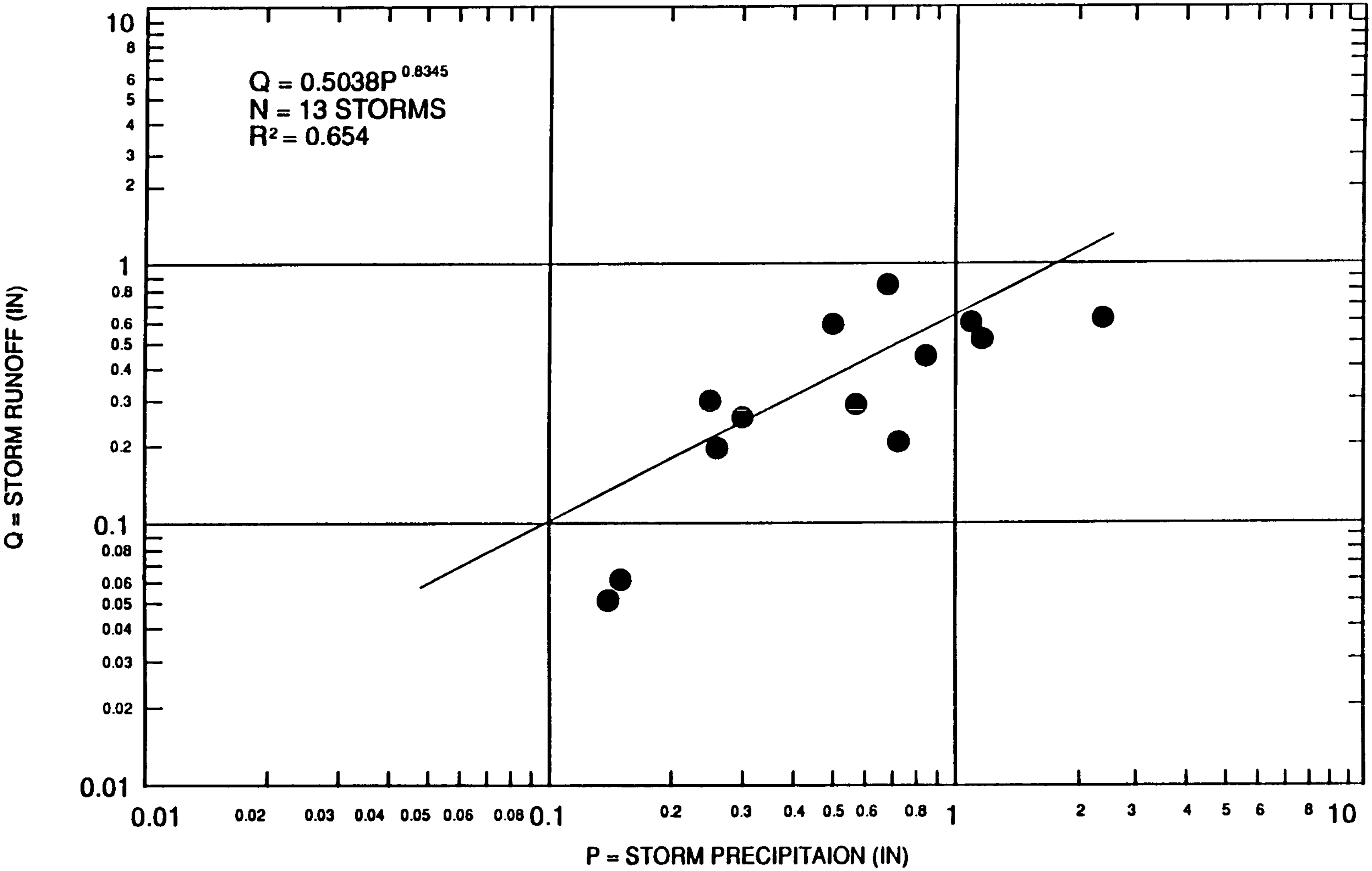


RAINFALL - RUNOFF RELATIONSHIP
SITE SW022

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

Project No's: 208.0102
208.0103

FIGURE C-1



RAINFALL - RUNOFF RELATIONSHIP
SITE SW023

Project No's: 208.0102
208.0103

NON-POINT SOURCE ASSESSMENT AND STORM-SEWER I/I & E STUDY
ZERO-OFFSITE WATER DISCHARGE

FIGURE C-2

D

APPENDIX D

FIELD MEASUREMENTS
GROUND-WATER LEVELS AND WATER QUALITY
MAY 1990 THROUGH APRIL 1991

TABLE D-1

SITE NAME : WELL 3586

Coords: N750178 E2086218

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/30/90	08:45	8.63	5903.51	16.5	6.66	1000
06/06/90	09:20	8.75	5903.39	15.0	7.24	1050
06/13/90	09:00	9.07	5903.07	14.5	7.68	1060
06/19/90	12:40	9.26	5902.88	19.0	6.70	1150
06/28/90	08:00	9.38	5902.76	16.5	6.67	1180
07/03/90	08:10	9.30	5902.84	17.5	6.82	1100
07/12/90	--	10.16	5901.98	17.5	6.98	1150
07/18/90	08:45	10.02	5902.12	21.0	6.51	1250
07/25/90	10:20	9.77	5902.37	23.5	6.70	1150
08/02/90	08:50	9.82	5902.32	20.0	6.39	1200
08/09/90	07:20	10.02	5902.12	16.0	6.48	1190
08/15/90	--	10.90	5901.24	16.5	6.64	2200
08/23/90	09:08	9.80	5902.34	15.0	6.96	1400
08/29/90	09:40	--	--	16.0	6.76	1000
09/14/90	12:00	9.75	5902.39	16.5	3.90	1300
09/24/90	14.20	10.50	5901.64	18.0	6.44	1400
09/27/90	12:30	9.50	5902.64	18.5	6.77	--
10/04/90	5:50	9.60	5902.54	16.5	6.82	1300
10/11/90	10:00	9.65	5902.49	15.0	--	1500
10/18/90	--	10.24	5901.90	17.0	6.90	1200
10/25/90	11:39	10.36	5901.78	21.5	6.87	1500
11/09/90	16:37	10.20	5901.94	12.0	6.96	1950
11/16/90	8:06	10.35	5901.79	5.0	6.68	2000
11/21/90	6:50	10.60	5901.54	7.0	6.66	2000
11/28/90	13:45	10.30	5901.84	--	--	--
12/05/90	14:15	10.38	5901.76	--	--	--
12/27/90	14:05	9.92	5902.22	--	7.75	--
01/03/91	11:46	10.18	5901.96	3.0	7.63	1800
01/09/91	15:12	10.16	5901.98	--	7.28	--
02/12/91	14:00	9.36	5902.78	9.0	7.22	1750
03/26/91	10:42	9.12	5903.02	13.0	6.90	1900
04/04/91	12:38	9.35	5902.79	18.0	6.90	1800
04/26/91	10:13	8.71	5903.43	6.0	7.50	1170

TABLE D-2

SITE NAME : WELL 4486

Coords: N749254 E2082234

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/15/90	11:30	7.98	6014.80	19.0	7.03	290
05/23/90	--	8.34	6014.44	18.0	7.56	360
05/30/90	11:20	8.06	6014.72	18.5	7.47	400
06/06/90	11:05	7.98	6014.80	20.5	6.92	380
06/13/90	11:40	8.53	6014.25	18.0	6.56	410
06/19/90	12:50	8.70	6014.08	24.5	7.38	455
06/28/90	09:45	9.04	6013.74	21.0	6.55	475
07/03/90	09:45	9.09	6013.69	23.5	7.06	520
07/12/90	--	8.06	6014.72	24.0	7.34	420
07/18/90	11:20	7.88	6014.90	23.0	7.56	400
07/25/90	08:50	7.55	6015.23	20.0	6.65	445
08/02/90	10:20	7.70	6015.08	24.0	6.48	360
08/09/90	10:40	7.87	6014.91	25.0	7.29	440
08/15/90	15:20	7.77	6015.01	23.0	7.03	500
08/23/90	12:15	7.92	6014.86	24.0	6.91	460
08/29/90	11:46	--	--	21.0	6.87	350
09/14/90	14:49	7.65	6015.13	22.5	6.43	1800
09/24/90	16:20	7.30	6015.48	22.0	6.51	470
09/27/90	14:50	7.30	6015.48	21.0	4.94	460
10/04/90	10:55	7.35	6015.43	22.0	4.98	495
10/11/90	15:30	7.40	6014.28	19.0	--	490
10/18/90	--	8.50	6014.28	19.0	6.8	510
10/25/90	13:56	8.50	6014.28	24.0	7.16	440
11/09/90	15:27	7.34	6015.44	16.0	7.05	560
11/16/90	10:40	7.62	6015.44	19.0	7.14	620
11/21/90	11:18	7.25	6015.53	13.5	7.16	600
11/28/90	12:09	8.57	6014.21	7.0	--	625
12/05/90	13:25	8.87	6013.91	12.5	7.71	580
12/12/90	15:05	8.34	6014.44	--	--	--
12/27/90	13:50	10.48	6012.30	8.0	--	1600
01/09/91	13.28	15.98	6006.80	11.0	7.3	620
02/12/91	14.55	8.73	6014.05	8.5	7.6	1100
03/26/91	11:50	7.90	6014.88	14.0	7.9	420
04/04/91	13:43	8.16	6014.62	16.0	7.3	400
04/26/91	12:20	7.54	6015.24	17.0	8.3	690

TABLE D-3

SITE NAME : WELL PZ 0789

Coords: N748510 E2083546

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/23/90	00:00	9.07	6001.92	18.0	7.83	735
05/30/90	09:15	9.05	6001.94	15.0	7.31	760
06/06/90	09:35	9.36	6001.63	17.5	7.23	760
06/13/90	09:20	9.07	6001.92	18.0	7.10	790
06/19/90	12:20	9.97	6001.02	20.0	7.42	850
06/28/90	08:15	9.05	6001.94	20.0	6.94	880
07/03/90	08:25	9.20	6001.79	20.0	7.09	835
07/12/90	--	9.98	6001.01	20.5	7.21	910
07/18/90	09:20	9.88	6001.11	20.5	6.71	900
07/25/90	10:50	9.75	6001.24	28.0	6.88	900
08/02/90	09:25	9.95	6001.04	22.5	6.58	950
08/09/90	08:00	10.10	6000.89	21.0	6.89	990
08/15/90	14:35	9.32	6001.67	21.0	6.74	1100
08/23/90	09:50	9.40	6001.59	22.0	7.02	1000
08/29/90	10:30	--	--	24.0	6.86	900
09/14/90	12:54	8.65	6002.34	22.5	4.34	1200
09/24/90	16:05	8.70	6001.30	21.0	6.43	1050
09/27/90	14:15	8.80	6002.19	22.0	4.98	1100
10/04/90	09:45	9.10	6001.89	22.0	5.13	1050
10/11/90	13.40	10.05	6000.94	18.5	--	1100
10/18/90	14:10	10.02	5999.98	20.0	6.60	1200
10/25/90	12:10	9.73	6000.27	22.0	7.11	1200
11/09/90	16:12	9.87	6001.12	14.5	7.16	1140
11/16/90	08:46	7.95	6003.04	11.0	9.95	1650
11/21/90	09:52	9.70	6001.29	11.5	7.17	1400
11/28/90	12:45	9.94	6001.05	10.0	--	1200
12/05/90	12:08	10.17	6000.82	17.0	7.60	1200
12/12/90	13:15	9.50	6001.49	10.0	7.79	1600
12/27/90	12:50	11.50	5999.49	11.0	8.01	1250
01/03/91	14:15	11.28	5999.71	16.0	7.89	1200
01/09/91	13:40	11.50	5999.49	9.0	8.65	1150
02/12/91	15:05	10.38	6000.61	9.0	7.40	1200
03/26/91	13:10	10.90	6000.09	15.0	7.40	1030
04/04/91	13:19	11.10	5999.89	18.0	7.30	1600
04/26/91	11:12	9.80	6001.19	10.0	8.10	1160

TABLE D-4

SITE NAME : WELL PZ 2389

Coords: N749461 E2083653

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/23/90	--	9.74	5989.56	17.5	7.46	1650
05/30/90	09:05	9.95	5989.35	15.0	6.78	2335
06/06/90	12:05	10.16	5989.14	17.0	7.11	2450
06/13/90	09:35	10.47	5988.83	15.0	6.83	2300
06/19/90	12:10	11.15	5988.15	20.0	7.48	2400
06/28/90	10:00	11.00	5988.30	19.0	6.70	2800
07/03/90	08:40	11.03	5988.27	18.5	6.92	2550
07/12/90	10:35	11.09	5988.21	18.5	6.80	2750
07/18/90	09:10	11.05	5988.25	19.0	6.37	2900
07/25/90	10:40	11.30	5988.00	25.0	6.70	2650
08/02/90	09:10	11.75	5987.55	21.0	6.47	2800
08/09/90	07:40	11.96	5987.34	17.5	6.48	2850
08/15/90	--	11.80	5987.50	23.5	6.73	3800
08/23/90	09:35	11.95	5987.35	22.0	6.65	3200
08/29/90	09:55	--	--	19.0	6.61	3000
09/14/90	15:20	--	--	20.0	5.59	3400
09/24/90	14:20	11.25	5988.05	21.0	5.67	3600
09/27/90	12:45	11.40	5987.90	19.0	6.70	3400
10/04/90	8:10	11.60	5987.70	18.5	6.54	3300
10/11/90	11:00	11.70	5987.60	17.0	--	3800
10/18/90	15:35	12.68	5986.62	18.0	6.90	4100
10/25/90	11:25	13.05	5986.25	22.5	6.20	4000
11/09/90	16:25	12.94	5986.36	15.0	7.12	4300
11/16/90	8:25	10.95	5988.35	6.5	7.07	4800
11/21/90	7:20	12.40	5986.90	7.5	6.98	4800
11/28/90	13:33	13.17	5986.13	6.0	--	4000
12/05/90	14:00	13.66	5985.64	12.5	7.48	3990
12/12/90	13:00	12.88	5986.42	8.0	7.06	4200
12/27/90	12:28	13.99	5985.31	9.0	8.01	4800
01/03/91	13:36	14.00	5985.30	--	7.99	5000
01/09/91	15:05	14.00	5985.30	--	--	--
02/12/91	14:07	11.99	5987.31	9.5	7.13	4100
03/26/91	13:25	12.32	5986.98	12.0	7.20	4020
04/04/91	12:48	12.65	5986.65	17.0	6.80	2800
04/26/91	10:32	12.29	5987.01	5.0	7.90	3800

TABLE D-5

SITE NAME : WELL PZ 4289

Coords: N749943 E2803043

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/15/90	10:45	10.15	5996.17	19.00	6.60	340
05/23/90	--	10.43	5995.89	19.00	7.40	460
05/30/90	11:40	10.58	5995.74	15.00	6.97	295
06/06/90	11:30	10.70	5995.62	17.50	6.99	465
06/13/90	11:40	10.70	5995.62	16.50	6.62	470
06/19/90	11:50	11.48	5994.84	18.00	7.42	470
06/28/90	09:30	11.33	5994.99	18.50	6.86	520
07/03/90	09:00	11.40	5994.92	18.00	7.02	490
07/12/90	08:00	11.18	5995.14	27.50	7.05	400
07/18/90	11:30	10.95	5995.37	20.00	6.58	550
07/25/90	09:50	10.24	5996.08	26.00	6.90	460
08/02/90	10:40	10.80	5995.52	22.00	6.56	550
08/09/90	09:30	11.76	5994.56	22.00	7.33	520
08/15/90	14:10	11.30	5995.02	27.50	6.71	615
08/23/90	10:50	11.45	5994.87	24.00	7.04	620
08/29/90	12:07	--	--	20.50	6.88	590
09/14/90	14.29	11.40	5995.12	19.50	8.21	280
09/24/90	14:40	11.20	5995.12	18.00	5.60	300
09/27/90	13:00	11.40	5994.92	20.00	6.50	620
10/04/90	8:25	11.77	5994.55	19.50	6.61	640
10/11/90	11:30	11.85	5994.47	18.00	--	700
10/18/90	15:25	12.77	5993.55	20.00	6.90	720
10/25/90	13:31	12.64	5993.68	26.50	7.19	730
11/09/90	15:40	11.36	5993.68	16.00	7.21	800
11/15/90	11:56	11.52	5994.80	17.00	7.06	770
11/21/90	7:41	11.05	5995.27	7.00	7.20	880
11/28/90	12:35	12.11	5994.21	10.00	--	795
12/05/90	11:35	12.35	5993.97	15.00	7.44	725
12/12/90	14:45	12.23	5994.09	9.00	7.31	850
12/27/90	13:33	13.87	5992.45	--	7.94	1100
01/03/91	12:55	14.40	5991.92	9.00	7.96	820
01/09/91	14:41	14.76	5991.56	--	8.47	--
02/12/91	14:15	13.24	5993.08	9.50	7.25	800
03/26/91	12:36	14.07	5992.25	15.00	7.30	820
04/04/91	14:11	14.30	5992.02	16.00	7.00	780
04/26/91	13:03	11.40	5994.92	13.00	8.00	1100

TABLE D-6

SITE NAME : WELL PZ 4589

Coords: N749958 E2081661

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/15/90	11:00	15.61	6017.19	19.0	7.26	160
05/23/90	--	15.55	6017.25	19.5	7.95	205
05/30/90	10:00	15.53	6017.27	13.9	6.71	200
06/06/90	10:20	15.53	6017.27	14.0	7.16	205
06/13/90	10:10	15.47	6017.33	14.5	7.23	210
06/19/90	11:35	16.28	6016.52	17.5	7.52	220
06/28/90	09:20	15.10	6017.70	16.5	6.97	225
07/03/90	13:20	16.08	6016.72	18.0	7.06	245
07/12/90	10:20	15.70	6017.10	18.5	6.92	240
07/18/90	10:00	15.33	6017.47	19.0	6.94	245
07/25/90	11:40	14.55	6018.25	25.0	7.01	215
08/02/90	10:10	15.13	6017.67	20.0	7.02	230
08/09/90	08:30	15.06	6017.74	18.0	7.28	240
08/15/90	15:10	14.03	6018.77	14.0	7.41	350
08/23/90	10:40	13.95	6018.85	24.0	7.39	300
08/29/90	11:00	--	--	18.5	7.30	240
09/14/90	14:04	10.80	6022.00	17.5	7.10	1200
09/24/90	15:10	13.70	6019.10	15.0	6.42	395
09/27/90	13:35	12.70	6020.10	16.0	5.60	560
10/04/90	8:55	12.75	6020.05	19.0	5.70	320
10/11/90	12:30	12.75	6020.05	16.5	--	350
10/18/90	15:05	13.68	6019.12	18.0	7.70	390
10/25/90	13:09	13.75	6019.05	22.5	7.41	420
11/09/90	15:52	13.86	6018.94	15.0	7.55	420
11/16/90	9:30	14.00	6018.80	13.5	7.57	420
11/21/90	8:41	13.20	6019.60	7.5	7.63	530
11/28/90	13:22	14.10	6018.70	7.5	--	420
12/05/90	11:54	14.31	6018.49	14.0	8.20	380
12/12/90	14:30	14.45	6018.35	10.5	7.72	420
12/27/90	13:18	14.98	6017.82	8.0	8.41	1400
01/03/91	14:50	15.25	6017.55	7.0	8.14	450
01/09/91	14:32	15.36	6017.44	--	8.75	--
02/12/91	14:30	15.32	6017.48	10.0	8.05	390
03/26/91	12:45	16.53	6016.27	14.0	8.00	410
04/04/91	14:19	16.73	6016.07	15.0	7.20	380
04/26/91	11:40	16.45	6016.35	14.0	8.20	500

TABLE D-7

SITE NAME : WELL PZ 5589

Coords: N748604 E2080719

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/15/90	15:15	5.90	6048.87	19.5	6.75	150
05/23/90	--	6.50	6048.27	19.0	7.10	225
05/30/90	09:50	6.50	6048.27	15.5	7.05	205
06/06/90	10:10	7.90	6046.87	17.0	6.32	200
06/13/90	09:55	7.30	6047.47	16.0	6.71	220
06/19/90	11:20	7.96	6046.81	26.0	6.11	220
06/28/90	08:55	9.97	6044.80	18.0	6.14	230
07/03/90	13:00	8.52	6046.25	24.5	6.22	215
07/12/90	10:00	9.13	6045.64	24.0	6.10	220
07/18/90	09:45	9.33	6045.44	21.0	6.06	240
07/25/90	11:20	6.75	6048.02	25.5	6.81	215
08/02/90	09:50	8.05	6046.72	24.0	5.96	225
08/09/90	09:15	--	--	19.5	6.80	225
08/15/90	14:55	9.28	6045.49	15.0	6.68	400
08/23/90	10:18	9.81	6044.96	20.0	6.85	260
08/29/90	10:50	--	--	21.0	6.30	220
09/14/90	13:34	10.12	6044.65	17.0	7.33	1000
09/24/90	13:29	9.00	6045.77	15.0	5.49	262
09/27/90	13:35	9.65	6045.12	16.5	4.28	250
10/04/90	9:10	10.25	6044.52	18.5	5.01	280
10/11/90	13:00	10.30	6044.47	16.5	--	300
10/18/90	14:45	12.25	6042.52	19.0	6.90	310
10/25/90	13:00	11.72	6043.05	20.0	6.66	600
11/09/90	15:59	9.45	6045.32	13.5	7.03	320
11/16/90	9:06	9.75	6045.02	9.0	6.99	400
11/21/90	9:00	9.20	6045.57	9.0	6.90	360
11/28/90	13:10	10.11	6044.66	8.0	--	320
12/05/90	12:25	11.07	6043.70	14.5	7.47	320
12/12/90	13:45	11.40	6043.37	9.0	7.13	380
12/27/90	13:05	14.74	6040.03	10.0	8.15	380
01/03/91	14:35	16.02	6038.75	4.0	8.08	380
01/09/91	14:15	16.84	6037.93	--	8.72	--
02/12/91	14:40	16.00	6038.77	9.0	8.14	310
03/26/91	12:55	15.34	6039.43	17.0	6.90	320
04/04/91	14:26	15.55	6039.22	13.0	5.80	330
04/26/91	11:30	10.22	6044.55	12.0	7.60	500

TABLE D-8

SITE NAME : WELL PZ 6189

Coords: N748147 E2081941

DATE	TIME	DEPTH (ft)	ELEVATION (ft MSL)	TEMP (C)	pH (std)	SC (uS/cm)
05/23/90	00:00	29.70	6007.61	19.0	5.70	640
05/30/90	09:30	29.78	6007.53	16.0	7.51	640
06/06/90	09:20	29.48	6007.83	16.0	7.31	600
06/13/90	09:40	30.57	6006.74	15.5	7.57	610
06/19/90	12:30	30.77	6006.54	22.5	7.27	610
06/28/90	08:35	30.08	6007.23	17.5	7.53	650
07/03/90	09:30	30.20	6007.11	18.0	7.32	635
07/12/90	--	30.05	6007.26	18.5	7.30	620
07/18/90	09:35	29.65	6007.66	18.0	6.97	600
07/25/90	11:00	29.00	6008.31	21.5	7.30	495
08/02/90	09:35	30.42	6006.89	17.5	6.89	505
08/09/90	08:15	29.80	6007.51	16.5	6.82	530
08/15/90	14:45	29.87	6007.44	14.5	7.41	680
08/23/90	10:05	30.05	6007.26	18.0	8.45	620
08/29/90	10:40	--	--	15.0	7.45	620
09/14/90	13:16	23.30	6014.01	16.5	5.80	620
09/24/90	15:52	23.25	6014.06	16.0	6.79	710
09/27/90	13:50	29.25	6008.06	17.0	5.45	700
10/04/90	9:30	29.25	6008.06	17.0	5.37	700
10/11/90	13:15	28.30	6009.01	14.0	--	760
10/18/90	14:25	30.12	6007.19	16.0	7.50	890
10/25/90	12:21	30.30	6007.01	22.0	7.27	840
11/09/90	16.07	30.35	6006.96	13.5	7.70	920
11/16/90	8:58	30.32	6006.99	10.0	7.67	980
11/21/90	9:27	28.45	6008.86	8.5	7.34	940
11/28/90	12:55	30.43	6006.88	9.5	--	960
12/05/90	12:16	30.48	6006.83	15.0	7.84	800
12/12/90	13:30	29.70	6007.61	11.0	7.40	980
12/27/90	12:56	30.70	6006.61	12.0	8.27	1000
01/03/91	14.25	30.81	6006.50	10.0	8.08	910
01/09/91	13:50	30.87	6006.44	--	8.73	2200
02/12/91	14:45	31.05	6006.26	11.0	7.47	890
03/26/91	13:02	31.15	6006.16	14.0	7.60	980
04/26/91	11:20	30.96	6006.35	12.0	8.40	1100

E

APPENDIX E

SUBCONTRACTOR REPORT:

ENVIRONMENTAL CONSTITUENTS IN THE ROCKY FLATS AREA - NON-FACILITY RELATED SOURCES PERTINENT TO WATER QUALITY

By R. E. Moran (Moran & Associates, Inc.)

ENVIRONMENTAL CONSTITUENTS IN THE ROCKY FLATS AREA - NON-FACILITY RELATED SOURCES PERTINENT TO WATER QUALITY

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Final: December 10, 1990

ASI Project No. 208-0103

ENVIRONMENTAL CONSTITUENTS IN THE ROCKY FLATS AREA - NON-FACILITY RELATED SOURCES PERTINENT TO WATER QUALITY

[This is a preliminary report, prepared from available information without the benefit of extensive research or field verification. Much of the data and observations come from unpublished work performed by R. E. Moran during the mid-1970's while with the U. S. Geological Survey and will be updated in future reports. Rocky Flats here refers to the geomorphic feature; RFP refers to the Rocky Flats Plant.]

1.0 INTRODUCTION

Numerous sources have reported releases of environmental contaminants from Rocky Flats Plant (RFP)-related sources. To adequately evaluate such studies/data, it is important to be able to distinguish releases from background, as it is at any site where potential contamination exists. The RFP environmental situation is aggravated by the complex geologic conditions of this site located at the transition zone between the Great Plains and the Rocky Mountains. This results in two main geologic complexities: 1) the pertinent lithologic units on and upgradient of the RFP are often not laterally continuous, or geochemically homogeneous, and 2) many of the natural RFP-area sediments and ground waters have anomalously high concentrations of nitrate, sulfate, strontium, selenium, and radioactivity (that is, as measured in terms of uranium, gross alpha and gross beta) - constituents that are often associated with wastes. In addition, waters and sediments at the margins of the RFP site have been impacted by other, non RFP-related, waste-generating activities, which may not have been considered in previous regional interpretations of water quality.

2.0 SOURCES OF ANOMALOUS CHEMICAL CONSTITUENT CONCENTRATIONS

2.1 Background

Geologic materials in the RFP-area are known to contain the following:

- sedimentary uranium deposits (e.g., at the Laramie hogback on Highway 93 near Leyden) (see Gude and McKeown, 1952, and Van Horn, 1976);
- primary uranium deposits (e.g., tertiary intrusives in Precambrian crystalline rocks west of RFP). NOTE: Both primary and sedimentary uranium deposits have been reported from many localities throughout the Front Range and the Denver Basin (Boberg and Runnells, 1971; Wenrich-Verbeek et.al., 1977; Marsh and Queen, 1974).
- dissolved uranium concentrations in the range of 100 to 500 ug/L are reported from wells completed in Paleozoic and Precambrian materials in Coal Creek Canyon west of the RFP (unpublished data, Colorado Department of Health). Scott and Vogeli (1961) report anomalous radiochemical analyses for ambient waters, many from Jefferson and Boulder Counties, as well as other portions of the Front Range.
- coal/lignites (numerous deposits in Marshall, Leyden areas; lignites are common in the Laramie and Arapahoe Formations), see Van Horn (1976) and Lovering and Goddard (1950). Many occurrences of lignites and organic-rich shales were noted by the author during a USGS drilling program conducted to the southeast of the RFP during 1975. Coals and lignites contain a wide variety of trace constituents that can be released to the environment during weathering processes (Averitt, et.al., 1972).

Such organic-rich materials may also remove dissolved and/or colloidal constituents from surface or ground waters.

- metalliferous shales - at least partly marine with volcanic materials, and significant trace constituent concentrations (e.g., Niobrara, Pierre). As with other organic-rich sediments such as coals/lignites, organic shales are known to contain significant concentrations of trace constituents (Tourtelot, 1964) and are reported from many formations within the RFP area (Crosby,1976; Van Horn, 1976).

- alluvial deposits derived from locally mineralized Precambrian metamorphic and igneous rocks. Mineralization includes amongst others, sulfides of copper, lead, zinc, manganese, and various forms of tin and tungsten (Lovering and Goddard, 1950).

2.2 Anthropogenic Sources

Human activities in the RFP area have included the following factors, potentially affecting water quality:

- industrial wastes - miscellaneous dumps along the southern margin of the flats; old Tosco refinery; clay-pit and miscellaneous industrial wastes - northwest of RFP at Hwy. 93;

- coal mines - workings, air shafts, collapsed areas, wastes. Van Horn (1976) discusses the presence of several old coal mines in the Golden Quadrangle, especially in the Leyden area. Similar old mines are reported from the lower Laramie Formation in Boulder County near Marshall and immediately north of the RFP. As of the mid to late 1970's, the new Leyden mine was used for natural gas storage by Public Service Company, and considerable amounts of the gas were reported to have leaked out of the mine workings (conversations with public service staff). Lignites are common in the Laramie and Arapahoe Formations throughout much of the Denver Basin.

- landfills - old Jeffco site near Hwy. 72/Indiana; present landfill near Hwy. 93;
- railroad tracks - oils, creosote, spill materials, bed materials often composed of mine-derived wastes;
- uranium mine and wastes - Schwartzwalder pitchblend mine, and possibly other mines, west of Leyden Gulch. Local residents reported the presence of uranium test pits in the Laramie hogback at Hwy. 93 and the Leyden Road. This area had isolated "hot" spots when tested with a scintillometer by the author in 1975.
- irrigation ditches - numerous, such as Farmers Highline, Croke, Church, Smart, McKay;
- leach fields and septic tanks at the margins of the RFP;
- agricultural run-off;
- underground storage tanks; locations unknown, but presence assumed at the margins of the RFP.

The specific locations and magnitudes of impacts for many of these factors are unknown at this time.

3.0 WATER QUALITY - SOUTH/SOUTHEAST OF RFP

Tables 1 and 2 summarize water quality data collected by the USGS during the early and middle 1970's from domestic and agricultural wells located to the south and southeast of Rocky Flats and completed within the Arapahoe Formation. (Rocky Flats, here, refers to the geomorphic feature; RFP refers to the Rocky Flats Plant.)

Median concentrations of sulfate, nitrate, bicarbonate, hardness, dissolved solids, sodium and dissolved organic carbon were quite high when compared to many other commonly - encountered ground waters from sedimentary sources. In addition, anomalously high concentrations of selenium, strontium and gross alpha were detected in several wells. Uranium was determined for only two wells and they contained 47 and 57 ug/L, both of which are anomalously high when compared to "average" ground waters from continental sediments. Wells having high trace constituent concentrations (i.e. selenium, iron, manganese, strontium, radioactivity) seem to be areally discontinuous. That is, wells in the Ralston Gulch area separated by less than 100 feet (ft) had overall chemical characteristics that differed drastically (see Figure 1).

Cuttings from two Arapahoe wells installed as part of the same USGS program cited previously contained relatively high concentrations of selenium, organic carbon and Kjeldahl nitrogen in several zones, especially the organic-rich shales and lignites. Downhole measurements of dissolved oxygen in these two wells indicated moderately oxidizing conditions in upper intervals of the boreholes.

The Arapahoe Formation south and southwest of Rocky Flats is composed of interfingering stream channel (coarse-grained) and overbank (fine-grained) facies. Most of the flow occurs within the coarser sands and gravels, which have neutral to alkaline pH and oxidizing Eh conditions. In areas where greater percentages of organic-rich, fine-grained sediments are encountered, Eh would be lowered. The oxidation of organic-rich sediments would explain the presence of much of the nitrate and dissolved organic carbon (DOC) concentrations. Varying redox conditions would strongly impact the solubility of iron, and thus sorption and desorption reactions. Preliminary results of the water quality/geochemistry from these USGS activities were presented as a talk to the Geological Society of America, November 1976 (Moran, 1976). Based on the work of Hurr (1976), Arapahoe ground waters in the RFP area flow to the east, thus the Arapahoe wells previously mentioned would not have been impacted by releases from the RFP.

4.0 IMPLICATIONS OF SOURCES - GENERAL COMMENTS

Several chemical constituents commonly encountered in RFP-type wastes are also found naturally in some ground waters at the margins of Rocky Flats. Nitrate and sulfate, for example, are generally hydrochemically mobile and are common indicators of industrial and often radiochemical wastes. In the wells south of Rocky Flats, most of the dissolved sulfate probably results from the weathering of metal-sulfides, clays, organic-rich sediments, and evaporite minerals such as gypsum, which are common in the local geologic section (personal observations). The high nitrate concentrations seem to result from the oxidation of organic rich shales and lignites. No evidence exists to suggest that significant nitrate is being contributed by animal wastes, irrigation return flows, or septic systems. High radioactivity, selenium, and strontium appear to result from ambient processes. Sedimentary uranium deposits are commonly associated with arsenic, molybdenum, selenium, vanadium and other trace elements commonly mobile as oxyanions (Rose, Hawkes and Webb, 1979).

Analyses of bottom sediments from Ralston Reservoir (collected by USGS personnel in 1972) yielded relatively high trace-metal concentrations - especially noteworthy were strontium, manganese, zinc, chromium, copper, cobalt, molybdenum, uranium, and nickel (see Tables 3 and 4). The reservoir received runoff from eroded Precambrian rock and upgradient mine-related wastes. This reservoir is a water supply for the City of Denver and contributes flow to Ralston Creek. Analyses of bottom sediments from Standley Lake undoubtedly would also contain elevated concentrations of ambient trace constituents.. Most reservoirs in similar settings act as sinks for nonmobile constituents. NOTE: As this report was in preparation, Moran and Associates received several reports that discussed past sediment sampling pertinent to the RFP. At least one (Thomas and Robertson, 1981) discusses sediment sampling from Standley Lake. These reports have not been reviewed or considered in the preparation of this report.

In the early 1970's, Jefferson County Department of Health and the USGS received numerous questions regarding possible relationships between diseases in humans and livestock and releases from the RFP. Central nervous system ailments were reported near 72nd Avenue and Indiana Street, but no obvious relationship to the RFP could be found. Reports of diseases and birth defects in poultry and livestock were reported to the east of RFP in Broomfield. No obvious evidence of releases was noted (data and correspondence of Jefferson County Health Department).

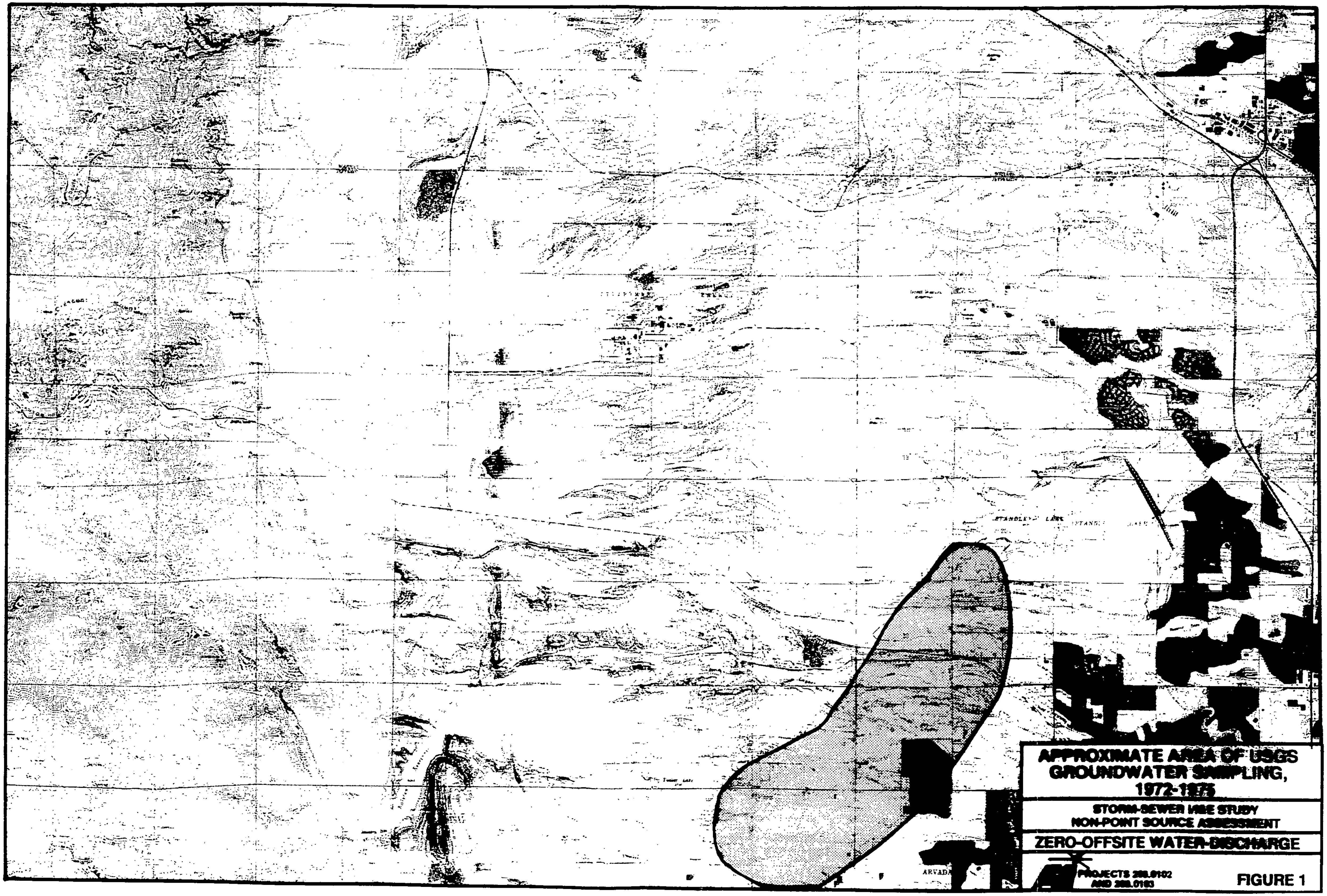
Two reservoirs east and southeast of the RFP contribute to municipal drinking-water supplies. Great Western Reservoir, which receives flow from Walnut and South Walnut Creeks is a supply for the City of Broomfield. Standley Lake, which receives flow from Woman Creek, is a supply for the cities of Westminster, Northglenn, and Thornton. Both of these water bodies are located within sediments that could yield water quality similar to that discussed in Section 3.0.

Surface water is diverted from Clear Creek in Golden via the Croke Canal (and possibly the Church Ditch), and is discharged into Standley Lake. Some of the chemical constituent loadings entering Standley Lake thus also comes from mine drainage sources in the Central City - Blackhawk Superfund site which drain into Clear Creek above Golden.

5.0 RECOMMENDATIONS

The following should be considered for inclusion in future activities:

- o Expand ground-water sampling to areas at the perimeter of the RFP not covered in Figure 1. Resample selected wells within the area shown on Figure 1 for a "complete" list of trace constituents.
- o Review available reports on lake sediment sampling for the RFP area to determine whether such data can help in quantifying background concentrations for both radiogenic and nonradiogenic constituents.
- o Attempt to obtain available data on ambient radioactivity in ground-waters from mountainous areas to the west of the RFP. The Colorado Department of Health has such data for many private wells and public school water supplies.



APPROXIMATE AREA OF USGS GROUNDWATER SAMPLING, 1972-1975

STORM-SEWER USE STUDY
NON-POINT SOURCE ASSESSMENT

ZERO-OFFSITE WATER-DISCHARGE

PROJECTS 288.0102
AND 288.0103

FIGURE 1

TABLE 1

Arapahoe Aquifer Ground-Water Quality,
Selected Constituents, South-Southeast of RFP.

Constituent	Units	Minimum	Maximum	Median
pH	Std. Units	6.6	9.0	7.1
Sp. Cond.	micromhos/cm	580	8160	1600
Diss. Solids	mg/l	355	5310	1150
Nitrate	mg/l	0.02	45.0	3.5
Alkalinity	mg/l	126	445	264
Bicarbonate	mg/l	153	543	335
Hardness	mg/l	25	2700	475
Calcium	mg/l	9.6	620	135
Magnesium	mg/l	0.3	270	43
Sodium	mg/l	15.0	840	170
Potassium	mg/l	0.7	8.3	3.5
Chloride	mg/l	4.5	1800	35.0
Fluoride	mg/l	0.3	2.9	1.5
Sulfate	mg/l	42.0	1500	435
Iron	ug/L	10.0	3900	70.0
Manganese	ug/L	<10.0	440	25.0
Selenium	ug/L	<1.0	440	10.0
Strontium	ug/L	70.0	9400	1650
Gross Alpha (as U-nat.)	ug/L	67.0	160	130
Gross Beta (as Cs-137)	pCi/L	19.0	66.0	33.0
Gross Beta (as Sr-90/Y-90)	pCi/L	16.0	58.0	29.0
Org. Carbon, Diss.	mg/l	1.9	13.0	3.5

Based upon unpublished data from 41 wells located within an area southeast of the RFP site, collected between 1972 and 1975 by the USGS (see Figure 1).

TABLE 2

Arapahoe Ground-Water Quality,
South-Southeast of RFP
Selected Trace Constituents (ug/L)

Constituent	n	Minimum	Maximum	Median
Arsenic	9	<1.0	4.0	1.0
Barium	4	ND	ND	--
Beryllium	4	ND	ND	--
Boron	9	<10.0		
Cadmium	15	<1.0	2.0	1.0
Chromium (hex.)	10	ND	ND	--
Cobalt	10	<1.0	2.0	1.0
Copper	15	1.0	400	40.0
Lead	15	<1.0	21.0	5.0
Lithium	9	40	210	170
Mercury	15	<0.1	1.7	0.4
Molybdenum	9	1.0	6.0	3.0
Nickel	15	2.0	11.0	4.0
Silver	10	ND	ND	--
Vanadium	4	<0.1	0.6	0.6
Zinc	15	20.0	2100	290

ND = Not Detected
-- = Not Determined

TABLE 3

Bottom Sediment Analysis, Ralston Reservoir, Collected by USGS, September 13, 1972*

Constituent (total)	Concentration (micrograms/100g)
Selenium	Not detected
Cobalt	1,200
Copper	12,000
Iron	3,600
Lead	4,200
Manganese	160,000
Nickel	13,000
Zinc	15,000
Cadmium	100
Silver	300
Mercury	13

*Determined by atomic absorption techniques, USGS, W.R.D. Laboratory, Salt Lake City, Utah. Sample was dried and digested with HCl prior to analysis.

TABLE 4

Bottom Sediment Analyses, Ralston Reservoir, Collected by USGS, September 13, 1972*

Constituent (Total)	Concentration Sediment Residue (mg/kg)	Concentration Supernatant from Sediment (mg/L)
Chloride	750	12,500
Bromide	<35	3,660
Sodium	6.4	30,000
Calcium	3,300	629,000
Magnesium	27,500	222,000
Strontium	<100	12,000
Vanadium	172	30
Aluminum	81,800	5,380
Manganese	539	123,000
Mercury	6.3	21.0
Zinc	2,100	<1.0
Chromium	108	6.6
Copper	100	
Arsenic	25	<0.05
Antimony	4.2	0.7
Cobalt	25	430
Molybdenum	60	<1.0
Cadmium	35	<2.0
Uranium	112	45
Lanthanum	89	31
Samarium	3.9	2.3
Selenium	5.2	<5.0
Thorium	34	
Scandium	25	
Nickel	400	

* Determined by neutron activation techniques, USGS, W.R.D. Research Lab, Denver, Colorado. Original sediment sample was centrifuged to separate 20 ml of clear supernate. Residue was dried but not digested prior to analysis.

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APPENDIX F

DOCUMENTS RELATED TO WATER-QUALITY STANDARDS, STREAM SEGMENTS IN THE RFP AREA

RECEIVED
SEP 29 1988 TPS 9/29/88
IN-SITU, INC. DENVER, CO

WATER QUALITY CONTROL COMMISSION

NOTICE OF FINAL ADOPTION

PURSUANT to the provisions of Sections 24-4-103(5) and 24-4-103(11)(a), C.R.S.

NOTICE IS HEREBY GIVEN that the Colorado Water Quality Control Commission, after public hearing on March 7 through 11, 1988, and complying with the provisions of 24-4-103(3) and 25-8-401(1), C.R.S., amended on August 1, 1988, pursuant to 25-8-202(1)(a), (b) and (2); 25-8-203; and 25-8-204, C.R.S., and Section 2.1.3 of the "Procedural Rules for all Proceedings Before the Water Quality Control Commission and the Water Quality Control Division" the regulation entitled:

"The Basic Standards and Methodologies for Surface Water 3.1.0 (5 CCR 1002-8)".

Providing for revisions to numerous sections of the regulation.

Also, pursuant to 24-4-103(8)(b), C.R.S., these amendments were submitted to the Attorney General for review and were found to be within the authority of the Water Quality Control Commission to promulgate, and further that there are no apparent constitutional deficiencies in their form or substance. Furthermore, these amendments incorporate by reference a general Statement of Basis and Purpose and Fiscal Impact Statement in compliance with 24-4-103(4) and (8)(d), C.R.S.

These amendments will be submitted to the Legislative Drafting Office within twenty (20) days after the date of the Attorney General's Opinion, pursuant to 24-4-103(8)(d), C.R.S., and to the Secretary of State in time for September, 1988 publication in the Colorado Register pursuant to 24-4-103(11)(d), C.R.S. Pursuant to 24-4-103(5), C.R.S., these amendments will become effective September 30, 1988.

A copy of the amended regulation is attached and made a part of this notice.*

Dated this 9th day of August, 1988, at Denver, Colorado.

Water Quality Control Commission

Paul D. Frohardt

Paul D. Frohardt, Administrator

* A copy of this amended regulation is available at a charge of $5.00 pursuant to 24-4-103(9), C.R.S.

4210 EAST 11TH AVENUE DENVER COLORADO 80220 PHONE (303) 320-8333

COLORADO DEPARTMENT OF HEALTH
WATER QUALITY CONTROL COMMISSION

THE BASIC STANDARDS AND METHODOLOGIES FOR SURFACE WATER

****

ADOPTED: May 22, 1979

EFFECTIVE: July 10, 1979

AMENDED: December 12, 1983

EFFECTIVE: January 30, 1984

AMENDED: June 2, 1987

EFFECTIVE: July 31, 1988

AMENDED: June 6, 1988

EFFECTIVE: July 31, 1988

AMENDED: August 1, 1988

EFFECTIVE: September 30, 1988

3.1.16 TABLES

(1) INTRODUCTION

The numeric levels for parameters listed in Tables I, II, and III shall be considered and applied as appropriate by the Commission in establishing site-specific numeric standards, in accordance with section 3.1.7.

For the purposes of integrating these parameters into NPDES discharge permits, the duration of the averaging period for the numeric level is designated in the Tables. Chronic levels and 30-day levels are to be averaged as defined in 3.1.5(7). Acute levels and 1-day levels are to be averaged as defined in 3.1.5(2).

The toxic metals for Aquatic Life have different numeric levels for different levels of water hardness. Water hardness is being used here as an indication of differences in the complexing capacity of natural waters and the corresponding variation of metal toxicity. Other factors such as organic and inorganic liquids, pH, and other factors affecting the complexing capacity of the waters may be considered in setting site-specific numeric standards in accordance with section 3.1.7. Metals listed in Table III for aquatic life uses are stated in the dissolved form unless otherwise indicated.

(2) TESTING PROCEDURES

Various testing procedures to determine that numeric values for water quality parameters may be appropriate to present to the Water Quality Control Commission at stream classification hearings. (See Section 3.1.6(3)). These include:

(a) Standard Test Procedures:

(i) Code of Federal Regulations, Title 40, Part 136;

(ii) The latest approved EPA Methods for Chemical Analysis of Water and Wastes;

(iii) Standard Methods for the Examination of Water and Wastewater (current edition), American Public Health Association;

(iv) ASTM Standards, Part 31, Water;

(v) EPA Biological Field and Laboratory Methods.

(b) Bioassay Procedures:

(i) The lastest EPA Methods for Chemical Analysis of Water and Wastewater; ASTM, Standard Methods for Examination of Water, Wastewater;

(ii) Water Quality Control Division guideline titled: Guidelines for Developing Site Specific Aquatic Life Criteria, Water Quality Control Division. This reference does not include later amendments to or additions of such document and is available at the Office of the Director of the Water Quality Control Division, 4210 East 11th Avenue, Denver, Colorado.

(iii) Other approved EPA methods.

(c) Other Procedures:

Other procedures may be deemed appropriate by either the Water Quality Control Commission and/or the Water Quality Control Division.

(3) REFERENCES

Capital letters following levels in the Tables indicate the sources of the level; they are referenced below. In some cases, the source is described in a footnote.

(A) EPA Quality Criteria for Water, July 1976, U.S. Environmental Protection Agency, U.S. Government Printing Office: 1977 0-222-904, Washington, D.C. 256 p.

(B) EPA - Water Quality Criteria 1972, Ecological Research Series, National Academy of Sciences, National Academy of Engineering, EPA-R3-73-033, March 1973, Washington, D.C. 594 p.

(C) Davies, P.H. and Goettl, J.P., Jr., July 1976, Aquatic Life - Water Quality Recommendations for Heavy Metal and Other Inorganics.

(D) Parametrix Inc., Attachment II, Parametrix Reports - Toxicology Assessments of As, Cu, Fe, Mn, Se, and Zn, May 1976, bellevue, Washington, 98005. submitted to Water Quality Control Commission by Gulf Oil Corp., Inc., 161 p.

(E) EPA National Interim Primary Drinking Water Regulations, 40 Code of Federal Regulations, Part 141.

(F) EPA, March 1977, Proposed National Secondary Drinking Water Regulation, Federal Register, Vol. 42 No. 62, pp 17143-17147.

(G) Recommendations based on review of all available information by the Committee on Water Quality Standards and Stream Classification.

(H) American Fishery Society, June 1978, A Review of the EPA Red Book Quality Criteria for Water, (Preliminary Edition).

(I) Section 307 of the Clean Water Act, regulations promulgated pursuant to Section 307.

(J) Final Report of the Water Quality Standards and Methodologies Committee to the Colorado Water Quality Control Commission, June 1986.

(K) Proposed Nitrogenous Water Quality Standards for the State of Colorado, by the Nitrogen Cycle Committee of the Basic Standards Review Task Force, March 12, 1986 (Final Draft).

(M) m superscript: level modified by Commission.

TABLE I

PHYSICAL AND BIOLOGICAL

PARAMETERS

PARAMETER	RECREATIONAL		AQUATIC LIFE			AGRICULTURE	DOMESTIC WATER SUPPLY
	CLASS 1 PRIMARY CONTACT	CLASS 2 SECONDARY CONTACT	CLASS 1 COLD WATER BIOTA	CLASS 1 WARM WATER BIOTA	CLASS 2		
PHYSICAL:					TO BE ESTABLISHED ON A CASE-BY-CASE BASIS		
D.O. (mg/l)[1]	3. 0. (A)	3.0 (A)	6.0[2](G) 7.0(spawning)	5.0 (A)		3.0(A)	3.0(A)
pH (Std. Units)[3]	6.5-9.0(B^m)		6.5-9.0(a)	6.5-9.0(A)			5.0-9.0(A)
Suspended Solids(mg/l)	(4)	(4)	(4)	(4)		(4)	(4)
Temperature (°C)			Max 20°C, with 3°C Increase[5](G)	Max 30° C, with 3°C Increase[5](G)			
BIOLOGICAL:							
Fecal Coliforms per 100 ml(Geometric Mean)	200[6](A)	2000[6](G^m)					2000(E)

Note: Capital letters in parentheses refer to references listed in section 3.1.16(3); Numbers in parentheses refer to Table I footnotes.

TABLE I - FOOTNOTES

(1) Standards for dissolved oxygen are 1-day minima, unless specified otherwise. For the purposes of permitting, dissolved oxygen may be modeled for average conditions of temperature and flow for the worst case time period. Where dissolved oxygen levels less than these levels occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

(2) A 7.0 mg/liter standard (minimum), during periods of spawning of cold water fish, shall be set on a case-by-case basis as defined in the NPDES permit for those dischargers whose effluent would affect fish spawning.

(3) The pH standards of 6.5 (or 5.0) and 9.0 are an instantaneous minimum and maximum, respectively, to be applied as effluent limits.

(4) Suspended solid levels will be controlled by Effluent Limitation Regulations, Basic Standards, and Best Management Practices (BMP's).

(5) Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to the resident aquatic life. Generally, a maximum 3 degrees Celsius increase over a minimum of a four-hour period, lasting for 12 hours maximum, is deemed acceptable for discharges fluctuating in volume or temperature. Where temperature increases cannot be maintained within this range using BMP, BATEA and BPWTT control measures, the Division will determine whether the resulting temperature increases preclude an aquatic life classification.

(6) Fecal coliform is an indicator only. It may indicate the presence of pathogenic organisms; however, fecal coliform counts from agriculture or urban runoff may not indicate organisms detrimental to human health. The bacteria standard is based on the geometric mean of representative stream samples.

(7) For drinking water with or without disinfection.

TABLE II

INORGANIC PARAMETERS

PARAMETER	AQUATIC LIFE			AGRICULTURE	DOMESTIC WATER SUPPLY
	CLASS 1 Cold Water Biota	CLASS 1 Warm Water Biota	CLASS 2		
INORGANICS:					
Un-ionized AMMONIA (mg/l as N)	chronic = 0.02(K) acute = 0.43/FT/FPH/2[4]	chronic = 0.06(K) acute=0.62/FT/FPH/2[4]	acute: see (1) chronic: Cold = 0.02 Warm = 0.06-0.10[1]		0.5[2](K) (30-DAY)
-Total residual Chlorine (mg/l)	0.003(H) (1-DAY)	0.003(H) (1-DAY)			
Cyanide - Free(mg/l)	0.005(H) (1-DAY)	0.005(H) (1-DAY)		0.2(G) (1-DAY)	0.2(B,D[m]) (1-DAY)
Fluoride (mg/l)					2.0[5](E) (1-DAY)
Nitrate (mg/l as N)				100[3](B)	10[6](K) (1-DAY)
Nitrite (mg/l as N)	TO BE ESTABLISHED ON A CASE BY CASE BASIS (5)	(5)		10[3](B) (1-DAY)	1.0[2](6)(K) (1-DAY)
Sulfide as H_2S(mg/l)	0.002 undissociated(A) (30-DAY)	0.002 undissociated(A) (30-DAY)			0.05(F) (30-DAY)
Boron (mg/l)				0.75(A,B) (30-Day)	
Chloride (mg/l)					250(F) (30-Day)
Sulfate (mg/l)					250(F) (30-Day)

NOTE: Capital letters in parentheses refer to references listed in 3.1.16(3); numbers in parentheses refer to table II footnotes.

TABLE II - FOOTNOTES

(1) For class 2 warm water aquatic life segments, where table value standards are to be applied, a specific chronic standard in the 0.06 to 0.10 mg/l range for un-ionized ammonia shall be selected based upon the aquatic life present or to be protected and whether the waters have been adversely impacted by factors other than ammonia. The Commission may consider a standard higher than 0.08 mg/l un-ionized ammonia where a higher risk of sublethal effects is justified by habitat limitations or other water quality factors. Where a site-specific study has been conducted, the Commission may apply appropriate alternative chronic standards in accordance with section 3.1.7(1)(b)(iii). Acute standards for cold and warm water class 2 segments generally shall be established at the respective levels listed in table II for class 1 segments, except where site-specific information submitted justifies an alternative acute standard.

(2) To be applied at the point of water supply intake.

(3) In order to provide a reasonable margin of safety to allow for unusual situations such as extremely high water ingestion or nitrite formation in slurries, the NO_3-N plus NO_2-N content in drinking waters for livestock and poultry should be limited to 100ppm or less, and the NO_2-N content alone be limited to 10ppm or less.

(4) $FT = 10^{0.03(20-TCAP)}; TCAP \leq T \leq 30$

$FT = 10^{0.03(20-T)}; 0 \leq T \leq TCAP$

$TCAP = 20^{\circ}$ C cold water aquatic life species present

$TCAP = 25^{\circ}$ C cold water aquatic life species absent

$FPH = 1; 8 \leq pH \leq 9$

$$FPH = \frac{1 + 10^{(7.4-pH)}}{1.25}; \quad 6.5 \leq pH \leq 8$$

FPH means the acute pH adjustment factor, defined by the above formulas.

FT Means the acute temperature adjustment factor, defined by the above formulas.

T means temperature measured in degrees celsius.

TCAP means temperature CAP; the maximum temperature which affects the toxicity of ammonia to salmonid and non-salmonid fish groups.

NOTE: If the calculated acute value is less than the calculated chronic value, then the calculated chronic value shall be used as the acute standard.

(5) Salmonids and other sensitive fish species present:

Acute= 0.10 (0.59 * [Cl^-]+3.90) mg/l NO_2-N
Chronic= 0.10 (0.29 * [Cl^-]+0.53) mg/l NO_2-N
(upper limit for Cl^- =40 mg/l)

Salmonids and other sensitive fish species absent:

Acute= 0.20 (2.00 * [Cl^-]+0.73) mg/l NO_2-N
Chronic=0.10 (2.00 *[Cl^-]+0.73) mg/l NO_2-N
[Cl^-] = Chloride ion concentration
(upper limit for Cl^- =22 mg/l)

(6) A combined total of nitrite and nitrate at the point of intake to the domestic water supply shall not exceed 10 mg/l.

TABLE III

METAL PARAMETERS
(Concentrations in ug/l)

METAL(1)	AQUATIC LIFE (1)(3)(4)(J)	AGRICULTURE(2)	DRINKING WATER SUPPLY(2)
Aluminum	Acute = 950 Chronic = 150		
Arsenic	Acute = 360 Chronic = 150	100(A) (30-DAY)	50(E) (1-DAY)
Barium			1,000(E) (1-DAY)
Beryllium		100(A,B) (30-DAY)	
Cadmium	Acute = $e^{(1.128[\ln(hardness)]-2.905)}$ "(Trout) = $e^{(1.128[\ln(hardness)]-3.828)}$ Chronic = $e^{(0.7852[\ln(hardness)]-3.490)}$	10(B) (30-DAY)	10(E) (1-DAY)
Chromium III(5)	Acute = $e^{(0.819[\ln(hardness)]+3.688)}$ Chronic = $e^{(0.819[\ln(hardness)]+1.561)}$	100(B) (30-DAY)	50(E) (1-DAY)
Chromium VI(5)	Acute = 16 Chronic = 11	100(B) (30-DAY)	50(E) (1-DAY)
Copper	Acute = $\frac{1}{2}e^{(0.9422[\ln(hardness)]-0.7703)}$ Chronic = $e^{(0.8545[\ln(hardness)]-1.465)}$	200(B) (30-DAY)	1,000(F) (30-DAY)
Iron	Chronic = 1,000(tot.rec.)(A,C)		300(dis)(F) (30-DAY)

(Continued on Next Page)

TABLE III (CONTINUED)

METAL(1)	AQUATIC LIFE (1)(3)(4)(J)	AGRICULTURE(2)	DRINKING WATER SUPPLY(2)
Lead	Acute = $\frac{1}{2}e^{(1.6148[\ln(hardness)]-2.1805)}$ Chronic = $e^{(1.417[\ln(hardness)]-5.167)}$	100(B) (30-DAY)	50(E) (1-DAY)
Manganese	Chronic = 1,000(tot. rec.)(C)	200(B) (30-DAY)	50(dis)(F) (30-DAY)
Mercury	Acute = 2.4 Chronic = 0.1 FRV(fish) (6) = 0.01		2.0(E) (1-DAY)
Nickel	Acute = $\frac{1}{2}e^{(0.76[\ln(hardness)]+4.02)}$ Chronic = $e^{(0.76[\ln(hardness)]+1.06)}$	200(B) (30-DAY)	
Selenium	Acute = 135 Chronic = 17	20(B,D) (30-DAY)	10(E) (1-DAY)
Silver	Acute = $\frac{1}{2}e^{(1.72[\ln(hardness)]-6.52)}$ Chronic = $e^{(1.72[\ln(hardness)]-9.06)}$ "(Trout) = $e^{(1.72[\ln(hardness)]-10.51)}$		50(E) (1-DAY)
Thallium	Chronic = 15(C)		
Uranium	Acute = $e^{(1.1021[\ln[hardness)]+2.7088)}$ Chronic = $e^{(1.1021[\ln(hardness)]+2.2382)}$		
Zinc	Acute = $\frac{1}{2}e^{(0.809(\ln[hardness)]+2.351)}$ Acute (Trout) = 1/2 Acute Chronic (hardness>200 mg/1) = $e^{(1.924[\ln(hardness)]-6.393)}$ Chronic(hardness $\leq$ 200 mg/1) = 45	2000(B) (30-DAY)	5000(F) (30-DAY)

NOTE: Capital letters in parentheses refer to references listed in Section 3.1.16(3); Numbers in parentheses refer to Table III footnotes.

TABLE III - FOOTNOTES

(1) Metals for aquatic life use are stated as dissolved unless otherwise specified.

(2) Metals for agricultural and domestic uses are stated as total recoverable unless otherwise specified.

(3) Hardness values to be used in equations are in mg/l as calcium carbonate. The hardness values used in calculating the appropriate metal standard should be based on the the lower 95 per cent confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. Where insufficient site-specific data exists to define the mean hardness value at the periodic low flow criteria, representative regional data shall be used to perform the regression analysis. Where a regression analysis is not appropriate, a site-specific method should be used. In calculating a hardness value, regression analyses should not be extrapolated past the point that data exist.

(4) Both acute and chronic numbers adopted as stream standards are levels not to be exceeded more than once every three years on the average.

(5) Unless the stability of the chromium valence state in receiving waters can be clearly demonstrated, the standard for chromium should be in terms of chromium VI. In no case can the sum of the instream levels of Hexavalent and Trivalent Chromium exceed the water supply standard of 50ug/l total chromium in those waters classified for domestic water use.

(6) FRV means final residual value. This value, based on the maximum allowed concentration of a material in the water that can affect marketability through bioaccumulation or bioconcentration, is to be applied as a 30-day average in all water supporting populations of fish or shellfish with a potential for human consumption.

STATE OF COLORADO

WATER QUALITY CONTROL COMMISSION
4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 331-4525

NOTICE OF FINAL ADOPTION

9-13-90

PURSUANT TO THE provisions of Sections 24-4-103(6) and 24-4-103(11)(a), C.R.S.:

NOTICE IS HEREBY GIVEN that the Colorado Water Quality Control Commission, after public hearing on December 4, 1989, and complying with the provisions of 25-4-103(3), 25-8-401(1), and 25-8-402(1), C.R.S., amended on February 5, 1990, pursuant to 25-8-202(1)(b) and (2); and 25-8-204, C.R.S., and Section 2.1.3 of the Procedural Rules (5 CCR 1002-1) the Commission's regulation entitled:

"Classifications and Numeric Standards for South Platte River Basin; Republican River Basin; Smoky Hill River Basin" 3.8.0 (5 CCR 1002-8)

Providing for resegmentation of Big Dry Creek, and adoption of revised use classifications and water quality standards for tributaries to Standley Lake and Great Western Reservoir.

Also, pursuant to 24-4-103(8)(b), C.R.S., this amendment was submitted to the Attorney General for review and was found to be within the authority of the Water Quality Control Commission to promulgate, and further that there are no apparent constitutional deficiencies in its form or substance. Furthermore, in adopting this amendment, the Commission adopted a Statement of Basis, Specific Statutory Authority and Purpose in compliance with 24-4-103(4), C.R.S.

This amendment will be submitted to the Office of Legislative Legal Services within twenty (20) days after the date of the Attorney General's Opinion, pursuant to 24-4-103(8)(d), C.R.S., and to the Secretary of State in time for March, 1990 publication in the Colorado Register pursuant to 24-4-103(5) and (11)(d), C.R.S., and will become effective March 30, 1990.

A Copy of said amendment is attached and made a part of this notice and will be incorporated into the full text of said regulation.*

Dated this 15th day of February, 1990, at Denver, Colorado.

WATER QUALITY CONTROL COMMISSION

Maria L. Linker

Marla L. Linker, Staff Assistant

1631m/0160m/cmc

STATE OF COLORADO

WATER QUALITY CONTROL COMMISSION
4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 331-4525

NOTICE OF FINAL ADOPTION
OF TEMPORARY RULE

PURSUANT TO THE provisions of Sections 24-4-103(6) and 24-4-103(11)(a), C.R.S.:

NOTICE IS HEREBY GIVEN that the Colorado Water Quality Control Commission, after public hearing on July 10, 1989, and complying with the provisions of 24-4-103(6), 25-8-202(1)(a), (b) and (2); 25-8-203; and 25-8-204, C.R.S., and Section 2.1.3(N) of the Procedural Rules (5 CCR 1002-1) adopted on July 11, 1989, temporary amendments to the Commission's regulation entitled:

"Classifications and Numeric Standards for South Platte River Basin; Republican River Basin; Smoky Hill River Basin" 3.8.0 (5 CCR 1002-8)

Providing for resegmentation of Big Dry Creek, and adoption of revised use classifications and water quality standards for tributaries to Standley Lake and Great Western Reservoir.

Also, pursuant to 24-4-103(8)(b), C.R.S., this amendment was submitted to the Attorney General for review and was found to be within the authority of the Water Quality Control Commission to promulgate, and further that there are no apparent constitutional deficiencies in its form or substance. Furthermore, this amendment incorporates a Statement of Findings Regarding the Basis for Temporary Rule in compliance with 24-4-103(6), C.R.S.

This amendment will be submitted to the Office of Legislative Legal Services within twenty (20) days after the date of the Attorney General's Opinion, pursuant to 24-4-103(8)(d), C.R.S., and to the Secretary of State in time for August, 1989 publication in the Colorado Register.

This amendment became effective on a temporary basis upon adoption and shall remain in effect on a temporary basis until March 30, 1990.

This amendment is attached and made a part of this NOTICE.*

Dated this 11th day of July, 1989, at Denver, Colorado.

WATER QUALITY CONTROL COMMISSION

*A copy of the amended regulation is available at a charge of $5.00 pursuant to 24-4-103(9), C.R.S.

Kathleen Reilly
Kathleen Reilly, Acting Administrator

0392m/0025m

TDJ
RECEIVED
5-31-90

LIST OF PARTY PARTICIPANTS TO THE FEBRUARY, 1989 SOUTH PLATTE PUBLIC RULEMAKING HEARING

1. Division of Wildlife
2. Cities of Westminster & Thornton
3. Metropolitan Denver Sewage Disposal District #1
4. The City of Louisville
5. Northern Colorado Water Conservancy District and Municipal Subdistrict
6. City of Boulder
7. North Front Range Water Quality Planning Association
8. Adolph Coors Company
9. The North Poudre Irrigation Company
10. City of Northglenn
11. City of Arvada
12. City of Ft. Collins
13. Thompson Water Users Association
14. The Cache La Poudre Water Users Association
15. Campbell Development, Inc.
16. Landfill, Inc.

7/89 Temporary
12/89 Permanent

Table A

WATER SUPPLY SEGMENTS

CARCINOGENIC ORGANIC CHEMICALS [4]

Parameter	CAS No.	Standard [1] (ug/l)	Detection Levels (ug/l) GC	GC/MS
Aldrin	309-00-2	0.002 (I)	0.1	
Benzene	71-43-2	5		5
Benzidine	92-87-5	0.0002 (I)		50
Carbon Tetrachloride	56-23-5	5		5
Chlordane	57-74-9	0.03 (I)		10
Chloroethyl Ether (BIS-2)	111-44-4	0.03 (I)		10
D[illegible]	50-29-3	0.1 (I)		10
Dichloroethane 1,2	107-06-2	5		5
Dichloropropane 1,2	78-87-5	0.56 (L)		6
Dieldrin	60-57-1	0.002 (I)		10
Dioxin (2,3,7,8-TCDD)	1746-01-6	2.2×10^{-7} (L)		0.01 [3] 3 [5]
Diphenylhydrazine 1,2	122-66-7	0.05 (I)		20
Heptachlor	76-44-8	0.008 (L)	0.1	
Heptachlor Epoxide	1024-57-3	0.004 (L)	0.1	
Hexachlorobenzene	118-74-1	0.02 (L)		10
Hexachlorocyclohexane (Lindane)	58-89-9	4	0.10	

Table A (cont.)

WATER SUPPLY SEGMENTS

CARCINOGENIC ORGANIC CHEMICALS (4)

Parameter	CAS No.	Standard (1) (ug/l)	Detection Levels (ug/l) GC	GC/MS
Polychlorinated Biphenyls (PCBs)	1336-36-3	0.005 (I)	0.5	
Toxaphene	8001-35-2	5	1.0	
Trichloroethylene	79-01-6	5		5
Trichlorophenol 2,4,6	88-06-2	2.0 (I)		10
Trihalomethanes (total) (2)		100		5
Vinyl Chloride	75-01-4	2		2

(1) Standards are based on the MCL for drinking water unless otherwise noted.
(2) Total trihalomethanes are considered the sum of the concentrations of bromodichloromethane (CAS NO. 75-27-4), dibromochloromethane (CAS No. 124-48-1), tribromomethane (bromoform, CAS NO. 75-25-2) and trichloromethane (chloroform, CAS NO. 67-66-3).
(3) For permit issuance and compliance purposes use Test Methods for Evaluating Solid Wastes, Vol. 1B, EPA, November 1986, Method 8280.
(4) Organic chemicals not on this partial list are covered under section 3.1.11 (1) (d).
(5) For routine surveillance and screening using EPA Method 625

(I) Based on 10^{-6} Cancer risk from EPA Integrated Risk Information System
(L) Based on EPA life time drinking water health advisory.

GC Gas Chromatography (Pesticides EPA-Method 508/608)
GC/MS Gas Chromatography / Mass Spectrometry (Methods 624 and 625)
CAS No. Chemical Abstracts Service identification number.

Table B

WATER SUPPLY SEGMENTS

NON-CARCINOGENIC ORGANIC CHEMICALS (3)

Parameter	CAS No.	Standard (ug/l)	Detection Levels (ug/l) GC	GC/MS
Aldicarb	116-06-3	10 (L)	10 (2)(1)	
Carbofuran	1563-66-2	36 (L)		10
Chlorobenzene	108-90-7	300 (L)		10
Dichlorobenzene 1,2	95-50-1	620 (L)		10
Dichlorobenzene 1,3	541-73-1	620 (L)		10
Dichlorobenzene 1,4	106-46-7	75 (M)		10
Dichloroethylene 1,1	75-35-4	7 (M)		5
Dichloroethylene 1,2-Cis	156-59-2	70 (L)		5
Dichloroethylene 1,2-Trans	156-60-5	70 (L)		5
Dichlorophenol 2,4	120-83-2	21 (L)		10
Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	100 (M)	0.1	
Endrin	72-20-8	0.2 (M)	0.1	
Ethylbenzene	100-41-4	680 (L)		5
Hexachlorobutadiene	87-68-3	14 (I)		10
Hexachlorocyclopentadiene	77-47-4	49 (I)		10
Isophorone	78-59-1	1,050 (I)		10
Methoxychlor	72-43-5	100 (M)	0.1	
Nitrobenzene	98-95-3	3.5 (I)		10
Pentachlorobenzene	608-93-5	6 (I)		10

Table B (cont.)

WATER SUPPLY SEGMENTS

NON-CARCINOGENIC ORGANIC CHEMICALS (3)

Parameter	CAS No.	Standard (ug/l)		Detection Levels (ug/l) GC	GC/MS
Pentachlorophenol	87-86-5	200	(L)		50
Tetrachlorobenzene 1,2,4,5	95-94-3	2	(I)		10
Tetrachloroethylene	127-18-4	10	(L)		5
Toluene	108-88-3	2,420	(L)		5
Trichloroethane 1,1,1	71-55-6	200	(M)		5
Trichloroethane 1,1,2	79-00-5	28	(I)		5
Trichlorophenol 2,4,5	95-95-5	700	(I)		10
Trichlorophenoxypropionic Acid (2,4,5-TP)	93-72-1	10	(M)	0.05	

(1) PQL is based on Colorado Department of Health Laboratory's best professional judgment
(2) HPLC - High Pressure Liquid Chromatography PQL (Method 531.1)
(3) Organic chemicals not on this partial list are covered under section 3.1.11 (1) (d).
(M) Based on MCL for drinking water.
(L) Based on EPA life time drinking water health advisory.
(I) Based on reference dose from EPA Integrated Risk Information System (IRIS).

GC Gas Chromatography (Pesticides EPA-Method 508/608) (Herbicides AWWA-Method 509 EPA Method 515.1)
GC/MS Gas Chromatography / Mass Spectrometry (Methods 624 and 625)
CAS No. Chemical Abstracts Service identification number.

Table C

FISH AND WATER INGESTION STANDARDS

Parameter	Standard (ug/1)
Acrylonitrile	0.058
Aldrin	0.000074
Benzidine	0.00012
Chlordane	0.00046
Chloroform	0.19
Chloromethyl Ether (BIS)	0.0000037
DDT	0.000024
Dichlorobenzidine	0.01
Dieldrin	0.000071
Dioxin (2,3,7,8-TCDD)	0.000000013
Halomethanes	0.19
Heptachlor	0.00028
Hexachloroethane	1.9
Hexachlorobenzene	0.00072
Hexachlorobutadiene	0.45
Hexachlorocyclohexane, Alpha	0.0092
Hexachlorocyclohexane, Beta	0.0163
Hexachlorocyclohexane, Gamma	0.0186
Hexachlorocyclohexane, Technical	0.0123
Nitrosodibutylamine N	0.0064
Nitrosodiethylamine N	0.0008
Nitrosodimethylamine N	0.0014
Nitrosodiphenylamine N	4.9
Nitrosopyrrolidine N	0.016
PCBs	0.000079
Polynuclear Aromatic Hydrocarbons	0.0028
Tetrachloroethane 1,1,2,2	0.17
Tetrachloroethylene	0.8
Trichloroethane 1,1,2	0.6
Trichlorophenol 2,4,6	1.2

0391m/0025m

Table D

RADIONUCLIDE STANDARDS

Parameter	Picocuries per Liter
Americium 241	30
Curium 244	60
Neptunium 237	30
Plutonium 241	1,000
Plutonium 242	30
Uranium (total of all isotopes)	40

Also, note that the following radionuclide standards have previously been adopted and are in effect for all state surface waters:

Parameter	Picocuries per Liter
Cesium 134	80
Plutonium 238, 239, and 240	15
Radium 226 and 228	5
Strontium 90	8
Thorium 230 and 232	60
Tritium	20,000

3.8.29 FINDINGS REGARDING BASIS FOR TEMPORARY RULE ADOPTED JULY 11, 1989

The Commission adopted revised classifications and water quality standards for all tributaries to Standley Lake and Great Western Reservoir, on a temporary basis. These classifications and standards are effective immediately and will remain in effect until March 30, 1990, unless permanent standards are adopted at an earlier date. The Commission is scheduling a rulemaking hearing for December, 1989 to consider permanent adoption.

This action creates a new segment for tributaries to Great Western Reservoir and Standley Lake in northern Jefferson County, which encompasses Walnut Creek and Woman Creek, the two streams which drain the Rocky Flats Plant. Heretofore, these tributaries were included in the general classification of Big Dry Creek Segment 1, which does not include the water supply classification, and which contains only dissolved oxygen, pH, and fecal coliforms as standards. Recent attention to the drainage of Walnut Creek and Woman Creek into Great Western Reservoir and Standley Lake, both of which are actually used as public water supplies, has heightened the need to protect all waters entering the reservoirs via the adoption of the water supply classification and associated standards.

Immediate adoption of these rules on a temporary basis is imperatively necessary to preserve the public health, safety and welfare by insuring that the appropriate water quality standards are incorporated into federal permits for the Rocky Flats Plant and that water supply standards are met at the point of discharge. This in turn will provide an extra layer of protection of downstream water supplies from the two reservoirs, each of which are already classified as domestic water supplies.

The United States Environmental Protection Agency is currently in the process of renewing its NPDES discharge permit for the Rocky Flats Plant. EPA intends to issue the permit for public comment by October 1, 1989. Appropriate standards would not be effective by October 1 if the procedures set forth in section 25-8-402(1), C.R.S. were followed. These standards thus would not become a part of the federal permit. Immediate adoption of these rules pursuant to section 24-4-103(6), C.R.S. is in the public interest and will insure that the appropriate classifications and standards become a part of the federal permitting process.

The numeric standards adopted include:

(1) D.O., pH and fecal coliform standards from Table I of the Basic Standards and Methodologies for Surface Water;

(2) Standards to protect agriculture and domestic water supply uses, for physical and biological, inorganic and metals parameters from Tables I, II and III of the Basic Standards and Methodologies for Surface Water;

(3) Drinking water supply standards for carcinogenic and non-carcinogenic organic chemicals (Tables A and B);

(4) Additional standards for organic chemicals based on EPA Gold Book fish and water ingestion criteria (Table C); and

(5) Standards for several radionuclides not included in the list of statewide standards contained in section 3.1.11 of the Basic Standards and Methodologies for Surface Water (Table D).

For the organic pollutants contained in Tables A and B, the practical quantitation limits (PQLs) listed as "detection levels" are to be used as the compliance thresholds. For any organic pollutants listed in Table C that do not appear in Tables A or B, the Commission intends that these standards be applied in accordance with PQLs determined appropriate by the Colorado Department of Health laboratory.

PARTIES TO THE PROCEEDINGS

1. City of Broomfield

2. Environmental Defense Fund

3.8.30 STATEMENT OF BASIS, SPECIFIC STATUTORY AUTHORITY, AND PURPOSE (GREAT WESTERN RESERVOIR, STANDLEY LAKE AND TRIBUTARIES)

The provisions of sections 25-8-202(1)(a),(b), and (2); 25-8-203; and 25-8-204; C.R.S., provide the specific statutory authority for adoption of the attached regulatory amendments. The Commission also adopted, in compliance with section 24-4-103(4) C.R.S., the following statement of basis and purpose.

(1) Segmentation

The Commission has revised the segmentation for certain tributaries to the Big Dry Creek drainage. Two separate segments have been established for portions of the Walnut Creek and Woman Creek basins, which flow from property occupied by the Rocky Flats Plant to Great Western Reservoir and Standley Lake, respectively.

Segment 4 encompasses all of Woman Creek and its tributaries except for pond C 2, and the lower portion of Walnut Creek and its tributaries above Great Western Reservoir. This segment has been established to facilitate the application of water quality classifications and standards that will help protect the uses of water in the downstream segments -- Great Western Reservoir and Standley Lake.

Segment 5 encompasses the upper watersheds of North Walnut Creek and South Walnut Creek, as well as Pond C-2, which is located adjacent to Woman Creek. A separate segment has been established for these waters because they are currently impacted by the wastewater management system at the plant. Walnut Creek has been segmented at two points immediately downstream of ponds A-4 and B-5 -- the last in a series of ponds constructed on the streams at the Rocky Flats complex. This is to recognize that the upper portions of Walnut Creek and these "instream" ponds currently contain some treated sanitary wastewater and storm water runoff from the Rocky Flats facility and cannot be expected to meet the high quality of water required by the standards as the water leaves the plant ponds. Similarly, Pond C-2 near Woman Creek collects runoff from the plant site, and so has been included in segment 5.

(2) Classifications

The Commission previously adopted new water supply classifications for Walnut Creek and Woman Creek on a temporary basis, as the result of a rulemaking hearing held in July, 1989. The continuation of extensive, protective use classifications and water quality standards for Standley Lake, Great Western Reservoir, and the major tributaries which drain into them is necessary because of the drinking water use made of the reservoirs, and the threat to human health posed by the Rocky Flats industrial complex which is immediately upstream. Except for the addition of a water supply classification for segments 4 and 5, the existing classifications for these streams and reservoirs have been left in place.

For segment 5, a "goal" qualifier has been added to the classifications, in recognition of the current impact of Rocky Flats operations on these waters, as described in (1) above. A goal of classification for all uses is appropriate since Rocky Flats has committed in the recent Agreement in Principle between the State and the Department of Energy (DOE) to pursuing elimination of discharges from the plant site. As a matter of policy, the Commission believes that these state waters should be returned as soon as possible to a condition that will support a full range of uses.

At the hearing, the DOE argued that a water supply classification should not be applied to segments 4 and 5 because water is not withdrawn directly from these segments for drinking water and because of the potential that water from these segments may be diverted around the two downstream water supply reservoirs in the future. The Commission recognizes that water is not withdrawn directly from Walnut or Woman Creek for water supply purposes. This classification has been added to these segments because of the Commission's policy determination that it is appropriate to establish an extra layer of protection for the major water supplies in Great Western Reservoir and Standley Lake, particularly considering the proximity upstream of a major industrial, complex utilizing nuclear materials.

Although it appears from the evidence that some potential exists for diverting Walnut and Woman Creek water around the two reservoirs in the future, the water supply classification for these streams is currently appropriate. As long as a significant potential exists that the water in these creeks will enter the downstream water supplies, the option for that use should be protected. This is particularly true since it was demonstrated this past summer that X discharges from the Rocky Flats Plant can, with appropriate treatment if necessary, meet the standards (or associated compliance thresholds) that are now being adopted. If in the future permanent diversion structures are constructed, with an appropriate capacity to assure that Walnut and Woman Creek water will not enter the two reservoirs, the Commission can reconsider the appropriateness of the water supply classification at that time.

(3) Standards

Several sets of new water quality standards have been adopted for the waters addressed in this hearing. With respect to organic chemicals, two sets of numerical standards adopted on a temporary basis in July (Tables A and B) have in the interim been adopted statewide, and therefore were not addressed in this hearing. The "Additional Organic Chemical Standards" adopted for segments 2, 3, 4 and 5 in this hearing (Table 1) include 1) standards based on fish and water ingestion criteria from EPA's "Gold Book"; 2) standards for two herbicides: atrazine and simazine; and 3) a "zero" standard for other manmade organics, for which no numerical limit has been established.

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Assignment of the criteria as standards to protect humans from health risk posed by consuming both fish and water is appropriate on both the reservoirs as well as the tributary streams because of the large numbers of people who depend on these reservoirs as their drinking water supply. In addition, Standley Lake is a popular fishery and provides many fishermen with edible species which are likely consumed regularly along with the potable water supplied from the lake. Great Western Reservoir also contains fish, and although fishing is presently forbidden, the potential for allowing that use in the future is possible, and water quality adequate to support that use should be preserved. Assigning the organics standards to tributaries is necessary to provide an extra layer of protection to the waters entering the lakes, and to allow a means of limiting the introduction of organics into the environment at the source, due to the short distance between the sources and the reservoirs.

The inclusion of standards for atrazine and simazine is necessary because these two herbicides are potential carcinogens, and both have been detected in water samples from Rocky Flats in the on-site holding ponds. The standards are based on a proposed MCL for atrazine and a current EPA Health Advisory for simazine. Both are established at levels protective of human health.

Consistent with the approach taken by the Commission in establishing statewide organic chemical standards in section 3.1.11 of the Basic Standards and Methodologies for Surface Water, the Commission has adopted detection levels based on practical quantitation limits (PQLs) to be used as compliance thresholds for the standards in Table 1. The PQLs for these compounds were derived by the Colorado Department of Health laboratory. The PQLs are based on the gas chromatography (GC) laboratory analysis except where noted. This is consistent with analyses that have been required to date for water discharged from the Rocky Flats Plant.

A narrative standard has been adopted for other organic chemicals, interpreting the existing statewide "no toxics in toxic amount" provision (Section 3.1.11(1)(d)) as zero, with the compliance threshold for enforcement based on appropriate PQLs. The Commission has determined as a policy matter that this standard is appropriate due to the inability to predict with certainty at this time all chemicals of potential concern that could be discharged to these waters. If it is determined that this approach is unnecessarily stringent for a particular chemical that is found to be present, based on use-protective numerical criteria for such a chemical, then such criteria can be used to set a different numerical standard for that chemical in the future. In the meantime, in the absence of better information the Commission has chosen as a matter of policy to err in the direction of minimizing organic chemical pollution of state waters.

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The adoption of the organic chemical standards described above should not have a major economic impact on the Rocky Flats Plant. From extensive sampling of the plant's on-site holding ponds prior to discharges this past summer, the only organics detected at levels exceeding the standards (or applicable PQLs) now being adopted were atrazine and simazine. Counsel for the DOE conceded the appropriateness of the proposed standards for these two constituents during the Commission's hearing. Moreover, to the extent that there is an economic impact of complying with such standards, that impact was essentially already incurred by DOE by entering into the Agreement in Principle with the State of Colorado in June, 1989.

The Commission also has adopted new radionuclide standards for segments 2, 3, 4 and 5. The adoption of these standards is appropriate due to the risk of discharge of radionuclides from the Rocky Flats Plant. For curium and neptunium, the standards are based on criteria developed by the International Commission on Radiological Protection. For gross alpha, gross beta, plutonium, americium, tritium and uranium, standards are based on existing ambient quality in the respective segments.

Adoption of these standards is not expected to have a major economic impact on the Rocky Flats Plant. In particular, the ambient quality-based standards have been established taking any existing impact from Rocky Flats into account. Moreover, the specific standards are based on the mean plus approximately two standard deviations of the available data (upper 95 percent confidence limit of the mean) which in this case is more lenient than the 85th percentile normally used by the Commission for ambient quality-based standards. Even if there were an economic impact on the Rocky Flats Plant, as a matter of policy the Commission believes it is appropriate to limit radionuclides in state waters to their lowest practical level, to minimize environmental exposure to such constituents. At the same time, these standards clearly are sufficient to protect the classified uses, since they are all below (more stringent than) current drinking water standards or other available health-based criteria for these radionuclides.

At the hearing, DOE argued that the Commission should not adopt radionuclide standards because DOE is self-regulating with respect to such pollutants. The Commission is authorized by the federal Clean Water Act and the Colorado Water Quality Control Act to adopt ambient water quality standards. The issue of regulatory authority over discharges from DOE facilities is not within the scope of this hearing and need not be addressed in adopting such standards. However, even if there are restrictions on the ability of the State or EPA to implement these standards, their adoption by the Commission is appropriate, to inform DOE and the public of the levels that this Commission believes can and should be met.

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In addition to the organic chemical and radionuclide standards, the Commission has adopted the aquatic life, water supply and agricultural values for inorganics and metals from Tables II and III of the Basic Standards and Methodologies for Surface Water as standards for segments 4 and 5. These additional standards will help provide the extra layer of protection for the uses of waters in the downstream segments (2 and 3). The Commission also revised the metals standards for Standley Lake, to correspond with the new table values contained in Table III.

For segment 5, the Commission has adopted a narrative temporary modification based on existing ambient quality, to remain in effect until February, 1993. In accordance with the discussion of this segment above, temporary modifications appear necessary due to the current impacts of Rocky Flats Plant operations, until such time as those impacts can be eliminated and the underlying classifications and standards achieved. Temporary modifications at a level of ambient quality does not reduce environmental protection in the short run, since public health is protected by the more stringent requirements on the downstream segments.

The goal of the Commission is for the classifications and standards of segment 4 to be achieved in segment 5 as soon as possible. It is recognized that Rocky Flats may not be able to meet the standards immediately and that temporary modifications may be necessary. However, insufficient data presently exists upon which to develop a full set of numerical temporary modifications at this time. It is expected that sufficient data should be generated in the next 3 years to allow time to collect adequate data for DOE to decide whether to seek numeric temporary modifications for particular parameters.

(4) Designations

Based on their existing classifications and the evidence submitted at the hearing regarding their existing quality, the Commission has determined that it is appropriate to adopt a High Quality 2 designation for the waters in Great Western Reservoir and Standley Lake (segments 2 and 3). From the best information currently available, it appears that existing quality in these reservoirs for the 12 parameters listed in section 3.1.8(1)(b)(i)(C) of the Basic Standards and Methodologies for Surface Water is better than that specified in Tables I, II and III for the protection of aquatic life class 1 and recreation class 1 uses.

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PARTY ST. S LIST
OF
RULEMAKING HEARING

DECEMBER 4, 1989

REVISED 10/13/89
For consideration of adoption of a permanent water supply classification and appropriate numerical water quality standards for tributaries to Standley Lake and Great Western Reservoir, including Woman Creek and Walnut Creek.
(Robert Pearson - Hearing Chairman)

NAME	REPRESENTED BY	MAILING ADDRESS	TELEPHONE
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0807m/0018m

STREAM CLASSIFICATIONS and WATER QUALITY STANDARDS

REGION:

BASIN: Big Dry Creek

Stream Segment Description	CLASSIFICATIONS: HIGH QUAL. Class 1	HIGH QUAL. Class 2	REC. Class 1	REC. Class 2	AQUATIC LIFE CL. 1 Cold	CL. 1 Warm	CL. 2 Cold	CL. 2 Warm	WATER SUPPLY	AGRICULTURE	NUMERIC STANDARDS: PHYSICAL and BIOLOGICAL	INORGANIC mg/l	METALS ug/l	METALS ug/l (cont.)	TEMPORARY MODIFICATIONS and QUALIFIERS
1. Mainstem of Big Dry Creek, including all tributaries, lakes, and reservoirs, from the source to the confluence with the South Platte River, except for the specific listing in Segment 2, 3, 4, and 5.				X				X		X	D.O. = 5.0 mg/l pH = 6.5 - 9.0 Fecal Coliforms = 2000/100 ml				
2. Standley Lake.		X	X			X			X	X	D.O. = 5.0 mg/l pH = 6.5 - 9.0 Fecal Coliforms = 200 /100 ml	NH_3(ac)=0.02([illegible]) NH_3(ch) = 0.06 Cl_2 = 0.003 CN = .005 S = 0.002 B = 0.75 NO_2 = 1.0 NO_3 = 10.0 Cl = 250.0 SO_4 = 250.0	As(ac) = 50 (Trec) Cd(ac/ch) = TVS CrIII(ac) = 50 (Trec) CrVI (ac/ch)= TVS Cu (ac/ch) = TVS Fe(ch) = 300 (dis) Fe(ch) = 1,000(Trec) Pb(ac/ch) = TVS Mn(ch) = 50 (dis) Mn(ch) = 1,000 (Trec) Hg(ch) = .01 (Trec)	Ni(ac/ch)= TVS Se(ac) = 10 (Trec) Ag(ac/ch)= TVS Zn(ac/ch)= TVS	See attached tables 1 and 2 for additional standards for segment 2.
3. Great Western Reservoir		X	X			X			X		D.O. = 5.0 mg/l pH = 6.5 - 9.0 Fecal Coliforms = 300/100 ml	NH_3(ac)=0.02([illegible]) NH_3(ch) = 0.06 Cl_2 = 0.003 CN = .005 S = 0.002 B = 0.75 NO_2 = 1.0 NO_3 = 10.0 Cl = 250.0 SO_4 = 250.0	As(ac) = 50 (Trec) Cd(ac/ch) = TVS CrIII(ac) = 50 (Trec) CrVI (ac/ch) = TVS Cu (ac/ch) = TVS Fe(ch) = 300(dis) Fe(ch) = 1,000 (Trec) Pb(ac/ch) = TVS Mn(ch)= 50 (dis)	Mn(ch) = 1,000(Trec) Hg(ch) = .01 (Trec) Ni(ac/ch)= TVS Se(ac) = 10 (Trec) Ag(ac/ch)= TVS Zn(ac/ch)= TVS	See attached Tables 1 and 2 for additional standards for segment 3.
4. Mainstems and all tributaries to Woman and Walnut Creeks from sources to Standley Lake and Great Western Reservoir except for specific listings in Segment 5.				X				X	X	X	D.O. = 5.0 pH = 6.5 - 9.0 units Fecal Coliforms = 2000/100 ml	NH_3(ac)=0.02([illegible]) NH_3(ch) = 0.06 Cl_2 = 0.003 CN = .005 S = 0.002 B = 0.75 NO_2 = 1.0 NO_3 = 10.0 Cl = 250.0; SO_4 = 250.0	As(ac)= 50 (Trec) Cd(ac/ch) = TVS CrIII(ac)= 50 (Trec) CrVI (ac/ch) = TVS Cu(ac/ch) = TVS Fe(ch)= 300(dis) Fe(ch)= 1,000 (Trec) Pb(ac/ch) = TVS	Mn(ch)= 50(dis) Mn(ch) = 1,000 (Trec) Hg(ch) = .01 (Trec) Ni(ac/ch) = TVS Se(ac) = 10 (Trec) Ag(ac/ch) = TVS Zn(ac/ch) = TVS	See Attached Tables 1 and 2 for additional standards for segment 4.
5. Mainstems of North and South Walnut Creek, including all tributaries, lakes, and reservoirs, from their sources to the outlet of ponds A-4 and B-5, Pond C-2.				X				X	X	X	D.O. = 5.0 pH = 6.5 - 9.0 units Fecal Coliforms = 2000/100 ml	NH_3(ac)=0.02([illegible]) NH_3(ch) = 0.06 Cl_2 = 0.003 CN = .005 S = 0.002 B = 0.75 NO_2 = 1.0 NO_3 = 10.0 Cl = 250.0 SO_4 = 250.0	As(ac) = 50 (Trec) Cd (ac/ch) = TVS CrIII(ac) = 50 (Trec) CrVI(ac/ch) = TVS Cu(ac/ch) = TVS Fe(ch) = 300 (dis) Fe(ch) = 1,000(Trec) Pb(ac/ch) = TVS	Mn(ch) = 50 (dis) Mn(ch) = 1,000 (Trec) Hg(ch) = .01 (Trec) Ni(ac/ch)= TVS Se(ac) = 10 (Trec) Ag(ac/ch) = TVS Zn(ac/ch) = TVS	All water quality standards have the temporary modification of ambient quality until June, 1991. See Attached Tables 1 and 2 for additional standards for segment 5.

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APPENDIX F

COMPARISON OF EPA DRINKING WATER STANDARDS AND STREAM STANDARDS

		EPA DRINKING WATER STD ug/L (unless otherwise indicated)	STANDARD* ug/L (unless otherwise indicated)	DETECTION* Levels, ug/L
I.	**General and Biological**			
A.	Dissolved oxygen, mg/l	---	5.0(1)	---
B.	pH, units, minimum	6.5	6.5(1)	---
C.	pH, units, maximum	8.5	9.0(1)	---
D.	Fecal coliform, #/100 ml	1	2000.0(2,3)	---
II.	**Inorganic substances**			
A.	Unionized ammonia, chronic, mg/l	---	0.06(1)	---
B.	Unionized ammonia, acute, mg/l	---	0.62(1)	---
C.	Residual chlorine, mg/l	---	0.003(1)	---
D.	Cyanide, mg/l	---	0.005(1)	---
E.	H_2S, mg/l	---	0.002(1)	---
F.	Boron, mg/l	---	0.75(4)	---
G.	Nitrite, mg/l as N	---	1.0(2)	---
H.	Nitrate, mg/l as N	10.0	10.0(2)	---
I.	Chloride, mg/l	250.0	250.0(2)	---
J.	Sulfate, mg/l	250.0	250.0(2)	---
K.	Fluoride (seldom applied), mg/l	2.4-4.0	---	---
III.	**Metals - ug/l****			
A.	Arsenic, total recoverable	50.0	50.0(2)	---
B.	Cadmium, calculated from hardness	10.0	---. (1)	---
C.	Chromium +3, total recoverable	50.0	50.0(2)	---
D.	Chromium +6	---	11.0(1)	---
E.	Chromium +6, acute	---	16.0	---
F.	Copper, calculated from hardness	1000.0	---. (1)	---
G.	Lead, calculated from hardness	50.0	---. (1)	---
H.	Iron soluble	300.0	300.0(2)	---
I.	Iron total	---	1000.0(1)	---
J.	Manganese soluble	50.0	50.0(2)	---
K.	Manganese total	---	1000.0(1)	---
L.	Mercury	2.0	0.01(2)	---
M.	Nickel, calculated from hardness	---	---. (1)	---
N.	Selenium, total	10.0	10.0(2)	---
O.	Silver, calculated from hardness	50.0	---. (1)	---
P.	Zinc, calculated from hardness	---	---. (1)	---
Q.	Aluminum (seldom applied)	---	---	---

APPENDIX F

COMPARISON OF EPA DRINKING WATER STANDARDS AND STREAM STANDARDS
(Continued)

		EPA DRINKING WATER STD ug/L (unless otherwise indicated)	STANDARD* ug/L (unless otherwise indicated)	DETECTION* Levels, ug/L
III.	**Metals - ug/l**** (Continued)			
R.	Barium (seldom applied)	1000.0	---	---
S.	Beryllium (seldom applied)	---	---	---
T.	Thalium	---	15.0[(1)]	---
IV.	**Carcinogenic organic chemicals (Table A, Basic Standards)**			
A.	Aldrin	---	0.002 (I)	0.1
B.	Benzene	5	5	5
C.	Benzidine	---	0.0002 (I)	50
D.	Carbon Tetrachloride	5	5	5
E.	Chlordane	---	0.03 (I)	10
F.	Chloroethyl Ether (BIS-2)	---	0.03 (I)	10
G.	DDT	---	0.1 (I)	10
H.	Dichloroethane 1,2	5	5	5
I.	Dichloropropane 1,2	---	0.56 (L)	6
J.	Dieldrin	---	0.002 (I)	10
K.	Dioxin (2,3,7,8-TCCD)	---	2.2×10^{-7} (L)	0.01
L.	Diphenylhydrazine 1,2	---	0.05 (I)	20
M.	Heptachlor	---	0.008 (L)	0.1
N.	Heptachlor Epoxide	---	0.004 (L)	0.1
O.	Hexachlorobenzene	---	0.02 (L)	10
P.	Hexachlorocyclohexane (Lindane)	4	4	0.1
Q.	Polychlorinated Biphenyls (PCBs)	---	0.005 (I)	0.5
R.	Toxaphene	5	5	1.0
S.	Trichloroethylene	5	5	5
T.	Trichlorophenol 2,4,6	---	2.(I)	10
U.	Trihalomethanes (total)	100	100	5
V.	Vinyl Chloride (chloroethene)	2	2	2
V.	**Noncarcinogenic organic chemicals (Table B, Basic Standards)**			
A.	Aldicarb	---	10 (L)	10
B.	Carbofuran	---	36 (L)	10
C.	Chlorobenzene	---	300 (L)	10
D.	Dichlorobenzene 1,2	---	620 (L)	10
E.	Dichlorobenzene 1,3	---	620 (L)	10
F.	Dichlorobenzene 1,4	75	75 (M)	10
G.	Dichloroethylene 1,1	7	7 (M)	5

APPENDIX F

COMPARISON OF EPA DRINKING WATER STANDARDS AND STREAM STANDARDS
(Continued)

		EPA DRINKING WATER STD ug/L (unless otherwise indicated)	STANDARD* ug/L (unless otherwise indicated)	DETECTION* Levels, ug/L
V.	**Noncarcinogenic organic chemicals (Table B, Basic Standards)** (continued)			
H.	Dichloroethylene 1,2-Cis	---	70 (L)	5
I.	Dichloroethylene 1,2-Trans	---	70 (L)	5
J.	Dichlorophenol 2,4	---	21 (L)	10
K.	Dichlorophenoxyacetic Acid (2,4-D)	---	100 (M)	0.1
L.	Endrin	0.2	0.2 (M)	0.1
M.	Ethylbenzene	---	680 (L)	5
N.	Hexachlorobutadiene	---	14 (I)	10
O.	Hexachlorocyclopentadiene	---	49 (I)	10
P.	Isophorone	---	1050 (I)	10
Q.	Methoxychlor	---	100 (M)	0.1
R.	Nitrobenzene	---	3.5 (I)	10
S.	Pentachlorobenzene	---	6 (I)	10
T.	Pentachlorophenol	---	200 (L)	50
U.	Tetrachlorobenzene 1,2,4,5	---	2 (I)	10
V.	Tetrachloroethylene	---	10 (L)	5
W.	Toluene	---	2420 (L)	5
X.	Trichloroethane 1,1,1	200	200 (M)	5
Y.	Trichloroethane 1,1,2	---	28 (I)	5
Z.	Trichlorophenol 2,4,5	---	700 (I)	10
AA.	Trichlorophenoxypropionic Acid (2,4,5-TP)	---	10 (M)	0.05

VI. Additional organic substances - (Fish and water ingestion: Table C, hearing proceedings)

		Standard ug/l	Detection Levels, ug/l
A.	Acrylonitrile	0.058	15
B.	Aldrin	0.000074	0.1
C.	Atrazine	3.0	1.0
D.	Benzidine	0.00012	10
E.	Chlordane	0.00046	0.1
F.	Chloroform	0.19	1.0
G.	Chloroethyl Ether (BIS)	0.0000037	10
H.	DDT	0.000024	0.1
I.	Dichlorobenzidine	0.01	10
J.	Dieldrin	0.000071	0.1
K.	Dioxin (2,3,7,8-TCDD)	0.000000013	0.01
L.	Halomethanes	0.19	1.0

APPENDIX F

COMPARISON OF EPA DRINKING WATER STANDARDS AND STREAM STANDARDS
(Continued)

VI. Additional organic substances - (Fish and water ingestion: Table C, hearing proceedings) (Continued)

		Standard ug/l	Detection Levels, ug/l
M.	Heptachlor	0.00028	0.1
N.	Hexachloroethane	1.9	1.0
O.	Hexachlorobenzene	0.00072	1.0
P.	Hexachlorobutadiene	0.45	1.0
Q.	Hexachlorocyclohexane, Alpha	0.0092	0.1
R.	Hexachlorocyclohexane, Beta	0.0163	0.1
S.	Hexachlorocyclohexane, Gamma (Lindane)	0.0186	0.1
T.	Hexachlorocyclohexane, Technical	0.0123	0.5
U.	Nitrosodibutylamine N	0.0064	5
V.	Nitrosodiethylamine N	0.0008	5
W.	Nitrosodimethylamine N	0.0014	5
X.	Nitrosodiphenylamine N	4.9	10
Y.	Nitrosopyrrolidine N	0.016	10
Z.	PCBs	0.000079	1.0
AA.	Polynuclear Aromatic Hydrocarbons	0.0028	1.0
BB.	Simazine	4.0	1.0
CC.	Tetrachloroethane 1,1,2,2	0.17	1.0
DD.	Tetrachloroethylene	0.8	1.0
EE.	Trichloroethane 1,1,2	0.6	1.0
FF.	Trichlorophenol 2,4,6	1.2	1.0

VII. Radionuclide standards (Revised Table D, hearing proceedings; picocuries per L)

	EPA Drinking Water Standard	Standley Lake	Great Western Reservoir	Woman Creek	Walnut Creek
Gross Alpha	15	6	5	7	11
Gross Beta	50	9	12	5	19
Plutonium	---	0.03	0.03	0.05	0.05
Americium	---	0.03	0.03	0.05	0.05
Tritium	20,000	500	500	500	500
Uranium	---	3	4	5	10
Curium 244	---	60	60	60	60
Neptunium 237	---	30	30	30	30
Cesium 137	---	80	80	80	80
Radium 226 and 228	5	5	5	5	5
Strontium 90	---	8	8	8	8
Thorium 230 and 232	---	60	60	60	60

APPENDIX F

COMPARISON OF EPA DRINKING WATER STANDARDS AND STREAM STANDARDS
(Continued)

VIII. Non-naturally occurring toxic substances (No Toxics Rule)

Use a broad-ranging scan for volatile and nonvolatile organics.

IX. Other measurements that will be useful or necessary by implication, but not directly required.

A. Temperature (ammonia, aquatic life)
B. Hardness (metals; can measure or calculate from Ca, Mg)
C. Conductance (tracking)

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* For I-III, limiting use upon which standard is based is indicated in parentheses: [(1)] = aquatic life, [(2)] = domestic water supply (or human health), [(3)] = recreation, [(4)] = agriculture. For IV-VIII, all standards are for human health.

** For permitted discharges, use protocol for potentially dissolved; for all other locations, use protocol for dissolved when limit is for dissolved (dissolved unless indicated as total).

(I) Based on 10^{-6} cancer risk from EPA Integrated Risk Information System.
(L) Based on EPA life time drinking water health advisory.
(M) Based on MCL for drinking water.

Sources: EPA (1989)
DOE (1990)

APPENDIX G

SUMMARY INVENTORY OF THE RFP STORM-SEWER SYSTEM

TABLE G-1

Summary Inventory of RFP Storm Sewer System

Pipe Diameter (inches)	Length (feet)	Pipe Material[1)]
2	101	STL
3	940	PVC
3	76	CMP
3	280	CI
4	125	CI
4	20	CMP
6	1,342	CMP
6	1,700	PVC
6	97	CI
6	103	STL
6	347	VCP
6	150	AC
8	297	CMP
10	302	CMP
10	331	VCP
18x11[2)]	458	CMP
12	3,355	CMP
22x13	117	CMP
14	1,225	CMP
15	248	VCP
15	1,096	CMP
15	486	RCP

TABLE G-1 (Continued)

Summary Inventory of RFP Storm Sewer System

Pipe Diameter (inches)	Length (feet)	Pipe Material[1)]
21x15	398	CMP
16	546	CMP
25x16	31	CMP
18	2,425	CMP
18	1,116	RCP
18	145	VCP
21	557	RCP
36x22	138	RCP
36x22	20	CMP
24	1,051	CMP
24	413	RCP
28	100	CMP
30	912	RCP
50x31	32	CMP
36	877	CMP
36	170	RCP
48	876	CMP
48	544	RCP
54	225	CMP

TABLE G-1 (Continued)

Summary Inventory of RFP Storm Sewer System

Pipe Diameter (inches)	Length (feet)	Pipe Material[1]
88x57	77	CMP
60	2,247	CMP
60	574	RCP
72	2,369	CMP
Unknown[3]	4,541	Unknown[3]
TOTAL	33,580	

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1) CMP = Corrugated Metal Pipe
   RCP = Reinforced Concrete Pipe
   PVC = Polyvinyl Chloride Pipe
   CI = Cast Iron Pipe
   STL = Steel Pipe
   AC = Asbestos Concrete Pipe

2) Arch Culvert (Span x Height)

3) Mostly CMP Culverts. RFP utility drawings did not identify pipe diameter or material for these culverts.