WORK PLAN
REVISION 2A

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SEDIMENT OPERABLE UNIT COMBINED DESIGN INVESTIGATION TASK WORK PLANS

FIELDS BROOK SITE
ASHTABULA, OHIO

SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION (VOLUME 3)

Prepared for
Fields Brook PRP Organization
September 1993

Woodward-Clyde

Woodward-Clyde Consultants
122 South Michigan Ave., Suite 1920
Chicago, Illinois 60603

Project Number: 86C3609 N

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LIST OF ACRONYMS

ACT	accelerated column test
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BAT	Best Available Technology
BCT	Best Conventional Technology
BMP	Best Management Practice
BOD	biochemical oxygen demand
CDI	Combined Design Investigation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Certified Laboratory Program
CST	Capillary Suction Time
DI	Design Investigation
DQOs	Data Quality Objectives
Eh	Reduction Oxidation Potential
FS	Feasibility Study
FSDI	Facility Siting Design Investigation
FSP	Field Sampling Plan
GAC	granular activated carbon
FBPRPO	Fields Brook Potentially Responsible Parties Organization
HSL	Hazardous Substance List
HSWA	Hazardous and Solid Waste Amendment
K_{oc}	partition coefficient
MCL	Maximum Contaminant Level

K_{oc} - the distribution coefficient between the organic content of the adsorbent (sediments) and the contaminant of interest

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LIST OF ACRONYMS (Continued)

NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
OSHA	Occupational Safety and Health Administration
PACT	powdered activated carbon technology
PCBs	polychlorinated biphenyls
POTW	Publicly Owned Treatment Works
PRPs	Potentially Responsible Parties
QAPjP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SCRI	Source Control Remedial Investigation
SDWTDI	Sediment Dewatering and Wastewater Treatment Design Investigation
SLDI	Solidification Design Investigation
SOP	Standard Operating Procedure
SOU	Sediment Operable Unit
SOUEDI	Sediment Operable Unit Engineering Design Investigation
SOW	Statement of Work
SQDI	Sediment Quantification Design Investigation
SSP	Site Safety Plan
SVOCs	Semi-volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TDS	total dissolved solids
TSCA	Toxic Substance Control Act

LIST OF ACRONYMS (Concluded)

TSS	total suspended solids
TTDI	Thermal Treatment Design Investigation
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VOCs	Volatile Organic Compounds
WCC	Woodward-Clyde Consultants

EXECUTIVE SUMMARY

The Fields Brook site, as defined in the Unilateral Administrative Order (U.S.Environmental Protection Agency [USEPA] 1989a), consists of Fields Brook, its tributaries, and surrounding areas that contribute, potentially may contribute, or have contributed to the contamination of Fields Brook and its tributaries. The site is located in northeastern Ohio in Ashtabula County.

This Fields Brook Sediment Operable Unit (SOU) work plan identifies the scope of work for the Sediment Dewatering and Wastewater Treatment Design Investigation (SDWTDI) and identifies objectives and describes the specific activities of the work to be conducted.

The Fields Brook Record of Decision (ROD), dated September 30, 1986 (USEPA 1986a), recommends the excavation of contaminated sediments from Fields Brook, the temporary storage and dewatering of excavated materials, thermal treatment of a portion of the excavated materials (i.e., sediments), and solidification and landfilling of the remaining materials. Waters and other aqueous waste streams generated during the excavation of the sediments, dewatering, thermal treatment, solidification or collected within the temporary storage cell of the Resource Conservation and Recovery Act/Toxic Substance Control Act (RCRA/TSCA)-type landfill will be treated on-site with system(s) using filtration and granular activated carbon (GAC). Treated water will be discharged under an approved permit to either the Ashtabula Publicly Owned Treatment Works (POTW) or directly to Fields Brook/Ashtabula River or one of its tributaries in accordance with National Pollutant Discharge Elimination System (NPDES) requirements.

The objectives of the SDWTDI, as stated in the USEPA Statement of Work (SOW) SOU dated 14, March 1989 (USEPA 1989b) are to:

- Evaluate the physical and chemical characteristics of aqueous waste streams that could require treatment prior to discharge from Fields Brook site remedial actions, and determine the relative dewaterability of sediments;

- Re-evaluate applicable treatment technologies based upon results of waste stream characterization;

- Establish treatment efficiency of filtration and GAC on selected representative waste streams;

- Evaluate variation in flow and chemical characteristics of aqueous waste streams;

- Identify Applicable or Relevant and Appropriate Requirements (ARARs) pertinent to wastewater treatment and discharge, as required by the SOW; and

- Develop data necessary for performance specifications for vendor design, construction and operation of the wastewater treatment unit.

To achieve the stated objectives, the following activities must be implemented:

- Field sampling,
- Physical and chemical testing and characterization,
- Treatment technology evaluation,
- Bench-scale treatability tests, and
- Physical and chemical testing and characterization of the process residuals generated during bench-scale testing.

Field sampling of sediment, surface water, groundwater, and free liquids removed from dewatered sediments will be conducted. The identified locations for these field samples will be coordinated with the thermal treatment design investigation (TTDI), the solidification design investigation (SLDI), and the Source Control Remedial Investigation (SCRI). Sampling and analysis of the field samples will be performed in accordance with the SDWTDI Field Sampling Plan (FSP), the SOU Quality Assurance Project Plan (QAPjP), and the Site Safety Plan (SSP), as amended. Sediment samples will be collected and used as part of the dewaterability evaluation, material handling characterization, and testing. Water samples (i.e., surface water, groundwater and free liquids) will be collected and analyzed for physical and chemical characterization, and will be used as part of the bench-scale treatability tests.

To evaluate the relative dewaterability of the excavated sediments from Fields Brook, physical testing and bench-scale testing will be conducted. The bench-scale tests include:

- Gravity Drainage Test,
- Capillary Suction Time Test,
- Buchner Funnel Test,
- Filter Leaf Test, and
- Filter Press Test.

The sediment samples will be tested for moisture content before and after each bench-scale test as a measure of the effectiveness of the dewatering process. The results of these dewatering tests will be used to estimate the quantity of water generated during the dewatering process and will provide preliminary data on the sediments for both the thermal and solidification treatment systems.

The results of the physical and chemical characterization of the various water streams will be used to evaluate the need for additional removal/treatment and/or identify technologies other than filtration and GAC that meet potential discharge requirements. Additional treatment technologies to be evaluated following waste stream characterization include precipitation, air stripping, ultraviolet (UV) oxidation, chemical oxidation, and biological treatment. This review of technologies will focus on identifying the treatment train that enables compliance with the discharge limitations.

To generate information on the effectiveness of specific technologies, bench-scale treatability testing will be conducted. Treatability test samples will be prepared to represent a range of solids loadings and compositions of aqueous waste streams anticipated during remediation activities. Preliminary treatability tests will include suspended solids removal tests (coagulation and flocculation) and carbon adsorption tests. The suspended solids removal tests will use different polymers and filter aids to evaluate the effectiveness of solids removal. The GAC tests will consist of a series of test runs to evaluate organics removal through GAC from waters and aqueous wastes generated during remedial activities.

Additional technologies for organics removal may require treatability testing and will be incorporated into the existing treatability test program, on an as needed basis. These organic removal technologies specifically include bioremediation, UV oxidation and chemical oxidation. The performance of these treatability tests will be evaluated following review of the physical and chemical characterization data of the aqueous waste streams, and preliminary treatability test results.

In addition to the treatability tests for solids and organics removal, a metals precipitation treatability test will be performed. This test will be conducted if data from the physical and chemical characterization of the aqueous waste streams indicate the concentrations of metals may exceed the discharge limitations.

Physical/chemical data and treatability test results will be evaluated and presented in the SDWTDI report. The report will summarize the work performed in the SDWTDI and present the data and design criteria developed from the investigation. Preliminary order-of-magnitude costs to perform both full-scale dewatering and wastewater treatment activities will be generated based on the data and information collected during the SDWTDI. Recommendations for performance of additional studies and tests will also be provided, on an as needed basis.

1.0 INTRODUCTION

1.1 BACKGROUND

The Record of Decision (ROD), dated September 30, 1986 (U.S. Environmental Protection Agency [USEPA] 1986a), identified thermal treatment and solidification as viable remedial options for treatment of sediments removed from Fields Brook and its tributaries. The Sediment Dewatering and Wastewater Treatment Design Investigation (SDWTDI) was required as part of the Sediment Operable Unit Engineering Design Investigation (SOUEDI) Statement of Work (SOW), dated March 14, 1989 (USEPA, 1989b), to evaluate the dewaterability of the excavated materials (i.e., sediments) and the treatment of aqueous waste streams generated during remedial activities. This document is submitted as part of the Combined Design Investigation (CDI) Task Work Plans, Revision 2, and incorporates USEPA and Ohio Environmental Protection Agency (OEPA) comments from January 8, 1993, on the CDI Report, Revision 1, submitted to the agencies on October 13, 1992.

Available data and information on the sediments, reported in the Remedial Investigation (RI) (USEPA 1985), Feasibility Study (FS) (USEPA 1986b), and Sediment Quantification Design Investigation (SQDI) Phase I Analytical Data (WCC 1991) reports, have identified the presence of a variety of organic compounds and metals in the sediments of Fields Brook and its tributaries. The ROD (USEPA 1986a) requires on-site thermal treatment of sediments contaminated with high mobility organic contaminants that exceed the ROD-defined 10^{-6} health risk level and/or sediments with polychlorinated biphenyls (PCBs) levels exceeding 50 ppm. Solidification was recommended for the treatment of excavated sediments which do not require thermal treatment. Excavated sediments may require dewatering prior to thermal or solidification treatment. In addition to sediment dewatering, treatment operations and other site remedial activities may generate wastewaters requiring treatment prior to discharge.

High mobility organic contaminants are defined as organic compounds with a sediment-water partition coefficient (K_{oc}) less than 2,400 ml/g. Table 1-1 lists the K_{oc} values for selected chemicals. In addition to K_{oc} values and PCB concentrations, there are several additional key chemical and physical parameters of interest to the DIs. Table 1-2 presents information on these key chemical and physical parameters. These data were identified on the basis of sediment concentrations reported in the RI, FS and SQDI Phase I Analytical Data.

1.2 SEDIMENT DEWATERING AND WASTEWATER TREATMENT OBJECTIVES

Sediment dewatering and wastewater treatment testing is required to support the design of the dewatering procedures, sediment treatment system(s) and other remedial activities (i.e., materials handling issues). A preliminary aqueous waste stream source identification and characterization will be performed to provide physical and chemical characterization of the wastewaters and other aqueous waste streams generated during remedial activities. Sediment testing will be performed to evaluate both the assisted and unassisted dewaterability of the excavated materials. The necessity and extent of sediment dewatering will be evaluated based on analyses and testing performed in conjunction with the Thermal Treatment Design Investigation (TTDI) and Solidification Design Investigations (SLDI). Other objectives of the SDWTDI include:

- Re-evaluation of applicable treatment technologies based upon the results of waste stream characterization;
- Determination of the efficiency of filtration and GAC treatment technologies on selected aqueous waste streams;
- Evaluation of variations in flow rate and physical/chemical characteristics of the aqueous waste streams;
- Identification of ARARs pertinent to wastewater treatment and discharge; and
- Generation of data necessary to support the development of performance specifications for vendor design, construction and operation of the wastewater treatment system.

2.0
ADMINISTRATIVE TASKS

2.1 PROJECT MANAGEMENT

Project management includes coordination of tasks specific to the SDWTDI as well as other related DIs of the SOU. Project management duties include project and individual work planning, monthly and other periodic reporting requirements, interaction and communication with the USEPA and OEPA, management and monitoring of project team progress, and monitoring of the technical aspects of the work.

Figure 2-1 presents a general Project Organization Chart for the Fields Brook Project SOU, DI phase. The SOU Project Manager will be responsible for implementing the DI task work and will report directly to the WCC Senior Project Manager. The Senior Project Manager will be responsible for coordinating all administrative and technical activities of the Fields Brook project.

In addition to WCC project management, the Fields Brook Potentially Responsible Parties Organization (FBPRPO) has appointed Mr. Joseph A. Heimbuch of de maximus, inc., as the Technical Project Coordinator. Mr. Heimbuch or, in his absence, Mr. Michael Percival of de maximus, inc., will have the primary responsibility for coordinating work at the site, interfacing with the WCC Senior Project Manager, and communicating with the USEPA and OEPA.

2.2 QUALITY ASSURANCE/QUALITY CONTROL

This section outlines the policies and procedures necessary for producing deliverables of known and acceptable quality. The Quality Assurance (QA) Program consists of a set of procedures that monitor the appropriate application of quality control throughout the program, and that delineate any nonconformities to allow for implementation of corrective measures in a timely manner. The procedures that follow will assure the precision, accuracy, completeness, and representativeness of the information generated and/or collected during performance of the SDWTDI.

The QA process sets specific information control tasks and monitors project performance to assure that the quality of deliverables addresses and meets the specific project objectives and requirements. Information control tasks include:

- Objectives management,
- Data gathering management, and
- Data assessment management.

QA functions are applied at various steps in the monitoring and control of information including:

- Quality control (QC) checks and reviews, and
- Peer reviews.

The WCC QA process is shown in Figure 2-2.

2.2.1 Objectives Management

The objectives for data quality during performance of the SDWTDI tasks will be based upon Data Quality Objectives (DQOs) for Remedial Response Activities (USEPA 1987). Data quality objectives were developed following a review of existing data pertinent to the SDWTDI and are discussed in Section 3.2.

A SOU Quality Assurance Project Plan (QAPjP) has been developed that includes work under the SDWTDI Work Plan. The QAPjP provides sample acquisition and testing procedures required to provide data of sufficient quality to meet the DQOs of the SDWTDI Work Plan. The QAPjP also contains quality control procedures which will be implemented to verify that sample and non-sample data acquisition has been properly obtained and reported.

2.2.2 Data Gathering Management

The data gathering management task includes control and review of data verification and storage steps during field activities.
Field activities are broken into two major categories:

- Sample acquisition, and
- Non-sampling data acquisition.

The analytical data generated by the laboratories under the SDWTDI Work Plan will be evaluated for precision, accuracy, and completeness. The data validation process for this project will consist of data generation, reduction, and two levels of review and validation in accordance with Section 10 of the SOU QAPjP.

A quality control review team will be assembled prior to implementation of field activities. The review team will perform periodic internal review of project files, field audits during field activities, and project progress. A QA/QC plan is included in the QAPjP.

2.2.3 Data Assessment Management

The data assessment management task includes a review of the useability of the verified data and identification of the data's intended use for the generation of project reports and documents. The QA process relies upon peer reviews of generated documents to assess and evaluate the appropriate data usage. Peer reviews will be performed at the senior peer review, peer review, and calculation checking level. Senior peer reviews will be provided periodically through out the duration of the project, especially at major deliverable levels (e.g., major reports). Technical documents containing recommendations or evaluations will be peer reviewed during its generation and prior to final submission. Calculations (e.g., volumes of contaminated materials, costs of remediation) will be checked and initialed by the checker on each calculation page.

The overall QA process will be controlled by the WCC Business Unit QA Officer, who reports directly to the WCC Corporate QA Officer.

2.3 REVIEW MEETINGS

A minimum of two review meetings with the USEPA and OEPA should be scheduled during the execution of the SDWTDI to review and monitor project progress. An initial meeting should be scheduled at the beginning of the SDWTDI to review and confirm the scope of work. A second meeting should be scheduled prior to submission of the SDWTDI report to discuss test results.

3.0 PREPARATORY TASKS

3.1 DESCRIPTION OF POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

In accordance with the SOW for the SDWTDI, potential ARARs must be identified for the treatment and discharge of wastewater. In addition to the identification of potential ARARs associated with the treatment and discharge of aqueous waste streams, the potential ARARs for the disposal of the wastewater treatment sludge and other residual materials generated during dewatering and treatment will also be identified. A description of the requirements associated with the identification of potential ARARs will be provided in this section.

This section addresses the potential ARARs that will be evaluated to establish a technical basis for remedial actions associated with the SDWTDI. ARARs associated with other remedial activities at the site are addressed in the specific DI work plans.

3.1.1 Statutory Basis for ARARs

The Superfund Amendments and Reauthorization Act of 1986 (SARA), Public Law 99-499, Section 122(a), added Section 121 to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regarding cleanup standards for Superfund sites.

The Fields Brook Record of Decision (ROD) was signed on September 30, 1986, less than one month prior to the enactment of SARA. Therefore, ARARs, including State ARARs, as defined in SARA and the current National Contingency Plan (NCP), and the other provisions of Section 121 do not apply to the Fields Brook Sediment Operable Unit.

The ARARs originally specified by the 1985 NCP (see 50 FR 47917) do apply. Although the same terminology was used and the same federal regulations are considered ARARs pursuant to the 1985 NCP and SARA, these two types of ARARs operate fundamentally differently.

SARA rigidly requires all remedial actions to meet ARARs unless a waiver has been granted. The 1985 NCP ARARs were used as general guidelines in determining the extent of the remedial action (as a matter of policy) (50 FR 47917). These 1985 ARARs are much more flexible in their application than the SARA ARARs. In effect, the nonbinding and flexible ARARs in the 1985 NCP were and are the ARARs applicable to the implementation of the Fields Brook ROD.

Additionally, it is EPA policy "to 'freeze ARARs' when the ROD is signed rather than at initiation of remedial action because continually changing remedies to accommodate new or modified requirements would ... disrupt CERCLA cleanups." (55 FR 8757) This policy applies with even more force for pre-SARA RODs. SARA Section 121(b) provides that the "requirements of Section 121 of CERCLA shall not apply to any remedial action for which the Record of Decision was signed . . . before the date of enactment" (PL 99-499, Section 122(b)).

3.1.2 Definition of ARARs

The following definitions of "applicable" and "relevant and appropriate" are presented in the 1985 NCP. The NCP consists of the regulations that implement the provisions of the CERCLA law as of September 30, 1986.

> Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site.

"Applicability" implies that the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement.

> Relevant and Appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

The determination that a requirement is relevant and appropriate is a two-step process: (1) determination must be made as to whether a requirement is relevant, and (2) determination must be made as to whether a requirement is appropriate. Generally, this involves a comparison of a number of site-specific factors, including the characteristics of the remedial action, the hazardous substances present at the site, or the physical circumstances of the site, with those addressed in the statutory or regulatory requirement.

There are several different types of requirements with which CERCLA actions must comply. To provide some guidance on how to identify and comply with ARARs, the following classification system was developed:

> Chemical-specific requirements are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.
>
> Action-specific requirements are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste.
>
> Location-specific requirements are restrictions placed on the concentration of hazardous substances or conduct of activities solely because they occur in special locations.

3.1.3 Federal and State RCRA Requirements

Federal regulations under RCRA establish minimum national standards defining the acceptable management of hazardous waste. States can be authorized by EPA to administer and enforce RCRA hazardous waste management programs in lieu of federal programs if the states have equivalent statutory and regulatory authority. Where the CERCLA site is located in a state such as Ohio, with an authorized RCRA program, the State of Ohio's promulgated RCRA requirements are to be considered requirements but are not potential ARARs.

A review of both the RCRA regulations and the Ohio hazardous waste regulations will be conducted, to determine if any of these regulations should be considered. Once this review is completed, a determination will be made as to which regulations would be followed at the site.

3.1.4 Identification and Screening Procedures for Potential ARARs

The identification of potential ARARs for the Sediment Dewatering and Wastewater Treatment Design Investigation remedial alternative involves the following four steps: (1) review federal and State of Ohio environmental statutes and regulations identified in the ROD, (2) evaluate their applicability to the treatment alternative, (3) evaluate their relevance or appropriateness to the treatment alternative, and (4) screen out those requirements that are not applicable, relevant or appropriate for the treatment alternative.

Presented below is the list of potential federal and State of Ohio regulatory requirements which will be reviewed for applicability, relevancy and appropriateness. A through review of the ARARs identified below will be conducted in conjunction with the treatability test tasks.

<u>Occupational Safety and Health Regulations</u> (29 CFR 1910 and 1926)

The Occupational Safety and Health Administration (OSHA) has promulgated a comprehensive set of occupational health and safety standards. These regulations take a two-pronged approach to worker safety by establishing safe working practices, as well as safe levels of exposure to a variety of materials. These regulations are applicable during the remedial activities.

Clean Water Act, National Pollutant Discharge Elimination System
(40 CFR 122, 125, 129, 133)

These regulations control point source discharges to waters of the United States. Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis. Water quality based effluent limitations are based on state narrative and numeric water quality criteria. Water quality criteria are based on type of stream and type of pollutants discharged to the stream. Best management practices (BMP) to control toxic discharges must also be considered.

These regulations are potentially applicable if treated wastewater is discharged from the site to Fields Brook or the Ashtabula River.

Clean Water Act, EPA Pretreatment Standards
(40 CFR 403)(40 CFR 122, 125, 129, 133)

These requirements regulate the discharge of industrial users to Publicly Owned Treatment Works (POTW). It prohibits introduction of pollutants to a POTW that "pass-through" [exit the POTW in quantities or concentrations that violate the POTW's National Pollutant Discharge Elimination System (NPDES) permit] or cause "interference" (inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal, thereby causing a violation of the NPDES permit). These standards also prohibit the following from entry into a POTW:

- Pollutants which create a fire or explosion hazard, including but not limited to, waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21;

- Pollutants which will cause corrosive structural damage;

- Solid or viscous pollutants that will obstruct flow, pollutants discharged at a flow rate and/or concentration that will cause interference, and/or harm sanitary workers;

- Heat that will inhibit biological activity;

- Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

- Pollutants which will result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and

- Any trucked or hauled pollutants, except at discharge points designated by the POTW.

These regulations would be applicable if treated wastewater from the site is discharged to the local POTW.

Safe Drinking Water Act (40 CFR 141 and 143)

The Safe Drinking Water Act establishes primary drinking water quality standards to protect human health and secondary water quality standards to ensure the aesthetic quality of drinking water. These standards are referred to as Maximum Contaminant Levels (MCLs). For water that is to be used for drinking, the MCLs are generally applicable or relevant and appropriate. MCLs are applicable where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. If MCLs are applicable, they are applied at the tap. In addition, MCLs are relevant and appropriate as in situ cleanup standards where either surface water or groundwater is or may be used for drinking water.

If the treated wastewater from the site is discharged to Fields Brook or the Ashtabula River and either of those bodies of water is used for drinking water, then MCLs will be considered relevant and appropriate for site remediation.

Ohio NPDES Program (OAC 3745-33-01)

These rules regulate the point source discharge to waters of the state. A point source discharge to waters of the state must comply with applicable water quality standards, as well as applicable effluent limitations (national effluent limitations, national standards for new sources, and national toxic and pretreatment effluent limitations).

Ohio Water Quality Standards (ORC Chapter 3745-1)

These regulations define ambient surface water quality criteria. Fields Brook must meet the narrative and numerical water quality standards. Fields Brook is designated as a limited warm water aquatic life habitat; agricultural and industrial water supply; and primary contact for recreation (3654-1-14). Warm water criteria are used for limited warm water streams. However, individual criteria for limited warm water streams may vary and may supersede the criteria for warm water habitat.

These regulations are applicable if wastewater from the site is discharged to Fields Brook.

Ohio Drinking Water Regulations (OAC Title 3745, Chapter 81 and 82)

The Ohio primary and secondary drinking water standards are the same as the national drinking water standards except that the pH is 7.0-10.5.

If the treated wastewater from the site is discharged to Fields Brook or the Ashtabula River and either of those bodies of water is used for drinking water, then the Ohio primary or secondary drinking water standards will be considered relevant and appropriate for site remediation.

Ohio Hazardous Waste Generator Standards (OAC Title 3745, Chapter 52)

These regulations specify standards for owners/operators at facilities where hazardous waste is generated. These requirements include standards for the storage of hazardous waste, the need to manifest waste shipped off site, and pre-transport requirements.

Ohio Hazardous Waste Management (OAC Title 3745, Chapter 55)

These regulations regulate the treatment and storage of hazardous waste. If hazardous waste is stored on site, then it must be stored in compliance with the regulations for containers, tanks, surface impoundments, or waste piles. These regulations also specify the design and operating standards that must be met for the treatment of hazardous waste.

RCRA Hazardous Waste Generator Standards (40 CFR 262)

These regulations stipulate requirements for owner/operators that generate hazardous waste. Requirements include procedures for identifying/classifying hazardous waste, design and operating standards for the storage of hazardous waste, and manifest procedures for off-site shipment of waste.

RCRA Storage Requirements (40 CFR 264)

These regulations define the design and operating standards for units that are used to store or treat hazardous waste. If hazardous wastes are to be stored on site, then the storage area must comply with the regulations for containers (Subpart I), or tanks (Subpart J). Design and operating standards for treatment of hazardous waste in a unit can be found at the following citations: tanks (40 CFR 264.190-192), surface impoundments (40 CFR 264.221), incinerators (40 CFR 264.343-345), and miscellaneous units (40 CFR 264.601).

3.2 APPROACH AND DATA QUALITY OBJECTIVES

3.2.1 Approach

The SDWTDI is one of five DIs to be conducted in support of the remedial design for the Fields Brook SOU. The interactions among these DIs is illustrated in Figure 3-1. A field sampling program is required to collect sample materials for the dewaterability evaluation and treatability tests. Some of the SDWTDI treatability test samples will be collected in conjunction with the field sampling for the TTDI and SLDI.

The SDWTDI testing will produce sludges and other residual materials generated during metals precipitation and suspended solids removal testing. The characteristics of the sludge will be established by both physical and Toxicity Characteristic Leachate Procedure (TCLP) testing. Samples of these sludges may be incorporated into the DIs and testing programs conducted as part of the SLDI. (This testing will be based on the results of the TCLP test results and will be conducted in the event that the materials indicated properties of hazardous materials.)

The Facility Siting Design Investigation (FSDI) is intended to evaluate and recommend the final location for installation of the required facilities in support of the Fields Brook remedial activities. The FSDI will require an exchange of information generated during the SDWTDI regarding spacial area requirements for the aqueous treatment facility(ies), site access, and materials handling requirements.

Finally, Phase II sampling and analysis for the SQDI will provide additional chemical and physical characterization of the site sediments. The SQDI will provide refined estimates of the extent and degree of contamination, further define the areas of sediments which will require excavation followed by thermal or solidification treatment, and improved estimates of the volume of material to be treated.

The SDWTDI objectives will be addressed through field activities, dewaterability evaluation, physical and chemical testing, data analysis, technology evaluation and treatability testing, and preparation of a design investigation report. The design investigation will consist of the following primary activities:

- Sample collection of sediment, surface water, groundwater, and free liquids removed from dewatered sediment samples;
- Chemical and physical characterization of the sediments, surface water, groundwater and free liquid samples;
- Aqueous waste stream source identification and quantification;
- Wastewater treatment technology evaluation;
- Bench-scale testing including sediment dewaterability evaluation and treatability testing;
- Chemical and physical characterization of the process residuals (supernatant, filtrate, sludge, filter cake) generated during the bench-scale testing;
- Validation and evaluation of the chemical and physical analyses data; and
- Preparation of a SDWTDI Report.

Proper sample collection is essential for providing representative samples on which the subsequent characterization, treatability testing and technology evaluation will be based. Sediment and water sampling will be performed to obtain representative materials for treatability and dewatering testing. Collection, testing and use of these samples will be coordinated with activities performed as part of the TTDI, SLDI and the Source Control Remedial Investigation (SCRI).

As part of the primary activities for the SDWTDI, representative sediments will be collected from several areas for use during bench-scale demonstration of the effectiveness of dewatering. Surface water within the sediment sample areas will be obtained and analyzed to aid in the characterization of waters generated during remedial activities. In addition, free liquids released during staging and dewatering of the sediment samples and groundwater samples will be collected to characterize potential inflows during sediment excavation.

The sediments will be physically and chemically characterized as part of the TTDI, SLDI and during the aqueous waste stream characterization and dewaterability evaluation portion of the SDWTDI. Sediments collected for the dewaterability evaluation will be characterized to determine the physical properties of the materials both before and after dewatering tests. Surface water, groundwater and free liquids removed from dewatered sediments will be chemically characterized to supply data necessary to establish treatment system performance criteria and to evaluate the effectiveness of the technologies demonstrated during the bench-scale tests.

The chemical characterization will include analysis for Target Analyte List/Target Compound List (TAL/TCL) parameters and other water quality parameters (i.e., hardness, total suspended solids (TSS), total dissolved solids (TDS) and oil & grease). Physical characterization will include measurement of unit weight (density), moisture content, unconfined compressive strength, and other parameters. As required, the data will be used to evaluate treatment technologies. The samples used for characterization will be composited and combined to generate test samples for the bench-scale dewaterability evaluation and treatability testing. The bench-scale tests will include metals precipitation, suspended solids removal, and gravity and mechanical dewatering tests. The residual products generated from the bench-scale tests (i.e., supernatant, sludge) will be sampled and analyzed to determine their physical and chemical properties. TCLP tests will be conducted on the sludges to evaluate disposal options via solidification.

The analytical data generated during performance of these tests will be validated and reviewed during preparation of the design investigation report. This report will describe the test procedures, results and relative effectiveness of the demonstrated dewatering and wastewater treatment technologies. The design investigation report will provide recommendations as to additional tests or evaluation programs that may be warranted to support full-scale design for Fields Brook remedial systems.

3.2.2 Data Quality Objectives

DQOs for the SDWTDI must be sufficient to support the evaluation, sizing and design of sediment dewatering and systems for treatment of aqueous waste streams generated during Fields Brook remedial activities. The DQOs will generally be quantitative in nature. USEPA SW-846 Analytical Level 3 protocols and American Society for Testing and Materials (ASTM) methods will be used, as applicable, for chemical and physical analysis of sediments and sludges generated during the treatability tests. USEPA Contract Laboratory Program protocols (Analytical Level 4) will be used for the analysis of baseline characterization samples, verification samples (final test run), and for aqueous waste streams and other waters sampled for parameters including volatile organics, semivolatile organics, pesticides/PCBs, and metals. USEPA SW-846 or equivalent validated methodology will be used for other applicable analyses. The DQOs for each design investigation and testing procedure are defined in the specific sections of this document describing the detailed testing activities.

The QA/QC protocols are discussed in the SOU QAPjP. The QAPjP outlines sampling procedures, methods, data verification, and validation for analytical and physical testing that will be performed during implementation of the SDWTDI.

The data generated in the SDWTDI are expected to be sufficient to:

- Estimate physical and chemical characteristics of wastewaters generated during the remediation;
- Investigate the dewatering characteristics of sediments;
- Measure the ability of GAC to treat wastewaters for TAL/TCL parameters;
- Evaluate the effectiveness of filtration and GAC systems for removal of suspended solids, organics and other compounds that may be included in a discharge permit;
- Identify effective operating parameters of the treatment technologies (polymer requirements, settling time, carbon utilization rates);

- Estimate physical and chemical characteristics of process residuals (supernatant and sludge);
- Generate a first line cost estimate for performance of dewatering and wastewater treatment remedial activities; and
- Provide criteria and performance specifications to support additional design tasks.

3.3 SUPPORT PLANS

Support plans and their addenda and amendments for the SDWTDI Work Plan are as follows:

- Field Sampling Plan (FSP);
- SOU QAPjP; and
- Site Safety Plan (SSP), as amended.

These plans are discussed briefly in the following sections.

3.3.1 Field Sampling Plan (FSP)

The FSP (WCC 1992b) for the SDWTDI is contained in Appendix A. The FSP provides specific details regarding collection, handling, and shipment of samples for the SDWTDI.

3.3.2 Quality Assurance Project Plan (QAPjP)

The SOU QAPjP establishes QA/QC protocols for sample handling, analyses for TCL, TAL parameters, and physical testing of sediments and solidified material. Analytical and physical testing which will be in accordance with the methods specified in Section 9 of the SOU QAPjP for the parameters of interest specified in the SDWTDI Work Plan.

3.3.3 Site Safety Plan (SSP)

The SQDI SSP (WCC 1989), as amended, will be used for activities associated with the SDWTDI. Site work performed in conjunction with the SDWTDI will consist mainly of sediment, and water sampling activities detailed in the SQDI SSP. Revised decontamination procedures are described in the SDWTDI FSP.

4.0
FIELD WORK TASKS

4.1 FIELD WORK SUPPORT

Decontamination facilities, equipment storage, sample staging areas, field preparation activities and office space for use by personnel during field work will be provided and are discussed in Section 2.2 (Mobilization Tasks) of the SDWTDI FSP.

4.2 SAMPLE COLLECTION

Types of samples to be collected during the SDWTDI include surface water, groundwater, free liquids and sediment samples. The sample locations, quantities of materials to be collected, and identification of the selected characterization and treatability testing to be performed are discussed in the following sections. Information regarding sample collection, handling, and documentation are discussed in Section 3.0 of the SDWTDI FSP. Sample locations have been selected based on the location of field samples to be obtained as part of the TTDI, SLDI, FSDI and the SQDI, the location of existing groundwater monitoring wells, and previous field sampling and analysis.

4.2.1 Surface Water

The objectives of the surface water sampling activities are (1) to obtain samples which can be used to characterize and develop water quality data for the aqueous waste streams waters, and (2) to collect samples that will be used to generate representative composite samples for treatability and dewaterability evaluation testing.

Surface water samples for the bench-scale dewaterability evaluation and treatability tests will be collected from the following locations (Figures 4-1 and 4-2):

- Reach 2-1, Cross Section 10,

- Reach 2-2, Cross Section 3,
- Reach 5-1, Cross Section 2,
- Reach 5-2, Cross Section 4,
- Reach 6, Cross Section 1, and
- Reach 11-4, Cross Section 2.

The surface water sampling locations coincide with the location of sediment samples to be collected for the TTDI and SLDI. The collection of surface water samples will be performed during TTDI and SLDI sediment sampling activities. These water samples include standing water and waters collecting in the open excavations during the remedial activities. Surface waters collected in this manner will be representative of aqueous materials resulting from disruption of the surface cover and excavation of sediments.

Surface water samples collected from each of the sampling locations will be characterized for the baseline parameters listed in Table 4-1. Approximately 5 gallons of surface water will be required from each sampling location to perform baseline aqueous waste stream characterization. An additional surface water volume of 10 to 15 gallons from each location will be collected for use in generation of the treatability and dewaterability samples. A total of volume of 100 gallons of surface water will be collected for the SDWTDI. Characterization and/or treatability sample volumes may be adjusted based on actual volumes of surface waters collected.

Each surface water sample will be field measured for the following parameters: pH, turbidity, conductivity, Eh, temperature, and dissolved oxygen. Laboratory analyses of these parameters will also be performed for confirmation. Procedures for field measurement of these parameters are contained in Section 2.4 of the FSP.

4.2.2 Groundwater

The objectives of the groundwater sampling activities are (1) to obtain samples which can be used to characterize and develop water quality data for groundwater inflows, and (2) to collect samples that will be used to generate representative composite samples for the treatability and dewaterability evaluation testing.

Groundwater samples for the bench-scale dewaterability evaluation and treatability testing will be collected from several newly installed groundwater monitoring wells. The location of these wells will be coordinated with the SCRI to place the wells in locations where monitoring wells have not previously been located. Groundwater monitoring wells for SDWTDI will be installed in the following reaches (Figures 4-3 through 4-7):

- Reach 2-1,
- Reach 4,
- Reach 5-2,
- Reach 6,
- Reach 8-2, and
- Reach 13-1.

These monitoring wells will be located within 50 feet of the banks of the Fields Brook and its tributaries in order to obtain samples of water that are representative of potential inflows of water into open excavations. Monitoring wells will be developed and samples collected from purged monitoring wells in accordance with the procedures described in Section 2.4.1 - Groundwater Sampling of the SDWTDI FSP. Details of the monitoring well installation, development procedure and testing procedures are also contained in Section 2.3 of the SDWTDI FSP.

Groundwater samples collected from each of the newly installed monitoring wells will be characterized for the baseline parameters listed in Table 4-1. Approximately 5 gallons of groundwater will be required from each monitoring well to perform the baseline characterization. An additional groundwater volume of 5 gallons from each well will be collected for use in generation of the treatability and dewaterability samples. A total of volume of 10 gallons of groundwater will be collected from each of the monitoring wells for a total of 60 gallons of groundwater for the SDWTDI. Characterization and/or treatability sample volumes may be adjusted based on actual volumes of groundwater collected.

Each groundwater sample will be field measured for the following parameters: pH, turbidity, conductivity, Eh, temperature, and dissolved oxygen. Laboratory analyses of these parameters will also be performed for confirmation. Procedures for field measurement of these parameters are contained in Section 2.4 of the FSP.

4.2.3 Sediment

The objectives of the sediment sampling activities are (1) to obtain samples which can be used to physically characterize potential excavation materials, and (2) to collect samples that will be used to generate representative composite samples for the treatability and dewaterability evaluation testing.

Sediment samples for the bench-scale dewaterability evaluation and treatability tests will be collected in the following reaches (Figures 4-1, 4-2, and 4-8):

- Reach 2-1, Cross-section 10;
- Reach 2-2, Cross-section 3;
- Reach 5-1, Cross-section 2;
- Reach 5-2, Cross-section 14;
- Reach 6, Cross-section 1;
- Reach 11-4, Cross-section 2; and
- Reach 13-B, Cross-section 2.

The sediment samples collected for the SDWTDI coincide with the sediment sampling locations chosen for the TTDI and SLDI. The TTDI and SLDI sampling locations include reaches and cross sections where the concentrations of compounds such as organics and PCBs may effect treatment by solidification and/or incineration. An additional location, Reach 13-B, was selected for use in the SDWTDI due to the relatively high moisture content sediments found in the reach based on data from previous sampling. High moisture sediments may impact the effectiveness of dewatering procedures and the design capacity of wastewater treatment systems.

Sediment samples collected from each of the sampling locations will be characterized for the baseline physical parameters listed in Table 4-3. Approximately 20 gallons of sediment will be collected from each sampling location to perform the baseline characterization and for use in generation of the treatability and dewaterability samples. A total of volume of 140 gallons of sediments will be collected for the DIs.

4.2.4 Free Liquids

The objectives of the free liquids sampling activities are: (1) to obtain samples which can be used to characterize and develop water quality data for the aqueous waste streams waters, and (2) to collect samples that will be used to generate representative composite samples for treatability and dewaterability evaluation testing.

Free liquid samples for the bench-scale dewaterability evaluation and treatability testing will be collected from the following sources:

- Water accumulating on the top of containerized sediment samples; and
- Liquids generated from dewatering of sediment samples.

These free liquids will be obtained from each of the sediment samples collected as identified in Section 4.2.3.

Free liquid samples collected from each of the sediment samples will be characterized for the baseline parameters listed in Table 4-1. The volume of free liquid samples collected will be variable and cannot be estimated prior to actual sample collection. Characterization and/or treatability sample volumes may be adjusted based on actual volumes of free liquids collected.

During field collection of the free liquids from each of the sediment samples, the liquids will be measured for the following parameters: pH, turbidity, conductivity, Eh, temperature, and dissolved oxygen. Laboratory analyses of these parameters will also be performed for confirmation. Procedures for field measurement of these parameters are contained in Section 2.4 of the FSP.

4.3 SAMPLE CUSTODY

Sample handling, shipping, and custody are discussed in detail in SOU QAPjP and Section 3.0 of the SDWTDI FSP (Appendix A).

5.0
TREATABILITY STUDY TASKS

5.1 WASTE STREAM CHARACTERIZATION

Waste stream characterization is essential to the development of performance specifications and design of sediment dewatering and wastewater treatment systems. Prior to establishing treatment goals and/or performance criteria for the treatment system, a detailed waste stream characterization is needed to identify the sources of aqueous waste to the system; to estimate the waste loading and volume contributions of individual sources; and to determine treatment and discharge requirements based on the ARARs. Once these questions have been answered, the dewaterability evaluation, wastewater treatment technology evaluation and treatability testing can be performed.

5.1.1 Waste Stream Source Identification and Quantification

During the remedial activities in Fields Brook and its tributaries, a variety of aqueous waste streams will be generated that will require treatment and/or disposal. To identify these aqueous waste streams, the selected methods of excavation and materials handling procedures will be evaluated and reviewed. In addition, the process flow diagrams and material balances for both the TTDI and SLDI will be reviewed. This review will be performed to identify potential aqueous waste streams generated during the remedial activities. Several aqueous waste stream sources have been identified and include:

- Free-liquids released from sediments during excavation, transport and staging activities;
- Surface water/precipitation/storm water intercepted or collected in active work areas that have potential contact with excavated sediments;
- Groundwater seepage/inflows into the active work areas prior to site restoration;

- Aqueous filtrate/decant generated from sediment dewatering prior to thermal treatment or solidification;
- Process aqueous waste streams generated during sediment treatment by thermal treatment or solidification (i.e., scrubber blowdown);
- Leachate generated during construction, filling, and capping of the landfill; and
- Wash water resulting from decontamination activities of tools, equipment, and personnel utilized during remedial activities.

Additional sources of aqueous waste streams may be identified at a later date.

With the identification of an aqueous waste stream, the chemical and physical loadings and the volumes of each of the identifiable waste stream sources will be estimated. The total estimated volume will be used to: (1) determine the capacity of the wastewater treatment system; (2) size treatment equipment and other process units; (3) establish the treatment performance criteria; (4) identify spacial and utility requirements; and (5) evaluate system flexibility and backup systems that may be required to compensate for fluctuations in the individual waste stream sources. Because the estimates generated during waste stream identification and quantification are based on engineering calculations, simulations and models, the direct application of the results and data from these exercises must be carefully managed when applied to the full-scale aqueous system design. Frequent evaluation and recalculation of these estimates will be performed as the generation of additional data or other information warrants such updates.

The quantity of free liquids removed from sediments during excavation, transport, and staging activities will be estimated based on results obtained during the dewaterability evaluation. Free liquid samples from each sampled reach will be analyzed to establish the chemical composition of the individual aqueous waste streams. The quality and volume of water generated from each of the sediment samples will be a function of the sampling location (i.e., specific reach and cross section), the physical properties of the excavated material, the method of excavation, and the material handling procedures. An estimate of the total free liquids flow and composition will be made by classifying unsampled reaches with sampled reaches based on their physical and chemical similarities. This estimate will likely vary with changes to the excavation and materials handling procedures.

Surface water, precipitation and storm water that does not contact an open excavation will be diverted untreated to the Fields Brook or one of its tributaries. The diversion of uncontaminated waters will help to segregate waters and minimize the quantity of wastewaters generated. Any water trapped and collected in open excavations or other active work areas contacting potentially contaminated sediments will be treated and discharged. Surface water samples from each of the selected reaches, in the form of water from Fields Brook or its tributaries, will be analyzed to establish the chemical composition. An estimate of the volume and quality of this waste source will be generated from field data measuring seasonal stream and tributary water levels, and local meteorological data for a 2-year, 24-hour storm event. Preliminary excavation plans and methods of flow diversion will help to identify the areas subject to surface water collection. This information will also be used to estimate waste source quality and quantity. More accurate estimates will need to be performed as excavation plans and flow diversion systems are more fully developed.

The quantity of free liquids removed from sediments during excavation, transport, and staging activities will be estimated based on results obtained during the dewaterability evaluation. Free liquid samples from each of the selected reaches will be analyzed to determine the chemical composition of the aqueous waste stream. The quality and quantity of water collected from each of the sediment samples will be a function of the sampling location (i.e., specific reach and cross section), the method of excavation, the material handling procedures and the staging times. An estimate of the total free liquid waste stream flow and composition can be determined by classifying unsampled reaches with sampled reaches based on physical and chemical similarities. This estimate will likely vary with changes to the excavation plan and materials handling procedures.

The amount of groundwater inflow into excavation sites will be numerically calculated using a simple analytical method and a groundwater flow model. Groundwater samples collected from newly installed monitoring wells will be analyzed to provide a representative characterization for inflows into excavation areas. Using available field data including piezometer measurements, historical meteorological data, and sediment properties, an initial groundwater flow estimate will be performed based on Darcy's Law and the Dupuit-Forchheimer assumptions followed by verification using a Theissian well simulator or other methods based on two-dimensional flow nets.[1] A predictive two-dimensional computer model[2] will then be used to more fully estimate the inflows into excavation areas. The models will be modified to provide more updated estimates as additional data are available.

The quantities of aqueous filtrate/decant water collected from during sediment dewatering will be estimated based on the results of the dewaterability evaluation performed during the SDWTDI. Filtrate/decant water generated during the dewatering test will be collected and characterized. This data will be used to predict the quality and quantity of filtrate/decant water produced as a result of full-scale dewatering. The total volume and chemical composition of the filtrate/decant water will be calculated using the preliminary excavation plans and total volume of materials to be remove and treated. Selection of a dewatering technology, methods of excavation, transport and staging, and changes in the sediment characteristics may result in variations to the estimate of filtrate/decant water generation rates. More accurate estimates will be performed as excavation plans, materials handling and dewatering procedures are more fully developed.

Generation rates of aqueous process waste streams will be estimated from data obtained from the treatability testing as part of the TTDI and SLDI. Characterization of the aqueous process waste streams will be performed during these DIs. Material balances will be developed and calculations will be performed to estimate the quantity and quality of aqueous wastewater and other residual product streams. An estimate of the total process waste stream flow and composition can be determined using information on the volume and types of materials that will be processed by thermal treatment and

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[1]Cedergren, *Seepage, Drainage and Flow Nets, 3rd Edition*, Wiley, 1969.

[2]Franz, T. and N. Guiger, Flowpath, ver. 4.0, Waterloo Hydrogeologic Software, 1991.

solidification. Selection of a dewatering method may affect the estimated process waste stream calculations.

Leachate generated following completion and capping of the land disposal facility is not included as an aqueous waste stream source in the SDWTDI. The collection, treatment, and disposal/discharge of leachate generated following the closure of the land disposal facility will be addressed in the final remedial design activities. Leachate collected or generated during construction and filling of the land disposal facility will be subject to treatment in the aqueous waste treatment system. Waste stream characterization will not be performed on the leachate. Estimates of leachate generation will be calculated from meteorological data including historical storm event data and precipitation levels. The time that the open units/cells are subject to leachate generation will be approximated based on preliminary facility design, and material processing and placement plans. These estimates of leachate generation rates will be calculated for both average and worst-case condition scenarios.

Wash water resulting from decontamination of tools, equipment, and personnel utilized during remedial activities will be estimated based on data included in the preliminary excavation plans, the proposed schedule of remedial activities, and equipment selection. Waste stream characterization will not be performed for wash water. More detailed estimates of the quantities of wash water generated during remedial activities will be calculated as decontamination procedures, staffing requirements, equipment usages, and sediment excavation plans are fully developed.

Following waste stream source identification and quantification, additional activities will include establishing the performance requirements of the aqueous treatment system, evaluating waste loading rates, identifying waste minimization and/or methods for waste segregation and determining any pretreatment/separate treatment needs (example: high concentrations of BOD in the surface water samples).

5.1.2 Data Quality Objectives

The purpose of the waste stream characterization is to determine the chemical properties of the wastewater sources requiring treatment and/or disposal. The data collection and characterization efforts will focus on obtaining information that will be sufficient to:

- Obtain and/or generate samples that are representative of aqueous waste streams;
- Select analytical parameters that will provide data to support the design of the aqueous treatment system, and selection of appropriate methods for materials handling and excavation procedures: and
- Establish treatment goals and system performance requirements based on selected discharge options.

Results and data generated during waste stream characterization will be used to supplement the design and operation of other remedial actions including sediment excavation, materials handling processes, thermal and solidification system designs and transport/conveying systems.

5.1.3 Sample Location and Collection

The aqueous waste streams that will be initially sampled and characterized include the following:

- Free-liquids drained from sediment samples;
- Surface water from sediment sampling locations;
- Groundwater from the newly installed monitoring wells; and
- Filtrate/decant water generated during dewaterability evaluation and wastewater treatability tests.

The aqueous waste streams that will NOT be sampled and characterized include the following:

- Process aqueous waste streams generated during sediment treatment by thermal or solidification (i.e., scrubber blowdown);
- Leachate generated during construction and filling of the landfill; and
- Wash water resulting from decontamination activities of tools, equipment, and personnel utilized during remedial activities.

The remaining aqueous waste stream sources cannot be directly sampled and require synthesis and/or full-scale system operations to generate representative samples. These aqueous waste stream sources (i.e., process waters, leachate and wash water) will not be sampled in the SDWTDI. Wastewater resulting from these unsampled sources are expected to contain concentrations of chemicals at levels below the concentrations associated with free liquids, surface water, groundwater and filtrate/decant water samples which are in contact with the contaminated sediments for extended periods of time. In the case of process waters, the aqueous waste stream from the thermal treatment process will likely contain concentrations of VOCs and PCBs in levels below the other waste stream sources due to the highly effective destruction efficiency of the incineration process, but the levels of solids (TDS and TSS) and metals may be slightly higher than some of the other identifiable waste sources. To obtain samples of process water, leachate or wash water streams, synthesis methods and/or sampling methods may directly influence and affect the analytical results. For these reasons, characterization by sampling and analysis is not recommended for the process water, leachate, or wash water streams.

Surface water samples will be obtained from the following locations and will be collected in the designated quantities for use during the SDWTDI:

- Reach 2-1, Cross section 10, 15 gallons;
- Reach 2-2, Cross section 3, 15 gallons;
- Reach 5-1, Cross section 2, 15 gallons;
- Reach 5-2, Cross section 14, 20 gallons;
- Reach 6, Cross section 1, 20 gallons; and
- Reach 11-4, Cross section 2, 15 gallons.

Groundwater samples will be obtained from newly installed monitoring well at locations in the following reaches and will be collected in the designated quantities for use during the SDWTDI:

- Reach 2-1, 10 gallons;
- Reach 4, 10 gallons;
- Reach 13-1, 10 gallons;
- Reach 8-2, 10 gallons;
- Reach 5-2, 10 gallons; and
- Reach 6, 10 gallons.

Groundwater samples will be collected from six monitoring wells installed along the Fields Brook. The reaches identified for installation of new monitoring wells were selected to provide a representative distribution of wells throughout the area and to obtain groundwater information in areas where monitoring wells had not previously been installed. In addition, these areas were selected based on a review of the previous groundwater elevations, site topography, and sediment classification within the individual reaches. The groundwater samples collected from the monitoring wells will provide preliminary characterization to aid in the estimation of the groundwater inflows during site excavation.

Free liquid samples, drained from sediments during staging and storage of field samples for the TTDI and SLDI, will be obtained from the following locations and in the designated quantities for use during the SDWTDI:

- Reach 2-1, Cross section 10, 20 gallons;
- Reach 2-2, Cross section 3, 20 gallons;
- Reach 5-1, Cross section 2, 20 gallons;
- Reach 5-2, Cross section 14, 20 gallons;
- Reach 6, Cross section 1, 20 gallons;
- Reach 11-4, Cross section 2, 20 gallons; and
- Reach 13-B, Cross-section 2, 20 gallons.

Free liquids are likely to be collected in limited quantities from the dewatered sediment samples. The list of analytical parameters for characterization may be abbreviated to reflect the sample volume constraints.

5.1.4 Analytical Testing

The wastewaters generated that are characteristic of aqueous waste streams resulting from remedial activities will be sampled and analyzed for the baseline chemical characterization parameters listed in Table 4-1 and will be performed using Certified Laboratory Program (CLP) methods. The flow diagram, Figure 5-2, shows waste stream characterization. These parameters were selected to provide characterization of the aqueous waste streams, to evaluate contaminant loadings, to identify chemicals of concern requiring treatment, to aid in the selection of materials for construction (i.e., PVC, galvanized steel, stainless steel), to evaluate treatment technologies, and to supply the necessary data to support the discharge permitting process.

Intermediate test samples generated during the dewaterability evaluation and treatability testing will use methods of analysis in accordance with SW-846 or equivalent methods for all parameters of interest. Confirmation samples analyzed at the conclusion of the treatability testing will use the CLP methods used for preliminary sample characterization.

5.2 DEWATERABILITY EVALUATION

The details and rationale for performing the sediment dewaterability evaluation are discussed in the following sections.

5.2.1 Approach

The purpose of the dewaterability evaluation is to investigate basic dewatering techniques on samples of the sediments excavated from Fields Brook. The techniques employed in the dewaterability evaluation will be representative of settling and separations that occur during staging, transport and storage of the excavated materials.

To perform this evaluation, samples will be collected from several different reaches where sediments are anticipated to be thermally treated, areas where treatment by solidification is recommended, and from an area (Reach 13-B) where the previous sampling data indicates high moisture sediments are present. Samples from these various reaches are representative of the types of materials that will be excavated during remedial activities.

To evaluate the dewaterability of the excavated materials, five types of bench-scale tests will be performed using composited sediment samples. Figure 5-3 shows the dewaterability evaluation tests including the following:

- Gravity Drainage Test,
- Capillary Suction Time Test,
- Buchner Funnel Test,
- Filter Leaf Test, and
- Filter Press Test.

The Gravity Drainage test will be used to simulate an unassisted method for recovery and removal of free liquids from staged sediments currently proposed for the remedial activities. The Capillary Suction Time, Buchner Funnel and Filter Leaf tests are standard wastewater treatment bench-scale tests used to evaluate the relative dewaterability of materials under assisted conditions. These three tests evaluate dewaterability of the sediments with the use of conditioners (Capillary Suction Time), vacuum-assisted dewatering with the addition of conditioning agents (Buchner Funnel), and the optimum time and dosages for vacuum-assisted dewatering (Filter Leaf). The bench-top Filter Press test will be used to simulate and test the effectiveness of standard mechanical dewatering equipment. The series of dewaterability tests are proposed to provide the information on the degree of dewatering necessary to meet the requirements for feed solids to either thermal treatment or solidification. The scope of testing and dewatering techniques may be expanded to meet more rigorous dewatering objectives should this need be identified through further studies including the evaluation of additional methods for dewatering (i.e., centrifugation).

The dewaterability evaluation tests will be performed at the facilities of Kiber Environmental Services, Inc. in Atlanta, Georgia (Kiber), under the oversight of WCC.

Specific objectives of tests performed as part of the dewaterability evaluation are provided in the following sections. More detailed testing procedures, data objectives and materials handling processes are described Section 1.0 of the Bench-Scale Test Plans (Appendix B).

5.2.2 Bench-Scale Test Objectives

Bench-scale dewaterability tests will be performed to evaluate several methods of dewatering in support of site excavation, materials handling processes, solids removal from aqueous waste streams, and sediment treatment by thermal or solidification methods. Data collected during the dewaterability bench-scale testing will be used to establish the design basis for sediment dewatering and aqueous treatment, and to characterize treatment process residual materials. The following sections outline the objectives of each dewatering test.

5.2.2.1 Gravity Drainage Test Objectives

A simulation of sediment gravity dewatering will be performed to aid in estimating the volume of free liquids generated during excavation and handling of the sediments. The bench-scale Gravity Drainage test will also be used to evaluate the settling times of the unassisted dewatering process.

5.2.2.2 Capillary Suction Time Test Objectives

The primary objective of the Capillary Suction Time (CST) test is to characterize the relative dewaterability of sediments, and to calculate their specific resistance*** through

***_specific resistance (r)_ - a measure of the filterability of the sediment; equal to the pressure differential required to produce a unit rate of filtrate flow of a unit viscosity through a unit weight of filter cake.

the assistance of conditioning agents. A number of soil and sludge conditioners (i.e., diatomaceous earth, amorphous silica-based filtration aids, synthetic polymers and Betz-Entech 962, which was demonstrated to be an effective conditioning polymer in a similar study[4]) will be added to the sediments to alter the physical properties of the sediments and enhance the settling process. The calculated specific resistance will allow for a comparison and an evaluation of the effectiveness of various soil and sludge conditioners with a sample without the addition of conditioning agents.

5.2.2.3 Buchner Funnel Test Objectives

The Buchner Funnel test will be performed to simulate and evaluate vacuum-assisted dewatering. The data generated during the Buchner Funnel test will be used to estimate the specific resistance of the sediments and the solids generated from other treatability tests (i.e., metal precipitation, suspended solids) under methods of enhanced dewatering. The use of soil and sludge conditioners and their relative effectiveness will also be evaluated during the Buchner Funnel test. Filtrate/decant water generated from this test will be used for characterization of the process residuals.

5.2.2.4 Filter Leaf Test Objectives

The primary objective of the Filter Leaf test is to evaluate the physical properties of the sludges/solids generated during the dewatering process with time. The optimum dosages of soil and sludge conditioners resulting from the Buchner Funnel test will be used in the Filter Leaf test to correlate the properties of the filter cake with settling time. Sludge/solid properties that will be evaluated include filter yield, weight of cake, and moisture content and will be generated under conditions of vacuum-assisted dewatering. Filtrate/decant water generated during the Filter Leaf test will be used for characterization of the process residuals.

[4]"Bayou Bonfouca Site 1988 Treatability Study Report".

5.2.2.5 Filter Press Test Objectives

The Filter Press test will be performed to simulate and evaluate the effectiveness of mechanical dewatering devices on the excavated sediments. The specific test objectives are to:

- Evaluate the effectiveness of different types of mechanical dewatering devices (i.e., plates and frame press, membrane press, belt press, vacuum filter) on the excavated sediments;
- Evaluate the addition of filter aids on dewatering including required dosages and cost;
- Estimate residual filter cake properties including moisture content and liquid retention; and
- Identify the properties of the filtrate including suspended solids and other water quality parameters.

5.2.3 Treatability Samples

The field samples collected and transported to the Kiber laboratory will consist of the following samples:

- Sediment from Reach 2-1, Cross-section 10,
- Sediment from Reach 2-2, Cross-section 3,
- Sediment from Reach 5-1, Cross-section 2,
- Sediment from Reach 5-2, Cross-section 14,
- Sediment from Reach 6, Cross-section 1,
- Sediment from Reach 11-4, Cross-Section 2, and
- Sediment from Reach 13-B, Cross-Section 2.

Approximately 20 gallons of excavated material will be collected from each reach and placed in large sealed sample containers. Free liquids collecting in each container of sediments will be measured, recovered and used during waste stream characterization and the treatability testing.

Upon receipt at Kiber's laboratory, the received volume of sediment will be measured and recorded in each sample container. Any separate free liquids will be measured and removed. The containerized sediments will be mixed thoroughly to re-suspended solids and provide a representative sample should two separate phases form. No water will be added prior to filtration testing. Physical testing including sample weight, moisture content and particle-size distribution will be performed on each of the sediment samples. The remaining sediment samples will be used during the dewaterability evaluation testing. The preparation of these dewaterability samples is shown in Figure 5-3.

5.3 WASTEWATER TREATMENT TECHNOLOGY DETERMINATION

A wastewater treatment technology evaluation will be performed to identify and select viable treatment technologies, and evaluate the need for further treatability testing. This treatability and bench-scale testing program is intended to facilitate the design of a wastewater treatment system for excavation by mechanical means. In the Feasibility Study (FS), the removal of suspended solids and dissolved organics were identified as minimum treatment requirements associated with the Fields Brook remedial activities. The treatment technologies identified during the FS process that address the minimum treatment requirements included filtration and GAC. Without the benefit of waste stream characterization, identification of project-specific treatment goals and a suitable treatment train cannot be fully evaluated.

In support of the technologies identified in the FS and following preliminary waste stream characterization, a broad evaluation of potential treatment technologies will be performed. A thorough evaluation of other treatment technologies and re-evaluation of filtration and GAC in conjunction with the identification of discharge performance criteria will help to select suitable treatment technologies. In addition to identifying treatment technologies that are efficient, mobile, low maintenance and cost effective, the wastewater treatment technology evaluation may be needed to identify treatment technologies for the removal/treatment of other parameters such as metals and conventional wastewater parameters (i.e., BOD, COD, and oil & grease).

Potential parameters of concern for the waste streams generated during remedial activities and treatment technologies are listed below:

Parameters of Concern	Treatment Technologies
Solids	Sedimentation Filtration Flocculation/Coagulation Clarification Centrifugation
Organics (including BOD and COD)	Granular Activated Carbon Air Stripping Steam Stripping Powdered Activated Carbon Technology (PACT) Ultraviolet Oxidation Chemical Oxidation Biological Treatment Ultrafiltration Reverse Osmosis
Metals	Reverse Osmosis Ion Exchange Precipitation
Oil and Grease	Coalescer Flotation Bioremediation

The wastewater treatment technology evaluation will start with a preliminary review and evaluation of potential treatment technologies. This review and evaluation will include a literature search of existing or demonstrated technologies for treatment of the parameters of concern. Discussions will be held with treatment vendors to supply technology/treatment data, case histories, preliminary cost ranges, and operational information. Computer simulations/models will be employed when available to predict the effectiveness of the treatment technologies. The review and evaluation of appropriate treatment technologies will be based on the following criteria:

- Treatment efficiency and ability to meet the identifiable ARARs;
- Treatment capacity and ability to interface with other treatment operations;
- Consistency and reliability of the treatment technology;
- Spacial requirements;
- Operation and maintenance requirements;
- Quantity and quality of any residual waste products;
- Acceptance and approval by local, state and federal regulatory agencies; and
- Capital equipment and operating costs.

5.4 WASTEWATER TREATABILITY TESTS

The details and rationale for performing the wastewater treatability studies are discussed in the following sections.

5.4.1 Approach

The objective of the wastewater treatability tests is to evaluate potential treatment technologies including filtration and GAC. The treatability tests will be used to select suitable technologies for the treatment and removal of suspended solids and organics from aqueous waste streams generated during remedial activities. To achieve these objectives, aqueous waste stream samples will be collected and used to prepare treatability samples for use during the treatability tests. Aqueous samples to be collected include surface water, groundwater and free liquids recovered from excavated sediment samples. The aqueous waste streams and sediment samples will be used to prepare six composite treatability samples in a range of suspended solids concentrations. This variation of solids concentrations in the treatability samples will be used to anticipate and evaluate wastewater treatment concerns over a wide range of methods for excavation, materials handling and dewatering techniques that may be employed during the remedial activities.

To evaluate the treatment of the aqueous waste streams, several bench-scale tests will be performed using the composite treatability samples. Figure 5-6 shows the sequence of the treatability testing. The treatability test will include the following tests:

- Precipitation Test,
- Suspended Solids Test,
- Settling Velocity Test, and
- GAC Test.

The Precipitation test will be used to evaluate the effectiveness of chemical precipitation for metals removal from the aqueous waste streams. Data generated from the Suspended Solids tests will help establish the effectiveness of coagulants for the removal of TSS by gravity settling from the wastewaters. Like the Suspended Solids test, the Settling Velocity test will evaluate the settability of solids from the aqueous waste streams under gravity settling conditions. To evaluate the effectiveness of GAC adsorption for the removal of organics from the wastewaters, a bench-scale GAC test will be performed.

The proposed series of tests for the wastewater treatability testing are anticipated to provide the data necessary to provide preliminary design of a filtration and GAC treatment system. The scope of treatability testing may be expanded to meet additional treatment requirements should it be necessary through the evaluation of additional treatability tests.

The wastewater treatability tests, with the exception of the GAC test, will be performed at the facilities of Kiber Environmental Services, Inc. in Atlanta, Georgia (Kiber) under the oversight of WCC. The GAC test will be performed by Calgon Carbon Corporation (Calgon) at their Pittsburgh, Pennsylvania, facility.

Specific objectives of tests performed as part of the treatability testing are provided in the following sections. More detailed testing procedures, data objectives and materials handling processes are described Section 2.0 of the Bench-Scale Test Plans (Appendix B).

When waste stream characterization data has been generated, proper evaluation and selection of a treatment train can be performed. In the event that data collected during the waste stream characterization of the SDWTDI indicates other constituents require wastewater treatment prior to discharge, additional treatability testing may be recommended and implemented. A decision tree (Figure 5-1) analysis method will be used to facilitate the decision-making process to determine the necessity and extent of additional treatability tests. The decision tree will also be used during the implementation of each of the treatability tests to decide whether or not additional bench-scale testing is required. Constituents found at significant levels in the aqueous waste stream that will likely initiate additional treatability tests include metals, oil & grease, BOD and COD. As an example, if the waste stream characterization results indicate BOD concentrations in the aqueous waste streams are higher than the NPDES or POTW discharge limits, then treatability tests for nutrient biological demand tests may be performed to determine the effectiveness of biological treatment for BOD removal.

5.4.2 Bench-Scale Test Objectives

Bench-scale wastewater treatability tests will be performed to evaluate several technologies for treatment of aqueous waste streams containing VOCs, SVOCs, solids, and metals. These tests will use bench-scale testing protocols. The term "bench-scale testing" refers to bench-top separation, reaction, or other treatment processes performed in the laboratory environment with equipment designed to simulate the basic principles of a treatment process. Bench-scale testing is intended to evaluate the applicability of the technology, and to gain qualitative and/or quantitative information to assess the performance of a technology. Data generated during the wastewater treatability evaluation bench-scale testing will aid in clarifying the design basis for aqueous treatment, and to characterize treatment process residues. The following sections outline the objectives of the specific wastewater treatability tests.

5.4.2.1 Precipitation Test Objectives

Precipitation tests will be performed to evaluate methods of chemical precipitation for waste streams generated during remedial activities. Varying chemical additives and reaction times will be tested to optimize the precipitation reactions for metals removal. When the optimum dosages and reaction times have been determined for the test sample, each of the remaining treatability samples will be tested for confirmation at the optimum conditions. Properties of the sludge, including Toxicity Characteristic Leachate Procedures (TCLP) for VOCs, SVOCs and PCBs, and moisture content, generated during the optimum test conditions will be determined.

5.4.2.2 Suspended Solids Removal Test Objectives

The principle objectives of the Suspended Solids Removal tests will be to evaluate the relative settability of solids and to determine the effectiveness of solids removal from the aqueous waste streams. Representative aqueous samples, both with and without the addition of coagulant/flocculent aids, will be tested in the Suspended Solids Removal test. Optimum chemical dosage rates and settling times will be evaluated to achieve the maximum solids removal. Dissolved solids concentration and turbidity of the supernatant will be determined at the optimum conditions. The treated wastewater will be analyzed for Total Organic Carbon (TOC) and for the organic chemicals of concern to assess the efficiency of any sedimentation or filtration process on removing suspended solids.

5.4.2.3 Settling Velocity Test Objective

The primary objective of the Settling Velocity test is to evaluate effluent quality relative to settling time. The Settling Velocity test will use samples from the Precipitation and Suspended Solids test where the solid/liquid interface is undefined or in cases where no solid/liquid separation occurs.

5.4.2.4 Granular Activated Carbon (GAC) Test Objectives

The GAC tests will be performed to simulate and evaluate the effectiveness of carbon adsorption for the removal of organics and treatment of aqueous waste streams generated during remedial activities. Design parameters that will be evaluated during the GAC test include the selection of the appropriate type of carbon, the rate of carbon breakthrough, and wastewater-specific breakthrough curve for a full-scale absorber.

5.4.3 Treatability Samples

The field samples collected and transported to the Kiber laboratory will consist of the types of samples listed below.

5.4.3.1 Sample Collection

Surface Water Samples

- Surface water from Reach 2-1, Cross section 10,
- Surface water from Reach 2-2, Cross section 3,
- Surface water from Reach 5-1, Cross section 2,
- Surface water from Reach 5-2, Cross section 14,
- Surface water from Reach 6, Cross section 1, and
- Surface water from Reach 11-4, Cross section 2.

Approximately 15 to 20 gallons of surface water will be collected from each reach and placed in large sealed sample containers. The collected surface waters will be field tested, sampled and used during waste stream characterization and the treatability testing.

Upon receipt at Kiber's laboratory, the received volume of surface water will be measured and recorded for each sample container. The waters will be mixed thoroughly to provide homogenized samples prior to use in preparation of other composite samples. Chemical testing of surface water samples will be performed as part of waste stream characterization (Section 5.1). The remaining surface water will be composited in equal volumes to generate a single composite surface water sample. Approximately 50 gallons of the surface water composite sample will be generated.

Groundwater Samples

- Groundwater from monitoring well installed in Reach 2-1,
- Groundwater from monitoring well installed in Reach 4,
- Groundwater from monitoring well installed in Reach 5-2,
- Groundwater from monitoring well installed in Reach 6,

- Groundwater from monitoring well installed in Reach 8-2, and
- Groundwater from monitoring well installed in Reach 13-B.

Approximately 10 gallons of groundwater will be collected from each monitoring well and placed in sealed sample containers. The collected groundwater will be field tested, sampled and used during waste stream characterization and treatability testing.

Upon receipt at Kiber's laboratory, the received volume of groundwater will be measured and recorded for each sample container. The waters will be mixed thoroughly to provide homogenized samples prior to use in preparation of other composite samples. Chemical testing of groundwater samples will be performed as part of waste stream characterization (Section 5.1). The remaining groundwater will be composited in equal volumes to generate a single composite groundwater sample. Approximately 12 gallons of the groundwater composite sample will be generated.

<u>Free Liquid Samples</u>

- Free liquid recovered from sediments in Reach 2-1, Cross section 10,
- Free liquid recovered from sediments in Reach 2-2, Cross section 3,
- Free liquid recovered from sediments in Reach 5-1, Cross section 2,
- Free liquid recovered from sediments in Reach 5-2, Cross section 14,
- Free liquid recovered from sediments in Reach 6, Cross section 1,
- Free liquid recovered from sediments in Reach 11-4, Cross section 1, and
- Free liquid recovered from sediments in Reach 13-B, Cross section 2.

The volume of free liquids collected from the sediment samples in each reach will vary and cannot be estimated. The free liquids collected from each area will be placed in sealed sample containers. The collected free liquids will be field tested, sampled and used during waste stream characterization and treatability testing, as sample volumes allow.

Upon receipt at Kiber's laboratory, the received volume of free liquids will be measured and recorded for each sample container. The waters will be mixed thoroughly to provide homogenized samples prior to use in preparation of other composite samples. Chemical testing of free liquid samples will be performed as part of waste stream characterization

(Section 5.1). The remaining free liquids will be composited in equal volumes to generate a single composite free liquid sample. In the event that adequate quantities of free liquids are not obtained, an abbreviated waste stream characterization may be performed and/or free liquids compositions in the treatability samples may be modified.

All samples (groundwater and free liquids) will be stored at 4° C until testing is initiated.

5.4.3.2 Treatability Sample Preparation

The purpose of treatability sample preparation is to develop composite samples that are representative of aqueous waste streams generated during the Fields Brook remedial activities. Treatability testing using these samples will provide data and other information that is required to evaluate and select the most effective technology(ies) for the wastewater treatment train. Six treatability samples will be prepared to represent a range of aqueous waste streams that may be generated during remediation. The six samples have been designed to provide a range of solids concentrations (from a minimum of 100 mg/L to a maximum of approximately 10 to 20 % solids) and organic loadings for evaluation by treatability testing. By staging these samples with the solids, losses of organic compounds through volatilization and re-equilibrium will be minimized. Identification of the six samples is given by TS-01, TS-02, TS-03, TS-04, TS-05 and TS-06. The preparation of these treatability samples is shown in Figure 5-5.

Sample TS-01 will be composited to contain a concentration of approximately 100 mg/L of total suspended solids (TSS). This sample will be prepared by mixing one part of the composite groundwater sample to three parts of the composite surface water sample. Additional sediment from the composite solids sample will be added to and mixed with the water sample to increase the TSS concentrations to the desired level.

Sample TS-02 will be composited to contain a concentration of approximately 1,000 mg/L of TSS. This sample will be prepared by mixing one part of the composite groundwater sample to three parts of the composite surface water sample. Additional sediment from the composite solids sample will be added to and mixed with the water sample to increase the TSS concentrations to the desired level.

Sample TS-03 will be composited to contain a concentration of approximately 1 % of TSS. This sample will be prepared by mixing one part of the composite groundwater sample to three parts of the composite surface water sample. Additional sediment from the composite solids sample will be added to and mixed with the water sample to increase the TSS concentrations to the desired level.

Sample TS-04 will be composited to contain a concentration of approximately 10 to 20 % TSS. This sample will be prepared by mixing one part of the composite groundwater sample to three parts of the composite surface water sample. Additional sediment from the composite solids sample will be added to and mixed with the water sample to increase the TSS concentrations to the desired level. The composition of sample TS-04 is representative of aqueous wastewater that may result from excavation procedures involving vacuuming processes.

Sample TS-05 will be comprised solely of the composite free liquids sample.

Sample TS-06 will be prepared by mixing one part of the composite groundwater sample, three parts of the composite surface water sample and one part of the composite free liquid sample.

The additional weight of the composite sediment sample to be added will be calculated based on the TSS concentration measured in the surface water samples and the moisture content measured in the sediment samples. A high level of accuracy in the sediment addition is not required. Prior to addition to the treatability samples, the sediments will be sieved through a U.S. Standard Sieve No. 40 (0.45 mm), and the weight and description of any additional materials will be noted.

Sample TS-02 will be used for most of the bench-scale treatability tests described in this document. Approximately 10 gallons of sample TS-02 will be transferred from Kiber to Calgon for performance of the GAC tests. The sample will be filtered to remove suspended solids immediately prior to performing the GAC tests. Sample TS-01 and TS-03 through TS-06 will be used as confirmation samples to demonstrate effectiveness over a range of concentrations once optimum conditions have been established in the individual bench-scale tests. All samples will remain composited until testing is initiated to minimize losses of organic compounds due to volatilization.

6.0 DATA EVALUATION TASKS

6.1 DATA VALIDATION

The analytical data generated by the laboratories under the SDWTDI Work Plan will be evaluated for precision, accuracy and completeness. The data validation process for this project will consist of data generation, reduction, and two levels of review and validation in accordance with the SOU QAPjP.

6.2 SAMPLE AND DATA MANAGEMENT

The task manager for the SDWTDI will be responsible for scheduling and tracking all samples and sample data through the laboratories, and reporting the developments to the SOU Manager. The WCC QC review team will periodically evaluate sample tracking associated with the DIs.

The task manager will place project requests for analytical services, coordinate shipments of samples and materials, communicate sampling information, resolve problems in scheduling laboratory services and supplies, receive all sample data packages for document control, and manage the project database system. The sample document control system is outlined in the SOU QAPjP.

A data management system will provide a mechanism for data tracking, reduction, storage, retrieval, and identification of appropriate QA/QC procedures. The procedures to be used in tracking, reducing, and processing information and analytical data collected during the investigation phases of this work are outlined below. The collected information and data will be processed and documented in a format which will make them available for use in evaluating the objectives of the SDWTDI.

6.3 DATA EVALUATION

Data generated from the SDWTDI will be summarized and evaluated in terms of the DQOs. Data evaluation should not begin until data validation is complete.

The specific areas which will be addressed are:

- The chemical analyses of field samples of the various potential sources of wastewater which may be generated during remediation will identify contaminants of concern for treatment and disposal of this water. The chemical characterization will be used to select treatment technologies which may be required.

- The physical characterization of sediment samples collected from the site will provide information on the requirements for design of materials handling processes for the remediation. The bench-scale tests of sediments dewatering methods will support the selection and design of appropriate dewatering equipment.

- Bench-scale tests of coagulation precipitation, filtration, GAC adsorption, and other potential treatment technologies will demonstrate the effectiveness of these treatments and provide data needed for design.

- Physical and chemical characterization of residuals from the bench-scale tests will establish whether additional treatment of these residuals (such as stabilization) will be required.

7.0
SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION (SDWTDI) REPORT

The SDWTDI Report will be prepared summarizing the field and laboratory work, and test results and conclusions. The report will present the ARARs review and the design criteria developed from the investigation including an order of magnitude cost estimate for remediation activities associated with dewatering and wastewater treatment. The SDWTDI Report will include the following:

- Sediment and water sampling locations and sample collection procedures;
- Sediment sample chemical and physical characteristics generated from the TTDI and SLDI;
- Water sample chemical characteristics;
- Description of equipment and procedures used in the treatability studies;
- Analyses conducted and test results obtained during treatability testing;
- Discussion of the test results and limitations;
- Description of anticipated waste stream characteristics and quantities;
- Description of treatment objectives and ARARs for discharge of treated wastewater to either Fields Brook or the local POTW; and ARARs for disposal of the treatment sludges;
- Sediment dewatering and wastewater treatment technologies evaluation;
- Description of design criteria based on assumed discharge to Fields Brook or POTW;
- Description of equipment and procedures anticipated for use in remediation activities associated with dewatering and wastewater treatment;

- Description of system flexibility/adaptability to changes in waste stream loadings;
- Description of performance monitoring protocols to be used;
- Estimates of volume and characteristics of wastewater treatment sludge produced and methods of sludge disposal management; and
- Preliminary order-of-magnitude cost estimate for remedial action activities associated with dewatering and wastewater treatment.

The following will be addressed in the Bench-Scale Testing Section of the Report:

- Evaluation of metals precipitation;
- Evaluation of different polymer/flocculents used in the jar tests;
- Evaluation of settling times and sludge production rates;
- Characteristics of the sludge;
- Characteristics of the supernatant;
- Evaluation of the various dewatering tests;
- Results of drainage, dewatering, paint filter liquids test, liquid retention, and penetrometer test; and
- Results of carbon adsorption tests and breakthrough curves.

The report will be organized as shown in Figure 7-1 which was taken from the SOU SOW (USEPA 1989b).

8.0
SCHEDULE

The SDWTDI project schedule is presented in Figure 8-1. The investigation activities in this work plan will be implemented in accordance with the schedule. Major deliverables of the SDWTDI are:

- Draft SDWTDI Report; and
- Final SDWTDI Report.

9.0
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TABLES

TABLE 1-1

Koc VALUES FOR SELECT COMPOUNDS

Selected Parameters	Koc Value (mL/g)
Benzene	97
Chloroform	34
1,4-Dichlorobenzene	594
1,1-Dichloroethene	217
Ethyl Benzene	622
Methylene Chloride	25
1,1,2,2-Tetrachloroethane	88
Tetrachlorethene	303
1,1,1-Trichloroethane	155
1,1,2-Trichloroethane	49
Trichloroethene	152
Toluene	242
Vinyl Chloride	704
Benzo(a)pyrene	282,185
Bis(2-ethyl hexyl)phthalate	12,200
Diethyl phthalate	123
Dimethyl phthalate	81
Di-n-butyl phthalate	217
Fluoranthene	19,800
Hexachlorobenzene	3,910
Hexachloroethane	2,450
Hexachlorobutadiene	4,330
N-nitrosodiphenylamine	229
Phenol	27
Aroclor - 1254	63,914
Heptachlor	78,400
alpha-BHC	2,627
gamma-BHC (Lindane)	28,900
PCBs (total)	- - -

TABLE 1-2

CONCENTRATION RANGES FOR PHYSICAL AND CHEMICAL PARAMETERS IN SEDIMENTS

PARAMETER	RANGE (mg/kg)
Organic Compounds	
Polychlorinated Biphenyls (PCBs)	BDL - 1,100
1,1,2,2-Tetrachloroethane	BDL - 19,000
1,1,2-Trichloroethane	BDL - 320
Benzene	BDL - 0.2
Chloroform	BDL - 1.2
N-Nitrosodiphenylamine	0
Tetrachloroethene	BDL - 35,000
Trichloroethene	BDL - 15,000
Vinyl Chloride	BDL - 9
1,4-Dichlorobenzene	BDL - 34
Hexachlorobenzene	BDL - 490
Metals	
Arsenic	2 - 419
Cadmium	BDL - 8.9
Chromium	5 - 87
Lead	5 - 414
Mercury	BDL - 58
Selenium	BDL - 57
Physical Properties	
Clay Content	20 - 80 %
Sand Content	20 - 40 %
% Moisture	20 - 80 %

BDL = Below Detection Limit

TABLE 4-1

WATER QUALITY PARAMETERS FOR BASELINE CHARACTERIZATION

SAMPLE MATRIX	PARAMETERS
Aqueous Streams (Including groundwater, surface water, and free liquids)	Volatile Organic Compounds
	Semi-Volatile Organic Compounds
	Pesticides/PCBs
	TAL Metals (total and dissolved)
	Phenols
	Sulfate/Sulfite
	Ammonia
	Nitrate/Nitrite
	Phosphate
	Silica (total and soluble)
	Chloride (soluble)
	Flouride
	Dissolved Oxygen*
	Conductivity*
	Temperature*
	Total Organic Carbon (TOC)
	Total Suspended Solids (TSS)
	Total Dissolved Solids (TDS)
	pH*
	Eh*
	Turbidity*
	Alkalinity (carbonate, bicarbonate, hydroxide)
	Hardness (as CaCO3)
	Biochemical Oxygen Demand (BOD)
	Chemical Oxygen Demand (COD)
	Oil & Grease

Note: Parameters marked with an asterisk (*) will be measured both in the field and in the laboratory.

TABLE 4-2

DEWATERABILITY EVALUATION AND TREATABILITY TESTING SAMPLING LOCATIONS AND VOLUMES

SAMPLE MATRIX	LOCATION	VOLUME (Gallons)
SEDIMENT	Reach 2-1, Cross Section 10	20
	Reach 2-2, Cross Section 3	20
	Reach 5-1, Cross Section 2	20
	Reach 5-2, Cross Section 14	20
	Reach 6, Cross Section 1	20
	Reach 11-4, Cross Section 2	20
	Reach 13-B, Cross Section 2	20
GROUNDWATER	Reach 2-1	10
	Reach 4	10
	Reach 5-2	10
	Reach 6	10
	Reach 8-2	10
	Reach 13-1	10
SURFACE WATER	Reach 2-1, Cross Section 10	15
	Reach 2-2, Cross Section 3	15
	Reach 5-1, Cross Section 2	15
	Reach 5-2, Cross Section 14	20
	Reach 6, Cross Section 1	20
	Reach 11-4, Cross Section 2	15

Sediment and surface water samples will be collected as part of the TTDI and SLDI (except Reach 13-B Sediments).

TABLE 4-3

SEDIMENT TESTING PARAMETERS

PHYSICAL PARAMETERS
Paint Filter Liquids (free liquids)
Bulk Density
Permeability
Pocket Penetrometer (load bearing)
Atterburg Limits
Moisture Content
USCS Classification
Particle Size Analysis
Liquid Retention

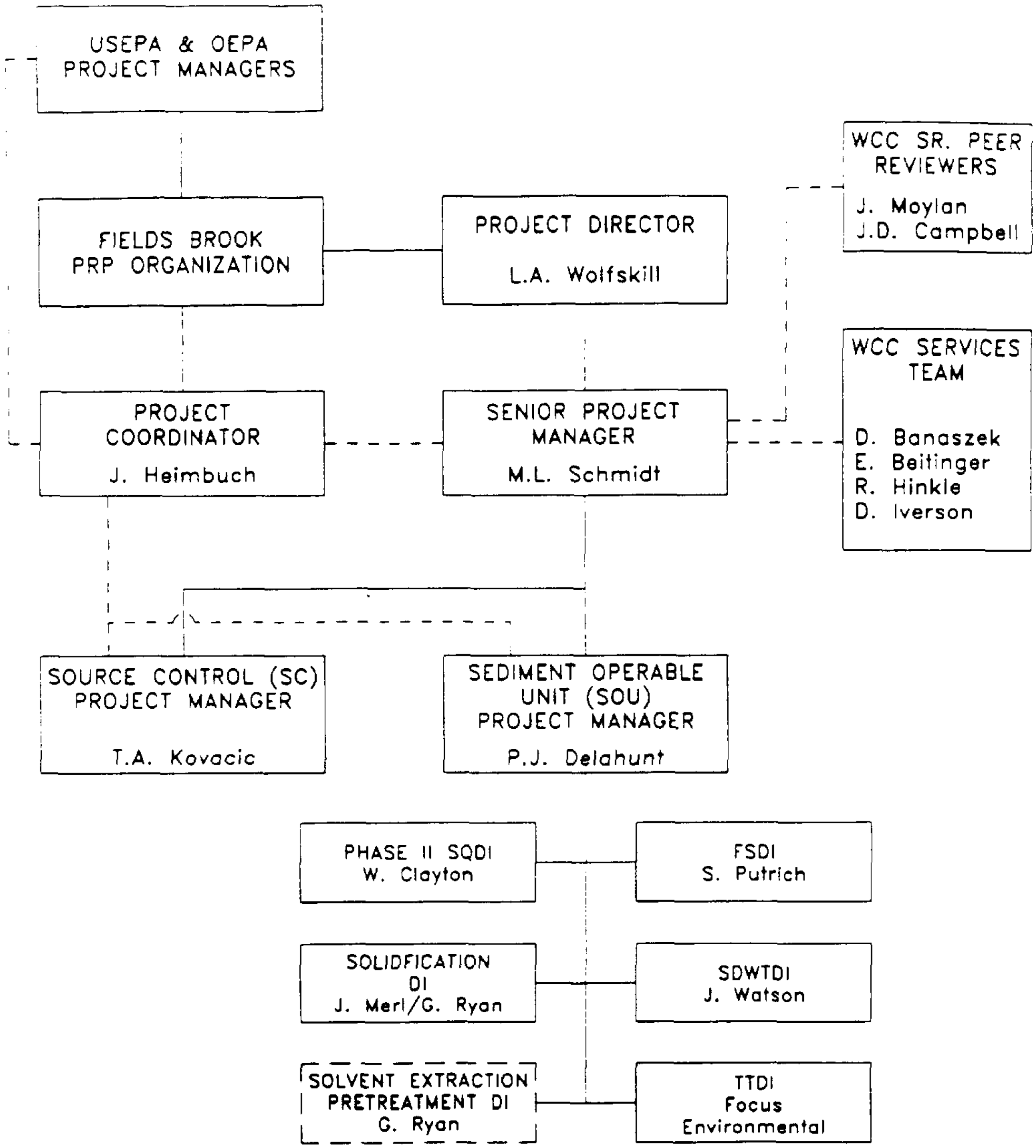
TABLE 5-1

ESTIMATED DISCHARGE LIMITATIONS

DISCHARGE PARAMETERS OF INTEREST	NPDES DISCHARGE LIMITS				POTW LIMITS	
	Ashtabula River		Fields Brook		City of Ashtabula	
	Daily Maximum (ug/L)	30 Day Average (ug/L)	Daily Maximum (ug/L)	30 Day Average (ug/L)	7 Day Maximum (ug/L)	30 Day Average (ug/L)
Antimony	190	650	190	650	- - -	- - -
Arsenic	190	360	190	360	- - -	50
Cadmium	1.6	6.8	8.1	64.3	640	700
Chromium, total	240	2,094	1,290	11,243	- - -	2,000
Chromium, hexavalent	11	15	11	15	- - -	- - -
Copper	14	21	93	169	840	1,610
Cyanide, free	12	46	12	46	- - -	250
Lead	8.7	167	120.5	2,298	- - -	400
Mercury	0.20	1.1	0.20	1.1	- - -	2
Nickel	203	1,828	1,213	10,918	- - -	760
Selenium	5.0	20	5.0	20	- - -	- - -
Silver	1.3	2.2	1.3	74.6	- - -	700
Thallium	16	71	16	71	- - -	- - -
Zinc	124	136	697	770	- - -	1,460
Polychlorinated Biphenyls	0.001	- - -	0.001	- - -	- - -	- - -
Phenol	- - -	- - -	- - -	- - -	- - -	470
Total Suspended Solids	- - -	- - -	- - -	- - -	- - -	150,000
Biochemical Oxygen Demand	- - -	- - -	- - -	- - -	- - -	200,000
Phosphate	- - -	- - -	- - -	- - -	- - -	5,000
Chemical Oxygen Demand	- - -	- - -	- - -	- - -	- - -	400,000
Oil & Grease	- - -	- - -	- - -	- - -	- - -	200,000

NOTE: The NPDES discharge parameters for Ashtabula River and Fields Brook are based on hardness values for the for the receiving streams. These values were determined in a report entitled Technical Information Attachment for Dischargers Within the Fields Brook Drainage dated May 1992. The determined mean hardness values are 120 ug/L for Ashtabula River and 934 ug/L for Fields Brook.

FIGURES



Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

FIELDS BROOK PROJECT
SEDIMENT OPERABLE UNIT
DESIGN INVESTIGATIONS
ORGANIZATION CHART

DESIGN:	PJD	SCALE:	NONE	PROJECT NO.	FIG. NO.
DRAWN:	KDW	DATE:	7/6/93	86C3609N	2-1

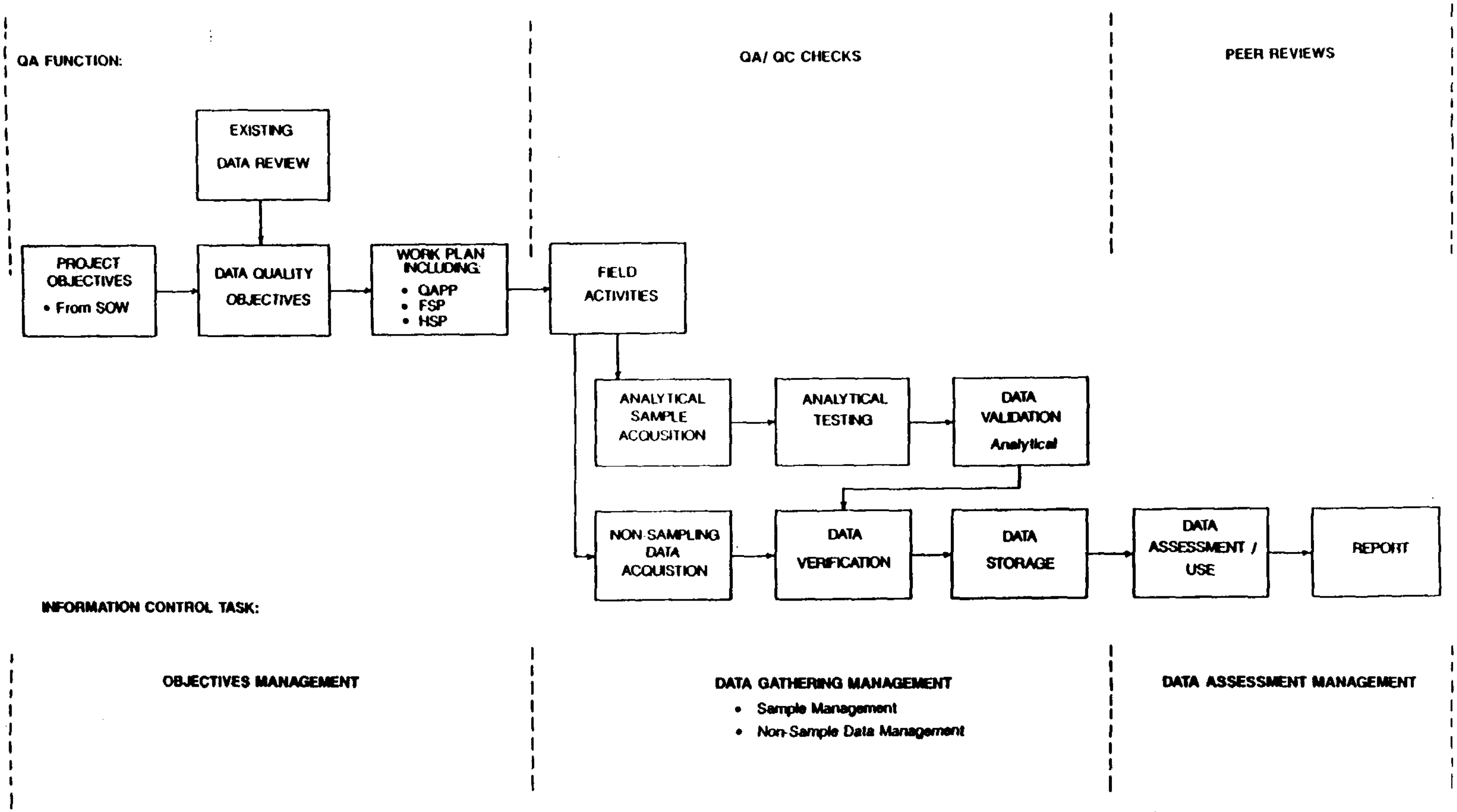
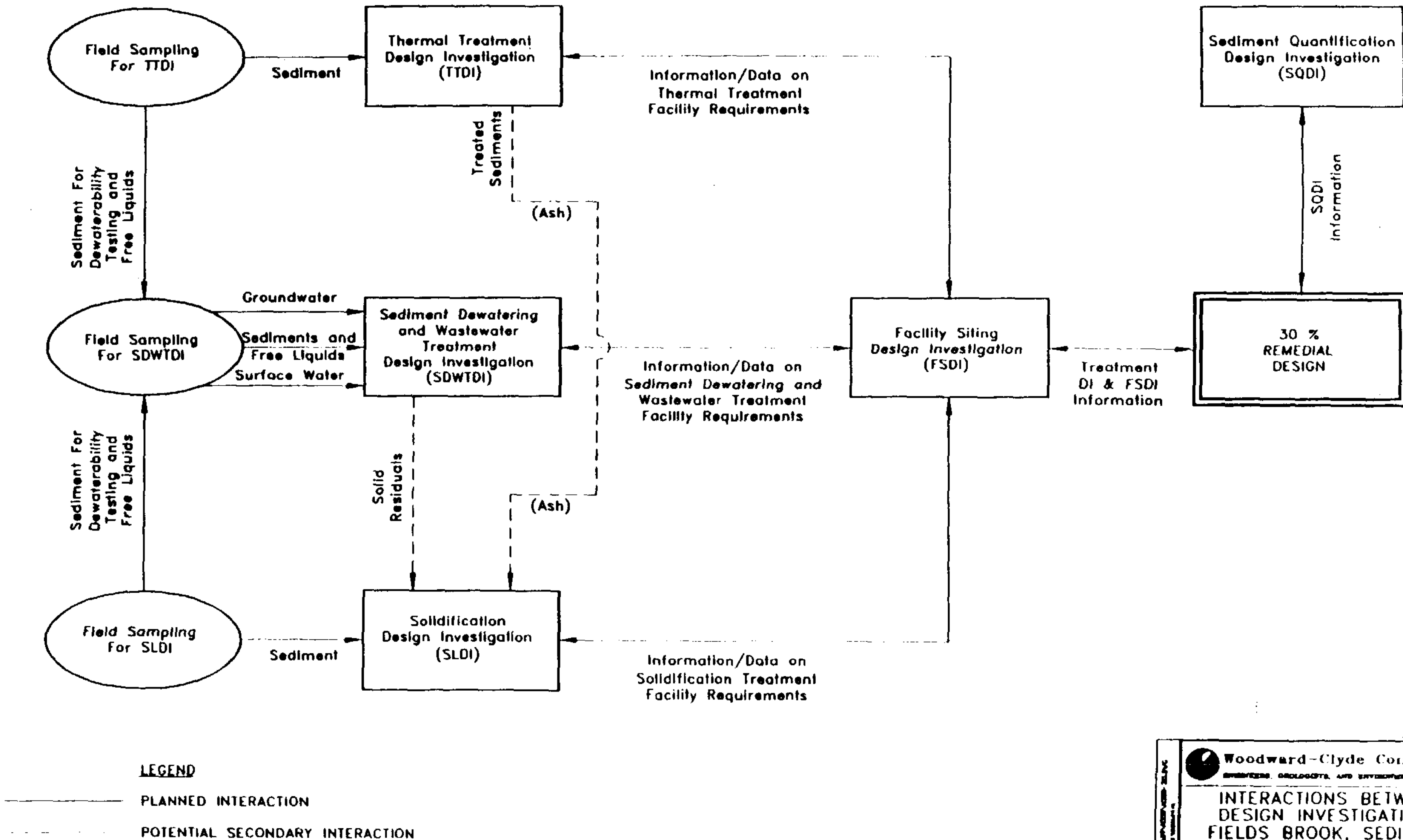


FIGURE 2-2 QUALITY ASSURANCE PROCESS

WCC,86C3609E



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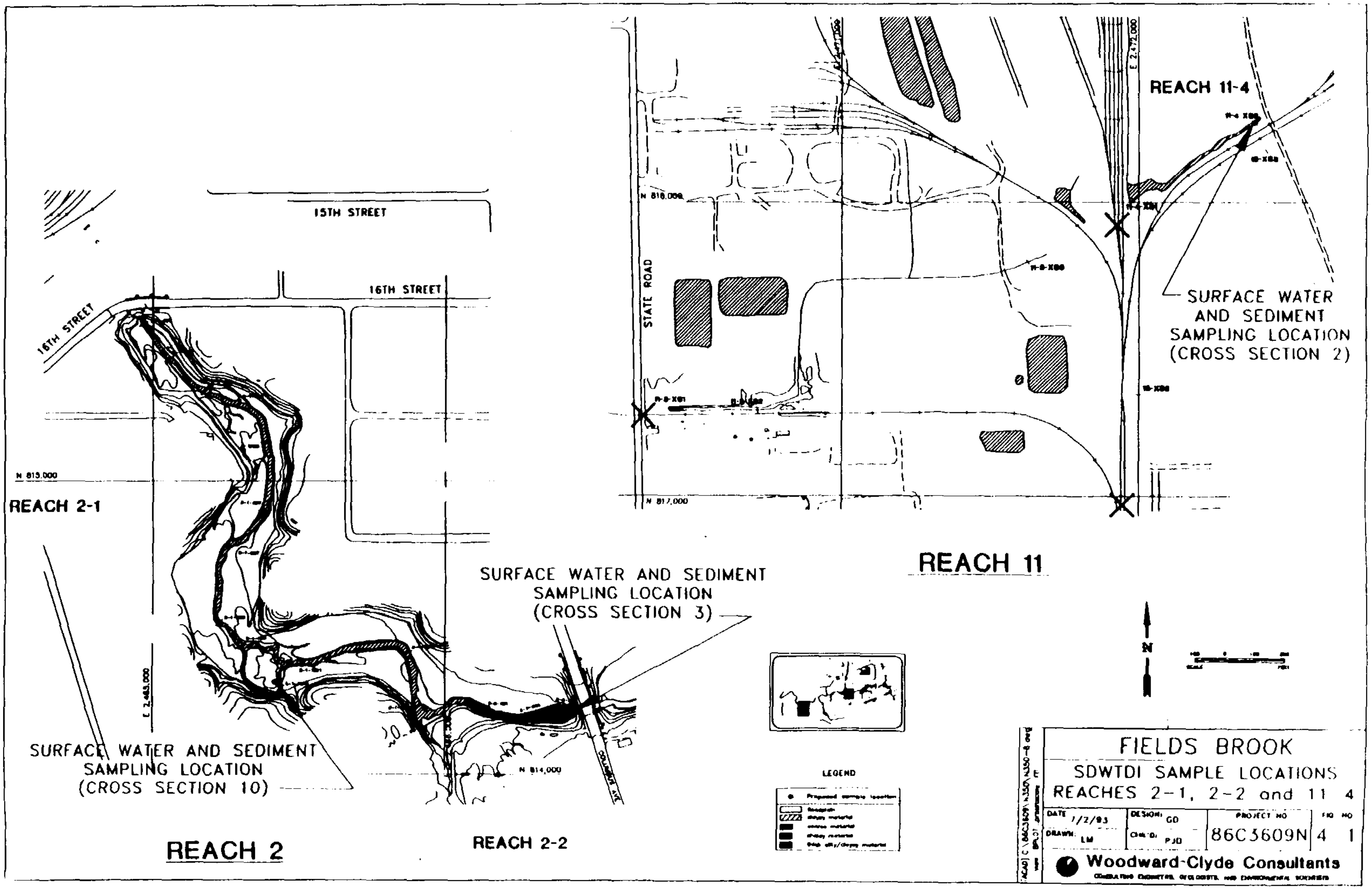
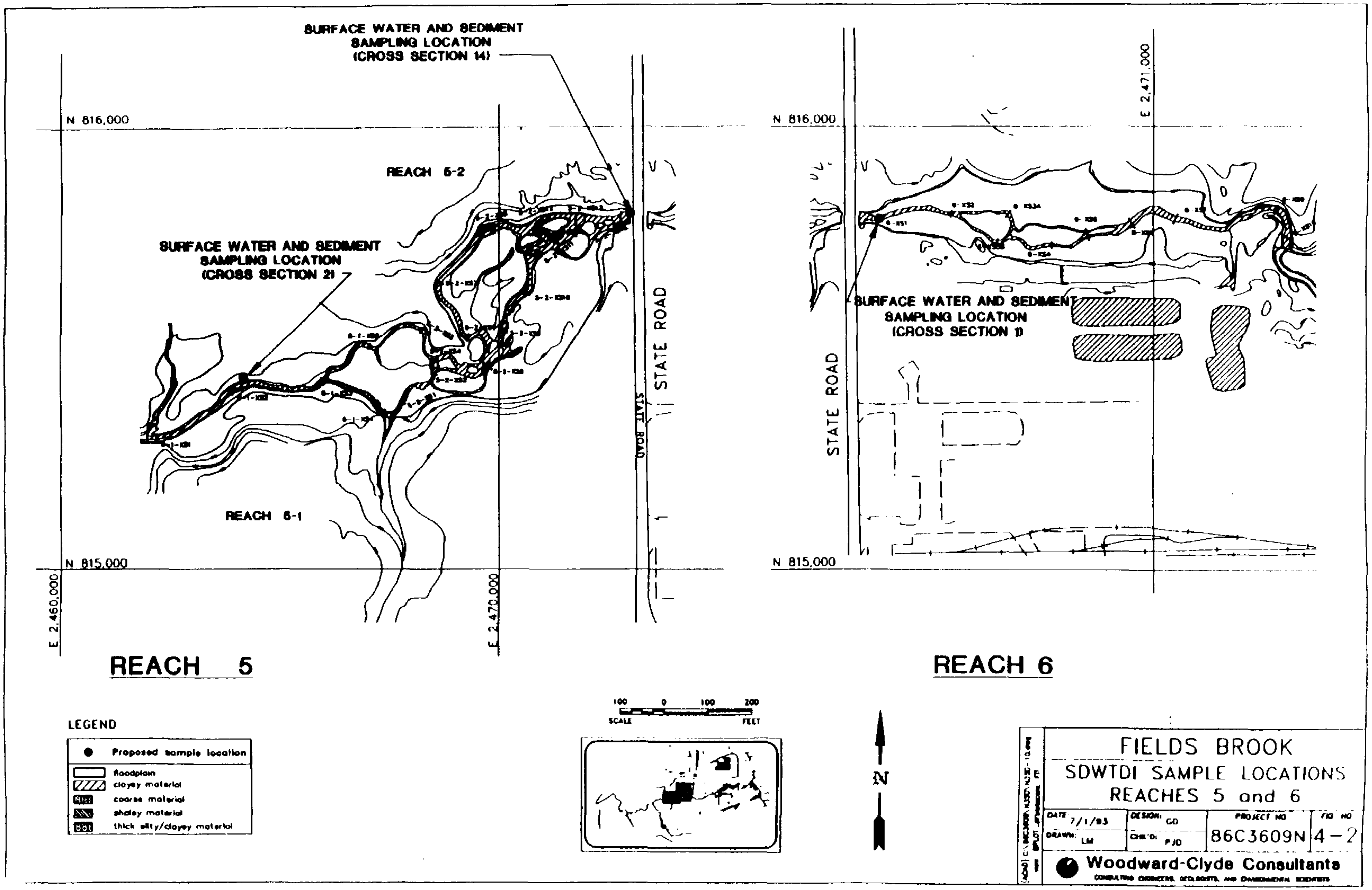
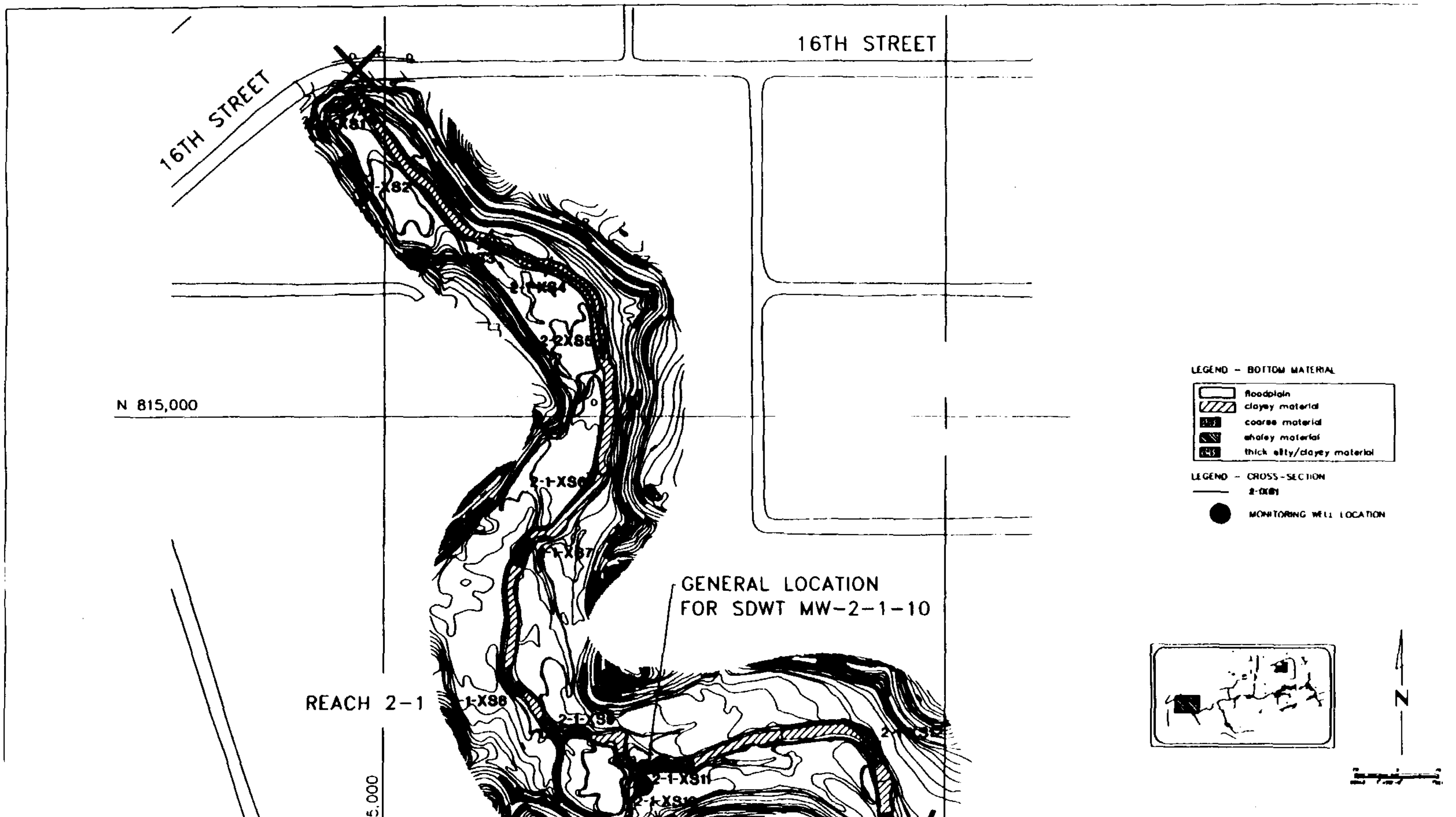
INTERACTIONS BETWEEN DESIGN INVESTIGATIONS FIELDS BROOK, SEDIMENT OPERABLE UNIT

SCALE: NONE	DATE: 7/8/88	PROJECT NO. 88C3609N	FIG. NO. 3-1


15TH STREET
16TH STREET
16TH STREET
N 815,000
REACH 2-1
E 2,469,000
N 814,000
SURFACE WATER AND SEDIMENT
SAMPLING LOCATION
(CROSS SECTION 10)
REACH 2
REACH 2-2
SURFACE WATER AND SEDIMENT
SAMPLING LOCATION
(CROSS SECTION 3)
STATE ROAD
N 818,000
N 817,000
E 2,472,000
REACH 11-4
SURFACE WATER
AND SEDIMENT
SAMPLING LOCATION
(CROSS SECTION 2)
REACH 11
N
LEGEND
FIELDS BROOK
SDWTDI SAMPLE LOCATIONS
REACHES 2-1, 2-2 and 11 4
DATE 7/2/93
DESIGN GD
DRAWN LM
CHK'D PJD
PROJECT NO 86C3609N
FIG NO 4 1
Woodward-Clyde Consultants



SURFACE WATER AND SEDIMENT SAMPLING LOCATION (CROSS SECTION 14)
N 816,000
REACH 5-2
SURFACE WATER AND SEDIMENT SAMPLING LOCATION (CROSS SECTION 2)
STATE ROAD
REACH 5-1
N 815,000
E 2,460,000
E 2,470,000
REACH 5
N 816,000
E 2,471,000
SURFACE WATER AND SEDIMENT SAMPLING LOCATION (CROSS SECTION 1)
STATE ROAD
N 815,000
REACH 6
LEGEND
Proposed sample location
floodplain
clayey material
coarse material
shaley material
thick silty/clayey material
100 0 100 200
SCALE FEET
N
FIELDS BROOK
SDWTDI SAMPLE LOCATIONS
REACHES 5 and 6
DATE 7/1/93
DRAWN LM
DESIGN GD
CHK'D PJD
PROJECT NO 86C3609N
FIG NO 4-2
Woodward-Clyde Consultants



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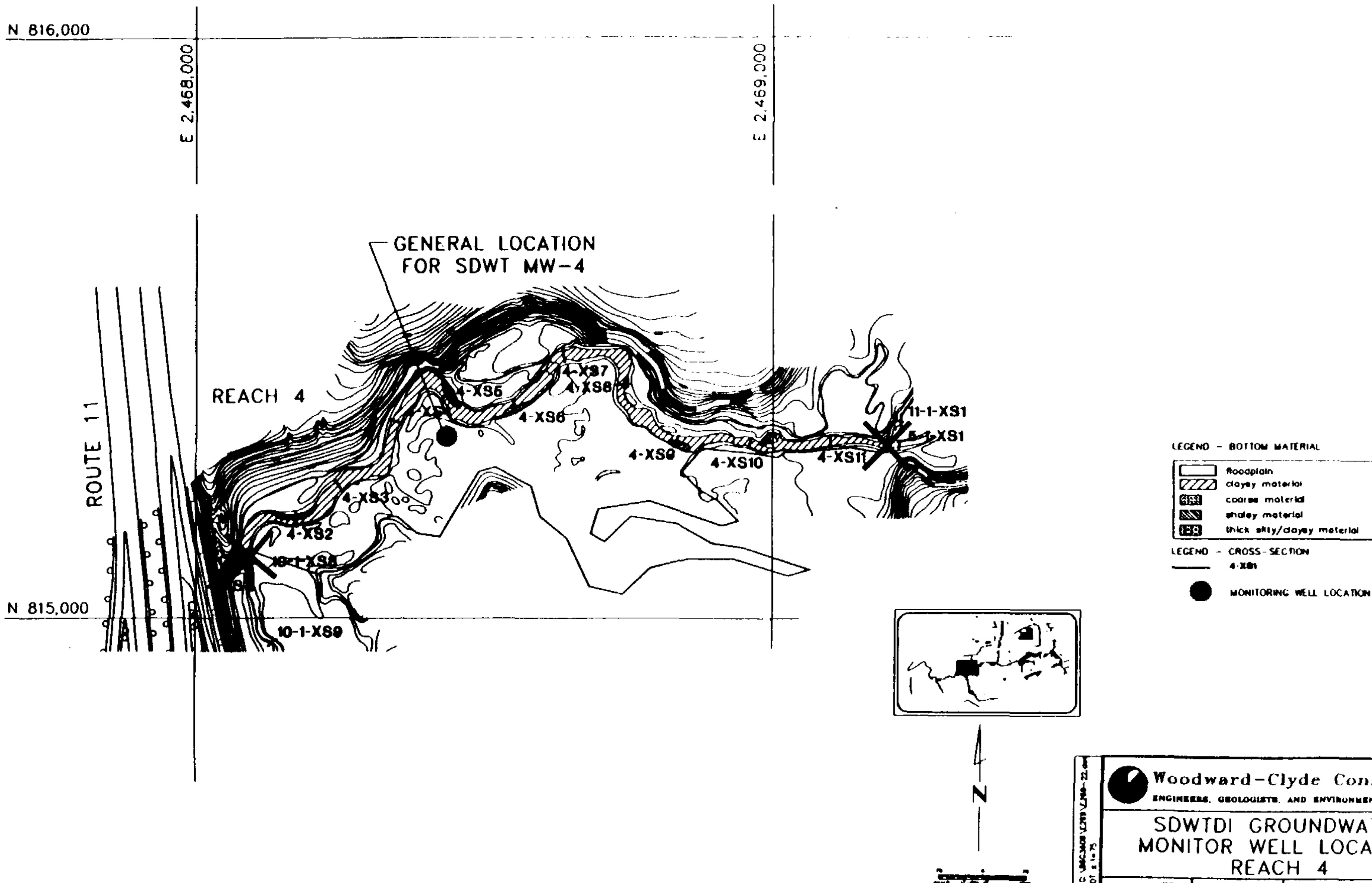
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACH 2-1

DESIGN: GD	SCALE: SHOWN	PROJECT NO	86C3609N	FIG. NO 4-3
DRAWN: LM	DATE: 7/1/93			



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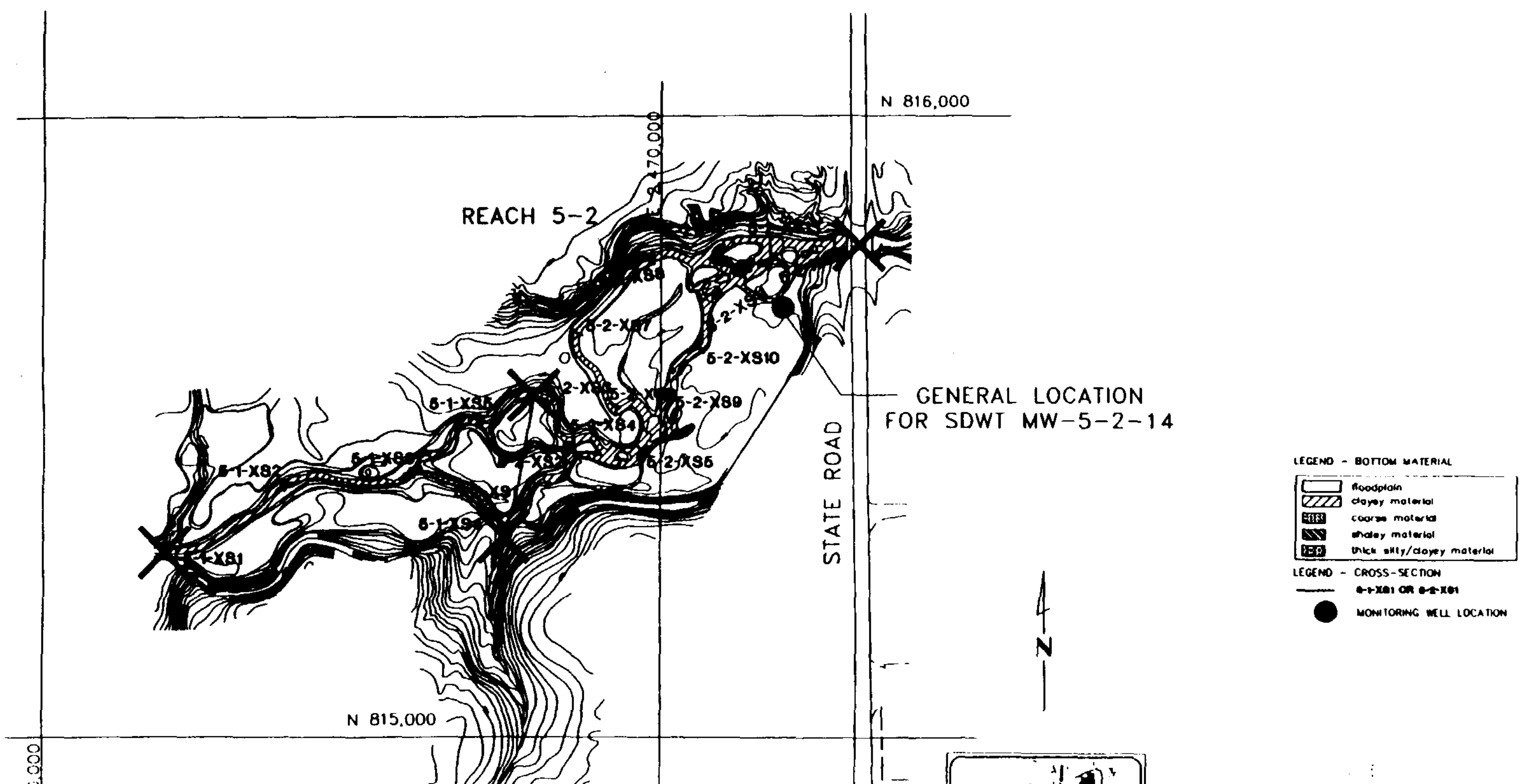
SDWTDI GROUNDWATER MONITOR WELL LOCATION REACH 4

DESIGN: ER	SCALE: SHOWN	PROJECT NO.	FIG. NO
DRAWN: LM	DATE: 10/2/92	86C3609N	4-4



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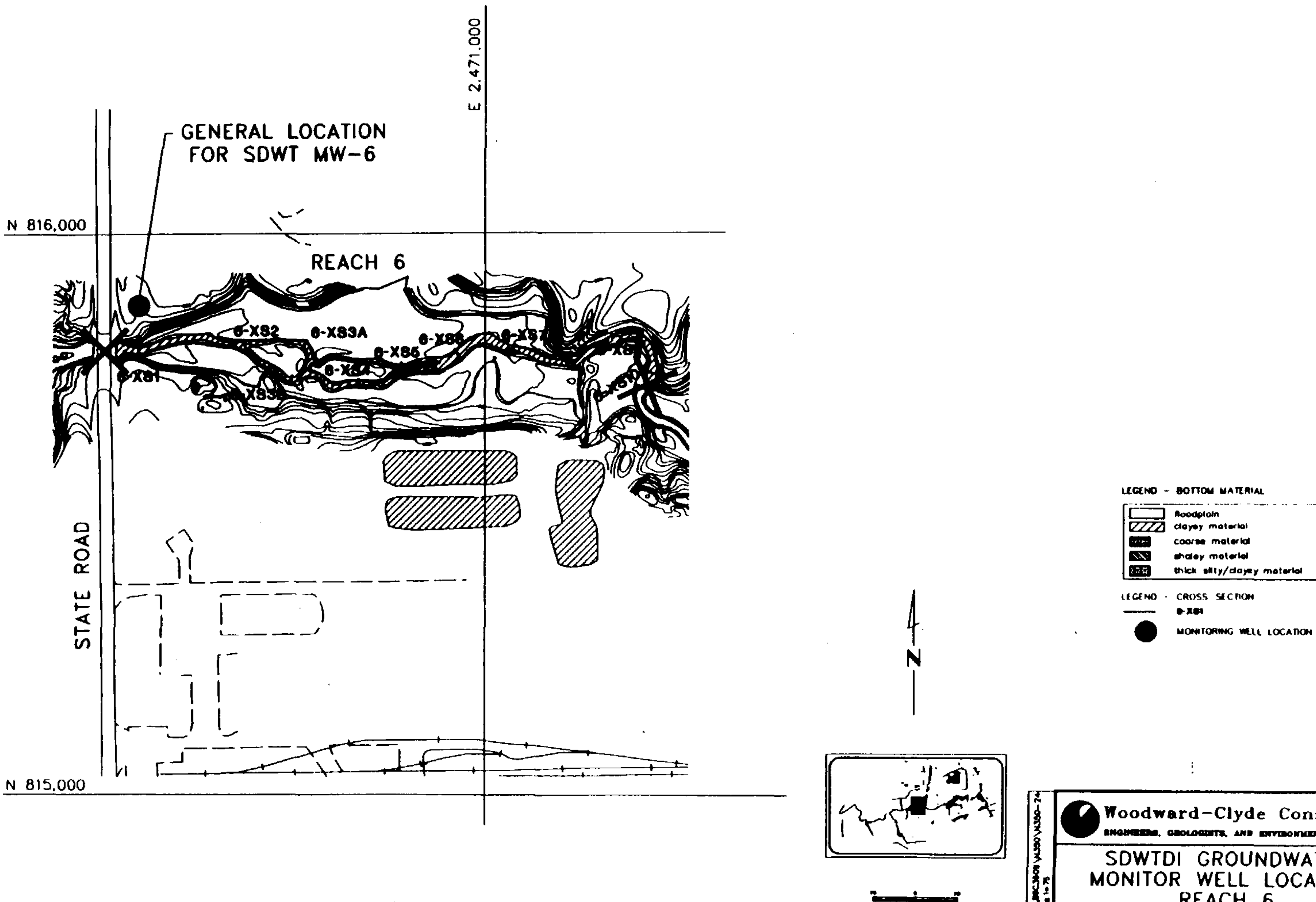
SDWTDI GROUNDWATER MONITOR WELL LOCATION REACH 5-2

DESIGN: GD	SCALE: SHOWN	PROJECT NO. 86C3609N	FIG NO 4-5
DRAWN: LM	DATE: 7/1/93		



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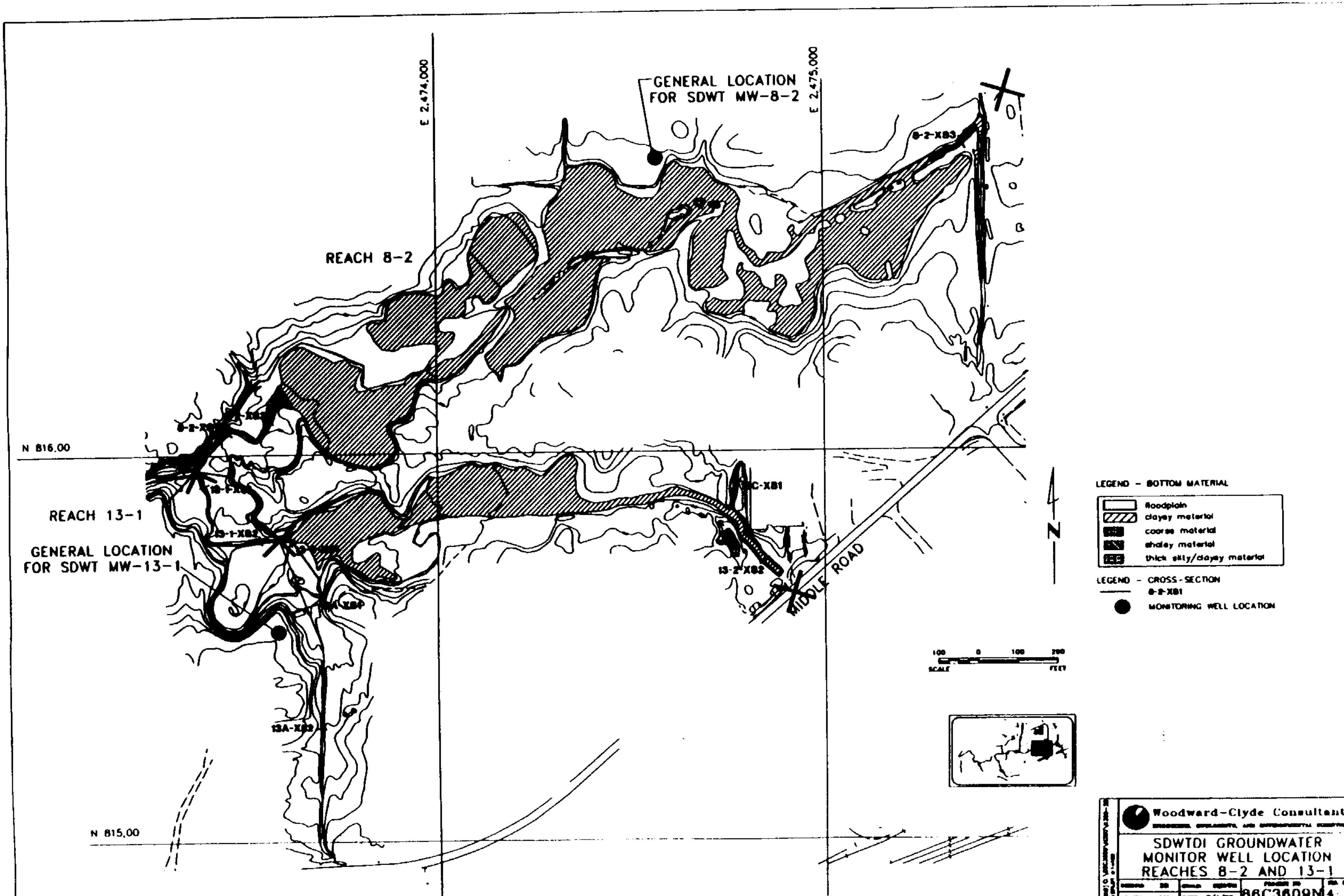
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACH 6

DESIGN:	GD	SCALE:	SHOWN	PROJECT NO.		FIG. NO.
DRAWN:	LM	DATE:	7/1/88	86C3609N		4-6



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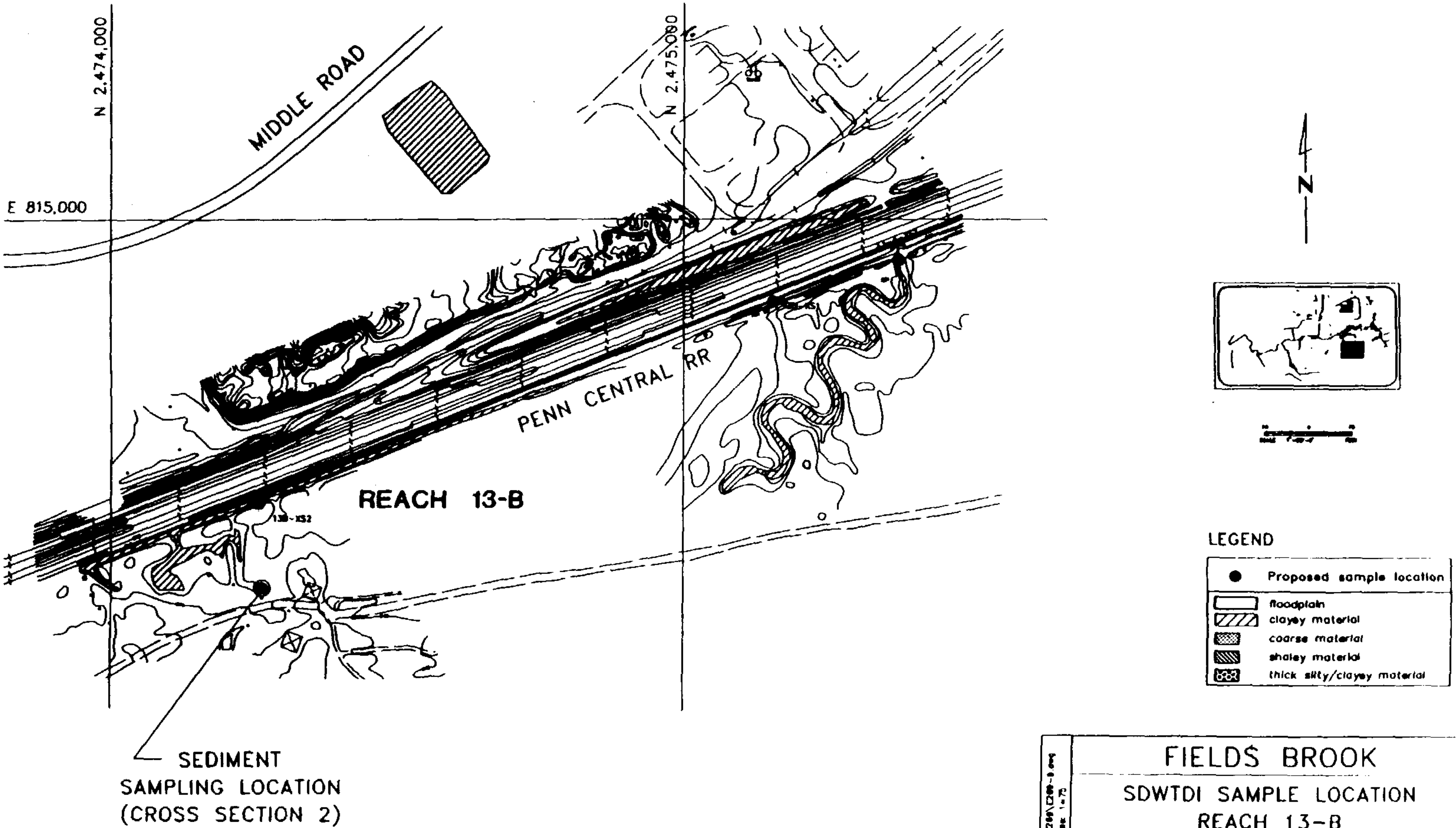
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACHES 8-2 AND 13-1

86C3609N 4.7



FIELDS BROOK

SDWTDI SAMPLE LOCATION
REACH 13-B

DATE: 10/2/92	DESIGN: ER/GD	PROJECT NO.	FIG. NO.
DRAWN: LM	CHK'D: PJD	86C3609N	4-8

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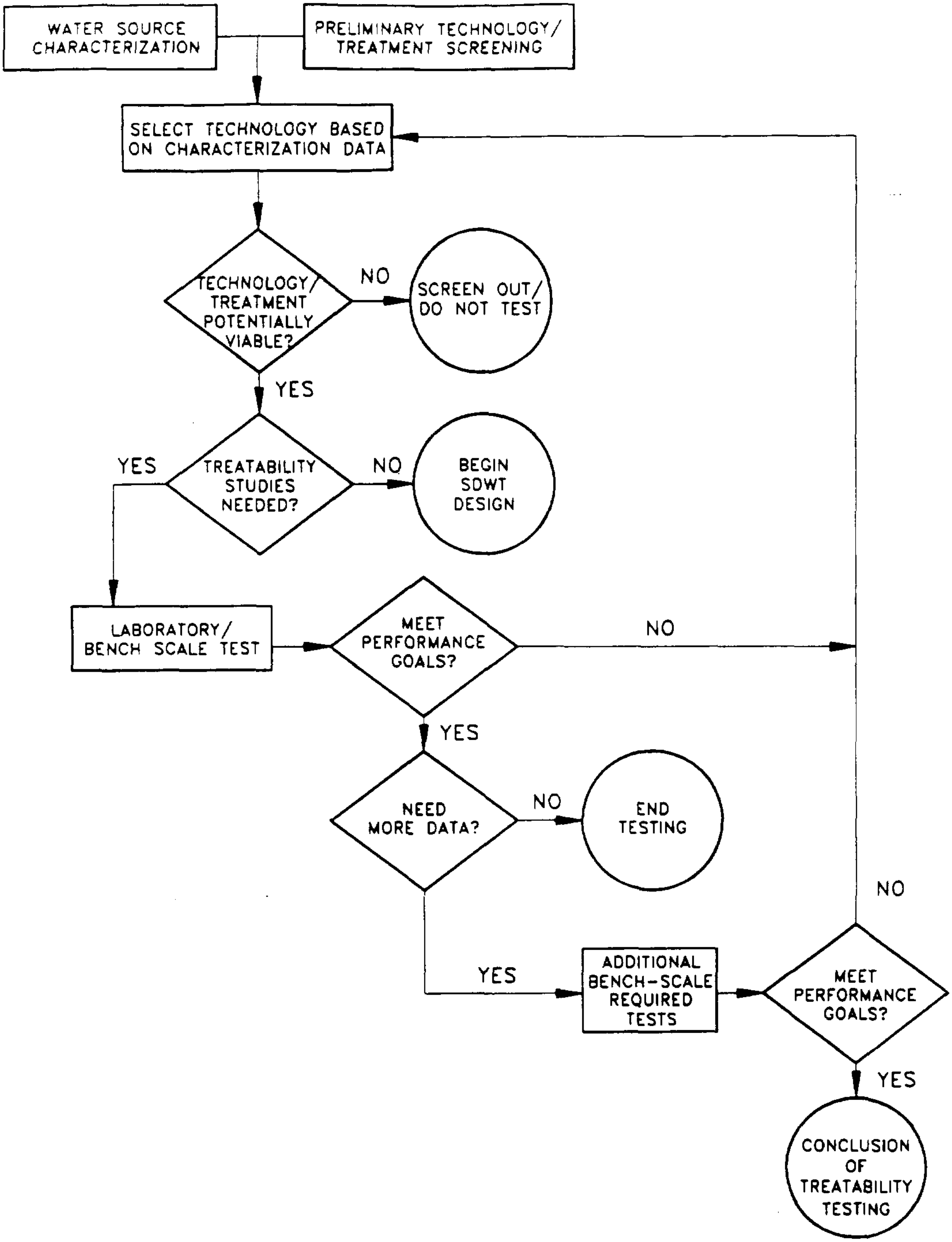
CONSULTING ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS



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TREATABILITY TESTING DECISION TREE

DESIGN: ER	CHK'D: PJD	PROJECT NO. 86C3609E	FIG. NO. 5-1
DRAWN: LO	DATE: 6/14/93		

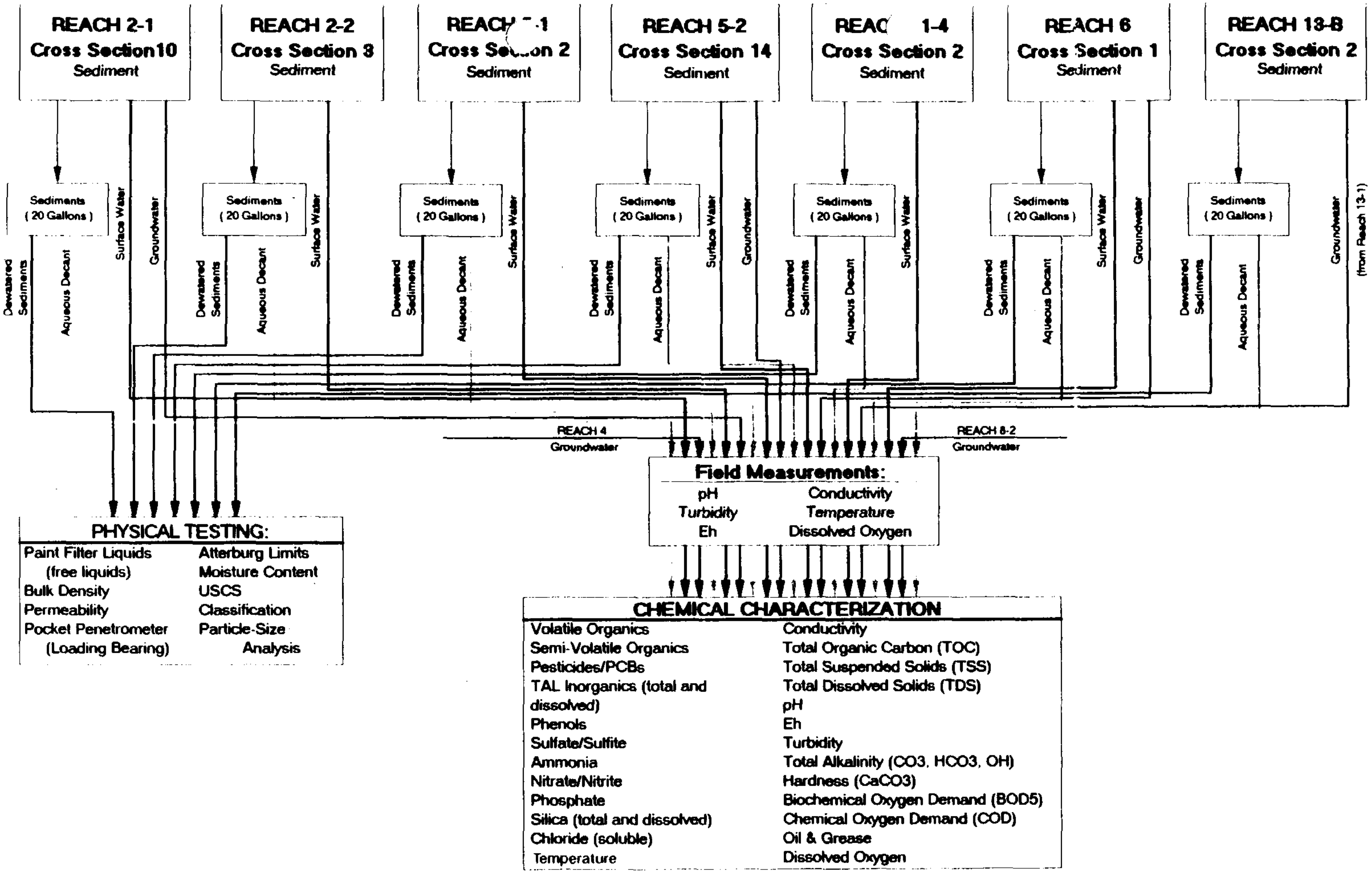


FIGURE 5-2 - WASTE STREAM CHARACTERIZATION

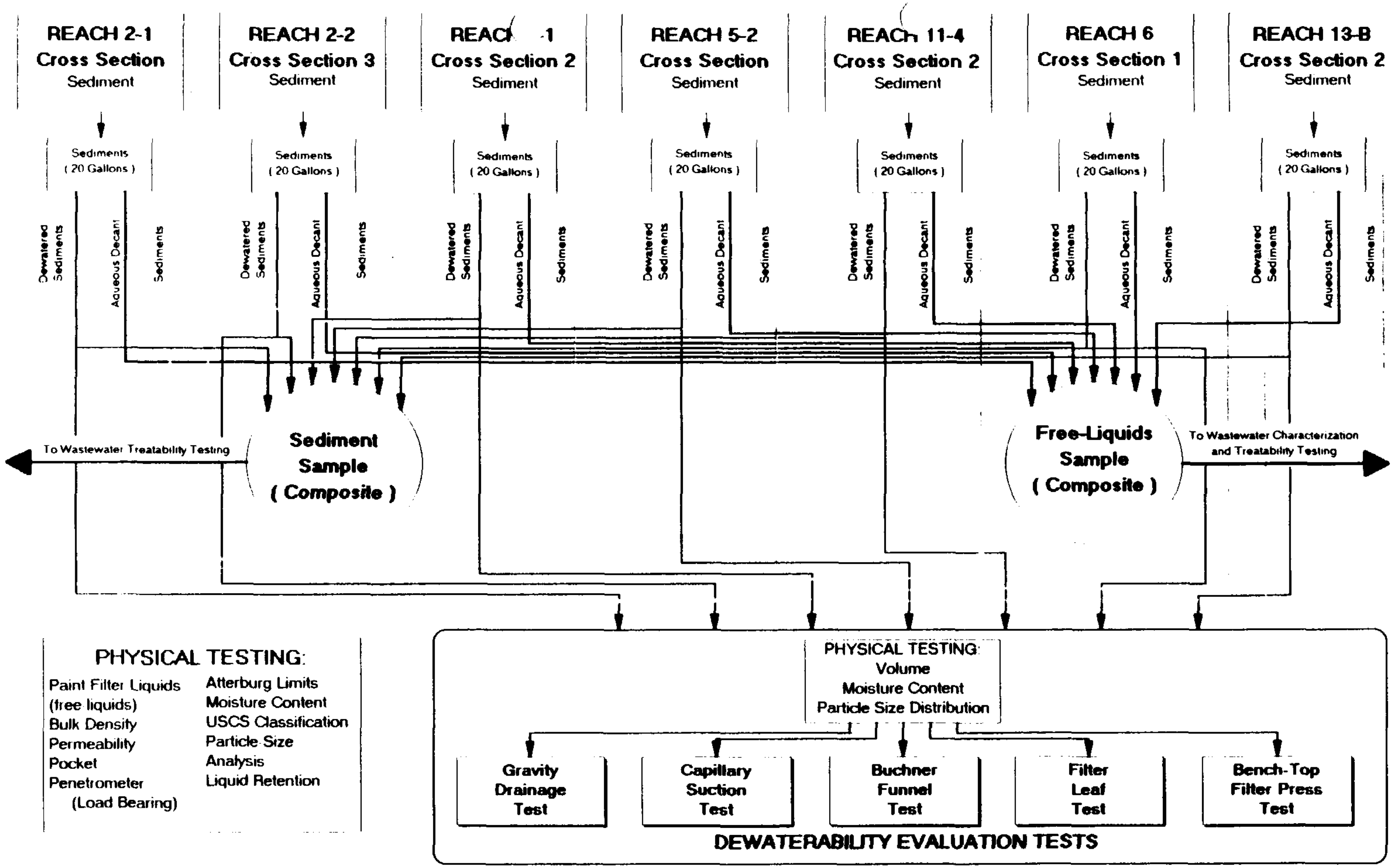


FIGURE 5-3 - DEWATERABILITY EVALUATION SAMPLE PREPARATION

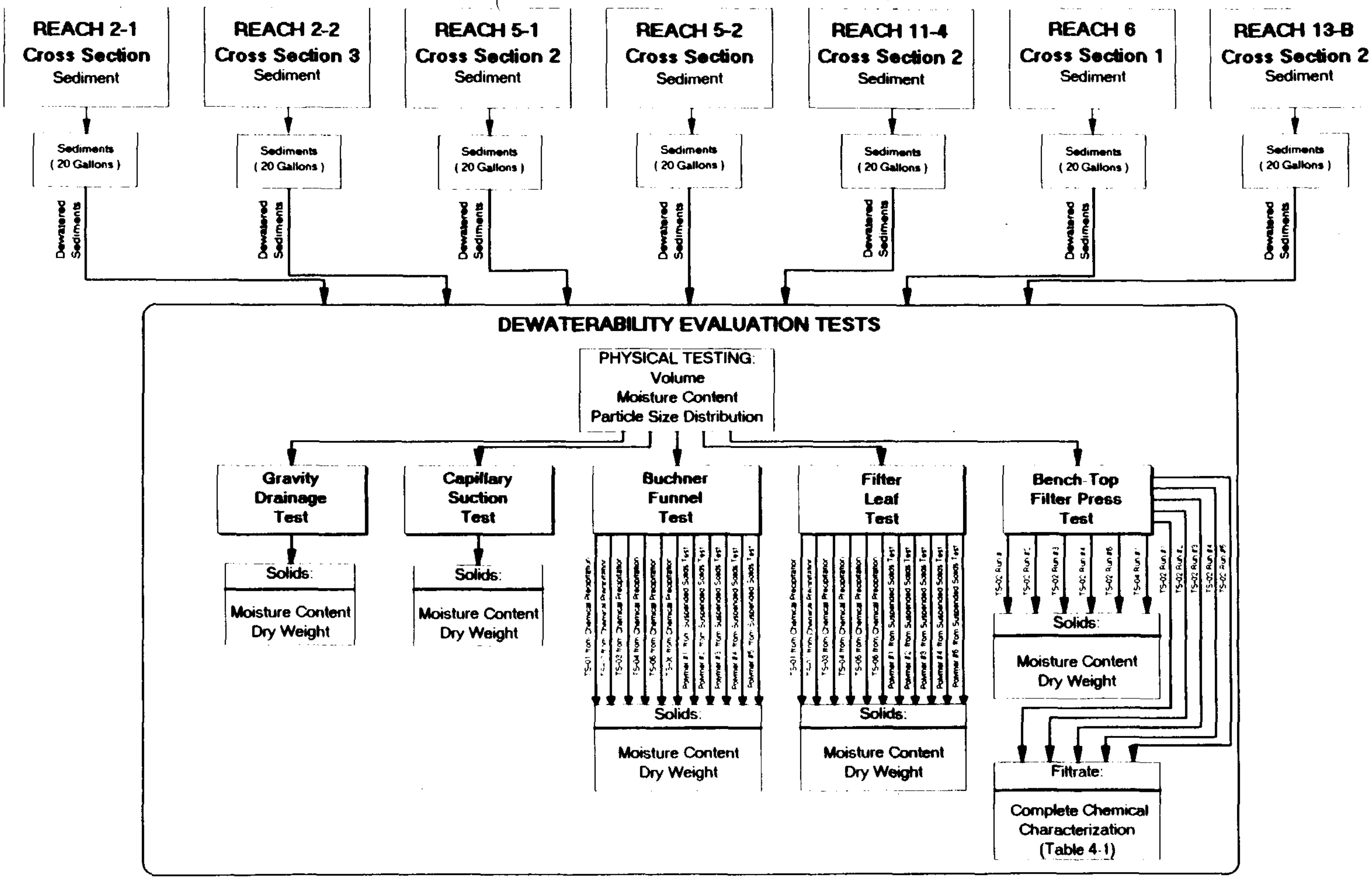
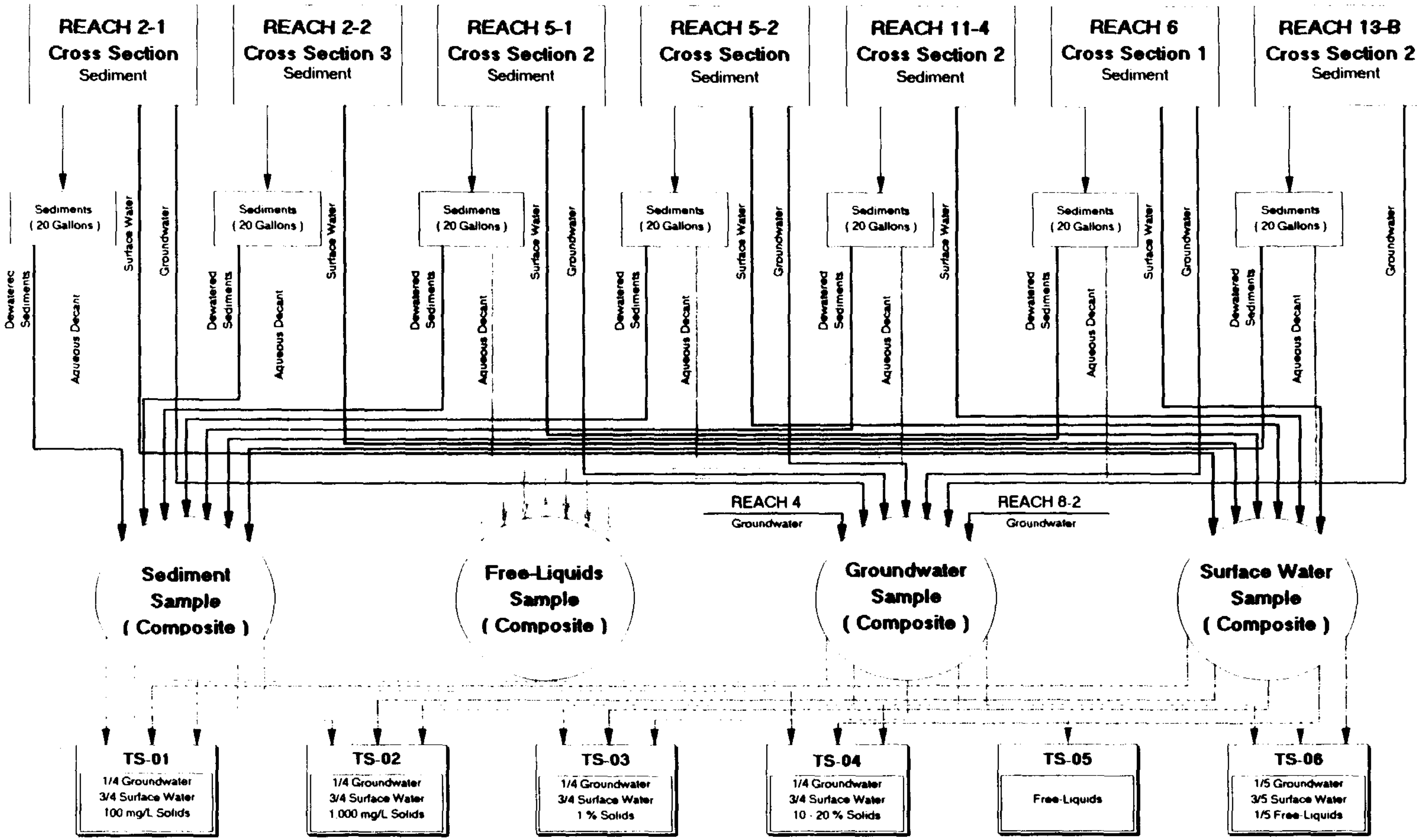


FIGURE 5-4 - DEWATERABILITY EVALUATION TESTS



I:\FBK\5FIGURE5.xls

FIGURE 5-5 - TREATABILITY SAMPLE PREPARATION

6/93
Revision 2

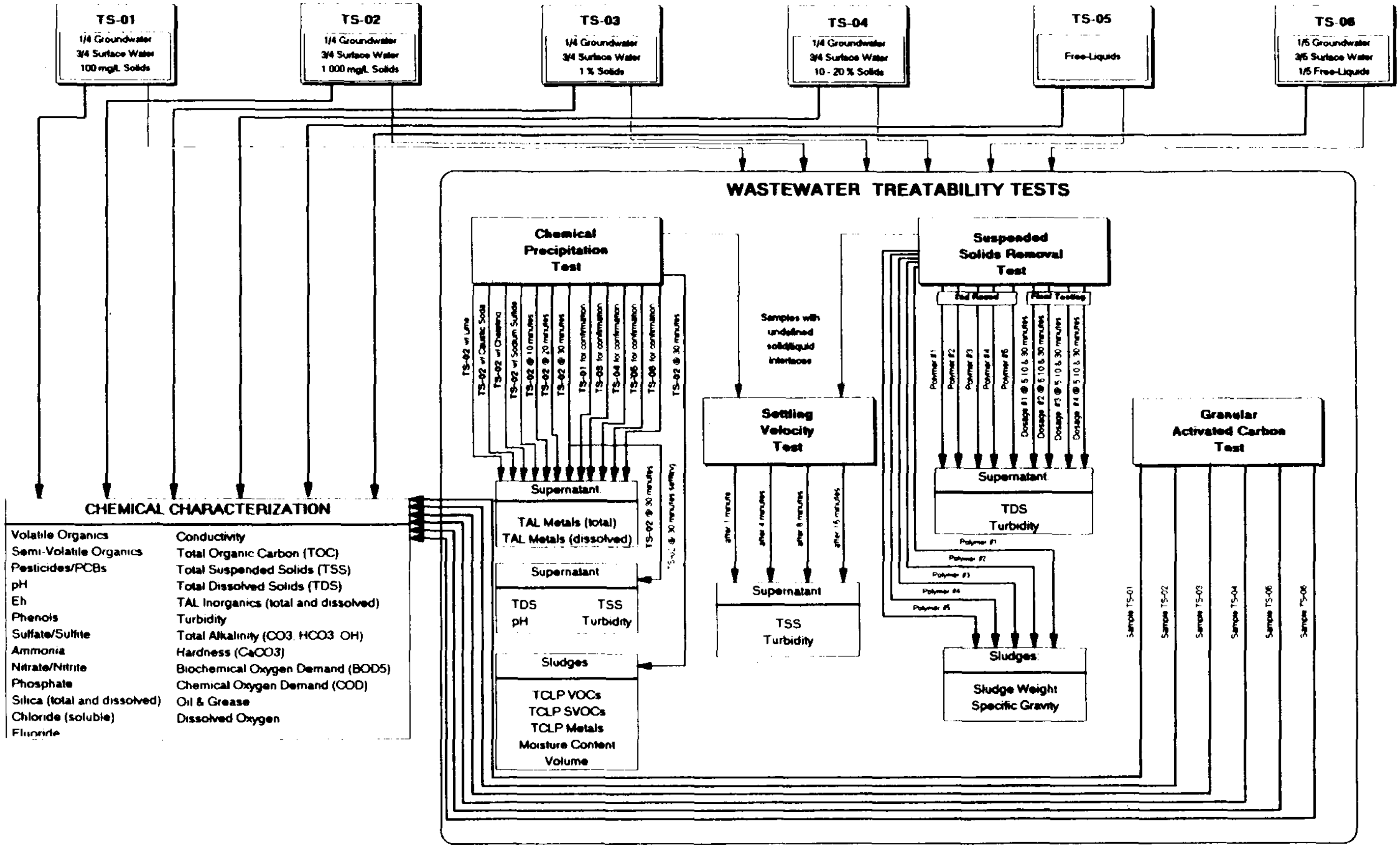


FIGURE 5-6 - WASTEWATER TREATABILITY TESTS

FIGURE 7-1
SUGGESTED OUTLINE FOR
SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION (SDWTDI) REPORT
FROM 1989 STATEMENT OF WORK (SOW)

A. Introduction

B. Objectives and Scope

C. Results of Investigation Tests

1. General

    a. Sampling Procedures
    b. Sample Custody

2. Analytical and Bench-Scale Testing

    a. Data Quality Objectives (DQOs)
    b. Analytical Procedures
    c. Bench-Scale Tests
    d. Results
    e. Data Assessment, Procedures, and Corrective Action
    f. Data Limitations

3. Pilot-Scale Testing

    a. DQOs
    b. Pilot-Scale Tests
    c. Results
    d. Data Assessment, Procedures, and Corrective Action
    e. Data Limitations

D. Conceptual Implementation Plan

1. Waste Stream Characterization
2. Treatment Technologies
3. Treatment Objectives and ARARs
4. Design Criteria
5. Performance Monitoring
6. Residuals Disposal
7. Refined Order-of-Magnitude Cost Estimate for Sediment Dewatering/Wastewater Treatment Activities

E. Appendixes

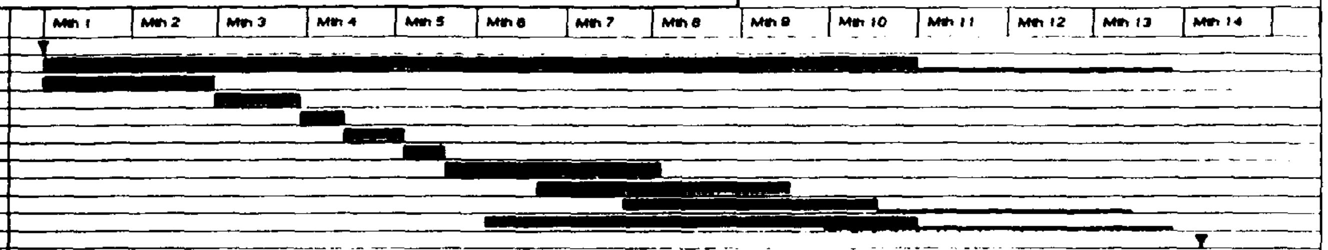
1. Data and QC Discussion
2. Manufacturer's Data

10-13-92	
SDWTDI	Page 1 / 1
FIELD WORK ACTIVITIES WILL NOT BE INITIATED PRIOR TO APRIL 1, 1993	

FIGURE 8-1
SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION (SDWTDI) SCHEDULE

Legend
Critical · Non-Crit · Summary · Hammock
Plan
Early
Late

Description	Dur
SDWTDI WORK PLAN SUBMITTED	0
SDWTDI SUMMARY	304
AGENCY REVIEW	60
DOCUMENT REVISION	30
AGENCY APPROVAL	15
MOBILIZATION	21
FIELD SAMPLING (WEATHER DEPENDENT)	14
BENCH TESTING	75
LABORATORY TESTING	[illegible]
DATA VALIDATION	[illegible]
DRAFT SDWTDI REPORT PREPARATION	120
SUBMIT PRELIMINARY DESIGN REPORT	0



APPENDIX A

FIELD SAMPLING PLAN FOR SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION, FIELDS BROOK SUPERFUND SITE

APPENDIX A

FIELD SAMPLING PLAN SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION (SDWTDI)

FIELDS BROOK SITE ASHTABULA, OHIO

Prepared for
Fields Brook PRP Organization
July 1993

Woodward-Clyde Consultants
122 South Michigan Avenue
Suite 1920
Chicago, Illinois 60603

Project Number 86C3609N
Revision 2

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LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS (Continued)

LIST OF FIGURES (Concluded)

LIST OF ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
BOD	Biochemical Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COD	Chemical Oxygen Demand
FID	Flame Ionization Detection
FRC	Field Record Custodian

FSP	Field Sampling Plan
GAC	Granular Activated Carbon
HCBD	Hexachlorobutadiene
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPL	National Priorities List
OEPA	Ohio Environmental Protection Agency
OSHA	Occupational Safety and Health Administration
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PVC	Polyvinyl chloride
QAPjP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RI/FS	Remedial Investigation/Feasibility Study
SDWTDI	Sediment Dewatering and Wastewater Treatment Design Investigation
SLDI	Solidification Design Investigation
SQDI	Sediment Quantification Design Investigation
SSO	Site Safety Officer
SSP	Site Safety Plan
STL	Sampling Team Leader
STM	Sampling Team Member
STP	Standard Penetration Test
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TEGD	Technical Enforcement Guidance Document

LIST OF ACRONYMS (Concluded)

TOC	Total Organic Carbon
TSS	Total Suspended Solids
TTDI	Thermal Treatment Design Investigation
USEPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds
WCC	Woodward-Clyde Consultants

1.0
PROJECT OVERVIEW

1.1 INTRODUCTION

This Field Sampling Plan (FSP) supports and describes the field activities associated with the Sediment Dewatering and Wastewater Treatment Design Investigation (SDWTDI) for the Fields Brook project in Ashtabula, Ohio. Field activities include installation of monitoring wells, collection of groundwater and surface water samples, collection of sediments samples, and generation and collection of aqueous waste streams from these samples. The samples will be analyzed for physical, chemical, and treatability test parameters. This document is written for personnel involved in field sampling and data-gathering activities at the Fields Brook site, and presents the methods and procedures to implement the scope of work presented in the SDWTDI Work Plan (July 1993). The SDWTDI FSP will serve as an instructional aid and guidance document for all personnel assigned to sampling-related tasks. Standardized sample collection and analytical procedures will aid in generation of consistent and representative data over the life of the project.

1.2 BACKGROUND

1.2.1 Site Description

Fields Brook is located in the city, township, and county of Ashtabula, in northeastern Ohio (Figure A1-1). Fields Brook drains a 5.6-square mile area. The eastern portion of the watershed drains Ashtabula Township and the western portion drains an eastern portion of the city of Ashtabula. The 3.9-mile reach of the main channel begins at Cook Road just south of the Penn Central Railroad (Figure A1-1). From this point, Fields Brook flows northwesterly to Middle Road, then westerly to its confluence with the Ashtabula River. From Cook Road downstream to State Highway 11, Fields Brook flows through an industrial area. Downstream of State Highway 11 to near its confluence with the Ashtabula River, Fields Brook flows through a residential area within the City of Ashtabula. Fields Brook empties into the Ashtabula River about 8,000 feet (ft) upstream from Lake Erie. In order to facilitate locating features along Fields Brook and its tributaries, the fluvial system has been divided into numerous segments identified by reach numbers. These reach numbers are identified in Figure A1-2.

The Fields Brook Site as defined in the Unilateral Administrative Order (U.S. Environmental Protection Agency (USEPA) 1989) "consists of Fields Brook, Ashtabula County, Ohio, its tributaries, and any surrounding areas which contribute, potentially may contribute, or have contributed to the contamination of the brook and its tributaries."

1.2.2 Site History

Fields Brook was determined by the USEPA and the Ohio Environmental Protection Agency (OEPA) to contain contaminated sediments resulting from industrial discharges (USEPA 1986a). The Fields Brook Site was included on the National Priorities List (NPL) of controlled hazardous waste sites under the Comprehensive Environmental Response. Compensation, and Liability Act (CERCLA) on September 8, 1983. The site was placed on the NPL because of the possibility of direct contact with the sediment, movement of contaminated sediment into the Ashtabula River (and then Lake Erie), possible movement of contaminants into the public water supply of the City of Ashtabula, and the possibility of uncontrolled releases of hazardous materials from the sediment (USEPA 1985).

The USEPA conducted a Remedial Investigation and Feasibility Study (RI/FS) at the Fields Brook site. Their study began in April 1983 and concluded in July 1986 with submittal of the FS. A partial list of the findings from the RI Report (USEPA 1985) are presented below:

- Chlorinated benzene compounds, polynuclear aromatic hydrocarbons (PAHs), hexachlorobutadiene (HCBD), and polychlorinated biphenyls (PCBs) were detected in sediment and surface water samples from Fields Brook.
- Organic compounds detected in surface water samples also were detected in sediment and/or industrial effluent samples.

- Volatile Organic Compounds (VOCs), chlorinated benzene compounds, PAHs, HCBD, and phthalate compounds were reported in relatively high concentrations in some sediment samples.

- Concentrations greater than 50 mg/kg of PCBs in sediments were reported in samples from Fields Brook at some locations.

- Some chemicals were detected in fish tissue.

1.3 OBJECTIVES OF FIELD INVESTIGATION

The objectives of the SDWTDI field investigation are to:

- Evaluate the physical and chemical characteristics of aqueous waste streams that could require treatment prior to discharge from the Fields Brook site remedial actions and to determine the relative dewaterability of sediments;

- Re-evaluate of applicable treatment technologies based upon results of waste stream characterization;

- Establish treatment efficiency of filtration and granular activated carbon (GAC) on selected representative waste streams;

- Evaluate variation in flow and chemical characteristics of aqueous waste streams;

- Identify Applicable or Relevant and Appropriate Requirements (ARARs) pertinent to wastewater treatment and discharge; and

- Develop data necessary for performance specifications for vendor design, construction, and operation of the wastewater treatment unit.

In meeting the SDWTDI field investigation objectives, the following tasks will be performed:

- Collect sediment samples for use in preparation of treatability test samples, for dewaterability evaluation and physical characterization;

- Collect bulk drained water samples (during SLDI and TTDI) representative of waste streams generated from sediment removal and handling for preparation of treatability test samples;

- Collect groundwater samples representative of waste streams generated during sediment removal and handling for physical and chemical characterization; and

- Collect surface water samples for physical and chemical characterization, for preparation of treatability test samples.

1.4 SAMPLING TEAM RESPONSIBILITIES

The procedures described in the SDWTDI FSP will be performed by the sampling team personnel. The sampling team consists of the following personnel:

- Sampling Team Leader,
- Sampling Team Member(s),
- Field Record Custodian,
- Site Safety Officer, and
- Quality Assurance/Quality Control Officer.

One person may assume more than one role in the sampling team. The function and responsibilities of sampling team personnel will be consistent with the worker's level of training. Job function and responsibilities of the sampling team are described below.

Sampling Team Leader

The Sampling Team Leader (STL) will be responsible for coordinating and documenting the activities of the Sampling Team Members. These activities will include: managing, and, in part, conducting the sampling program; daily maintenance and calibration of the field instruments; ensuring the availability of all sampling equipment and materials; and providing shipping and packing materials. The STL will supervise and be responsible for: completion of all chain-of-custody records; proper labeling, handling, and shipping of samples; and the accurate completion of field logbooks by the Sampling Team Members.

Sampling Team Member(s)

The Sampling Team Member(s) (STM) will be responsible for: inspecting field operations such as boring and well installations; performing field installations and measurements (including instrument calibration); collecting samples and transferring them for shipping; completion of accurate and thorough field logbooks; and decontamination of sampling equipment.

Field Record Custodian

The Field Record Custodian (FRC) will assume custody of samples from the sampling team. The FRC will be responsible for checking all chain-of-custody records and sample labels.

The FRC will also be responsible for maintaining communications with on-site personnel and off-site laboratory personnel, and for logging pertinent communications and the site entries and departures of all personnel.

Site Safety Officer

The Site Safety Officer (SSO) will be responsible for monitoring compliance with the project Site Safety Plan (SSP). The SSP (WCC, 1989), as amended, will be used for site activities associated with the SDWTDI, in which personnel may be exposed to potentially hazardous chemicals. The SSP is summarized in Section 6.0 of this FSP. Detailed personnel and equipment procedures are described in Section 4.0 of this FSP.

The SSO will meet daily with the STL to coordinate project activities and safety considerations for the personnel at the site. The SSO will be responsible for adherence to all site safety requirements by the STMs. The SSO will assist all on-site personnel in conducting site briefing meetings and will perform the final safety checks. Additional SSO responsibilities include:

- Providing new or additional safety equipment or updating procedures based upon new information gathered during the site activities;

- Upgrading the levels of protection as directed by the SSP;
- Enforcing the "buddy system";
- Assisting the STL with tracking and maintenance of field monitoring equipment;
- Determining and posting locations and routes to medical facilities, including poison control centers; arranging for emergency transportation to medical facilities;
- Notifying local public emergency officers (i.e., police and fire departments) of the nature of the team's operations and posting their telephone numbers;
- Examining work party members for symptoms of exposure or stress; and
- Providing emergency on-site medical care and first aid, as necessary.

The SSO has the ultimate responsibility and the authority to stop any operation that threatens the health and safety of the team or surrounding populace.

Quality Assurance/Quality Control Officer

The Quality Assurance/Quality Control (QA/QC) officer will ensure that all work, measurements, and sampling procedures comply with protocol and procedures outlined in this FSP and the Sediment Operable Unit (SOU) Quality Assurance Project Plan (QAPjP).

The following are a list of tasks that the QA/QC officer will perform:

- Approval and distribution of all QA/QC procedure revisions, if any, used on the project;
- Performance and/or system audits of laboratory, field, and engineering operations to assure compliance with the QAPjP;
- Review and validation of laboratory data for compliance with precision, accuracy, and completeness objectives;

- Introduction of performance evaluation samples into the analytical flow scheme, as needed;
- Prompt notification of the Project Manager of any QC deficiencies;
- Provisions of guidance and coordination to rapidly resolve any QA/QC problems;
- Maintenance and retrieval of all project QA records and assembly of project QA data for inspection by regulatory agency personnel;
- Independent review of the quality of all deliverables or outputs from the sampling team; and
- Interaction and communication with client QA personnel to resolve QA/QC problems specific to the project, as directed by the Project Manager.

1.5 PROJECT SCHEDULE

The SDWTDI project schedule is presented as Figure A1-3. The investigation activities described in this FSP will be implemented in accordance with the project schedule.

2.0 SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION

2.1 INTRODUCTION

Groundwater, surface water, sediment and drained water samples for the SDWTDI bench scale treatability tests will be collected from Reaches 2-1, 2-2, 5-1, 5-2, 11-4, 6 and 13-B of Fields Brook, and its tributaries and floodplains. Reach locations are shown on Figure A2-2. Sampling locations are shown on Figures A2-1a through A2-1c, and A2-2a through A2-2e. These reaches contain chemical constituents which exceed the USEPA's 1993 Cleanup Goals for Fields Brook sediments.

Reach 2-1 has been identified in the Solidification Design Investigation (SLDI) as an area where fine-grained sediments contain concentrations of inorganic and low mobility organic compounds above the USEPA's 1993 Cleanup Goals. Reach 7-2 has been identified in the SLDI as an area where fine-grained sediments contain concentrations of inorganic compounds above the USEPA's 1993 Cleanup Goals. Reach 2-2 has been identified in the SLDI as an area where coarse-grained sediments contain inorganic and organic compounds above the USEPA's 1993 Cleanup Goals. Reaches 5-1, 5-2 and 6 have been identified in the Thermal Treatment Design Investigation (TTDI) as areas where sediments contain PCBs and highly mobile organic compounds in sufficient quantities to use thermal treatment as the remediation process. Reach 13-B was selected for use in the SDWTDI due to the relatively high moisture content found in the reach sediments. These types of materials will exhibit varying dewatering characteristics and will generate worst-case concentrations of contaminated water for SDWTDI bench-scale treatability testing.

2.2 MOBILIZATION TASKS

Mobilization tasks will include the preparation and coordination of field sampling personnel and activities, and efforts associated with equipment return and site tear-down.

2.2.1 Premobilization

Premobilization tasks will be performed prior to on-site activities associated with the SDWTDI field sampling. These tasks include:

- Coordination of drilling and sampling efforts;
- Ordering of field instruments;
- Organization of fieldwork support; and
- Site reconnaissance.

Coordination of drilling operations, sampling equipment, and sample containers will be performed prior to on-site mobilization. Equipment, containers, shipping coolers, and sample documentation forms will be shipped to the site and organized before field sampling.

Field instruments will be ordered and shipped to the site prior to mobilization. Necessary tools, repair items, additional support supplies, and instrument accessories will be included with the field instruments for mobilization to the site.

Before on-site mobilization, the following will be secured: designated areas for personnel and sampling equipment decontamination; storage facilities for sampling equipment and sample staging; and office space for field personnel and supplies.

A preliminary site reconnaissance will be performed to assess the site and sampling locations prior to field mobilization. The sampling locations will be walked to identify any clearance restrictions, special hazards, or environmental limitations. Necessary stream channelization and/or diversion of flows for collection of sediment and water samples will be determined and evaluated.

2.2.1.1 Utility Clearance

Utility clearances will be obtained prior to initiating subsurface activities such as drilling and subsurface sampling. Utility clearances will include water, gas, electricity, communications, product supply lines, high pressure pipelines, and wastewater lines.

The procedure for utility clearance is as follows:

1. Mark or stake subsurface sampling locations.
2. Notify the owners/representatives of properties prior to implementing subsurface activities and provide locations requiring utility clearance.
3. Contact the appropriate local utility company to mark lines with survey flags or spray paint. Meet with the city personnel at the site, if possible.
4. Document "Okay to Proceed" provided by appropriate authorities.

Drill rig masts will not be located closer than 20 ft to any overhead power lines.

2.2.2 Demobilization

Before demobilization all equipment used on-site during the SDWTDI will be decontaminated. as described in Section 4.0 of this FSP. An inventory will be taken of all equipment removed or stored on site. If necessary. a storage shed will be set up to store sampling equipment to be kept on site. The site will be cleaned and all nonhazardous waste will be properly disposed. The outer well casings of the monitoring wells will be locked and checked before leaving the site. At least one person will stay on site until demobilization is complete. Rented equipment will be cleaned and inspected before being returned to vendors.

2.2.2.1 Generated Wastes

Disposable protective clothing and sampling equipment; liquids generated by decontamination procedures, monitor well development and sampling; and soils removed from boreholes during drilling activities, will be collected in on-site containers during the SDWTDI. Solids and liquids will be contained separately. These materials will be stored at a designated on-site location in sealed containers, pending receipt and review of sample analytical results. All generated wastes will then be properly disposed. The assigned hazardous waste generator identification number for the Fields Brook Superfund Site is OHD 980614572.

2.3 FIELD INVESTIGATION ACTIVITIES AND PROCEDURES

Field investigation activities conducted during the SDWTDI include installation of monitor wells, collection of groundwater and surface water samples, collection of a bulk sediment sample, and field measurements of additional aqueous design parameters. These parameters include temperature, pH, specific conductivity, oxidation-reduction potential (Eh), dissolved oxygen (DO) and turbidity.

Aqueous samples will be collected for analyses of chemical and physical parameters listed on Table A2-1. Quality Assurance/Quality Control (QA/QC) samples for chemical testing will be obtained according to Section 2.5.1.1 of this FSP. The following bulk samples will be collected for SDWTDI bench-scale treatability testing: one sediment, six surface water, and six groundwater samples. Refer to Table A2-2 for bulk sample volumes and to Table A2-3 for number of samples to be collected (including QA/QC samples). In addition, six undrained bulk sediment samples and six drained bulk water samples will be obtained from each investigative reach during the TTDI and SLDI for SDWTDI bench-scale treatability testing.

Samples collected during the SDWTDI will be obtained from the following locations:

- Groundwater from monitoring wells located along the Fields Brook Reaches 2-1, 4, 5-2, 6, 8-2 and 13-1.
- Sediment near Cross-section 2 of Reach 13B.
- Sediment and surface water (collected during SLDI) near Cross-section 10 of Reach 2-1.
- Sediment and surface water (collected during SLDI) near Cross-section 3 of Reach 2-2.
- Sediment and surface water (collected during TTDI) near Cross-section 2 of Reach 5-1.
- Sediment and surface water (collected during TTDI) near Cross-section 14 of Reach 5-2.

- Sediment and surface water (collected during TTDI) near Cross-section 1 of Reach 6.

- Sediment and surface water (collected during SLDI) near Cross-section 2 of Reach 11-4.

Each bulk sediment sample will consist of approximately 20 gallons of undrained material, and each bulk water sample will consist of 15 to 20 gallons of water (volumes are field dependent). A flame ionization detector (FID) or photoionization detector (PID) will be used continuously during sampling activities for monitoring of ambient conditions for worker safety.

Details on monitor well borehole drilling methods, construction materials, installation, development, groundwater level measurements, and slug testing procedures are described below.

2.3.1 Monitor Well Borehole Drilling

Six monitor wells will be installed during the SDWTDI in accordance with OEPA guidelines. Refer to Figures A2-2a through A2-2e for general monitor well locations. The wells will be installed along the banks of, and within a 50-ft distance from, Reaches 2-1, 4, 5-2, 6, 8-2 and 13-1 to obtain and evaluate chemical and physical groundwater quality of potential inflow during excavations. Screened intervals should straddle the encountered groundwater level and extend approximately 3 feet below the existing sediments, or shallower upon reaching competent bedrock, to allow for both seasonal fluctuations in the groundwater level and for anticipated excavation depths. Exact monitor well borehole depths will be determined after encountering groundwater in the field during drilling. It is anticipated that groundwater will be encountered at depths ranging from 2 to 7 ft below ground surface (bgs). Depth to bedrock at Reach 2-1 is expected to be from zero to two feet below the existing channel bottom. Therefore, a temporary well point may be used to collect a groundwater sample at this location.

Preparation

Before drilling begins at the site, the drilling contractor will become acquainted with the features and the planned boring locations. Access roads and work areas will be cleared of surficial obstructions. Some drilling may occur in loose soils. Light-weight drill rigs will be used in these areas. If soils are soft and/or wet; mats or other methods will be used to mitigate disturbance to these soils. Preventive measures will also be taken to prevent soil loss and erosion. The drilling crew will be briefed on the site conditions, read the Site Safety Plan (SSP), and acknowledge the site-specific environmental and safety conditions by signing the SSP form. The drilling equipment will be decontaminated before entering the site, between boreholes, and before leaving the site. Decontamination of the drilling rig and drill augers will be done at a temporary wash pad constructed on site, according to procedures outlined in Section 4.3. Disposal procedures for these liquids are discussed in Section 2.2.2.1.

Drilling Methods

Drilling operations will be performed using a 4½-in. inside diameter hollow-stem auger. All boreholes will be continuously sampled with a 2-ft-long, 2-in. outer diameter (OD) split-spoon sampler to the total depth of the boring.

Documentation

Drilling will take place under the technical oversight of a Woodward-Clyde Consultants (WCC) field engineer or geologist. The geologist or engineer will log all borings and, as a minimum, will note the following on each log:

- Boring identification;
- Drilling contractor;
- Drilling date(s);
- Drilling equipment used;
- Depth at which water is first encountered;
- Sampling equipment and sample depths;
- Sample recovery;

- Sample description in accordance with the Unified Soil Classification System (USCS) Symbol;
- Approximate depths of observed strata changes and discolored zones if applicable;
- Standard penetration test (SPT) results for split-spoon sampling events;
- PID and/or FID monitoring results;
- General remarks and observations; and
- Drilling fluid characteristics (e.g., type of mud, viscosity, number of bags of bentonite used).

A typical boring log form is shown in Figure A2-3. A field copy of each boring log will be kept on site with the field logbooks.

2.3.2 Monitor Well Construction Materials

Monitor wells will be constructed of Schedule 40 polyvinyl chloride (PVC) flush-threaded pipe. No solvents or cement will be used in well fabrication. Well installation operations will be performed by the drilling subcontractor with oversight and documentation by the WCC field engineer or geologist. After completion of the monitor well construction and development, the top of the well riser will be surveyed.

Well materials shall be new and undamaged. Materials that are damaged or determined not to be in accordance with specifications will be rejected. Well pipe materials will be decontaminated just before use to minimize the potential for introducing contaminants into the groundwater. Typical well design details are shown in Figure A2-4.

Well Screen: Well screens will be 10 ft in length and will consist of 2-in. inside diameter flush-threaded, Schedule 40 PVC pipe with No. 10 (0.01-inch) slots. Teflon tape may be used on the threads to promote a tighter seal.

Well Riser: Well risers for the monitoring wells will consist of 2-in. inside diameter flush-threaded Schedule 40 PVC riser pipe. The risers for the wells will extend from the top of the well screen to approximately 2 ft above ground surface. Well risers will be fitted with a leak resistant cap. No solvents or cements will be used to connect sections of pipe. Teflon tape may be used as an added seal on the riser threads.

Well Caps: Well caps will be used that are equipped with a top washer, an O-ring seal, and a bottom washer. These types of well caps are designed to offer a water tight seal and complies with OEPA reasoning for wells constructed within floodplain areas.

Sand Pack Material: The annular space between the well screen and the borehole wall will be tremie backfilled with clean, washed, well-graded, 100 percent silica sand.

Buffer Sand: A minimum 2-ft thick buffer sand layer will be placed above the sand pack. The sand will be the same grade sand used for the sand pack. The buffer will be used to restrict the overlying bentonite from infiltrating into the sand pack placed around the screened interval.

Bentonite Seal: A minimum 2-ft-thick layer of bentonite pellets will be placed above the buffer sand. The pellets will be tremied to prevent blocking and/or bridging. The pellets will be allowed to hydrate in accordance with manufacturer's instructions before placement of the remaining annular backfill.

Cement/Bentonite Grout Backfill: The annular space between the well casing and the borehole will be tremie backfilled with grout from the top of the bentonite seal up to the ground surface. Use cement/bentonite mixture ratio between 1.0:0.02 to 1.0:0.05.

Protective Steel Casing: A 5-ft-long, protective steel casing with lockable steel cap shall be installed in the grout over the monitor well PVC riser pipe of each well. The casing cap will fit securely and be designed to offer a water-tight seal.

Concrete Pad: Concrete will be poured around the base of the protective steel casing at the ground surface to hold the riser securely in place. The pads will be sloped away from the well casing.

Steel Guard Posts: Steel guard posts may be placed around the monitor wells after consideration of the well location with regard to potential traffic or other equipment. They will be 4-in.-diameter, 5-ft-long steel pipes. The guard posts will be spaced, as determined in the field, around the monitor well near the perimeter of the concrete pad. The pipes will be painted with a bright rust-inhibiting paint before installation, and filled with concrete after installation.

Upon completion of the installation of each monitor well, the well will be marked on the protective steel casing, including well designation numbers both inside the well cap and outside on the steel casing. Casings will be equipped with common-key locks.

2.3.3 Monitor Well Installation Procedures

Exact monitor well depths and screened intervals will be determined after groundwater depths are encountered during drilling. It is anticipated that groundwater will be encountered at depths between 2 and 7 ft bgs. The following procedure will be used by the drilling subcontractor under supervision of a WCC field engineer or geologist for the installation of the monitoring wells:

- Premeasure each point of riser pipe and screen to maintain an accurate tally of the length of well.
- Decontaminate screen and casing according to the procedures described in Section 4.0 of this FSP.
- Place a 6-in.-thick layer of sand filter pack in the bottom of the boring through the hollow auger stem.
- Connect 10 ft of 2-in.-diameter screen to a bottom plug and to a 10-ft length of 2-in.-diameter well riser. Suspend this assembled portion of the monitor well in the borehole and add additional sections of casing until the screen is positioned at the desired depth. This will be checked by the joint tally recorded earlier.
- Secure the well cap to the last riser pipe length (stick-up). Stick-up pipe will be cut-down and modified to 2 ft above ground surface in the field during installation.
- Support the completed well so that the bottom of the screen is sitting on the bottom filter pack material.

- Tremie backfill sand filter pack material into the annulus between the well screen and the exposed borehole wall through the hollow auger stem. Continue to backfill sand to a minimum of 6 in. (for very shallow wells) above the top of the screen. Periodic depth soundings will be taken to monitor the level of sand and detect any bridging. Clean, fresh, potable water may be added only if necessary to avoid sand bridging.

- Install a minimum 6-in.-thick seal of bentonite pellets above the filter pack. The seal will be installed in 6-in. lifts. Approximately one quart of distilled water will be added after placement of each bentonite lift. If plugging of the borehole occurs due to expansion of the bentonite into the borehole wall, the bentonite seal will be achieved by placing a thick bentonite slurry above the filter pack.

- Tremie backfill the remaining borehole annulus with the cement/bentonite grout mixture up to the ground surface.

- Before the grout sets, center the protective steel casing on the well riser and insert into the grouted annulus. Secure and lock the casing cap.

- Install the concrete pad and steel guard posts (if necessary).

- The elevation of the top of the well riser pipe and the horizontal location of the well will be surveyed by a registered land surveyor.

Documentation

A well installation data sheet will be completed by a WCC field engineer or geologist to record results and procedures. The well installation data sheet will provide details on the well and its installation. A typical well installation form is shown in Figure A2-5. The well installation data sheet and the boring log will serve as a complete record for each installation.

2.3.4 Well Development Procedures

No sooner than 24 hours after monitoring well installation, each well will be developed to increase yield and to remove fluids that may have been introduced during drilling operations. Development will proceed by pumping or by hand bailing. Each well will be developed by removing a minimum of five well volumes of water, or until the well is free of apparent turbidity. At well locations with very slow recharge or little water, wells will be developed dry two times, allowing adequate time between pumping or bailing for the well to recharge. Water removed from the wells during the development will be contained for subsequent treatment or disposal.

The following procedures will be used for well development:

1. Approach the well from an upwind direction, obtain and record FID and/or PID readings at the well head (with cap off) and in the breathing zone. The field team may continue to work in modified Level D personnel protection if the FID/PID readings do not exceed the action level set in the SSP.

2. Check the well for aboveground damage.

3. Equipment will be decontaminated prior to well development using the procedures outlined in Section 4.0 of this FSP.

4. Measure and record the depth from the top of the well casing to the top of the static water level in the well casing. Measure the total depth of the well relative to the top of the well casing. Calculate the height of water column (ft) and standing volume (gallons) of water in the well, based upon known well details from installation records or measured total depth of well.

5. If a pump is used for development, lower the decontaminated pump into the well to a point approximately 1 ft above the bottom of the well. Begin pumping. If a bailer is used, bail the well from the bottom of the screened interval, frequently surging the well prior to bringing the bailer to the surface.

6. Measure and record temperature, pH and conductivity during well development (see Section 2.4.4).

7. Development will continue until three to five well volumes of water have been removed from the well. The well will be considered developed when the groundwater is relatively clear and constant temperature, pH and conductivity readings are achieved. At well locations with very slow recharge or little water, wells will be developed until dry two times allowing adequate time between pumping or bailing for the well to recharge. Noticeable odors, discoloration, and turbidity or suspended sediment content should also be noted and described on the field sheet or field notebook.

8. Additional surging (with approval of the Field Activities Manager) may be required to suspend sediment for removal from the wells if greater than 6 in. of sediment is measured in the bottom of the well.

9. After the monitor well is developed, measure and record dissolved oxygen (DO), oxidation-reduction potential (Eh), and turbidity readings (see Section 2.4.4).

10. Record the following information on the appropriate field sheet or in the field notebook:

    - Monitor Well Number;
    - Well development method;
    - Initial static water level;
    - Total depth of well;
    - Date and time of start of well development;
    - Date and time of well development completion;
    - Post pumping/bailing water level;
    - Volume of water removed: and
    - Recovery rate.

11. Equipment will be decontaminated following well development using the procedures outlined in Section 4.0 of this FSP.

12. Replace well cap and lock protective casing.

13. Store development water until appropriate arrangements can be made for proper treatment or disposal.

Documentation

A well development data sheet will be completed by a WCC field engineer or geologist to record results and procedures. The well development data sheet and the boring log will serve as a complete record for each installation.

A typical well development form is shown in Figure A2-6. A field copy of each boring/well log will be kept on site with the field logbooks. In addition to documentation on the boring logs, bound field logbook(s) will also be kept to record data that are not recorded on the boring logs.

2.3.5 Groundwater Level Measurement

No sooner than 24 hours after completion of well development, the depth to groundwater will be measured in the wells. Additional sets of readings will be made on an as needed basis to establish ambient groundwater conditions for the site.

Groundwater level measurements will be made with either an electronic water level indicator or a measuring tape with a securely attached stainless steel acoustic sounding device. Readings will be recorded in the field logbook with the depth below top of riser as the reference elevation. The water level meter or tape will be decontaminated in between wells, following decontamination procedures outlined in Section 4.2 of this FSP. Water levels should be measured in the Fields Brook every time groundwater levels are measured.

2.3.6 Slug Testing

Slug tests will be conducted during the SDWTDI from the six newly installed monitor wells. An equipment list and pre-test data recording and testing procedures are explained below.

Equipment List

Field equipment to be used for the slug testing activities includes:

- Electronic water level indicator;
- Slug of known volume for 2-in. diameter wells;
- Pressure transducer (10-50 psi);
- Data logger (Hermit) and Operation Manual;
- Weighted measuring tape; and;
- Nylon rope.

Pre-test Data Recording

Pre-test data will be collected in accordance with the following procedures:

1. The monitor well will be approached from upwind.

2. The well cap will be unlocked and removed from the protective casing.

3. Before beginning the slug test, the following information will be recorded:

   - Project name;
   - Project number;
   - Date and time of test;
   - Well number;
   - Personnel present;
   - Nature of any visible well damage;
   - FID and/or PID readings;
   - Water level before start of test (from top of well pipe);
   - Well depth, screen length, riser pipe radius, well screen radius, and radius of sand pack plus the well screen depth and radius;
   - Aquifer or groundwater zone (lithology) being tested;
   - Volume of solid cylinder (slug);and
   - Type of measuring device used.

<u>Testing Procedure</u>

The following procedure will be used for slug test:

1. The static water level in the well and total depth of the well will be determined to the nearest 0.01 ft. The appropriate pressure transducer will be inserted and the Hermit Data Logger activated. The water level recording interval will be programmed on the data logger to the logarithmic mode.

2. The slug of known volume will be instantaneously introduced to (or removed from) the well, taking care to fully submerge (or withdraw) the slug. It is important to remove or add the volume as quickly as possible because the analysis assumes an "instantaneous" change in volume in the well. Falling head tests are not valid for the wells where the water level is below the top of the screen. Only rising head test data should be recorded from such wells.

3. With the moment (time) of volume addition or removal assigned time zero, the depth of water will be measured and recorded. The pressure transducer will monitor water level change. Care must be taken to ensure that the transducer in submerged throughout the test. Once the test has started, the transducer elevation must not be changed.

Water level measurements will be taken according to the following schedule:

Time Frame	Measurement Interval
0 to 2 min.	every 10 to 15 sec.
2 to 5 min.	every 30 sec.
5 to 10 min.	every 1 min.
10 to 30 min.	every 2 min.
30 to 60 min.	every 5 min.
over 60 min.	every 15 min.

4. The test will continue until the water level has been stabilized or 90 percent of the excess head has been dissipated. The time required for a slug test to be completed is a function of the volume of the "slug" and the hydraulic conductivity of the formation; the length of the test may range from less than a minute to several hours.

5. Data on water levels and time will be collected, recorded, and plotted in the field book or entered into a computerized data logger.

6. The slug testing equipment will be removed and wrapped for decontamination.

7. The well will be locked upon completion.

8. Gloves, aluminum foil/visquene will be disposed of as appropriate.

9. The slug will be decontaminated before the next slug test, according to decontamination procedures outlined in Section 4.0 of this FSP.

10. The slug test data will be downloaded from the data logger to a field printer to confirm the successful completion of the test prior to departing the site.

2.4 FIELD SAMPLING PROCEDURES

2.4.1 Groundwater Sampling

Groundwater samples will be collected during the SDWTDI from the six newly installed monitor wells. Refer to Figures A2-2a through A2-2e for general monitoring well locations. Sampling will be performed no sooner than 24 hours after completion of well development. Wells will be sampled, upon significant recharge, immediately after purging. Before each sampling event, groundwater levels and total depths of the wells will be measured (on the same day). Groundwater samples will be collected for chemical and physical parameters according to the sample information contained in Tables A2-1 through A2-4. The SOU QAPjP describes the analytical methods. Level IV analytical methods (CLP procedures) will be used for baseline and verification samples, and Level VI (e.g. SW-846 methods) will be used for intermediate treatability samples. Bulk groundwater samples will be collected for treatability testing. Refer to Table A2-2 for bulk sample volumes.

The following procedure will be used for sampling the wells:

1. Follow steps 1-4 on well development from Section 2.3.4 of this FSP.

2. No sooner than 24 hours after well development, purge the well by removing three well volumes of water. Decontaminated bailers or pumps will be used to purge each well. Record time of initiating and stopping bailing and/or pumping purge activities on the field sheet or in the field log book. Avoid purging the well dry to prevent de-watering of the filter pack. If possible, the water level in the well will be maintained at or above the top of the screen. Water purged from the wells will be collected and containerized for disposal. according to Section 2.2.2.1 of this FSP. Temperature, pH, and specific conductance readings will also be collected while purging the wells (see Section 2.4.4). If the water quality parameters stabilize (± 5%) at the conclusion of the purging of three well volumes, the purging is considered adequate. If the water quality parameters fail to stabilize, purging should continue until five well volumes have been removed. The last set of readings will be recorded as the actual readings from each well. After completion of purging, measure and record dissolved oxygen (DO), oxidation-reduction potential (Eh), and turbidity readings.

3. Sample wells using bottom entry/discharge stainless-steel bailers with nominal 0.25-in.-diameter polypropylene (or equivalent material) cord or stainless-steel and Teflon bladder pumps. If samples are collected from a well using a bladder pump, the pump flow rate will be turned down to a slow steady stream before filling the sample jars. This is especially important for filling VOC sample containers.

4. Using sample containers prescribed in Table A2-4, fill the sample bottles in the following sequence:

   - VOCs;
   - Semivolatile compounds (SVOCs) and other organic analyses (as required);
   - Total cyanide;
   - Free cyanide,
   - Total metals; and
   - Dissolved metals.

   Use the first bailer of water to fill the VOC vials. Fill the VOC vials such that a meniscus is formed on the rim of the vial, and carefully cap the bottle. Tip the bottle upside down, tap on capped end, and inspect for air bubbles. Should noticeable air bubbles appear, repeat the process until an air-free sample is obtained. Use subsequent bailers to fill the remaining sample containers. Preserve samples as indicated in Table A2-4.

   Additional groundwater will then be collected for other baseline characterization samples and the treatability and dewaterability samples (Table A2-2). Use the containers specified in Table A2-4 for the baseline characterization samples and use 2- or 5-gallon plastic buckets with sealable lids for the treatability and dewaterability samples.

5. Place the samples in a secure shipping container(s) after decontamination of the outside of the sample bottles. All sample containers will be placed in coolers. Use large coolers for the treatability and dewaterability samples.

6. The following information will be recorded on the field sheet:

   - Project name;
   - Project number;
   - Date;
   - Well number;

- Personnel present;
- Sample number;
- Nature of any visible well damage;
- FID and/or PID readings;
- Water level before purging (from top of well pipe);
- Total depth of well (from top of well pipe);
- Time begin purging;
- Time end purging;
- Water level after purging (from top of well pipe);
- Approximate volume of water removed during purging;
- Sampling time;
- Temperature;
- pH (pH meter check before and after sample analysis);
- Specific conductivity;
- Oxidation-reduction potential (Eh);
- Dissolved oxygen (DO);
- Turbidity;
- Preservation, if applicable; and
- Other data as required.

7. Replace well cap and lock protective casing.

8. Complete field documentation and chain-of-custody records for each sample according to Section 3.0 of this FSP.

9. Decontaminate the outside of the sample containers.

10. Follow the packaging and shipping protocol described in Section 3.3 of this FSP.

11. Decontaminate sampling equipment after sampling activities, using the procedures outlined in Section 4.0 of this FSP.

2.4.2 Surface Water Sampling

Surface water samples will be collected from the Fields Brook investigative reaches during the SDWTDI. Refer to Figures A2-1a and A2-1b for sample locations. Surface water samples will be collected for chemical and physical parameters according to the sample information contained in Table A2-1 through A2-4. The SOU QAPjP describes the analytical methods. Bulk surface water samples will be collected for treatability testing. Refer to Table A2-2 for bulk sample volumes.

The following procedures will be used for obtaining surface water samples:

1. Collect water samples starting from downstream locations of Fields Brook, and ending with upstream locations. (This will avoid cross-contamination of samples because of streambed disturbances).

2. Make a maximum effort to collect a complete set of samples at the same time from each surface water sampling location. (Sampling from flowing water is representative when the complete set of sample bottles are collected at the same time, e.g., for VOC analysis, a set of three 40-ml vials are required and all three vials should be filled with water collected at one time using a separate glass container. If three vials are filled by collecting water at three different times then the results may not be the same for the three vials.) At locations where surface water is stagnant then sample jars can be filled by immersing the appropriate sample container in water until full, or they can be filled using a glass container.

3. Use decontaminated glass jars to fill sample bottles.

4. Record temperature, pH, specific conductance, oxidation-reduction potential (Eh) dissolved oxygen (DO), turbidity, time, and sampling locations (see Section 2.4.4).

5. Using sample containers prescribed in Table A2-3, fill the sampling bottles in the following sequence:

   - VOCs;
   - SVOCs and other organic analyses;
   - Total cyanide;
   - Free cyanide;
   - Total metals; and
   - Dissolved metals.

   Preserve samples as indicated in Table A2-4.

   Additional surface water will then be collected for other baseline characterization samples and the treatability and dewaterability samples (Table A2-2). Use the containers specified in Table A2-4 for the baseline characterization samples and use 2- or 5-gallon plastic buckets with sealable lids for the treatability and dewaterability samples.

6. Place the samples in a secure shipping container(s) after decontamination of the outside of the sample bottles. All sample containers will be placed in coolers. Use large coolers for the treatability and dewaterability samples.

7. Record the following information on the field sheet:

   - Project name;
   - Project number;
   - Date;
   - Location number;
   - Personnel present;
   - Sample number;
   - Nature of any visible contamination;
   - PID/FID readings;
   - Water level before sampling;
   - Time begin sampling;
   - Time end sampling;
   - Temperature;
   - pH (pH meter check before and after sample analysis);
   - Specific conductivity;
   - Oxidation-reduction potential (Eh);
   - Dissolved oxygen (DO);
   - Turbidity;
   - Preservation, if applicable; and
   - Other data as required.

8. Complete field documentation and chain-of-custody records for each sample according to Section 3.0 of this FSP.

9. Decontaminate the outside of the sample containers.

10. Follow the packaging and shipping protocol described in Section 3.3.

11. Decontaminate sampling equipment after sampling activities, using the procedures outlined in Section 4.0 of this FSP.

2.4.3 Sediment and Drained Water Sampling

One undrained bulk sediment sample will be collected from Cross-section 2 of Reach 13B (Figure A2-1c) during the SDWTDI for bench-scale treatability testing. Approximately 20 gallons of sediment (Table A2-2) will be collected with a decontaminated stainless-steel shovel. The sediments will be placed in 2- to 5-gallon plastic buckets, labeled, and shipped to the treatability laboratory for SDWTDI bench-scale treatability testing. Additional undrained bulk sediment and drained water samples will be collected from each investigative reach during the SLDI and TTDI for SDWTDI bench-scale treatability testing.

2.4.4 Water Sample Physical Measurement Procedures

Measure temperature, pH, and specific conductivity (using calibrated meters) as soon as possible after collecting a purge water sample and again just prior to collection of water samples. Measure the oxidation-reduction potential (Eh, dissolved oxygen (DO) and turbidity of the sample after filling all required sample bottles.

Temperature Measurement

Measure the temperature by immersing the thermometer in the purge or water sample and reading the thermometer after it stabilizes. Take the reading immediately after collecting the water sample.

Rinse the thermometer with distilled water after the temperature has been measured. Record time and temperature readings in the field logbook.

pH Measurement

Measure pH by immersing the tip of the electrode in the purge or water sample and reading the pH after the meter stabilizes.

Rinse the probe with distilled water after the pH has been measured. Record time and pH readings in the field logbook.

Specific Conductivity Measurement

Measure specific conductivity by immersing the electrode in the purge or water sample and reading the meter after it stabilizes.

Rinse the probe with distilled water after the conductivity has been measured. Record time and conductivity readings in the field logbook.

Oxidation-Reduction Potential (Eh) Measurement

Before measuring the oxidation-reduction potential (Eh) set the ph function switch to the millivolts (mV) mode and read the bottom display. There are no adjustments in this mode. so any sensor that is attached to this input jack should be tested against some known standard as defined by its manufacturer.

When no electrode is attached to the mV input. the attached shorting cap should be installed on this jack. If the pH input is not in use when an Eh electrode is on the mV input. the shorting cap should be connected to the pH input jack. With the shorting cap installed. the display will read 000 ±002.

Measure the Eh by immersing the tip of the electrode in the water sample and reading the Eh after the meter stabilizes.

Rinse the probe with distilled water after the Eh has been measured. Record time and Eh readings in the field logbook.

Dissolved Oxygen Measurement

Measure the dissolved oxygen (DO) by immersing the calibrated probe of the prepared instrument in the water sample while stirring sample.

Stirring for the probe can best be accomplished with a submersible stirrer. If a submersible stirrer is not used, provide manual stirring by raising and lowering the probe about 1 ft per second. If a calibration chamber is used, the entire chamber may be moves up and down in the water at about 1 ft per second.

Switch to TEMP mode and read the temperature from the lower meter scale after the meter stabilizes. Set the O_2 SOLUBILITY FACTOR dial to the observed temperature, taking care to use the appropriate salinity index (see manufacturer's instructions).

Switch to READ O_2 and read the DO value in mg/L directly from the meter after the meter has stabilizes.

Rinse the probe with distilled water after the DO has been measured. Record time and DO readings in the field logbook.

Turbidity Measurement

Measure the turbidity by pouring the sample water into the glass tubes supplied with the meter and reading the turbidity after the meter has stabilized.

Rinse the probe with distilled water after the turbidity has been measured. Turbidity may also be done visually. Record time and turbidity readings in the field logbook.

2.4.5 Water Sample Filtering Procedures

Samples for metals and cyanide analyses can either be filtered during the field sampling event using a filter apparatus and vacuum pump, or collected unpreserved and filtered in the laboratory.

The following procedure is to be used for filtering:

- Decontaminate equipment following procedures given in Section 4.2 of the this FSP. If using an in-line filtering system, replace the tubing before filtering, and between sample locations.

- Assemble filter device according to manufacturer's instructions.

- Filter samples either by pouring sample in the top portion of filter unit or pumping through an in-line filter using a peristaltic pump.

- Discard the first 25 ml of water passed through the filter apparatus. This initial volume is more likely to be contaminated by residues on the equipment than are subsequent water volumes.

- Transfer the filtered sample to appropriate preserved and labeled sample bottles.

- Place the used filter membrane or apparatus in a garbage bag for disposal along with the personal protective equipment (see Section 2.2.2.1).

2.5 ANALYTICAL REQUIREMENTS

2.5.1 Chemical Parameters

Aqueous samples collected during the SDWTDI will be analyzed for the chemical parameters listed on Table A2-1. A summary of total sample volumes required for analytical testing is provided on Table A2-2. Number of samples, containers, volumes, preservations, and holding times for the samples are shown on Tables A2-3 and A2-4. Analytical methods are described in the SOU QAPjP. Quality Assurance/Quality Control (QA\QC) requirements are described below.

2.5.1.1 Quality Assurance/Quality Control

Quality Assurance/Quality Control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on all samples collected for chemical analysis. Details are provided in the SOU QAPjP. These checks will be updated and maintained by project personnel throughout the project. The QA/QC checks will include field duplicates, trip blanks, field blanks, equipment rinsate blanks, and matrix spike (MS) and matrix spike duplicates (MSD) for extractable organics (MS/D for inorganics).

Samples will also be shared (split) in the field with the USEPA and/or OEPA, upon request. Location and number of shared samples will be determined before the initiation of field sampling.

Field Duplicates

For aqueous samples, one duplicate sample (of the same type and container size) will be collected for every 20 samples (or portion thereof) collected during the SDWTDI. The duplicate samples will be shipped to the laboratory for analyses of chemical parameters listed on Table A2-1.

Trip Blanks

For aqueous samples, one trip blank will be supplied by the laboratory for each shipping case, or every 20 samples. The trip blanks will accompany the sample containers from the laboratory, to the field, and back to the laboratory for analyses of VOCs.

Field Blanks

For aqueous samples, a field blank will be collected at every 20 sampling locations. Sample containers will be filled with distilled water and shipped to the laboratory for analyses of chemical parameters listed on Table A2-1.

Equipment Rinsate Blanks

Equipment rinsate blanks will be obtained at the frequency of 1 per 20 per type of field sampling device used during the collection of aqueous samples during the SDWTDI. The equipment blanks will be taken just prior to collection of the samples as an equipment decontamination quality check. The blanks will be sent to the laboratory for analyses of TCL and TAL parameters.

Matrix Spike/Matrix Spike Duplicates

One MS and one MSD sample (MS/D for inorganics analyses) will be collected for every 20 aqueous samples (or portion thereof) collected in the field during the SDWTDI. The MS/MSD samples will be sent to the laboratory where they will be analyzed for VOCs, SVOCs and PCB/pesticides parameters. The MS/D samples will be analyzed for metals and cyanide. The MS/MSD and MS/D samples will be analyzed by the laboratory to evaluate whether matrix recoveries falling outside the acceptance windows are attributable to sample matrix interferences and not laboratory analytical errors. The organic MSD samples and inorganic laboratory duplicates (D) will be analyzed to evaluate the analytical precision.

2.5.2 Physical Parameters

Aqueous samples collected during the SDWTDI will be analyzed for the physical parameters listed on Table A2-1. A summary of total sample volumes for analytical testing is provided on Table A2-2. Number of samples, container sizes and types, volumes, preservation and holding times for the samples are shown on Tables A2-3 and A2-4. Analytical methods are described in the SOU QAPjP. No QA/QC samples are required for the physical testing.

2.6 MONITOR WELL SURVEYING

Monitor wells installed during the SDWTDI will be surveyed by a registered land surveyor. Locations will be tied into state plane coordinates. Elevations at the ground surface and top of the well riser will be measured to the nearest one-tenth (0.1) of a foot and one-hundredth (0.01) of a foot, respectively. Horizontal control measurements will be made to the nearest one-tenth (0.1) of a foot. Surface water elevations will be measured in conjunction with the groundwater level measurements.

2.7 FIELD LOGBOOKS

Logbook entries will be as detailed as possible so that at a later date the reader could reconstruct each event without reliance on the memories of field team members. The logbooks will be permanently bound and pages sequentially numbered. Each logbook will be identified by the project-specific document number. Entries in the logbooks will be made by field personnel in blue or black permanent ink. Errant entries in the logbooks will be stricken with a single strike mark, initialed, and dated by the person who made the entry. Field logbooks will be maintained in a secure location and archived at the end of the project.

Field documentation will contain, at a minimum, the following information as is applicable to the specific task at hand:

- Project name and number;
- Date/time/weather;
- Personnel present;
- Sampling location(s) and methods;
- Sample type and collection depth;
- Sample number and collection time;
- Air quality readings, instrument calibration; and
- Other general information.

Data collected during boring activities (Section 2.3.1); monitoring well installation (Section 2.3.3); well development (Section 2.3.4); groundwater sampling (Section 2.4.1); surface water sampling (Section 2.4.2); and slug testing (Section 2.3.6) will be documented on separate forms as well as in field logbooks. Detailed sample collection documentation will be kept in the Sample Logbook, as described in Section 3.4.3 of this FSP.

3.0 SAMPLE COLLECTION, HANDLING, AND DOCUMENTATION

3.1 PARAMETERS OF INTEREST

This Fields Brook SDWTDI FSP addresses the collection of samples to be analyzed for the specific chemical and physical parameters listed in Table A2-1 and for the treatability and dewaterability studies described int he SDWTDI Work Plan.

3.2 SAMPLE CONTAINERS, PRESERVATIVES, AND VOLUMES

Table A2-4 lists the recommended sample containers and sample preservation requirements for the chemical and physical analyses to be performed on samples in conjunction with the Fields Brook SDWTDI. This table provides information relative to the minimum sample volume required for each analytical test to be performed and the type of container to be used. In general, the container size should exceed the minimum requirements to ensure that a sufficient volume of sample is collected to conduct the specific analytical method and any associated quality control procedures.

Samples to be collected for the treatability and dewaterability studies should be collected in 2- or 5-gallon plastic buckets with sealable lids. These samples shall be preserved by placing into large coolers packed with ice (in sealed bags) or "blue ice".

3.3 SAMPLE PACKING AND SHIPPING PROTOCOL

All samples collected as part of the SDWTDI will be carefully packaged and shipped via overnight express delivery to the laboratory. Samples will be received by the designated laboratory within 24 hours after sampling, to allow for initiation of analyses within the specified holding times (Table A2-4). Prior to shipping, appropriate samples will be preserved (Table A2-4), to retard chemical and biological changes that occur in response to physical conditions. After proper preservation, samples bottles will be sealed and maintained at 4° C until laboratory testing is initiated.

All environmental samples will be packaged and shipped in the following manner:

1. Inspect sample labels for completeness, legibility and accuracy of information.

2. Verify that labels are covered with wide, clear tape to protect labels during shipping.

3. Visually inspect the outside of sample containers for proper decontamination. If containers appear soiled, decontaminate again.

4. Secure sample container lids tightly to prevent leakage.

5. Contact STL or his/her designee to complete and review chain-of-custody documents, following prescribed custody procedures.

6. Place labeled sample containers into a sealed plastic bag.

7. Wrap and cushion glass containers in an absorbent packing material such as styrofoam or vermiculite.

8. If required, place at least two bags of ice sealed in double plastic bags in each sample cooler to maintain samples at 4°C.

9. Fill excess space in cooler with packaging material to prevent movement of the sample containers. Styrofoam beads or peanuts, or other packaging material may be used.

10. Place chain-of-custody document in a sealed plastic bag and tape to the inside of the sample cooler.

11. Tape the shipping container shut forming a seal around the lid to prevent leakage in the event the cooler is tipped over.

12. Tape the cooler drain plug so it will not open.

13. Place a completed address label on the lid of the cooler, including the name, address and phone number of the receiving laboratory, and the shipper's name, return address and phone number.

14. Place a "This End Up" label on the lid of the cooler and "This End Up" arrows on all four sides.

15. Affix a signed custody seal across the cooler lid and sides.

16. Relinquish sample cooler to express carrier for shipping according to the Department of Transportation regulations.

3.4 SAMPLE DOCUMENTATION

Sample activities will be documented through completion of chain-of-custody forms, boring logs, well installation and development forms, and written entries into bound logbook(s) dedicated to the project. These procedures are discussed in the following sections.

3.4.1 Sample Numbering System

A sample numbering system will be used to allow identification, retrieval and cross referencing of sample information, and data management

Samples collected and submitted for analytical testing will be assigned and identified by a unique sample identification number. The sample identification number will consist of six parts:

- Design Investigation Code:

  SDWT - Sediment Dewatering and Wastewater Treatment.

- Sample Location:

  A dashed code following the Design Investigation code. The first two digits identify the reach and the last digit following the dash is the subreach.

- Sample Matrix:

  WT - Aqueous.
  SE - Sediments.

- Sample Number:

  A two-digit number following the dash will identify the sample within the reach.

- Sample Type:

  S - Sample.
  D - Duplicate.
  C - Composite.
  B - Field Blank.
  T - Trip Blank.
  E - Equipment Rinsate Blank.

- Sampling Phase:

  A single digit following the Sample Type will identify the sampling event conducted for the Design Investigation.

An example of a sample identification number is as follows:

SDWT-10-2WT-04D1	This sample number indicates the sample is part of the Sediment Dewatering and Wastewater Treatment Design Investigation from Reach 10-2; it is the fourth aqueous sample collected; and it is a duplicate sample collected during the first phase of sampling.

3.4.2 Sample Labeling

All samples collected and received for laboratory analyses, design evaluation, or treatment testing must be clearly identified to ensure proper sample tracking and data management. A standard sample label or tag providing information will be affixed at the time of sample collection. Information on the sample labels will include the following as a minimum:

- Sample Identification Number.
- Sample Matrix.
- Time and Date of Sample Collection.
- Analytical Sampling Method.
- Method of Sample Preservation (if required).
- Sampler's Initials.

Sample containers received or transported without a sample label will be classified as an invalid sample.

3.4.3 Sample Logbook

All information pertinent to the sampling procedures will be recorded by field personnel in the sample logbook. The sample logbook will be a bound, hard covered notebook with sequentially numbered pages. Sample logbooks are intended to provide sufficient data and observations to accurately document the process and sampling events. Multiple sample logbooks may be used for clarity and convenience. Each logbook will be identified by the project-specific document number.

Logbook entries will include the following:

- Date and Time (24-hour clock) at the initiation of each entry.
- Name of Sampler(s).
- Sample Location.
- Sample Identification Number.
- Sample Matrix.
- Analytical Sampling Method.
- Quantity of Sample Collected.
- Method of Sample Preservation (if required).
- Process/Sample Observations (i.e., Sampling Conditions).
- Shipper and Sample Destination.
- Additional References (e.g., Photo Logs, Process Measurements)

All entries in the logbooks will be made in blue or black permanent ink. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed and dated by the person who made the entry. Sample logbooks will be maintained in a secure location and archived at the end of the project.

3.4.4 Sampling Activity Photographs

Representative photographs of sampling stations with respect to the surrounding area and relative to objects used to locate the station will be taken as directed by the Field Manager.

and at the discretion of on-site staff. If photographs are to be taken within or in close proximity to active manufacturing portions of on-site facilities, then prior approval will be obtained from the facility manager. The picture number and roll number will be logged in the field logbook to identify which sampling site or operation is depicted in the photograph. The film roll number will be identified by taking a photograph of an informational sign on the first frame of the roll. This sign will display the job and film roll number so as to identify the pictures contained on the roll. For example:

> Fields Brook;
> Roll Number;
> Frame Number 1 of 36;
> August 3, 1993; and
> Project No. 86C3609N2-XXX, (where XXX is the task number).

3.4.5 Sample Custody Procedures

The purpose of chain-of-custody is to document the identity of the sample and its handling from the point of collection until analysis is completed and laboratory QA/QC procedures confirm accuracy. Documentation supports this by providing a written record of sampling, handling, and custody. This information is documented on the chain-of-custody form.

A minimum number of persons will handle the samples and a designated member of the sample team will assume responsibility for the chain-of-custody. Sample records and chain-of-custody will be completed at the time of sample collection. When a sample changes custody (i.e., is transferred from one party to another), the party receiving the sample signs, dates and notes the time of transfer on the chain-of-custody form accompanying the sample. If at any time, the chain-of-custody is broken, the last person on the chain-of-custody form record will be notified to identify and correct the problem.

4.0
DECONTAMINATION PROCEDURES

Decontamination of personnel, and field equipment will be performed to prevent possible transport of contaminants off site and between work areas. Detailed decontamination procedures are described below.

4.1 PERSONNEL DECONTAMINATION

Sampling personnel will be required to use clean gloves while collecting each sample. Non-disposable personal protective gear will be decontaminated before personnel enter the support area. The procedure for personnel decontamination is as follows:

1. Place equipment and/or samples in designated area; move to next station.
2. Remove outer coveralls and booties and place in appropriate containers.
3. Wash boots and outer gloves using soap (Alconox or equivalent), and potable water rinse. Remove and store outer gloves in appropriate place.
4. Remove respirator, if used, and store in appropriate place.
5. Remove inner gloves and place in appropriate containers.
6. Wash hands and face.
7. Collect and store rinsate for disposal.

4.2 SAMPLING EQUIPMENT DECONTAMINATION

Sampling equipment, including bailers, will be decontaminated before use. The directives contained in the "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (TEGD) (USEPA 1986d) will be followed. Reusable, non-dedicated equipment, such as bailers, stainless-steel probes, split-spoons and scoops, will be decontaminated between each sampling event and before removal from the site. The procedure for sampling equipment decontamination is as follows:

1. Remove loose soil.
2. Non-phosphate soap wash.
3. 0.1 N HCl rinse.
4. Tap water rinse.
5. Methanol rinse.
6. Pesticide grade hexane rinse.
7. Methanol rinse.
8. Double rinse with laboratory-grade deionized/distilled water.
9. Air dry.
10. Collect and store rinsate for disposal.

4.3 HEAVY EQUIPMENT DECONTAMINATION

Prior to commencing work on or leaving the site, drill rigs, vehicles, and other equipment used for soil borings, well installation, and sampling activities, will be fully decontaminated. The Subcontractor will construct and supply all materials for a decontamination pad. The exact location of the decontamination pad will be determined in the field.

The decontamination pad will be approximately 20 ft longer and 20 ft wider than the largest drilling vehicle on site. The decontamination pad shall consist of a seamless heavy gauge (30 ml or greater) plastic sheet, or other material approved by WCC, which will be laid over the ground surface. The sides of the sheet will be raised by tacking them to a 2-in. by 4-in. length of wood (two-by-four), thereby creating a lip along the perimeter. The front and rear of the sheets will be placed over a small, smooth soil berm to permit the drilling equipment to drive onto and off the pad. A sump will be dug at one corner of the decontamination pad to collect decontamination fluids. A pump will pump the fluid from the sump to 55-gallon drums. A metal grate will be placed on the plastic to allow for better traction and to prevent tearing of the plastic sheet during decontamination procedures. The following procedures will be used for heavy equipment decontamination:

1. Move equipment to the central decontamination station after sampling/ field activities are complete.

2. Decontaminate equipment using a high pressure stream cleaner with a soap cycle and water cycle. Scraping and scrubbing may be necessary to remove encrusted materials.

3. Collect and store rinsate for disposal.

5.0
INSTRUMENT CALIBRATION AND MAINTENANCE PROCEDURES

The calibration and maintenance of instruments used to take measurements is an important aspect of the project's sampling program. The following is a list of field instruments and equipment to be used during the SDWTDI:

- FID and/or PID;
- Water level indicator;
- Thermometer;
- pH meter;
- Specific conductivity meter;
- Oxidation-reduction potential (Eh) meter;
- Dissolved oxygen (DO) meter; and
- Turbidity meter.

5.1 FIELD INSTRUMENT AND EQUIPMENT CALIBRATION

The calibration and maintenance of field instruments is the responsibility of the Sampling Team Leader (STL) or designated personnel. A field logbook will be maintained by these individuals to document calibration, maintenance, and status of instruments used during the field investigation. The calibration record will contain, but not be limited to, the following information:

- Date and time of calibration;
- Type of equipment and identification number (such as serial number);
- Reference standard used for calibration;
- Name of person conducting the calibration; and
- Results of calibration performed.

Field calibration will be performed following the manufacturer's directions. Operation manuals for each piece of equipment will be kept in the field by the SSO or STL. Equipment that fails calibration, or becomes questionable or inoperable, will be removed from service and isolated from use. The equipment will be properly tagged to indicate that it is out of calibration. Equipment that cannot be recalibrated will be replaced immediately to minimize field sampling downtime.

Thermometer Calibration

Use a thermometer with an accuracy of ±0.5° C and calibration certified by the manufacturer. If the thermometer's calibration is in doubt, check it against a laboratory-grade thermometer before going into the field.

pH Meter Calibration

Calibrate the pH meter before taking any readings and at least once daily Follow the manufacturer's specific instructions for calibration and operation of the pH meter.

In general, calibration is accomplished by adjusting the meter while the probe is immersed in standard buffers that bracket the expected pH of the field water.

If the electrode is replaced, the instrument must be recalibrated. The temperature setting on the pH meter may not exactly match the sample temperature after calibration. The pH readings will be accurate if the meter measures the pH of the buffers correctly.

Rinse the probe with distilled or deionized water after calibration. Record the time and temperature of the buffer in the field logbook.

Specific Conductivity Meter Calibration

Calibrate the specific conductivity meter before taking any readings and a minimum of once daily by following the procedures specified by the manufacturer.

Calibrate the meter with a standard solution. Note the response of the meter to the solution. If the instrument has a calibration knob, adjust the meter response to match the calibration standard in use.

Use solution standards which bracket the values expected to be encountered in the field. Typical standards of 100; 1,000; 10,000; and 100,000 μmho/cm should be adequate for the ranges of specific conductivities expected.

Flush the meter with distilled water between solutions. Record time, temperature, and instrument response to each standard in the field logbook.

Eh (oxidation-reduction) Meter Calibration

The Eh system should be calibrated against the supplied reference solution on a daily basis by following the manufacturer's instructions. The frequency with which the millivolt (mV) function needs to be evaluated depends on the electrode, the monitor and characteristics of the water to which the electrode is exposed.

Set the pH function switch on the meter to mV. Connect the shorting cap to the mV input jack. The display should read 000 $\pm$200 mV. This indicates that the electrodes are zeroed.

Calibrate the meter against the standard and allow the sensors to equilibrate, and note the reading. The displayed mV value is not temperature compensated and should be corrected to 25°C at 1.3 mV/°C.

The calculated value of the standard should be within the specified range of 231 $\pm$10 mV. This confirms that the Eh system is working properly.

Rinse the sensors with deionized or distilled water after calibration. Record the time and instrument response in the field logbook.

Dissolved Oxygen Meter Calibration

Calibrate the dissolved oxygen (DO) meter daily before each series of measurements according to manufacturer's instructions. Calibration can be disturbed by physical shock, touching the membrane, fouling of the membrane or drying out of the electrode.

Calibration of the DO meter is accomplished by exposing the probe to a known oxygen concentration, such as water-saturated air (%), or water of a known oxygen content (mg/L), and then adjusting the calibration controls so the meter indicates a reading matching the oxygen concentration of the known water sample.

Rinse the probe with deionized or distilled water after calibration. Record the time and instrument response in the field logbook.

Turbidity Meter Calibration

Calibrate the turbidity meter daily before taking any field measurements according to the manufacturer's instructions.

Calibrate the meter by noting the response of the meter to standard turbidity solutions. Adjust (if possible) the instrument to match the calibration standard.

Use standards which bracket the range of values expected to be encountered in the field. Typical solutions of 0.20, 1.00, 10.00, and 40.00 nephelometric turbidity units (NTU) should be adequate for the range of values expected.

Rinse the probe with distilled water between the solutions. Record time, standards, and instrument response in the field logbook.

5.2 PREVENTIVE MAINTENANCE

Field instruments and equipment will have a prescribed routine maintenance schedule in addition to a calibration schedule. Field instrumentation, sampling equipment, and accessories will be maintained in accordance with the manufacturer's recommendations, specifications and established field practice.

Maintenance will be performed and documented by the appointed equipment manager or his/her designee. Documentation of maintenance performed will be similar to that for calibration and will become part of the project file. Documentation will include scheduled maintenance and unscheduled maintenance. Unscheduled maintenance, which could have an adverse effect on field activities, will be reported to the STL and Task Manager. The STL or designee will review calibration and maintenance records on a regular basis to verify required maintenance.

6.0
SITE SAFETY PLAN SUMMARY

The SQDI SSP (WCC, 1989), as amended, will be used for the SDWTDI sampling activities and will be available from the SSO. Field personnel are required to read and comply with the SSP. A brief summary of selected sections of the SQDI SSP is presented below. Detailed personnel, and equipment decontamination procedures are described in Section 4.0 of this FSP.

6.1 PERSONNEL PROTECTION LEVELS AND EQUIPMENT

Personal Protection Level D and Associated Equipment

Modified Level D protective equipment will be worn, as a minimum, by site personnel when performing field activities on site and when present in an exclusion zone. Field activities include: soil drilling and sampling; monitor well installation and development; groundwater sampling; field measurements; homogenization; sample preparations for treatability testing; and equipment decontamination. Modified Level D protection is defined for this project as:

- Hard hat (as required by OSHA);
- Tyvek or polycoated Tyvek (for splash hazards);
- Chemical-resistant, steel-toed boots, or work boots with covers;
- Inner gloves (latex or vinyl);
- Outer, chemical-resistant gloves (nitrile);
- Goggles, safety glasses, or face shield;
- Splash shield, as required;
- Monitoring equipment (PID or FID); and
- Air purifying respirator with organic vapor/mist cartridge (readily available but not worn).

Criteria for Upgrade from Level D to Level C Personal Protective Equipment

Personnel will upgrade to Level C respiratory protective equipment when visible dust is present in the air, or if consistent organic vapor readings of 5 ppm above background in the worker breathing zone for 5 minutes are encountered as measured by a FID or PID. Personnel will be allowed to downgrade to modified Level D protection according to the air monitoring guidelines in the SSP.

Level C protection is defined for this project as:

- Air-purifying respirator with an organic vapor/particulate combination filter cartridge;
- Hard hat (as required by OSHA);
- Tyvek or Polycoated Tyvek (for splash hazards);
- Chemical-resistant, steel-toed boots, or work boots with covers;
- Inner gloves (latex or vinyl);
- Outer, chemical-resistant gloves (nitrile);
- Goggles or safety glasses (with half-face respirator);
- Splash shield, as required; and
- Monitoring equipment (FID or PID).

<u>Field Monitoring and Other Equipment</u>

- FID and/or PID;
- Combustible gas/O_2 meter;
- First aid kit (large);
- Eye, hand, and body wash;
- Fire extinguisher;
- Outdoor thermometer;
- Walkie-talkies; and
- Scale to measure weight loss due to chemical exposure or heat loss (scale may be kept in Command Post Trailer).

6.2 COMPLIANCE AGREEMENT AND SAFETY MEETINGS

The following SSP items will be addressed before and during the field activities:

- A project briefing meeting will be conducted at the beginning of the field investigations to summarize health and safety requirements to the team members.

- Field personnel will read the project SSP and sign the compliance agreement prior to initiating work at the site.

- As detailed in the SSP, the SSO will inform field crews on any modifications to the approved SSP and update personnel on any new safety protocol.

6.3 HOSPITAL INFORMATION AND EMERGENCY PHONE NUMBERS

A map of the route to the hospital will be posted on site. A list of emergency contacts is provided in the SQDI SSP, as amended.

7.0
REFERENCES

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TABLES

APPENDIX A

TABLE A2-4 (CONT'D)

SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIMES
FOR CHEMICAL AND PHYSICAL TESTING
SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION

Sample Matrix	Parameter[1]	Analysis Method	Recommended Number and Type of Container(s)[2]	Minimum Sample Volume (ml)	Preservation Requirement	Maximum Sample Holding Time
Aqueous	Carbonate Bicarbonate Hydroxide	EPA 310.1 or EPA 310.2	(1) 1 L plastic bottle	1000	cooled to 4°C	14 days
	Oil/Grease	SW-846-9071	(1) 1 L glass bottle	1000	cooled to 4°C H_2SO_4 to pH<2	28 days
	Sulfate/Sulfite	SW-846-5050/9256	(1) 50 ml glass or plastic bottle	50	cooled to 4°C	28 days
	Biochemical Oxygen Demand	EPA 405.1	(1) 250 ml plastic bottle	250	cooled to 4°C	48 hours
	Chemical Oxygen Demand	EPA 410.1	(1) 50 ml glass or plastic bottle	50	cooled to 4°C H_2SO_4 to pH<2	28 days
	Alkalinity (total)	EPA 310.2	(1) 100 ml glass or plastic bottle	100	cooled to 4°C	14 days to analysis
	Hardness (as $CaCO_3$)	EPA 931.1 or EPA 931.2	(1) 1 L plastic or glass bottle	1000	cooled to 4°C H_2SO_4 to pH<2	14 days
	Physical [5]					
	Turbidity	EPA 180.1	(1) 1 L plastic or glass bottle	1000	cooled to 4°C	14 days and Field Measurement
	Oxidation-Reduction Potential (Eh)	ASTM-D4646	(2) 50 ml glass or plastic bottle	100	cooled to 4°C	14 days and Field Measurement
	Temperature	EPA 170.1	(1) 40 ml glass or plastic jar	25	None	Field Measurement
	pH	SW-846-9040	(1) 40 ml glass or plastic jar	25	None	(unpreserved) Field Measurement
	Conductivity	SW-846-9050	(1) 40 ml plastic or glass jar	25	None	Field Measurement
	Dissolved Oxygen (DO)	EPA 360.1	(1) 100 ml plastic bottle	100	KOH	14 days and Field Measurement

NOTES:

1) Samples collected for chemical testing will be sent to Hazleton Laboratories; samples for physical testing will be sent to *Earth Technology Corporation.*

2) QA/QC samples will be taken for each chemical parameter at field-determined sample locations, according to Section 2.5.1.1 of the FSP.

3) HDPE = *High Density Polyethylene*

4) If TDS and TSS are to performed on the same sample, only one (1) 250 ml plastic container is required.

5) All physical samples will be measured in both the field and laboratory.

FIGURES

APPENDIX A

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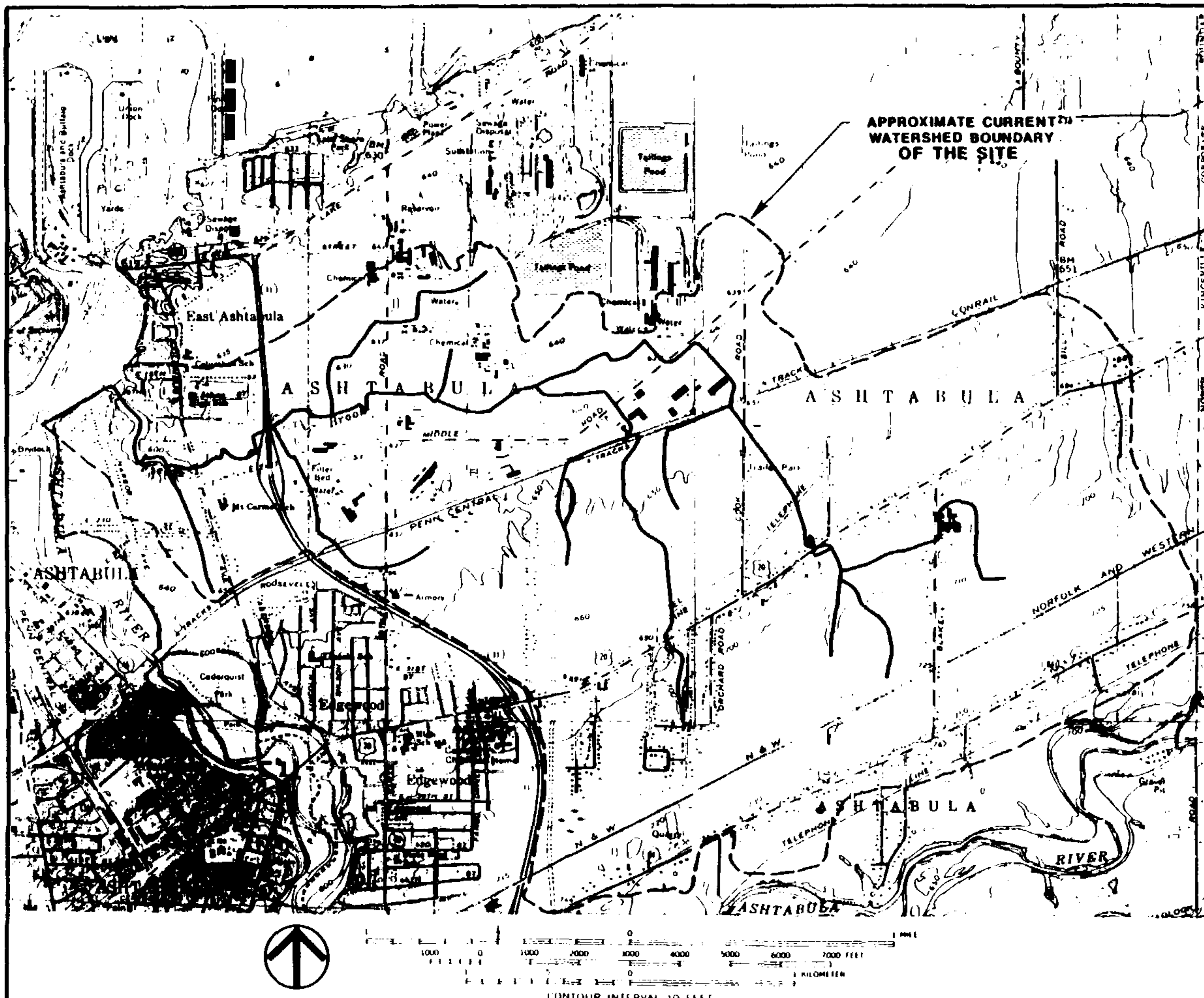


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ASHTABULA NORTH, OHIO
NE/4 ASHTABULA 15' QUADRANGLE

NORTH KINGSVILLE, OHIO

ASHTABULA SOUTH, OHIO
SE/4 ASHTABULA 15' QUADRANGLE

GAGEVILLE, OHIO

LEGEND

- FIELDS BROOK WATERSHED
- WATER (FIELDS BROOK AND ITS TRIBUTARIES)
- PROPERTY BOUNDARY

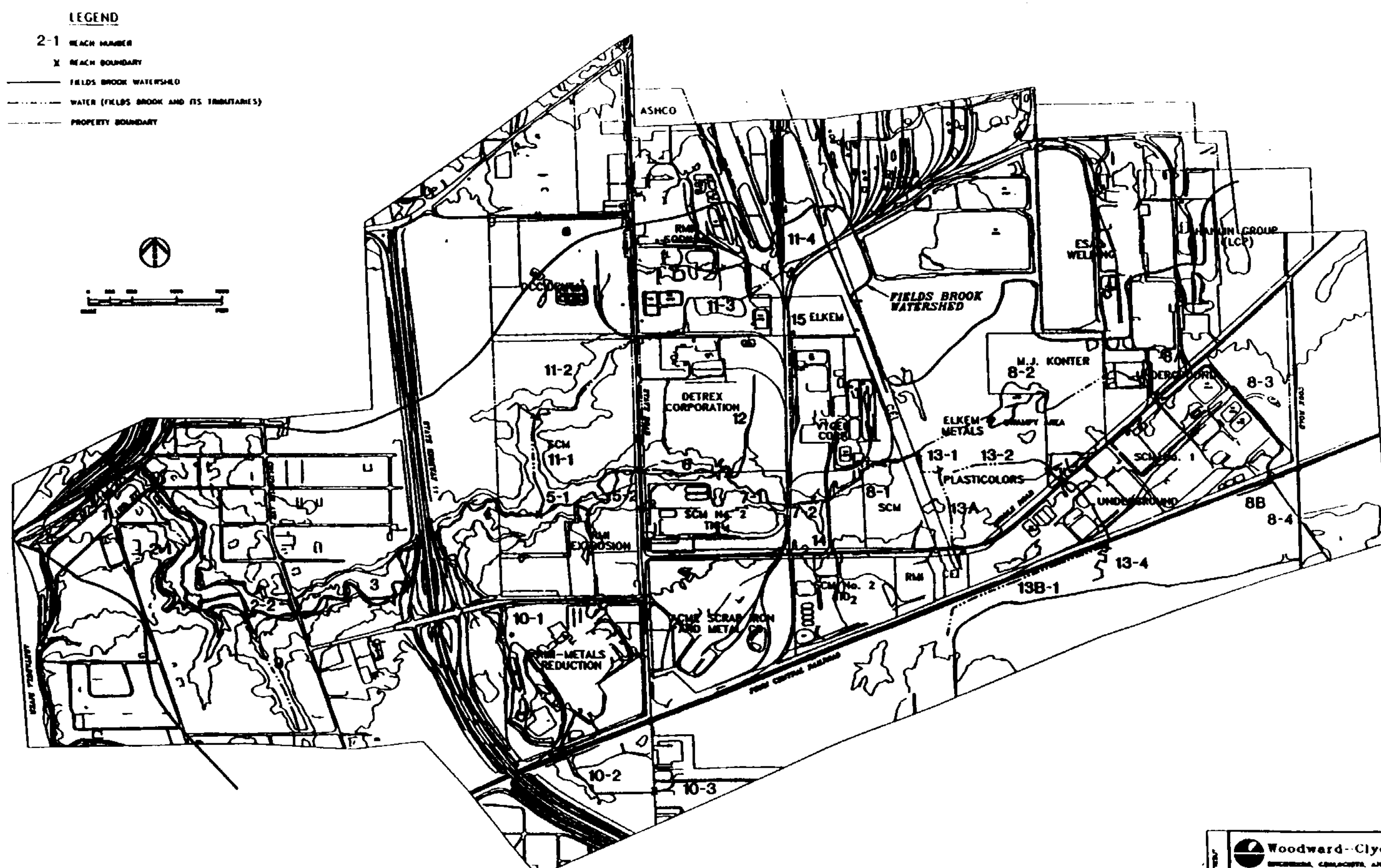
OHIO

QUADRANGLE LOCATION

SITE MAP
FIELDS BROOK - ASHTABULA, OHIO

Woodward-Clyde Consultants

DRAWN: REM	JOB NUMBER	DATE: 10/7/82
CHECKED: WEC	88C3609E	FIGURE NO: A1-1



Woodward-Clyde Consultants

REACH LOCATIONS
FIELDS BROOK
AND TRIBUTARIES

86C3609E

Date: 10/09/92	
SDWTDI	Page 1 / 1
Project Start: 10/13/92	

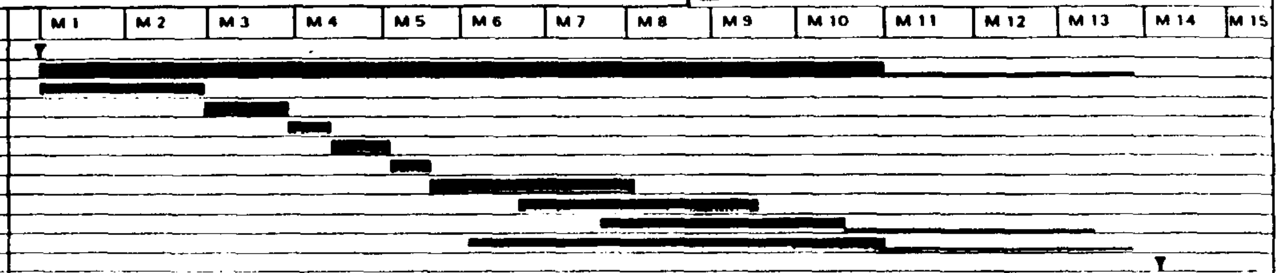
FIGURE A1-3
SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION (SDWTDI) SCHEDULE

Legend

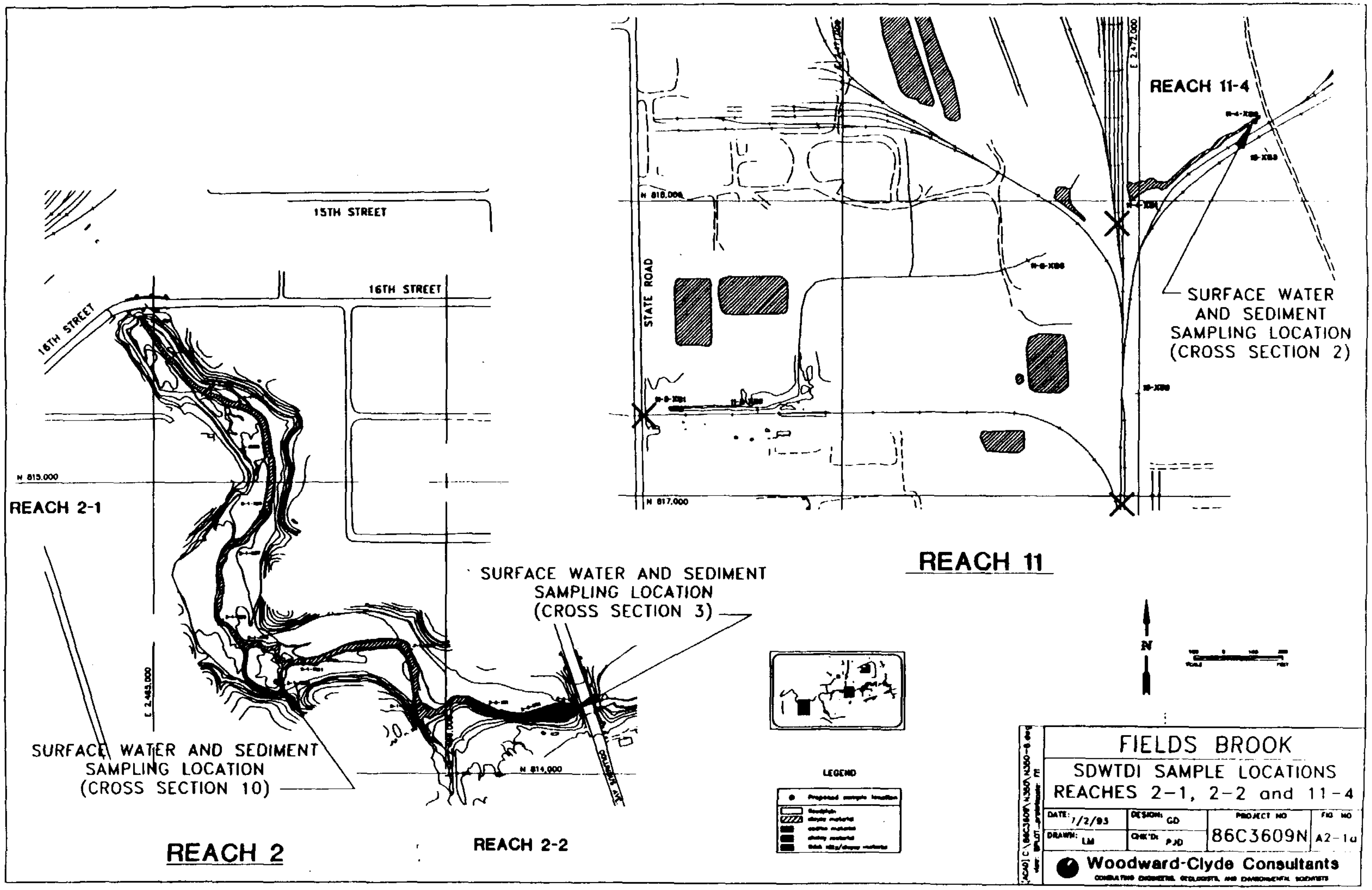
- Critical
- Non-Crit.
- Summary
- Hammock

Plan
Early
Late

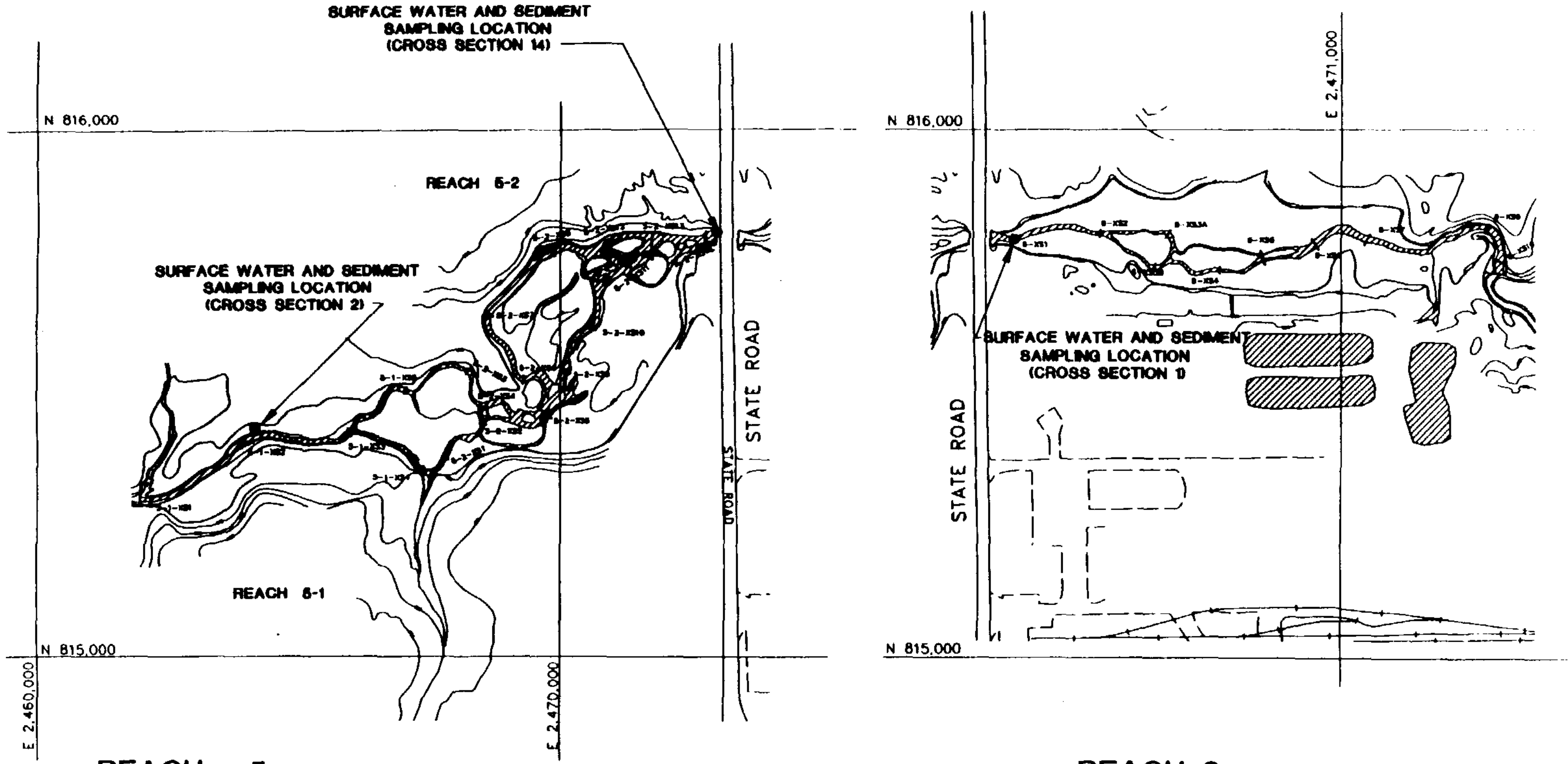
Description	Dur
SDWTDI WORK PLAN SUBMITTED	0
SDWTDI SUMMARY	304
AGENCY REVIEW	60
DOCUMENT REVISION	30
AGENCY APPROVAL	15
MOBILIZATION	21
FIELD SAMPLING (WEATHER DEPENDENT)	14
BENCH TESTING	75
LABORATORY TESTING	88
DATA VALIDATION	88
DRAFT SDWTDI REPORT PREPARATION	120
SUBMIT PRELIMINARY DESIGN REPORT	0



NOTE: Field Work Activities Will Not Be Initiated Prior to April 1, 1993.

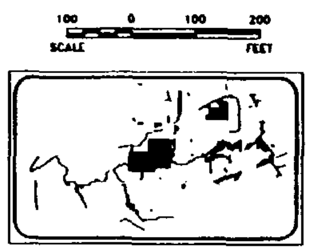


REACH 11-4
SURFACE WATER AND SEDIMENT SAMPLING LOCATION (CROSS SECTION 2)
STATE ROAD
N 818,000
N 817,000
E 2,472,000
REACH 11
15TH STREET
16TH STREET
16TH STREET
N 815,000
REACH 2-1
SURFACE WATER AND SEDIMENT SAMPLING LOCATION (CROSS SECTION 3)
E 2,463,000
N 814,000
COLUMBUS AVE.
SURFACE WATER AND SEDIMENT SAMPLING LOCATION (CROSS SECTION 10)
REACH 2
REACH 2-2
N
LEGEND
Proposed sample location
FIELDS BROOK
SDWTDI SAMPLE LOCATIONS
REACHES 2-1, 2-2 and 11-4
DATE: 7/2/93
DESIGN: GD
PROJECT NO
86C3609N
FIG NO
A2-1a
DRAWN: LM
CHK'D: PJD
Woodward-Clyde Consultants



LEGEND

●	Proposed sample location
	floodplain
	clayey material
	coarse material
	shaley material
	thick silty/clayey material



N

FIELDS BROOK

SDWTDI SAMPLE LOCATIONS REACHES 5 and 6

DATE: 7/1/93	DESIGN: GO	PROJECT NO	FIG NO
DRAWN: LM	CHK'D: PJD	86C3609N	A2-1b

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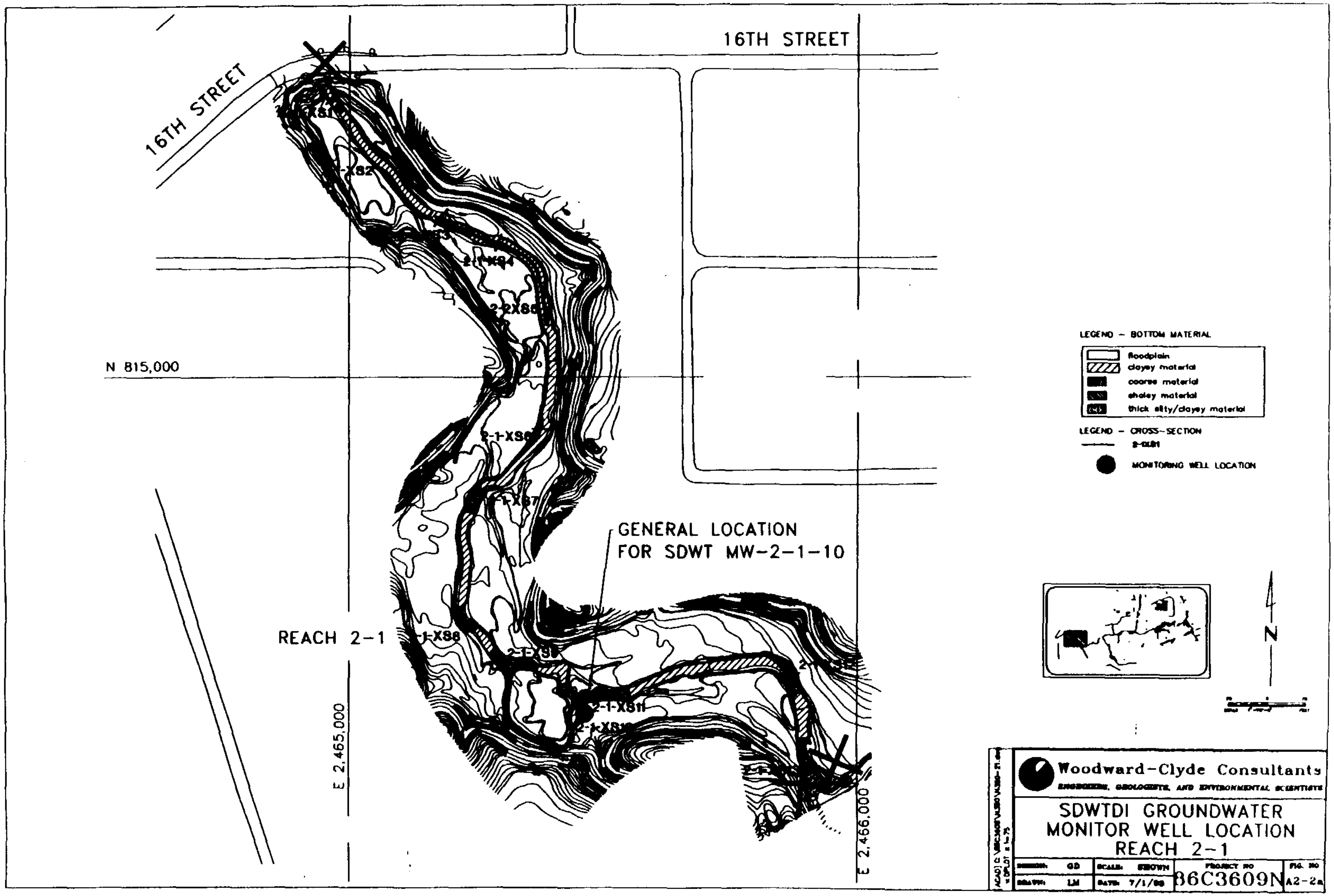
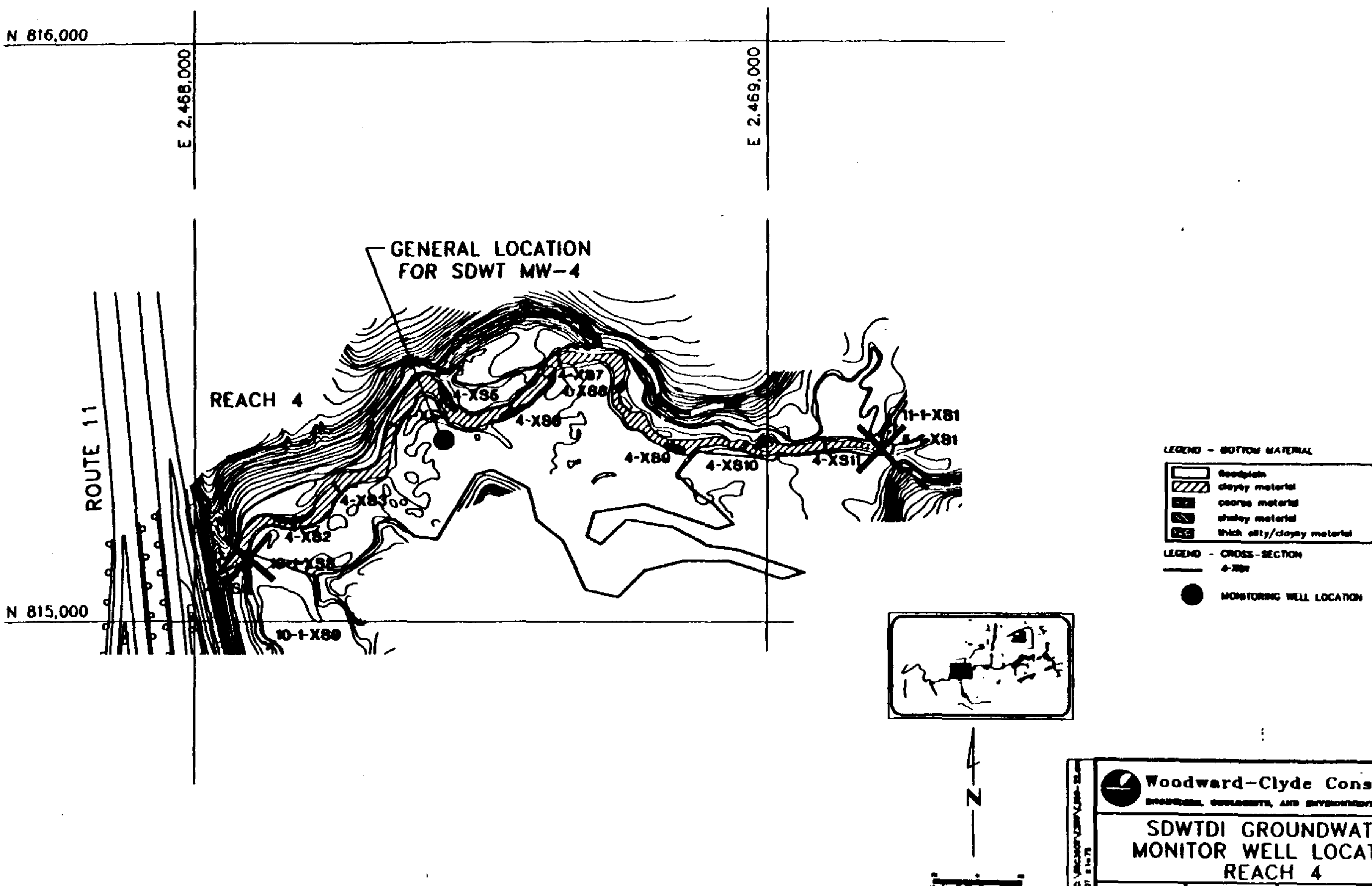

16TH STREET
16TH STREET
N 815,000
E 2,465,000
E 2,466,000
REACH 2-1
2-1-XS2
2-1-XS4
2-1-XS6
2-1-XS9
2-1-XS11
GENERAL LOCATION
FOR SDWT MW-2-1-10
LEGEND - BOTTOM MATERIAL
floodplain
clayey material
coarse material
shaley material
thick silty/clayey material
LEGEND - CROSS-SECTION
MONITORING WELL LOCATION
N
Woodward-Clyde Consultants
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACH 2-1
GD
SCALE: SHOWN
LM
DATE: 7/1/88
PROJECT NO
86C3609N
FIG. NO
A2-2a



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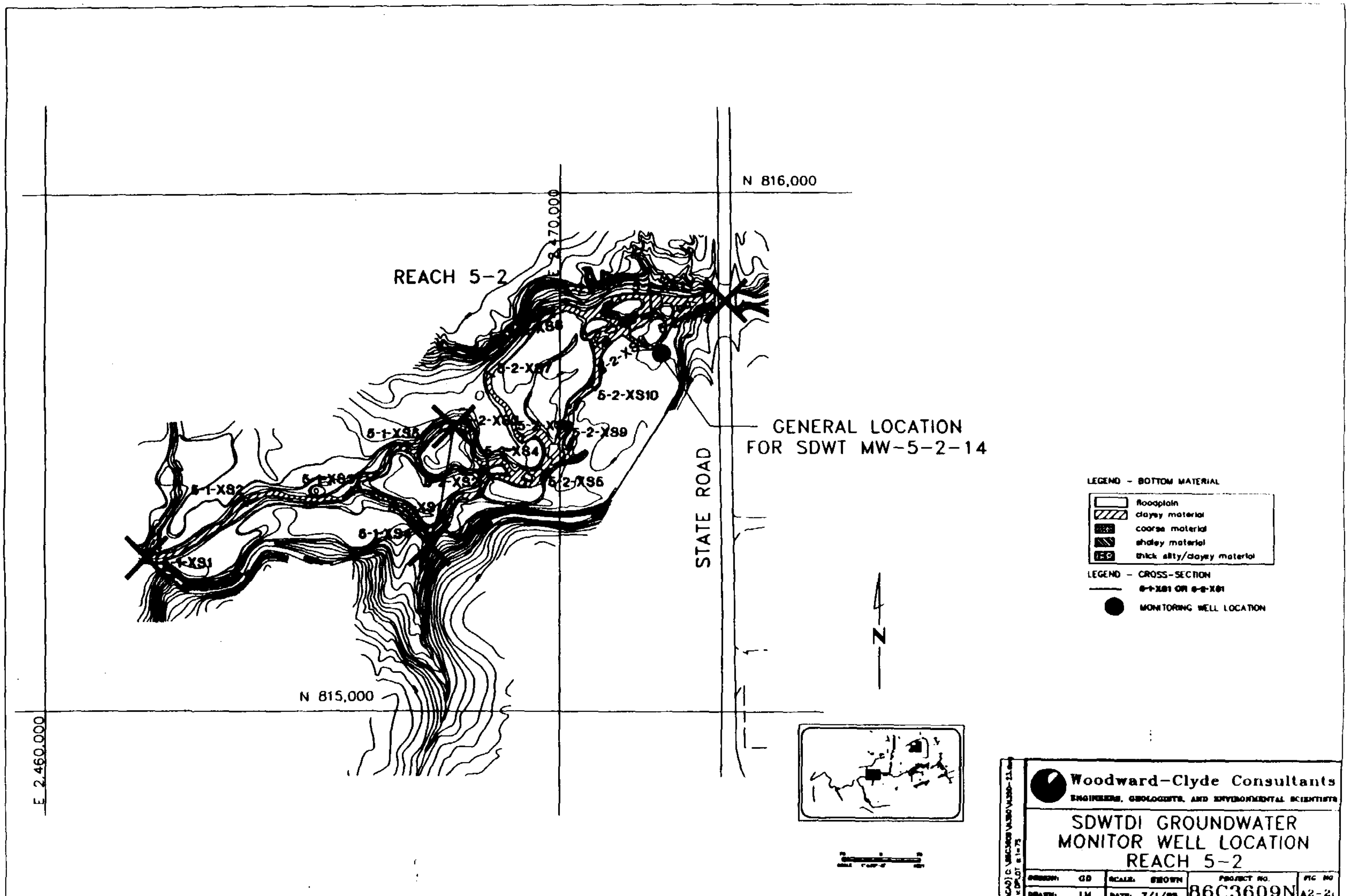
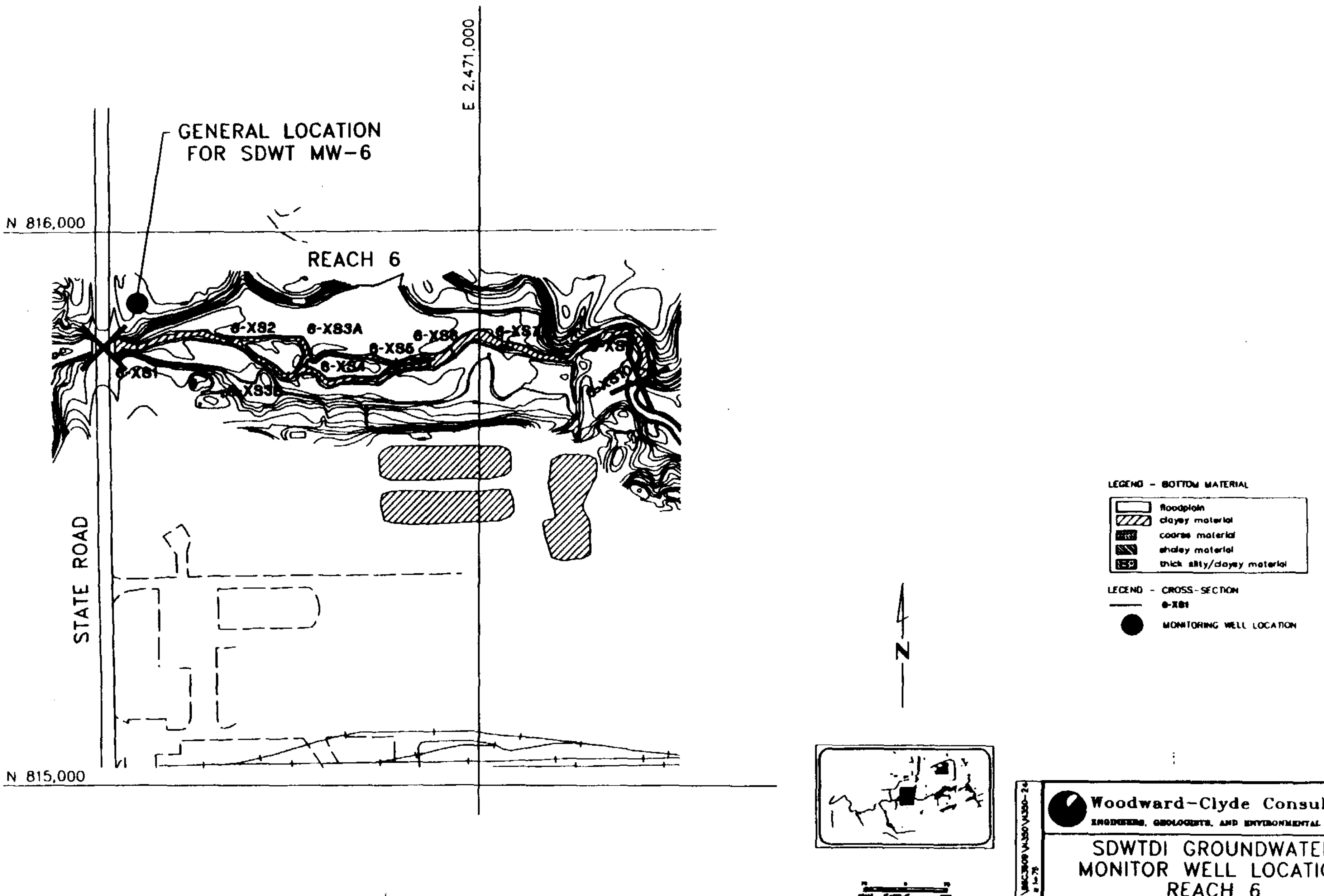
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACH 4

86C3609E | A2-2b

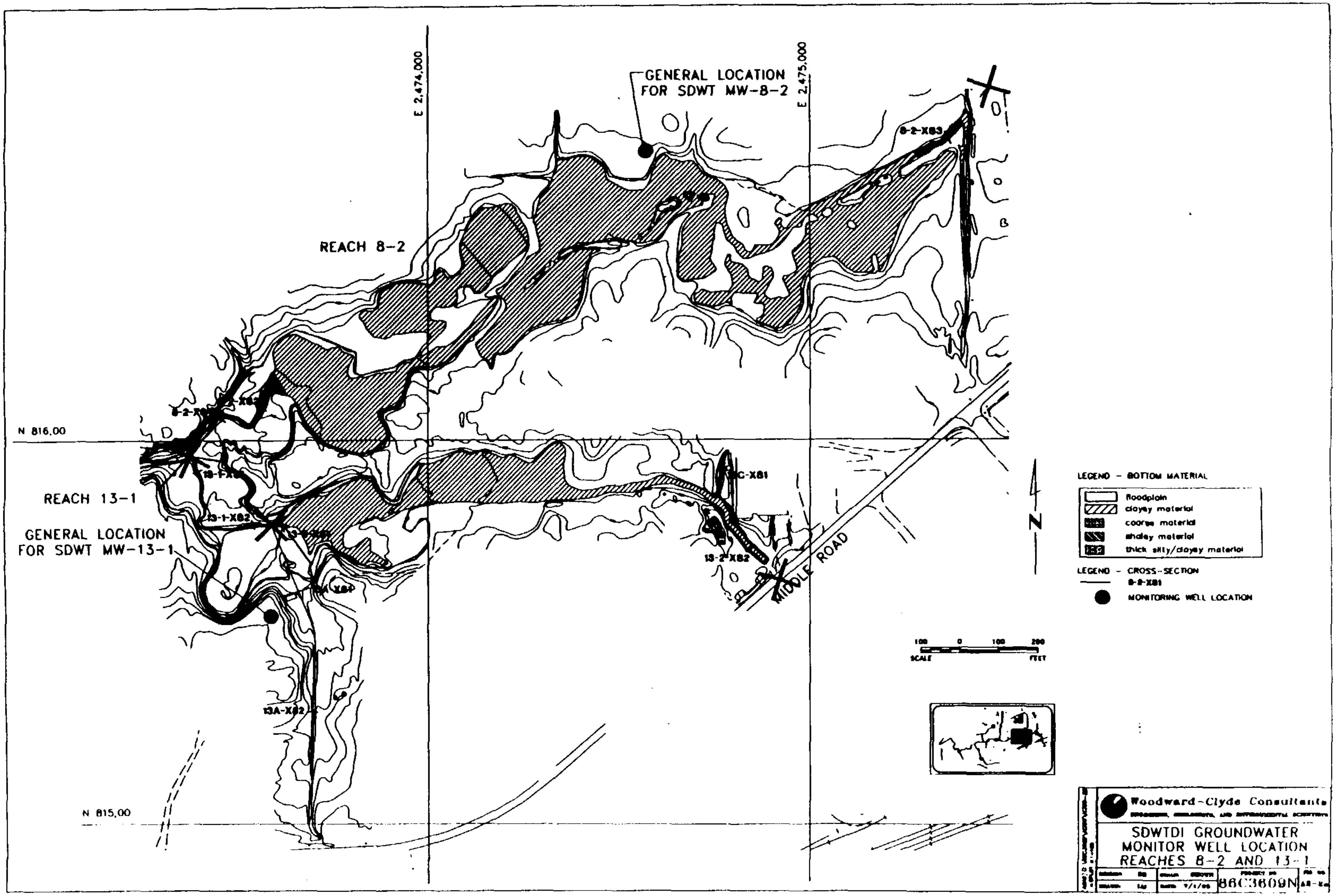

N 816,000
E 2,470,000
REACH 5-2
5-2-XS10
5-2-XS9
5-2-XS6
5-2-XS4
5-1-XS2
5-1-XS1
GENERAL LOCATION
FOR SDWT MW-5-2-14
STATE ROAD
N 815,000
E 2,460,000
N
LEGEND - BOTTOM MATERIAL
floodplain
clayey material
coarse material
shaley material
thick silty/clayey material
LEGEND - CROSS-SECTION
MONITORING WELL LOCATION
Woodward-Clyde Consultants
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACH 5-2
GD
LM
SHOWN
86C3609N



Woodward-Clyde Consultants

SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACH 6

GD	SCALE: SHOWN	PROJECT NO. 86C3609N	FIG. NO A2-2d
LM	DATE: 7/1/86		



GENERAL LOCATION FOR SDWT MW-8-2
E 2,474,000
E 2,475,000
REACH 8-2
8-2-XS3
N 816,00
REACH 13-1
GENERAL LOCATION FOR SDWT MW-13-1
13-1-XS2
13-2-XS2
13A-XS2
MIDDLE ROAD
N 815,00
N
LEGEND - BOTTOM MATERIAL
floodplain
clayey material
coarse material
shaley material
thick silty/clayey material
LEGEND - CROSS-SECTION
MONITORING WELL LOCATION
100
0
100
200
SCALE
FEET
Woodward-Clyde Consultants
SDWTDI GROUNDWATER
MONITOR WELL LOCATION
REACHES 8-2 AND 13-1
88C3609N

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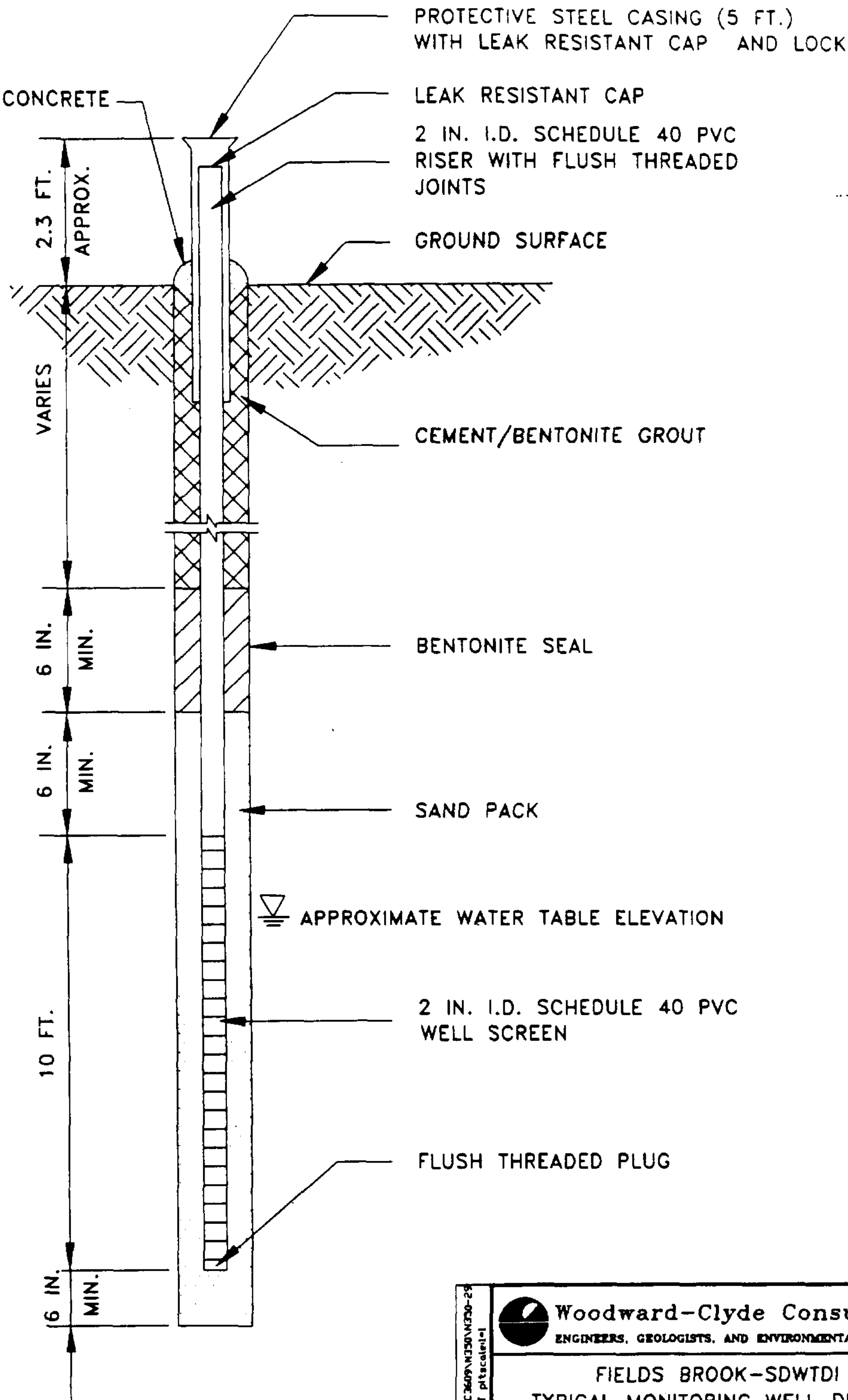
LOG OF BORING ______ SHEET 1 OF ____

PROJECT AND LOCATION FIELDS BROOK SDWTDI			ELEVATION AND DATUM	PROJECT NO. 86C3609E
DRILLING AGENCY		FOREMAN	DATE STARTED	DATE FINISHED
DRILLING EQUIPMENT			COMPLETION DEPTH	ROCK DEPTH
SIZE AND TYPE OF BIT	SIZE AND TYPE CORE BARREL		NO SAMPLES: DIST.	UNDIST. / CORE
CASING			WATER LEVEL (FT): FIRST	COMPL. / 24 HR.
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION	
SAMPLER				
SAMPLER HAMMER	WEIGHT	DROP	INSPECTOR	

CASING PENETR. RESIST. BL/FT	DESCRIPTION	PIEZ.	DEPTH, FT	SAMPLES: TYPE NUMBER	SAMPLES: RECOV. FT	SAMPLES: PENETR. RESIST. BL/6 IN.	R. CORE: RECOVERY %	R. CORE: RQD	INDEX TESTS: W_n, %	INDEX TESTS: LL, %	INDEX TESTS: PL, %	INDEX TESTS: -200, %	REMARKS
			1										
			2										
			3										
			4										
			5										
			6										
			7										
			8										
			9										
			10										
			11										
			12										
			13										
			14										
			15										
			16										
			17										
			18										
			19										

FIGURE A2-3



ACAD) C:\36C3609\N350\N330-29
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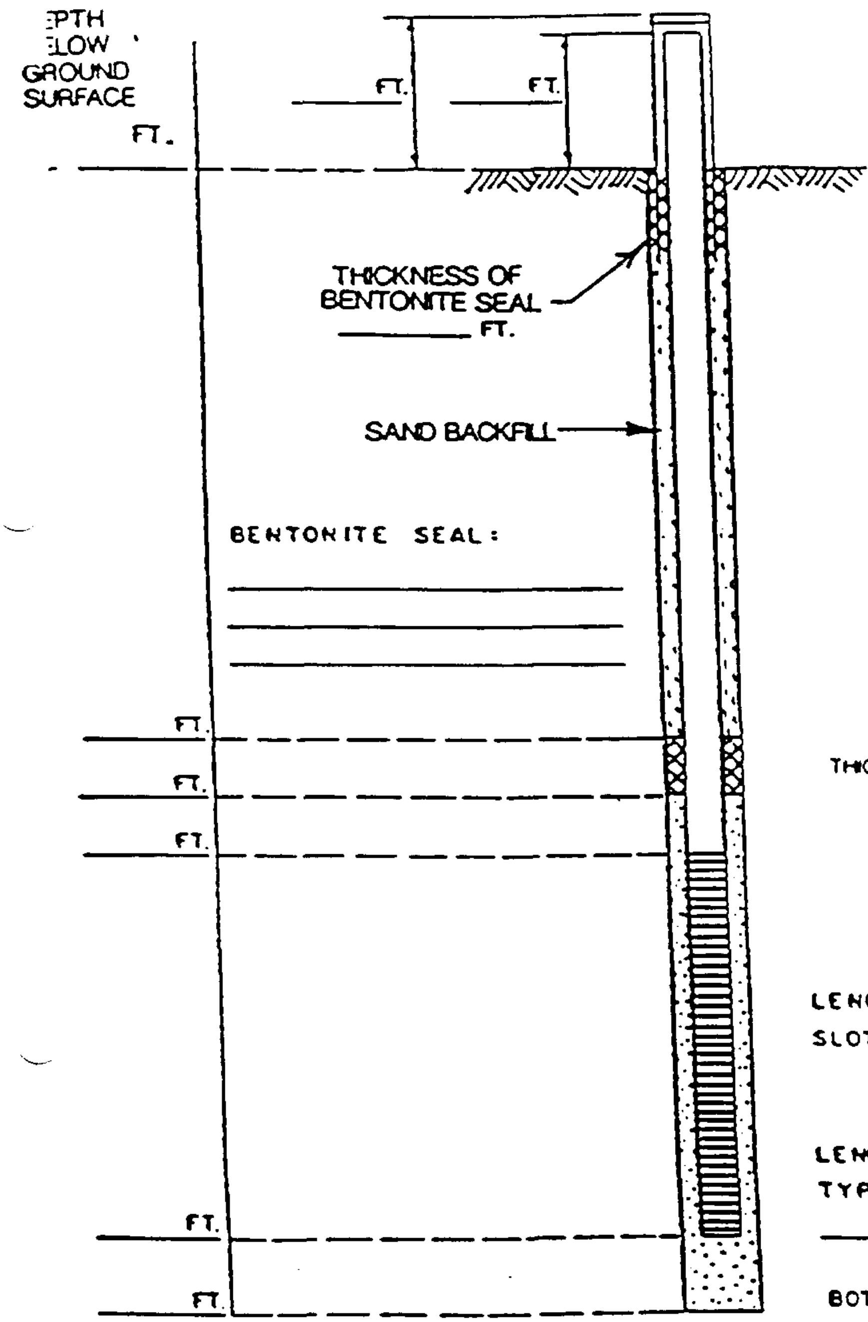
FIELDS BROOK-SDWTDI
TYPICAL MONITORING WELL DESIGN

DESIGN: GD	SCALE: NONE	PROJECT NO.	FIG. NO.
DRAWN: LM	DATE: 7/1/93	86C3609N	A2-4

MONITORING WELL INSTALLATION REPORT

INSTALLED: ____________
WELL NO.: ____________
BORING NO.: ____________
PROJECT NO.: ____________
PREPARED BY: ____________
CHECKED BY: ____________



TOP OF GROUND SURFACE EL. ________ FT.
RISER PIPE EL. ________ FT.
PROTECTIVE WELL COVER CASING:
____
____
____

RISER PIPE SCHEDULE ________
ASTM DESIGNATION ________
I.D. ________ O.D. ________
COUPLINGS ________
PIPE IN ________ FT. LENGTHS

PIPE ________ FT.
PIPE ________ FT.
SCREEN ________ FT.
TOTAL ________ FT.

THICKNESS OF BENTONITE SEAL ________ FT.

LENGTH OF SCREEN ________ FT.
SLOT SIZE ________ IN.

LENGTH OF FILTER PACK ________ FT.
TYPE OF FILTER PACK ________
____

BOTTOM OF BORING

REMARKS: ____________
____
____
____
____
____

Typical Monitor Well Installation Form

WELL DEVELOPMENT SUMMARY

Project________________ Well Number________________

Project Number____________ Date________ Page___ of ___

Well Inside Diameter: ____________ inches

Depth of bottom: ____________ ft. below ground surface

Length of sand pack: ____________ feet

Diameter of sand pack: ____________ inches

Measured by ______________________________

Recorded by ______________________________

Air Temperature (°F) ______________________

Weather Condition ________________________

WITHDRAWAL OF WELL VOLUMES

FLUSHING

	WELL VOLUME	WELL VOLUME	WELL VOLUME
Water Level Before *			
Water Level After *			
Time Begin Flushing			
Time End Flushing			
Time Water Level After			
Total Estimated Volume Flushed (gal)			

FIELD ANALYSIS

Water Temperature (°C)			
Sample pH			
Sample Conductivity (mS)			
Buffer Before			
Buffer After			
Odor			
Color			
Other			

Comments

*Feet Below top of PVC Casing

APPENDIX B

BENCH-SCALE TEST PLANS FOR SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION, FIELDS BROOK SUPERFUND SITE

TABLE A2-1

CHEMICAL AND PHYSICAL PARAMETERS
FOR
SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION

Sample Matrix: Surface Water, Groundwater and Drained Water

Chemical Parameters:

- Target Compound List (TCL) Volatile Organic Compounds (VOCs)
- TCL Semivolatile Organics (SVOCs)
- TCL Polychlorinated biphenyls (PCBs)/Pesticides
- Target Analyte List (TAL) Metals (total and dissolved)
- Cyanide (total and free)
- Phenols
- Oil/Grease
- Silica (total and soluble)
- Sulfate/Sulfite
- Ammonia
- Nitrate/Nitrite
- Phosphate
- Chloride (Soluble)
- Fluoride
- Carbonate, Bicarbonate, Hydroxide
- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Organic Carbon (TOC)

- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)

- Total Alkalinity
- Hardness (as $CaCO_3$)

- pH
- Dissolved Oxygen (DO)

TABLE A2-1 (Cont.)

CHEMICAL AND PHYSICAL PARAMETERS
FOR
SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION

Sample Matrix: Surface Water, Groundwater and Drained Water

Physical Parameters:

- Temperature
- Specific Conductivity
- Oxidation Reduction Potential (Eh)
- Turbidity

TABLE A2-2

SUMMARY OF TOTAL SAMPLE VOLUMES
FOR
ANALYTICAL TESTING

SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION

Sample Location	Sample Matrix	Minimum Sample Volume required
Reach 13-B Cross-section 2	Sediment	20 gal.
Reach 2-1 Cross-section 10 Reach 2-2 Cross-section 3 Reach 5-1 Cross-section 2 Reach 5-2 Cross-section 14 Reach 6 Cross-section 1 Reach 11-4 Cross-section 2	Sediment(1)	20 gal. each location(2)
Reach 2-1 Cross-section 10 Reach 2-2 Cross-section 3 Reach 5-1 Cross-section 2 Reach 5-2 Cross-section 14 Reach 6 Cross-section 1 Reach 11-4 Cross-section 2	Surface Water(1)	15 to 20 gal. each location(3) (5 gal. baseline charact. plus 10 to 15 gal. treat. studies)
Reach 2-1 Cross-section 10 Reach 2-2 Cross-section 3 Reach 5-1 Cross-section 2 Reach 5-2 Cross-section 14 Reach 6 Cross-section 1 Reach 11-4 Cross-section 2	Free Liquids	As available(3)
Monitoring Wells along Reaches 2-1, 4, 5-2, 6, 8-2, 13-1	Groundwater	10 gal. each location(3) (5 gal. baseline charact. plus 5 gal. treat. studies)

NOTES:
1) These sediment and surface water samples will be collected during the SLDI and TTDI.
2) Sediment samples for the SDWTDI will NOT be drained.
3) Exact volumes are field-dependent and will be collected during the SLDI and TTDI.

I:\FBK\COMBDIWP\TAB\TABA2-2W.WK3

TABLE A2-3

**NUMBER OF SAMPLES TO BE COLLECTED
FOR ANALYTICAL TESTING FOR
SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION**

Parameter(1)	Surface Water	Groundwater	Free Liquids (See Note 1)	Field Duplicates	Trip Blanks	Field Blanks	MS/MSD and MS/D	Rinsate Blanks	Total
Chemical									
TCL VOCs	6	6	6	3	(See Note 2)	3	3	3	30+
TCL SVOCs	6	6	6	3	NA	3	3	3	30
TCL PCBs/Pest	6	6	6	3	NA	3	3	3	30
Total TAL Metals (unfiltered)	6	6	6	3	NA	3	3	3	30
Dissolved TAL Metals (filtered)	6	6	6	3	NA	3	3	3	30
Total Cyanide (unfiltered)	6	6	6	3	NA	3	3	3	30
Free Cyanide (filtered)	6	6	6	3	NA	3	3	3	30
Total Suspended Solids	6	6	6	3	NA	3	3	3	30
Total Dissolved Solids	6	6	6	3	NA	3	3	3	30
Total Organic Carbon	6	6	6	3	NA	3	3	3	30
Alkalinity (total)	6	6	6	3	NA	3	3	3	30
Silica, Total	6	6	6	3	NA	3	3	3	30
Silica, Dissolved	6	6	6	3	NA	3	3	3	30
Phenols	6	6	6	3	NA	3	3	3	30
Phosphate	6	6	6	3	NA	3	3	3	30
Ammonia	6	6	6	3	NA	3	3	3	30
Nitrate/Nitrite	6	6	6	3	NA	3	3	3	30
Chloride (soluble)	6	6	6	3	NA	3	3	3	30
Fluoride	6	6	6	3	NA	3	3	3	30
Carbonate, Bicarbonate, Hydroxide	6	6	6	3	NA	3	3	3	30
Hardness (as $CaCO_3$)	6	6	6	3	NA	3	3	3	30
Oil/Grease	6	6	6	3	NA	3	3	3	30
Sulfate/Sulfite	6	6	6	3	NA	3	3	3	30
Biochemical Oxygen Demand	6	6	6	3	NA	3	3	3	30
Chemical Oxygen Demand	6	6	6	3	NA	3	3	3	30
Physical (See Note 3)									
Turbidity	6	6	6						18
Oxidation-Reduction Potential (Eh)	6	6	6						18
Temperature	6	6	6						18
pH	6	6	6						18
Conductivity	6	6	6						18
Dissolved Oxygen (DO)	6	6	6						18
Treatability/Dewaterability									
Treatability/Dewaterability	6	6	6						18

NOTES:

1) Volumes are field dependent and will be collected during the SLDI and TTDI.

2) The frequency of trip blanks to be included is one per cooler containing samples for VOC analysis; the total number of trip blanks is to be determined.

3) All physical samples except temperature will be measured in both field and laboratory; temperature will be measured in the field only.

TABLE A2-4

SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIMES
FOR CHEMICAL AND PHYSICAL TESTING
SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION

Sample Matrix	Parameter(1)	Analysis Method	Recommended Number and Type of Container(s)(2)	Minimum Sample Volume (ml)	Preservation Requirement	Maximum Sample Holding Time
Aqueous	Chemical					
	TCL VOCs	SW-846-8240	(2) 40 ml glass vials with Teflon-lined septa	80	cooled to 4°C HCL to pH<2	14 days to analysis
	TCL SVOCs	SW-846-8270	(2) 1 L glass bottle with Teflon-lined cap	2000	cooled to 4°C	7 days to extraction 40 days to analysis
	TCL PCBs/ Pesticides	SW-846-8080	(1) 1 L glass bottle with Teflon-lined cap	1000	cooled to 4°C	7 days to extraction 40 days to analysis
	Total TAL Metals (unfiltered)	SW-846-3010/6000/7000	(1) 1 L plastic bottle with Teflon-lined cap	1000	cooled to 4°C HNO_3 to pH<2	Hg 28 days, all others 6 months
	Dissolved TAL Metals (filtered)	SW-846-3010/6000/7000	(1) 1 L plastic bottle with Teflon-lined cap	1000	cooled to 4°C HNO_3 to pH<2	Hg 28 days, all others 6 months
	Total Cyanide (unfiltered)	SW-846-9010	(1) 500 ml plastic bottle	500	cooled to 4°C NaOH to pH range 10-12	14 days
	Free Cyanide (filtered)	SW-846-9010	(1) 500 ml plastic bottle	500	cooled to 4°C NaOH to pH range 10-12	14 days
	Total Suspended Solids	EPA 160.1	(1) 250 ml plastic bottle(4)	250	cooled to 4°C	7 days to analysis
	Total Dissolved Solids	EPA 160.2	(1) 250 ml plastic bottle(4)	250	cooled to 4°C	7 days to analysis
	Total Organic Carbon	SW-846-9060	(1) 1 L glass bottle	1000	cooled to 4°C H_3PO_4 to pH<2	28 days
	Silica, Total	EPA 370.1	(1) 1 L plastic bottle	1000	cooled to 4°C	28 days
	Silica, Dissolved	EPA 370.1	(1) 1 L plastic bottle	1000	cooled to 4°C	28 days
	Phenols	SW-846-9065/9066	(1) 1 L glass bottle	1000	cooled to 4°C 0.008% $Na_2S_2O_3$	28 days
	Phosphate	SW-846-5050/9256	(1) 1 L plastic or glass bottle	1000	cooled to 4°C	28 days
	Ammonia	EPA 350.3	(1) 1 L plastic or glass bottle	1000	cooled to 4°C	28 days
	Nitrate/Nitrite	SW-846-5050/9256	(1) 1 L plastic or glass bottle	1000	cooled to 4°C	28 days
	Chloride (soluble)	SW-846-5050/9256	(1) 1 L glass bottle	1000	cooled to 4°C	28 days
	Fluoride	SW-846-5050/9256	(1) 1 L glass bottle	1000	cooled to 4°C	28 days

TABLE A2-4 (CONT'D)

SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIMES
FOR CHEMICAL AND PHYSICAL TESTING
SEDIMENT DEWATERING AND WASTEWATER TREATMENT
DESIGN INVESTIGATION

Sample Matrix	Parameter(1)	Analysis Method	Recommended Number and Type of Container(s)(2)	Minimum Sample Volume (ml)	Preservation Requirement	Maximum Sample Holding Time
Aqueous	Carbonate Bicarbonate Hydroxide	EPA 310.1 or EPA 310.2	(1) 1 L plastic bottle	1000	cooled to 4°C	14 days
	Oil/Grease	SW-846-9071	(1) 1 L glass bottle	1000	cooled to 4°C H_2SO_4 to pH<2	28 days
	Sulfate/Sulfite	SW-846-5050/9256	(1) 50 ml glass or plastic bottle	50	cooled to 4°C	28 days
	Biochemical Oxygen Demand	EPA 405.1	(1) 250 ml plastic bottle	250	cooled to 4°C	48 hours
	Chemical Oxygen Demand	EPA 410.1	(1) 50 ml glass or plastic bottle	50	cooled to 4°C H_2SO_4 to pH<2	28 days
	Alkalinity (total)	EPA 310.2	(1) 100 ml glass or plastic bottle	100	cooled to 4°C	14 days to analysis
	Hardness (as $CaCO_3$)	EPA 931.1 or EPA 931.2	(1) 1 L plastic or glass bottle	1000	cooled to 4°C H_2SO_4 to pH<2	14 days
	Physical (5)					
	Turbidity	EPA 180.1	(1) 1 L plastic or glass bottle	1000	cooled to 4°C	14 days and Field Measurement
	Oxidation-Reduction Potential (Eh)	ASTM-D4646	(2) 50 ml glass or plastic bottle	100	cooled to 4°C	14 days and Field Measurement
	Temperature	EPA 170.1	(1) 40 ml glass or plastic jar	25	None	Field Measurement
	pH	SW-846-9040	(1) 40 ml glass or plastic jar	25	None	(unpreserved) Field Measurement
	Conductivity	SW-846-9050	(1) 40 ml plastic or glass jar	25	None	Field Measurement
	Dissolved Oxygen (DO)	EPA 360.1	(1) 100 ml plastic bottle	100	KOH	14 days and Field Measurement

NOTES:

1) Samples collected for chemical testing will be sent to Hazleton Laboratories; samples for physical testing will be sent to Earth Technology Corporation.

2) QA/QC samples will be taken for each chemical parameter at field-determined sample locations, according to Section 2.5.1.1 of the FSP.

3) HDPE = High Density Polyethylene

4) If TDS and TSS are to performed on the same sample, only one (1) 250 ml plastic container is required.

5) All physical samples except temperature will be measured in both the field and laboratory; temperature will be measured in the field only.

APPENDIX B

BENCH-SCALE TEST PLANS
SEDIMENT DEWATERING AND WASTEWATER TREATMENT DESIGN INVESTIGATION (SDWTDI)

FIELDS BROOK SITE
ASHTABULA, OHIO

Prepared for
Fields Brook PRP Organization
July 1993

Woodward-Clyde Consultants
122 South Michigan Avenue
Suite 1920
Chicago, Illinois 60603

Project Number 86C3609N
Revision 2

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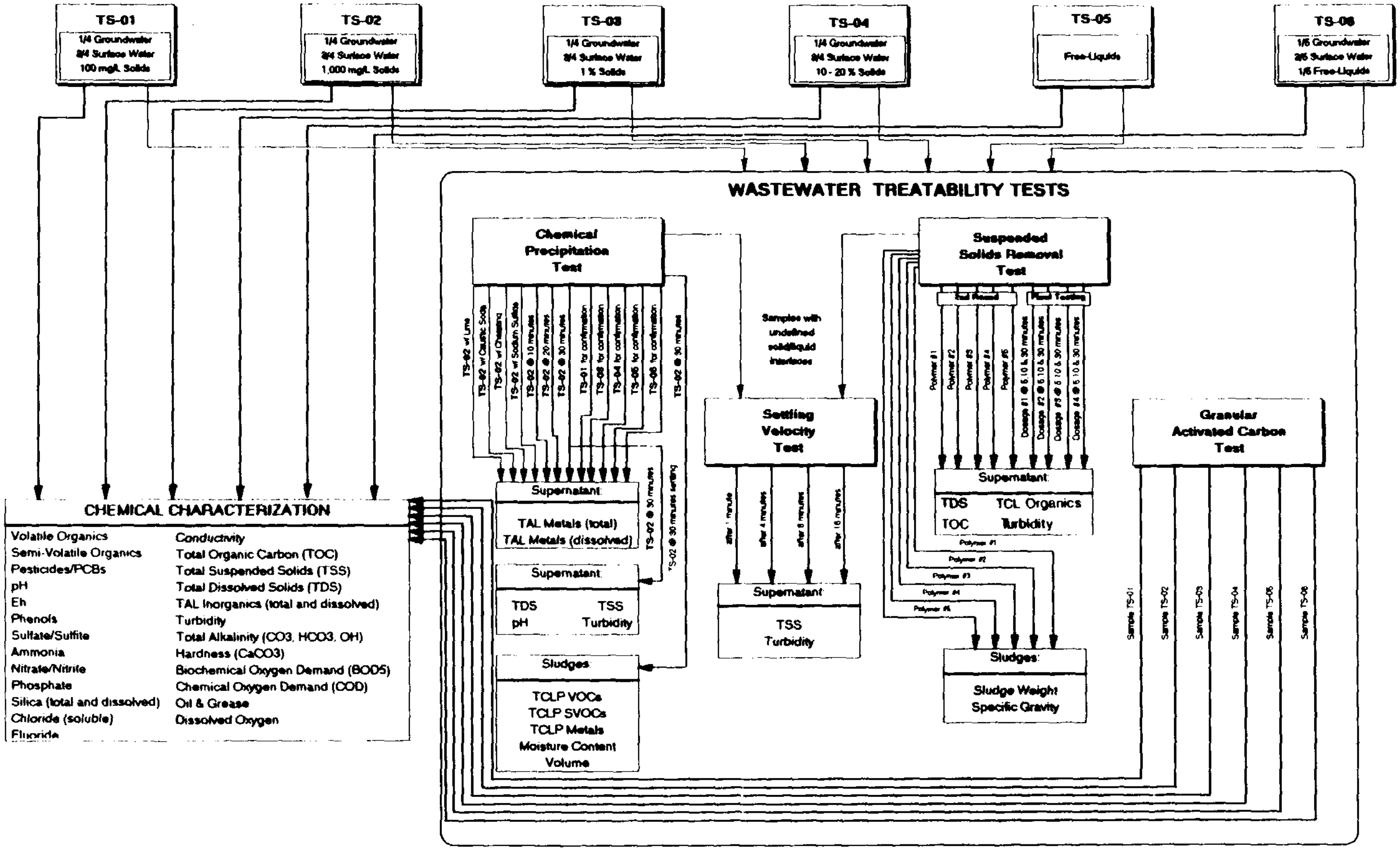


FIGURE 5-6 - WASTEWATER TREATABILITY TESTS

1.0 DEWATERABILITY EVALUATION

1.1 GRAVITY DRAINAGE TEST PROTOCOL

A test procedure was developed to evaluate the reduction in moisture content that can be achieved by allowing the sediments to gravity drain on a pad. These sediments will be excavated from the brook and placed in a pile on a pad to facilitate the removal of free liquids from the sediments.

1.1.1 Description

The test setup will consist of a column of sediments placed on a draining medium. The volume of free liquid draining recovered the column and the weight of the sediments will be measured at regular intervals to estimate the sediment moisture content with time.

1.1.2 Experimental Procedures

The sample preparation and testing procedure will be as follows:

1. Collect approximately two gallons (or 30 lbs) of sediments from one of the sample containers received from the field and weigh the sample.

2. Add surface water (collected from the same reach) to the sediment sample to increase the moisture content of the sediment to about 70 percent. The quantity of water to be added will be based on the initial measured moisture content of the sediments received in the laboratory.

3. Mix thoroughly to obtain a homogeneous sample. Obtain a subsample for moisture content determination and split the sample for duplicate testing can be performed.

4. Set sample mold over a saturated filter paper supported by a mesh or a sieve. The mold will be an open-end 12-inch long, 6-inch diameter pipe section

made of Teflon, PVC or HDPE. This setup will be weighted prior to adding the sediments.

5. Place the sediments loosely into the mold until the level of the sediments is flush with the top of the mold.

6. Place a cap on the mold and weight the filled mold. The cap will have a small perforation to allow venting and will be set to leave a small air space above the sediment.

7. Place the screen and mold with sediments over a Buchner funnel set over a 2,000 ml graduated beaker.

8. Measure the liquid level in the beaker at 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours, and 24 hours.

9. Weigh the mold at the end of the experiment. Remove the sediments from the mold, mix the sediments and take a sample for moisture content determination.

1.1.3 Process Data Requirement, Sampling and Analysis

Detailed observations and record keeping for all phases of testing will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details, if necessary.

1.1.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

1.2 CAPILLARY SUCTION TEST PROTOCOL

The capillary suction test (CST) will be performed on sediment test samples as well as sludges generated from the precipitation and suspended solids removal test. The CST will provide a quick, inexpensive, and reproducible method of characterizing and comparing the relative dewaterability of the sediments. The results will be used to calculate the specific resistance of the dewatered materials which is a measure of the sediments' resistance to filtration. Variables that affect the dewatering process are the solids concentration; and chemical and physical composition, such as particle size and shape; and moisture content.

1.2.1 Description

The bench scale CST will be conducted using the following apparatus:

- One plexiglass plate 4-3/8 inch square by 5/8 inch thick. The underside of this top plate is recessed 1/16 inch, to a radius of 1-7/8 inch and has concentric circles inscribed at 1/4-inch intervals out from the reservoir at the center. The sample reservoir is a 1-inch length of 3/4 inch diameter, type L, copper tubing coated with epoxy enamel. The bottom of the reservoir is set even with the bottom surface of the outer rim of the top plate.

- One plexiglass plate 4-3/8 inch square by 5/8 inch thick (bottom plate).

- Whatman No. 17 chromatography paper.

- Stopwatch.

- Automatic timer. This could involve wire electrodes set in the bottom plates one beneath each of the circles inscribed in the top plates. These electrodes are connected to a timer equipped with relays and switches. The electrodes extend slightly into the filter media which enable the timer to be activated when the filtrate reaches the selected electrode and stopped when the interface reaches the next electrode.

The CST test measures the travel time of the filtrate from the sediments through a known length of chromatography paper.

1.2.2 Experimental Procedure

The following is a recommended approach to the bench scale procedures for conducting the CST:

1. Define and record planned experiment in the data book.
2. Place a sheet of Whatman No. 17 chromatography paper on the bottom plate of the apparatus. Be sure to align the grain of the paper in the direction of the filtrate movement. If the electrical timer is used, the grain of the paper should be placed parallel to the line of the electrodes.
3. Place the top plate over the filter media or paper on the bottom plate. If using the electrical timer, press the top plate firmly onto the bottom plate to in-place the paper onto the electrodes.
4. Place approximately 3 ml of conditioned sediments in the sample reservoir.
5. Time the filtrate movement between two reference marks in the top plate. A 1/4-inch length is sufficient.
6. Record the time of travel as the capillary suction time (CST) and record the temperature of the sludge in the reservoir.
7. Rerun the test following the same procedures.

1.2.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all testing runs will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details if necessary.

The values from the CST can easily be correlated with specific resistance.

1.2.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

1.3 BUCHNER FUNNEL TEST PROTOCOL

The Buchner funnel test will also be performed on sediment test samples and sludges generated from precipitation and suspended solids removal tests. This test will be performed to evaluate the dewaterability of the excavated materials.

1.3.1 Description

The bench scale Buchner funnel test will be conducted using the following apparatus:

- 250 ml glass volumetric cylinder with standard taper joint neck
- Glass adapter with side arm
- Rubber stopper for volumetric cylinder with hole for Buchner funnel
- No. 2 Buchner funnel
- Whatman No. 42 paper
- Wire screen support for filter paper
- Pinch clamp
- 1/4 hp vacuum pump with vacuum gage, tubing and valves, and
- stopwatch

1.3.2 Experimental Procedure

The following is a recommended approach to the bench scale procedures for conducting the Buchner funnel test:

1. Measure the initial solids content.

2. Prepare the Buchner funnel using a screen and filter paper. Wet the paper with water and apply a vacuum to obtain a seal.

3. Close the valve and adjust vacuum to 15 or 20 inches of Hg.

4. Place 200 ml of the sludge sample in a 400 ml beaker and add the appropriate conditioners. If $FeCl_3$ and lime are used, add the lime about 30 seconds after mixing $FeCl_3$ with sludge. Mix for two minutes.

5. Add 200 ml sludge to Buchner funnel and allow sufficient time for a cake to form (usually about 10 seconds).

6. Release the pinch-clamp.

7. Record the filtrate volume until vacuum breaks or the rate of filtrate collection drops to about 1 ml per minute.

8. Repeat Steps 1 through 7 using varying concentrations of coagulant or polymer. Depending on the nature of the sludge, $FeCl_3$ and/or lime dosages may vary from 2 to 10% by weight and polyelectrolyte dosages may vary from 0.1 to 1.5% by weight.

9. Determine specific resistance for each situation and then delineate the optimum conditions that generate the minimum specific resistance.

1.3.3 Process Data Requirements, Sampling and Analysis

Detailed observation and record keeping for all test runs will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details if necessary.

As a minimum, the specific conditions of the test should be recorded (i.e., filter paper area, vacuum, initial and final sludge/sediment solids concentration).

Data collected will be used to determine the t/v versus V relationship and specific resistance.

1.3.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

1.4 FILTER LEAF TEST PROTOCOL

The filter leaf test will be performed on sediment test samples and sludges generated from precipitation and suspended solids removal tests.

1.4.1 Description

The bench scale filter leaf test will be conducted using the following apparatus:

- Erlenmeyer flask with sidearm, 500 ml
- Rubber stopper with one hole
- 1/4 hp vacuum pump with vacuum gage, tubing and valves
- filter test leaf, and
- Several types of synthetic or wire mesh media

This test is used to develop coefficients (m,n,s,R_o) by relating filter loading L, (lb/sq ft-hr) to form time, t_f, solids concentration, c, and vacuum, P. In addition, final cake moisture content can be related to dry time, t_d.

1.4.2 Experimental Procedures

The following is a recommended approach to the bench scale procedures for conducting the filter leaf test. Several runs should be made where the parameters (filter loading, form time, solids concentration, vacuum) are varied. A single run will consist of submerging the filter leaf in a specific concentration of sediment for a selected form time. The leaf is then removed and allowed to dry for a selected dry time after which the quantity and percent moisture of the cake are determined. A minimum series of 8 runs should be performed to generate the design criteria:

1. Using the results of the Buchner funnel test, add the optimum coagulant dosage as a percent by weight or lb/ton of dry solids.

2. Flocculate the mixture for 30 seconds (in some cases a series of tests should be run to determine the optimum flocculation time).

3. Submerge the leaf in the flocculated sludge mixture for the specified form time. Total cycle time can range from 1 to 6 minutes, with a variation in form time of 0.25 to 3 minutes. Maintain a gentle mixing of the sludge to avoid deposition.

4. Remove the leaf from the sludge and hold vertically for the specified dry time keeping it under full vacuum.

5. Transfer the entire cake from the filter leaf to a tared dish (compressed air may be gently applied to loosen the cake from the leaf). With thin cakes (< 3/8 inch thick), it is generally necessary to scrape the cake from the media with a knife blade.

6. Weigh the wet cake, dry at 103°C and reweigh the dried cake; measure and record the cake thickness and percent moisture.

7. Repeat Steps 2 through 6, varying vacuum (5 to 20 inches Hg), initial solids concentration, form and dry times.

1.4.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all test runs will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details if necessary. The data collected will be used to formulate design criteria.

1.4.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

1.5 BENCH TOP FILTER PRESS TEST PROTOCOL

1.5.1 Description

The bench scale filter press testing was selected to evaluate material handling of the different samples and reduction in moisture content that can be achieved by mechanical dewatering. The test set-up can use a bench scale pressure filter apparatus or a bench top model recessed chamber press or membrane press. The following equipment is also necessary:

- Pre-coat tank with pressure gage
- Filter-feed tank approximately 2-3 gallon capacity with pressure gage
- Feed lines for sediments, sludge, conditioner and filter pre-coat material
- Gas cylinder with pressure gages and regulators or air compressor

The parameters which are important in evaluating the pressure filter process include:

- Feed temperature
- Chemical addition
- Cycle time
- Cake characteristics
- Filtrate characteristics

1.5.2 Experimental Procedures

The following is a recommended procedure for the bench-scale filter press testing:

1. Initially determine the type and optimum dosage of conditioner using the Buchner funnel test described in Section 1.3 of this Appendix with sediments generated from precipitation or suspended solids removal tests.

2. Hook up all connecting lines and test for leaks.

3. Close the small filter and lock it.

4. Make up a dilute mixture pre-coat material or fly ash in the pre-coat tank. A solution of about 1,000 mg/l will suffice. An adequate amount of this material is fed to the filter to form a pre-coat under a pressure of 90 psig. The gas cylinder is used to pressurize the pre-coat tank to 90 psig. and then the tank is emptied to the filter. This pre-coat cycle will only last a few seconds.

5. Add the proper mixture of sediments and conditioner in the feed tank and thoroughly mix. If fly ash is used, the ratio will be about one part fly ash for each part of suspended solids on a dry weight basis. Sludges with relatively low suspended solids levels may require more fly ash, while concentrated, thickened sludges may take less than a 1:1 ratio for dewatering. Close the tank and pressurize with the gas cylinder to 230 psig. As soon as the pre-coat cycle is complete, the sludge-conditioner mass should be fed immediately to the filter. The feed to the filter will continue for varying lengths of time depending on the solids concentration, type and quantity of conditioner, and nature of filter media.

6. Collect the filtrate for chemical analysis (parameters listed in Table 4-1 of SDWTDI WP).

7. The cycle is assumed to be complete when the filtrate begins to drip rather slowly.

8. At the end of the cycle, measure the moisture content of the cake and send filtrate for analyses.

9. Repeat the filter cycle at different conditioner doses according to the results of the Buchner funnel tests. Follow steps 2 through 8.

The above procedure can be used with the bench scale filter apparatus or bench top model filter press.

The above test procedures will be used on the sediment samples, as well as the sludges generated from metals and suspended solids removal testing. If sufficient quantity of sludge is not generated, a treatability test sample will be prepared. In addition, a run will be made using treatability Sample No. TS-4 to evaluate dewatering of a dredged type slurry material.

The use of filter aids will also be evaluated during these tests.

1.5.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all phases of testing will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details, if necessary.

1.5.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other treatability testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

2.0 WASTEWATER TREATABILITY

2.1 PRECIPITATION TEST PROTOCOL

Metals removal will be evaluated using jar tests. The primary objective of these tests is to determine the feasibility of efficient removal of metals in order to comply with discharge limits. Precipitation will be performed with and without the use of coagulant aids (polymers).

The details of the metals precipitation test depends on the metals characterization of each of the water sources that makes up the remediation water. After reviewing the analytical results from the current sampling, the details of the test as well as the composition of the water sample used in the precipitation test may be revised.

Currently, we anticipate that the precipitation test protocol will be conducted using a composite of drain water and water mixed with sediments, which is anticipated as the water having the highest metals concentrations.

2.1.1 Description

The bench scale treatability study to investigate the precipitation of metals will be conducted using jar tests. Slaked lime ($Ca(OH)_2$), caustic soda ($NaOH$), a chelating polymer (i.e., TMT-15 or other), and sodium sulfide (Na_2S) will be used separately at pH values ranging from 7 to 12. The jar test will be conducted in two-liter beakers using a four unit laboratory stirrer to mix the samples. The test parameters for the precipitation studies are provided in Table B2-1.

During the performance of the bench scale metals precipitation study, if it is believed that a set of conditions provided (e.g., pH range, reaction times, settling times) do not adequately determine the effectiveness of metals precipitation, the test conditions may be modified to examine additional pH levels, alkaline materials, additional technologies, and/or other variables. An indication of ineffectiveness would be no formation of precipitate or poor settling. Any changes from this Work Plan will be noted in the SDWTDI Report. Justification for revising the Work Plan will also be provided in the Report.

2.1.2 Experimental Procedures

The following is a recommended approach to the bench scale procedures for conducting the precipitation test:

1. Define and record planned experiment in the data book (include pH, reagent dosage, reaction times, etc.).

2. Collect sample of untreated water for baseline analysis.

3. Set up four-unit variable speed laboratory stirrer with four 2-liter beakers.

4. For each reagent, determine approximate minimum dosage for which a floc will be formed. Add reagent in 1 ml increments to 200 ml of water sample and slowly stir until first evidence of a floc is observed.

5. Prepare neutralization curve for the water sample and quantify the acidity or alkalinity of the reagents. This will facilitate subsequent pH adjustment.

6. Add 1.5 liters of water to each beaker.

7. Prepare reagent solutions for addition to the sample beakers. For the lime, make a 10 percent slurry by weight. For the caustic soda, make a 1N solution. The lime slurry will need to be agitated to assure that settling does not occur and interfere with the measurement of lime addition rate. Sodium sulfide should be prepared as a 2.0 percent solution.

8. Add reagents to the beakers and immediately start the flash-mix step, which should be done at 120 rpm for 2 minutes.

9. Reduce agitator speed to 30 rpm for the reaction/precipitation step. This will be done for 15 minutes. If small or pin floc forms, add 1 mg/l to 5 mg/l of polymer, or other chemical flocculent in order to enhance floc formation.

10. Measure the pH at the beginning and at 3-minute intervals for the 15 minute test in order to verify that the pH has stabilized.

11. Discontinue mixing and allow samples to settle for approximately 1 hour or until it appears that all precipitate has settled.

12. Following settling, the supernatant from each beaker will be divided into two equal volumes. The first volume will be collected and analyzed for total metals (unfiltered). The second volume will be filtered through a 0.45-micron filter and analyzed for dissolved metals (filtered).

13. The sludge resulting from the precipitation sedimentation steps will be collected and measured for both volume and weight (dry and wet).

14. Upon completion of the test, wash beakers and other equipment which came in contact with the water samples with detergent (Liquinox® or equivalent) solution and rinse with hot tap water followed by distilled water.

15. Repeat steps 1 through 13 for caustic soda for reaction/precipitation time of 15 minutes.

16. Repeat steps 1 through 13 for chelating polymer (i.e., TMT-15 or other) for reaction/precipitation time of 15 minutes.

17. Repeat steps 1 through 13 for sodium sulfide for reaction/precipitation time of 15 minutes.

18. Following completion of the tests outlined in Table B2-1, evaluate the results of tests for effectiveness in reducing total and dissolved metals.

19. Select the test conditions with the lowest pH and the lowest reaction time that provided acceptable metals reduction for the lime, sulfide, chelating polymer, and caustic soda reagents.

20. Rerun the tests following the conditions selected in step 19. Following the reaction time (15 minutes) allow the water samples to settle for 30 minutes, collecting grab samples at 10, 20, and 30 minutes for metals analyses (total and soluble). The interface level should be noted every 2 minutes for the first 10 minutes and then every 10 minutes thereafter. Sludge samples will also be collected after the 30-minute settling time for lime, caustic soda, chelating polymer, and sulfide tests.

21. At the end of 30 minutes settling, a sample of the supernatant should be taken for analysis as described in Table B2-2.

22. Two-Stage Test: Depending on the number of heavy metals present, it may be necessary to perform additional tests in series at different pH values. The need for this additional testing will be based on the results from the previous tests. The same basic procedures will be used except that the water being tested will be treated at one pH, decanted and treated again at the second pH.

23. Rerun the test using other treatability test samples to confirm applicability for these samples.

24. A sample of sludge from one of the final runs for TS-2 should be taken for analysis as described in Table B2-2.

2.1.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all phases of testing will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details, if necessary. The effectiveness of metals removal by precipitation will be evaluated by comparison of results before and after chemical precipitation for overall reduction in parameter concentrations. Samples from one of the final runs will be sent to an independent approved analytical laboratory for full analysis as described in Table 4-1 of the SDWTDI Work Plan. The samples will be preserved and shipped on ice according to the recommendations of the lab.

2.1.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other treatability testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

2.2 SUSPENDED SOLIDS REMOVAL TEST PROTOCOL

Removal of suspended solids will be evaluated using jar tests. The primary objective of these tests is to identify a number of polymers that will facilitate the efficient removal of suspended solids via coagulation/clarification. Therefore, the test will be initially run on water that has not undergone any other treatment (i.e., precipitation). Since it was highly desirable to minimize the amount of sludge formed, metal salts such as aluminum sulfate and ferric chloride will not be evaluated. However, if a suitable polymer cannot be found, the settleability test will be expanded to include these chemicals. Various types of polymers will be evaluated at various dosages and combinations. Evaluation criteria include an analysis of the supernatant liquor for suspended solids as well as a determination of the sludge settling rates and sludge characteristics. The suspended solids removal test protocol will be conducted initially on treatability sample No. TS-2.

2.2.1 Description

Multiple jar testing apparatus with stirrers or approved equal will be used for jar testing. Testing will be done using Mallory direct reading settleometers. A vacuum filter funnel with Whatman's filter paper will be used for sludge collection. If temperature fluctuations are experienced, a constant temperature bath will be used to house the jars. To aid in determination of the settling rate, the jars will be illuminated from either the bottom or the rear by fluorescent lighting as required.

2.2.2 Experimental Procedures

The following is a recommended phased approach to the bench scale procedures for conducting the suspended solids removal tests.

I. Initial Screening

A. Polymers

1. Cationic Polymer - 3 different types (as primary coagulant)

2. Non Ionic Polymer - 3 different types (as primary coagulant and/or coagulant aid)

3. Anionic Polymers - 3 different types (as coagulant aid)

B. Screening Tests

1. For each polymer, try four dosages as recommended by supplier in simultaneous tests using multiple jar test apparatus.

2. 200-ml minimum test sample is required.

3. Adjust pH per polymer manufacturer's recommendation for each polymer.

4. Flash mix for two minutes.

5. Add coagulant aid (if used).

6. Slow mix for 20 minutes.

7. Allow to settle for one hour while qualitatively observing settleability characteristics over the hour period (feed, floc formation, quality, speed at which interface appears to drop, etc.).

8. Record supernatant turbidity, and amount and rate of sludge produced.

9. Based on results in steps 7 and 8, select best five polymers for further testing. Additional polymers and/or dosages may be screened in order to identify three good candidates for further testing.

II. Polymer Testing - Second Round

1. Each polymer identified in the initial screening will again be tested separately.

2. Prepare 1-liter aliquots of sample. Add selected polymer to the samples at dosages of 0.5 mg, 1 mg, 5 mg, and 10 mg/liter. (Actual dosages to be selected based on initial tests.) Stir rapidly using an up and down motion for two minutes; add coagulant aid (if used); then stir slowly for 20 minutes.

3. Allow to settle for one hour. Note solids interface levels every minute for the first 15 minutes, every five minutes thereafter until 30 minutes and then every 10 minutes. The final volume of settled sludge should be recorded.

4. Decant off supernatant after collecting a 350 ml sample for analysis (TSS and turbidity).

5. Measure settled sludge weight. Determine specific gravity of sludge.

6. Filter an aliquot of sludge from each test and record wet and oven-dried sludge weights.

III. Final Testing

1. Select the best four polymer/dosage combinations from second round (based on settling rate and supernatant quality). Testing will be done using 2-liter samples in greater than two liter jar.

2. Rerun test using same procedure. Also run against test with no polymer (base case). The settling velocity test described in Section 2.3 of this Appendix should be performed only if an interface does not form for any sample.

3. Withdraw 25 ml of supernatant at a minimum of 20 cm from water surface after 5, 10, and 30 minutes of settling.

4. After settling, the supernatant liquor will be vacuum-filtered through an appropriate sized Whatman's filter paper in a Buchner funnel.

5. One sample of the supernatant liquor will be sent to the lab for water analyses listed in Table 4-1 of the SDWTDI Work Plan.

2.2.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all phases of testing will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details, if necessary. Qualitative visual observations of sludge settling rate during the jar testing will indicate the dosage of coagulant or flocculent. Samples from one of the final runs will be sent to an independent approved analytical laboratory for full analyses as described in Table 4-1 of the SDWTDI Work Plan. The samples will be preserved and shipped on ice according to the recommendations of the lab.

2.2.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by products will be packaged accordingly and disposed according to appropriate regulatory protocol.

2.3 SETTLING VELOCITY TEST PROTOCOL

2.3.1 Description

The settling velocity tests will be performed in conjunction with the precipitation and suspended solids removal jar tests. This test will be performed on samples where a noticeable solids interface does not form. The primary objective of the tests is to determine a settling velocity as a function of solids remaining.

2.3.2 Experimental Procedures

The following is a recommended procedure for the settling velocity test:

1. Add the reagent chemicals being tested with the jar test procedures described previously using two liter volume of sample.

2. Withdraw samples (a minimum of 25 ml) from a fixed depth of 20 cm below the liquid surface in graduated cylinders. Samples shall be withdrawn at 1, 4, 8, and 16 minutes after the slow mix step has been completed (settling times may be extended if necessary). This can be done using a pipette tube with a clamp. The end of the tube inside the jar shall be set horizontally at the desired depth. The tube should be purged of waste before collecting the samples.

3. Analyze the samples for TSS and turbidity.

4. Calculate % TSS remaining by the following formula (for each sample):

$$\% \ TSS \ remaining = \frac{sample \ TSS}{Initial \ TSS} \ x \ (100)$$

5. Convert each sample time to settling velocity:

$$Settling/velocity \ (cm/\text{min}) = \frac{depth \ of \ sample \ point \ (cm)}{sample \ collection \ time \ (\text{min})}$$

6. Plot Percent TSS Remaining vs. corresponding settling velocity on log-log paper.

2.3.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all phases of testing will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details, if necessary.

2.3.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the treatability study will be decontaminated using an appropriate cleaning solution. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by-products will be packaged accordingly and disposed according to appropriate regulatory protocol.

2.4 GRANULAR ACTIVATED CARBON (GAC) TEST PROTOCOL

Organics treatment of remediation waters and aqueous wastes may involve carbon adsorption. Therefore, screening tests will be performed to evaluate effectiveness of GAC for the removal of organic contaminants from the remediation waters and wastes. Carbon adsorption will be evaluated using the Calgon Carbon Accelerated Column Test (ACT).

2.4.1 Description

The ACT uses a miniature carbon-filled column to rapidly simulate the adsorption breakthrough curve that would be obtained by treating an aqueous stream in a large carbon adsorption system. Calgon's ACT will be performed using a liquid reservoir, a pump, and a carbon column as shown in Figure B2-1.

The length of the column is approximately 6 inches with a diameter of 1/4 inch. The exact physical dimensions of the column may vary depending on the operation design parameters of the application, such as contact time requirements and/or full-scale system simulation.

The types of carbon that will be tested are reactivated and virgin carbon. The size of the absorber vessel in an ACT is small, which does not allow for solids in the influent stream. Therefore, particulate filtration may be required as a pretreatment step to conduct the ACT.

2.4.2 Experimental Procedures

ACT will be performed on a combination of several water and aqueous waste types. A sample volume of 15 gallons is required for each test. The flow rate will be 2 gpm/ft^2 for each test. This simulation and contact time of the ACT will be determined by the characterization and discharge requirements of the water.

To predict the volume and time breakthrough curve for the full-scale absorber, the ACT results will be multiplied by the volume scale factor determined for each carbon type. The scaling factors for sizing the full-scale absorbers from the ACT column data are proprietary and based on the chemistry of adsorption on activated carbon. Calgon will provide the experimental procedure and equipment specifications from the testing.

2.4.3 Process Data Requirements, Sampling and Analysis

Detailed observations and record keeping for all phases of testing will be performed to enable a thorough evaluation of the testing results and allow for clarification of any process details, in necessary. To evaluate carbon breakthrough, Calgon shall perform analytical methods for the indicator/target compounds. The tests shall continue beyond breakthrough of indicator/target compounds. Prior to and after all testing, samples will be sent to an independent approved analytical laboratory for full analysis as described on Table 4-1 in the SDWTDI Work Plan.

2.4.4 System Decontamination and Residual Management

In order to minimize the risk of human exposure to hazardous substances, equipment and supplies used in the bench scale study will be decontaminated using an appropriate cleaning solution. The small amount of spent carbon generated during the ACT will be sent to Calgon Carbon's Neville Island, Pennsylvania, reactivation facility. Wash water and decontamination equipment will be placed in containers, properly labeled, and disposed. Other testing residuals and by-product will also be package accordingly and disposed according to appropriate regulatory protocol.

TABLES
APPENDIX B

TABLE B2-1

TEST PARAMETERS - METALS PRECIPITATION
BENCH-SCALE TESTING

Test No. Values*	Alkaline Material	Reaction Time (Minutes)	pH
1	Lime ($Ca(OH_2)$)	15	8 9 10 11 12
2	Caustic Soda ($NaOH$)	15	8 9 10 11 12
3	Chelating Polymers (i.e., TMT-15 or other)		10
4	Sodium Sulfide (Na_2S)	15	6 7

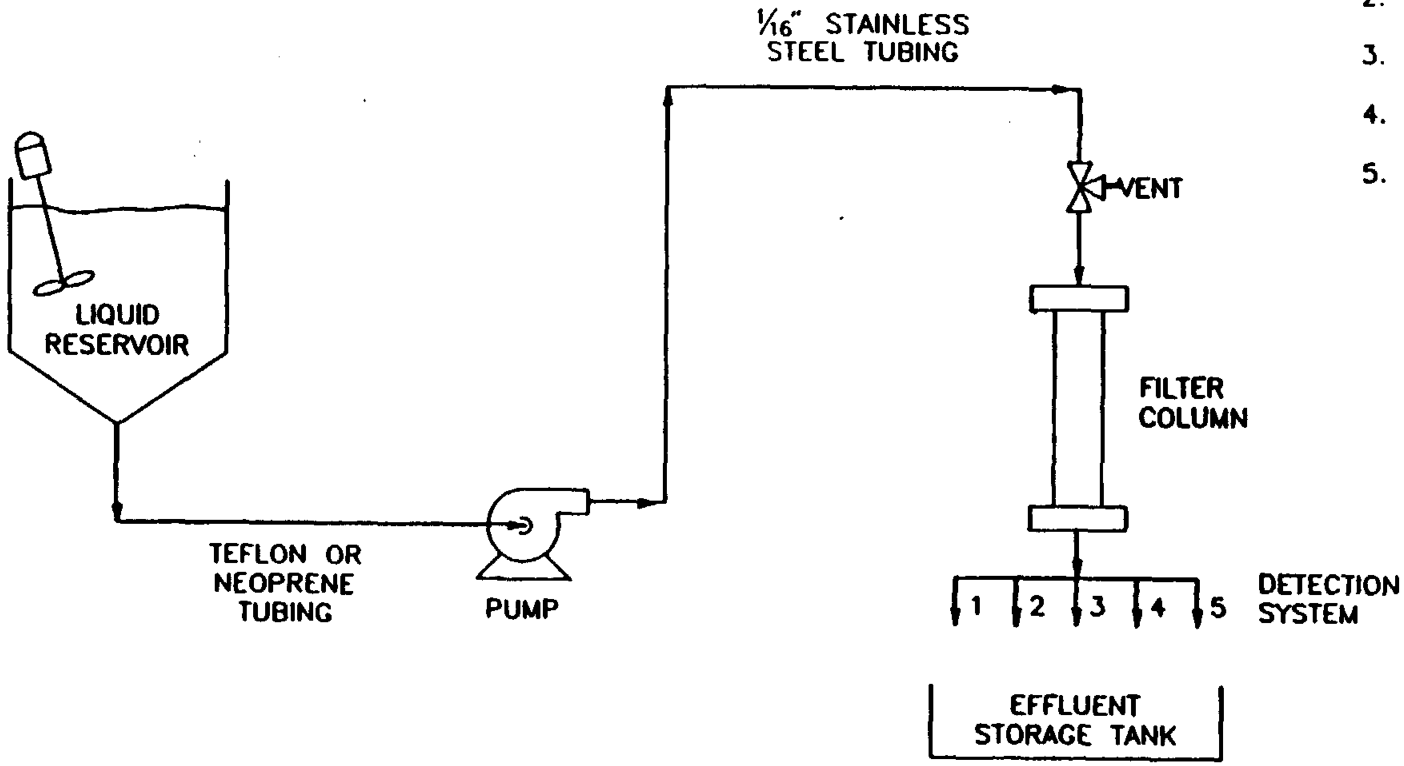
* Plus or minus 0.1 pH unit.

TABLE B2-2

BY-PRODUCT TESTING PARAMETERS

Sample Matrix	Parameter
Sludge	Volume Moisture Content TCLP volatiles TCLP semi-volatiles TCLP metals
Supernatant	TDS TSS pH Turbidity

FIGURES
APPENDIX B



LEGEND

1. UV CONTINUOUS MONITORING
2. TOC LOW LEVEL
3. TOC HIGH LEVEL
4. GC FLAME IONIZATION
5. GC ELECTRON CAPTURE

ACAD) C:\86C3609\E269\E269-B2R
VWPLOT3 s=1=1

Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

FIELDS BROOK
CARBON ACCELERATED COLUMN
TEST EQUIPMENT SCHEMATIC

DESIGN:	ER	CHK'D	JCW	PROJECT NO.	FIG. NO.
DRAWN:	LM	DATE:	7/6/93	86C3609N	B2-1