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DRAFT FINAL

Groundwater Monitoring Plan for the Rocky Flats Sanitary Treatment Plant Sludge Drying Beds

Rocky Flats Plant
Golden, Colorado

July 25, 1990

EG&G ROCKY FLATS

DRAFT FINAL

GROUNDWATER MONITORING PLAN FOR THE ROCKY FLATS SANITARY TREATMENT PLANT SLUDGE DRYING BEDS

EG&G JOB NUMBER 98705100

Prepared For

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JULY 25, 1990

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1.0 INTRODUCTION

This document is being submitted as a result of a Draft Federal Facility Compliance Agreement (FFCA), between the U S Department of Energy (DOE) and the U S Environmental Protection Agency (EPA) Specifically, the Draft FFCA (Section IV, Item C) requires a submittal to the EPA by July 31, 1990, of a groundwater monitoring plan for the area of the sludge drying beds, which are located adjacent to the Rocky Flats Plant (RFP) Sanitary Treatment Plant (STP), Building 995 (Figures 1-1 and 1-2) As stated in the Draft FFCA, the area of the STP sludge drying beds requires groundwater monitoring because historically these units have been unlined and as such groundwater degradation may have occurred as a result of movement of fluids from the sludge drying beds into the groundwater This document is intended to serve as the groundwater monitoring plan for the STP sludge drying beds area and fulfill Section IV, Item C of the Draft FFCA The primary goal of this plan is to provide a system for arresting potential impacts of the existing sludge drying beds in the groundwater resources of the area

This Groundwater Monitoring Plan is divided into the following four functional sections

- Site History,
- Geologic/Hydrologic Setting,
- Geologic/Hydrologic Characterization Plan, and
- Groundwater Monitoring Plan

The following rationale served as the basis for this report format

- Background information is essential to assess
  - historic source terms both temporally and spatially,
  - local geologic setting,

- local hydrologic setting, and
- level of effort related to the hydrologic characterization activities

- Once background information has been reviewed, a detailed plan to characterize the site-specific hydrologic regime can be developed to assess

  - current source of contaminants both within and outside of the area of the STP sludge drying beds,
  - site-specific geologic setting,
  - site-specific hydrogeologic setting,
  - site-specific groundwater-flow rate and direction,
  - potential contaminant-dispersion factors,
  - potential contaminant-migration pathways,
  - spatial distribution of contaminants in soil and water, and
  - data generation and fulfillment of objectives of a groundwater monitoring program

- Having completed a background information search and a site- specific hydrologic characterization study, a groundwater monitoring plan can be developed to assess·

  - nature and extent of contamination,
  - contaminant-dispersion factors,
  - contaminant fates,
  - seasonal fluctuations in groundwater-flow direction and rate, and
  - possible physical constraints related to subsequent remedial activities.

The rationale presented above suggests that the most effective method to develop a groundwater monitoring plan is to first assess what locations should be monitored, then assess which parameters should be monitored at these locations, and finally assess the frequency at which these parameters should be monitored

2.0 SITE HISTORY

The following information was gathered as a result of reviewing reports related to the Rocky Flats Plant (RFP) and conducting interviews with RFP personnel responsible for the operation of the Sanitary Treatment Plant (STP) sludge drying beds

2 1 STP Drying Bed Operation

2 1 1 General Operation

The STP collects sanitary influent from throughout the RFP facility and treats these influent streams The STP is a conventional activated sludge facility consisting of an equalization basin (Building 990) and two parallel treatment trains Each train consists of a primary clarifier, aeration basin and a final clarifier Following each train, the effluent is flocculated, settled, and pressure filtered and the final effluent is chlorinated and dechlorinated prior to discharge to the receiving stream The result of these treatment efforts produces a liquid effluent, which is discharged to South Walnut Creek (Pond B-3) under an existing NPDES permit, and effluent solids, which are discharged to the subject drying beds The sludge processing train consists of two digestors, which are placed in series, and drying beds Sludge from the primary clarifiers passes through the digestors and is sent to the drying beds

Approximately of 2,000 gallons of sludge are pumped from the STP sludge digestors to a single drying bed per application This sludge has a consistency of approximately 2 to 3 percent solids to liquids (by weight) The free liquids entrained with the sludge are decanted through an underdrain system and returned to the STP primary clarifier

Following the decanting of liquids, the remaining solids are air dried until a solid-to-liquid ratio of greater than 43 percent (by weight) is achieved If, based on the results of laboratory analyses of five samples per drying bed, the sludge has achieved a solid-to-liquid ratio of at least 43 percent, the sludge is mixed with cement to form "Sludge Crete" which is packaged in 4-foot by 4-foot by 7-foot polyethylene-lined plywood containers and stored as low-level radioactive waste for subsequent disposal

2 1 2 Operational History

The sludge drying beds have been in operation since 1952, when the STP was constructed at the RFP The size and configuration of the beds have changed over time The following paragraphs detail the operational history of the drying beds

Initially, three drying beds to the east of the present STP were constructed (Figure 2-1) A review of the construction drawings indicates that the surface directly beneath the drying beds is unlined, native soil In 1962, the westernmost drying bed was removed to make space for the expansion of the STP and construction of Digestor No 2 (Figure 2-1)

Concurrent with the removal of the westernmost drying bed in 1962, three additional drying beds were constructed, two to the south and one to the east of the original drying beds These beds are believed to have been constructed according to the design specifications indicated on Figure 2-2, which show the base of these drying beds is unlined, native soil

Due to the inability of the drying beds to effectively reduce sludge volumes which accumulated in Digestors 1 and 2, three additional drying beds were constructed in 1985 (Figure 2-1) Two of these beds were constructed east of the original northern drying beds and one was constructed east of the southern drying beds These drying beds are believed to have been constructed as shown on Figure 2-3 A review of these drawings indicates that the surface directly beneath the drying beds is native soil also (Figure 2-3)

At the time of construction of the three beds in 1985, metal buildings were erected to shelter all six of the drying beds

In late 1989, the northwestern drying bed was retro-fitted with a concrete lining at the base of the drying bed Above the concrete liner, perforated polyethylene tiles were placed to allow decanting of free liquids and air drying of the sludge

During the summer months of a given year, the capacity of the drying beds to dry the sludge exceeds the sludge generation rate, however, during the winter months, when the drying capacity of the beds is diminished, sludge accumulates in the digestors When Digestors 1 and 2 are filled excess sludge is pumped into drying beds already holding partially dried sludge This double-dosing practice causes re-wetting of the partially dried sludge and decreases drying efficiency Drying beds at Building 910 are used to help minimize the amount of double-dosing required at the STP drying beds, however, even with the added capacity of the beds at Building 910, the combined sludge drying capacity is exceeded during winter months

2 2 SWMUs in the Vicinity of the STP

Six Solid Waste Management Units (SWMU) have been identified in the vicinity of the STP sludge drying beds (Figure 2-4)

- SWMU 121 Original Process Waste Lines,
- SWMU 141 Sludge Dispersal Plume,
- SWMU 142 5 Retention Pond B-1,
- SWMU 165 Triangle Area,
- SWMU 190 Caustic Flow Path, and
- SWMU 192 Chromium Flow Path

2 2 1 SWMU 121 - Original Process Waste Lines

The Original Process Waste Lines are abandoned process sewer lines which once conveyed process effluent from the process areas at the facility to the B-series retention ponds These lines have been abandoned in-place and are scheduled to undergo closure Groundwater contaminants potentially originating from the vicinity of these lines are tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride (CCl_4), radionuclides, and nitrates These constituents are anticipated to be similar to contaminants potentially originating from the sludge drying beds The distance between the drying beds and the waste lines should allow for the differentiation of possible groundwater contamination related to each of these potential sources

2 2 2 SWMU 141 - Sludge Dispersal Plume

The Sludge Dispersal area is the area believed to have been impacted by wind dispersion of dried sludge from the STP drying beds prior to the construction of the metal shelters Potential groundwater contaminants originating from this source area are thought to be identical to those contaminants which originate at areas at the sludge drying beds Due to the proximity of the dispersal area to the sludge drying beds, differentiation of these possible sources of groundwater contamination may be difficult

2 2 3 SWMU 142 5 - Retention Pond B-1

Pond B-1 was believed to have been contaminated by various wastes containing nitrates and low levels of radioactive waste Because Pond B-1 is located a significant distance downstream from the drying beds, differentiation of the potential source of groundwater contamination related to the drying beds and those related to Pond B-1 should be possible

2 2 4 SWMU 165 - Triangle Area

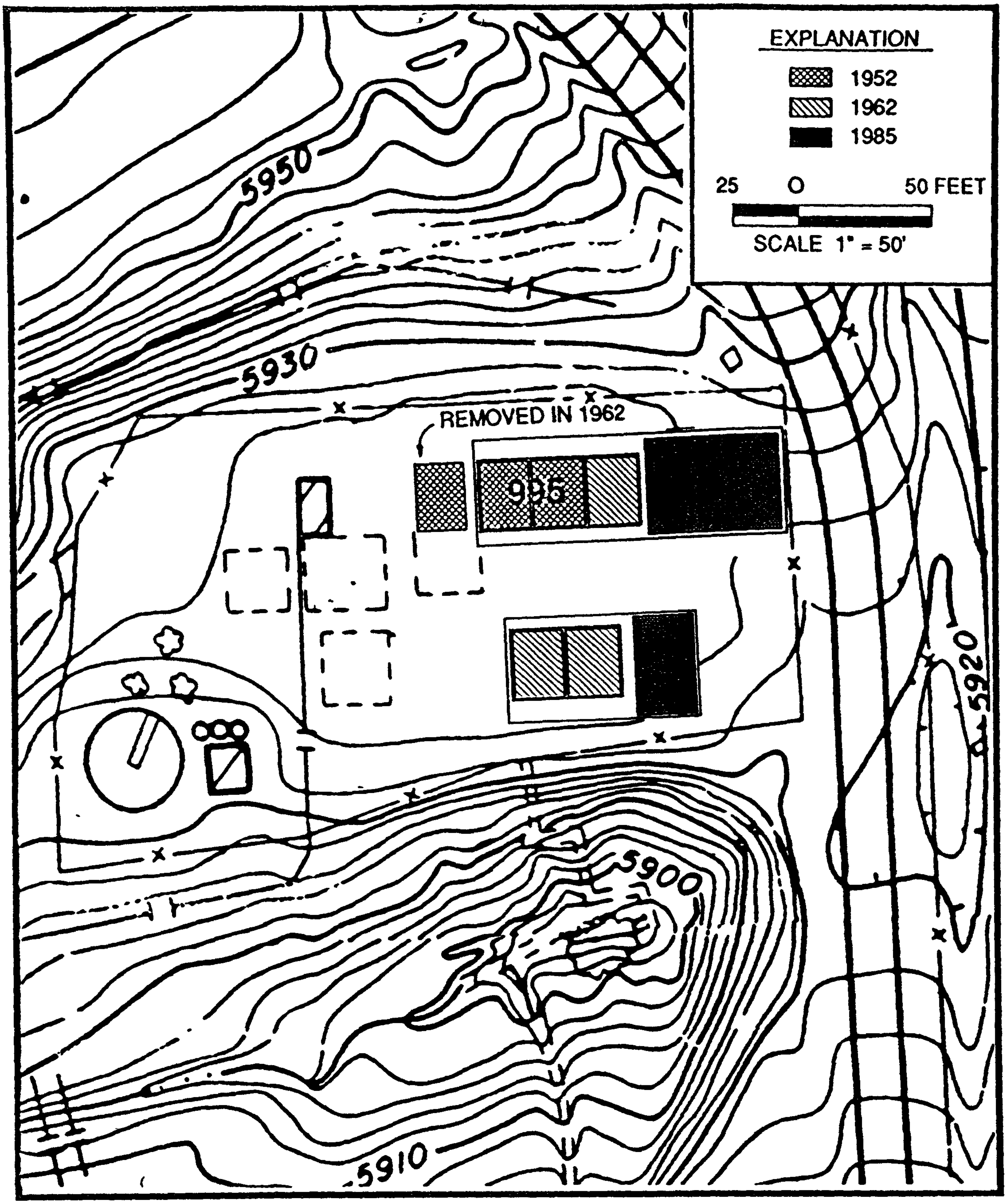
The Triangle Area was used from late 1966 to 1975 for the storage of drums containing plutonium-contaminated wastes Contaminated waste from a 1969 fire at the RFP was also stored in this area By 1975, the wastes stored at the Triangle Area had been removed with no subsequent use of the area since that time Potential groundwater contaminants within the Triangle Area are thought to be similar to contaminants potentially originating from the sludge drying beds The apparent upgradient location of the Triangle Area relative to the sludge drying beds may make differentiation of this possible source of groundwater contamination in the area of the sludge drying beds difficult

2 2 5 SWMU 190 - Caustic Flow Path

The Caustic Flow Path was caused by a spill of caustic wastes near the steam plant (Building 443) Following the spill incident, snowmelt is believed to have transported potassium hydroxide (which had been neutralized) to Pond B-1 Potential groundwater contaminants which may have their source areas within the Caustic Flow Path are thought to be unique when compared to contaminants having their source area at the sludge drying beds Due to the apparent downstream location of the Caustic Flow Path relative to the sludge drying beds, differentiation of this potential source of groundwater contamination in the area of the sludge drying beds should be possible

2 2 6 SWMU 192 - Chromium Flow Path

The Chromium Flow Path was caused by the transport of cooling-tower blowdown to Pond B-1 This blowdown may have contained chromium-laden biocides Potential groundwater contaminants which may have their source area within the Chromium Flow Path are thought to be unique when compared to those contaminants which may have their source areas at the sludge drying beds Due to the apparent downstream location of the Caustic Flow Path relative to the sludge drying beds, differentiation of this potential source of groundwater contamination in the area of the sludge drying beds should be possible



DRYING BED CONSTRUCTION HISTORY

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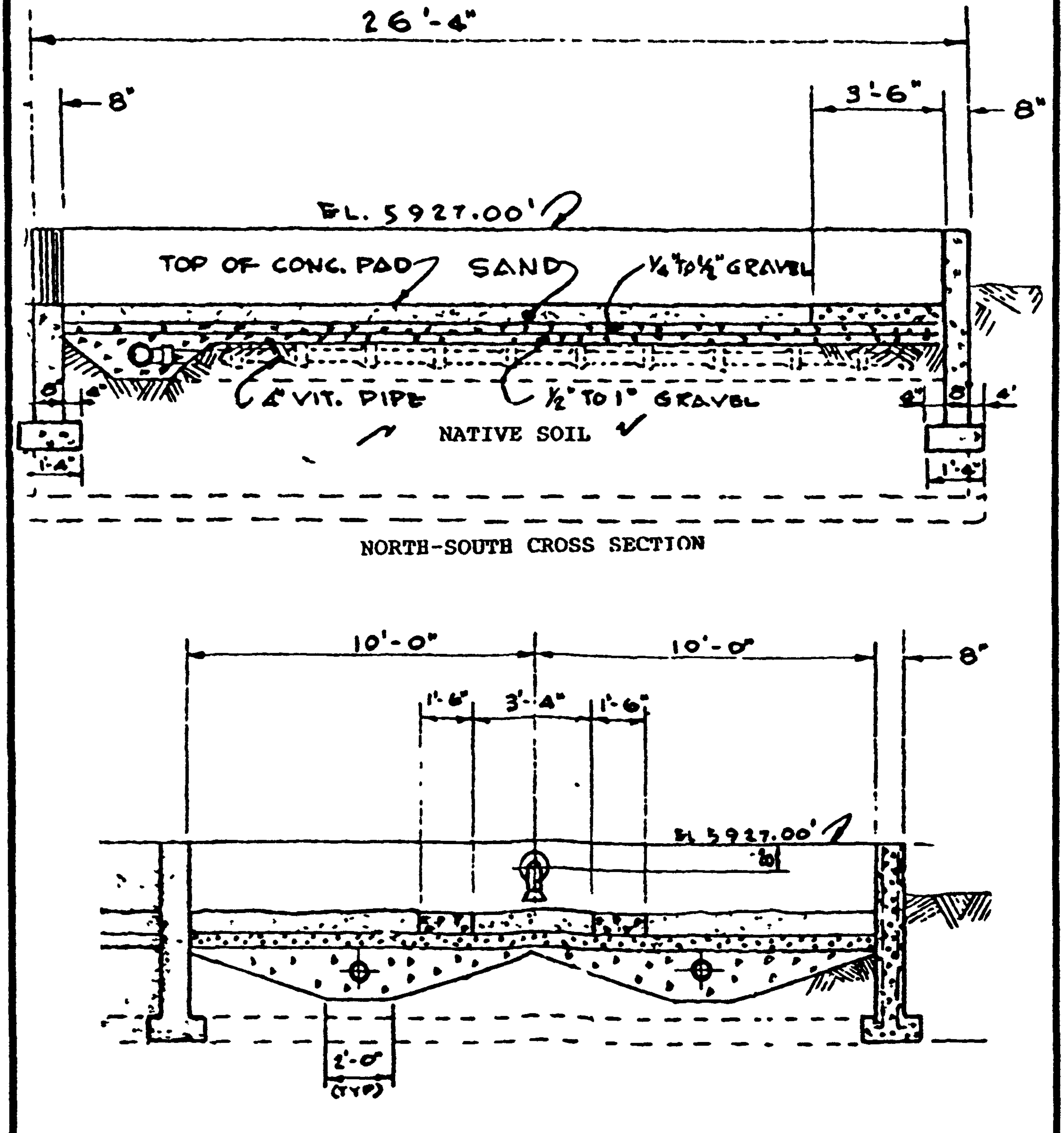
STP DRYING BEDS
GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

FIGURE 2-1



Source Rockwell International Sewer Plant Drying Bed Expansion Drawings

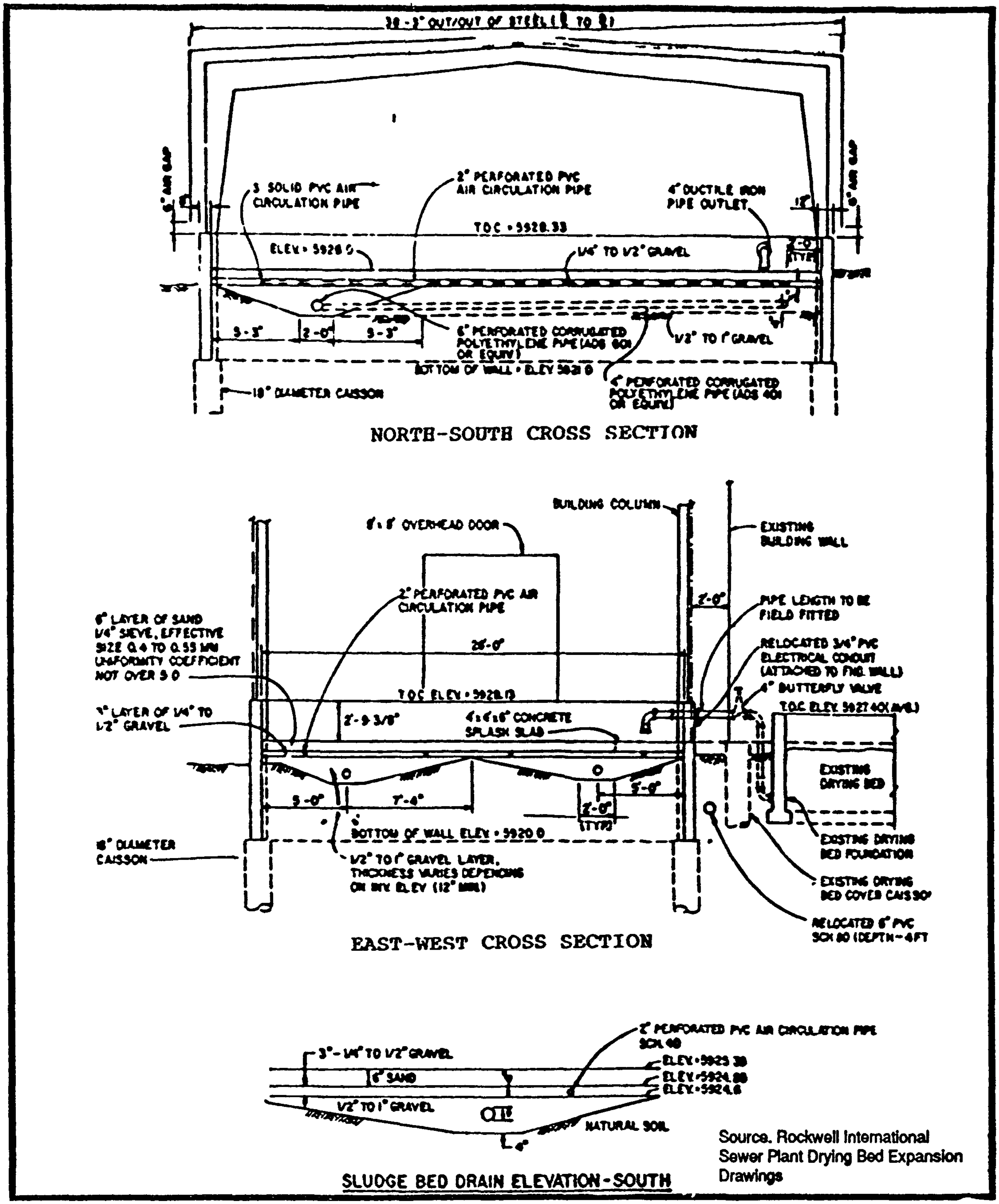
SLUDGE DRYING BEDS 1962 ADDITIONS

EG&G

STP DRYING BEDS
GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

FIGURE 2-2



Source. Rockwell International Sewer Plant Drying Bed Expansion Drawings

SLUDGE DRYING BEDS 1985 ADDITIONS

EG&G

STP DRYING BEDS
GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

FIGURE 2-3

3.0 GEOLOGIC/HYDROLOGIC SETTING

3 1 Local Geologic Setting

3 1 1 Alluvium/Colluvium

The surficial geology in the area of the drying beds includes a thin veneer of Rocky Flats Alluvium (Qrf), colluvium (Qc), and Valley Fill Alluvium (Qvf) overlying bedrock (Figures 3-1, 3-2, 3-3, and 3-4) The thickness of the alluvium and colluvium generally ranges from 0 to 25 feet The Rocky Flats Alluvium developed during Nebraskan or Aftonian time in the Pre-Wisconsin Pleistocene It consists of poorly sorted, unconsolidated deposits of gravel (granular to cobbles and boulders) with clay, silt, and sand matrices Gravels are primarily quartzite and granite fragments and may be weathered, sands are primarily composed of quartz grains (see annotated bibliography associated with EG&G, 1990a)

Colluvium is a poorly sorted mixture of topsoil, weathered bedrock, and reworked Rocky Flats Alluvium The colluvium is comprised of silty clay and clayey silt with some quartzite gravel Valley Fill Alluvium is a poorly sorted mixture of reworked Rocky Flats Alluvium, colluvium, and weathered bedrock found in drainages throughout the area

3 1 2 Bedrock

The Arapahoe Formation lies beneath the alluvium and colluvium (Figures 3-1, 3-2, 3-3, and 3-4) This Upper Cretaceous unit consists of mainly claystones and silty claystones Significant sandstone intervals occur within the claystone The Arapahoe Formation is up to 250 feet in thickness in the RFP area (EG&G, 1990a).

The characteristics of the sandstone intervals are generally very fine to medium grained, poorly to moderately sorted, subangular to subrounded, silty, clayey, and quartzitic with trough and tabular cross-stratification

There are at least six mappable sandstone intervals in the Arapahoe Formation in the RFP area In descending order, they are

Sandstone Number 1

Sandstone Number 1 probably crops out within 100 feet north of the drying beds (Figures 3-2 and 3-4) The base of Sandstone Number 1 is thought to occur at an elevation of approximately 5930 feet The drying beds are located at an approximate elevation of 5915 feet above mean sea level (MSL) It is believed that Sandstone Number 1 was deposited by a meandering stream that flowed under a very low gradient (EG&G, 1990a) The drying beds are situated south of an inside bend of the meandering channel deposit (Figure 3-1) Thicknesses of 15 to 25 feet of Sandstone Number 1 are postulated to occur directly to the north, northeast, and northwest of the drying beds (Figures 3-1)

Sandstone Numbers 2 through 6

Sandstone Numbers 2 through 6 were deposited under a steeper hydraulic gradient than Sandstone Number 1 by streams that had straighter channel boundaries than Sandstone Number 1 Sandstone Number 3 has been recognized in the area south of the drying beds in Well 34-86 (Figure 3-1) The base of Sandstone Number 3 occurs at an approximate elevation of 5856 feet and is about six feet in thickness (Figure 3-3 and 3-4)

3 2 Site Specific Geology

Presently, four alluvial monitoring wells and two bedrock monitoring wells are located within a 750-foot radius of the drying beds (Figure 3-1) Based upon the geologic data obtained as a result of the drilling of these wells and related information contained in the Draft Geologic Characterization Report (EG&G, 1990a), a north-south cross section was constructed (Figure 3-4) Construction of this cross section involved extrapolations based on topography and general geometry of the geologic materials

3 2 1 Alluvium/Colluvium

Presently, it is not known what materials lie directly beneath the drying beds It is estimated that there is 0 to 15 feet of artificial fill material directly beneath the drying beds (Figure 3-4) This fill material is believed to have been excavated from the hillside directly north of the drying beds The fill material probably extends south to the stream channel of South Walnut Creek

East of the drying beds is an elevated segment of compacted road fill and east of the road the surficial materials are thought to be colluvium and valley fill in and around the stream channel of South Walnut Creek and in and around Detention Pond B-1 (Figure 1-2) The roadway fill material is believed to have been excavated from the hillside located to the northeast of the drying beds Valley Fill Alluvium and colluvium are thought to occur overlying the claystone bedrock in South Walnut Creek

North of the drying beds is a hillside topped with Rocky Flats Alluvium and covered with colluvium along the slope (Figure 3-4)

3 2 2 Bedrock

An approximately 15-foot thick sequence of weathered claystone of the Arapahoe Formation is thought to lie directly beneath the surficial materials in the immediate area of the site (Figure 3-4) Underlying the weathered material is believed to be 25 to 40 feet of competent claystone of the Arapahoe Formation Underlying the competent claystone is believed to be a six foot thick sequence of sandstone (Sandstone Number 3 of the Arapahoe Formation)

3 3 Local Hydrologic Setting

3 3 1 Groundwater

The Rocky Flats Alluvium and the Upper Arapahoe Formation are believed to comprise a hydraulically-connected groundwater-flow system in the area of the sludge drying beds, with Sandstone Number 1 being in direct contact with the alluvial and colluvial materials at this location (Figures 3-2 and 3-4) The unconfined aquifer in the Rocky Flats Alluvium, colluvium, and Arapahoe Sandstone Number 1 is recharged by infiltration from incident precipitation, streams, ponds, and diversion channels There are large seasonal fluctuations in the water table which may cause periods of little or no saturated conditions in the alluvium Groundwater flow in the unconfined aquifer system is locally determined by topography

Claystones in the Arapahoe Formation are weathered near the contact with the surficial materials Groundwater from the Rocky Flats Alluvium recharges weathered bedrock and also the bedrock-flow system where the weathered bedrock includes subcropping sandstones Groundwater flows in the claystone fluctuate considerably with seasonal weather variations It is thought that during periods of high groundwater levels, the water table roughly conforms with surface features and that in the area of the drying beds groundwater flow is toward South Walnut Creek Neither the Sandstone Number 1 nor Sandstone Number 3 units are thought to influence the unconfined groundwater flow regime in the area of the drying beds (Figures 3-2, 3-3, and 3-4)

3 3 2 Surface Water

South Walnut Creek is the major surface water feature in the area of the drying beds and is located about 100 feet to the south (Figure 1-2) Flow in this reach of South Walnut Creek is to the east-northeast and is directed through culverts beneath the roads adjacent to the area of the drying beds Topography is relatively steep between the drying beds and South Walnut Creek, dropping 25 feet in less than 100 horizontal feet During periods of high water-table conditions, South Walnut Creek in the area directly south of the sludge drying beds may be a local discharge point for saturated Rocky Flats Alluvium and colluvium Beginning approximately 600 feet to the east of the drying beds, the B-series retention ponds and diversion channels control the flow of South Walnut Creek.

3 4 Site Specific Hydrology

3 4 1 Groundwater

Groundwater is found in the surficial sediments which are monitored by Wells 35-86 and 36-86 south of South Walnut Creek (Figures 3-1 and 3-3) Measured water-level elevations in Well 35-86 have varied from 5902 feet (1/15/89) to 5905 feet (8/4/87) during the period from September 1986 to July 1989 Measured water-level elevations in Well 36-86 have varied from less than 5875 feet (dry - 8/27/86) to 5878 feet (7/8/87) during the period from August 1986 to January 1990, with dry conditions being noted in the fall of 1986, fall of 1988, and winter of 1989

North of South Walnut Creek, water levels in surficial materials have been monitored in Wells P213989 and B213789 (Figures 3-1 and 3-2). Both wells P21389 and B213789 have been found to be dry during the period from September 1989 to January 1990

Groundwater is found in the bedrock (Sandstone Number 3) which is monitored by Well 34-86 south of South Walnut Creek (Figures 3-1 and 3-3) Water-level elevations in Well 34-86 have varied from 5888 feet (9/12/86) to 5891 feet (6/30/89) during the period from September 1986 through August 1989

3 5 Site Specific Geochemistry

Presently, no information is known to be available on the geochemistry in the area of the site Historical data related to laboratory analysis of the sludge which was placed in the sludge drying beds are presented in Table 3-1 These data indicate that volatile organic compounds, radionuclides, nitrates, and metals occur for potential migration from the sludge drying beds into surrounding soil or groundwater

TABLE 3-1

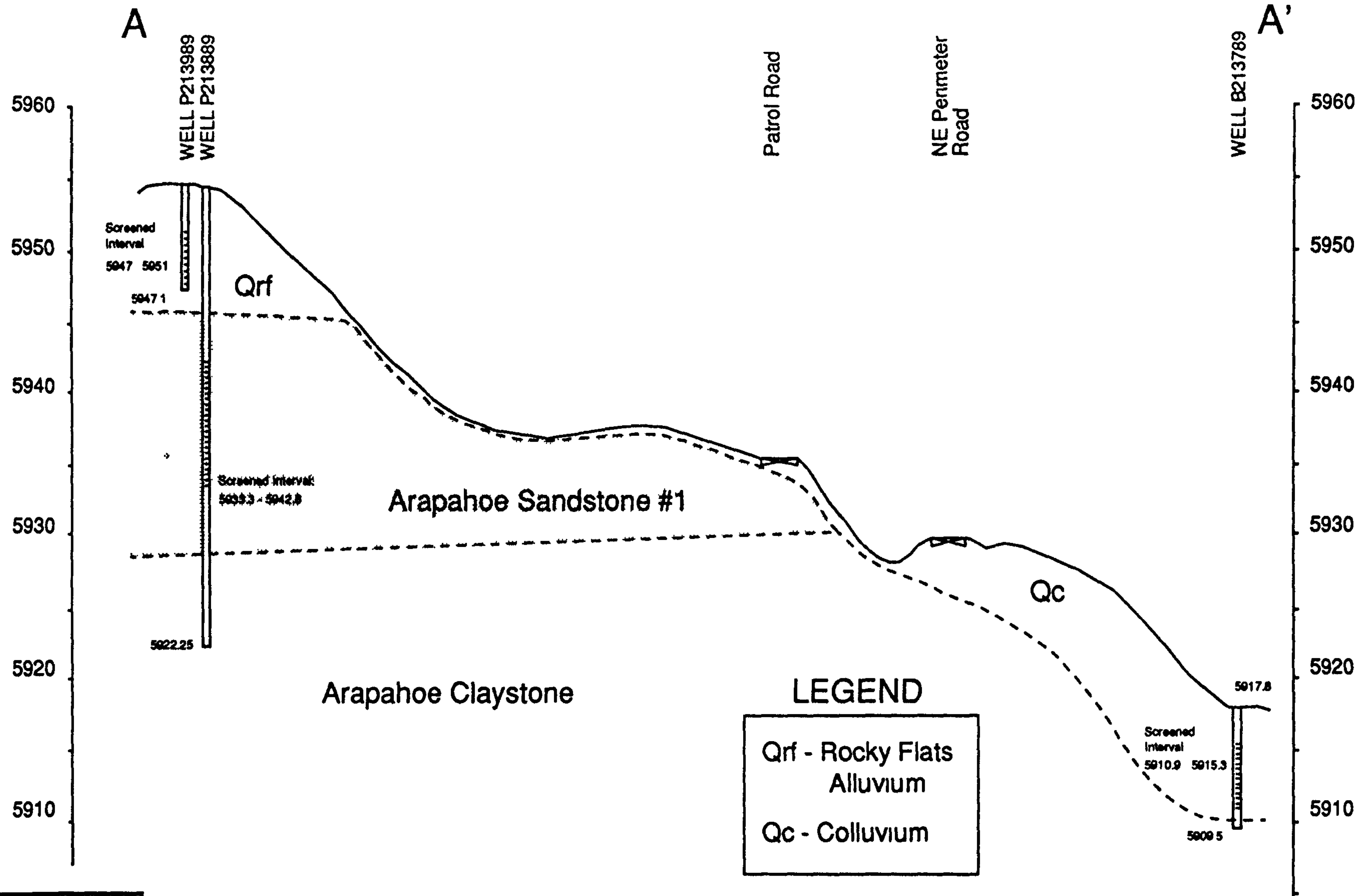
SUMMARY OF MAXIMUM VALUES OF CONSTITUENTS DETECTED IN SEWAGE SLUDGE

Constituent	Conc (ppb)
Methylene Chloride	160
Chloroform	66
Freon 12	9 4
Acetone	560
Toluene	39
Xylenes	16
Ethylbenzene	11
Benzene	1 5
Carbon Disulfide	6
Methyl Ethyl Ketone	17
bis (2-ethylhexyl) Phthalate	18000
Benzo[a]pyrene	930
Fluoranthene	1900
di n-octyl Phthalate	980
Benzoic Acid	4400
Anthracene	1600
Pyrene	2900
Butyl Benzyl Phthalate	1500
Aluminum	49300
Antimony	15 4
Arsenic	25 7
Barium	890
Beryllium	2 9
Cadmium	128
Calcium	215600
Chromium	380
Copper	1110
Iron	25530
Lead	239
Magnesium	3190
Manganese	278
Mercury	9 8
Nickel	75
Potassium	50800
Selenium	4 8
Silver	38700
Zinc	3500
Hydrogen Sulfide	36000
Cyanide	620

TABLE 3-1
(concluded)

SUMMARY OF MAXIMUM VALUES OF CONSTITUENTS DETECTED IN SEWAGE SLUDGE

Constituent	Conc (pCi/g)
Gross Alpha	130+/-20
Gross Beta	180+/-10
Pu 239	11+/-1
Am 241	2 2+/-0 3
U-233,234	24+/-2
U-238	110+/-10
Tritium	0 28+/-0 22 pCi/ml



SCALES
Horizontal 1" = 80'
Vertical 1" = 10'

CROSS SECTION A - A'

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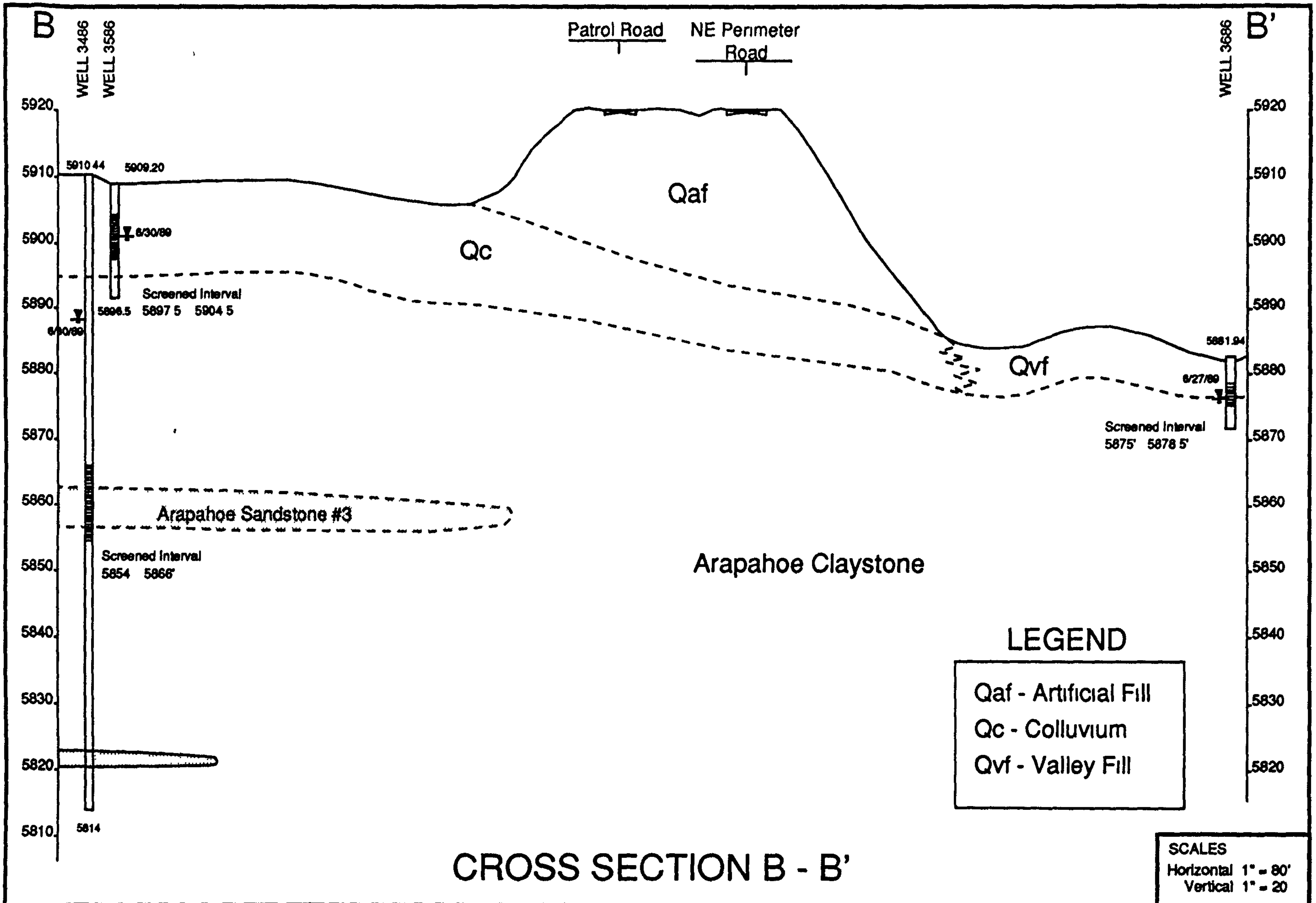
GROUNDWATER MONITORING PLAN

PROJECT No 208 0201
FIGURE 3-2

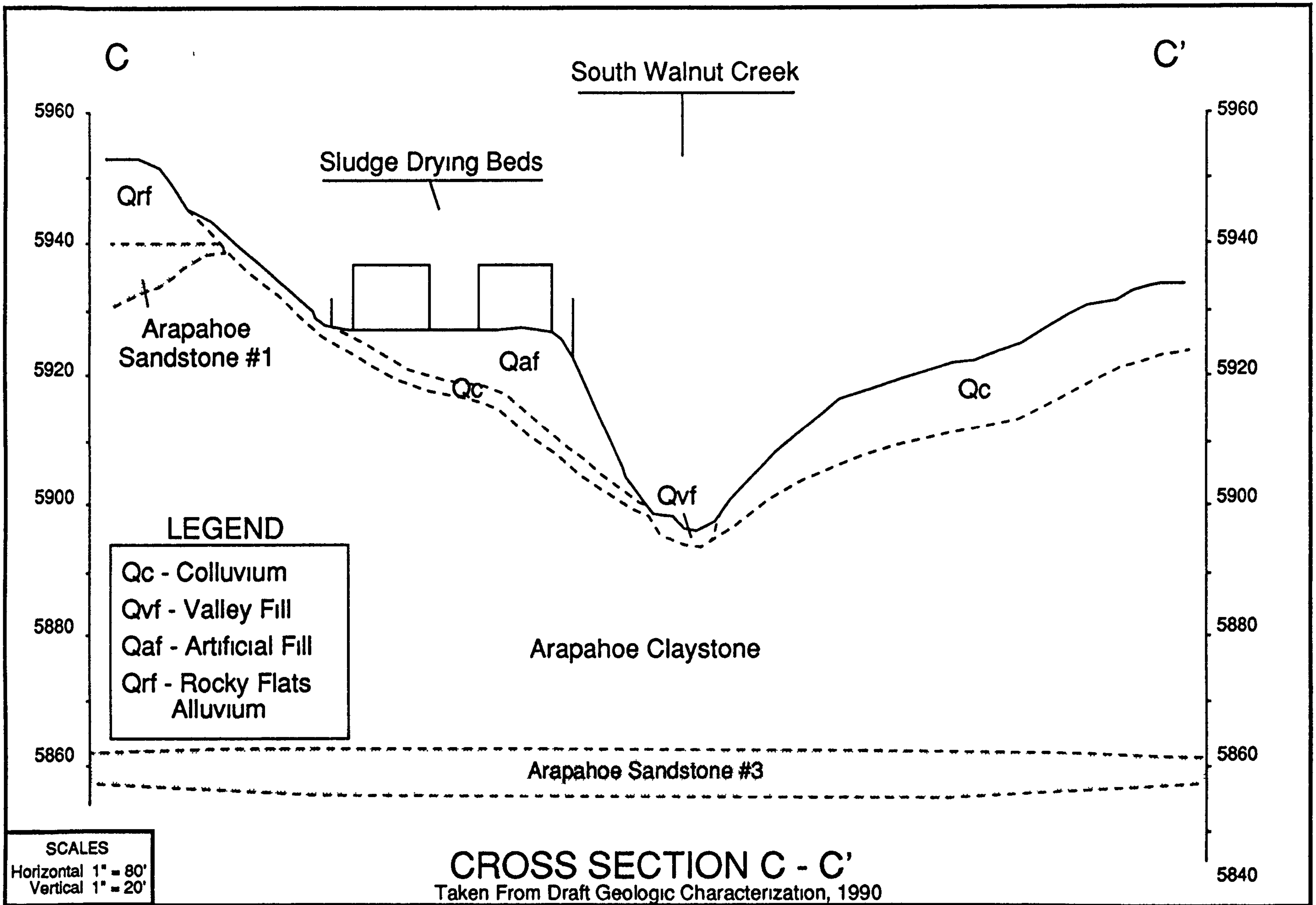


CROSS SECTION B - B'

EG&G

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201
FIGURE 3-3



CROSS SECTION C - C'
Taken From Draft Geologic Characterization, 1990

EG&G

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201
FIGURE 3-4

4.0 GEOLOGIC/HYDROLOGIC CHARACTERIZATION PLAN

4 1 Geologic Characterization Plan

4 1 1 Site Geology

The purpose of this geologic characterization plan is to more accurately assess the type and geometry of materials which underlie the drying beds Four shallow borings are proposed to be drilled adjacent to the drying beds to aid in characterizing the site-specific surficial geology (Figure 4-1) These borings will penetrate deep enough to encounter 15 feet of saturated weathered claystone From these borings, the depth to bedrock as well as lithologic variations in the colluvium and fill can be identified (Figure 4-2)

4 1 2 Site Geochemistry

During the drilling of the four shallow borings, soil samples will be collected using continuous coring techniques These core samples will be scanned immediately after retrieval from the borehole using organic vapor and alpha, beta, and gamma radiation meters Samples will be selected for laboratory analysis at five-foot intervals This sampling interval would produce laboratory data related to approximately 26 samples Based upon the results of the field meter screening or visual observation of staining, additional samples may be selected for laboratory analysis Based on the maximum-value data presented on Table 3-1, the analyte list presented on Table 4-1 was selected to characterize the fill, alluvium, and bedrock underlying the drying beds

4 2 Hydrologic Characterization Plan

4 2 1 Site Hydrology

To aid in characterizing the groundwater in the Rocky Flats Alluvium and upper claystone bedrock, four shallow wells will be constructed as part of this monitoring program to assess conditions in this area (Figure 4-1) These wells will be screened from two feet above the total depth of the borehole for ten feet with approximately one foot of filter pack above the top of the screened interval Each well will be surveyed to provide state plane coordinates and USGS elevation datum

Water-level measurements will be made at each well and flow directions and flow gradients will be calculated If sufficient yield is present in the wells, either constant discharge or rising head slug tests will be preformed at each well to assess hydraulic conductivity, transmissivity, and storativity The results of these tests in conjunction with the flow direction and hydraulic gradient information will be used to assess flow rates

4 2 2 Site Hydrogeochemistry

Based on the information presented on Table 3-1, water samples will be collected from the four monitoring wells and will be analyzed for the analyte list presented on Table 4-2 Should there be an insufficient quantity of sample collected from a given sampling location, the following prioritization will be used for the selection of which constituents will be analyzed

- Nitrates,
- Plutonium, Uranium, and Americium;
- Metals,
- Volatile Organic Compounds;

- Other Major Ions, and
- Other Radionuclides

This prioritization of constituents is based on contaminants of concern in the area of the Solar Ponds, which are roughly adjacent to the drying beds In addition, the contaminants found in the area of the Solar Ponds may be similar to those found at the drying beds, due to the past practice of the drying beds having accepted sludges which may have been contaminated by laundry waste water

4 3 Schedule

Assuming a 60 day review period by EPA and a 30 day contracting cycle, site characterization activities may begin as soon as late October 1990 It is presently anticipated that field activities will require one month for completion, which suggests that site characterization activities may be completed as soon as late November 1990 It is anticipated that a Geologic/Hydrologic Characterization Report will be submitted for EPA review approximately 90 days following completion of field activities This schedule is summarized below

Work Plan Submittal	July 31, 1990
Work Plan Approval	September 30, 1990
Preparation of HASP	October 31, 1990
Contractor Selection	October 31, 1990
Execution of Work Plan	November 30, 1990
Site Characterization	March 4, 1991

TABLE 4-1
SOIL SAMPLING PARAMETERS

Target Analyte List

Trace Metals
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Cesium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Strontium
- Thallium
- Tin
- Vanadium
- Zinc

Anions
- Carbonate
- Bicarbonate
- Chloride
- Sulfate
- Nitrate (as N)
- Cyanide

Cations
- Calcium
- Magnesium
- Potassium
- Sodium

TABLE 4-1
(continued)

SOIL SAMPLING PARAMETERS

Target Compound List - Volatiles:

Organics

- Chloromethane
- Bromomethane
- Vinyl Chloride
- Chloroethane
- Methylene Chloride
- Acetone
- Carbon Disulfide
- 1,1-Dichloroethene
- 1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Chloroform
- 1,2-Dichloroethane
- 2-Butanone
- 1,1,1-Trichloroethane
- Carbon Tetrachloride
- Vinyl Acetate
- Bromodichloromethane
- 1,1,2,2-Tetrachloroethane
- 1,2-Dichloropropane
- trans-1,3-Dichloropropene
- Trichloroethene
- Dibromochloromethane
- 1,1,2-Trichloroethane
- Benzene
- cis-1,3-Dichloropropene
- Bromoform
- 2-Hexanone
- 4-Methyl-2-pentanone
- Tetrachloroethene
- Toluene
- Ethyl Benzene
- Styrene
- Total Xylenes

TABLE 4-1
(concluded)

SOIL SAMPLING PARAMETERS

Radionuclides

- Gross Alpha
- Gross Beta
- Uranium 233+234, 235, and 238
- Americium 241
- Plutonium 239+240
- Strontium 89+90
- Cesium 137
- Tritium
- Radium 226, 228

TABLE 4-2
GROUND-WATER SAMPLING PARAMETERS

Field Parameters
- pH
- Specific Conductance
- Temperature
- Total Alkalinity

Indicators
- Total Dissolved Solids
- pH

Metals
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Cesium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Strontium
- Thallium
- Tin
- Vanadium
- Zinc

TABLE 4-2
(continued)

GROUND-WATER SAMPLING PARAMETERS

Anions

- Carbonate
- Bicarbonate
- Chloride
- Sulfate
- Nitrate (as N)
- Cyanide

Cations

- Calcium
- Magnesium
- Potassium
- Sodium

Organics

- Chloromethane
- Bromomethane
- Vinyl Chloride
- Chloroethane
- Methylene Chloride
- Acetone
- Carbon Disulfide
- 1,1-Dichloroethene
- 1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Chloroform
- 1,2-Dichloroethane
- 2-Butanone
- 1,1,1-Trichloroethane
- Carbon Tetrachloride
- Vinyl Acetate
- Bromodichloromethane
- 1,1,2,2-Tetrachloroethane
- 1,2-Dichloropropane
- trans-1,3-Dichloropropene
- Trichloroethene
- Dibromochloromethane

TABLE 4-2
(concluded)

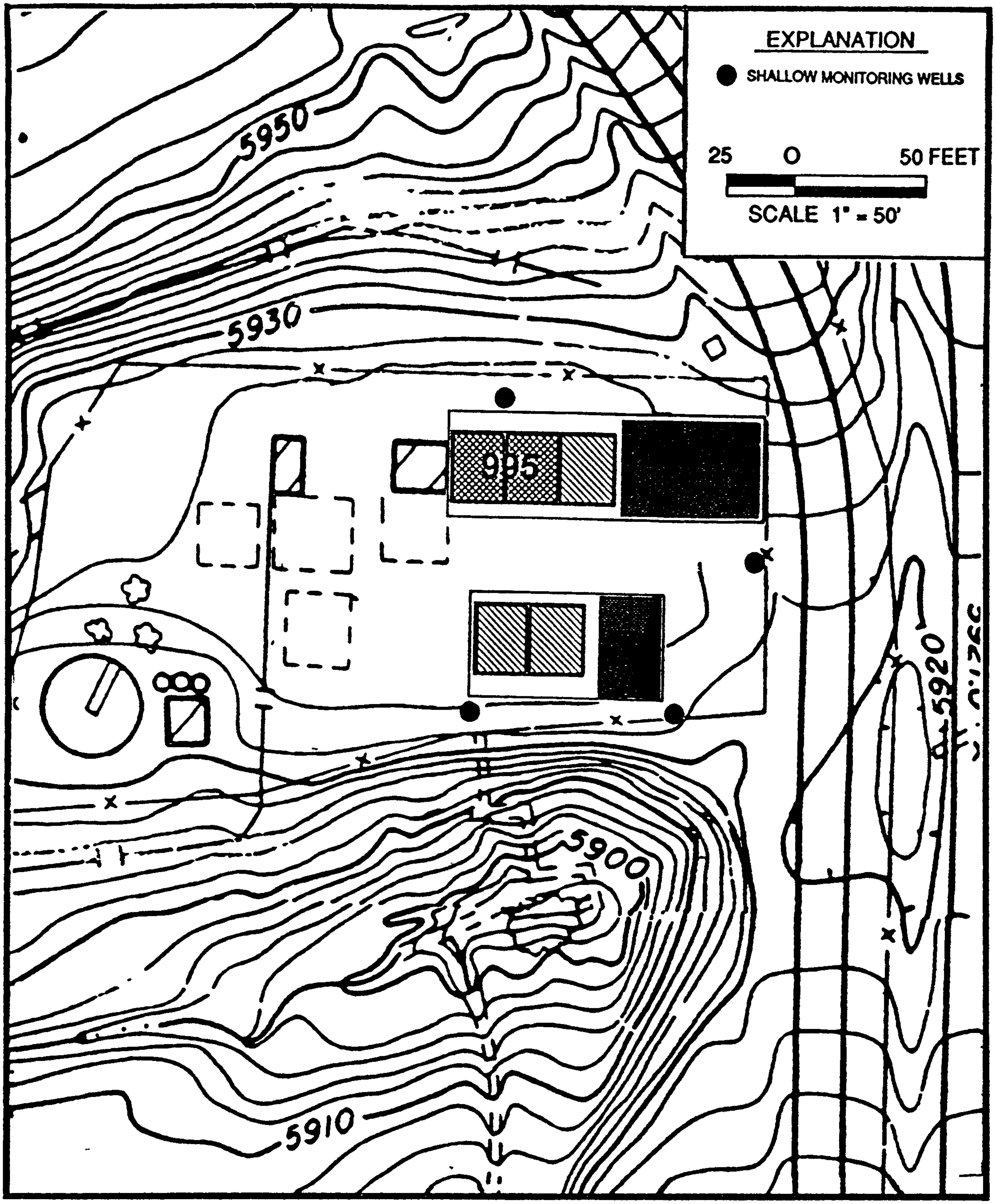
GROUND-WATER SAMPLING PARAMETERS

Organics (continued)

- 1,1,2-Tnchloroethane
- Benzene
- cis-1,3-Dichloropropene
- Bromoform
- 2-Hexanone
- 4-Methyl-2-pentanone
- Tetrachloroethene
- Toluene
- Ethyl Benzene
- Styrene
- Total Xylenes

Radionuclides

- Gross Alpha
- Gross Beta
- Uranium 233+234, 235, and 238
- Amencium 241
- Plutonium 239+240
- Strontium 89+90
- Cesium 137
- Tntium
- Radium 226, 228



PROPOSED MONITORING WELL LOCATIONS

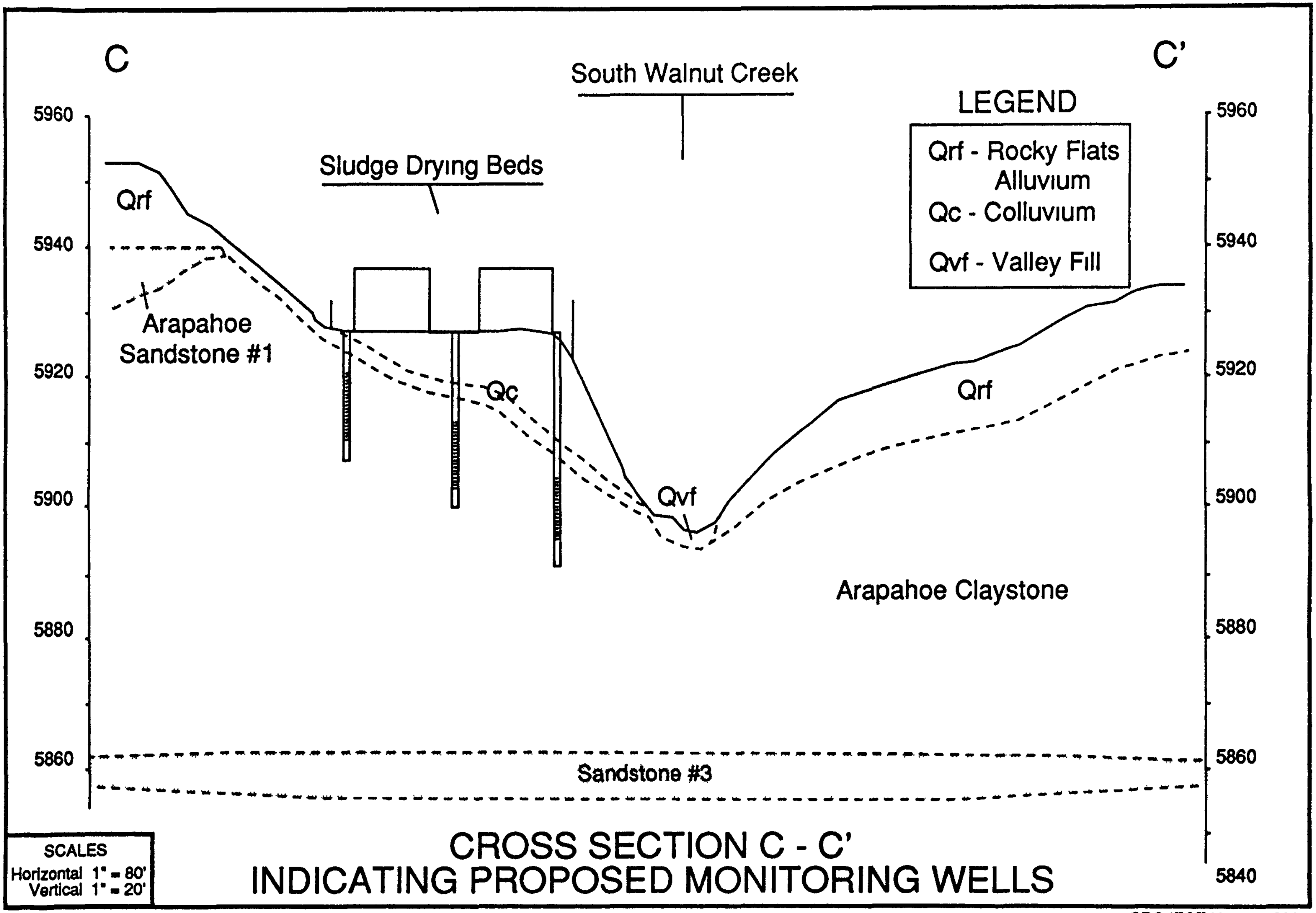
EG&G

STP DRYING BEDS

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

FIGURE 4-1



CROSS SECTION C - C'
INDICATING PROPOSED MONITORING WELLS

EG&G

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201
FIGURE 4-2

5 0 GROUNDWATER MONITORING PLAN

5 1 Monitoring Locations

Four shallow wells are proposed as groundwater monitoring locations (Figures 4-1 and 4-2) The four shallow well monitoring locations were selected based on the assumption that shallow groundwater flow will occur predominantly toward South Walnut Creek to the south of the drying beds If this assumption is correct, then this configuration of wells would provide for monitoring of shallow groundwater upgradient, cogradient, and downgradient of the sludge drying beds

5 2 Monitoring Schedule

Assuming that the site characterization schedule presented in Section 4 6 is achieved, groundwater monitoring could begin as early as January 1991 Groundwater monitoring will continue on a quarterly basis until such time as it is deemed no longer necessary

Due to variations in the saturated thickness in the shallow water-bearing zone, water may not be present in any given monitoring well at all scheduled monitoring times In these cases, attempts will be made to collect samples monthly until a sample is collected Once a sample is collected, the regular quarterly schedule will be reinstated

Because water samples are scheduled to be collected in mid November 1990 as a result of the site characterization activities, quarterly groundwater monitoring is scheduled to begin in January 1991 A schedule of quarterly sampling was selected, based on the relatively small groundwater velocities anticipated in the area of the drying beds

5 3 Analyte Suite

The analyte suite will be identical to that presented in Table 4-2, however, based on the results of the initial year's monitoring data, an extended period of monitoring may be recommended

5 4 Reporting Schedule

The laboratory results related to the quarterly groundwater sampling efforts will be submitted to the EPA 60 days following sample collection Yearly, on or about March 1, a summary of the previous year's quarterly monitoring will be submitted to the EPA

6 0 PROCEDURES

6 1 Health and Safety Plan

Pnor to initiating any charactenzation activities, a site specific Health and Safety Plan (HASP) will be developed The HASP will incorporate the specific safety practices and procedural review requirements for Rocky Flats Plant and will include the requirements of DOE as specified in DOE Orders It is DOE's policy that its operations shall be conducted in a manner that will (1) limit nsks to the health and safety of the public and employees and (2) adequately protect property and the environment DOE has responsibility for health, safety, and environmental protection programs at DOE-owned contractor-operated facility

The main tenet of the HASP is to keep human exposure to toxic matenals and radiation at levels as low as reasonably achievable (ALARA) Specific ALARA procedures will include engineenng controls, administrative controls, and the use of personnel protective equipment The length of time employees spend in areas with elevated levels of radioactive or toxic matenals will be minimized If conditions produce airborne contaminants, dust- suppressant measures will be taken Pnor to onsite charactenzation activities at the Sludge Drying Beds, a Rocky Flats Plant Safety Evaluation Form will be completed and submitted

6 2 Sampling Protocol

The sampling and analysis activities will be implemented using procedures to assure that the precision, accuracy, completeness, and representativeness of data are known and documented At a minimum, this will include adherence to the Environmental Restoration (ER) Program Quality Assurance/Quality Control (QA/QC) Plan The QA/QC Plan presents the organization, objectives, functional activities, and specific quality assurance and quality control activities associated with the ER Program The QA/QC Plan is designed to achieve specific data quality goals for ER Program sampling the analysis activities at the Rocky Flats Plant Procedures and objectives of sampling activities will comply with EG&G's Quality Assurance/Quality Control Plan (Rockwell International 1989a)

7.0 REFERENCES

EG&G, 1990a, Draft Geologic Characterization Report, Rocky Flats Plant, Golden, Jefferson County, Colorado, January

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____, 1990c, Groundwater Protection Monitoring Program, Rocky Flats Plant, Golden, Jefferson County, Colorado, May

____, 1990d, Sewage Sludge Drying Capacity, correspondence, Rocky Flats Plant, Golden, Jefferson County, Colorado, May

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____, 1989b, Quality Assurance/Quality Control Plan, Environmental Restoration Program, Rocky Flats Plant, Golden, Jefferson County, Colorado, January

____, 1989c, 1988 Annual RCRA Ground-Water Monitoring Report for Regulated Units at Rocky Flats Plant, Golden, Jefferson County, Colorado, March

____, 1989d, Background Geochemical Characterization Report, Rocky Flats Plant, Golden, Jefferson County, Colorado, December

____, 1989e, Status on the Regulatory Classification/Identification of Sewage Sludge, correspondence, Rocky Flats Plant, Golden, Jefferson County, Colorado, December

____, 1987, Waste Stream Identification, Rocky Flats Plant, Golden, Jefferson County, Colorado, April

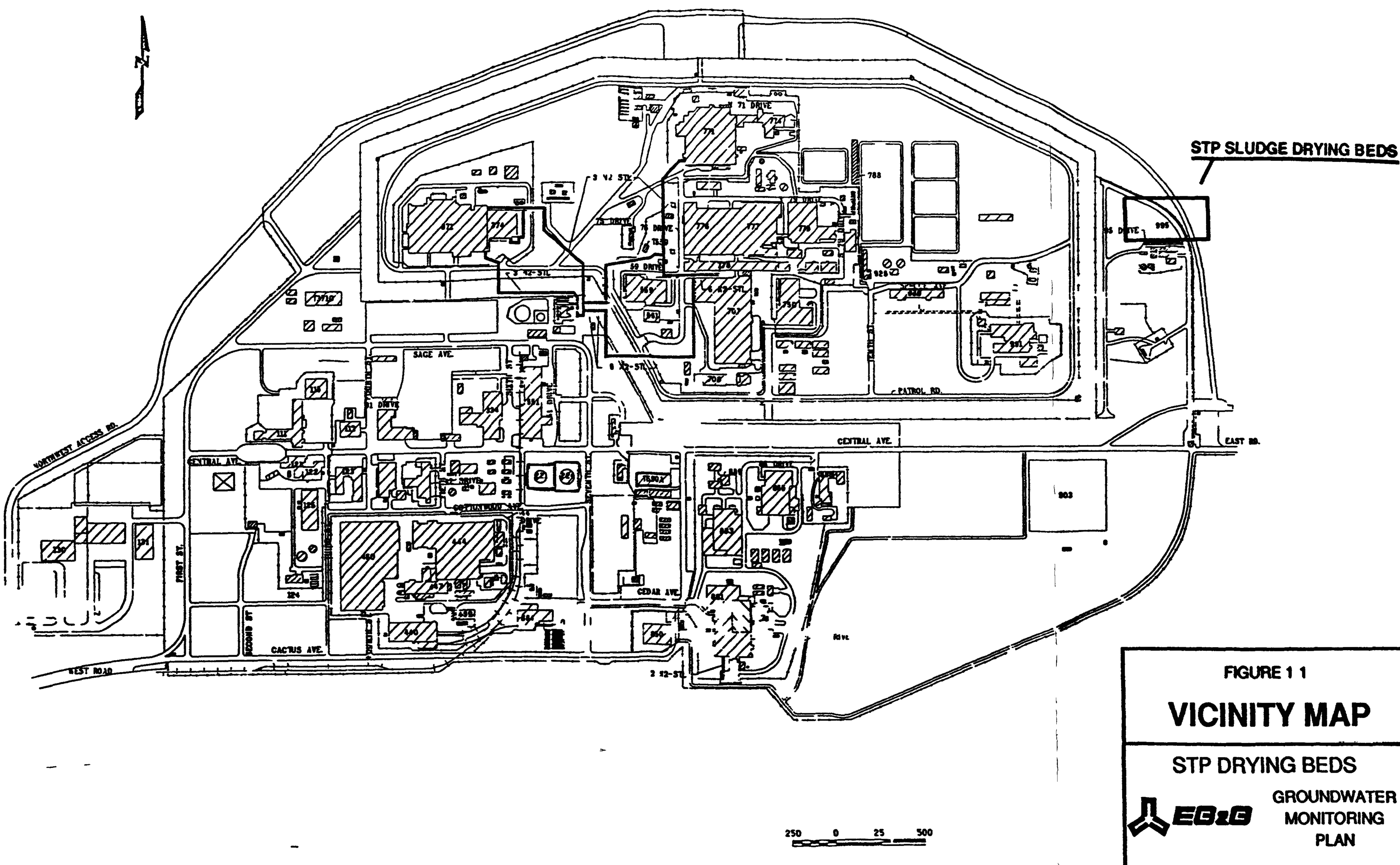


FIGURE 1 1

VICINITY MAP

STP DRYING BEDS

EG&G GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

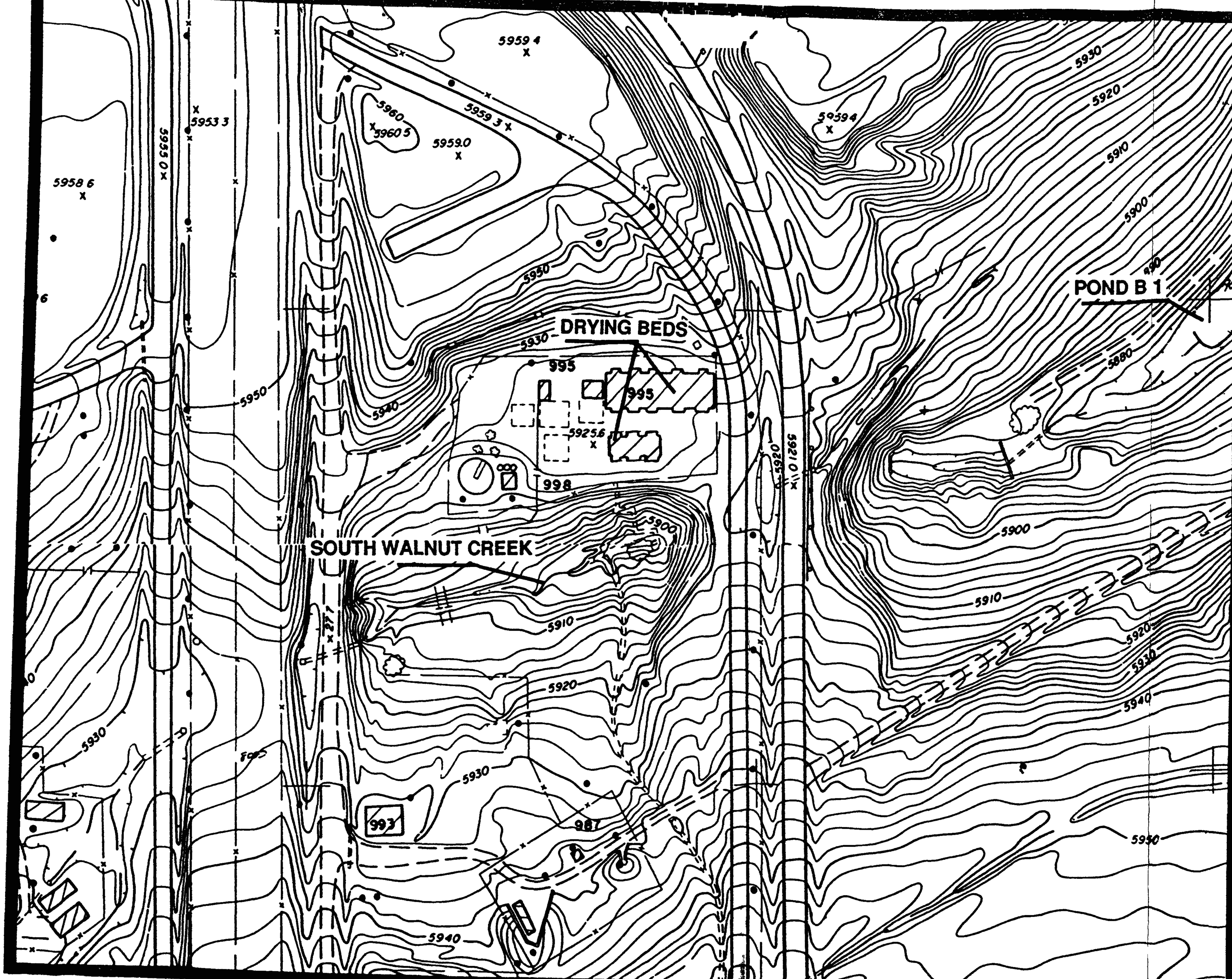


FIGURE 1 2

SITE LOCATION MAP

STP DRYING BEDS

EG&G

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

SCALE 1" = 100'

50 0 100 Feet

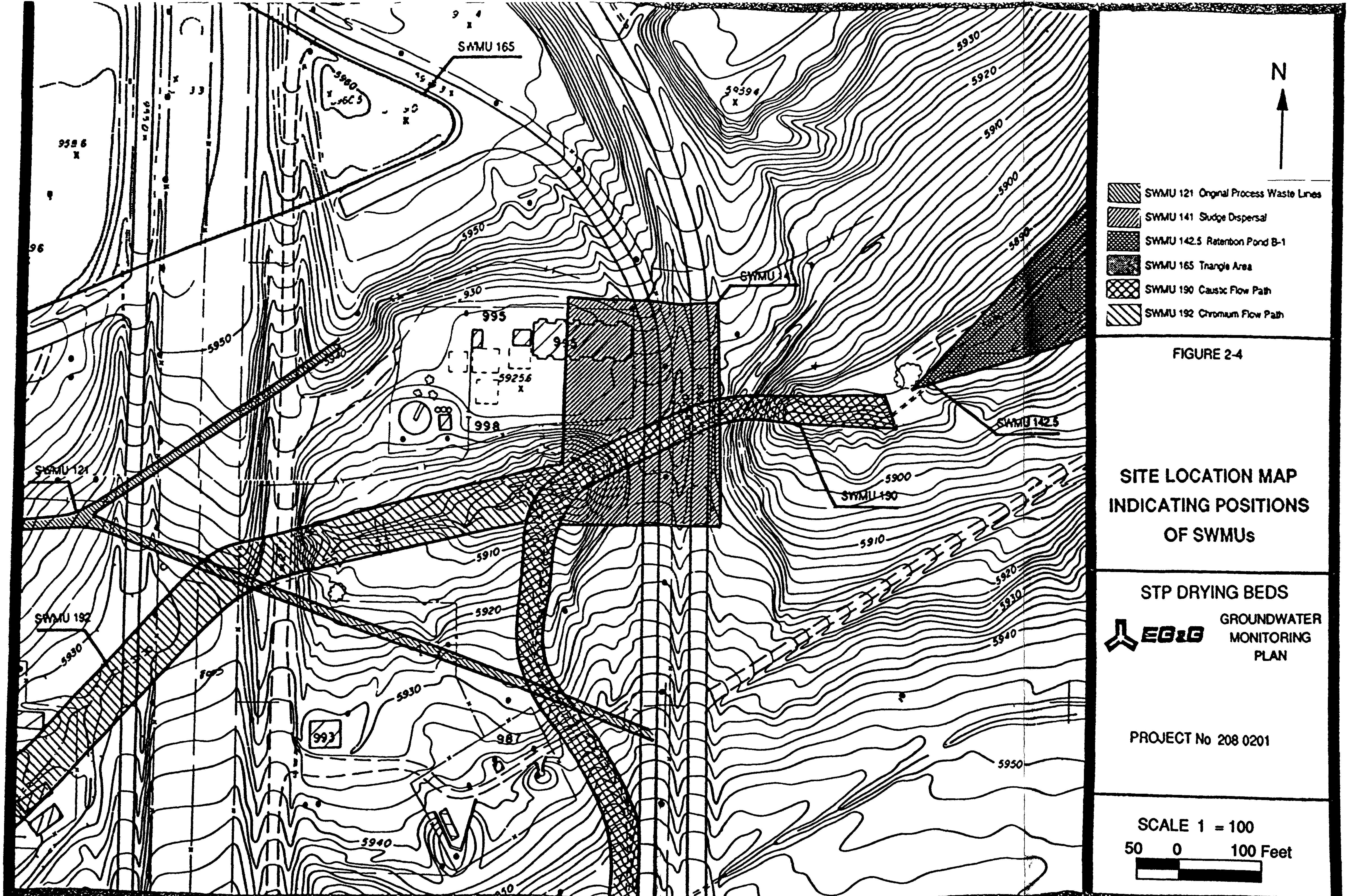


FIGURE 2-4

SITE LOCATION MAP INDICATING POSITIONS OF SWMUs

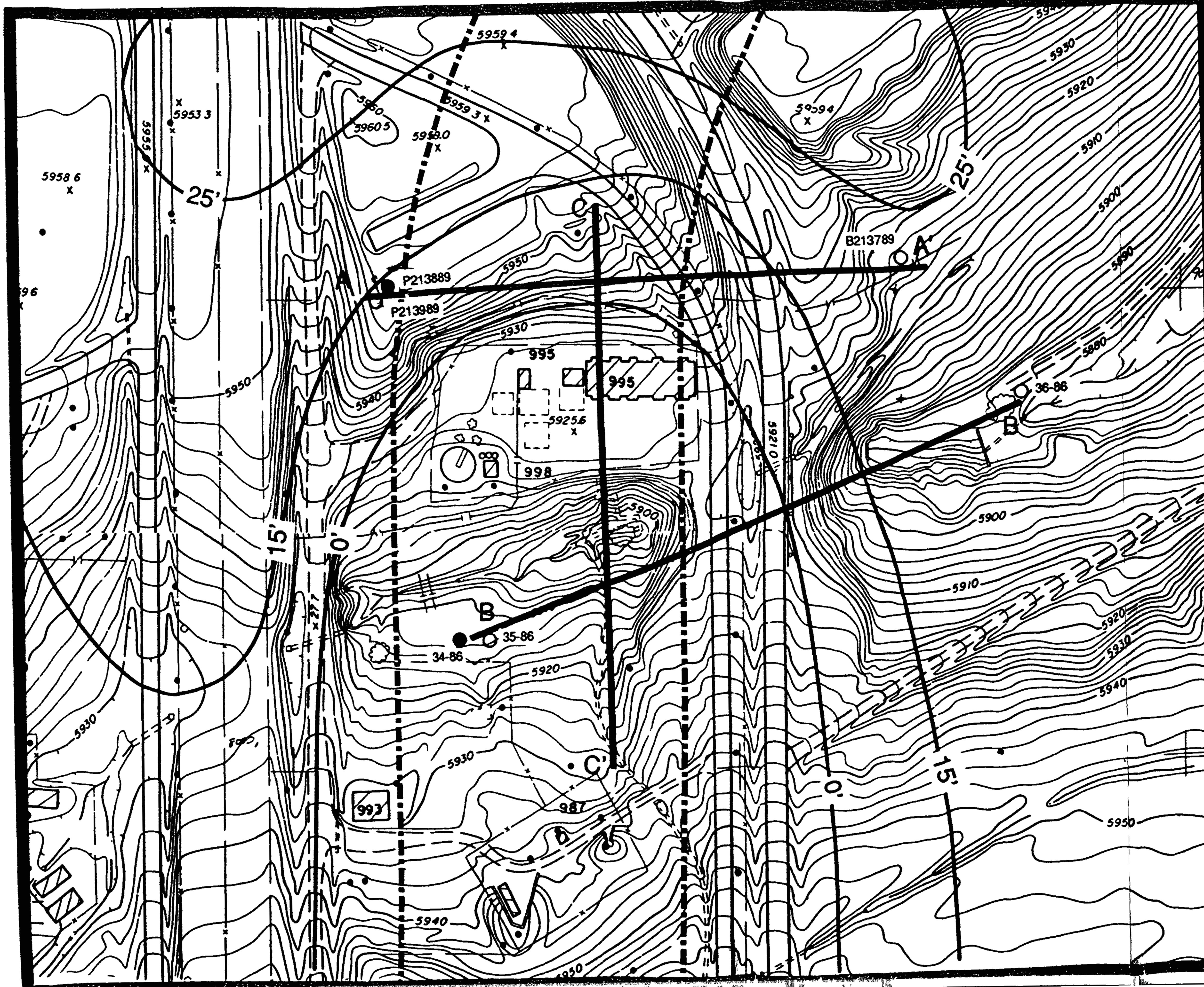
STP DRYING BEDS

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

SCALE 1 = 100

50 0 100 Feet



N

SANDSTONE #1

SANDSTONE #3

● Bedrock Monitoring Well

○ Alluvial Monitoring Well

FIGURE 3 1

ISOPACH MAP WITH CROSS SECTIONS

EG&G

GROUNDWATER MONITORING PLAN

PROJECT No 208 0201

SCALE 1" = 100

50 0 100 Feet