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Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL: FINAL SITEWIDE EXCAVATION PLAN, CHANGE PAGES TO AREA 1, PHASE I CERTIFICATION REPORT, FINAL AREA 2, PHASE I INTEGRATED REMEDIAL DESIGN PACKAGE, AND DRAFT CERTIFICATION REPORT FOR AREA 8, PHASE I

The purpose of this letter is to transmit, for your review and approval, the following Soils Remediation documents and reports:

- Final Sitewide Excavation Plan
- Change Pages finalizing the Area 1, Phase I Certification Report
- Final Area 2, Phase I Integrated Remedial Design Package including a draft comment response package addressing comments received on the characterization addendum (final construction drawings will be submitted by August 14, 1998).
- Draft Certification Report for Area 8, Phase I

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If you should have any questions or comments, please contact Robert Janke at (513) 648-3124.

Sincerely,

Johnny Reising

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Johnny W. Reising
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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

AREA 2, PHASE I
SOUTHERN WASTE UNITS IMPLEMENTATION PLAN
FOR OPERABLE UNIT 2

INFORMATION
ONLY

JULY 1998

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

2502-WP-0029
REVISION 0
FINAL

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

AREA 2, PHASE I
SOUTHERN WASTE UNITS IMPLEMENTATION PLAN
FOR OPERABLE UNIT 2

JULY 1998

INFORMATION ONLY

U.S. DEPARTMENT OF ENERGY
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TABLE OF CONTENTS

Executive Summary ES-1
References R-1
List of Figures vi
List of Tables vi
List of Acronyms vii

1.0 Introduction 1-1
1.1 Scope and General Approach of the Implementation Plan 1-2
1.2 Background and Description of the Remediation Area 1-5
1.2.1 Waste Units 1-5
1.2.1.1 Inactive Flyash Pile 1-5
1.2.1.2 South Field 1-6
1.2.1.3 Active Flyash Pile 1-7
1.2.1.4 Implications to Remediation Activities 1-8
1.2.2 Excavation Priorities 1-8
1.2.2.1 Locations with Contamination Above OSDF WAC 1-9
1.2.2.2 Potentially Characteristically Hazardous Areas 1-9
1.2.2.3 Special Materials 1-9
1.2.3 Stock Piles Nos. 5 and 7 1-9
1.3 Summary of Regulatory Drivers 1-10
1.3.1 ARARs and TBCs 1-11
1.3.2 Permits 1-11
1.3.3 Natural Resource Trusteeship 1-11
1.4 Components of the Remedy 1-13
1.5 Lessons Learned 1-15
1.5.1 A1PI Lessons Learned 1-15
1.5.2 A2PI Site Preparation Lessons Learned 1-16
1.5.3 Lessons Learned Summary 1-16

2.0 Predesign Investigations 2-1
2.1 Summary of RI/FS and Predesign Investigations 2-1
2.1.1 RI/FS Data Review 2-1
2.1.2 Additional Sampling/Measurements 2-3
2.1.3 Sampling and Analysis in Stock Pile No. 5 2-3
2.2 Identification of Excavation ASCOCS 2-4
2.3 Summary of Surface and Subsurface Conditions 2-4
2.3.1 Surface Coverage and Drainage Pattern 2-4
2.3.2 Soil Stratigraphy and Geotechnical Properties 2-5
2.3.3 Perched Groundwater Zone 2-5
2.3.4 At- and Below-Grade Structures and Debris 2-6
2.3.5 Groundwater Monitoring Wells 2-6
2.4 Anticipated Excavation Boundaries 2-7

2.4.1 Above-WAC Material 2-7
2.4.2 Potentially Characteristically Hazardous Areas 2-7
2.4.3 Fill/Above FRL Material 2-7

3.0 Remedial Action Approach 3-1
3.1 Site Preparation 3-2
3.1.1 Establishing Site Boundaries and Controls 3-3
3.1.2 Surveying and Site Layout 3-3
3.1.3 Establishing the Support Area 3-3
3.1.4 Clearing 3-3
3.1.5 Tie-In of Utility Hookups 3-4
3.1.6 Installation of Equipment Wash Facility 3-5
3.1.7 Installation of Surface Water Management System 3-5
3.1.7.1 Overall Approach 3-5
3.1.7.2 Existing FEMP Facilities 3-6
3.1.7.3 Diversion Ditches and Related Devices 3-6
3.1.7.4 Excavation Sumps 3-7
3.1.7.5 Collection Ditches 3-7
3.1.7.6 Retention Basins 3-7
3.1.7.7 Other Erosion and Sediment Control Devices 3-9
3.1.8 Monitoring Well Abandonment/Protection 3-10
3.1.9 Construction/Relocation of Stockpiles 3-10
3.1.10 Installation of Treatment and Discharge Lines 3-11
3.2 At- and Below-Grade Structure Demolition 3-11
3.3 Soil Excavation and Segregation 3-12
3.3.1 Excavation Sequence and Prioritization 3-13
3.3.2 General Excavation Approach 3-14
3.3.2.1 Grinding of Stumps 3-15
3.3.2.2 Prioritized Excavation 3-15
3.3.2.3 Excavation of Below-WAC Material 3-18
3.3.2.4 Excavation of Debris 3-18
3.3.2.5 Excavation of Special Materials 3-19
3.3.2.6 Control of Surface Water 3-20
3.3.2.7 Monitoring Well Abandonment/Protection 3-21
3.3.3 Transportation and Disposition of Impacted Material 3-22
3.3.3.1 Impacted Material Haul Road 3-22
3.3.3.2 Equipment Wash Facility 3-23
3.3.4 Excavation Control Monitoring 3-23
3.3.4.1 Material with Contaminant Levels Exceeding the OSDF WAC 3-24
3.3.4.2 Lead-Contaminated Soil 3-25
3.3.4.3 Below-WAC Material 3-25
3.3.4.4 Special Materials 3-26
3.3.5 Miscellaneous Excavation Requirements 3-26
3.3.6 Excavating Material from Stock Pile No. 5 3-27

000006

3.4 Material Handling and Treatment 3-28
3.4.1 General Requirements and Objectives 3-28
3.4.2 WAC Attainment 3-29
3.4.2.1 Attainment of OSDF WAC 3-29
3.4.2.2 Special Material Not Meeting OSDF WAC 3-30
3.4.3 Lead Contaminated Material 3-31
3.5 Precertification and Certification 3-31
3.5.1 A2PI Waste Unit Areas 3-32
3.5.2 A2PI Non-Waste Unit Areas 3-33
3.6 Interim Restoration 3-34
3.6.1 A2PI Waste Unit Areas 3-34
3.6.2 A2PI Non-Waste Unit Areas 3-35
3.7 Institutional Controls 3-36

4.0 Project-Specific Environmental Controls and Monitoring 4-1
4.1 Natural Resource Impacts 4-1
4.1.1 Control Mechanisms 4-1
4.1.2 Monitoring 4-2
4.2 Air Pathway 4-2
4.2.1 Noise 4-3
4.2.1.1 Control Mechanisms 4-3
4.2.1.2 Monitoring 4-3
4.2.2 Fugitive Emissions 4-4
4.2.2.1 Control Mechanisms 4-4
4.2.2.2 Monitoring 4-6
4.2.3 Airborne Radiological Particulates 4-7
4.2.3.1 Control Mechanisms 4-7
4.2.3.2 Monitoring 4-7
4.2.4 Radon 4-8
4.2.4.1 Control Mechanisms 4-8
4.2.4.2 Monitoring 4-8
4.2.5 Direct Radiation 4-8
4.2.5.1 Control Mechanisms 4-8
4.2.5.2 Monitoring 4-8
4.3 Surface Water Pathway 4-9
4.3.1 Control Mechanisms 4-9
4.3.2 Inspection 4-10
4.4 Groundwater Pathway 4-12
4.4.1 Control Mechanisms 4-12
4.4.2 Monitoring 4-13

5.0 Project-Specific Health and Safety 5-1

6.0 Remedial Action Management Strategy 6-1
6.1 Organization and Responsibilities 6-1
6.1.1 Management 6-2
6.1.1.1 SCEP Project Director 6-2
6.1.1.2 Area Project Manager and A2PI Construction Manager 6-3
6.1.1.3 Administration Support 6-4
6.1.1.4 Project Controls 6-5
6.1.2 Primary Technical Areas 6-5
6.1.2.1 Engineering 6-6
6.1.2.2 Construction 6-6
6.1.2.3 Characterization 6-8
6.1.3 Functional Support 6-8
6.1.3.1 Safety and Health 6-8
6.1.3.2 Radiological Control 6-9
6.1.3.3 Environmental Compliance 6-9
6.1.3.4 Quality Assurance 6-9
6.1.3.5 Sampling 6-10
6.1.3.6 Waste Management 6-10
6.1.3.7 Natural Resources 6-10
6.1.3.8 Cultural Resources 6-11
6.1.4 Coordination of Excavation Site Activities 6-11
6.1.4.2 Typical Field Team 6-13
6.1.4.3 Management of Field Personnel 6-14
6.2 Configuration Management 6-14
6.3 Contractor Procurement and Award Strategy 6-15
6.3.1 IFB for Site Preparation 6-15
6.3.2 RFP for Excavation 6-16
6.3.3 Equipment and Material Procurement 6-16
6.4 Contractor Management 6-16
6.4.1 Status Meetings 6-17
6.4.2 Surveillance and Inspection 6-17
6.4.3 Health and Safety Oversight 6-17
6.4.4 Radiological Monitoring and Oversight 6-18
6.5 Impacted Material Management 6-18
6.5.1 Waste Planning 6-18
6.5.2 Waste Stream Excavation 6-19
6.5.3 Waste Stream Staging, Treatment, and Disposal 6-19
6.6 Contingency Management 6-21
6.7 Record Keeping and Data Management 6-21
6.8 QA/QC and Regulatory Audit 6-21
6.9 Integration of A2PI Excavation with Other FEMP Activities 6-22
6.10 Schedule 6-24

000008

Appendix A Design Criteria Package
Appendix B Surface Water Management Plan
Appendix C Earthwork Calculations
Appendix D Area 2, Phase I Predesign Data Summary

LIST OF TABLES

Table 2-1 Summary of Contaminants Pertinent to Excavation in Area 2, Phase I
Table 3-1 Status of A2PI Groundwater Monitoring Wells
Table 4-1 Constituents which will be Analyzed in the South Field Extraction System Monitoring Wells
Table 4-2 Groundwater Monitoring Wells for Remediation Area 2, Phase I
Table 6-1 Impacted Material Waste Streams
Table 6-2 Material Segregation Protocols
Table 6-3 Protocols for Special Material
Table 6-4 Area 2, Phase I Records
Table 6-5 Area 2, Phase I Implementation Schedule

LIST OF FIGURES

Figure 1-1 Location Map of Remediation Area
Figure 1-2 Location Map of Area 2, Phase I
Figure 1-3 Wetlands in Area 2
Figure 3-1 SWUs Prior to Excavation (May 1998)
Figure 3-2 Development of Excavation Design
Figure 3-3 SWUs After First Year of Excavation (December 1998)
Figure 3-4 SWUs After Second Year of Excavation (December 1999)
Figure 3-5 SWUs After Completion of Excavation (December 2000)
Figure 3-6 General Excavation on Top of Above-WAC Material
Figure 3-7 Above-WAC Excavation Approach
Figure 3-8 Excavation of Lead Contaminated Soil
Figure 3-9 Typical Excavation Approach
Figure 3-10 Excavation Sequencing
Figure 3-11 A2PI Certification Boundaries
Figure 3-12 SWU Restoration Plan
Figure 6-1 Area 2, Phase I Project Organization During Investigation, Design and Certification Phases
Figure 6-2 Area 2, Phase I Project Organization During Construction Phase

000010

ACRONYMS AND ABBREVIATIONS

A/E	Architect/Engineer
A1PI	Area 1, Phase I
A2PI	Area 2, Phase I
ACA	Amended Consent Agreement
ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
APM	Area Project Manager
ARARs	applicable or relevant and appropriate requirements
ASL	analytical support level
ASCOC	area-specific contaminants of concern
AWAC	above waste acceptance criteria
AWWT	Advanced Wastewater Treatment (Facility)
BAT	best available technology
BWAC	below waste acceptance criteria
CAM	cost account manager
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIS	Characterization Investigation Study
CM	Construction Manager
COC	constituent of concern
COM	contract order monitor
CP	change proposal
CU	certification unit
DCN	design change notice
DOE	U.S. Department of Energy
DOE-FEMP	U.S. Department of Energy - Fernald Area Office
DOT	Department of Transportation
DQO	data quality objective
EC	Environmental Compliance
ECDC	Engineering/Construction Document Control
EDwg	Excavation Construction Drawing
EPA	U.S. Environmental Protection Agency
ESpec	Excavation Construction Specification
FAR	Federal Acquisition Requirements
FDF	Fluor Daniel Fernald, Inc.
FEMP	Fernald Environmental Management Project
FRLs	final remediation levels
FS	Feasibility Study
FTL	field tracking log
GIS	Geographic Information System
HPGe	high purity germanium detector
ICD	Interface Control Document

ACRONYMS AND ABBREVIATIONS
(continued)

IEMP	Integrated Environmental Monitoring Program
IFB	Invitation for Bid
IIMS	Integrated Information Management System
IMPTSAP	Impacted Materials Prototype Sampling and Analysis Plan
IMPP	Impacted Materials Placement Plan
IRDP	Integrated Remedial Design Package
MP	mobile and persistent
MTL	material tracking location
NPDES	National Pollutant Discharge Elimination System
NRRP	Natural Resource Restoration Plan
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OSHA	Occupational Safety and Health Administration
PEP	Project Execution Plan
PSHSRM	Project-Specific Health and Safety Requirements Matrix
PSP	Project-Specific Plan
PWID	Project Waste Identification and Disposition
QA	quality assurance
QAPP	SEP Quality Assurance Project Plan
QC	quality control
RA	remedial action
RCI	Request for Clarification of Information
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RFP	request for proposal
RI	remedial investigation
ROD	Record of Decision
RSS	Radiological Scanning System
RTRAK	Real Time Radiation Tracking System
S&H	Safety and Health
SCEP	Soil Characterization and Excavation Project
SCQ	Sitewide CERCLA Quality Assurance Project Plan
SED	Sitewide Environmental Database
SEP	Sitewide Excavation Plan
SFES	South Field Extraction System
SOP	Standard Operating Procedure
SPDwg	Site Preparation Construction Drawing
SPSpec	Site Preparation Technical Specification
SWIFTS	Sitewide Waste Information Forecasting and Tracking System
SWPPP	Stormwater Pollution Prevention Plan
SWRB	Stormwater Retention Basin

000012

EXECUTIVE SUMMARY

This Implementation Plan describes the specific activities the U.S. Department of Energy (DOE) intends to execute to remediate soils, perched groundwater, and debris in Area 2 Phase I (A2PI) at the Fernald Environmental Management Project (FEMP). The A2PI area consists of the Inactive Flyash Pile, South Field, and Active Flyash Pile, collectively known as the Southern Waste Units (SWUs) and part of Operable Unit 2, as well as adjacent peripheral areas that are part of Operable Unit 5.

This Implementation Plan describes the area-specific remedial design/remedial action process steps discussed in the Sitewide Excavation Plan (i.e., predesign investigations, remedial design, remedial action, precertification, and interim restoration activities). Certification and final restoration are addressed in this in a general manner; they will be performed after remediation and will be addressed in detail in future documents.

Remedial action in A2PI will be performed in phases by separate contractors: site preparation and excavation. The site preparation phase will consist of all work necessary to prepare the site for excavation. This includes construction of a storm water management system to segregate runoff from A2PI from adjacent areas to prevent contamination and recontamination. The excavation phase will include excavation and treatment/disposition of impacted material from within the waste unit areas of A2PI. The excavation phase will be staged to address the most contaminated areas first and accommodate funding constraints. The current plan is to remediate the Inactive Flyash Pile in the first year of the excavation contract, the Active Flyash Pile and part of the South Field in the second year, and the remainder of the South Field in the third year. Seasonal protection for the winter shutdown period and temporary seeding for disturbed areas that sit idle for more than 45 days are included in both the site preparation and excavation contracts. Construction drawings and technical specifications have been prepared for each phase. The construction drawings and technical specifications for the excavation phase are included with this Implementation Plan as part of the Integrated Remedial Design Package.

Remediation of non-waste unit areas within A2PI will be performed subsequent to the excavation phase, following certification of the remediated waste unit areas.

The remedial action requirements described in the construction drawings and technical specifications were developed in accordance with the concepts described in this Implementation Plan, as guided by the OSDF WAC Attainment Plan and the SEP. As the integrating document for the IRDP, the Implementation Plan provides a comprehensive description of planned remediation activities.

The history and use of the SWUs suggest that a wide variety of material and contamination levels will be encountered during remedial action activities. The location of much of this material cannot be identified prior to excavation. Therefore, an integrated approach to excavation and excavation control monitoring will be implemented to assure that special material and material with contamination levels above the waste acceptance criteria (WAC) for the On-Site Disposal Facility (OSDF) are identified, segregated, and properly dispositioned. This integrated approach includes both visual and radiological monitoring during excavation activities.

Material to be excavated from A2PI consists primarily of fill material that was placed into the SWUs during FEMP operations and material with contaminant levels above final remediation levels (FRLs). Excavation and remediation of A2PI is expected to generate approximately 347,000 cubic yards of impacted material. It is anticipated that approximately 342,000 cubic yards of this material will be hauled to and dispositioned in the OSDF, with the remainder dispositioned in permitted off-site commercial disposal facilities.

Material that is not acceptable for placement in the OSDF will be excavated from A2PI on a priority basis. Approximately 4,800 cubic yards of impacted material with total uranium concentrations above the OSDF WAC will be segregated and temporarily staged in the SP-7 Stockpile pending off-site shipment and disposal at a permitted commercial facility. An additional 100 cubic yards (based on predesign data) of lead-contaminated soil is considered mixed waste and will be excavated, containerized, and shipped off site for treatment and disposal. An estimated 200 cubic yards of certain special materials that are prohibited in the OSDF are anticipated and will also be shipped off site for disposal.

Site preparation activities began in August 1997, with issuance of the Notice to Proceed to the site preparation contractor, who mobilized to the site in September 1997. To accommodate this schedule, a draft Site Preparation Plan was submitted to the U.S. Environmental Protection Agency (EPA) and

Ohio Environmental Protection Agency (OEPA) for review in July 1997. The provisions of that document, along with EPA and OEPA comments, have been incorporated into the design drawings, technical specifications, and this Implementation Plan.

This Implementation Plan covers the remediation of all of A2PI, scheduled for completion in early 2002. The excavation contract, however, which will include placement of impacted material in the OSDF, is scheduled to end December 31, 2000. Another contract for operation and construction of the OSDF is scheduled to be awarded in early 2001. Therefore, subcontract support for supplemental excavation that may be required after December 2000, as well as any associated interim grading and restoration, will be performed by another contractor. To the extent practical, interim restoration activities within the A2PI area will take into account final remediation plans, as defined in a future Natural Resources Restoration Plan. Final restoration will be performed in the future under separate contract, depending on the final land use selected for the area, and may involve more than one remediation area. The overall schedule is dependent upon federal funding, regulatory approval, and weather conditions.

1.0 INTRODUCTION

This Implementation Plan describes the activities the U.S. Department of Energy (DOE) intends to execute to remediate Area 2 Phase I (A2PI) at the Fernald Environmental Management Project (FEMP). It details how the general remediation strategies set forth in the Sitewide Excavation Plan [SEP (DOE 1997a)] will be applied to remediation of A2PI.

The FEMP site has been divided into ten areas for remediation of soil and at- and below-grade structures and debris. As shown on Figure 1-1, Location Map of Remediation Areas, the southwestern corner of the FEMP has been identified as Remediation Area 2. The remediation of this area has been separated into three phases to prioritize removal of material that presents the greatest risk to human health and the environment. This Implementation Plan addresses Phase I of Area 2 (Figure 1-2, Location Map of Area 2, Phase I), which consists of the Inactive Flyash Pile, the South Field, and the Active Flyash Pile, collectively known as the Southern Waste Units (SWUs), as well as adjacent peripheral areas that are part of Operable Unit 5. Therefore, the details provided are based on the selected remedies described in both the Operable Unit 2 and Operable Unit 5 Records of Decision [RODs (DOE 1995a, 1996a)].

The SWUs, the Solid Waste Landfill, and the Lime Sludge Ponds comprise the Operable Unit 2 waste units. For remediation purposes, the SWUs have been separated from the Solid Waste Landfill and the Lime Sludge Ponds because of priority of risk (i.e., the SWUs contribute greater risk to human health and the environment due to the magnitude of contamination and close proximity of this contamination to the Great Miami Aquifer), geographical location, activities scheduled for surrounding areas, and drainage patterns associated with excavation sequencing. The Lime Sludge Ponds will be remediated with Remediation Area 3, and the Solid Waste Landfill with Remediation Area 6.

All A2PI excavation activities will be performed in accordance with the A2PI Integrated Remedial Design Package (IRDP). The IRDP consists of the following area- and project-specific documents:

- Implementation Plan and Appendices (this document)
- Construction Drawings and Technical Specifications (excavation phase)
- Construction Drawings and Technical Specifications (site preparation phase).

The remedial action requirements described in the construction drawings and technical specifications were developed in accordance with the concepts described in this Implementation Plan, as guided by the SEP. As the integrating document for the IRDP, the Implementation Plan provides a comprehensive description of planned remediation activities. This will facilitate regulatory agency review and define the scope of work necessary to procure equipment, supplies, and services for implementation of remediation.

Remediation involves strategic planning, preparation of design packages (construction drawings and technical specifications), and detailed remedial action planning. As presented in the Amended Consent Agreement [ACA (EPA 1991)], this remediation process includes preparation of remedial action work plans to cover construction activities and the establishment of an enforceable remedial action schedule. The goals of remedial design and remedial action, and the intent of the ACA, will be addressed through sitewide excavation planning, development of IRDPs, development of the OSDF Impacted Materials Placement Plan [IMPP (DOE 1996b)] and the Waste Acceptance Criteria (WAC) Attainment Plan (DOE 1997b), coordination with other FEMP activities, and remediation/construction activities. This Implementation Plan, as part of the IRDP and in conjunction with the SEP and these documents, fulfills the ACA requirements.

1.1 SCOPE AND GENERAL APPROACH OF THE IMPLEMENTATION PLAN

As shown on Figure 1-1 of the SEP, the area-specific remedial design/remedial action (RD/RA) process involves several steps, including:

- Predesign investigations
- Remedial design
- Remedial action
- Precertification and certification
- Post remediation activities.

This Implementation Plan covers all of these steps except certification and final restoration and follow on post-remediation. As stated in the SEP, a Certification Design Letter will be prepared and submitted to the regulatory agencies following completion of the precertification process. This will provide a summary of the area-specific remediation completed, results of the precertification activities, and design of the certification sampling and analysis program. Following completion of certification

000017

activities and agency approval, interim restoration (Section 3.6) will be completed. Final restoration and follow-on post remediation activities will take place following interim restoration and be guided on a sitewide basis by the final version of the Natural Resource Restoration Plan [NRRP (DOE 1997c)].

Remedial action in A2PI will be completed in two stages, under two separate contracts: site preparation and excavation. Since this work will be completed under separate contracts, the construction drawings and technical specifications portions of the IRDP are also divided into site preparation and excavation packages. To expedite site preparation activities, a draft Site Preparation Plan (DOE 1997d) and site preparation construction drawings and technical specifications were submitted to the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (OEPA) for review in July 1997. The provisions of the draft Site Preparation Plan, along with EPA and OEPA comments, have been integrated into the design drawings, technical specifications, and this Implementation Plan. Only activities necessary to prepare the site for excavation will be performed during site preparation. Material excavated during construction of site preparation facilities will be temporarily stockpiled (Section 3.1.9), used in the construction of temporary facilities associated with site preparation, or, in the case of special materials (Section 3.3.2.5), segregated and dispositioned by site personnel (Section 3.3.3).

The excavation phase involves removal and disposition of impacted material, including that stockpiled during the site preparation phase. Impacted material, for the purposes of this Implementation Plan, consists of all material that was placed in the SWUs as fill material and all non-fill material with contaminant levels above the A2PI final remediation levels (FRLs) for the area-specific constituents of concern (ASCOCs) (Section 2.2). In addition, all sediment collected in ditches and retention basins and on erosion control measures will be considered impacted. Impacted material that does not meet the chemical/radiological WAC for the On-Site Disposal Facility (OSDF) will be shipped off site to a permitted commercial disposal facility for final disposition (Section 3.3.2.2 and 3.4.2.2). Impacted material that does not meet the OSDF physical WAC will be processed to achieve the WAC and dispositioned to the OSDF (Section 3.4.2.1). Impacted material that meets the OSDF chemical, radiological, and physical WAC will be hauled to that facility for disposition (Sections 3.3.2.3 and 3.4.2.1). Impacted material from potentially toxicity characteristic locations specified in the SEP that offers a reasonable site-specific potential for cost-effective treatment will be shipped off site to a permitted commercial disposal facility for treatment and final disposition (Section 3.3.2.2 and 3.4.3).

The excavation phase also includes excavating material from Stock Pile No. 5 (SP-5) to place in the OSDF, thus creating SP-7 which will stage material that does not meet the chemical/radiological WAC for the OSDF (Section 3.3.2.2).

The extent of excavation (Section 2.4) is based on:

- 1952 topographical maps, which show ground level elevations after some disposal activities had taken place
- Soil boring data to supplement the 1952 topographical maps to determine the 1951 (pre-disposal) ground level elevations
- Computer modeling of FRL concentrations using remedial investigation/feasibility study (RI/FS) data supplemented by predesign investigation data (Section 2.1.2).

The excavation grades shown on the construction drawings represent: 1) the original 1951 ground elevations that existed prior to initial waste placement, or 2) the ground elevations required to reach FRLs, as defined in the Operable Unit 2 or 5 ROD, whichever is more stringent (Section 2.2), or 3) the graded slope necessary to drain the area and provide stable slopes. The final excavation extent will be based on actual field conditions, radiological field survey measurements, and physical sampling results.

This Implementation Plan provides the overall framework and strategy for performing the included remediation activities. These remedial action activities are described in more detail in the construction drawings and technical specifications. The specific methods, means, and procedures to accomplish the work will be proposed by the selected contractors and presented in Safe Work Plans subject to review and approval by the contractor selected to manage remediation at the FEMP for DOE. Currently, this contractor is Fluor Daniel Fernald (FDF).

This Implementation Plan consists of the following sections:

- Section 1.0 - Introduction, which summarizes the purpose and scope of this Implementation Plan and describes programmatic strategies and requirements for implementation of this remedial action project.

000019

- Section 2.0 - Predesign Investigations, which describes the ASCOCs for A2PI, the surface and subsurface conditions of the SWUs, the nature and extent of contamination, and the anticipated excavation boundaries based on remedial investigation/feasibility study (RI/FS) data and other data collected to fill data gaps.

- Section 3.0 - Remedial Action Approach, which summarizes the approach that will be used to implement excavation (i.e., site preparation, soil excavation and segregation, excavation control monitoring, material handling and treatment, seasonal protection, interim restoration, and institutional controls).

- Section 4.0 - Project-Specific Environmental Controls and Monitoring, which discusses environmental controls and associated monitoring which will be initiated as part of the remediation of A2PI.

- Section 5.0 - Project-Specific Health and Safety, which summarizes project-specific health and safety requirements and procedures.

- Section 6.0 - Remedial Action Management Strategy, which discusses the strategy for managing remediation activities in A2PI.

1.2 BACKGROUND AND DESCRIPTION OF THE REMEDIATION AREA

This subsection provides a brief discussion of the remediation area, including a description of the waste units and a description of potential priority areas that may be encountered during remediation of A2PI. Also included is a description of Stock Pile No. 5 (SP-5), which will be excavated prior to the SWUs, and SP-7, which will replace SP-5.

1.2.1 Waste Units

As previously mentioned, the SWUs consist of the Inactive Flyash Pile, the South Field, and the Active Flyash Pile. The following is a brief discussion of each waste unit. Detailed descriptions are provided in the Operable Unit 2 RI (DOE 1995b) and FS (DOE 1995c) Reports.

1.2.1.1 Inactive Flyash Pile

The Inactive Flyash Pile is located approximately 2,000 feet southwest of the former production area (Figure 1-2, Location Map of Area 2, Phase I) and immediately west of the South Field. Although there is no well-defined boundary between the Inactive Flyash Pile and the South Field, the Inactive Flyash Pile area is estimated to be 3.4 acres.

Beginning in 1951, the Inactive Flyash Pile received flyash and bottom ash from the on-site coal-fired boiler plant. Materials such as building rubble, concrete, asphalt, rebar, and transite (presumed to contain asbestos) were also discarded in this area and are visible throughout the Inactive Flyash Pile and South Field. Until March 1990, drill cuttings from soil borings outside the former production and waste storage areas, including off-property wells, were disposed of in the Inactive Flyash Pile.

The Inactive Flyash Pile was not an engineered disposal site but was constructed by dumping material off the previously existing erosional terrace face adjacent to Paddys Run. Additional dumping occurred along a haul road constructed along a south-facing embankment, thereby creating a south-facing slope. The Inactive Flyash Pile is bounded on the west by a drainage ditch and a portion of Paddys Run, on the north by an access road, on the south by the former running track/firing range facility, and on the east by the South Field. Once disposal activities were discontinued, portions of the southern part of the Inactive Flyash Pile were covered with soil/fill. A covering of trees and dense brush has grown over the Inactive Flyash Pile.

The Inactive Flyash Pile contains predominantly flyash with up to six feet of silty clay and clay cover in the southern half of the unit. The flyash overlies the till surface existing in 1951; therefore, the topography of the flyash fill/till interface is characterized by erosional features that were cut into the pre-existing till surface prior to 1951. Cross sections of these features are included in the Operable Unit 2 FS (DOE 1995c).

Glacial till is present beneath most of the Inactive Flyash Pile, but thins toward the western and southern boundaries of the unit. Soil borings conducted in the Inactive Flyash Pile area indicate that the thickness of the glacial till ranges from zero in the southernmost portion of the unit to approximately 27 feet on the northern side. The Great Miami Aquifer, consisting of glacial outwash deposits of sand and gravel, underlies the glacial till.

1.2.1.2 South Field

The South Field is located approximately 2,000 feet southwest of the former production area (Figure 1-2), adjacent to the Inactive Flyash Pile, and covers approximately 10 acres. A running track and firing range used by FEMP security personnel were also located in the South Field/Inactive Flyash Pile area. The South Field was not an engineered disposal site. It was used randomly, on an as-needed

basis, resulting in a variable thickness of fill and nature of waste. The South Field was used until the mid-1960s as a disposal site for construction rubble and as a disposal area for soil excavated from the former production area. Soil, building rubble, concrete, asphalt, flyash, and rebar have been encountered during previous sampling activities. Transite panels, presumed to contain asbestos, have also been observed in the South Field area. As discussed in the Operable Unit 2 ROD (DOE 1995a), field investigations indicate process waste may also have been disposed of in the South Field.

An east-west access road borders the northern extent of the South Field. A north-south access road, which leads to the former running track/firing range facility, borders the eastern and southern extent of the South Field. The west side of the South Field borders the Inactive Flyash Pile and running track area. The western South Field border slopes to the west; a portion of the western slope was used as the backstop for the FEMP security firing range for 35 years. The South Field was graded with a covering of clay fill and is now overgrown with grass, brush, and trees.

Boring log data indicate fill material of variable thickness is underlain by glacial till deposits in the South Field/Inactive Flyash Pile area. As with the Inactive Flyash Pile, the Great Miami Aquifer underlies the glacial till. The glacial till is composed primarily of silty clay interbedded with lenses of clay and silt, sandy clay, and sand and gravel. These more granular lithologies (i.e., sand and gravel) are discontinuous and often cannot be correlated laterally between soil borings.

The southern portions of the South Field and Inactive Flyash Pile overlie till ranging in thickness from 0-2 feet, indicating that fill materials at the southern end of the South Field and Inactive Flyash Pile lie directly upon the sand and gravel of the unsaturated Great Miami Aquifer, with a few feet of colluvial material separating them.

1.2.1.3 Active Flyash Pile

The Active Flyash Pile is located approximately 2,000 feet south of the former production area and east of the South Field (Figure 1-2). The Active Flyash Pile covers an area of approximately 2.2 acres.

The Active Flyash Pile is a steep-sided pile of flyash and boiler ash that has been built up since the mid-1960s with dumped and compacted flyash from the coal-fired boiler plant. The Active Flyash Pile is surrounded on the east and south by dense trees and brush, and on the north by a grass field. The

Active Flyash Pile is bounded on the west by a gravel access road that separates it from the South Field. There is a ditch between the Active Flyash Pile and this road. To the north, east, and south, the Active Flyash Pile is bounded by an area that slopes toward the Storm Sewer Outfall Ditch. The Active Flyash Pile is uncovered, but wind barriers and crusting agents have been applied to mitigate wind erosion. Silt barriers and rock berms have been installed to control surface water erosion.

Soil boring data indicate that the Active Flyash Pile was constructed on glacial till materials ranging from less than 2 feet thick (south of the Active Flyash Pile) to 16 feet thick (north of the Active Flyash Pile).

1.2.1.4 Implications to Remediation Activities

The history and use of the SWUs suggest that a wide variety of material and associated contamination levels will be encountered during remedial action activities. Because of the heterogeneity of this material, the specific location of all above-WAC contamination areas and special materials could not be totally identified in the RI/FS or predesign investigations. Therefore, special procedures will be implemented to:

- Ensure that excavated material with contamination levels above the OSDF WAC is identified, segregated, and properly dispositioned (see Sections 3.3 and 3.4)

- Ensure that special material encountered during excavation activities is properly identified (Section 3.3.4), handled, and dispositioned (Section 3.4).

1.2.2 Excavation Priorities

Potential excavation priorities listed in the SEP include locations with contamination levels above the OSDF WAC, hazardous waste management units, underground storage tanks, potentially toxicity characteristic areas, and special materials. In terms of the A2PI remediation project, there are no hazardous waste management units or underground storage tanks. The following paragraphs describe the priorities that are applicable to the remediation of A2PI, including above-WAC material, potentially characteristically hazardous material, and special materials.

000023

1.2.2.1 Locations with Contamination Above OSDF WAC

One area within the Inactive Flyash Pile has been identified as containing total uranium contamination in excess of the OSDF WAC. Four other areas in the SWUs area were identified as potentially containing total uranium/technetium-99 levels in excess of the OSDF WAC. Predesign investigations (Section 2.1.2.2) have been completed to confirm and delineate the extent of contamination in these areas (Section 2.4.1).

1.2.2.2 Potentially Characteristically Hazardous Areas

The former firing range area within A2PI has been identified as containing soil that has the potential to exhibit the toxicity characteristic for lead (40 CFR 261.24). Predesign sampling (Section 2.1.2.3) has been performed to delineate the extent of this contamination (Section 2.4.2).

1.2.2.3 Special Materials

Special materials that have been identified in the SWUs include presumed asbestos containing material (PACM), miscellaneous debris, piping, and non-soil residues. Based on the history and use of the SWUs, these and other types of special materials are expected in the Inactive Flyash Pile and South Field. See Sections 3.3.2.5 and 3.3.4 for further discussion.

1.2.3 Stock Pile Nos. 5 and 7

Stock Pile No. 5 (SP-5) is located north of the former Third Street and the Plant 1 pad in the northwest corner of the former production area and north of the impacted material haul road that connects the SWUs with the OSDF. The stockpile area is approximately 360 feet long (east-west) and 200 feet wide (north-south). The stockpile itself is generally rectangular in shape and all sides are moderately sloped (approximately 4 horizontal:1 vertical); SP-5 is approximately 14 feet high and contains approximately 18,000 cubic yards of material. SP-5 is completely surrounded by a chain link fence; the fence is located near the toe of the pile on the west side and most of the north and south sides. An area approximately 100 feet long (east-west) and 200 feet wide (north-south) on the east side of SP-5 is also enclosed by the fence. All runoff from SP-5 is controlled by the FEMP stormwater management system.

SP-5 was established in the late 1980s to provide a construction staging area for soils and rubble containing less than 150 parts per million total uranium. The stockpile primarily received soil and

construction debris from the following projects during construction: Laboratory Building upgrade, Rotary Kiln, Drum Reconditioning Building, Tank Farm, Derby Slag Area, Plant 1 Pad extension, and Plants 4, 6, and 8 warehouse construction. Soil with rubble was also generated from activities associated with the maintenance of various utilities. The last addition of soil to the pile occurred in 1993.

SP-5 currently consists of two distinct areas: Area 1 and Area 2. Area 1 is the larger west side of the SP-5 and contains approximately 85 to 90 percent of the SP-5 volume. It consists of soil and soil-like material and is expected to be generally classified as OSDF Category 1 material. Area 1 was recently sampled for WAC attainment in accordance with the Project Specific Plan (PSP) described in Appendix D. Area 2 is located at the east end of the stockpile and consists of construction debris (primarily comprised of concrete rubble). This construction debris is classified as an OSDF Category 2 Impacted Material. There has been no recent physical sampling of Area 2 material, however, a visual assessment of the amount, physical characteristics, and type of debris was conducted during the recent sampling of Area 1.

Both Areas 1 and 2 of SP-5 will be excavated as part of the initial excavation work that began in late June 1998. Material from SP-5 that meets the OSDF WAC will be hauled to, and placed in, the OSDF. Material that exceeds the OSDF WAC will remain in the SP-5 Area. After all WAC-compliant material is removed from SP-5, the stockpile will be renamed SP-7 and located in the same area as the former SP-5. SP-7 will be constructed and built with above-WAC material excavated from other parts of the FEMP. The material in SP-7 will be temporarily stockpiled pending off-site disposal. The stockpiles were given different designations because they will operate in different time periods, contain different material, and serve different functions; only the location will remain the same.

1.3 SUMMARY OF REGULATORY DRIVERS

Several regulatory criteria and legal obligations provide the basis for remediation activities within A2PI. These include:

- Applicable or Relevant and Appropriate Requirements (ARARs) or To Be Considered Criteria (TBCs).

000025

- Permits
- Natural Resources Trusteeship.

The pertinence of each of these to the remediation of A2PI is discussed in the following paragraphs.

1.3.1 ARARs and TBCs

The ARARs and TBCs for the A2PI remediation project are presented in the Design Criteria Package (Appendix A).

1.3.2 Permits

Storm water discharges from the A2PI project area during remediation are covered under the existing National Pollution Discharge Elimination System (NPDES) permit (OEPA Permit Number 1IO00004*ED) through the implementation of the permit-required sitewide Storm Water Pollution Prevention Plan (RM-0039). Thus, no modifications to the permit are required as a result of the A2PI remedial action. The A2PI retention basin pumping activity (Section 3.1.7.6) will be acknowledged in the forthcoming 1997 NPDES permit renewal application.

1.3.3 Natural Resource Trusteeship

Two mechanisms drive protection of natural resources during remediation, the natural resource trusteeship process and the pertinent federal and state regulations. Both of these mechanisms have been incorporated into A2PI remedial design.

A conceptual restoration design for A2PI has been presented to the Natural Resource Trustees as part of the NRRP. The proposed restoration (Section 3.6) consists of expanded riparian habitat and restored upland woodlots. The final plan will be implemented after approval by the Natural Resource Trustees.

Regulatory drivers for the management of natural resources and associated monitoring are grouped into three areas: threatened and endangered species protection, wetlands/floodplain protection, and cultural resource management.

Threatened and Endangered Species

Based upon 1993-1994 updated threatened and endangered species surveys at the FEMP, DOE does not expect to encounter any federal- or state-listed threatened or endangered species or critical habitat in A2PI. Therefore, no additional threatened/endangered species surveys have been conducted or have been planned.

Wetlands/Floodplains

Jurisdictional wetlands and waters of the U.S. were delineated in the 1993 FEMP Wetland Delineation, officially approved by the U.S. Army Corps of Engineers on August 19, 1993. Based on a review of an overlay of the A2PI boundary on the 1993 FEMP Jurisdictional Wetland Delineation (Figure 1-3), no jurisdictional wetlands or waters of the U.S. are anticipated to be dredged and filled during excavation of the A2PI remediation area.

A portion of A2PI is located within the 100-year floodplain of Paddys Run. The floodplain elevations of Paddys Run reach the western slope of the Inactive Flyash Pile and the toe of the South Field slope [Site Preparation Construction Drawing (SPDwg) G0003]. Potential impacts will be minimized through the design and implementation of appropriate erosion and sedimentation controls (Section 3.1.7). All of the stormwater retention basin berm elevations have been designed above the elevation of a 10-year flood event in Paddys Run at a minimum. Retention Basin 3 was designed with the capacity to store runoff from a 10-year, 24-hour storm event. Retention Basins 1 and 2 were designed with the capacity to store runoff from the 25-year, 24-hour storm event. No long-term impacts or changes in the elevation of the 100-year flood in Paddys Run are anticipated as a result of A2PI remediation activities. The A2PI remediation activities are authorized by Nationwide Permit #38 (Cleanup of Hazardous and Toxic Waste) under 33 CFR 330.1(c).

Cultural Resource Management

The SWUs have been designated as a disturbed area (DOE 1997e), which means that a Phase I archeological survey is not required, since it is unlikely that any cultural resources are present. All areas in A2PI surrounding the SWUs have been surveyed, and no historic properties have been identified. All cultural resource activities pertaining to A2PI will be conducted in accordance with both a programmatic agreement (DOE 1997e) and the inadvertent discovery of cultural resources provisions of the Native American Graves Protection and Repatriation Act List and 43 CFR Part 10.

In the event that cultural resources are discovered, project personnel will follow the procedures outlined in Appendix F.4.2 of the SEP, and FEMP procedure EP-0003, "Unexpected Discovery of Cultural Resources." In such cases, the DOE will consult with the appropriate parties pursuant to 36 CFR Part 800 to determine a course of action to avoid and minimize, to the extent practical, any adverse impacts. If human remains, associated or unassociated funerary objects, sacred objects, or objects of cultural patrimony are discovered, the appropriate Native American tribe(s) will be consulted. During the consultation, DOE will cease activity in the immediate area and make a reasonable attempt to secure the remains and/or objects. Work stoppages in the immediate area would likely last at least 30 days.

1.4 COMPONENTS OF THE REMEDY

As described in the Operable Unit 2 ROD, the remedy selected to provide protection of human health and the environment involves the excavation of all impacted materials, material processing (if necessary) to meet sizing and moisture criteria for the OSDF, disposal in the OSDF of that material which meets the OSDF WAC, and off-site disposal of excavated material exceeding the OSDF WAC. The components of the selected remedy, as presented in the Operable Unit 2 ROD and as applicable to A2PI, and the commitment to ensure these elements are met include the following:

- Establishment of OSDF WAC for the on-site disposal of Operable Unit 2 materials. The OSDF WAC have been established and are discussed in detail in the IMPP, and the WAC Attainment Plan.

- Excavation, transportation and off-site disposal of approximately 4,800 yd^3 of material with a total uranium concentration above the OSDF WAC. This material will be staged in the SP-7 Stockpile prior to off-site shipment to a permitted commercial disposal facility (see Section 3.3 for additional details). Note that the volume may increase through the identification of additional above-WAC areas using radiological monitoring (Section 3.3.4.1).

- Excavation, treatment, and off-site disposal of approximately 100 yd^3 of soil from the former South Field firing range as mixed waste if toxicity characteristic leachate procedure (TCLP) analyses indicate it is characteristically hazardous for lead. The remaining impacted material excavated from the former firing range will be managed per sitewide procedure EW-1019, "Management of At- and Below-Grade Impacted Material" (see Section 2.4.2 for further details).

- Excavation to the depth established by the Operable Unit 2 FS. Excavation will be performed in such a way as to minimize dilution of waste and keep exposure to humans as low as reasonably achievable (ALARA). Excavation includes removal of all fill material placed in the SWUs by former DOE operations as well as all soil and debris with contaminant levels above FRLs (see Section 3.3 for additional details).

- Segregation of debris (e.g., concrete, steel, and pallets) from Operable Unit 2 subunits that meets the OSDF chemical and radiological WAC and requires processing to meet OSDF physical WAC prior to disposal in the OSDF. Strategies for excavation, including segregation of debris, are presented in Sections 3.3 and 3.4.

- Transportation and on-site disposal of excavated material that meets the OSDF WAC. A discussion of transportation and disposition is presented in Section 3.3.3.

- Collection and treatment of construction water from the Operable Unit 2 subunits. Strategies for excavation, including collection and treatment of surface water, are presented in Section 3.1.7 and the Surface Water Management Plan (Appendix B).

- Certification (previously identified as verification in the Operable Unit 2 ROD selected remedy components) sampling and analysis in the excavated areas to confirm material with ASCOC levels above FRLs has been removed. As discussed in Section 7.2 of the SEP, a Certification Design Letter (CDL) will detail the proposed certification activities. If results of the certification sampling and analysis indicate that contamination above FRLs remains, supplemental excavation and certification sampling and analysis will be performed. The certification program is discussed in Section 3.4 of the SEP.

- Restoration of Operable Unit 2 subunits following excavation and certification sampling and analysis. Restoration of the Operable Unit 2 subunits will include seeding and fencing, as appropriate. The extent of final restoration will depend on the end use of the area and the appropriate habitat. Information regarding the interim restoration of A2PI is included in Section 3.6. The final land use will be included in the final version of the NRRP.

- Institutional controls such as access restrictions and groundwater monitoring at the Operable Unit 2 subunits. During remediation, access to the A2PI area will be restricted through the use of barriers and warning/caution signs. Groundwater monitoring, as listed in the Operable Unit 2 ROD, will be implemented using wells designated for long-term groundwater monitoring. These wells (located north of the Inactive Flyash Pile, south of the South Field, and south and east of the Active Flyash Pile), as well as long-term sampling and monitoring strategies, are identified in the Integrated Environmental Monitoring Plan [IEMP (DOE 1997f)]. Long-term institutional controls necessary to implement restoration goals under the site's selected remedy are presented in the NRRP.

000029

- Maintenance of the remediated Operable Unit 2 subunit areas after restoration. Periodic checks will be made to assure stable slopes. Maintenance of the SWUs area will be conducted in accordance with the habitat and end use of the area.

1.5 LESSONS LEARNED

A lessons learned program has been implemented to apply knowledge accumulated during successive remedial efforts conducted under the SEP. Integration of lessons learned from past remedial activities [i.e., Area 1 Phase I (A1PI)] is imperative to ensure future remedial activities meet all requirements and achieve the highest possible levels of quality at the project level.

1.5.1 A1PI Lessons Learned

Lessons learned during the A1PI remediation project were incorporated into the SEP and the A2PI IRDP (both the site preparation and excavation design documents). The lessons learned from A1PI include managerial, administrative and technical improvements. These lessons have been incorporated into the A2PI project. Some examples of these lessons learned improvements include:

The reorganization of the SCEP into area projects is a significant managerial improvement. Review of the A1PI project indicated improved coordination and control among key disciplines (characterization, engineering and construction) could improve the performance of the project. In this regard, soil remedial action activities are now organized into area projects. These projects (including A2PI) are now managed by a single person with the responsibility and authority to manage and direct the dedicated resources for the project. This reorganization (Section 6.1) will ensure better control over all activities associated with the remediation of each area and facilitate the dissemination of key information among project personnel.

One administrative change in the project is that the Implementation Plans (IPs) will address interim restoration and the certification concept for each area. Because of the long lead time associated with some aspects of the project, and because certification details will be described in area specific CDLs, the IPs may address these issues on a conceptual level; however, they will be addressed. For example: within the A2PI IP, Retention Basins 1 and 3 are proposed to remain as part of the long term restoration of the area, and Retention Basin 2 is proposed to be backfilled. This information presents assurances to stakeholders that the longer term is being addressed and provides the opportunity to

comment on, and revise, the long term plan before it is finalized and implemented. The details of this restoration will be integrated into the future CDL and construction packages.

Technical improvements will also be made based on lessons learned. For example: some of the outlet devices on the A1PI sedimentation structures did not drain rapidly enough to function efficiently and required modification after they were built. The lessons learned from this aspect of the project was that wrapping basin drains with filter fabric will soon "blind" the filter fabric and not allow water to drain. This performance is related to many factors including site soil conditions. Some of the soils in A2PI are similar to A1PI, therefore, the riser pipes in the three sedimentation basins were designed with consideration of that lesson and the drainage from these basins should improve.

1.5.2 A2PI Site Preparation Lessons Learned

Lessons learned from the A2PI Site Preparation phase were incorporated into the A2PI Excavation design documents. Two examples of these lessons are summarized as follows.

During the A2PI Site Preparation Phase, excavation of the South Field was very similar to the excavation that will be performed during the A2PI Excavation Phase throughout the SWUs. Initial excavation in the South Field proceed very slowly because of a number of reasons, including the fact that the area was classified as a "soil contamination" area. This classification required stopping work every time a potential special material was encountered. In order to improve efficiency of the work, the area was upgraded to a "contamination area." This upgrade required all workers in the excavation area to wear anti-Cs and allowed potential special material to be handled more efficiently. During the excavation phase, the entire A2PI SWU area will be classified as a "contamination" area and excavation should proceed more efficiently than if was classified as a "soil contamination" area.

Another lesson learned during Site Preparation excavation concerned excavation techniques and identification of special materials. Actual experience during excavation of the South Field indicated that special materials can be identified by visual observation and that the equipment operators can be very useful at spotting and identifying special materials. Both of these lessons were considered and incorporated into the SWU excavation and excavation monitoring approaches.

1.5.3 Lessons Learned Summary

Because of the general complexity and site-specific nature of soil remediation activities, soil remediation at the FEMP will continue to evolve based on lessons learned during successive remedial efforts. Lessons learned will continue to be applied to future work efforts to ensure that the highest possible quality of work is attained.

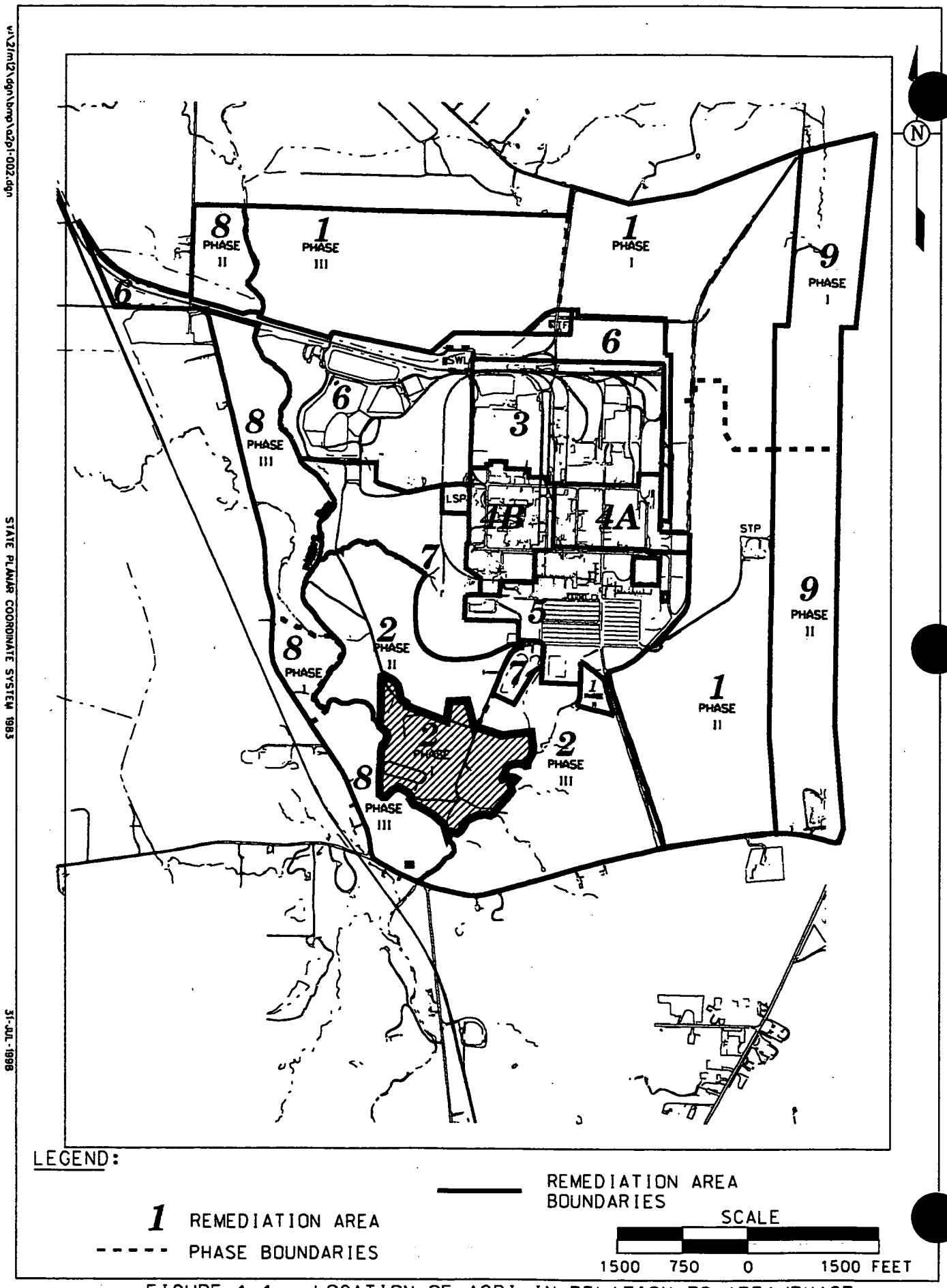

FIGURE 1-1. LOCATION OF A2PI IN RELATION TO AREA/PHASE REMEDIATION AREAS.

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STATE PLANAR COORDINATE SYSTEM 1983
31-JUL-1998

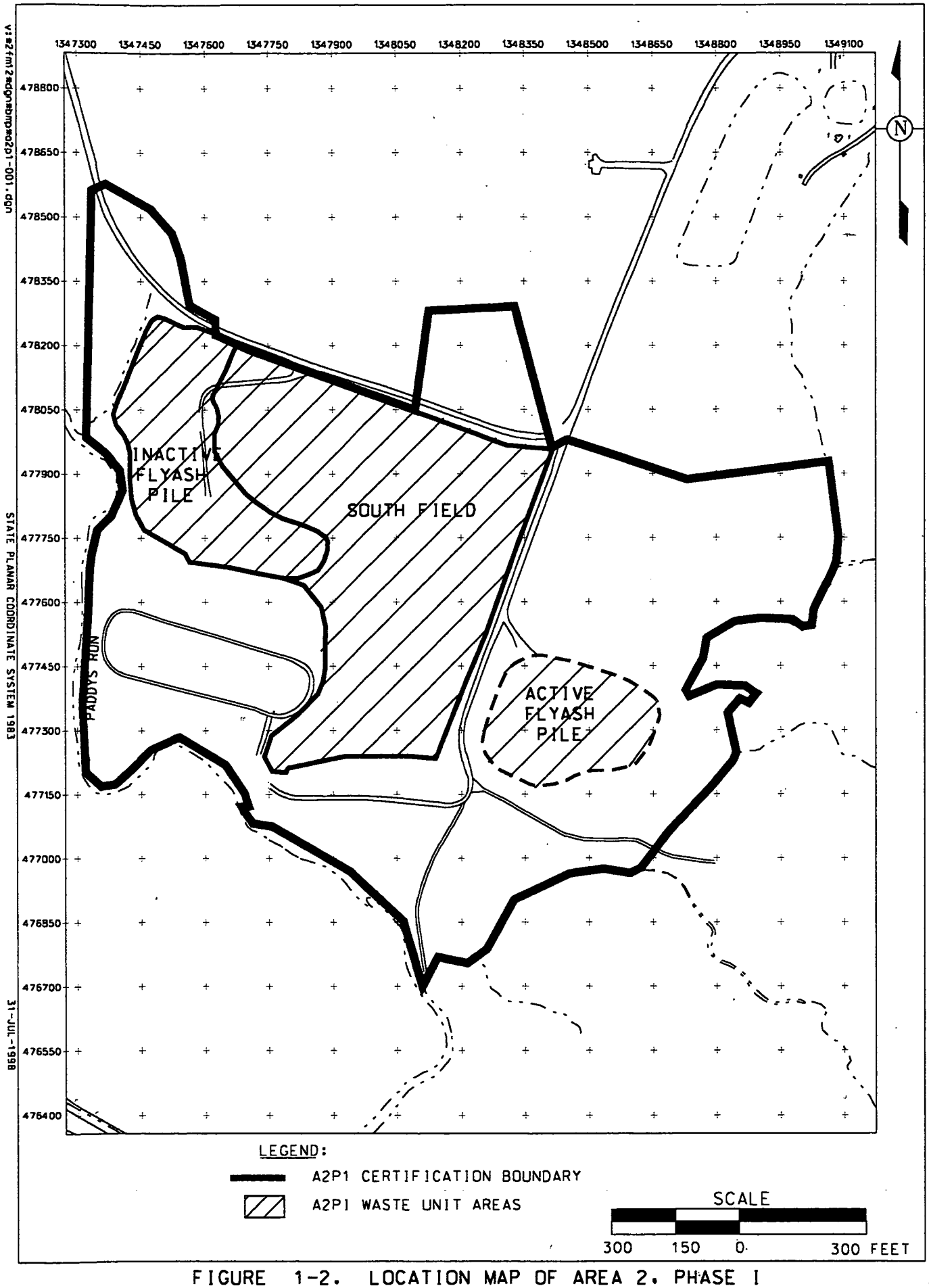

FIGURE 1-2. LOCATION MAP OF AREA 2, PHASE I

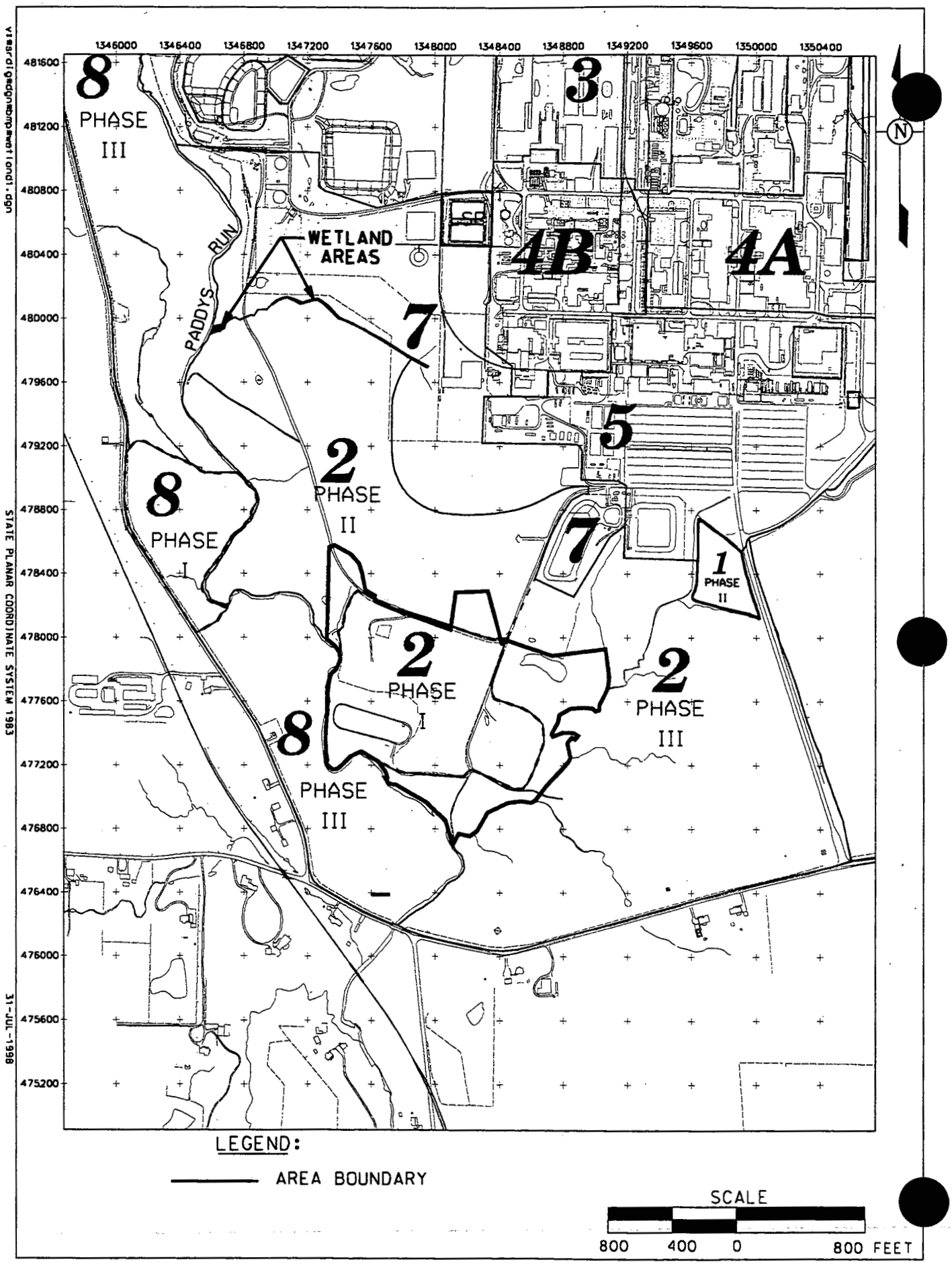

FIGURE 1-3. WETLANDS IN AREA 2

2.0 PREDESIGN INVESTIGATIONS

This section summarizes the investigations in A2PI that have been used in remedial design. These investigations include:

- The Operable Units 2 and 5 RI/FS activities
- Additional sampling and analyses to establish the presence of, and delineate the extent of, above-WAC contamination.

This information has been used to identify the ASCOCs for A2PI, describe the surface and subsurface conditions expected, and present the expected excavation boundaries.

2.1 SUMMARY OF RI/FS AND PREDESIGN INVESTIGATIONS

Predesign investigations that have been used to characterize A2PI include studies conducted as part of Operable Units 2 and 5 RI/FS studies and additional sampling and measurements that have been completed pursuant to RI/FS activities.

2.1.1 RI/FS Data Review

The nature and extent of radiological and chemical constituents within the SWUs are based on data collected during RI/FS field investigation activities. More detailed information regarding the extent and nature of contamination within the SWUs is available in Section 4.0 of the Operable Unit 2 RI Report (DOE 1995b). In addition, for the areas surrounding the SWUs, but still within the A2PI boundaries, details are provided in Section 4.0 of the Operable Unit 5 RI Report (DOE 1995d). The development and list of Final Remediation Levels (FRLs) pertinent to Operable Units 2 and 5 are presented in the respective RODs (DOE 1995a and DOE 1996a).

Data gathered in the SWUs indicate that large volumes of solid waste and debris have been randomly deposited, along with small volumes of radiological and/or chemical wastes. The following paragraphs summarize the expected conditions in each of the SWUs.

Inactive Flyash Pile

In addition to flyash, other waste material, including sludge, clay drain tile, wood, nails, wire, transite, construction debris, and small amounts of organic waste, have been deposited in the Inactive Flyash Pile. The waste, except the flyash, have exhibited above-background levels of radioactive contamination where sampled. The occurrence of uranium contamination in the perched groundwater under the Inactive Flyash Pile appears to be related to waste materials buried within or near the subunit. In addition, the Inactive Flyash Pile appears to be a source of uranium contamination for the Great Miami Aquifer beneath the central part of the subunit. Uranium is the only constituents of concern (COC) detected in the Great Miami Aquifer downgradient from the Inactive Flyash Pile.

There is an area within the Inactive Flyash Pile with total uranium concentrations in excess of the OSDF WAC. There were four other A2PI areas where uranium and/or technetium-99 levels in excess of the OSDF WAC were suspected. The presence and boundaries of this above-WAC material have been defined through predesign sampling activities (Section 2.1.2.2 and Appendix D).

South Field

A wide range of waste materials has been encountered in the South Field, including concrete, steel pipe, sheet steel, wood, and clay tile. The level of contamination associated with some of this material suggests that it represents a potential source of radionuclides leaching into the groundwater. Some material at the former firing range contains potentially toxicity characteristic hazardous concentrations of lead. The boundaries of this lead-contaminated material have been defined through predesign sampling (Section 2.1.2 and Appendix D).

Active Flyash Pile

Field observations and historical documentation suggest that the Active Flyash Pile contains only flyash. Uranium-234, uranium-235/236, and uranium-238 were detected in the Great Miami Aquifer downgradient of the subunit, but, as discussed in Section 2.3.3, this is not believed to be associated with the Active Flyash Pile.

000037

A2PI Area Surrounding SWUs

Review of the existing data suggests that most of the radiological and chemical contamination in A2PI outside of the SWUs is present in the surface soil. Uranium is the primary radiological contaminant. Inorganic constituents (beryllium, cadmium, cyanide, lead, molybdenum, and silver) have been detected at above-background levels. In general, the concentration of uranium decreases rapidly with depth.

2.1.2 Additional Sampling/Measurements

The nature and extent of soil contamination at the FEMP site poses considerable demands on the coordination of characterization and excavation activities carried out during the remediation process. In many remediation areas, data generated from RI activities are not comprehensive for the purpose of preparing detailed engineering designs and excavation drawings, and additional radiological surveys and sampling programs must be implemented to collect the needed data. Real-time, field-deployable instruments have the capability to satisfy a major portion of these additional data needs, and their use will be integrated with discrete sampling and subsequent laboratory analysis to maintain efficiency in the remediation process.

Three additional investigations have been conducted in A2PI pursuant to the RI/FS phase. These include:

- Sampling of site preparation areas
- Delineation of areas exceeding OSDF WAC
- Delineation of lead-contaminated soil at the former firing range facility.

The purpose and results of each of these investigations are discussed in detail in Appendix D.

2.1.3 Sampling and Analysis in Stock Pile No. 5

The data for SP-5 includes the following:

- Total uranium data from an Remedial Site Evaluation (RSE) sampling event in 1990
- Characterization data (including an extensive list of radionuclides, organic compounds, and metals) from a 1993 sampling event under Removal Action 17
- Operable Unit 3 RI/FS sampling performed in 1994

- Recent (April and May 1998) data obtained from real-time gamma spectrometry and physical sampling.

The purpose and results of the most recent investigation (April and May 1998) are discussed in detail in Appendix D.

2.2 IDENTIFICATION OF EXCAVATION ASCOCS

The selected remedies for Operable Units 2 and 5 discuss the full suite of on-site COCs as well as their corresponding FRLs. Operable Unit 2 FRLs are the primary drivers for remediation in the SWUs. However, only three of these affect remedial design and excavation in A2PI (Table 2-1):

- Total uranium, which drives design and excavation of above-WAC material in the Inactive Flyash Pile
- Lead, which drives design and excavation of the potentially characteristically hazardous and above-FRL material in the South Field
- Uranium-238, which drives design and excavation of above-FRL material in the remainder of A2PI.

These three are considered excavation ASCOCs because their combined extent bounds the extent of other COCs in A2PI. For these three, as indicated in Table 2-1, the more stringent (i.e., lower concentration) FRL between Operable Unit 2 and Operable Unit 5 has been selected. In the case of uranium-238, the most stringent FRL for the SWUs has been used (i.e., that for the South Field and Active Flyash Pile). As noted in Appendix D, no above-FRL/WAC levels of technetium-99 were detected in A2PI. Based on this, technetium-99 is not considered an excavation ASCOC.

2.3 SUMMARY OF SURFACE AND SUBSURFACE CONDITIONS

Surface and subsurface conditions in A2PI are described in the following paragraphs in terms of surface coverage and drainage patterns, soil stratigraphy and geotechnical properties, the perched groundwater zone, at- and below-grade structures and debris, and groundwater monitoring wells.

2.3.1 Surface Coverage and Drainage Pattern

The SWUs cover approximately 15.6 acres within a total watershed area of 26.0 acres and have steep outslopes to the west, south, and southwest. The Inactive Flyash Pile and South Field outslopes are heavily vegetated with trees and brush. Existing drainage consists of sheet flow and shallow

000039

concentrated flow that is generally uncontrolled before reaching Paddys Run. A portion of the Inactive Flyash Pile is situated adjacent to Paddys Run. A rock embankment was constructed under Removal Action 29 along a section of the eastern bank of Paddys Run to protect the Inactive Flyash Pile from stream erosion. A seepage control and collection system was constructed under Removal Action 31 to collect contaminated seepage from the Inactive Flyash Pile and South Field. The system pumps the collected seepage to the Advanced Wastewater Treatment Facility (AWWT) for treatment. Drainage area maps and calculations for A2PI are contained in the Surface Water Management Plan (Appendix B).

2.3.2 Soil Stratigraphy and Geotechnical Properties

The stratigraphy in the A2PI SWUs area consists of six classifications: flyash, fill, brown till, gray till, Great Miami Aquifer sand and gravel, and stratified glacial deposits. The depths and locations of these strata are given in Section 4.0 of the "Fly Ash Piles and South Field Waste Units Geotechnical Report" (Parsons 1996c). The geotechnical parameters summarized in the following paragraphs are taken from Section 5.0 of that same report.

The ash material in the Active and Inactive Flyash Piles is composed of mixed bottom ash and flyash and exhibits a wide range of moisture contents (from 16 to 52 percent). This suggests that some moisture conditioning of the material may be beneficial to facilitate handling and disposal. Earthen fill materials are generally classified as clays with varying amounts of gravel. Difficulties handling these earthen materials are not expected.

The brown and gray till have characteristics similar to soil and the stratified glacial deposits commonly contain zones of clay. Therefore, no significant difficulties in excavating, handling, and placing these materials are anticipated. Zones of saturated material may be encountered due to the presence of perched groundwater within the till, which may result in seepage into the excavation (Sections 3.1.7.4 and 3.3.2.6).

2.3.3 Perched Groundwater Zone

The perched groundwater at the Inactive Flyash Pile is located in saturated silty sand lenses within the till beneath the flyash, and in a saturated zone of flyash directly above the till. The till under the flyash apparently slopes to the west, southwest, and south and truncates on the surface of the Great Miami

Aquifer. This is believed to be the most significant mechanism to transport contamination from the SWUs to the Great Miami Aquifer.

Data suggest that perched groundwater in the northern portion of the Inactive Flyash Pile is flowing through waste materials containing uranium. This may be the source for uranium in the seepage.

Ten metals were detected at greater than background concentrations in the perched groundwater at the Inactive Flyash Pile. These include cobalt, nickel, and thallium, which were detected at elevated levels in the flyash. Uranium was also detected at elevated levels (up to 6700 μg/L) in the same perched groundwater (DOE 1995b).

Total uranium was detected in all perched groundwater wells at the South Field. Perched groundwater north of the southeast corner of the South Field may be a source of recharge to the Great Miami Aquifer. The source of contamination in the perched groundwater beneath the Active Flyash Pile appears to be the South Field. A total of 22 constituents have been detected at above background levels in the Great Miami Aquifer beneath the SWUs (DOE 1995d).

2.3.4 At- and Below-Grade Structures and Debris

There are no known at- or below-grade structures present in the A2PI area. The SWUs were created by randomly placing material in undeveloped areas. Below-grade debris is anticipated, since the SWUs were used for uncontrolled dumping of various materials. Based on process knowledge and RI/FS data, it is known that a wide range of materials such as building rubble, construction debris, concrete, asphalt, clay pipe, wood, steel pipe, rebar, and transite is present in the Inactive Flyash Pile and South Field. The Active Flyash Pile is primarily composed of flyash and bottom ash, thus the presence of other types of debris is not anticipated.

2.3.5 Groundwater Monitoring Wells

There are 37 groundwater monitoring wells in A2PI. Of these, 17 monitoring wells which will be encountered during excavation activities will be abandoned (plugged or removed) by FDF prior to the commencement of construction activities in the area. Fourteen groundwater monitoring wells and four extraction wells will remain and must be protected during construction activities. Wells remaining in place and requiring protection are shown on the construction drawings (SPDwg G0003 and

EDwg G0004). FDF will install the protection systems for these wells and the contractors will be responsible for any damage inflicted upon the wells. There is one groundwater monitoring well that was scheduled to be abandoned prior to excavation activities that is not completely abandoned. The excavation contractor will be responsible for removal of the well casings and concrete surrounding the casings to complete the abandonment process. Section 3.1.8 of this Implementation Plan provides additional details regarding the groundwater wells present in the A2PI area.

2.4 ANTICIPATED EXCAVATION BOUNDARIES

The anticipated boundaries of excavation in A2PI are defined in the following paragraphs in terms of addressing above-WAC material, potentially characteristically hazardous areas, and fill/above-FRL material.

2.4.1 Above-WAC Material

As described in Section 2.1.1 and confirmed during predesign investigations (Appendix D), there is a volume of material with total uranium contamination in excess of the OSDF WAC (1,030 mg/kg) in the Inactive Flyash Pile. Based on the RI/FS and predesign information, there are approximately 4,800 yd^3 of this material (EDwg G0006). This material requires a specific excavation approach, which is presented in Section 3.3.2.2.

2.4.2 Potentially Characteristically Hazardous Areas

As described in Section 2.1.1 and confirmed during predesign investigations Appendix D the South Field contains material with the potential to exhibit the toxicity characteristic for lead (i.e., fails a TCLP test). This has been delineated by analytical results from the predesign investigation and is discussed in detail in Appendix D. Based on RI/FS and predesign information, there are approximately 100 yd^3 of soil with lead contamination in excess of the FRL (400 mg/kg). This material is assumed to be characteristically hazardous and is therefore a mixed waste, which requires a specific remediation approach, which is presented in Section 3.3.2.2.

2.4.3 Fill/Above FRL Material

Operable Units 2 and 5 RI/FS data, predesign investigations (Section 2.1.2) and the South Field/Active Flyash Pile uranium-238 FRL (Section 2.2) were used to establish the extent of excavation of impacted material in A2PI. Approximately 262,000 yd^3 of impacted material in A2PI exceed the total uranium

FRL and meet the chemical/radiological WAC for the OSDF. An additional 80,000 yd^3 of material must be excavated to remove the remainder of all fill material and return the area to its original 1951 contours. After WAC attainment is demonstrated (Section 3.3.4.3), all of this material will be dispositioned to the OSDF. The footprint of this excavation covers nearly all of the SWUs and extends to the following depths:

- Site Preparation: Excavation of impacted (24,000 yd^3) and non-impacted (16,000 yd^3) material to construct site preparation facilities
- Inactive Flyash Pile: Existing grade level (msl elevation 570) in the northern and eastern portions, to approximately 30 feet deep (msl elevation 540) in the southern and western portions (EDwg G0005), a total of approximately 124,000 yd^3 (including above-WAC excavation)
- South Field: Existing grade level (msl elevation 563) in the northern portion, to approximately 20 feet deep (msl elevation 540) in the southern portion (EDwg G0007), a total of approximately 137,000 yd^3
- Active Flyash Pile: Existing grade level around the edges, to approximately 35 feet deep (msl elevation 555) in the south-central portion (EDwg G0007), a total of approximately 62,000 yd^3.

Backup calculations for these estimated earthwork volumes are provided in Appendix C. The excavation procedures to be used are discussed in Section 3.3.2.3.

000043

TABLE 2-1

SUMMARY OF CONTAMINANTS PERTINENT TO EXCAVATION IN AREA 2, PHASE I

			Final Remediation Levels							
			Operable Unit 5 [b]		Operable Unit 2 [c]					
Constituent	Waste Acceptance Criteria for Soil and Sediment in the On-Site Disposal Facility [a]	Benchmark Toxicity Value	On-Property Soil	Sediment	Inactive Flyash Pile (over GMA)	Inactive Flyash Pile (> 16 ft natural soil)	South Field (over GMA)	South Field (> 16 ft natural soil)	Active Flyash Pile	FRLs Selected for use in SWUs
Uranium, total (mg/kg) (High K_L) [b]	1.03E+03	2.30E+02	8.20E+01	2.10E+02					2.80E+01	
Uranium, total (mg/kg) (Low K_L) [b]			2.00E+01		2.48E+01	2.48E+01	2.48E+01	2.48E+01		20[d]
Uranium-238 (pCi/g)	3.46E+02	1.20E+04			6.12E+00	3.22E+00	6.12E+00	3.22E+00	6.12E+00	3.22
Lead (mg/kg)		2.00E+02	4.00E+02				4.00E+02 [e]			400

Notes:
[a] From *Impacted Materials Placement Plan - On-Site Disposal Facility* (DOE 1996b).
[b] From Operable Unit 5 ROD (DOE 1996a).
[c] From Operable Unit 2 ROD (DOE 1995a).
[d] Listed because Operable Unit 2 FRLs were developed. The FRL for uranium-238 is more stringent and will be applied to all of A2PI.
[e] Only applies to the Firing Range.
ND = Not Detected

3.0 REMEDIAL ACTION APPROACH

This section presents the approach that will be used to remediate A2PI. The general approach is in accordance with "Excavation Approach B - Excavation in Waste Storage/Management Areas Outside the Former Production Area," described in Section 4.2 of the SEP (DOE 1997a). The performance requirements for implementing this approach are presented on the construction drawings and technical specifications for excavation activities included as part of the IRDP. As stated in Section 1.0, the construction drawings and technical specifications for site preparation activities have already been submitted. The drawings and specifications will become part of the Contract Documents, which will govern remediation activities performed by the construction contractors. Specific methods and procedures to perform the work will be detailed by the contractors in Safe Work Plans. As required by the contract documents, the Safe Work Plan for the site preparation and excavation contracts will include the following individual plans:

	Contract	
Component of Safe Work Plan	Site Preparation	Excavation
Material Documentation Work Plan	✓	✓
Traffic Control Plan	✓	✓
Dust Control Plan	✓	✓
Site Clearing Work Plan	✓	-
Excavation Work Plan	✓	✓
Impacted Material Work Plan	✓	-
Sheeting and Shoring Plan	✓	-
Quality Assurance/Inspection Program	✓	-
Water Management Plan	✓	-
Presumed Asbestos Containing Material Handling Plan	-	✓
Surface Water Management and Erosion/Sediment Control Plan	-	✓
Equipment Wash Plan	-	✓

The Safe Work Plans will be reviewed and approved by FDF before applicable remedial activities are implemented.

As described in Section 1.0, two contractors (the site preparation contractor and the excavation contractor) will perform the required remedial activities in a separate and sequential manner. The scope of work included in each of these contracts is described in the following subsections.

3.1 SITE PREPARATION

Site preparation began in late summer of 1997. Site preparation activities consist of those tasks necessary to prepare the site for excavation. These activities were performed by a construction contractor in accordance with the Site Preparation Contract Documents, which include the construction drawings and technical specifications. Site preparation activities were completed before the initiation of excavation phase activities.

Impacted material excavated during site preparation activities was stockpiled (Section 3.1.9) in the South Field and will be dispositioned to the OSDF by the excavation contractor. Impacted material exhibits soil and soil-like characteristics and consists primarily of flyash and soil, with some building and construction debris. Material from installation of the retention basins (Section 3.1.7) determined to be non-impacted was stockpiled (Section 3.1.9) within A2PI for potential future reuse as clean fill.

Site preparation tasks included the following:

- Establishing site boundaries and access controls
- Surveying and site layout
- Establishing the support area
- Clearing
- Tie-in of utility hookups
- Installation of equipment wash facility
- Installation of surface water management system
- Installation of erosion and sediment controls
- Monitoring well abandonment/protection
- Construction/relocation of stockpiles.

000046

3.1.1 Establishing Site Boundaries and Controls

The entire A2PI area was classified as a radiological "soil contamination" area during initial site preparation activities; existing posted areas within A2PI were maintained. Initial preparation of the A2PI area included establishing the defined construction area in the field and posting appropriate signs at the boundaries (SPSpec 02100 and SPDwg G0005). Based on field conditions encountered during excavation of the South Field, part of the site was upgraded to a "contamination" area. The upgraded area was fenced and access controlled. Upgraded PPE was required in the area. The A2PI construction area was defined by signs and construction fencing, which also defined the control boundary for the site. Gates will be installed at equipment access points.

3.1.2 Surveying and Site Layout

Project site survey control points (including baselines and temporary benchmarks) were established in the field based on the coordinate system shown on the construction drawings (SPSpec 01050 and SPDwg G0004). In addition, all site preparation facilities, including the support area, ditches, retention basins, roads, equipment wash facility, utility lines, and other structures, were located and staked.

3.1.3 Establishing the Support Area

A support area was established at the northeastern edge of A2PI (SPDwg G0002) and outside the proposed excavation area. The area includes a radiological control point facility, field office, parking, laydown area, and other contractor facilities (SPDwg G0006). The radiological control point facility (SPSpec 13125) consists of a trailer with radiological personnel monitoring equipment, an emergency shower, wash basins, and change-out room(s). During the excavation phase of the project, all personnel will enter and exit the work area through this facility. The field office facility (SPSpec 13126) will consist of a trailer with office space and restrooms for construction management personnel.

3.1.4 Clearing

Generally all areas to be disturbed during A2PI remediation (site preparation and excavation) will be cleared during site preparation. Clearing (SPSpec 02100) will consist of cutting all trees and brush in these areas to a height of approximately one foot above grade, then chipping the material for use as on-site mulch during remediation. The chips will be stored in the woodchip stockpile (Section 3.1.9)

and will be turned by the site preparation (SPSpec 02100) contractor and FDF as necessary to prevent combustion. During the excavation phase of the project, FDF will be responsible for the maintenance of the Woodchip Stockpile. The stumps in the site preparation areas will then be ground in place (SPSpec 02205) and excavated with the surface soil for staging in the Impacted Material Stockpile (Section 3.1.9).

The stumps in areas to be disturbed during excavation will remain in place (during site preparation) and be ground and removed during the excavation phase (Section 3.3.2.1).

Because of potential stability concerns no clearing will occur in the lead contaminated area in the South Field and the side slopes of the Active Flyash Pile during site preparation. Those areas will be cleared just prior to excavation in the subsequent phase.

3.1.5 Tie-In of Utility Hookups

Existing electric and water service were extended to the facilities associated with remediation of A2PI during the site preparation phase. This power was extended from the substation near the Storm Water Retention Basin (SWRB) using power poles and overhead lines (SPDwg E0005). The electrical service provides power to the support area, equipment wash facility, lift stations, as well as for the South Field Extraction System. The power is used for lighting, alarms, pumps, control systems, and other components.

Water service (SPSpec 02667) is provided to the support area trailers, the equipment wash facility, and a yard hydrant (SPDwg N0003) by tapping into an existing 6-inch diameter drinking water line that parallels the road between the South Field and the Active Flyash Pile. Water will be used for drinking, emergency showers, washing equipment, and dust control.

Pipelines (SPDwg N0002) are necessary to transport water from the A2PI retention basins to the respective lift station (SPSpec 02668), and on to the SWRB (SPSpec 02669), as well as from the equipment wash facility, through the oil/sediment separator, and to the existing seepage collection lift station for transport to Retention Basin 1.

000048

Trenches for underground utilities were constructed and backfilled according to specification (SPSpec 02225). In general, trenches were excavated to a depth below the bottom of the utility line, pipe bedding was placed and compacted, the utility line was installed, the remainder of the pipe bedding was placed and compacted above the utility line, and the trench was backfilled and compacted. Impacted debris, including pipe, fencing, concrete, and conduits, that are removed during these activities will be handled according to established site procedures (Section 3.3.2.5). All soil and soil-like material was returned to the trench pending final disposition during final restoration of the area.

3.1.6 Installation of Equipment Wash Facility

An equipment wash facility was constructed during the site preparation phase at the point haul equipment from A2PI will access the dedicated Impacted Material Haul Road (SPDwgs G0002 and G0007). The equipment wash facility will be used by the excavation contractor to wash haul equipment (Section 3.3.3.2). The excavation contractor will be responsible for maintaining the haul road clear of mud, debris, and potentially impacted materials by washing the wheels and undercarriage of the haul equipment from A2PI accessing the haul road and routine cleaning of the haul road.

3.1.7 Installation of Surface Water Management System

A comprehensive surface water management system will be implemented to provide both management of stormwater/perched groundwater and erosion and sedimentation control. Major components of the system were constructed during the site preparation phase and will be maintained throughout the excavation phase. The types and sizes of the surface water management system components are summarized in the following paragraphs and detailed in the Surface Water Management Plan (Appendix B).

3.1.7.1 Overall Approach

Remediation activities and surface water management system practices will be performed to achieve the following general objectives:

- Prevent runoff from other areas from entering the project area
- Collect, control and provide sedimentation capacity for all runoff from disturbed areas

- Collect potentially contaminated runoff from support areas and potentially contaminated runoff/perched groundwater from excavation areas and treat it in existing FEMP treatment facilities

- Control storm water to prevent an increase in peak runoff.

The surface water management system consists of the following (SPDwgs G0005 and N0002):

- Existing FEMP facilities
- Diversion ditches and related devices
- Excavation sumps
- Collection ditches
- Retention basins
- Other erosion and sediment control devices.

In general, the surface water management system has been designed to control, at a minimum, the runoff from a 10-year, 24-hour storm event. Certain components of the system, as described in the following paragraphs, have been designed for a 25-year, 24-hour storm event.

3.1.7.2 Existing FEMP Facilities

Integral components of the surface water management system for A2PI include the SWRB and the AWWT facility. All water collected in the retention basins under the design conditions will be pumped to the SWRB for treatment at the AWWT facility.

3.1.7.3 Diversion Ditches and Related Devices

Runoff from uncertified areas upgradient and adjacent to A2PI (generally located north of A2PI) will be collected and diverted around A2PI and its associated surface water collection system. During remediation, this diversion will reduce the quantity of water requiring treatment. Following remediation, the diversion system will remain in place to prevent potential recontamination of A2PI.

Runoff from the forested area on the north side of the Inactive Flyash Pile and South Field is currently conveyed in a roadside ditch which flows to the west side of the Inactive Flyash Pile and into Paddys Run (SPDwg G0003). This ditch was expanded during site preparation activities to direct runoff to a pipe culvert installed under the new Impacted Material Haul Road as part of the construction of the road (SPDwg G0005). This water flows into the existing catch basin and pipe system on the west side

000050

of the Inactive Flyash Pile, which currently conveys the flow to Paddys Run (SPDwg G0007). The existing pipe was extended to convey this flow around the existing ditch (SPDwg G0008), and used to convey runoff from the Inactive Flyash Pile to Retention Basin 1.

Runoff from upgradient areas north and east of the Active Flyash Pile is collected in existing ditches and conveyed to the Storm Sewer Outfall Ditch (SSOD) (SPDwgs G0008 and G0005).

3.1.7.4 Excavation Sumps

As excavation is performed, active areas will be graded to drain to temporary collection sumps constructed by the excavation contractor within the excavation. The excavation contractor will install temporary excavation sumps in these collection points that will become part of the surface water management system. Since these sumps will be installed in the excavation phase, details regarding their design and construction are provided in Section 3.3.2.6.

3.1.7.5 Collection Ditches

Collection ditches were constructed on the downgradient portions of the SWUs to collect potentially contaminated runoff from all the areas disturbed during excavation (SPDwg G0005). These ditches convey the runoff to the A2PI retention basins (Section 3.1.7.6). A silt fence (SPSpec 02270) was installed between the toe of the SWUs and the collection ditches to reduce sediment loading to the ditches and the retention basins. Where excavation for construction of the ditches extends into the Great Miami Aquifer (SPDwg G0012), a geomembrane liner (SPSpec 02713) was placed in the bottom of the collection ditches. Runoff collection ditches D2 and D6, located on the perimeter of A2PI and adjacent to Paddys Run (SPDwg G0005), which discharge to Retention Basins 1 and 2, have been designed for a 25-year, 24-hour storm event; other runoff collection ditches have been designed for a 10-year, 24-hour storm event (see Appendix B for further details).

3.1.7.6 Retention Basins

Runoff from disturbed areas within A2PI is collected in retention basins and pumped to the SWRB for treatment in the AWWT facility prior to discharge to the Great Miami River. The retention basins were constructed south of, and adjacent to, the SWUs. These retention basins were designed to comply with or exceed pertinent Ohio Department of Transportation and Ohio Department of Natural Resources guidelines. The basins provide sediment and storm water storage (SPDwgs G0009, G0010,

and G0011). Retention Basins 1 and 2 were designed to store runoff from a 25-year, 24-hour storm event; Retention Basin 3 was designed to store runoff from a 10-year, 24-hour storm event (see Appendix B for further details).

Since the excavation of these retention basins extends into the Great Miami Aquifer, an HDPE (high density polyethylene) liner was installed in all basins (SPSpec 02713). In addition to the HDPE liner, an infiltration barrier was installed in Retention Basins 1 and 3. This infiltration barrier will consist of a one-foot thick layer of clay (SPSpec 02200). The clay was excavated from the designated OSDF sediment basin stockpile (SPDwg G0001) and hauled to A2PI by the site preparation contractor. The one-foot thick clay layer will provide additional protection of the Great Miami Aquifer and minimize potential deer damage. An 8-foot high chain link fence was installed around Retention Basin 2 to help protect the HDPE liner from damage. Additional measures may be taken to protect the Great Miami Aquifer if the HDPE liner is not sufficient.

The outlet works for the retention basins are a combination riser pipe and lift station. A riser pipe was constructed within the storage area of each basin. The riser pipe has low level outlets and the outlets are surrounded by a layer of aggregate. The low level outlets and aggregate act as a filter for sediment. A discharge line conveys flow from the riser pipes to lift stations near each retention basin. The lift stations pump the water from the retention basins, through a common transfer line, to the SWRB.

The lift stations are designed to remove water from the retention basins within 72 hours. Pumping will be initiated when the water level in the lift station reaches a pre-established level and will continue until the water level returns to the low-level shutoff (SPDwg G0013).

The SWRB is designed for a 10-year, 24-hour storm event. When the SWRB's storage capacity is exceeded, flow bypasses around the AWWT and discharges directly to the Great Miami River. To reduce the risk of overflow from the SWUs retention basins into Paddys Run, A2PI Retention Basins 1 and 2 are designed with additional storage capacity. During periods when the SWRB is bypassing, the lift stations will continue to pump until the SWRB reaches its maximum capacity (i.e., the point of overflowing into the storm sewer outfall ditch, and subsequently into Paddys Run). When the SWRB reaches this level, the A2PI lift stations will be turned off. After the level in the SWRB drops below its

000052

freeboard capacity, the lift stations will be restarted. In this manner, there should be no direct discharge from Retention Basins 1 and 2 under design conditions.

To accommodate periods when the level in Paddys Run rises to a level near the top of the embankment for Retention Basin 1, the height of the embankment adjacent to Paddys Run was constructed to an elevation of 541.5 feet msl.

Steps have been taken to decrease potential overtopping from Paddys Run into Retention Basin 2, including realigning and stabilizing a section of Paddys Run upstream and adjacent to the basin and increasing the minimum height of the berm and overflow outlet from the basin. The realigned and stabilized Paddys Run channel will direct the flow in Paddys Run away from Retention Basin 2. The minimum berm height of the basin was increased to an elevation of 538 msl and the invert of the overflow outlet was increased to an elevation of 537 msl.

Accumulated sediment from the A2PI retention basins, ditches and erosion control measures will be sampled and analyzed for attainment of OSDF radiological WAC prior to removal and dispositioned accordingly when the sediment depth reaches the sediment cleanout level indicated on the risers (SPDwgs G0013).

3.1.7.7 Other Erosion and Sediment Control Devices

Erosion and sedimentation control is a component of the surface water management system described in the Surface Water Management Plan (Appendix B) and the previous paragraphs. These controls are further detailed in the construction drawings (SPDwgs G0012 and G0013) and technical specifications (SPSpec 02270) and include:

- Silt fences
- Erosion control blankets
- Rock fill
- Silt berms/sediment barriers
- Temporary seeding
- Permanent seeding
- Crusting agents.

3.1.8 Monitoring Well Abandonment/Protection

Prior to contractor work in A2PI, FDF will abandon most of the monitoring wells within the excavation boundaries which exceed the depth of the proposed limit of excavation. General guidelines for abandoning wells are included in the SEP; general details regarding abandoning these wells are provided in the Sitewide CERCLA Quality Assurance Project Plan (SCQ) (DOE 1998).

A total of 17 monitoring wells will be abandoned in the A2PI area (Table 3-1 and EDwg G0004). The abandonment of one well (2945) which was scheduled to be abandoned by FDF will not be complete before the excavation phase begins and will have to be completed by the excavation contractor (Section 3.3.2.7). Monitoring wells remaining in the A2PI area for use in long-term monitoring programs are identified on the construction drawings and Table 3-1. FDF will install protection systems around these wells. It is the responsibility of both the site preparation and excavation contractors to ensure integrity of these wells is maintained by observing in place protection of the wells and preventing damage to the wells from any contractor activities (SPSpec 02100 and ESpec 02150).

3.1.9 Construction/Relocation of Stockpiles

The site preparation contractor constructed three new stockpiles, relocated one existing stockpile, and prepared the location for one additional stockpile. The new stockpiles include:

- A woodchip stockpile, located north of the support area in the northeast corner of A2PI just west of the SWRB, near the meteorological tower (SPDwg G0002)

- The South Field Impacted Material Stockpile (SPSpec 02205), located in the South Field, just west of the support area (SPDwg G0002). A geotextile fabric (SPSpec 02713) was used to separate the stockpile material from the underlying soil (SPDwg G0005). Samples of material that was placed in the South Field Impacted Material Stockpile were collected and analyzed prior to site preparation excavation activities. Analysis indicated that the material did not exceed the OSDF WAC. During excavation of that material, visual monitoring was performed and special materials were identified and segregated. Because a greater than expected quantity of special materials were encountered during excavation of the South Field, part of the area was upgraded to a "contamination" area and a separate area was delineated on the South Field Impacted Material Stockpile. Visual monitoring was performed to segregate potential special materials on all material excavated during site preparation and no observed special materials were placed in the South Field Impacted Material Stockpile.

000054

- Non-Impacted Material Stockpile No. 1 (SPSpec 02200), located at the former running track in the southwest corner of A2PI. A geotextile fabric and geomembrane liner (SPSpec 02713) were used to separate the stockpile material from the underlying soil (SPDwg G0005).

The South Field Impacted Stockpile is divided into two sections, one of which is within a radiologically controlled area which resulted from the excavation of the slope north of Retention Basin 2. The soil placed into both sections of the South Field Impacted Stockpile was managed in identical fashion; all excavation was subject to visual observation for presence of special material and radiological monitoring for OSDF WAC. Excavation of the entire stockpile will include visual observation for additional special material, and will be performed in 3 ± 1 foot lifts.

The area for Non-Impacted Stockpile No. 2 was also constructed during site preparation, located northwest of the support area. It was constructed in a manner similar to Non-Impacted Stockpile No. 1. No material was placed in Non-Impacted Stockpile No. 2 during site preparation. It will be a contingency stockpile area which may be used in the subsequent excavation phase.

The approximately 90 tons of material in the existing riprap stockpile, which was located at the site where Retention Basin 1 was constructed, was relocated just south of Retention Basin 1 (SPDwg G0005). The riprap stockpile is maintained for use in making repairs to the existing berm between Paddys Run and the Inactive Flyash Pile.

3.1.10 Installation of Treatment and Discharge Lines

Portions of the treatment and discharge lines that are associated with the groundwater recovery project and pass through A2PI were installed during the site preparation phase. These lines were installed in trenches that are common to those required for certain A2PI facilities. Since installation of these lines is not part of the remediation of A2PI, it is not discussed in this Implementation Plan.

3.2 AT- AND BELOW-GRADE STRUCTURE DEMOLITION

As stated in Section 2.3.4, there are no at- or below-grade structures present in the A2PI area, and therefore demolition issues are not relevant.

3.3 SOIL EXCAVATION AND SEGREGATION

Excavation activities will follow site preparation activities under a separate contract. A conceptual diagram of conditions following completion of site preparation activities is included as Figure 3-1. The excavation contractor will be responsible for:

- Excavating impacted material within A2PI
- Loading, hauling, and unloading impacted material that does not meet the OSDF WAC to temporary staging locations [i.e., the SP-5 Stockpile Area (to be named SP-7) or the Special Materials Transfer Area] prior to offsite treatment and/or disposal
- Containerizing and staging lead contaminated mixed waste in the Lead Contaminated Soil Container Transfer area
- Loading, hauling, and unloading impacted material that meets WAC in the OSDF.

As discussed in Section 1.0, impacted material, as used in this Implementation Plan, consists of all material that was placed in the SWUs as fill material and all non-fill material with contaminant levels above the FRLs. In addition, sediment collected in ditches, retention basins, and in other erosion control devices will be considered impacted. Non-impacted material consists of natural soil exhibiting contaminant levels below the FRLs.

The limit of the design excavation depth was developed in accordance with the approach presented on Figure 3-2. As shown on that figure, the depth of excavation was developed by first determining:

- Original Ground - The original ground surface elevation was estimated by a review of 1952 topographic maps and soil boring data to determine the 1951 (predisposal) surface elevations
- FRL Model Line - The extent of contaminants above the FRLs was estimated by incorporating RI/FS and predesign data into a geostatistical model, which then provided an estimated surface of contaminant concentrations that are below FRLs.

The excavation design depth was then finalized by taking the deeper (lower) of the above lines and, when necessary, smoothing the contours to provide stable slopes. This excavation design depth is shown on the construction drawings and is the minimum excavation depth that will be achieved. Excavation control monitoring (Section 3.3.4), precertification sampling (Section 3.5), and certification

000056

sampling and analysis (Section 3.4 of the SEP) will determine the final excavation depth, which may exceed the design depth.

3.3.1 Excavation Sequence and Prioritization

The remedial action excavation will be performed in a phased manner consistent with the concepts presented in the SEP. The actual phasing and sequencing was developed based on:

- Contamination priorities. Excavation of impacted material in a given area with relatively high concentrations of contaminants (above WAC or characteristically hazardous) will be prioritized.

- Physical constraints. Excavation will be continuously monitored (Section 3.3.4) and must be performed at a pace that matches the limitations of the monitoring equipment and the ability of personnel to work safely within the area.

- Flow to OSDF. Excavation will be performed to support OSDF placement requirements and maintain the scheduled flow of material to achieve the target debris-to-soil ratio.

Based on the criteria presented above, contracting and funding requirements, and expected funding levels, the excavation period is scheduled to extend through three construction years, as follows:

- The first year will involve excavation of the Inactive Flyash Pile and SP-5, as well as creation of SP-7 from the former SP-5. This will consist of approximately 12,000 yd^3 of material excavated from SP-5, with the remaining material (approximately 7,300 yd^3) forming the new SP-7. SP-7 will then receive above-WAC material from the SWU excavation. In addition, the Inactive Flyash Pile excavation will consist of approximately 119,000 yd^3 of impacted material and 4,800 yd^3 of above-WAC material. The above-WAC material was made a priority because of its close proximity to the Great Miami Aquifer. At the end of the first year (Figure 3-3), the Inactive Flyash Pile will be covered with a crusting agent (Section 3.3.5), since it will be too late in the season (Section 6.10) for seeding, followed by seeding in the spring of 1999.

- The second year of the excavation contract will involve removal and disposition of the Impacted Material Stockpile (in the South Field) generated during the site preparation phase, excavation of the west side of South Field, and excavation of the entire Active Flyash Pile. An estimated 146,000 yd^3 of impacted material will be excavated during this phase (24,000 yd^3 from the stockpile, 60,000 yd^3 from the South Field and 62,000 yd^3 from the Active Flyash Pile). The lead contaminated soil which is associated with the former firing range (an additional 100 yd^3) will be prioritized. Lead contaminated soil will be excavated, containerized, and staged in a designated area prior to off-site treatment and final disposition. At the end of the second year

(Figure 3-4), the west side of the South Field and the Active Flyash Pile will be covered with a crusting agent (Section 3.3.5), since it will be too late in the season (Section 6.10) for seeding, followed by seeding in the spring of 2000.

- The third year will involve excavation of the remaining material in the South Field (east side), an estimated 77,000 yd^3. At the end of this year (Figure 3-5), the newly disturbed areas of the South Field will be covered with a crusting agent and seeded the following spring. If timing allows, the area may be seeded in the year 2000 (Section 3.3.5).

It is expected that the contractor will require at least two excavation crews throughout the contract period to meet the schedule constraints, including the initial period of excavation in SP-5 and the Inactive Flyash Pile during year one. Conceptually the implications of this are:

- In the Inactive Flyash Pile (year one), one crew will be working in the above-WAC area (Section 3.3.2.2) while the other excavates below-WAC material (Section 3.3.2.3). Once all of the above-WAC material is removed, that crew would then excavate below-WAC material as well.

- In the South Field and Active Flyash Pile (year two), one crew will excavate the South Field Impacted Material Stockpile while the other excavates other below-WAC material in the South Field. The South Field crew will also excavate the lead contaminated soil after the over burden is removed. After the South Field Impacted Material Stockpile is excavated, that crew will excavate the Active Flyash Pile.

- During excavation of the east side of the South Field (year three), both crews will excavate below-WAC material (Section 6.10).

In all cases, if special material (Section 3.3.2.5) or unexpected cultural resources (Section 1.3.3) are encountered, or if the crew is awaiting monitoring of a completed area (Sections 3.3.2.3 and 3.3.4.3), that crew will have to excavate in another location a safe distance from the non-excavation activities associated with these conditions (ESpec 02205). Thus, it is expected that at least three excavation areas may be open at any one time.

3.3.2 General Excavation Approach

During excavation, the A2PI area will be classified as a radiological "contamination" area. Excavation activities include the following:

- Grinding of stumps

000058

- Prioritized excavation of impacted material
- Excavation of below-WAC material
- Excavation of debris
- Excavation of special materials
- Control of surface water
- Monitoring well abandonment/protection
- Transportation and disposition of impacted material
- Excavation control monitoring.

Each of these activities is discussed in detail in the following paragraphs. In addition, the excavation contractor will be responsible for placing soil and debris into Cells 1 and 2 of the OSDF, as well as construction of Cell 3. Requirements for these activities are included in the construction drawings and technical specifications for the OSDF Project.

3.3.2.1 Grinding of Stumps

All trees in areas to be excavated will be cut approximately one foot above the ground during the site preparation phase. All stumps located in areas that will be disturbed during site preparation (i.e., retention basins, stockpiles, utility corridors, ditches, support area, and equipment wash area) will be ground and chipped during site preparation. All other stumps will be ground in place and removed with the impacted material by the excavation contractor (ESpec 02205).

3.3.2.2 Prioritized Excavation

Impacted material that is known to exceed the OSDF WAC or that is RCRA characteristically hazardous will be excavated separately from material in the area that does meet the OSDF WAC. RI/FS and predesign sampling (Section 2.1.2) have been used to define the extent of impacted material that will be excavated in a priority manner (EDwg G0004). As these areas are excavated, the material will be segregated and handled separately and excavation control monitoring will be performed by FDF to ensure that the remaining material is below the OSDF WAC.

Above-WAC Material in the Inactive Flyash Pile

As discussed in Section 2.4.1, there are approximately 4,800 yd^3 of material in the Inactive Flyash Pile with total uranium contamination above the OSDF WAC of 1,030 mg/kg. The limit of above-WAC material was conservatively estimated from the environmental model. After the horizontal limits of the above-WAC material were determined by the model, an additional 15 feet was added for design and

construction purposes. This 15-foot area will be used to establish an inwardly sloping area at each lift. Vertically, the above-WAC area was conservatively determined to be between elevation 558 and 550. The actual approach that will be used to excavate this above-WAC material is shown on Figures 3-6 and 3-7. Overburden material with contamination below OSDF WAC will be excavated (Figure 3-6) to the top of the above-WAC material. A portion of the above-WAC area has been extended from elevation 558 to 559, based on analytical results. Once the excavation has reached elevation 560, the overburden will be excavated in two lifts, each approximately one foot. After the top of the above-WAC area is encountered (elevation 558), excavation within the limits of this above-WAC material will be performed in four-foot lifts.

As shown on Figure 3-7, the side slope of each lift will be cut on a 2H:1V side slope. The side slope will be scanned with field survey instruments (Section 3.3.4.1) to confirm that the limits of the above-WAC material do not extend laterally. If RSS is used, a four-second acquisition time at 1.0 mph will be used. If the gross counts and total uranium concentrations using the RSS system indicate above-WAC material, additional material will be excavated, as required. Alternatively, HPGe measurements at a distance of one foot from the side of the cut face (or closer, depending upon the height) may be used to scan for the presence of above-WAC material instead of the RSS system, or to determine if the gross counts from the RSS system are a result of the presence of uranium. In any case, if measurements indicate the presence of above-WAC material, additional material will be excavated until all such above-WAC material is removed. If additional above-WAC material is detected, the lift will be expanded in the direction(s) indicated by the above-WAC measurement(s) until such material is removed.

After a lift is excavated in the above-WAC material, the adjacent below-WAC material will be excavated (Figure 3-7). For each lift, the above-WAC area will be left approximately one foot lower than the surrounding area, and the surrounding area will be sloped away to facilitate control of surface water. Excavation will continue in this manner until, based on design data, the bottom of the above-WAC material is reached. Upon reaching the design-based floor of the above-WAC excavation (elevation 550), the entire floor will be scanned, to the extent possible, for total uranium in excess of the WAC with the RSS or RTRAK system or HPGe equipment. One hundred percent coverage by RTRAK or RSS will consist of paths offset by approximately two meters with a four-second acquisition time at 1.0 mph. If the gross counts and total uranium concentration using the RSS or RTRAK system

000060

indicate above-WAC material, additional material will be excavated, as required. If only gross counts using the RSS or RTRAK system indicate the potential presence of above-WAC material, additional HPGe measurements at a reduced read height may be used to determine if the gross counts are a result of the presence of uranium. As needed in any case, total uranium activity that indicates above-WAC material will be excavated.

Above-WAC soil and soil-like material will be loaded into trucks and hauled to the SP-7 Stockpile which will be in the former location of SP-5. The loading area will be adjacent to the above-WAC area, toward the equipment wash facility, and sloped to drain into the above-WAC area (ESpec 02205). The location may be changed during excavation to facilitate loading. The contractor will be required to dump the material at the SP-7 Stockpile area without contaminating the wheels of the haul equipment (ESpec 02205). The above-WAC material will be transported off site for final disposition (Section 3.4.2.2) at a permitted commercial disposal facility.

Quality assurance and control measures will be implemented during all phases of the construction activity and field measurements. Data obtained in above-WAC excavation will be managed such that waste profiles can certify material shipment for off-site disposal.

Lead Contaminated Soil in the South Field

As discussed in Section 2.4.2, there are approximately 100 yd^3 of material associated with the former firing range in the South Field with lead contamination above the FRL (400 mg/kg). This material is located on the west side of the South Field, at the base of a steep slope (EDwg G0008). The lead-contaminated soil is assumed to be toxicity characteristically hazardous and will be considered mixed waste. This material will be segregated and handled separately (Section 3.4.3). An additional investigation was conducted (Section 2.1.2.3 and Appendix D) to delineate the extent of the toxicity characteristically hazardous material.

Although not contaminated with lead, material at the top of the slope will be excavated (Section 3.3.2.3) and dispositioned to the OSDF. This excavation is required to keep material from sloughing down the slope, because of its steepness, and creating an unsafe condition during excavation of the lead contaminated soil. The mixed waste will then be excavated to the limits shown on the construction drawings (EDwg G0008). The approach that will be used to excavate this material is

shown on Figure 3-8. The mixed waste will be placed in containers, pending off-site shipment for treatment and disposal.

Following excavation of the toxicity characteristically hazardous material, fill and above-FRL material (in native soil) will be removed. After this excavation is completed, discreet samples will be collected to verify all of the above-lead FRL material has been removed. As required by these measurements, supplemental excavation will then be performed if necessary. The above-FRL material will be transported and disposed in the OSDF.

3.3.2.3 Excavation of Below-WAC Material

Excavation of below-WAC material will typically take place in 3± 1-foot lifts (Figures 3-9 and 3-10). This lift dimension is based on the approximate height of two passes with a typical excavator bucket. In addition to the specified lift height, the contractor will be required to excavate from an elevation higher than that of the material being excavated to assure that the face of the excavation is not obstructed and can be continuously visually monitored. The combination of lift height, visual monitoring, and radiological survey monitoring will ensure that special materials and above-WAC gamma-emitting contamination are identified. Visual monitoring (Section 3.3.4.3) by FDF and contractor personnel will take place during this excavation to identify special materials. If special materials are identified, they will be handled in accordance with Section 3.3.2.5.

Upon completion of a lift in an approximately 100' by 200' area, the contractor will provide at least a 50-ft. buffer zone (ESpec 02205) between the completed area and on-going excavation activities to allow radiological survey monitoring (Section 3.3.4.3) by FDF in the completed area. The purpose of this monitoring will be to identify above-WAC material. If any such material is identified, it will be handled in accordance with the procedures outlined in this subsection.

Upon completion of the excavation to the design depth, the entire area will be precertified (Section 3.5) to assure that the excavation depth is adequate to attain FRLs. As necessary, additional material will be excavated until the radiological surveying indicates that FRLs have been attained. The area will then be ready for certification (Section 3.4 of the SEP).

000062

3.3.2.4 Excavation of Debris

Debris, such as reinforced concrete and structural steel, is anticipated to be encountered and removed from the A2PI area. Such material that exceeds the OSDF physical WAC will be excavated, processed to comply with physical sizing criteria discussed in the OSDF Impacted Material Placement Plan (DOE 1996b), and subsequently hauled to the OSDF for disposal. Processing of debris (Section 3.4.2.1) will occur with appropriate controls based on the processing method and area/material conditions. Debris that meets the OSDF physical WAC will be excavated with the surrounding soil and soil-like material and dispositioned to the OSDF.

3.3.2.5 Excavation of Special Materials

As described in the SEP, and used in this document, special materials include:

Friable presumed asbestos containing materials	Medical/infectious waste
Lead acid batteries	Pressurized containers
Piping/pumps	Tires
Nonpressurized containers (drums)	Uranium metal
Non-soil residues (process-related)	Miscellaneous debris
Transformers/electrical equipment	Acid brick

When these materials are encountered, excavation will stop for the radiological level to be determined by FDF Radiological Control Technicians [RCTs (Section 6.1.4)] for occupational health and safety considerations. Special material that cannot be handled by the contractor due to health and safety concerns will be handled completely by FDF. Under normal circumstances, these special materials will be identified, excavated, handled, and documented in accordance with the guidelines provided in Appendix F of the SEP and the requirements of the technical specifications (ESpec 02205). The excavation contractor will prepare procedures for special material handling and include these as part of the Safe Work Plan. Special materials will be placed in a safe configuration (i.e., container, plastic, etc.), as required, and temporarily staged in a Special Materials Transfer Area (to be located by the excavation contractor and approved by FDF) for later disposition by FDF Waste Management.

An HPGE measurement of residual soil will be taken to ensure any above-WAC material has been removed; upon verification, excavation will again be initiated. If the HPGe measurement indicates

above-WAC material is still present, additional excavation will continue until real-time measurements indicate the above-WAC material is no longer present. The excavated above-WAC residual soil will be segregated and dispositioned by FDF Waste Management.

FDF Waste Acceptance Operations (WAO) will provide a field representative to observe all excavation activities (Section 6.1.3.6). This representative's primary function will be to assist with the identification and handling of special materials, as well as documentation of the disposition of impacted material.

3.3.2.6 Control of Surface Water

Surface water will be controlled by the surface water management system constructed by the site preparation contractor (Section 3.1.7). The excavation contractor will use the surface water management facilities to support the excavation work. This will include monitoring and maintaining the retention basins, ditches and other facilities until all excavation is completed and the area is certified and turned over to FDF.

In addition to the surface water management components constructed by the site preparation contractor, the excavation contractor will construct interceptor ditches and excavation sumps to control surface water. Interceptor Ditch No. 1 will be constructed on the east side of the Inactive Flyash Pile (EDwg G0005). Since excavation of the Inactive Flyash Pile will occur in the first year of the contract and the South Field in the second year (Section 3.3.1), this ditch will prevent runoff from the South Field from cross-contaminating and recontaminating the Inactive Flyash Pile during and after remediation. This ditch is 12 feet deep at the down-stream end and constructed in fill material, thus there is a potential to encounter special and/or above-WAC material. Excavation control monitoring (Section 3.3.4.3) will be used during construction of the ditch. This monitoring may utilize HPGe equipment in locations inaccessible to the RSS/RTRAK.

Interceptor Ditches Nos. 2 and 3 will be constructed at the bottom of the terrace face which slopes to the sands and gravels of the Great Miami Aquifer (EDwg G0005 and G0007). These ditches will divert runoff from uncertified areas away from the exposed sands and gravels of the Great Miami Aquifer.

000064

As excavation is performed, active areas will be graded to drain to collection points located within the excavation. Temporary excavation sumps (EDwg G0018) will be installed in these collection points to maintain a relatively dry work area, minimize the amount of runoff that may flow over the outslope of A2PI, and provide sediment capacity near the active area of excavation. The primary function of the excavation sumps is to centralize sediment from active excavation areas and prevent unnecessary dispersion of sediment from runoff. Excavation sumps are additional and temporary facilities that will serve no long-term use. The sumps will be temporary in nature and generally reconstructed after each lift. 'Sumps will be constructed in a low point and excavation and grading performed to continually drain to the sump. Sediment storage capacity will be provided in each excavation sump below the intake for the pump. Water will be pumped out of the sumps and into the retention basins on an as-needed basis to keep the excavation area functional. Multiple excavation sumps may be used at the same time and will be continually moved as remediation progresses to keep them in close proximity to the active excavation.

The estimated top of the Great Miami Aquifer is shown on the construction drawings, ranging from elevation 551 to elevation 540. Sumps in the above-WAC material that extend into the Great Miami Aquifer will be lined to minimize infiltration (ESpec 02205). Also, when the excavation in the Inactive Flyash Pile and South Field is within one foot of estimated top of the Great Miami Aquifer based on construction drawings, the sump will be lined. The liner will consist of a 60-mil HDPE liner or other approved material.

Excavation of the Inactive Flyash Pile and above-WAC material is inherently protective of the Great Miami Aquifer, since water currently percolating through the Inactive Flyash Pile (including the above-WAC material) into the Great Miami Aquifer will no longer do so following excavation. The area surrounding the above-WAC excavation will be graded to drain away from the above-WAC excavation, further minimizing the amount of water entering the above-WAC excavation area and, ultimately, the Great Miami Aquifer.

3.3.2.7 Monitoring Well Abandonment/Protection

As discussed in Section 3.1.8 and shown in Table 3-1, FDF will abandon most of the groundwater monitoring wells in A2PI which exceed the depth of the proposed excavation. One well (2945) has been partially abandoned by FDF, but the excavation contractor will be responsible for removal of the

well to a depth below the design depth of excavation. Installation of this well was achieved using progressively smaller casing sizes ("telescoping") to ensure well integrity. Currently, the cross section contains a 4-inch diameter stainless steel casing within a 10-inch diameter stainless steel casing, which is within a 12-inch diameter stainless steel casing, which is within a 16-inch diameter stainless steel casing; between all the casings is a total of 12 inches of concrete. The excavation contractor will be responsible for removal of the well casings and the concrete within the casings to a depth five feet below that of expected excavation (i.e., the casings will be cut off at 25 feet below present grade). The casings and concrete are to be removed in a manner so as not to compromise personnel safety; excavation removal strategy will be presented as part of the contractor's Safe Work Plan and is subject to FDF review and approval.

3.3.3 Transportation and Disposition of Impacted Material

Impacted material excavated from the A2PI area will be hauled to the OSDF (the majority of the material) or the SP-7 Stockpile (for above-WAC material), the Special Materials Transfer Area (for special materials), or the Lead Contaminated Soil Container Transfer Area. The majority of this movement will use the Impacted Material Haul Road. To minimize the amount of material tracked onto the Impacted Material Haul Road, equipment wash facilities (Section 3.3.3.2) will be installed at the SWUs for equipment leaving the SWUs, and at the OSDF for equipment leaving the OSDF. Lead-contaminated soil will be placed in containers and staged in the Lead Contaminated Container Soil Transfer Area (EDwg G0005), pending off-site shipment for treatment and disposal. Special materials will be staged in a Special Materials Transfer Area for disposition by FDF Waste Management. Measures will also be implemented to control the generation of dust during the hauling of material (Section 4.2.2).

3.3.3.1 Impacted Material Haul Road

The Impacted Material Haul Road (EDwg G0002) will begin at the northwest corner of A2PI and generally head in a northerly direction along the west side of the former production area, then turn east along the north side of the former production area and connect with the north end of the OSDF. The haul road was constructed as part of initial construction activities associated with the OSDF. The haul road was designed for standard highway H-20 loading but can accommodate off-road haul equipment up to a gross weight of approximately 53 tons without adversely affecting its operational performance and life. It will be operational prior to initiation of the excavation phase of remediation in A2PI. The

000066

haul road will be used to transport impacted material meeting the WAC to the OSDF for disposition, as well as material exceeding OSDF WAC to the SP-7 Stockpile.

During the excavation phase, the entire A2PI area, Impacted Material Haul Road, and OSDF will be classified as one radiological "contamination" area. Dust control measures and equipment washing procedures will minimize the spread of soil and contamination within the area. The OSDF equipment decontamination facility will be used to decontaminate equipment before it leaves radiologically controlled areas.

3.3.3.2 Equipment Wash Facility

As described in Section 3.1.6, an equipment wash facility will be constructed by the site preparation contractor in A2PI where haul equipment will access the new Impacted Material Haul Road. The excavation contractor will install the wash equipment at the facility and operate and maintain it during the excavation phase to meet the performance criteria established in the technical specifications (ESpec 02850). This equipment wash facility will be used to remove soil and debris from the equipment wheels and undercarriage to minimize the amount of material deposited on the haul road, thereby minimizing potential dust generation.

3.3.4 Excavation Control Monitoring

During remediation activities in A2PI, excavation- and disposition-focused monitoring will occur in regard to the following types of material:

- Material with contaminant levels exceeding the OSDF WAC
- Lead-contaminated soil
- Material with contaminant levels below the OSDF WAC
- Special materials.

Since RI/FS data indicate there are no organic COCs in A2PI that affect design or excavation (Section 2.2) or that exceed the OSDF WAC, only organic monitoring associated with health and safety requirements will be performed.

A full time Health and Safety Representative and a Radiological Technician, both DOE representatives, will be in the field to monitor for occupational exposure to the workers. These professionals will use

the tools that are available to them to monitor the excavation work area as necessary and appropriate, including photo-ionization detectors (PIDs) and radiological friskers. The information obtained by these personnel will be used to make decisions regarding personal protective equipment (PPE) and other worker related issues. This information will also be available to Waste Management and WAO personnel and will be used to determine if additional monitoring and/or sampling is necessary to characterize the material for disposal purposes.

Based on lessons learned during the site preparation phase of the project, all excavations will be subject to continuous visual observation by both the contractor and FDF personnel (Section 1.5). Visual observation will be conducted for change in soil media, including the presence of Great Miami Aquifer sands and gravels, and the presence of special materials. The contractor personnel will receive field instruction and assistance in identifying both Great Miami Aquifer and special material.

3.3.4.1 Material with Contaminant Levels Exceeding the OSDF WAC

Excavation of the known above-WAC material in the Inactive Flyash Pile (Section 3.3.2.2), as well as other such material encountered during excavation (Section 3.3.4.3), will be monitored and controlled using radiological field survey measurements. The RI/FS data and results from the predesign investigations (Section 2.1.2) have delineated the extent of an area of above-WAC concentrations of uranium in the Inactive Flyash Pile (Section 2.4.1). This material will be excavated as described in Section 3.3.2.2 and shown on Figure 3-7. The RSS or HPGe detector will be used to monitor the side of the cut face of each lift to verify that material exceeding the OSDF uranium WAC is not present. If necessary, additional material will be excavated until the sides of the excavation are confirmed to be below the OSDF total uranium WAC. Upon removal of all above-WAC material from that lift, the excavation/scanning process will iterate through successive lifts until the design depth is reached. The entire floor of the excavation will then be scanned with the RTRAK, RSS, or HPGe to verify that material exceeding the OSDF total uranium WAC has been removed. If above-WAC material is detected in the floor of the excavation at the design depth, additional material will be removed, as necessary, and the floor will be rescanned.

000068

3.3.4.2 Lead-Contaminated Soil

Excavation of the lead-contaminated soil (Section 3.3.2.2) will be monitored using a portable XRF instrument. The RI/FS data and results from the predesign investigation (Section 2.1.2.3) have delineated the extent of soil that contains lead contamination above the FRL and all lead contaminated soil that will be classified as characteristically hazardous (Section 2.4.2). This soil will be excavated, containerized, and staged pending off-site treatment and disposal (Section 3.3.2.2).

After the delineated lead contaminated soil has been removed, discrete soil samples will be collected from within the limits of the lead excavation and undergo XRF analysis via a portable field instrument to obtain preliminary verification that all above-lead FRL soil has been removed. Alternatively, in situ analyses may be performed. If the XRF screening indicates the presence of soil containing above-FRL concentrations of lead, additional excavation will take place and the XRF screening will be repeated. This step will be reiterated until the screening indicates the remaining soil is below the lead FRL.

After XRF screening indicates that all above-FRL soil has been removed, discrete samples will be collected from locations at the base of the lead excavation and sent to a laboratory for lead analysis. If laboratory results indicate that above-FRL material persists, additional material will be removed and the base of the footprint will be resampled for further laboratory analysis. In addition, radiological monitoring will be performed to confirm that all above-FRL radiological contamination has been removed. Upon confirmation that all above-FRL material has been excavated, the area will be ready for certification (Section 3.4 of the SEP).

3.3.4.3 Below-WAC Material

As stated in Section 3.3.2.3, excavation of below-WAC material will typically occur in lifts. As the face of a lift progresses across an area, two types of monitoring will take place (Figures 3-9 and 3-10). First, the face of the excavation will be continuously visually monitored for special materials and changes in the appearance of the soil/material. If special materials are identified, they will be excavated and handled according to guidelines provided in Section 3.3.2.5 and detailed in the contractor's Safe Work Plan. A change in the appearance of the soil/material being excavated may indicate other unexpected conditions, and the contractor will coordinate with FDF construction manager and WAO field personnel (Section 6.6) to determine the required action, if any. As necessary, the contractor will stop work, or proceed in another area, until the issue is resolved.

In addition to visually monitoring the face of the excavation, radiological monitoring of the entire surface of each lift will be conducted, to the extent possible, with RSS/RTRAK or HPGe equipment to identify above-WAC uranium activity that may be present. If potentially above-WAC uranium activity is identified, additional material will be excavated, as necessary, to remove all above-WAC material (ESpec 02205). In cases where the radiological monitoring indicates the potential for extensive above-WAC contamination, either vertically or horizontally, physical samples and real-time analysis of collected cores may be utilized to delineate the extent of above-WAC material prior to excavation.

Following completion of excavation to the limits shown on the construction drawings (EDwgs G0005 and G0007), measurements will be taken to precertify (Section 3.5) the floor of the excavation for gamma-emitting radionuclides. If precertification criteria are not met, additional excavation will take place to remove the identified contamination. Excavation will cease when the floor of the excavation is shown to meet the precertification protocol for gamma-discernable radionuclides. The excavated surface will then be certified, as described in the Certification Design Letter (CDL) (Section 7.2 of the SEP), which will be developed subsequent to excavation in each area.

3.3.4.4 Special Materials

Continuous visual monitoring will be performed during all excavations for special materials. This monitoring will be performed by trained personnel.

3.3.5 Miscellaneous Excavation Requirements

During site preparation, impacted material will be temporarily placed into the South Field Impacted Material Stockpile (Section 3.1.9). This stockpile will be located in the South Field to prevent material from being removed from the SWUs during site preparation. It will contain approximately 24,000 yd^3 of impacted material excavated during site preparation activities. This stockpile will be excavated during the excavation phase and placed directly into the OSDF. As described in Section 2.1.2, WAC attainment sampling and analysis was performed on the impacted material prior to excavation. As discussed in Section 3.1.9, the South Field Impacted Material Stockpile has been divided into two sections, both of which will be excavated in the same manner. Special materials were encountered in the excavation of the slope north of Retention Basin 2, which required segregation and separate waste management practices. The underlying soil was monitored at that time for radiological WAC, and following the determination that the soil was not in exceedance of the OSDF radiological WAC, the soil

000070

was placed in the South Field Impacted Material Stockpile. Visual monitoring and radiological field monitoring will be performed during excavation and loading of this stockpile.

Appropriate measures will be implemented to control the generation of dust. These measures include temporary seeding or application of a crusting agent in areas to be left idle for more than 45 days (ESpec 02275), and the use of water, dust suppressants, crusting agents, and other measures to control dust during actual excavation activities (Section 4.2.2).

All interim and final movements of impacted material will be documented as required by the construction drawings and technical specifications (ESpec 02205). This data will be incorporated into the Integrated Information Management System (IIMS [Section 3.4 and 6.7]).

3.3.6 Excavating Material from Stock Pile No. 5

Sampling and analysis results from Area 1 of SP-5 were used to delineate the boundary between: 1) the above-WAC material in SP-5 that will remain and become part of SP-7, and 2) the material in SP-5 that can be excavated and placed in the OSDF. The entire top 6 feet of SP-5 will be excavated and placed in the OSDF; below a depth of 6 feet, the south half of SP-5 will remain in place and become part of SP-7, and the entire northern half of SP-5 will be excavated and placed in the OSDF.

The material that will be excavated from SP-5 will be removed in 3 ± 1 foot lifts as unclassified impacted material, in accordance with ESpec 02205. FDF will visually monitor all excavations for special materials [as defined in the SEP (DOE 1997a)]. After each 3-foot lift is excavated, FDF will perform a real-time scan of the surface of each lift for total uranium. Based on the real-time gamma spectrometry results, the contractor will be given further direction which may include one or more of the following:

- Continue to excavate and transport to the OSDF
- Stop excavation and leave the remaining material for future incorporation into SP-7
- Excavate a portion of the material
- A combination of the above.

The excavation contractor will continue to excavate until the lines and grades shown on the SP-5 excavation drawing are achieved, real-time monitoring indicates that the area primarily consists of above-WAC material, or another decision is made based on field conditions.

The excavation contractor will stage the excavation to segregate above-WAC material and associated equipment from the other WAC-compliant material and equipment. The contractor will not be permitted to load equipment in the above-WAC area for transport to the OSDF.

The excavation contractor is required to keep the haul road clean of mud, dirt, and debris. The specific means, methods, and equipment to achieve this requirement will be presented in the Safe Work Plan that will be prepared by the contractor and reviewed and approved by FDF.

The excavation contractor will provide a portable equipment wash facility and/or other methods and procedures at SP-5 to keep the impacted material haul road clean during excavation of SP-5.

Material from SP-5 that exceeds the OSDF WAC will remain in the SP-5 area and become part of SP-7. After WAC-compliant material is excavated from SP-5, the stockpile will be renamed SP-7 and the area will be ready to receive above-WAC material from the SWUs. Preparing the site to receive above-WAC material will include construction of an access road and ramp (in accordance with ESpec 02205). This will include some type of facility that will prevent haul equipment tires from coming into contact with above-WAC material during unloading and associated activities.

3.4 MATERIAL HANDLING AND TREATMENT

Excavation in A2PI will consist primarily of soil, flyash, and debris. Excavation of this material will be in accordance with the requirements contained in the project-specific technical specifications (ESpec 02205) and shown on the construction drawings. Specific construction methods and procedures to achieve these requirements will be detailed in the excavation contractor's Safe Work Plan, (ESpec 02205).

3.4.1 General Requirements and Objectives

The technical specifications provide general requirements for the removal and handling of excavated material. Flow charts in Appendix F of the SEP provide general guidelines for the excavation and

000072

handling of special materials expected to be encountered in A2PI. Because most of the excavated impacted material will be placed in the OSDF, the OSDF Impacted Material Placement Plan is included as part of the contract documents.

During excavation, it is possible that unexpected conditions will be encountered that are not addressed through standard excavation specifications and guidelines. The combination of specifications and contractor Safe Work Plans establish procedures to be implemented in such cases, including moving excavation activities to another area to allow evaluation of the unexpected condition. This approach will minimize and/or prevent work stoppages/slowdowns and keep the excavation process moving forward.

3.4.2 WAC Attainment

Attainment of WAC involves both criteria for disposal in the OSDF as well as criteria for disposal in off-site facilities for material that does not meet the OSDF WAC.

3.4.2.1 Attainment of OSDF WAC

A key component of the OSDF WAC attainment program is the IIMS tracking system (Section 6.7), which maintains traceability of excavated impacted material to RI/FS, predesign, precertification, and supplementary WAC data.

The following actions will be performed to demonstrate compliance with the OSDF WAC:

- Assign OSDF-bound materials to material profiles
- Implement IIMS tracking requirements
- Segregate impacted materials according to OSDF Impacted Materials Placement Plan Categories 1 through 5 (DOE 1998a)
- Reduce size, fill void spaces, package (if required), and otherwise comply with physical OSDF WAC requirements
- Visually inspect the material to verify it meets physical OSDF WAC requirements
- Visually inspect the material to verify it does not include prohibited items

- Perform IIMS WAC attainment query in conjunction with manifest preparation, to verify material meets OSDF chemical/radiological WAC
- For OSDF Category 5 non-soil residues:
  - Complete a supplementary sampling program to assess type and level of contamination
  - Implement required actions

Material that does not meet the OSDF physical WAC will be processed and hauled to the OSDF for disposal. It is expected that, based on the types of material expected in the SWUs, the need for this segregation and processing will be minimal. Therefore, such required processing will take place at or near the area from which the material was excavated. Anticipated processing includes size reduction of concrete, pipe, and debris using excavation equipment. Before size reduction, pipe will be inspected to ensure that it contains no process material.

Processing of debris will be appropriately controlled based on the processing method and area/material conditions. Such controls, if required, may include water sprays, dust suppressants, or foam to reduce the generation of fugitive dust.

3.4.2.2 Special Material Not Meeting OSDF WAC

Management of special materials (Section 3.3.2.5) that do not meet the OSDF WAC will be coordinated with FDF Waste Management be in accordance with the SEP, WAC Attainment Plan, and "Management of At- and Below-Grade Impacted Material" (EW-1019). The following generator information will be provided to IIMS (Section 6.7) by the FDF WAO representative in the field and excavation contractor for material not meeting the OSDF WAC:

- Estimated volume
- Material Tracking Location (MTL) of origin
- Visual description of material.

FDF Waste Management will be responsible for assuring off-site WAC are met prior to transportation of material to such off-site disposal facilities. Responsibilities for materials that fail the chemical/radiological OSDF WAC are listed below:

000074

- Completion of waste profile
- Evaluation for treatment
- Identification of appropriate off-site disposition
- Receipt of approval from the receiving facility
- Packaging for shipment
- Certification for Department of Transportation (DOT) requirements
- Coordinating off-site shipment.

3.4.3 Lead Contaminated Material

Lead contaminated soil from the former firing range that is demonstrated to exceed RCRA toxicity characteristic limits will require treatment to comply with land disposal restrictions [LDRs (40 CFR 268)] before final disposition. Management of this soil will also be coordinated with FDF Waste Management. The same generator information required for above-WAC material will be provided to IIMS by the excavation contractor. FDF Waste Management will be responsible for assuring off-site WAC are met prior to transportation.

3.5 PRECERTIFICATION AND CERTIFICATION

After excavation, the A2PI area will be precertified and certified. Precertification and certification will be performed in a phased manner and in two general A2PI areas: the A2PI waste unit areas and the A2PI non-waste unit areas. Section 6.10 presents the schedule for these activities. Generally, the A2PI waste unit areas consist of the areas originally covered by the waste units (Inactive Flyash Pile, South Field, and Active Flyash Pile); the major exception to that definition is the south part of the South Field. The south part of the South Field will be covered by Retention Basin 2 and is part of the A2PI non-waste unit areas. The overall A2PI certification boundary and the general A2PI areas are shown on Figure 3-11.

Precertification will be performed with real-time instruments as excavation is completed to verify an area is ready for certification. Real-time instruments (RTRAK, RSS and/or HPGe) will measure primary radiological COC concentrations in the surface soil. The equipment will be selected and used based on actual field conditions as described in the User Guidelines, Measurement Strategies, and Operational Factors for Deployment of In-Situ Gamma Spectrometry at the Fernald Site (DOE 1998c). The results will be used to identify the following:

- Soil with contaminants that exceed FRL concentrations
- "Hot Spot" areas (as defined in the SEP)
- Residual contamination patterns.

Based on precertification results, supplemental excavation will be performed if necessary. Supplemental excavation will be performed in areas where precertification results indicate that existing surface soil contaminant concentrations exceed FRLs. Additional precertification will be performed in areas where supplemental excavation is performed. Precertification and supplemental excavation will continue until precertification results indicate that the area is ready for certification; results will be used to finalize the certification units (CUs) and prepare the CDL. Certification will be performed in accordance with the CDL as described in the SEP to verify that residual soil constituents are below FRLs. Based on certification results, supplemental excavation may again be performed in areas where residual constituents fail certification criteria. Additional certification will be performed in areas where supplemental excavation is performed. Certification sampling and analysis and supplemental excavation will continue until certification results indicate that the soil surface conditions satisfy certification and hot spot criteria.

3.5.1 A2PI Waste Unit Areas

Precertification and certification will be performed and completed in the A2PI waste unit areas before the A2PI non-waste unit Areas. Most of the work and associated supplemental excavation will be performed when the SWU excavation contractor is working in the area.

Precertification. Precertification will be performed within the A2PI waste unit areas after the areas are excavated to the lines and grades shown on the construction drawings (Section 3.3). This process will be a continuation of the excavation process and supplemental excavation (if required), performed by the SWU excavation contractor. Real-time monitoring will be performed as excavation reaches the grades shown on the drawings and performed in different areas as excavation is completed. The two interceptor ditches in the South Field/Inactive Flyash Pile area will remain in place until the entire area is ready for precertification. After all upgradient areas are precertified, the interceptor ditches will be removed and precertification performed underneath the area of the interceptor ditches. Precertification will be complete after real-time monitoring indicates that the entire A2PI waste unit area is ready for certification.

000076

Certification. Certification will be performed within the A2PI waste unit areas after the precertification is complete and the CDL is approved. The CDL will define the CUs and the sampling and analysis requirements.

3.5.2 A2PI Non-Waste Unit Areas

Precertification and certification will be performed and completed in the A2PI non-waste unit areas after the A2PI waste unit areas. The approximate limits of the A2PI non-waste unit areas are shown on Figure 3-11. The A2PI non-waste unit areas will be divided into subareas based on field conditions and logistical requirements. For example: Retention Basin 2 area must be precertified and certified before the area under Non-Impacted Stockpile No. 1 can be precertified because soil from Non-Impacted Stockpile No. 1 will be used to backfill Retention Basin 2 (Section 3.6.2).

There will be three types of subareas precertified and certified in the non-waste unit areas:

- Areas with A2PI support facilities and other manmade structures
- "Undisturbed" areas with no obvious signs of contamination
- Dirty corridors.

The first two areas listed above will be precertified and certified as part of A2PI non-waste unit areas. The dirty corridors will be remediated and certified as part of Area 10 - Corridors and Roads.

Final details concerning certification of non-waste unit areas will be presented in a CDL. However, the approach presented will indicate that certification will be performed after:

- Removal of manmade structures and devices (i.e., riser pipes, HDPE liners)
- Removal of obvious impacted material (e.g., flyash, special material).

The HDPE liners will be removed from all three retention basins prior to precertification. The anchor trenches associated with the HDPE liners and the top of the basin embankments will be removed. This will include flyash and other impacted material. Within Retention Basins 1 and 3, initial precertification will be performed on the clay infiltration barrier (that was installed in the two basins) and the underlying sand layer. If precertification indicates that contaminant levels in the clay are above the FRLs, the clay layer will be removed and precertification and certification will be performed on the

sand layer below. If precertification indicates that contaminant levels in the clay are below the FRLs, only the clay layer will be certified.

After manmade structures and obvious impacted material is removed, both disturbed areas and non-disturbed areas will be certified as described in the CDL. Supplemental excavation will be performed as necessary.

3.6 INTERIM RESTORATION

Following removal of impacted material from A2PI and certification of FRL attainment (Section 3.4 of the SEP), A2PI will be interimly restored consistent with expected natural resource restoration plans. Interim restoration refers to a stabilized soil condition which promotes habitat until final restoration is implemented. The draft NRRP defines final restoration of A2PI as:

> "An expanded riparian habitat will be established in the downgradient areas of A2PI. The remaining slopes and upgradient areas will be restored to an upland forest that is typical of southwestern Ohio. These sections will require the application of topsoil and extensive revegetation. Some bank stabilization will also be required along various sections of Paddys Run."

Interim restoration will be performed to support the final restoration plan as much as possible. Interim restoration will be performed separately in the A2PI waste unit areas and the A2PI non-waste unit areas if necessary.

3.6.1 A2PI Waste Unit Areas

Significant regrading is not expected in A2PI waste unit areas since the final excavation contours were designed to provide stable slopes and adequate drainage. Interim restoration is expected to be performed by the SWU restoration contractor. Minor grading may be performed based on actual conditions encountered in the field and will be limited to grading to enhance stability and promote drainage as required. Therefore, after certification is completed and minor grading performed (if required), a temporary cover will be applied. As a temporary cover (ESpec 02275), the soil will be mulched and hydro seeded (Section 3.3.1) with a permanent seed mixture (ESpec 02900). The specifications were developed and soil will be stabilized in accordance with the guidelines for stabilizing of disturbed areas as presented in the SEP.

3.6.2 A2PI Non-Waste Unit Areas

After certification of the A2PI waste unit areas, runoff from A2PI will no longer require collection and treatment. Therefore, the surface water management facilities in A2PI will be modified to be more consistent with the final restoration plan of the area, including removing the HDPE liners (Section 3.5.2) and other modifications as described herein. Surface water controls installed during construction along the perimeter of A2PI will remain to prevent cross-contamination from upgradient areas.

Because some earthwork is required (approximately 15,000 cubic yards of material must be moved), precertification, certification and interim restoration in the A2PI non-waste unit areas will be performed in a phased and overlapping manner. These activities are not scheduled to begin until the year 2001. The detailed certification approach will be presented in a CDL. Also, a separate and more detailed natural resource restoration design package (NRRDP) will be prepared prior to initiation of the work. Therefore, this Implementation Plan presents the general restoration concept only.

The major components of interim restoration are shown on Figure 3-12. Interim restoration in A2PI non-waste unit areas will include:

- Removal of HDPE liners and riser pipes (all three retention basins)
- Excavating open channel spillways in Retention Basins 1 and 3
- Removal of chain link fence around Retention Basin 2
- Removal of underground pipes (some will remain until Area 10 corridors are removed)
- Placing material from Non-Impacted Stockpile No. 1 into Retention Basin 2
- Removing the Equipment Wash Facility

Soil will be stabilized in accordance with the guidelines for stabilization of disturbed areas as presented in the SEP.

The HDPE liner will be removed from all three basins, and the clay layer below the HDPE liner may remain in place if certification sampling indicates it is acceptable. Retention Basins 1 and 3 are planned for conversion into some type of long term basins and/or wetlands, based on their geographic locations, the type of liner systems used, and other factors. The potentially remaining clay liner makes these two basins suitable to a long term option. Retention Basin 2 is planned to be backfilled using material from Non-Impacted Stockpile 1. This approach is based on a timing/scheduling issue: it will allow the area

beneath Non-Impacted Stockpile 1 (which is included in the Non-Waste Units Area) to be certified as soon as possible after the Waste Units Area. The restoration approach may be revised based on precertification and certification data.

Additionally, there will be a radiological downposting of the area from a "radiological contamination" area during excavation, to a "soil contamination" area following precertification, to a final "certified" posting following certification.

3.7 INSTITUTIONAL CONTROLS

Institutional controls, such as fencing, posting of signs, and groundwater monitoring, are a key component of the Operable Units 2 and 5 selected remedies. Commitments to ensure the intent of the selected remedy is met are discussed in Section 1.3.

Access restriction to remediated areas is necessary to prevent cross-contamination during and following remediation. Access to for certified areas will be granted in accordance with FEMP site procedures. Institutional controls to restrict access to the remediated A2PI area include installing construction fencing around the area and posting the appropriate caution and warning signs. The construction fence will define the control boundary of the A2PI site and gates will be installed at equipment access points.

The access restrictions will remain in place until the area is released after restoration. Following the completion of remediation, during the final restoration phase, the institutional controls will be dictated by the NRRP.

Long-term groundwater monitoring will be conducted to determine the effectiveness of the remedy. The designated monitoring wells, as well as sampling methods and constituents, are presented in the IEMP.

TABLE 3-1

STATUS OF A2PI GROUNDWATER MONITORING WELLS

Well #	Location	Plans for Well
21190 (1016)	IFP	Plugged/abandoned by FDF
1045	AFP	Plugged/abandoned by FDF
1046	SF	Plugged/abandoned by FDF
1047	North of IFP	Plugged/abandoned by FDF
1048	AFP	To remain/requires protection
1433	SF	To be plugged/abandoned by FDF
1711	IFP	To be plugged/abandoned by FDF
1941	SF	To be plugged/abandoned by FDF
1942	SF	Plugged/abandoned by FDF
1954	SF	Plugged/abandoned by FDF
2016	IFP	To remain/requires protection
2045	AFP	IEMP well: To remain/requires protection
2046	SF	IEMP well: To remain/requires lowering and protection
2047	North of IFP	Plugged/abandoned by FDF
2048	AFP	To remain/requires protection
2049	South of AFP	IEMP well: To remain/requires protection
2385	North of AFP	IEMP well: To remain/requires protection
2401	IFP	Plugged/abandoned by FDF
2943	SF	Plugged/abandoned by FDF
2944	SF	Plugged/abandoned by FDF
2945	SF	Removed by excavation subcontractor
2954	SF	Plugged/abandoned by FDF
2955	IFP	Plugged/abandoned by FDF
3016	IFP	Plugged/abandoned by FDF
3045	AFP	IEMP well: To remain/requires protection
3046	SF	IEMP well: To remain/requires lowering and protection
3049	South of AFP	IEMP well: To remain/requires protection
3385	North of AFP	IEMP well: To remain/requires protection
4016	IFP	To remain/requires protection
11032	North of SF	To remain/requires protection
21033	AFP	IEMP well: To remain/requires protection
21065	North of SF	To remain/requires protection
21191	South of SF	To remain/requires protection
31563	South of AFP	Extraction well: To remain/requires protection
31564	South of SF	Extraction well: To remain/requires protection
31565	IFP	Extraction well: To remain/requires protection
31566	AFP	Extraction well: To remain/requires protection

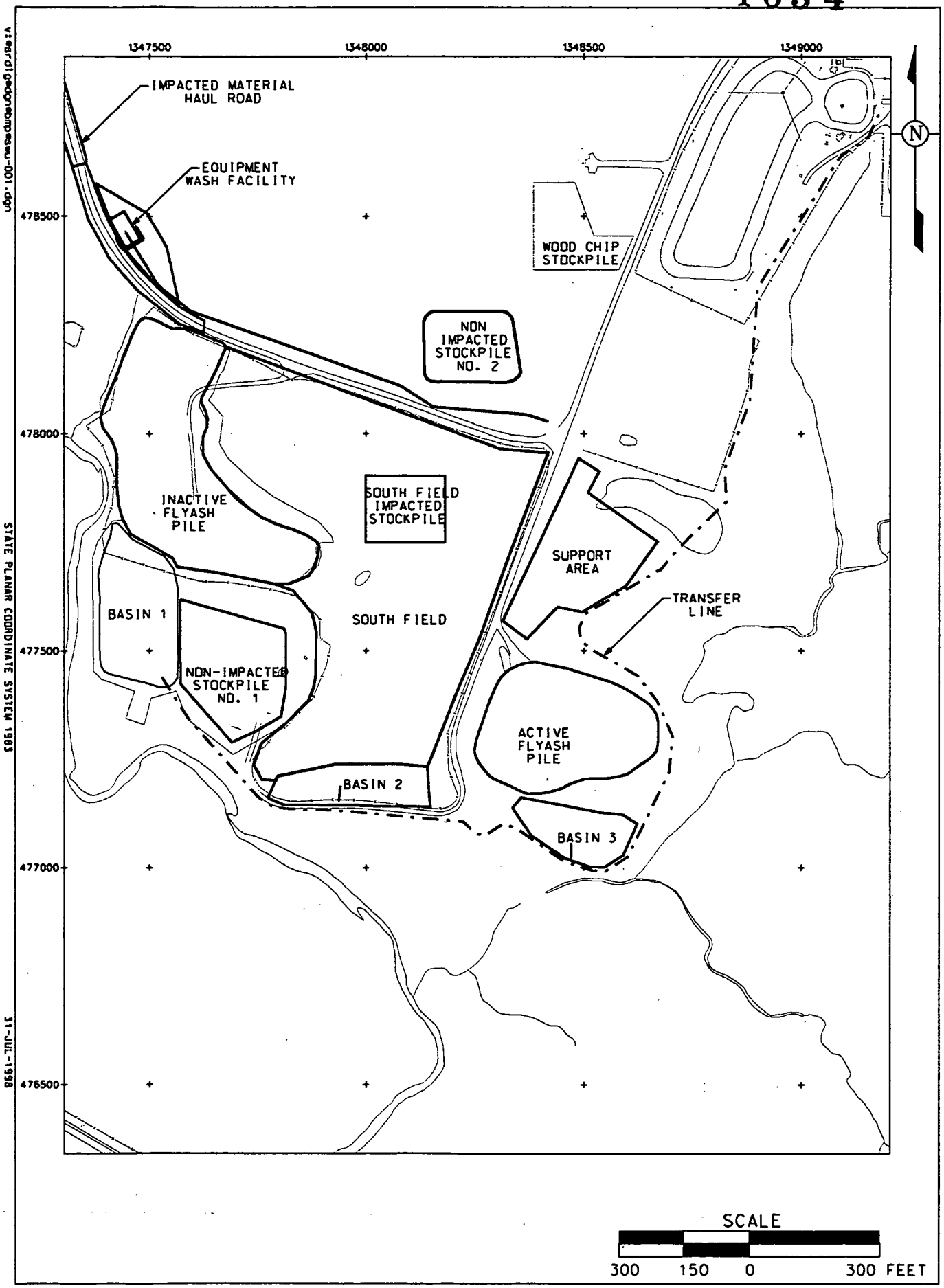

FIGURE 3-1. SWUs PRIOR TO EXCAVATION (MAY 1998)

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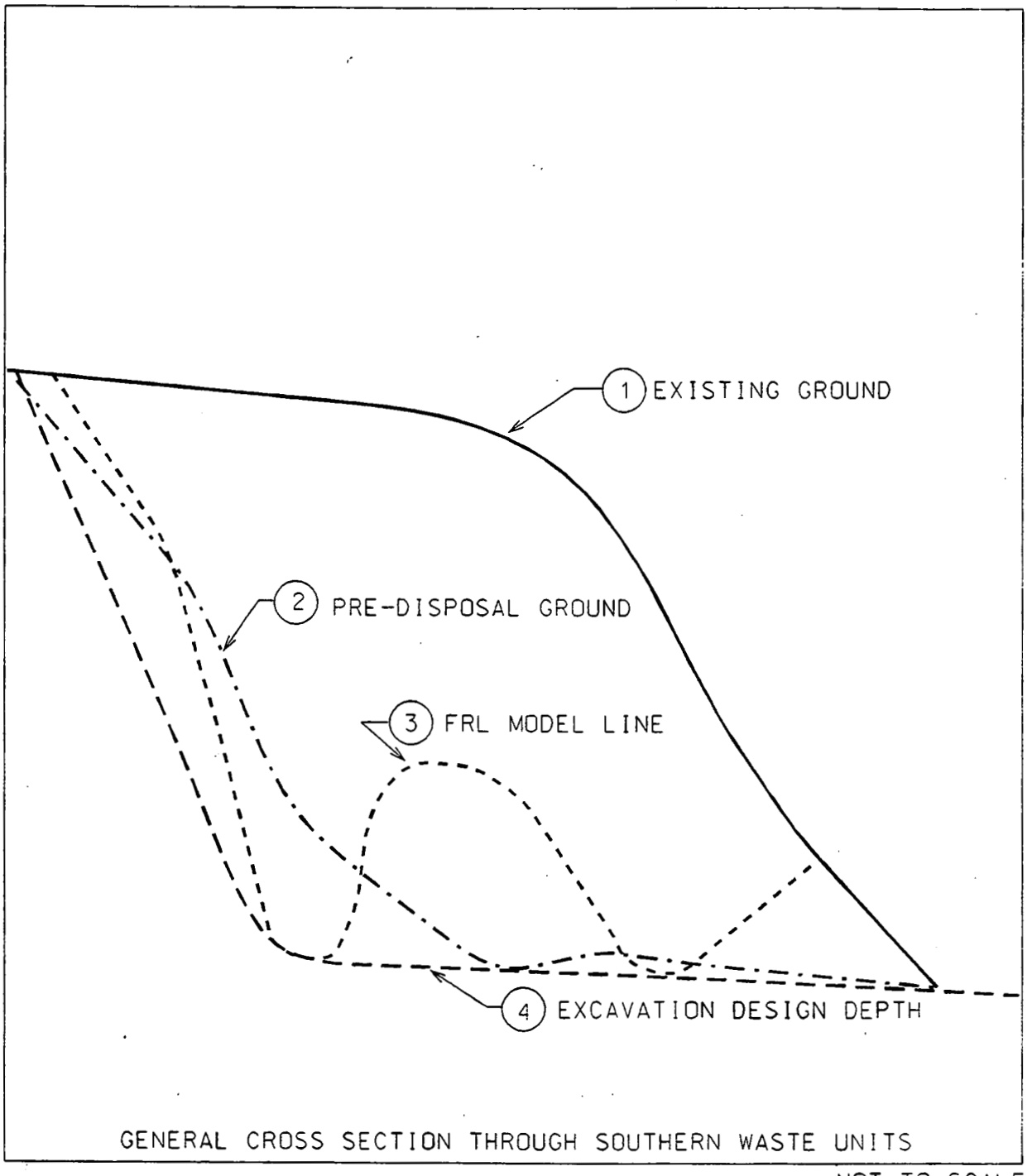

NOT TO SCALE

1. EXISTING GROUND (FROM 1992 AERIAL PHOTOGRAPHY).
2. PRE-DISPOSAL GROUND - (FROM 1952 TOPOGRAPHIC MAPPING AND BORING LOG INFORMATION).
3. FINAL REMEDATION LEVEL (FRL) MODEL LINE - (FROM ENVIRONMENTAL GEOSTATISICAL MODEL BASED ON RI/FS AND PREDESIGN DATA).
4. EXCAVATION DESIGN DEPTH - DEEPER OF (2) PRE-DISPOSAL GROUND, AND (3) FRL MODEL LINE WITH ADDITIONAL SMOOTHING TO DEVELOP STABLE GRADES.

FIGURE 3-2. DEVELOPMENT OF EXCAVATION DESIGN

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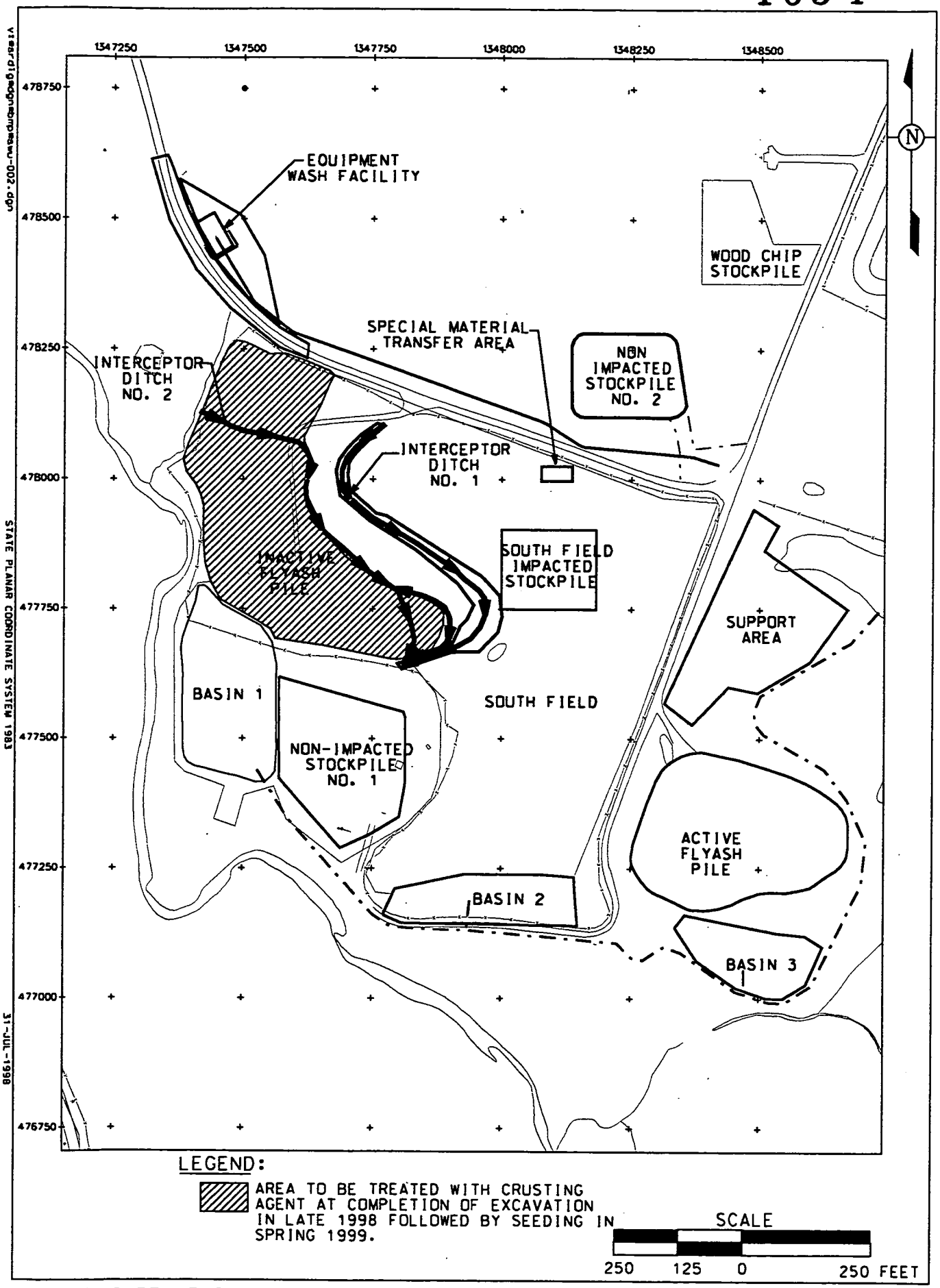


FIGURE 3-3. SWUs AFTER FIRST YEAR OF EXCAVATION (DEC. 1998)

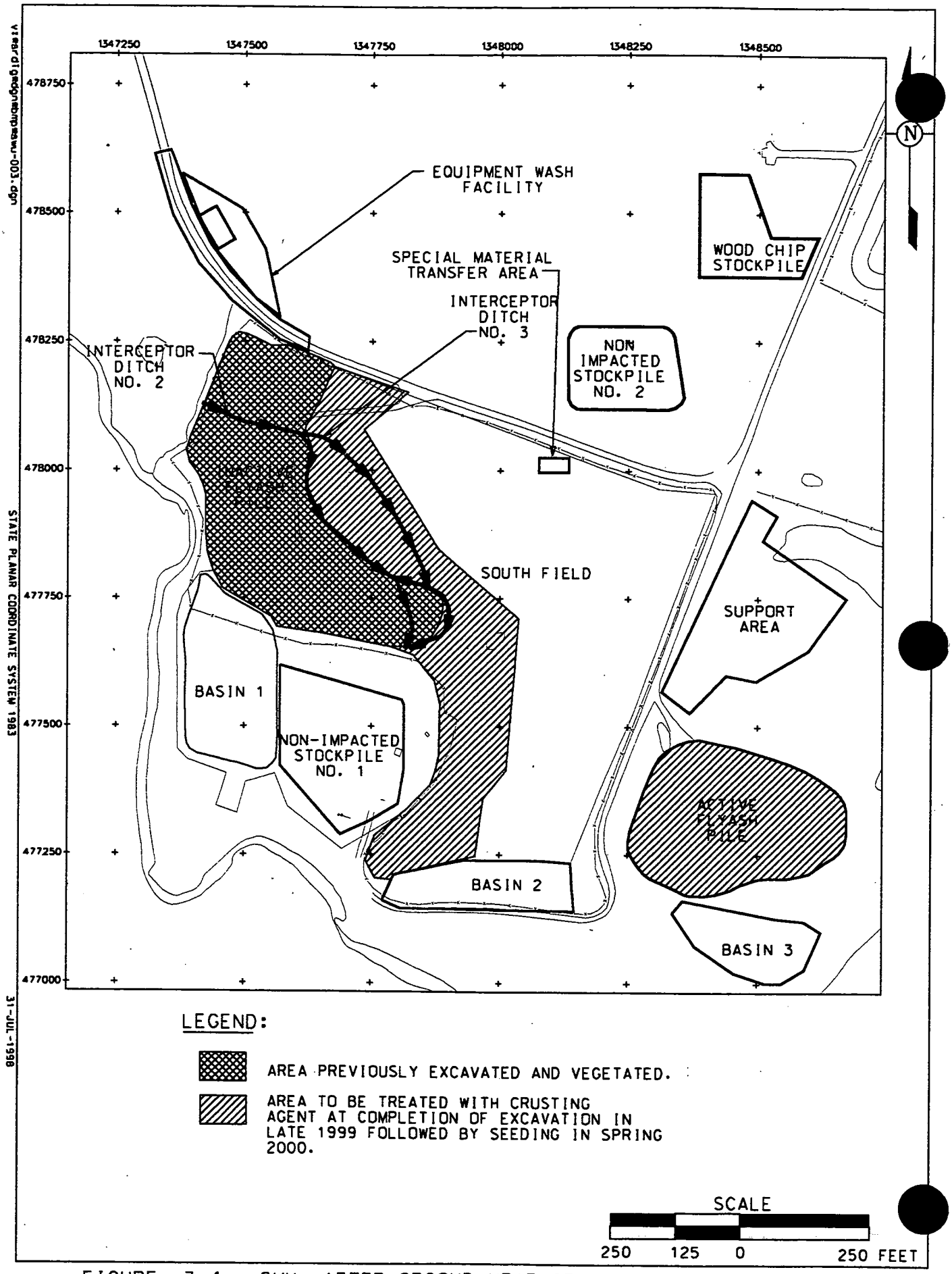


FIGURE 3-4. SWUs AFTER SECOND YEAR OF EXCAVATION (DEC. 1999)

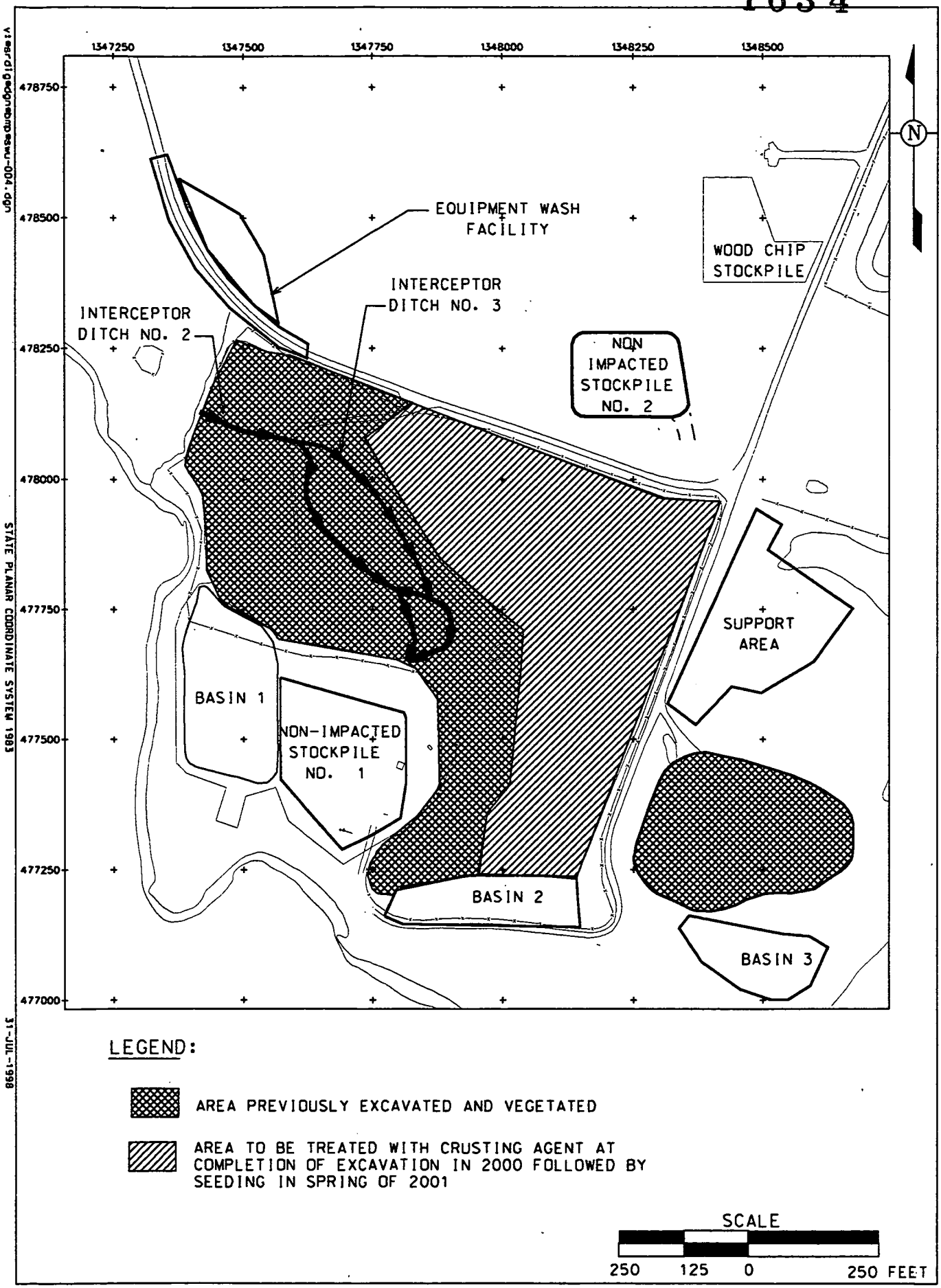
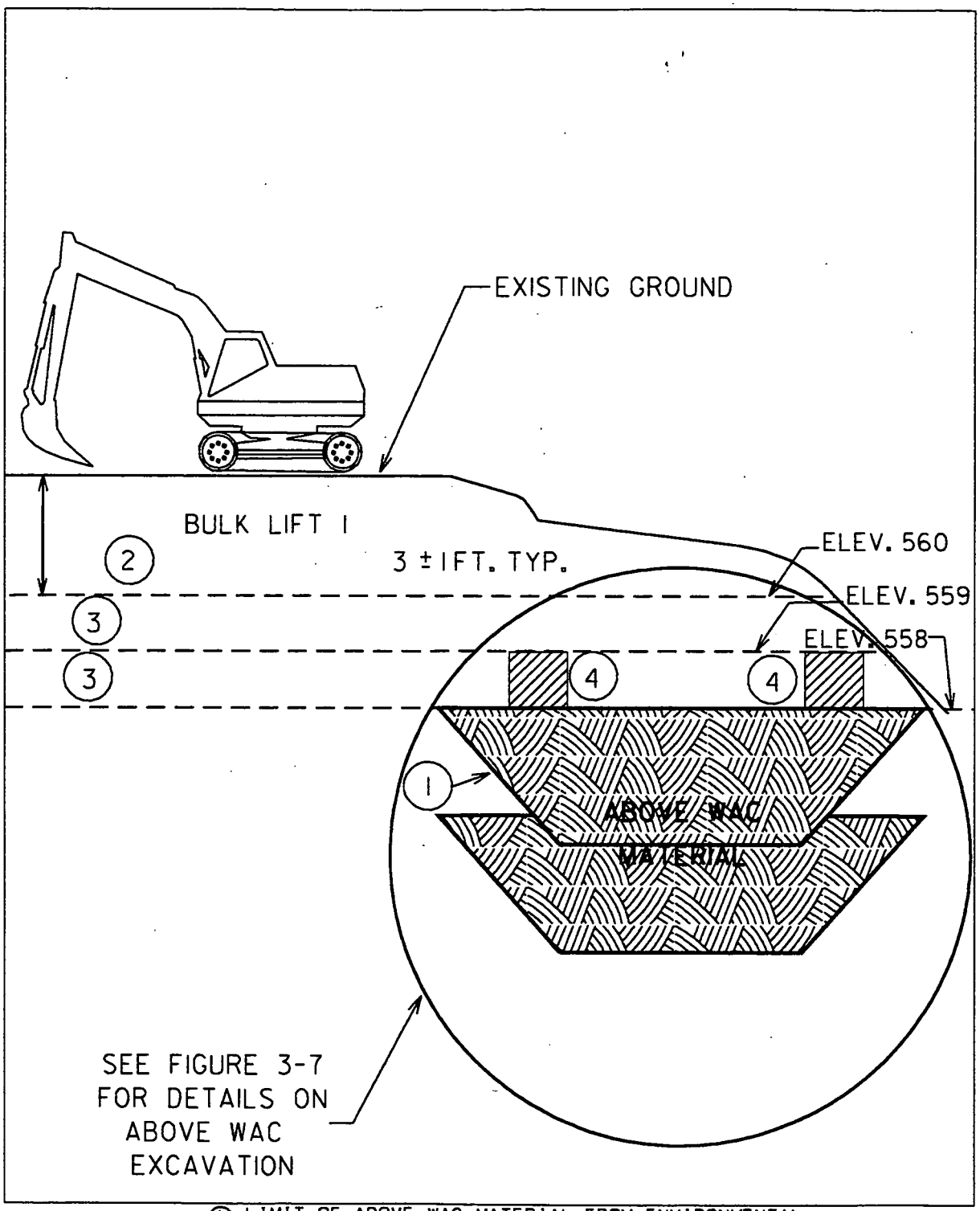


FIGURE 3-5. SWUs AFTER COMPLETION OF EXCAVATION (DEC. 2000)



① LIMIT OF ABOVE WAC MATERIAL FROM ENVIRONMENTAL MODEL BASED ON RI/FS AND PRE-DESIGN SAMPLING DATA.

② BULK EXCAVATE MATERIAL TO TOP OF ABOVE WAC MATERIAL.

③ AT ELEVATION 560. EXCAVATE TWO-1 FT. LIFTS (FROM 560 TO 559 AND FROM 559 TO 558).

④ TWO 10 X 10 FT. ABOVE WAC AREAS BETWEEN ELEV. 559 AND 558; WILL BE FIELD STAKED BY FDF.

FIGURE 3-6. GENERAL EXCAVATION ON TOP OF ABOVE WAC MATERIAL

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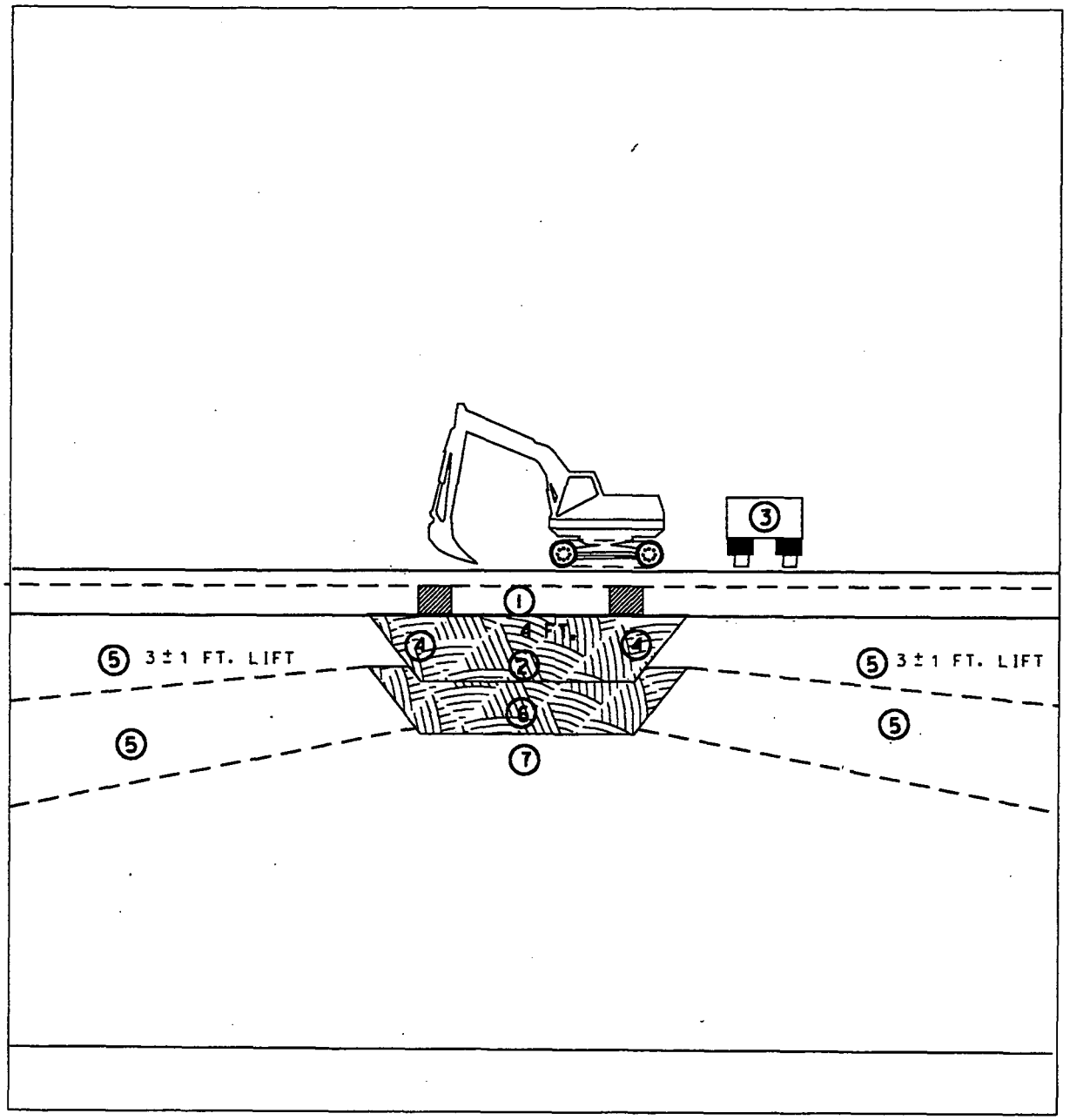

1. EXCAVATE TWO 10 X 10 FT. ABOVE WAC AREAS BETWEEN ELEVATION 559 AND 558.
2. EXCAVATE ABOVE-WAC MATERIAL IN FOUR FOOT LIFTS SIDE SLOPES SHALL BE APPROXIMATELY 2H:1V
3. LOAD TRUCKS OUTSIDE OF ABOVE-WAC MATERIAL AREA.
4. FDF SHALL FIELD SURVEY SIDE SLOPE OF EACH LIFT IN ABOVE-WAC MATERIAL.
5. EXCAVATE 3 ±1 FT. LIFT OUTSIDE ABOVE WAC MATERIAL AS PER FIGURE 3-9 AFTER EXCAVATION OF EACH 4 FT. LIFT IN ABOVE-WAC MATERIAL. GRADE AWAY FROM ABOVE WAC MATERIAL
6. CONTINUE AND REPEAT STEPS 1 THROUGH 4 TO BOTTOM OF ABOVE-WAC MATERIAL.
7. FIELD SURVEY BOTTOM OF ABOVE-WAC MATERIAL. AND EXCAVATE ADDITIONAL LIFTS AS NECESSARY.

ABOVE WAC MATERIAL

FIGURE 3-7. ABOVE WAC EXCAVATION APPROACH

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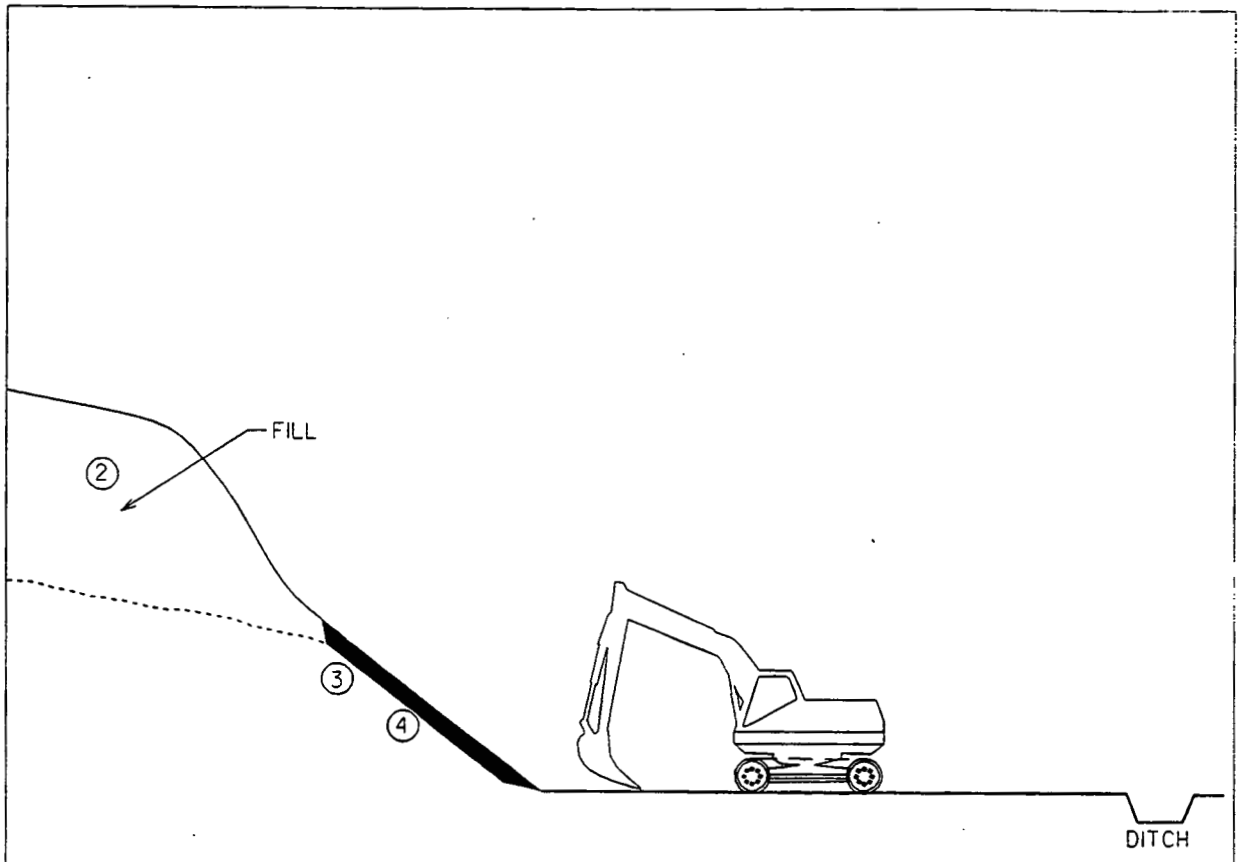

LEAD CONTAMINATED SOIL

1. SURVEY AND STAKE LIMIT OF LEAD CONTAMINATED SOIL BASED ON PREDESIGN SAMPLING. (NOT SHOWN)
2. EXCAVATE IMPACTED MATERIAL ABOVE LEAD CONTAMINATED SOIL IN 3 ±1FT. LIFTS.
3. EXCAVATE LEAD CONTAMINATED SOIL TO DEPTH SHOWN ON CONSTRUCTION DRAWINGS.
4. PERFORM CONFIRMATORY SAMPLING.
5. PERFORM SUPPLEMENTAL EXCAVATION AS NEEDED BASED ON CONFIRMATORY SAMPLING. (NOT SHOWN)

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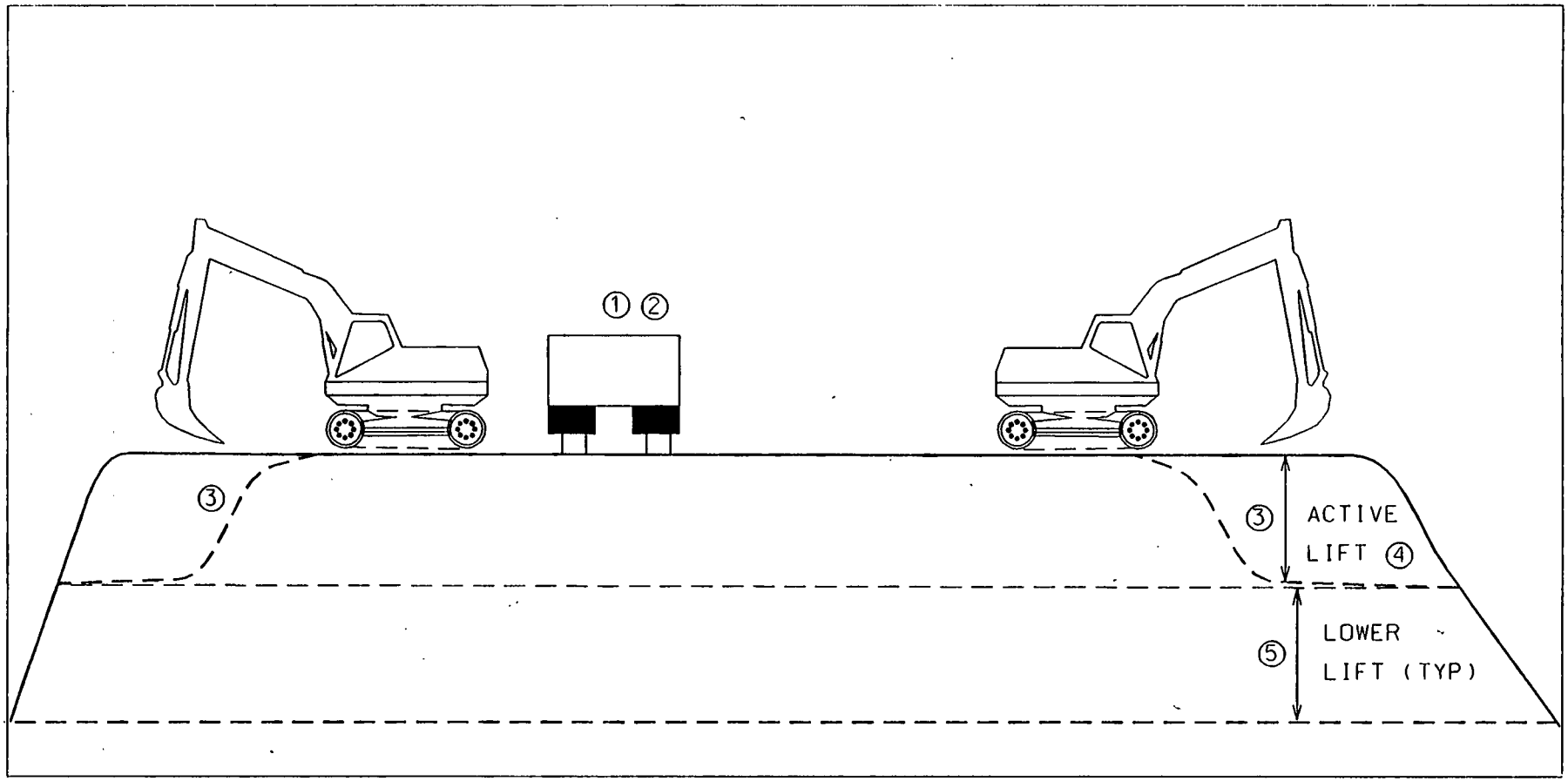
FIGURE 3-8. EXCAVATION OF LEAD CONTAMINATED SOIL



① MATERIAL SHALL BE LOADED DIRECTLY INTO TRUCKS.

② TRUCKS SHALL GO THROUGH EQUIPMENT WASH FACILITY BEFORE ENTERING HAUL ROAD TO OSDF.

③ VISUAL MONITORING AT ACTIVE EXCAVATION.

④ FIELD SURVEY FOR LOWER LIFTS SHALL BE PERFORMED IN ACTIVE LIFT BEHIND EXCAVATION.

⑤ EXCAVATE LOWER LIFT(S) AFTER FIELD SURVEY OF LIFT IS COMPLETE.

FIGURE 3-9. TYPICAL EXCAVATION APPROACH

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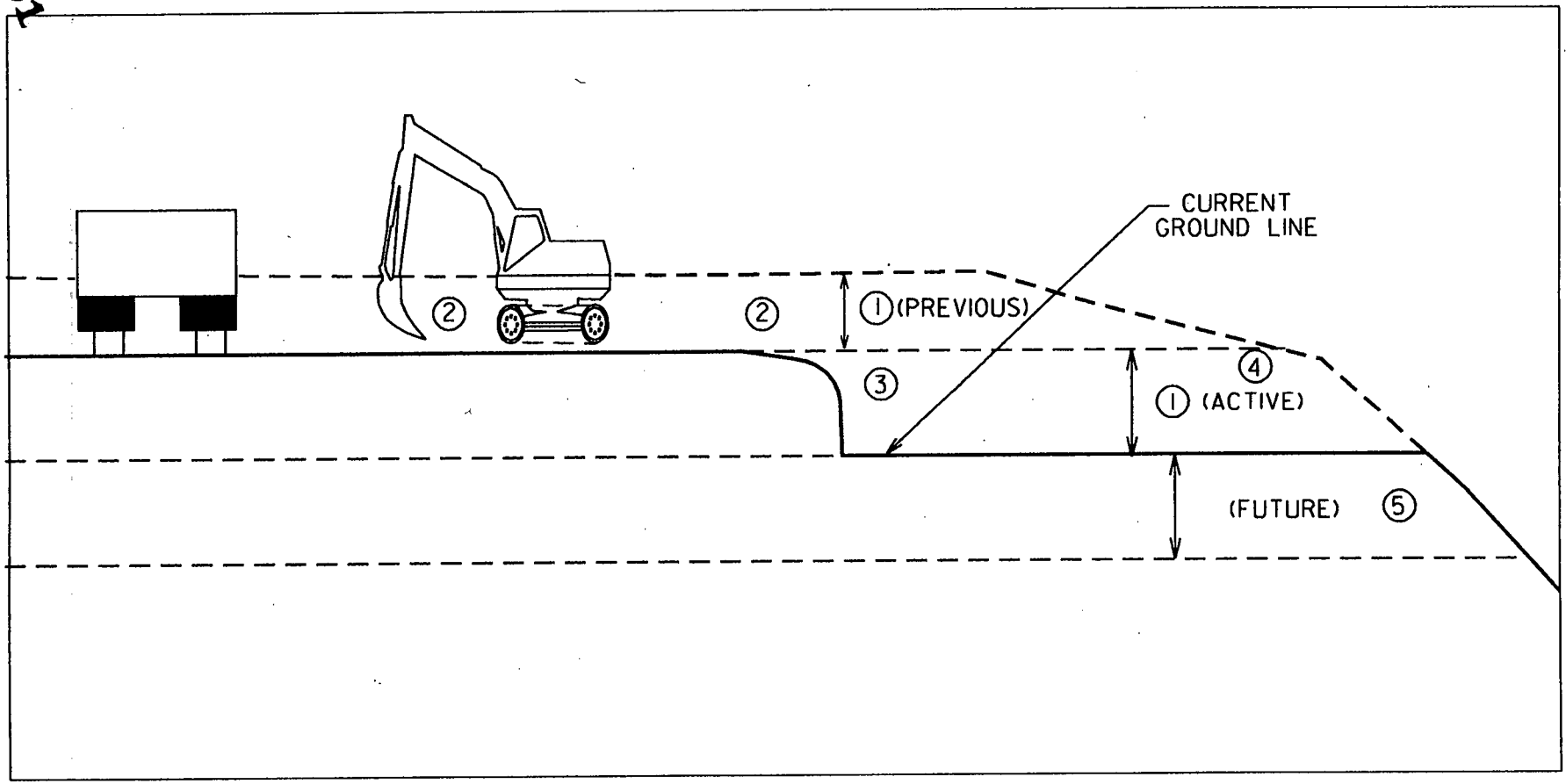

1. LIFTS FOR UNCLASSIFIED IMPACTED MEDIUM SHALL BE 3 ±1 FT DEEP.
2. ACTIVE EXCAVATION AND LOADING AREA.
3. VISUAL MONITORING AT ACTIVE EXCAVATION.
4. FIELD SURVEY OF FUTURE LIFT (MINIMUM OF 50 FT. BEHIND ACTIVE EXCAVATION)
5. EXCAVATE FUTURE LIFT AFTER MONITORING IS COMPLETE ON ACTIVE LIFT.

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FIGURE 3-10. EXC ION SEQUENCING

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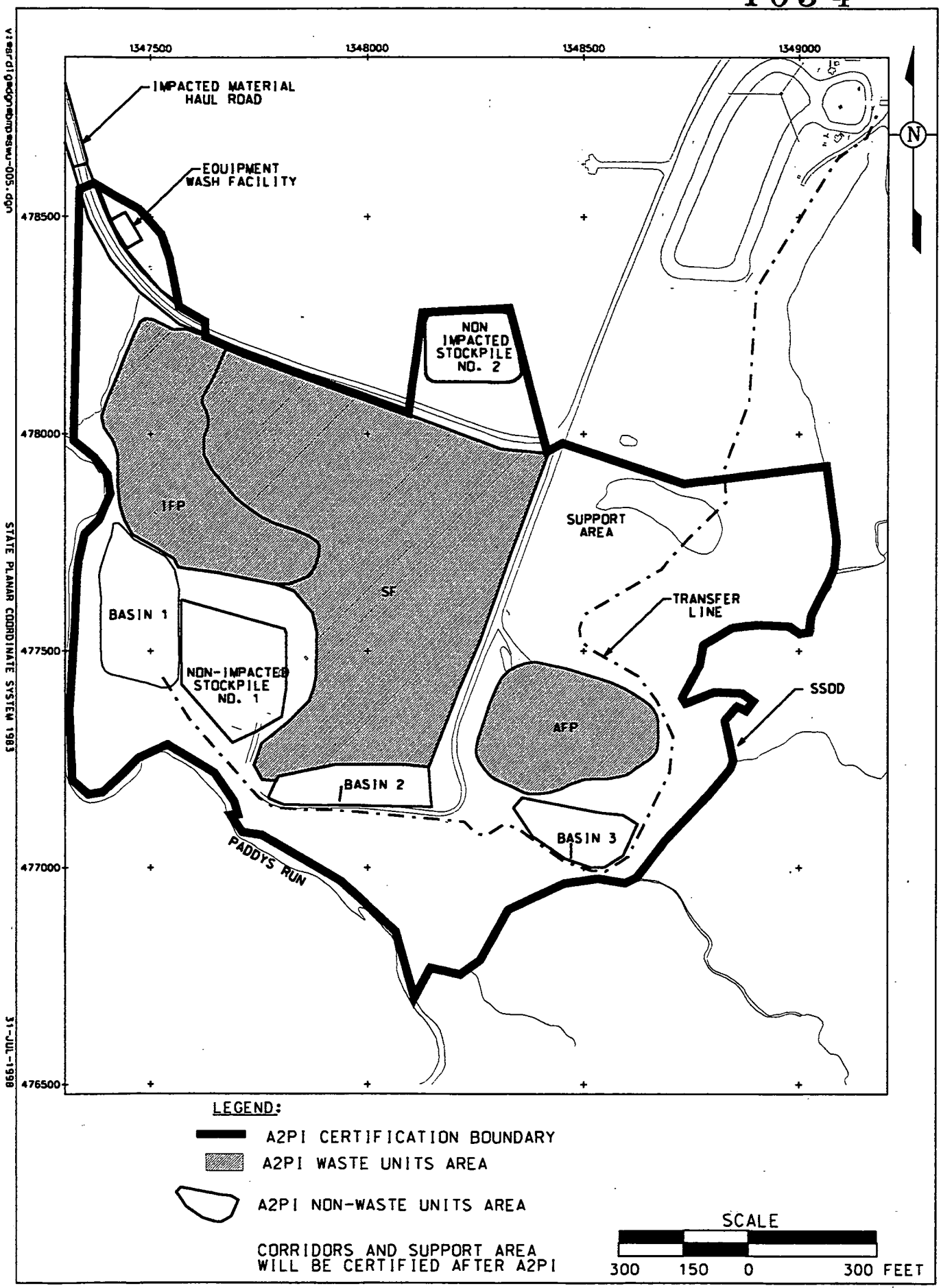

FIGURE 3-11. A2PI CERTIFICATION BOUNDARIES

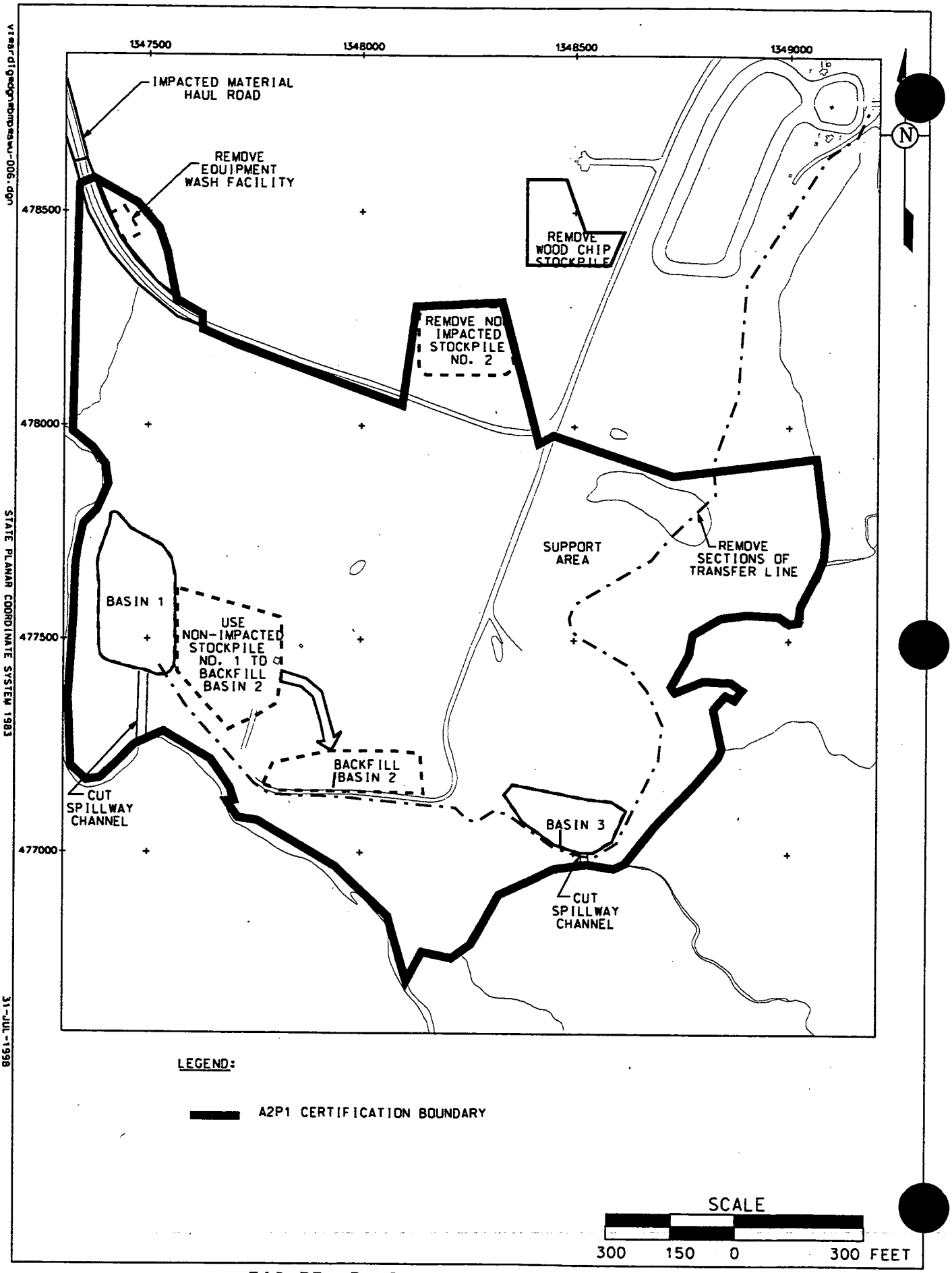

FIGURE 3-12. SWU RESTORATION PLAN

4.0 PROJECT-SPECIFIC ENVIRONMENTAL CONTROLS AND MONITORING

This section defines the project-specific environmental controls and monitoring that will be performed as part of the remediation of A2PI, how the resulting information will be used by the project organization, and how it will be integrated with sitewide monitoring and reporting requirements. Control mechanisms and monitoring/inspection requirements are provided for impacts to natural resources, as well as environmental impacts through the air, surface water and groundwater pathways.

The IEMP provides a summary reporting link and a cumulative feedback function for the project-specific monitoring conducted by the individual remediation projects. This link will assist with interpretation of project-specific results from a sitewide perspective. It should be noted, however, that routine "process-adjustment" decisions, which will be made by the SCEP to react and respond to project-specific operating conditions and process-control objectives, will not be reported as part of the IEMP reporting cycles. Rather, these types of routine decisions will be maintained as part of the project organization's daily operations log and are considered to be a normal course of day-to-day practice to achieve project-specific operating objectives. Figure 5-1 of the SEP summarizes the FEMP sitewide and project-specific environmental monitoring and control mechanisms.

4.1 NATURAL RESOURCE IMPACTS

Impacts to natural resources include those associated with threatened and endangered species, cultural resources, and wetlands/floodplains. As stated in Section 1.3.3, the only expected natural resource-related area expected to be encountered during the remediation of A2PI is the 100-year floodplain of Paddys Run that reaches the Inactive Flyash Pile and the South Field. The following paragraphs describe the control mechanisms and monitoring that will be implemented in A2PI in regard to natural resource impacts.

4.1.1 Control Mechanisms

The SEP establishes a four component strategic control mechanism for natural resource impacts.

The first component, identification of unavoidable impacts to natural resources anticipated to result from remediation activities, has been addressed by the RODs for Operable Units 2 and 5

(DOE 1995a, 1996a). These RODs identified the unavoidable potential natural resource impacts anticipated to occur as a result of remediation activities relevant to A2PI to be initiated under the SEP.

The second component, avoidance of impacts to FEMP natural resources as practicable, has been controlled through planning and design. Sensitive natural resource areas have been delineated at the FEMP. These "Priority Natural Resource Areas" are illustrated in the Natural Resource Impact Monitoring Plan (briefly discussed below) and Figure 5-2 of the SEP. No Priority Natural Resource Areas are located within A2PI. All access points, laydown areas, etc., for the A2PI soil remediation project are outside Priority Natural Resource Areas. Potential impacts to other FEMP natural resources will be minimized through the incorporation of appropriate environmental control mechanisms as well. These are addressed in the subsequent, media-specific discussions.

The third component, monitoring to document the actual extent of impacts, is addressed in Section 4.1.2.

The fourth component, natural resource restoration, is briefly described in Section 1.3.3, and is the subject of the NRRP.

4.1.2 Monitoring

Monitoring of natural resource impacts associated with A2PI and other sitewide remedial activities will be conducted under the Natural Resources Impact Monitoring Plan (part of the IEMP). Descriptions of the objectives, regulatory drivers, monitoring, data evaluation, and reporting requirements for the program are provided therein. Sitewide monitoring of natural resource impacts will continue under the IEMP during A2PI soil remediation activities. Monitoring under that program will verify and document the actual extent of natural resource impacts anticipated by and identified in the RODs and will identify any unanticipated impacts to wetlands and floodplains associated with Paddys Run and its tributaries and threatened and endangered species habitat. The natural resource monitoring data collected from the FEMP will be updated in the NRRP as it is relevant to restoration.

4.2 AIR PATHWAY

This subsection presents the air pathway control and monitoring requirements for noise, fugitive emissions (visible dust), airborne radiological particulates and radon, and direct radiation during A2PI

soil remediation activities. Air pathway monitoring activities, to the maximum extent possible, will make use of both the existing FEMP occupational air monitoring program and the sitewide environmental monitoring program (described in Section 6.0 of the IEMP). Using existing monitoring programs will help ensure that project-specific data are of comparable quality and are beneficial in evaluating and reporting project-specific air pathway releases under the various regulatory drivers associated with these monitoring programs. Administrative and engineering control techniques, in accordance with the "Fugitive Dust Control Requirements" (RM-0047) developed from the FEMP fugitive dust control "best available technology" (BAT) determination, will be implemented during A2PI soil remediation activities including excavation, hauling, and placement of soils to mitigate potential emissions of fugitive dust and airborne radiological particulates.

4.2.1 Noise

4.2.1.1 Control Mechanisms

Noise control and abatement during the remediation of A2PI will include noise control devices (mufflers) on equipment and machinery, proper maintenance of equipment and machinery, and also may include rescheduling time periods in which heavy equipment is used in the field. Currently, only minimal remediation activities are anticipated to be performed after sunset.

To ensure that Occupational Safety and Health Administration (OSHA) and American Conference of Governmental and Industrial Hygienists (ACGIH) noise limits are met, an administrative action level below these limits has been specified in the project-specific health and safety plans (see Section 5.0). This administrative action level will be used to assess the need for hearing protection for field personnel in the areas of remediation activities, the need for maintenance of equipment and machinery, and the need for additional noise control and abatement.

4.2.1.2 Monitoring

Noise monitoring will be conducted to implement the A2PI project-specific health and safety requirements. Noise measurements will be made in the field by FDF health and safety personnel, using health and safety protocols for noise monitoring, to assess: whether administrative action levels are exceeded; the need for hearing protection; the need for maintenance of equipment and machinery; the need for additional noise control or abatement; and, compliance with OSHA and ACGIH occupational noise limits.

Components of noise monitoring will include establishing remediation area-specific background levels prior to the start of excavation activities, and occasional monitoring during implementation of remedial activities. If the environmental noise level falls within 5 dBA of the administrative action level (85 dBA, as specified in the health and safety requirements), health and safety personnel will contact the project field manager to begin appropriate corrective actions.

Field managers will be responsible for documenting noise monitoring in the field in accordance with the record keeping guidelines presented in Section 6.7, as well as for initiating noise abatement measures.

4.2.2 Fugitive Emissions

4.2.2.1 Control Mechanisms

Water, commercially available dust suppression agents, or other appropriate methods and work practices will be used proactively to reasonably minimize dust generation from A2PI soil remediation activities including soil excavation, handling, hauling, and placement. In general, the opportunity for dust generation will be minimized using work practices, including removing material from the undercarriage of equipment, sweeping haul roads, and covering the beds of haul equipment. Beyond that, water or other dust suppression agents will be applied in quantity sufficient to reasonably minimize dust generation, but limited so that they do not result in migration of the agent beyond work area boundaries, ponding, or disruption of other portions of work.

For excavation activities, dust control will be by progressive increments focused on making the material less dusty. The base mechanism is anticipated to be reliance on inherent moisture in the soil and soil-like material. If visible dust emissions occur during excavation, one or a combination of the following dust control methods are anticipated to be used:

- Apply water mist
- Add surfactants or other agents to the water mist
- Apply resins, crusting agents, or foams in lieu of water mist.

For soil handling, hauling, and placement activities, dust control will be focused on making the material to be transported unlikely to become airborne. The base mechanism is anticipated to be reliance on inherent moisture in the soil or soil-like materials, coupled with a 10-mile-per-hour speed

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limit during hauling. In addition, the beds of all haul equipment will be required to be covered when transporting potentially dusty material. If visible dust emissions occur during handling, hauling, or placement, one or a combination of the following dust control methods are anticipated to be used:

- Change configuration of material (e.g., place less in the trucks)
- Apply water mist
- Add surfactants or other agents to the water mist
- Apply resins, crusting agents, or foams in lieu of water mist
- Reduce equipment speed
- Cover load during hauling.

Equipment wash facilities will be used at the point where equipment enters the Impacted Material Haul Road from A2PI or the OSDF. Clods, clumps, or visible deposits of soil or other materials that could readily become visible fugitive emissions from paved or treated unpaved roadways/parking areas will be promptly removed. Appropriate dust control mechanisms will be applied to reasonably minimize the generation of visible dust that may result from the removal process.

The number or type of dust suppression equipment in operation will not preclude stopping work if there is visible dust or excessive visible dust. Visible dust indicates the need to increase the level of dust control effort. Increasing levels of visible dust indicate a need to increase the level of dust control effort, including possible alteration, slowdown, or temporary suspension of the work activities generating the visible dust. The work activity(ies) observed to be generating the visible dust will be temporarily suspended if the visible dust exceeds the site-specific limit or Ohio standard [see "Fugitive Dust Control Requirements" (RM-0047)]. Dust controls will be increased and/or work practices will be modified to bring the fugitive emissions to a level below the limit/standard during dust-generating activities.

Personnel will be on-call during non-work periods seven days per week (including holidays) to respond to an "off-hours dust alert," which is defined as whenever FDF gives notification to the contractor that visible particulate emissions exceed six minutes during any 60-minute observation period. Site personnel will notify the contractor of such an alert and dust suppression will begin no more than three hours after such notification.

The contractor will develop a Dust Control Plan, as part of the Safe Work Plan, which will specify:

- A narrative description of how the contractor will implement the "Dust Control Plan," monitor for visible dust, progressively implement increased dust control or alter work activities when required, and maintain appropriate records of dust control activities
- A listing of methods to be used to suppress dust, and the associated frequency that routine dust suppression is to take place
- By method, the materials to be used to suppress dust (e.g., water, dust suppression agents, etc.)
- By method, the specific types and quantities of equipment to be used to suppress dust
- A description of the notification process, including designation of personnel, that the contractor intends for SCEP personnel to utilize during non-work periods to notify the contractor of a "dust alert."

The contractor's "Dust Control Plan" will be reviewed against these criteria by FDF for adequacy. FDF approval of that plan is a prerequisite to authorization of earthmoving activities.

4.2.2.2 Monitoring

Project personnel will tour the areas of remediation activities at the start of the day and periodically during the day. Real-time observation of visible dust, in accordance with the criteria described in "Fugitive Dust Control Requirements" (RM-0047), will be used to assess fugitive dust emissions and progressively implement corrective measures.

Additionally, visual monitoring will be conducted in accordance with 40 CFR Part 60, Appendix A, Method 22, "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emission from Flares." Visual determination of opacity will be conducted on "project field activities" and "material handling/vehicle traffic on storage piles" [identified in the table in "Fugitive Dust Control Requirements" (RM-0047)]. That determination will be in accordance with 40 CFR Part 60, Appendix A, Method 9, "Visual Determination of Opacity of Emissions from Stationary Sources" (or an approved alternative method).

Field managers will be responsible for documenting visible emission monitoring in the field, in accordance with the record keeping guidelines defined in Section 6.7, as well as for initiating fugitive

dust abatement measures. Records of the following information for each work day (including off-hours dust-alert response, except as noted below) will be maintained for the A2PI soil remediation project:

- The date, weather conditions, and scheduled work activities (e.g., excavation, trenching, hauling, placement, compaction, loading, etc.)
- Records of opacity readings (if any) conducted that day in accordance with 40 CFR Part 60, Appendix A, Method 9, "Visual Determination of Opacity of Emissions from Stationary Sources" (or an approved alternative method) [NOTE: not required for off-hours dust alert responses]
- Time of off-hours dust alert notification given to the contractor, names of the individuals involved, FDF person providing notification, contractor employee notified, and contractor dust-alert responders, and time of initiation of dust suppression activity [NOTE: required only for days when such notification occurs]
- Identification of areas (or segments) where dust control was performed
- The manner or type of dust control activity(ies) applied by area
- Application rate of water or other dust suppression agents — at a minimum, tank truck load capacity and number of tankloads applied per area to which applied
- Identification of the party(ies) responsible for the dust control activity by area — at a minimum, name of the contractor.

4.2.3 Airborne Radiological Particulates

4.2.3.1 Control Mechanisms

All airborne radiological particulate emissions associated with A2PI soil remediation activities are anticipated to be from fugitive emissions. Control mechanisms for fugitive emissions are presented in the preceding subsection. No airborne radiological particulate control mechanisms beyond those provided by fugitive emission control are anticipated to be required for environmental or public safety concerns as a result of A2PI soil remediation activities.

4.2.3.2 Monitoring

Airborne radiological particulate emissions associated with A2PI soil remediation activities will be monitored via the sitewide airborne radiological particulate monitoring program presented in Section 6.0 of the IEMP. The monitoring network encompasses all the current and expected diffuse and point sources at the FEMP site. The data collected under the sitewide airborne radiological particulate

monitoring program will be used to assess the collective effect of concurrent remediation activities at the FEMP site under various regulatory drivers described in Section 6.0 of the IEMP.

No supplement or modification to the sitewide airborne radiological particulate monitoring program is anticipated to be required as a result of A2PI soil remediation activities. Monitoring stations already exist downwind (under the prevailing wind) of the A2PI soil remediation activities, and the monitoring frequency and analyses addressed by the program adequately address the COCs in the A2PI remediation area. No airborne radiological particulate monitoring stations need relocation to facilitate A2PI soil remediation activities.

4.2.4 Radon

4.2.4.1 Control Mechanisms

Emission of radon from soil being remediated under the A2PI soil remediation project is not anticipated to be an environmental or public safety concern. Hence, no project-specific radon control mechanisms are anticipated to be required as a result of A2PI soil remediation activities.

4.2.4.2 Monitoring

Any potential radon emissions associated with A2PI soil remediation activities will be monitored via the sitewide radon monitoring program presented in Section 6.0 of the IEMP. No supplement or modification to that sitewide radon monitoring program is anticipated to be required as a result of A2PI soil remediation activities.

4.2.5 Direct Radiation

4.2.5.1 Control Mechanisms

No project-specific direct radiation control mechanisms beyond that provided by fugitive emissions control are anticipated to be required for environmental or public safety concerns as a result of A2PI soil remediation activities.

4.2.5.2 Monitoring

Environmental radiation levels associated with A2PI soil remediation activities will be monitored via the sitewide environmental direct radiation monitoring program presented in Section 6.0 of the IEMP.

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No supplement or modification to that sitewide environmental direct radiation monitoring program is anticipated to be required as a result of A2PI soil remediation activities.

4.3 SURFACE WATER PATHWAY

4.3.1 Control Mechanisms

As a condition of its National Pollutant Discharge Elimination System (NPDES) Permit (OEPA Permit No. 1IO00004*ED), the FEMP was required to develop and implement a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP identifies potential sources of pollution associated with construction and industrial activities that may affect storm water quality at the FEMP and describes the practices that will be employed to reduce pollutants within these types of discharges. The SWPPP also contains provisions on the inspection programs which are being implemented to ensure that discharges of storm water associated with construction and industrial activities comply with the requirements of the FEMP NPDES Permit and the SWPPP.

A2PI is located outside the "storm water runoff controlled" former production area drainage basin; prior to these A2PI soil remediation activities, the A2PI area drains to NPDES-permitted storm water outfall *4004. Outside the FEMP's former production area drainage basin, storm water from construction activity is regulated as an industrial activity (if a certain magnitude of earth-moving activities is involved). A2PI soil remediation activities to be initiated under the SEP are a subset of construction activities. In accordance with both the SWPPP (under the FEMP's NPDES permit) and the SEP, erosion and sediment controls will be installed where appropriate to protect downgradient areas. These controls will be designed and installed in accordance with A2PI's Surface Water Management Plan to manage surface water run-on and runoff, minimize erosion, and control sedimentation in on-site surface waters such as Paddys Run.

The clearing and grading associated with the A2PI soil remediation activities will result in the generation of substantial quantities of downed trees and brush. During the site preparation phase of A2PI soil remediation activities, the majority of such material is anticipated to be handled by chipping (or shredding) and stockpiling near the meteorological data tower (see the site preparation package construction drawings) for potential use as mulch during future site restoration activities. During the excavation phase of A2PI soil remediation activities, the stumps and roots remaining from site preparation phase activities are anticipated to be managed by grinding them in place, then removing

them with the soil during excavation. Such management of chipped material is in accordance with the SEP; see Section 5.1.3 of the SEP for further discussion.

In accordance with the SWPPP and the SEP, an A2PI surface water management system will be constructed and operated to prevent runoff from contaminated and potentially contaminated areas from reaching areas downgradient from A2PI. Storm water runoff from such contaminated and potentially contaminated A2PI areas will be collected in Retention Basins and conveyed to the SWRB, where under normal (non-bypass) conditions, it is treated through the AWWT facility. For further discussion of A2PI surface water management, see Section 3.1.7, the A2PI Surface Water Management Plan, and the site preparation package construction drawings.

The FEMP drainage area map (Figure 2-1 of the SWPPP) has been revised to show changes in the drainage areas flowing to NPDES-permitted storm water outfall *4004 that result from the A2PI soil remediation activities. Revisions to the descriptions of the watershed basins currently provided in Section 4.0 of the SWPPP will be provided with the annual SWPPP update, along with a FEMP drainage area map (updated for changes from subsequent projects).

It is anticipated that the surface water management and sediment/erosion control systems for A2PI will remain in place until remediation of the area has been completed. They will be dismantled or reconfigured in phases (area-by-area) during interim and final restoration of A2PI. To the extent practical, surface water runoff from the area being worked will be conveyed via pumping or other appropriate mechanism to the adjacent area where the conveyance system is still intact. In accordance with the SWPPP and the SEP, once the A2PI area is certified clean, the pumps will be taken out of basins and the flow diverted to Paddys Run.

4.3.2 Inspection

Construction activity inspections mandated by the SWPPP will be conducted in the A2PI remediation area. Under the FEMP's construction activity inspection program, weekly inspections will be conducted within all construction areas at the site and after any rain events totaling 0.5 inch or more within a 24-hour period. Construction activity inspections are documented and maintained as part of the NPDES and SWPPP files at the facility.

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Industrial activity inspections might also be conducted in the A2PI remediation area, if required under the SWPPP. The industrial activity inspection program covers both areas within and outside the former production area drainage basin. However, industrial activity inspections are not typically conducted in areas subject to the more frequent construction activity inspections. Under the FEMP's industrial activity inspection program, inspections are conducted in areas draining to the site's controlled storm sewer system (former production area drainage basin) and the uncontrolled watershed basins draining through NPDES permitted storm water outfalls *4003 through *4006. Industrial activity inspections are documented and maintained as part of the NPDES and SWPPP files at the facility.

Inspections conducted in the A2PI areas will ensure that:

- Erosion and sedimentation controls required under the A2PI Surface Water Management Plan and/or the contractor's work plan are in place and are well maintained
- Work practices and housekeeping activities are conducted in a manner that reduces the potential discharge of pollutants in association with storm water discharges from disturbed areas
- Corrective actions related to the establishment and/or maintenance of erosion and sedimentation control structures are documented and tracked to resolution
- Excessive erosion and/or siltation to Paddys Run or other off-property waterways is not occurring as a result of construction activities initiated under the A2PI soil remediation activities.

The SEP discusses potential project-specific storm water monitoring programs for soil remediation areas located outside the formerly storm-water-runoff-controlled production area drainage basin. The objectives of such a program would be to monitor performance of erosion and sedimentation control structures (e.g., sediment traps and basins) against their anticipated design efficiencies, and to determine whether the runoff presents an unacceptable impact to surface water quality or presents an unacceptable cross-media impact to the Great Miami Aquifer.

As previously described, the A2PI surface water management system captures all potentially contaminated storm water runoff within the A2PI area and directs it to the A2PI Retention Basins, which in turn convey the water to the SWRB and then to the AWWT (under design conditions). Potentially contaminated A2PI storm water runoff receives treatment before discharge to the receiving

surface water, the SWRB and AWWT are monitored under IEMP-conducted NPDES permit monitoring, and discharge from the non-controlled A2PI drainage areas flows to NPDES-permitted storm water outfall *4004 which also is monitored under IEMP-conducted NPDES monitoring. Because the objectives of the SEP-contemplated storm water monitoring program are met through other existing means no project-specific storm water monitoring program will be implemented for the A2PI soil remediation project.

4.4 GROUNDWATER PATHWAY

4.4.1 Control Mechanisms

The Great Miami Aquifer is an extensive aquifer located, in part, beneath the entire FEMP (including the A2PI area). Impacted perched water zones are known or reasonably expected to exist in the A2PI project area (see Section 2.3.3). Additional information on the Great Miami Aquifer in the A2PI area is provided in the Operable Unit 2 RI, and in the Operable Unit 5 RI. During remediation of A2PI, excavation will expose and extend into the unsaturated sands and gravels of the Great Miami Aquifer. Uncontrolled exposure of the Great Miami Aquifer in this manner may provide a pathway for contaminated and potentially contaminated water to infiltrate into the Great Miami Aquifer. Therefore, measures will be implemented to protect the Great Miami Aquifer during construction of surface water control facilities and when excavation of impacted material extends into and/or exposes the Great Miami Aquifer. These measures include the installation of geomembrane liners in ditches (Section 3.1.7.5) constructed into the unsaturated sands and gravels of the Great Miami Aquifer and infiltration barriers (e.g., clay and/or geomembrane) in all retention basins (Section 3.1.7.6). This approach will minimize infiltration into the Great Miami Aquifer through this pathway.

Measures will be implemented to minimize run on to exposed surfaces during excavation. Runon from upgradient areas will be diverted around the construction area. Runon diversion controls are discussed in Section 3.1.7.3.

Measures will also be implemented to minimize the potential for contaminated runoff to discharge into the Great Miami Aquifer during construction. As previously stated, the A2PI Retention Basins will be constructed with infiltration barriers. Retention basins are discussed in Section 3.1.7.6.

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During excavation of the Inactive Flyash Pile and the South Field, cover soil including impacted material and glacial till will be removed and the sands and gravels of the Great Miami Aquifer will be exposed. For these cases, interceptor ditches will be constructed to direct runoff from uncertified areas into the retention basins and around the exposed sands and gravels of the Great Miami Aquifer.

4.4.2 Monitoring

Groundwater in the Great Miami Aquifer in the A2PI area is impacted, and flows from approximately west-northwest to east-southeast. As determined during the Operable Unit 2 RI, Great Miami Aquifer concentrations of total uranium, the primary COC for the SWUs, ranged from approximately 1,820 parts per billion (ppb) down to 1.8 ppb. The hydraulic gradient for this area is approximately 0.0005.

The sitewide management strategy for monitoring groundwater during remedial activities is described in detail in Section 3.0 of the IEMP (DOE 1997f). Descriptions of the objectives, regulatory drivers, monitoring, data evaluation, and reporting requirements for the program are provided therein. Sitewide monitoring of groundwater will continue under the IEMP during A2PI soil remediation activities.

Twenty-one existing monitoring wells were selected under the IEMP to monitor the South Field Extraction area in 1997 and 1998. For the most part, these existing monitoring wells are located along the Storm Sewer Outfall Ditch, although a few of the wells are located along the northern edge of the A2PI excavation area. All 21 wells are located outside or very close to the edge of the A2PI surface excavation area. Considering the spatial distribution of these existing wells and the dispersion of groundwater due to the gradient, the well configuration as it remains after preceding well abandonment activities (see Section 3.1.8 for discussion on monitoring well abandonment) will be adequate to identify (screen for) potential impacts to the regional aquifer during, or as a result of, A2PI remediation activities. The following paragraphs briefly present the groundwater monitoring program for these wells. The sampling will be conducted according to the requirements identified in the IEMP.

Groundwater monitoring will focus on FRL constituents that have been detected in the Great Miami Aquifer at concentrations above the established FRLs, and FRL constituents that are predicted to have a potential to migrate from the glacial overburden to the aquifer due to their mobility and persistence. In

order to determine Great Miami Aquifer baseline conditions, the Great Miami Aquifer will be sampled prior to A2PI site preparation activities. Groundwater samples will be collected quarterly and analyzed for the five constituents categorized as mobile and persistent (MP), as well as detected in the Great Miami Aquifer at concentrations above the FRLs. These five constituents are in bold type in Table 4-1. A quarterly sampling frequency was selected so that seasonal concentration changes could be monitored. In addition to the quarterly sampling, groundwater samples will be collected annually and analyzed for the remaining 20 constituents identified in Table 4-1. A yearly sampling frequency was selected for these constituents because they are less mobile or not currently present in the aquifer above their respective FRLs. The full list of constituents (25 constituents) will be monitored initially and subsequent quarters will monitor the smaller list of constituents (five constituents).

In addition to the above sampling identified in the IEMP, four extraction wells will be sampled for total uranium during the initial sampling of the South Field Extraction System Monitoring Module in order to establish more comprehensive baseline conditions. The analytical requirements will be consistent with the IEMP, at ASL B. These four extraction wells, 31563, 31564, 31565, and 31566, are also located around the perimeter of, or within, the A2PI excavation area. Table 4-2 identifies the relevant groundwater wells for monitoring during A2PI remediation.

Data from this program will be used to assess the impact of remedial activities on the Great Miami Aquifer and will be provided in the IEMP reports. During implementation of A2PI soil remediation activities, the data will be evaluated in conjunction with Aquifer Restoration and Waste Water Project personnel to spot a trend or change in trend that could indicate a potential adverse impact to groundwater quality within the Great Miami Aquifer. The data will be carefully scrutinized in an effort to determine whether the soil remediation activities are adversely affecting the Great Miami Aquifer (e.g., vertical migration through the glacial overburden as a result of surface water infiltration), or whether other conditions (migration of existing plume, groundwater remediation activities) are the likely impacting factors. In the event that data indicate a potential adverse impact, an appropriate future course of action will be evaluated and implemented, considering the following:

- Is this area of the Great Miami Aquifer already planned for groundwater remediation? If not, should it be remediated (in accordance with the criteria in the OU5 ROD [DOE 1996a])?

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- If the answer to either of the above is yes: Is Great Miami Aquifer groundwater remediation of this area already ongoing? If not, should Great Miami Aquifer groundwater remediation for the area be re-prioritized?

- After project-specific groundwater monitoring ceases as previously determined, should monitoring of those wells be continued under the IEMP?

- What modifications, if any, can be retrofitted to the A2PI soil remediation project to mitigate the situation?

- What modifications to approach can be implemented in subsequent soil remediation projects to further minimize potential adverse impacts to the Great Miami Aquifer from soil remediation activities?

TABLE 4-1
CONSTITUENTS WHICH WILL BE ANALYZED IN THE SOUTH FIELD EXTRACTION SYSTEM MONITORING WELLS

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony	**Neptunium-237**	Alpha-Chlordane
Nitrate/Nitrite	Arsenic	Strontium-90	Bromodichloromethane
	Boron	Technetium-99	Carbon Disulfide
	Cadmium	Thorium-228	1,2 Dichloroethane
	Total Chromium	Thorium-232	Trichloroethene
	Lead	**Total Uranium**	Vinyl Chloride
	Manganese		
	Mercury		
	Nickel		
	Selenium		
	Zinc		

Note: Constituents categorized as "MP" (shown in **Bold**) are analyzed quarterly. Other constituents are analyzed annually.

Source: Section 3.5.1.2 of the IEMP.

TABLE 4-2
GROUNDWATER MONITORING WELLS FOR REMEDIATION AREA 2 PHASE I

Count	Well ID	IEMP Groundwater Monitoring Program [A]	
		South Field Extraction Monitoring Wells [B]	Groundwater Elevation [C]
1	2014	✓	✓
2	3014	✓	✓
3	2045	✓	✓
4	3045	✓	✓
5	2046	✓	✓
6	2049	✓	✓
7	3049	✓	✓
8	2068	✓	✓
9	3068	✓	✓
10	2385	✓	✓
11	3385	✓	✓
12	2386	✓	✓
13	2387	✓	✓
14	3387	✓	✓
15	2390	✓	✓
16	3390	✓	✓
17	2397	✓	✓
18	3397	✓	
19	2402	✓	✓
20	3402	✓	✓
21	21033	✓	✓
22	31563	South Field Extraction System recovery wells to be monitored only for establishment of baseline	
23	31564		
24	31565		
25	31566		

(A) Source: Integrated Environmental Monitoring Plan (IEMP), Section 3.0, Groundwater Monitoring Program.

(B) Source: IEMP Section 3.5.1.2, South Field Extraction System Monitoring Module

(C) Source: IEMP Section 3.5.1.6, Routine Water-Level Monitoring Program

000110

5.0 PROJECT-SPECIFIC HEALTH AND SAFETY

All DOE and FDF employees, visitors, vendors, and contractors are required to abide by the provisions of FDF-prepared applicable Project-Specific Health and Safety Requirements Matrices (PSHSRMs), FDF Work Permits, and the FDF-approved Safe Work Plan prepared by the contractor. Managers and supervisors are responsible for ensuring that PSHSRM requirements are met. All personnel have stop-work authority for imminent safety hazards resulting from noncompliance with the applicable health and safety practices.

All site preparation/excavation contractor activities conducted in support of this project are governed by the safety requirements specified in the remediation contract, which addresses environmental, occupational, industrial, and construction health and safety. In addition to the contract requirements, PSHSRMs, and permits, the contractors will comply with all federal, state, and local requirements (e.g., OSHA, ACGIH). Health and safety requirements and procedures for this Implementation Plan are governed by the A2PI PSHSRM, FDF Work Permits, and the overall strategy discussed in Section 6.0 of the SEP.

A project-specific occupational monitoring strategy will be developed by the FDF Safety and Health (S&H) department for the A2PI project. The contractors will incorporate their occupational exposure monitoring requirements into Section 3 of their FDF-approved Safe Work Plans. These strategies will address the constituents of concern (COCs) for the A2PI project area and will comply with all federal, state, and local requirements (e.g., OSHA, ACGIH).

In accordance with "Developing Project-Specific Health and Safety Requirements," FEMP-SH-0001, a PSHSRM will be developed for A2PI construction, excavation, and impacted material placement activities. The applicable PSHSRM will be included in the contract solicitation packages (Invitation for Bid/Request for Proposal) and will provide the contractors with information related to the possible hazards and the safety requirements to execute each task. The contractor can develop their specific Safe Work Plans using this information. The PSHSRM may be revised after reviewing the contractor's Safe Work Plans, as tasks and/or associated hazards and mitigators are identified, added, or deleted. Upon specific request by the EPA, the DOE would submit the PSHSRM(s) for informational purposes

only. The PSHSRM(s), as well as the detailed Safe Work Plans, will be maintained at the project site, with controlled copies in the project document control files.

FDF will provide all radiological occupational monitoring for the contractor. FDF radiological control technicians will provide the necessary support for A2PI activities. The contractual radiological control requirements for the performance of A2PI work will be documented in FDF job-specific radiological work permits (RWPs). Personnel performing work that requires an RWP will be briefed on the specific hazards and requirements for the task prior to commencing work. FDF radiological control personnel will evaluate the data obtained from the monitoring to determine the effectiveness of the radiological controls and relay this information to the contractor.

000112

6.0 REMEDIAL ACTION MANAGEMENT STRATEGY

This section describes the strategy for managing the remediation of A2PI, specifically the organizational structure, the process for selecting and managing the site preparation and excavation contractors, the strategy for managing impacted material, the record keeping and data management procedures that are in place and will be used, the quality assurance/quality control (QA/QC) process, the integration of project activities with other FEMP activities, and the schedule of activities.

6.1 ORGANIZATION AND RESPONSIBILITIES

The governing document for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions at the FEMP is the ACA (DOE 1991) between DOE and Region V of the EPA. As such, ultimate project management responsibility lies with those two entities. The DOE is the lead agency responsible for CERCLA activities at the FEMP. The DOE Fernald Area Office (DOE-FEMP) is the ultimate authority for ensuring the A2PI remedial action is performed in a manner that meets all project goals, standards, specifications, and requirements of the Operable Unit 2 ROD (DOE 1995a), the Operable Unit 5 ROD, and the A2PI IRDP. The OEPA has been granted regulatory authority over certain RCRA activities.

Within each agency, various organizations and offices have been delegated specific program responsibilities. The DOE-FEMP Operable Unit 5 Team Leader will provide the overall DOE programmatic direction for A2PI. The DOE-FEMP will conduct field oversight through technical leads responsible for construction, excavation/remediation, engineering, quality assurance and control, health and safety, and other pertinent aspects of the project.

The FDF SCEP will provide the overall project management and technical guidance to the A2PI Project Team. The A2PI Project Team will provide all of the necessary technical, regulatory, and administrative input required for the A2PI project. As the A2PI Project moves through different phases, the project organization will change to perform each particular phase of the project efficiently. The basic project organization will stay the same throughout the project; however, the overall leader will change to best meet the needs of the project. During investigation, study, design, and certifications phases, the project will be managed by the Area Project Manager (APM). During construction phases, the project will be managed by the Construction Manager. This organizational

structure will provide clear lines of responsibility during the project and provide project leadership with the necessary experience at various phases of the project (i.e., the Construction Manager will lead the project during construction phases). The A2PI project organizations are shown in Figures 6-1 and 6-2. As shown on those figures, each functional area will contribute personnel resources to support the A2PI Project during all phases of the project.

The A2PI project includes the following groups, as shown on Figure 6-1:

- Management
- Primary Technical Areas
- Functional Support.

The roles and responsibilities for these groups within SCEP are presented below.

6.1.1 Management

A2PI management includes the SCEP Project Director, APM, A2PI Construction Manager (during construction) and administrative support. Except for positions specific to the SCEP, some of the personnel roles and responsibilities listed below are explained in detail in FEMP procedures. Specific responsibilities will be assigned to various groups and personnel during the project.

The roles and responsibilities of points of interface between other FEMP projects and A2PI are discussed in Section 6.9. These points of contact with other projects will be critical to the progress and success of the project.

6.1.1.1 SCEP Project Director

The SCEP Project Director will have overall responsibility for general direction, guidance, management, and oversight of the project. The SCEP Project Director reports directly to the Vice President of the Soil and Water Projects Division. The Project Director provides guidance and a point of interface for the APM and A2PI Construction Manager and serves as the primary contact for the SCEP with the DOE and the regulatory agencies.

000114

6.1.1.2 Area Project Manager and A2PI Construction Manager

The APM oversees and manages the project and has overall responsibility to complete the project scope within budget and schedule parameters during the investigative, design, and certification phases of the project. The overall responsibility for the project during construction is the A2PI Construction Manager (A2PI CM).

The hand off point between the design phase and the construction phase of the project is the approval of the IRDP and the CFC drawings. During investigation, design and certification, the project is managed by the APM who is supported by the primary technical areas (engineering, characterization and construction) and functional support. Similarly during construction, the overall project is managed by the A2PI CM and supported by the APM (who will continue to coordinate the Project Engineer and Characterization Manager) and functional support. The A2PI APM will report to the SCEP Project Director at all times. During construction, the APM will also report to the A2PI CM. The general responsibilities of the APM include:

- Updating the area PEP when necessary
- Overall management of engineering the design
- Managing non-construction personnel assigned to the area project
- Resolving EPA comments through the development of draft responses received on the IRDP
- Assuring the technical accuracy and quality of the CFC drawings and the technical specifications through the completion of construction
- Ensuring that the DCN process is properly evaluated and efficiently managed by the Project Engineer
- Coordinating the Project Engineer, Characterization Manager, and other SCEP resources to provide timely and sufficient technical supports per Construction Manager's request (during construction)
- Facilitating timely and sufficient implementation of oversight functions (e.g., QA/QC and WAO, etc.) provided by FDF independent oversight functional organizations on engineering and characterization procedures
- Closing NCR on engineering and characterization procedures and/or deliverables.

The A2PI Construction Manager will report to the APM during the investigative, design, and certification phases of the project as shown on Figure 6-1. During construction, the A2PI CM will report to the Soil and Water Division CM and the SCEP Project Director. The A2PI CM is in charge of, and accountable for, all A2PI construction activities. Other specific responsibilities include:

- Managing all the FDF construction personnel (i.e., Construction Contract Managers, Field Construction Engineers, and Construction Coordinators) matrixed to SCEP
- Managing the construction contractor through the designated Construction Contract Manager
- Ensuring all contractor-initiated Change Orders are properly evaluated and managed through the Construction Contract Manager with technical input from the SCEP and Project Engineer
- Obtaining all the required FDF permits
- Ensuring all the FDF permit requirements are fully understood and followed by the construction contractor
- Facilitating timely and sufficient implementation of oversight functions (e.g., QA/QC, Safety and Health, WAO, etc.) provided by FDF independent oversight functional organizations on construction procedures and/or deliverables
- Closing any NCR on construction procedures and/or deliverables
- Providing all documentation/information and support required to satisfy the SSR requirements for completed operational facilities
- Requesting engineering, characterization, and other administrative support during construction through the APM.

6.1.1.3 Administrative Support

Administrative Support coordinates and produces all A2PI documents. Specific responsibilities that are pertinent to the project include:

- Interfacing with Engineering/Construction Document Control (ECDC)
- Managing project documents
- Managing project document reviews, including the review/comment/response process.

000116

6.1.1.4 Project Controls

The Project Controls group provides the APM and CM with cost and schedule information for all accounts within the project. Specific responsibilities include:

- Ensuring cost and schedule requirements are defined, planned, and monitored against an integrated baseline so that performance can be measured and reported consistent with overall commitments, budgets and available funding
- Establishing and maintaining cost, schedule, and technical baselines through the issuance of change proposals
- Collecting monthly status reports to evaluate current trends which may result in forecast variances from the established baselines
- Assisting A2PI Control Account Managers (CAMs) and other project personnel in the various administrative duties associated with establishing the baselines and forecasts, as well as ensuring that all charges are directed to the proper accounts as defined in the baselines
- Working with sitewide training coordinators to ensure that individuals assigned to the project are in compliance with established training procedures and guidelines
- Working with division and site commitment trackers to ensure that all project commitments are entered into the tracking systems and that responsible personnel are kept informed of the requirements of each commitment
- Providing adequate documentation of commitment completion to sitewide and division trackers.

6.1.2 Primary Technical Areas

The primary technical areas for A2PI are:

- Engineering and Design
- Construction
- Characterization.

Each primary technical area will receive support from the functional support groups. Engineering and construction will be supported by contractors.

6.1.2.1 Engineering

Engineering, under the lead of the Project Engineer, provides technical expertise for engineering and design throughout the project. Engineering is responsible to the APM for developing project-specific designs and associated documentation and design modifications. An Architect/Engineer (A/E) Subcontractor will perform design, engineering and construction phase services (Title I/II and III) for A2PI. Engineering will serve as the primary contact and liaison with the A/E, work with the A/E on a day-to-day basis to address project technical issues, review the A/E's designs and work products, and evaluate the A/E's services. During construction, Engineering processes all Requests for Clarification of Information (RCIs) and Design Change Notices (DCNs). Specific responsibilities include:

- Reviewing and approving all engineering documents submitted by the A/E and construction contractors, as required by contract documents
- Developing responses to RCIs
- Developing DCNs
- Instructing the A/E when to revise construction drawings/technical specifications
- Reviewing and approving "As-Built Drawings" supplied by the Construction contractors at the completion of field work
- Reviewing and approving RCIs and DCNs
- Verifying that all contractual work has been performed by the A/E
- Verifying that all regulatory commitments are completed and approved.

6.1.2.2 Construction

Construction, under the lead of the CM, will be the lead organization during remedial action, including managing the construction contractors. The CM has a construction coordinator, a construction field engineer, and a construction contracts manager on staff to support these activities. During remedial design, construction will provide input and constructability reviews. Specific responsibilities include:

- Coordinating daily work activities in the field and providing technical direction to the construction contractors within the scope of the contract
- Coordinating day-to-day management of the A2PI field operations labor force
- Coordinating with/directing the contractor

000118

- Performing contract administration
- Reviewing and approving any modifications or changes to the contract documents
- Approving contract submittals
- Utilizing the primary area and functional area resources as necessary.

Separate construction contractors provide remedial action/construction services during the site preparation and excavation phases. In accordance with the contract documents, the contractors shall be registered/permitted in accordance with applicable local, state, and federal requirements and shall demonstrate significant prior related experience.

The contractors report contractually to the CM. They coordinate daily work activities with, and take technical direction from, the CM within the contract scope. The contractors are responsible for all equipment, materials, and activities relating to the project. The contractors are also responsible for scheduling and coordinating work with lower-tier contractors to complete the project within the schedule approved by the CM. The contractors are responsible for updating all construction drawings for any deviations from the original plans and specifications on a daily basis and will prepare as-built drawings.

The contractors are represented on site by field representatives, who shall be qualified individuals who are capable of supervising the performance of all tasks associated with A2PI activities. They are responsible for coordinating and supervising the contractors' work in A2PI. At a minimum, the contractors' field representatives will be responsible for the following:

- Implementing a safety program in accordance with the contract documents
- Discussing and interpreting all elements of the A2PI design and informing the CM of any discrepancies between the plans and specifications and the field conditions
- Recommending changes or modifications to the project specifications for approval by the CM
- Distributing all documentation required by the project specifications in a timely manner
- Attending all project coordination meetings

- Scheduling all phases of the applicable A2PI activities
- Maintaining a daily log of all A2PI activities and assisting the CM in reviewing and approving submittals, as necessary
- Implementing and verifying all QC procedures required of the contractor and/or contractor's lower-tier contractors
- Submitting proposed alternative materials or methods to the CM for approval prior to acquisition and use
- Coordinating all technical requirements with the CM.

6.1.2.3 Characterization

The Characterization Manager will coordinate field measurements, sample collection, laboratory analysis, and data management associated with the characterization of waste materials and soil in A2PI.

These responsibilities include:

- Developing project-specific plans (PSPs) and coordinating sampling and analysis to support predesign
- Evaluating and reporting data and providing associated recommendations and documentation
- Reporting precertification and certification sampling/measurements.

6.1.3 Functional Support

The A2PI Project will require support from internal SCEP functional areas. Personnel from these functional areas will be matrixed to the project. Generally, the lead technical group will manage the functional support staff. To the extent possible, functional support will be provided by personnel dedicated to the SCEP.

6.1.3.1 Safety and Health

S&H support during the project will include:

- Preparing all S&H documents for the project (including a Safety Assessment and S&H matrix)

000120

- Reviewing project documents as they are prepared for compliance with S&H requirements
- Implementing the A2PI Project-Specific Health and Safety Plan (PSHSP)
- Assuring that contractors follow safe work practices.

The S&H representative has stop-work authority if unsafe work practices go uncorrected. Any employee of FDF or a contractor can stop work if he or she feels that the work situation is unsafe.

6.1.3.2 Radiological Control

Radiological Control support during the project will include:

- Preparing all required radiological control documents for the project (including radiological ALARA)
- Reviewing project documents as they are prepared for compliance for radiological requirements.

6.1.3.3 Environmental Compliance

Environmental Compliance (EC) support during the project will include:

- Preparing all required EC documents for the project, including the ARARs crosswalk, and environmental ALARA
- Reviewing project documents as they are prepared for EC requirements
- Coordinating with internal and external groups, including regulatory agencies, regarding regulatory matters
- Providing oversight to ensure compliance with environmental requirements.

6.1.3.4 Quality Assurance

The Quality Assurance (QA) representative will be matrixed to the project from the FDF QA organization. The QA representative will administratively report to the APM and CM but will be independent of the project team. The QA representative will be responsible for developing and implementing QA plans for the project. The primary responsibility of the QA representative is oversight of QA/QC activities during design, sampling, waste disposition, and construction excavation tasks. The QA representative will monitor and provide support to the project to ensure compliance

with FEMP requirements and procedures. QA for A2PI will be performed in accordance with quality program elements identified in the FEMP Quality Assurance Program (RM-0012), the Sitewide CERCLA Quality Assurance Project Plan (SCQ; FD-1000), and the SEP Quality Assurance Project Plan. The QA representative has stop-work authority if quality concerns go unresolved.

6.1.3.5 Sampling

Sampling personnel are responsible for providing input on PSPs, collecting field data, and performing data management for all sampling activities related to A2PI, except for environmental monitoring sampling.

The individual sampling tasks are defined in PSPs prepared by the A2PI Characterization Manager, with the technical and writing assistance of Sampling personnel.

Environmental monitoring sampling is not performed by A2PI Sampling. Environmental monitoring sampling is covered under the IEMP and will be performed by Environmental Monitoring personnel.

6.1.3.6 Waste Management

Waste management support will be provided by a representative from the WAO. Support will include preparation of Project Waste Identification and Disposition (PWID) forms; definition of Material Tracking Locations (MTLs); technical direction and oversight for waste stream segregation and management; preparation of Field Tracking Logs (FTLs) and OSDF Manifests; preparation of waste stream profiles; and coordination with the CM, SCEP Characterization, and Waste Management and Technologies for handling and disposition of waste streams.

6.1.3.7 Natural Resources

Natural Resources personnel will be responsible for assessing the natural resources within the A2PI project area and assessing potential damages for consideration during the design and planning stages of the project. Natural resources personnel will not monitor natural resources impacts. Monitoring is covered under the IEMP and will be performed by Environmental Monitoring personnel.

Natural resources personnel will also be responsible for planning and implementing interim and final restoration of the A2PI area as described in the NRRP.

000122

6.1.3.8 Cultural Resources

Cultural Resources will be responsible for handling unexpected discoveries of cultural resources during site preparation and excavation in A2PI.

6.1.4 Coordination of Excavation Site Activities

Several non-excavation activities will be on-going at each active excavation site. Because of the potential safety hazards associated with construction, these activities must be properly coordinated and supervised. Such activities include:

- Visual Observation
- WAC Attainment Monitoring
- Radiological Occupational Monitoring
- Asbestos Monitoring
- Material Documentation
- Occupational Health & Safety Monitoring
- Construction Monitoring
- Surveying
- Visual Dust Monitoring
- Environmental Monitoring
- Safety Inspections.

The following paragraphs describe each of these activities, the personnel involved, and the time requirement for their involvement. In addition to these responsibilities, the contractor is expected to have one full-time equipment operator, the equivalent of one full-time truck driver, and a part-time supervisor at each active excavation area.

Visual Observation

The active face of all excavation areas will be visually monitored (Section 3.3.4.3) on a continual basis to identify special materials encountered during excavation. This monitoring will be performed by FDF personnel (Section 6.1.3.6) and the excavation contractor.

WAC Attainment Monitoring

After completion of a lift in a discrete excavation area (normally 100-foot-by-200-foot), WAC attainment monitoring (Section 3.3.4.3) will be performed using RSS/RTRAK or HPGe equipment to identify above-WAC material. FDF sampling (Section 6.1.3.5) will perform this function under the general direction of the A2PI Characterization Manager. One person is required to operate each

RSS/RTRAK unit and should normally take two to four hours to collect the data in the discrete area. The processing of this data is expected to take up to 48 hours. Upon completion of the data processing, the A2PI Characterization Manager will notify the CM of the results.

If above-WAC material is identified, its presence will be confirmed and the horizontal and vertical extent determined using HPGe measurements and/or physical samples. FDF sampling (Section 6.1.3.5) will perform these functions under the general direction of the A2PI Characterization Manager. The following personnel are required for these activities:

Measurement Method:	HPGe	Physical Samples
Personnel Required:	2 operators per unit	2 Geoprobe® operators 2 technicians 1 geologist 1 documentation person

Radiological Occupational Monitoring

Radiological Control (Section 6.1.3.2) will have one full-time RCT in the field to monitor (Section 6.4.4) for general radiological levels, RWP compliance, and changes in material affecting the classification of the area (such as elevating it from a contamination area to a high contamination area), and to scan special materials if any are encountered.

Asbestos Monitoring

An "asbestos competent person" will be in the field full-time to monitor excavations for Presumed Asbestos Containing Material (PACM). The contractor will be required to perform this function, however, FDF will also monitor this activity. With proper training, this responsibility may be included with "visual observation" responsibilities.

Material Documentation

A full-time FDF representative will complete paperwork to document the transfer of material from the SWUs to the OSDF. This will include OSDF manifests and FTLs. All trucks hauling to the OSDF from A2PI must leave with an OSDF manifest. The FTL will include tracking by MTL. The FDF representative will use verbal information from contractor personnel to document movements between MTLs. These responsibilities may be included with "visual observation" responsibilities.

000124

Occupational Health and Safety

The contractor will be responsible to monitor the work area for occupational health and safety concerns. This will include occupational dust, compliance with the Safe Work Plan, chemical exposure, other hazards, and changes in field conditions affecting worker safety. FDF S&H (Section 6.1.3.1) will periodically observe health and safety conditions at the active excavation area.

Construction Monitoring

FDF construction (Section 6.1.2.2) will monitor (Section 6.4.2) the work for compliance with the contract documents and direct the actual work. This will be accomplished by one full-time person in A2PI and other personnel on a periodic, part-time basis.

Surveying

The Contractor will have a two- to three-person survey crew in the field to provide construction control and to monitor the excavation as the basis for progress payments. FDF may also perform limited surveying to check construction progress.

Visual Dust Monitoring

The contractor will have the primary responsibility to monitor for dust. However, FDF will also monitor the area for compliance with the BAT dust policy requirements.

Environmental Monitoring

Environmental monitoring will be done on a regular basis by FDF. This will include weekly inspections of surface water control facilities and inspections of surface water control facilities after every major rain event to satisfy SWPPP requirements.

Safety Inspections

FDF S&H (Section 6.1.3.1) will perform weekly safety inspections (Section 6.4.3) of the work area with the contractor. This activity can be coordinated with occupational health and safety monitoring.

6.1.4.2 Typical Field Team

The typical field team at each excavation will consist of one RCT (radiological occupational monitoring), one FDF representative (visual observation and material documentation) and two

construction personnel. However, it is possible that 12 or more people (six conducting radiological surveys with HPGe equipment or taking physical samples, one performing occupational health and safety monitoring and a health and safety inspection, one performing environmental and dust control monitoring, one performing construction monitoring, and three construction personnel) could be near an active excavation site at any one time. However, only personnel required for actual construction activities will be allowed within 50 feet of the active excavation.

6.1.4.3 Management of Field Personnel

Such a potentially large group of personnel at a single excavation site at any given time creates logistical and safety concerns. Therefore, the responsibility for the management and coordination of all field personnel and activities has been assigned to the CM (Section 6.1.2.2). All personnel needing access to the excavation site will sign in with the CM before entering the excavation area and sign out upon leaving the area. In this way, the CM can control the number of people in a given area, as well as know how many people are in the construction area in the event of an emergency.

6.2 CONFIGURATION MANAGEMENT

Configuration Management will be implemented throughout the A2PI Project. Configuration Management is the management process by which the technical baseline for projects are identified, graded, tracked, and controlled. Configuration Management establishes consistency among the design requirements, physical configuration, and technical documentation, and will ensure this consistency is maintained throughout construction and operation. Configuration Management also ensures the systematic evaluation, coordination, disposition, documentation, implementation, and verification of all changes, and their impact on cost, schedule, and technical baselines. Site procedure CM-0001, "Configuration Management," will be used as the Configuration Management guideline throughout the A2PI Project.

Procedure ED-12-4015, Performance Grading, has been used and this project has been assigned Performance Grade 5, using the graded approach for systems, structures, and components, based on the importance of their function of hazard mitigation and safety. Performance Grade 5 will primarily require documentation control.

000126

6.3 CONTRACTOR PROCUREMENT AND AWARD STRATEGY

Procurement and contract awards for all activities to support and implement the A2PI remediation project will generally be performed through fixed price/unit price contracts. The FDF acquisition system follows requirements of the Federal Acquisition Requirements (FARs) and is designed to ensure adequate and effective competition among prospective bidders/proposers. The site preparation contractor was procured through an Invitation for Bid (IFB) process. The excavation contractor will be procured through an RFP.

Minimum qualifications are established in the prequalification phase in order to be considered for the competitive bid process. Those firms not meeting the minimum qualifications are not considered. The IFB/RFP solicitation package is prepared during the design process by the FDF Construction Engineer with input from Engineering, Health and Safety, QA/QC, Procurement personnel, and other applicable disciplines. The solicitation package is made up of several parts, including technical specifications and construction drawings, the PSHSRM and training requirements, QA/QC requirements, and the statement of work. Sealed bids/proposals are required to be submitted by potential contractors at a specified place, date, and time.

Following the pre-award survey and the determination that the bidder/proposer is both responsive and responsible, the FDF Contract Administrator recommends and makes the final award. The IFB/RFP solicitation package dictates how many days after award or Notice to Proceed that contractor performance begins and ends.

6.3.1 IFB for Site Preparation

Because the site preparation work is well defined, the contractor was selected based on responses to the IFB. The site preparation procurement process has been completed. The solicitation package was issued as an IFB on June 24, 1997; the pre-bid meeting for potential bidders was held July 8, 1997. Sealed bids from five bidders were received and opened on July 28, 1997. The contract was awarded to Kelchner Environmental on August 6, 1997. Construction was initiated the last week of August 1997, with issuance of the Notice to Proceed. The contractor mobilized to the site on September 3, 1997.

6.3.2 RFP for Excavation

The remedial action excavation for the SWUs has been combined with Phase II construction of the OSDF. Therefore, the construction drawings and technical specifications for the SWUs excavation were combined with the drawings and specifications for the OSDF and presented to prospective contractors in one combined Request for Proposal (RFP). The RFP approach was selected in order to allow prospective contractors flexibility to propose innovative and alternative methods of performing the work. Combining A2PI excavation and OSDF construction under one contract will reduce coordination issues.

The A2PI excavation/OSDF construction RFP was sent to prospective offerers in November 1997. The contract was awarded to Petro Environmental Technologies on May 4, 1998; Notice to Proceed was issued on May 14, 1998. The contractor began mobilization on June 26, 1998, construction began in July 1998.

6.3.3 Equipment and Material Procurement

The majority of the standard support equipment and materials for the A2PI project will be procured by the contractor performing the remediation during the site preparation phase. Procurement of equipment and material will be in accordance with design/specification requirements consistent with the submittal schedule included in the subcontract, pending FDF approval. Vendor data will be submitted by the contractor for applicable Project Team Management (contractor's field representative, CM) review to ensure design and specification requirements are met. Responsibility for maintenance and repair of procured equipment and material lies with the contractor until final acceptance and turnover to FDF on behalf of the DOE.

6.4 CONTRACTOR MANAGEMENT

FDF will directly oversee the contractor performing remediation work and will be responsible for construction management during the work. Construction management includes, but is not limited to, conducting status meetings, daily work surveillance and inspections, and daily safety tours and oversight of the project. The CM will ensure that safety concerns are brought to the attention of the FDF S&H Officer and the responsible contractor(s) who will correct these concerns. FDF is responsible for implementing the A2PI remedial action project in accordance with DOE direction.

000128

6.4.1 Status Meetings

Upon the award of the contracts, the CM will conduct regularly scheduled status meetings. These meetings are to ensure orderly and timely completion of the work and to provide coordination and communication between all parties involved. Attendees will include the CM, the APM, Engineering, Health and Safety, QA, contractor representative(s), and others, as warranted. The meetings will address action item status, project progress, planning, schedule status, safety items, quality, environmental protection, and problem resolution.

In addition to the status meetings, the contractor(s) will be required to submit a daily report (or log) to the CM. The contractor's daily report will cover the previous day's work status and identify any safety or quality problems encountered and a description of work performed. In addition to the contractor-generated daily report, the CM will also generate a daily report. Both reports will be maintained in the FDF project file.

6.4.2 Surveillance and Inspection

The contractors have first line responsibility to inspect work and correct any deficiencies. In addition to the generation and review of daily reports throughout excavation in the A2PI area, inspection and surveillance of the contractor's work will be conducted by FDF with support from the contractor's field representative. The surveillance and inspections will provide independent checks that the design is being properly implemented and contract requirements are being satisfied. Quality control inspection will also occur in accordance with the contractor's Construction Quality Assurance Plan and design requirements. If a deficiency is noted, the contractor will be notified immediately in order to implement the necessary corrective action(s) as soon as possible. The contractor's failure to satisfactorily correct a deficiency will constitute cause to issue a cure order/notice to stop work.

6.4.3 Health and Safety Oversight

A S&H representative will be assigned to the A2PI project. While all contractor personnel are responsible for following all safety requirements identified in the PSHSRM and subsequent Safe Work Plans, as appropriate, the A2PI Project Team personnel will perform periodic surveillance during the A2PI remedial action project to monitor compliance. Although all project personnel have stop work authority for imminent safety hazards, the S&H representative will have stop-work authority in the event of threat to worker and/or public safety until the proper corrective follow up actions are taken.

The S&H representative assigned to the field project will be the single point of contact for all safety, industrial hygiene, fire protection, and radiological issues or concerns, and will direct those concerns to the CM for resolution/implementation.

6.4.4 Radiological Monitoring and Oversight

To ensure occupational radiological compliance, FDF RCTs will be assigned to the A2PI project. The assigned RCTs will perform the necessary radiological monitoring and oversight to provide documentation demonstrating project compliance with regulatory occupational exposure control requirements. The PSHSRM will be the basis for the required project radiological monitoring and will identify controls (engineering or administrative) to ensure personnel radiological safety as well as industrial/occupational safety.

6.5 IMPACTED MATERIAL MANAGEMENT

Impacted material management protocols described below will be implemented in conformance with "Management of At- and Below-Grade Impacted Material" (EW-1019). This procedure provides for the programmatic segregation and characterization of wastes to ensure that only material that meets the OSDF WAC is disposed on site. This procedure adheres to the requirements set forth in the SEP, OSDF WAC Attainment Plan, and the OSDF Impacted Material Placement Plan.

6.5.1 Waste Planning

The impacted material waste streams anticipated to be generated during remediation of the SWUs are shown in Table 6-1, Impacted Material Waste Streams. This information will be incorporated into a PWID form prior to field implementation of each project phase. Each waste stream will be associated in the PWID with at least one source MTL. The MTLs are based on data from kriging models that are developed for designing project excavations. A material documentation drawing which identifies MTLs is included in the design packages (SPDwg G0022, EDwg G0019).

The PWID will govern disposition of waste streams throughout project execution. Compliance with the PWID during project activities will be documented by completing FTLs for interim movements (e.g., stock piling, backfilling, transfer to containers), and by completing manifests for OSDF disposition. Waste stream information, including but not limited to PWIDs, MTLs, FTLs, manifests, and supporting data, will be tracked in the IIMS database.

000130

6.5.2 Waste Stream Excavation

Waste streams within each MTL will be segregated as they are excavated, in accordance with the protocols indicated in Table 6-2, Material Segregation Protocols.

Waste disposition staff will support construction during waste excavation activities by conducting the following activities:

- Providing technical direction and oversight for identifying, segregating, and managing impacted material waste streams
- Preparing FTLs/manifests for transfer of material between MTLs, including but not limited to, stockpiles and the OSDF
- Preparing waste stream profiles for material dispositioned to stockpiles or the OSDF
- Tracking waste streams in IIMS
- Preparing weekly inventory reports for staged material
- Conducting weekly audits of staged material for inventory security and erosion controls.

6.5.3 Waste Stream Staging, Treatment, and Disposal

Each of the anticipated waste streams identified in Table 6-1 will require interim management as well as final disposition. In some cases, interim management will be limited to integration between field and office to ensure that manifests are prepared and sufficiently backed by electronic data in IIMS to support direct disposition to the OSDF upon excavation of impacted material. In other cases, interim management will be more complex, requiring staging the material in a stockpile or container for sampling and analysis, or simply to await scheduling for on- or off-site disposition.

Typically, only final disposition can be clearly defined for a waste stream prior to project implementation. Most interim management requirements are subject to project conditions such as availability of OSDF capacity for a specific waste matrix (e.g., soil versus debris) and the quality of excavated material for construction purposes. Consequently, only anticipated stockpile and container staging, and the anticipated final disposition of waste streams, are recorded in the original PWID. Any

additional management approaches that are implemented during project execution are documented by updating the PWID.

The following outline identifies all possible interim and final disposition options that may be used during a project. Requirements are identified in Section 7 of EW-1019.

- Bulk waste stream management for on-site disposition: Waste streams that meet the OSDF chemical, radiological, and physical WAC (Section 7.5 of EW-1019)
  - Project-specific stockpiles
  - Sitewide stockpiles
  - Cut-and-fill working stockpiles
  - Back fill
  - OSDF - from project area
  - OSDF - from a stockpile
- Bulk waste stream management for off-site disposition: Waste streams that exceed the OSDF chemical or radiological WAC, and can be managed bulk (Section 7.6 of EW-1019)
  - Project-specific stockpiles
  - SP-7 stockpile
- Containerized waste streams that are dispositioned on-site: (Section 7.8 of EW-1019)
  - Interim container staging pending characterization
  - Bulked prior to OSDF disposition
- Containerized waste streams that are dispositioned off-site (Section 7.7 of EW-1019)
  - Materials that exceed the OSDF WAC and cannot be managed bulk
  - Transferred to WPM for off-site disposition in container system.

FTLs/manifests will be used in all cases for tracking material that will be dispositioned to the OSDF. Information that supports WAC determinations will be retrievable through IIMS using either the FTL (interim staging) or manifest (OSDF disposition) form numbers. This information will be available for review by WAO.

The FTLs also will be used to track above-OSDF-WAC containerized materials from the project area. However, subsequent management of the material will be conducted under existing site waste

management procedures, with tracking conducted in the Sitewide Waste Information Forecasting and Tracking System (SWIFTS) database.

Stockpile management protocols (Section 3.1.9) will include administrative controls (posting and boundary delineation) that ensure only suitable material is staged at the stockpile locations. Silt fencing and either vegetative or crusting agent covers will be installed to control erosion and runoff. When stockpiles are in use, dust controls will include daily compaction and application of water mist for visible dust.

6.6 CONTINGENCY MANAGEMENT

The potentially contaminated or hazardous materials identified in Table 6-3, Protocols for Special Material, will require special handling and controls if encountered during soil excavation activities, due to potential health and safety concerns.

The SEP provides additional information regarding protocols for managing special materials. As indicated in Table 6-1, some special materials may meet the OSDF WAC, while others will require off-site shipment. The SCEP Waste Disposition Support Services will provide assistance to Construction for field decisions related to management and disposition of special materials, and, if applicable, will arrange for movement of materials to the appropriate FEMP staging and handling areas for characterization, treatment evaluation, and final disposition arrangements.

6.7 RECORD KEEPING AND DATA MANAGEMENT

Record keeping and data management for the A2PI Project will be in accordance with Section 3.6 of the SEP. The primary documents that will be generated during A2PI remediation activities and the files in which they will be maintained are identified in Table 6-4, A2PI Records.

6.8 QA/QC AND REGULATORY AUDIT

The A2PI project activities will be assessed to verify compliance to program requirements specified in the A2PI Implementation Plan. This will include audits, surveillances and inspections commensurate to the scope of assessment and level of verification with respect to field tasks, subcontract execution and programmatic implementation of driver documents. Quality assurance programmatic drivers are

considered to be the DOE approved FDF Quality Assurance Plan (RM-0012), the EPA approved SCQ, and the draft SEP Appendix E, SEP Quality Assurance Job Specific Plan (QajSP).

The applicable quality requirements will be specified in all planning documents defining project activities. This includes Data Quality Objectives (DQOs) and PSPs that serve as planning and field instructions for environmental radiological field survey measurements and physical sampling to support project data collection. Additionally, the engineering design packages will include the necessary QC to assure conformance to design specifications. Part 9 of the design packages describes appropriate QA requirements. A Construction QA plan will be submitted by construction contractors for SCEP QA approval. Other documents that require QA review and concurrence are procedures, purchase requisitions and the Project Execution Plan (PEP).

The SCEP QA lead will coordinate project QA/QC oversight through audits, surveillances, inspections, vendor surveys, and other internal assessments needed to verify quality related to IRDP activities. External assessments from FDF will also be coordinated with the SCEP QA lead. The contractor will be responsible for field inspections, nonconformance identification, and corrective action that is documented and reflected in a controlled manner through DCNs.

The DOE-FEMP and EPA/OEPA have ready access to IRDP field activities, planning documents, and databases as necessary to assess and verify IRDP implementation. The OEPA has FEMP oversight responsibility for NPDES, RCRA, dust and noise control, groundwater, monitoring, radiological pathways, and related split-sampling programs.

All FDF procurement requisitions are reviewed and signed by SCEP QA. The A2PI QA representative will identify materials receipt inspection requirements and when vendor source inspections are necessary. Nonconforming items will be tagged and dispositioned as unacceptable until corrective measures are determined.

6.9 INTEGRATION OF A2PI EXCAVATION WITH OTHER FEMP ACTIVITIES

The A2PI Project is related to, and must be integrated with, other projects (external to the SCEP) at the FEMP. The major projects that will impact A2PI and their relationship to A2PI are as follows:

000134

- OSDF. Impacted material (soil, fill material, flyash, ground stumps, debris, etc.) will be excavated from A2PI. Most of this material is expected to meet the OSDF WAC and will be hauled to, and placed in, the OSDF, where it will be placed in ratios defined in the Impacted Material Placement Plan with available debris from the former production area. The excavation phase of A2PI remediation will be integrated into one contract package with Phase II of the OSDF. Excavation, loading, hauling, unloading, and subsequent placement of impacted material in the OSDF will be performed by one construction contractor.

- Waste Acceptance Organization (WAO). WAO, an FDF organization independent of both soil- and debris-generating projects and the receiving OSDF project, has responsibility for the OSDF WAC attainment compliance assurance program presented in the WAC Attainment Plan (20100-PL-0014). WAO representatives will provide oversight of field activities from impacted material origin to OSDF receipt.

- Waste Pits Remedial Action Project (WPRAP). Material excavated from A2PI that is above the OSDF WAC will be sent off site for disposal through WPRAP. Above-WAC material will be hauled to, and unloaded at, the SP-7 Stockpile by the excavation contractor. The SP-7 Stockpile will be located in the area of the SP-5 Stockpile; the area will be used to store above-WAC material following excavation of SP-5 material (and transportation to the OSDF) by the SWU excavation subcontractor.

- Waste Management. Special materials and lead-contaminated soil from the SWUs will be managed by FDF Waste Management. The excavation contractor will coordinate the transfer with Waste Management through the CM.

- Impacted Material Haul Road. Haul equipment transporting material from the A2PI area to the OSDF and the SP-7 Stockpile will use the Impacted Material Haul Road. Prior to accessing the Haul Road, the haul equipment will be routed through the A2PI equipment wash facility. The equipment wash facility will be located adjacent to the Impacted Material Haul Road near the Inactive Flyash Pile area. Haul equipment returning from the OSDF and SP-7 Stockpile to the A2PI area will also use the Impacted Material Haul Road. At certain designated crossings, Operable Unit 1 activities and Operable Unit 4 activities will also necessitate accessing the Impacted Material Haul Road.

- AWWT and Water Projects. Part of the South Field Extraction System (SFES) will be built in the area of the SWUs. Part of the SFES will be put in by the site preparation contractor. Access to groundwater extraction wells during A2PI remediation activities will be provided. Also, water from the three A2PI retention basins will be pumped to the SWRB.

- Storm Water Retention Basin (SWRB). Contaminated and potentially contaminated storm water runoff collected from the A2PI excavation activities will be pumped from the A2PI retention basins to the SWRB.

- Site Utilities. Electrical power will be required for lighting, alarms, pumps, and controls. FDF will route all electric power for contractor tie-ins. Potable water will be obtained by the contractor from the site public water supply line.

6.10 SCHEDULE

In accordance with the ACA, this Implementation Plan identifies A2PI remedial action project-specific milestones subject to enforceable deadlines by the EPA. A conceptual schedule is provided on Figure 6-2. This schedule is based on current funding assumptions and the overall site remediation schedule.

Site preparation work was initiated in August 1997, with award of the contract and issuance of the Notice to Proceed. The contractor mobilized to the site in September 1997. Excavation activities were initiated in July 1998. The excavation contract is scheduled to end on December 31, 2000.

Excavation of the waste units is scheduled for completion in the summer of 2000 with final excavation of the South Field. The Certification Design Letter for the A2PI Waste Units Area will be submitted on July 1, 2000 and certification will be completed the following year pending any necessary supplemental excavation.

Certification of the non-waste units areas will begin after the waste unit areas are certified and will begin with a Certification Design Letter scheduled for submission of July 1, 2001. Final certification of A2PI is scheduled to be completed on September 1, 2002.

000136

TABLE 6-1

IMPACTED MATERIAL WASTE STREAMS

Waste Stream	Source Location	OSDF WAC Status	Final Disposition	Est. Vol. (Yd^3)
Lead-contaminated Soil	South Field Firing Range	AWAC[a]	Off-site bulk shipment by truck to PCDF[b], pending sample results	100
Fly Ash/Soil	Inactive Fly Ash Pile	AWAC	Staged in SP-7 Stockpile for off-site rail shipment to PCDF	4,800
OSDF Category 1 Impacted Material	Inactive Fly Ash Pile	BWAC[c]	OSDF[d]	101,000
OSDF Category 1 Impacted Material	Active Fly Ash Pile	BWAC	OSDF	62,000
OSDF Category 1 Impacted Material	South Field	BWAC	OSDF	116,000
OSDF Category 1 Impacted Material	Impacted Stockpile on South Field	BWAC	OSDF	24,000
Wood Chips	All Areas	BWAC	On-site reuse	1,000
OSDF Category 2 Debris	All Areas	BWAC	OSDF	39,000
OSDF Category 3 Debris	All Areas	BWAC	OSDF	250 [f]
OSDF Category 5 Material	All Areas	BWAC	OSDF	200 [f]
Prohibited Items	All Areas	AWAC	Off-site containerized shipment by truck to NTS[e] or PCDF	100 [f]
Special materials	All Areas	AWAC	Off-site containerized shipment by truck to NTS or PCDF	100 [f]
Special materials (Various OSDF Categories)	All Areas	BWAC	OSDF	100 [f]

[a] AWAC = Above OSDF Waste Acceptance Criteria
[b] PCDF = Permitted Commercial Disposal Facility
[c] BWAC = Below OSDF Waste Acceptance Criteria
[d] OSDF = On-Site Disposal Facility
[e] NTS = Nevada Test Site
[f] Assumed value to reflect expectation of encountering such material

TABLE 6-2

MATERIAL SEGREGATION PROTOCOLS

Material Type	Segregation Protocols
AWAC Special Material	See Table 1 of EW-1019 for list of special materials.
BWAC Special Material	See Table 1 of EW-1019 for list of special materials.
Prohibited Items	See Table 2 of EW-1019 for list of prohibited items.
AWAC Soil	See Table 4 of EW-1019 for chemical and radio nuclides of concern, and Table 3 of EW-1019 for prohibited constituents of concern. Note that Table 3 prohibitions apply only to areas defined in the OU2 and OU5 RODs as potentially RCRA characteristic.
AWAC Debris	AWAC debris that is not classified as special material or prohibited items, requires physical sizing or processing to meet the OSDF WAC.
BWAC Material	Segregate in accordance with OSDF waste stream categories in Table 5 of EW-1019.

AWAC = Above OSDF Waste Acceptance Criteria.
BWAC = Below OSDF Waste Acceptance Criteria

000138

TABLE 6-3

PROTOCOLS FOR SPECIAL MATERIAL

SPECIAL MATERIAL	EXAMPLES	PROTOCOLS
Asbestos/Presumed Asbestos Containing Material (PACM)	Transite panels, floor tile, feeder cable, piping insulation	General: Unprotected ACM may not be staged in the excavation area. If delays are expected prior to OSDF disposition, containerize and transport to interim storage. Wrapped pipe: Size reduce, double bag or equivalent for OSDF Category 3 or 5. Pipe may be split axially or radially. Transite sheets: Band and manage as OSDF Category 3. Other ACM that meets OSDF Category 5: Double bag ACM that does not meet OSDF WAC: Containerize and transport to interim storage for off-site evaluation. Note: OSDF Category 5 is evaluated on a case-by-case basis. A Request For Disposal (RFD) is required.
Non-pressurized Containers	Intact drums, metal and wood boxes, cans	Intact containers: Visually inspect for leaks and indication of contents. Overpack or repack leaking containers prior to movement from area of discovery. If safety considerations allow, open container and record description of contents on Visual Inspection Form. Transport to interim storage for further evaluation. Empty containers: Crush or size reduce and manage as OSDF Category 2.
Pressurized Containers	Aerosol cans, Freon containers, gas cylinders, propane tanks, fire extinguishers	General: Handle intact containers as though they contain material. Evaluate container integrity. Intact containers: Overpack and move to FEMP interim storage area for evaluation. If container is to be dispositioned in OSDF, it must be punctured, crushed or cut so that the interior is open to the atmosphere. Breached containers: Evaluate for OSDF Categories 2, 3 and 5. Category 5 is evaluated on a case-by-case basis and requires a RFD.
Piping and pumps	Drain lines, sewer lines, process piping, floor pumps	General: Elevate one end of exposed pipe, cut, and empty flowable material into a container. Transport containers to interim storage for evaluation. Process piping: Cap and remove pipe after emptying. Evaluate piping for OSDF Category 2. Containerize any piping that requires off-site disposition. General piping: Cap and remove pipe after emptying. Manage as OSDF Category 2. Sumps: Remove after emptying. Manage as OSDF Category 2. Note: MEF/SWIFTS research is required prior to trenching activities.
Non-soil Residues	Green salt, black oxide, sump cake	Field screen to determine radionuclide content. Segregate uranium-bearing residues, containerize, and transport to interim storage for evaluation. Stockpile non-uranium residues and evaluate for OSDF Category 1 or 5. Category 5 requires a RFD.
Transformers	Electrical equipment	General: Segregate and evaluate to determine if contains fluids. Empty transformers: Manage as OSDF Category 2, 3, or 5. Fill void spaces greater than 1 cf. with flowable, cohesionless material or a quick set grout. Category 5 requires an RFD. Transformers containing fluids: Drain fluids into a container and transport to interim storage. Evaluate fluids for off-site disposition. Manage emptied transformer as described above.
Lead Acid Batteries		Segregate, containerize and transport to interim storage for evaluation.
Uranium Metal	Derbies, ingots, billets, irregularly shaped scrap	Segregate, containerize, and transport to interim storage area for evaluation for disposal.
Medical/Infectious Waste	Syringes, vials	Evaluate on case-by-case basis for OSDF Category 5 (requires a RFD). Containerize and move to interim storage if field operations do not allow timely completion of this evaluation. Medical/infectious waste not meeting OSDF requirements will be containerized and transported to interim storage for off-site evaluation.
Miscellaneous Debris	Oil/air filters, radiators, cable/wire, tools, heavy equipment, office materials, documents	Evaluate on case-by-case basis for OSDF Category 5 (requires a RFD). Containerize and move to interim storage if field operations do not allow timely completion of this evaluation. Miscellaneous debris not meeting OSDF requirements will be containerized and transported to interim storage for off-site evaluation.
Tires	Tires from miscellaneous equipment	Containerize and transport to interim storage for off-site evaluation.

TABLE 6-4

AREA 2, PHASE I RECORDS

Document	File
Construction drawings and associated field logs	• IIMS GIS Component • Engineering/Construction Document Control
Miscellaneous Field Logs	• Engineering/Construction Document Control
Manifest-type Documents	• IIMS SWIFTS Component • Engineering/Construction Document Control
Containerized Impacted Material Documents	• IIMS SWIFTS Component • Site Operating Record
Analytical Data and Associated Field Logs	• IIMS SED Component • Engineering/Construction Document Control

000140

TABLE 6-5

AREA 2, PHASE I IMPLEMENTATION SCHEDULE

Milestone	Schedule Date
Select excavation contractor	May 1, 1998*
Excavation contractor mobilizes	June 15, 1998
Begin excavation of SWUs	July 7, 1998*
Begin excavation of above-WAC material in Inactive Flyash Pile	July 17, 1998
Complete excavation of Inactive Flyash Pile	November 23, 1998
Begin excavation of South Field (west)	April 1, 1999
Complete excavation of lead contaminated soil in South Field	June 1, 1999
Complete excavation of South Field west and Active Flyash Pile	November 15, 1999
Start excavation of South Field (east)	April 3, 2000
Submit SWU Certification Design Letter for A2PI Waste Unit Areas	July 1, 2000*
Complete certification of A2PI Waste Unit Areas	July 1, 2001*
Submit SWU Certification Design Letter for A2PI Non-waste Unit Areas	July 1, 2001*
Complete certification of A2PI Non-waste Unit Areas	September 1, 2002

* Milestone DOE commitment dates. Other dates are presented for information only.

Figure 6-1
Area 2, Phase I Project Organization During Investigation, Design and Certification Phases

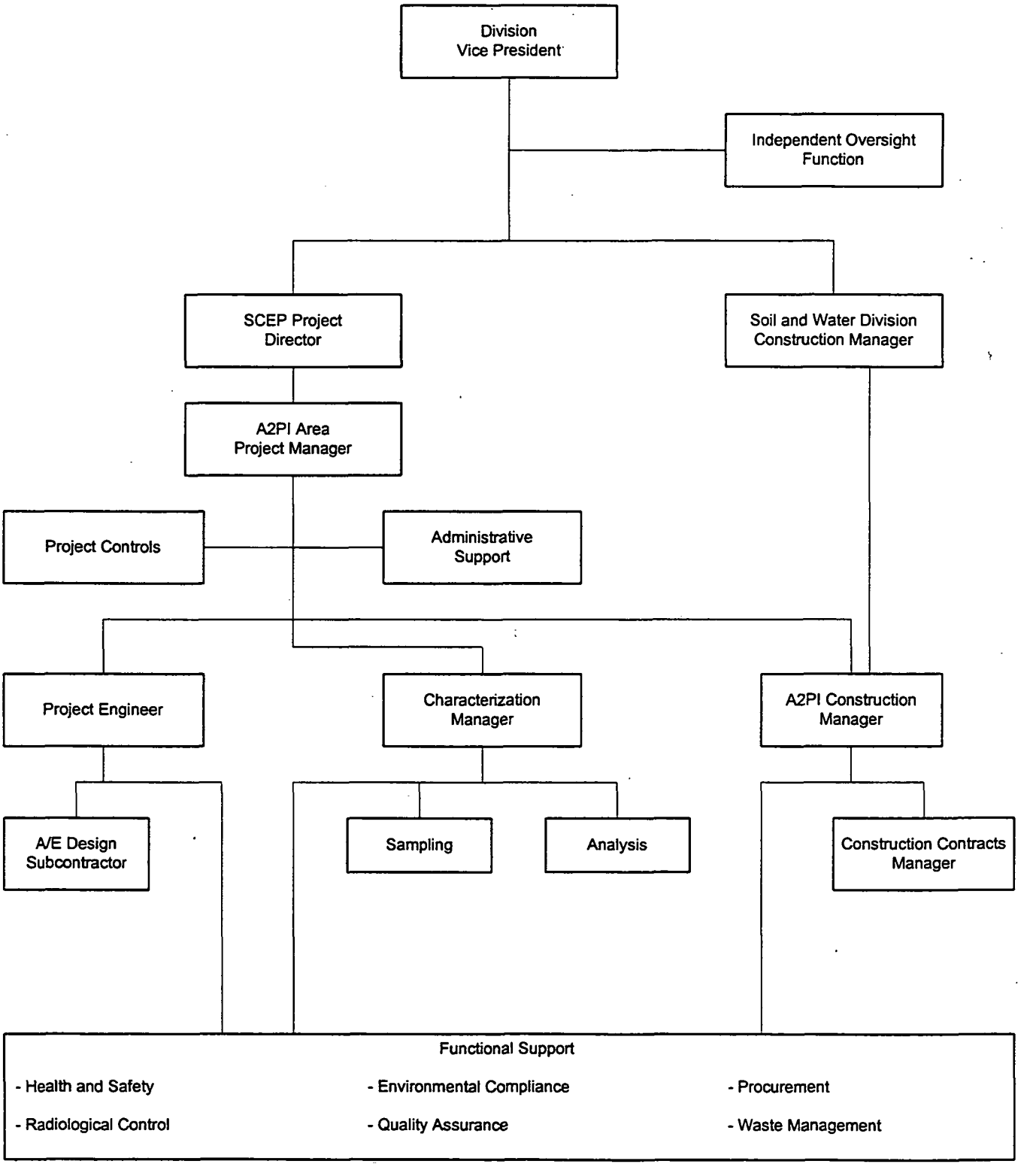
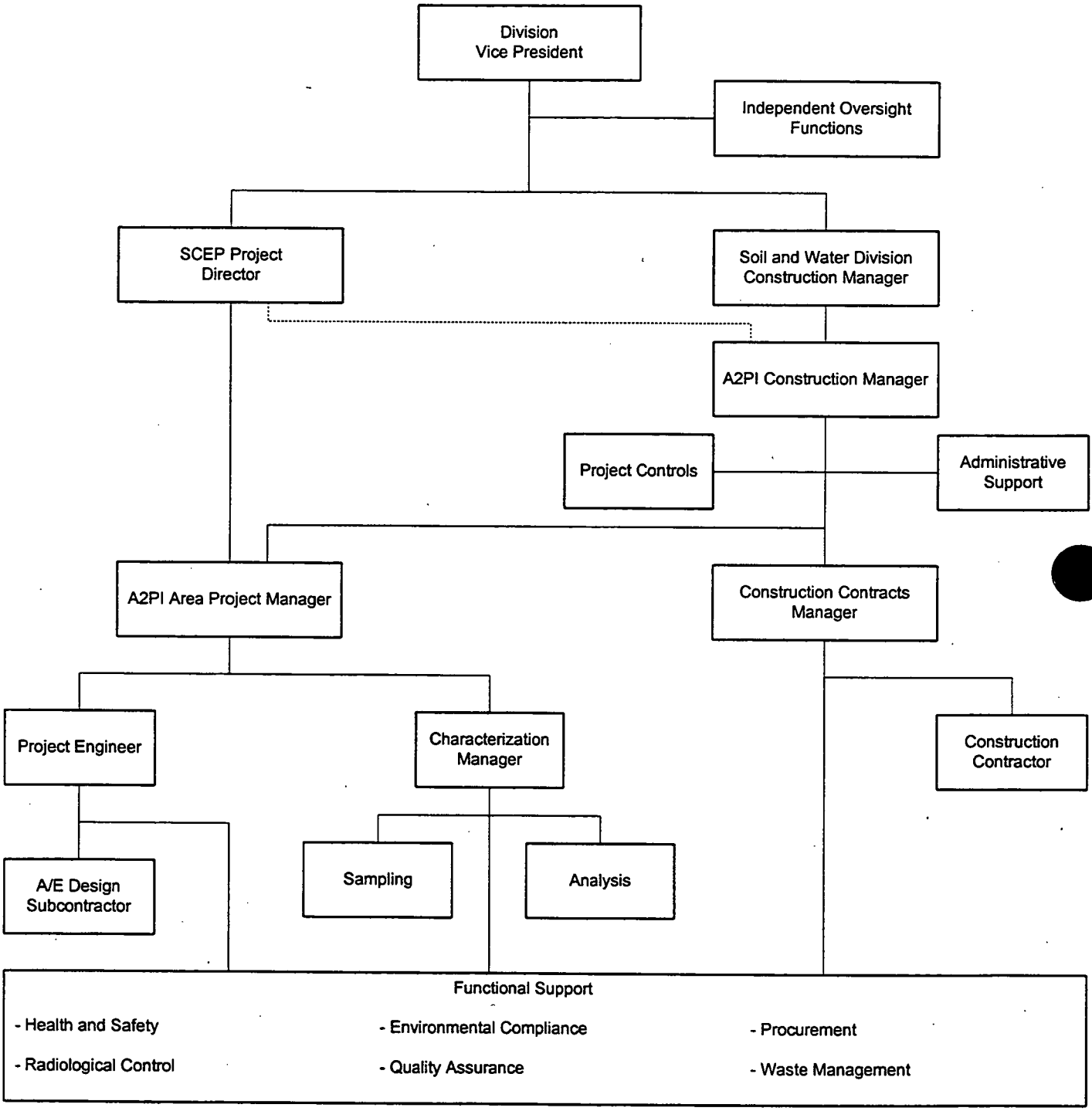


Figure 6-2
Area 2, Phase I Project Organization During Construction Phase



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000145

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Design Criteria Package for Area 2, Phase I ~~Southern Waste Units~~ Remedial Action Project Design and Construction 20400-DC-0001

Project Order 165

July 1998
Revision 2

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Subcontract No. 2-21487

PARSONS

175 Tri-County Parkway
Cincinnati, Ohio 45246

Design Criteria Package
for
Area 2, Phase I
~~Southern Waste Units~~
Remedial Action Project
Design and Construction
Revision 2

CONTENTS

SECTION

1.0 Project Description 1-1
- 1.1 Project Scope 1-1
- 1.2 Description of Alternative Selected 1-2
- 1.3 General Description of the Project Components 1-2
- 1.4 Assumptions/Clarifications 1-4
- 1.5 Project Interfaces 1-6

2.0 Design Basis 2-1
- 2.1 Functional Requirements 2-1
- 2.2 Design Criteria 2-1
- 2.3 Discipline Criteria 2-8

3.0 References 3-1

APPENDICES

A ARARs and TBCs for Area 2, Phase I

LIST OF ILLUSTRATIONS

TABLES

2-1 Civil Drawings

2-2 Division 1, 2, and 3 Specifications

2-3 Electrical Drawings

2-4 Electrical Specifications

~~2-5 Material Handling Drawings~~

~~2-6~~5 Mechanical Process/Piping Drawings

~~2-7~~6 Division 15 Specifications

~~2-7~~ Division 13 Specifications

000149

LIST OF ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACGIH	American Conference of Governmental Industrial Hygienists
AFP	Active Flyash Pile
ALARA	As Low As Reasonably Achievable
ASCE	American Society of Civil Engineers
ANSI	American National Standards Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWWA	American Water Works Association
AWWT	Advanced Wastewater Treatment (Facility)
CFC	Certified for Construction
CFR	Code of Federal Regulations
cy	cubic yards
DCP	Design Criteria Package
DOE	United States Department of Energy
EPA	Environmental Protection Agency
FDF	Fluor Daniel Fernald, Inc.
FEMP	Fernald Environmental Management Project
FRL	Final Remediation Level
FS	Feasibility Study
GMA	Great Miami Aquifer
gpm	gallons per minute
HDPE	High Density Polyethylene
IFP	Inactive Flyash Pile
ICS	Industrial Control and Systems Section
ISC3	Industrial Source Complex Version 3
μg	micrograms
m	meter
msl	mean sea level
MSS	Manufacturers Standardization Society
NEMA	National Electrical Manufacturers Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources

000150

ODOT	Ohio Department of Transportation
OSDF	On-Site Disposal Facility
OU	Operable Unit
PACM	Presumed Asbestos Containing Materials
PCDF	Permitted Commercial Disposal Facility
PSHSP	Project-Specific Health and Safety Plan
psi	pounds per square inch
rem	roentgens-equivalent man
RI	Remedial Investigation
SCS	Soil Conservation Service
SF	South Field
SFES	South Field Extraction System
SFVH	South Field Valve House
S/RID	Standards/Requirements Identification Document
SSC	Structure, System, and Component
STD	Standard
SWMP	Surface Water Management Plan
SWRB	Stormwater Retention Basin
TBC	To Be Considered
TWA	Time-Weighted Average
UBC	Uniform Building Code
WAC	Waste Acceptance Criteria

000151

SECTION 1

PROJECT DESCRIPTION

The Fernald Environmental Management Project (FEMP) is a 1,050-acre facility located in southwestern Ohio approximately 18 miles northwest of downtown Cincinnati. The FEMP facility contains low-level radioactive, solid, and hazardous wastes. Much of the impacted material is to be disposed of in an On-Site Disposal Facility (OSDF) as delineated in the Operable Units Records of Decision. It is anticipated that approximately 2.5 million cubic yards (cy) of material will be removed from the FEMP operable units during the remediation activities and will be placed in the OSDF for permanent disposition. The impacted material that has been approved for placement in the OSDF from the Operable Unit (OU) 2 Area 2, Phase I consists of approximately ~~346,500~~ 342,000 cy of soil (in situ), debris, fly ash, sludge, and solid waste. In addition, approximately ~~3,000~~ 4,800 cy of material will be transported to the ~~OU-1~~ SP-5 Stockpile Area (to be renamed SP-7 Stockpile) pending shipment to an off-site permitted commercial disposal facility (PCDF). Approximately ~~300~~ 100 cy of lead-contaminated soil will be excavated and shipped offsite for treatment and disposal.

This Design Criteria Package (DCP) addresses the issues and concerns for design and construction of the Area 2, Phase I Remedial Action Project. The DCP is developed consistent with the requirements in the ~~draft~~ Functional Requirements Document prepared by Fluor Daniel Fernald, Inc. (FDF), the Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) requirements prepared by FDF and listed in Appendix A, appropriate United States Department of Energy (DOE) regulations and orders, United States Environmental Protection Agency (EPA) directives, and FDF Standards/ Requirements Identification Documents (S/RIDs).

This DCP will serve as the basis for Title I, II, and III design services for design and construction of the Area 2, Phase I Remedial Action Project.

This DCP was prepared consistent with the outline provided in the FEMP Engineering Procedure Number 12-4003, *Design Criteria Package*, Revision 0.

1.1 Project Scope

PARSONS will provide Title I/II engineering services to prepare Certified for Construction (CFC) design packages for the Area 2, Phase I. Separate Site Preparation and Excavation packages will be prepared for the Area 2, Phase I which include the following:

- South Field (SF)
- Inactive Flyash Pile (IFP)

- Active Flyash Pile (AFP)

Title III services will be provided during construction of the Area 2, Phase I Remedial Action Project.

1.2 Description of Alternative Selected

The selected remedy for the OU-2 Area 2, Phase I includes excavation of all impacted material with contaminants of concern above the established OU-2 Remedial Investigation (RI)/Feasibility Study (FS) final remediation levels (FRLs) or all fill material, whichever extends deeper. For the remediation of the Area 2, Phase I areas, this includes excavating down to the original grade or deeper if indicated by the RI/FS FRLs. In addition to excavation, the remediation process will include material processing for specified size requirements, moisture control, and on-site disposal in the OSDF. Excavated impacted material that exceeds the radiological waste acceptance criteria (WAC) of the OSDF will be segregated and transported to the ~~OU-1~~ SP-5 Stockpile Area (to be renamed SP-7 Stockpile). This material will be packaged and shipped by FDF to a PCDF. It is estimated that approximately ~~346,500~~ 342,000 cy of in situ impacted material will meet the OSDF WAC and thus be disposed of on-site. Approximately ~~3,000~~ 4,800 cy of material may not meet the radiologic WAC for the OSDF and will be disposed of off-site at a PCDF. Additionally, approximately ~~300~~ 100 cy of soil containing lead will be removed from the former firing range and packaged for shipment to a PCDF. This material will be staged within the Area 2, Phase I project site prior to shipment.

1.3 General Description of the Project Components

1.3.1 Excavation

After site preparation, excavation will be performed in a phased manner by area. The general phases will be IFP, SF, and AFP. Within each area priority material that exceeds the OSDF WAC (i.e., above WAC and lead contaminated soil), will be excavated first and segregated as it is encountered. Material that meets the OSDF WAC will be transported to the OSDF for disposal. Impacted material will be removed and the underlying substrate monitored for contaminant levels. As the Area 2, Phase I area is remediated it will be graded to provide for positive drainage and seeded for erosion control.

1.3.2 Stormwater Controls

Stormwater runon will be controlled by constructing diversion ditches upslope of excavations. Runoff from within the excavated areas will be collected and controlled. The excavated areas within the Area 2, Phase I will serve as collection sumps for stormwater control. Retention basins will be designed to store, at a minimum, the 10-year, 24-hour storm event with sediment level at the required cleanout volume. The sediment cleanout level shall be based on 27-cubic yards of sediment storage per acre of drainage area. Additional detail is provided in Section 2.3 and describes use of 25-year, 24-hour storm event criteria for some stormwater controls. At the Area 2, Phase I, the potentially contaminated water from the retention basins will

000153

be pumped via a common pipeline to the FEMP Stormwater Retention Basin (SWRB). Retention basins will be designed to dewater the 10-year storm within approximately 72 hours. All stormwater is to be routed so that it can be sent to the SWRB. Water from the SWRB is then sent to the Advanced Waste Water Treatment (AWWT) Facility for treatment.

A Surface Water Management Plan (SWMP) has been prepared for the Area 2, Phase I Remedial Action Project and includes construction and post-construction controls for surface water runon and runoff.

1.3.3 Pipeline

Stormwater piping from the retention basins lift station to the SWRB will be double-walled below elevation 560 ft.; above elevation 560 ft., it will be single-walled. Double-walled pipe will be used in areas where the pipe goes through the sands and gravel of the Great Miami Aquifer (GMA). High Density Polyethylene (HDPE) pipe will be used for piping located below grade. This pipe will be buried a minimum of 3.5 feet to prevent freezing. Cleanouts will be placed at critical low points to assist in cleanout if the lines should become clogged. Air release valves will be installed at high points.

1.3.4 Equipment Wash Facility

An Equipment Wash Facility will be required prior to accessing the Haul Road at the Area 2, Phase I excavation areas. The Equipment Wash Facility will be constructed with a collection sump to collect potentially contaminated water so it can be sent to the AWWT for treatment. A water supply flow rate of 15 gpm is assumed. Potable water will be used. Wash water pressure may be increased with a commercially available pressure washing unit. The Equipment Wash Facility will be used for gross decontamination by removing loose contaminants from vehicle tires and undercarriages. Water supply for the wash facility will be from the 6-inch diameter public water supply line that serves the FEMP. A backflow prevention system will be installed at the tie-in point and locally at post hydrants.

1.3.5 Radiological Control Point Facility Trailer

Support facilities (trailers) will be provided at the Area 2, Phase I access point. A radiological control trailer and an office trailer (for FDF use) will be provided. The radiological control trailer will be used as the normal ingress and egress point for the contamination areas and will include personnel contamination monitoring and radiological access control equipment, lockers, change-out areas, sinks and emergency showers. The office trailer will be provided with lavatory facilities (sink and toilet). Water supply for the trailers will be from the 6-inch diameter public water supply line that serves the FEMP. Sanitary water will be collected in holding tanks and periodically removed by the contractor and handled in accordance with site water treatment requirements. Sanitary facilities consisting of portable toilets located outside of contamination areas at the Area 2, Phase I area, will also be provided.

1.3.6 Electrical Power

Electrical power will be provided at the Area 2, Phase I areas for services to the trailers, stormwater excavation pumping, equipment wash facility, lighting and other loads. In the Area 2, Phase I area, a 13.2 kV aerial circuit will be extended from the primary of substation N18-1 to serve local 13.2 Kv - 480 V pole mounted transformer banks for the required loads. For these areas, a starter rack type service will be installed adjacent to the equipment requiring electrical power. Pumps associated with the remediation will be 480 V, 3 phase with local starters.

1.3.7 Surface Water Management Plan

A SWMP has been prepared for the Area 2, Phase I area. The plan addresses how surface water will be controlled, stormwater management, erosion and sediment control measures, implementation, and maintenance of the control measures.

1.3.8 Systems Plan

A Systems Plan has been developed for each system with mechanical or electrical components which includes instructions for safe operations and maintenance.

1.3.9 Title III Services

Title III services will be provided during the construction of the Area 2, Phase I Remedial Action Project. These services include attendance at construction meetings, preparation of observation reports, and review of site preparation and excavation contractor submittals including Vendor Data Submittals, Requests for Clarification of Information, and Design Change Notices.

1.4 Assumptions/Clarifications

1) Retention basins for the Area 2, Phase I will be designed to store either the 25-year, 24-hour storm event or the 10-year, 24-hour storm event (see Section 2.3) with sediment level at the required cleanout volume. The sediment cleanout level shall be based on 27-cubic yards of sediment storage per acre of drainage area. Ditches and culverts will also be designed using a 10-year frequency storm. Ditches and culverts located between the construction area and Paddys Run will be designed for the 25-year, 24-hour storm.

2) FDF will be responsible for compliance with stormwater management and wetlands issues, including all National Pollutant Discharge Elimination System requirements and permits. FDF will provide guidance on stormwater and wetland compliance.

000155

3) The Project-Specific Health and Safety Plan (PSHSP) will be prepared by FDF.

4) The construction contractor will remove and handle impacted material as shown on the design documents.

5) FDF will prepare and implement any sampling and analysis plans to characterize soil, guide excavation, and determine compliance with clean-up levels.

6) Air monitoring will be provided by FDF in accordance with ARARs.

7) Heat tracing will be provided on all aboveground piping where adequate slope for drainage cannot be achieved.

8) At elevations below 560 ft. msl double-walled pipe will be required for stormwater runoff transferred from the Area 2, Phase I. Single-walled pipe will be used above elevation 560 ft.

9) Leak detection will not be required for stormwater runoff/transfer piping.

10) Above-grade vegetation will be cut, chipped, and either stockpiled in locations shown on the construction documents or hauled to the OSDF.

11) Geomembrane liners will be used in the non-impacted stockpiles. Geomembrane liners and soil infiltration barriers will be used in retention basins. A clay or clay-like soil, obtained from the OSDF Sediment Basin stockpile or other suitable source, will be used for the infiltration barrier material in retention basins and ditches where the ~~Great Miami Aquifer (~~GMA~~)~~ will be exposed due to excavation. NOTE: Field conditions and time constraints allowed that a geomembrane liner only be installed in Retention Basin No. 2. In lieu of the secondary protection the infiltration barrier would have provided, an intruder barrier (fence) was installed around the basin to prevent liner damage.

12) The personnel monitoring trailer requirements will be specified by FDF. Drawings and specifications on the personnel monitoring trailer will be provided by PARSONS.

13) The FDF office trailer requirements will be specified by FDF. Drawings and specifications (meeting Ohio Department of Transportation Type C field office trailer requirements) for the FDF office trailer will be provided by PARSONS.

14) The contractor will be required to provide his own office trailer and a pole will be designated for the power supply.

15) Structures, systems, and components (SSCs) are classified as PC-2 for Natural Phenomena Hazards design.

1.5 Project Interfaces

The Area 2, Phase I requires interfacing with existing systems and procedures. The existing physical interfaces include:

1) Site access and haul roads
2) Site utilities and storm drains
3) ~~OU-1~~ SP-5 Stockpile Area
4) AWWT Facility and SWRB
5) OSDF and off-site disposal
~~6)~~ ~~SWRB~~
~~7~~6) OU-5 South Field Extraction System
~~8~~7) Miscellaneous material stockpiles

1.5.1 Site Access and Haul Roads

A traffic plan shall be included in the bid documents to illustrate to the contractor the site access and support area access, the haul route to the OSDF, above WAC ~~OU-1~~ SP-5 Stockpile Area, other stockpiles to be cleared, and the vehicle decontamination location.

1.5.2 Site Utilities and Storm Drains

The Area 2, Phase I will tie into the 6-inch public water line which serves the FEMP with potable water for the Equipment Wash Facility, emergency shower in the access control trailer, lavatory facilities in the office trailer, and for water spray for the AFP. The contractor shall supply a temporary storage tank at the AFP as direct application from the 6-inch public water supply line will not be permitted. Electrical power will be required at the Equipment Wash Facility, Area 2, Phase I support area, and the stormwater lift stations. See 1.3.6 for description. The existing east seepage control lift station and effluent line are to be removed during excavation. The west seepage control lift station shall pump water from the Equipment Wash Facility.

Between the SF area and the AFP is a utility corridor that contains the FEMP's water and gas supply along with groundwater lines for the South Plume Remediation.

000157

1.5.3 ~~OU-1~~ SP-5 Stockpile Area

Excavation and removal of the SP-5 Stockpile will be included in the design. The area of the SP-5 Stockpile will be used to stockpile Above WAC material. This Stockpile will be named the SP-7 Stockpile. Impacted materials above the OSDF radiological WAC will be transported to an ~~OU-1~~ SP-7 Stockpile ~~Area~~ for off-site disposal. The contractor will be responsible for maintaining and controlling the stockpile and for unloading the impacted materials in a manner to prevent contamination of the vehicle tires and undercarriages.

1.5.4 Advanced Wastewater Treatment Facility and SWRB

All Area 2, Phase I stormwater for storms up to the design storm will be collected and routed to the AWWT for treatment. The Area 2, Phase I stormwater will be routed to retention basins ~~within Area 1, Phase II~~ and then transferred to the FEMP's SWRB from where it is then transferred to the AWWT. Effluent from the AWWT discharges to the Great Miami River. The flow from the Area 2, Phase I retention basins will be limited to 600 gpm and will be pumped directly to the SWRB.

1.5.5 OSDF and Off-Site Disposal

An OSDF will be constructed (not as a part of this project) to dispose of low level impacted material and waste fill. The Area 2, Phase I contractor will be responsible to ensure that the impacted material meets all OSDF physical WAC including size and moisture content. Impacted material or other material that does not conform to the OSDF ~~radiological~~ WAC will be segregated and queued in areas designated by FDF (above WAC ~~OU-1~~ SP-7 Stockpile ~~Area~~, special materials transfer area, and lead contaminated soil transfer area) for further processing for off-site disposal.

1.5.6 OU-5 South Field Extraction System (SFES)

The OU-5 SFES project has wells, underground lines, and a valve house (SFVH) in the general area of the Area 2, Phase I. The soil stockpile east of retention basin number 1 will require that the treatment and discharge lines from extraction well 13 (EW-13) and the power supply to EW-13 shown on CFC drawings be revised prior to their installation. The Area 2, Phase I work will require the gravel road between the AFP and SF be closed. This will cut off clean access to the SFVH, EW-13, 14, 15, and 16. EW-15 and 17 will be given access from the Area 2, Phase I support area. A new access road (not as a part of this project) will need to be provided and built for the SFVH, EW-13, 14, and 16 by OU-5.

1.5.7 Miscellaneous Material Stockpiles

A series of ~~Remedial Actions and other~~ stockpiles have been identified for removal and cleanup as part of the Area 2, Phase I project work. These stockpiles will be identified on the traffic routing plan and controls provided for cleanup of the stockpiles.

1.6 Remediation Schedules

Construction activities for the Area 2, Phase I will be divided into two bid packages, site preparation and excavation. Site Preparation, which started in summer of 1997, shall include the stormwater and erosion control measures, infrastructure improvements, and clearing. The Excavation package will include the excavation of the impacted material (remediation grading), interim restoration grading, and vegetative stabilization, and is anticipated to start in the ~~spring~~ summer of 1998. The start of remediation grading activities is contingent upon completion of the Haul Road to the OSDF and the ability of the OSDF to accept material from Area 2, Phase I.

000159

SECTION 2

DESIGN BASIS

2.1 Functional Requirements

The functional requirements for the Area 2, Phase I Remedial Action Project will be in accordance with the Functional Requirements Document prepared by FDF for this project.

2.2 Design Criteria

State and local building codes will be followed unless they conflict with DOE Order 6430.1A, in which case the most conservative will apply. Title I, II, and III work will be performed in compliance with pertinent S/RIDs as identified in the FDF *Policies and Requirements Manual*. Pertinent S/RIDs for this project are those requirements in the following S/RIDs contained in PARSONS Generic Requirements List forwarded to FDF on April 19, 1996 (PARSONS ID# 27:000:041:0132-96).

1) S/RID No. 2, Engineering Design
2) S/RID No. 3, Emergency Preparedness and Management
3) S/RID No. 5, Environmental Protection
4) S/RID No. 6, Fire Protection
5) S/RID No. 8, Management Systems
6) S/RID No. 9, Nuclear and Systems Safety
7) S/RID No. 10, Occupational Safety and Health
8) S/RID No. 12, Packaging and Transportation
9) S/RID No. 14, Radiological Protection
10) S/RID No. 15, Security
11) S/RID No. 17, Environmental Restoration and Waste Management

2.2.1 Regulations, Codes, Standards, Orders, Manuals, and Guides

This section presents the general regulations, codes, standards, and orders that are to be followed for the design of the Area 2, Phase I Remedial Action Project other than ARARs/TBCs. This information is organized by engineering discipline. Pertinent ARARs/TBCs developed by FDF are listed in Appendix A.

Civil

1) American Association of State Highway and Transportation Officials (AASHTO), GDHS-90, "Policy on Geometric Design of Highways and Streets," 1990, by AASHTO.

2) American Society of Civil Engineers (ASCE), Manual 37, "Design and Construction of Sanitary and Storm Sewers," ASCE.

3) American Water Works Association (AWWA) C 906-90 Polyethylene Pressure Pipe and Fittings, 4 Inch through 63 Inch for Water Distribution.

4) AWWA, C 600-93 Installation of Ductile-Iron Water Mains and Their Appurtenances.

5) FEMP Stormwater Pollution Prevention Plan for Construction Activities.

6) North American Datum of 1983.

7) North American Vertical Datum of 1929.

8) Ohio Department of Transportation (ODOT), Location and Design Manual, Volume II, Drainage Design.

9) ODOT, Construction and Material Specifications, January 1995.

10) Ohio Department of Natural Resources (ODNR), "Rainwater and Land Development, Ohio's Standard for Stormwater Management, Land Development, and Urban Stream Protection," 2nd ed., 1996.

11) Soil Conservation Service (SCS), Soil Survey of Hamilton County, Ohio.

12) SCS, "TR-55 Urban Hydrology for Small Watersheds," Technical Release 55, SCS.

13) TM 5 814-2, "Sanitary and Industrial Wastewater Collection - Pumping Stations and Force Mains," U.S. Dept. of Army.

14) AASHTO HS-20, Traffic Loadings Across Force Mains.

Cost Estimating

1) FEMP, PCS-002, Cost Estimating.

2) DOE Office of Infrastructure Acquisition (FM-50), "Cost Estimating Guide, Cost Guide, Volume 6."

000161

Electrical

1) American Bearing Manufacturers Association (ABMA) 9-90 Load Ratings and Fatigue Life for Ball Bearings.

2) ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.

3) American National Standards Institute (ANSI) C80.1-90 Rigid Steel Conduit-Zinc Coated.

4) ANSI C2-97 National Electrical Safety Code.

5) ANSI C29.2-92 Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type.

6) ANSI C29.4-89 Wet-Process Porcelain Insulators - Strain Type.

7) ANSI C29.5-84 Wet-Process Porcelain Insulators - Low and Medium Voltage Types.

8) ANSI C29.7-83 Wet-Process Porcelain Insulators - High Voltage Line-Post Type.

9) ANSI C37.30-89 Definitions and Requirements for High-Voltage Air Switches, Insulators, and Bus Supports.

10) ANSI C62.1-89 Gapped Silicon-Carbide Surge Arresters for AC Power Circuits

11) ANSI C62.11-87 Metal-Oxide Surge Arresters for AC Power Circuits

12) ANSI C82.4-85 Ballasts for High Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

13) ANSI C135.1-79 Galvanized Steel Bolts and Nuts for Overhead Line Construction.

14) ANSI C135.22-88 Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction.

15) ANSI O5.1-92 Wood Poles Specifications and Dimensions.

16) American Society for Testing and Materials (ASTM) A36/A36M-96 Standard Specification for Carbon Structural Steel.

17) ASTM A475-95 Standard Specification for Zinc-Coated Steel Wire Strand.

18) ASTM A675/A675M Steel Bars, Carbon, Rev. A-90 Hot-Wrought, Special Quality, Mechanical Properties.

19) ASTM B231-90 Concentric-Lay- Stranded Aluminum 1350 Conductors.

20) ASTM B232-92 Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR).

21) American Wood-Preservers Association (AWPA):

22) AWPA C4-89 Poles - Pressure Process.

23) AWPA C25-89 Standard for the Preservative Treatment of Crossarms by the Pressure Process.

24) International Electrical Testing Association (NETA) NETA ATS-95 Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

25) Institute of Electrical and Electronics Engineers (IEEE) 48-90 Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.

26) IEEE 112-91 Standard Test Procedure for Polyphase Induction Motors and Generators.

27) National Electrical Manufacturers Association (NEMA) AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.

28) NEMA ICS 1-93 Industrial Control and Systems General Requirements.

29) NEMA ICS 2-93 Industrial Control and System Controllers, Contractors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.

30) NEMA ICS 4-93 Industrial Control and Systems Terminal Blocks.

31) NEMA ICS 6-93 Industrial Control and Systems Enclosures.

32) NEMA LA 1-92 Surge Arresters.

33) NEMA MG 1-93 Motors and Generators.

34) NEMA MG 13-84 Frame Assignments for AC Integral-Horsepower Induction Motors.

000163

35) NEMA OS 1-89 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

36) NEMA PB 1-90 Panelboards.

37) NEMA PB 1.1-91 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

38) NEMA ST 20-92 Dry Type Transformers for General Applications.

39) NEMA TC 3-90 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

40) NEMA TC 6-90 PVC and ABS Plastic Utilities Duct for Underground Installation.

41) NEMA WC 7-88 Cross-Linked-Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

42) NEMA WC 8-88 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

43) NEMA WD 1-83 General Requirements for Wiring Devices.

44) NEMA WD 6-88 Wiring Devices - Dimensional Requirements.

45) NEMA 250-91 Enclosures for Electrical Equipment (1,000 Volts Maximum).

46) National Fire Protection Association (NFPA) 70 National Electrical Code, 1996 Edition.

47) NFPA 101-94 Code for Safety to Life from Fire in Buildings and Structures.

48) Underwriters Laboratories, Inc. (UL) Electrical Construction Materials Directory-95.

49) UL 360-86 UL Standard for Safety Liquid-Tight Flexible Steel Conduit.

50) UL 486A-91 UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

51) UL 510-94 UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

52) UL 854-96 Service-Entrance Cables.

53) UL 870-95 UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.

54) UL 467-93 UL Standard for Safety Grounding and Bonding Equipment.

55) UL 96-94 UL Standard for Safety Lightning Protection Components.

Environmental Safety and Health

1) 29 Code of Federal Regulations (CFR) 1910, "Occupational Safety and Health Standards."

2) 29 CFR 1926, "Safety and Health Regulations for Construction."

3) 10 CFR 835, "Occupational Radiation Protection" (this is the promulgation of DOE Order 5480.11).

4) DOE Order 5480.10, "Contractor Industrial Hygiene Program."

5) DOE/EH-0256T, Radiological Control Manual.

6) DOE-EM-STD-5502-94, "Hazard Baseline Documentation."

7) DOE-STD-1088-95, DOE Standard "Fire Protection for Relocatable Structures," June 1995.

8) RM-0016, Management Plan FDF Policies and Requirements Manual.

9) RM-0020, Radiological Control Requirements Manual

10) RM-0021, Safety Performance Requirements Manual.

Geotechnical

1) American Society for Testing and Materials (ASTM) D2216, Laboratory Determination of Water (Moisture) Content of Soil and Rock.

2) ASTM D422, Standard Test Method for Particle-Size Analysis of Soils.

3) ASTM D4318, Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

4) ASTM D698, Laboratory Compaction Characteristics of Soil Using Standard Effort.

000165

5) ASTM D5084, Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter.

6) ASTM D5321, Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic Friction by Direct Shear Method.

Material Handling

1) ANSI B30.10-87, Hooks

2) DOE/ID-10500, Hoisting and Rigging Manual

3) Ohio Administrative Code (OAC) 3745-20-05, Standards for Asbestos Waste Handling

Mechanical Process/Piping

1) American Society of Mechanical Engineers (ASME) B31.3, Chemical Plant and Refinery Piping.

2) American Society for Non-Destructive Testing (ASNT) SNT-TC-1A, Recommended Practices.

3) ASTM A36, Standard Specifications for Carbon Structural Steel.

4) ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

5) ASTM A105/A105M Revision B, Standard Specification for Carbon Steel Forgings for Piping Applications.

6) ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

7) ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Material for High Temperature Service.

8) ASTM A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

9) ASTM C552, Standard Specification for Cellular Glass Thermal Insulation.

10) American Welding Society D1.1, Structural Welding Code, Steel.

11) Manufacturers Standardization Society (MSS) SP-58, Pipe Hangers and Support-Materials, Design, and Manufacture.

12) MSS SP-69, Pipe Hangers and Support-Selection and Application.

13) MSS SP-89, Pipe Hangers and Support-Fabrication and Installation Practices.

Mechanical Utilities

1) Ohio Plumbing Code, 1995.

Structural

1) ASCE 7-95, Minimum Design Loads for Buildings and Other Structures.

2) DOE Order 5480.28, "Natural Phenomena Hazards Mitigation."

3) DOE-STD-1020-94, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities."

4) Ohio Basic Building Code, 1995.

5) Uniform Building Code, 1994.

2.3 Discipline Criteria

2.3.1 Civil and Site Development

General

The emphasis of the civil design will relate to site preparation required to support construction activities; site preparation of the Area 2, Phase I; control of stormwater; sending potentially contaminated and contaminated water to treatment; excavation of impacted material; sediment control; and interim restoration grading and stabilization.

Site Preparation

The Area 2, Phase I excavation area will have a radiological control point facility trailer and FDF office trailer to support the construction activities. The contractor will provide his own construction trailer. The trailers will require utilities in order to function. A public water source is available for the trailers and equipment

000167

wash facility in the ~~A2PI~~ Area 2 Phase I area. The contractor is to provide a storage tank at the equipment wash facility, if necessary, and the yard hydrant north of the AFP. PARSONS will design electrical power to the trailers, pumps, and all fire and evacuation alarm services (as required). New roads or drives will also be required to serve the trailers and construction activities as well as access to OU-5 SFES activities. The design of these improvements shall use the requirements specified in DOE Order 6430.1A, Division 2 as guidance. The locations for the roads, trailers, utilities, as well as access control and security issues will be coordinated with FDF.

Clearing

Clearing is required for the Area 2, Phase I areas because they are moderately to heavily wooded. Trees, bushes, and high grass will need to be removed from the areas that require excavation. The vegetation will be chipped and transferred to a designated stockpile area. The Site Preparation Package for the Area 2, Phase I shall specify that the contractor will clear the entire Area 2, Phase I area but will only grind stumps at the retention basins and areas to be excavated during site preparation. The excavation package will specify the contractor grind remaining stumps as necessary. This is to limit the area that has been cleared at any one time to limit the amount of erosion and sedimentation from exposed/disturbed areas.

Stormwater Controls

One of the major design issues is how stormwater is controlled, both during and after construction. Stormwater runon needs to be minimized to the extent practical, since stormwater that contacts potentially contaminated areas must also be considered contaminated and be treated prior to leaving the site. This will be accomplished primarily by diversion dikes, culverts, ditches, and similar drainage controls upstream of the contaminated areas being excavated. Stormwater controls at the Area 2, Phase I areas will focus on preventing runon from adjacent areas and preventing runoff from the excavation area from reaching existing drainage systems. Other perimeter erosion and sediment control measures will be used to control erosion and limit sediment from leaving the work area. Sediment and erosion control measures will follow ODNR, ODOT, SCS, and FEMP standards. Runoff controls will be designed consistent with the ODNR "Rainwater and Land Development Manual". Overall surface water management in Area 2 Phase I, including all stormwater controls, will be described in a separate SWMP.

Retention Basins

The Area 2, Phase I will have three retention basins to collect runoff as well as any water pumped from the excavation areas. Basins 1 and 2 will be sized to store a minimum of the 25-year, 24-hour storm event with a sediment load. Basin 3 will be sized to store a minimum of the 10-year, 24-hour storm event with a sediment load. The sediment load is the amount of sediment allowed prior to cleanout. This must at least equal to 27 cy per watershed acre. Since each basin is expected to be excavated into the soils of the GMA, an HDPE liner and infiltration barrier will be used to limit infiltration in Retention Basins 1 and 3. An HDPE liner will be

used in Retention Basin 2, a chain link fence will be installed around Retention Basin 2 to restrict deer. Each basin will have a perforated riser which will drain to a lift station. Each lift station will discharge into a common HDPE transfer line ~~which~~ that will empty ~~into~~ through the sluice gate between the east and west basins of the SWRB. The combined flow from the three lift stations shall not exceed 600 gpm.

Once the Area 2, Phase I area is certified below FRLs, interim restoration activities will be completed that will be consistent with the final overall site reclamation and regrading plan.

Excavation

Excavation of impacted material will be accomplished through a controlled excavation process. Within their respective areas prioritized excavation (above WAC material and lead contaminated soil) will be performed first. Impacted material that meets the OSDF WAC will be transported to the OSDF. Pockets of impacted material exceeding the radiologic WAC will be excavated and transported to the ~~OU-1~~ SP-5 Stockpile Area as they are encountered. Each of the excavated areas will serve as the initial sump for stormwater control. The sequence of excavation needs to consider the stormwater control and floodplain issues.

Stabilization and Landscaping

During excavation of the waste units, interim seeding with a quick-germinating seed mixture or other temporary stabilization measures, such as crusting agents, will be applied within seven days to limit erosion of excavated areas not expected to be worked for a period of 45 days or more. The final configuration of the sites will be graded to blend in with the adjacent topography.

Maximum slopes during initial excavation/grading will be determined by slope stability calculations and may be exceeded only with the approval of the FDF Construction Manager. The maximum slope after final grading shall be 2 horizontal to 1 vertical. Flatter slopes shall be used where feasible to provide a slope that is easier to maintain. Once final excavation has occurred, seed and mulch will be applied according to ODOT standards. No other landscaping or improvements are planned as part of this project.

Pipeline

The stormwater transfer line will be double-walled for the Area 2, Phase I when installed below elevation 560 ft. msl. For elevations above 560 ft., single-walled pipe will be used. Stormwater piping will be buried a minimum of 3.5 feet to prevent freezing. Underground force mains shall be protected at all road crossings from AASHTO HS-20 traffic loadings. The minimum force main velocity during the pumping cycle shall be 3.0 feet per second to resuspend solids that may have settled during quiescent periods. Aboveground piping that has positive drainage will not need to be heat traced. A minimum slope of 1/4 inch per foot fall is assumed to provide adequate positive drainage. Draining the fluid back through the pump is not

000169

recommended, so additional valving and piping will be required. Cleanouts and air release valves along the transfer line shall be provided and shall ~~also~~ be double- or single-walled matching the pipelme at that location.

Leak Detection System/High Level Alarm

~~A leak detection system is not required. The high level alarm shall detect liquid levels above a maximum setpoint in the lift stations. The setpoint shall have sufficient freeboard to provide response time for maintenance personnel to repair the station. The setpoint must be located high enough above the normal maximum liquid level to prevent turbulence in the wet well from falsely activating the high water alarm. The setpoint shall be no more than 6 feet above the invert of the inlet per OAC 3745-27-08.~~ Neither a leak detection system nor a high level alarm system is required. Backup infiltration barriers in the retention basins and double-walled pipe will be used where required to safeguard against leaks. Lift station top elevations will be set above maximum retention basin water levels to assure the lift stations do not overflow.

Site Preparation

1) Support Area: The Area 2, Phase I will require an area for a radiological control point facility trailer, FDF office trailer, contractor and other support trailers (as necessary), and parking. The support areas for Area 2, Phase I will be gravel.

2) Roads: Roads shall be crowned with a transverse slope of 2 percent. Longitudinal slopes shall be between 1 and 6 percent. Roads shall comply with AASHTO GDHS-90.

3) Dust control will be required for activities within a contaminated area. Dust control procedures will be provided by the contractor as required by ODOT or as directed by FDF. Air particulate emission requirements are listed in the ARARs in Appendix A.

   The contractor will apply water or a dust suppressant using tanks with a suitable sprinkling device to control dust within the project area for all activities involving the potential for generating airborne emissions.

4) Access Control: The type, size, and location of fences and gates will be determined in conjunction with FDF.

5) Stormwater diversion in the area north of the SF and the AFP will discharge to the existing channel adjacent to the north side of the AFP. This channel has some major erosion problems at its confluence with the SWRB outfall channel. The erosion problems will require repair.

Utilities

The locations of existing utilities are available on FEMP Grid Utilities drawings. Major utilities include the Cincinnati Gas and Electric-supplied 6-inch gas line, the FEMP's public water supply line, South Plume groundwater extraction line, electrical lines, SF leachate collector, pump, and force main, all of which are in the gravel road between the SF and the AFP. Due to site conditions, utility relocation will be avoided if possible. Potable and process water will be obtained from the 6-inch public water supply line for the Area 2, Phase I. A back-flow preventer will be installed at a tie-in to the water supply line ~~for non-potable use~~.

Civil Design Drawings and Specifications

The following approximate number of design drawings and specifications will be included in the CFC Design Packages:

Table 2-1 - Civil Drawings

Drawing	Qty. A2,PI DP Site Prep	Qty. A2,PI DP EXCAV
Project Title Sheet	1	1
Drawing Index ~~of Sheets~~	1	1
Legend and ~~Symbols~~ General Notes	1	1
Master Site/Utility Plan	1	~~1~~
Master Site Plan		1
Existing Conditions Plans	1	~~1~~
Existing Conditions and Monitoring Well Improvement Plan		1
Traffic Flow Plan	1	~~1~~
Stockpile Locations and Traffic Routes		1
Survey Information and Soil Stripping Plan	1	
Benchmarks and Baseline Location Plan	~~1~~	1
Excavation Grading Plans-		
~~Site Preparation/Drainage Control~~ Plans 1, 2, and 3	~~1~~	3
Above WAC~~/Initial Excavation~~ Material		1
Lead Contaminationed Soil		1
~~Excavation/Remediation~~		~~1~~
~~Utility Removal and Demolition Plan~~		~~1~~

000171

Table 2-1 - Civil Drawings (Continued)

Drawing	Qty. A2,PI DP Site Prep	Qty. A2,PI DP EXCAV
Baseline A, B, and C Cross-Sections		8
Enlargement Retention Basins #1, #2, and #3	3	
Transfer Line - Plan and Profiles ~~- Transfer Line~~	3	
Miscellaneous Details	3	~~1~~
Details		1
Erosion and Sediment Control	2	~~1~~
Site Plans:		
Site Plan (overall)	1	
Wheel Wash Area	1	
Paddys Run Area	1	
Support Area	~~3~~ 1	
Wheel Wash Pad- ~~Plan and~~ Structural Details	1	
Wheel Wash ~~Effluent Line~~ Sump Discharge - Profile and Details	1	
~~Profile and~~ Water Line Details	1	
Material Documentation Plan	1	1
TOTAL	26	22

DP - Design Package
SP - Site Preparation Package
EXCAV - Excavation Package

Table 2-2 - Division 1, 2, and 3 Specifications

(1)	Specification	A2,PI SP	A2,PI EXCAV
01050	Surveying	X	
01450	Material Documentation	X	
02050	Surveying		X
02100	Site Preparation	X	
02150	Traffic Control		X

Table 2-2 - Division 1, 2, and 3 Specifications (Continued)

(1)	Specification	A2,PI SP	A2,PI EXCAV
02200	Non Impacted Material Earthwork	X	
02205	Impacted Material Excavation and Handling	X	
02205	Impacted Material Excavation		X
~~02206~~	~~Restoration~~		
~~01123~~ 02210	~~Separation and Packaging of~~ Presumed Asbestos Containing Materials (PACM)		X
02225	Trenching ~~and Backfill~~	X	
02270	Erosion and Sediment Control	X	
02275	Erosion and Sediment Control		X
~~02300~~	~~Boring and Jacking~~		
02506	Aggregate Surface	X	
02510	Asphaltic Concrete Paving	X	
02667	Drinking Water Lines	X	
02668	Transfer Line	X	
02669	Discharge Line and Treatment Lines	X	
02713	Goemembrane Liner	X	
02720	Site Drainage and Water Management	X	
02831	Chain Link Fences	X	
02850	Equipment Wash Facility		X
02900	Soil Preparation and Seeding	X	
02900	Seeding		X
02999	Miscellaneous and Specialty Items	X	
03001	Concrete	X	

NOTE (1): Specification nos. ~~shown is for the Site Preparation Package.~~ and titles for the Excavation Package ~~the~~ specifications ~~no. will be~~ have been revised ~~so that it can be used in conjunction with~~ to be consistent with similar specifications in an associated OSDF package.

000173

Calculations

The following calculations will be provided:

1) System total dynamic head
2) Earthwork
3) Stormwater (runon and runoff) management
4) Storm drainage
5) Water lines

2.3.2 Electrical

General

Electrical power will be provided to the Area 2, Phase I support area and lift stations. Three- and single-phase power will be obtained from an existing substation and routed to the support area and lift stations via an overhead electrical distribution system supported by wood poles, crossarms and porcelain type insulators. Step-down transformers required shall be pole-mounted.

Freeze Protection

As required, electrical freeze protection will be provided for aboveground (and underground for depths less than 3.5 feet) piping and other features (e.g., pumps, valves, etc.) where sloped drainage (i.e., 1/4-inch drop per foot of run) is inadequate.

Electrical Design Drawings and Specifications

The following approximate number of design drawings and specifications will be included in the CFC Design Packages:

Table 2-3 - Electrical Drawings

Drawing	Qty. A2,PI SP	Qty. A2,PI EXCAV
Symbols and Legend	1	
Single Line Diagrams	3	
Overall Site Power Plan	1	
Elementary Diagrams	1	

Table 2-4 - Electrical Drawings (Continued)

Panel Schedules	1	
Details	6	
~~Conduit/Cable~~ Cable and Conduit Schedules	1	
TOTALS	14	

SP - Site Preparation Package EXCAV - Excavation Package

Table 2-4 - Electrical Specifications

	Specifications	Qty. A2,PI SP	Qty. A2,PI EXCAV
~~15170~~	~~Motors~~	~~x~~	
16050	Basic Electrical Materials and Methods	x	
16118	Underground Ductbanks	x	
16121	Medium Voltage Cables	x	
16170	Grounding and Bonding	x	
16311	Primary Switchgear	x	
16370	Overhead Power Distribution	x	
16462	Dry-Type Transformer/ Panelboards	x	
16470	Panelboards	x	
16500	Lighting	x	
16855	Heating Cables	x	

2.3.3 Environmental Safety and Health Requirements

The subsections below describe worker health and safety, radiation exposure control, and other regulatory requirements. All of the requirements provided are derived from pertinent S/RIDs identified in the *Management Plan, FDF Policies and Requirements Manual (RM-0016)*, and PARSONS Generic Requirements List.

000175

Worker Health and Safety

Several health-and-safety-related requirements for this project are provided below. This subsection complements the PSHSP (to be prepared by FDF) and is not to be considered a replacement or summary of the Health and Safety Plan.

Area 2, Phase I excavation activities will take place in contaminated areas; therefore, workers shall be required to have Hazardous Waste Operations and Emergency Response training in accordance with 29 CFR 1910.120.

Site clearing activities shall be done in accordance with 29 CFR 1926.604. Equipment used in site clearing activities shall also meet this requirement.

Material handling equipment shall meet the requirements of 29 CFR 1926.602. These requirements address seat belts, brakes, rollover protection, audible alarms, and scissor points.

Workers may be required to enter excavated trenches to relocate or remove utilities. This type of work will be minimized to the maximum extent possible. Excavations shall be maintained in accordance with 29 CFR 1926, Subpart P.

Measures shall be identified and implemented which comply with American Conference of Governmental Industrial Hygienists (ACGIH) and FDF requirements to prevent heat stress during warm weather. Heat stress hazards are more serious for activities where special protective clothing and equipment are required.

Valves, switches, and like devices shall be designed to accept a FDF Facility Owner's lock shank to provide a means for energy control.

Worker Exposure

1) Radiological: Site radiological control documents and procedures implement 10 CFR 835 requirements. The radiological control requirements applicable to the project will be incorporated into project documents to maintain worker exposures below regulatory limits and As Low As Reasonably Achievable (ALARA).

   Internal exposure is the primary occupational exposure concern for this project. Waste unit material will become airborne during earth-moving activities within the project Contamination Areas. To control airborne emissions from soil, conventional dust suppression methods, as discussed in Subsection 2.3.1 of this DCP, Shall be used. The radiological control and PPE requirements (including respiratory protection requirements) will be specified in the PSHSP and Matrix and in the Radiological Work Permit.

External exposure is a secondary occupational exposure concern for this project. Waste materials of varying concentrations are expected within the waste units. External sources of radiation will be identified through the performance of field radiological surveys and controlled through compliance with site and project radiological control requirements.

2) Asbestos: The *Feasibility Study Report for Operable Unit 2* indicates that asbestos is presumed to be present in the Area 2, Phase I. Asbestos emissions from the Area 2, Phase I will be modeled during design to estimate worker exposure. Modeling will be performed using Industrial Source Complex Version 3 (ISC3). Per 29 CFR 1910.1001, the Permissible Exposure Limits for asbestos are:

(1) Time-Weighted Average (TWA) of 0.1 fiber per cubic centimeter of air as an 8-hour TWA

(2) Excursion limit of 1.0 fiber per cubic centimeter of air as averaged over a sampling period of 30 minutes

Exposure monitoring shall be required that is representative of the 8-hour TWA and 30-minute short-term exposures of each employee. FDF shall establish appropriate action levels and monitoring of workers per Appendix A of 29 CFR 1910.1001.

3) Particulates, Gases, and Vapors: Remedial activities will have the potential to generate various particulates, gases, and vapors. Where necessary, exposure monitoring will be provided to ensure that worker exposures are properly controlled within Occupational Safety and Health Administration (29 CFR 1910 and 1926) and ACGIH limits. Specific control measures and Personal Protective Equipment will be identified in the PSHSP to be developed by FDF.

The excavation of the IFP and the AFP will generate particulate emissions that may exceed regulatory requirements for airborne particulates. Particulates are regulated under OAC 3745-17-02. This requirement states that the level of the primary and secondary 24-hour ambient air quality standards for total suspended particulates is 150 $\mu g/m^3$, 24-hour average concentrations. The level of the primary and secondary annual standards for total suspended particulates is 50 $\mu g/m^3$, annual arithmetic mean. Also, the emission rates provided in OAC 3745-17-11 apply (see Appendix A for values). Particulate emissions from excavation of the piles will be modeled using ISC3.

Applicable or Relevant and Appropriate Requirements

The ARARs for this project have been prepared by FDF and are provided in Appendix A of this DCP. The table provides a requirement summary and implementation strategy for each ARAR. The implementation strategy references applicable sections of this DCP where appropriate.

000177

2.3.4 Geotechnical

General

The nature, level, and extent of contamination at the Area 2, Phase I waste units and the clean-up levels defined in the OU-2 Record of Decision provide the bases for establishing the extent, boundaries, and approach for the excavation required for the design. Data regarding the nature, level, and extent of radiological contamination at the OU-2 Waste Units is summarized in the *Remedial Investigation Report for Operable Unit 2*, the *Feasibility Study Report for Operable Unit 2*, and in associated electronic data bases maintained and provided by FDF.

Geotechnical data that provide the bases for the remedial design are summarized in the above RI/FS documents as supplemented by data summarized in the following geotechnical report:

Flyash Piles and South Field Waste Units Geotechnical Report, Revision 0, April 1996

Active Flyash Pile, Inactive Flyash Pile and South Field Waste Units

The emphasis of geotechnical design will relate to support for excavation planning and slope stability analyses. An Intergraph Geologic Information System computer platform will be used to assist in developing the civil excavation plan for the Area 2, Phase I. The platform will be used to evaluate contaminant data provided by FDF. Slope stability analyses will use XSTABL slope stability software and will consider temporary slopes during excavation and permanent slopes established in the final grading plan.

Calculations

1) Slope stability

2.3.5 Material Handling

General

The design will describe methods for waste excavation or retrieval, size reduction, and segregation into separate waste streams. Packaging and transportation requirements will be established for on- and off-site disposal for the various waste streams, including low-level radioactive, hazardous, and mixed waste. The method for separation, handling, and packaging of Presumed Asbestos Containing Materials (PACM) and lead will be addressed in ~~separate~~ the technical specifications. Material Handling will develop these specifications with input from Environmental Safety and Health. Asbestos encountered during this remedial action must be prepared for disposal in accordance with the requirements of OAC 3745-20-05 (Standards for Asbestos Waste Handling) and the Impacted Material Placement Plan for the OSDF.

Impacted material that is to be placed within the OSDF must satisfy OSDF WAC, ~~for~~ including moisture content and size.

Equipment

1) Mobile size reduction equipment may include chipper, grinder, shredder, shear, and baler

2) Excavation equipment may include front-end loaders, backhoe, hydraulic crane, and track dozers

3) Transportation equipment may include covered or uncovered dump trucks, stake-bed trucks, forklift, flatbed semi trucks, and tank trucks

Testing

Lifting devices shall be tested in accordance with DOE/ID-10500 Hoisting and Rigging Manual.

Material Handling Specifications

Separation, packaging, and transportation of impacted materials and asbestos containing material are part of the Division 2 specifications. Refer to Section 2.3.1, Table 2-2.

2.3.6 Mechanical Process/Piping

General

Storage and transfer systems shall meet the requirements of DOE Order 6430.1A. Design shall emphasize the use of multiple barriers to restrict the movement of wastewater which has the potential for human contact or reducing groundwater quality.

Retention basin lift stations will be equipped with a submersible pump on a guide system to minimize the need to enter the lift station. A check valve will be used to prevent backflow through the pump. Fill controls will regulate the pump operation. Mechanical Process is responsible for the specifications of pumps, above-ground pipe, pipe supports, and insulation.

Equipment

Confinement systems shall meet the criteria in DOE Order 6430.1A, Paragraphs 1300-7 and 1323-5 Radioactive Liquid Waste Facility. Pumps shall be provided to transfer Area 2, Phase I retention basin contents in a common transfer line at a total rate of 600 gpm (maximum) to the SWRB.

000179

Equipment Wash Facility

An equipment wash facility will be located near the Haul Road exit of the Area 2, Phase I. This facility is intended to be used to remove bulk solids from haul vehicles by high-pressure spray. Collected wash water from the equipment wash facility will be piped to the existing seepage lift station.

Process and Potable Water

Area 2, Phase I potable and process water will be obtained from the existing 6-inch public water supply line. A back-flow preventer will be placed at the tie-in to the supply line for the equipment wash facility, ~~and~~ support area hydrants, and trailers. ~~Potable water supply will be obtained from the existing 6-inch public water supply line for the personnel monitoring trailer.~~ Below grade piping will be HDPE.

Stormwater Piping

~~Double-walled~~ HDPE pipe will be used for below grade stormwater transfer piping. No leakage monitoring will be provided. ~~to detect leakage into the space between the inner and outer pipes.~~ Transfer line piping installed below elevation 560 ft. will be double-walled.

Testing

Except for the buried systems (HDPE), pipe and pipe systems testing shall conform to the requirements set forth in ASME B31.3 and ASNT SNT-TC-1A.

Heat Tracing and Insulation

Electrical heat tracing and/or insulation will be provided for above-grade piping, fittings, valves, and equipment that are subject to freezing temperatures and for below-grade piping less than a frost depth of 3.5 feet, as required. Insulation requirements shall be in accordance with the applicable ASTM insulation and sheeting specifications.

Pipe Supports

Pipe supports shall be spaced in accordance with ASME B31.3 and PARSONS' span table. Pipe hanger material, design, manufacture, selection, application, fabrication, and installation shall be in accordance with MSS SP-58, SP-69, and SP-89. Auxiliary steel supports shall be in accordance with ASTM A-36 and A-576.

Welding/Joining

Welding shall be in accordance with ASME B31.3 and American Welding Society D1.1. HDPE pipe material shall be joined/fused per manufacturer's instructions.

Materials

Corrosion, abrasion resistance, and ease of decontamination shall be considered when selecting pipe, fittings, valves, and equipment items.

Mechanical Process/Piping Design Drawings and Specifications

Table 2-5 lists the approximate number of design drawings that will be included in the CFC Package.

Table 2-5 - Mechanical Process/Piping Drawings

Drawing	Qty. A2,PI SP	Qty. A2,PI EXCAV
P&ID - Symbols and Legend ~~Sheet~~	1	1
P&ID - Wastewater Collection and Transfer	1	~~1~~
P&ID - Water Collection and Transfer		1
P&ID - Drinking Water System	1	
TOTAL	3	2

Table 2-6 lists the approximate number of specifications that will be included in the CFC Package.

Table 2-6 - Division 15 Specifications

	Specification	Qty. A2,PI SP	Qty. A2,PI EXCAV
15060	Piping, Fittings, Valves, and Accessories	x	
15090	Piping Supports and Anchors	x	
15160	Lift Station Pumps	x	
15170	Motors	x	
15250	Insulation	x	

SP - Site Preparation Package EXCAV - Excavation Package

000181

Calculations

The following calculations will be provided:

1) Pipeline sizing
2) Pump sizing

2.3.7 Mechanical Utilities

General

A radiological control point facility will be established at the egress point of the Area 2, Phase I excavation. Lockers and change-out area will be provided. An emergency shower will also be provided at the Area 2, Phase I radiological control point trailer. Shower and sink wash water will be collected in a tank and will be periodically removed by the contractor. The FDF office trailer will have lavatory facilities and will have a tank for collection of wastewater. Utility water will be supplied to the trailers by connection to the 6-inch public water supply line in Area 2, Phase I. Portable sanitary facilities will be used at all of the waste units and will be serviced periodically by the contractor.

Piping

Utility piping for the personnel trailers will be constructed of copper tubing and will comply with ASTM B88. Outside aboveground piping will be heat traced and insulated.

Table 2-7 - Division 13 Specifications

	Specification	Qty. A2, PI SP	Qty. A2, PI EXCAV
13125	Modular Radiological Control Facility	*	
13126	Modular Field Office Facility	*	

* Table 2-7 lists the specifications for the trailers that will be included in the CFC Package.

2.3.8 Structural

General

The design and evaluation of ~~Structure, System, and Components (~~SSCs~~)~~ due to wind, earthquake, and flood shall be in accordance with DOE Order 6430.1A and DOE-STD-1020 for PC-2 type structures. SSCs for Area 2, Phase I include guys, miscellaneous steel supports, and concrete foundations.

Dead Loads

Dead loads are all loads that remain permanently in place, including weights of all permanent materials, equipment, piping, self-weights, and provisions for future loads, if required. The unit weights of materials and assemblies may be based on sources or data from manufacturers' drawings and catalogs, and Table C3-1A of ASCE 7-95.

Live Loads

Live loads shall include all loads resulting from use of the SSCs. Live loads may act in any direction. Impact loads, moving loads, and operating loads shall be considered as part of live loads. Live loads for structures shall not be less than the minimum uniform or concentrated loads stipulated in ASCE 7-95.

Wind Loads

Wind loads design criteria presented in this section shall be based on the requirements of DOE Order 6430.1A, DOE-STD-1020, and ASCE 7-95. The Ohio Basic Building Code Exposure "C" shall be used for all wind load calculations.

Tornado Loads

Tornado loads are not applicable and will not be considered given that the SSCs are assumed PC-2, that most piping will be located underground, and construction/excavation operation will cease during rain/stormy weather.

Seismic Design and Evaluation

The seismic criteria for the design and evaluation of SSCs shall be based on procedures detailed in Subsection 2.3.1 of DOE-STD-1020, PC-2, and Uniform Building Code (UBC) Section 1628. The earthquake response shall be evaluated in accordance with procedures given in UBC Section 1627.8 using the static force method. The capacities will be evaluated using the strength design or allowable stress design method. Story drift limitations shall be per UBC Section 1628.8. Nonbuilding structures shall meet the requirements of UBC

Section 1632. Lateral forces on elements of structures and nonstructural components supported by structures shall be in accordance with UBC Section 1630.

Other Loads

Load criteria not specified above shall be in accordance with DOE Order 6430.1A, paragraph 0111-2.8, "Other Loads for Buildings and Other Structures."

Other Structural Material/Design Requirements

Design requirements for structural materials and design are as follows:

1) Concrete: Concrete material, design, and construction shall be per American Concrete Institute 318-89. Minimum concrete strength at 28 days shall be 3,000 psi for foundations and 4,000 psi for slabs.

2) Reinforcement: Deformed billet steel shall conform to ASTM A615, Grade 60.

3) Grout: High strength, nonshrink grout shall be 1-inch minimum thickness.

4) Structural Steel: Design, details, fabrication, and erection of structural steel shall conform to the UBC and the American Institute of Steel Construction Manual, Ninth Edition. The material for structural steel shapes and plates shall conform to ASTM A36. All structural steel shall be painted or galvanized. Primary connection bolts shall be high-strength ASTM A325 with hardened nut and washer. Secondary connections may be made with A307 bolts, nuts, and washers.

5) Field Connections: Connections may be bolted or welded using E70XX electrodes.

6) Foundations/Slabs: The provisions of UBC Chapter 18 shall govern the design of foundations. Footings will be placed in the upper natural soils or properly compacted fill. Foundations and slabs will be designed for an allowable soil bearing pressure based on available geotechnical data or pressure or presumptive values. The bottoms of footings will be placed a minimum of 3 feet below adjacent final grade for frost protection.

Structural Design Drawings and Specifications

Drawings

The structural design drawings are included with the civil list, Table 2-1.

Specifications

Division 3 specifications are with the civil list, Table 2-2.

Calculations

The following calculations will be provided:

1) Foundations/slabs
2) Structural steel/pipe supports
3) Guy wire supports

000185

SECTION 3

REFERENCES

This DCP is based on the following documents:

1) FERMCO, September 1994. FEMP Engineering Procedure, Document No. 12-4003, Design Criteria Package. Fernald, Ohio: FERMCO.

2) FERMCO, February 16, 1996. *Policies and Requirements Manual.* Fernald: FERMCO.

3) FERMCO, September 30, 1994. Document No. RM-0012, *Quality Assurance Program, Revision 3.* Fernald: FERMCO.

4) FERMCO, February 28, 1996. *Site Procedures Manuals*, Volumes 1 - 12. Fernald: FERMCO.

5) Project Order 165, Revision 0, *Operable Unit 2 Waste Units Remediation Statement of Work,* December 7, 1995.

6) United States Department of Energy, 1987/1992. DOE Order 4700.1, "Project Management System."

7) U.S. Department of Energy, 1989. DOE Order 6430.1A, "General Design Criteria."

8) U.S. Department of Energy, 1995a, *Final Remedial Investigation for Operable Unit 2, FEMP. Fernald, OH, Remedial Investigation, Feasibility Study,* U.S. DOE Fernald Office, Fernald, OH.

9) U.S. Department of Energy, 1995a, *Final Feasibility Study Report for Operable Unit 2, FEMP, Fernald OH, Remedial Investigation, Feasibility Study,* U.S. DOE Fernald Office, Fernald, OH.

10) U.S. Department of Energy, 1995a, *Final Record of Decision for Remedial Actions at Operable Unit 2, FEMP, Fernald, OH,* U.S. DOE Fernald Office, Fernald OH.

11) U.S. Department of Energy, 1995, *Draft Remedial Design Work Plan for Remedial Actions at Operable Unit 2, FEMP, Fernald, OH,* U.S. DOE Fernald Office, Fernald OH.

12) United States Environmental Protection Agency, 1990. *OSWER Directive 9355.5-01, Interim Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties.*

APPENDIX A

ARARs AND TBCs FOR AREA 2, PHASE I

Appendix A has been prepared by FDF and identifies design and implementation-related ARARs and TBCs for the A2PI (a.k.a. Area 2, Phase I Remediation Project). Compliance with these ARARs/TBCs is addressed therein. See the Sitewide Excavation Plan and the Implementation Plan for further discussion.

TABLE A-1

GROUPINGS OF ARARs AND TBCs USED IN TABLE A-2

FOR REMEDIATION AREA 2 PHASE I

Presentation Group	Topical Subdivision(s)	Page
Natural and Cultural Resources	Threatened and Endangered Species Protection	A-2
	Archeological, Historic, and Cultural Resource Protection	A-3
Air Pathway	Noise Pollution Control	A-7
	Air Emissions	A-7
Surface Water Pathway	Wetlands/Floodplain Protection	A-16
	Discharge to Surface Water	A-23
Groundwater Pathway	Groundwater Protection	A-27
	Wells - Construction	A-27
	Wells - Abandonment	A-27
Soil Remediation	Radionuclide Concentrations	A-28
	Lead Concentration	A-31
	PCB Concentration	A-32
	Certification of Cleanup	A-32
Impacted Material Management	Definitions and General Facility Standards	A-34
	Management of Low-level Radioactive Waste Material	A-48
	Management of Hazardous Remediation Waste	A-48
	Management of PCB-tainted Material	A-55
Post-Closure	Description of Post-closure Care	A-57
	Modifications to Post-closure Care Plan or Period	A-59
	Property Use Restrictions	A-59
	Post-closure Notice/Survey Plat	A-61
	Deed Notation	A-61

000189

TABLE A-2

PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
NATURAL & CULTURAL RESOURCES						
THREATENED & ENDANGERED SPECIES PROTECTION						
Procedures for Implementing the National Environmental Policy Act 40 CFR §6.302(h) 10 CFR Part 1021 Endangered Species Act 16 U.S.C. §1531, et seq. Endangered and Threatened Wildlife and Plants 50 CFR §17.21, §17.31, §17.61, §17.71, and §17.94 Interagency Cooperation-Endangered Species Act 50 CFR §402.01	All federal agencies must ensure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the constituent elements essential to the conservation of a listed species within a defined critical habitat. Additional requirements apply if it is determined that a proposed activity could adversely affect these species or their habitat.	Appl	Appl	Appl	Findings of 1993-94 updated surveys at the FEMP property: • Populations of the state-listed threatened Sloan's crayfish (*Orconectes sloanii*) are located in sections of Paddy's Run. • Good habitat for the federally-listed endangered Indiana bat (*Myotis sodalis*) exists along Paddy's Run and the storm sewer outfall ditch. • Suitable habitat exists in limited areas for the federal-listed endangered running buffalo clover (*Trifolium stoloniferum*), and only in the northern woodlot for the state-listed threatened spring corralroot (*Corallorhiza wisteriana*). • Marginal habitat for the state-listed endangered cave salamander (*Eurycea lucifuga*) exists in a very limited single area. • Neither habitat nor populations were located for the state-listed endangered mountain bindweed (*Polygonum cilinode*) and slender fingergrass (*Digitaria filiformis*).	Addressed in Section 5.1 of the Sitewide Excavation Plan, and will be addressed in the IEMP's Natural Resource Impact Monitoring Plan (NRIMP); however, DOE does not expect to encounter any federal- or state-listed threatened or endangered species or critical habitat in the Remediation Area 2 Phase I areas to be addressed by this remediation project; no additional surveys conducted or planned.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
THREATENED & ENDANGERED SPECIES PROTECTION, continued						
Interagency Cooperation-Endangered Species Act 50 CFR §402.12(a), (b)	A biological assessment shall evaluate the potential effects of the action on listed and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary. These procedures are required for federal actions that are "major construction activities."	Appl	Appl	Appl	No critical habitat is present on the Fernald property. Updated surveys of the FEMP property in 1993 found marginal habitat for the state-listed endangered cave salamander (*Eurycea lucifuga*) exists in a very limited single area.	See preceding.
Endangered Species Regulations ORC 1531.25	No person shall take or possess any native species of wild animal, or any eggs or offspring thereof, that is endangered with state-wide extinction.	Appl	Appl	Appl	Updated surveys of the FEMP property in 1993-94 found populations of the state-listed threatened Sloan's crayfish (*Orconectes sloanii*) in sections of Paddy's Run.	See preceding.
Endangered Species Regulations ORC 1518.02 OAC 1501:18-1	No person shall root-up, injure, destroy, remove, or carry away on or from public highways, public property, or waters of the state, or on or from the property of another, without the written permission of the owner, lessee, or other person entitled to possession, any endangered plant listed in OAC 1501:18-1.	Appl	Appl	Appl	Surveys of the FEMP property in 1994 did not locate populations of the following plants: the federal-listed endangered running buffalo clover (*Trifolium stoloniferum*); the state-listed endangered mountain bindweed (*Polygonum cilinode*) and slender fingergrass (*Digitaria filiformis*); and the state-listed threatened spring corralroot (*Corallorhiza wisteriana*).	See preceding.
ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION						
Antiquities Act of 1906 16 U.S.C. §431	No person may appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity situated or controlled by the Government of the United States without an applicable permit. Identification and preservation of cultural resources on federal lands is required, including natural landmarks.	Appl	Appl	Appl	Proposed areas of disturbance will be surveyed and consultation will occur between DOE, the Advisory Council on Historic Preservation and the State of Ohio Historic Preservation Office (OHPO) as agreed upon in the Programmatic Agreements (later entries).	Section F.4.2 of the Sitewide Excavation Plan
Historic Sites Preservation Act 16 U.S.C. §461-467		✓	Appl	Appl		

000191

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION, continued						
Archaeological Resources Protection Act 16 U.S.C. § 470aa-470ll Procedures for *Implementing the* National Environmental Policy Act 40 CFR §6.301(c) Protection of Archaeological Resources 43 CFR §7.4(a)	Whenever any Federal agency finds, or is notified, in writing, by an appropriate historical or archaeological authority, that its activities in connection with any Federal construction project or federally licensed project, activity, or program may cause irreparable loss or destruction of significant scientific prehistorical, historical, or archaeological data, such agency shall notify the Secretary of the Interior, in writing, and shall provide the Secretary with appropriate information concerning the project, program, or activity. No person may excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands unless such activity is pursuant to a permit. If an EPA activity may cause irreparable loss or destruction of significant scientific, prehistoric, historic, or archaeological data, the responsible official or the secretary of the Interior is authorized to undertake data recovery and preservation activities.	Appl	Appl	Appl	See preceding.	See preceding.
National Historic Preservation Act (NHPA) 16 U.S.C. §470 Protection of Historic Properties 36 CFR Part 800 Procedures for Implementing the National Environmental Policy Act 40 CFR §6.301(a), (b)	A federal agency (DOE) must take into account the effect of an undertaking on historic properties and accord the Advisory Council on Historic Preservation a reasonable opportunity to comment. Historic properties are defined as any prehistoric or historic district, building, site, structure, or object included in or eligible for inclusion in the National Register of Historic Places. This term includes artifacts, records, and persons released to and located within such properties. Historic properties that are to be substantially altered or demolished must be recorded for future use and reference. The purpose of this Act is not only to protect those properties listed in or eligible for the National Register of Historic Places, but also those properties that have not been listed or formally determined eligible for the listings. The heads of all Federal agencies shall assume responsibility for the preservation of historic properties which are owned or controlled by such agency. Prior to any Federal undertaking which may directly and adversely affect any National Historic Landmark, the head of the responsible agency shall, to the extent possible, minimize the harm to such landmark.	Appl	Appl	Appl	See preceding.	See preceding.
Archaeological and Historic Preservation Act 16 U.S.C. §469	Upon discovery that a project may cause the irreparable loss, destruction, significant scientific finding, prehistorical finding, or loss of historical or archaeological data, DOE must notify the Dept. of the Interior in writing and provide appropriate information concerning the project. DOE must, with possible assistance from the OHPO, undertake recovery, protection, and preservation of the data.	√	Appl	Appl	See preceding.	See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION, continued					
Executive Order 11593, Protection and Enhancement of Cultural Environment 3 CFR Part 54	An inventory of a site with potential historic places is required for eligibility in the National Register of Historic Places.	√	Appl	Appl	See preceding and following entries.	See preceding.
Programmatic Agreement Regarding Archaeological Investigations at the Fernald Environmental Management Project (March 6, 1997)	Annual report packages, the first of which must be submitted on July 1,1997, must be submitted to the Ohio Historic Preservation Office (OHPO) and the Advisory Council on Historic Preservation (the Advisory Council) containing the following information: 1 list of all response actions and associated activities initiated within the year reported on; 2. map showing locations of above response actions/ associated activities; 3. list of response actions/associated activities conducted in previously surveyed (archeological survey) areas; 4. a list of surveys which identified no eligible historic properties; 5. a list of eligible historic properties that were avoided when implementing response actions and/or associated activities; 6. a list of Phase I-III reports generated; and 7. a map of locations of areas identified in item 6 and all properties identified. DOE-FEMP must also submit any and all Phase I reports generated within the last year, and not previously submitted, with the annual report. By September 2, 1997 (within 180 days of the signing of the Programmatic Agreement), submit to the OHPO and the Advisory Council a literature search, examination of aerial photographs, and use of a predictive model for all disturbed and/or contaminated areas of the FEMP (as defined in the Agreement). The predictive model is to utilize existing archeological data from the FEMP and surrounding area to determine the likelihood of additional archeological sites within the contaminated/disturbed areas and the spatial distribution, physical characteristics, and uses.	√	√	√	The Southern Waste Units (Remediation Area 2 Phase I) area has been designated in this programmatic agreement as a disturbed area, which means that no Phase I survey is required. All areas in Remediation Area 2 Phase I surrounding the Southern Waste Units have been surveyed, and no historic properties have been identified. Unexpected discoveries will be addressed accordingly (see Section F.4.2 of the SEP). Draft reports are under preparation for submission to the OHPO and the Advisory Council. Once finalized, the reports will be available to the public in the Public Environmental Information Center and archived as appropriate.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION, continued						
Native American Graves Protection and Repatriation Act 25 U.S.C. §3001 et seq.	Identification and preservation of cultural resources on federal lands is required, including natural landmarks. DOE must consult with appropriate Indian tribes before the intentional excavation or removal after an inadvertent discovery of Native American cultural items including human remains and objects of cultural significance.	Appl	Appl	Appl	DOE will consult with likely culturally affiliated tribes to determine the excavation, treatment, analysis and preparation of any extra reviews, associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony. Consultation will be coordinated with NHPA compliance when possible.	See preceding.
43 CFR Part 10	Provides for the return of human remains and cultural objects from Native American graves to affiliated tribes.	Appl	✓	✓		
American Indian Religious Freedom Act 42 U.S.C. §1996	Provides for tribal access by native peoples to grave sites and sites of cultural, symbolic, or religious significance.	Appl	Appl	Appl	See preceding.	See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
AIR PATHWAY						
	NOISE POLLUTION CONTROL					
Noise Control Act, as amended 42 U.S.C. §4901, *et seq.* Noise Pollution and Abatement Act 42 U.S.C. §7641	The public must be protected from noises that jeopardize health and welfare.	Appl	Appl	R&A	Appropriate engineering controls and best management practices will be implemented so that nuisance noise from vehicles and equipment will be reduced to the maximum practicable extent during conduct of the actions.	Section 5.1.2.1 of the Sitewide Excavation Plan
	AIR EMISSIONS					
Solid Waste and Infectious Waste Regulations, Authorized, Limited, and Prohibited Solid Waste Disposal Methods OAC 3745-27-05 ORC 3734.03	Open dumping of solid waste is prohibited [OAC 3745-27-05(C)]. Solid waste disposal by means of open burning, as defined in OAC 3745-19, is permitted only as provided therein [OAC 3745-27-05(B)].	Appl	Appl	Appl		Addressed through the description of the selected remedy in the OU2 ROD (Section 9.0), OU5 ROD (Section 9.0), and OU3 ROD (Section 8.0)
Criteria for Classification of Solid Waste Disposal Facilities and Practices, Air 40 CFR §257.3-7]	Open burning of residential, commercial, institutional or industrial solid waste is prohibited. This requirement does not apply to infrequent burning of agricultural wastes in the field, silvicultural wastes for forest management purposes, land-clearing debris, diseased trees, debris from emergency clean-up operations, and ordnance [40 CFR §257.3-7].	✓	✓	Appl		
Open Burning Standards, Open Burning in Unrestricted Areas OAC 3745-19-04®	Open burning is allowed for the following purposes [OAC 3745-19-04(C)]: • Recognized horticultural, silvicultural, range, or wildlife management practices [OAC 3745-19-04(C)(5)]. • Disposal of land clearing waste if the following conditions are met [OAC 3745-19-04(C)(4)]: - The fire is set only when atmospheric conditions will readily dissipate contaminants; - The fire does not create a visibility hazard on roadways, railroad tracks, or air fields; - The fire is located at a point on the premises no less than 1000 feet from any inhabited building not located on said premises.	✓	✓	Appl		

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
General Provisions on Air Pollution Control, Air Pollution Nuisances Prohibited OAC 3745-15-07 ORC 3704.01-.05	Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state. The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors and combinations of the above in such a manner or in such amounts as to endanger the health, safety, and welfare of the public, or to cause unreasonable injury or damage to property shall be declared to be a public nuisance. It is unlawful for any person to cause, permit, or maintain any such public nuisance.	Appl	Appl	Appl	Only fugitive dust (dirt, flyash, bottom ash) is anticipated from this soil remedial action project. Air pollution nuisance prohibitions will be met by employing best management practices for control of fugitive dust.	FEMP Fugitive Dust Control BAT Determination, Fugitive Dust Control Requirements (RM-0047), and Section 5.1.2 of the Sitewide Excavation Plan
ORC 3734.02(I)	No owner or operator of a hazardous waste facility, in the operation of the facility, shall cause, permit, or allow the emission therefrom of any particulate matter, dust, fumes, gas, mist, smoke, vapor, or odorous substances that, in the opinion of the Director [of Environmental Protection, a.k.a., the Director of the OEPA], unreasonably interferes with comfortable enjoyment of life or property by persons living or working in the vicinity of the facility, or that is injurious to public health. Any such action is hereby declared to be a public nuisance.	✓	✓	R&A		
Particulate Matter Standards, Non-Degradation Policy OAC 3745-17-05	The significant and avoidable deterioration of air quality in any part of the area where presently existing air quality is better than the particulate ambient air quality standards in OAC 3745-17-02 (described above) shall be prohibited.	Appl	Appl	✓	Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions. Also see preceding entry.	FEMP Fugitive Dust Control BAT Determination, Fugitive Dust Control Requirements (RM-0047), and Section 5.1.2.2 of the Sitewide Excavation Plan
Particulate Matter Standards, Control of Visible Particulate Emissions from Stationary Sources OAC 3745-17-07(A)(1)(a)	Visible particulate emissions from any point source shall not exceed 20 percent opacity, as a six-minute average, but shall not exceed 60 percent opacity, as a six-minute average, at any time. Transient exceedance limits are included in this regulation.	Appl	Appl	Appl	All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions.	As necessary, monitoring requirements will be addressed in the appropriate IRDP.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
Particulate Matter Standards, Control of Visible Particulate Emissions from Stationary Sources OAC 3745-17-07(B)(1)	Visible particulate emissions from any fugitive dust source shall not exceed 20 percent opacity, as a three-minute average.	✓	✓	✓	Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions.	See preceding.
Particulate Matter Standards, Control of Visible Particulate Emissions from Stationary Sources OAC 3745-17-07 (B)(4), (5), (6)	There shall be no visible particulate emissions from any paved roadway or paved parking area except for a period of time not to exceed six minutes during any 60-minute observation period. There shall be no visible particulate emissions from any unpaved roadway or unpaved parking area except for a period of time not to exceed 13 minutes during any 60-minute observation period. There shall be no visible particulate emissions from any material storage piles except for a period of time not to exceed 13 minutes during any 60-minute observation period.	Appl	R&A	✓	Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions.	FEMP Fugitive Dust Control BAT Determination, Fugitive Dust Control Requirements (RM-0047), and Section 5.1.2.2 of the Sitewide Excavation Plan
Particulate Matter Standards, Restriction of Emission of Fugitive Dust OAC 3745-17-08(B)	No person shall cause or permit any fugitive dust source to be operated; or any materials to be handled, transported, or stored; or a building (or its appurtenances) or a road to be used, constructed, altered, repaired, or demolished without taking or installing reasonably available control measures to prevent fugitive dust from becoming airborne. Such reasonably available control measures shall include, but are not limited to, one or more of the following which are appropriate to minimize or eliminate visible particulate emissions of fugitive dust. • The use of water or other suitable dust suppression chemicals for the control of fugitive dust from the demolition of existing buildings or structures, construction operations, the grading of roads, or the clearing of land; or • The periodic application of asphalt, oil, water, or other suitable dust suppression chemicals on dirt or gravel roads and parking lots, and any other surfaces that may cause emissions of fugitive dust.	Appl	R&A	Appl	This requirement is applicable only to certain cities in Butler and Hamilton Counties. Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
Particulate Matter Standards, Restrictions on Particulate Emissions from Industrial Processes OAC 3745-17-11	The following are restrictions for particulates from any operation, process, or activity which releases or may release particulate emissions into the ambient air. These limits are based on the weight of material being processed. Process Weight at Maximum Capacity (lb/hr) — Allowable Particulate Emission Rate (lb/hr) 100 — 0.551 200 — 0.877 400 — 1.40 600 — 1.83 800 — 2.22 1000 — 2.58 *These limits do not apply to generation of fugitive dust* subject to OAC 3745-17-08 (listed above).	Appl		R&A	All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions.	See preceding.
Permit to Install New Sources of Pollution OAC 3745-31-05 (A)(3)	The installation or modification and operation of an air contaminant source, solid waste disposal facility, water pollution source, disposal system, land application of sludge, or public water system, must employ the best available technology. The terms used in the above are defined in OAC 3745-15-01, unless otherwise defined in OAC 3745-31-01.	R&A	Appl	R&A	Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions. All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions.	FEMP Fugitive Dust Control BAT Determination, Fugitive Dust Control Requirements (RM-0047), and Section 5.1.2.2 of the Sitewide Excavation Plan

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
Standards of Performance for New Stationary Sources, Subpart OOO—*Standards of Performance for Nonmetallic Mineral Processing Plants* 40 CFR §60.672(a), (d), (e)	No owner or operator shall cause to be discharged into the atmosphere from a crusher any emissions which: • Contain particulate matter in excess of 0.05 grams per dry cubic meter at standard conditions (g/dscm); and • Exhibit greater than 7 percent opacity Truck dumping of nonmetallic minerals into any crusher is exempt from these requirements.	R&A	✓		It is not anticipated that a crusher will be used during this remedial action project. All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions.	See preceding.
	AIR EMISSIONS, continued					
40 CFR Part 61, Subpart M-National Emission Standard for Asbestos, Standard for Waste Disposal for Manufacturing, Fabrication, Demolition, Renovation, and Spraying Operation 40 CFR §61.150	(a) Discharge no visible emissions to the outside air during the collection, processing, packaging, or transporting of any asbestos-containing waste material, or use one of the emission control methods specified in paragraphs (a)(1) through (4) of this section: (1) Adequately wet asbestos-containing material. After wetting, seal all asbestos-containing waste material in leak-tight containers while wet; or, put materials that will not fit into containers without additional breaking into leak-tight wrapping. Label the containers or wrapped materials in accordance with 29 CFR 1910.1001(j)(2) or 1926.58(k)(2)(iii). ... (4) Use an alternative emission control and waste treatment method that has received prior approval from the Administrator. (5) As applied to demolition and renovation, the requirements above under paragraph (a) of this section do not apply to Category I non-friable ACM waste and Category II non-friable ACM waste that did not become crumbled, pulverized, or reduced to powder.	✓	✓	Appl		See preceding, and following sections of the Sitewide Excavation Plan: 2.5.8 Special Materials 3.3.2.2 Special Materials F.4.1.1 Asbestos

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
Asbestos Emission Control, Standard for Active Asbestos Disposal Sites OAC 3745-20-06(A)&(B) [40 CFR Part 61, Subpart M-National Emission Standard for Asbestos, Standard for Active Waste Disposal Sites, 40 CFR §61.154]	(A) Each owner or operator of an active asbestos waste disposal site shall cause or permit no visible emissions [of asbestos] to the outside air; or shall comply with the requirements of paragraph (B) of this rule. (B) Rather than meet the no visible emissions requirement of paragraph (A) of this rule, each owner or operator of an active asbestos waste disposal site shall comply with the following: (1) There shall be no visible emissions from asbestos-containing waste materials during the on-site transportation, transfer, deposition or compacting operations. (2) Deposition and burial operations shall be conducted in a manner which prevents handling by equipment or persons that causes asbestos-containing waste materials to be broken-up or dispersed before the materials are buried. (3) As soon as practicable after deposition of the asbestos-containing waste materials but no later than at the end of each operating day, the asbestos-containing waste material deposited at the site during the operating day shall be buried with at least twelve inches of compacted nonasbestos-containing material. Alternatively, any owner or operator of an active asbestos waste disposal site may apply for approval of the Director [of Environmental Protection, a.k.a. Director of the OEPA] to utilize alternative control measures to bind dust, control wind erosion or convert [friable] asbestos to non-friable forms. (4) During the unloading, deposition, burial, and initial compaction of asbestos-containing materials, the owner or operator of the active [asbestos] waste disposal site shall establish a restricted area adequate to deter the unauthorized entry of the general public and any unauthorized personnel from any location within one hundred feet of the operations, and shall display the following information on a sign not less than twenty by fourteen inches, so that it is visible before entering the restricted area: ASBESTOS DUST HAZARD Do Not Remain In Area Unless Your Work Requires It Breathing Asbestos Dust Is Hazardous To Your Health	✓	✓	Appl	Pertinent to the management of asbestos-containing materials. Also note that requirements from paragraphs (A) and (B) which are pertinent to disposal of asbestos-containing materials, are included in the OSDF Impacted Materials Placement Plan.. NOTE: The sizing & language for warning signs under (B)(4) at left conflicts with that required by OSHA under 29 CFR §1926.1101(k)(7). The FEMP will follow the OSHA requirements. Sign language: DANGER ASBESTOS CANCER & LUNG DISEASE HAZARD AUTHORIZED PERSONNEL ONLY OSHA does not impose a minimum sign size.	See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
Asbestos Emission Control, Standard for Inactive Asbestos Disposal Sites OAC 3745-20-07® [40 CFR Part 61, Subpart M-National Emission Standard for Asbestos, Standard for Inactive Waste Disposal Sites, for Asbestos Mills and Manufacturing and Fabricating Operations 40 CFR §61.151]	The owner or operator may use an alternate control method that has received prior approval of the Director [of Environmental Protection, a.k.a. Director of the OEPA] rather than comply with the requirements of paragraph (A) [emissions and cover requirements] or (B) [posting and access control requirements] of this rule.	✓	✓	Appl	These requirements for inactive asbestos waste disposal sites are very similar to those for active asbestos waste disposal sites under OAC 3745-20-06 (preceding entry). During soil remediation activities under this remedial action project, the requirements for active asbestos disposal sites (preceding entry) will be followed while managing friable asbestos-containing material. Also note that requirements pertinent to disposal of asbestos-containing materials under paragraphs (A) and (C) of OAC 3745-20-07 are included in the OSDF Impacted Materials Placement Plan.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
Asbestos Emission Control, Standard for Inactive Asbestos Disposal Sites OAC 3745-20-07(D) [40 CFR Part 61, Subpart M-National Emission Standard for Asbestos, Standard for Inactive Waste Disposal Sites for Asbestos Mills and Manufacturing and Fabricating Operations, 40 CFR §61.151(d)]	Each owner or operator of an inactive asbestos waste disposal site shall notify the Director [of Environmental Protection, a.k.a. the Director of the OEPA] in writing prior to disturbing or removing any asbestos-containing waste material. The notice shall contain:	✓	✓	✓	Submission of the project-specific IRDPs to OEPA constitute this notification.	
	• the reason for disturbing the waste,					The reason for disturbing the material is documented in the OU2, OU5 and OU3 RODs.
	• the procedures to be used to control emissions,					FEMP Fugitive Dust Control BAT Determination, Fugitive Dust Control Requirements (RM-0047), the OSDF Impacted Materials Placement Plan, and following sections of the Sitewide Excavation Plan: 2.5.8 Special Materials 3.3.2.2 Special Materials 5.1.2.2 Fugitive Emissions F.4.1.1 Asbestos
	• the duration of the operation, and				Project schedules contained in project-specific IRDPs.	
	• the location of the final disposal site.					The OSDF, unless the OSDF WAC is not met; else, an off-site permitted/licensed disposal facility.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	AIR EMISSIONS, continued					
National Emission Standards for Hazardous Air Pollutants, Subpart H—National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities, 40 CFR §61.90, §61.91 and §61.92 - .97 [Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (1)(b)]	Emissions of radionuclides (except radon-220 and radon-222) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr. To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA-approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval.	Appl	Appl	Appl		Section 6 of the Integrated Environmental Monitoring Plan (IEMP) and the following sections of the Sitewide Excavation Plan: 5.1.2.3 Airborne Radiological Particulates 5.1.2.4 Radon 5.1.2.5 Direct Radiation
National Emission Standards for Hazardous Air Pollutants, Subpart Q—National Emission Standards for Radon Emissions From Department of Energy Facilities 40 CFR §61.190, §61.192	No source at a DOE facility shall emit more than 20 pCi/m²/sec of radon-222 as an average for the entire source into the air.	Appl	Appl	R&A	The existing distribution of contaminants within the site soils attains compliance with this requirement. Will be addressed sitewide as necessary by the Integrated Environmental Monitoring Plan (IEMP).	

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000203

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
SURFACE WATER PATHWAY						
	WETLANDS/FLOODPLAIN PROTECTION					
Executive Order 11990, Protection of Wetlands	Federal agencies are required to take action to avoid adversely impacting wetlands wherever possible, to minimize wetland destruction, and to preserve the values of wetlands.	Appl	Appl		Floodplain and wetland impacts associated with soil remediation activities will be minimized and avoided to the maximum extent practicable. Projects with unavoidable impacts will be undertaken in accordance with 33 CFR Parts 323 and 330. Based on a review of an overlay of the Remediation Area 2 Phase I boundary on the FEMP Jurisdictional Wetland Delineation (Drwg. 75X-5500-G-00372), no jurisdictional wetlands or waters of the U.S. are anticipated to be dredged and filled during excavation of the remediation area.	Approximately 35.9 acres of jurisdictional wetlands and 8.9 acres of waters of the United States were identified on the FEMP property as a result of the 1993 Jurisdictional Wetlands & Waters of the U.S. (1993 FEMP Wetland Delineation). The U.S. Army Corps of Engineers officially approved the delineation on August 19, 1993. See also: Appendix H of the OU2 FS Report; Appendix J of the OU5 FS Report, and Appendix J of OU3 RI/FS. The Natural Resources Restoration Plan (NRRP); also, operable unit closure reports must include NEPA compliance, as per following sections of the Sitewide Excavation Plan: 1.4.2 Related Documents 7.3 Certification Report 7.4 Other Related Future Documents

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	WETLANDS/FLOODPLAIN PROTECTION, continued					
Procedure for Implementing the National Environmental Policy Act 40 CFR §6.302(a)	Federal agencies conducting certain activities must avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands, and avoid support of new construction in wetlands when a practicable alternative exists.	Appl	Appl		See preceding.	See preceding.
Executive Order 11988, Floodplain Management Procedures for Implementing the National Environmental Policy Act 40 CFR §6.302(b)	Federal agencies must evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain.	Appl	Appl		Remediation is needed, and can not be avoided. Nationwide Permit # 38 (subsequent entry) authorizes such remedial activity in a floodplain. The floodplain will not be developed as a result of this federal agency action. A portion of Remediation Area 2 Phase I is located within the 100-year floodplain of Paddy's Run. Impacts to the floodplain were addressed in a Floodplain/Wetland Assessment included in Appendix H of the OU2 FS Report (March 1995). Consistent with the fiindings of that assessment, temporary floodplain impacts in the form of increased stormwater runoff and/or siltation have the potential to occur during site preparatiuon activities. These potential impacts will be minimized through the design and implementation of appropriate erosion and sedimentation controls (see Section 5.1.3 of the Sitewide Excavation Plan). All three Area 2 Phase I stormwater retention basins will be designed to at least retain runoff from a 10-year storm event; basins 1 and 2 will be designed to retain runoff from a 25-year storm event. Stormwater retention basin berm elevations will be designed above the elevation of a 10-year flood event. No long term impacts or changes in the pool elevation of the 100-year flood are anticipated.	An updated floodplain determination was conducted in October 1992 for Paddy's Run using the U.S. Army Corps of Engineers' standard HEC2 water surface profile analysis program. The 100-year flood elevations reach the western slope of the Inactive Flyash Pile and the toe of the South Field slope.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	WETLANDS/FLOODPLAIN PROTECTION, continued					
DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements 10 CFR §1022.3(a), 3(b)(1), 3(b)(2), 3(b)(3), 3(b)(5), 3(b)(6), 3(c), 3(d), 3(e)	DOE shall exercise leadership and take action to: • Avoid to the extent possible the long- and short-term adverse impacts associated with the destruction of wetlands and the occupancy and modification of floodplains and wetlands, and avoid direct and indirect support of floodplain and wetland development wherever there is a practicable alternative. • Incorporate floodplain management goals and wetlands protection considerations into its planning, regulatory, and decision-making processes and shall to the extent practicable: - Reduce the hazard and risk of flood loss. - Minimize the impact of floods on human safety, health, and welfare. - Restore and preserve natural and beneficial values served by the floodplain. - Minimize the destruction, loss, or degradation of wetlands. - Preserve and enhance the natural and beneficial values of wetlands. • Undertake a careful evaluation of the potential effects of any DOE action taken in a floodplain and any new construction undertaken by DOE in wetlands not located in a floodplain. • Identify, evaluate, and as appropriate, implement alternative actions which may avoid or mitigate adverse floodplain/wetlands impacts. • Provide opportunity for early public review of any plans or proposals for actions in floodplains and new construction in wetlands.	Appl	Appl	Appl	10 CFR Part 1022 is the DOE implementing regulation for Executive Orders 11988 and 11990 (see corresponding preceding entries).	Remediation decisions included avoidance to/ minimization of wetlands impacts. See: Appendix H of the OU2 FS Report; Appendix J of the OU5 FS Report, and Appendix J of OU3 RI/FS. Also, see preceding entries.
DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements 10 CFR §1022.5(b), (h)	This part shall apply to all proposed floodplain/wetlands actions, including those sponsored jointly with other agencies, where practicable alternatives to the proposed actions are still available. The policies and procedures of this part which are applicable to floodplain actions shall apply to all proposed actions which occur in a wetlands located in a floodplain.	Appl	Appl	Appl	See preceding entries.	See preceding entries.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	WETLANDS/FLOODPLAIN PROTECTION, continued					
DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements 10 CFR §1022.11 (a), (b), (c)	Concurrent with its review of a proposed action to determine appropriate NEPA requirements, DOE shall determine applicability of the floodplain management and wetlands protection requirements of this part. In making a floodplain determination, DOE shall utilize the Flood Insurance Rate Maps (FIRMs) or the Flood Hazard Boundary Maps (FHBMs) prepared by the Federal Insurance Administration of the Department of Housing and Urban Development to determine if a proposed action is located in the base or critical action floodplain, as appropriate. For a proposed action in an area of predominately federal or state land holdings where FIRM or FHBM maps are not available, information shall be sought from the land administering agency (e.g., Bureau of Land Management, Soil Conservation Service, etc.) or from agencies with floodplain analysis expertise.	Appl	Appl		See preceding entries.	See preceding entries.
DOE Compliance with Floodplain/ Wetlands Assessments 10 CFR §1022.12(a)	If DOE determines, pursuant to 10 CFR §§ 1022.5 and 1022.11, that this part is applicable to the proposed action, DOE shall prepare a floodplain/wetlands assessment, according to the requirements in this section (10 CFR §1022.12).	Appl	Appl		See preceding entries.	See preceding entries.
DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements 10 CFR §1022.15(a)	If DOE finds that no practicable alternative to locating in the floodplain/wetland is available, consistent with the policy set forth in Executive Order 11988, DOE shall, before taking action, design, or modify its action in order to minimize potential harm to or within the floodplain or wetland.	Appl	Appl		See preceding entries.	See preceding entries.
Federal Water Pollution Control Act (a.k.a., Clean Water Act) General Regulatory Policies 33 CFR §323.3	Permits will be required for the discharge of dredged or fill material into waters of the United States including wetlands. Certain discharges specified in 33 CFR Part 330 are permitted by that regulation (nationwide permits). If a discharge of dredged or fill material is not permitted by 33 CFR Part 330 (Nationwide Permits), an individual section 404 permit will be required for the discharge of dredged or fill material into waters of the United States. Discharges of dredged or fill material into waters of the United States done by or on behalf of any Federal agency, other than the Corps of Engineers, are subject to the authorization procedures of these regulations. Remedial actions involving the discharge of dredge and fill material into these areas shall meet the substantive requirements of this section and 40 CFR Part 230.	Appl	Appl		See preceding entry for Executive Order 11990 (first Floodplain/Wetland Protection entry).	See preceding entries.

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000207

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	WETLANDS/FLOODPLAIN PROTECTION, continued					
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit (NWP) Program 33 CFR Part 330	The U.S. Army Corps of Engineers has authorized certain categories of activities involving the discharge of dredged and fill material into wetlands and waters of the United States under the NWP program. Activities involving the discharge of dredged and fill material will be conducted in accordance with the substantive requirements of applicable NWPs as required. Discharges not authorized by NWP will be conducted in accordance with the substantive requirements of 33 CFR Part 323 and 40 CFR Part 230.	✓	Appl	R&A	See preceding entries.	Following sections of the Sitewide Excavation Plan: 3.3.1 Implementation of Construction, Excavation, and Material Handling Activities 5.1.1 Natural Resource Impacts 5.1.3 Surface Water Pathway
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program 33 U.S.C. §1341(a)(1), (d) 33 CFR §330.1(c)	An activity is authorized under an Nationwide Permit (NWP) only if that activity and the permittee satisfy all of the individual NWP's terms and conditions. Potentially applicable NWPs include: • Nationwide Permit #38 — Cleanup of Hazardous and Toxic Waste - This permit authorizes specific activities required to affect the containment, stabilization or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority provided the permittee notifies the district engineer. - For discharges in special aquatic sites, including wetlands, the notification must include a delineation of affected special aquatic sites, including wetlands. - This nationwide permit does not authorize the establishment of new disposal sites or the expansion of existing sites used for the disposal of hazardous or toxic waste. • Nationwide Permit #26 — Headwaters and Isolated Waters Discharges - The discharge does not cause the loss of more than 10 acres of waters of the United States. - The permittee notifies the district engineer if the discharge would cause the loss of waters of the United States greater than one acre. - For discharges in special aquatic sites, including wetlands, the notification must also include a delineation of affected special aquatic sites, including wetlands. - The discharge, including all attendant features, both temporary and permanent, is part of a single and complete project.	Appl	Appl	R&A	See preceding entries for Executive Orders 11990 (Protection of Wetlands) and 11988 (Floodplain Management).	January 17, 1992 letter from Donald R. Schregardus, Director of the OEPA, to the U.S. Army Corps of Engineers, "401 Certification — Grant," the OEPA conditionally certified that projects authorized by NWP #s 38 and 26 will comply with the applicable provisions of the Federal Water Pollution Control Act.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	WETLANDS/FLOODPLAIN PROTECTION, continued					
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program Section B(26) to Appendix A of 33 CFR Part 330	Discharges of dredged or fill material into headwaters and isolated waters [under Nationwide Permit # 26] are approved provided: • The discharge does not cause the loss of more than 10 acres of waters of the United States. • The permittee notifies the district engineer if the discharge would cause the loss of waters of the United States greater than one acre. • For discharges in special aquatic sites, including wetlands, the notification must also include a delineation of affected special aquatic sites, including wetlands. • The discharge, including all attendant features, both temporary and permanent, is part of a single and complete project.	✓	✓	✓	See preceding and following entries.	See preceding and following entries.
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program 33 CFR §330.4 (c)(1) Ohio Section 401 State Water Quality Certifications OAC 3745-32-02	Section 401 State Water Quality Certification pursuant to Section 401 of the Clean Water Act, or waiver thereof, is required to prior to issuance or reissuance of individual or nationwide permits authorizing (dredge and fill) activities which may result in a discharge into waters of the United States. State Water Quality Certification is granted provided: 1. The discharge does not prevent or interfere with the attainment or maintenance of applicable water quality standards; and 2. The discharge does not result in a violation of any applicable provisions of the Federal Water Pollution Control Act (a.k.a., Clean Water Act).	Appl	Appl		See preceding and following entries.	January 17, 1992 letter from Donald R. Schregardus, Director of the OEPA, to the U.S. Army Corps of Engineers, "401 Certification – Grant," the OEPA conditionally certified that projects authorized by the NWP #s 38 and 26 (see previous entry) will comply with the applicable provisions of the Federal Water Pollution Control Act.
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program Section C of Appendix A to 33 CFR Part 330	In addition to the General Conditions, the following [Section 404 only] conditions apply only to activities that involve the discharge of dredge or fill material and must by followed in order for authorization of the nationwide permits to be valid: • No discharge of dredged or fill material may consist of unsuitable material (e.g., trash, debris, car bodies, etc.). And material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act). • Discharges of dredged or fill material into waters of the United States must be minimized or avoided to the maximum extent practicable at the project site, unless the District Engineer has approved a compensation mitigation plan for the specific regulated activity.	✓	✓		See preceding entries.	The Natural Resources Restoration Plan (NRRP)

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	WETLANDS/FLOODPLAIN PROTECTION, continued					
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program Section C of Appendix A to 33 CFR Part 330	Factors that the District Engineer will consider when determining the acceptability of appropriate and practicable mitigation include, but are not limited to: • To be practicable, the mitigation must be available and capable of being done considering costs, existing technology, and logistics in light of overall project purposes. • To the extent appropriate, permittees should consider mitigation banking and other forms of mitigation including contribution to wetland trust funds, which contribute to the restoration, creation, replacement, enhancement, or preservation of wetlands. • Furthermore, examples of mitigation that may be appropriate and practicable include but are not limited to: reducing the size of the project; establishing buffer zones to protect aquatic resource values; and replacing the loss of aquatic resource values by creating, restoring, and enhancing similar functions and values. In addition, mitigation must address impacts and cannot be used to offset the acreage of wetland losses that would occur in order to meet the acreage limits of some of the nationwide permits.	✓	✓		See preceding entries.	The Natural Resources Restoration Plan (NRRP)
Federal Water Pollution Control Act (a.k.a., Clean Water Act) §404 (33 U.S.C. §1344) Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, Subpart B—Compliance With the Guidelines, Restrictions on Discharge 40 CFR §230.10	No discharge of dredged or fill material shall be permitted: • If there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as, the alternative does not have other significant adverse environmental consequences. • Unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. No discharge of dredged or fill material shall be permitted if it: • Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable state water quality standard. • Violates any applicable toxic effluent standard or prohibition under section 307 of the Clean Water Act. • Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification or a habitat which is determined to be a critical habitat under the Endangered Species Act of 1973, as amended.	Appl	✓	✓	See preceding entries.	Appendix H of the OU2 FS Report; Appendix J of the OU5 FS Report, and Appendix J of OU3 RI/FS.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DISCHARGE TO SURFACE WATER					
Pollution to Waters of the State ORC 6111.04	No person shall cause pollution or place or cause to be placed any sewage, industrial waste, or other wastes in a location where they cause pollution of any waters of the state. No person to whom a permit has been issued shall place or discharge, or cause to be placed or discharged, in any waters of the state any sewage, industrial waste, or other wastes in excess of the permissive discharges specified under such existing permit without first receiving a permit from the Director to do so. Pollution to waters of the state is prohibited.	Appl	Appl	R&A		FEMP Site NPDES Permit Number 1IO00004*ED, the FEMP Stormwater Pollution Prevention Plan (RM-0039), Section 4 of the Integrated Environmental Monitoring Plan (IEMP), and the following section of the Sitewide Excavation Plan: 5.1.3 Surface Water Pathway
Compliance with Ohio Water Pollution Control Requirements ORC 6111.07(A), (C)	Failure to comply with water pollution control requirements is prohibited.	√	Appl	Appl		See preceding.
Water Quality Standards, Criteria Applicable to All Waters OAC 3745-1-04	To every extent practical and possible, all surface waters of the State of Ohio shall be free from: • Suspended solids or other substances that enter the waters as a result of human activity that will form putrescent or otherwise objectionable sludge deposits • Floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation • Materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to create a nuisance • Substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone • Nutrients entering the waters in concentrations that create nuisance growths of aquatic weeds or algae	√	R&A	R&A		See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DISCHARGE TO SURFACE WATER, continued					
Water Quality Standards, Antidegradation Policy OAC 3745-1-05(A)&(B)	(A) Existing instream water uses as defined in OAC 3745-1-07 [subsequent entry] shall be maintained and protected. No further water quality degradation which would interfere with or become injurious to designated uses is allowable. (B) Waters in which existing water quality is better than the criteria prescribed in these rules and exceeds those levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water shall be maintained and protected. ... Degradation of water quality shall not interfere or become injurious to existing or planned uses, and the Director shall require that ... feasible management or regulatory programs pursuant to Section 208 and 303 of the Act [Clean Water Act], 33 U.S.C. Sections 1288 and 1313, be applied to nonpoint sources.	✓	✓	Appl	Soil remedial action projects will ensure that existing instream water uses of the Great Miami River and Paddy's Run will be maintained as health protective.	See preceding.
Water Quality Standards, Great Miami River OAC 3745-1-21	Paddy's Run and the Great Miami River are designated as: • Warm water aquatic life habitat • Agricultural and industrial water supply • Primary contact recreation The Great Miami River between Ross Road (RM 95.7) to Taylorsville Dam (RM 92.6) is a state resource water, and RM 130 and 118 are public water supplies.	Appl	Appl	Appl	Discharges to the Great Miami River and Paddy's Run must not cause a violation of applicable numeric or narrative water quality standards for these designations. The FEMP effluent discharge pipe, located at River Mile (RM) 24.73 on the Great Miami River, is downstream of the state resource waters and public water supplies.	See preceding.
National Pollutant Discharge Elimination System 40 CFR §122.26(a)(l)(ii), 40 CFR §122.26(b)(14)(v), (x)	A discharge composed entirely of storm water associated with industrial activity is required to obtain a NPDES permit. These categories of facilities are considered to be engaging in "industrial activity": • Landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection), including those that are subject to regulation under Subtitle D of RCRA; and • Construction activities including clearing, grading, and excavation that disturbs five acres or more of total land area.	Appl	Appl	Appl	Discharges of stormwater associated with industrial and/or construction activities are regulated in accordance with the existing FEMP NPDES Permit, and the FEMP Stormwater Pollution Prevention Plan.	See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DISCHARGE TO SURFACE WATER, continued					
Ohio NPDES Permits, Ohio NPDES Permits Required OAC 3745-33-02(A)	No person may discharge any pollutant or cause, permit, or allow a discharge of any pollutant [from a point source] without applying for and obtaining an Ohio NPDES permit in accordance w with the requirements of this Chapter, 3745-33.	✓	✓	✓	See preceding and following entries.	FEMP Site NPDES Permit (Ohio EPA Number 1IO00004*ED), and the FEMP Stormwater Pollution Prevention Plan (RM-0039).
Ohio NPDES General Permits, Ohio NPDES Permit Required OAC 3745-38-02(A)	No person may discharge any pollutant or cause, permit, or allow a discharge of any pollutant from a point source without either applying for and obtaining an Ohio NPDES permit in accordance w with the requirements of Chapter 3745-33 of the Administrative Code [preceding entry], ... or have authorization to discharge under an Ohio NPDES general permit in accordance with the requirements of this chapter [3745-38]. NOTE: In September 1992, the FEMP applied for an individual stormwater permit to cover its industrial stormwater discharges to Paddy's Run. On the basis of the information provided in the original FEMP Stormwater Permit Application , Ohio EPA has chosen to regulate FEMP site industrial stormwater discharges under the individual permit process (OAC 3745-33, preceding entry), by incorporating stormwater monitoring requirements at Paddy's Run into the NPDES Permit. The site NPDES permit also addresses discharges of stormwater associated with construction activities by requiring a Stormwater Pollution Prevention Plan that defines the manner in which these discharges will be managed.	✓	✓	✓	In accordance with the note at left, the general permitting process described in OAC 3745-38 is not applicable to the FEMP site stormwater discharges. Rather, these are regulated within the context of the existing FEMP NPDES Permit (Ohio EPA Number 1IO00004*ED) and the FEMP Stormwater Pollution Prevention Plan (RM-0039), both of which derive their regulatory basis from OAC 3745-33 (preceding entry).	See preceding entries.
Rules and Regulations of the Hamilton County Soil and Water Conservation District Governing Earthwork for Unincorporated Hamilton County, Ohio	Temporary and/or permanent erosion and sediment control features and devices shall be designed and constructed in general accordance with the State of Ohio Temporary Erosion Control Specifications. *Exempted* from these requirements are: • *any public work performed by or under control of any governmental agency*, provided such operations do not cause instability of any adjacent or contiguous property and substantially equivalent sediment control policies are applied [3.10 E]. • *operations involving process and stockpiling of soils or rock materials where controlled by other regulations*, provided such operations do not cause instability of any adjacent or contiguous property [3.10 H].	✓	TBC	TBC		FEMP Site NPDES Permit (OEPA Number 1IO00004*ED), and the FEMP Stormwater Pollution Prevention Plan (RM-0039), and the following sections of the Sitewide Excavation Plan: 5.1.3 Surface Water Pathway App F Implementation of Construction

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DISCHARGE TO SURFACE WATER, continued					
Federal Water Pollution Control Act (a.k.a., Clean Water Act) Subpart K—Best Management Practices (BMP) Programs 40 CFR §125.104	BMP programs shall be developed in accordance with good engineering practices and: 1) Be documented in narrative form and include any necessary plot plans, drawings or maps; 2) Establish specific objectives for the control of toxic and hazardous pollutants: (a) Each facility component or system shall be examined for its potential for causing a release of significant amounts of toxic or hazardous pollutants to waters of the United States due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc. (b) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g., precipitation), or other circumstances to result in significant amounts of toxic or hazardous pollutants reaching surface waters, the program should include a prediction of the direction, rate of flow and total quantity of toxic or hazardous pollutants which could be discharged from the facility as a result of each condition or circumstance; 3) Establish specific BMPs to meet the objectives identified in (2) above, addressing each component or system capable of causing a release of significant amounts of toxic or hazardous pollutants to the waters of the United States.		Appl	R&A	BMP requirements will be met by implementing FEMP's BMP Plan. The BMP Plan will be progressively updated to accommodate changing site activities during the conduct of CERCLA remedial actions.	Addressed as part of the selected remedy described in the OU5 ROD. Also see preceding entries.

000213

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
GROUNDWATER PATHWAY						
GROUNDWATER PROTECTION						
Safe Drinking Water Act 42 U.S.C. §1424(e)	All Federal financially assisted projects constructed in the area of a sole source aquifer and its principal recharge zone will be subject to EPA's review to insure that these projects are designed and constructed so that they do not create a significant hazard to public health.	Appl	Appl	Appl	A notice in 53 FR 15876 (May 4, 1988) designated the Buried Valley Aquifer System of the Great Miami/ Little Miami River Basins of southwestern Ohio as a sole or principal source of drinking water. The Fernald site is located above this aquifer.	EPA and OEPA review of project submittals
WELLS – CONSTRUCTION						
Water Well Standards, Pumping Wells OAC 3745-9-08(C)	Pumps may only be primed with potable water.		Appl		Pertains to all well pumps that require priming.	The Sitewide CERCLA Quality Assurance Project Plan (SCQ), the Integrated Environmental Monitoring Plan (IEMP), and the individual project-specific plans for sampling.
Water Well Standards, Monitoring Well Maintenance and Modification OAC 3745-9-09(A) through (C), and (E) through (G)	Monitoring wells must be maintained or modified to avoid cross-contamination of groundwater.		Appl		Pertains to all groundwater wells and piezometers.	The Sitewide CERCLA Quality Assurance Project Plan (SCQ), the Integrated Environmental Monitoring Plan (IEMP), and the following section of the Sitewide Excavation Plan: F.6.3 Monitoring Well Preservation
WELLS – ABANDONMENT						
Water Well Standards, Abandonment of Test Holes and Wells OAC 3745-9-10	Upon completion of testing, a test hole shall be either completely filled with grout or such other material as will prevent contaminants from entering groundwater. If a well [or similar device] containing walls is not being used for obtaining groundwater or for determining the quality, quantity, or level of groundwater, it shall be completely filled with grout or other similar material as will prevent contaminants from entering groundwater, or maintained in strict accordance with all applicable requirements of OAC 3745-9-09.		Appl	Appl	After they are no longer needed, wells, peizometers and lysimeters are to be properly plugged and abandoned in accordance with these requirements.	The Sitewide CERCLA Quality Assurance Project Plan (SCQ), the Integrated Environmental Monitoring Plan (IEMP), and the following section of the Sitewide Excavation Plan: F.6.1 Plugging and Abandonment F.6.2 Monitoring Well Excavation

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
SOIL REMEDIATION						
	RADIONUCLIDE CONCENTRATIONS					
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter I (4) and Chapter II (2)	An "as low as reasonably achievable (ALARA)" process is to be used in planning and carrying out all DOE activities that have the potential to cause radiation exposure to the public. ALARA requires judgement with respect to what is reasonably achievable. Factors that relate to societal, technological, economic, and other public policy considerations shall be evaluated to the extent practicable. Factors to be considered, at a minimum, include: • Maximum dose to members of the public; • Collective dose to the population; • Alternative processes, such as alternative treatment of discharge streams, operating methods, or controls; • Doses for each process alternative; • Cost for each of the technological alternatives; • Examination of the changes in cost among alternatives; and • Changes in societal impact associated with process alternatives (e.g., differential doses from various pathways). Except for meeting requirements of NEPA, qualitative analyses are acceptable, in most instances, for ALARA judgements, especially when the potential doses are well below the dose limit. The bases for these judgements should be documented. More detailed analyses should be considered if the decision might result in doses that approach the limit.	TBC	TBC		In addition to the evaluations conducted as part of the CERCLA selection of remedy process (the short- and long-term risk assessments of the Comprehensive Remedial Action Risk Evaluation (CRARE) within the feasibility studies (FSs)), documentation of "equivalent evaluations" for environmental ALARA are performed in accordance with the "FEMP Environmental ALARA Plan" and retained as part of the site and project records.	Addressed through the approved selected remedy in the RODs. An ALARA goal is set in the OU5 ROD for the total uranium FRL.
10 CFR Part 834 (PROPOSED)			TBC			

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	RADIONUCLIDE CONCENTRATIONS, continued					
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Subpart B— Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites 40 CFR §192.12(a)	Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials, the concentration of radium-226 in land averaged over any area of 100 m^2 shall not exceed the background level by more than: • 5 pCi/g averaged over the first 15 cm of soil below the surface, and • 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface.	R&A	R&A	R&A	Met through the selection of FRLs based on risk assessment, followed by certification of cleanup.	The selected remedy in the OU2 and OU5 RODs established more stringent clean-up levels for radium-226 of 1.7 pCi/g, as opposed to 5.0 pCi/g above background.
Subpart C— Implementation 40 CFR §192.20	Compliance with this requirement should be shown through measurements performed within the accuracy of currently available types of field and laboratory instruments in conjunction with reasonable survey and sampling procedures.					
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Subpart C— Implementation 40 CFR §192.21(f) and §192.22(b)	Where radionuclides other than radium-226 and its decay product are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials, remedial actions shall, in addition to satisfying the standards of Subpart A in 40 CFR §192.02 and Subpart B in 40 CFR §192.12 (both listed above), reduce other residual radioactivity to levels that are ALARA.	R&A	R&A	R&A		The approved selected remedy in the OU5 ROD set an ALARA goal for the total uranium FRL.
Postclosure Standards for Uranium and Thorium Mill Tailings, Subpart D— Standards for the Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended 40 CFR §192.32 (b)(2)	The requirements for the management of uranium byproduct materials after closure of a disposal area [40 CFR §192.32(b)(1)] shall not apply to any portion of a disposal site which contains a concentration of radium-226 in land, averaged over areas of 100 m^2, which, as a result of uranium byproduct material, does not exceed the background level by more than the limits specified in 40 CFR §192.12(a) (see above).	R&A	R&A	R&A		See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	RADIONUCLIDE CONCENTRATIONS, continued					
Management of Thorium Mill Tailings, Subpart E— Standards for the Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended 40 CFR §192.40 - §192.42	The following are requirements for the management of thorium byproduct materials: • The provisions for the management of uranium byproduct material (40 CFR §192.32) shall apply to thorium byproduct material and: - Provisions applicable to the element uranium shall also apply to the element thorium - Provisions applicable to radon-222 shall also apply to radon-220 - Provisions applicable to radium-226 shall also apply to radium-228 With the concurrence of EPA, alternative provisions may be substituted for any of the above requirements provided the alternative provisions will provide at least an equivalent level of protection for human health and environment.	R&A	R&A	R&A		See preceding.
Radiation Protection of the Public and the Environment, DOE Order 5400.5 Chapter IV (4)(a)	Guidelines for residual concentrations of radionuclides other than thorium and radium shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property data where available. Procedures for these derivations are given in DOE/CH-8901. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2.	TBC				Considered in the development of the selected remedy in the OU2 and OU5 RODs.
Radiation Protection of the Public and the Environment, DOE Order 5400.5 Chapter IV (4)(a)(1) 10 CFR Part 834 (PROPOSED)	If the average residual concentration of radionuclides in any surface or below- surface area less than or equal to 25 m^2 exceeds the limit or guideline by a factor of $(100/A)^{0.5}$ [where A is the area (in square meters) of the region in which the concentrations are elevated], limits for "hot spots" shall also be developed and applied. Procedures for calculating these hot spots limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit in the soil, irrespective of the average concentration in the soil.	TBC	TBC			Considered in the development of the selected remedy in the OU2 and OU5 RODs.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	RADIONUCLIDE CONCENTRATIONS, continued					
Radiation Protection of the Public and the Environment, DOE Order 5400.5 Chapter IV (4)(a)(2)(3) 10 CFR Part 834 (PROPOSED)	The generic guidelines for residual concentrations of radium-226, radium-228, thorium-230, and thorium-232 are: • 5 pCi/g, averaged over the first 15 cm of soil below the surface; and • 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface. These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If both thorium-230 and radium-226, or both thorium-232 and radium-228, are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that either the dose for the mixture will not exceed the basic dose limit or the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1. Explicit formulas for calculating residual concentrations guidelines for mixtures are given in DOE/CH-8901.	TBC	TBC		Included as it is more restrictive than the federal standard in 40 CFR §192, .02, .12(a), .20, .21(f), .22(b), .32(b)(2), .40-.42.	Considered in the development of the selected remedy in the OU2 and OU5 RODs.
Guidelines for Residual Radioactive Material—Surface Contamination DOE Order 5400.5 Chapter IV (4)(d) 10 CFR Part 834 (PROPOSED)	These generic surface contamination guidelines are applicable to existing structures and equipment. These guidelines are generally consistent with standards of the NRC (1982) and functionally equivalent to Section 4, "Decontamination for Release for Unrestricted Use," of Regulatory Guide 1.86, but apply to nonreactor facilities. These limits apply to both interior equipment and building components that are potentially salvageable or recoverable scrap. If a building is demolished, the guidelines in paragraph IV (6)(a) are applicable to the resulting contamination in the ground.		TBC		Will be used for any process facility building or structures built and/or used for the remedial action, including the AWWT, soil staging, etc.	The operable unit closure reports identified in Section 7.4 of the Sitewide Excavation Plan.
	LEAD CONCENTRATION					
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive # 9355.4-12 (July 14, 1994)	EPA recommends using 400 ppm soil lead as a screening level for lead in soil for residential scenarios at CERCLA sites and at RCRA Corrective Action sites. Residential areas with soil lead below 400 ppm generally require no further action. Site-specific preliminary remediation goals (PRGs) at CERCLA sites and media cleanup standards at RCRA corrective action facilities for residential land use are described.	TBC	TBC			The selected remedy in the OU2 and OU5 RODs established this value as the lead FRL.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	PCB CONCENTRATION					
Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions, Subpart A— Applicability, Definitions 40 CFR §761.3	PCB materials which appear at concentrations less than 50 ppm are excluded from the PCB disposal requirements in this regulation.	R&A	√	R&A	Operable Unit 2 does not contain PCB materials which have a concentration greater than 50 ppm.	Following sections of the Sitewide Excavation Plan: 2.5.8 Special Materials 3.3.2.2 Special Materials F.4.1 Materials Which Require Special Handling
Subpart G— PCB Spill Cleanup Policy, Requirements for PCB Spill Cleanup 40 CFR §761.125(c)	PCBs at a concentration of greater than 50 ppm are subject to TSCA decontamination requirements in 40 CFR §761.120(b). Soil in restricted access areas contaminated by a PCB spill shall be cleaned to 25 ppm PCBs by weight [40 CFR §761.125(c)(3)(v)]. At such times as restricted access areas (other than outdoor electrical substations) are converted to another use, the spill site shall be cleaned up to the non-restricted access area requirements of 40 CFR §761.125(c)(4)(v). Soils in non-restricted access areas contaminated by a PCB spill shall be cleaned to 10 ppm PCBs by weight, provided that the soil is excavated to a minimum depth of 10 inches. The excavated soil will be replaced with clean soil (i.e., containing less than 1 ppm PCBs by weight), and the spill site will be restored (e.g., replacement of turf) [40 CFR §761.125(c)(4)(v)].		TBC	TBC	Soil containing PCBs will be excavated as necessary to attain FRLs; soil concentrations are expected to be less than 50 ppm by weight.	The OU5 ROD established FRLs for the PCBs Arochlor-1254 and Arochlor-1260 as 0.13 mg/kg (ppm by weight).
Subpart G— PCB Spill Cleanup Policy, Sampling Requirements 40 CFR §761.130	Criteria that the EPA uses to determine the adequacy of the cleanup of spills resulting from the release of regulated PCB materials at concentrations of ≥50 ppm by weight. Applies to spills which occur after May 4, 1987.			TBC	Applies to spills of regulated PCB materials (i.e., those that have a concentration ≥50 ppm by weight) that occurred after May 4, 1987.	See preceding.
	CERTIFICATION OF CLEANUP					
Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media EPA 230/02-89-042 NTIS PB89-234959 February 1989	This EPA guidance document describes methods for testing whether soil chemical concentrations at a site are statistically below a cleanup standard or ARAR. If it can be reasonably concluded that the remaining soil or treated soil at a site has concentrations that are statistically less than relevant cleanup standards then the site can be judged protective of human health and the environment.	TBC	√			Following sections of the Sitewide Excavation Plan: 2.2.2 Certifying FRL Attainment 3.4 Certification App G Certification Design R[illegible]de

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	CERTIFICATION OF CLEANUP, continued					
RCRA/CERCLA Integrated Closure Director's Final Findings and Orders (June 4, 1996) Section V.4 in lieu of Closure and Post-Closure Under Interim Standards Certification of Closure OAC 3745-66-15	For the HWMUs identified in Attachment A of these Orders, the Respondent ... are hereby exempted from complying with OAC rule 3745-66-15 provided that they submit Remedial Action Reports for the HWMUs contained in operable units 1, 3, and 5 within sixty (60) days from completion of remedial activities at each operable unit, which is determined by the U.S. EPA, in accordance with CERCLA. These Remedial Action Reports shall certify that the HWMUs contained in operable units 1 and 3 have been closed, and that the environmental media in operable unit 5 has been managed, in accordance with the final remedies contained in the Records of Decision and in accordance with the Director's closure performance standards. Attachment C [of these Orders] summarizes the documents that will be provided during remediation process. These CERCLA documents contain the substantive requirements of the RCRA and Ohio hazardous waste closure regulations.		✓	✓	Pertinent to closures of HWMUs listed in preceding entries (from Table 2-1 of the Sitewide Excavation Plan, derived from the DF&O's Attachment A) during the CERCLA soil remediation activities.	Following sections of the Sitewide Excavation Plan: 3.4.6 Certification Report 7.3 Certification Report 7.4 Other Related Future Documents

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
IMPACTED MATERIAL MANAGEMENT						
	DEFINITIONS & GENERAL FACILITY STANDARDS					
Resource, Conservation, and Recovery Act 42 U.S.C. §6903 (27)	Solid waste means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities, but does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954.	Appl	✓	✓		Following sections of the Sitewide Excavation Plan: 3.0 General Implementation Approach App F Implementation of Construction
Solid Waste and Infectious Waste Regulations, Definitions OAC 3745-27-01 (B)(40)	Solid wastes means such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, *excluding earth or material from construction, mining, or demolition operations, or other waste materials of the type that would normally be included in demolition debris, nontoxic flyash, spent nontoxic foundry sand, and slag and other substances that are not harmful or inimical to public health*, and includes, but is not limited to, garbage, tires, combustible and noncombustible material, street dirt, and debris. Solid waste does not include any material that is an infectious waste or a hazardous waste. For the purpose of this definition, "semisolid material" does not contain liquids which can be readily released under normal climatic conditions, as determined by method 9095 (paint filter liquids test) in SW-846: "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods".	Appl	✓	✓		See preceding.
Solid Waste and Infectious Waste Regulations, Definitions OAC 3745-27-01 (B)(15) OAC 3745-27-30 (A), (E), (H) ORC 3734.021 (A)(1)(c), (d)	Infectious waste is defined by nine categories of waste including human blood specimens and blood products, sharp wastes used in the treatment or inoculation of human beings, and any other waste materials generated in the diagnosis, treatment, or immunization of human beings. A generator who places all sharp infectious wastes and all unused hypodermic needles, syringes, and scalpel blades into a "SHARPS" container before they are transported and who generates less than 50 lbs. of infectious wastes each month and does not hold a certificate of registration as a generator of infectious wastes may transport and dispose of infectious wastes in the same manner as solid wastes. Treated infectious wastes can be transported and disposed in the same manner as noninfectious waste. Infectious waste that is also radioactive shall be managed in accordance with applicable Ohio Department of Health and U.S. Nuclear Regulatory Commission regulations.	Appl	✓			See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Identification and Listing of Hazardous Waste, Definition of Hazardous Waste OAC 3745-51-03(A) [Identification and Listing of Hazardous Waste, Subpart A—General, Definition of Hazardous Waste 40 CFR §261.3(a)]	A solid waste is a hazardous waste, if: (1) it is not excluded from regulation as a hazardous waste under OAC 3745-51-04(B) [40 CFR §261.4(b)]; and (2)(a) it exhibits any of the characteristics of hazardous waste identified in OAC 3745-51-20 to 3745-51-24, with certain exceptions noted therein; or (2)(b) it is listed as hazardous waste in OAC 3745-51-31 to 3745-51-33 [40 CFR §§ 261.30 - 261.35]; or (2)(c) it is a mixture of solid and hazardous wastes; (2)(d) it is a mixture of hazardous wastes as defined in OAC 3745-51-03(A)(2)(a) to 3745-51-03(A)(2)(c) [three previous bullets in this entry] and source material, special nuclear material, or by product material, as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq., or other radionuclides. However, only the hazardous components of the mixture are subject to regulation for purposes of this [OAC 3745-51] chapter.	Appl	√	√		See preceding.
Identification and Listing of Hazardous Waste, Exclusions OAC 3745-51-04(B)(4) [Identification and Listing of Hazardous Waste, Subpart A—General, Exclusions 40 CFR §261.4(b)(4)]	The following are not hazardous wastes: fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels.	Appl	√	√		See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Identification and Listing of Hazardous Wastes, Requirements for Recyclable Materials OAC 3745-51-06(A)(3) [40 CFR §261.6]	The following recyclable materials are not subject to regulation under rules 3745-50-40 to 3745-50-62 or Chapters 3745-52 to 3745-57 and 3745-65 to 3745-69 of the Ohio Administrative Code [Parts 262 through 266 or 268, 270, or 124 of 40 CFR], and are not subject to the notification requirements of Chapter 3734 of the Ohio Revised Code [Section 3010 of RCRA]: (b) used batteries (or used battery cells) returned to a battery manufacturer for regeneration; (c) used oil that exhibits one or more of the characteristics of hazardous waste but is recycled in some other manner than being burned for energy recovery; (d) scrap metal.	✓	✓	Appl	Pertinent to remediation generated materials. Recycling of remediation generated materials may be conducted.	Operable Unit 3 Integrated RD/RA Work Plan
Termination of Operating Licenses for Nuclear Reactors Section C.4 Decontamination for Release for Unrestricted Use U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 (June 1974)	A reasonable effort shall be made to eliminate residual surface radiological contamination and to achieve the acceptable surface contamination levels stated in this guide.	✓	✓	TBC	Pertinent to releasing to off-site any potentially radiologically-contaminated materials. Radiation surveys will be performed prior to releasing any potentially radiologically- contaminated materials off-site to demonstrate compliance with the surface contamination levels stated in this guide.	Operable Unit 1 Design Criteria Package
Identification and Listing of Hazardous Waste, Subpart A—General, Definition of Hazardous Waste 40 CFR §261.3	Debris means solid material exceeding a 60-mm particle size that is intended for disposal and that is a manufactured object, plant or animal matter, or natural geologic material.	✓	Appl	Appl	Applicable to hazardous debris that will be disposed of off-site.	Operable Unit 1 Design Criteria Package, and following sections of the Sitewide Excavation Plan: 1.3.2.4 Remediation Debris 2.5.10 Off-Site Shipments F.5.2 Off-Site Disposal

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Land Disposal Restrictions, Subpart A—General, Definitions Applicable to This Part 40 CFR §268.2	Hazardous debris means debris that contains a listed hazardous waste, or that exhibits a characteristic of hazardous waste.	✓	Appl	Appl	"contains a listed hazardous waste" portion is not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD.	See preceding.
Hazardous Waste Regulations Contained-In Policy 58 FR 48092 (September 14, 1993) Proposed rule. 58 FR 59976 (November 12, 1993) Notice to extend comment. 59 FR 10778 (March 8, 1993) Clarification, partial withdrawal.	Hazardous soil means soil that contains RCRA hazardous waste(s) listed in Subpart D of 40 CFR Part 261, or that exhibits one or more of the characteristics of a hazardous waste as defined in Subpart C of 40 CFR Part 261. This proposed rule recommends contained-in determinations for hazardous debris, hazardous soil and other environmental media. Any person may petition the Regional Administrator to exclude, under 261.3(f)(2) or 261.3(g) of this chapter, hazardous debris and hazardous soil or other environmental media, including but not limited to groundwater, surface water, and sediment, from regulation as hazardous waste. The petition for a contained-in determination must include information sufficient to demonstrate that specific constituent concentrations in the hazardous debris, hazardous soil, or other environmental media to be excluded do not pose a hazard to human health and the environment at that site. (Such a petition is not necessary for remedial actions conducted pursuant to RCRA or CERCLA authorities provided that a similar determination is made by the Regional Administrator based on substantially equivalent information including public notice and comment requirements).		TBC	TBC	Will be considered for managing treated soil that is contaminated with RCRA waste.	Addressed in the selected remedy in the OU5 ROD. Following sections of the Sitewide Excavation Plan: 3.3 Remedial Action App F Implementation of Construction
Ohio Petroleum Contaminated Soil Policy OEPA Policy PP.01-03-200	The basis of the "contained in" policy is that environmental media, such as soil or groundwater, are not considered to be waste material. Because they are not a solid waste, the mixture rule, as set forth in OAC 3745-51-03, does not apply when they become contaminated with a listed hazardous waste but only contains the waste. The result of this policy is that if the waste constituents can be removed, the soil is no longer considered to contain a hazardous waste. Therefore, since soil is not a waste material it does not have to be de-listed in order for it to be used for its intended purpose. However, as long as the soil contains the waste material, it must be managed as a hazardous waste. If this concept is applied to petroleum-contaminated soil, the soil containing a petroleum hydrocarbon would not need to be managed as a solid waste if the contaminants were removed.	TBC	TBC		Allows for treated/ clean soil to be used as backfill. Thus, all soil below FRLs can be backfilled as clean soil.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Hazardous Waste Management System: General, Subpart B—Definitions 40 CFR §260.10	Remediation waste means all solid and hazardous waste, and all media (including groundwater, surface water, soils, and sediments) and debris, which contain listed hazardous wastes or which themselves exhibit a hazardous waste characteristic, that are managed for the purpose of implementing corrective action requirements under 40 CFR §264.101 and RCRA section 3008(h). For a given facility, remediation wastes may originate only from within the facility boundary, but may include waste managed in implementing RCRA sections 3004(v) or 3008(h) for releases beyond the facility boundary.	R&A	✓	✓	Under the Consent Agreement as amended in 1991 (a.k.a., the ACA), remediation at the FEMP is conducted under the authorities of CERCLA as well as RCRA sections 3004(v) and 3008(h).	Following secctions of the Sitewide Excavation Plan: 1.3.2.1 Soil and Sediment 1.3.2.6 Corrective Action Management Unit Rule 3.3.4.1 WAC Attainment
CERCLA Compliance with Other Laws Manual Section 2.7	Placement/disposal of waste does not occur under the following circumstances: • waste is consolidated within a unit (including an area of contamination that can be viewed as a single unit); • waste is capped in place, including grading prior to capping; • waste is treated in situ; and • waste is processed within the unit in order to improve its structural stability for closure or for movement of equipment over the area.	TBC	✓	TBC	See following entry on the Corrective Action Management Unit.	See following entry.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Corrective Action Management Unit Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart S- 40 CFR §264.552 (58 FR 865829, February 16, 1993)	For the purpose of implementing remedies under Sec. 264.101 or RCRA Section 3008(h), the EPA Regional Administrator may designate an area at the facility as a corrective action management unit (CAMU). One or more CAMUs may be designated at a facility under the following conditions: 1) Emplacement of remediation wastes into or within a CAMU does not constitute land disposal of hazardous wastes. 2) Consolidation or emplacement of remediation wastes into or within a CAMU does not constitute creation of a unit subject to minimum technology requirements. 3) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies. 4) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to the wastes. 5) The CAMU shall include uncontaminated areas of the facility only if including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility. 6) Areas within the CAMU, where wastes remain in place after closure of the CAMU, shall be managed and contained so as to minimize future releases, to the extent practicable. 7) The CAMU shall expedite the timing of remedial activity implementation, when appropriate and applicable. 8) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of wastes that will remain in place after closure of the CAMU. 9) The CAMU shall, to the extent practicable, minimize the land area of the facility upon which wastes will remain in place after closure of the CAMU. The owner/operator shall provide sufficient information to enable the Regional Administrator to designate a CAMU in accordance with the criteria in Sec. 264.552. Note: RCRA regulated units (HWMUs) within a CAMU are fully subject to RCRA closure regulations.	R&A	Appl	R&A	Per the selected remedy in the OU5 ROD: • the FEMP site (bounded by its property boundaries) is designated as a CAMU; • consolidation or management of on-site remediation wastes into or within the CAMU does not constitute creation of a unit subject to minimum technology requirements (MTRs) [OAC 3745-68-101 and 40 CFR §265.301(a)] and does not invoke land disposal restrictions (LDRs)[OAC 3745-59 and 40 CFR§§268.40 through .44].	Section 9.1.8 of the OU5 ROD.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Generator Standards, Hazardous Waste Determination OAC 3745-52-11(A) through (F) [Standards Applicable to Generators of Hazardous Waste, Subpart A—General, Hazardous Waste Determination 40 CFR §262.11]	A person who generates a solid waste must determine if that waste is a hazardous waste using the following method: 1) First determine if the waste is excluded from regulation (not a solid waste) under OAC 3745-51-04 (40 CFR §261.4).	✓	R&A	R&A		Section 3.3.2 of the Sitewide Excavation Plan.
	2) If the waste is not excluded from regulation, then determine if the waste is listed as a waste ("listed waste") in OAC 3745-51-30 to 3745-51-33 (Subpart D of 40 CFR Part 261).				Not pertinent for on-site disposal because of the CAMU rule (see preceding entry); pertinent for off-site treatment or disposal.	See preceding entry, and following sections of the Sitewide Excavation Plan: 2.5.10 Off-Site Shipments F.5.2 Off-Site Disposal
	3) For purposes of complying with OAC 3745-59 (40 CFR Part 268), or if the waste is not a "listed waste" per step 2 above, then determine if the waste is a "characteristic waste" as identified in OAC 3745-51-20 through 3745-51-24 (Subpart C of 40 CFR Part 261), by either (a) testing the waste using appropriate methods, or (b) applying knowledge of the hazardous characteristic of the waste in light of the materials or processes used ("process knowledge").				Per the RODs, pertinent only to the following areas: In OU2: approx. 300 cubic yards of lead-containing soil in the South Field Firing Range. In OU5: 1) Abandoned sump west of Pilot Plant; 2) Area between KC-2 Warehouse and RR tracks; 3) Trap Range; 4) Paddy's Run streambank fill materials west of OU4's Silos 1-4; 5) Scrap Metal Pile area; and 6) Area north of maintenance building.	Sections 7.4 (@ p. 7-5), 9.1 (@ p. 9-2), and 10.2.2 (@ p. 10-4) of the OU2 ROD; Section 9.1.1 (@ p. 9-6) and Table 9-1 of the OU5 ROD

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Interim [Status Hazardous Waste Facility] Standards —General Provisions, General Provisions OAC 3745-65-13 through -16 [Interim Status Hazardous Waste Facility Standards, Subpart B—General Facility Standards 40 CFR §§265.13 through .16]	Owners/operators of a facility must obtain chemical and physical analyses of a representative sample of each hazardous or nonhazardous waste to be treated, stored or disposed of at the facility prior to treatment, storage or disposal. At a minimum, the analysis must contain all the information which must be known to treat, store or dispose of the waste, and may include using existing published or documented data on the waste or on waste generated from similar processes ("process knowledge") [OAC 3745-65-13].	✓	R&A	R&A	Pertinent to management of hazardous waste.	Following sections of the Sitewide Excavation Plan: 3.3.2 Impacted Materials ,Handling and Tracking 4.0 Location-Specific Excavation Approaches F.5 Excavated Material Management
	The facility owner/operator must prevent the unknowing entry, and minimize the possibility of unauthorized entry, to the active portion of the facility unless certain conditions apply [OAC 3745-65-14].				Controls which limit access to the FEMP will remain in place throughout remediation activities.	F.2.1 Establishing Excavation Boundaries and Access Controls
	The facility operator must maintain and inspect all monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment that are important to preventing human health hazards. The frequency of inspection may vary by item, and should be based on the rate of possible deterioration of the equipment/item and the probability of an environmental or human health incident if the deterioration, malfunction, or operator error goes undetected [OAC 3745-65-15]. The facility operator must train personnel for procedures relevant to the positions in which they are employed [OAC 3745-65-16].					F.8 Remediation Maintenance Activities
Hazardous Waste Facility Environmental Impact ORC 3734.05(D)(6)(c)	A hazardous waste facility installation and operation permit shall not be approved unless it is proven that the facility represents the minimum adverse environmental impact, considering the state of available technology, the nature and economics of various alternatives and other pertinent considerations	✓	Appl	✓	**NOTE:** Incorrectly cited in RODs as OAC 3745.05(D)(6)(c).	Appendix H of OU2 FS, Appendix J of OU5 FS, and Appendix J of OU3 RI/FS.

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000229

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Hazardous Waste Facility Minimum Risk ORC 3734.05(D)(6)(d)	A hazardous waste facility installation and operation permit shall not be approved unless it is proven that the facility represents the minimum risk of all the following: 1) contamination of groundwater and surface water; 2) fires or explosions from treatment, storage, or disposal methods; 3) accidents during transportation; 4) impact to public health and safety; 5) air pollution; and 6) soil contamination.	✓	Appl	✓	NOTE: Incorrectly cited in RODs as OAC 3745.05(D)(6)(d).	OU2, OU5, and OU3 FS Reports and RODs. Also, see preceding.
Interim [Status Hazardous Waste Facility] Standards—General Provisions, Preparedness and Prevention OAC 3745-65-31 through -35, and -37 [Interim Status Hazardous Waste Facility Standards, Subpart C—Preparedness and Prevention 40 CFR §§265.31 through .35, and .37]	TSD facility operators must design, construct, maintain and operate facilities to minimize the possibility of fire, explosion or any unplanned sudden or non-sudden release of hazardous waste to air, soil, or surface water which might threaten human health or the environment.	✓	R&A	R&A		See two preceding entries. For waste that is dispositioned for off-site disposal, see the Operable Unit 1 Design Criteria Package.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
DEFINITIONS & GENERAL FACILITY STANDARDS, continued						
Interim [Status Hazardous Waste Facility] Standards—General Provisions, Contingency Plan and Emergency Procedures OAC 3745-65-51, -52, -55 and -56 [Interim Status Hazardous Waste Facility Standards, Subpart D—Contingency Plan and Emergency Procedures 40 CFR §265.51, .52, .55 and .56]	Each facility operator must have a contingency plan designed to minimize hazards to human health and the environment due to fires, explosions, or any unplanned releases of hazardous waste constituents to air, soil or surface/groundwater.	✓	R&A	R&A	Pertinent to on-site facilities that treat, store, or dispose of hazardous waste.	FEMP Emergency Plan (PL-3020); all HWMUs identified in Table 2-1 of the Sitewide Excavation Plan (and the subset identified previously in this table) are addressed in Section G: Contingency Plan of the RCRA Part B Permit Application. Also, see three preceding entries. For waste that is dispositioned for off-site disposal, see the Operable Unit 1 Design Criteria Package.
Hazardous Waste Incinerators [and Miscellaneous Units], Environmental Performance Standards OAC 3745-57-91 and -92 [Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart X—Miscellaneous Units, 40 CFR §§264.601 through .603]	Prevention of any release that may have adverse effects on human health or the environment includes, but is not limited to: A. Migration of waste constituents in the groundwater or subsurface environment. B. Migration of waste constituents in surface water, or wetlands or on the soil surface. C. Migration of waste constituents in the air. Monitoring, tests, analytical data, inspections, response, and reporting procedures and frequencies must ensure compliance with pertinent portions of the OAC.	✓	R&A	✓	Pertinent to on-site facilities that treat, store, or dispose of hazardous waste in miscellaneous units unless the CAMU Rule is applied.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(d)	Low-level waste shall be characterized with sufficient accuracy to permit proper segregation, treatment, storage, and disposal. This characterization shall ensure that, upon generation after processing, the actual physical and chemical characteristics and major radionuclide content are recorded and known during all stages of the waste management process. Waste characterization data shall be recorded on a waste manifest and shall include: • the physical and chemical characteristics of the waste; • volume of the waste (total of waste and any solidification or absorbent media); • weight of the waste (total of waste and any solidification or absorbent media); • major radionuclides and their concentrations; and • packaging date, package weight, and external volume.	TBC	√	TBC	The CERCLA RI/FS process established the nature and extent of contamination at the FEMP. During excavation, monitoring will be performed in accordance with of the Sitewide Excavation Plan and individual IRDPs, and results will be documented in order to determine if impacted material meets the OSDF WACs or offsite WACs. These sources of characterization information (RI/FS sampling, pre-design investigations, FRL attainment, WAC attainment) will provide the required manifest information.	Addressed throughout the CERCLA RI/FS and selection of remedy process, culminated in the OU2, OU5 and OU3 RODs; OSDF Impacted Materials Placement Plan; following section of the Sitewide Excavation Plan: 3.3.2 Impacted Materials Handling and Tracking

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Waste Treatment DOE Order 5820.2A Chapter III (3)(f)	Waste treatment techniques such as incineration, shredding, and compaction to reduce volume and provide more stable waste forms shall be implemented as necessary to meet performance requirements. Use of waste treatment techniques to increase the life of the disposal facility and improve the long-term facility performance, by improved site stability and reduction of infiltrating water, is required to the extent it is cost effective. The development of large scale waste treatment facilities shall be supported by the appropriate National Environmental Policy Act documentation. Operation of waste treatment facilities shall be supported by adequate documentation.	TBC	TBC	TBC	Based upon CERCLA RI/FS data, the majority of the impacted material from OU2, OU5 & OU3 will meet the OSDF WACs and thus the performance objectives of the OSDF & DOE Order 5820.2A without treatment. This has been demonstrated through the modeling performed in the FSs to establish the OSDF WACs. Two categories of impacted materials may need to be treated before disposal. Characteristically hazardous materials from seven areas will be quantified & treated to the extent necessary to remove the characteristic(s) that cause them to be regulated as hazardous. Physical sizing & treatment as per the OSDF Impacted Material Placement Plan will be conducted as needed on debris for proper waste placement and stability within the OSDF. Some physical treatment may also be necessary for the sludge from the OU2 Lime Sludge Ponds to decrease the moisture content before placement into the OSDF.	Addressed throughout the CERCLA RI/FS and selection of remedy process, culminated in the OU2, OU5 and OU3 RODs; OSDF Impacted Materials Placement Plan; following sections of the Sitewide Excavation Plan: 1.3.2.7 RCRA Characteristic Waste Disposal 2.1.1.3 Characteristically Hazardous Waste 3.3.2 Impacted Materials Handling and Tracking F.5 Excavated Material Management

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(g)	The volume of waste and number of shipments of low-level wastes shall be minimized and the shipments will be conducted based on plans developed by field organizations. Generators shall provide an annual forecast in the third quarter of the fiscal year to the field organizations managing the off-site disposal facility to which the waste is to be shipped. Generators must receive advance approval from the receiving facility and shall certify prior to shipment that waste meets the receiving facility waste acceptance criteria. The certification program shall be auditable and able to withstand independent review.	TBC	TBC	TBC	The volume of impacted material to be disposed onsite in the OSDF will be minimized through a number of programs. First, extensive sampling has been performed during the CERCLA RI/FS process and the extent of excavation has been established using this data. Combined with the sampling/monitoring that will be performed during excavation in accordance with Section 3.3 of the Sitewide Excavation Plan and individual IRDPs, this will confirm that only impacted materials are excavated and sent to disposal. Compliance with the FEMP Pollution Prevention and Waste Minimization Awareness Plan will minimize the amount of low-level waste (i.e., equipment and personal protective equipment) generated during remediation.	FEMP Pollution Prevention and Waste Minimization Awareness Plan; also see preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DEFINITIONS & GENERAL FACILITY STANDARDS, continued					
Control of Residual Radioactive Material DOE Order 5400.5 Chapter IV (6)(b) 10 CFR Part 834 (PROPOSED)	Interim storage must provide: 1) Control and stabilization features shall be designed to provide, to the extent reasonably achievable, an effective life of 50 years with a minimum life of at least 25 years. 2) Controls shall be designed such that radon-222 concentrations in the atmosphere above facility surfaces or openings in addition to background levels, will not exceed: (a) 100 pCi/L at any given point; (b) An annual average concentration of 30 pCi/L over the facility site; and (c) An annual average concentration of 3 pCi/L at or above any location outside the facility site. (d) Flux rates from the storage of radon producing wastes shall not exceed 20 pCi/m^2/sec, as required by 40 CFR Part 61.	✓	TBC		The selected remedies are for a permanent remedy, not for interim storage; any short-term management of impacted material to be employed is to facilitate the permanent remedy.	Addressed through the approved selected remedy in the OU2 and OU5 RODs, associated remedial design documents (i.e., IRDPs).
	3) Controls shall be designed such that concentrations of radionuclides in the groundwater and quantities of residual radioactive material will not exceed applicable federal or state standards.					Section 5.0 of the Sitewide Excavation Plan, for environmental controls to be implemented during remediation.
	4) Access to a property and use of on-site material contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR Part 192. These control features should be designed to provide, to the extent reasonable, an effective life of at least 25 years.					Section 3.0 and Appendix F of the Sitewide Excavation Plan and IRDPs, for access controls to be implemented during remediation.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
MANAGEMENT OF LOW-LEVEL RADIOACTIVE MATERIAL						
Low-level Radioactive Waste Generation DOE Order 5820.2A Chapter III (3)(c)	Technical and administrative controls shall be directed to reducing the gross volume of waste generated and/or the amount of radioactivity requiring disposal. Waste reduction efforts shall include consideration of process modification, process optimization, materials substitution, and decontamination. All DOE low-level waste generators shall establish auditable programs to assure that the amount of low-level waste generated and/or shipped for disposal is minimized. Each DOE low-level waste generator shall separate uncontaminated waste from low-level waste to facilitate cost-effective treatment and disposal. Each DOE low-level waste generator preparing a design for a new process or process change shall incorporate principles into the design that will minimize the generation of low-level waste.	TBC	TBC	TBC	Implementation of the FEMP Pollution Prevention and Waste Minimization Awareness Plan will confirm that all newly generated waste is minimized during remediation. Additionally, excavation controls such as rapid test methodology and additional laboratory sampling will be implemented to confirm that only impacted material with contamination that is potentially above the FRLs is being excavated and sent to disposal. Physical sampling of the impacted materials and/or rapid test method methodology will also confirm that only material that exceeds the OSDF WAC is sent offsite for disposal.	Addressed throughout the CERCLA RI/FS and selection of remedy process, culminated in the OU2, OU5 and OU3 RODs; also, FEMP Pollution Prevention and Waste Minimization Awareness Plan.
MANAGEMENT OF HAZARDOUS REMEDIATION WASTE						
Identification and Listing of Hazardous Waste, Residues of Hazardous Waste in Empty Containers OAC 3745-51-07(A) &(B) [Identification and Listing of Hazardous Waste, Subpart A—General, Residues of Hazardous Waste in Empty Containers 40 CFR §261.7]	Any hazardous waste remaining in either an empty container or an inner liner removed from an empty container is not subject to regulation under 40 CFR Parts 261 through 265 (RCRA requirements). A container is empty if: 1) All wastes have been removed that can be removed using the practices commonly employed to remove materials from that type of container (e.g., pouring, pumping, and aspirating); and 2) No more than 2.5 cm (1 inch) of residue remains on bottom of the container or inner liner; or 3) No more than 3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is less than or equal to 110 gal. in size, or no more than 0.3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is greater than 110 gal. in size.	√	R&A	Appl	Pertinent when containerizing: soil contaminated by RCRA waste; any treatment residues exhibiting RCRA characteristics including advanced wastewater treatment (AWWT) sludges and soil decontamination residues.	Following sections of the Sitewide Excavation Plan: 2.5.8 Special Materials 3.3.2.2 Special Materials App F Implementation of Construction

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
Closure and Post-Closure Under Interim Standards, Condition of Containers OAC 3745-66-71 Compatibility of Containers OAC 3745-66-72 Management of Containers OAC 3745-66-73 Inspections OAC 3745-66-74 Special Requirements for Ignitable or Reactive Waste OAC 3745-66-76 Special Requirements for Incompatible Wastes OAC 3745-66-77 [Interim Status Standards, Subpart I—Use & Management of Containers, 40 CFR §§265.171 through .174, .176 and .177]	If a container holding hazardous waste is not in good condition (e.g., severe rusting, apparent structural defects) or begins to leak, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition or manage the waste in some other way that complies with this requirement.	✓	R&A	Appl	Pertinent to handling containers holding environmental media contaminated with RCRA waste.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
[New Facilities] Corrective Action, Closure and Post-Closure Requirements Containment OAC 3745-55-75 [Interim Status Hazardous Waste Facility Standards, Subpart I—Use & Management of Containers 40 CFR §§265.175(a) through (c)]	A containment system for RCRA container storage areas must be designed and operated to provide: 1). A sufficiently impervious base, which is sloped to collect any leaking liquids. 2) Sufficient capacity to contain liquids. 3) Prevention of run-on into the containment system. 4) A sump to prevent overflow of the collection system. Storage areas for containers holding only wastes that do not contain free liquids need not have a containment system, provided that: 1) The storage area is sloped or is otherwise designed and operated to drain and remove liquid resulting from precipitation, or 2) The containers are elevated or are otherwise protected from contact with accumulated liquid.	✓	R&A	Appl	Pertinent to handling soil contaminated with RCRA listed or characteristic hazardous waste. A Part B Permit Application for RCRA storage has been submitted to the OEPA.	See preceding.
[New Facilities] Surface Impoundments, Waste Piles, and Tanks [Waste Piles] Design and Operating Requirements OAC 3745-56-51(A) through (F)	A waste pile used to store or treat hazardous waste must have: 1) A liner that is designed, constructed, and installed to prevent any migration of waste out of the pile into the adjacent subsurface soil or groundwater or surface water at any time during the active life (including the closure period) of the waste pile, and 2) A leachate collection and removal system immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the pile.	✓	R&A	✓	Pertinent to on-site hazardous waste piles used for longer than 90 days unless the CAMU Rule is applied.	Addressed through remedial design documents (IRDPs).
	The owner/operator must design, construct, operate, and maintain a run-on control system capable of preventing flow onto the active portion of the pile during peak discharge from at least a 25-yr storm and manage a runoff management system to collect and control at least the water volume resulting from a 24-hr, 25-yr storm.	✓	R&A	✓		
	If the pile contains any particulate matter which may be subject to wind dispersal, the owner or operator must cover or otherwise manage the pile to control wind dispersal.	✓	R&A	✓		FEMP Fugitive Dust Control BAT Determination, Fugitive Dust Control Requirements (RM-0047), and Section 5.1.2.2 and Appendix F of the Sitewide Excavation Plan

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
Monitoring and Inspection OAC 3745-56-54(A) and (B)	During construction or installation, liners and cover systems must be inspected for uniformity, damage, and imperfections.	✓	R&A	✓		
	Collection and holding facilities associated with run-on and runoff control system must be inspected weekly and be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system.	✓	R&A	✓		FEMP Stormwater Pollution Prévention Plan (RM-0039), and Appendix F of the Sitewide Excavation Plan
Special Requirements for Ignitable or Reactive Waste OAC 3745-56-56(A) and (B) Special Requirements for Incompatible Wastes OAC 3745-56-57(A), (B) and (C) [Subpart L—Waste Piles, 40 CFR §§264.251 through .259]	Ignitable, reactive, or incompatible waste must not be added to a waste pile, unless specified in OAC 3745-56-56(A) and (B) or 57(A), (B) and (C).	✓	R&A	✓	The CERCLA RIs did not find evidence of ignitive or reactive material on-site. Impacted and non-impacted materials management will be segregated and managed in separate piles, based upon intended disposition (waste acceptance criteria).	Following sections of the Sitewide Excavation Plan: 3.3.2 Impacted Materials Handling and Tracking 4.0 Location-Specific Excavation Approaches F.5 Excavated Material Management
Temporary Units Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart S- 40 CFR §264.553 (a), (b) (58 FR 865829, February 16, 1993)	For temporary tanks and container storage areas used for treatment or storage of remediation wastes during remedial activities, the Regional Administrator may determine that a design, operating, or closure standard applicable to such units may be replaced by alternative requirements which are protective of human health and the environment. Any temporary unit to which alternative requirements are applied shall be: • located within the facility boundary; and • used solely for treatment or storage of remediation wastes.	R&A	✓	R&A	Pertinent to short-term management/storage of impacted materials during the CERCLA soil remediation activities.	Appendix F of the Sitewide Excavation Plan

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart DD—Containment Building 40 CFR §§264.1100 through .1102 57 FR 37194 (August 18, 1992)	The owner or operator is not subject to the definition of land disposal in RCRA Section 3004(k) provided that the unit: 1) Is a completely enclosed, self-supporting structure that is designed and constructed of synthetic materials of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the unit, and to prevent failure due to pressure gradients, settlement, compression, or uplift, physical contact with the hazardous wastes to which they are exposed, climatic conditions, and the stresses of daily operation, including the movement of heavy equipment within the unit and contact of such equipment with containment walls; 2) Has a primary barrier for management of solids, in addition to a liquid collection system and secondary containment for management of liquids. 3) Has controls sufficient to prevent fugitive dust emissions to meet the no visible emission standard in Sec. 264.1101(c)(1)(iv); and 4) Is designed and operated to ensure containment and prevent the tracking of materials from the unit by personnel or equipment. At closure, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components, contaminated subsoil, and structures and equipment contaminated with waste and leachate, and handle them as a hazardous waste.	✓	R&A	R&A	Pertinent to excavated RCRA hazardous soil and sediment that may require short-term management/ storage during the CERCLA soil remediation activities. NO CONTAINMENT BUILDINGS ARE ANTICIPATED.	Following sections of the Sitewide Excavation Plan: 3.3.2 Impacted Materials Handling and Tracking 4.0 Location-Specific Excavation Approaches F.5 Excavated Material Management

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
Procedures for Planning and Implementing Offsite Response Actions ("The CERCLA Offsite Rule") 40 CFR §300.400	Materials from remediation of a CERCLA site ("CERCLA waste") may only be transferred to offsite facilities that are in compliance with Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), or other applicable federal and state requirements. Only U.S. EPA has the authority to determine whether the facility in question meets the acceptability criteria and is acceptable for receiving CERCLA waste from offsite. A determination of acceptability for a potential receiving facility is to be made in advance (prior to initiating transportation offsite, and optimally prior to making offsite treatment/ storage/disposal contract arrangements). Materials covered under this rule ("CERCLA waste") are any hazardous substance, pollutant, or contaminant as defined under CERCLA sections 101(14) and 101(33). Samples of waste sent to a laboratory for characterization are exempt from the rule, as are certain treatability study waste. The receiving facility must meet compliance and release criteria presented therein. Facility is defined as the receiving unit(s) that directly stores, treats, or disposes of the CERCLA waste. Non-receiving units at the facility need not be in compliance in order for the U.S. EPA to determine that the receiving unit meets acceptance criteria. U.S. EPA may deem a facility acceptable even if certain minor violations have occurred at the facility. If a facility does not meet the criteria for receiving CERCLA wastes, the rule presents notification, determination, appeal/review and reinstatement procedures.	√	√	Appl	Pertinent to preparation of materials for off-site disposition.	Operable Unit 1 Design Criteria Package, and following sections of the Sitewide Excavation Plan: 2.5.10 , Off-Site Shipments F.5.2 Off-Site Disposal
[Hazardous Waste] Generator Standards OAC 3745-52-20 through -23, and -30 through -33 [40 CFR §§262.20 through .23, and .30 through .33]	Before transporting hazardous waste or offering hazardous waste for transportation off-site ("pre-transport"), for either treatment or disposal, general requirements for the generator, require a manifest [OAC 3745-52-20 through -23], in accordance with the requirements specified therein. Pre-transport requirements also include appropriate packaging [OAC 3745-52-30], labeling [OAC 3745-52-31], marking [OAC 3745-52-32], and placarding [OAC 3745-52-33], in accordance with the requirements specified therein.	√	Appl	Appl	Pertinent to preparation of RCRA hazardous waste for off-site treatment and/or disposal.	See preceding.

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TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
Implementation of the United Nations Recommendations, International Maritime Dangerous Goods Code, and the International Civil Aviation Organization's Technical Instructions 59 FR 67390 (December 29, 1994) as amended by 60 FR 26796 (May 18, 1995)	These rules (final rule was effective October 1, 1995) comprehensively revise the Hazardous Materials Regulations (HMR), 49 CFR Parts 171-173, 177, and 178, with respect to hazard communication, classification, and packaging requirements based on United Nations recommendations.	✓	✓	Appl	These Hazardous Materials Regulations are requirements embedded in both the state (OAC) and federal (CFR) regulations in both the generator standards (preceding entry) and the transporter standards (subsequent entry).	See preceding generator standards entry and subsequent transporter standards entry.
[Hazardous Waste] Land Disposal Restrictions OAC 3745-59 [Land Disposal Restrictions, Subpart D—Treatment Standards 40 CFR §§268.40 through .44]	A restricted hazardous waste may be land disposed only if: 1) An extract of the waste or of the treatment residue of the waste does not exceed the value shown in 40 CFR §268.41. 2) It is treated using a technology specified in 40 CFR §268.42(a) or an equivalent treatment method. 3) The constituent concentrations in the waste or treatment residue of the waste do not exceed the value shown in 40 CFR §268.43.	✓	Appl	Appl	Not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD. Applicable to those RCRA hazardous wastes that will be disposed of off-site.	See three preceding entries.
Land Disposal Restrictions, Subpart D—Treatment Standards, Treatment Standards Expressed as Concentrations in Waste Extract 40 CFR §268.41	The maximum concentration of lead (5.0 mg/L) may not be exceeded whether it is the extract of a waste or waste treatment residual.	R&A	Appl		Not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD. Applicable to those RCRA hazardous wastes that will be disposed of off-site.	See four preceding entries.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued					
Land Disposal Restrictions, Subpart D—Treatment Standards, Contaminated Debris 40 CFR §268.45	Hazardous debris must be treated before land disposal unless the EPA determines that the debris is no longer contaminated with hazardous waste or the debris is treated to the waste-specific treatment standard for the waste contaminating the debris. Provided the debris does not exhibit a RCRA characteristic it is not subject to regulation under 40 CFR 260, 261 to 266, 268, or 270 if: 1) The hazardous debris has been treated using one of the required extraction or destruction technologies specified in 40 CFR §268.45; or 2) The debris, considering the extent of contamination, is determined to no longer be contaminated with hazardous waste.	✓	Appl	Appl	Not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD. Applicable to those RCRA hazardous wastes that will be disposed of off-site.	See five preceding entries.
[Hazardous Waste] Transporter Standards OAC 3745-53-20 through -22, -30 and -31 [40 CFR §§263.20 through .22, .30 and .31]	General requirements for the transporter during transportation of hazardous waste for off-site treatment and/or disposal require acceptance and handling of hazardous waste and use of the manifest system [OAC 3745-53-20], compliance with the manifest [OAC 3745-53-21], and recordkeeping [OAC 3745-53-22], in accordance with the requirements specified therein. Appropriate response actions must be taken for any hazardous waste discharge during transportation [OAC 3745-53-30 and -31], in accordance with the requirements specified therein.	✓	Appl	Appl	Pertinent to transportation of RCRA hazardous wastes for off-site treatment and/or disposal.	See six preceding entries.
	MANAGEMENT OF PCB-TAINTED MATERIAL					
Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions, Subpart D—Storage and Disposal, Disposal Requirements 40 CFR §761.60(a)(4)	Any nonliquid PCBs at concentrations 50 ppm or greater in the form of contaminated soil, rags, or other debris shall be disposed of in an incinerator which complies with 40 CFR §761.70, or in a chemical waste landfill which complies with 40 CFR §761.75.		Appl	Appl	Pertinent if soil or other material containing PCBs above 50 ppm is excavated. PCBs were detected in soil beneath the Fire Training Facility.	Following sections of the Sitewide Excavation Plan: 3.3.2 Impacted Materials Handling and Tracking 4.0 Location-Specific Excavation Approaches F.5 Excavated Material Management

000242

1634

000243

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
MANAGEMENT OF PCB-TAINTED MATERIAL, continued						
Subpart D—[PCB] Storage and Disposal, Disposal Requirements 40 CFR §761.60(e)	Any person who is required to incinerate PCBs or PCB items under this subpart and who can demonstrate that an alternate method of destroying PCBs or PCB items can achieve a level of performance equivalent to the requirements under 40 CFR §761.70 may submit a written request to either the Regional Administrator or the Director, Exposure Evaluation Division, for an exemption from the incineration requirements of 40 CFR §§ 761.70 or 761.60. The applicant must show that the alternate method of destroying PCBs will not present an unreasonable risk of injury to health or the environment.		Appl	Appl	Pertinent only if PCB contaminated soil is greater than 50 ppm and is treated on-property using a method besides incineration. DOE neither currently anticipates any such material nor on-property treatment for any such material under the soil remediation projects.	See preceding entry, plus following sections of the Sitewide Excavation Plan: 2.5.10 Off-Site Shipments F.5.2 Off-Site Disposal
Subpart D—[PCB] Storage and Disposal, Storage for Disposal 40 CFR §761.65	This section applies to the design of storage areas to be used for later disposal of PCBs at concentrations of 50 ppm or greater.		Appl	Appl	Pertinent to storage of PCB-contaminated material at 50 ppm or greater. DOE does not currently anticipate any such material under the soil remediation projects.	See two preceding entries.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
POST-CLOSURE						
	DESCRIPTION OF POST-CLOSURE CARE					
[New Facilities Hazardous Waste] Surface Impoundments, Waste Piles, and Tanks, [Waste Piles] Post-Closure OAC 3745-56-58(B) [Subpart L—Waste Piles, 40 CFR §§264.251 through .259]	If, after removing or decontaminating all residues and making all reasonable effort to effect removal or decontamination of contaminated components, subsoil, structures and equipment, the owner/operator finds that not all contaminated subsoil can be practically removed or decontaminated, he must close the unit/facility and perform post-closure care in accordance with OAC 3745-57-10. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	R&A		Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	Currently addressed in the OSDF Post-closure Care and Inspection Plan (20100-PL-010, which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed. Will also be addressed in the Certification Report and Remedial Action Report — see following sections of the Sitewide Excavation Plan: 1.4.2 Related Documents 3.4.6 Certification Report 7.3 Certification Report 7.4 Other Related Future Documents
[New Facilities Hazardous Waste] Incinerators [and Miscellaneous Units], [Miscellaneous Units] Environmental Performance Standards OAC 3745-57-93 [Subpart X—Miscellaneous Units, 40 CFR §§264.601 through .603]	If a treatment or storage miscellaneous unit has contaminated soil or groundwater that cannot be completely removed or decontaminated during closure, the unit must also meet the requirements of OAC 3745-57-91 during the post-closure care period. The post-closure plan under OAC 3745-55-18 must specify the procedures that will be used to satisfy this requirement. A miscellaneous unit that is a disposal unit must be maintained in a manner that complies with OAC 3745-57-91 during the post-closure care period. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	R&A		Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	See preceding.

000244

1634

000245

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	DESCRIPTION OF POST-CLOSURE CARE, continued					
Closure and Post-Closure Under Interim Standards, Post-closure Care and Use of Property OAC 3745-66-17(A) [40 CFR §265.117(a)(2)]	Post-closure care of hazardous waste management units must begin after completion of closure of the unit and continue for 30 years after that date unless shortened by the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] in accordance with OAC 3745-66-18(G) (40 CFR §117(a)(2)). NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	Appl		NOTE: Identified in the OU5 ROD as applicable only to existing hazardous waste management units (HWMUs); also cited in RCRA/CERCLA Integrated Closure DF&O @ V.1. Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	See preceding.
Closure and Post-Closure Under Interim Standards, Post-closure Care and Use of Property OAC 3745-66-17(A)(1) [40 CFR §265.117(a)(1)]	Post-closure care...must consist of at least the following: • monitoring and reporting; and • maintenance and monitoring of waste containment systems. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	See preceding.
Closure and Post-Closure Under Interim Standards, Post-closure Plan; Amendment of Plan OAC 3745-66-18(A)&(C)	The owner of a hazardous waste disposal unit shall have a written post-closure plan, which shall identify the activities that will be carried on after closure of each unit and the frequency of those activities, and include at least: • a description of the planned monitoring activities and frequencies at which they will be performed; • a description of the planned maintenance activities and frequencies at which they will be performed, to ensure (a) the integrity of the cap and final cover or other containment systems, and (b) the functioning of the monitoring equipment; and • the name, address and telephone number of the person or office to contact about the hazardous waste disposal unit or facility during the post-closure period. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	MODIFICATIONS TO POST-CLOSURE CARE PLAN OR PERIOD					
Closure and Post-Closure Under Interim Standards, Post-closure Plan; Amendment of Plan OAC 3745-66-18(D)	The owner may amend the post-closure plan any time during the active life of the facility or during the post-closure period. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	Currently addressed in the OSDF Post-closure Care and Inspection Plan (20100-PL-010), which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed.
Closure and Post-Closure Under Interim Standards, Post-closure Plan; Amendment of Plan OAC 3745-66-18(G)	The post-closure plan and length of the post-closure period may be modified any time prior to the end of the post-closure care period. A modification of the post-closure plan may include, where appropriate, the temporary suspension rather than permanent deletion of one or more post-closure care requirements. At the end of the specified period of suspension, the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] would then determine whether the requirements should be permanently discontinued or reinstated to prevent threats to human health and the environment. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	See preceding.
	PROPERTY USE RESTRICTIONS					
Closure and Post-Closure Under Interim Standards, Post-closure Care and Use of Property OAC 3745-66-17[a] [40 CFR §265.117(c)]	Post-closure use of property on or in which hazardous waste remain after partial or final closure must never be allowed to disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the facility's monitoring systems, unless the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] approves otherwise. NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required.	✓	Appl	✓	NOTE: Identified in the OU5 ROD as applicable only to existing hazardous waste management units (HWMUs); also cited in RCRA/CERCLA Integrated Closure DF&O @ V.1. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs.	Currently addressed in the OSDF Post-closure Care and Inspection Plan (20100-PL-010, which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Subpart A— 40 CFR §192.02(a)	Controls of residual radioactive materials from inactive uranium processing sites shall be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years, and provide protection of groundwater.	R&A	R&A		Most pertinent to the design and closure of the On-Site Disposal Facility.	Addressed by selected remedies of OU2 and OU5 RODs in establishment of FRLs.

000246

1634

000247

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	PROPERTY USE RESTRICTIONS, continued					
Long-Term Management of Residual Radioactive Material DOE Order 5400.5 Chapter IV (6)(d) 10 CFR Part 834 (PROPOSED)	Controls of residual radioactive materials from inactive uranium processing sites shall be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years, and provide protection of groundwater.		TBC			Addressed by selected remedies of OU2 and OU5 RODs in establishment of FRLs.
	For long-term management of uranium, thorium, and their decay products, access to a property and use of on-site materials contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR 192. These controls should be designed to be effective to the extent reasonable for at least 200 years.	TBC	TBC			
Control of Residual Radioactive Material Above the Guidelines DOE Order 5400.5 Chapter IV (6)	Residual radioactive material with concentrations above the generic guidelines (see chemical-specific requirements) shall be managed in accordance with Chapter II, Requirements for Radiation Protection of the Public and the Environment, and operational and control requirements.	TBC	√			See preceding.
Supplemental Limits and Exceptions for Residual Radioactive Material DOE Order 5400.5 Chapter IV (7)	If special specific property circumstances indicate that the concentration guidelines or authorized limits are not appropriate, supplemental limits or an exception may be requested to those guidelines or limits.	TBC	√			See preceding.
Release of Property DOE Order 5400.5 Chapter II (5)	Real property (land and structures), personal property, materials, and equipment shall be released if the concentration of radioactivity is within the limits of residual radioactive contamination.	TBC	√			See preceding.

TABLE A-2 (Continued)
PERTINENT ARARs AND TBCs FOR REMEDIATION AREA 2 PHASE I

Citation	Requirement	OU2 ROD	OU5 ROD	OU3 ROD	Remarks	Cross-Reference
	POST-CLOSURE NOTICE/SURVEY PLAT					
Closure and Post-Closure Under Interim Standards, Survey Plat OAC 3745-66-16	The owner shall submit -- to the local zoning authority, or the authority with jurisdiction over local land use, and to the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] -- a survey plat, prepared and certified by a professional land surveyor, indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat must contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the hazardous waste disposal unit in accordance with OAC 3745-66-17(C).	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.	Currently addressed in the OSDF Post-closure Care and Inspection Plan (20100-PL-010), which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed.
Closure and Post-Closure Under Interim Standards, Post-closure Notices OAC 3745-66-19(A)	The owner shall submit -- to the local zoning authority, or the authority with jurisdiction over local land use, and to the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] -- a record of the type, location, and quantity of hazardous waste disposed of within each cell or disposal unit of the facility.	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.	See preceding.
	DEED NOTATION					
Closure and Post-Closure Under Interim Standards, Post-closure Notices OAC 3745-66-19(B)	The owner shall record, in accordance with state law, a notation on the deed of the facility property, or on some other instrument which is normally examined during title search, that will notify in perpetuity the potential purchasers of the property that: • the land has been used to manage hazardous wastes; • its use is restricted under the Ohio Administrative Code closure and post-closure rules; and • a survey plat and record of the type, location, and quantity of hazardous wastes disposed of within each cell or hazardous waste unit of the facility as required by OAC 3745-66-16 and OAC 3745-66-19(A) have been filed with the local zoning authority or the authority with jurisdiction over local land use and the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection].	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.	Currently addressed in the OSDF Post-closure Care and Inspection Plan (20100-PL-010), which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed. Will also be addressed in the NRRP.
Closure and Post-Closure Under Interim Standards, Post-closure Notices OAC 3745-66-19(B)	If the owner or any subsequent owner of the land upon which a hazardous waste disposal unit was located wishes to remove hazardous wastes and hazardous waste residues in satisfaction of the criteria in OAC 3745-66-17(C), the owner may request that the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] approve either: • the removal of the notation on the deed to the facility property or other instrument normally examined during title search; or • the addition of a notation to the deed or instrument indicating the removal of the hazardous waste.	✓	✓	✓	Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.	See preceding.

000248

1634

Surface Water Management Plan
for
Area 2, Phase I
~~Southern Waste Units~~
Remedial Action Project
Subcontract No. FSC607

July 1998
Revision 3

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

PARSONS

175 Tri-County Parkway
Cincinnati, Ohio 45246

Surface Water Management Plan
for
Area 2, Phase I
~~Southern Waste Units~~
Remedial Action Project

CONTENTS

SECTION

Executive Summary ES-1

1.0 Introduction and Project Description 1-1
- 1.1 Introduction 1-1
- 1.2 Purpose 1-1
- 1.3 Scope 1-2
- 1.4 Construction Drawings and Specifications 1-2

2.0 Surface Water Management System 2-1
- 2.1 Overall Approach 2-1
- 2.2 Specific System Components 2-3
- 2.3 Overall System Operation 2-7

3.0 Stormwater Management 3-1

4.0 Erosion and Sediment Control Measures 4-1
- 4.1 Overall Concept 4-1
- 4.2 Specific Components 4-1
- 4.3 Design Criteria and Standards 4-4

5.0 Implementation 5-1
- 5.1 General Construction Practices 5-1
- 5.2 Construction Sequencing 5-2

6.0 Sediment Control Maintenance and Monitoring 6-1
- 6.1 Monitoring and Inspection 6-1
- 6.2 Maintenance 6-1

APPENDICES

A Calculations

B Drainage Area Maps

C Evaluation of the Potential Peak Stages in Paddys Run During Storm Events at Cross Sections Close to ~~the Proposed~~ Retention Basin No. 1

D Additional Sketches of Paddys Run Area

E Modification of Drainage Areas for Retention Basin No. 1 and 2 to Reflect Conditions Observed During Site Preparation Construction

FIGURES

Figure 2-1 Overall Operation of the Surface Water Management System

000251

LIST OF ACRONYMS AND ABBREVIATIONS

A2PI	Area 2, Phase I
AFP	Active Flyash Pile
AWWT	Advanced Wastewater Treatment (Facility)
cfs	cubic feet per second
DOE	United States Department of Energy
FEMP	Fernald Environmental Management Project
FDF	Fluor Daniel Fernald, Inc.
FRL	Final Remediation Level
GMA	Great Miami Aquifer
gpm	gallons per minute
HDPE	High Density Polyethylene
IFP	Inactive Flyash Pile
NPDES	National Pollutant Discharge Elimination System
ODNR	Ohio Department of Natural Resources
OSDF	On-Site Disposal Facility
SF	South Field
SWMP	Surface Water Management Plan
SWPPP	Stormwater Pollution Prevention Plan
SWRB	Stormwater Retention Basin
~~SWUs~~	~~Southern Waste Units~~
WAC	Waste Acceptance Criteria
~~WURP~~	~~Waste Units Remediation Project~~

EXECUTIVE SUMMARY

This Surface Water Management Plan (SWMP) addresses surface water management of ~~the Southern Waste Units (SWUs)~~ Area 2, Phase I (A2PI) during remediation. This SWMP addresses erosion and sedimentation, stormwater runoff, and other surface water issues at ~~the SWUs~~ A2PI.

~~The SWUs consist~~ A2PI consists of the South Field (SF), the Inactive Flyash Pile (IFP), and the Active Flyash Pile (AFP) areas. The remediation of ~~the SWUs involve~~ A2PI involves the excavation and removal of ~~approximately 340,000 bank cubic yards of~~ impacted material consisting of soil, debris (fill), and flyash. The ~~SWUs~~ A2PI remediation project will be performed in two phases- 1) Site Preparation, and 2) Excavation. The site preparation phase of the ~~SWUs~~ project is scheduled to begin in the summer of 1997. The excavation phase of the ~~SWUs~~ project is scheduled to begin in the ~~Spring~~ Summer of 1998. The excavation phase is scheduled to require three construction seasons.

Three retention basins (Nos. 1, 2, and 3) will be constructed in the ~~SWUs~~ A2PI area to manage surface water during remediation. The retention basins will be lined with one foot of compacted clay ~~overlain by~~ and/or a geomembrane liner. The non-impacted soil stockpiles and selected collection ditches will be lined with a geomembrane liner. Both sediment and stormwater storage capacity will be provided in the retention basins. A minimum of 27 cubic yards/watershed acre of storage capacity in each basin will be provided for sediment storage. Stormwater storage capacity has been provided above the sediment storage capacity level to store the runoff from a 25-year, 24-hour storm for basins 1 and 2 and to store the runoff from a 10-year, 24-hour storm for basin 3. Stormwater collected in the basins will discharge through riser pipes and gravity flow to lift stations located adjacent to each of the retention basins. From the lift stations, collected runoff will be pumped through a common ~~double-walled~~ pipe to the Stormwater Retention Basin (SWRB), and subsequently conveyed to the Advanced Wastewater Treatment (AWWT) facility for treatment prior to discharge to the Great Miami River.

The overall operation of the surface water management system was planned and designed to minimize the generation of contaminated runoff and to collect potentially contaminated surface water prior to discharge. Run-on control ditches will be constructed prior to remediation to prevent water from upgradient areas from flowing across the construction area. These run-on control ditches will remain after remediation to prevent potential recontamination. Runoff from disturbed areas will drain to collection ditches which will route the runoff to the retention basins. These basins provide temporary storage while allowing for additional sediment removal prior to runoff being conveyed to the SWRB and AWWT. Excavation of the ~~SWU~~ A2PI area with the highest known levels of contamination (IFP) was prioritized; it will be excavated first. Within the IFP and other areas, excavation will be performed to minimize potential cross-contamination.

Upon completion of the remediation/excavation activities ~~the site~~, the surface will be graded to drain and, where possible, graded to approximate ~~original (1952)~~ the topographic~~al~~ (thus stormwater runoff) conditions that existed circa 1952.

SECTION 1

INTRODUCTION AND PROJECT DESCRIPTION

1.1 Introduction

The Fernald Environmental Management Project (FEMP) is a 1,050-acre facility located in southwestern Ohio approximately 18 miles northwest of downtown Cincinnati. The FEMP contains low-level radioactive, solid, and hazardous wastes. The ~~Operable Unit 2 Waste Units~~ A2PI Remediation Project ~~(WURP)~~ consists of the following waste units:

- Active Flyash Pile (AFP)
- Inactive Flyash Pile (IFP)
- South Field (SF)
- ~~Lime Sludge Ponds (LSPs)~~
- ~~Solid Waste Landfill (SWL).~~

The SF, IFP, and the AFP are also collectively known as the Southern Waste Units ~~(SWUs)~~.

~~The LSPs and SWL have been separated from the SWUs due primarily to remedial action schedule; it was determined that since the IFP contributes a greater source of contamination to the Great Miami Aquifer (GMA), the SWUs remediation was of high priority. Therefore, the LSPs and SWL will be addressed separately from the SWUs.~~

This SWMP addresses surface water management during remediation of ~~the SWUs~~ A2PI. The ~~SWUs~~ project will involve excavation and removal of ~~approximately 340,000 bank cubic yards of~~ impacted material from ~~the SWUs~~ A2PI. Impacted material consists of all material placed in the area by previous United States Department of Energy (DOE) operations and includes soil, debris (fill), and flyash. Impacted material also includes material with contamination levels above the final remediation level (FRL). Most of the impacted material will be placed in the OSDF. In addition, ~~approximately 1,690 cubic yards of~~ material which exceeds the OSDF Waste Acceptance Criteria (WAC) will be transported to the ~~Above-WAC Queue~~ SP-5 Stockpile Area pending shipment to an off-site permitted commercial disposal facility. ~~Approximately 100 cubic yards of~~ Also, some lead-contaminated soil from A2PI will be excavated and shipped offsite for treatment and disposal.

1.2 Purpose

The FEMP is operating under a National Pollutant Discharge Elimination System (NPDES) Permit which requires the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP). This

SWPPP became effective May 1, 1996. Section 6 of the SWPPP addresses discharges related to construction activities. The measures outlined in the SWMP and details shown on the Construction Drawings and specifications will be implemented to effectively manage stormwater and limit the amount of erosion and the release of sediment that will occur during ~~the~~ remediation of ~~the SWUs~~ A2PI.

Stormwater, erosion and sediment control measures are also required to minimize release of radiological contaminants. This SWMP has been prepared as a guide to minimize construction-related impacts on water quality from erosion and sedimentation, and minimize the spread of contamination during remediation of ~~the SWUs~~ A2PI. During remediation, Fluor Daniel Fernald, Inc. (FDF) will perform required NPDES monitoring at the permitted stormwater outfalls and comply with all applicable Federal, State, DOE, and FEMP requirements.

1.3 Scope

This SWMP provides the following information:

- Background discussion of the scope of the ~~SWUs~~ A2PI project,
- Description of the ~~SWUs~~ proposed surface water management system for the ~~Southern Waste Units~~ A2PI Remediation Action Project,
- Description of proposed general and area-specific erosion and sediment control measures,
- Description of the type and frequency of maintenance activities required to support the control measures.

The SWMP addresses stormwater management, erosion prevention, sediment control, hydrologic and hydraulic loading, physical site characteristics that impact the selection and implementation of control measures, and references to established design criteria. Supporting engineering data and calculations are attached as Appendix A.

1.4 Construction Drawings and Specifications

The construction within ~~the SWUs~~ A2PI will be accomplished in 2 phases; the site preparation phase and the excavation phase. Construction Drawings and Technical Specifications from both phases are incorporated herein by reference. They will be a part of the contract bid documents for that phase of remediation of ~~the SWUs~~ A2PI. The site preparation phase construction will address the stormwater and erosion control measures herein discussed (including the retention basins and ditches), the support area, equipment wash area, transfer line and all other items required to remove impacted material from ~~the~~

~~SWUs~~ A2PI. The excavation phase construction will address the removal of impacted material from ~~the~~ ~~SWUs~~ A2PI and the subsequent disposition of that material.

SECTION 2

SURFACE WATER MANAGEMENT SYSTEM

2.1 Overall Approach

The principal objectives of surface water management in ~~the SWUs~~ A2PI are to prevent or minimize stormwater runon to the work areas and to control water and runoff which has come into contact with contamination and/or impacted material. Runon from upgradient areas will be prevented (via diversion ditches and berms) from flowing into the construction area; this will minimize the generation of contaminated stormwater and sediment. Runon control ditches will be designed to handle the 10-year, 24-hour storm event except for ditch 2, ditch 6, and interceptor ditches 1-3, all of which will be designed to handle the 25-year, 24-hour storm event. Surface water in the ~~SWUs~~ A2PI project will be treated as potentially contaminated and will be collected in ditches and conveyed to three retention basins. Water from the retention basins will then be pumped to the SWRB and subsequently to the AWWT facility for treatment. The design for basins 1 and 2 used in the stormwater controls ~~are~~ is based on a 25-year, 24-hour storm event; ~~and~~ a 10-year, 24-hour storm event is used for basin 3 design. Water that enters the excavations during construction will be collected in excavation sumps and handled as described in this plan.

~~The SWUs consist of~~ A2PI includes the IFP, SF, and the AFP areas and ~~cover~~ covers approximately 15.8 acres within a total watershed area of 26.0 acres. ~~The SWUs have~~ A2PI area has steep outslopes to the west, south, and southwest. The IFP and SF outslopes are heavily vegetated with trees and brush. Existing drainage consists of sheet flow and shallow concentrated flow that is generally uncontrolled before reaching Paddys Run. A portion of the IFP is situated adjacent to Paddys Run. A rock embankment was constructed under Removal Action 29 along a section of the eastern bank of Paddys Run to protect the IFP from stream erosion.

Because of the proximity of ~~the SWUs~~ A2PI to Paddys Run and the nature of the remediation activities, a surface water management system will be used during remediation. Some components of the surface water control system will remain in operation through restoration of the ~~SWUs~~ A2PI area. The surface water management system will include diversion ditches and berms to prevent runon from entering the remediation areas, and excavation sumps, collection ditches, retention basins, lift stations, and transfer lines to control runoff. Existing drainage patterns and facilities will be utilized for stormwater management, wherever possible, by implementing improvements to convey design flows and incorporating erosion control materials and revegetation to limit erosion along drainage paths. Where necessary, new ditches or diversion berms will be constructed to redirect existing drainage paths away from the construction area.

See Figure 2-1 for the overall operation of the surface water management system.

000258

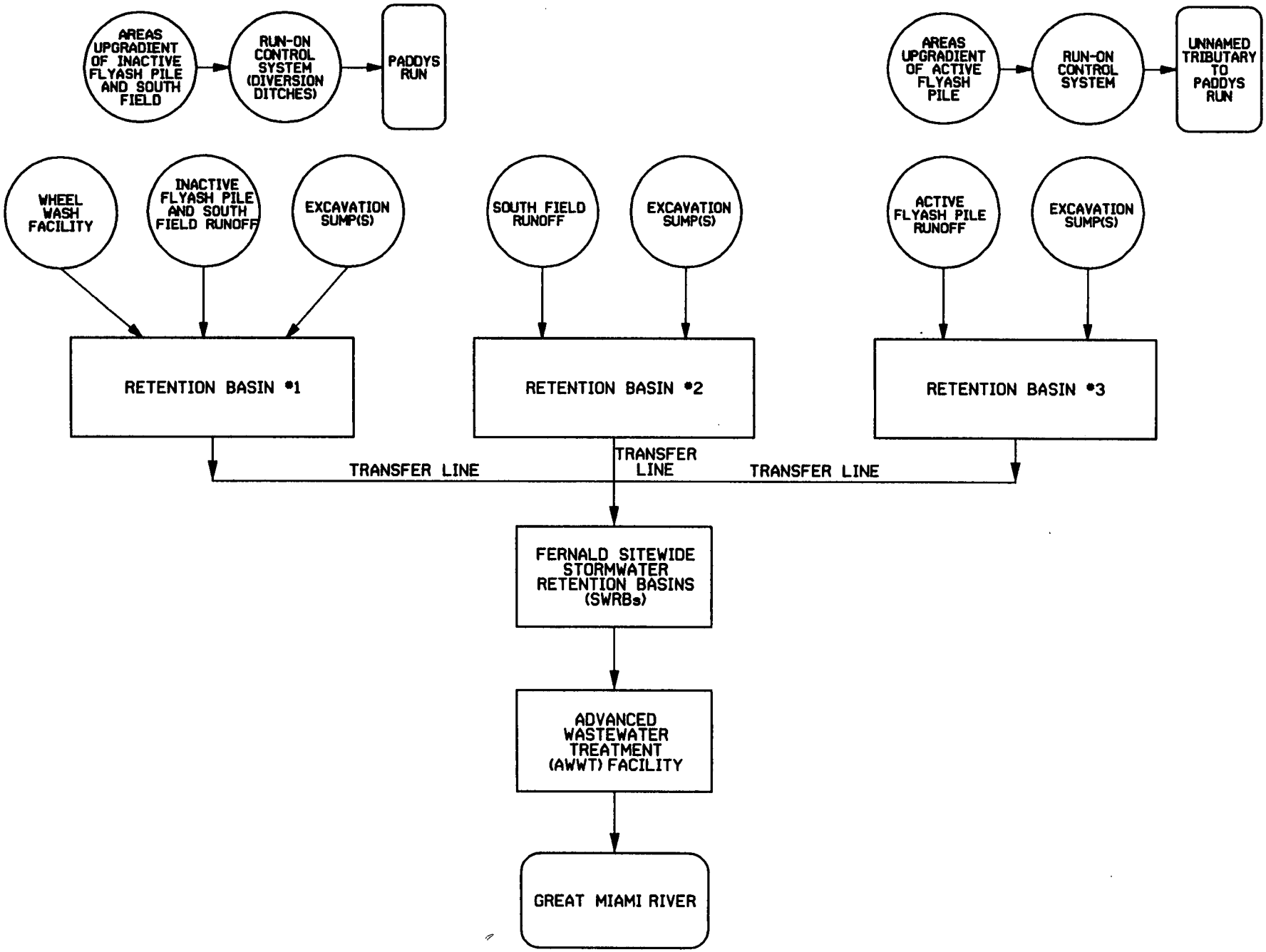

FIGURE 2-1. SURFACE WATER [illegible]AGEMENT SYSTEM FOR SOUTHERN WASTE UN[illegible]

2.2 Specific System Components

Specific components of the surface water management system are shown in Figure 2-1 and are described below. See the Construction Drawings and Technical Specifications for detailed design information concerning stormwater controls. See Appendix A for design calculations. Drainage area maps are presented in Appendix B.

2.2.1 Diversion Ditches and Related Devices

Runon from upgradient areas will be collected and diverted around the excavation area. Runon will be handled by diversion ditches and other components generally located on the north side of ~~the SWUs~~ A2PI.

A ditch (designated as D-12 on the Construction Drawings) north of the existing road that runs along the northern edge of the IFP and SF will be constructed to intercept runon and convey this water westward to a new pipe under the road and into an existing catch basin. This catch basin is located at the northwest corner of the IFP, and has an 18-inch corrugated polyethylene pipe which conveys this runon to an existing drainage way, approximately 300 feet north of the existing National Pollution Discharge Elimination System (NPDES) Discharge Point No. *4004 at Paddys Run. An earthen berm will be constructed around the existing catch basin to collect potential runon water from the south side of the road and prevent potentially contaminated runoff from entering the system. The existing 18-inch pipe will be extended to discharge at the existing NPDES Discharge Point No. *4004. Impacted runoff will be diverted away from NPDES Discharge Point No. *4004 and into the retention basins.

During ~~the base bid and interim grading activities~~ excavation of A2PI interceptor ditches 1-3 will be constructed and utilized to intercept runoff and prevent drainage from flowing onto the sands and gravels of the Greater Miami Aquifer (GMA).

An earthen berm will be constructed across a low area (topographically) north of the AFP to ensure that runon water will not enter the AFP remediation area.

The runon control components of the surface water management system will remain in place after restoration to prevent runon from uncertified areas upgradient from potentially contaminating the restored areas of ~~the SWUs~~ A2PI.

2.2.2 Excavation Sumps

As remediation is performed, active areas of excavation will be graded to drain to collection points located within the excavation area to the extent practical. Temporary excavation sumps will be excavated at these

collection points to temporarily hold the stormwater. Water will be pumped out of the sumps and into retention basins on an as-needed basis to keep the excavation area functional. Multiple sumps/pumps may be used for dewatering of the excavation area and will be moved as the excavation of the work face progresses.

2.2.3 Collection Ditches and Related Devices

Collection ditches will be constructed around the perimeter of the remediation/construction areas to collect and convey stormwater runoff to the ~~SWUs~~ A2PI retention basins. Where possible, the channel slopes will follow the existing topography to minimize excavation. The ditches will be trapezoidal (flat bottom) or triangular in shape depending on anticipated flow rates and site constraints. Ditches will be lined to prevent channel erosion with either erosion control blanket or dumped rock depending on the design flow velocities, see Summary of Ditch Performance, Sheet B34, Appendix A. Collection and interceptor ditches excavated into the sand and gravels of the GMA will be lined with a geomembrane liner.

2.2.4 Retention Basins

The ~~SWUs~~ A2PI project area is divided into three major drainage areas (P1, P2, and P3 as shown in Appendix B) based on existing topography. Three retention basins (one per drainage area) will be constructed to retain potentially contaminated stormwater runoff. Non-impacted soil removed during basin construction will be placed in non-impacted soil stockpile areas (stockpile #1 and stockpile #2 as indicated on the Construction Drawings). Material in the non-impacted soil stockpile areas will be left in place for possible future use. The retention basins will be graded to prevent retention of water during the restoration phase of the project.

Each retention basin will have a lift station which will pump runoff to the SWRB. The lift station will consist of a manhole, pump, and related piping/wiring/etc., and will be located adjacent to each basin. A high density, polyethylene (HDPE) riser/intake structure will be constructed inside the basin to feed the lift station. The riser will be designed with ~~three hooded~~ orifices sized to prevent starvation of the pump. The top of the riser will have a cap-type perforated lid. Construction details for the lift station and riser/intake structure are shown on the Construction Drawings.

Overflow outlets will be provided for all three basins. The overflow outlets will consist of open, trapezoidal channels with invert elevations above the top of the riser pipe and below the top elevation of the basin embankment. The overflow outlets for basins 1 and 2 will not discharge unless the 25-year, 24-hour storm is exceeded. The overflow outlet for basin 3 will not discharge unless the 10-year, 24-hour storm is exceeded. However, all three basins are located in the 100-year floodplain (see Evaluation of the Potential Peak Stages in Paddys Run During Storm Events at Cross Sections Close to the Proposed Retention Basin No. 1, and additional cross sections, Appendix C ~~&~~ and Appendix D). Under certain circumstances, the SWRB will bypass the AWWT and discharge directly to the Great Miami River (in

0260

accordance with the OU5 ROD, Sections 9.1.4 and 9.1.5: Treatment of Discharges). During these periods of stormwater bypass, the outlet pumps from the ~~Area 2, Phase I~~ A2PI retention basins will continue to pump until the SWRB reaches its capacity below the freeboard level. When the SWRB reaches its capacity, the outlet pumps from the ~~Area 2 Phase I~~ A2PI retention basins will be turned off and the water will be stored in these basins.~~, which will be designed for 25-year or 10-year storm~~. After a sufficient amount of water from the SWRB has been bypassed and the water level is below the freeboard level, the outlet pumps at the ~~Area 2, Phase I~~ A2PI retention basins will resume operations and pump the water to the SWRB.

After ~~remediation and restoration is completed,~~ the A2PI waste unit areas are excavated and certified, the retention basin areas will also be remediated and certified. Remediation will consist of removing all material above FRLs, geomembrane liners, pipes, and associated appurtenances. Larger spillways will be cut for retention basins 1 and ~~2~~ 3 ~~will be graded to prevent the retention of water. For retention basins 1 and 2 the lift station pumps and geomembrane liners will be removed. The compacted clay subgrade will remain.~~ Retention basin ~~3~~ 2 will ~~remain in operation. Material removed from the basins will be hauled to the OSDF.~~ be backfilled with material from non-impacted material Stockpile No. 1.

The retention basins and respective drainage areas are described as follows:

2.2.4.1 Retention Basin 1

The proposed (developed conditions) P1 watershed is approximately 15.2 acres in size and contains the IFP and a portion of the SF and non-impacted soil stockpile area #1. Runoff will be collected and conveyed to Retention Basin 1 (see Construction Drawings and calculations) via collection ditches D1, D2 (D2A ~~&~~ and D2B), D3, and D4. Retention Basin 1 will be located south of the IFP and SF and will cover approximately 1.5 acres of surface area. This basin is designed to retain the runoff volume from a 25-year, 24-hour storm event without discharge to the environment. A lift station with a 400 gallons per minute (gpm) pump system will be installed to pump collected runoff to the SWRB. Anticipated dewatering time for a 25-year, 24-hour storm event is approximately 72 hours. A 20-foot wide, open trapezoidal channel will be constructed to provide positive drainage for overflow occurring from storm events in excess of the 25-year, 24-hour storm or during sufficiently large sequential rain events.

Basin 1 will be constructed almost entirely by excavation with only a minimal amount of fill used for berms. Because Basin 1 is located within the GMA, the bottom and side slopes of the basin will be lined with a one- foot filtration barrier (of compacted clay) and a geomembrane liner.

2.2.4.2 Retention Basin 2

The proposed (developed conditions) P2 watershed is approximately 6.0 acres in size and contains the SF, the remainder of the non-impacted soil stockpile area #1, and all of non-impacted soil stockpile area #2.

Runoff will be collected and conveyed to Basin 2 through collection ditches D5, D6, D7, and D8 (D8A ~~&~~ and D8B). Basin 2 will be located south of the SF and will cover approximately 0.5 acre of surface area. This basin is designed to retain the runoff volume from a 25-year, 24-hour storm event without discharge to the environment. A lift station with a 100 gpm pump system will be provided to pump collected runoff to the SWRB. Anticipated dewatering time for a 25-year, 24-hour storm event is approximately 72 hours. A 15-foot wide, open trapezoidal channel will be constructed to provide positive drainage for overflow occurring from storm events in excess of the 25-year, 24-hour storm.

Basin 2 will be constructed by excavation. Because this basin is located within the GMA, the bottom and side slopes of the basin will be lined with ~~one foot of compacted clay and~~ a geomembrane liner. Note: Weather conditions and scheduling requirements precluded installation of the compacted clay infiltration barrier. For protection of the geomembrane liner from intruder damage (primarily deer) a fence was installed around Basin 2.

2.2.4.3 Retention Basin 3

The proposed (developed conditions) P3 watershed is approximately 4.8 acres in size and contains the AFP.

Runoff will be collected and conveyed to Basin 3 through collection ditches D9, D10 (D10A ~~&~~ and D10B) and D11. Basin 3 will be located south of the AFP and will cover approximately 0.4 acre of surface area. This basin is designed to retain the runoff volume from a 10-year, 24-hour storm event without discharge to the environment. A lift station with a 100 gpm pump system will be provided to pump collected runoff to the SWRB. Anticipated dewatering time for a 10-year, 24-hour storm event is approximately 72 hours. A 15-foot wide, open trapezoidal channel will be constructed to provide positive drainage for overflow occurring from storm events in excess of the 10-year, 24-hour storm.

Basin 3 will be constructed by excavation. Because this basin is located within the GMA, the bottom and side slopes of the basin will be lined with one foot of compacted clay and a geomembrane liner.

2.2.5 Transfer Line

An ~~double-walled,~~ HDPE pipe will be installed to convey runoff collected in the retention basins to the SWRB. Double-walled pipe will be used below elevation 560 ft. The main transfer line begins at the lift station at Basin 1 and proceeds in an eastward direction where the lift stations for Basins 2 and 3 discharge into the transfer line. From Basin 3 the transfer line runs northward, east of the AFP, until reaching the termination point at the SWRB diversion box (see Construction Drawings). Cleanouts will be provided at strategic low points along the run of pipe. Air relief valves will be provided at strategic high points.

000262

2.2.6 SWRB and AWWT

The SWRB will receive all water pumped from the ~~Area 2, Phase I (~~A2PI~~)~~ retention basins. Under normal conditions, the SWRB is pumped to the AWWT facility for treatment and discharge, consistent with the NPDES and OU-5 ROD requirements.

2.2.7 Equipment Wash Facility

An equipment wash facility will be constructed north of the IFP. It will be used to remove mud and debris from the wheels and undercarriage of haul vehicles prior to using the haul road. Water from the equipment wash facility will gravity flow via underground pipe through an oil-water separator ~~to the west seepage control lift station and be pumped to the AWWT~~. and discharge directly into Retention Basin No. 1.

2.3 OVERALL SYSTEM OPERATION

A major goal of the surface water management system is to prevent potentially contaminated surface water from being discharged to the environment prior to treatment. Initial management will be provided by constructing diversion ditches and berms at strategic locations to prevent surface water runon from entering the A2PI area ~~of the SWUs~~ that will be remediated. Runoff from the A2PI area that will be remediated will be managed through a series of excavation sumps and collection ditches, which collect and convey runoff from the remediation areas to three retention basins.

The retention basins will provide temporary storage for runoff and pre-treatment of the water by providing detention time for sediments to settle out. Lift stations are provided to transfer runoff stored in the basins to the SWRB through an ~~double-walled,~~ HDPE transfer line. At the SWRB the potentially contaminated runoff is stored until it can be treated at the AWWT. During high flow conditions when the SWRB is at full capacity, the pumps at the retention basin lift stations will be shut off until adequate drawdown at the SWRB.

At the AWWT facility the water will be treated as required prior to being released to the Great Miami River.

SECTION 3

STORMWATER MANAGEMENT

Stormwater management as described in this Surface Water Management Plan addresses the peak runoff that discharges (and will discharge) from the A2PI area during existing, construction/remediation, and restoration conditions. The goal of stormwater management is to prevent a significant increase in the peak runoff during remediation and restoration activities.

The A2PI project site is currently vegetated and consists of sheet flow and shallow concentrated flow in the upper watershed areas, leading to concentrated flows in drainage ways around the area. All stormwater from the ~~SWUs~~ A2PI project site presently flows into Paddys Run. Prior to the start of remediation a surface water management system will be implemented to prevent runon to the site, and collect and convey runoff from the site for storm events up to the 25-year, 24-hour storm for Retention Basins 1 ~~&~~ and 2, ditches 2 ~~&~~ and 6, and interceptor ditches 1-3. Retention Basin 3 and the remaining ditches will collect and convey runoff from the site for storm events up to the 10-year, 24-hour storm. Since runoff from the site will be pumped to the SWRB, the peak runoff from the area to Paddys Run will be reduced during remediation/excavation.

After remediation the area will be restored to the approximate original topography. Land use after remediation will be undeveloped with a vegetated cover. Based on an undeveloped land use scenario, the peak and total amount of runoff from ~~the SWUs~~ A2PI after remediation can be expected to be similar to the conditions that existed ~~in~~ circa 1952.

SECTION 4

EROSION AND SEDIMENT CONTROL MEASURES

4.1 Overall Concept

Soil conservation practices, combining vegetative and structural measures, have been incorporated in construction documents to mitigate soil erosion damage, off-site sediment migration, and water pollution from erosion. Many of these measures will be long-term in nature and will become part of the completed construction project (i.e., grading, and permanent seeding). Other measures will be temporary and will be removed by the excavation Contractor at the completion of excavation and interim restoration. The selection of erosion and sediment control measures was based on several general principles including the following:

- minimization of erosion through project design,
- incorporation of temporary and permanent erosion control measures,
- removal of sediment prior to discharge.

Erosion and sediment control measures incorporated into the A2PI project incorporate applicable State, Federal, DOE, and FEMP requirements. The FEMP standards for erosion and sediment control follow the Ohio Department of Natural Resources (ODNR) and United States Soil Conservation Service standards for construction and materials. Vegetative stabilization, silt fencing, and ditch protection will be implemented in accordance with Ohio Department of Transportation Construction and Material Specifications and the Location and Design Manual, Volume Two, Drainage. A generalized description of proposed erosion and sediment control measures is presented in this section. Construction details for erosion and sediment control measures are included in the Construction Drawings and Technical Specifications.

4.2 Specific Components

There are two types of erosion and sediment control measures: temporary and long-term measures. Temporary measures include silt fencing, crusting agents, stabilization measures (vegetation, matting, dumped rock), and sediment storage capacity within retention basins. Long-term measures include design features such as grading, vegetation, and dumped rock. Both temporary and long-term measures are discussed below.

4.2.1 Silt Fencing

Silt fencing will be used to intercept sheet flow, retain sediments, and disperse flow prior to runoff reaching the collection ditches. Prior to clearing, grading, and excavation activities, silt fencing will be installed along downgradient perimeters to prevent migration of sediment eroded from exposed areas. Silt fencing will consist of a woven filter fabric attached to wooden posts. Silt fencing will be constructed so that the toe of the filter fabric is securely buried to prevent water from undercutting the fence. Silt fencing will be installed in accordance with details presented on the drawings and in accordance with manufacturers recommendations. The locations presented on the Construction Drawings for the project areas are considered the minimum necessary during construction. Intermediate silt fencing may be used by the Contractor to control and slow down flows in active excavation areas. The Contractor shall install breaks and overlaps in the silt fencing to allow vehicle access to the construction areas.

Inspection of silt fence shall occur at regular intervals as outlined in Section 6.

~~4.2.2 Temporary Stabilization~~

~~As a result of phased construction, portions of the project areas may be left in intermediate/incomplete conditions. Intermediate areas may include rough graded areas awaiting final grading. Intermediate areas where activities will not resume for a period of 45 consecutive days or greater shall be stabilized (e.g., seeded with a quick germinating seed mixture, covered with a layer of straw mulch, or application of a crusting agent) within 7 days. Temporary measures will help to stabilize exposed soil and limit erosion. As construction progresses, temporary vegetation, straw mulch, or the crusting agent will be left in place until final seeding or until construction resumes.~~

4.2.32 Retention Basins

Although the primary purpose of the retention basins is to collect and hold runoff for treatment, the basins also provide an additional measure of sediment control. Runoff is detained in the retention basins until pumped to the SWRB. Because the rate of pumping to the SWRB is less than 1 cubic feet per second (cfs) (one cfs is 448.8 gallons per minute), which is small compared to discharges from standard outlet structures (usually several cfs), the retention basins provide a large detention storage time for sediments to settle out.

To account for the sediment removal capability of the retention basins, the basins have been designed with sediment storage capacities in excess of the 27 cubic yards per watershed acre as recommended in the ODNR's "Rainwater and Land Development Manual". For storm routing purposes, the sediment storage volume was assumed as dead storage (i.e., at full sediment capacity) and was not included in the basin

000266

volume computations. The designed versus required sediment storage capacity for each basin is given below:

Retention Basin 1

Watershed Area = 15.2 Acres
Sediment Storage Required = 0.25 Acre-Feet
Sediment Storage as Designed = 0.38 Acre-Feet

Retention Basin 2

Watershed Area = 6.0 Acres
Sediment Storage Required = 0.10 Acre-Feet
Sediment Storage as Designed = 0.11 Acre-Feet

Retention Basin 3

Watershed Area = 4.8 Acres
Sediment Storage Required = 0.08 Acre-Feet
Sediment Storage as Designed = 0.10 Acre-Feet

4.2.43 Grading and Design Features

Grading design features incorporated into the remedial design to control erosion include runon controls, limiting steep slopes, routing runoff to surface water collection ditches, limiting discharge and flow velocities in the collection ditches to the extent practical, and lining collection ditches with erosion control blankets or dumped rock as required to maintain non-erosive velocities. A sediment barrier, comprised of a geotextile fabric tube filled with crushed rock, is used to slow velocities in critical areas in ditches with geomembrane liners.

4.2.54 ~~Vegetation~~ Stabilization of Disturbed Areas

~~Subsequent to final remediation of the A2PI area, a revegetation program will be implemented to establish a permanent variety of vegetation. The vegetation layer (turf type grass) will reduce erosion, enhance evapotranspiration of water, and improve the quality of water leaving the area. The project area~~ will ~~be seeded in stages as remediation is completed. In addition to seeding with a permanent variety of grass seed, mulch will be placed on graded slopes to prevent erosion during turf establishment. As an aid to turf establishment, seeded areas will be fertilized with a starter fertilizer as described in the Technical Specifications.~~

Stabilization of disturbed areas will be initiated at the completion of construction in a given area or upon a decision to suspend construction for more than 45 days. Depending on the schedule for future work in a given area and the degree of contamination that may remain in the area, a variety of stabilization

measures will be employed. These measures range from use of crusting agents to various seed mixtures according to the time of year and whether interim or permanent vegetation is desired. The Construction Drawings and Technical Specifications will provide the necessary detailed information.

4.2.65 Dumped Rock

Where added erosion protection is necessary for protection from excessive velocities, diversion ditches will be lined with dumped rock. Also, the existing drainageway north of the AFP, and where the unnamed tributary discharges into Paddys Run just west of the IFP, will be lined with dumped rock. Dumped rock will be placed in these locations to prevent further erosion as shown on the Construction Drawings.

4.3 Design Criteria and Standards

The criteria used to design the various components of the surface water management plan are described below.

- Retention Basins 1 and 2 are designed to retain the runoff from a 25-year, 24-hour storm event without discharge to the environment. Retention Basin 3 is designed to retain the runoff from a 10-year, 24-hour storm event without discharge to the environment.

- Retention basins are designed with a sediment storage capacity which exceeds the recommended 27 cubic yards per watershed acre.

- Pump rates at the lift stations are designed to convey accumulated water from the design storm event in approximately 72 hours.

- Runon and diversion and collection ditches (drainage ditches) and culverts are designed based on a 10-year, 24-hour storm frequency, except ditches 2 and 6, and interceptor ditches 1-3, which are designed based on a 25-year, 24-hour storm frequency, see Summary of Ditch Performance, ~~Sheet B34,~~ Table 2, Sheet B42 in Attachment B of Appendix A of this SWMP.

Various standards and good engineering practices were used in the technical portion of the design. See calculations in Appendix A of this SWMP for a listing and discussion of the standards and practices used.

000268

SECTION 5

IMPLEMENTATION

Because of the large expanse of area that will be impacted by remediation, relatively steep slopes, and close proximity to Paddys Run, intensive erosion control measures will be required to minimize erosion and maximize the capture of sediment. In conjunction with stormwater management measures, silt fencing will be installed along perimeter downslope areas (along contours) and drainage ditches, where necessary, prior to the beginning of excavation activities.

Once excavation of impacted material and contaminated soil begins, erosion and sediment control measures will be integrated with stormwater management measures. Runoff from the active working face will either be gravity drained to collection ditches and basins, or collected in excavation sumps and pumped to collection ditches or directly to the retention basins. Initiation of the surface water management system will commence during site preparation and remain in operation until the final phase of ~~Area 2, Phase 1~~ A2PI soil remediation is complete. Runoff from all areas will be routed to the retention basins until the areas are certified below FRLs and all upslope soils are stabilized with vegetation. The Contractors will be required to periodically remove sediments from silt fences, drainage ditches, and retention basins to maintain desired performance. Sediment removed from silt fences, drainage ditches, and basins will be managed as impacted material and disposed of in the OSDF, in accordance with the Technical Specifications.

Areas in which work will not occur for 45 days will be stabilized within 7 days (see Site Preparation Technical Specification ~~Section~~ 02270 and Excavation Package Technical Specification 02275). Vegetation standards, specifically percent grass coverage, are discussed in Site Preparation Technical Specification ~~Section~~ 02900 and Excavation Package Technical Specification 02900. Areas will also be stabilized to the extent practical prior to winter shutdown.

5.1 General Construction Practices

In general, it is advantageous to disturb only as ~~much~~ little area as necessary to accommodate construction needs. Limiting the extent of grading and excavation will minimize disturbed areas subject to erosion at any given time. However, disturbed areas may be expanded to separate work areas and provide more room to work for safety reasons. The construction phasing ultimately incorporated into the work plan is dependent on several factors including the following:

- Contractor's management strategies,
- construction conditions,
- seasonal and weather conditions.

The following construction practices will be followed as a general rule.

- All erosion and sediment control measures are to be installed prior to or as the first step in excavation.

- Disturbed/exposed areas will be excavated as quickly as practical. Disturbed areas which will remain unworked for 45 consecutive days or greater will be stabilized with a temporary vegetative cover or other measures, such as mulching, within 7 days.

- All erosion and sediment control measures shall be maintained and/or modified as approved by FDF in accordance with regulatory criteria during construction to comply with this plan.

- Potential cross-contamination from vehicle traffic will be prevented by stabilization of entry/exit routes, equipment washing, and monitoring vehicles exiting the work zone.

5.2 Construction Sequencing

The following sections discuss the general erosion control sequencing plan (during site preparation) and the excavation sequencing plan.

5.2.1 General Erosion Control Sequencing Plan (During Site Preparation)

Step 1. Establish site boundaries and access controls.

Step 2. Install silt fence and diversion ditches in locations indicated on the Construction Drawings.

Step 3. Strip the surface (if not certified below FRLs by FDF) from areas designated for retention basin construction and stockpile the material within the boundaries of the impacted material stockpile within the SF to be field located as noted on the Construction Drawings.

Step 4. Complete excavation of retention basins to lines and grades shown on the plans. Prior to excavation (to the extent practical), FDF will determine whether material to be excavated is below FRLs. During excavation FDF may perform additional monitoring with real-time instruments. Soil suspected to be impacted (not below FRLs) will be placed in Impacted Material Stockpile shown on the Construction Drawings. Other soil will be placed in the Non-Impacted Material Stockpile Areas as shown on the Construction Drawings.

000270

Step 5. Install risers, barrels, lift stations, and transfer lines for the retention basins as shown on the Construction Drawings.

Step 6. Install compacted clay subgrade (in Retention Basins 1 and 3) and geomembrane liner in the retention basins.

Step 7. Divert flow into the retention basins by constructing collection ditches.

Step 8. Construct equipment wash facility and associated devices.

5.2.2 Excavation Sequencing Plan for Impacted Material Excavation

Step 1. Establish site boundaries and access controls.

Step 2. Establish erosion, siltation, and surface water controls in locations indicated on the plans and as shown in the details. Confirm that all erosion and sediment controls are in place and all runoff from potentially contaminated and disturbed areas flows to the retention basins.

Step 3. Clear remaining trees and vegetation. Stumps will be ground in place and excavated with surface soil removal.

Step 4. Excavate impacted material to the limits indicated on the Construction Drawings.

Step 5 Excavate construction sumps near working face to collect runoff.

Step 6 As excavation progresses, relocate sumps as required.

Step 7. When excavation is completed in a discrete area, certification samples will be collected (by FDF).

Step 8. Upon certification that soils remaining in the remediation area meet FRLs, interim restoration shall be performed.

Step 9. Apply seed and mulch to all disturbed areas.

Step 10. Install temporary erosion and sedimentation controls for decommissioning of retention basins.

Step 11. Upon verification that the ~~excavation~~ A2PI Waste Unit Area meets FRLs and has an established stand of vegetation, accumulated sediments, ~~compacted clay subgrade,~~ and the geomembrane liner shall be removed from the retention basins 1 ~~and~~ 2, and ~~2~~ 3.

Step 12 Precertification, certification, and supplemental excavation of the Retention Basin area shall then be performed.

Step ~~12~~13. Remove temporary erosion and sedimentation controls following completion of final grading activities and after the excavation areas have an established stand of vegetation. Seed and mulch any areas disturbed by this activity.

000272

SECTION 6

SEDIMENT CONTROL MAINTENANCE AND MONITORING

6.1 Monitoring and Inspection

The erosion and sediment controls identified in this SWMP will be monitored by a qualified representative of the Contractor and FDF every 7 calendar days or within 24 hours of a precipitation event of 0.5 inches or greater during the construction phase of the project. Inspections will include areas under excavation, unstabilized exposed areas, erosion control measures, and locations where vehicles enter/exit the project area. Where portions of the project area have been completed and permanent erosion control measures have been implemented, inspection will be conducted at least once every month until the entire project area is completely stabilized. All inspections will be conducted and documented in accordance with the SWPPP.

Disturbed areas and areas used for storage of materials that are exposed to the elements will be inspected for evidence of, or for the potential of, pollutants entering local drainage systems. Locations where vehicles exit the A2PI area will be inspected for evidence of off-site tracking of contaminated soil or impacted material.

If the inspections indicate that control measures are not adequate or effective, modifications to the control measure will be implemented immediately by the Contractor. A report summarizing the scope of the inspection, name of the inspector, inspection date, observations relating to the implementation of this plan, and necessary corrective action measures (if any) will be made and retained in the FDF project files to demonstrate compliance. The reports will either identify any areas of noncompliance with this plan, or contain a certification that control measures are effective and in compliance with this plan.

6.2 Maintenance

Erosion and sediment controls will be maintained in good operating condition until the A2PI area has been completely stabilized and the soils remaining in the A2PI area are certified to meet FRLs. Specific maintenance procedures will address silt fencing, drainage ditches, retention basins, and the equipment wash facility.

6.2.1 Silt Fencing

As sediment collects along the silt fences, the fences will be cleaned to maintain desired removal performance and prevent structural failure of the fence. During site preparation the sediment will be removed by the Contractor and managed as impacted material and placed in the impacted material stockpile

for subsequent placement into the OSDF. During excavation, the sediment will be removed by the Contractor and placed into the OSDF. The perimeter silt fencing will remain in place until excavation activities in the area are completed and vegetative cover or other erosion control measures are adequately established.

6.2.2 Drainage Ditches

The Contractor will be required to periodically remove sediment from the drainage ditches to maintain conveyance. Sediment removed from ditches during site preparation will be managed as impacted material and placed in the impacted material stockpile for subsequent placement into the OSDF. During excavation, the sediment will be removed by the Contractor and placed into the OSDF.

6.2.3 Retention Basins

The Contractor will be required to periodically remove sediment from the retention basins to maintain desired sediment storage capacity. Sediment removed from basins during site preparation will be managed as impacted material and placed in the impacted material stockpile for subsequent placement into the OSDF. During excavation, the sediment will be removed by the Contractor and placed into the OSDF.

6.2.4 Equipment Wash Facility

Sediments will be removed from the trench and oil/water separator as required. During site preparation, sediments removed from the Equipment Wash Facility will be managed as impacted material and placed in the impacted material stockpile for subsequent placement in the OSDF. During excavation, the sediment will be removed by the Contractor and placed into the OSDF.

000274

APPENDIX A

CALCULATIONS

PARSONS
ERA PROJECT

DESIGN CALCULATIONS INDEX

Discipline CIVIL Project Order No. 165 OU No. 2

CALCULATION NO.	SUBJECT	COMPUTER GENERATED (Y/N)	ORIGINATING AUTHOR	CHECKED BY	REV. NO./ DATE
15-01	STORMWATER MANAGEMENT	BOTH	T. BROWN	B. PARTON	0/ 5/22/97
15-01	STORMWATER MANAGEMENT	BOTH	T. BROWN	B. PARTON	1/ 8/15/97
15-01	STORMWATER MANAGEMENT	BOTH	T. BROWN	B. PARTON	2/ 10/10/97

APPROVED Franklin M. Porter Jr. DATE 10/10/97
Technical Lead

TABLE OF CONTENTS

Engineering Calculations
- Title and Summary Sheet . . . . . 1 of 12
- Basis Sheet . . . . . 2-4 of 12
- Computer Calculation Summary Sheet . . . . . 5-7 of 12
- Results . . . . . 8 of 12
- Computer 9-12

Attachment A, Retention Basins
- Methodology A1-A3
- Retention Basin 1 . . . . . A4
  - Computation for Time of Concentration (t_c) . . . A5, A6
  - Channel FlowWorksheet A7
  - Runoff Curve Number Data A8
  - Runoff Curve Number Summary A9
  - Tabular Inflow Hydrograph A10-A15
  - Stage-Storage Volume A16
  - Tabulated Routing (Outflow) Hydrograph . . . A17-A21
  - Summary of Routing Results: 10 yr - 24 hr . . A22-A24
- Retention Basin 2 . . . . . A25
  - Computation for Time of Concentration (t_c) (Existing Conditions) A26, A27
  - Runoff Curve Number Data (exist. cond.) A28
  - Runoff Curve Number Summary (exist. cond.) . . A29
  - Tabular Inflow Hydrograph (exist. cond.) . . . A30-A35
  - Computation for Time of Concentration (t_c) (Proposed Conditions) A36, A37
  - Runoff Curve Number Data (prop. cond.) A38
  - Runoff Curve Number Summary (prop. cond.) . . . A39
  - Tabular Inflow Hydrograph (prop. cond.) A40-A45
  - Estimated Storage (Existing Conditions) A46
  - Estimated Storage (Proposed Conditions) A47
  - Stage-Storage Volume A48
  - Tabulated Routing (Outflow) Hydrograph . . . A49-A53
  - Summary of Routing Results: 10 yr - 24 hr . . A54-A56
- Retention Basin 3 . . . . . A57
  - Computation for Time of Concentration (t_c) . A58, A59
  - Runoff Curve Number Data A60
  - Runoff Curve Number Summary A61
  - Tabular Inflow Hydrograph A62-A67
  - Stage-Storage Volume A68
  - Tabulated Routing (Outflow) Hydrograph . . . A69-A73
  - Summary of Routing Results: 10 yr - 24 hr . . A74-A76

TABLE OF CONTENTS (CONT)

Attachment B, Ditches

Methodology B1, B2
Table 1, Drainage Area and Peak Flow Summary B3
Drainage Area/Peak Flow-Existing/Proposed Conditions B4-B35
Table 2, Summary of Ditch Performance B36
Ditch Worksheets & Rating Tables B37-B89

Attachment C, Culverts

Methodology C1
Culvert 1 . . . . . C2-C7
Culvert 2 . . . . . C8-C14
Culvert 3 . . . . . C15-C19
Culvert 4 . . . . . C20-C27
Culvert 5 . . . . . C28-C34
Culvert 6 . . . . . C35-C40
Culvert 7 . . . . . C41-C46
Culvert 8 . . . . . C47-C52

Attachment D
Soils Map D1
Rainfall Intensity-Duration-Frequency Curve D2, D3

Attachment E
Calculation 15-02, PO158, Haulroad Drainage

Attachment F
Calculation 15-01, PO139, Design of Seepage
Collection & Removal of Sediment

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

Date 10/10/97
Sheet 1 of 12

Proj. Order No. 165 Calculation No. 15-01

Project Title SOUTHERN WASTE UNITS

Calculation Subject STORMWATER MANAGEMENT Date Verified/Checked 10/10/97

STATUS: PRELIMINARY ____ FINAL X SUPERSEDED ____ VOID ____

STATEMENT OF PROBLEM

1) Determine size of three retention basins required to collect and retain runoff from the 25 yr-24 hr precipitation event (Basins 1 & 2) and the 10 yr-24 hr precipitation event (Basin 3).

2) Determine size of collection ditches and culverts required to convey a 10-yr storm event to the retention basins. Due to the close proximity to Paddys Run, Ditch 2 & Ditch 6 will also be evaluated for the 25-yr storm event.

SUMMARY OF CONCLUSIONS

1) The basins, as shown on Dwg. 92X-5900-G-00282 are of sufficient size to collect runoff from the 10 yr-24 hr (Basin 3), or 25 yr-24 hr (Basins 1 & 2) storm event as required.
2) Ditches and culverts shown on Dwg. 92X-5900-G-00282, Dwg. 92X-5900-G-00283, and 92X-5900-G-00453 are of sufficient size to convey the 10-yr or 25-yr storm event, as required, to the basins.

Originator's Signature and Date: [signature] 10/10/97

CHECKING METHOD

1. Review ____
2. Alternate Calculation ____

Checker's Signature and Date: Franklin M. Parton Jr. 10/10/97

Lead Discipline Engineer's Signature and Date: Franklin M. Parton Jr. 10/10/97

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date
1	B3	ADDED 25 yr. STORM FOR DITCH 6	C. Schroeder 4/3/98	YUNUS AFSHAR 4/3/98	CS for F. PARTON 4/3/98

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Proj. Order No. 165 Calculation No. 15-01

Project Title Southern Waste Units

Calculation Subject Stormwater Management Date Verified/Checked 10/10/97

Prepared By: T. Brown TJB Checked/Verified By: Frank Porter

Date 10/10/97

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

Data Sources

1. PARSONS DWGs. (used to create drainage area maps)
2. Haestad Methods. 1989. Quick TR-55™ *Urban Hydrology for Small Watersheds*
3. Haestad Methods. 1989. Pond-2™ *Detention Pond Analysis*
4. Haestad Methods. 1995. Flow Master™ v 5.13
5. U.S. Weather Bureau. *Rainfall Frequency Atlas of the United States*
6. Soil Conservation Service. *Soil Survey of Hamilton County, Ohio*. August 1982
7. ODOT. *Location and Design Manual, Vol. 2, Drainage Design*
8. FHWA. *Hydraulic Design of Highway Culverts*. HDS No. 5. 1985
9. Brater, E.F., & King, H.W., "*Handbook of Hydraulics*", 6th ed., 1976. McGraw-Hill

CODES

Applicable sections of the Ohio Department of Natural Resources *Rainwater and Land Development Manual*

ASSUMPTIONS

1. Retention basins: The retention basins will be in place and operational prior to excavation. Therefore, the contributing watershed areas prior to, and during excavation were examined to identify the worst-case for storm volumes.

ENGINEERING CALCULATIONS
BASIS SHEET
SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS (continued)

2. Ditches and Culverts: Both existing and proposed conditions were evaluated, with the one producing the highest flow rates used in design.
3. The Rainfall Intensity-Frequency-Duration Curve for the Fernald area has the shortest duration equal to 10 minutes. The time of concentrations (t_c) computed for drainage areas P1, P2, and P3 were less than 10 minutes. Since the drainage areas for ditches are smaller than basin drainage areas (and subsequent t_c's for ditches less than those for basins), calculations for t_c for ditch and culvert drainage areas were not performed (except for Ditch-12, and Culvert-4). Instead, the smallest duration (10 min.) from the Rainfall Intensity-Frequency-Duration Curve were used to calculate rainfall intensities. For Ditch-12 and Culvert-4, t_c's were calculated using SCS methodologies due to the relatively large, flat drainage areas.
4. Ditches were designed based on uniform flow.
5. The existing ditches and 24" dia. culvert at the proposed wheel wash area were designed under Calculation No. 15-02, for PO158 (Haulroad Upgrade Project), and is included for information as an attachment to this calculation.
6. The existing catch basin and 18" corrugated HDPE storm drain located west of the Inactive Flyash Pile was designed under Calculation No. 15-01, for PO139 (Design of Seepage Collection & Removal of Sediment), and is included for information as an attachment to this calculation.
7. The Contingency Stockpile Area (Stockpile #2), located north-northwest of ditch-12, may or may not be utilized, depending on the amount of excess soil. Therefore, ditches 8A, 8B, and Basin 2 were designed assuming that this stockpile area would be utilized.
8. Dumped Rock Fill will be used in ditches that do not have a geomembrane liner where velocities are greater than 4.0 fps for erosion control blanket lining. ODOT Type "C" dumped rock fill will be used due to the small geometrical shape of the ditches.

9. Ditches 2B, 3-7, and 9 will have a geomembrane liner. Where velocity checks are used, flow depths will be determined using a broad-crested weir analysis.

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

OU: 2 PO: 165 Job Number: 7663-0165-11112-141

Computer Code: OTR-55 Version: 5.46

Code Verification Status: REV 0, Nov 1992

Description of Program: Developes runoff hydrographs per SCS TR-55, Determines peak flows per Modified Rational Method

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: To determine volume of runoff produced by 10-yr, 24-hr storm event, Retention Basins will be sized to accommodate these volumes.

To determine peak flows for design of ditches and culverts.

Run Performed By: T. Brown

Date/Time of Run: various, see computer printouts

Computer Time of Run: n/a

Input Filename: See attached list on Sheets 8-11

Output Filename: See attached list on Sheets 8-11

Files Saved to Diskname: p:\engdata\c&sdata\po165\swu\swcalc Disk Location: network directory, backup with discipline files

Results: Refer to calculation

Performed By: T. Brown TB Date: 10/10/97

Checked By: [signature] Date: 10/10/97

Approved By: Date:

5 of 6 of 12

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

OU: 2 PO: 165 Job Number: 7663-0165-11112-141

Computer Code: Flow Master Version: 5.13

Code Verification Status: Rev 0, Feb. 1997

Description of Program: Computes solutions to uniform flow open channel hydraulic problems

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: Used to evaluate and select drainage channel geometry and acceptable lining material.

Run Performed By: T. Brown

Date/Time of Run: various, see computer print-outs

Computer Time of Run: n/a

Input Filename: See attached list on Sheets 8-11

Output Filename: See attached list on Sheets 8-11

Files Saved to Diskname: p:engdata\c&sdata\po165\swu\swcalc Disk Location: network directory, backup with discipline files

Results: Refer to calculation

Performed By: T. Brown TJB Date: 10/10/97

Checked By: Frank Paxton Jr Date: 10/10/97

Approved By: Date:

12/92 ENG095

000284

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

OU: 2 PO: 165 Job Number: 7663-0165-11112-141

Computer Code: POND -2 Version: 5.17

Code Verification Status: REV 0, NOV 1992

Description of Program: Computes solution for routing inflow hydrograph generated by OTR-55 and generates an outflow hydrograph using level-pool routing techniques

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: Used to size retention basins to ensure no discharge for 10-year, 24-hour storm event.

Run Performed By: T. Brown

Date/Time of Run: various, see computer print-outs

Computer Time of Run: n/a

Input Filename: See attached list on Sheets 8-11

Output Filename: See attached list on Sheets 8-11

Files Saved to Diskname: p:\engdata\c&sdata\po165\swu\swcalc Disk Location: network directory, backup with discipline files

Results: Refer to calculation

Performed By: T. Brown Date: 10/10/97

Checked By: Frank Pulsa Jr Date: 10/10/97

Approved By: Date:

REV	BY	DATE	CK	DATE	TITLE: STORMWATER MANAGEMENT	
2	TJB	10/10/97	[illegible]	10/10/97		OU - 2
					AUTHOR: T. Brown SHEET 8 of 12	PO165

RESULTS:

The results from the routing of the 25-year, 24-hour storm event through retention basins 1 & 2 are as follows:

RETENTION BASIN 1

Q_{25} =	88 CFS
Initial Storage (Assumed full of sediment) =	0.36 Ac-Ft
Overflow Elev. =	538.5
Water Surface Elev. (WSE_{25}) =	537.87
Q_{25} Discharge =	0 CFS

RETENTION BASIN 2

Q_{25} =	34 CFS
Initial Storage (Assumed full of sediment) =	0.11 Ac-Ft
Overflow Elev. =	537.0
Water Surface Elev. (WSE_{25}) =	536.63
Q_{25} Discharge =	0 CFS

The results from the routing of the 10-year, 24-hour storm event through retention basin 3 are as follows:

RETENTION BASIN 3

Q_{10} =	21 CFS
Initial Storage (Assumed full of sediment) =	0.10 Ac-Ft
Overflow Elev. =	540.0
Water Surface Elev. (WSE_{10}) =	539.89
Q_{10} Discharge =	0 CFS

The retention basins do not discharge during the design storm events and are acceptable.

The diversion ditches and culverts were designed to accommodate a 10-year storm event.
The results for diversion ditches and culverts are included within the body of the calculations.

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c1p.mod
c2ep.mod
c2p.mod
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SHT 11-12

1634

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p3a.rcn
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SHT 12-12

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sw3a.vol
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swu.fm2
swu.idf
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swu1.fm2
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ATTACHMENT A, RETENTION BASINS

Methodology

This calculation is performed by examining the existing and proposed conditions to identify the "worst case" for storm volumes.

The existing drainage area for each basin is computed using the existing topography. The proposed drainage area for each basin is computed on the final grading plan. Time of concentrations are determined using sheet flow, shallow concentrated flow, and channel flow as required by the drainage characteristics of each drainage area. See Drainage Area Map in Appendix B of the Surface Water Management Plan. A weighted curve number is developed for each drainage area based on soil types and conditions within the drainage area. The proposed inflow hydrographs are then developed using SCS Technical Release No. 55 (TR-55) and the computer program Quick TR-55. Retention Basins No. 1 & 2 will use the 25 yr - 24 hr storm as the design storm event. Retention Basin No. 3 will use the 10 yr - 24 hr storm as the design storm event. The drainage areas for each basin under existing and proposed conditions are as follows:

	EXISTING	PROPOSED
Basin 1	14.33 AC	15.23 AC
Basin 2	7.04 AC	6.1 AC
Basin 3	4.78 AC	4.78 AC

By inspection, The worst-case volume condition for basin 1 and basin 3 will occur during proposed conditions due to the size of the drainage areas and the use of higher curve numbers for disturbed conditions. However, for basin 2 it is not apparent which condition will generate the largest storm runoff volume. Therefore, runoff hydrographs will be generated for each condition and routed through the storage volume estimate routine of the Pond-2 computer program. The condition which produces the largest estimated storage volume will be used as the worst-case and will be routed through the basin.

Stage-storage information is developed from the grading plans for each basin. This information is entered into the Pond-2 computer program. Since the basins retain the design storm instead of regulating outflow, an outflow rating table is not required. Also, the pumping rate at the lifts stations (400 gallons per minute at basin 1, and 100 gpm at basins 2 & 3) was not considered when routing the design storm event.

The inflow hydrographs are then routed through the basins using level-pool reservoir routing techniques found in the Pond-2 computer program. Maximum water surface elevations due to storage of the entire storm volume are evaluated to ensure that adequate volume is provided to contain the design storm events.

Variables used in development of the inflow hydrographs are taken from TR-55. Variable definitions, values used, and reference location within TR-55 are defined.

Time of Concentration

Time of concentration is comprised of travel times from sheet flow, shallow concentrated flow, and channel flow components. Each component is described as follows:

Sheet Flow (Equation 3-3)

$$T_t = \frac{0.007\,(n \times L)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

where:

T_t = Travel time (hrs)
n = Manning's roughness coefficient. Use following values from Table 3-1, Page 3-3 for n:

n = 0.011 for bare soil conditions,
n = 0.13 for range conditons (vegetated)

P_2 = 2 yr - 24 hr rainfall (in.). The 2 yr - 24 hr rainfall is used in the SCS equation for sheet flow for any storm frequency. For the Fernald Area use 3.0 inches (Reference 5)
L = Flow Length (ft)
s = Land slope (ft/ft)

Shallow Concentrated Flow (Page 3-1)

$$T_t = L / 3600 \times V$$

where:

T_t = Travel time (hrs)
L = Flow Length (ft)
3600 is conversion factor from seconds to hours
V = Average velocity (ft/s) taken from Figure 3-1

Channel Flow (Page 3-3)

$$T_t = L / 3600 \times V$$

T_t = Travel time (hrs)
L = Flow Length (ft)
3600 is conversion factor from seconds to hours
V = Average channel velocity taken from equation 3-4

Runoff Curve Number

A weighted curve number is derived for watershed areas based on the soil type, hydrologic soil group, cover type, and treatment. The soil types in the area and the hydrologic soil groupings are based on soil surveys of the area (Reference 6, see Attachment E). The cover types and treatment (i.e., proposed-bare soil conditions, or existing-wooded conditons) are based on the expected conditions to be encountered during the project. Curve numbers are assigned based on the Curve Number Tables 2-2a, 2-2b, and 2-2c.

SHT A4

RETENTION BASIN 1

SHT A5

Quick TR-55 Ver.5.46 S/N:
Executed: 10:05:30 08-19-1997 c:\po165tk\P1.TCT

1634

RETENTION BASIN - 1

Tc COMPUTATIONS FOR: P1

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description	BARE		
Manning's roughness coeff., n		0.0110	
Flow length, L (total < or = 300)	ft	280.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0210	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.05	= 0.05

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	240.0	
Watercourse slope, s	ft/ft	0.1120	
$Avg.V = Csf * (s)^{0.5}$	ft/s	5.3996	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	10.00	
Wetted perimeter, Pw	ft	12.47	
Hydraulic radius, r = a/Pw	ft	0.802	
Channel slope, s	ft/ft	0.0080	
Manning's roughness coeff., n		0.0400	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.8758	
Flow length, L	ft	305	
T = L / (3600*V)	hrs	0.03	= 0.03

::

TOTAL TIME (hrs) 0.09

USE 0.1 hrs

SHT A6

Quick TR-55 Ver.5.46 S/N:
Executed: 10:05:30 08-19-1997 c:\po165tk\P1.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN - 1

Subarea descr.	Tc or Tt	Time (hrs)
P1	Tc	0.09

USE 0.1 hrs

000296

SHT A7

1634

P1 WATERSHED, CHANNEL FLOW
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	P1 WATERSHED, CHANNEL FLOW
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft

Results		
Discharge	28.68	cfs
Flow Area	10.00	ft^2
Wetted Perimeter	12.47	ft
Top Width	12.00	ft
Critical Depth	0.69	ft
Critical Slope	0.028706	ft/ft
Velocity	2.87	ft/s
Velocity Head	0.13	ft
Specific Energy	1.13	ft
Froude Number	0.55	
Flow is subcritical.		

Notes:

THIS ANALYSIS WAS TO DETERMINE THE FLOW AREA, WETTED PERIMETER, AND HYDRAULIC RADIUS OF D-3 FLOWING 1 FT. DEEP.

RESULTS USED TO DETERMINE TRAVEL TIME FOR CHANNEL FLOW COMPONENT OF TIME OF CONCENTRATION OF P1 DRAINAGE AREA.

SHT A8

Quick TR-55 Ver.5.46 S/N:
Executed: 10:15:12 08-19-1997

RETENTION BASIN 1
59% HoA, 20% HeF, 10% MaB,
10% Gn, 1% Gravel Road

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN
HoA, (C): FALLOW, BARE SOIL	8.97	91
MaB, (C): FALLOW, BARE SOIL	1.52	91
HeF, (B): FALLOW, BARE SOIL	3.04	86
Gn, (B): FALLOW, BARE SOIL	1.55	86
Gravel Road	0.15	91
COMPOSITE AREA --->	15.23	89.5 ~~(89)~~

::

(90)

000298

SHTA9

Quick TR-55 Ver.5.46 S/N:
Executed: 10:15:12 08-19-1997

1634

RETENTION BASIN 1
59% HoA, 20% HeF, 10% MaB,
10% Gn, 1% Gravel Road

RUNOFF CURVE NUMBER SUMMARY

Subarea Description	Area (acres)	CN (weighted)
	15.23	~~89~~ USE 90

SEE PREVIOUS SHEET

SHT A10

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:17:37
Watershed file: --> C:\PO165TK\P1 .MOP
Hydrograph file: --> C:\PO165TK\P1-25.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
P1	15.23	90.0	0.10	0.00	4.80	3.68	.05	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 15.23 acres or 0.02380 sq.mi
Peak discharge = 88 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P1	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

000300

SHT A11

Return Frequency: 25 years

1634

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:17:37
Watershed file: --> C:\PO165TK\P1 .MOP
Hydrograph file: --> C:\PO165TK\P1-25.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P1	88	12.1
Composite Watershed	88	12.1

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:17:37
Watershed file: --> C:\PO165TK\P1 .MOP
Hydrograph file: --> C:\PO165TK\P1-25.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P1	2	3	5	29	57	88	55	19	13
Total (cfs)	2	3	5	29	57	88	55	19	13

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P1	11	9	8	7	6	5	4	4	4
Total (cfs)	11	9	8	7	6	5	4	4	4

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P1	3	3	3	3	2	2	2	2	2
Total (cfs)	3	3	3	3	2	2	2	2	2

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P1	2	1	1	1	0
Total (cfs)	2	1	1	1	0

SHT A13

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 10:17:37
Watershed file: --> C:\PO165TK\P1 .MOP
Hydrograph file: --> C:\PO165TK\P1-25.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	2	14.8	3
11.1	2	14.9	3
11.2	3	15.0	3
11.3	3	15.1	3
11.4	4	15.2	3
11.5	4	15.3	2
11.6	5	15.4	2
11.7	13	15.5	2
11.8	21	15.6	2
11.9	29	15.7	2
12.0	57	15.8	2
12.1	88	15.9	2
12.2	55	16.0	2
12.3	19	16.1	2
12.4	13	16.2	2
12.5	11	16.3	2
12.6	9	16.4	2
12.7	8	16.5	2
12.8	7	16.6	2
12.9	6	16.7	2
13.0	6	16.8	2
13.1	5	16.9	2
13.2	5	17.0	2
13.3	4	17.1	2
13.4	4	17.2	2
13.5	4	17.3	2
13.6	4	17.4	2
13.7	4	17.5	2
13.8	4	17.6	2
13.9	3	17.7	2
14.0	3	17.8	2
14.1	3	17.9	2
14.2	3	18.0	2
14.3	3	18.1	2
14.4	3	18.2	2
14.5	3	18.3	2

14.6	3	18.4	2	SM A14
14.7	3	18.5	2	

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 10:17:37
Watershed file: --> C:\PO165TK\P1 .MOP
Hydrograph file: --> C:\PO165TK\P1-25.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	1	22.4	1
18.7	1	22.5	1
18.8	1	22.6	1
18.9	1	22.7	1
19.0	1	22.8	1
19.1	1	22.9	1
19.2	1	23.0	1
19.3	1	23.1	1
19.4	1	23.2	1
19.5	1	23.3	1
19.6	1	23.4	1
19.7	1	23.5	1
19.8	1	23.6	1
19.9	1	23.7	1
20.0	1	23.8	1
20.1	1	23.9	1
20.2	1	24.0	1
20.3	1	24.1	0
20.4	1	24.2	0
20.5	1	24.3	0
20.6	1	24.4	0
20.7	1	24.5	0
20.8	1	24.6	0
20.9	1	24.7	0
21.0	1	24.8	0
21.1	1	24.9	0
21.2	1	25.0	0
21.3	1	25.1	0
21.4	1	25.2	0
21.5	1	25.3	0
21.6	1	25.4	0
21.7	1	25.5	0
21.8	1	25.6	0
21.9	1	25.7	0
22.0	1	25.8	0
22.1	1	25.9	0
22.2	1		
22.3	1		

SHT A16

POND-2 Version: 5.17
S/N:

RETENTION BASIN NO. 1

CALCULATED 08-19-1997 10:23:58
DISK FILE: c:\po165tk\SW1 .VOL

Planimeter scale: 1 inch = 40 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
531.40	0.00	0.00	0.00	0.00	0.00
532.00	5.27	0.19	0.19	0.04	0.04
533.00	16.74	0.61	1.15	0.38	0.42
534.00	23.83	0.88	2.22	0.74	1.16
535.00	25.38	0.93	2.71	0.90	2.07
536.00	26.97	0.99	2.88	0.96	3.03
537.00	28.60	1.05	3.06	1.02	4.05
538.00	31.45	1.16	3.31	1.10	5.15
539.00	35.20	1.29	3.67	1.22	6.38
540.00	36.27	1.33	3.94	1.31	7.69

Elevations With Areas Interpolated From
The Closest Two Planimeter Readings

532.90	-----	0.56	1.09	0.33	0.36
538.50	-----	1.22	3.57	0.59	5.75

* Incremental volume computed by the Conic Method for Reservoir Volumes.

SHT A17

1634

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*************************
*                       *
*   RETENTION BASIN 1   *
* 25 YR - 24 HR STORM   *
* PROPOSED CONDITIONS   *
*                       *
*                       *
*************************
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Inflow Hydrograph: c:\po165tk\P1-25 .HYD
Rating Table file: c:\po165tk\SW1 .PND

----INITIAL CONDITIONS----
Elevation = 532.90 ft — MAX. SEDIMENT CLEANOUT ELEV.
Outflow = 0.00 cfs
Storage = 0.36 ac-ft — MAX. SEDIMENT STORAGE VOLUME

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
531.40	0.0	0.000
532.00	0.0	0.040
532.90	0.0	0.360
533.00	0.0	0.420
534.00	0.0	1.160
535.00	0.0	2.070
536.00	0.0	3.030
537.00	0.0	4.050
538.00	0.0	5.150
538.50	0.0	5.750
539.00	0.0	6.380
540.00	0.0	7.690

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
9.7	9.7
87.1	87.1
101.6	101.6
280.7	280.7
500.9	500.9
733.3	733.3
980.1	980.1
1246.3	1246.3
1391.5	1391.5
1544.0	1544.0
1861.0	1861.0

Time increment (t) = 0.100 hrs.

SHT A18

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 10:26:34

Pond File: c:\po165tk\SW1 .PND
Inflow Hydrograph: c:\po165tk\P1-25 .HYD
Outflow Hydrograph: c:\po165tk\SW1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	2.00	-----	87.1	87.1	0.00	532.90
11.100	2.00	4.0	91.1	91.1	0.00	532.93
11.200	3.00	5.0	96.1	96.1	0.00	532.96
11.300	3.00	6.0	102.1	102.1	0.00	533.00
11.400	4.00	7.0	109.1	109.1	0.00	533.04
11.500	4.00	8.0	117.1	117.1	0.00	533.09
11.600	5.00	9.0	126.1	126.1	0.00	533.14
11.700	13.00	18.0	144.1	144.1	0.00	533.24
11.800	21.00	34.0	178.1	178.1	0.00	533.43
11.900	29.00	50.0	228.1	228.1	0.00	533.71
12.000	57.00	86.0	314.1	314.1	0.00	534.15
12.100	88.00	145.0	459.1	459.1	0.00	534.81
12.200	55.00	143.0	602.1	602.1	0.00	535.44
12.300	19.00	74.0	676.1	676.1	0.00	535.75
12.400	13.00	32.0	708.1	708.1	0.00	535.89
12.500	11.00	24.0	732.1	732.1	0.00	536.00
12.600	9.00	20.0	752.1	752.1	0.00	536.08
12.700	8.00	17.0	769.1	769.1	0.00	536.15
12.800	7.00	15.0	784.1	784.1	0.00	536.21
12.900	6.00	13.0	797.1	797.1	0.00	536.26
13.000	6.00	12.0	809.1	809.1	0.00	536.31
13.100	6.00	12.0	821.1	821.1	0.00	536.36
13.200	5.00	11.0	832.1	832.1	0.00	536.40
13.300	4.00	9.0	841.1	841.1	0.00	536.44
13.400	4.00	8.0	849.1	849.1	0.00	536.47
13.500	4.00	8.0	857.1	857.1	0.00	536.50
13.600	4.00	8.0	865.1	865.1	0.00	536.53
13.700	4.00	8.0	873.1	873.1	0.00	536.57
13.800	4.00	8.0	881.1	881.1	0.00	536.60
13.900	4.00	8.0	889.1	889.1	0.00	536.63
14.000	3.00	7.0	896.1	896.1	0.00	536.66
14.100	3.00	6.0	902.1	902.1	0.00	536.68
14.200	3.00	6.0	908.1	908.1	0.00	536.71
14.300	3.00	6.0	914.1	914.1	0.00	536.73
14.400	3.00	6.0	920.1	920.1	0.00	536.76
14.500	3.00	6.0	926.1	926.1	0.00	536.78
14.600	3.00	6.0	932.1	932.1	0.00	536.81
14.700	3.00	6.0	938.1	938.1	0.00	536.83
14.800	3.00	6.0	944.1	944.1	0.00	536.85
14.900	3.00	6.0	950.1	950.1	0.00	536.88
15.000	3.00	6.0	956.1	956.1	0.00	536.90
15.100	3.00	6.0	962.1	962.1	0.00	536.93
15.200	3.00	6.0	968.1	968.1	0.00	536.95
15.300	2.00	5.0	973.1	973.1	0.00	536.97
15.400	2.00	4.0	977.1	977.1	0.00	536.99

1634

nd File: c:\po165tk\SW1 .PND
nflow Hydrograph: c:\po165tk\P1-25 .HYD
Outflow Hydrograph: c:\po165tk\SW1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	2.00	4.0	981.1	981.1	0.00	537.00
15.600	2.00	4.0	985.1	985.1	0.00	537.02
15.700	2.00	4.0	989.1	989.1	0.00	537.03
15.800	2.00	4.0	993.1	993.1	0.00	537.05
15.900	2.00	4.0	997.1	997.1	0.00	537.06
16.000	2.00	4.0	1001.1	1001.1	0.00	537.08
16.100	2.00	4.0	1005.1	1005.1	0.00	537.09
16.200	2.00	4.0	1009.1	1009.1	0.00	537.11
16.300	2.00	4.0	1013.1	1013.1	0.00	537.12
16.400	2.00	4.0	1017.1	1017.1	0.00	537.14
16.500	2.00	4.0	1021.1	1021.1	0.00	537.15
16.600	2.00	4.0	1025.1	1025.1	0.00	537.17
16.700	2.00	4.0	1029.1	1029.1	0.00	537.18
16.800	2.00	4.0	1033.1	1033.1	0.00	537.20
16.900	2.00	4.0	1037.1	1037.1	0.00	537.21
17.000	2.00	4.0	1041.1	1041.1	0.00	537.23
17.100	2.00	4.0	1045.1	1045.1	0.00	537.24
17.200	2.00	4.0	1049.1	1049.1	0.00	537.26
17.300	2.00	4.0	1053.1	1053.1	0.00	537.27
17.400	2.00	4.0	1057.1	1057.1	0.00	537.29
17.500	2.00	4.0	1061.1	1061.1	0.00	537.30
17.600	2.00	4.0	1065.1	1065.1	0.00	537.32
17.700	2.00	4.0	1069.1	1069.1	0.00	537.33
17.800	2.00	4.0	1073.1	1073.1	0.00	537.35
17.900	2.00	4.0	1077.1	1077.1	0.00	537.36
18.000	2.00	4.0	1081.1	1081.1	0.00	537.38
18.100	2.00	4.0	1085.1	1085.1	0.00	537.39
18.200	2.00	4.0	1089.1	1089.1	0.00	537.41
18.300	2.00	4.0	1093.1	1093.1	0.00	537.42
18.400	2.00	4.0	1097.1	1097.1	0.00	537.44
18.500	2.00	4.0	1101.1	1101.1	0.00	537.45
18.600	1.00	3.0	1104.1	1104.1	0.00	537.47
18.700	1.00	2.0	1106.1	1106.1	0.00	537.47
18.800	1.00	2.0	1108.1	1108.1	0.00	537.48
18.900	1.00	2.0	1110.1	1110.1	0.00	537.49
19.000	1.00	2.0	1112.1	1112.1	0.00	537.50
19.100	1.00	2.0	1114.1	1114.1	0.00	537.50
19.200	1.00	2.0	1116.1	1116.1	0.00	537.51
19.300	1.00	2.0	1118.1	1118.1	0.00	537.52
19.400	1.00	2.0	1120.1	1120.1	0.00	537.53
19.500	1.00	2.0	1122.1	1122.1	0.00	537.53
19.600	1.00	2.0	1124.1	1124.1	0.00	537.54
19.700	1.00	2.0	1126.1	1126.1	0.00	537.55
19.800	1.00	2.0	1128.1	1128.1	0.00	537.56
19.900	1.00	2.0	1130.1	1130.1	0.00	537.56
20.000	1.00	2.0	1132.1	1132.1	0.00	537.57

SHT A20

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 10:26:34

Pond File: c:\po165tk\SW1 .PND
Inflow Hydrograph: c:\po165tk\P1-25 .HYD
Outflow Hydrograph: c:\po165tk\SW1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	1.00	2.0	1134.1	1134.1	0.00	537.58
20.200	1.00	2.0	1136.1	1136.1	0.00	537.59
20.300	1.00	2.0	1138.1	1138.1	0.00	537.59
20.400	1.00	2.0	1140.1	1140.1	0.00	537.60
20.500	1.00	2.0	1142.1	1142.1	0.00	537.61
20.600	1.00	2.0	1144.1	1144.1	0.00	537.62
20.700	1.00	2.0	1146.1	1146.1	0.00	537.62
20.800	1.00	2.0	1148.1	1148.1	0.00	537.63
20.900	1.00	2.0	1150.1	1150.1	0.00	537.64
21.000	1.00	2.0	1152.1	1152.1	0.00	537.65
21.100	1.00	2.0	1154.1	1154.1	0.00	537.65
21.200	1.00	2.0	1156.1	1156.1	0.00	537.66
21.300	1.00	2.0	1158.1	1158.1	0.00	537.67
21.400	1.00	2.0	1160.1	1160.1	0.00	537.68
21.500	1.00	2.0	1162.1	1162.1	0.00	537.68
21.600	1.00	2.0	1164.1	1164.1	0.00	537.69
21.700	1.00	2.0	1166.1	1166.1	0.00	537.70
21.800	1.00	2.0	1168.1	1168.1	0.00	537.71
21.900	1.00	2.0	1170.1	1170.1	0.00	537.71
22.000	1.00	2.0	1172.1	1172.1	0.00	537.72
22.100	1.00	2.0	1174.1	1174.1	0.00	537.73
22.200	1.00	2.0	1176.1	1176.1	0.00	537.74
22.300	1.00	2.0	1178.1	1178.1	0.00	537.74
22.400	1.00	2.0	1180.1	1180.1	0.00	537.75
22.500	1.00	2.0	1182.1	1182.1	0.00	537.76
22.600	1.00	2.0	1184.1	1184.1	0.00	537.77
22.700	1.00	2.0	1186.1	1186.1	0.00	537.77
22.800	1.00	2.0	1188.1	1188.1	0.00	537.78
22.900	1.00	2.0	1190.1	1190.1	0.00	537.79
23.000	1.00	2.0	1192.1	1192.1	0.00	537.80
23.100	1.00	2.0	1194.1	1194.1	0.00	537.80
23.200	1.00	2.0	1196.1	1196.1	0.00	537.81
23.300	1.00	2.0	1198.1	1198.1	0.00	537.82
23.400	1.00	2.0	1200.1	1200.1	0.00	537.83
23.500	1.00	2.0	1202.1	1202.1	0.00	537.83
23.600	1.00	2.0	1204.1	1204.1	0.00	537.84
23.700	1.00	2.0	1206.1	1206.1	0.00	537.85
23.800	1.00	2.0	1208.1	1208.1	0.00	537.86
23.900	1.00	2.0	1210.1	1210.1	0.00	537.86
24.000	0.00	1.0	1211.1	1211.1	0.00	537.87
24.100	0.00	0.0	1211.1	1211.1	0.00	537.87
24.200	0.00	0.0	1211.1	1211.1	0.00	537.87
24.300	0.00	0.0	1211.1	1211.1	0.00	537.87
24.400	0.00	0.0	1211.1	1211.1	0.00	537.87
24.500	0.00	0.0	1211.1	1211.1	0.00	537.87
24.600	0.00	0.0	1211.1	1211.1	0.00	537.87

SMT A21

1634

Pond File: c:\po165tk\SW1 .PND
Inflow Hydrograph: c:\po165tk\P1-25 .HYD
Outflow Hydrograph: c:\po165tk\SW1 .HYD

INFLOW HYDROGRAPH

TIME (hrs)	INFLOW (cfs)
24.700	0.00
24.800	0.00
24.900	0.00
25.000	0.00
25.100	0.00
25.200	0.00
25.300	0.00
25.400	0.00
25.500	0.00
25.600	0.00
25.700	0.00
25.800	0.00
25.900	0.00

ROUTING COMPUTATIONS

I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87
0.0	1211.1	1211.1	0.00	537.87

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: c:\po165tk\SW1 .PND
Inflow Hydrograph: c:\po165tk\P1-25 .HYD
Outflow Hydrograph: c:\po165tk\SW1 .HYD

Starting Pond W.S. Elevation = 532.90 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 88.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 537.87 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.36 ac-ft
Peak Storage From Storm = 4.64 ac-ft

Total Storage in Pond = 5.00 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

PEAK ELEV 537.87 < OVERFLOW ELEV 538.5

∴ BASIN IS ACCEPTABLE

SAT A23

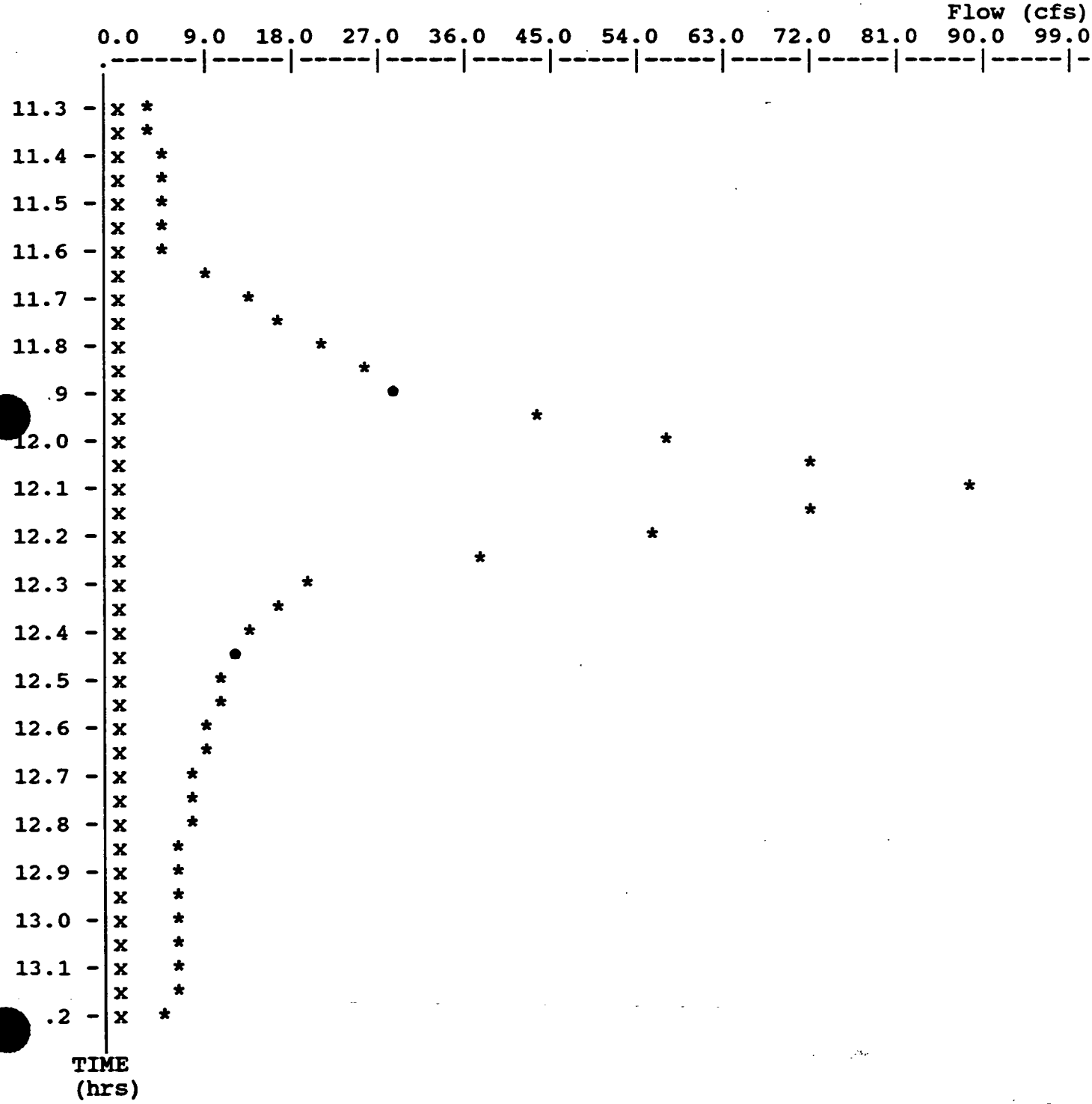
>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

POND-2 Version: 5.17 S/N:

Pond File: c:\po165tk\SW1 .PND
Inflow Hydrograph: c:\po165tk\P1-25 .HYD
Outflow Hydrograph: c:\po165tk\SW1 .HYD

EXECUTED: 08-19-1997
10:26:34

Peak Inflow = 88.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 537.87 ft



SHT A24

```
*  File:  c:\po165tk\P1-25   .HYD   Qmax =    88.0 cfs
x  File:  c:\po165tk\SW1     .HYD   Qmax =     0.0 cfs
```

000314

SHT A 25

1634

RETENTION BASIN 2

SHT A26

Quick TR-55 Ver.5.46 S/N:
Executed: 10:33:15 08-19-1997 c:\po165tk\P2E.TCT

RETENTION BASIN 2
EXISTING CONDITIONS

Tc COMPUTATIONS FOR: P2

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		RANGE	
Manning's roughness coeff., n		0.1300	
Flow length, L (total < or = 300)	ft	266.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0450	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.24	= 0.24

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	160.0	
Watercourse slope, s	ft/ft	0.0970	
$Avg.V = Csf * (s)^{0.5}$	ft/s	5.0251	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	1.48	FROM DITCH BB CALC.
Wetted perimeter, Pw	ft	3.85	
Hydraulic radius, r = a/Pw	ft	0.384	
Channel slope, s	ft/ft	0.1000	
Manning's roughness coeff., n		0.0600	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	4.1518	
Flow length, L	ft	280	
T = L / (3600*V)	hrs	0.02	= 0.02

::

TOTAL TIME (hrs) 0.27

000316

SHT A27

Quick TR-55 Ver.5.46 S/N:
Executed: 10:33:15 08-19-1997 c:\po165tk\P2E.TCT

1634

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 2
EXISTING CONDITIONS

Subarea descr.	Tc or Tt	Time (hrs)
P2	Tc	0.27

SHT A28

Quick TR-55 Ver.5.46 S/N:
Executed: 10:33:45 08-19-1997

RETENTION BASIN 2, EXISTING CONDITIONS
HoA 51.0%, Gn 36.9%, HeF 6.4%,
GRAVEL ROAD 3.0%,
MaC2 2.7%

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA (C): BRUSH, FAIR	2.43	70	
HoA (C): FALLOW, BARE SOIL	1.16	91	
Gn (B): BRUSH, FAIR	1.00	56	
Gn (B): FALLOW, BARE SOIL	1.60	86	
HeF, (B): BRUSH, FAIR	0.45	56	
MaC2, (C): BRUSH, FAIR	0.19	70	
GRAVEL ROAD	0.21	91	
COMPOSITE AREA --->	7.04	74.8	(75)

::

000318

SHT A29

Quick TR-55 Ver.5.46 S/N:
Executed: 10:33:45 08-19-1997

1634

RETENTION BASIN 2, EXISTING CONDITIONS
HoA 51.0%, Gn 36.9%, HeF 6.4%,
GRAVEL ROAD 3.0%,
MaC2 2.7%

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	7.04	75

SH A30

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:40:24
Watershed file: --> C:\PO165TK\P2EX .MOP
Hydrograph file: --> C:\PO165TK\P2E-25.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
P2	7.04	75.0	0.30	0.00	4.80	2.29	I.14 .14

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 7.04 acres or 0.01100 sq.mi
Peak discharge = 17 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P2	0.27	0.00	0.30	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 10:40:24
Watershed file: --> C:\PO165TK\P2EX .MOP
Hydrograph file: --> C:\PO165TK\P2E-25.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P2	17	12.3
Composite Watershed	17	12.3

SHA32

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:40:24
Watershed file: --> C:\PO165TK\P2EX .MOP
Hydrograph file: --> C:\PO165TK\P2E-25.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P2	0	1	1	2	5	10	16	17	12
Total (cfs)	0	1	1	2	5	10	16	17	12

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P2	7	5	4	3	2	2	2	1	1
Total (cfs)	7	5	4	3	2	2	2	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P2	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P2	1	0	0	0	0
Total (cfs)	1	0	0	0	0

SAT A33

Return Frequency: 25 years

1634

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:40:24
Watershed file: --> C:\PO165TK\P2EX .MOP
Hydrograph file: --> C:\PO165TK\P2E-25.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	0	14.8	1
11.1	0	14.9	1
11.2	1	15.0	1
11.3	1	15.1	1
11.4	1	15.2	1
11.5	1	15.3	1
11.6	1	15.4	1
11.7	1	15.5	1
11.8	2	15.6	1
11.9	2	15.7	1
12.0	5	15.8	1
12.1	10	15.9	1
12.2	16	16.0	1
12.3	17	16.1	1
12.4	12	16.2	1
12.5	7	16.3	1
12.6	5	16.4	1
12.7	4	16.5	1
12.8	3	16.6	1
12.9	2	16.7	1
13.0	2	16.8	1
13.1	2	16.9	1
13.2	2	17.0	1
13.3	2	17.1	1
13.4	2	17.2	1
13.5	2	17.3	1
13.6	1	17.4	1
13.7	1	17.5	1
13.8	1	17.6	1
13.9	1	17.7	1
14.0	1	17.8	1
14.1	1	17.9	1
14.2	1	18.0	1
14.3	1	18.1	1
14.4	1	18.2	1
14.5	1	18.3	1

SHT A34

14.6	1	18.4	1
14.7	1	18.5	1

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 10:40:24
Watershed file: --> C:\PO165TK\P2EX .MOP
Hydrograph file: --> C:\PO165TK\P2E-25.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	0	22.4	0
18.7	0	22.5	0
18.8	0	22.6	0
18.9	0	22.7	0
19.0	0	22.8	0
19.1	0	22.9	0
19.2	0	23.0	0
19.3	0	23.1	0
19.4	0	23.2	0
19.5	0	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

SHTA36

Quick TR-55 Ver.5.46 S/N:
Executed: 10:45:26 08-19-1997 c:\po165tk\P2.TCT

RETENTION BASIN 2
PROPOSED CONDITIONS

Tc COMPUTATIONS FOR: P2

SHEET FLOW (Applicable to Tc only)

Segment ID		1			
Surface description		BARE			
Manning's roughness coeff., n		0.0110			
Flow length, L (total < or = 300)	ft	250.0			
Two-yr 24-hr rainfall, P2	in	3.000			
Land slope, s	ft/ft	0.0280			
$T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.04		=	0.04

SHALLOW CONCENTRATED FLOW

Segment ID		2		3		
Surface (paved or unpaved)?		Unpaved		Unpaved		
Flow length, L	ft	210.0		220.0		
Watercourse slope, s	ft/ft	0.1190		0.0100		
Avg.V = Csf * $(s)^{0.5}$	ft/s	5.5658		1.6135		
where: Unpaved Csf = 16.1345						
Paved Csf = 20.3282						
T = L / (3600*V)	hrs	0.01	+	0.04	=	0.05

CHANNEL FLOW

Segment ID		N/A		
Cross Sectional Flow Area, a	sq.ft	0.00		
Wetted perimeter, Pw	ft	0.00		
Hydraulic radius, r = a/Pw	ft	0.000		
Channel slope, s	ft/ft	0.0000		
Manning's roughness coeff., n		0.0000		
$V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000		
Flow length, L	ft	0		
T = L / (3600*V)	hrs	0.00	=	0.00

::

TOTAL TIME (hrs) 0.09

000326

use 0.1 hrs

SHT A37

Quick TR-55 Ver.5.46 S/N:
Executed: 10:45:26 08-19-1997 c:\po165tk\P2.TCT

1634

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 2
PROPOSED CONDITIONS

Subarea descr.	Tc or Tt	Time (hrs)
P2	Tc	0.09

USE 0.1 hrs

000327

SHT A38

Quick TR-55 Ver.5.46 S/N:
Executed: 10:45:54 08-19-1997

RETENTION BASIN 2, PROPOSED CONDITIONS
HoA 49.5%, Gn 38.1%, HeF 6.6%,
GRAVEL ROAD 3.5%,
MaC2 2.3%

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA (C): FALLOW, BARE SOIL	3.00	91	
Gn (B): FALLOW, BARE SOIL	2.31	86	
HeF, (B): FALLOW, BARE SOIL	0.40	86	
MaC2, (C): FALLOW, BARE SOIL	0.14	91	
GRAVEL ROAD	0.21	91	
COMPOSITE AREA --->	6.06	88.8	(89)

::

SHT A39

Quick TR-55 Ver.5.46 S/N:
Executed: 10:45:54 08-19-1997

1634

RETENTION BASIN 2, PROPOSED CONDITIONS
HoA 49.5%, Gn 38.1%, HeF 6.6%,
GRAVEL ROAD 3.5%,
MaC2 2.3%

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	6.06	89

SHT A40

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:56:59
Watershed file: --> C:\PO165TK\P2 .MOP
Hydrograph file: --> C:\PO165TK\P2-25.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
P2	6.06	89.0	0.10	0.00	4.80	3.58	I.05	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 6.06 acres or 0.00947 sq.mi
Peak discharge = 34 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P2	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

000330

Return Frequency: 25 years

1634

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:56:59
Watershed file: --> C:\PO165TK\P2 .MOP
Hydrograph file: --> C:\PO165TK\P2-25.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P2	34	12.1
Composite Watershed	34	12.1

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 10:56:59
Watershed file: --> C:\PO165TK\P2 .MOP
Hydrograph file: --> C:\PO165TK\P2-25.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P2	1	1	2	11	22	34	21	7	5
Total (cfs)	1	1	2	11	22	34	21	7	5

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P2	4	4	3	3	2	2	2	2	1
Total (cfs)	4	4	3	3	2	2	2	2	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P2	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P2	1	1	0	0	0
Total (cfs)	1	1	0	0	0

SHT A43

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 10:56:59
Watershed file: --> C:\PO165TK\P2 .MOP
Hydrograph file: --> C:\PO165TK\P2-25.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	1	14.8	1
11.1	1	14.9	1
11.2	1	15.0	1
11.3	1	15.1	1
11.4	1	15.2	1
11.5	2	15.3	1
11.6	2	15.4	1
11.7	5	15.5	1
11.8	8	15.6	1
11.9	11	15.7	1
12.0	22	15.8	1
12.1	34	15.9	1
12.2	21	16.0	1
12.3	7	16.1	1
12.4	5	16.2	1
12.5	4	16.3	1
12.6	4	16.4	1
12.7	3	16.5	1
12.8	3	16.6	1
12.9	2	16.7	1
13.0	2	16.8	1
13.1	2	16.9	1
13.2	2	17.0	1
13.3	2	17.1	1
13.4	2	17.2	1
13.5	2	17.3	1
13.6	2	17.4	1
13.7	1	17.5	1
13.8	1	17.6	1
13.9	1	17.7	1
14.0	1	17.8	1
14.1	1	17.9	1
14.2	1	18.0	1
14.3	1	18.1	1
14.4	1	18.2	1
14.5	1	18.3	

14.6	1	18.4	1
14.7	1	18.5	1

SHT A44

SKT A45

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 10:56:59
Watershed file: --> C:\PO165TK\P2 .MOP
Hydrograph file: --> C:\PO165TK\P2-25.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	1	22.4	0
18.7	1	22.5	0
18.8	1	22.6	0
18.9	1	22.7	0
19.0	1	22.8	0
19.1	1	22.9	0
19.2	1	23.0	0
19.3	1	23.1	0
19.4	1	23.2	0
19.5	1	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

SHT A46

POND-2 Version: 5.17 S/N:

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

Inflow Hydrograph: c:\po165tk\P2E-25 .HYD
Qpeak = 17.0 cfs

Estimated Outflow: c:\po165tk\ESTIMATE.EST
Qpeak = 0.0 cfs

Approximate Storage Volume
(computed from t= 11.00 to 25.90 hrs)

1.3 acre-ft

SHT A47

POND-2 Version: 5.17 S/N:

1634

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Qpeak = 34.0 cfs

Estimated Outflow: c:\po165tk\ESTIMATE.EST
Qpeak = 0.0 cfs

Approximate Storage Volume
(computed from t= 11.00 to 25.90 hrs)

1.7 acre-ft

NOTE: VOLUME ESTIMATE FOR EXISTING CONDITIONS = 1.3 AC.-FT (PREVIOUS SHEET)

VOLUME ESTIMATE FOR PROPOSED CONDITIONS = 1.7 AC-FT

USE PROPOSED CONDITIONS
FOR ROUTING

POND-2 Version: 5.17
S/N:

SHT A48

RETENTION BASIN 2
W/3:1 SIDE SLOPES

CALCULATED 08-19-1997 11:11:30
DISK FILE: c:\po165tk\SW2-T1 .VOL

Planimeter scale: 1 inch = 10 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
528.70	0.00	0.00	0.00	0.00	0.00
529.00	25.38	0.06	0.06	0.01	0.01
530.00	42.26	0.10	0.23	0.08	0.08
531.00	62.78	0.14	0.36	0.12	0.20
532.00	83.00	0.19	0.50	0.17	0.37
533.00	104.32	0.24	0.64	0.21	0.58
534.00	127.21	0.29	0.80	0.27	0.85
535.00	154.79	0.36	0.97	0.32	1.17
536.00	185.99	0.43	1.17	0.39	1.56
537.00	215.38	0.49	1.38	0.46	2.02

Elevations With Areas Interpolated From
The Closest Two Planimeter Readings

530.30	-----	0.11	0.31	0.03	0.11

* Incremental volume computed by the Conic Method for Reservoir Volumes.

000338

SKT A49

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44

1634

```
************************
*                      *
*   STORM BASIN NO. 2  *
*   W/3:1 SIDE SLOPES  *
*                      *
*                      *
*                      *
************************
```

Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Rating Table file: c:\po165tk\SW2-T1 .PND

----INITIAL CONDITIONS----
Elevation = 530.30 ft —— MAX. SEDIMENT CLEANOUT ELEV
Outflow = 0.00 cfs
Storage = 0.11 ac-ft —— MAX. SEDIMENT STORAGE VOLUME

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
528.70	0.0	0.000
529.00	0.0	0.010
530.00	0.0	0.080
530.30	0.0	0.110
531.00	0.0	0.200
532.00	0.0	0.370
533.00	0.0	0.580
534.00	0.0	0.850
535.00	0.0	1.170
536.00	0.0	1.560
537.00	0.0	2.020

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
2.4	2.4
19.4	19.4
26.6	26.6
48.4	48.4
89.5	89.5
140.4	140.4
205.7	205.7
283.1	283.1
377.5	377.5
488.8	488.8

Time increment (t) = 0.100 hrs.

SHT A50

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44

Pond File: c:\po165tk\SW2-T1 .PND
Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Outflow Hydrograph: c:\po165tk\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	1.00	-----	26.6	26.6	0.00	530.30
11.100	1.00	2.0	28.6	28.6	0.00	530.36
11.200	1.00	2.0	30.6	30.6	0.00	530.43
11.300	1.00	2.0	32.6	32.6	0.00	530.49
11.400	1.00	2.0	34.6	34.6	0.00	530.56
11.500	2.00	3.0	37.6	37.6	0.00	530.65
11.600	2.00	4.0	41.6	41.6	0.00	530.78
11.700	5.00	7.0	48.6	48.6	0.00	531.01
11.800	8.00	13.0	61.6	61.6	0.00	531.32
11.900	11.00	19.0	80.6	80.6	0.00	531.78
12.000	22.00	33.0	113.6	113.6	0.00	532.47
12.100	34.00	56.0	169.6	169.6	0.00	533.45
12.200	21.00	55.0	224.6	224.6	0.00	534.24
12.300	7.00	28.0	252.6	252.6	0.00	534.61
12.400	5.00	12.0	264.6	264.6	0.00	534.76
12.500	4.00	9.0	273.6	273.6	0.00	534.88
12.600	4.00	8.0	281.6	281.6	0.00	534.98
12.700	3.00	7.0	288.6	288.6	0.00	535.0[illegible]
12.800	3.00	6.0	294.6	294.6	0.00	535.12
12.900	2.00	5.0	299.6	299.6	0.00	535.17
13.000	2.00	4.0	303.6	303.6	0.00	535.22
13.100	2.00	4.0	307.6	307.6	0.00	535.26
13.200	2.00	4.0	311.6	311.6	0.00	535.30
13.300	2.00	4.0	315.6	315.6	0.00	535.34
13.400	2.00	4.0	319.6	319.6	0.00	535.39
13.500	2.00	4.0	323.6	323.6	0.00	535.43
13.600	2.00	4.0	327.6	327.6	0.00	535.47
13.700	2.00	4.0	331.6	331.6	0.00	535.51
13.800	1.00	3.0	334.6	334.6	0.00	535.55
13.900	1.00	2.0	336.6	336.6	0.00	535.57
14.000	1.00	2.0	338.6	338.6	0.00	535.59
14.100	1.00	2.0	340.6	340.6	0.00	535.61
14.200	1.00	2.0	342.6	342.6	0.00	535.63
14.300	1.00	2.0	344.6	344.6	0.00	535.65
14.400	1.00	2.0	346.6	346.6	0.00	535.67
14.500	1.00	2.0	348.6	348.6	0.00	535.69
14.600	1.00	2.0	350.6	350.6	0.00	535.71
14.700	1.00	2.0	352.6	352.6	0.00	535.74
14.800	1.00	2.0	354.6	354.6	0.00	535.76
14.900	1.00	2.0	356.6	356.6	0.00	535.78
15.000	1.00	2.0	358.6	358.6	0.00	535.80
15.100	1.00	2.0	360.6	360.6	0.00	535.82
15.200	1.00	2.0	362.6	362.6	0.00	535.8[illegible]
15.300	1.00	2.0	364.6	364.6	0.00	535.8[illegible]
15.400	1.00	2.0	366.6	366.6	0.00	535.88

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44

ond File: c:\po165tk\SW2-T1 .PND
Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Outflow Hydrograph: c:\po165tk\SW2-T1 .HYD

1634

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	1.00	2.0	368.6	368.6	0.00	535.91
15.600	1.00	2.0	370.6	370.6	0.00	535.93
15.700	1.00	2.0	372.6	372.6	0.00	535.95
15.800	1.00	2.0	374.6	374.6	0.00	535.97
15.900	1.00	2.0	376.6	376.6	0.00	535.99
16.000	1.00	2.0	378.6	378.6	0.00	536.01
16.100	1.00	2.0	380.6	380.6	0.00	536.03
16.200	1.00	2.0	382.6	382.6	0.00	536.05
16.300	1.00	2.0	384.6	384.6	0.00	536.06
16.400	1.00	2.0	386.6	386.6	0.00	536.08
16.500	1.00	2.0	388.6	388.6	0.00	536.10
16.600	1.00	2.0	390.6	390.6	0.00	536.12
16.700	1.00	2.0	392.6	392.6	0.00	536.14
16.800	1.00	2.0	394.6	394.6	0.00	536.15
16.900	1.00	2.0	396.6	396.6	0.00	536.17
17.000	1.00	2.0	398.6	398.6	0.00	536.19
17.100	1.00	2.0	400.6	400.6	0.00	536.21
17.200	1.00	2.0	402.6	402.6	0.00	536.23
17.300	1.00	2.0	404.6	404.6	0.00	536.24
17.400	1.00	2.0	406.6	406.6	0.00	536.26
17.500	1.00	2.0	408.6	408.6	0.00	536.28
17.600	1.00	2.0	410.6	410.6	0.00	536.30
17.700	1.00	2.0	412.6	412.6	0.00	536.32
17.800	1.00	2.0	414.6	414.6	0.00	536.33
17.900	1.00	2.0	416.6	416.6	0.00	536.35
18.000	1.00	2.0	418.6	418.6	0.00	536.37
18.100	1.00	2.0	420.6	420.6	0.00	536.39
18.200	1.00	2.0	422.6	422.6	0.00	536.41
18.300	1.00	2.0	424.6	424.6	0.00	536.42
18.400	1.00	2.0	426.6	426.6	0.00	536.44
18.500	1.00	2.0	428.6	428.6	0.00	536.46
18.600	1.00	2.0	430.6	430.6	0.00	536.48
18.700	1.00	2.0	432.6	432.6	0.00	536.49
18.800	1.00	2.0	434.6	434.6	0.00	536.51
18.900	1.00	2.0	436.6	436.6	0.00	536.53
19.000	1.00	2.0	438.6	438.6	0.00	536.55
19.100	1.00	2.0	440.6	440.6	0.00	536.57
19.200	1.00	2.0	442.6	442.6	0.00	536.58
19.300	1.00	2.0	444.6	444.6	0.00	536.60
19.400	1.00	2.0	446.6	446.6	0.00	536.62
19.500	0.00	1.0	447.6	447.6	0.00	536.63
19.600	0.00	0.0	447.6	447.6	0.00	536.63
19.700	0.00	0.0	447.6	447.6	0.00	536.63
19.800	0.00	0.0	447.6	447.6	0.00	536.63
19.900	0.00	0.0	447.6	447.6	0.00	536.63
20.000	0.00	0.0	447.6	447.6	0.00	536.63

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44

Pond File: c:\po165tk\SW2-T1 .PND
Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Outflow Hydrograph: c:\po165tk\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	0.00	0.0	447.6	447.6	0.00	536.63
20.200	0.00	0.0	447.6	447.6	0.00	536.63
20.300	0.00	0.0	447.6	447.6	0.00	536.63
20.400	0.00	0.0	447.6	447.6	0.00	536.63
20.500	0.00	0.0	447.6	447.6	0.00	536.63
20.600	0.00	0.0	447.6	447.6	0.00	536.63
20.700	0.00	0.0	447.6	447.6	0.00	536.63
20.800	0.00	0.0	447.6	447.6	0.00	536.63
20.900	0.00	0.0	447.6	447.6	0.00	536.63
21.000	0.00	0.0	447.6	447.6	0.00	536.63
21.100	0.00	0.0	447.6	447.6	0.00	536.63
21.200	0.00	0.0	447.6	447.6	0.00	536.63
21.300	0.00	0.0	447.6	447.6	0.00	536.63
21.400	0.00	0.0	447.6	447.6	0.00	536.63
21.500	0.00	0.0	447.6	447.6	0.00	536.63
21.600	0.00	0.0	447.6	447.6	0.00	536.63
21.700	0.00	0.0	447.6	447.6	0.00	536.63
21.800	0.00	0.0	447.6	447.6	0.00	536.63
21.900	0.00	0.0	447.6	447.6	0.00	536.63
22.000	0.00	0.0	447.6	447.6	0.00	536.63
22.100	0.00	0.0	447.6	447.6	0.00	536.63
22.200	0.00	0.0	447.6	447.6	0.00	536.63
22.300	0.00	0.0	447.6	447.6	0.00	536.63
22.400	0.00	0.0	447.6	447.6	0.00	536.63
22.500	0.00	0.0	447.6	447.6	0.00	536.63
22.600	0.00	0.0	447.6	447.6	0.00	536.63
22.700	0.00	0.0	447.6	447.6	0.00	536.63
22.800	0.00	0.0	447.6	447.6	0.00	536.63
22.900	0.00	0.0	447.6	447.6	0.00	536.63
23.000	0.00	0.0	447.6	447.6	0.00	536.63
23.100	0.00	0.0	447.6	447.6	0.00	536.63
23.200	0.00	0.0	447.6	447.6	0.00	536.63
23.300	0.00	0.0	447.6	447.6	0.00	536.63
23.400	0.00	0.0	447.6	447.6	0.00	536.63
23.500	0.00	0.0	447.6	447.6	0.00	536.63
23.600	0.00	0.0	447.6	447.6	0.00	536.63
23.700	0.00	0.0	447.6	447.6	0.00	536.63
23.800	0.00	0.0	447.6	447.6	0.00	536.63
23.900	0.00	0.0	447.6	447.6	0.00	536.63
24.000	0.00	0.0	447.6	447.6	0.00	536.63
24.100	0.00	0.0	447.6	447.6	0.00	536.63
24.200	0.00	0.0	447.6	447.6	0.00	536.63
24.300	0.00	0.0	447.6	447.6	0.00	536.63
24.400	0.00	0.0	447.6	447.6	0.00	536.63
24.500	0.00	0.0	447.6	447.6	0.00	536.63
24.600	0.00	0.0	447.6	447.6	0.00	536.63

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44

1634

Pond File: c:\po165tk\SW2-T1 .PND
Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Outflow Hydrograph: c:\po165tk\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.00	0.0	447.6	447.6	0.00	536.63
24.800	0.00	0.0	447.6	447.6	0.00	536.63
24.900	0.00	0.0	447.6	447.6	0.00	536.63
25.000	0.00	0.0	447.6	447.6	0.00	536.63
25.100	0.00	0.0	447.6	447.6	0.00	536.63
25.200	0.00	0.0	447.6	447.6	0.00	536.63
25.300	0.00	0.0	447.6	447.6	0.00	536.63
25.400	0.00	0.0	447.6	447.6	0.00	536.63
25.500	0.00	0.0	447.6	447.6	0.00	536.63
25.600	0.00	0.0	447.6	447.6	0.00	536.63
25.700	0.00	0.0	447.6	447.6	0.00	536.63
25.800	0.00	0.0	447.6	447.6	0.00	536.63
25.900	0.00	0.0	447.6	447.6	0.00	536.63

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: c:\po165tk\SW2-T1 .PND
Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Outflow Hydrograph: c:\po165tk\SW2-T1 .HYD

Starting Pond W.S. Elevation = 530.30 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 34.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 536.63 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.11 ac-ft
Peak Storage From Storm = 1.74 ac-ft

Total Storage in Pond = 1.85 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

SHT A55

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

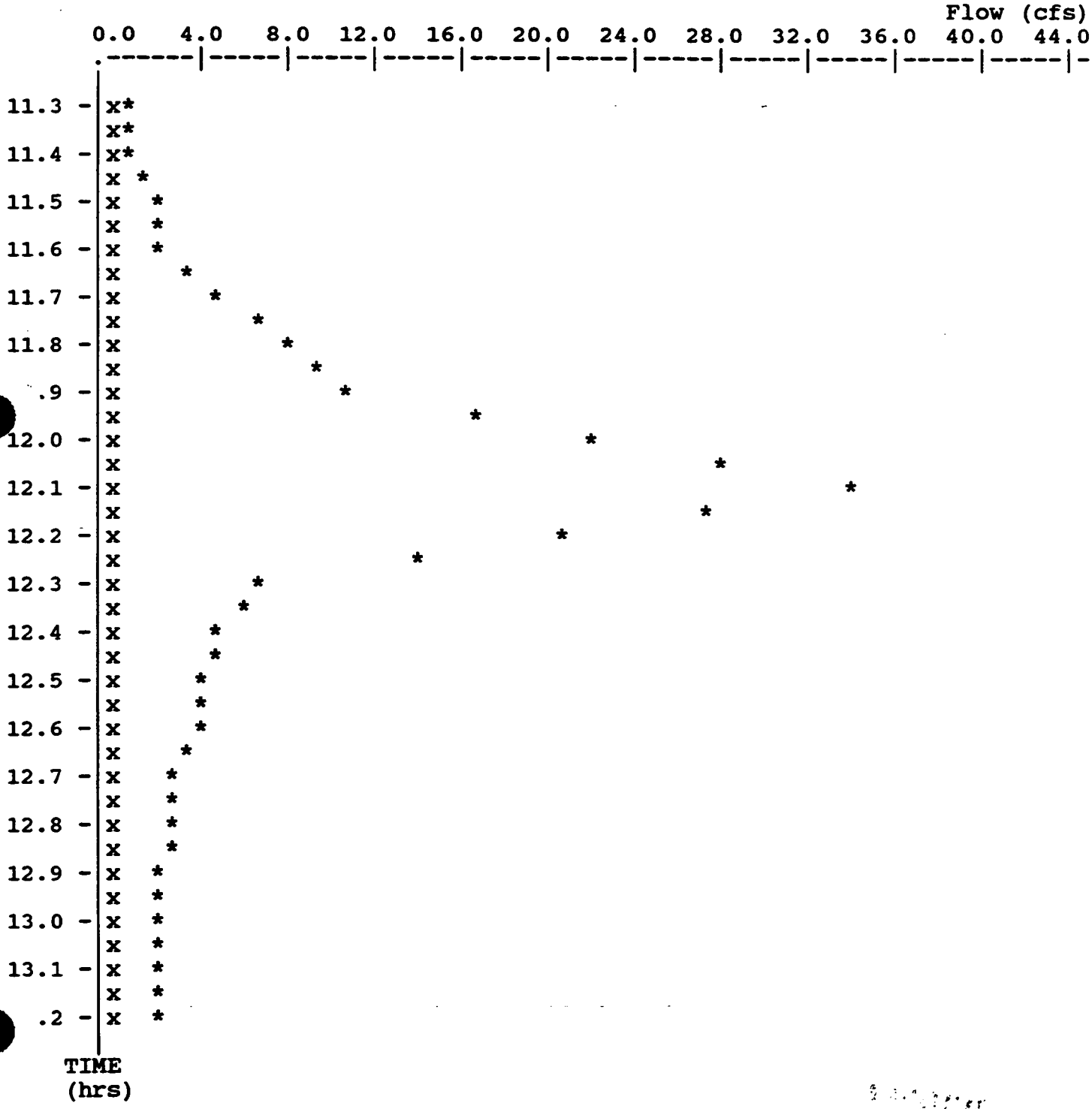
POND-2 Version: 5.17 S/N:

1634

Pond File: c:\po165tk\SW2-T1 .PND
Inflow Hydrograph: c:\po165tk\P2-25 .HYD
Outflow Hydrograph: c:\po165tk\SW2-T1 .HYD

EXECUTED: 08-19-1997
11:12:44

Peak Inflow = 34.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 536.63 ft



```
*  File:  c:\po165tk\P2-25    .HYD   Qmax =    34.0 cfs
x  File:  c:\po165tk\SW2-T1   .HYD   Qmax =     0.0 cfs
```

SHT A56

000346

SWT A57

1634

RETENTION BASIN 3

SHT A58

Quick TR-55 Ver.5.46 S/N:
Executed: 11:20:38 08-19-1997 c:\po165tk\P3.TCT

RETENTION BASIN 3

Tc COMPUTATIONS FOR: P3

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		BARE SOIL	
Manning's roughness coeff., n		0.0110	
Flow length, L (total < or = 300)	ft	222.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0810	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.02	= 0.02

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	145.0	
Watercourse slope, s	ft/ft	0.0760	
$Avg.V = Csf \bullet (s)^{0.5}$	ft/s	4.4480	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		N/A	
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.03

USE 0.1 hrs

SHT A59

Quick TR-55 Ver.5.46 S/N:
Executed: 11:20:38 08-19-1997 c:\po165tk\P3.TCT

1634

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 3

Subarea descr.	Tc or Tt	Time (hrs)
P3	Tc	0.03

USE 0.1 hrs

SHT A60

Quick TR-55 Ver.5.46 S/N:
Executed: 11:20:53 08-19-1997

RETENTION BASIN 3
HoA 35%, MoE2 30%, Gn 15%, HeF 11.6%
GRAVEL SURFACE = 8.4%%
ASSUMED ANY VEG AREA AS BARE

RUNOFF CURVE NUMBER DATA

::

Composite Area: P3

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA, (C): FALLOW, BARE SOIL	1.67	91	
MoE2, (B): FALLOW, BARE SOIL	1.43	86	
Gn, (B): FALLOW, BARE SOIL	0.72	86	
HeF, (B): FALLOW, BARE SOIL	0.56	86	
GRAVEL ROAD	0.40	91	
COMPOSITE AREA --->	4.78	88.2	(88)

::

000350

SHT A61

Quick TR-55 Ver.5.46 S/N:
Executed: 11:20:53 08-19-1997

1634

RETENTION BASIN 3
HoA 35%, MoE2 30%, Gn 15%, HeF 11.6%
GRAVEL SURFACE = 8.4%%
ASSUMED ANY VEG AREA AS BARE

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
P3	4.78	88

SHT A52

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 11:22:38
Watershed file: --> C:\PO165TK\P3 .MOP
Hydrograph file: --> C:\PO165TK\P3-10.HYD

RETENTION BASIN 3

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
P3	4.78	88.0	0.10	0.00	4.10	2.82	I.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 4.78 acres or 0.00747 sq.mi
Peak discharge = 21 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P3	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

000352

SKA63

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 11:22:38
Watershed file: --> C:\PO165TK\P3 .MOP
Hydrograph file: --> C:\PO165TK\P3-10.HYD

RETENTION BASIN 3

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P3	21	12.1
Composite Watershed	21	12.1

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-19-1997 11:22:38
Watershed file: --> C:\PO165TK\P3 .MOP
Hydrograph file: --> C:\PO165TK\P3-10.HYD

RETENTION BASIN 3

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P3	1	1	1	7	14	21	13	5	3
Total (cfs)	1	1	1	7	14	21	13	5	3

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P3	3	2	2	2	1	1	1	1	1
Total (cfs)	3	2	2	2	1	1	1	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P3	1	1	1	1	1	0	0	0	0
Total (cfs)	1	1	1	1	1	0	0	0	0

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P3	0	0	0	0	0
Total (cfs)	0	0	0	0	0

SHT A65

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 11:22:38
Watershed file: --> C:\PO165TK\P3 .MOP
Hydrograph file: --> C:\PO165TK\P3-10.HYD

RETENTION BASIN 3

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	1	14.8	1
11.1	1	14.9	1
11.2	1	15.0	1
11.3	1	15.1	1
11.4	1	15.2	1
11.5	1	15.3	1
11.6	1	15.4	1
11.7	3	15.5	1
11.8	5	15.6	1
11.9	7	15.7	1
12.0	14	15.8	0
12.1	21	15.9	0
12.2	13	16.0	0
12.3	5	16.1	0
12.4	3	16.2	0
12.5	3	16.3	0
12.6	2	16.4	0
12.7	2	16.5	0
12.8	2	16.6	0
12.9	1	16.7	0
13.0	1	16.8	0
13.1	1	16.9	0
13.2	1	17.0	0
13.3	1	17.1	0
13.4	1	17.2	0
13.5	1	17.3	0
13.6	1	17.4	0
13.7	1	17.5	0
13.8	1	17.6	0
13.9	1	17.7	0
14.0	1	17.8	0
14.1	1	17.9	0
14.2	1	18.0	0
14.3	1	18.1	0
14.4	1	18.2	0
14.5	1	18.3	0

SKT A60

14.6	1	18.4	0
14.7	1	18.5	0

SAT A67

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

1634

Executed: 08-19-1997 11:22:38
Watershed file: --> C:\PO165TK\P3 .MOP
Hydrograph file: --> C:\PO165TK\P3-10.HYD

RETENTION BASIN 3

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	0	22.4	0
18.7	0	22.5	0
18.8	0	22.6	0
18.9	0	22.7	0
19.0	0	22.8	0
19.1	0	22.9	0
19.2	0	23.0	0
19.3	0	23.1	0
19.4	0	23.2	0
19.5	0	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

POND-2 Version: 5.17
S/N:

SHT A68

RETENTION BASIN 3
W/3:1 SIDE SLOPES
1' DEEPER

CALCULATED 08-19-1997 13:16:51
DISK FILE: c:\po165tk\SW3-T1 .VOL

Planimeter scale: 1 inch = 10 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
532.50	0.00	0.00	0.00	0.00	0.00
533.00	26.52	0.06	0.06	0.01	0.01
534.00	36.29	0.08	0.22	0.07	0.08
535.00	47.04	0.11	0.29	0.10	0.18
536.00	58.73	0.13	0.36	0.12	0.30
537.00	71.40	0.16	0.45	0.15	0.45
538.00	85.08	0.20	0.54	0.18	0.63
539.00	99.71	0.23	0.64	0.21	0.84
540.00	117.39	0.27	0.75	0.25	1.09
541.00	131.90	0.30	0.86	0.29	1.3[illegible]

Elevations With Areas Interpolated From
The Closest Two Planimeter Readings

540.10	-----	0.27	0.81	0.03	1.11
540.20	-----	0.28	0.82	0.05	1.14
540.30	-----	0.28	0.82	0.08	1.17
540.40	-----	0.28	0.83	0.11	1.20
540.50	-----	0.29	0.83	0.14	1.23
540.60	-----	0.29	0.84	0.17	1.26
540.70	-----	0.29	0.84	0.20	1.28
540.80	-----	0.30	0.85	0.23	1.31
540.90	-----	0.30	0.85	0.26	1.34

* Incremental volume computed by the Conic Method for Reservoir Volumes.

SKT A69

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 13:19:51

1634

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*****************************
*                           *
* STORM WATER BASIN NO. 3   *
*                           *
*                           *
*                           *
*                           *
*****************************
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Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Rating Table file: c:\po165tk\SW3-T1 .PND

----INITIAL CONDITIONS----
Elevation = 534.20 ft — MAX. SEDIMENT CLEANOUT ELEV.
Outflow = 0.00 cfs
Storage = 0.10 ac-ft — MAX. SEDIMENT STORAGE

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
532.50	0.0	0.000	0.0	0.0
533.00	0.0	0.010	2.4	2.4
534.00	0.0	0.080	19.4	19.4
535.00	0.0	0.180	43.6	43.6
536.00	0.0	0.300	72.6	72.6
537.00	0.0	0.450	108.9	108.9
538.00	0.0	0.630	152.5	152.5
539.00	0.0	0.840	203.3	203.3
540.00	0.0	1.090	263.8	263.8
540.10	3.2	1.110	268.6	271.8
540.20	6.5	1.140	275.9	282.4
540.30	9.7	1.170	283.1	292.8
540.40	13.0	1.200	290.4	303.4
540.50	16.2	1.230	297.7	313.9
540.60	22.1	1.260	304.9	327.0
540.70	29.6	1.280	309.8	339.4
540.80	37.8	1.310	317.0	354.8
540.90	46.8	1.340	324.3	371.1
541.00	56.5	1.370	331.5	388.0

Time increment (t) = 0.100 hrs.

SNT A 70

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 13:19:51

Pond File: c:\po165tk\SW3-T1 .PND
Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Outflow Hydrograph: c:\po165tk\SW3-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	1.00	-----	24.2	24.2	0.00	534.20
11.100	1.00	2.0	26.2	26.2	0.00	534.28
11.200	1.00	2.0	28.2	28.2	0.00	534.37
11.300	1.00	2.0	30.2	30.2	0.00	534.45
11.400	1.00	2.0	32.2	32.2	0.00	534.53
11.500	1.00	2.0	34.2	34.2	0.00	534.61
11.600	1.00	2.0	36.2	36.2	0.00	534.70
11.700	3.00	4.0	40.2	40.2	0.00	534.86
11.800	5.00	8.0	48.2	48.2	0.00	535.16
11.900	7.00	12.0	60.2	60.2	0.00	535.57
12.000	14.00	21.0	81.2	81.2	0.00	536.24
12.100	21.00	35.0	116.2	116.2	0.00	537.17
12.200	13.00	34.0	150.2	150.2	0.00	537.95
12.300	5.00	18.0	168.2	168.2	0.00	538.31
12.400	3.00	8.0	176.2	176.2	0.00	538.47
12.500	3.00	6.0	182.2	182.2	0.00	538.59
12.600	2.00	5.0	187.2	187.2	0.00	538.68
12.700	2.00	4.0	191.2	191.2	0.00	538.7[illegible]
12.800	2.00	4.0	195.2	195.2	0.00	538.84
12.900	2.00	4.0	199.2	199.2	0.00	538.92
13.000	1.00	3.0	202.2	202.2	0.00	538.98
13.100	1.00	2.0	204.2	204.2	0.00	539.02
13.200	1.00	2.0	206.2	206.2	0.00	539.05
13.300	1.00	2.0	208.2	208.2	0.00	539.08
13.400	1.00	2.0	210.2	210.2	0.00	539.11
13.500	1.00	2.0	212.2	212.2	0.00	539.15
13.600	1.00	2.0	214.2	214.2	0.00	539.18
13.700	1.00	2.0	216.2	216.2	0.00	539.21
13.800	1.00	2.0	218.2	218.2	0.00	539.25
13.900	1.00	2.0	220.2	220.2	0.00	539.28
14.000	1.00	2.0	222.2	222.2	0.00	539.31
14.100	1.00	2.0	224.2	224.2	0.00	539.35
14.200	1.00	2.0	226.2	226.2	0.00	539.38
14.300	1.00	2.0	228.2	228.2	0.00	539.41
14.400	1.00	2.0	230.2	230.2	0.00	539.44
14.500	1.00	2.0	232.2	232.2	0.00	539.48
14.600	1.00	2.0	234.2	234.2	0.00	539.51
14.700	1.00	2.0	236.2	236.2	0.00	539.54
14.800	1.00	2.0	238.2	238.2	0.00	539.58
14.900	1.00	2.0	240.2	240.2	0.00	539.61
15.000	1.00	2.0	242.2	242.2	0.00	539.64
15.100	1.00	2.0	244.2	244.2	0.00	539.68
15.200	1.00	2.0	246.2	246.2	0.00	539.7[illegible]
15.300	1.00	2.0	248.2	248.2	0.00	539.7[illegible]
15.400	1.00	2.0	250.2	250.2	0.00	539.78

SHT A71

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 13:19:51

Pond File: c:\po165tk\SW3-T1 .PND
Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Outflow Hydrograph: c:\po165tk\SW3-T1 .HYD

1634

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	1.00	2.0	252.2	252.2	0.00	539.81
15.600	1.00	2.0	254.2	254.2	0.00	539.84
15.700	1.00	2.0	256.2	256.2	0.00	539.87
15.800	0.00	1.0	257.2	257.2	0.00	539.89
15.900	0.00	0.0	257.2	257.2	0.00	539.89
16.000	0.00	0.0	257.2	257.2	0.00	539.89
16.100	0.00	0.0	257.2	257.2	0.00	539.89
16.200	0.00	0.0	257.2	257.2	0.00	539.89
16.300	0.00	0.0	257.2	257.2	0.00	539.89
16.400	0.00	0.0	257.2	257.2	0.00	539.89
16.500	0.00	0.0	257.2	257.2	0.00	539.89
16.600	0.00	0.0	257.2	257.2	0.00	539.89
16.700	0.00	0.0	257.2	257.2	0.00	539.89
16.800	0.00	0.0	257.2	257.2	0.00	539.89
16.900	0.00	0.0	257.2	257.2	0.00	539.89
17.000	0.00	0.0	257.2	257.2	0.00	539.89
17.100	0.00	0.0	257.2	257.2	0.00	539.89
17.200	0.00	0.0	257.2	257.2	0.00	539.89
17.300	0.00	0.0	257.2	257.2	0.00	539.89
17.400	0.00	0.0	257.2	257.2	0.00	539.89
17.500	0.00	0.0	257.2	257.2	0.00	539.89
17.600	0.00	0.0	257.2	257.2	0.00	539.89
17.700	0.00	0.0	257.2	257.2	0.00	539.89
17.800	0.00	0.0	257.2	257.2	0.00	539.89
17.900	0.00	0.0	257.2	257.2	0.00	539.89
18.000	0.00	0.0	257.2	257.2	0.00	539.89
18.100	0.00	0.0	257.2	257.2	0.00	539.89
18.200	0.00	0.0	257.2	257.2	0.00	539.89
18.300	0.00	0.0	257.2	257.2	0.00	539.89
18.400	0.00	0.0	257.2	257.2	0.00	539.89
18.500	0.00	0.0	257.2	257.2	0.00	539.89
18.600	0.00	0.0	257.2	257.2	0.00	539.89
18.700	0.00	0.0	257.2	257.2	0.00	539.89
18.800	0.00	0.0	257.2	257.2	0.00	539.89
18.900	0.00	0.0	257.2	257.2	0.00	539.89
19.000	0.00	0.0	257.2	257.2	0.00	539.89
19.100	0.00	0.0	257.2	257.2	0.00	539.89
19.200	0.00	0.0	257.2	257.2	0.00	539.89
19.300	0.00	0.0	257.2	257.2	0.00	539.89
19.400	0.00	0.0	257.2	257.2	0.00	539.89
19.500	0.00	0.0	257.2	257.2	0.00	539.89
19.600	0.00	0.0	257.2	257.2	0.00	539.89
19.700	0.00	0.0	257.2	257.2	0.00	539.89
19.800	0.00	0.0	257.2	257.2	0.00	539.89
19.900	0.00	0.0	257.2	257.2	0.00	539.89
20.000	0.00	0.0	257.2	257.2	0.00	539.89

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 13:19:51

Pond File: c:\po165tk\SW3-T1 .PND
Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Outflow Hydrograph: c:\po165tk\SW3-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	0.00	0.0	257.2	257.2	0.00	539.89
20.200	0.00	0.0	257.2	257.2	0.00	539.89
20.300	0.00	0.0	257.2	257.2	0.00	539.89
20.400	0.00	0.0	257.2	257.2	0.00	539.89
20.500	0.00	0.0	257.2	257.2	0.00	539.89
20.600	0.00	0.0	257.2	257.2	0.00	539.89
20.700	0.00	0.0	257.2	257.2	0.00	539.89
20.800	0.00	0.0	257.2	257.2	0.00	539.89
20.900	0.00	0.0	257.2	257.2	0.00	539.89
21.000	0.00	0.0	257.2	257.2	0.00	539.89
21.100	0.00	0.0	257.2	257.2	0.00	539.89
21.200	0.00	0.0	257.2	257.2	0.00	539.89
21.300	0.00	0.0	257.2	257.2	0.00	539.89
21.400	0.00	0.0	257.2	257.2	0.00	539.89
21.500	0.00	0.0	257.2	257.2	0.00	539.89
21.600	0.00	0.0	257.2	257.2	0.00	539.89
21.700	0.00	0.0	257.2	257.2	0.00	539.89
21.800	0.00	0.0	257.2	257.2	0.00	539.89
21.900	0.00	0.0	257.2	257.2	0.00	539.89
22.000	0.00	0.0	257.2	257.2	0.00	539.89
22.100	0.00	0.0	257.2	257.2	0.00	539.89
22.200	0.00	0.0	257.2	257.2	0.00	539.89
22.300	0.00	0.0	257.2	257.2	0.00	539.89
22.400	0.00	0.0	257.2	257.2	0.00	539.89
22.500	0.00	0.0	257.2	257.2	0.00	539.89
22.600	0.00	0.0	257.2	257.2	0.00	539.89
22.700	0.00	0.0	257.2	257.2	0.00	539.89
22.800	0.00	0.0	257.2	257.2	0.00	539.89
22.900	0.00	0.0	257.2	257.2	0.00	539.89
23.000	0.00	0.0	257.2	257.2	0.00	539.89
23.100	0.00	0.0	257.2	257.2	0.00	539.89
23.200	0.00	0.0	257.2	257.2	0.00	539.89
23.300	0.00	0.0	257.2	257.2	0.00	539.89
23.400	0.00	0.0	257.2	257.2	0.00	539.89
23.500	0.00	0.0	257.2	257.2	0.00	539.89
23.600	0.00	0.0	257.2	257.2	0.00	539.89
23.700	0.00	0.0	257.2	257.2	0.00	539.89
23.800	0.00	0.0	257.2	257.2	0.00	539.89
23.900	0.00	0.0	257.2	257.2	0.00	539.89
24.000	0.00	0.0	257.2	257.2	0.00	539.89
24.100	0.00	0.0	257.2	257.2	0.00	539.89
24.200	0.00	0.0	257.2	257.2	0.00	539.89
24.300	0.00	0.0	257.2	257.2	0.00	539.89
24.400	0.00	0.0	257.2	257.2	0.00	539.89
24.500	0.00	0.0	257.2	257.2	0.00	539.89
24.600	0.00	0.0	257.2	257.2	0.00	539.89

Pond File: c:\po165tk\SW3-T1 .PND
Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Outflow Hydrograph: c:\po165tk\SW3-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.00	0.0	257.2	257.2	0.00	539.89
24.800	0.00	0.0	257.2	257.2	0.00	539.89
24.900	0.00	0.0	257.2	257.2	0.00	539.89
25.000	0.00	0.0	257.2	257.2	0.00	539.89
25.100	0.00	0.0	257.2	257.2	0.00	539.89
25.200	0.00	0.0	257.2	257.2	0.00	539.89
25.300	0.00	0.0	257.2	257.2	0.00	539.89
25.400	0.00	0.0	257.2	257.2	0.00	539.89
25.500	0.00	0.0	257.2	257.2	0.00	539.89
25.600	0.00	0.0	257.2	257.2	0.00	539.89
25.700	0.00	0.0	257.2	257.2	0.00	539.89
25.800	0.00	0.0	257.2	257.2	0.00	539.89
25.900	0.00	0.0	257.2	257.2	0.00	539.89

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: c:\po165tk\SW3-T1 .PND
Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Outflow Hydrograph: c:\po165tk\SW3-T1 .HYD

Starting Pond W.S. Elevation = 534.20 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 21.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 539.89 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.10 ac-ft
Peak Storage From Storm = 0.96 ac-ft

Total Storage in Pond = 1.06 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

PEAK ELEV - 539.89 < OVERFLOW OUTLET ELEV 540.0

∴ BASIN IS ACCEPTABLE

SHT A75

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

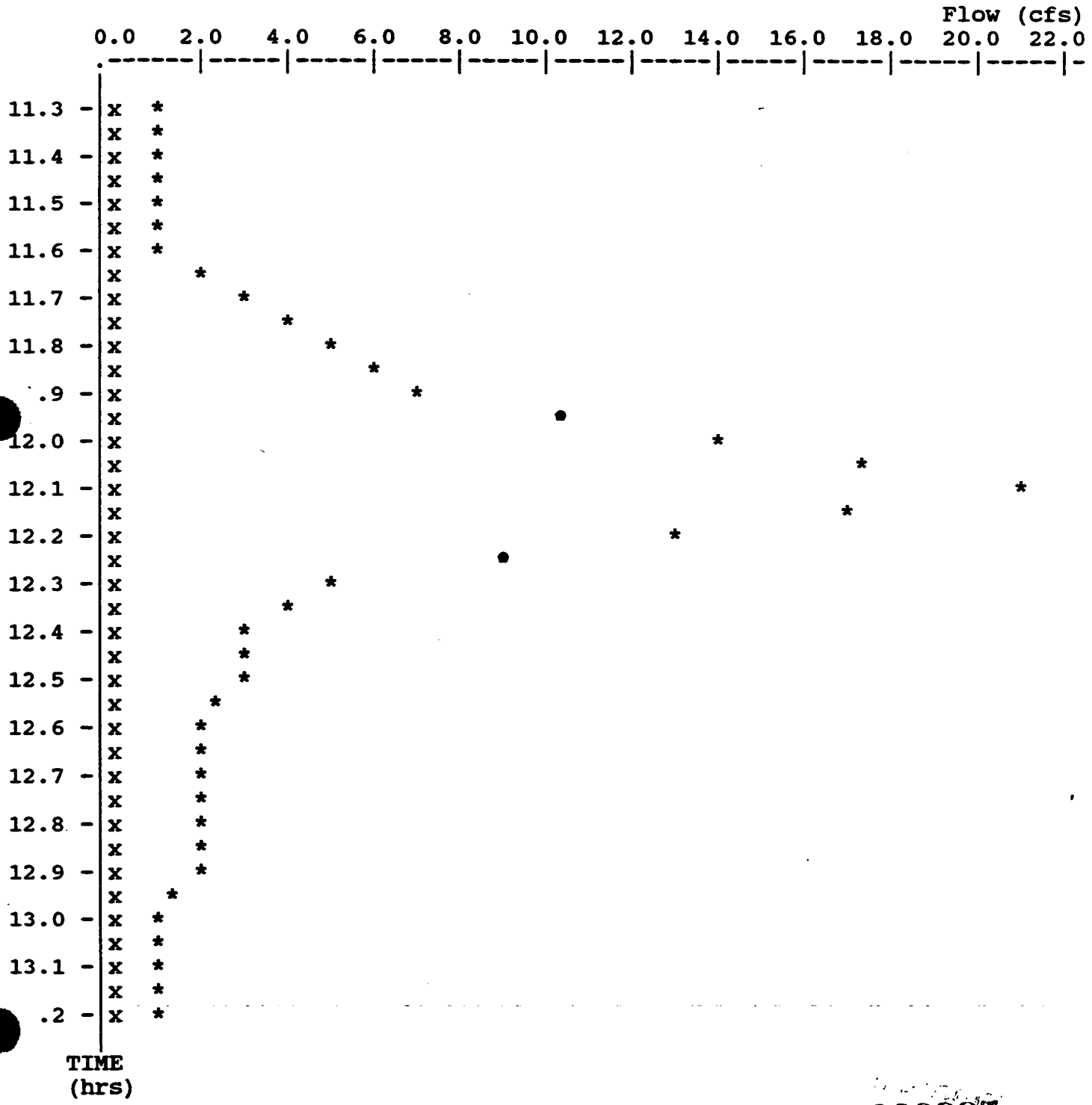
POND-2 Version: 5.17 S/N:

1634

Pond File: c:\po165tk\SW3-T1 .PND
Inflow Hydrograph: c:\po165tk\P3-10 .HYD
Outflow Hydrograph: c:\po165tk\SW3-T1 .HYD

EXECUTED: 08-19-1997
13:19:51

Peak Inflow = 21.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 539.89 ft



SKTA76

```
*  File:  c:\po165tk\P3-10    .HYD   Qmax =    21.0 cfs
x  File:  c:\po165tk\SW3-T1   .HYD   Qmax =     0.0 cfs
```

ATTACHMENT B, DITCHES

Methodology

This calculation is performed using the "worst case" scenario for peak flows. Each ditch was evaluated under existing conditions (after construction of ditches and basins, but before remediation activities begin), and proposed conditions (after remediation activities have been completed).

The Modified Rational Method (Reference 2) was used to determine peak flows for the 10 year and 25 year (Ditches 2 & 6 only) frequency storm events. After drainage areas (existing and proposed) were calculated for each ditch, a weighted runoff coefficient (C) was determined based on land use area and type. A rainfall intensity was selected based on the shortest duration (duration = 10 min for all ditches except ditch 12) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

Ditch 12 has a large, relatively flat drainage area (see last assumption on this page). SCS procedures were used to find the time of concentration (duration) for the ditch 12 drainage area. The rainfall intensity was selected based on the time of concentration (duration) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

With the peak flows known for both existing and proposed conditions, the highest peak flow was selected for design. Ditches were designed based on the uniform flow theory using Manning's equation. In most cases ditch slopes varied. In one instance the bottom width varied. In order to evaluate ditch design and performance of ditch lining, the worst case flow conditions for velocity and flow depth were considered for the three types of ditch lining (i.e. erosion control blanket, dumped rock fill, or exposed geomembrane liner). The Flow Master computer program was used to evaluate the effects of the varying components on the performance of the ditch (Reference 4).

Ditch sections 2A and 2B, and ditch sections 2C and 2D are all the same ditch. Ditch sections 2A and 2B will be constructed to accommodate existing conditions. The section of ditch labeled 2A has channel slopes of approximately 10% and will be lined with riprap (dumped rock fill). The section of ditch labeled 2B has flat channel slopes (approx. 0.8%), and will be lined with erosion control blanket.

Ditch section 2C under proposed condtiions is the same section as 2A under existing conditions. Since ditch section 2C under proposed conditions has less flow than section 2A under existing condtiions, section 2C will not be modified.

Ditch section 2D will replace ditch section 2B during grading activities. This ditch section will have a flat channel slope (approx 0.7%) with a varying left-side slope.

Ditch 12 will be designed assuming that an existing culvert located east of the drainage area (see Proposed Conditions, Sheet 2 of 2 drainage area map) becomes

clogged and forces additional water into the normal drainage area for Ditch 12.

Ditches 13 & 14 and the existing 24" culvert at the wheel wash area were originally designed under Calculation No. 15-02, PO158 (Haul Road Upgrade Project). These ditches were relocated eastward to accommodate construction of the Wheel Wash Facility. The total drainage area or land use did not change. Therefore, the design geometry proposed for these ditches under PO158 will be used on this project. New calculations are not provided.

Two types of ditch lining were evaluated for most ditches; vegetated using erosion control blankets, and dumped rock fill. Ditches 2B, 3-7, and 9 will have an exposed geomembrane liner. Roughness coefficients for the erosion control blanket and dumped rock fill were selected from Reference 7, and are as follows:

Erosion Control Blankets $n = 0.04$
Riprap $n = 0.06$

Maximum flow velocity for using erosion control blankets as a lining material was established at 4.0 feet per second (Reference 7).

Roughness coefficient for the exposed geomembrane liner was derived from values typically used for polyethylene pipe:

Geomembrane liner $n = 0.009$

In addition to the ditches described above, three interceptor ditches (Interceptor Ditch 1, 2, & 3) will be constructed during various phases of remediation to prevent runon to the exposed GMA (See Construction Drawings 92X-5900-G-00286, G-00333, and G-00413). Interceptor ditch 1 will have both erosion control blanket lining and dumped rock lining. Interceptor ditches 2 & 3 will have a geomembrane lining.

Calculations are included on the following pages.

SHT B3

1634

TABLE 1
DRAINAGE AREA AND PEAK FLOW SUMMARY

DITCH	EXISTING CONDITIONS		PROPOSED CONDITIONS	
	DRAINAGE AREA (AC)	FLOW (CFS)	DRAINAGE AREA (AC)	FLOW (CFS)
10 YEAR STORM FREQUENCY				
DITCH - 1	1.57	3.88	0.54	2.18
DITCH - 2A	3.45	8.18	N/A	N/A
DITCH - 2B	3.45	8.18	N/A	N/A
DITCH - 2C	N/A	N/A	1.82	6.09
DITCH - 2D	N/A	N/A	3.54	12.65
DITCH - 3	8.40	19.31	6.63	25.33
DITCH - 4	0.69	2.67	0.69	2.67
DITCH - 5	0.62	2.37	0.62	2.37
DITCH - 6	0.47	1.79	0.47	1.79
DITCH - 7	1.76	5.90	2.04	7.87
DITCH - 8A	1.80	5.88	1.45	5.56
DITCH - 8B	3.21	9.21	1.82	7.02
DITCH - 9	3.31	11.50	3.42	13.22
DITCH - 10 (A & B)	0.41	1.34	0.27	0.88
DITCH - 11	1.17	4.28	0.85	3.24
DITCH - 12	7.52	8.91	7.52	8.91
DITCH - 13	DESIGNED UNDER PO158, HAUL ROAD UPGRADE			
DITCH - 14	DESIGNED UNDER PO158, HAUL ROAD UPGRADE			
DITCH - 15	0.20	1.0	0.2	1.0
25 YEAR STORM FREQUENCY				
DITCH - 2A	3.45	10.06	N/A	N/A
DITCH - 2B	3.45	10.06	N/A	N/A
DITCH - 2C	N/A	N/A	1.82	7.49
DITCH - 2D	N/A	N/A	3.54	15.56
INTERCEPTOR DITCH - 1A	N/A	N/A	2.65	12.43
INTERCEPTOR DITCH - 1B	N/A	N/A	4.27	20.03
INTERCEPTOR DITCH - 2	N/A	N/A	2.10	9.85
INTERCEPTOR DITCH - 3	N/A	N/A	2.88	13.51
DITCH 6	0.47	2.20	0.47	2.20

SHT B4

Quick TR-55 Ver.5.46 S/N:
Executed: 15:18:48 10-27-1996

DITCH-1
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	1.46						
GRAVEL RD	0.900	0.11						
			10.00	0.454	0.454	5.450	1.57	3.88

000370

SHT B5

1634

Quick TR-55 Ver.5.46 S/N:
Executed: 14:50:44 10-27-1996

DITCH-1
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, S>4:1								
	0.700	0.43						
GRAVEL RD	0.900	0.11						
			10.00	0.741	0.741	5.450	0.54	2.18

000371

SHT B6

Quick TR-55 Ver.5.46 S/N:
Executed: 06:37:27 02-04-1997

DITCH-2A
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	3.34						
GRAVEL ROAD	0.900	0.11						
			10.00	0.435	0.435	5.450	3.45	8.18

000372

SHB7

Quick TR-55 Ver.5.46 S/N:
Executed: 14:09:34 07-21-1997

1634

DITCH-2A
DRAINAGE AREA P1
EXISTING CONDITIONS, 25 YR STORM

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	3.34						
GRAVEL ROAD	0.900	0.11						
			10.00	0.435	0.435	6.700	3.45	10.06

SHT B8

Quick TR-55 Ver.5.46 S/N:
Executed: 06:38:22 02-04-1997

DITCH-2B
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	3.34						
GRAVEL ROAD	0.900	0.11						
			10.00	0.435	0.435	5.450	3.45	8.18

000374

SHT B9

Quick TR-55 Ver.5.46 S/N:
Executed: 14:10:15 07-21-1997

1634

DITCH-2B
DRAINAGE AREA P1
EXISTING CONDITIONS, 25 YR STORM

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	3.34						
GRAVEL ROAD	0.900	0.11						
			10.00	0.435	0.435	6.700	3.45	10.06

SHT B10

Quick TR-55 Ver.5.46 S/N:
Executed: 06:43:08 02-04-1997

DITCH-2C
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, >4:1	0.700	0.82						
WOODED, FAIR	0.500	0.89						
GRAVEL ROAD	0.900	0.11						
			10.00	0.614	0.614	5.450	1.82	6.

000376

Quick TR-55 Ver.5.46 S/N:
Executed: 14:11:45 07-21-1997

SHT B11

1634

DITCH-2C
DRAINAGE AREA P1
PROPOSED CONDITIONS, 25 YR STORM

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.82						
WOODED, FAIR	0.500	0.89						
GRAVEL ROAD	0.900	0.11						
			10.00	0.614	0.614	6.700	1.82	7.49

000377

SHT B12

Quick TR-55 Ver.5.46 S/N:
Executed: 06:43:50 02-04-1997

DITCH-2D
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, >4:1	0.700	2.54						
WOODED, FAIR	0.500	0.89						
GRAVEL ROAD	0.900	0.11						
			10.00	0.656	0.656	5.450	3.54	12.

000378

Quick TR-55 Ver.5.46 S/N:
Executed: 16:54:32 08-19-1997

SHT B13

1634

DITCH-2D
DRAINAGE AREA P1
PROPOSED CONDITIONS, 25 YR STORM

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, >4:1	0.700	2.54						
WOODED, FAIR	0.500	0.89						
GRAVEL ROAD	0.900	0.11						
			10.00	0.656	0.656	6.700	3.54	15.56

SHT B14

Quick TR-55 Ver.5.46 S/N:
Executed: 15:56:04 10-27-1996

DITCH-3
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. S>4:1	0.420	8.37						
GRAVEL ROAD	0.900	0.03						
			10.00	0.422	0.422	5.450	8.40	19.31

000380

SHT B15

Quick TR-55 Ver.5.46 S/N:
Executed: 15:00:44 01-22-1997

1634

DITCH-3
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
`C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	6.60						
GRAVEL ROAD	0.900	0.03						
			10.00	0.701	0.701	5.450	6.63	25.33

000381

SHT B16

Quick TR-55 Ver.5.46 S/N:
Executed: 15:07:33 04-26-1997

DITCH-4
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.66						
GRAVEL ROAD	0.900	0.03						
			10.00	0.709	0.709	5.450	0.69	2.67

000382

SHT B17

Quick TR-55 Ver.5.46 S/N:
Executed: 15:06:30 04-26-1997

1634

DITCH-4
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.66						
GRAVEL ROAD	0.900	0.03						
			10.00	0.709	0.709	5.450	0.69	2.67

Quick TR-55 Ver.5.46 S/N:
Executed: 14:15:21 04-28-1997

SHT B18

DITCH-5
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.62						
			10.00	0.700	0.700	5.450	0.62	2.37

000384

SHT B19

Quick TR-55 Ver.5.46 S/N:
Executed: 14:16:50 04-28-1997

1634

DITCH-5
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.62						
			10.00	0.700	0.700	5.450	0.62	2.37

SHT B20

Quick TR-55 Ver.5.46 S/N:
Executed: 14:18:30 04-28-1997

DITCH-6
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.47						
			10.00	0.700	0.700	5.450	0.47	1.79

000386

SHT B21

1634

Quick TR-55 Ver.5.46 S/N:
Executed: 14:19:02 04-28-1997

DITCH-6
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.47						
			10.00	0.700	0.700	5.450	0.47	1.79

B22

Quick TR-55 Ver.5.46 S/N:
Executed: 17:07:06 08-19-1997

DITCH-6
DRAINAGE AREA P2
EXISTING CONDITIONS, 25 YR STORM

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.47						
			10.00	0.700	0.700	6.700	0.47	2.20

000388

B23

1634

Quick TR-55 Ver.5.46 S/N:
Executed: 17:07:40 08-19-1997

DITCH-6
DRAINAGE AREA P2
PROPOSED CONDITIONS, 25 YR STORM

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
`C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.47						
			10.00	0.700	0.700	6.700	0.47	2.20

000389

SHT B24

Quick TR-55 Ver.5.46 S/N:
Executed: 16:06:06 04-29-1997

DITCH-7
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	0.59						
BARE,>4:1	0.700	1.09						
GRAVEL RD	0.900	0.08						
			10.00	0.615	0.615	5.450	1.76	5.90

000390

SHT B25

Quick TR-55 Ver.5.46 S/N:
Executed: 07:34:14 04-29-1997

1634

DITCH-7
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	1.96						
GRAVEL RD	0.900	0.08						
			10.00	0.708	0.708	5.450	2.04	7.87

SHT B26

Quick TR-55 Ver.5.46 S/N:
Executed: 10:46:30 04-30-1997

DITCH-8A
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
`C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.10						
VEG, FAIR	0.420	0.67						
GRAVEL RD	0.900	0.03						
			10.00	0.599	0.599	5.450	1.80	5.88

000392

SHT B27

Quick TR-55 Ver.5.46 S/N:
Executed: 14:47:00 04-29-1997

1634

DITCH-8A
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.42						
GRAVEL RD	0.900	0.03						
			10.00	0.704	0.704	5.450	1.45	5.56

SHT B28

Quick TR-55 Ver.5.46 S/N:
Executed: 10:46:56 04-30-1997

DITCH-8B
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.10						
VEG, FAIR	0.420	2.04						
GRAVEL RD	0.900	0.07						
			10.00	0.526	0.526	5.450	3.21	9.21

000394

SHT B29

Quick TR-55 Ver.5.46 S/N:
Executed: 14:48:13 04-29-1997

1634

DITCH-8B
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.75						
GRAVEL RD	0.900	0.07						
			10.00	0.708	0.708	5.450	1.82	7.02

000395

SHT B30

Quick TR-55 Ver.5.46 S/N:
Executed: 16:47:01 01-20-1997

DITCH-9
DRAINAGE AREA P3
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	2.63						
BARE	0.700	0.40						
GRAVEL RD	0.900	0.28						
			10.00	0.637	0.637	5.450	3.31	11.50

000396

SHT B31

Quick TR-55 Ver.5.46 S/N:
Executed: 16:47:37 01-20-1997

1634

DITCH-9
DRAINAGE AREA P3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	2.89						
GRAVEL RD	0.900	0.28						
VEG, POOR	0.600	0.25						
			10.00	0.709	0.709	5.450	3.42	13.22

000397

SHT B32

Quick TR-55 Ver.5.46 S/N:
Executed: 09:27:01 11-24-1996

DITCH-10 (10A AND 10B)
DRAINAGE AREA P3
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.41						
			10.00	0.600	0.600	5.450	0.41	1.34

000398

SHT B33

Quick TR-55 Ver.5.46 S/N:
Executed: 09:27:45 11-24-1996

1634

DITCH-10 (10A AND 10B)
DRAINAGE AREA P3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.27						
			10.00	0.600	0.600	5.450	0.27	0.88

SHT B34

Quick TR-55 Ver.5.46 S/N:
Executed: 16:49:52 01-20-1997

DITCH-11
DRAINAGE AREA P3
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.89						
GRAVEL	0.900	0.28						
			10.00	0.672	0.672	5.450	1.17	4.28

000400

SHT B35

Quick TR-55 Ver.5.46 S/N:
Executed: 16:49:22 01-20-1997

1634

DITCH-11
DRAINAGE AREA P3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.57						
GRAVEL	0.900	0.28						
			10.00	0.699	0.699	5.450	0.85	3.24

SHT B36

Quick TR-55 Ver.5.46 S/N:
Executed: 14:03:23 02-04-1997

DITCH-12
EXISTING/PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
WOODS	0.300	6.32						
VEG, FAIR	0.420	1.00						
GRAVEL ROAD	0.900	0.20						
			20.40	0.332	0.332	3.570	7.52	8.91

000402

SHT B37

Quick TR-55 Ver.5.46 S/N:
Executed: 14:02:25 02-04-1997 c:\po165d\D12P.TCT

1634

DITCH 12

Tc COMPUTATIONS FOR: DITCH 12

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		WOODS, LT	
Manning's roughness coeff., n		0.4000	
Flow length, L (total < or = 300)	ft	122.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.30	= 0.30

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		2	
Cross Sectional Flow Area, a	sq.ft	7.50	
Wetted perimeter, Pw	ft	8.71	
Hydraulic radius, r = a/Pw	ft	0.861	
Channel slope, s	ft/ft	0.0130	
Manning's roughness coeff., n		0.0400	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	3.8441	
Flow length, L	ft	485	
T = L / (3600*V)	hrs	0.04	= 0.04

::

TOTAL TIME (hrs) 0.34

SHT B38

Quick TR-55 Ver.5.46 S/N:
Executed: 14:02:25 02-04-1997 c:\po165d\D12P.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

DITCH 12

Subarea descr.	Tc or Tt	Time (hrs)
DITCH 12	Tc	0.34

SHT B39

TIME OF CONCENTRATION, DITCH 12
Worksheet for Trapezoidal Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	TIME OF CONC., DITCH 12
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.013000	ft/ft
Depth	1.50	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	28.76	cfs
Flow Area	7.50	ft²
Wetted Perimeter	8.71	ft
Top Width	8.00	ft
Critical Depth	1.25	ft
Critical Slope	0.027917	ft/ft
Velocity	3.83	ft/s
Velocity Head	0.23	ft
Specific Energy	1.73	ft
Froude Number	0.70	
Flow is subcritical.		

000405

SHT B40

DITCHES 13 & 14 DESIGNED UNDER PO158, HAUL ROAD UPGRADE PROJECT

SHT B 41

Quick TR-55 Ver.5.46 S/N:
Executed: 09:39:59 06-10-1997

1634

DITCH 15
EXISTING AND PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
GRAVEL	0.900	0.20						
			10.00	0.900	0.900	5.450	0.20	0.98

SNT B41A

Quick TR-55 Ver.5.46 S/N:
Executed: 13:49:28 09-28-1997

INTERCEPTOR DITCH 1A
V-DITCH GEOMETRY
BASE BID GRADING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	2.65						
			10.00	0.700	0.700	6.700	2.65	12.43

000408

SHT B41B

Quick TR-55 Ver.5.46 S/N:
Executed: 13:54:34 09-28-1997

1634

INTERCEPTOR DITCH 1B
FLAT BOTTOM GEOMETRY
BASE BID GRADING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	4.27						
			10.00	0.700	0.700	6.700	4.27	20.03

SHT B41C

Quick TR-55 Ver.5.46 S/N:
Executed: 14:14:12 09-28-1997

INTERCEPTOR DITCH 2

BASE BID GRADING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	2.10						
			10.00	0.700	0.700	6.700	2.10	9.85

000410

SKT. B41D

Quick TR-55 Ver.5.46 S/N:
Executed: 13:58:54 09-28-1997

1634

INTERCEPTOR DITCH 3

INTERIM GRADING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	2.88						
			10.00	0.700	0.700	6.700	2.88	13.51

TABLE 2

SUMMARY OF DITCH PERFORMANCE

DITCH	Q (CFS)	SLOPE		VELOCITY		FLOW DEPTH		COMMENTS
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
10 YR STORM EVENT								
DITCH - 1	3.88	0.5	2.6	1.6	3.0	0.8	1.1	EROSION CONTROL BLANKET
DITCH - 2A	8.18	10.0	10.0	4.5	4.5	1.0	1.0	DUMPED ROCK FILL
DITCH - 2B	8.18	0.8	0.8	7.2	7.2	0.8	0.8	GEOMEMBRANE LINER
DITCH - 2C	6.09 CFS < 8.18 CFS UNDER EXISTING CONDITIONS, USE SAME AS D-2B							
DITCH - 2D	12.65	0.7	0.7	1.3	2.3	0.6	1.4	EROSION CONTROL BLANKET
DITCH - 3	25.33	0.7	0.7	7.0	8.1	0.4	0.6	GEOMEMBRANE LINER
DITCH - 4	2.67	0.9	0.9	4.9	4.9	0.2	0.2	GEOMEMBRANE LINER
DITCH - 5	2.37	1.5	1.5	5.7	5.7	0.2	0.2	GEOMEMBRANE LINER
DITCH - 6	1.79	1.4	1.4	5.1	5.1	0.2	0.2	GEOMEMBRANE LINER
DITCH - 7	7.87	1.1	2.9	7.5	10.4	0.3	• D_n = 0.4 • D_u = 1.6	GEOMEMBRANE LINER
DITCH - 8A	5.88	0.8	0.8	2.2	2.2	1.2	1.2	EROSION CONTROL BLANKET
DITCH - 8B	9.21	10.0	10.0	4.6	4.6	1.0	1.0	DUMPED ROCK FILL
DITCH - 9	13.22	1.1	6.7	7.6	14.1	0.2	• D_n = 0.4 • D_u = 1.7	GEOMEMBRANE LINER
DITCH - 10A	1.34	4.3	4.3	2.8	2.8	0.5	0.5	EROSION CONTROL BLANKET
DITCH - 10B	1.34	20.0	20.0	3.7	3.7	0.4	0.4	DUMPED ROCK FILL
DITCH - 11	4.28	2.6	4.0	3.1	3.6	0.8	• D_n = 0.8 • D_u = 1.7	EROSION CONTROL BLANKET
DITCH - 12	8.91	0.8	1.4	2.4	2.9	0.8	1.0	EROSION CONTROL BLANKET
DITCHES - 13 & 14	DITCH DESIGNED UNDER PO158, HAUL ROAD UPGRADE							EROSION CONTROL BLANKET
DITCH - 15	1.0	2.5	3.0	2.1	2.3	0.5	0.5	EROSION CONTROL BLANKET
25 YR STORM EVENT								
DITCH - 2A	10.1	10.0	10.0	4.7	4.7	1.0	1.0	DUMPED ROCK FILL
DITCH - 2B	10.1	0.8	0.8	7.6	7.6	0.8	0.8	GEOMEMBRANE LINER
DITCH - 2D	12.65	0.7	0.7	1.3	2.3	0.6	1.4	EROSION CONTROL BLANKET
DITCH - 6	2.20	1.4	1.4	5.4	5.4	0.2	0.2	GEOMEMBRANE LINER
INTERCEPTOR DITCH - 1A	12.43	0.8	0.8	2.6	2.6	1.6	1.6	EROSION CONTROL BLANKET
INTERCEPTOR DITCH - 1B	20.03	2.3	20.0	3.1	6.6	0.6	1.1	DUMPED ROCK FILL
INTERCEPTOR DITCH - 2	9.85	0.5	13.0	6.0	18.8	0.2.	0.5	GEOMEMBRANE LINER
INTERCEPTOR DITCH - 3	13.51	0.9	0.9	8.2	8.2	0.5	0.5	GEOMEMBRANE LINER

Normal flow depth * D_u = Flow depth upstream of velocity check

000412

SHT 8 of 12

SHT B43

DITCH-1 (D1)
Worksheet for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-1 (D1)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.005000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	3.88	cfs

Results		
Depth	1.09	ft
Flow Area	2.38	ft^2
Wetted Perimeter	4.88	ft
Top Width	4.37	ft
Critical Depth	0.75	ft
Critical Slope	0.037554	ft/ft
Velocity	1.63	ft/s
Velocity Head	0.04	ft
Specific Energy	1.13	ft
Froude Number	0.39	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 on slopes from 0.5% to 3.6% (See Rating Table).

Use Erosion Control Blanket for channel lining

000413

SHT B44

DITCH-1 (D1)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-1 (D1)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	3.88 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020
Channel Slope	0.005000	0.026000	0.021000 ft/ft

Rating Table

Channel Slope (ft/ft)	Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.005000	0.040	1.09	1.63
0.005000	0.060	1.27	1.20
0.026000	0.040	0.80	3.02
0.026000	0.060	0.93	2.23

000414

SHT B45

1634

DITCH 2A, EXISTING CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2A, EXISTING CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	8.18	cfs

Results		
Depth	0.82	ft
Flow Area	1.36	ft^2
Wetted Perimeter	3.68	ft
Top Width	3.29	ft
Critical Depth	1.01	ft
Critical Slope	0.033997	ft/ft
Velocity	6.03	ft/s
Velocity Head	0.57	ft
Specific Energy	1.39	ft
Froude Number	1.66	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04, Not acceptable

Use Riprap for channel lining on steep section

000415

SHT 846

DITCH 2A, EXISTING CONDITIONS
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2A, EXISTING CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	8.18 cfs

Input Data			
	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.82	6.03
0.060	0.96	4.45

000416

SHT B47

DITCH 2A-25
Worksheet for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2A-25
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.060	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	10.10	cfs

Results		
Depth	1.04	ft
Flow Area	2.15	ft^2
Wetted Perimeter	4.64	ft
Top Width	4.15	ft
Critical Depth	1.10	ft
Critical Slope	0.074376	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energy	1.38	ft
Froude Number	1.15	
Flow is supercritical.		

000417

SHT B48

DITCH 2B, EXISTING CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2B, EXISTING CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	8.18	cfs

Results		
Depth	0.76	ft
Flow Area	1.14	ft^2
Wetted Perimeter	3.38	ft
Top Width	3.02	ft
Critical Depth	1.01	ft
Critical Slope	0.001721	ft/ft
Velocity	7.16	ft/s
Velocity Head	0.80	ft
Specific Energy	1.55	ft
Froude Number	2.05	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 8.2 fps: OK

000418

SHT B49

DITCH 2B-25
Worksheet for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2B-25
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	10.10	cfs

Results		
Depth	0.82	ft
Flow Area	1.34	ft^2
Wetted Perimeter	3.66	ft
Top Width	3.27	ft
Critical Depth	1.10	ft
Critical Slope	0.001673	ft/ft
Velocity	7.55	ft/s
Velocity Head	0.89	ft
Specific Energy	1.70	ft
Froude Number	2.08	
Flow is supercritical.		

000419

SHT B50

DITCH 2C, PROPOSED CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2C PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	8.18	cfs

Results		
Depth	0.82	ft
Flow Area	1.36	ft^2
Wetted Perimeter	3.68	ft
Top Width	3.29	ft
Critical Depth	1.01	ft
Critical Slope	0.033997	ft/ft
Velocity	6.03	ft/s
Velocity Head	0.57	ft
Specific Energy	1.39	ft
Froude Number	1.66	
Flow is supercritical.		

Notes:

This is same ditch with same discharge as ditch 2A under existing conditions.

000420

SHT B51

DITCH 2C, PROPOSED CONDITIONS
Rating Table for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2C PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	8.18 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.82	6.03
0.060	0.96	4.45

000421

SHT B52

DITCH 2C-25
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2C-25
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	7.49	cfs

Results		
Depth	0.80	ft
Flow Area	1.27	ft^2
Wetted Perimeter	3.56	ft
Top Width	3.19	ft
Critical Depth	0.97	ft
Critical Slope	0.034401	ft/ft
Velocity	5.90	ft/s
Velocity Head	0.54	ft
Specific Energy	1.34	ft
Froude Number	1.65	
Flow is supercritical.		

SHT 853

DITCH 2C-25
Rating Table for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2C-25
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	7.49 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.80	5.90
0.060	0.93	4.36

000423

SHT B54

DITCH 2D, PROPOSED CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D, PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.007000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	12.70	cfs

Results		
Depth	1.35	ft
Flow Area	5.51	ft^2
Wetted Perimeter	8.62	ft
Top Width	8.13	ft
Critical Depth	1.02	ft
Critical Slope	0.031514	ft/ft
Velocity	2.31	ft/s
Velocity Head	0.08	ft
Specific Energy	1.44	ft
Froude Number	0.49	
Flow is subcritical.		

Notes:

DITCH 2D WITH VARYING LEFT SIDE SLOPE.

TWO CRITERIA FOR ACCEPTANCE:
1.COMPARE LEFT SIDE SLOPE WITH FLOW DEPTH TO ENSURE FREEBOARD,
2. COMPARE VELOCITY TO ENSURE THAT
V < 4.0 FPS FOR EROSION CONTROL BLANKET.

OK FOR BOTH

000424

SHT B 55

DITCH 2D, PROPOSED CONDITIONS
Rating Table for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D, PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Channel Slope	0.007000	ft/ft
Right Side Slope	2.000000	H : V
Discharge	12.70	cfs

Input Data	Minimum	Maximum	Increment
Left Side Slope	4.000000	60.000000	2.000000 H : V

Rating Table

Left Side Slope (H : V)	Depth (ft)	Velocity (ft/s)
4.000000	1.35	2.31
6.000000	1.21	2.17
8.000000	1.11	2.06
10.000000	1.04	1.97
12.000000	0.98	1.90
14.000000	0.93	1.84
16.000000	0.89	1.79
18.000000	0.85	1.75
20.000000	0.82	1.71
22.000000	0.80	1.67
24.000000	0.77	1.64
26.000000	0.75	1.61
28.000000	0.73	1.58
30.000000	0.71	1.56
32.000000	0.70	1.53
34.000000	0.68	1.51
36.000000	0.67	1.49
38.000000	0.66	1.47
40.000000	0.64	1.46
42.000000	0.63	1.44
44.000000	0.62	1.42
46.000000	0.61	1.41
48.000000	0.60	1.39

000425

SHT B 56

DITCH 2D, PROPOSED CONDITIONS
Rating Table for Triangular Channel

Rating Table		
Left Side Slope (H : V)	Depth (ft)	Velocity (ft/s)
50.000000	0.59	1.38
52.000000	0.59	1.37
54.000000	0.58	1.36
56.000000	0.57	1.34
58.000000	0.56	1.33
60.000000	0.56	1.32

000426

SHT 657

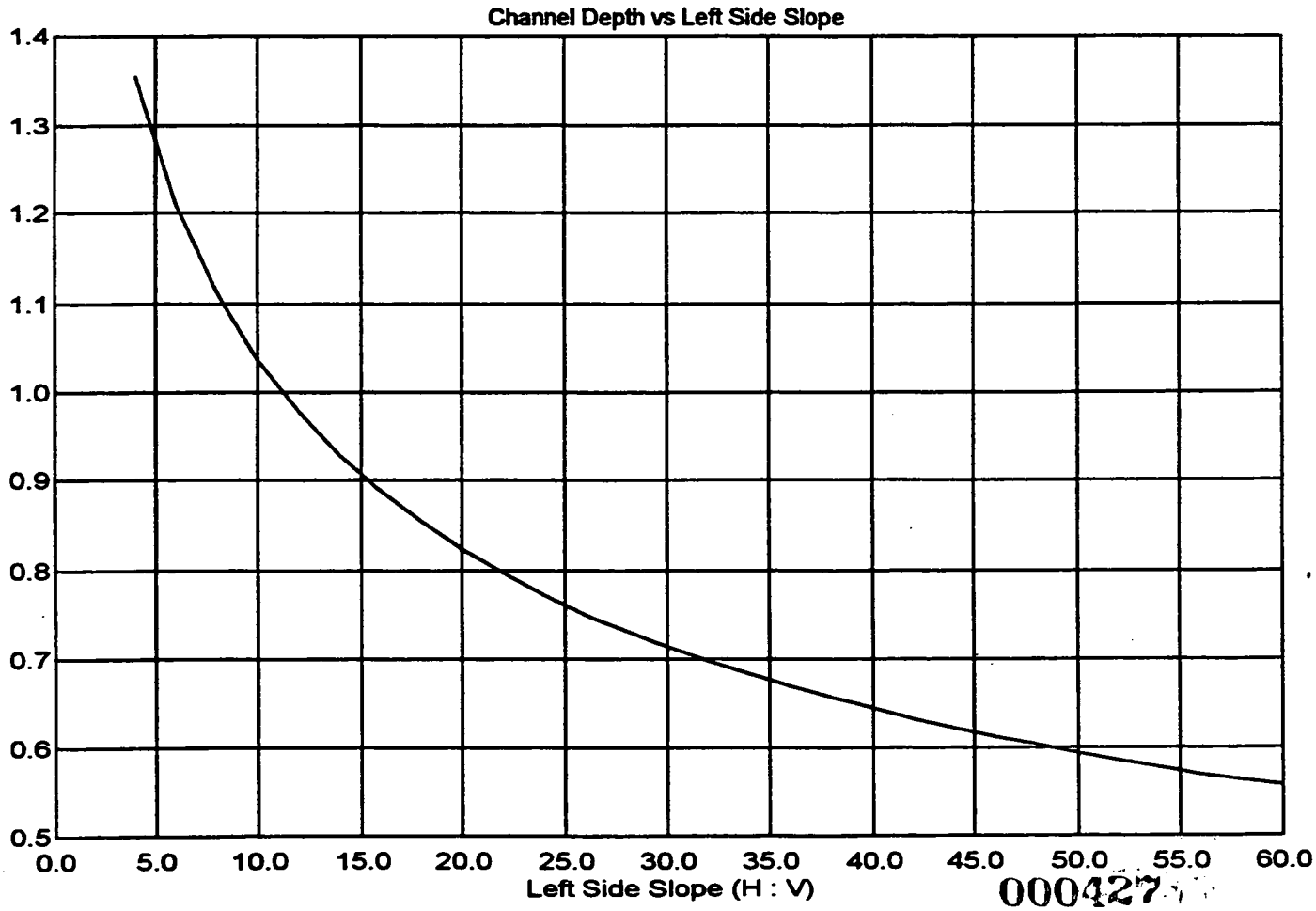
1634

DITCH 2D, PROPOSED CONDITIONS
Plotted Curves for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D, PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Mannings Coefficient	0.040
Channel Slope	0.007000 ft/ft
Right Side Slope	2.000000 H : V
Discharge	12.70 cfs

Input Data			
	Minimum	Maximum	Increment
Left Side Slope	4.000000	60.000000	2.000000 H : V



000427

SHT B58

DITCH 2D-25
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D-25
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.007000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	12.65	cfs

Results		
Depth	1.35	ft
Flow Area	5.49	ft²
Wetted Perimeter	8.60	ft
Top Width	8.12	ft
Critical Depth	1.02	ft
Critical Slope	0.031530	ft/ft
Velocity	2.30	ft/s
Velocity Head	0.08	ft
Specific Energy	1.44	ft
Froude Number	0.49	
Flow is subcritical.		

Notes:

DITCH 2D-25 WITH VARYING LEFT SIDE SLOPES

TWO CRITERIA FOR ACCEPTANCE:
1. COMPARE LEFT SIDE SLOPE WITH FLOW DEPTH TO ENSURE FREEBOARD,
2. COMPARE VELOCITY TO ENSURE THAT V < 4,0 FPS FOR EROSION CONTROL BLANKET

OK FOR BOTH

000928

SHT B59

1634

DITCH 2D-25
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D-25
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Channel Slope	0.007000	ft/ft
Right Side Slope	2.000000	H : V
Discharge	12.65	cfs

Input Data			
	Minimum	Maximum	Increment
Left Side Slope	4.000000	60.000000	2.000000 H : V

Rating Table		
Left Side Slope (H : V)	Depth (ft)	Velocity (ft/s)
4.000000	1.35	2.30
6.000000	1.21	2.16
8.000000	1.11	2.06
10.000000	1.03	1.97
12.000000	0.98	1.90
14.000000	0.93	1.84
16.000000	0.89	1.79
18.000000	0.85	1.74
20.000000	0.82	1.70
22.000000	0.79	1.67
24.000000	0.77	1.64
26.000000	0.75	1.61
28.000000	0.73	1.58
30.000000	0.71	1.55
32.000000	0.70	1.53
34.000000	0.68	1.51
36.000000	0.67	1.49
38.000000	0.66	1.47
40.000000	0.64	1.45
42.000000	0.63	1.44
44.000000	0.62	1.42
46.000000	0.61	1.41
48.000000	0.60	1.39

000429

SHT 8 60

DITCH 2D-25
Rating Table for Triangular Channel

Rating Table		
Left Side Slope (H : V)	Depth (ft)	Velocity (ft/s)
50.000000	0.59	1.38
52.000000	0.59	1.37
54.000000	0.58	1.35
56.000000	0.57	1.34
58.000000	0.56	1.33
60.000000	0.56	1.32

000430

SHT B61

DITCH-3 (D3)
Worksheet for Trapezoidal Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-3 (D3)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.006700	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	25.33	cfs

Results		
Depth	0.60	ft
Flow Area	3.12	ft^2
Wetted Perimeter	6.68	ft
Top Width	6.40	ft
Critical Depth	0.92	ft
Critical Slope	0.001432	ft/ft
Velocity	8.13	ft/s
Velocity Head	1.03	ft
Specific Energy	1.63	ft
Froude Number	2.05	
Flow is supercritical.		

Notes:

NOTE: 4' WIDE DITCH SECTION DOES NOT GET TOTAL "Q"

GEOMEMBRANE LINER

V = 8.1 fps: OK

000431

SHT B62

DITCH-3 (D3)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-3 (D3)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Mannings Coefficient	0.009
Channel Slope	0.006700 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	25.33 cfs

Input Data	Minimum	Maximum	Increment
Bottom Width	4.00	8.00	4.00 ft

Rating Table		
Bottom Width (ft)	Depth (ft)	Velocity (ft/s)
4.00	0.60	8.13
8.00	0.41	6.96

000432

SHT B63

DITCH-4 (D4)
Worksheet for Trapezoidal Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-4 (D4)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.008600	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	2.67	cfs

Results		
Depth	0.22	ft
Flow Area	0.54	ft^2
Wetted Perimeter	2.99	ft
Top Width	2.89	ft
Critical Depth	0.34	ft
Critical Slope	0.001943	ft/ft
Velocity	4.91	ft/s
Velocity Head	0.37	ft
Specific Energy	0.60	ft
Froude Number	2.00	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 4.91 fps: OK

000433

SHT B64

DITCH-5 (D5)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-5 (D5)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.015000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	2.37	cfs

Results		
Depth	0.18	ft
Flow Area	0.42	ft^2
Wetted Perimeter	2.79	ft
Top Width	2.71	ft
Critical Depth	0.32	ft
Critical Slope	0.001977	ft/ft
Velocity	5.69	ft/s
Velocity Head	0.50	ft
Specific Energy	0.68	ft
Froude Number	2.56	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 5.7 fps: OK

000434

SHT B65

DITCH-6 (D6)
Worksheet for Trapezoidal Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-6 (D6)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.014000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	1.79	cfs

Results		
Depth	0.15	ft
Flow Area	0.35	ft^2
Wetted Perimeter	2.69	ft
Top Width	2.61	ft
Critical Depth	0.27	ft
Critical Slope	0.002064	ft/ft
Velocity	5.06	ft/s
Velocity Head	0.40	ft
Specific Energy	0.55	ft
Froude Number	2.42	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 5.1 fps: OK

000435

Str B66

DITCH 6-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 6-25
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.014000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	2.20	cfs

Results		
Depth	0.17	ft
Flow Area	0.41	ft^2
Wetted Perimeter	2.77	ft
Top Width	2.69	ft
Critical Depth	0.30	ft
Critical Slope	0.002000	ft/ft
Velocity	5.42	ft/s
Velocity Head	0.46	ft
Specific Energy	0.63	ft
Froude Number	2.46	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 5.4 fps: OK

000436

SHT E67

DITCH-7 (D7)
Worksheet for Trapezoidal Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-7 (D7)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.011000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	7.87	cfs

Results		
Depth	0.38	ft
Flow Area	1.05	ft^2
Wetted Perimeter	3.70	ft
Top Width	3.52	ft
Critical Depth	0.63	ft
Critical Slope	0.001671	ft/ft
Velocity	7.48	ft/s
Velocity Head	0.87	ft
Specific Energy	1.25	ft
Froude Number	2.41	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

Vmin = 7.5 fps @ S = 1.1% - OK
Vmax = 10.4 fps @ S = 2.9% - USE VELOCITY CHECK

000437

SHT B68

DITCH-7 (D7)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-7 (D7)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.009	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	2.00	ft
Discharge	7.87	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.011000	0.028600	0.017600 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.011000	0.38	7.48
0.028600	0.29	10.43

NORMAL DEPTH

FOR FLOW DEPTH UPSTREAM OF VELOCITY CHECK, USE BROAD-CRESTED WEIR

$Q = CLH^{3/2}$ where $C = 2.61$ (REFERENCE 9 for $h = 0.4$)

$L = 6'$

$$H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{7.87}{2.61 \times 6}\right)^{2/3} = 0.63 \text{ ft}$$

FLOW DEPTH = 1.0 ft (velocity check h) + 0.63 ft = **1.63 ft**

000438

SHT E69

DITCH-8A (D8A)
Worksheet for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-8A (D8A)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000001	H : V
Right Side Slope	2.000000	H : V
Discharge	5.88	cfs

Results		
Depth	1.17	ft
Flow Area	2.73	ft^2
Wetted Perimeter	5.22	ft
Top Width	4.67	ft
Critical Depth	0.88	ft
Critical Slope	0.035527	ft/ft
Velocity	2.16	ft/s
Velocity Head	0.07	ft
Specific Energy	1.24	ft
Froude Number	0.50	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for slope = 0.8% - OK

Use Erosion Control Blanket for channel lining

000439

SHT B70

DITCH-8B (D8B)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-8B (D8B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	9.21	cfs

Results		
Depth	0.86	ft
Flow Area	1.48	ft²
Wetted Perimeter	3.85	ft
Top Width	3.44	ft
Critical Depth	1.06	ft
Critical Slope	0.033465	ft/ft
Velocity	6.22	ft/s
Velocity Head	0.60	ft
Specific Energy	1.46	ft
Froude Number	1.67	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04, Not acceptable

Use Riprap for channel lining

000440

SAT B71

1634

DITCH 8B (D8B)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-8B (D8B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	9.21 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.86	6.22
0.060	1.00	4.59

000441

SNT B72

DITCH-9 (D9)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-9 (D9)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.011000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	13.22	cfs

Results		
Depth	0.36	ft
Flow Area	1.69	ft^2
Wetted Perimeter	5.61	ft
Top Width	5.44	ft
Critical Depth	0.62	ft
Critical Slope	0.001573	ft/ft
Velocity	7.80	ft/s
Velocity Head	0.95	ft
Specific Energy	1.30	ft
Froude Number	2.46	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

Vmin = 7.8 fps @ S = 1.1% - OK

Vmax = 14.1fps @ S = 6.7% - USE VELOCITY CHECK

000442

DITCH-9 (D9)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-9 (D9)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.009	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	4.00	ft
Discharge	13.22	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.011000	0.066700	0.055700 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.011000	0.36	7.80
0.066700	0.21	14.08

NORMAL DEPTH

FOR FLOW DEPTH UPSTREAM OF VELOCITY CHECK, USE BROAD-CRESTED WEIR

$Q = CLH^{3/2}$ WHERE $C = 2.61$ (REFERENCE 9, TABLE 5-3)

$L = 8$ ft

$$H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{13.22}{2.61 \times 8}\right)^{2/3} = 0.74 \text{ ft}$$

FLOW DEPTH = 1.0 ft (velocity check ht) + 0.74 ft = $\boxed{1.74 \text{ ft}}$

SHT B74

DITCH-10A (D10A)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10A (D10A)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.043000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	1.34	cfs

Results		
Depth	0.49	ft
Flow Area	0.48	ft^2
Wetted Perimeter	2.19	ft
Top Width	1.96	ft
Critical Depth	0.49	ft
Critical Slope	0.043270	ft/ft
Velocity	2.80	ft/s
Velocity Head	0.12	ft
Specific Energy	0.61	ft
Froude Number	1.00	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 on 4.3% slope, OK

Use Erosion Control Blanket for channel lining

000444

SHT 875

DITCH-10A (D10A)
Rating Table for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10A (D10A)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.043000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	1.34 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.49	2.80
0.060	0.57	2.06

000445

SHT 376

DITCH-10B (D10B)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10B (D10B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.060	
Channel Slope	0.200000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	1.34	cfs

Results		
Depth	0.43	ft
Flow Area	0.36	ft^2
Wetted Perimeter	1.91	ft
Top Width	1.71	ft
Critical Depth	0.49	ft
Critical Slope	0.097364	ft/ft
Velocity	3.67	ft/s
Velocity Head	0.21	ft
Specific Energy	0.64	ft
Froude Number	1.40	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04 on steeper slopes,
(See Rating Table), Not acceptable

Use Riprap for channel lining

000446

SHT B77

DITCH-10B (D10B)
Rating Table for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10B (D10B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.200000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	1.34 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.37	4.98
0.060	0.43	3.67

000417

SHT B78

DITCH-11 (D11)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-11
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.026000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	4.28	cfs

Results		
Depth	0.83	ft
Flow Area	1.38	ft^2
Wetted Perimeter	3.72	ft
Top Width	3.33	ft
Critical Depth	0.78	ft
Critical Slope	0.037065	ft/ft
Velocity	3.10	ft/s
Velocity Head	0.15	ft
Specific Energy	0.98	ft
Froude Number	0.85	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 on slopes from 2.6% to 4.0% (See Rating Table) OK

Use Erosion Control Blanket for channel lining

000448

SHT B79

DITCH-11 (D11)
Rating Table for Triangular Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-11
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

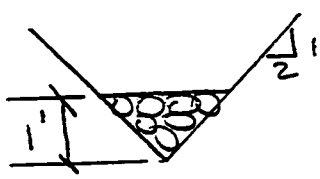
Constant Data	
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	4.28 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020
Channel Slope	0.026000	0.040000	0.014000 ft/ft

Rating Table

Channel Slope (ft/ft)	Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.026000	0.040	0.83	3.10
0.026000	0.060	0.97	2.28
0.040000	0.040	0.77	3.64
0.040000	0.060	0.89	2.69

NORMAL DEPTH



FOR FLOW DEPTH UPSTREAM OF CHECK DAM, USE BROAD-CRESTED WEIR

$Q = CLH^{3/2}$ WHERE $C = 2.61$ (REFERENCE 9, TABLE 5-3)

$L = 4$ ft

$$H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{4.28\text{ cfs}}{2.61 \times 4}\right)^{2/3} = 0.55\text{ ft}$$

FLOW DEPTH = 1.0 ft (CHECK DAM) + 0.55 ft = 1.55 ft

000449

SHT B 80

DITCH 12 (REVISED)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 12 (REVISED)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	8.90	cfs

Results		
Depth	0.96	ft
Flow Area	3.77	ft^2
Wetted Perimeter	6.30	ft
Top Width	5.85	ft
Critical Depth	0.68	ft
Critical Slope	0.032473	ft/ft
Velocity	2.36	ft/s
Velocity Head	0.09	ft
Specific Energy	1.05	ft
Froude Number	0.52	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 OK

Use Erosion Control Blanket for channel lining.

000450

SHT B81

1634

DITCH 12 (REVISED)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 12 (REVISED)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	8.90	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.008000	0.014000	0.006000 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.008000	0.96	2.36
0.014000	0.84	2.90

000451

SHT B82

DITCH - 15
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH - 15
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.025000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	1.00	cfs

Results		
Depth	0.49	ft
Flow Area	0.47	ft^2
Wetted Perimeter	2.17	ft
Top Width	1.94	ft
Critical Depth	0.43	ft
Critical Slope	0.044992	ft/ft
Velocity	2.12	ft/s
Velocity Head	0.07	ft
Specific Energy	0.56	ft
Froude Number	0.76	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04: OK

Use Erosion Control Blanket for Channel Lining

000452

SAT B83

1634

DITCH - 15

Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH - 15
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Discharge	1.00	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.025000	0.030000	0.005000 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.025000	0.49	2.12
0.030000	0.47	2.27

000453

SHT 884

INTERCEPTOR DITCH 1A
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	INTERCEPTOR DITCH 1A
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	12.43	cfs

Results		
Depth	1.55	ft
Flow Area	4.78	ft^2
Wetted Perimeter	6.92	ft
Top Width	6.19	ft
Critical Depth	1.19	ft
Critical Slope	0.032153	ft/ft
Velocity	2.60	ft/s
Velocity Head	0.10	ft
Specific Energy	1.65	ft
Froude Number	0.52	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04; OK

Use Erosion Control Blanket

000454

SHT 685

1634

INTERCEPTOR DITCH 1B
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	INTERCEPTOR DITCH 1B
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.060	
Channel Slope	0.200000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	20.03	cfs

Results		
Depth	0.59	ft
Flow Area	3.04	ft^2
Wetted Perimeter	6.63	ft
Top Width	6.35	ft
Critical Depth	0.80	ft
Critical Slope	0.065788	ft/ft
Velocity	6.59	ft/s
Velocity Head	0.67	ft
Specific Energy	1.26	ft
Froude Number	1.68	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04

Use Dumped Rock Fill for lining.

000455

SHT B 86

INTERCEPTOR DITCH 1B
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	INTERCEPTOR DITCH 1B
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	4.00	ft
Discharge	20.03	cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020
Channel Slope	0.023000	0.200000	0.177000 ft/ft

Rating Table

Channel Slope (ft/ft)	Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.023000	0.040	0.85	4.11
0.023000	0.060	1.06	3.08
0.200000	0.040	0.47	8.69
0.200000	0.060	0.59	6.59

000456

SHT B87

INTERCEPTOR DITCH 2
Worksheet for Trapezoidal Channel

1634

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	INTERCEPTOR DITCH 2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.130000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	9.85	cfs

Results		
Depth	0.22	ft
Flow Area	0.52	ft^2
Wetted Perimeter	2.97	ft
Top Width	2.86	ft
Critical Depth	0.71	ft
Critical Slope	0.001622	ft/ft
Velocity	18.77	ft/s
Velocity Head	5.47	ft
Specific Energy	5.69	ft
Froude Number	7.73	
Flow is supercritical.		

Notes:

Geomembrane Liner

000457

SHT B88

INTERCEPTOR DITCH 2
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	INTERCEPTOR DITCH 2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.009	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	2.00	ft
Discharge	9.85	cfs

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.005000	0.130000	0.125000 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.005000	0.53	6.04
0.130000	0.22	18.77

000458

SHT B89

1634

INTERCEPTOR DITCH 3
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	INTERCEPTOR DITCH 3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.009000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	13.51	cfs

Results		
Depth	0.54	ft
Flow Area	1.66	ft^2
Wetted Perimeter	4.41	ft
Top Width	4.15	ft
Critical Depth	0.85	ft
Critical Slope	0.001557	ft/ft
Velocity	8.16	ft/s
Velocity Head	1.03	ft
Specific Energy	1.57	ft
Froude Number	2.28	
Flow is supercritical.		

Notes:

Geomembrane Liner

000459

ATTACHMENT C, CULVERTS

Methodology

This calculation is performed using the "worst case" scenario for peak flows. Each culvert was evaluated under existing conditions (after construction of ditches and basins, but before remediation activities begin), and proposed conditions (after remediation activities have been completed).

The Modified Rational Method (Reference 2) was used to determine peak flows for the 10 year frequency storm event. After drainage areas (existing and proposed) were calculated for each culvert, a weighted runoff coefficient (C) was determined based on land use area and type. A rainfall intensity was selected based on the shortest duration (duration = 10 min for all culverts except culvert 4) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

Culvert 4 has a large, relatively flat drainage area. SCS procedures were used to find the time of concentration (duration) for the culvert 4 drainage area. The rainfall intensity was selected based on the time of concentration (duration) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

Calculations are included on the following pages.

SHT C2

Quick TR-55 Ver.5.46 S/N:
Executed: 15:17:59 01-20-1997

CULVERT 1

EXISTING/PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.60						
GRAVEL	0.900	0.90						
			10.00	0.820	0.820	5.450	1.50	6.70

PROJECT: Southern Waste Units
Culvert - 1

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

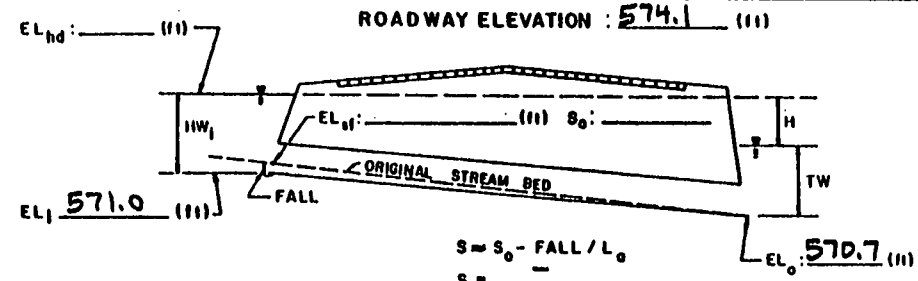
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	6.7	*

ROADWAY ELEVATION: 574.1 (ft)



$S = S_o - FALL / L_o$

$S =$ —

$L_o = \approx 30'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE

	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HW i/D (2)	HW i	FALL (3)	EL hi (4)	TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
			INLET CONTROL				OUTLET CONTROL									
TRY 15" Φ CMP	6.7	6.7	1.8	2.25	—	573.3	0.5	1.0	1.1	1.1	0.9	2.2	574.0	574.0	—	OUTLET CONTROL TOO HIGH
TRY 18" Φ CMP	6.7	6.7	1.13	1.70	—	572.7	0.5	0.95	1.2	1.2	0.9	0.85	572.8	572.8	—	OUTLET CONTROL OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

* ASSUMES OUTLET DRAINAGEWAY FLOWING 0.5' DEEP

PROJECTING END ∴ $K_e = 0.9$

CULVERT BARREL SELECTED:

SIZE: 18" Φ

SHAPE: ROUND

MATERIAL: CMP n 0.024

ENTRANCE: PROJECTING

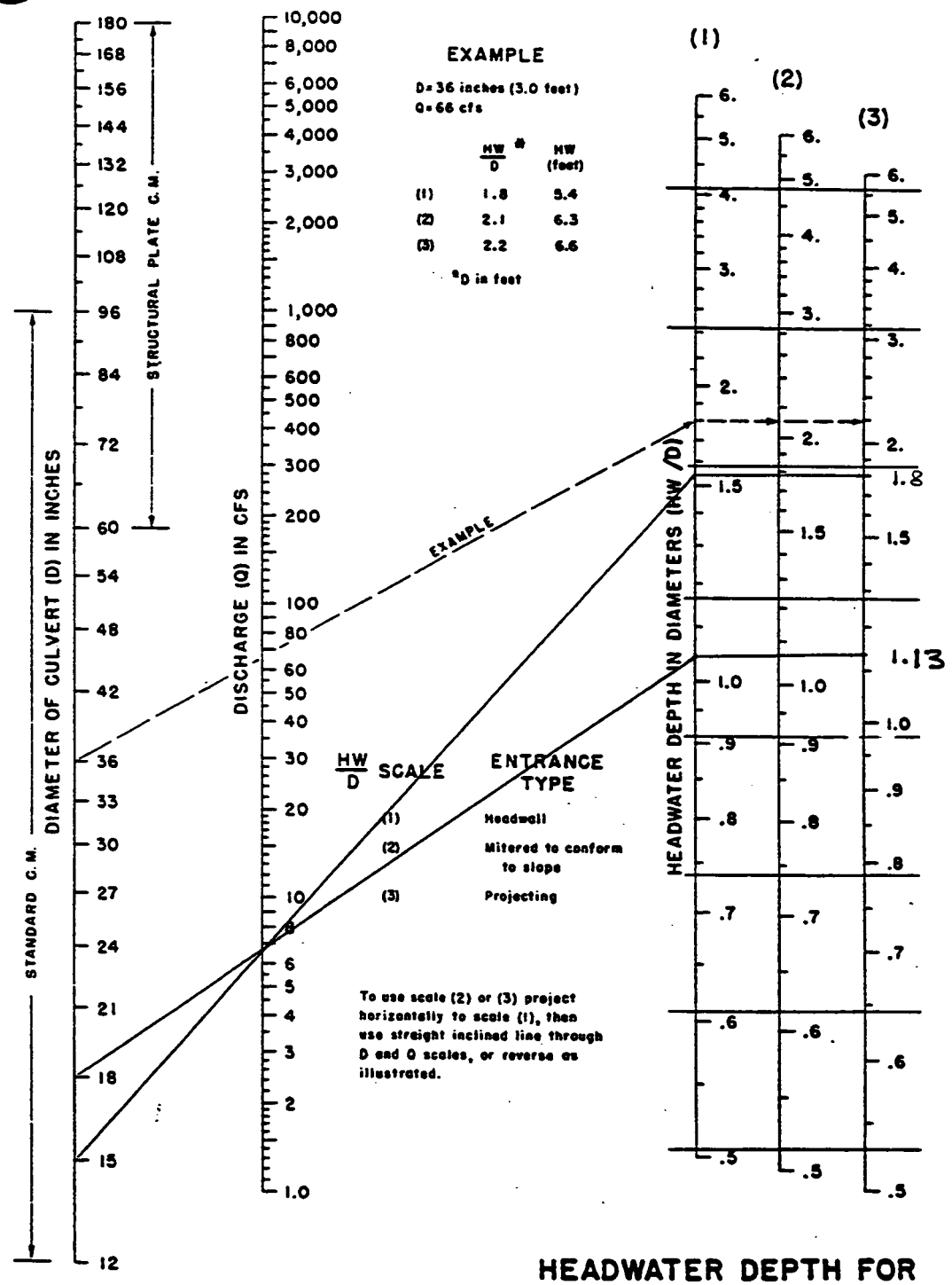
240

1634 SHT C3

000462

SHT C4

CHART 2

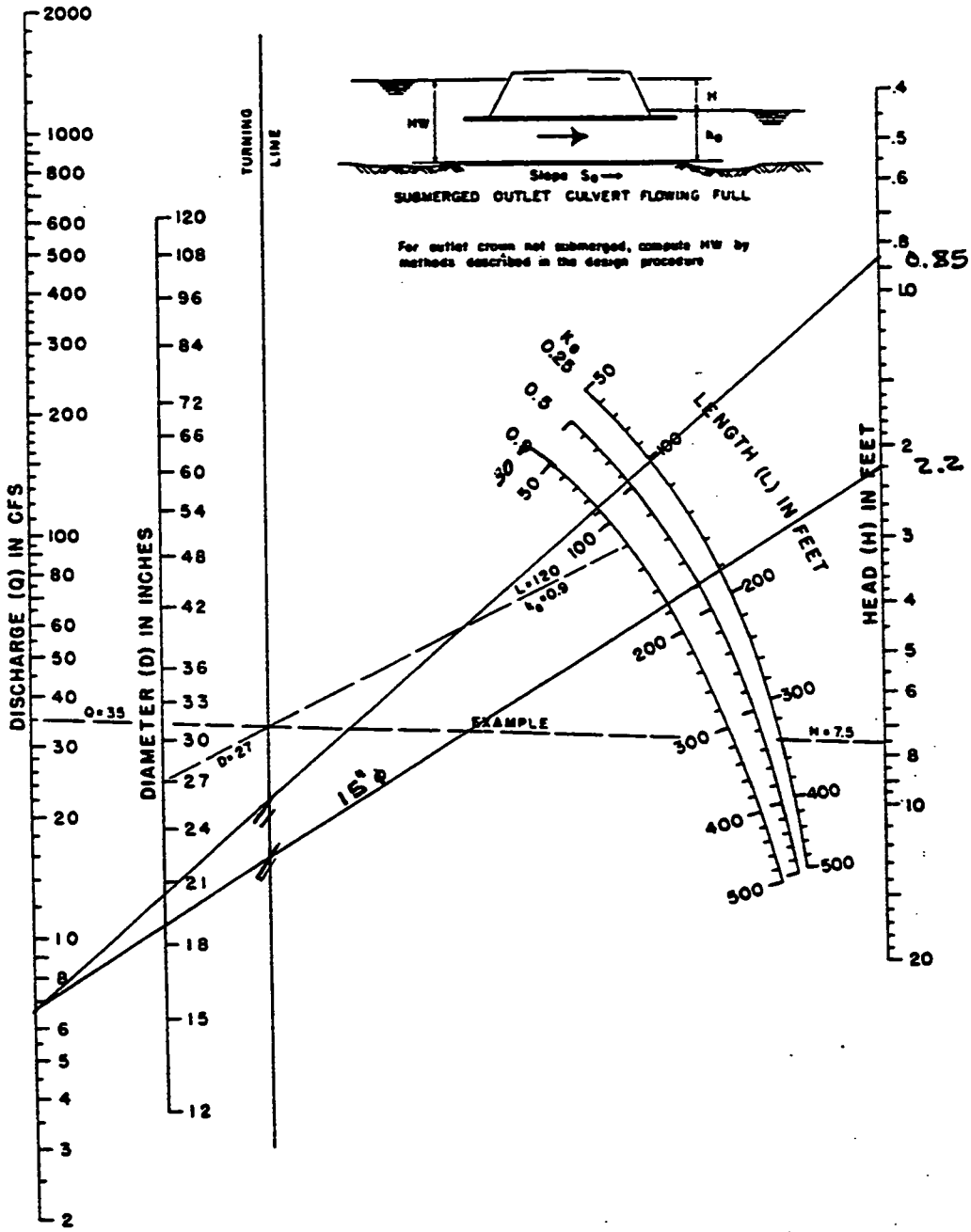


HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000463

CHART 6

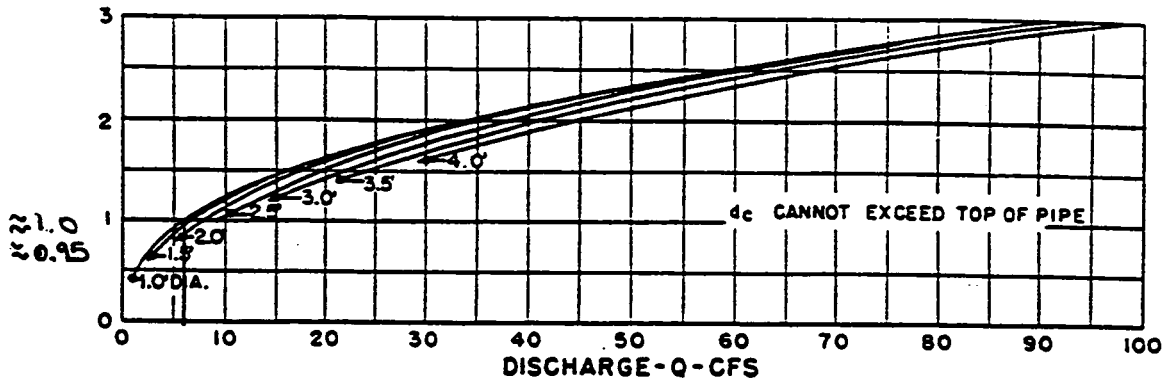


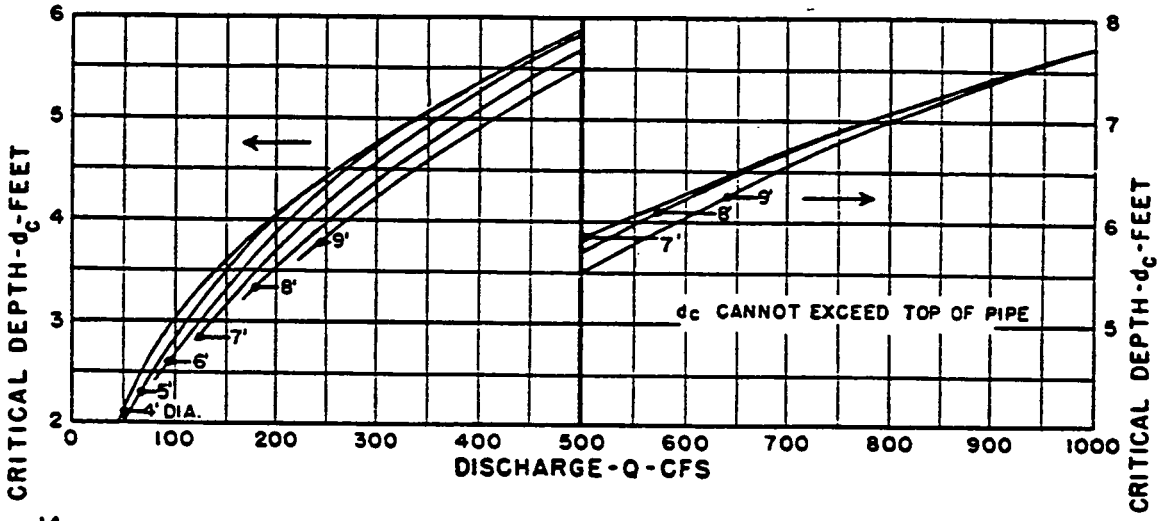
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

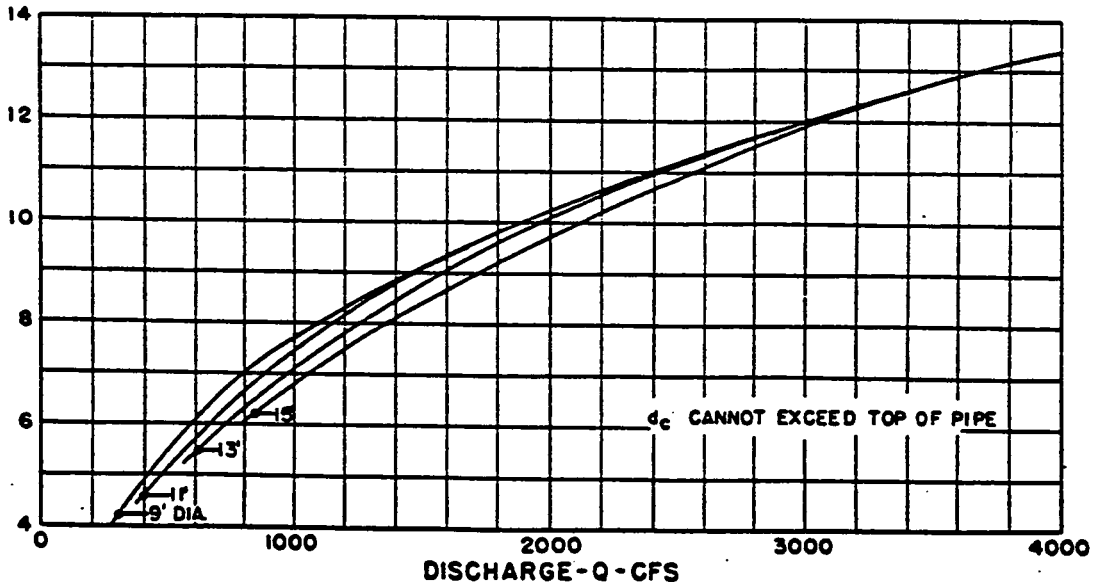
BUREAU OF PUBLIC ROADS JAN. 1963

SHT C6

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000465

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

SHT C8

Quick TR-55 Ver.5.46 S/N:
Executed: 16:48:53 01-20-1997

CULVERT 2
USE SAME AS D11
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.89						
GRAVEL	0.900	0.28						
			10.00	0.672	0.672	5.450	1.17	4.28

000467

1634 SHT C9

Quick TR-55 Ver.5.46 S/N:
Executed: 16:48:20 01-20-1997

CULVERT 2
USE SAME AS D11
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.57						
GRAVEL	0.900	0.28						
			10.00	0.699	0.699	5.450	0.85	3.24

000469

PROJECT: SOUTHERN WASTE UNITS
CULVERT-2

STATION: _____
SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

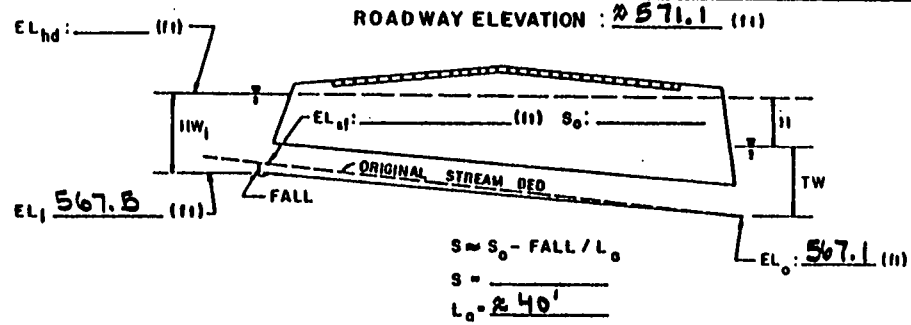
HYDROLOGICAL DATA

SEE ADD'L. SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	4.3	*



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE

CULVERT DESCRIPTION	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" Φ CMP	4.3	4.3	1.12	1.4	–	568.9	0.8	0.8	1.03	1.03	0.9	0.9	569.0	569.0	—	OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

* ASSUME OUTLET FLOWING FULL, FROM D-11 CALC, DEPTH FOR n = 0.04 DITCH = 0.77' ⇒ USE TW = 0.8'

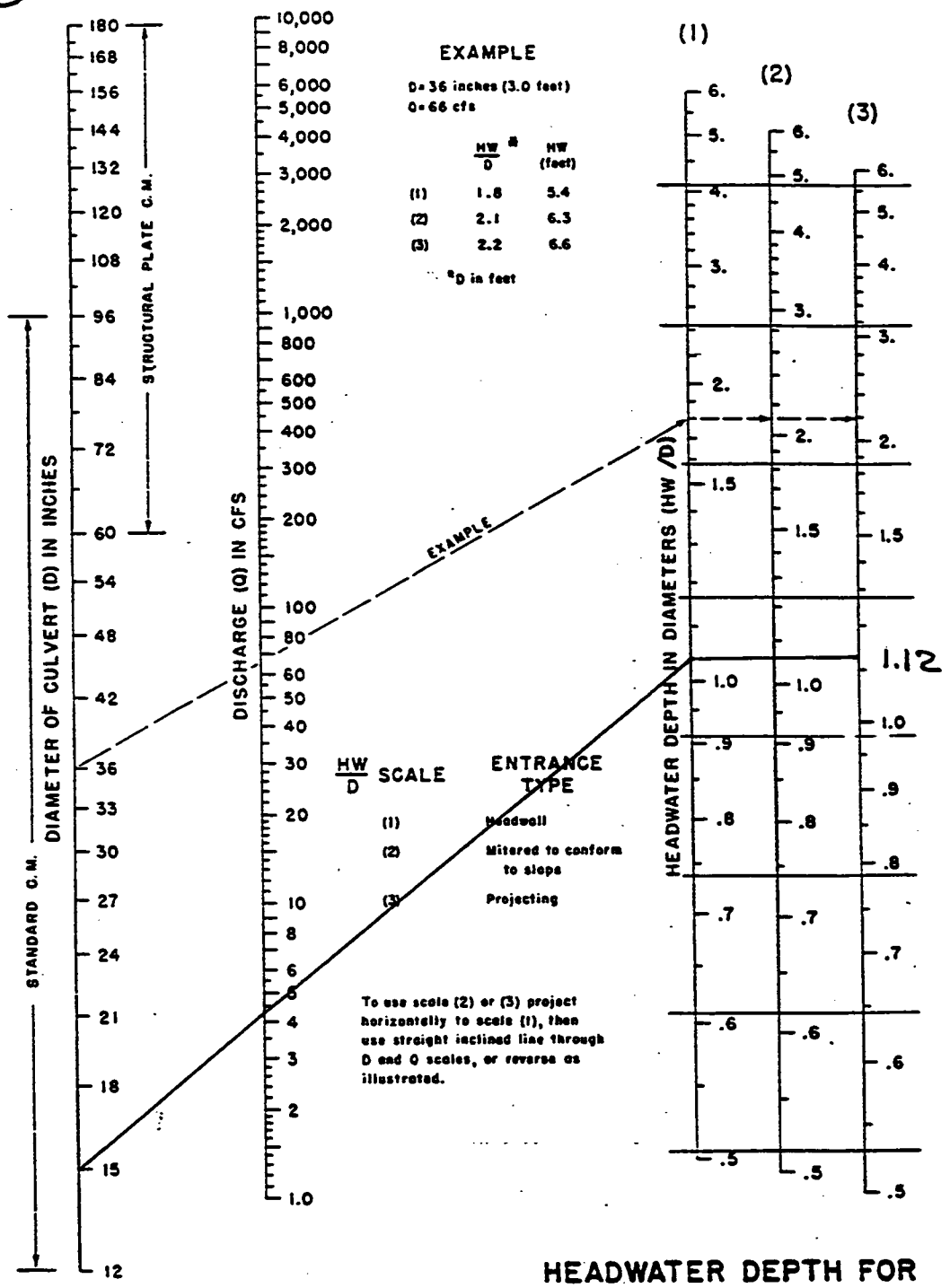
PROJECTING ENDS ∴ K_e = 0.9

CULVERT BARREL SELECTED:

SIZE: 15" Φ
SHAPE: ROUND
MATERIAL: CMP n 0.021
ENTRANCE: PROJECTING

SHT C11

CHART 2



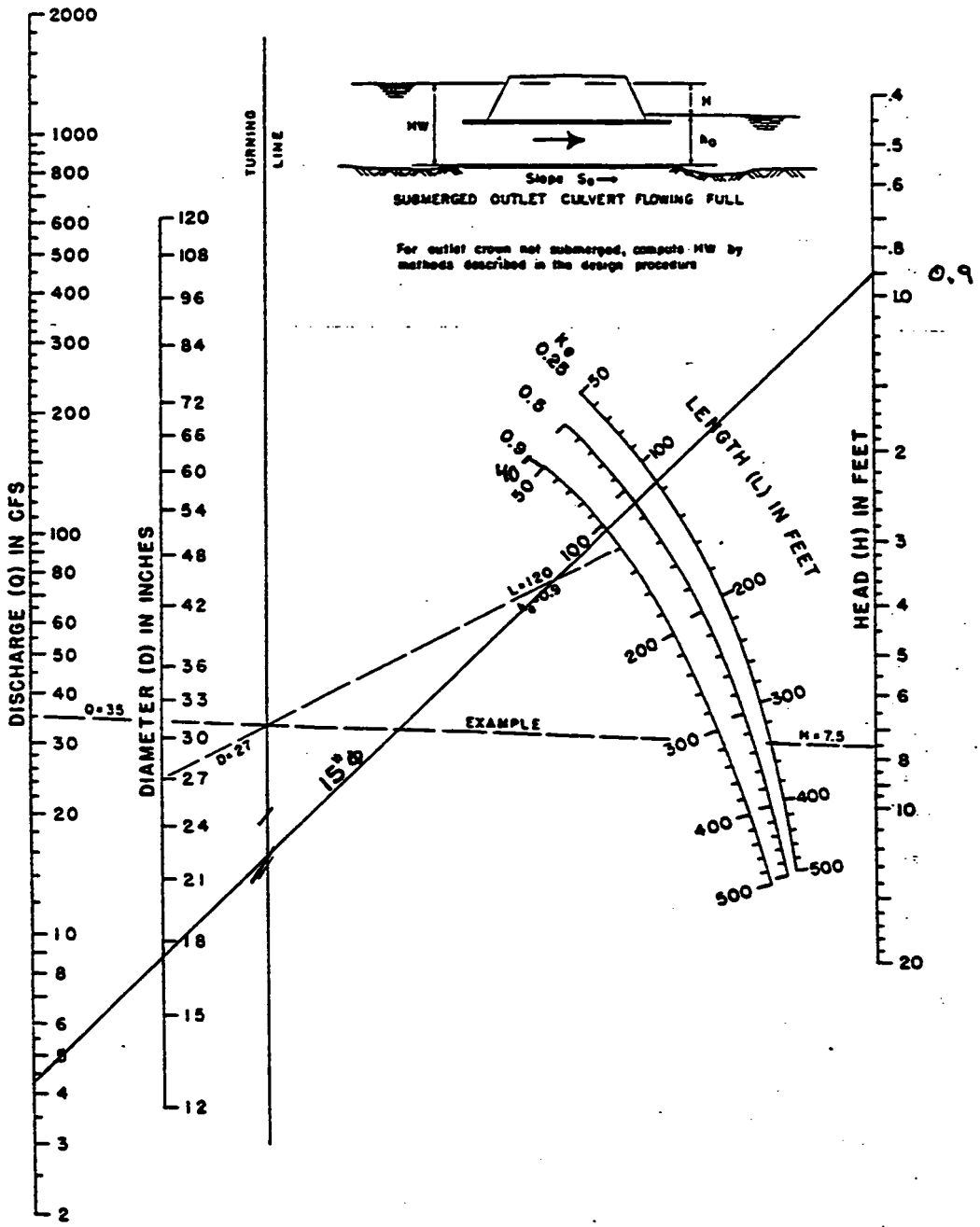
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000470

SHT C12

CHART 6

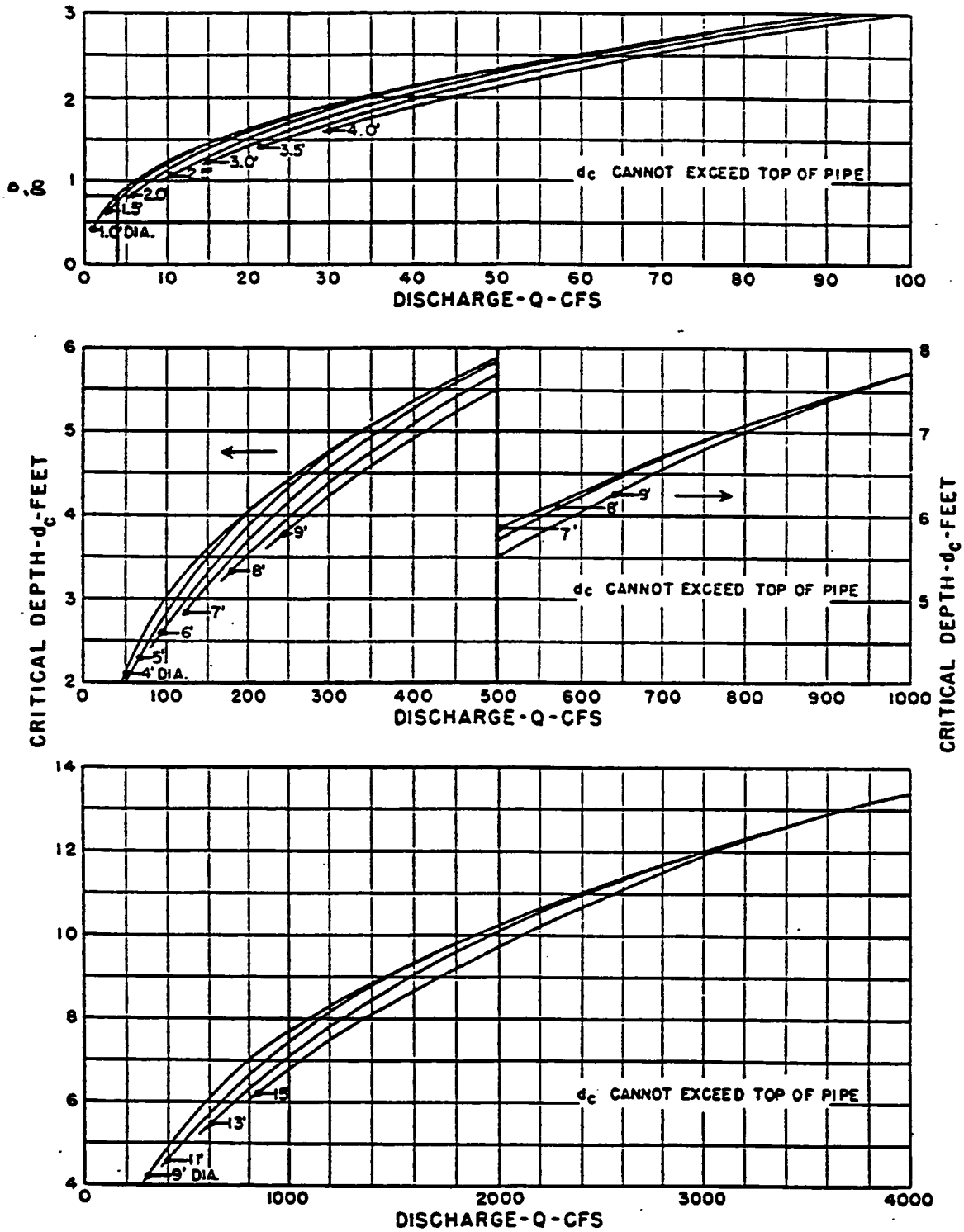


HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

000471

CHART 4



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

SHT C14

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

000473

Quick TR-55 Ver.5.46 S/N:
Executed: 14:39:46 04-28-1997

1634 SHT C15

DITCH-5 & 6 COMBINED
CULVERT 3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	1.09						
			10.00	0.700	0.700	5.450	1.09	4.16

000475

PROJECT: SOUTHERN WASTE UNITS CULVERT - 3	STATION: N/A SHEET — OF —	CULVERT DESIGN FORM DESIGNER / DATE: / REVIEWER / DATE: /

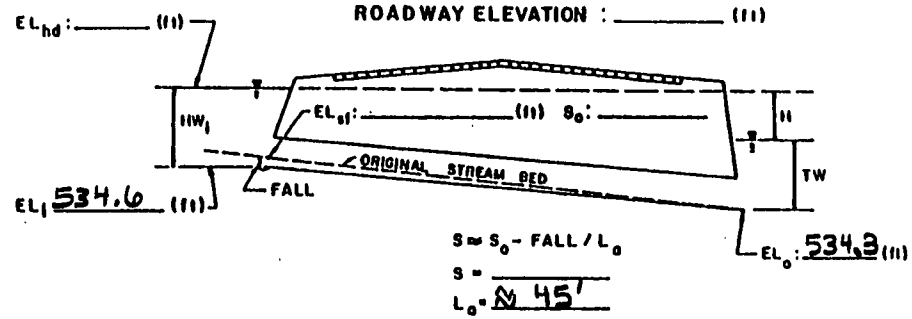
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	4.2	*



$S \approx S_o$ - FALL / L_o

S =

L_o = ≈ 45'

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" Φ CMP	4.2	4.2	1.1	1.38	—	536.0	0.8	0.8	1.03	1.03	0.9	0.82	536.15	536.15	—	OUTLET CONTROL

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = HW_i - (EL_{hd} - EL_{sf}); FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or (d_c + D/2) (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION: * ASSUME D-7 FLOWING FULL. FROM D-7 CALC, DEPTH = 0.8 FT

PROJECTING, K_e = 0.9

CULVERT BARREL SELECTED:

SIZE: 15"

SHAPE: ROUND

MATERIAL: CMP n 0.024

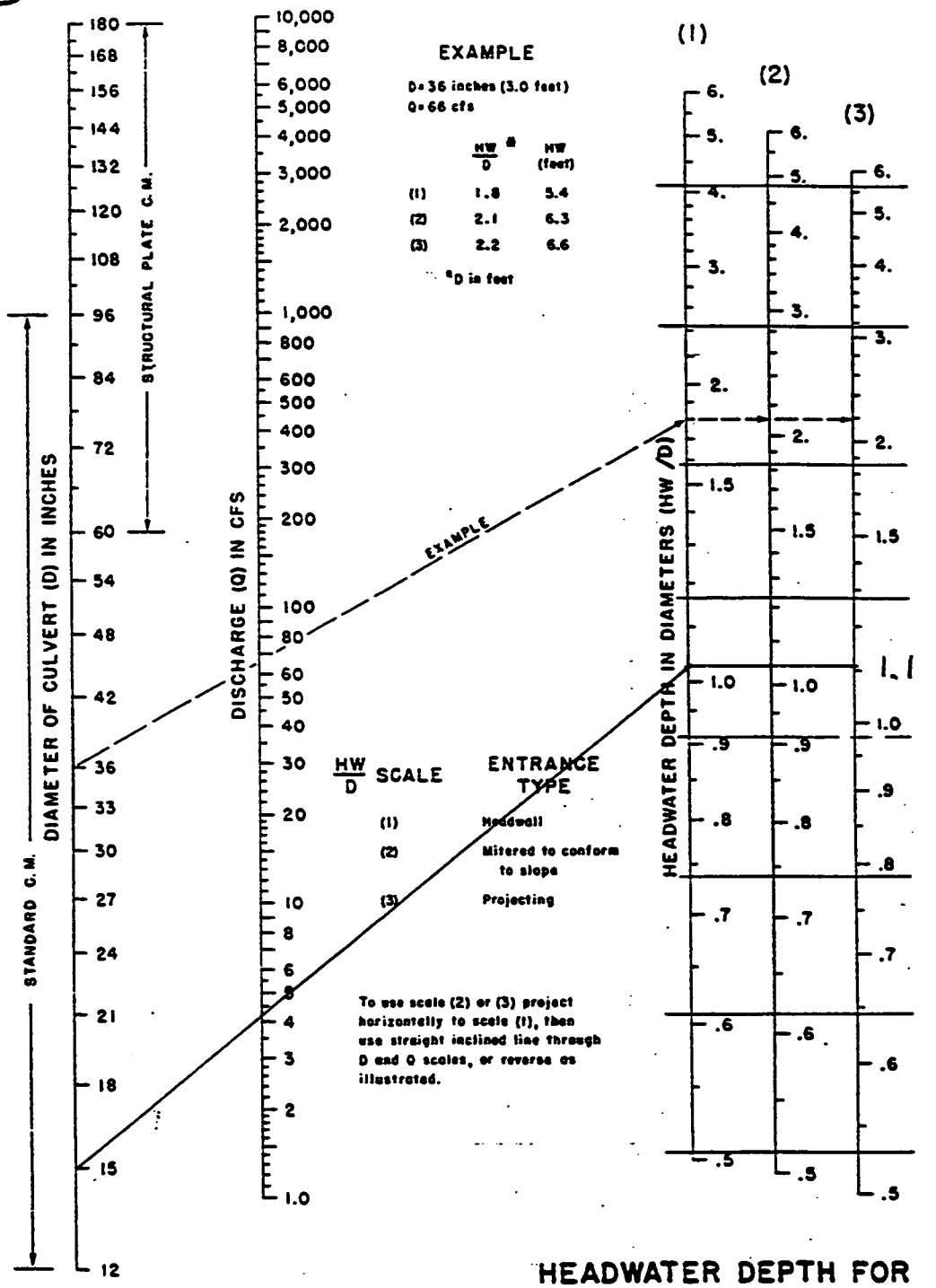
ENTRANCE: PROJECTING

SHT C16

SHT C17

1634

CHART 2



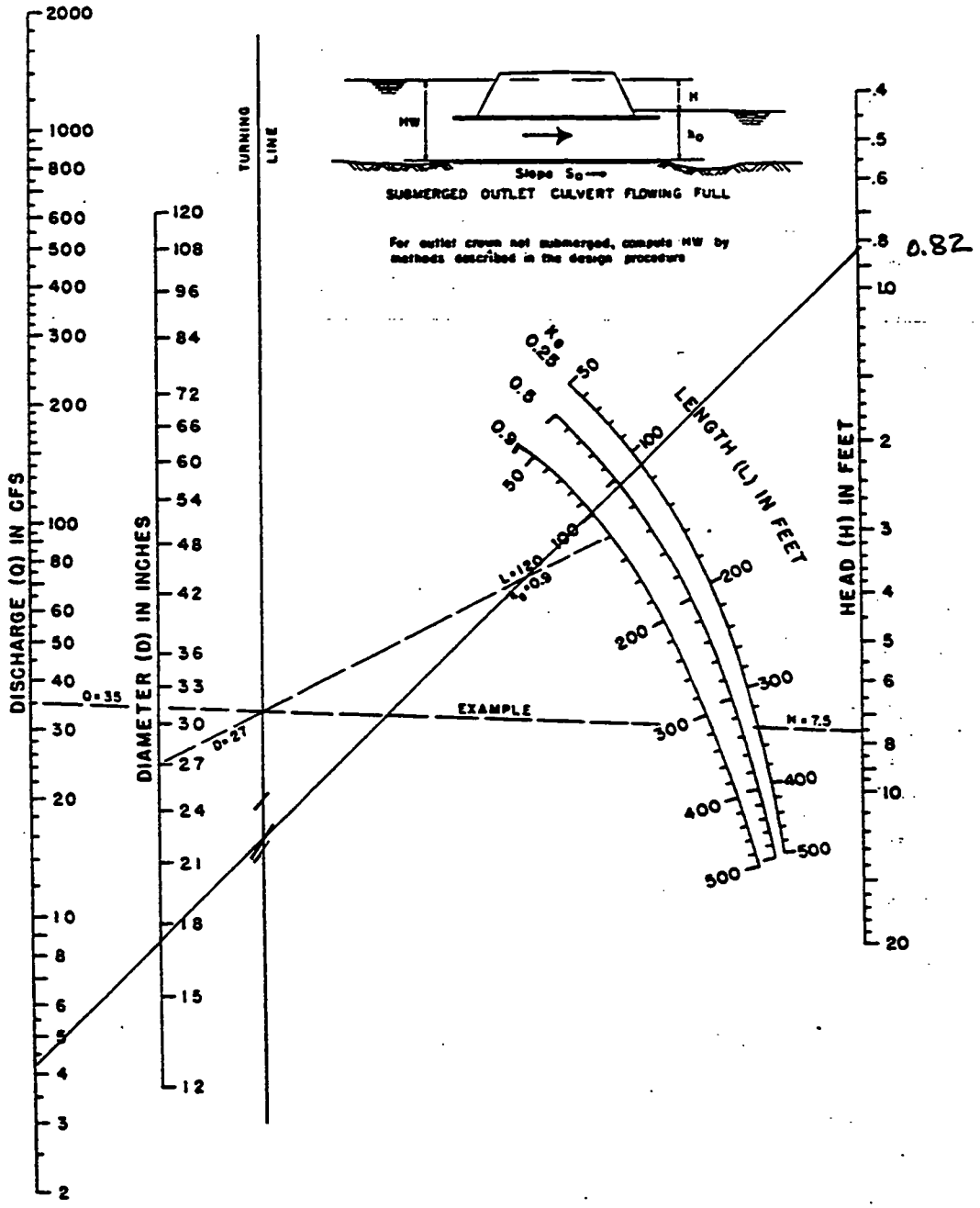
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000476

SHT C18

CHART 6



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

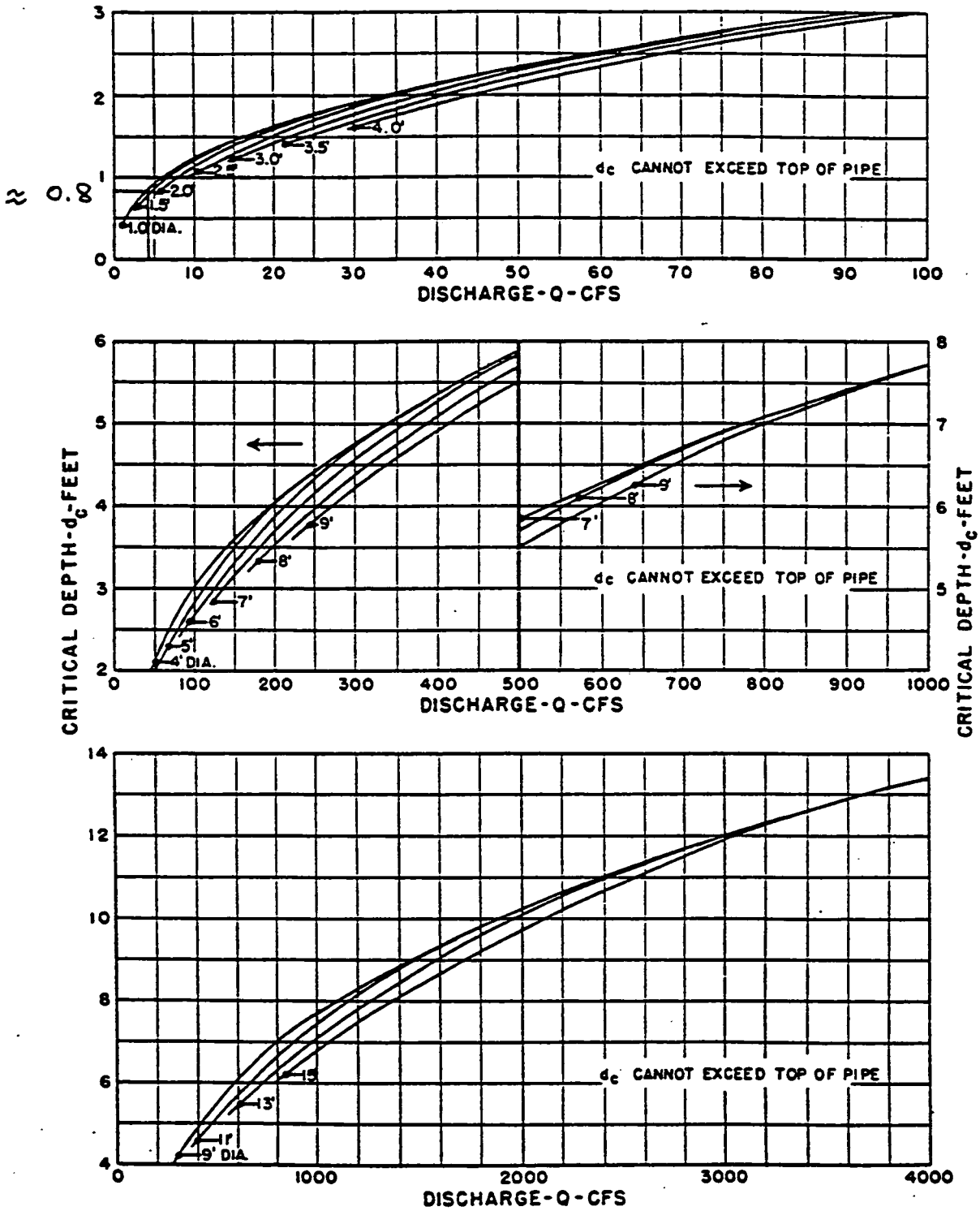
BUREAU OF PUBLIC ROADS JAN. 1963

000477

SHT C19

1634

CHART 4



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000478

SHT C20

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

000479

Quick TR-55 Ver.5.46 S/N:
Executed: 13:44:02 02-04-1997

SHT C21
1634

CULVERT 4

PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
WOODS	0.300	8.10						
VEG, FAIR	0.420	2.01						
GRAVEL RD	0.900	0.20						
BARE,(WDCHP)	0.700	0.50						
			39.00	0.352	0.352	2.750	10.81	10.46

SHT C22

Quick TR-55 Ver.5.46 S/N:
Executed: 13:42:27 02-04-1997 c:\po165d\C4.TCT

CULVERT 4

Tc COMPUTATIONS FOR: CULVERT 4

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		WOODS, LT	
Manning's roughness coeff., n		0.4000	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.62	= 0.62

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	345.0	
Watercourse slope, s	ft/ft	0.0290	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.7476	
where: Unpaved Csf = 16.1345 Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.03	= 0.03

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.65

SHT C23

Quick TR-55 Ver.5.46 S/N:
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1634

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

CULVERT 4

Subarea descr.	Tc or Tt	Time (hrs)
CULVERT 4	Tc	0.65

000483

240

PROJECT: SOUTHERN WASTE UNITS CULVERT - 4	STATION:	CULVERT DESIGN FORM
	SHEET ____ OF ____	DESIGNER / DATE: ____ / ____
		REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

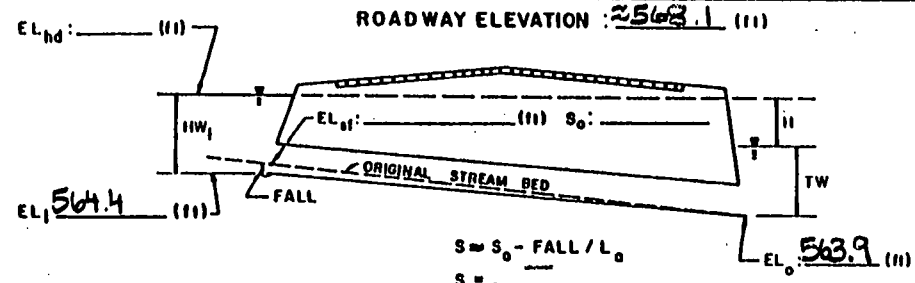
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: — ☐ STREAM SLOPE: —
- ☐ CHANNEL SHAPE: —
- ☐ ROUTING: — ☐ OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	10.5	2'

ROADWAY ELEVATION: ≈568.1 (ft)



$S \approx S_o - FALL / L_o$

$S =$

$L_o \approx 45'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW i/D (2)	HW i	FALL (3)	EL hi (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	h_e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 18" ϕ	10.5	10.5	1.8	2.7	—	567.1	2	1.3	1.4	2	0.9	2.4	568.3	568.3	—	
TRY 24" ϕ	10.5	10.5	0.95	1.9	—	566.3	2	1.2	1.6	2	0.9	0.7	566.6	566.6	—	
TRY 21" ϕ	10.5	10.5	1.2	2.1	—	566.5	2	1.25	1.5	2	0.9	1.2	567.1	567.1	—	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 21" ϕ

SHAPE: CIRCULAR

MATERIAL: CMP n 0.024

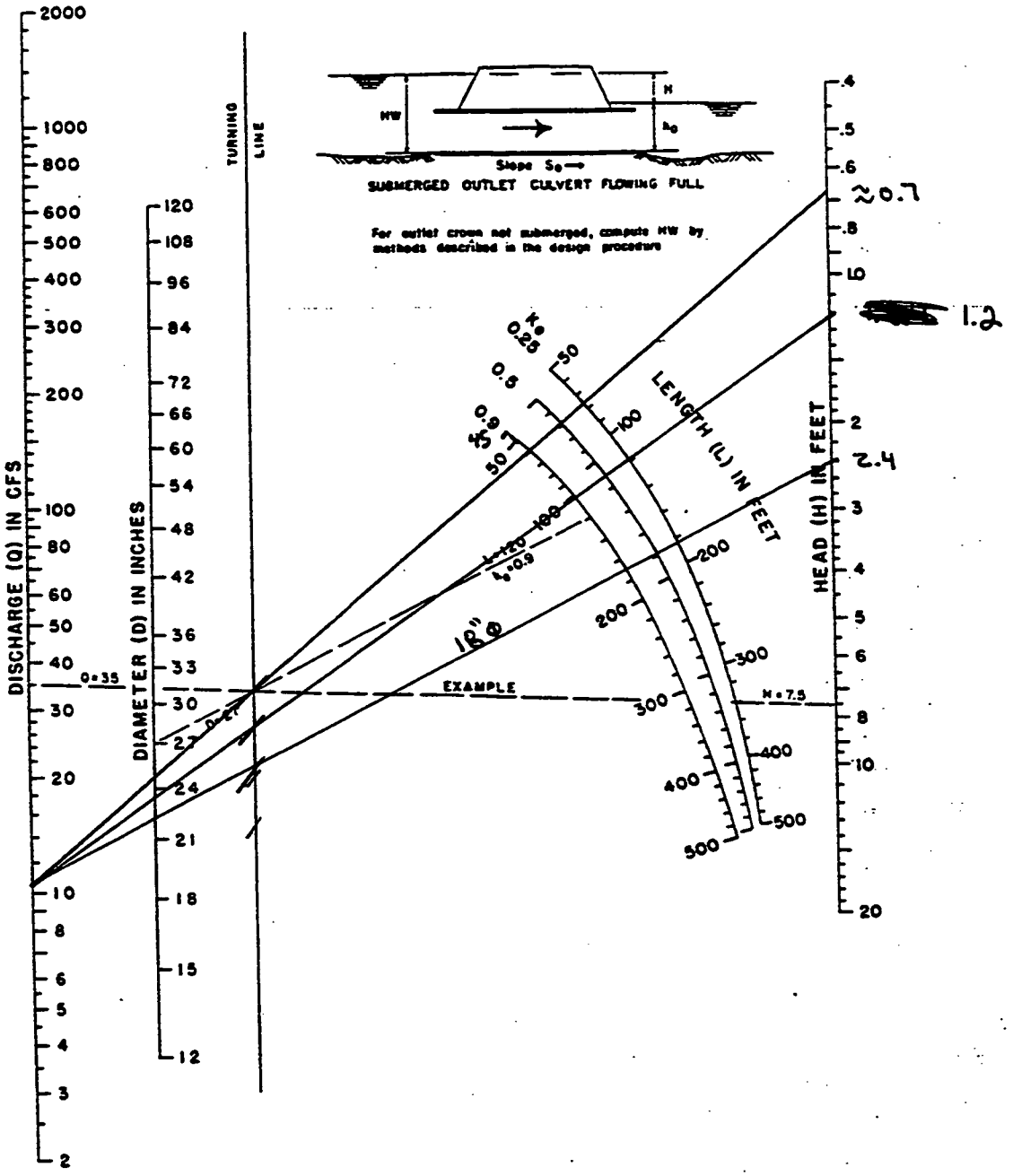
ENTRANCE: PROJECTING

SHT C24

SHT C25

1634

CHART 6



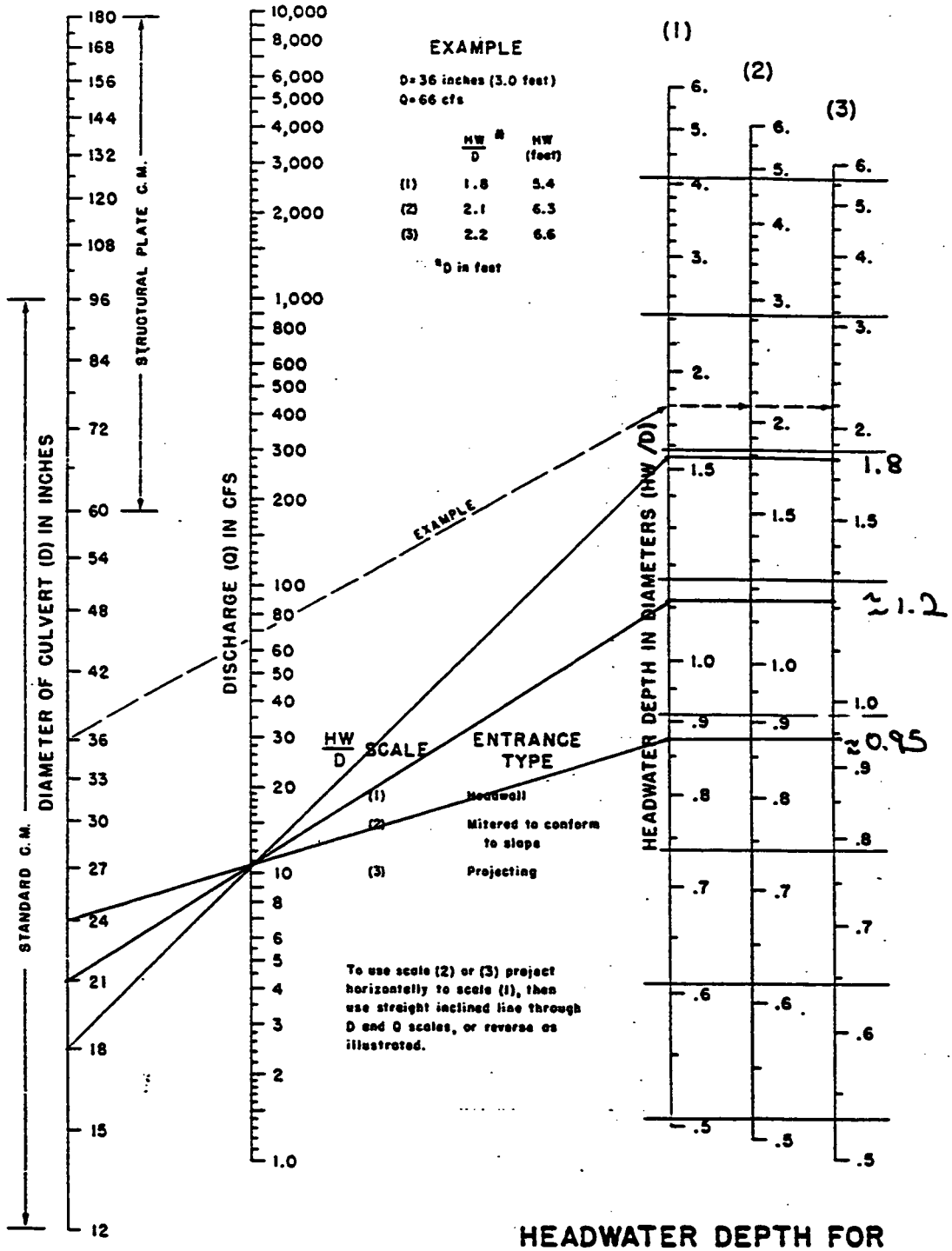
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

000484

SHT C26

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

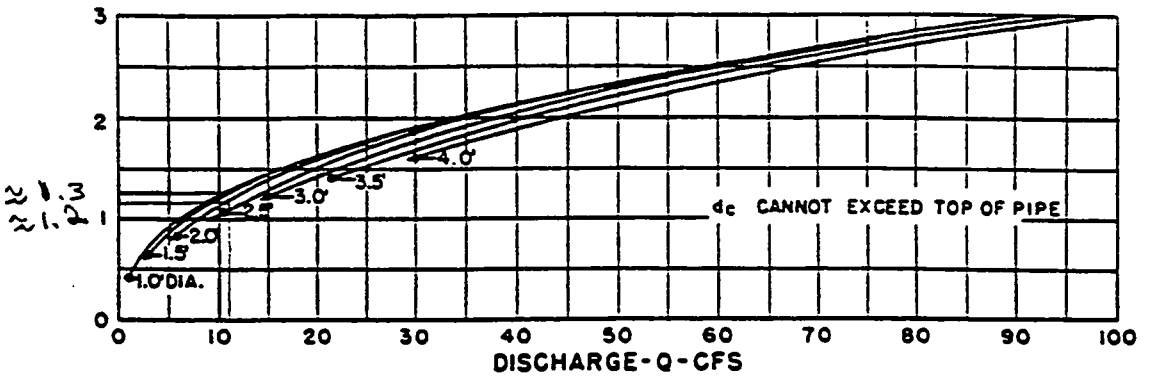
BUREAU OF PUBLIC ROADS JAN. 1963

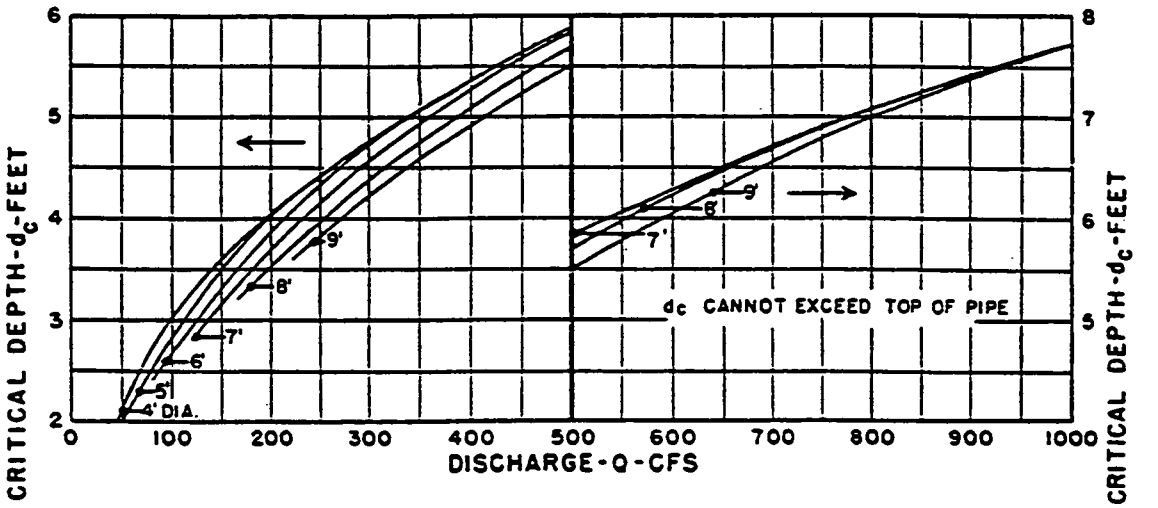
000485

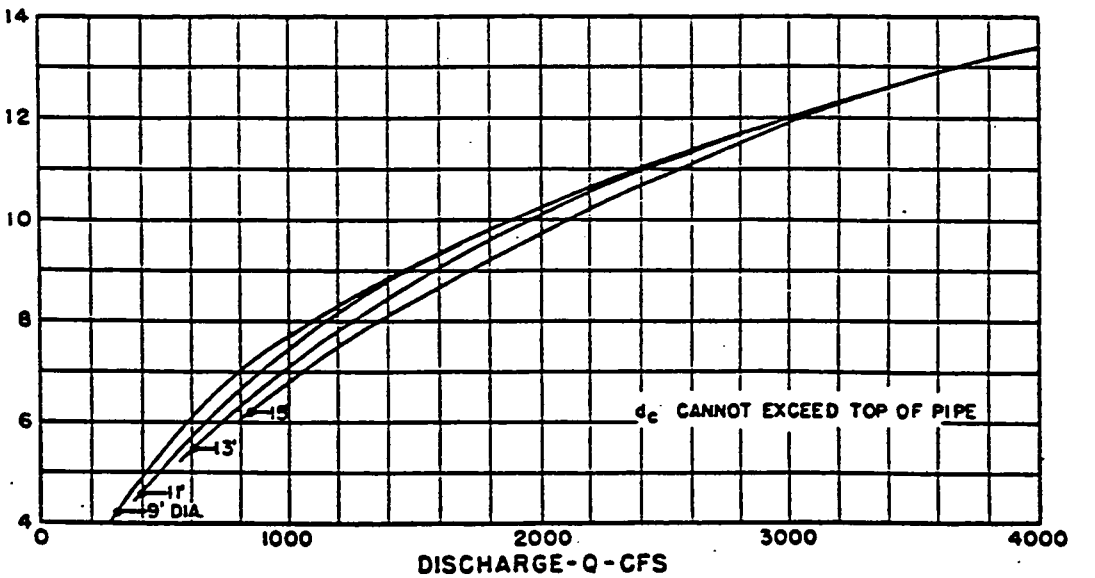
SHT C27

1634

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000486

SHT C28

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

SHT C29

1634

Quick TR-55 Ver.5.46 S/N:
Executed: 07:08:08 01-15-1997

CULVERT 5

PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
PAVEMENT	0.900	0.50						
			10.00	0.900	0.900	5.450	0.50	2.45

000489

240

PROJECT: SOUTHERN WASTE UNIT CULVERT-5	STATION: ____ SHEET ____ OF ____	CULVERT DESIGN FORM DESIGNER/DATE: ____ / ____ REVIEWER/DATE: ____ / ____

HYDROLOGICAL DATA

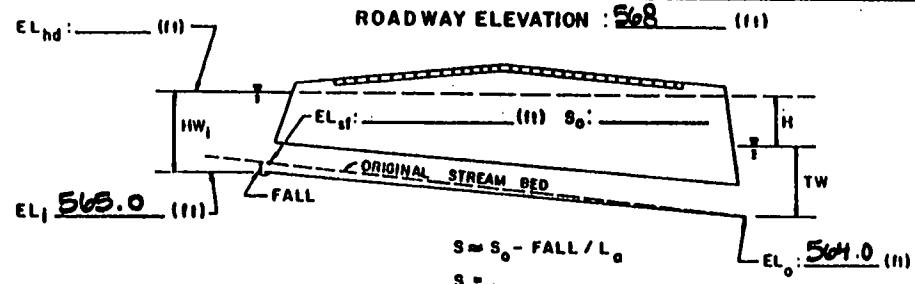
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	2.5	2

ROADWAY ELEVATION: 568 (ft)



$S \approx S_o - FALL / L_o$

$S =$ ____

$L_o \approx 95'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW i/D (2)	HW i	FALL (3)	EL hi (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" ϕ	2.5	2.5	0.78	0.98	—	568.98	2	0.6	0.98	2	0.9	0.85	566.6	566.6	—	OUTLET CONTROL
TRY 18" ϕ	2.5	2.5	0.59	0.89	-	568.89	2	≈0.6	1.05	2	0.9	≈0	566.0	566.0	—	OUTLET CONTROL

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

PROJECTING ENDS

CULVERT BARREL SELECTED:

SIZE: 15" ϕ

SHAPE: ROUND

MATERIAL: CMP n 0.024

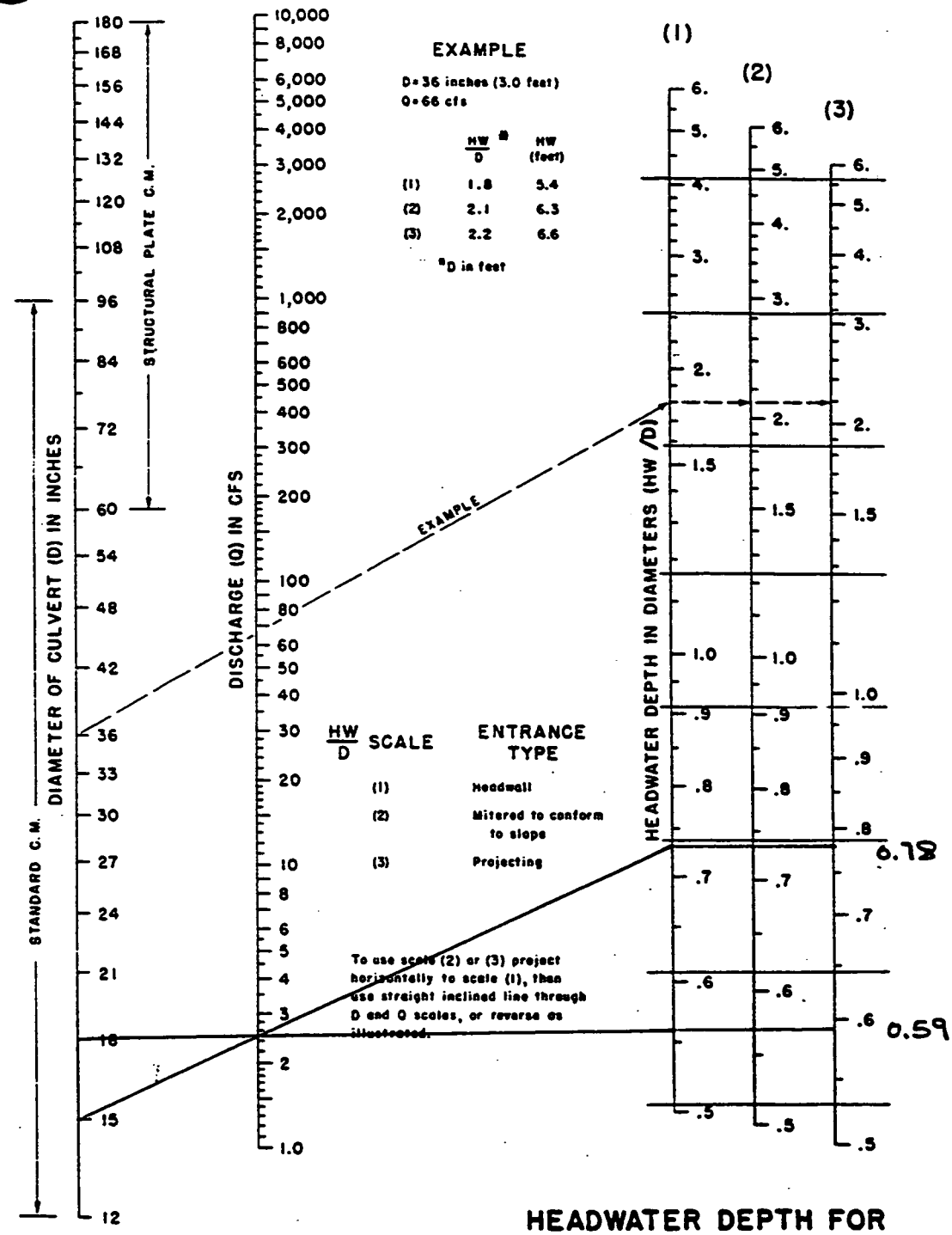
ENTRANCE: PROJECTING

SHT 130

SHT C31

1634

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

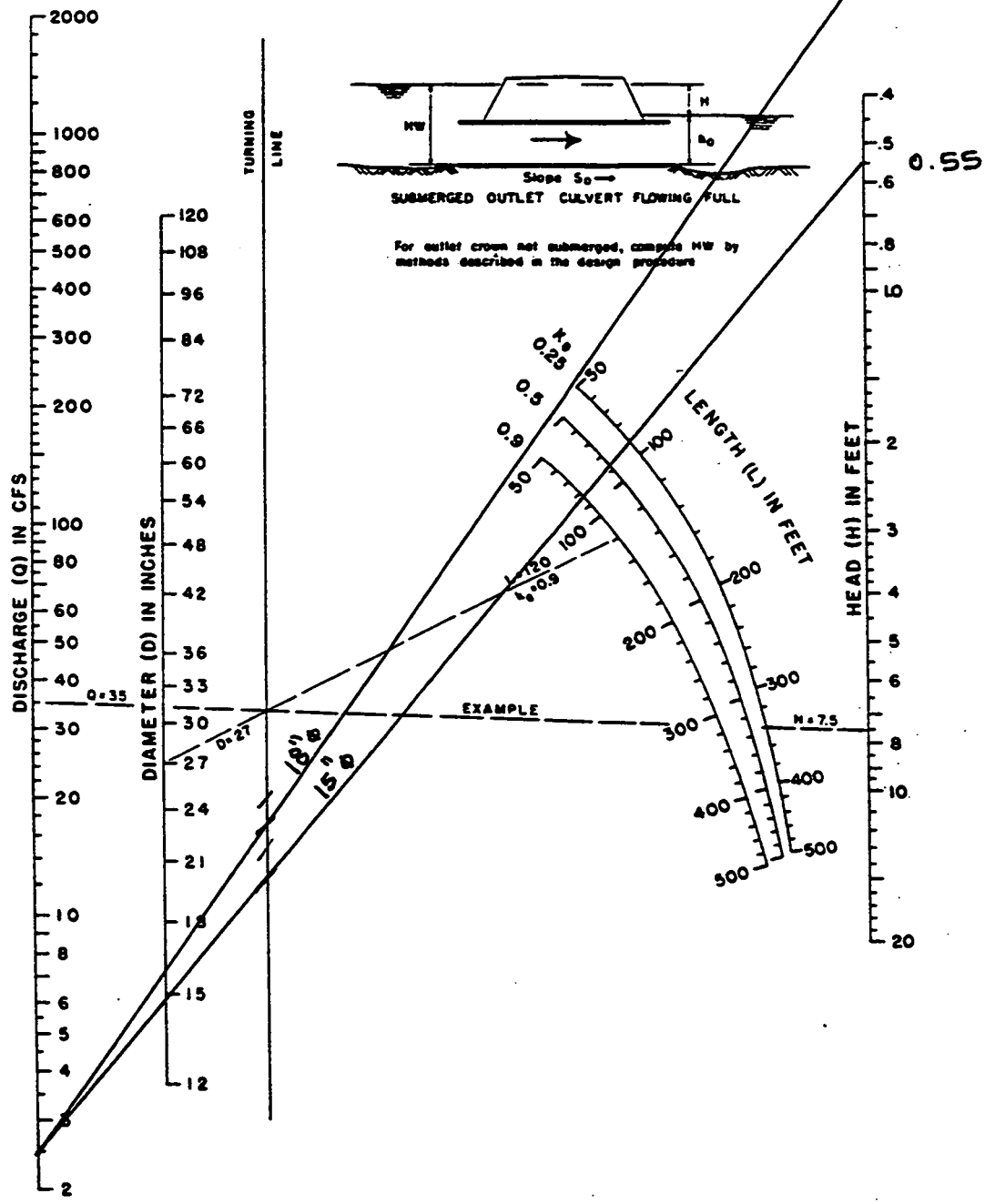
BUREAU OF PUBLIC ROADS JAN. 1963

000490

SHT C-2

CHART 6

INSIGNIFICANT



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

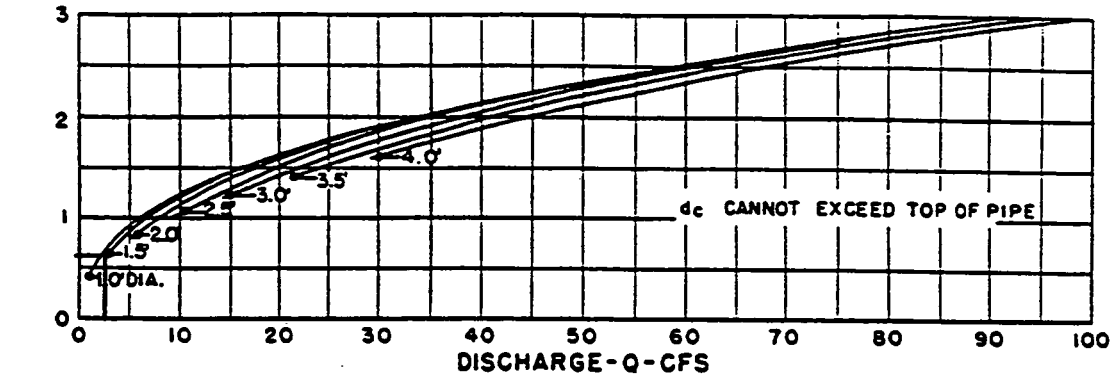
BUREAU OF PUBLIC ROADS JAN. 1963

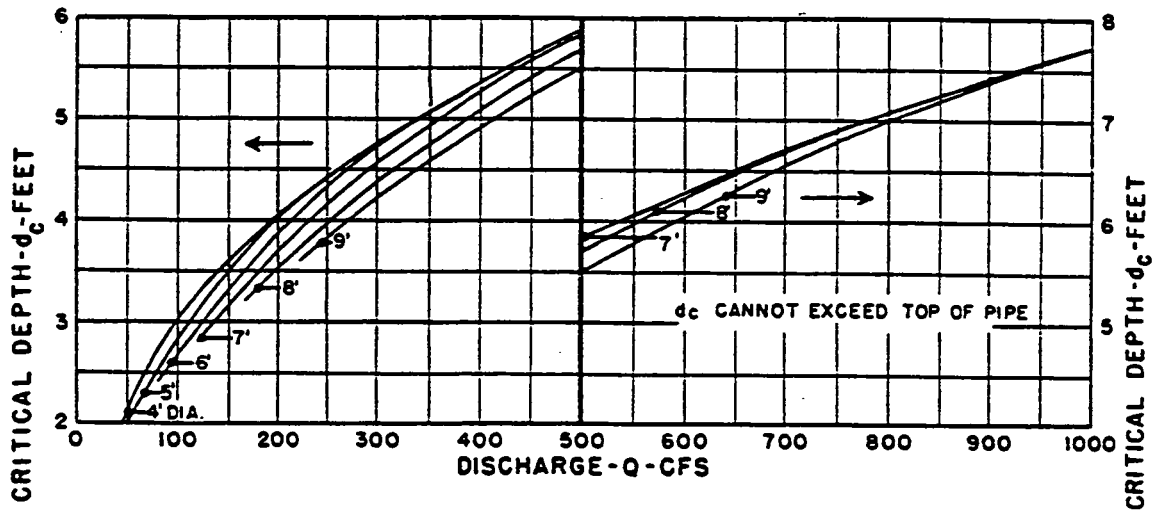
000491

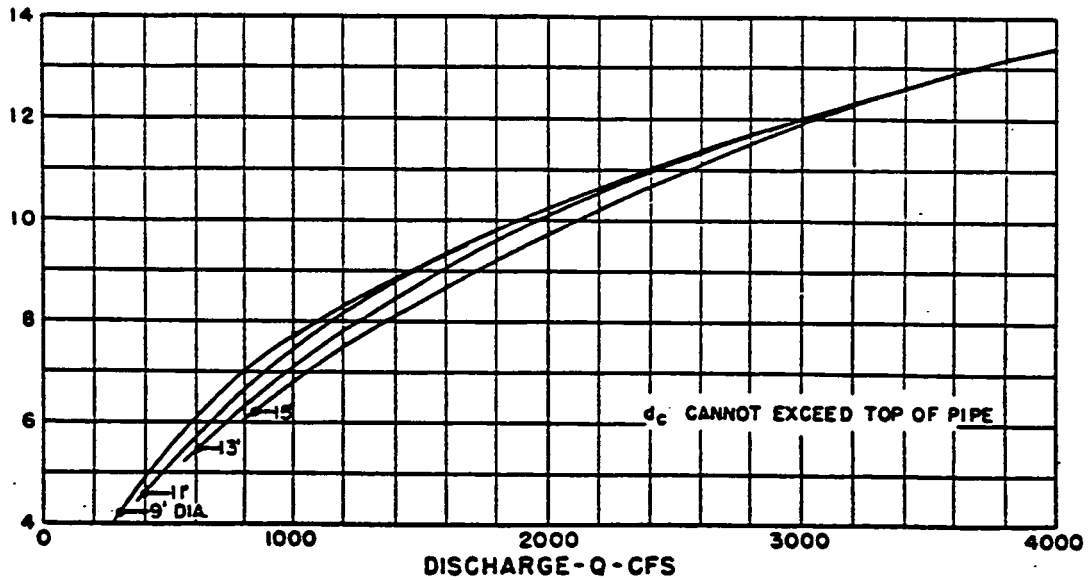
SHT C33

1634

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000492

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

000493

SHT C35

Quick TR-55 Ver.5.46 S/N:
Executed: 16:52:17 06-07-1997

1634

CULVERT-6
EXISTING AND PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	1.00						
			10.00	0.700	0.700	5.450	1.00	3.81

000495

PROJECT: SOUTHERN WASTE UNITS CULVERT - 6 (CONTINGENCY CULVERT)	STATION: — SHEET — OF —	CULVERT DESIGN FORM DESIGNER / DATE: — / — REVIEWER / DATE: — / —

HYDROLOGICAL DATA

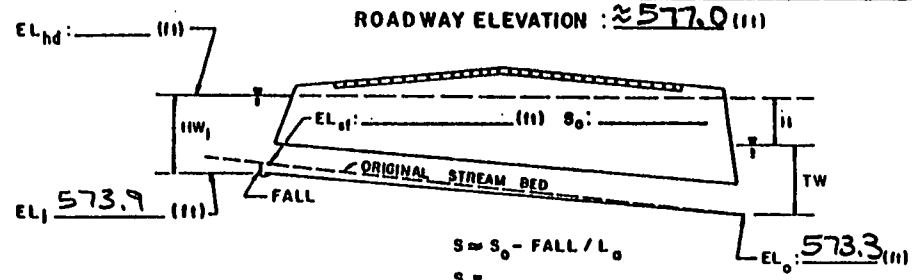
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	3.81	*

ROADWAY ELEVATION: ≈577.0 (ft)



$S \approx S_o - FALL / L_o$

$S =$

$L_o = \approx 55'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" ϕ	3.8	3.8	1.0	1.25	—	575.2	1.2	0.7	1.0	1.2	0.9	0.9	576.4	576.4	—	OUTLET CONTROL OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + h_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION: * ASSUME TW AT FLOW DEPTH FOR DITCH 2A, FROM CALC FOR 2A, TW = 1.2 ft

CULVERT BARREL SELECTED:

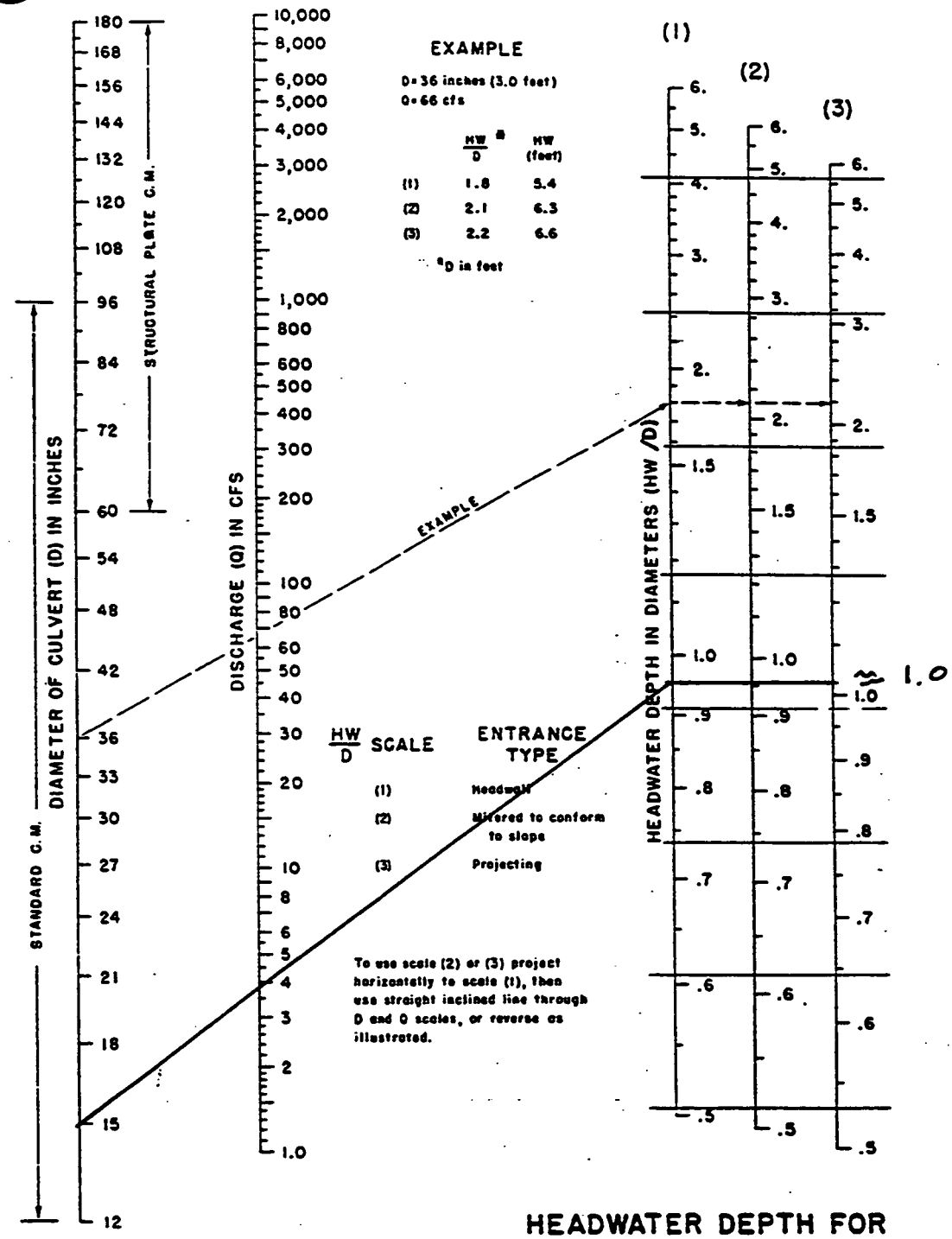
SIZE: 15"
SHAPE: ROUND
MATERIAL: CMP n=0.024
ENTRANCE: PROJECTING

SHT C36

SHT C37

1634

CHART 2



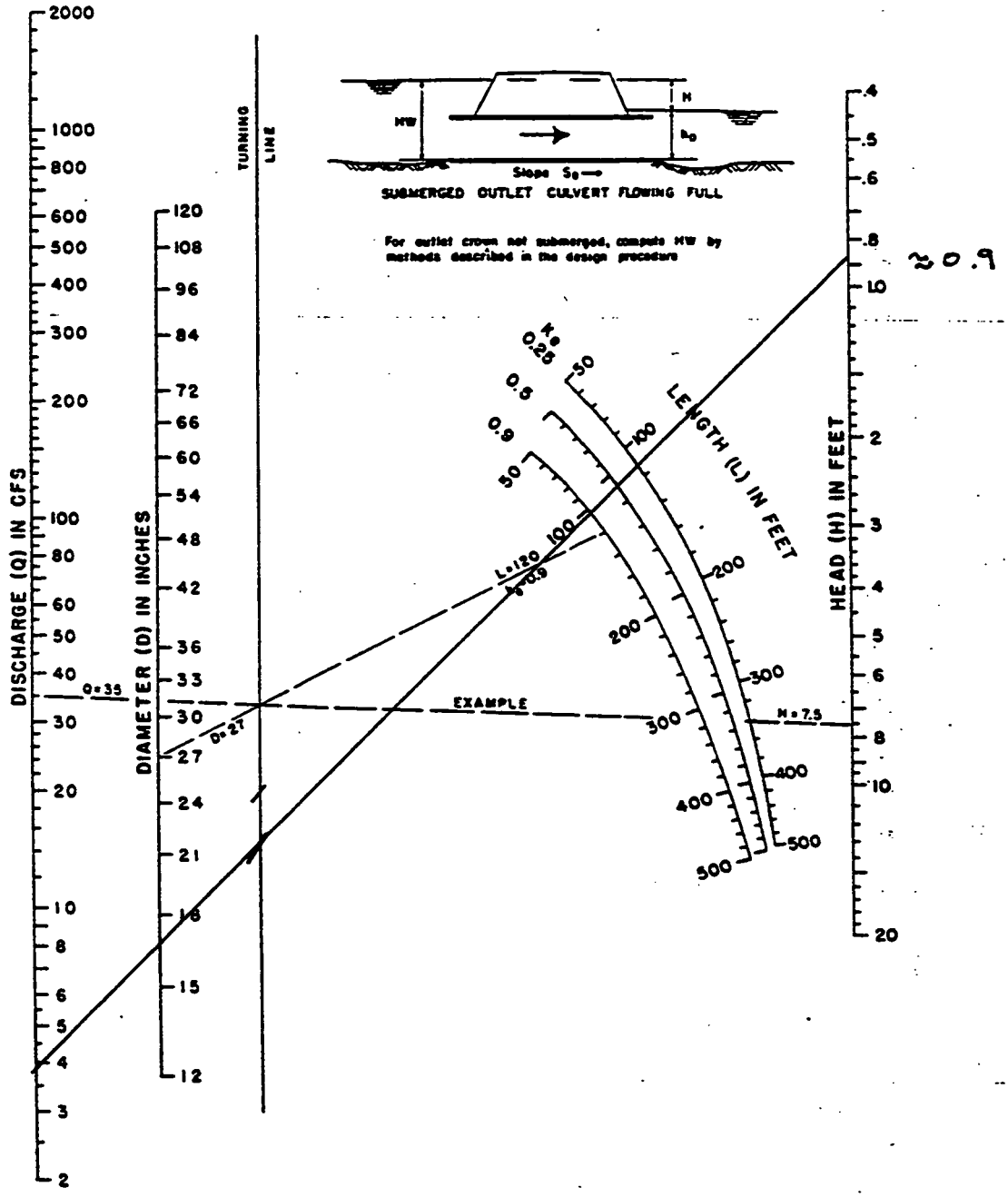
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000496

SHT C 38

CHART 6



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

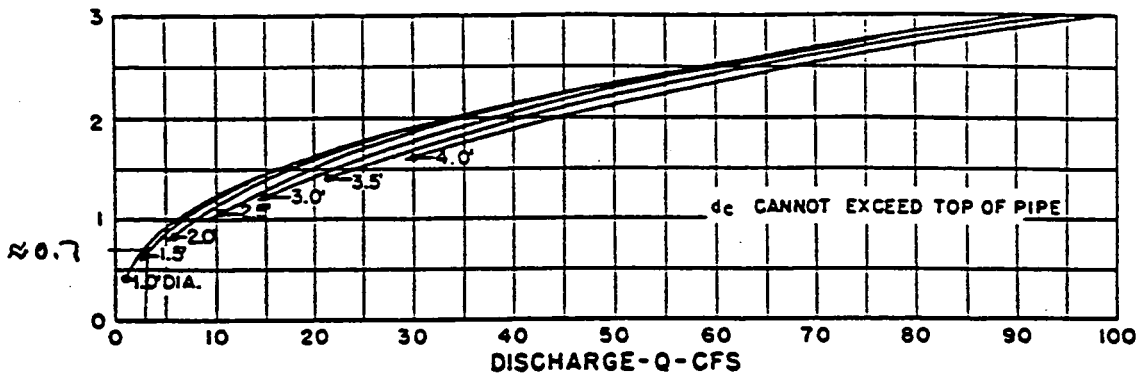
BUREAU OF PUBLIC ROADS JAN. 1963

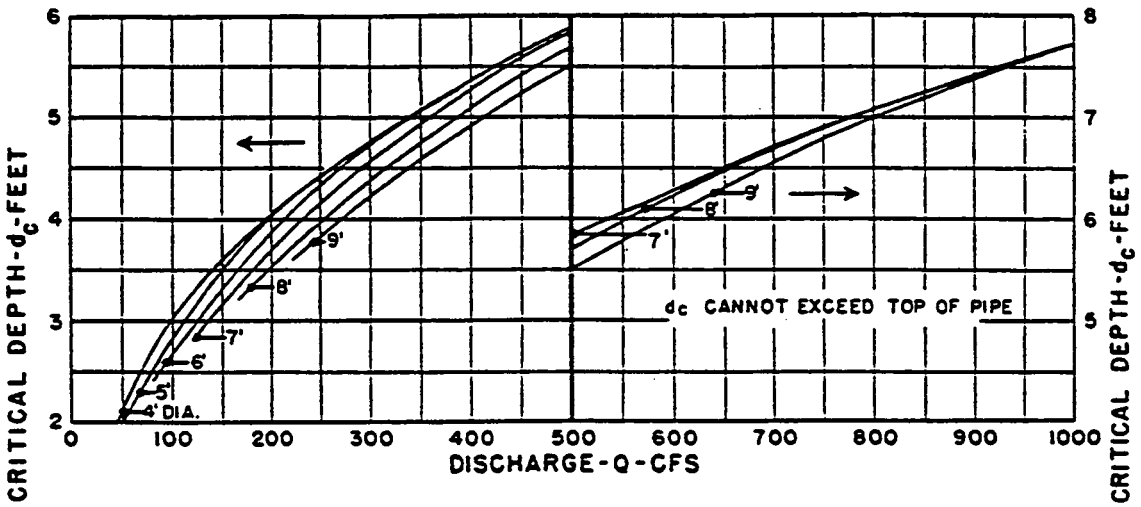
000497

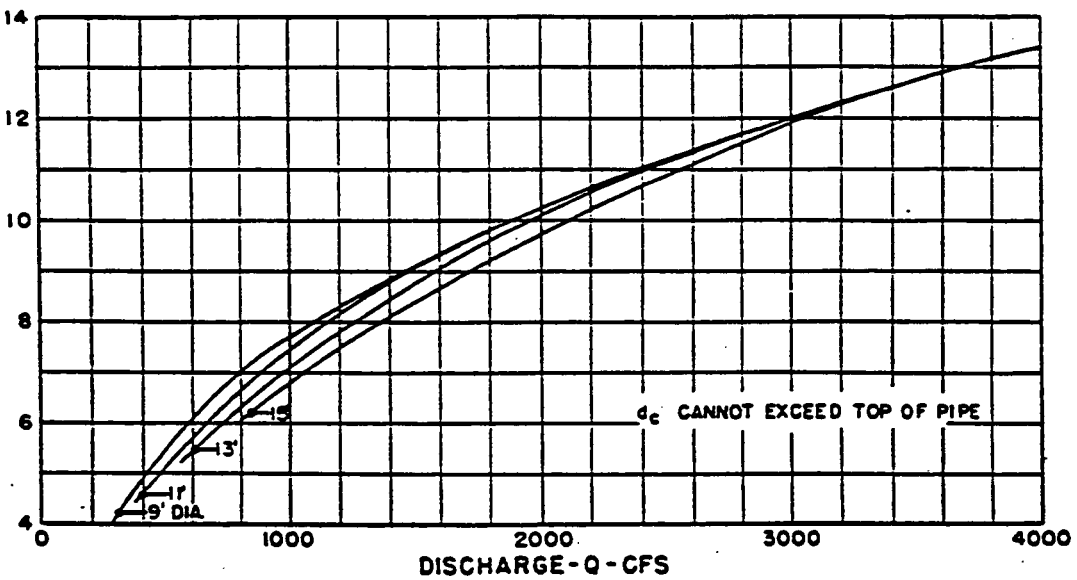
SHT C39

1634

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000498

SHTC40

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

000499

SHT C41

1634

Quick TR-55 Ver.5.46 S/N:
Executed: 16:53:28 06-07-1997

CULVERT-7
EXISTING AND PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
GRAVEL	0.900	0.20						
			10.00	0.900	0.900	5.450	0.20	0.98

000500

000501

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 7

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

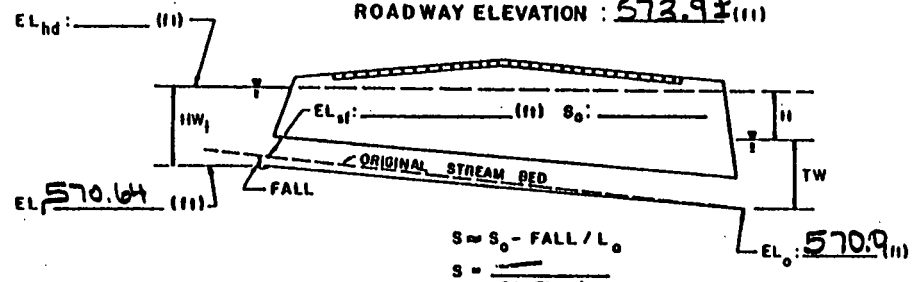
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: — ☐ STREAM SLOPE: —
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	0.98	*

ROADWAY ELEVATION: 573.9* (ft)



$S \approx S_o - FALL / L_o$
$S =$ —
$L_o = \approx 30'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL: HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL: TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 12" ϕ CMP	1.0	1.0	0.64	0.64	—	571.3	1	0.4	0.7	1	0.9	≈0	571.0	571.3	—	INLET CONTROL: OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

* ASSUME TW = 1.0 ft

CULVERT BARREL SELECTED:

SIZE: 12"
SHAPE: ROUND
MATERIAL: CMP n 0.024
ENTRANCE: PROJECTING

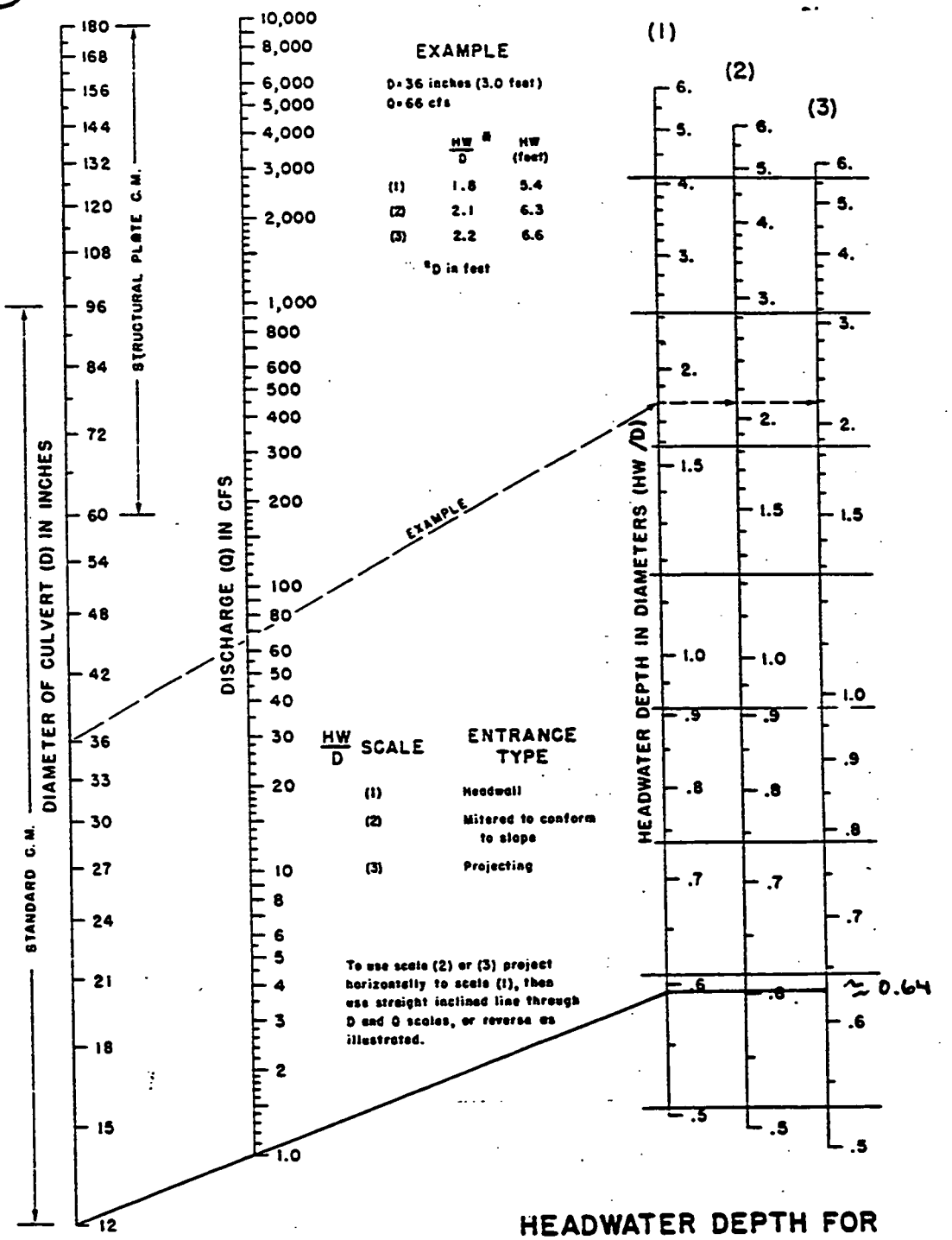
240

54T C42

SHT C43

CHART 2

1634



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

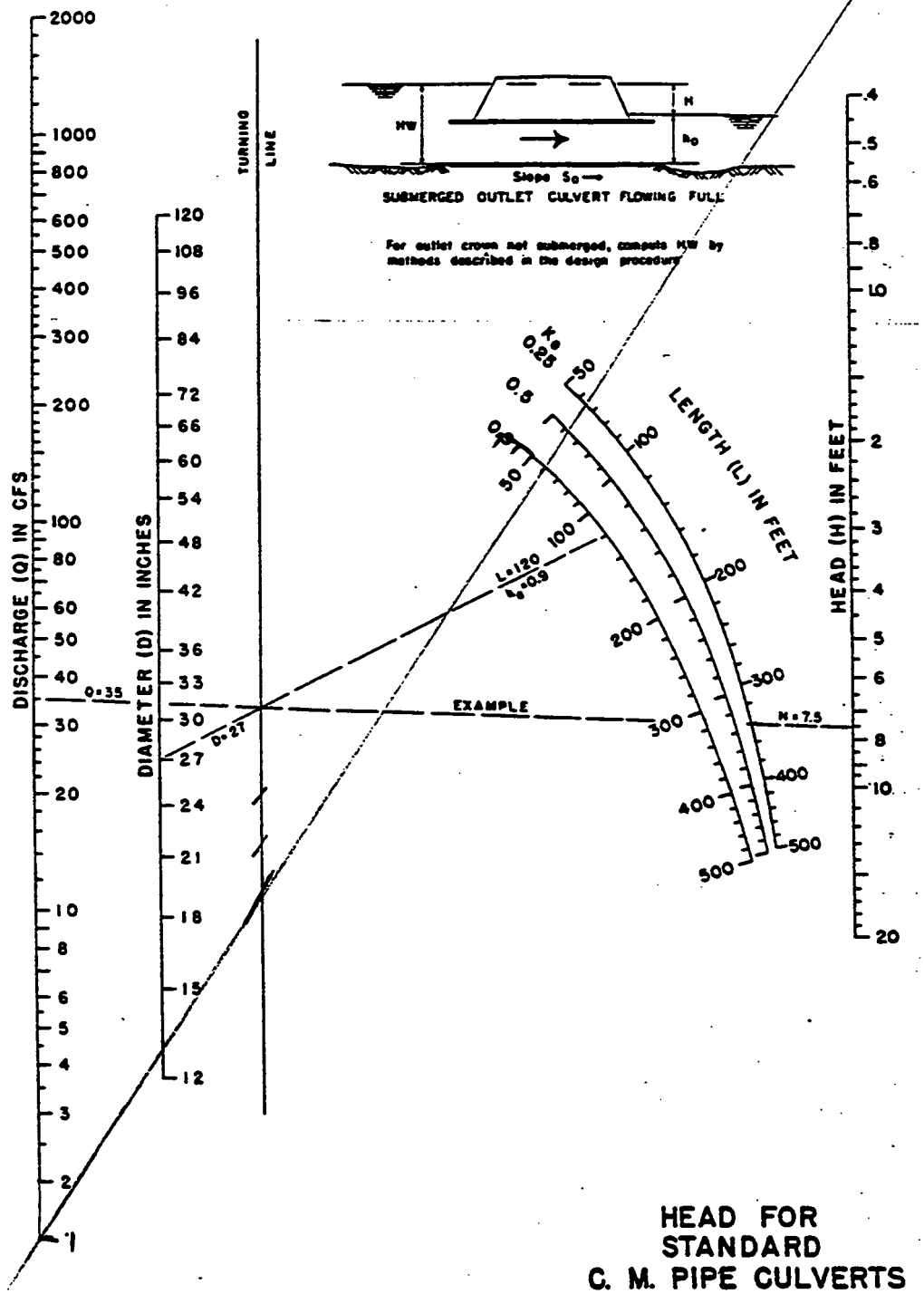
BUREAU OF PUBLIC ROADS JAN. 1963

000502

SHT C44

CHART 6

INSIGNIFICANT

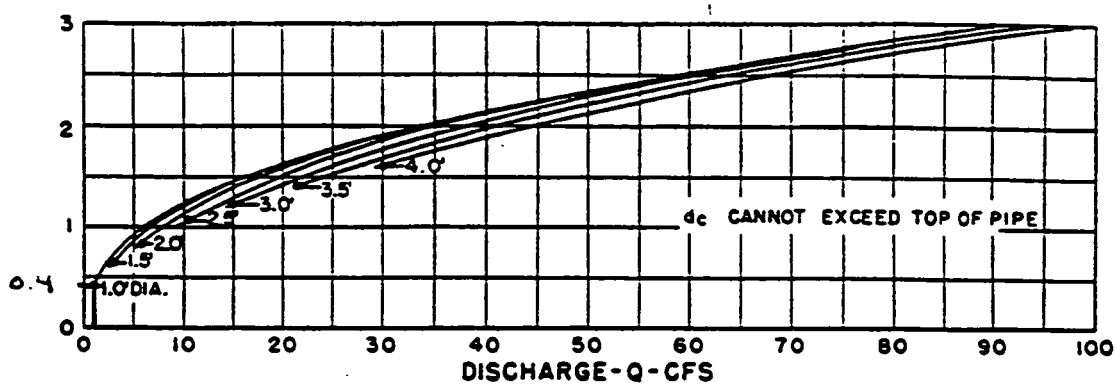


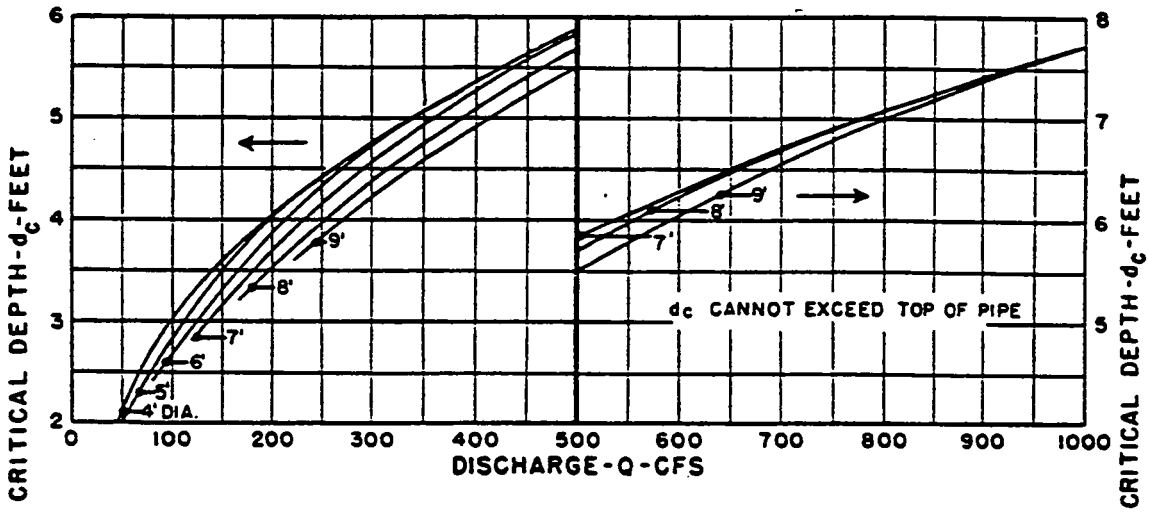
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

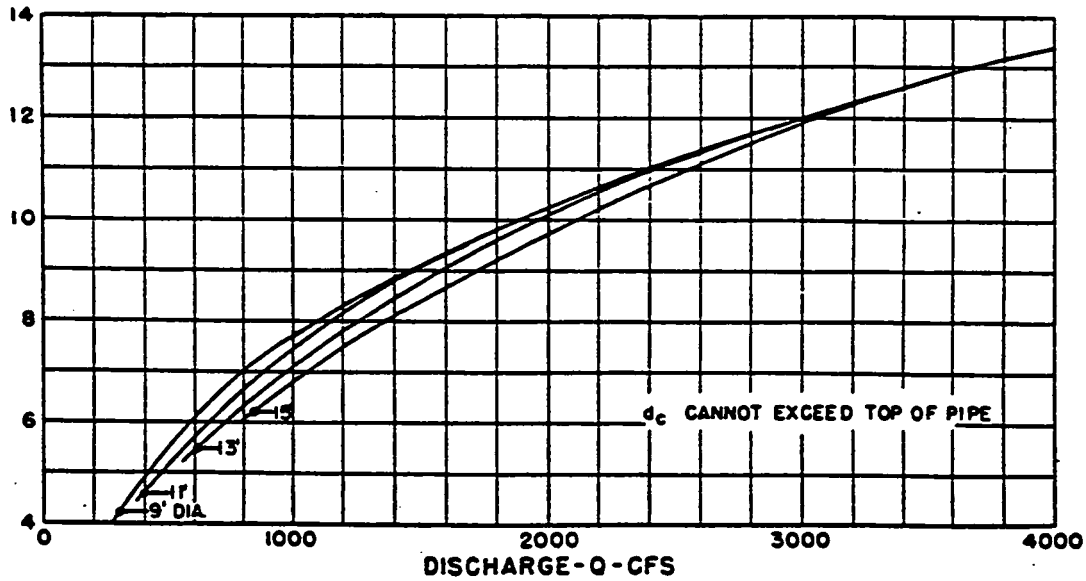
BUREAU OF PUBLIC ROADS JAN. 1963

000503

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

SHT C46

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

000505

Quick TR-55 Ver.5.46 S/N:
Executed: 07:29:49 10-08-1997

SHT C47

1634

CULVERT 8
RESTORED CONDITIONS
(listed as culvert 1 on dwg 92X-5900-G-00333)

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj • C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	6.60						
GRAVEL RD	0.900	0.43						
VEG, POOR	0.600	0.25						
			10.00	0.708	0.708	5.450	7.28	28.11

TJB

FROM D7 PROPOSED CONDITIONS = 7.87 CFS
FROM D8 PROPOSED CONDITIONS = 7.02 CFS
14.89 CFS

000506

000507

PROJECT: SWU - EXCAVATION PKG
CULVERT 8 (CULVERT -1 ON DWG 6003:23)

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM
DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

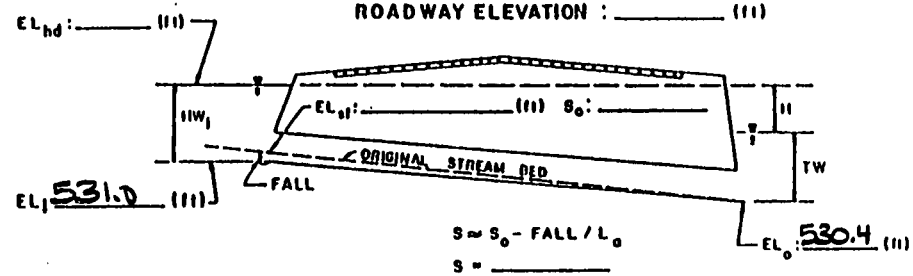
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	28.1	*

ROADWAY ELEVATION: _____ (ft)



$S \approx S_o - FALL / L_o$
$S =$ _____
$L_o =$ 130

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	h_o	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 3-15" Φ	14.9	5.0	1.3	1.6	—	532.6	1.3	≈1.0	1.1	1.3	0.9	3.2	533.6	533.6	—	OK

TECHNICAL FOOTNOTES:

(1) USE Q/HD FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

* ASSUME TW EL AT TOP OF PIPE ≈ 531.7

CULVERT BARREL SELECTED:

SIZE: _____
SHAPE: _____
MATERIAL: _____ (1) _____
ENTRANCE: _____

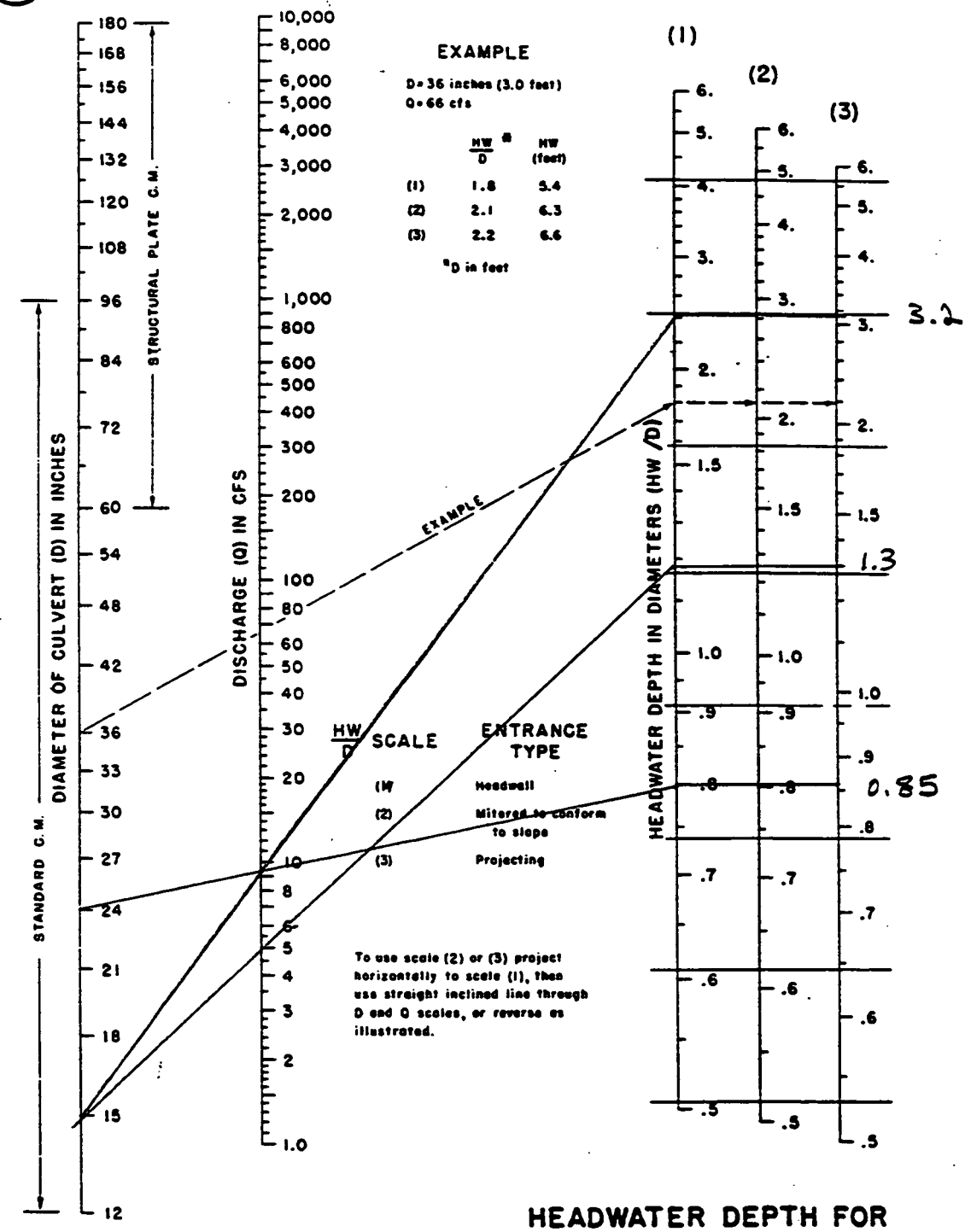
240

SHT C48

SHT C49

1634

CHART 2



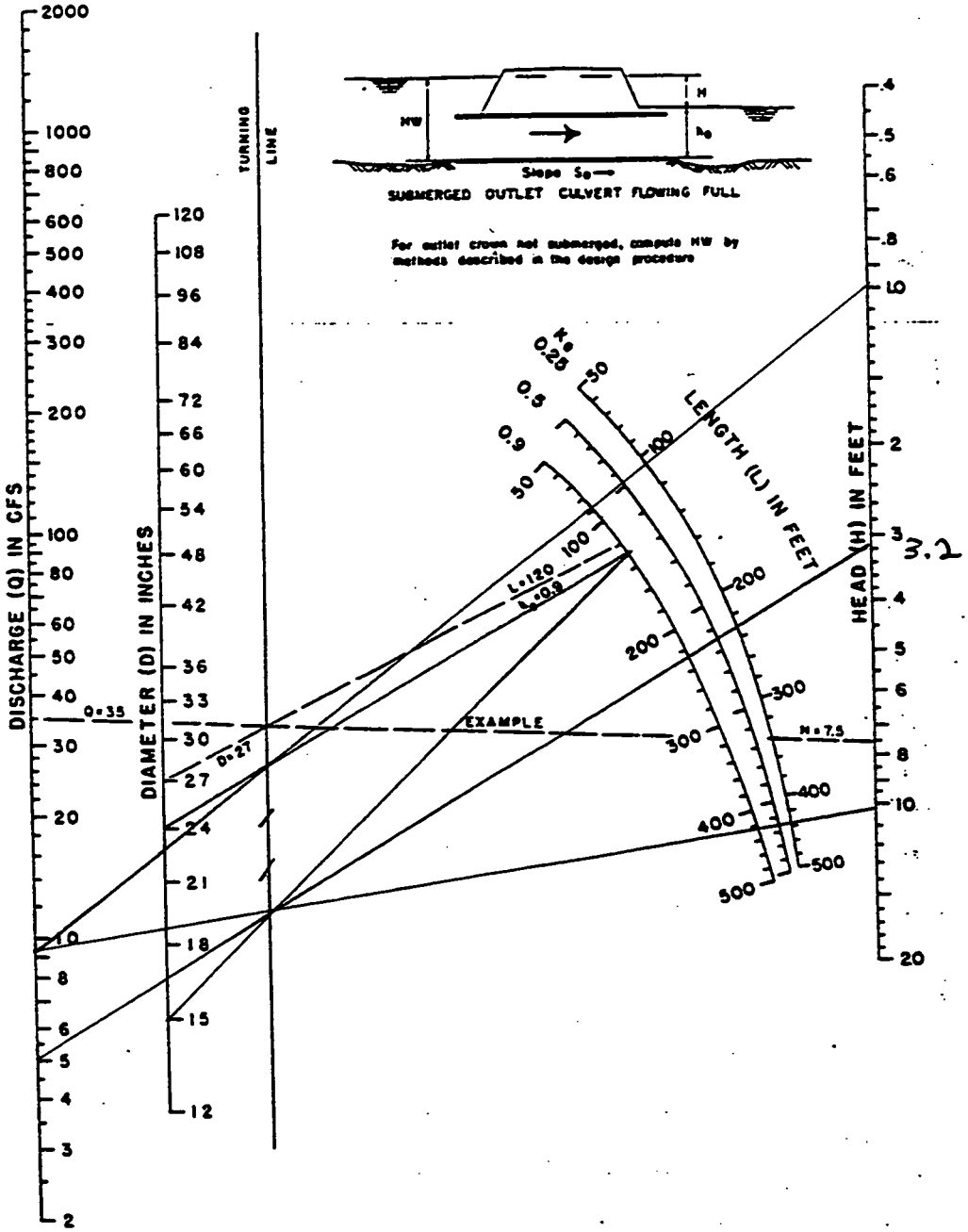
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000508

SHT C50

CHART 6



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

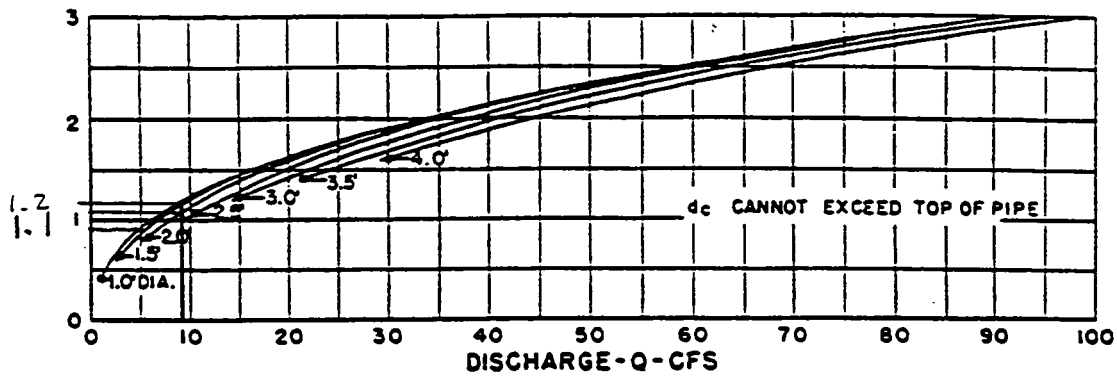
BUREAU OF PUBLIC ROADS JAN. 1963

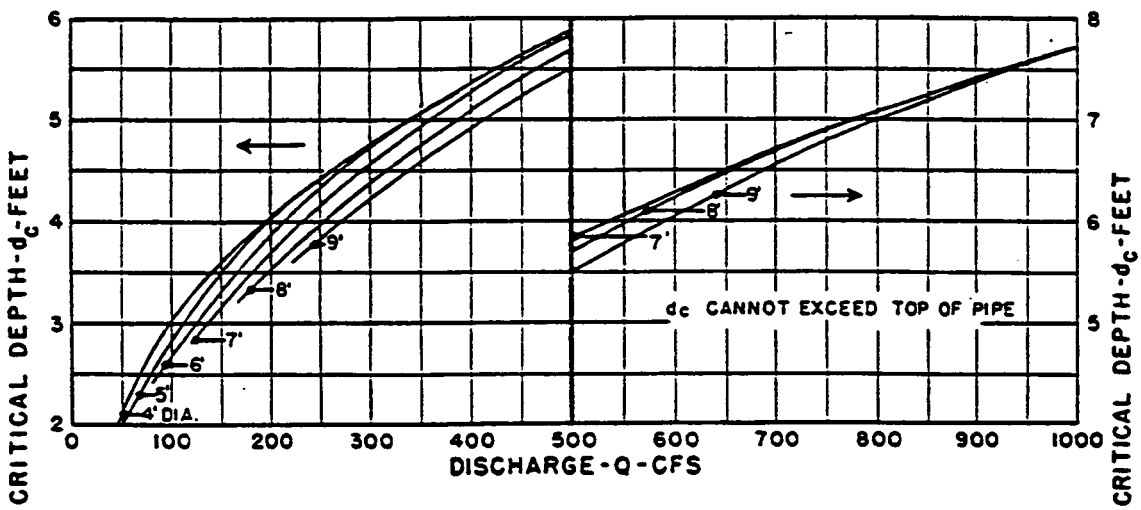
000509

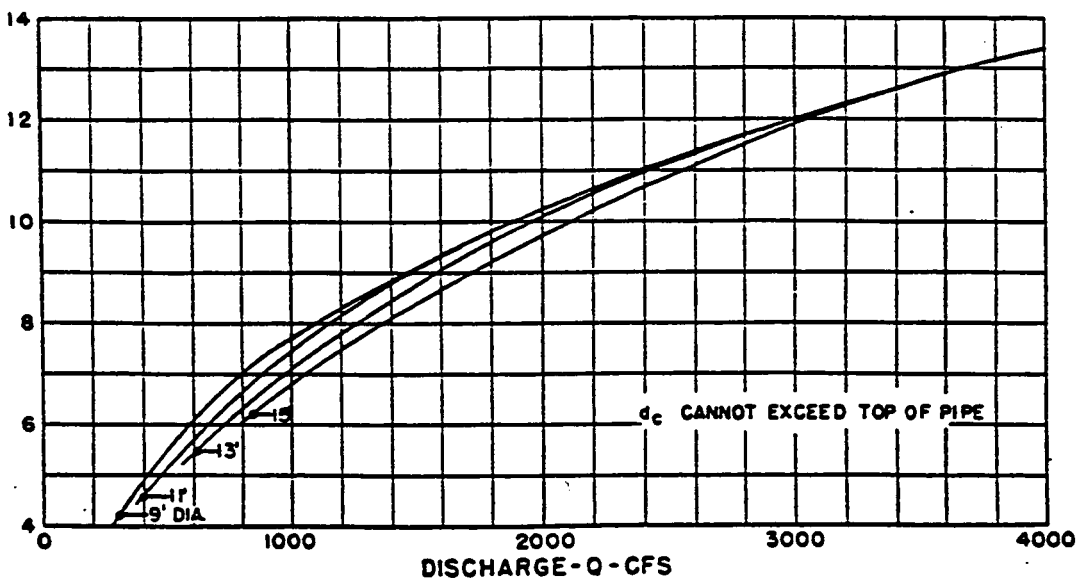
SHT C51

1634

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000510

SHT C52

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

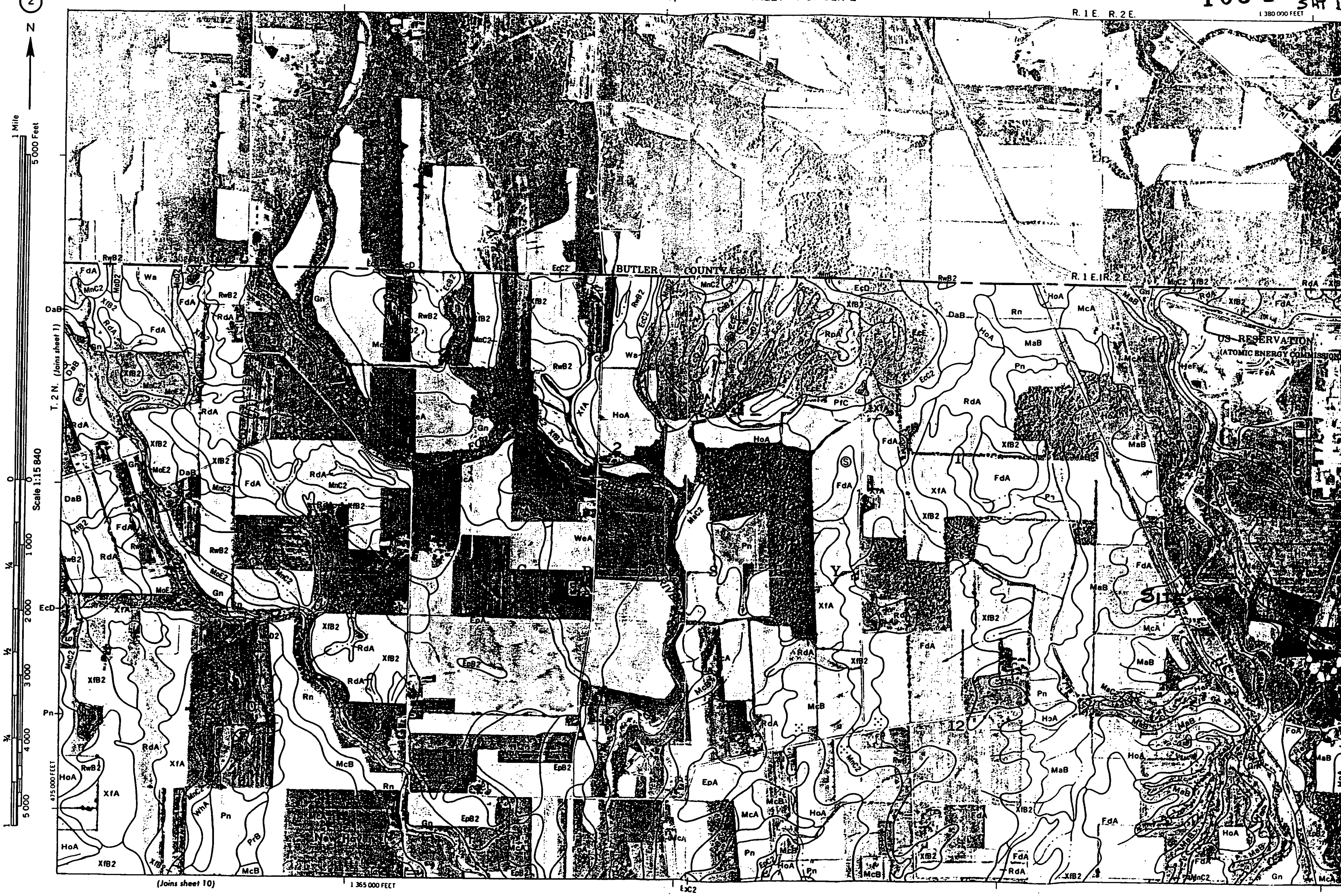
000511

ATTACHMENT D

1) Soils Map (Reference 6)
2) Rainfall Intensity-Duration-Frequency Curve (Reference 7)

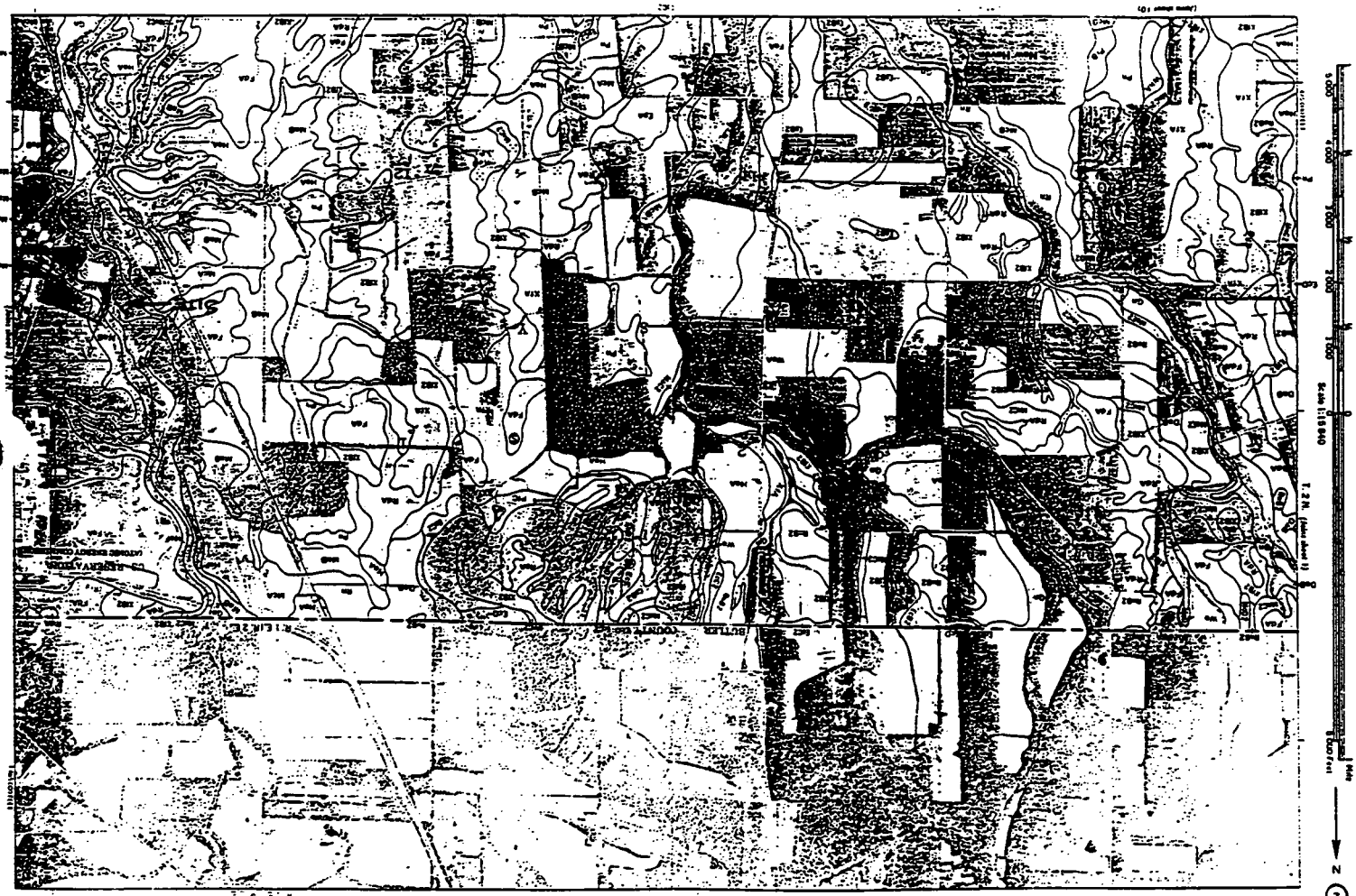
(2)

1634 SHT DI



This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

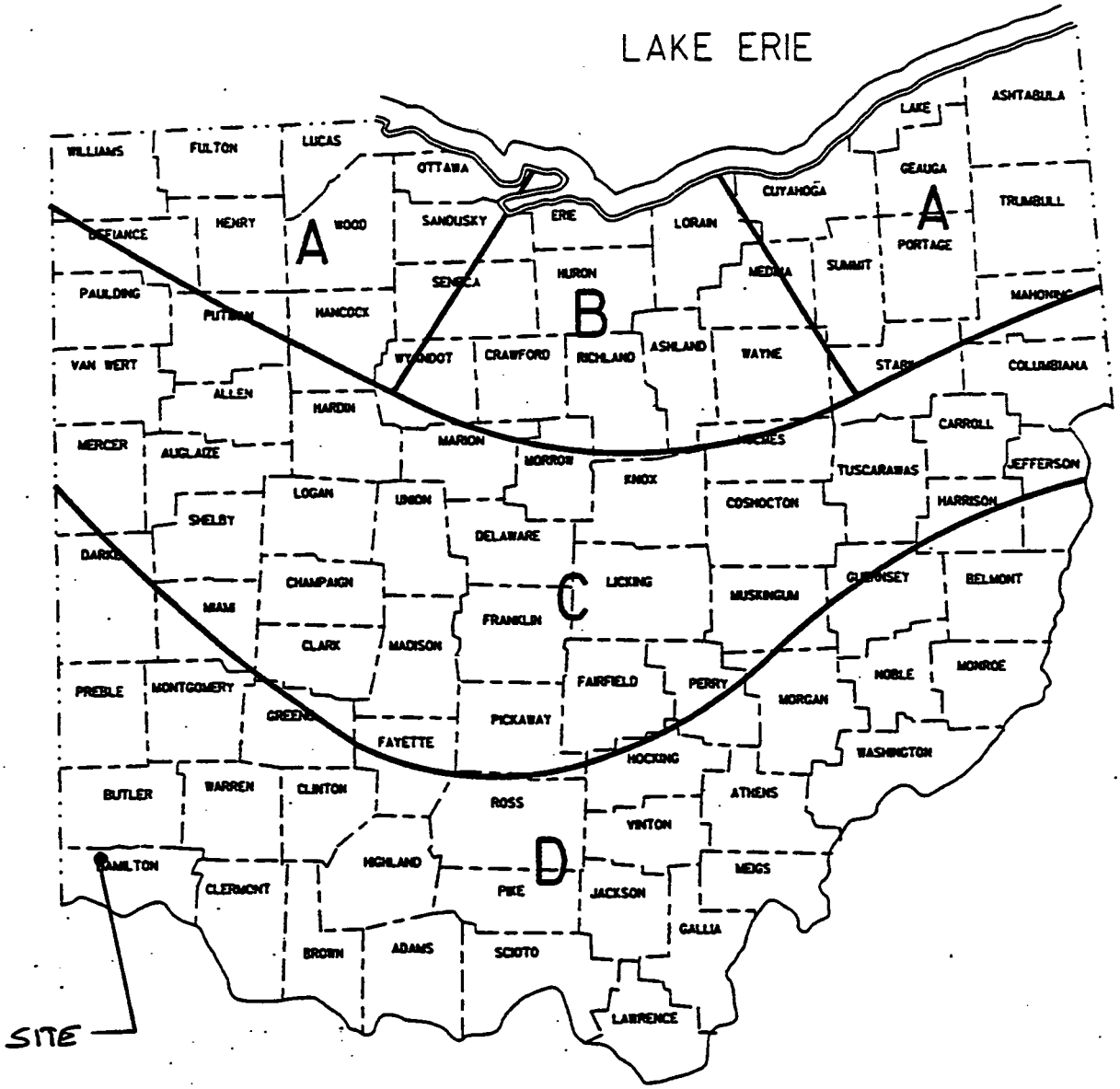
000513



HAMILTON COUNTY, OHIO - SHEET NUMBER 2

SHT D2

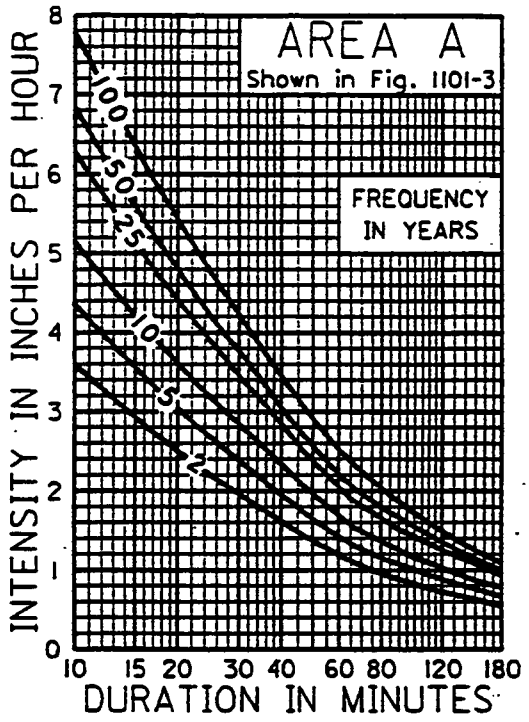
RAINFALL INTENSITY ZONE MAP	1101-3
	REFERENCE SECTION 1101.24

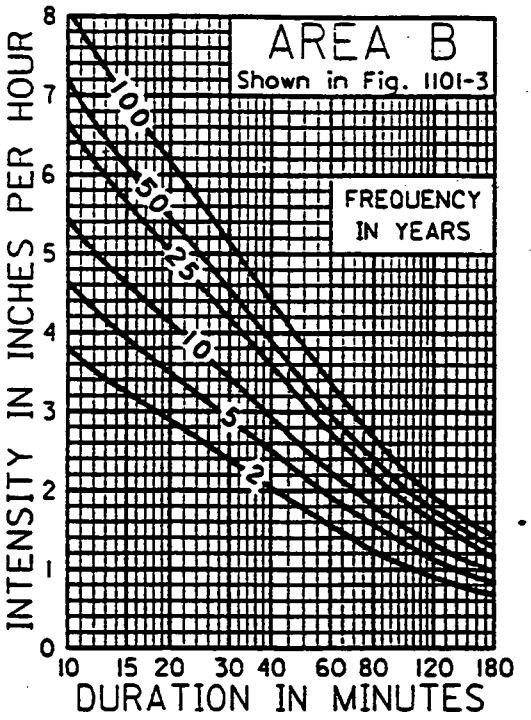


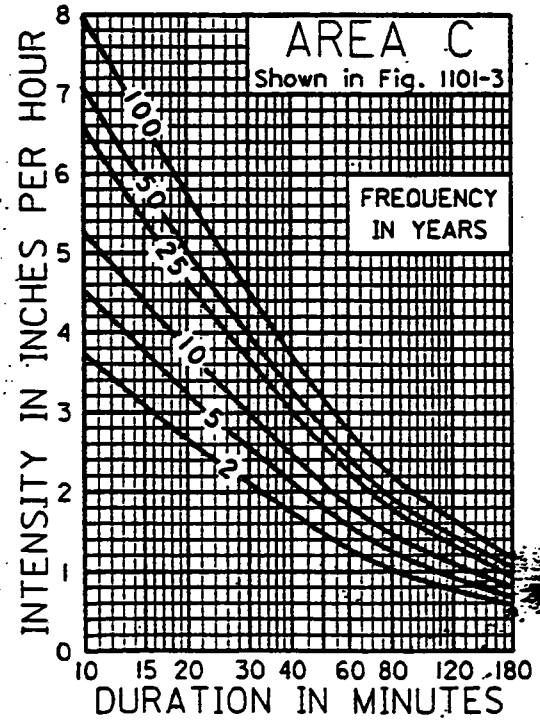
000515

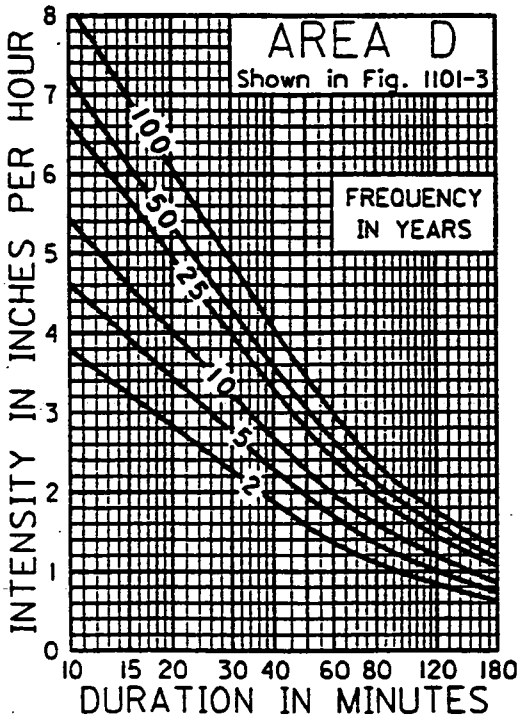
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES









USE D CURVE

ATTACHMENT E

Calculation 15-02

PO158

Haulroad Drainage

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

Date 7/23/96
Sheet 1 of 2

Proj. Order No. 158 Calculation No. 15-02

Project Title HAUL ROAD CONSTRUCTION

Calculation Subject DRAINAGE Date Verified/Checked 5/21/96

STATUS: PRELIMINARY _____ FINAL X SUPERSEDED _____ VOID _____

STATEMENT OF PROBLEM

DITCH & CULVERT DESIGN CALCULATIONS FOR THE HAUL ROAD.
HAUL ROAD MAXIMUM DITCH VELOCITY IS 2 FT/SEC.

SUMMARY OF CONCLUSIONS	Originator's Signature and Date
DITCHES ARE DESIGNED AND PLOTTED IN THE PROFILE AND CROSS SECTIONS	A Shanxon 5/21/96 REV 7/8/96
CHECKING METHOD	**Checker's Signature and Date**
1. Review X 2. Alternate Calculation ___	Am Chiuto 5/21/96 REV 7/8/96
	Lead Discipline Engineer's Signature and Date
	John Gilleslup 7/23/96

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Revision No. 0
Sheet 2 of 2

Proj. Order No. 158 Calculation No. 15-02

Project Title HAUL ROAD CONSTRUCTION

Calculation Subject DRAINAGE Date Verified/Checked 5/21/96

Prepared By: [illegible] Checked/Verified By: [illegible]

Date 5/21/96 REV 7/8/96

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

- ASSUMPTIONS - STATED IN CALCULATIONS
- CODES - ODOT LOCATION & DESIGN MANUAL
- SOURCES - PLAN DRAWINGS

000519

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 1 of 3
Made by: AJS Date: 7/3/96
Checked by: Amc Date: 7/8/96

Revised Conduit Design

Assumptions/Criteria

- Use Inlet Control: Allowable HW = D ($\frac{HW}{D} = 1$)
  Use ODOT L&D Manual, Fig 1100-245 (Attachment B)
- Use Corrugated Metal Pipe
- Design based on 25-year peak discharge, Rational Method
- 2 fps maximum ditch velocity ahead of Sta 121+00
- 3 fps maximum ditch velocity below Sta 121+00

Sta 101+20

A = 12.39 Acres

Overland flow width ≈ 800 ft

Ground slope = 0.01 = 1.0%

T_o = 33 min (Attachment D)

$$T_D = \frac{(106+50 - 101+20)}{3 \text{ fps}} = 176.67 \text{ sec} = 2.9 \text{ say } 3 \text{ min}$$

T_c = 36 min

i_{25} = 3.6 in/hr

$Q_{25} = 0.3(3.6)(12.39)$

$= 13.4$ cfs

Required Pipe Size is 24" (Attachment B)

Sta 109+30

A = 10.44 Acres

Overland flow width ≈ 800 ft

Ground slope = 1.0%

T_o = 33 min

$$T_D = \frac{109+30 - 106+50}{3 \text{ fps}} = 93.3 \text{ sec} = 1.56 \text{ say } 2 \text{ min}$$

$T_c = T_o + T_D$ = 35 min

i_{25} = 3.65 in/hr

Q_{25} = 0.3 (3.65)(10.44)

= 11.4 cfs

Req'd Pipe Size is 24" (Attachment B)

Sta 119+12

A = 9.15 Acres (East Side from Sta 116+50 to the K-65 Trench @ 126+50)

Overland flow width = 350 ft, Ground slope ≈ 0.8%

T_o = 26 min

$$T_D = \frac{(126+50 - 119+12)}{3 \text{ fps}} \times \frac{1}{60} = 4.1 \text{ min}$$

T_c = 30 min

i_{25} = 4 inches/hr

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 3 of 3
Made by: AJS Date: 7/3/96
Checked by: [illegible] Date: 7/8/96

Sta 119+12 (cont)

$Q_{25} = 0.3(4.0)(9.15)$

$= 10.98$ cfs say 11 cfs

Required pipe size is 24" (Attachment B)

Pipe Slopes

Assumptions / Restrictions

- Maximum velocity of 3 fps for stations below 121+00
- Velocity based on full flow using Mannings Equation

$$S_{MAX.\,ALLOWABLE} = \left[\frac{V\,n}{1.49(A/P)^{2/3}}\right]^2 \quad \text{where}$$

$V = 3$ fps

$A = \pi r^2 = 3.141$ ft^2

$P = 2\pi r = 6.283$ ft

} All Pipes are 24" dia.

$n = 0.024$ (Attachment C)

$$S_{MAX.\,ALLOWABLE} = \left[\frac{(3\text{ fps})(0.024)}{1.49\,(0.500)^{2/3}}\right]^2$$

$S_{MAX.} = 0.0059$

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 1 of 5

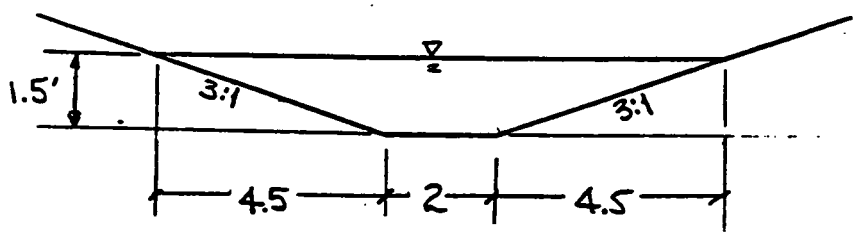
Made by: AJS
Date: 5/17/96
Checked by: AMC
Date: 5/22/96

Reiteration of Previous Calcs by DCB

Ditch Design

Assumptions / Restrictions

- Max velocity of 2 fps for Stations greater than 121+00
- Max velocity of 3 fps for Stations less than 121+00
- Trapezoidal Ditch Section; 2 foot bottom, 3:1 slopes
- Design Flow depth 1.5 ft. maximum



$A = 9.75\ ft^2$

$P = 11.49\ ft$

$R = A/P = 0.849\ ft$

Since capacity is not an issue on the Haul Rd due to small discharges, the main objective will be to control the velocity by means of restricting the allowable ditch slope.

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 2 of 5
Made by: AJS Date: 5/17/96
Checked by: AMC Date: 5/22/96

Reiteration of Previous Calc's by DCB

V = 3 fps (Sta 121+00 forward) n = 0.04 for sod lining
(ODOT L&D Manual, Table 1102-2 Attachment F)

$$S = \left[\frac{Vn}{1.49 R^{2/3}}\right]^2$$

$$= \left[\frac{(3\text{fps})(0.04)}{(1.49)(0.849)^{2/3}}\right]^2$$

$$= 0.008$$

$$= 0.80\% \text{ maximum}$$

V = 2 fps (Sta 121+00 back)

$$S = \left[\frac{(2\text{fps})(0.04)}{(1.49)(0.849)^{2/3}}\right]^2$$

$$= 0.0036$$

$$= 0.36\% \text{ maximum}$$

$$S = \left[\frac{(2\text{fps})(0.06)}{(1.49)(0.849)^{2/3}}\right]$$

$$= 0.008$$

$$= 0.80\% \text{ max}$$

Sta 121+00 to Sta 128+35

ΔElev = 573.05 − 569.10 = 3.95 ft

S = 3.95 ft / 735 ft = 0.0054

$$n = \frac{1.49}{V} R^{2/3} S^{1/2} = \frac{1.49}{2}(0.849)^{2/3}(0.0054)^{1/2} = 0.049$$

Use RCP, n = 0.06

AJS 5/14/96
Sheet 3 of 5
ck'd 5/22/96

Haul Road Ditch Checks (Steps)

- Restrict velocity to 2 fps maximum
- Minimize Use of Rock Channel Protection (try to limit to 'step' area)

Sta 130+07 to Sta 141+00
Ditch Length = 1093 ft
Drainage Area = 2.03 acres (from previous calcs)

From plans, the overland flow width to the high end of the ditch is 50 feet (±), and the ground slope is approximately 2% (0.02)

T_o = 10 min (L&D Manual, Figure 1101-1, Attachment D)

Based on a ditch velocity of 2 fps

T_D = 1093 ft / 2 ft/sec = 546.5 sec = 9 min

$T_c = T_o + T_D$ = 19 min

From Fig 1101-2, i_{25} = 5 inches/hr (Attachment E)

Q_{25} = 0.3 (5)(2.03) = 3.04 cfs

Assume a flow depth of 1.5 feet, trapezoidal cross section with a bottom width of 2 feet and 3:1 side slopes, and sod lining ($n = 0.04$).

Then the flow area is

$$A = \tfrac{1}{2}\left[2 + 2 + 2(3)(1.5)\right](1.5) = 9.75\ ft^2$$

The wetted perimeter is

$$P = 2 + 2\left[(1.5)^2 + (4.5)^2\right]^{1/2} = 11.49\ ft$$

And the hydraulic radius is

$$R = A/P = 9.75/11.49 = 0.849\ ft$$

The ditch flow capacity is

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

For $S = 0.008$, $Q = 29.12$ cfs $\gg$ Max. discharge $= 3$ cfs

For $S = 0.006$, $Q = 25.22$ cfs $\gg 3$ cfs

Let $S = 0.006$ and find normal depth for $Q = 3$ cfs (peak flow in the ditch 'step' area).

Let $d = 0.5$ ft

$A = \frac{1}{2}[2 + (2 + 2(3)(0.5))](0.5) = 1.75 \text{ ft}^2$

$P = 2 + 2[(0.5)^2 + (1.5)^2]^{1/2} = 5.16$ ft

$R = A/P = 0.339$ ft

$Q = \frac{1.49}{0.04}(1.75)(0.339)^{2/3}(0.006)^{1/2} = 2.45$ cfs

Let $d = 0.6$ ft

$A = \frac{1}{2}[2 + (2 + 2(3)(0.6))](0.6) = 2.28 \text{ ft}^2$

$P = 2 + 2[(0.6)^2 + (1.8)^2]^{1/2} = 5.79$ ft

$R = A/P = 0.393$ ft

$Q = \frac{1.49}{0.04}(2.28)(0.393)^{2/3}(0.006)^{1/2} = 3.53$ cfs OKAY

$V = Q/A = 3.53/2.28 = 1.55$ f.p.s. OKAY

∴ In step area, use 0.60% ditch grade and 2-foot drops lined with Rock Channel Protection locally. Remainder of ditch to be lined with sod. Step interval is 200 ft.

1100 Drainage Design Procedures

Attachment A

1634

1101 Estimating Design Discharge

1101.1 General

In order to properly design highway drainage facilities, it is essential that a reasonable estimate be made of the design and check discharges. Some of the more important factors affecting runoff are duration, intensity and frequency of rainfall, and the size, imperviousness, slope and shape of the drainage area. Also a proper evaluation should be made of probable changes in land use throughout the drainage area.

1101.2 Procedures

1101.21 Statistical Methods

The statistical methods developed by the U.S. Geological Survey and published in USGS Water Resources Investigations Reports 89-4126 and 86-4197 are recommended for estimating runoff from larger drainage areas. A description and limitations of these methods are described in Section 1003.

1101.22 Rational Method

The Rational method is considered to be more reliable for estimating runoff from small drainage areas, usually less than 6 acres; and for areas that contribute sheet flow only to the roadway ditch or pavement. The design discharge "Q" is obtained from the equation Q = CiA where:

C = Coefficient of runoff

i = Average rainfall intensity, in inches per hour, for a given storm frequency and for a duration equal to the time of concentration

A = Drainage area, in acres

The time of concentration is the time required for runoff to flow from the most remote point of the drainage area to the point of concentration. The point of concentration could be a culvert inlet or the checkpoint in a roadway ditch used to determine the need for protection. Time of concentration is ordinarily designated by T and is the summation of the time of overland flow "t_o" and the time of ditch flow "t_d".

Overland flow is that flow not carried in a discernible channel, and the time of such flow may be obtained from Figure 1101-1 or a similar overland flow chart.

1101.23 Coefficient Of Runoff

The recommended value for the coefficient of runoff for various contributing surfaces are shown in Table 1101-1. Where two values are shown, the higher value ordinarily applies to the steeper slopes.

Table 1101-1

Types of Surface	Coefficient of Runoff "C"
Pavement & Paved Shoulders	0.9
Berms and slopes 4:1 or flatter	0.5
Berms and slopes steeper than 4:1	0.7
Contributing Areas:	
Residential (single family)	0.4-0.6
Residential (multi-unit)	0.5-0.7
Woods	0.3
Cultivated	0.3-0.6

The total width contributing flow to a given point usually consists of surfaces having a variable land cover and thereby require a weighted coefficient of runoff "C". The weighted coefficient is obtained by averaging the coefficients for the different types of contributing surfaces, as noted in the following example:

Contributing Width "W"	Land Use	"C"	"CW"
20 Ft.	Paved Area	0.9	18
40 Ft.	Earth Berms & Slopes	0.7	28
140 Ft.	Residential Area	0.6	84
200 Ft.			130

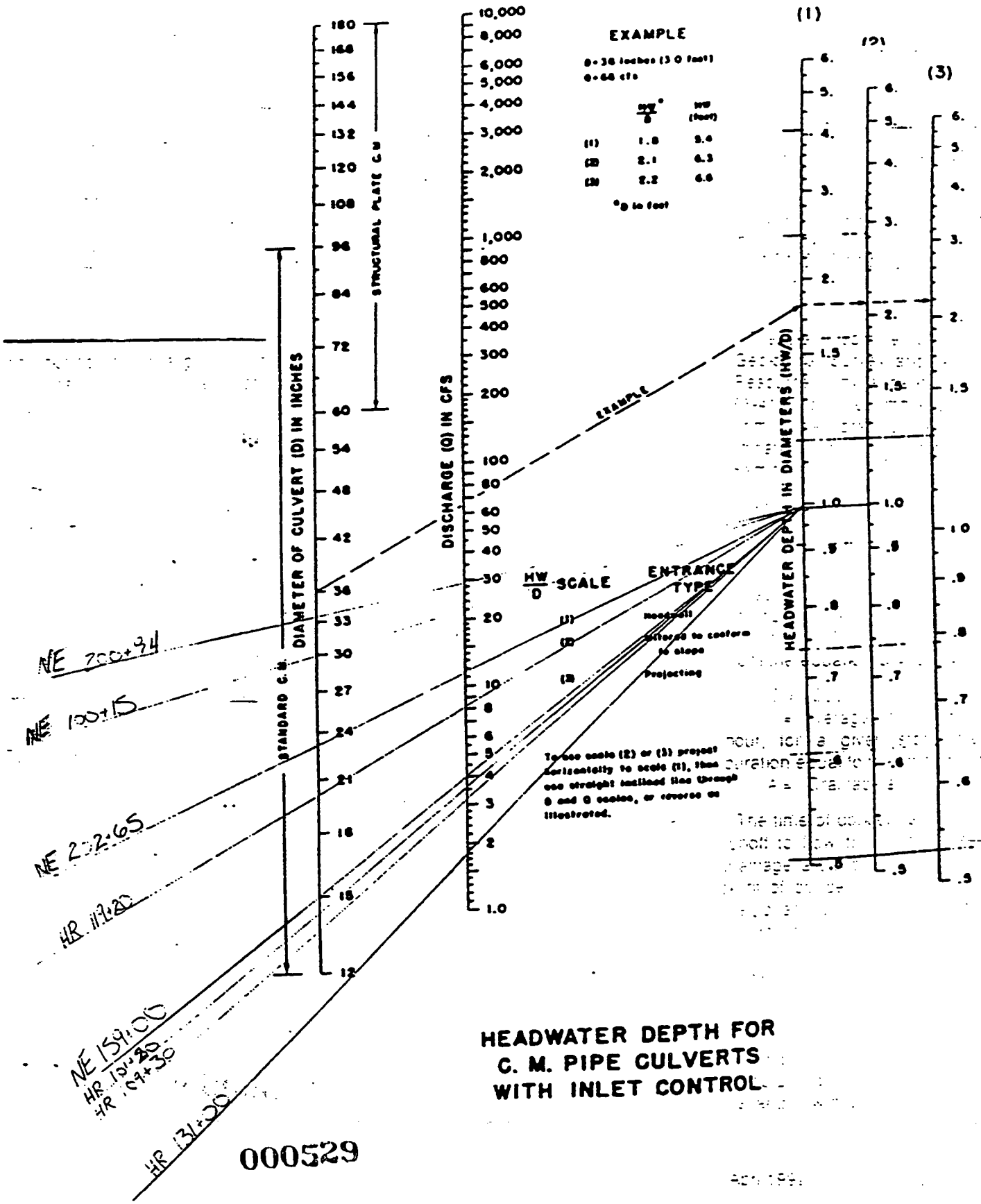
$$\text{Weighted "C"} = \frac{130}{200} = 0.65$$

1101.24 Rainfall Intensity

The average rainfall intensity "i" in inches per hour may be obtained from the Intensity-Frequency-Duration curves shown on Figure 1101-2. Each set of curves applies to a specific geographic area, A, B, C or D as shown on the Rainfall Intensity Zone Map, Figure 1101-3. The geographic areas were established from an analysis of rainfall records obtained from Weather Bureau stations in Ohio. Some political subdivisions may have developed curves for their specific area similar to Figure 1101-2. Such curves may be based on a much longer period of record,

Attachment B

Fig. 1100-245



HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

000529

91

[redacted]

TABLE 10.3 TYPICAL VALUES OF THE ROUGHNESS COEFFICIENT n

Lined Canals	n
Cement plaster	0.011
Untreated gunite	0.016
Wood, planed	0.012
Wood, unplaned	0.013
Concrete, troweled	0.012
Concrete, wood forms, unfinished	0.015
Rubble in cement	0.020
Asphalt, smooth	0.013
Asphalt, rough	0.016
Corrugated metal	0.024
Unlined Canals	
Earth, straight and uniform	0.023
Earth, winding and weedy banks	0.035
Cut in rock, straight and uniform	0.030
Cut in rock, jagged and irregular	0.045
Natural Channels	
Gravel beds, straight	0.025
Gravel beds plus large boulders	0.040
Earth, straight, with some grass	0.026
Earth, winding, no vegetation	0.030
Earth, winding, weedy banks	0.050
Earth, very weedy and overgrown	0.080

Manning Equation—Traditional System of Units

It can be shown that, in converting from SI to the traditional system one must apply a factor equal to 1.49 if the same value of n is used in systems. Thus in the traditional system the discharge equation using n is given as

[redacted]

EXAMPLE 10.16 If the channel of Example 10.15 has a slope what is the discharge in the channel and what is the numerical value ning's n for this channel?

Solution From Example 10.15, we have an f value of 0.130, and the mate value of R_h is 4.3 ft. In Example 10.14 it was shown that

$$V = \sqrt{\frac{8g}{f}}\sqrt{R_h S_0}$$

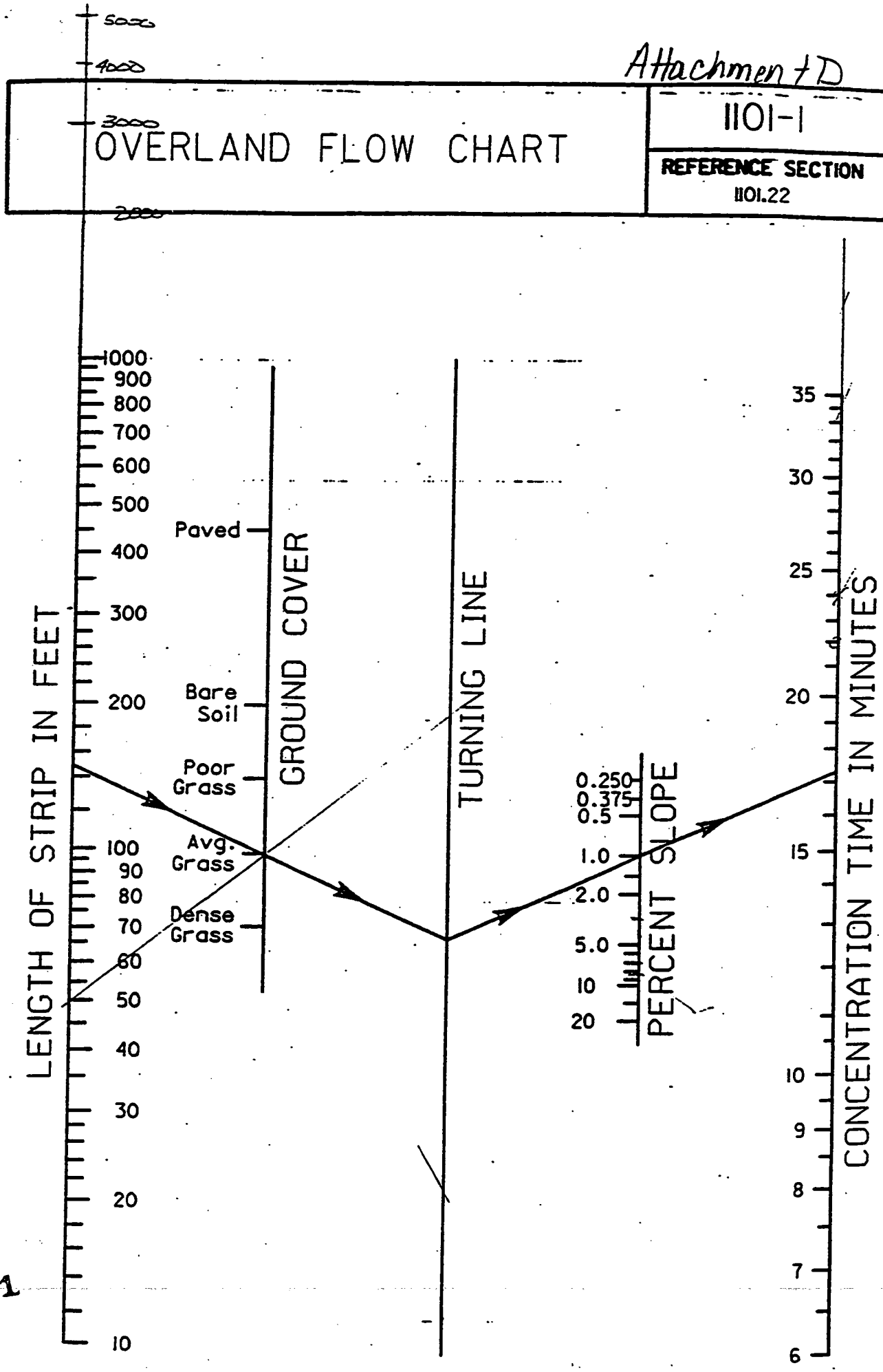
[redacted]

Attachment D

OVERLAND FLOW CHART

1101-1

REFERENCE SECTION
1101.22

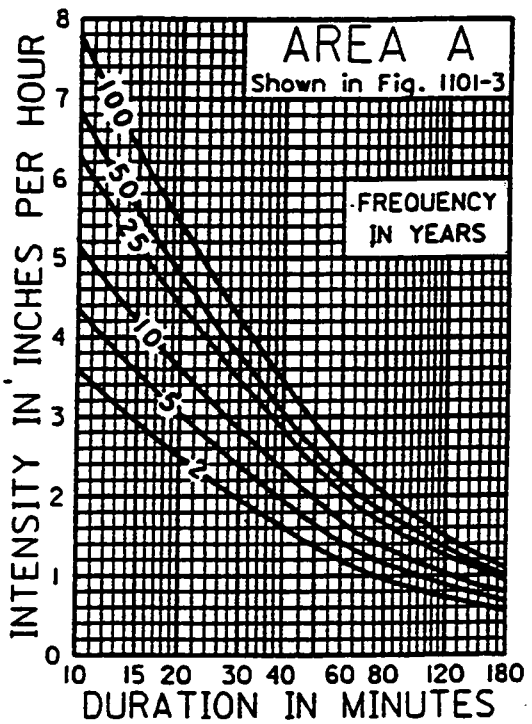


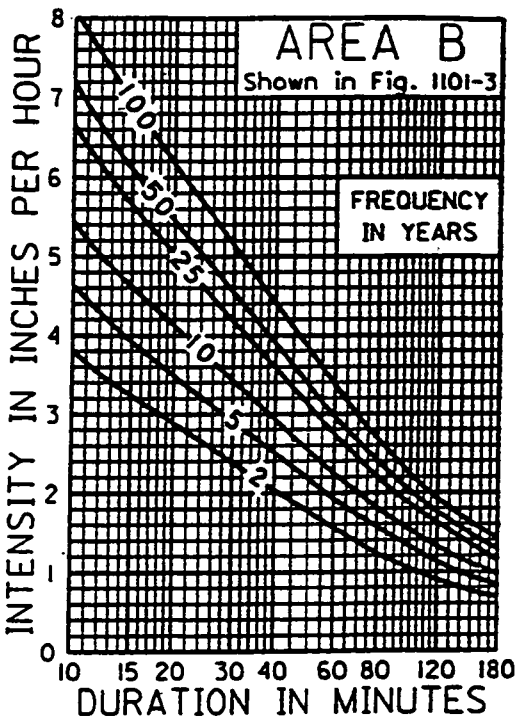
000531

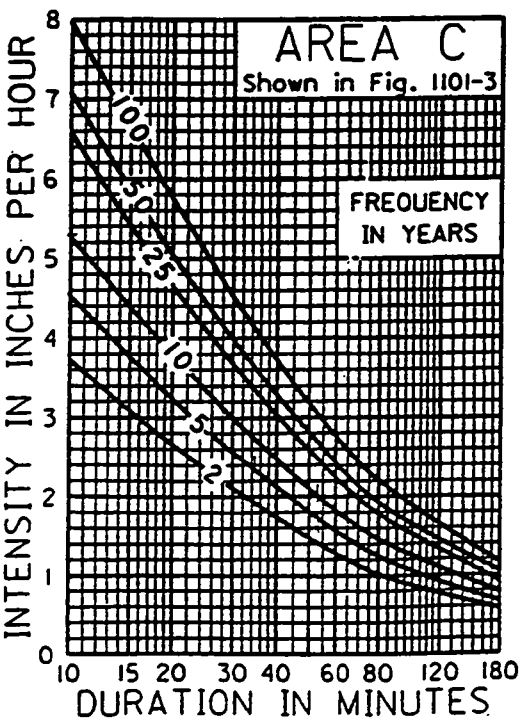
Attachment E

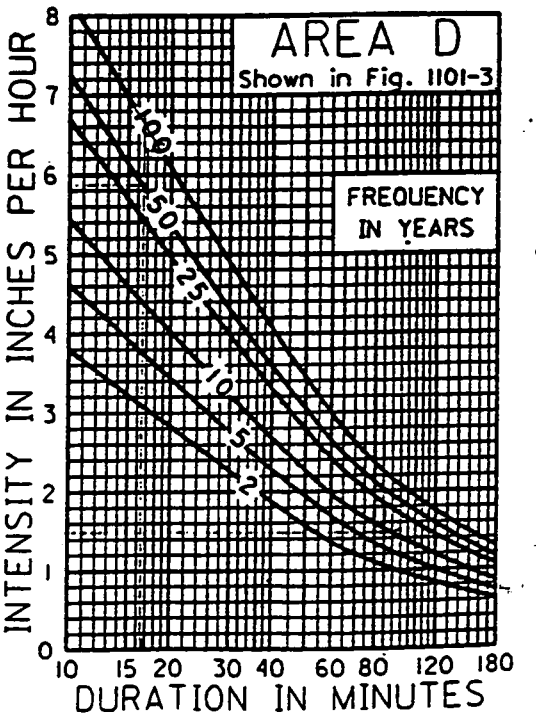
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES









Attachment F

1102.3 Ditch Design Criteria - Design Traffic Exceeding 2000 ADT

1102.31 Design Frequency

It is recommended that a 10-year frequency storm be used to determine the depth of flow, and a 5-year frequency be used to determine the velocity of flow and the depth of ditch lining where needed. Where a flexible ditch lining is required for calculated velocities exceeding the allowable for seed, the minimum width of the lining shall be 7-1/2 feet. The depth of flow shall be limited to an elevation 12 inches below the edge of pavement for the design discharge. Other ditches, including toe of slope, should not be overtopped by the design discharge.

1102.32 Velocity

The velocity for the five-year frequency storm should not exceed the values shown in Table 1102-1 for the various soil types and flexible linings.

Table 1102-1

ALLOWABLE DITCH VELOCITIES
(Ft. Per. Sec.)

Soil Type	Seed Lining (659)	Sod Lining (660)	Jute or Excelsior Matting (667) or (668)
Sand	1.5	3.5	3.0
Firm Loam	2.0	4.0	4.0
Clay	2.5	5.0	4.0
Gravel	3.5	6.0	5.0
Weathering Shale	4.5	6.0	5.0

If the calculated velocity exceeds that shown in the table, a concrete lining should be considered only as a last resort. Also Type B, C or D Rock Channel Protection may be used to line the ditch if the nearest point of the lining is outside the design clear zone or located behind guardrail. Item 838 Seeding and Erosion Control with Matting may be used in lieu of rock, where average flow velocity is less than 10 feet per second and the ditch slope is less than 10%. Type B or C rock should be considered for lining ditches on steep grades that carry flow from the end of a cut section down to the valley floor.

000533

1102.33 Roughness

Suggested values for Manning's Roughness Coefficient "n" for the various types of open water carriers covered in Section 1102.2 are listed in Table1102-2.

Table 1102-2

Type of Lining	Roughness Coefficient
Bare Earth	.02
Seeded	.03
Sod	.04
Jute Mat	.04
Excelsior Mat	.04
Item 838 Matting	.04
Concrete	.015
Bituminous	.018
Grouted Riprap	.02
Rock Channel Protection	.06 for ditches .04 for large channels

1102.34 Catch Basin Types

The Standard CB-4, 5 and 8 Catch Basins are suitable for the standard roadside designs covered in the Roadway Design Manual. The tilt built into the basin top provides a self-cleaning feature when the basins are used on continuous grades and the wide bar spacing minimizes clogging possibilities, thereby resulting in an efficient design. The bases of the 4, 5 and 8 Catch Basins can be expanded to accommodate larger diameter conduits by specifying 4A, 5A or 8A Basins, detailed on Standard Drawing CB-458A. The bar spacing can be decreased, when desirable for safety reasons, by specifying Grate E for the CB-4 and Grate B for CB-5. The following catch basin types are generally recommended based on the size and shape of the ditch.

A. Standard CB-4 for depressed medians wider than 40 feet.

B. Standard CB-5 for 40 foot radius roadside or median ditches (Use grate B where pedestrian traffic may be expected).

C. Standard CB-8 for 20 foot radius roadside or depressed medians 40 feet or less in width.

D. Standard CB-2-2-A catch basins may be used in trapezoidal toe ditches where the basin is located outside the design clear zone or behind guardrail and the protruding feature of the basin is

ATTACHMENT F

Calculation 15-01

PO139

Design of Seepage Collection & Removal of Sediment

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

Date 20 Feb 95
Sheet 1 of 2

Proj. Order No. 139 Calculation No. 15-01

Project Title Seepage Design and Sediment Removal

Calculation Subject Storm Drainage Date Verified/Checked

STATUS: PRELIMINARY ____ FINAL X SUPERSEDED ____ VOID ____

STATEMENT OF PROBLEM

Determine the peak runoff for the 25-year, 24-hour storm event for the proposed diversion pipe and size the pipe using corrugated HDPE. (Per FERMCO CRU-2 direction)

SUMMARY OF CONCLUSIONS

The peak discharge is 9 cfs and the pipe is 18 inch diameter.

Originator's Signature and Date

Kenneth F. Gerard 2/28/95

CHECKING METHOD

1. Review X
2. Alternate Calculation ____

Checker's Signature and Date

CR Tomongin 3/17/95

Lead Discipline Engineer's Signature and Date

Ed Kuk 3/17/95

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Revision No. 0
Sheet 2 of 6

Proj. Order No. 139 Calculation No. 15-01

Project Title Seepage Design and Sediment Removal

Calculation Subject Storm Drainage Date Verified/Checked 3/17/95

Prepared By: K. Gerard Checked/Verified By: CR TOMONGIN

Date 2/20/95

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

Data Sources

1. PARSONS DWG. (used as DA Map)
2. Haestad Methods, 1989. *Quick TR-55™ Urban Hydrology for Small Watersheds*
3. SCS Ohio 24-Hour Rainfall (inches)
4. SCS, August 1982. *Soil Survey of Hamilton County, Ohio*
5. Advanced Drainage Systems, Inc. (ADS), 1988. N-12 Pipe product literature
6. ODOT, *Location and Design Manual, Volume Two, Drainage Design*
7. Brater, Ernest F. & Horace Williams King, 1976. *Handbook of Hydraulics*, Sixth Ed. New York: McGraw-Hill Book Company
8. Heald, C.C., Ed., 1992. *Cameron Hydraulic Data Book*, 17 ed. Woodcliff Lake, N.J.: Ingersoll-Rand

Codes

1. DOE Order 6430.1A / RM-FMPC-0001

Assumptions

1. Use SCS TR-55 to determine peak discharge. (Haestad Methods Quick TR-55).
2. Use SCS storm events for Hamilton County, Ohio. (Ref 3)
3. Pipe will be used for a short term, low-traffic area. Per FERMCO CRU-2 directive to use HDPE pipe material, use corrugated polyethylene pipe using ADS N-12 pipe data. Mannings n for ADS N-12 is o.010 - 0.012. Use 0.011 to account for the bends.

ENGINEERING CALCULATIONS
BASIS SHEET
SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS (continued)

4. Land use is mixed. Use weighted Runoff Curve Number. See D.A. Map (in the back of the calculations) and calculations for land use, acreage, and coverage conditions used. All ground coverage conditions were assumed to be in good condition.

5. From Reference 4, the soils in the vicinity of the site and their HSG are as follows:

Gn	Genesee Loam, HSG B (This is most likely in the Paddy's Run Flood Plain and not in the DA)
HeF	Hennepin Silt Loam, 35 to 60 % slopes, HSG B (This is most likely in the steep slope areas adjacent to Paddy's Run and not in the DA)
HoA	Henshaw Silt Loam, 0 to 2 % slopes, HSG C
MaB	Markland Silty Clay Loam, 2 to 6 % slopes, HSG C
MaC2	Markland Silty Clay Loam, 6 to 12 % slopes, HSG C

A copy of the soil survey map is in the back of the calculations. Given the information from the soil survey map, HSG C is used for all land uses for the peak discharge calculations.

6. For computing Tc segment DE, the same open channel assumed to exist between the proposed pipe and the gravel road was assumed to exist where the runoff goes under the gravel road (existing culvert is assumed to exist and is operational).

7. For computing Tc segment DE, the proposed open channel between the proposed pipe and the gravel road is assumed to be a 2 ft. flat bottom trapezoidal ditch with 4:1 side slopes, rip rap lined.

8. Other assumptions are as specified in the calculations.

4 of 6

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

CRU: 2 PO: 139 Job Number: 7663-0139-11112-120

Computer Code: OTR-55 Version: 5.46

Code Verification Status: REV 0, Nov 1992

Description of Program: Computes peak discharge per SCS TR-55 Method

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: To determine peak discharge to size proposed storm drain

Run Performed By: K. Gerard

Date/Time of Run: 2/20/95

Computer Time of Run: n/a

Input Filename: WESTPIPE.***, *** = RCN, TCT, GPD

Output Filename: same as input

Files Saved to Diskname: a:\po139\SD Disk Location: with calc set w/ backup with discipline files

Results: Peak discharge for 25-year, 24-hour storm is 9 cfs.

Performed By: K. Gerard Date: 2/28/95

Checked By: CR TOMONGIN Date: 3/1/95

Approved By: Ed Kahn Date: 3/17/95

PARSONS ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

CRU: 2 PO: 139 Job Number: 7663-0139-11112-120

Computer Code: FlowMaster Version: 3.41

Code Verification Status: REV 0, Dec 1992

Description of Program: Computes solutions to open channel hydraulics problems

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: To determine Tc values and to size proposed storm drain

Run Performed By: K. Gerard

Date/Time of Run: 2/20/95 - 2/28/95

Computer Time of Run: n/a

Input Filename: WESTPIPE.H&H & PRODITCH.H&H

Output Filename: same as input

Files Saved to Diskname: a:\po139\SD Disk Location: with calc set w/ backup with discipline files

Results: Refer to the calculations.

Performed By: K. Gerard Date: 2/28/95

Checked By: CR TOMONGIN Date: 3/17/95

Approved By: E. Kaba Date: 3/17/95

REV	BY	DATE	CK	DATE	TITLE	
0	KG	2/20/95	CRT	3/17/95	Design of Seepage Collection & Sediment Removal	
					Storm Drain	CRU- 2
					AUTHOR: K. Gerard SHEET 6 OF	PO - 139

RESULTS

The results of the peak discharge calculations are as follows:

2-yr	3 cfs
10-yr	7 cfs
25-yr	9 cfs

The table below summarizes the results of the pipe design calculations for a pipe slope at 0.6%:

	Dia.	$V_{2\text{-}Yr}$ fps	$V_{25\text{-}Yr}$ fps	Q_{FULL} cfs	Q_{MAX} cfs
ADS	15"	4.84	–	5.91	•
ADS	18"	4.81	6.18	9.62	10.34
ADS	24"	4.69	6.36	20.71	22.28

• not calculated

CONCLUSIONS AND RECOMMENDATIONS

The velocity is sufficient at the 2-year storm to provide self cleaning of sediment. An 18" HDPE (ADS N-12) pipe is large enough for the 25-year storm and is recommended.

ODOT Table 1107-1 indicates that 6.5 l.f. of 6" stone, Type C is required. This is based on a V = 6.2 fps for the $Q_{25\text{-}Yr}$ condition.

An ODOT No. 2-2-A catch basin was evaluated and found acceptable when modified for an East Jordan Iron Works, (EJIW), 6610 grate.

ATTACHMENT A

SUPPORTING CALCULATIONS

Quick TR-55 Ver.5.46 S/N:
Executed: 09:17:20 02-20-1995

PO-139 RA #31
Design of Seepage Collection
and
Sediment Removal

RUNOFF CURVE NUMBER DATA

Composite Area: West Pipe

SURFACE DESCRIPTION	AREA (acres)	CN
Open Space/good/HSG C	3.13	74
Woods/good/HSG C	8.48	70
Gravel/HSG C	0.29	89
COMPOSITE AREA --->	11.90	71.5

72

SEE D.A. MAP

A-1

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Tc Calc

Comment: Tc Segment B-C

Solve For Discharge

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.0250 ft/ft
Depth.....	0.50 ft

Computed Results:

Discharge.....	1.08 cfs
Velocity.....	2.16 fps
Flow Area.....	0.50 sf
Flow Top Width...	2.00 ft
Wetted Perimeter.	2.24 ft
Critical Depth...	0.45 ft
Critical Slope...	0.0446 ft/ft
Froude Number....	0.76 (flow is Subcritical)

ASSUME Tc SEGMENT HAS THE INPUT DATA GIVEN

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

A-2

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Tc Calc

Comment: Tc Segment D-E

Solve For Discharge

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.0250 ft/ft
Depth.....	0.60 ft

Computed Results:

Discharge.....	9.30 cfs ≈ PEAK DISCHARGE, OK
Velocity.....	3.52 fps
Flow Area.....	2.64 sf
Flow Top Width...	6.80 ft
Wetted Perimeter.	6.95 ft
Critical Depth...	0.60 ft
Critical Slope...	0.0252 ft/ft
Froude Number....	1.00 (flow is Critical)

ASSUME Tc SEGMENT HAS THE INPUT DATA GIVEN,

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Quick TR-55 Ver.5.46 S/N:
Executed: 09:07:52 02-20-1995 a:\po139\sd\WESTPIPE.TCT

PO-139 RA #31
Design of Seepage Collection and Sediment Removal

Tc COMPUTATIONS FOR: West Pipe

SHEET FLOW (Applicable to Tc only)

Segment ID		AB	
Surface description		woods	
Manning's roughness coeff., n		0.4000	
Flow length, L (total < or = 300)	ft	210.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0025	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	1.54	= 1.54

SHALLOW CONCENTRATED FLOW

Segment ID		CD	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	270.0	
Watercourse slope, s	ft/ft	0.0075	
Avg.V = $Csf * (s)^{0.5}$	ft/s	1.3973	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.05	= 0.05

CHANNEL FLOW

Segment ID		BC		DE	
Cross Sectional Flow Area, a	sq.ft	0.50		2.64	
Wetted perimeter, Pw	ft	2.24		6.95	
Hydraulic radius, r = a/Pw	ft	0.223		0.380	
Channel slope, s	ft/ft	0.0250		0.0250	
Manning's roughness coeff., n		0.0400		0.0350	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.1673		3.5305	
Flow length, L	ft	260		125	
T = L / (3600*V)	hrs	0.03	+	0.01	= 0.04

::

TOTAL TIME (hrs) 1.63

000545

Quick TR-55 Version: 5.46 S/N:

>>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

PO-139 RA #31
Design of Seepage Collection and Sediment Removal

CALCULATED
DISK FILE: a:\po139\sd\WESTPIPE.GPD

Drainage Area	(acres)	11.9	--->	0.0186 sq.mi.
Runoff Curve Number	(CN)	72		
Time of Concentration,Tc	(hrs)	1.63		
Rainfall Distribution	(Type)	II		
Pond and Swamp Areas	(%)	0	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	2	10	25
Rainfall, P, 24-hr (in)	3.0	4.1	4.8
Initial Abstraction, Ia (in)	0.778	0.778	0.778
Ia/p Ratio	0.259	0.190	0.162
Unit Discharge, * qu (csm/in)	222	239	246
Runoff, Q (in)	0.81	1.53	2.05
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	3	7	9

Summary of Computations for qu

Ia/p	#1	0.100	0.100	0.100
C0	#1	2.553	2.553	2.553
C1	#1	-0.615	-0.615	-0.615
C2	#1	-0.164	-0.164	-0.164
qu (csm)	#1	260.210	260.210	260.210
Ia/p	#2	0.300	0.300	0.300
C0	#2	2.465	2.465	2.465
C1	#2	-0.623	-0.623	-0.623
C2	#2	-0.117	-0.117	-0.117
qu (csm)	#2	212.799	212.799	212.799
* qu (csm)		222	239	246

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 \bullet \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) • (Pond & Swamp Adj.)

A-5

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Description: Proposed Pipe at West Pump Station

Solve For Actual Depth

Given Constant Data;

Slope.....	0.0060	
Mannings n.....	0.011	ADS N-12 *
Q_2=Discharge.....	3.00	

Variable Input Data	Minimum	Maximum	Increment By
Diameter	1.25 15"	2.00 24"	0.25

* ADS Recommends a "n" value of 0.010 — 0.012.

A-6

VARIABLE				COMPUTED	COMPUTED	COMPUTED	
Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs Q2-YR	Depth ft	Velocity fps	Capacity Full cfs	
1.25	0.0060	0.011	3.00	0.63	4.84	5.91	
1.50	0.0060	0.011	3.00	0.58	4.81	9.62	
~~1.75~~	~~0.0060~~	~~0.011~~	~~3.00~~	~~0.54~~	~~4.75~~	~~14.51~~	N/A
2.00	0.0060	0.011	3.00	0.51	4.69	20.71	

Open Channel Flow Module, Version 3.41 (c)
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Description: Proposed Pipe at West Pump Station

Solve For Actual Depth

Given Constant Data;

Slope..... 0.0060
Mannings n..... 0.011 * ADS N-12
Q_{25}=Discharge..... 9.00 cfs

Variable Input Data	Minimum	Maximum	Increment By
Diameter	1.25 15"	2.00 24"	0.25

VARIABLE				COMPUTED	COMPUTED	COMPUTED	
Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs	Depth ft	Velocity fps	Capacity Full cfs	
Unable to compute this instance. (1.25' Ø Too small)							
1.50	0.0060	0.011	9.00	1.15	6.18	9.62	
~~1.75~~	~~0.0060~~	~~0.011~~	~~9.00~~	~~1.00~~	~~6.35~~	~~14.51~~	N/A
2.00	0.0060	0.011	9.00	0.92	6.36	20.71	

Open Channel Flow Module, Version 3.41 (c)
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Description: Proposed Pipe at West Pump Station

Solve For Full Flow Capacity

Given Constant Data;

Slope..... 0.0060
Mannings n..... 0.011 ADS N-12
Discharge..... 5.91

Variable Input Data	Minimum	Maximum	Increment By
Diameter	1.25	2.00	0.25
	15"	24"	

VARIABLE			COMPUTED	COMPUTED	COMPUTED	COMPUTED	
Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs	Depth ft	Velocity fps	Capacity Full cfs	
1.25	0.0060	0.011	5.91	1.25	4.82	5.91	
1.50	0.0060	0.011	9.62	1.50	5.44	9.62	
~~1.75~~	~~0.0060~~	~~0.011~~	~~14.51~~	~~1.75~~	~~6.03~~	~~14.51~~	N/A
2.00	0.0060	0.011	20.71	2.00	6.59	20.71	

Open Channel Flow Module, Version 3.41 (c)
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

A-1

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Comment: Proposed Pipe at West Pump Station

Solve For Actual Discharge @ 0.94D

Given Input Data:

	Diameter.....	1.50 ft	18"
	Slope.....	0.0060 ft/ft	
	Manning's n.....	0.011	ADS N-12
0.94D =	Depth.....	1.41 ft	

Computed Results:

QmAx =	Discharge.....	10.34 cfs
V@QmAx =	Velocity.....	6.00 fps
	Flow Area.....	1.72 sf
	Critical Depth....	1.24 ft
	Critical Slope....	0.0069 ft/ft
	Percent Full.....	94.00 %
	Full Capacity.....	9.62 cfs
	QMAX @.94D.....	10.34 cfs
	Froude Number.....	0.68 (flow is Subcritical)

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Comment: Proposed Pipe at West Pump Station

Solve For Actual Discharge @ 0.94 D

Given Input Data:

D =	Diameter.....	2.00 ft	24"
	Slope.....	0.0060 ft/ft	-
	Manning's n.....	0.011	ADS-N-12
0.94D =	Depth.....	1.88 ft	

Computed Results:

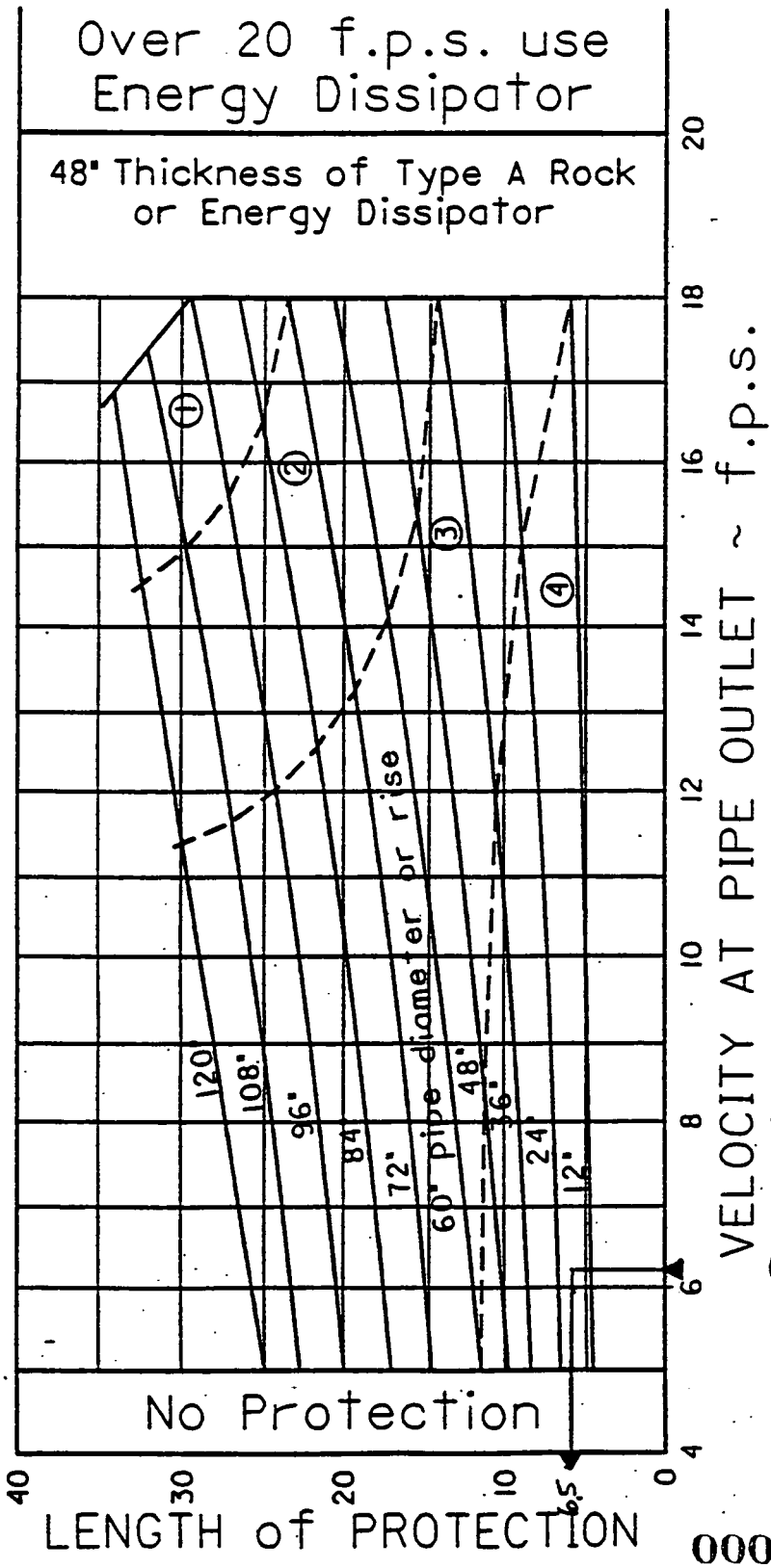
QMAX =	Discharge.....	22.28 cfs
VMAX =	Velocity.....	7.27 fps
	Flow Area.....	3.06 sf
	Critical Depth....	1.68 ft
	Critical Slope....	0.0066 ft/ft
	Percent Full.....	94.00 %
	Full Capacity.....	20.71 cfs
	QMAX @.94D.....	22.28 cfs
	Froude Number.....	0.71 (flow is Subcritical)

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

ROCK CHANNEL PROTECTION AT CULVERT AND STORM SEWER OUTLETS

1107-1

REFERENCE SECTION 1107.2



$Q_{25} = 1$ cfs
$V_{25} = 6.2$ fps

LEGEND

		ROCK TYPE
①	48' of 18" rock	A
②	36' of 18" rock	A
③	30' of 12" rock	B
④	18' of 6" rock	C

NOTES

Rock size (6", 12", 18") indicates the square opening on which 85% of the material, by weight, will be retained.

The width of protection shall be the width of the headwall, with 4' being the minimum.

(Where a stream bed will withstand the calculated velocity without erosion, no rock channel protection will be required.)

000555

A-4

PARSONS
ERA PROJECT

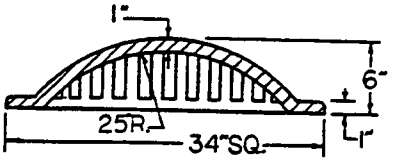
CALCULATION SHEET

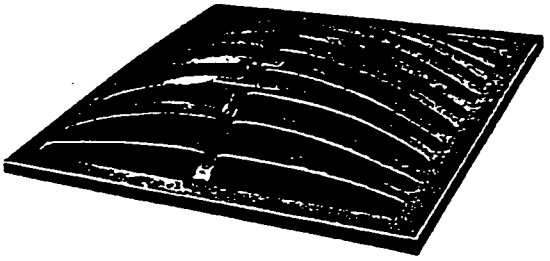
REV	BY	DATE	CK	DATE	TITLE
	KG	2/24/95	CRT	3/17/95	SEEPAGE CONTROL & SEDIMENT REMOVAL STORM DRAIN
					AUTHOR K. Gerard SHEET OF

CRU 2
PO 139

Heavy Duty
6610

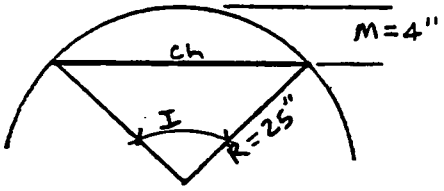
190 pounds total weight
Approximately 600 square inches of opening





104 *Always Specify EJIW Number*

***East Jordan Iron Works**, East Jordan, Michigan USA, 1-800-874-4100*



$M = R(1 - \cos I/2)$

$4" = 25"(1 - \cos I/2)$

$\cos I/2 = 1 - 0.16$

$I/2 = 32.8598°$

$Ch = 2R \sin I/2$

$= 2(25)(\sin 32.8598)$

$Ch = 27.13"$

ASSUME Ch IS THE PERIMETER DIMENSION / SIDE
ON LONG SLOT SIDES, MINUS 1" FOR STEEL, 2(26.13) = 52.26"
ON SHORT OPENING SIDE, 10 - 1" BARS OR 17.13"/SIDE 2(17.13) = 34.26

OPENING LENGTH @ PERIMETER = 86.52"
OR 7.2'

USE 7.2' FOR WEIR LENGTH, Lg, FOR WEIR CALCULATIONS.

$Q_w = 3.087 L H^{3/2}$ REF 7., pg 5-24

FOR ORIFICE FLOW CONDITIONS

$Q_o = C a (2gh)^{1/2}$ REF 7, pg 4-3

C = 0.66 (ASSUMED. SEE TABLE 4-5, REF 7 FOR 10:1 RECTANGLE @ h = 1FT.)

000556

12/93

ENG025

A-15

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/23/95
CRU-2 KG

FIND: Head, H, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume weir flow conditions using EJIW 6610 grate

Given:

Q25 =	9	cfs	Q = 3.087*L*H ^ (3/2)
Lw =	4	lf	Q = Qw + Qg
h =	0.42	ft	Qw = weir flow
Lg =	7.2	lf	Qg = grate flow

H, ft	Q, cfs	Qw	Hg, ft	Qg
0.42	3.36	3.36	0.00	0.00
0.50	3.36	3.36	0.00	0.00
0.58	3.74	3.36	0.08	0.38
0.67	4.53	3.36	0.17	1.17
0.75	5.44	3.36	0.25	2.08
0.83	6.52	3.36	0.33	3.16
0.92	7.90	3.36	0.42	4.54
1.00	9.25	3.36	0.50	5.89
1.16	12.30	3.36	0.66	8.94
1.25	14.19	3.36	0.75	10.83
1.33	15.97	3.36	0.83	12.61

Note:

1. There are 2-2' wide openings which are the Lw for "weir flow" condition. Weir height = h.
2. Maximum "Weir flow" is assumed when H = h. When H > 0.50', then its "grate flow" which is also calculated by weir flow equation. Hgrate = H-0.50'. The grate is 1" thick and its top elev. is 6" above the weir elev.
3. Lg is the inside perimeter of the inlet.
4. An efficiency factor of 0.75 is used for the grate condition to compensate for grating and trash accumilation.
5. Lg based on East Jordon Iron Works, (EJIW), 6610 grate.
6. Hg is measured from the base of grate.

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/23/95
CRU-2

FIND: Head, H, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume weir flow conditions using EJIW 6610 grate

Given:

7	Q25 =	9	cfs	Q = 3.087*L*H^(3/2)
	Lw =	3.33	lf	Q = Qw + Qg
9	h =	0.42	ft	Qw = weir flow
	Lg =	7.2	lf	Qg = grate flow

	A	B	C	D	E
	H, ft	Q, cfs	Qw	Hg, ft	Qg
13	0.42	+C13+E13	3.087*$A:$B$8*($A:$B$9^1.5)	+A13-$A:$B$9	0.75*3.087*$A:$B$10*(D13)^1.5
	0.50	+C14+E14	3.087*$A:$B$8*($A:$B$9^1.5)	+A14-$A:$B$9	0.75*3.087*$A:$B$10*(D14)^1.5
15	0.58	+C15+E15	3.087*$A:$B$8*($A:$B$9^1.5)	+A15-$A:$B$9	0.75*3.087*$A:$B$10*(D15)^1.5
	0.67	+C16+E16	3.087*$A:$B$8*($A:$B$9^1.5)	+A16-$A:$B$9	0.75*3.087*$A:$B$10*(D16)^1.5
17	0.75	+C17+E17	3.087*$A:$B$8*($A:$B$9^1.5)	+A17-$A:$B$9	0.75*3.087*$A:$B$10*(D17)^1.5
	0.83	+C18+E18	3.087*$A:$B$8*($A:$B$9^1.5)	+A18-$A:$B$9	0.75*3.087*$A:$B$10*(D18)^1.5
19	0.92	+C19+E19	3.087*$A:$B$8*($A:$B$9^1.5)	+A19-$A:$B$9	0.75*3.087*$A:$B$10*(D19)^1.5
	1.00	+C20+E20	3.087*$A:$B$8*($A:$B$9^1.5)	+A20-$A:$B$9	0.75*3.087*$A:$B$10*(D20)^1.5
21	1.16	+C21+E21	3.087*$A:$B$8*($A:$B$9^1.5)	+A21-$A:$B$9	0.75*3.087*$A:$B$10*(D21)^1.5
	1.25	+C22+E22	3.087*$A:$B$8*($A:$B$9^1.5)	+A22-$A:$B$9	0.75*3.087*$A:$B$10*(D22)^1.5
23	1.33	+C23+E23	3.087*$A:$B$8*($A:$B$9^1.5)	+A23-$A:$B$9	0.75*3.087*$A:$B$10*(D23)^1.5

Note:

1. There are 2-2' wide openings which are the Lw for "weir flow" condition. Weir height = h.
2. Maximum "Weir flow" is assumed when H = h. When H > 0.50', then its "grate flow" which is also calculated by weir flow equation. Hgrate = H-0.50'. The grate is 1" thick and its top elev. is 6" above the weir elev.
3. Lg is the inside perimeter of the inlet.
4. An efficiency factor of 0.75 is used for the grate condition to compensate for grating and trash accumilation.
5. Lg based on East Jordon Iron Works, (EJIW), 6610 grate.
6. Hg is measured from the base of grate.

\PO139\SS\139SD.WK3 A:

(This sheet is B in the LOTUS 1-2-3 file. Used to display formulas from A:)

000558

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/24/95
CRU-2 KG

FIND: Head, h, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume orifice flow conditions using EJIW 6610 grate

Given:

area, a =	600	sq in	Qo = C*a*(2*g*h) ^ (1/2)
	4.17	sq ft	H = Head – from bottom of weir
C =	0.66		hg = Head – above base of grate
g =	32.2	ft/s ^ 2	Q = Q – Total Flow
Qw =	3.36	cfs (from side weirs. See weir calc)	

H, ft	Q, cfs	Qw, cfs	hg ft	a, sq ft	Qo cfs
0.42	3.36	3.36	0	0.00	0.00
0.50	3.36	3.36	0.00	0.00	0.00
0.58	4.11	3.36	0.08	0.67	0.75
0.67	5.68	3.36	0.17	1.42	2.32
0.75	7.50	3.36	0.25	2.08	4.14
0.83	9.64	3.36	0.33	2.75	6.28
0.92	12.37	3.36	0.42	3.50	9.01
1	15.06	3.36	0.50	4.17	11.70

Note:
1. Assumes that there is no increase in weir flow under orifice flow conditions.
2. Assume an efficiency factor of 0.75 used for the grate condition to compensate for trash accumulation.
3. Assumes that the full 600 sq ft opening value is available when the water surface elevation is equal to the top elevation of the grate. The area, a, is proportional to the hg; a = (hg/0.5')*4.17 sq ft up to 0.5'. Initially, there will be weir flow which will transition to orifice. The "worst case" would be when hg is measured from the top of the grate and not the base.
4. EJIW – East Jordon Iron Works
5. The grate is 1" thick and its top elev. is 6" above the weir elev.

.\PO139\SS\139SD.WK3 C:

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/24/9
CRU-2

FIND: Head, h, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume orifice flow conditions using EJIW 6610 grate

Given:

47	area, a =	600	sq in	Qo = C*a*(2*g*h) ^ (1/2)
		4.17	sq ft	H = Head - from bottom of weir
49	C =	0.66		hg = Head - above base of grate
	g =	32.2	ft/s^2	Q = Q - Total Flow
51	Qw =	3.36	cfs (from side weirs. See weir calc)	

	A H, ft	B Q, cfs	C Qw, cfs	D hg ft	E a, sq ft	F Qo cfs
56	0.42	+C56+F56	+$C:$B$51	0	(D56/0.5)*$C:$B$48	0.75*$C:$B$49*E56*(2*$C:$B$10*D56) ^ 0.5
	0.50	+C57+F57	+$C:$B$51	+A57-0.5	(D57/0.5)*$C:$B$48	0.75*$C:$B$49*E57*(2*$C:$B$10*D57) ^ 0.5
58	0.58	+C58+F58	+$C:$B$51	+A58-0.42	(D58/0.5)*$C:$B$48	0.75*$C:$B$49*E58*(2*$C:$B$10*D58) ^ 0.5
	0.67	+C59+F59	+$C:$B$51	+A59-0.42	(D59/0.5)*$C:$B$48	0.75*$C:$B$49*E59*(2*$C:$B$10*D59) ^ 0.5
60	0.75	+C60+F60	+$C:$B$51	+A60-0.42	(D60/0.5)*$C:$B$48	0.75*$C:$B$49*E60*(2*$C:$B$10*D60) ^ 0.5
	0.83	+C61+F61	+$C:$B$51	+A61-0.42	(D61/0.5)*$C:$B$48	0.75*$C:$B$49*E61*(2*$C:$B$10*D61) ^ 0.5
62	0.92	+C62+F62	+$C:$B$51	+A62-0.42	(D62/0.5)*$C:$B$48	0.75*$C:$B$49*E62*(2*$C:$B$10*D62) ^ 0.5
	1	+C63+F63	+$C:$B$51	+A63-0.42	+$C:$B$48	0.75*$C:$B$49*E63*(2*$C:$B$10*D63) ^ 0.5

Note:

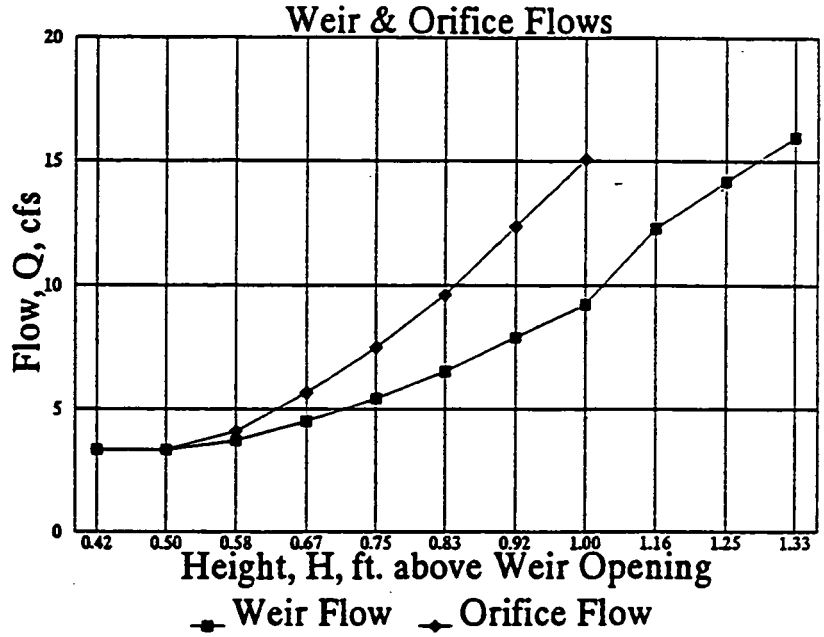
1. Assumes that there is no increase in weir flow under orifice flow conditions.
2. Assume an efficiency factor of 0.75 used for the grate condition to compensate for trash accumulation.
3. Assumes that the full 600 sq ft opening value is available when the water surface elevation is equal to the top elevation of the grate. The area, a, is proportional to the hg; a = (hg/0.5')*4.17 sq ft up to 0.5'. Initially, there will be weir flow which will transition to orifice. The "worst case" would be when hg is measured from the top of the grate and not the base.
4. EJIW - East Jordon Iron Works
5. The grate is 1" thick and its top elev. is 6" above the weir elev.

\PO139\SS\139SD.WK3 C:

(This sheet is D in the LOTUS 1-2-3 file. Used to display formulas from C:)

000560

Grate Flow Conditions



A-20

PARSONS ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN	CRU 2
0	KG	2/28/96	CRT	2/28/96		
					AUTHOR K. Gerard SHEET OF	PO 139

CALCULATE THE EQUIVALENT LENGTH OF PIPE FOR 22½° BEND

$L = KD/f$ (pg 3-120)

D = ID, ft
K = Resistance Coefficient, use 0.10. (pg 3-113) (30°)
f = Friction Factor

FIND: f

ASSUME N-12 HDPE HAS SIMILAR FRICTION PROPERTIES AS COPPER, BRASS, LEAD, TIN OR GLASS PIPE

HAZEN-WILLIAMS - C = 130 (pg 3-8)
ABSOLUTE ROUGHNESS ε = 0.000005' (pg 3-5)

$\varepsilon/D = 0.000005'/1.5' = 0.0000033$

$R = \frac{VD}{\nu}$ (pg 3-6)

V = velocity, fps
D = ID, ft
ν = Kinematic viscosity, ft²/sec.

Assume ν of fluid is similar to fresh water at 60°F, or 1.13 centistokes. (pg 4-45) (pg 4-27)

(1.13 centistokes)(0.0000107639) = 0.0000121 ft²/sec

For full flow conditions. (Q_F = 9.62 cfs) V = 5.44 fps

$R = (5.44\text{ fps})(1.5\text{ ft})/0.0000121\text{ ft}^2/\text{s}$

R = 674,882
6.75×10^5

Using Moody diagram, f = 0.0125

L = (0.10)(1.5')/(0.0125) = 12' each bend or 36' for 3 bends.

L_{TOTAL} = 212' + 36' = 248' USE 250' FOR CALCULATIONS.

NOTE: ALL PAGE No. REFERENCES TAKEN FROM CAMERON HYDRAULIC DATA

PARSONS
ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE
0	KG	2/28/95	CRT	3/17/95

TITLE DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL
STORM DRAIN

CRU 2

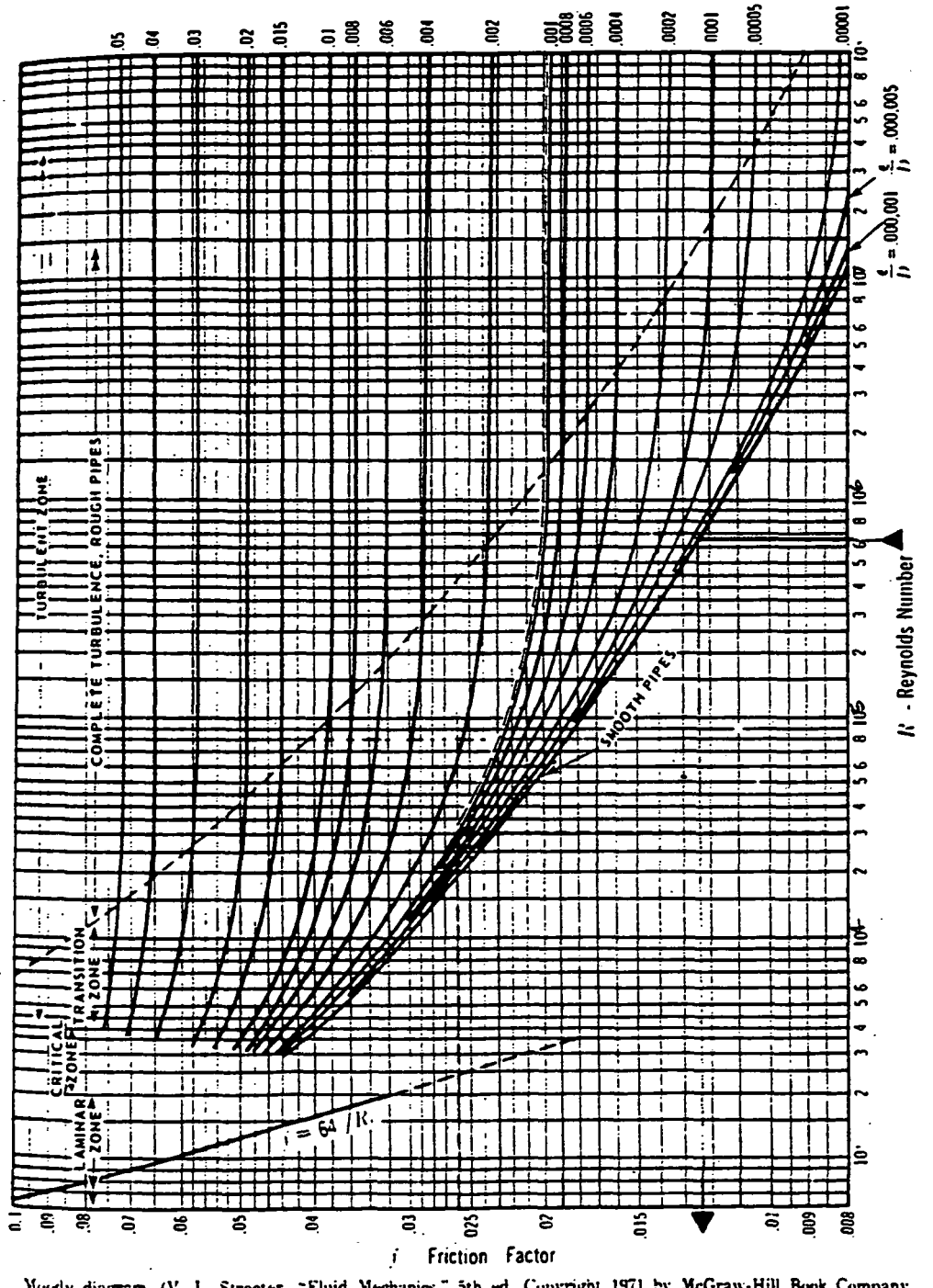
AUTHOR K. Gerard SHEET OF

PO 139

Friction Factors for Commercial Pipe

(for Darcy-Weisbach formula, page 3-3)

Relative Roughness $= \frac{\epsilon}{D}$



Moody diagram. (V. L. Streeter, "Fluid Mechanics," 5th ed. Copyright 1971 by McGraw-Hill Book Company, New York)

Note: Chart shows relation of relative roughnesss—ϵ/D where ϵ is absolute roughness in feet and D is diameter in feet.

(REF. No. 8)
pg 3-11

PARSONS
ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE
0	KG	2/28/95	CRT	3/7/95

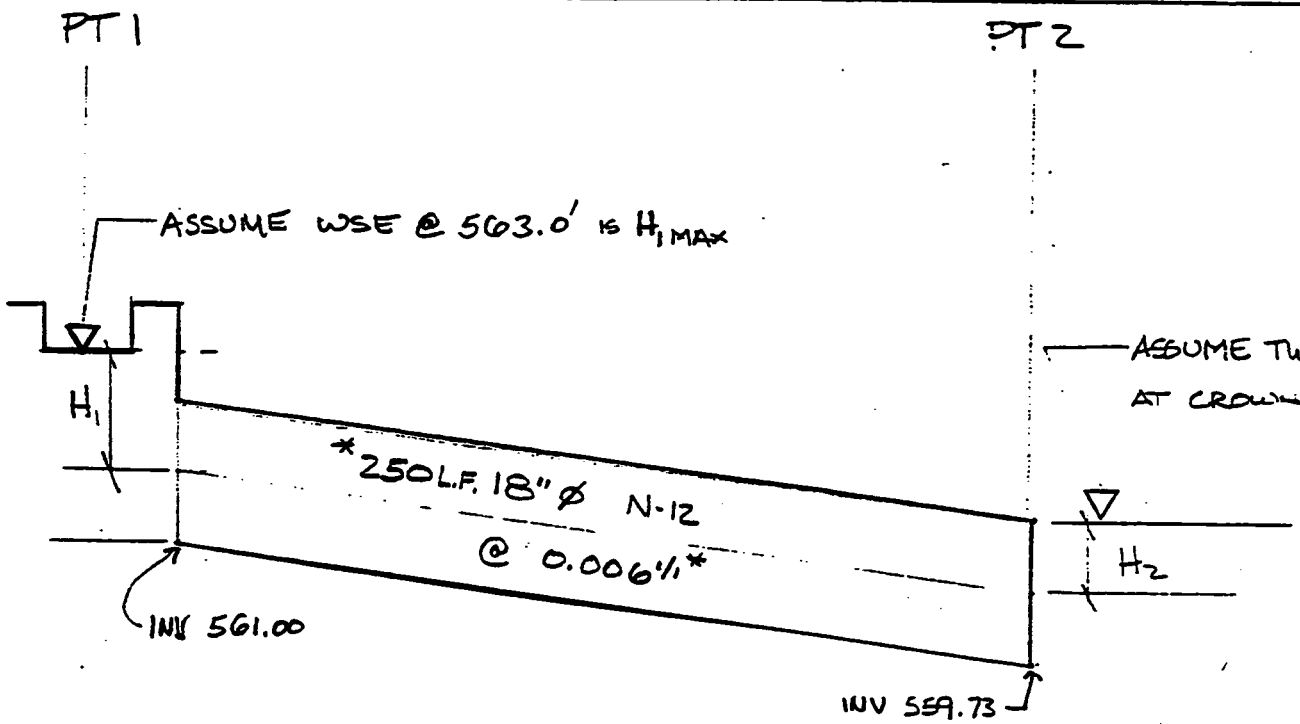
TITLE DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN

AUTHOR K. Gerard SHEET OF

CRU 2

PO 139

CHECK PIPE UNDER PRESSURE FLOW CONDITIONS



* 212' actual + 36' for bends. Invert elevations and S shown based on actual.

$$H_{1_{max}} = 1.25' \times 62.4\ lbs/CF \times 1SF/144\ in^2 = 0.54\ psi$$

$$Q_F = 9.62\ cfs \times 7.48\ gal/cf \times 60\ s/min. = 4317\ gpm \quad \text{use } 4320\ gpm$$

$$H_2 = 0.75' \times 62.4\ lb/CF \times 1SF/144\ in^2 = 0.27\ psi$$

SEE FLOWMASTER CALCULATIONS FOR HAZEN-WILLIAMS EQUATION.

Pressure Pipe Analysis & Design
Circular Pipe

Worksheet Name: West Diversion Pipe

Comment: Using 1/16 Bends

Solve For Pressure @ 1

Given Input Data:

Elevation @ 1.....	561.75	ft
Elevation @ 2.....	560.48	ft
Pressure @ 2.....	0.27	psi
Q_{FULL} = Discharge.....	4320.00	gpm (9.62 cfs)
Diameter.....	18.00	in
Length.....	250.00	ft
Hazen-Williams C..	130.00	

Computed Results:

Pressure @ 1.....	0.29	psi < 0.54 psi ∴ OK
Velocity.....	5.45	fps
Headloss.....	1.32	ft
Energy Grade @ 1..	562.89	ft
Energy Grade @ 2..	561.56	ft
Friction Slope....	5.289	ft/1000 ft

SEE SKETCH / CALC

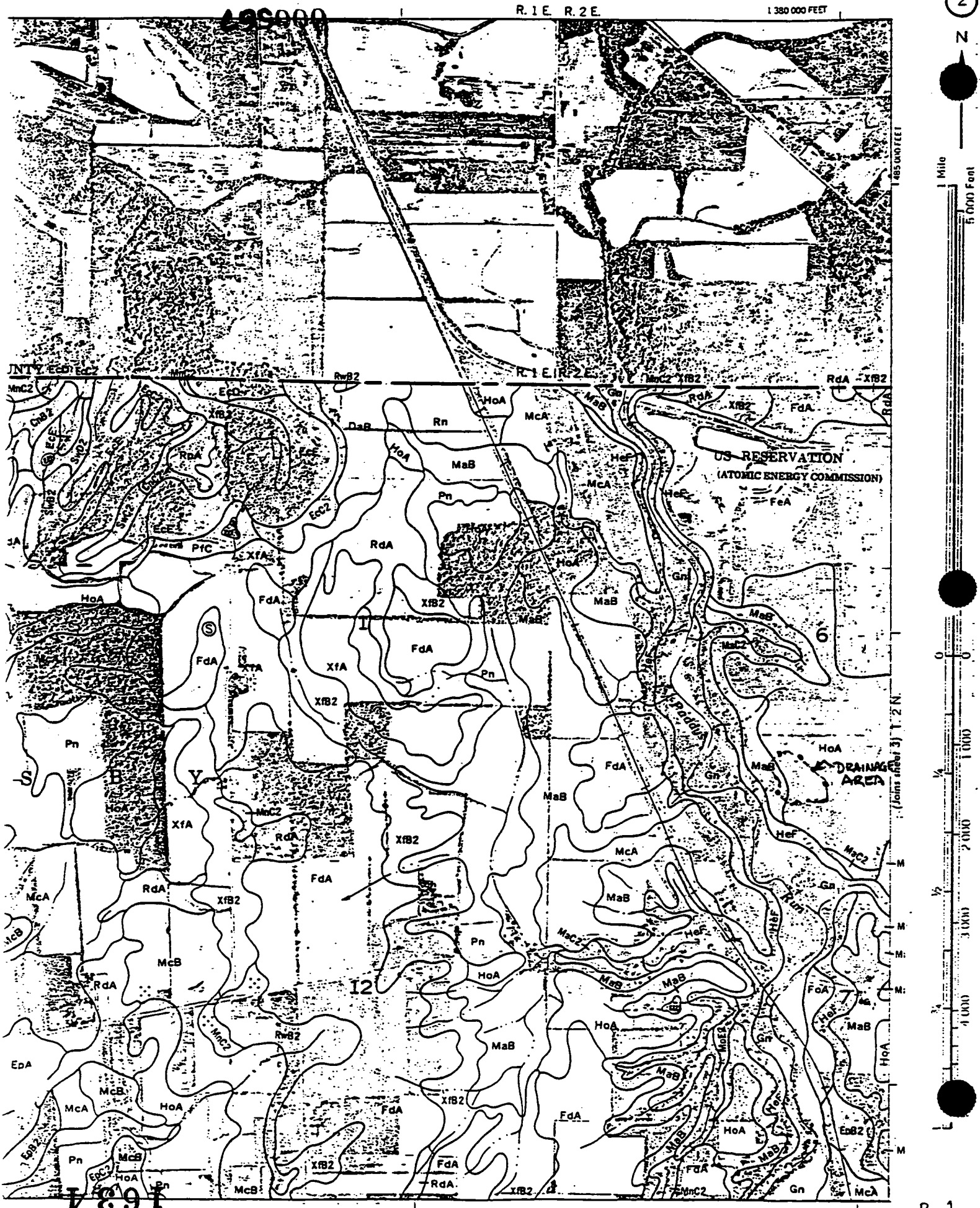
Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. • 37 Brookside Rd * Waterbury, Ct 06708

A-24

ATTACHMENT B

SUPPORTING FIGURES

L75 000

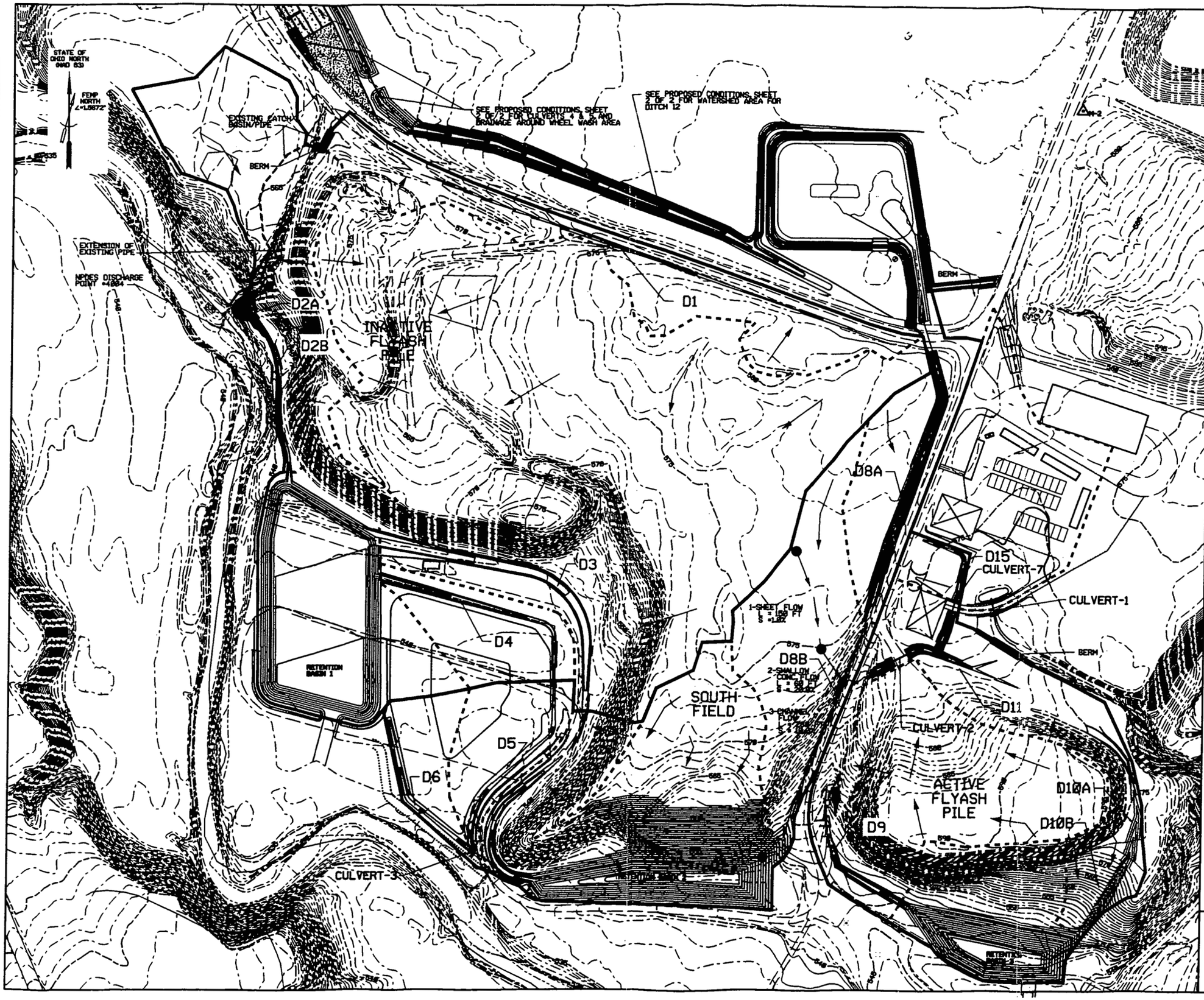


1621

B-1

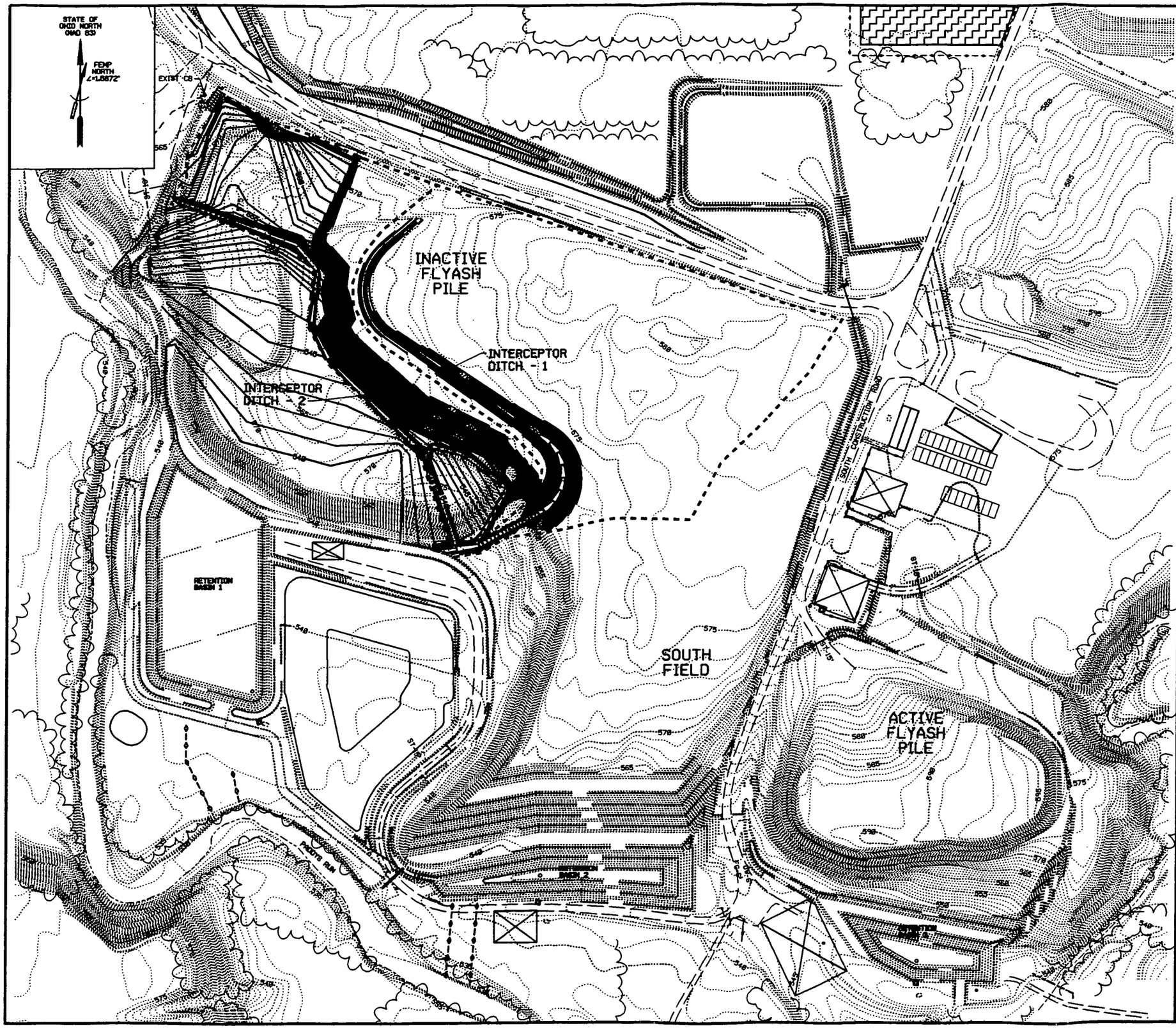
APPENDIX B

DRAINAGE AREA MAPS


STATE OF OHIO NORTH (NAD 83)
FEMP NORTH
EXISTING CATCH BASIN/PIPE
BERM
SEE PROPOSED CONDITIONS SHEET 2 OF 2 FOR CULVERTS 4 & 5 AND DRAINAGE AROUND WHEEL WASH AREA
SEE PROPOSED CONDITIONS SHEET 2 OF 2 FOR WATERSHED AREA FOR DITCH 12
EXTENSION OF EXISTING PIPE
NPDES DISCHARGE POINT
D2A
D2B
INACTIVE FLYASH PILE
D1
D3
D4
D5
D6
D8A
D8B
D9
D10A
D10B
D11
D15
CULVERT-1
CULVERT-2
CULVERT-3
CULVERT-7
SOUTH FIELD
ACTIVE FLYASH PILE
RETENTION BASIN 1
RETENTION BASIN 2
RETENTION BASIN 3
1-SHEET FLOW
2-SHALLOW CONC. FLOW
3-CHANNEL FLOW
LEGEND
RETENTION BASIN DRAINAGE AREA
DITCH/CULVERT DRAINAGE AREA
DIRECTION OF FLOW
EXISTING CONDITIONS
SCALE: 1" = 50'

000569

1634



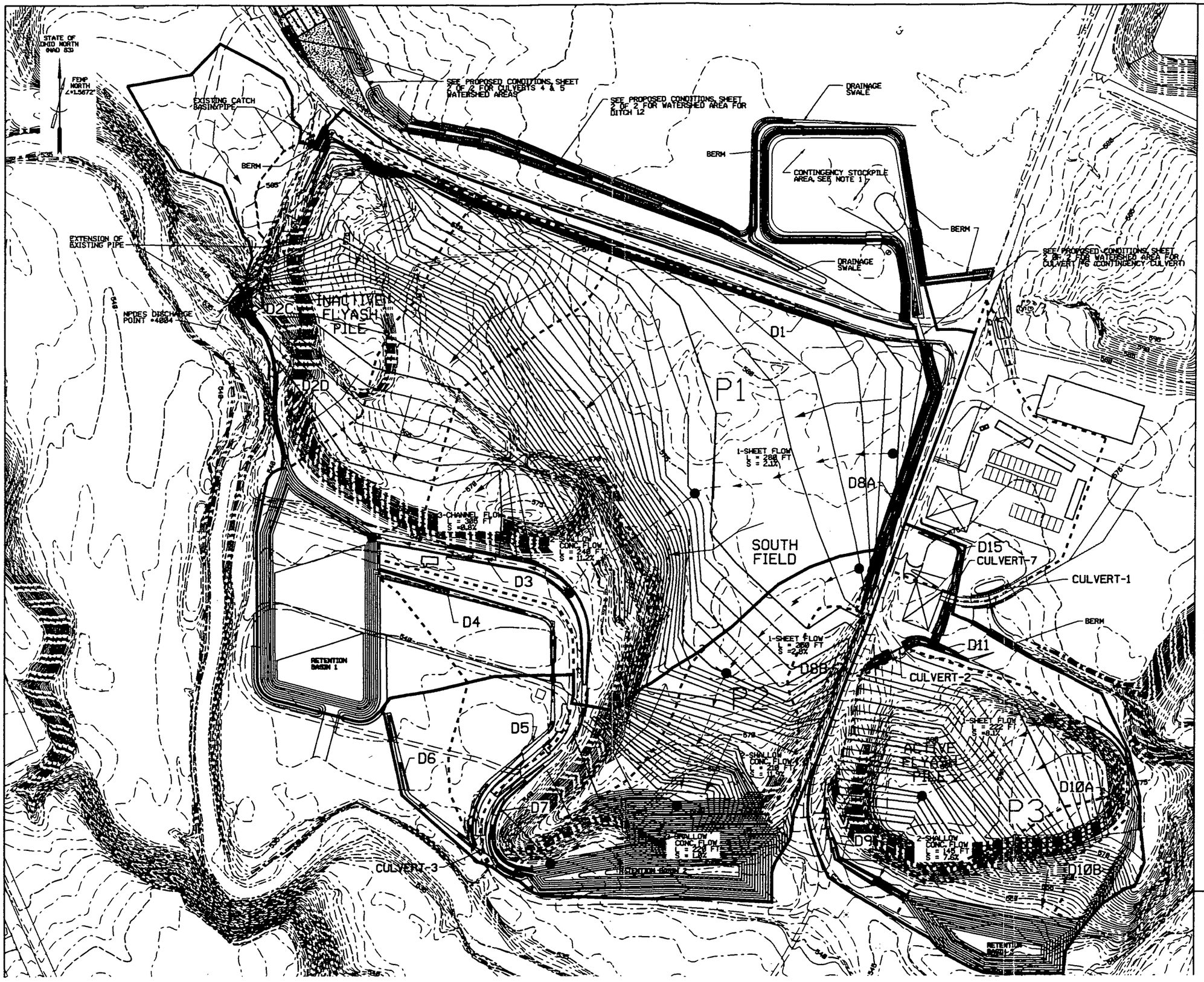
LEGEND

DITCH/CULVERT DRAINAGE AREA

000570

BASE BID EXCAVATION CONDITIONS

SCALE: 1" = 50'



1. CONTINGENCY STOCKPILE AREA (STOCK PILE #2) IS PROVIDED FOR ADDITIONAL SOIL STORAGE SHOULD PRIMARY STOCKPILE AREA BECOME TOO SMALL. DITCHES 8A, 8B, AND BASIN 2 ARE DESIGNED TO ACCOMMODATE THE CONTINGENCY STOCKPILE AREA IF USED.

1634

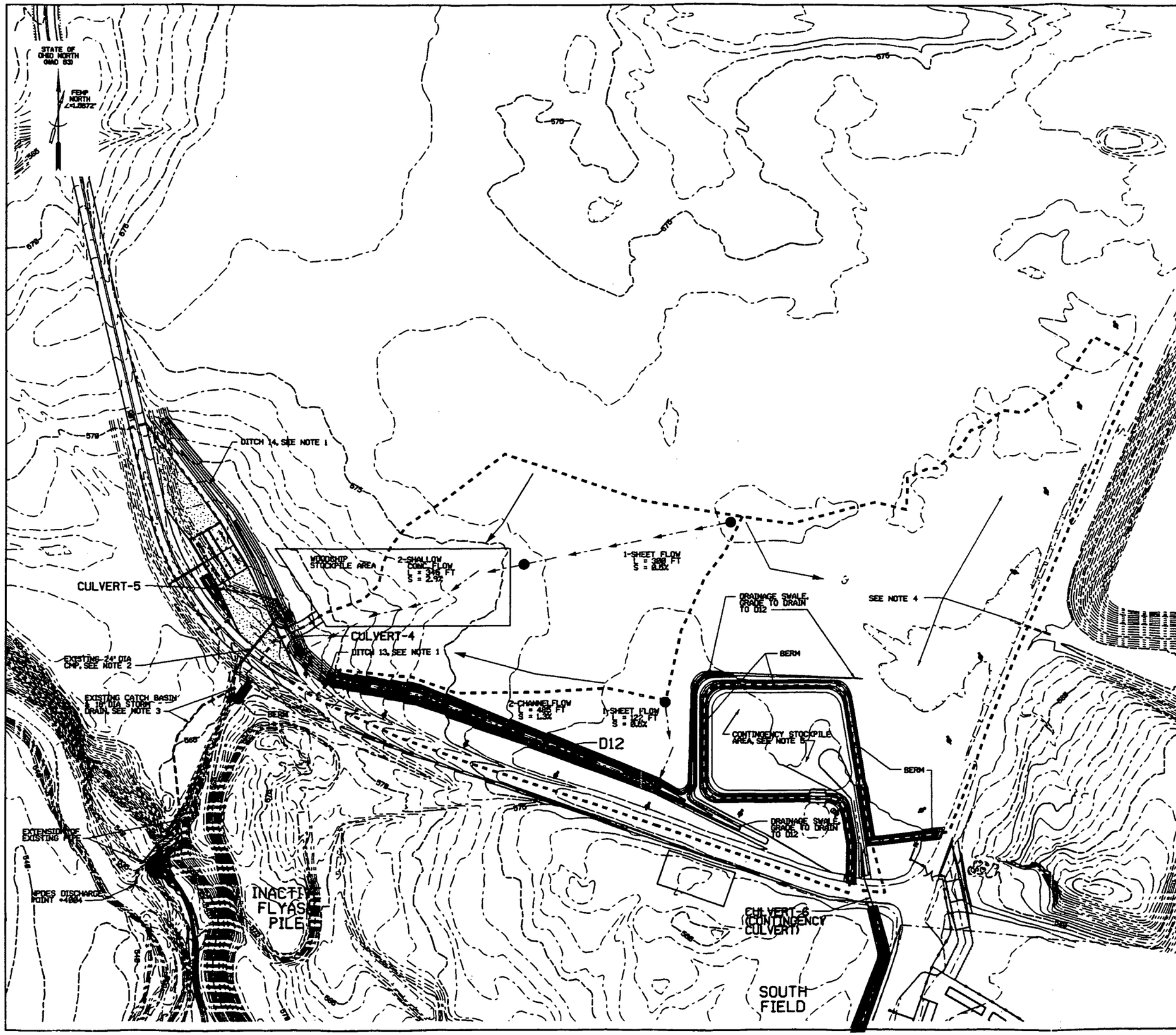
LEGEND

RETENTION BASIN DRAINAGE AREA	P1
DITCH/CULVERT DRAINAGE AREA	
DIRECTION OF FLOW	←

000571

PROPOSED CONDITIONS
SHEET 1 OF 2

50 0 50 100



NOTES:

1. EXISTING DITCHES IN THIS AREA WERE ORIGINALLY DESIGNED UNDER THE HAULROAD UPGRADE PROJECT, (P01581, CALCULATION NO. 15-02. DITCHES 13 & 14 WILL BE THE SAME SIZE AS THE EXISTING DITCHES AND WILL BE USED TO ROUTE RUNOFF AROUND NEW WORK.
2. EXISTING 24" DIA CMP WAS DESIGNED UNDER THE HAULROAD UPGRADE PROJECT (P01581, CALCULATION NO. 15-02.
3. EXISTING 18" DIA STORM DRAIN AND CATCH BASIN WERE DESIGNED UNDER THE SEEPAGE COLLECTION AND SEDIMENT REMOVAL PROJECT, (P01391, CALCULATION NO. 15-01.
4. DITCH-12 AND CULVERT-4 WERE DESIGNED ASSUMING THAT THE EXISTING CULVERT SHOWN WAS PLUGGED. IT WAS FURTHER ASSUMED THAT THE RUNOFF FROM THE ADDITIONAL DRAINAGE AREA SHOWN WOULD FLOW SOUTH TO DITCH-12 AND CULVERT-4.
5. CONTINGENCY STOCKPILE AREA (STOCKPILE #2) IS PROVIDED FOR ADDITIONAL SOIL STORAGE SHOULD PRIMARY STOCKPILE AREA BECOME TOO SMALL. DITCHES 8A, 8B, AND BASIN 2 ARE DESIGNED TO ACCOMMODATE THE CONTINGENCY STOCKPILE AREA IF USED.

1634

LEGEND

DITCH/CULVERT DRAINAGE AREA

DIRECTION OF FLOW

EXISTING POWER POLE

000572

PROPOSED CONDITIONS
SHEET 2 OF 2

50 0 50 100
SCALE: 1" = 50'

1634

LEGEND

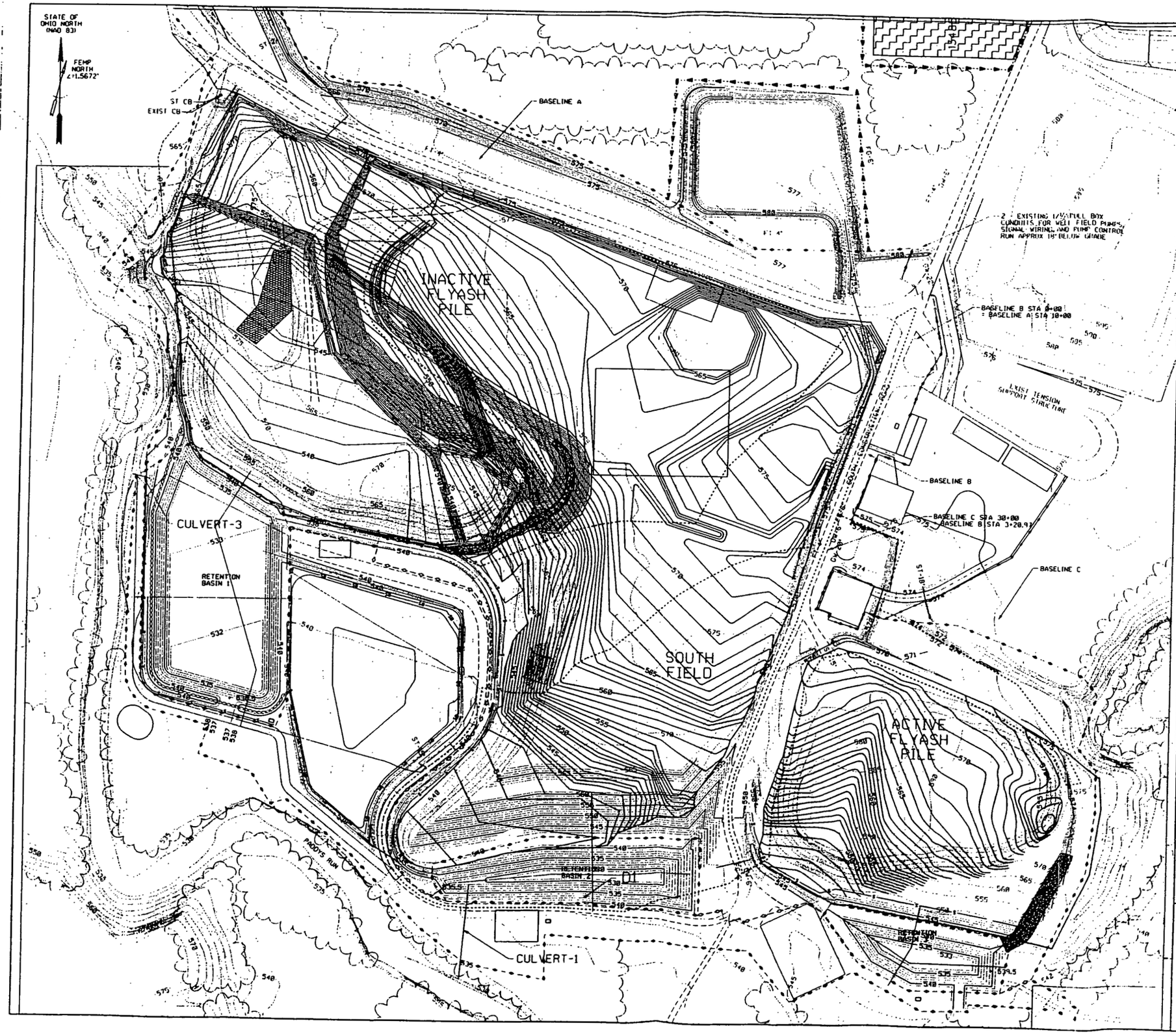
DITCH/CULVERT DRAINAGE AREA

000573

SOUTH FIELD & APF EXCAVATION GRADING CONDITIONS

SCALE: 1" = 50'

1634

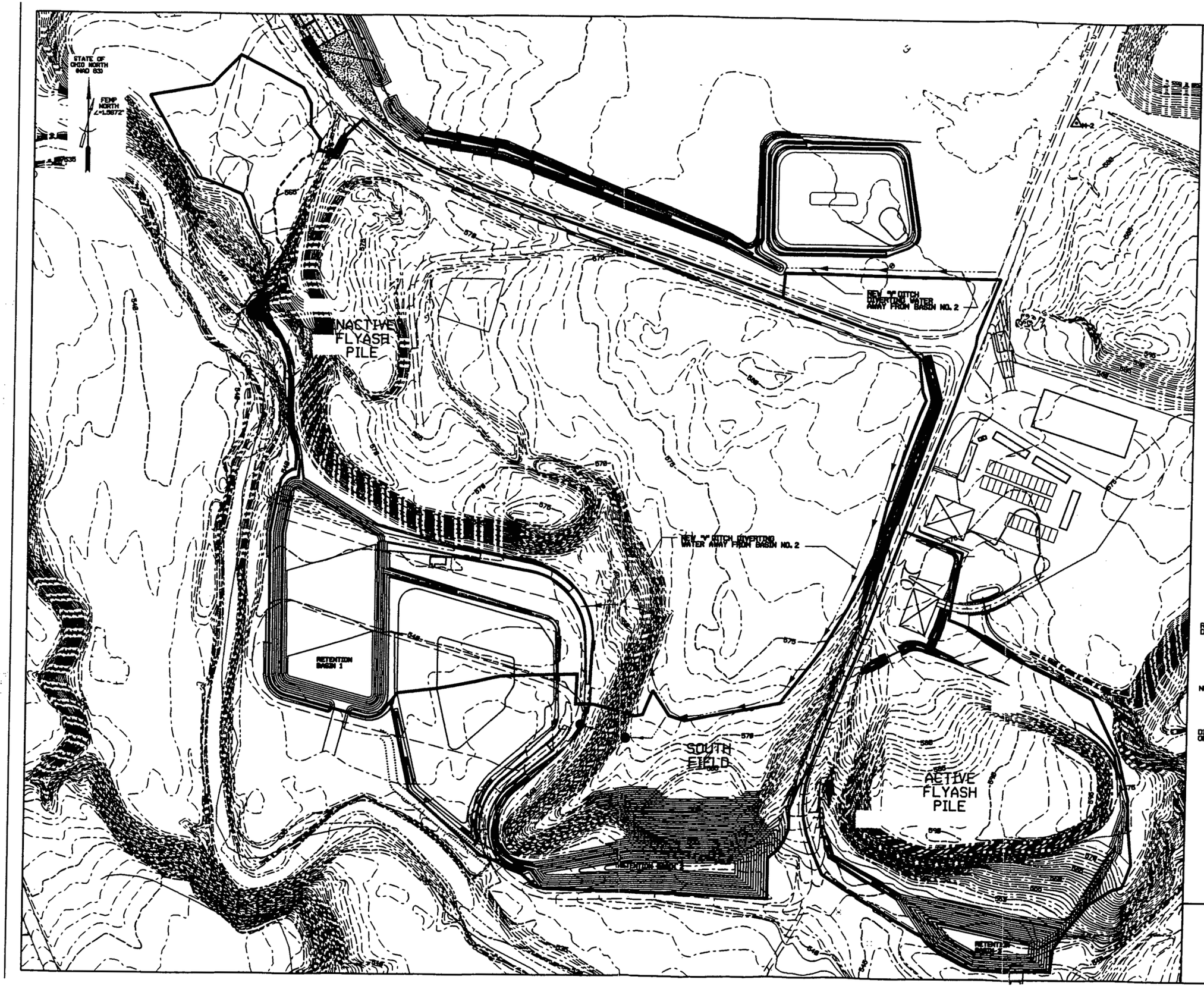


LEGEND

DITCH/CULVERT DRAINAGE AREA

000574

RESTORED CONDITIONS


STATE OF OHIO NORTH NAD 83
FEMP NORTH ∠=1.5872°
INACTIVE FLYASH PILE
NEW "V" DITCH DIVERTING WATER AWAY FROM BASIN NO. 2
NEW "V" DITCH DIVERTING WATER AWAY FROM BASIN NO. 2
RETENTION BASIN 1
SOUTH FIELD
ACTIVE FLYASH PILE
RETENTION BASIN 2
LEGEND
RETENTION BASIN DRAINAGE AREA
NEW DITCH
DIRECTION OF FLOW
CONDITIONS AFTER SITE PREPARATION
SCALE: 1" = 50'

APPENDIX C

Evaluation of the Potential Peak Stages in Paddys Run During Storm Events at Cross Sections Close to ~~the Proposed~~ Retention Basin No. 1

EVALUATION OF THE POTENTIAL PEAK STAGES IN PADDYS RUN DURING STORM EVENTS AT CROSS SECTIONS CLOSE TO THE PROPOSED RETENTION BASIN NO. 1

Fernald Environmental Management Project
Fernald, Ohio

Prepared By

BROWN & ROOT ENVIRONMENTAL
661 Andersen Drive
Pittsburgh, PA 15220

July, 1997

EVALUATION OF THE POTENTIAL PEAK STAGES IN PADDYS RUN DURING STORM EVENTS AT CROSS SECTIONS CLOSE TO THE PROPOSED RETENTION BASIN NO. 1

July, 1997

Objective

As proposed in the Area 2 Phase I Site Preparation Plan, a Surface Water Management Plan was prepared to address management of surface water at the Southern Waste Units (SWUs) during site preparation and excavation activities at the FEMP. According to this plan, the Retention Basin No. 1 will be constructed south of the Inactive Flyash Pile to control and collect potentially impacted storm water runoff from the Area 2, Phase I Remediation Area. The top bank elevations of the Retention Basin No.1 is proposed to be 540 feet. The objective of this task is to perform a hydraulic analysis to calculate the water surface elevations at the cross-sections A'-A', B'-B' and C'-C' along Paddys Run near the Retention Basin No.1, and to determine whether the water from Paddys Run will overflow into the proposed basin bank under 24-hour duration storms with the return periods of 1-year, 5-year, 10-year and 25-year, respectively. Locations of cross sections A'-A', B'-B' and C'-C' are shown in Figure 1.

Conceptual Model

The Paddys Run is an intermittent stream which drains a mid-size catchment (approximately 15 square miles) which includes most of the Fernald Environmental Management Project (FEMP) site. The Paddys Run drainage basin consists of land surface drained by streams and channels discharging to Paddys Run. The basin can be divided into subbasins so that the runoff from any particular area can be analyzed separately. The runoff from each of the subbasin can then be added together to yield the total hydrograph for the basin. The basin and subbasin boundaries were derived using topographic maps created by the U.S. Geological Survey (USGS) and supplemented with site topographic maps. Figure 2 shows all the subbasins in the simulation. The details of the boundaries of the basin and subbasins are presented in the Surface Water Flow and Infiltration Model (SWF&IM) Report (DOE 1993) developed for the FEMP and Operable Unit 5 RI/FS. The SWF&IM is a combination of the FEMP site-specific hydrological input parameters and several hydraulic and transport models used to simulate the various physical and chemical processes involved in the transport of contaminants from surface soil into surface water and subsequently into groundwater. The hydrologic/ hydraulic portion of the SWF&IM incorporated the U.S. Army

Corps of Engineers HEC-1 model to calculate runoff hydrographs and Manning's equation to calculate the Stage in Paddys Run. The methods are described in further detail in the following paragraphs.

Technical Approach

HEC-1 model was used to simulate surface runoff into Paddys Run. The HEC-1 model was developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers. The HEC-1 generates runoff hydrographs from many different subbasins and then combines and routes the hydrographs through the watershed. The entire Paddys Run drainage basin was modeled by linking the various subbasins together within the HEC-1 model. In the HEC-1 model, a runoff hydrograph is calculated for each subbasin. The hydrographs are then added together at locations called stations in the HEC-1 model. The combined runoff hydrographs can then be routed through a channel reaches, and combined with hydrographs from other subbasins.

The HEC-1 model provides hydrographs in terms of discharge rate versus time at each cross-section location. The rating curve (discharge versus depth relationship) is developed at each cross section based on the Mannings equation (Henderson, 1966). Mannings equation assumes that the channel flow is steady and uniform. The rating curve for each cross section is then used to obtain the peak river stage based on the cross-section-specific peak discharge in the hydrographs from HEC-1 model. It should be noted that this modeling approach was developed for the SWF&IM model whose primary purposed was contaminant fate and transport. The river stage is a relatively insensitive parameter in the contaminant model. The method used to develop the rating curve is relatively simplistic and reasonable conservative. If more accuracy is required more detailed analysis could be performed.

In the SWF&IM, cross sections D-D and E-E were called stations. Hydrographs at these two stations are computed based on hydrographs generated from upstream subbasins and then combined and routed to these stations. Cross section D-D is located at upstream of cross section C'-C' and cross section E-E is located at downstream of cross section A'-A' (see Figure 1). (Note: Cross sections in the SWF&IM were named A-A through K-K, three new sections A'-A', B'-B' and C'-C' are intermediate sections between the original D-D and E-E sections used to study this particular area of interest) The peak river stages at cross sections D-D and E-E are calculated by using the rating curve presented in the SWF&IM and the peak discharge output from the HEC-1 model. As mentioned earlier, the rating curves were developed using the Mannings equation, cross section of Paddys run and Manning roughness coefficients based on field reconnaissance. The peak river stages at cross sections A'-A', B'-B' and C'-C' are then linearly interpolated from the peak stages at cross sections D-D and E-E based on the distance between these cross sections.

The procedures used to obtain the peak stages in Paddys Run at cross sections A'-A', B'-B' and C'-C' are summarized as follows:

(1) Obtaining the peak discharges at cross sections D-D and E-E from the output of HEC-1 runs,

(2) Calculating the peak stages at cross sections D-D and E-E by using the rating curves, and

(3) Interpolating the peak stages at cross sections A'-A', B'-B' and C'-C' from the peak stages at cross sections D-D and E-E.

Input Data

The HEC-1 model requires input to represent the rainfall event and to describe the surface hydrological properties of the drainage area. Four 24-hour storm events with return periods of 1-year, 5-year, 10-year and 25-year, respectively, were chosen to evaluate the peak discharge and stage at the cross sections near the Retention Basin No. 1. The volume of precipitation contained in a storm event is often reported in depth. The storms have total precipitation depths of 2.5 inches, 3.6 inches, 4.1 inches and 4.8 inches for the 1-year, 5-year, 10-year and 25-year return periods, respectively. The method used to produce the storm hyetograph (the variation of rainfall intensity with time) used in the HEC-1 requires the rainfall amounts (depth) for storm of various durations up to the entire length of the storm being modeled. The depth-duration data required by the HEC-1 model is listed in Table 1. The rainfall depth listed in Table 1 were obtained from the rainfall frequency atlas of the United States (Hershfield 1961).

Most of the parameters used to describe the drainage basin were taken from topographic maps of the Paddys Run watershed. Some information, such as Paddys Run cross section data, used for channel routing, were obtained from topographic maps developed from field surveys. Parameters such as channel roughness, slope, catchment lengths and areas, and stream channel dimensions are required to define the water movement over the basin surface. The detailed description of the input data can be found in SWF&IM. Appendix A and Appendix B list all data used to characterize overland flow and channel flow elements, respectively. The Soil Conservation Service (SCS) curve number method was utilized to calculate precipitation losses. The curve number associated with each of the different soil types, land uses, and vegetation are then weighted and averaged to represent each subbasin for input into the HEC-1 model. Appendix C provides the weighting procedure used to determine the SCS curve number for the subbasins. The final curve number(s) used for each subbasin is also presented in this Appendix.

The area upstream of Section D-D is covered by eleven subbasins in this simulation. Storm water from the former production area of the FEMP and the waste pit area is assumed to be collected in the Storm Water Retention Basin

and pumped to the Great Miami River. therefore. the discharge from former production area and waste pit area does not affect the peak discharge at section A'-A'. B'-B' and C'-C'.

The rating curve (depth-discharge relationship) was developed for the cross sections D-D and E-E. The Mannings roughness coefficient and slope for each cross section used in a rating curve calculation are listed in Appendix B. Figures 3 and 4 show the geometry of cross sections D-D and E-E, respectively. The resulting rating curves for cross sections D-D and E-E are presented in Figures 5 and 6, respectively.

The HEC-1 model input files for 1-year, 5-year, 10-year, and 25-year return period storms are presented in Appendix E

Calibration

A comparison between the model simulated and field measured river stages was performed in response to the EPA comments on SWF&IM in 1994. Appendix D includes the detailed description of the performance of this calibration. As described in Appendix D, the curve number used for the HEC-1 model of the representative storm event are based on an Antecedent Moisture Condition-II (AMC-II) which represents an average moisture content in the surface soils prior to the storm rainfall event. AMC-I represents a dryer than average moisture content in the surface soil and AMC-III represents a wetter than average soil condition. The AMC-II curve number are primarily used for design purposes (SCS, Technical Release 55, June 1986).

In order to better evaluate the performance of the runoff model, actual rainfall data from FEMP from two storm event (the April 28-29 1989 event and another one on April 3-4 1989) and SCS curve number that represent actual soil conditions during an abnormally wet season were input into the HEC-1 model. The rainfall in the spring of 1989 was above average (DOE 1993, Groundwater Modeling Report Summary of Model Development) indicating that the ground surface could have been saturated prior to the storm event which would cause a larger amount of runoff. The SCS National Engineering Handbook, Section 4, Hydrology (NEH-4 [SCS 1985]) recommends that if more than 1.1 inches of precipitation falls during the five days before the storm event being modeled that a AMC-III should be used. Approximately 1.3 inches of rain fell in the five days prior to the storm event on April 28-29, 1989. Since this was in the range of AMC-III recommended in NEH-4, an AMC-III was used to simulate this storm. An AMC-III was also used for the simulation of the April 3-4 storm since this storm occurred four days after a storm event on March 31, 1989 which caused the Storm Water Retention Basin to overflow. The site precipitation data was not readily available for the March 31 storm, but it is valid to assume that such a event would create AMC-III soil conditions for the April 3-4 event. The area weighted SCS curve number is 64 for AMC-II condition and 81 for AMC-III condition used in HEC-1 model.

Table 2 presents the comparison of the modeled and measured rise in the flow depth of Paddys Run. The measured rise in water surface elevation was measured at two locations along Paddys Run in April 1989: Stilling Well 9 (near cross section location C-C) and Stilling Well 14 (near cross section location E-E). The location of cross section C-C is indicated in Figure 2. As stated in Appendix D, the conclusion of the comparison for the response to comments in1994 was that the surface water model can predict the water surface elevation with acceptable accuracy.

Simulation Results

The output from the HEC-1 model includes runoff hydrographs, peak discharge, and the total volume of runoff from each subbasin and cross section location in the model. The peak discharges at cross sections D-D and E-E under different storm events from the HEC-1 model were used to calculate the peak river stages based on the rating curves at these cross sections. The peak discharges and river stages at cross sections D-D and E-E are shown in Figures 5 and 6. The peak river stages at cross sections D-D and E-E were then used to interpolate the peak river stages at cross sections A'-A', B'-B' and C'-C'. Figure 7 shows the interpolated peak river stages at cross sections A'-A', B'-B' and C'-C'. Also, the peak river stages at these cross sections are tabulated in Table 3. The top elevation of the proposed bank for Retention Basin No. 1 at cross sections A'-A', B'-B' and C'-C' is about 540 feet. The river stages in Table 3 indicates that the Paddys Run does not overflow the proposed basin bank at these cross sections even under the 25-year return period, 24-hour storm event.

References

Henderson, F.M., 1966," Open Channel Flow," McMillian Publishing Co., Inc., New York pp. 96

Hershfield, D.M., 1961, " Rainfall Frequency Atlas of the United States," Technical Paper No. 40, Department of Commerce, Washington, DC.

U.S. Army Corps of Engineers, 1990, " HEC-1 Flood Hydrograph Package User's Manual," CPD-1A, Version 4.0.

U.S. Department of Energy, Fernald Office, 1993, "Surface Water Flow and Infiltration Model Summary Report."

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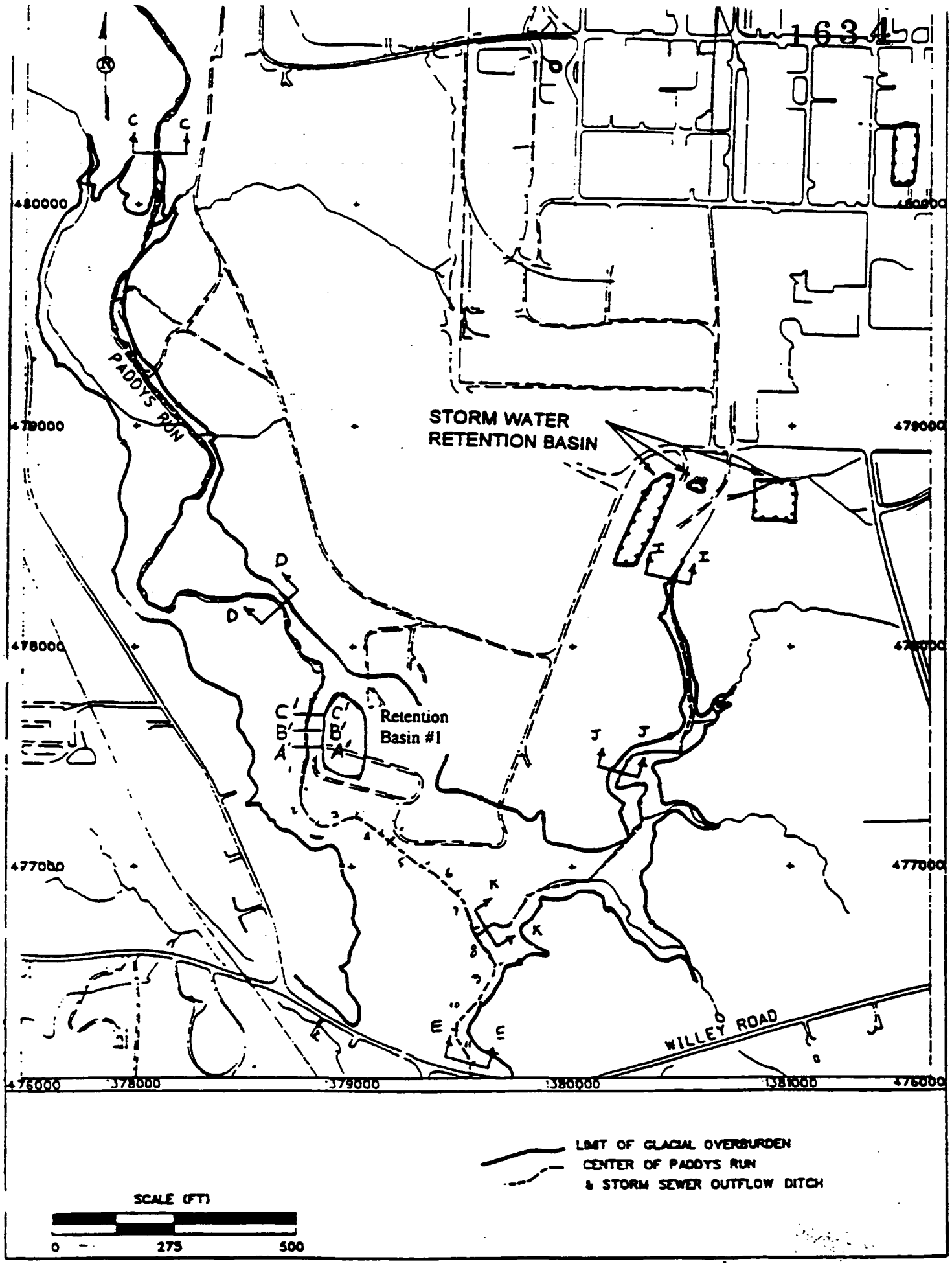

Figure 1 Location of Cross Sections

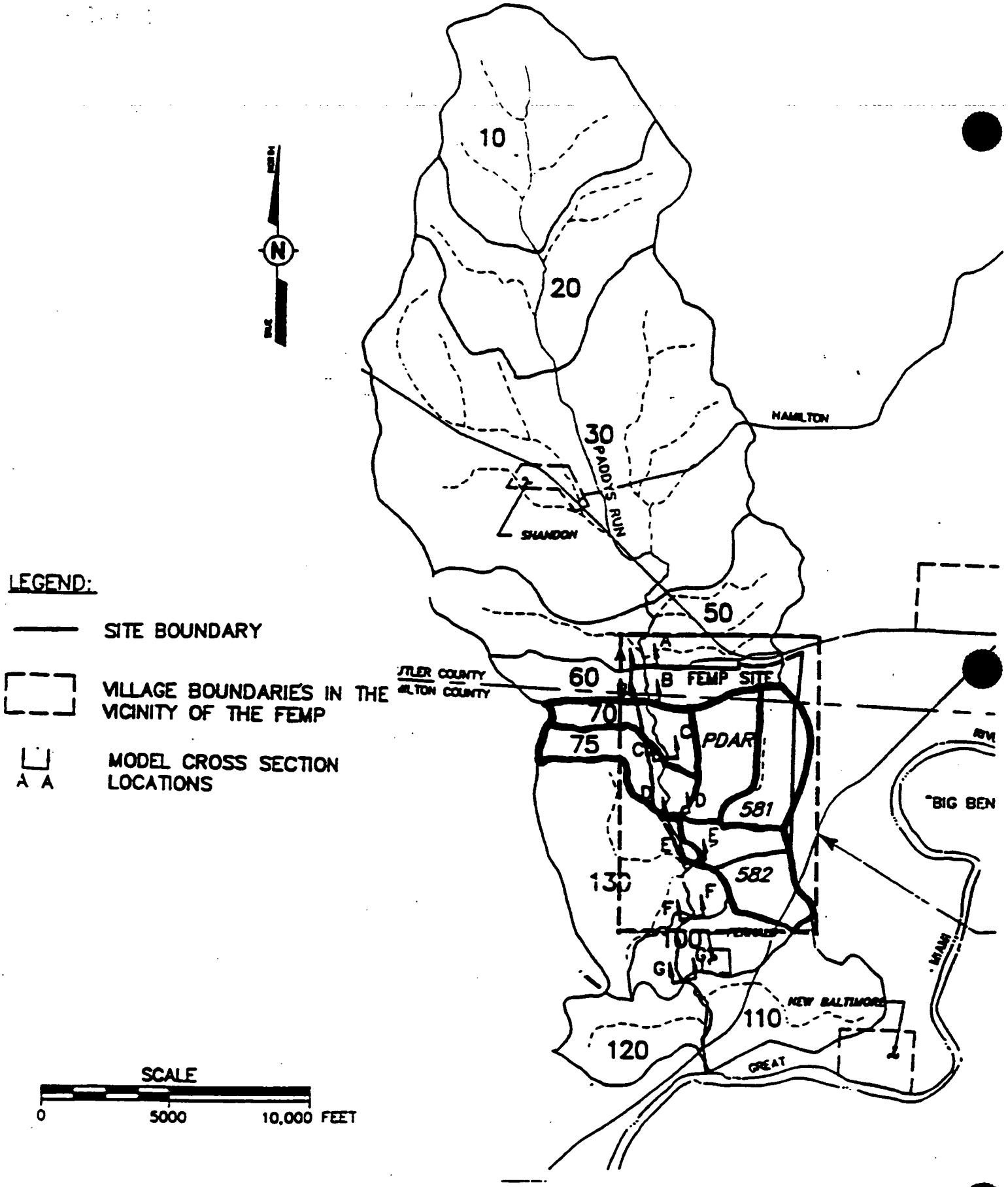

Figure 2 Paddys Run Subbasins

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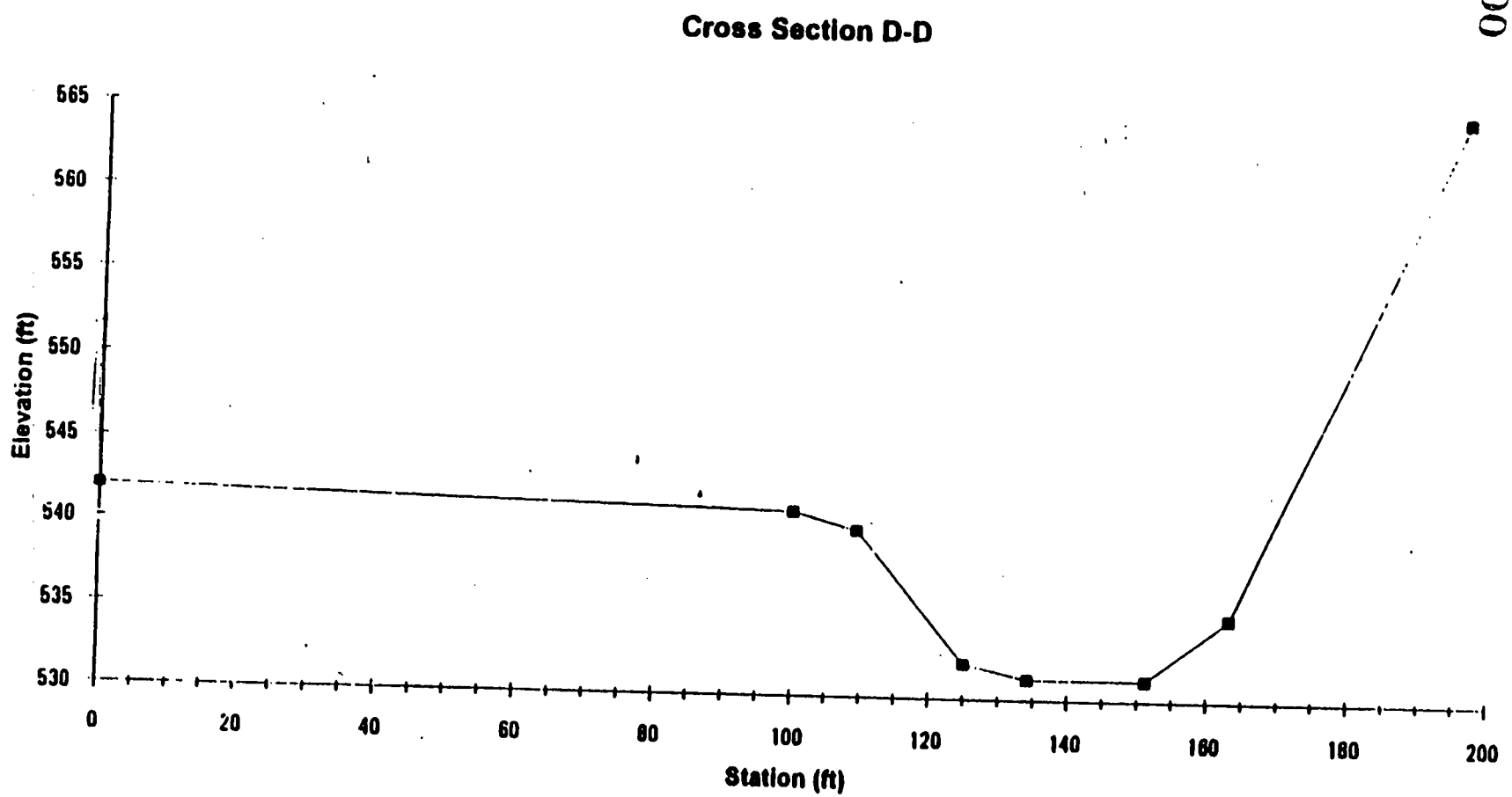

Figure 3 Cross Section D-D

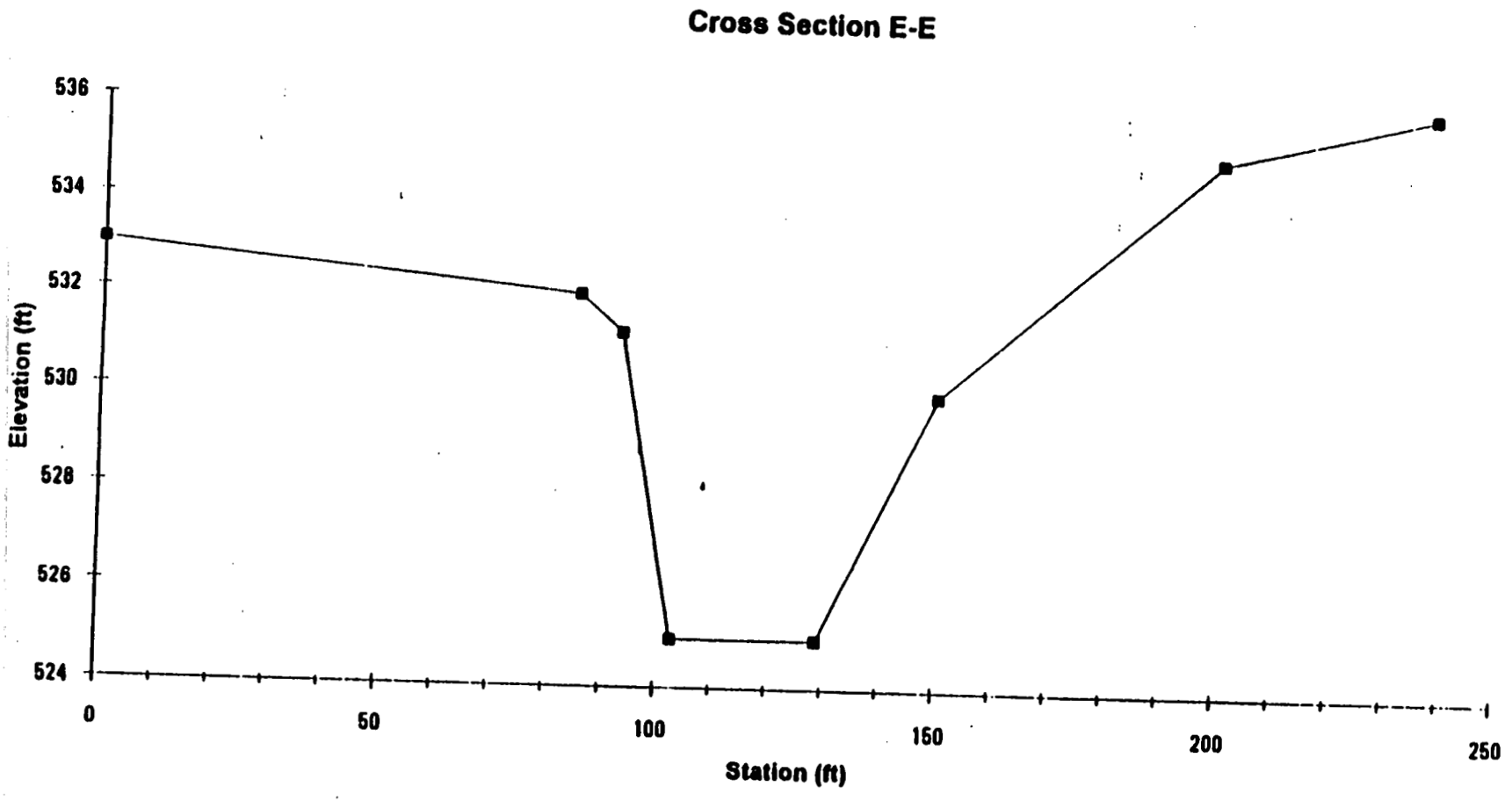

Figure 4 Cross Section E-E

000586

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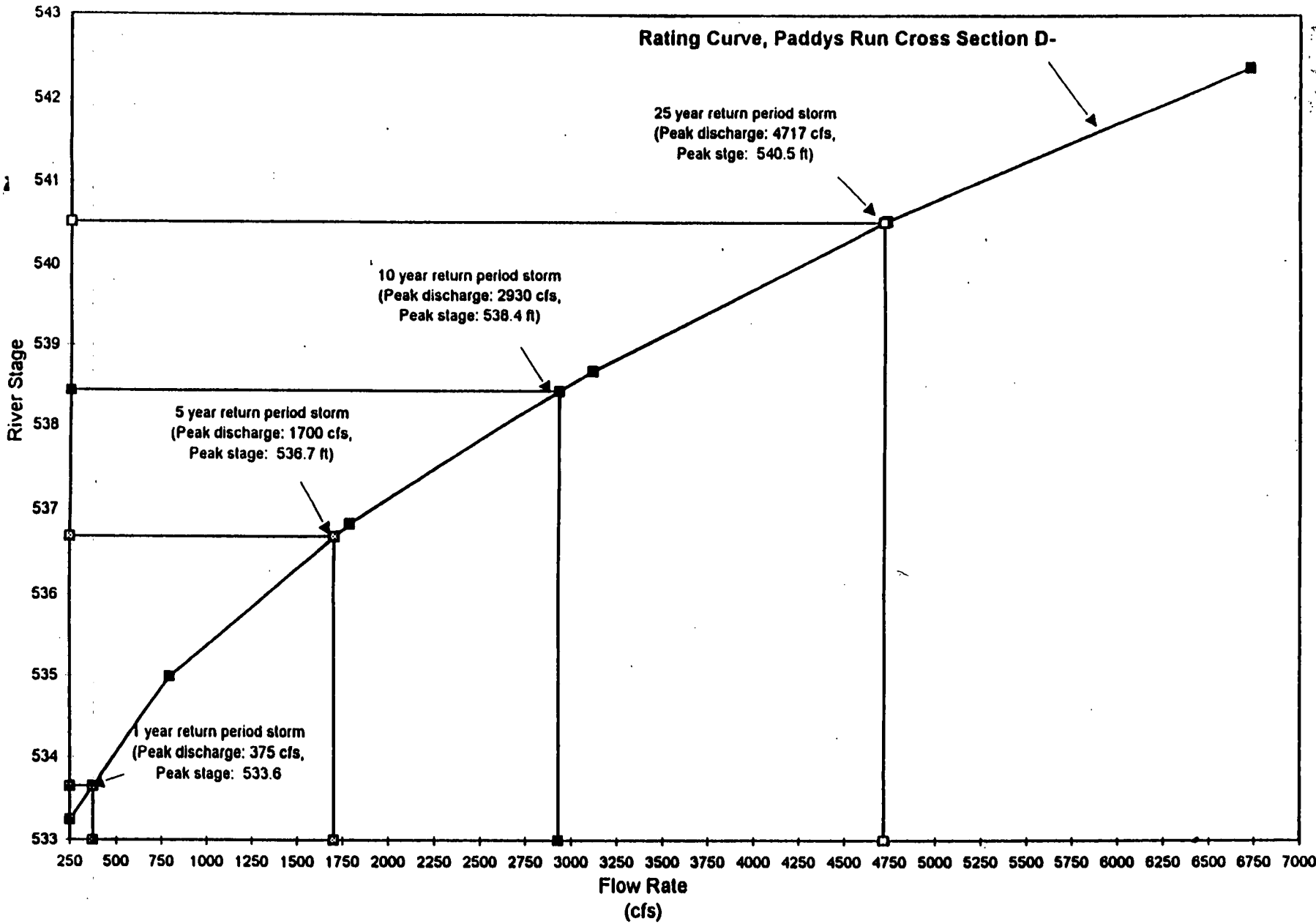

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Figure 5 Rating Curve, Peak Discharge and Stage at Cross Section D-D

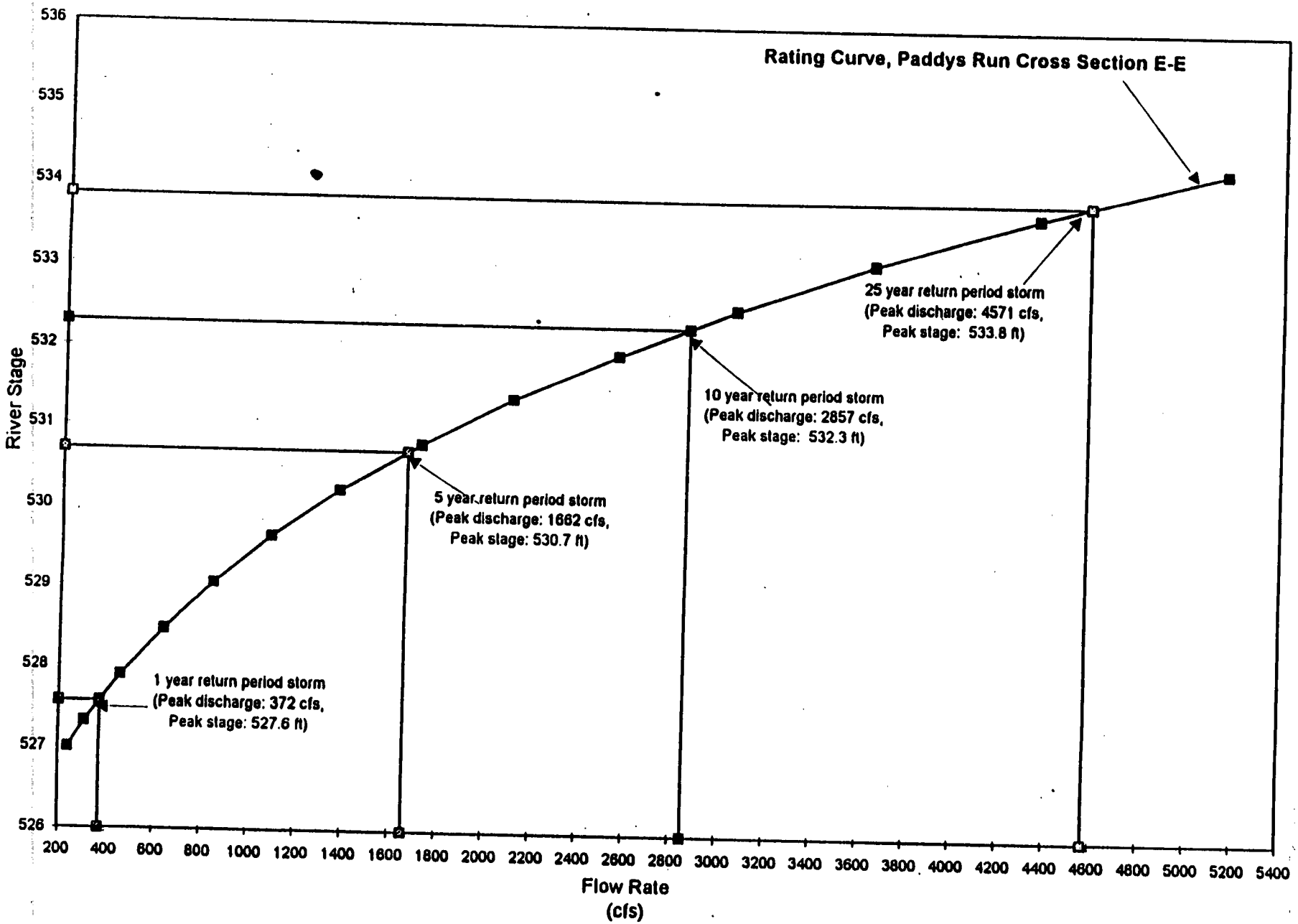

Figure 6 Rating Curve, Peak Discharge and Stage at Cross Section E-E

000588

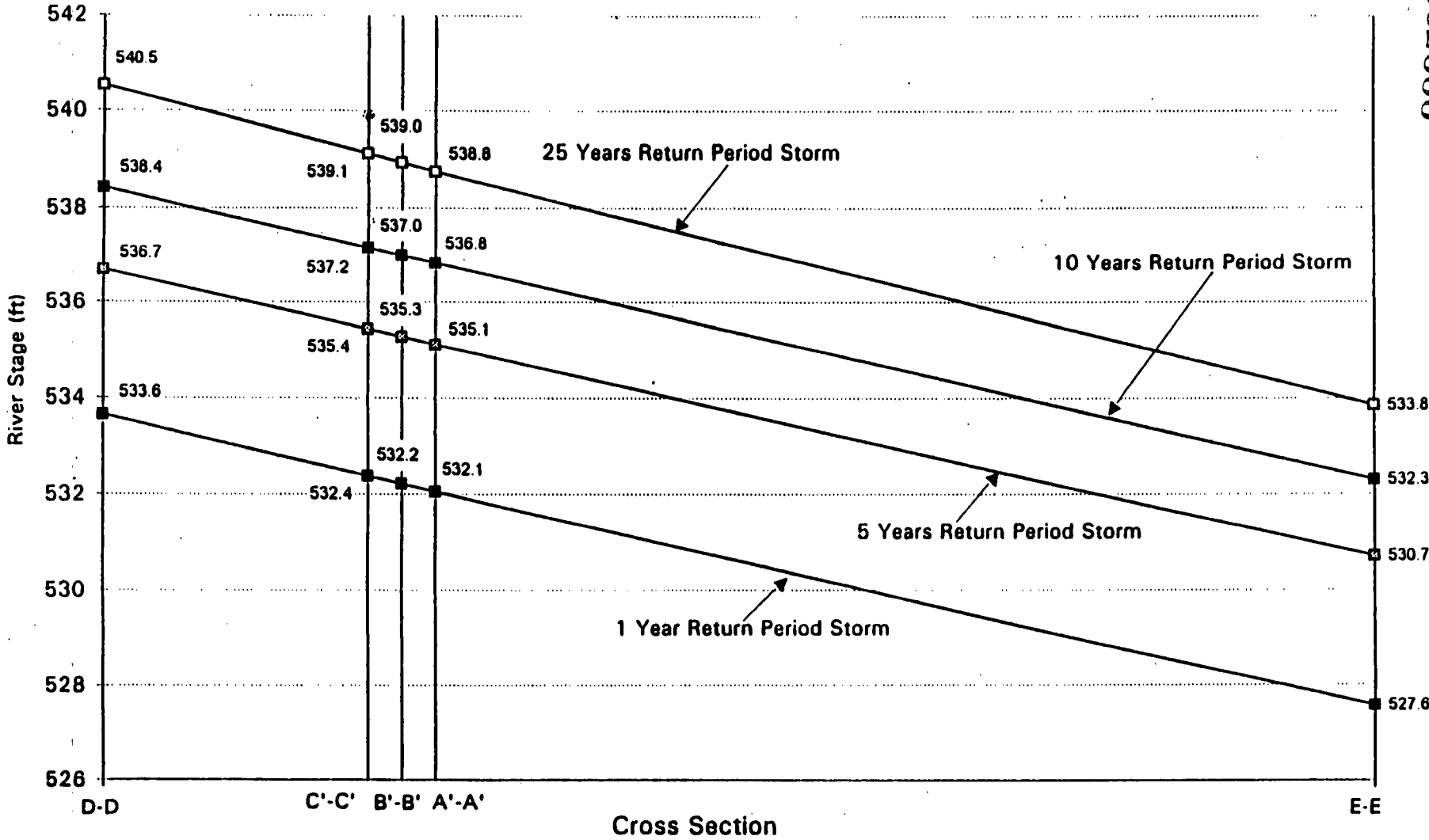

Figure 7 Interpolated Peak Stages at Cross Section A'-A', B'-B' and C'-C'

Table 1 Depth-Duration Data for 24-Hour Storm*

Duration	Depth (in)			
	1-Year Return Period Storm	5-Years Return Period Storm	10-Years Return Period Storm	25-Years Return Period Storm
5 minutes	0.330	0.500	0.540	0.625
15 minutes	0.625	1.000	1.125	1.250
60 minutes	1.100	1.500	1.900	2.220
2 hours	1.400	1.900	2.200	2.700
3 hours	1.480	2.100	2.400	3.000
6 hours	1.800	2.400	2.900	3.500
12 hours	2.100	3.000	3.360	4.100
24 hours	2.500	3.600	4.100	4.800

* Hershfield, D.M., 1961, Rainfall Frequency Atlas of the United States. Technical Paper No.40. Department of Commerce, Washington, D.C.

Table 2

COMPARISON OF MODELED AND MEASURED INCREASE OF PADDYS RUN FLOW DEPTHS

Date of Storm Event	Precipitation Amount IN.[a]	Cross Section C-C		Cross Section E-E	
		Measured Rise in Stream Depth (Stilling Well 9)[b] FT.	Modeled Rise in Stream Depth (STA70)[c] FT.	Measured Rise in Stream Depth (Stilling Well 14)[b] FT.	Modeled Rise in Stream Depth (STAEE)[c] FT.
April 3-4, 1989	1.92	4.06	3.99	5.51	5.35
April 28-29,1989	1.96	2.39	3.13	4.98	4.17

(a) Precipitation amounts from raingauge at the FEMP, except portion of April 28-29 storm which is supplemented with data from the Greater Cincinnati Airport due to missing data from the FEMP raingauge.

(b) Stream depth rise taken from data presented in Groundwater Report, Feed Materials Production Center, U.S. DOE December, 1990.

(c) Stream depth calculated from Paddys Run flow rate predicted with HEC-1 and Mannings equation.

Table 3 Peak River Stages at Cross Section A'-A', B'-B' and C'-C'

24-Hour Storm	River Stage (ft) at Cross Sections		
	A'-A'	B'-B'	C'-C'
1 Year Return Period	532.1	532.2	532.4
5 Years Return Period	535.1	535.3	535.4
10 Years Return Period	536.8	537.0	537.2
25 Years Return Period	538.8	539.0	539.1

Appendix A

HEC-1 INPUT DATA

SUBBASIN CHARACTERISTICS (OVERLAND FLOW PLANE DATA)

Subbasin	Overland Flow Length[a] (FT)	Overland Flow Slope[a] (ft/ft)	Resistance Factor[b] N	% Subbasin Area[a]	Drain Area[a] (Sq. mile)	SCS Curve Number[c]
10	150	0.07	0.4	100	1.869	65.4
20	200	0.075	0.4	100	1.589	63.7
30	200	0.08	0.4	100	5.188	63
50	200	0.04	0.4	100	1.288	66
60	200	0.08	0.4	100	0.599	59.8
70	150	0.013	0.4	75	0.313	61
	200	0.013	0.15	25		88.8
75	150	0.013	0.4	75	0.408	61
	200	0.013	0.15	25		88
PDAR	150	0.01	0.15	100	0.294	86.2
580	100	0.01	0.25	100	0.036	71.9
581	200	0.025	0.25	100	0.456	69.4
582	200	0.025	0.30	100	0.487	66.5
100	180	0.1	0.4	30	0.51	62.1
110	200	0.2	0.4	50	0.832	61.9
120	150	0.03	0.3	50		69
	100	0.28	0.4	100	0.561	69.4
130	200	0.033	0.4	100	1.385	68.2

000595

HEC-1 INPUT DATA

SUBBASIN CHARACTERISTICS (OVERLAND FLOW PLANE DATA)

SUBBASINS DIVIDED FOR CONTAMINATED CALCULATIONS

Subbasin	Overland Flow Length[d] (FT)	Overland Flow Slope[e] (ft/ft)	Resistance Factor[e] N	% Subbasin Area[a]	Drain Area[a] (Sq. mile)	SCS Curve Number[f]
60	200	0.08	0.4	100	0.282	59.9
560	200	0.10	0.4	100	0.317 0.599	62.9
70	200	0.01	0.4	100	0.121	62.4
570	200	0.017	0.25	100	0.120	76.7
WPA	200	0.024	0.15	100	0.072 0.313	76.8
75	150	0.15	0.40	100	0.288	67.6
575	200	0.013	0.15	25	0.120 0.408	69.8

[a]Estimated from USGS topographic map, Shandon, Ohio, N3915_W8437.5/7.5, 1981, DMA 4062 ISW-Series V852.

[b]Table 3.5, HEC-1 User's Manual.

[c]See Table 3-4 for SCS curve number calculation procedure.

[d]Estimated from USGS topographic map, Shandon, Ohio, N3915_W8437.5/7.5, 1981, DMA 4062 ISW-Series V852.

[e]Table 3.5, HEC-1 User's Manual.

[f]See Table 3-4 for SCS curve number calculation procedure.

Appendix B

HEC-1 INPUT DATA

CHANNEL CHARACTERISTICS

Element	Length[a] (ft)	Slope[a]	Manning[b] n	Area[a] (sq. mile)	Shape	Width (ft)	Side Slope (ft/ft)	Route Upstream Flow
Sub 10								
Subcollector Channel	500	0.07	0.045	0.08	TRAP	0	1	
Collector channel	3200	0.05	0.045	0.47	TRAP	0	1	
Main channel	5200	0.015	0.045		TRAP	0	1	No
Sub 20								
Collector channel	4500	0.065	0.045	0.132	TRAP		1	
Main channel	4800	0.015	0.045		TRAP	0	1	Yes
Sub 30								
Subcollector channel	3600	0.05	0.045	0.18	TRAP	0	1	
Collector channel	6000	0.007	0.045	1.297	TRAP	0	1	
Main channel	10800	0.003	0.045		TRAP	20	1	Yes
Sub 50								
Collector channel	5000	0.02	0.045	0.322	TRAP	0	1	
Main channel	2800	0.002	0.035		Irregular	–	1	Yes
Rout 60								
Main channel	1600	0.004	0.035		Irregular		1	Yes
Sub 60								
Collector channel	4500	0.04	0.02	0.15	TRAP	5	1	
Main channel	1600	0.004	0.035		Irregular		1	No
Rout 0								
Main channel	2986	0.004	0.025		Irregular			Yes
Sub 70								
Main channel	4000	0.013	0.045		TRAP	5	1	No

HEC-1 INPUT DATA

CHANNEL CHARACTERISTICS

SUBBASINS DIVIDED FOR CONTAMINANT CALCULATIONS

Element	Length[a] (ft)	Slope[a]	Manning[b] n	Area[a] (sq. mile)	Shape	Width (ft)	Side Slope (ft/ft)	Route Upstream Flow
Rout 1								
Main channel	3093	0.003	0.025		Irregular			Yes
Sub 75								
Main channel	4000	0.013	0.045		TRAP	5	1	No
Rout 2								
Main channel	2773	0.002	0.025		Irregular			Yes
PDAR								
Main channel	2600	0.005	0.015	–	CIRC	2	–	No
580								
Collector channel	500	0.100	0.04	0.020	TRAP	0	1	No
Main channel	600	0.010	0.035	–	TRAP	5	1	No
581								
Collector channel	1000	0.020	0.04	0.080	TRAP	0	1	No
Main channel	3300	0.012	0.030	–	TRAP	5	1	No
Rout 80								
Main channel	1300	0.009	0.035	–	Irregular	–	–	Yes

000598

HEC-1 INPUT DATA

CHANNEL CHARACTERISTICS

SUBBASINS DIVIDED FOR CONTAMINANT CALCULATIONS

Element	Length[a] (ft)	Slope[a]	Manning[b] n	Area[a] (sq. mile)	Shape	Width (ft)	Side Slope (ft/ft)	Route Upstream Flow
582								
Colector channel	3800	0.022	0.045	0.033	TRAP	5	1	No
Main channel	3800	0.015	0.025	–	TRAP	26	2.27	No
Rout 25								
Main channel	2613	0.002	0.025		TRAP	52.8	4.55	Yes
Sub 100								
Collector channel	4000	0.01	0.045	0.412	TRAP	5	1	
Main channel	2773	0.0003	0.025		TRAP	27.2	26.32	Yes
Rout 3								
Main channel	3828	0.0025	0.025		TRAP	63.6	7.3	Yes
Sub 110								
Collector channel	500	0.04	0.045	0.21	TRAP	0	1	
Main channel	10,000	0.009	0.025		TRAP	20	3.33	No
Sub 120								
Collector channel	500	0.2	0.045	0.15	TRAP	0	1	
Main channel	8000	0.021	0.045		TRAP	20	3.33	No
Sub 130								
Collector channel	5000	0.016	0.045	0.588	TRAP	5	1	
Main channel	1800	0.02	0.025		TRAP	52.8	4.55	No

HEC-1 INPUT DATA

CHANNEL CHARACTERISTICS

SUBBASINS DIVIDED FOR CONTAMINANT CALCULATIONS

Element	Length[c] (ft)	Slope[b]	Manning[d] n	Area[a] (sq. mile)	Shape	Width (ft)	Side Slope (ft/ft)	Route Upstream Flow
Sub 60								
Main Channel	4500	0.04	0.03	–	TRAP	0	1	No
Sub 560								
Main channel	4800	0.01	0.04	–	TRAP	0	1	No
Sub 70								
Main channel	4600	0.013	0.045	–	TRAP	0	1	No
Sub 570								
Main channel	1800	0.017	0.030	–	TRAP	0	1	No
WPA								
Main channel	1800	0.024	0.030	–	TRAP	0	1	No
Sub 75								
Main channel	4000	0.013	0.045	–	TRAP	5	1	No
Sub 575								
Main channel	650	0.067	0.045	–	TRAP	5	1	No

000600

[a]Estimated from USGS topographic map, Shandon, Ohio, N3915_W8437 5/7.5, 1981, DMA 4062 ISW-Series V852.

[b]Table 4.2, Henderson F.M., 1966, Open Channel Flow, MacMillan Publishing Co., Inc.

[c]Estimated from USGS topographic map, Shandon, Ohio, N3915_W8437 5/7.5, 1981, DMA 4062 ISW-Series V852.

[d]Table 4.2, Henderson F.M., 1966, Open Channel Flow, MacMillan Publishing Co., Inc.

Appendix C

SCS CURVE NUMBER WEIGHTING

Subbasin	Land Cover[a]	Hydraulic Condition	Hydrologic Soil Group[b]	Weighted SCS Number[c]	Average SCS Number
10	Woods 30%	Good	0.5C + 0.5B	0.5 x 71 + 0.5 x 55	
	Meadow 60%	Good	0.4C + 0.6B	0.4 x 71 + 0.6 x 58	65.4
	Hard surface 10%	--	0.5 C + 0.5B	0.5 x 84 + 0.5 x 90	
20	Woods 15%	Good	0.7C + 0.3B	0.7 x 70 + 0.3 x 55	
	Meadow 80%	Good	0.3C + 0.7B	0.3 x 71 + 0.7 x 58	63.7
	Hard surface 5%	--	0.5C + 0.5B	0.5 x 84 + 0.5 x 90	
30	Woods 10%	Fair	0.4C + 0.6B	0.4 x 73 + 0.6 x 60	
	Meadow 85%	Good	0.25C + 0.75B	0.25 x 71 + 0.75 x 58	63
	Hard surface 5%	--	0.5C + 0.5B	0.5 x 84 + 0.5 x 90	
50	Woods 20%	Fair	0.4C + 0.6B	0.4 x 73 + 0.6 x 60	
	Meadow 70%	Good	0.4C + 0.6B	0.4 x 71 + 0.6 x 58	66
	Hard Surface 10%	--	0.4C + 0.6B	0.4 x 84 + 0.6 x 90	
60	Woods 35%	Good	0.1C + 0.9B	0.1 x 70 + 0.9 x 55	
	Meadow 60%	Good	0.1C + 0.9B	0.1 x 71 + 0.9 x 58	59.8
	Hard surface 5%	--	0.1C + 0.9B	0.1 x 84 + 0.9 x 90	
70	Woods 10%	Fair	0.2C + 0.8B	0.2 x 73 + 0.8 x 60	61
	Meadow 65%	Good	0.2C + 0.8B	0.2 x 71 + 0.8 x 58	
	Hard surface 25%	--	0.2C + 0.8B	0.2 x 84 + 0.8 x 90	88.8
75	Woods 10%	Fair	0.2C + 0.8B	0.2 x 73 + 0.8 x 60	61
	Meadow 65%	Good	0.2C + 0.8B	0.2 x 71 + 0.8 x 58	
	Hard surface 25%	--	0.2C + 0.8B	0.2 x 84 + 0.8 x 90	88.8
80	Woods 10%	Fair	0.5C + 0.5B	0.5 x 73 + 0.5 x 60	65
	Meadow 65%	Good	0.5C + 0.5B	0.5 x 71 + 0.5 x 58	
	Hard surface 25%	--	0.5C + 0.5B	0.5 x 84 + 0.5 x 90	87

1634

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SCS CURVE NUMBER WEIGHTING

Subbasin	Land Cover[a]	Hydraulic Condition	Hydrologic Soil Group[b]	Weighted SCS Number[c]	Average SCS Number
580	Woods 45% Meadow 50% Hard Surface 5%	Good Good --	0.0B + 1.0C 0.0B + 1.0C 0.0B + 1.0C	0.0 x 55 + 1.0 x 71 0.0 x 58 + 1.0 x 71 0.0 x 84 + 1.0 x 90	71.95
PDAR	Woods 0% Meadow 20% Hard Surface 80%	Good Good --	0.0B + 1.0C 0.0B + 1.0C 0.0B + 1.0C	0.0 x 55 + 1.0 x 71 0.0 x 58 + 1.0 x 71 0.0 x 84 + 1.0 x 90	86.20
581	Woods 0% Meadow 85% Hard Surface 15%	Good Good --	0.5B + 0.5C 0.4B + 0.6C 0.0B + 1.0C	0.5 x 55 + 0.5 x 71 0.4 x 58 + 0.6 x 71 0.0 x 84 + 1.0 x 90	69.43
582	Woods 15% Meadow 75% Hard Surface 10%	Good Good --	0.5B + 0.5C 0.5B + 0.5C 0.5B + 0.5C	0.5 x 55 + 0.5 x 71 0.5 x 58 + 0.5 x 71 0.5 x 84 + 0.5 x 90	66.53
100	Woods 5% Meadow 90% Hard surface 5%	Fair Good --	0.2C + 0.8B 0.2C + 0.8B 0.2C + 0.8B	0.2 x 73 + 0.8 x 60 0.2 x 71 + 0.8 x 58 0.2 x 84 + 0.8 x 90	62.1
110	Woods 15% Meadow 75% Hard surface 10%	Fair Good --	0.1C + 0.9B 0.1C + 0.9B 0.1C + 0.9B	0.1 x 73 + 0.9 x 60 0.1 x 71 + 0.9 x 58 0.1 x 84 + 0.9 x 90	61.9
120	Woods 85% Meadow 10% Hard surface 5%	Good Good --	0.9C + 0.1B 0.9C + 0.1B 0.9C + 0.1B	0.9 x 70 + 0.1 x 55 0.9 x 71 + 0.1 x 58 0.9 x 84 + 0.1 x 90	69.4
130	Woods 10% Meadow 85% Hard surface 5%	Fair Good --	0.7C + 0.3B 0.7C + 0.3B 0.7C + 0.3B	0.7 x 73 + 0.3 x 60 0.7 x 71 + 0.3 x 58 0.7 x 84 + 0.3 x 90	68.2

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1634

SCS CURVE NUMBER WEIGHTING

SUBBASINS DIVIDED FOR CONTAMINANT CALCULATIONS

Subbasin	Land Cover[a]	Hydraulic Condition	Hydrologic Soil Group[b]	Weighted SCS Number[c]	Average SCS Number
60	Woods 30%	Good	0.9B + 0.1C	0.9 x 55 + 0.1 x 71	
	Meadow 65%	Good	0.9B + 0.1C	0.9 x 58 + 0.1 x 71	59.88
	Hard surface 5%	--	0.5B + 0.5C	0.5 x 84 + 0.5 x 90	
560	Woods 25%	Good	0.7B + 0.3C	0.7 x 55 + 0.3 x 71	
	Meadow 70%	Good	0.7B + 0.3C	0.3 x 58 + 0.3 x 71	62.63
	Hard surface 5%	--	0.5B + 0.5C	0.5 x 84 + 0.5 x 90	
70	Woods 20%	Good	0.2B + 0.8C	0.2 x 55 + 0.8 x 71	
	Meadow 75%	Good	0.9B + 0.1C	0.9 x 58 + 0.1 x 71	62.39
	Hard surface 5%	--	0.5B + 0.5C	0.5 x 84 + 0.5 x 90	
WPA	Woods 5%	Good	1.0B + 0.0C	1.0 x 55 + 0.0 x 71	
	Meadow 60%	Good	0.0B + 1.0C	0.0 x 58 + 1.0 x 71	76.85
	Hard Surface 35%	--	0.0B + 1.0C	0.0 x 84 + 1.0 x 90	
570	Woods 5%	Good	0.0B + 1.0C	0.0 x 55 + 1.0 x 71	
	Meadow 65%	Good	0.0B + 1.0C	0.0 x 58 + 1.0 x 71	76.70
	Hard surface 30%	--	0.0B + 1.0C	0.0 x 84 + 1.0 x 90	
75	Woods 25%	Good	0.4B + 0.6C	0.4 x 55 + 0.6 x 71	
	Meadow 65%	Good	0.4B + 0.6C	0.4 x 58 + 0.6 x 71	
	Hard surface 10%	--	0.5B + 0.5C	0.5 x 84 + 0.5 x 90	67.62
575	Woods 50%	Good	0.3B + 0.7C	0.3 x 55 + 0.7 x 71	
	Meadow 35%	Good	0.3B + 0.7C	0.3 x 58 + 0.7 x 71	
	Hard surface 15%	--	0.3B + 0.7C	0.3 x 84 + 0.7 x 90	69.82

[a]Estimated from USGS Topographic Map, Shandon, Ohio, N3915-W8437. 5/7.5, 1981, DMA 4062 I SW-Series V852.

[b]0.4C and 0.6B means 40% is hydrologic soil group C and 60% is hydrologic soil group B. Percentages of each group were determined from soil survey maps: Soil Survey of Butler Co., Ohio, USDA 1980; Soil Survey of Hamilton Co., Ohio, USDA, 1982.

000605

SCS CURVE NUMBER WEIGHTING

[c]SCS curve number obtained from G. O. Schwab, R. K. Frevert, T. W. Edminster, and K. K. Barnes, 1981, ***Soil and Water Conservation Engineering***, John Wiley and Sons, Inc., pp. 74.

[d]Estimated from USGS Topographic Map, Shandon, Ohio, N3915-W8437. 5/7.5, 1981, DMA 4062 I SW-Series V852.

[e]0.4C and 0.6B means 40% is hydrologic soil group C and 60% is hydrologic soil group B. Percentages of each group were determined from soil survey maps: Soil Survey of Butler Co., Ohio, USDA 1980; Soil Survey of Hamilton Co., Ohio, USDA, 1982.

[f]SCS curve number obtained from G. O. Schwab, R. K. Frevert, T. W. Edminster, and K. K. Barnes, 1981, ***Soil and Water Conservation Engineering***, John Wiley and Sons, Inc., pp. 74.

000303

Appendix D

sufficiently homogenous to only require one SCS curve number per subbasin.

For every subbasin, the last column in Table 3-2 labeled "Average SCS Number" represents a weighted average of the SCS curve numbers for each land use type. That is, a weighted curve number was calculated for each land use type (woods, meadow, or hard surface) based on the hydrologic soil group. This calculation is presented in the next to last column (labeled " Weighted SCS Number") of Table 3-2. The overall curve number for the subbasin was then calculated by averaging the curve numbers for each land use type weighted by the percent of the subbasin covered by each land use as indicated in the second column (labeled "Land Cover"). The results of this second weighted average (the overall curve numbers input into the HEC-1 model) are then presented in the last column of Table 3-2.

Action: The revised Surface Water Flow and Infiltration Model Summary Report submitted will contain additional text to clarify the contents of Table 3-2.

2. <u>Section 3.4.5. Page 3-39, Paragraph 4</u>

Comment: The report concludes that the model compares favorably to measured increases in the river stage of Paddys Run and the elevation of the groundwater in response to an observed precipitation event. The report also presents a reasonable explanation for the error associated with the increase in the groundwater levels. While these statements are qualitatively correct, the quantitative comparison indicated a potential for significant error. For example, the modeled river stage of Paddys Run rose only one-half the height of what was observed. Assuming that U.S. DOE's explanation of why the modeled groundwater elevation rose only 1.65 feet is correct, the modeled rise in the river stage of Paddys Run should have been much greater than what was reported. U.S. DOE should explain why the river stage did not increase as much as it should have. In addition, U.S. DOE should collect more field data to further verify the model.

Response: This comment raises two issues with the performance of the surface water model. The first is concerned with the predicted amount of infiltration and the response of the groundwater table to the representative storm event. The second is the comparison of the predicted rise in water surface elevation and the measured rise in water surface elevation in Paddys Run. As was discussed in the response to the first general comment, the infiltration model is very conservative in its estimation of

the annual percent of contaminated runoff which infiltrates into the GMA, so that the distribution of the infiltration determined from the representative storm event is more important than the actual volume of infiltration from that storm event. The infiltration distribution is then applied to the annual infiltration and in turn the contaminant loading. In addition, the differences in the initial conditions of the modeled event and the measured event make a true quantitative comparison difficult although qualitatively the general aquifer response was similar.

It is difficult to quantitatively compare the output from the model for the representative storm to actual field data because of the differences in the initial conditions of the ground surface and the streambeds, the duration of the storm event and the variation of intensity of the rainfall with time (hyetograph), and differences in the shape of the stream cross sections where the stage measurements and calculations were made. The Surface Water Flow and Infiltration Model Summary Report qualitatively compares the results from the model of the representative storm event to a rainfall event occurring in April of 1989 (note the report incorrectly indicates that the date of the rainfall event; it should have been reported as April 28-29). The curve numbers used for the HEC-1 model of the representative storm event are based on an Antecedent Moisture Condition-II (AMC-II) which represents an average moisture content in the surface soils prior to the storm rainfall event. AMC-I condition represents a dryer than average initial soil condition and AMC-III represents a wetter than average soil condition. The AMC-II curve numbers are primarily used for design (SCS, Technical Release 55, June 1986). The SCS curve numbers presented for use in the Superfund Exposure Assessment Manual (EPA, 1988) do not specifically indicate what AMC they are for, but they do match the curve numbers given for the same land use and soil type for AMC-II conditions in the SCS's Technical Release 55 (SCS 1986). Since AMC-II is most commonly used in design and because of the curve number presented in the Superfund Exposure Assessment Manual, AMC-II Curve numbers were also used in the HEC-1 model of the representative storm event. In order to better evaluate the performance of the runoff model, actual rainfall data from the FEMP from two storm events (the April 28-29 event and another one on April 3-4 1989) and SCS curve numbers that represent actual soil conditions during an abnormally wet season were input into the HEC-1 model. The input and results for these modeled conditions are discussed below.

The rainfall in the spring of 1989 was above average (DOE, 1993 Groundwater Modeling Report Summary of Model Development) indicating that the ground surface could have been saturated prior

000609

to the storm event which would cause a larger amount of runoff (and deeper depth in Paddys Run) than if the ground surface is unsaturated. If the ground surface is saturated prior to the storm event, a greater percentage of the rainfall will become runoff (than if the ground is unsaturated) since the ground surface does not have unsaturated pore spaces available to capture the rainfall. Storm water runoff is the only major source of flow in Paddys Run since flow from groundwater would only represent a small portion of the total flow during a fairly large storm event. The total amount of precipitation as measured at the Greater Cincinnati Airport by the National Weather Service (NWS) was 5.19 inches during April 1989. The average monthly rainfall of April for the years 1958 through 1992 also at the Greater Cincinnati Airport is 3.53 inches. The rain gauge information at the FEMP reported 6.09 inches of rainfall in the month of April 1989 before it stopped recording during the rainfall event on April 28. If the site rainfall data is supplemented with rainfall data from the Greater Cincinnati Airport to replace the missing data, a total of 7.48 inches of rain would have fallen on the FEMP in April 1989.

Storm events occurring on April 3-4 and 28-29, 1989 were simulated with the surface water model. Hourly precipitation data from the FEMP supplemented with data from the Greater Cincinnati Airport was input into the HEC-1 model with the curve number modified to represent an AMC-III initial moisture condition. The FEMP precipitation data was supplemented with data from the Greater Cincinnati Airport to replace several missing data points from the FEMP rain gauge. This data was used because it was the best information available for the missing data points in question. The SCS National Engineering Handbook, Section 4, Hydrology (NEH-4 [SCS 1985]) recommends that if more than 1.1 inches of precipitation falls during the five days before the storm event being modeled that a AMC-III should be used. Approximately, 1.3 inches of rain fell in the five days prior to the storm event on April 28-29, 1989. Since this was in the range for AMC-III recommended in NEH-4 an AMC-III was used to simulate this storm. An AMC-III was also used for the simulation of the April 3-4 storm since this storm occurred four days after a storm event on March 31, 1989 which caused the Storm Water Retention Basin to overflow. The site precipitation data was not readily available for the March 31 storm, but it is valid to assume that such a event would create AMC-III soil conditions for the April 3-4 event.

A comparison of the modeled and measured rise in flow depth of Paddys run is presented in the attached Table 1. The measured rise in water surface elevation was measured at two location along

Paddys Run in April of 1989; stilling well 9 (near cross section location C-C) and stilling well 14 (near cross section location E-E). The measured and modeled rises in stream elevation for the April 3-4 storm were within three percent of each other at both measuring locations on Paddys Run. The modeled rise in stream depth for the April 28-29 storm did not match as well although the differences between the modeled and the measured elevation rises are less than 10 inches. The second storm event may not match as well because the site rainfall data for this event had to be supplemented with rainfall data from the Greater Cincinnati Airport approximately 17 miles to the south. Based on the simulated actual storm events, it is determined that the surface water model is predicting the water surface elevations with acceptable accuracy so that additional field data is not required to verify the model.

Changing parameters in the HEC-1 model of the representative storm event to match the changes in the simulation of actual storm events discussed above (curve numbers based on AMC-III) is not necessary for the following reasons. An average Antecedent Moisture Condition (AMC-II) is usually used for designs and match values given in U.S. EPA documents. As was discussed in the response to the general comment, the representative storm event runoff is used to estimate the annual runoff. Using an AMC-II (average moisture condition) for the representative storm event would provide more realistic results to base the annual calculations on. An AMC-III initial moisture content will tend to increase the overall discharge from the basin, however, the amount of contaminant released in the dissolved phase is directly proportional to the amount of runoff from a subbasin so that the concentration should not change. The predicted mass of contaminant loaded to the GMA could increase for the simulated representative storm event. The single representative storm event will not have a significant effect on the annual loading to the GMA since the representative storm event only accounts for 6% of the annual runoff. The annual runoff is based on average moisture conditions since it is used to represent all of the different storms that occur during the year. In addition, the surface water model already is conservatively overestimating the annual loadings to the GMA. Modeled simulations performed for the Draft Remedial Investigation Report for Operable Unit 5 submitted for internal review at the U.S. Department of Energy (U.S. DOE) illustrated the conservativeness of the predicted loadings to the GMA. The surface water model was set up to predict the total amount of uranium-238 released to the GMA through the streambeds of Paddys Run and the SSOD. The predicted amount ranged from 6200 kg to 12300 kg. Out of the total estimated mass of 4800 kg of uranium within the plume of significant concentration in the GMA, 1860 kgs are

000611

located along the SSOD and Paddys Run south of the SSOD in the GMA. The 1860 kg of uranium is believed to originate primarily from the surface water loading.

Action: Actual storm rainfall was put into the HEC-1 model to compare the modeled rise in stream depth to the measured rise in stream depth. As was discussed in the Response to this comment, the model compared well with the measured data so that the collection of additional field data is not necessary. The comparison between the model output and measured data will be included in the revised Surface Water Flow and Infiltration Model Summary Report.

3. Section 3.4.5, Page 3-41, Paragraph 1.

Comment: U.S. DOE attempted to validate the model by conducting two types of volume calculations. The results of the two methods differed significantly but U.S. DOE stated that because the results of the two methods are within one order of magnitude, the results are therefore reasonable. An order of magnitude estimation of surface water infiltration does not appear to be accurate. Because the amount of water infiltrating into the GMA will affect the mass of contaminants entering the GMA and ultimately the concentration of contaminants in the GMA, U.S. DOE should provide additional documentation on the accuracy of its infiltration estimate.

Response: The response to the general comment discusses the relative importance of the predicted infiltration volume resulting from the representative storm event. Because of the conservative assumptions used in the method of predicting the contaminant loading (96 percent of the annual dissolved contaminant released is predicted to reach the GMA) the distribution of the infiltration amount along Paddys Run and the SSOD is more important than the actual infiltration volume.

The Surface Water Flow and Infiltration Model (SWF&IM) Summary Report in actuality only attempted to estimate the volume of infiltration with the VS2DT model. The other method discussed in the report (described as the verification infiltration volume calculation in the SWF&IM report) which simply involved the calculation of the unsaturated pore space beneath the streambed was only intended to be used as a general reference to check the range of the infiltration volume predicted with VS2DT. It was understood that the calculation of the unsaturated pore space beneath the streambed would yield results that are lower than actual infiltration volumes because it did not account for lateral movement of water in the unsaturated zone away from the streambed and it did not account for

000613

TABLE 1

COMPARISON OF MODELED AND MEASURED INCREASE OF PADDYS RUN FLOW DEPTHS

Date of Storm Event	Precipitation Amount IN.[a]	Cross Section C-C		Cross Section E-E	
		Measured Rise in Stream Depth (Stilling Well 9)[b] FT.	Modeled Rise in Stream Depth (STA70)[c] FT.	Measured Rise in Stream Depth (Stilling Well 14)[b] FT.	Modeled Rise in Stream Depth (STAEE)[c] FT.
April 3-4, 1989	1.92	4.06	3.99	5.51	5.35
April 28-29,1989	1.96	2.39	3.13	4.98	4.17

(a) Precipitation amounts from raingauge at the FEMP, except portion of April 28-29 storm which is supplemented with data from the Greater Cincinnati Airport due to missing data from the FEMP raingauge.

(b) Stream depth rise taken from data presented in Groundwater Report, Feed Materials Production Center, U.S. DOE December, 1990.

(c) Stream depth calculated from Paddys Run flow rate predicted with HEC-1 and Mannings equation.

Appendix E

```
ID          Paddy's Run Simulation (06-26-1997/wyu)

ID          1-year return period storm.
*DIAGRAM

IT     10 01JAN97    1200     300
IO      3       0
*
KK SUB10
KM  RUNOFF FROM SUBBASIN 10
KO      1
BA 1.869
PH                  0.333   0.625   1.100   1.400   1.480   1.800     2.1     2.5
LS           65.4
UK  150.     0.07     0.4     100
RK   500     0.07   0.045    0.06    TRAP       0       1
RK  3200     0.05   0.045    0.47    TRAP       0       1      NO
RK 5200.    0.015   0.045            TRAP       0       1
*
KK SUB20

KM RUNOFF FROM SUBBASIN 20
BA 1.589
LS           63.7
UK   200    0.075     0.4     100
RK  4500    0.065   0.045   0.132    TRAP       0       1
RK 4800.    0.015   0.045            TRAP               1     YES
*
KK SUB30
KM RUNOFF FROM SUBBASIN 30 40 AND 41
BA 5.188
LS             63
UK   200     0.08     0.4     100
RK  3600     0.05   0.045    0.18    TRAP       0       1
RK  6000    0.007   0.045   1.297    TRAP       0       1
RK 10800    0.003   0.045            TRAP      20       1     YES
*
KK SUB50
KO             0               1      21
KF   YES(f12.4)
BA 1.288
LS             66
UK   200     0.04     0.4     100
RD  5000     0.02   0.045   0.322    TRAP       0       1
RD                                                            YES
RC 0.045    0.035   0.045    2800   0.002
RX   129      140   141.1   144.1   168.1     190   194.1   196.2
RY566.08   563.07     560  559.03  559.03  561.17  562.12  564.07
*
KKROUT60
KM ROUTE FROM CROSS SECTION A-A TO B-B
KO             0               1      21
RD                                                            YES
RC 0.045    0.035   0.045  1599.8   0.004
RX    77       83      86    86.5   120.1     123     126   130.1
RY562.16   559.17     555  551.98  551.98  554.16     555     560
*
KK SUB60
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC B-B
KO             0               1      21
BA 0.282
LS           59.9
UK   200     0.08     0.4     100
RD  4500     0.04    0.03            TRAP       0       1      NO
*
KK SB560
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC B-B
KM ENCOMPASSES NPDES OUTFALL STRM 4
KO      1       0               1      21
BA 0.317
LS           62.6
UK   200     0.10     0.4     100
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RD  4800    0.01    0.04            TRAP       0       1      NO
*
KK  ST60
KM COMBINE RUNOFF FROM SUB60,SB560, AND UPSTREAM
KO     1       0                1      21
HC     3
*
KK ROUTO
KM ROUTE FROM CROSS SECTION B-B TO C-C
KO     1       0                1      21
RD                                                              YES
RC 0.045   0.025   0.045    2986   0.004
RX  11.3    53.7      85    95.9   119.8   168.8   179.7   194.6
RY   551     551     550     540     540     545     550     555
*
KK SUB70
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC C-C
KO             0                1      21
BA 0.121
LS          62.4
UK   200   0.010     0.4     100
RD  4600   0.013   0.045            TRAP       0       1
*
KK SB570
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC C-C
KM ENCOMPASSES NPDES OUTFALL STRM 3
KO     1       0                1      21
BA 0.120
LS          76.7
UK   200   0.017    0.25     100
RD  1800   0.017   0.030            TRAP       0       1
*
KK  ST70
KM COMBINE RUNOFF FROM 7OCT,SUB70 AND UPSTREAM FLOW
KO     1       0                1      21
HC     3
*
KK ROUT1
KM ROUTE FROM CROSS SECTION C-C TO D-D
KO     1       0                1      21
RD                                                              YES
RC 0.045   0.025   0.045    3093   0.003
RX   100   109.2    125.   134.2   151.1     163   195.9     200
RY541.07    540.   532.1   531.3   531.3     535     565   566.4
*
KK SUB75
KM SUBBASIN FLOW FROM THE WEST SIDE OF PADDYS RUN TO X-SEC D-D
KO             0                1      21
BA 0.288
LS          67.6
UK   150    0.15    0.40     100
RD  4000   0.013   0.045            TRAP       5       1
*
KK SB575
KM SUBBASIN FLOW FROM THE EAST SIDE OF PADDYS RUN
KM AREA ENCOMPASSES NPDES OUTFALL STRM 2
KO     1       0                1      21
BA 0.120
LS          69.8
UK   100   0.030    0.40     100
RD   650   0.067   0.045            TRAP       0       1
*
KK  ST75
KM COMBINE RUNOFF FROM TB75 AND UPSTREAM
KO     1       0                1      21
HC     3
*
KK ROUT2
KM  ROUTE FROM CROSS SECTION D-D TO E-E
KO     1       0                1      21
RD                                                              YES
RC 0.045   0.025   0.045    2773   0.002
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RX      0    82.3      93   102.9     129     150     200   237.8
RY    533     532   531.2     525     525     530     535     536
*
KK SB580
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH FROM THE RETENTION BASIN TO
KM CROSS SECTION J-J
KO      1       0                 1      21
BA 0.036
LS           71.9
UK    100   0.010    0.25     100
RD    500   0.100    0.04   0.020    TRAP       0       1
RD    600   0.010   0.035            TRAP       5       1
*
KK SB581
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH ABOVE THE RETENTION BASIN
KO      1       0                 1      21
BA 0.456
LS           69.4
UK    200   0.025    0.25     100
RD   1000   0.020    0.04   0.080    TRAP       0       1
RD   3300   0.012   0.030            TRAP       5       1
*
KK  STJJ
KM COMBINE RUNOFF FROM PRODUCTION AREA AND SB581
KO      1       0                 1      21
HC      2
*
KK ROT80
KM  ROUTE FROM RET. BASIN TO OUTFALL OF SSOD XSEC J-J TO K-K
KO      1       0                 1      21
RD                                                          YES
RC 0.035   0.035   0.035    1300   0.009
RX  360.    370.    372.    378.    380.    390.    395.    420.
RY 544.4   539.4   539.4   539.4   539.4   539.4   539.4   544.4
*
KK SB582
KM RUNOFF FROM SB582 (LOWER STORM SEWER OUTFALL DITCH)
KO      1       0                 1      21
BA 0.487
LS           66.5
UK    200   0.025     0.3     100
RD   3600   0.022   0.045    0.33    TRAP       5       1
RD   3800   0.015   0.025            TRAP      26    2.27
*
KK  ST80
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND SB582
KM THIS POINT COORISPONDS TO NPDES OUTFALL STRM 1
KO      1       0                 1      21
HC      2
*
KK  STEE
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND PADDY'S RUN
KO      1       0                 1      21
HC      2
*
KKROUT25
KM ROUTE FROM CROSS SECTION E-E TO F-F
KO              0                 1      21
RD   2613   0.002   0.025            TRAP    52.8    4.55     YES
*
KKSUB130
KM RUNOFF FROM SUBBASIN 130
KO              0                 1      21
BA 1.385
LS           68.2
UK    200   0.033     0.4     100
RD   5000   0.016   0.045   0.588    TRAP       5       1
RD   1800    0.02   0.025            TRAP    52.8    4.55
*
KK ST130
KM  COMBINE RUNOFF FROM FROM SUB130 TO PADDY'S RUN.
KO      1       0                 1      21
```

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HC      2
*
KKSUB100
KM RUNOFF FROM SUB100 AND ROUTE FROM CROSS SECTION F-F TO G-G
KO              0                1      21
BA 0.510
LS          62.1                    62.11
UK   180     0.1     0.4      30
UK   250   0.018     0.3      70
RD  4000    0.01   0.045   0.412    TRAP       5       1
RD  2773  0.0003   0.025            TRAP    27.2   26.32     YES
*
KK ROUT3
KM ROUTE FROM CROSS SECTION G-G TO H-H
RD  3626  0.0025   0.025            TRAP    63.6    7.30     YES
*
KKSUB110
KMRUNOFF FROM SUB110
BA 0.823
LS          61.9                       69
UK   200     0.2     0.4      50
UK   150    0.03     0.3      50
RD   500    0.04   0.045    0.21    TRAP       0       1
RD 10000   0.009   0.025            TRAP      20    3.33
*
KKSUB120
KM RUNOFF FROM SUB120
BA 0.561
LS          69.4
UK   100    0.28     0.4     100
RD   500     0.2   0.045    0.15    TRAP       0       1
RD  8000   0.021   0.045            TRAP      20    3.33
*
KK ST120
KM COMBINE RUNOFF FROM SUB110 AND SUB220 TO PADDY'S RUN
KO              0                1      21
HC      3
ZZ
```

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ID         Paddy's Run Simulation (06-26-1997/wyu)

ID         5-year return period storm.
*DIAGRAM

IT    10 01JAN97    1200     300
IO     3       0
*
KK SUB10
KM  RUNOFF FROM SUBBASIN 10
KO     1
BA 1.869
PH                  0.500   1.000   1.500   1.900   2.100   2.400     3.0     3.6
LS          65.4
UK  150.    0.07     0.4     100
RK   500    0.07   0.045    0.06    TRAP       0       1
RK  3200    0.05   0.045    0.47    TRAP       0       1      NO
RK 5200.   0.015   0.045            TRAP       0       1
*
KK SUB20

KM RUNOFF FROM SUBBASIN 20
BA 1.589
LS          63.7
UK   200   0.075     0.4     100
RK  4500   0.065   0.045   0.132    TRAP       0       1
RK 4800.   0.015   0.045            TRAP               1     YES
*
KK SUB30
KM RUNOFF FROM SUBBASIN 30 40 AND 41
BA 5.188
LS            63
UK   200    0.08     0.4     100
RK  3600    0.05   0.045    0.18    TRAP       0       1
RK  6000   0.007   0.045   1.297    TRAP       0       1
RK 10800   0.003   0.045            TRAP      20       1     YES
*
KK SUB50
KO             0                1      21
KF   YES(f12.4)
BA 1.288
LS            66
UK   200    0.04     0.4     100
RD  5000    0.02   0.045   0.322    TRAP       0       1
RD                                                          YES
RC 0.045   0.035   0.045    2800   0.002
RX   129     140   141.1   144.1   168.1     190   194.1   196.2
RY566.08  563.07     560  559.03  559.03  561.17  562.12  564.07
*
KKROUT60
KM ROUTE FROM CROSS SECTION A-A TO B-B
KO             0                1      21
RD                                                          YES
RC 0.045   0.035   0.045  1599.8   0.004
RX    77      83      86    86.5   120.1     123     126   130.1
RY562.16  559.17     555  551.98  551.98  554.16     555     560
*
KK SUB60
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC B-B
KO             0                1      21
BA 0.282
LS          59.9
UK   200    0.08     0.4     100
RD  4500    0.04    0.03            TRAP       0       1      NO
*
KK SB560
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC B-B
KM ENCOMPASSES NPDES OUTFALL STRM 4
KO     1       0                1      21
BA 0.317
LS          62.6
UK   200    0.10     0.4     100
```

```
RD  4800    0.01    0.04            TRAP       0       1      NO
*
KK  ST60
KM COMBINE RUNOFF FROM SUB60,SB560, AND UPSTREAM
KO     1       0               1      21
HC     3
*
KK ROUT0
KM ROUTE FROM CROSS SECTION B-B TO C-C
KO     1       0               1      21
RD                                                             YES
RC 0.045   0.025   0.045    2986   0.004
RX  11.3    53.7      85    95.9   119.8   168.8   179.7   194.6
RY   551     551     550     540     540     545     550     555
*
KK SUB70
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC C-C
KO             0               1      21
BA 0.121
LS          62.4
UK   200   0.010     0.4     100
RD  4600   0.013   0.045            TRAP       0       1
*
KK SB570
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC C-C
KM ENCOMPASSES NPDES OUTFALL STRM 3
KO     1       0               1      21
BA 0.120
LS          76.7
UK   200   0.017    0.25     100
RD  1800   0.017   0.030            TRAP       0       1
*
KK  ST70
KM COMBINE RUNOFF FROM 7OCT,SUB70 AND UPSTREAM FLOW
KO     1       0               1      21
HC     3
*
KK ROUT1
KM ROUTE FROM CROSS SECTION C-C TO D-D
KO     1       0               1      21
RD                                                             YES
RC 0.045   0.025   0.045    3093   0.003
RX   100   109.2    125.   134.2   151.1     163   195.9     200
RY541.07    540.   532.1   531.3   531.3     535     565   566.4
*
KK SUB75
KM SUBBASIN FLOW FROM THE WEST SIDE OF PADDYS RUN TO X-SEC D-D
KO             0               1      21
BA 0.288
LS          67.6
UK   150    0.15    0.40     100
RD  4000   0.013   0.045            TRAP       5       1
*
KK SB575
KM SUBBASIN FLOW FROM THE EAST SIDE OF PADDYS RUN
KM AREA ENCOMPASSES NPDES OUTFALL STRM 2
KO     1       0               1      21
BA 0.120
LS          69.8
UK   100   0.030    0.40     100
RD   650   0.067   0.045            TRAP       0       1
*
KK  ST75
KM COMBINE RUNOFF FROM TB75 AND UPSTREAM
KO     1       0               1      21
HC     3
*
KK ROUT2
KM  ROUTE FROM CROSS SECTION D-D TO E-E
KO     1       0               1      21
RD                                                             YES
RC 0.045   0.025   0.045    2773   0.002
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```
RX      0    82.3      93   102.9     129     150     200   237.8
RY    533     532   531.2     525     525     530     535     536
*
KK SB580
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH FROM THE RETENTION BASIN TO
KM CROSS SECTION J-J
KO      1       0                 1      21
BA 0.036
LS           71.9
UK    100   0.010    0.25     100
RD    500   0.100    0.04   0.020    TRAP       0       1
RD    600   0.010   0.035            TRAP       5       1
*
KK SB581
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH ABOVE THE RETENTION BASIN
KO      1       0                 1      21
BA 0.456
LS           69.4
UK    200   0.025    0.25     100
RD   1000   0.020    0.04   0.080    TRAP       0       1
RD   3300   0.012   0.030            TRAP       5       1
*
KK  STJJ
KM COMBINE RUNOFF FROM PRODUCTION AREA AND SB581
KO      1       0                 1      21
HC      2
*
KK ROT80
KM  ROUTE FROM RET. BASIN TO OUTFALL OF SSOD XSEC J-J TO K-K
KO      1       0                 1      21
RD                                                              YES
RC 0.035   0.035   0.035    1300   0.009
RX  360.    370.    372.    378.    380.    390.    395.    420.
RY 544.4   539.4   539.4   539.4   539.4   539.4   539.4   544.4
*
KK SB582
KM RUNOFF FROM SB582 (LOWER STORM SEWER OUTFALL DITCH)
KO      1       0                 1      21
BA 0.487
LS           66.5
UK    200   0.025     0.3     100
RD   3600   0.022   0.045    0.33    TRAP       5       1
RD   3800   0.015   0.025            TRAP      26    2.27
*
KK  ST80
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND SB582
KM THIS POINT COORISPONDS TO NPDES OUTFALL STRM 1
KO      1       0                 1      21
HC      2
*
KK  STEE
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND PADDY'S RUN
KO      1       0                 1      21
HC      2
*
KKROUT25
KM ROUTE FROM CROSS SECTION E-E TO F-F
KO              0                 1      21
RD   2613   0.002   0.025            TRAP    52.8    4.55     YES
*
KKSUB130
KM RUNOFF FROM SUBBASIN 130
KO              0                 1      21
BA 1.385
LS           68.2
UK    200   0.033     0.4     100
RD   5000   0.016   0.045   0.588    TRAP       5       1
RD   1800    0.02   0.025            TRAP    52.8    4.55
*
KK ST130
KM  COMBINE RUNOFF FROM FROM SUB130 TO PADDY'S RUN.
KO      1       0                 1      21
```

```
HC      2
*
KKSUB100
KM RUNOFF FROM SUB100 AND ROUTE FROM CROSS SECTION F-F TO G-G
KO              0                1      21
BA 0.510
LS          62.1                    62.11
UK   180     0.1     0.4      30
UK   250   0.018     0.3      70
RD  4000    0.01   0.045   0.412    TRAP       5       1
RD  2773  0.0003   0.025            TRAP    27.2   26.32     YES
*
KK ROUT3
KM ROUTE FROM CROSS SECTION G-G TO H-H
RD  3626  0.0025   0.025            TRAP    63.6    7.30     YES
*
KKSUB110
KMRUNOFF FROM SUB110
BA 0.823
LS          61.9                      69
UK   200     0.2     0.4      50
UK   150    0.03     0.3      50
RD   500    0.04   0.045    0.21    TRAP       0       1
RD 10000   0.009   0.025            TRAP      20    3.33
*
KKSUB120
KM RUNOFF FROM SUB120
BA 0.561
LS          69.4
UK   100    0.28     0.4     100
RD   500     0.2   0.045    0.15    TRAP       0       1
RD  8000   0.021   0.045            TRAP      20    3.33
*
KK ST120
KM COMBINE RUNOFF FROM SUB110 AND SUB220 TO PADDY'S RUN
KO              0                1      21
HC      3
ZZ
```

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ID          Paddy's Run Simulation (06-26-1997/wyu)

ID          10-year return period storm.
*DIAGRAM

IT     10 01JAN97    1200     300
IO      3       0
*
KK SUB10
KM  RUNOFF FROM SUBBASIN 10
KO      1
BA 1.869
PH                  0.540   1.125   1.900   2.200   2.400   2.900    3.36     4.1
LS           65.4
UK  150.     0.07     0.4     100
RK   500     0.07   0.045    0.06    TRAP       0       1
RK  3200     0.05   0.045    0.47    TRAP       0       1      NO
RK 5200.    0.015   0.045            TRAP       0       1
*
KK SUB20

KM RUNOFF FROM SUBBASIN 20
BA 1.589
LS           63.7
UK   200    0.075     0.4     100
RK  4500    0.065   0.045   0.132    TRAP       0       1
RK 4800.    0.015   0.045            TRAP               1     YES
*
KK SUB30
KM RUNOFF FROM SUBBASIN 30 40 AND 41
BA 5.188
LS             63
UK   200     0.08     0.4     100
RK  3600     0.05   0.045    0.18    TRAP       0       1
RK  6000    0.007   0.045   1.297    TRAP       0       1
RK 10800    0.003   0.045            TRAP      20       1     YES
*
KK SUB50
KO             0                1      21
KF   YES(f12.4)
BA 1.288
LS             66
UK   200     0.04     0.4     100
RD  5000     0.02   0.045   0.322    TRAP       0       1
RD                                                          YES
RC 0.045    0.035   0.045    2800   0.002
RX   129      140   141.1   144.1   168.1     190   194.1   196.2
RY566.08  563.07     560  559.03  559.03  561.17  562.12  564.07
*
KKROUT60
KM ROUTE FROM CROSS SECTION A-A TO B-B
KO             0                1      21
RD                                                          YES
RC 0.045    0.035   0.045  1599.8   0.004
RX    77       83      86    86.5   120.1     123     126   130.1
RY562.16  559.17     555  551.98  551.98  554.16     555     560
*
KK SUB60
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC B-B
KO             0                1      21
BA 0.282
LS           59.9
UK   200     0.08     0.4     100
RD  4500     0.04    0.03            TRAP       0       1      NO
*
KK SB560
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC B-B
KM ENCOMPASSES NPDES OUTFALL STRM 4
KO      1       0                1      21
BA 0.317
LS           62.6
UK   200     0.10     0.4     100
```

```
RD  4800    0.01    0.04            TRAP       0       1      NO
*
KK  ST60
KM COMBINE RUNOFF FROM SUB60,SB560, AND UPSTREAM
KO     1       0                1      21
HC     3
*
KK ROUT0
KM ROUTE FROM CROSS SECTION B-B TO C-C
KO     1       0                1      21
RD                                                              YES
RC 0.045   0.025   0.045    2986   0.004
RX  11.3    53.7      85    95.9   119.8   168.8   179.7   194.6
RY   551     551     550     540     540     545     550     555
*
KK SUB70
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC C-C
KO             0                1      21
BA 0.121
LS          62.4
UK   200   0.010     0.4     100
RD  4600   0.013   0.045            TRAP       0       1
*
KK SB570
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC C-C
KM ENCOMPASSES NPDES OUTFALL STRM 3
KO     1       0                1      21
BA 0.120
LS          76.7
UK   200   0.017    0.25     100
RD  1800   0.017   0.030            TRAP       0       1
*
KK  ST70
KM COMBINE RUNOFF FROM 70CT,SUB70 AND UPSTREAM FLOW
KO     1       0                1      21
HC     3
*
KK ROUT1
KM ROUTE FROM CROSS SECTION C-C TO D-D
KO     1       0                1      21
RD                                                              YES
RC 0.045   0.025   0.045    3093   0.003
RX   100   109.2    125.   134.2   151.1     163   195.9     200
RY541.07    540.   532.1   531.3   531.3     535     565   566.4
*
KK SUB75
KM SUBBASIN FLOW FROM THE WEST SIDE OF PADDYS RUN TO X-SEC D-D
KO             0                1      21
BA 0.288
LS          67.6
UK   150    0.15    0.40     100
RD  4000   0.013   0.045            TRAP       5       1
*
KK SB575
KM SUBBASIN FLOW FROM THE EAST SIDE OF PADDYS RUN
KM AREA ENCOMPASSES NPDES OUTFALL STRM 2
KO     1       0                1      21
BA 0.120
LS          69.8
UK   100   0.030    0.40     100
RD   650   0.067   0.045            TRAP       0       1
*
KK  ST75
KM COMBINE RUNOFF FROM TB75 AND UPSTREAM
KO     1       0                1      21
HC     3
*
KK ROUT2
KM  ROUTE FROM CROSS SECTION D-D TO E-E
KO     1       0                1      21
RD                                                              YES
RC 0.045   0.025   0.045    2773   0.002
```

```
RX      0    82.3      93   102.9     129     150     200   237.8
RY    533     532   531.2     525     525     530     535     536
*
KK SB580
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH FROM THE RETENTION BASIN TO
KM CROSS SECTION J-J
KO      1       0               1      21
BA 0.036
LS           71.9
UK    100   0.010    0.25     100
RD    500   0.100    0.04   0.020    TRAP       0       1
RD    600   0.010   0.035           TRAP       5       1
*
KK SB581
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH ABOVE THE RETENTION BASIN
KO      1       0               1      21
BA 0.456
LS           69.4
UK    200   0.025    0.25     100
RD   1000   0.020    0.04   0.080    TRAP       0       1
RD   3300   0.012   0.030           TRAP       5       1
*
KK  STJJ
KM COMBINE RUNOFF FROM PRODUCTION AREA AND SB581
KO      1       0               1      21
HC      2
*
KK ROT80
KM  ROUTE FROM RET. BASIN TO OUTFALL OF SSOD XSEC J-J TO K-K
KO      1       0               1      21
RD                                                            YES
RC 0.035   0.035   0.035    1300   0.009
RX  360.    370.    372.    378.    380.    390.    395.    420.
RY 544.4   539.4   539.4   539.4   539.4   539.4   539.4   544.4
*
KK SB582
KM RUNOFF FROM SB582 (LOWER STORM SEWER OUTFALL DITCH)
KO      1       0               1      21
BA 0.487
LS           66.5
UK    200   0.025     0.3     100
RD   3600   0.022   0.045    0.33    TRAP       5       1
RD   3800   0.015   0.025           TRAP      26    2.27
*
KK  ST80
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND SB582
KM THIS POINT COORISPONDS TO NPDES OUTFALL STRM 1
KO      1       0               1      21
HC      2
*
KK  STEE
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND PADDY'S RUN
KO      1       0               1      21
HC      2
*
KKROUT25
KM ROUTE FROM CROSS SECTION E-E TO F-F
KO              0               1      21
RD   2613   0.002   0.025           TRAP    52.8    4.55     YES
*
KKSUB130
KM RUNOFF FROM SUBBASIN 130
KO              0               1      21
BA 1.385
LS           68.2
UK    200   0.033     0.4     100
RD   5000   0.016   0.045   0.588    TRAP       5       1
RD   1800    0.02   0.025           TRAP    52.8    4.55
*
KK ST130
KM  COMBINE RUNOFF FROM FROM SUB130 TO PADDY'S RUN.
KO      1       0               1      21
```

```
HC      2
*
KKSUB100
KM RUNOFF FROM SUB100 AND ROUTE FROM CROSS SECTION F-F TO G-G
KO              0                1      21
BA 0.510
LS          62.1                    62.11
UK   180     0.1     0.4      30
UK   250   0.018     0.3      70
RD  4000    0.01   0.045   0.412    TRAP       5       1
RD  2773  0.0003   0.025            TRAP    27.2   26.32     YES
*
KK ROUT3
KM ROUTE FROM CROSS SECTION G-G TO H-H
RD  3626  0.0025   0.025            TRAP    63.6    7.30     YES
*
KKSUB110
KMRUNOFF FROM SUB110
BA 0.823
LS          61.9                      69
UK   200     0.2     0.4      50
UK   150    0.03     0.3      50
RD   500    0.04   0.045    0.21    TRAP       0       1
RD 10000   0.009   0.025            TRAP      20    3.33
*
KKSUB120
KM RUNOFF FROM SUB120
BA 0.561
LS          69.4
UK   100    0.28     0.4     100
RD   500     0.2   0.045    0.15    TRAP       0       1
RD  8000   0.021   0.045            TRAP      20    3.33
*
KK ST120
KM COMBINE RUNOFF FROM SUB110 AND SUB220 TO PADDY'S RUN
KO              0                1      21
HC      3
ZZ
```

```
ID          Paddy's Run Simulation (06-26-1997/wyu)

ID          25-year return period storm.
*DIAGRAM

IT     10 01JAN97    1200     300
IO      3       0
*
KK SUB10
KM  RUNOFF FROM SUBBASIN 10
KO      1
BA 1.869
PH                  0.625   1.250   2.220   2.700   3.000   3.500    4.10     4.8
LS          65.4
UK  150.    0.07     0.4     100
RK   500    0.07   0.045    0.06    TRAP       0       1
RK  3200    0.05   0.045    0.47    TRAP       0       1      NO
RK 5200.   0.015   0.045            TRAP       0       1
*
KK SUB20

KM RUNOFF FROM SUBBASIN 20
BA 1.589
LS          63.7
UK   200   0.075     0.4     100
RK  4500   0.065   0.045   0.132    TRAP       0       1
RK 4800.   0.015   0.045            TRAP               1     YES
*
KK SUB30
KM RUNOFF FROM SUBBASIN 30 40 AND 41
BA 5.188
LS            63
UK   200    0.08     0.4     100
RK  3600    0.05   0.045    0.18    TRAP       0       1
RK  6000   0.007   0.045   1.297    TRAP       0       1
RK 10800   0.003   0.045            TRAP      20       1     YES
*
KK SUB50
KO             0               1      21
KF   YES(f12.4)
BA 1.288
LS            66
UK   200    0.04     0.4     100
RD  5000    0.02   0.045   0.322    TRAP       0       1
RD                                                          YES
RC 0.045   0.035   0.045    2800   0.002
RX   129     140   141.1   144.1   168.1     190   194.1   196.2
RY566.08  563.07     560  559.03  559.03  561.17  562.12  564.07
*
KKROUT60
KM ROUTE FROM CROSS SECTION A-A TO B-B
KO             0               1      21
RD                                                          YES
RC 0.045   0.035   0.045  1599.8   0.004
RX    77      83      86    86.5   120.1     123     126   130.1
RY562.16  559.17     555  551.98  551.98  554.16     555     560
*
KK SUB60
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC B-B
KO             0               1      21
BA 0.282
LS          59.9
UK   200    0.08     0.4     100
RD  4500    0.04    0.03            TRAP       0       1      NO
*
KK SB560
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC B-B
KM ENCOMPASSES NPDES OUTFALL STRM 4
KO      1       0               1      21
BA 0.317
LS          62.6
UK   200    0.10     0.4     100
```

```
RD  4800    0.01    0.04            TRAP       0       1      NO
*
KK  ST60
KM COMBINE RUNOFF FROM SUB60,SB560, AND UPSTREAM
KO     1       0               1      21
HC     3
*
KK ROUT0
KM ROUTE FROM CROSS SECTION B-B TO C-C
KO     1       0               1      21
RD                                                            YES
RC 0.045   0.025   0.045    2986   0.004
RX  11.3    53.7      85    95.9   119.8   168.8   179.7   194.6
RY   551     551     550     540     540     545     550     555
*
KK SUB70
KM SUBBASIN FLOW FROM WEST SIDE OF PADDYS RUN TO X-SEC C-C
KO             0               1      21
BA 0.121
LS          62.4
UK   200   0.010     0.4     100
RD  4600   0.013   0.045            TRAP       0       1
*
KK SB570
KM SUBBASIN FLOW FROM EAST SIDE OF PADDYS RUN TO X-SEC C-C
KM ENCOMPASSES NPDES OUTFALL STRM 3
KO     1       0               1      21
BA 0.120
LS          76.7
UK   200   0.017    0.25     100
RD  1800   0.017   0.030            TRAP       0       1
*
KK  ST70
KM COMBINE RUNOFF FROM 70CT,SUB70 AND UPSTREAM FLOW
KO     1       0               1      21
HC     3
*
KK ROUT1
KM ROUTE FROM CROSS SECTION C-C TO D-D
KO     1       0               1      21
RD                                                            YES
RC 0.045   0.025   0.045    3093   0.003
RX   100   109.2    125.   134.2   151.1     163   195.9     200
RY541.07    540.   532.1   531.3   531.3     535     565   566.4
*
KK SUB75
KM SUBBASIN FLOW FROM THE WEST SIDE OF PADDYS RUN TO X-SEC D-D
KO             0               1      21
BA 0.288
LS          67.6
UK   150    0.15    0.40     100
RD  4000   0.013   0.045            TRAP       5       1
*
KK SB575
KM SUBBASIN FLOW FROM THE EAST SIDE OF PADDYS RUN
KM AREA ENCOMPASSES NPDES OUTFALL STRM 2
KO     1       0               1      21
BA 0.120
LS          69.8
UK   100   0.030    0.40     100
RD   650   0.067   0.045            TRAP       0       1
*
KK  ST75
KM COMBINE RUNOFF FROM TB75 AND UPSTREAM
KO     1       0               1      21
HC     3
*
KK ROUT2
KM  ROUTE FROM CROSS SECTION D-D TO E-E
KO     1       0               1      21
RD                                                            YES
RC 0.045   0.025   0.045    2773   0.002
```

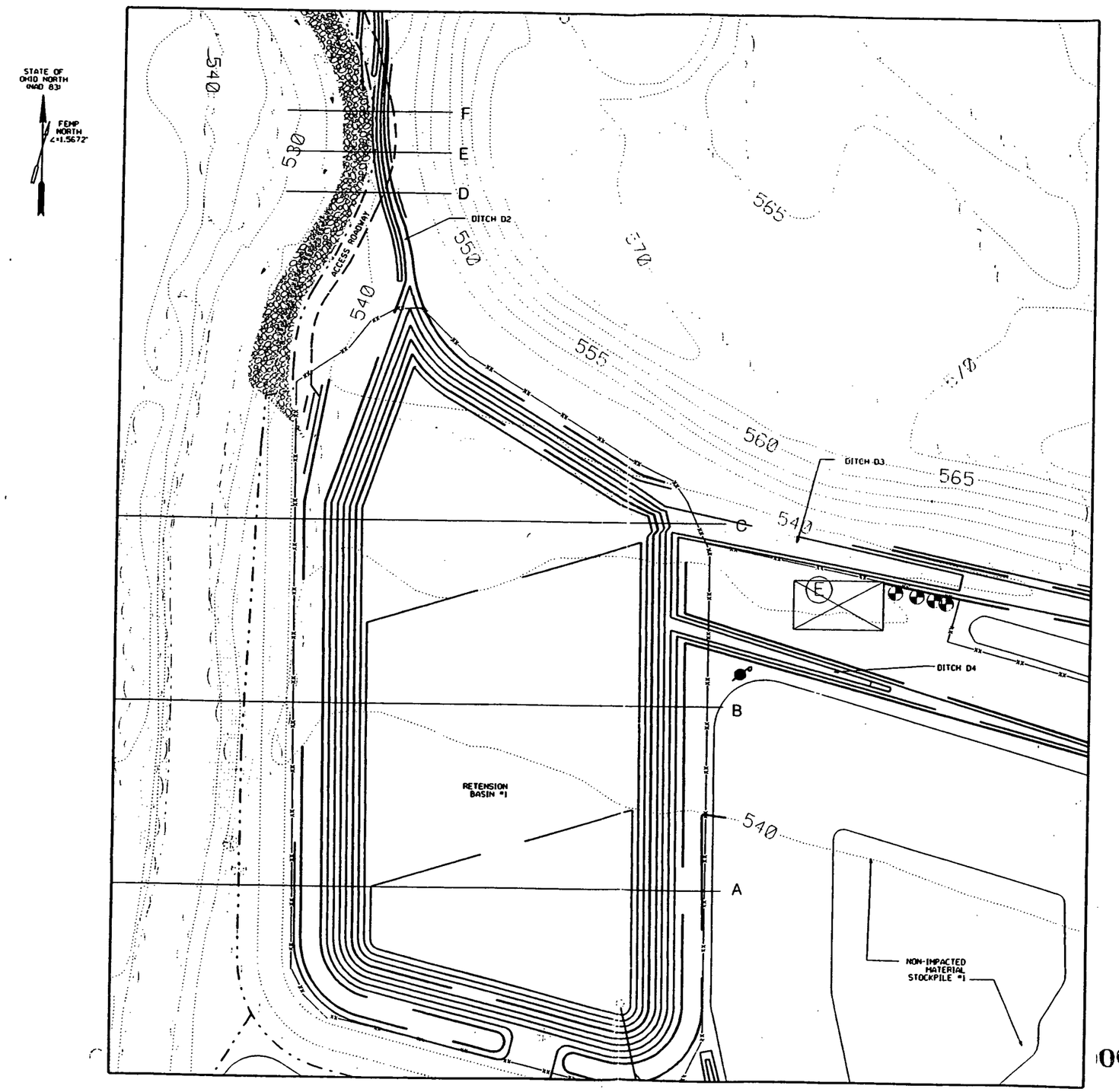
```
RX      0    82.3      93   102.9     129     150     200   237.8
RY    533     532   531.2     525     525     530     535     536
*
KK SB580
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH FROM THE RETENTION BASIN TO
KM CROSS SECTION J-J
KO      1       0               1      21
BA 0.036
LS          71.9
UK    100   0.010    0.25     100
RD    500   0.100    0.04   0.020    TRAP       0       1
RD    600   0.010   0.035           TRAP       5       1
*
KK SB581
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH ABOVE THE RETENTION BASIN
KO      1       0               1      21
BA 0.456
LS          69.4
UK    200   0.025    0.25     100
RD   1000   0.020    0.04   0.080    TRAP       0       1
RD   3300   0.012   0.030           TRAP       5       1
*
KK  STJJ
KM COMBINE RUNOFF FROM PRODUCTION AREA AND SB581
KO      1       0               1      21
HC      2
*
KK ROT80
KM  ROUTE FROM RET. BASIN TO OUTFALL OF SSOD XSEC J-J TO K-K
KO      1       0               1      21
RD                                                             YES
RC 0.035   0.035   0.035    1300   0.009
RX  360.    370.    372.    378.    380.    390.    395.    420.
RY 544.4   539.4   539.4   539.4   539.4   539.4   539.4   544.4
*
KK SB582
KM RUNOFF FROM SB582 (LOWER STORM SEWER OUTFALL DITCH)
KO      1       0               1      21
BA 0.487
LS          66.5
UK    200   0.025     0.3     100
RD   3600   0.022   0.045    0.33    TRAP       5       1
RD   3800   0.015   0.025           TRAP      26    2.27
*
KK  ST80
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND SB582
KM THIS POINT COORISPONDS TO NPDES OUTFALL STRM 1
KO      1       0               1      21
HC      2
*
KK  STEE
KM COMBINE RUNOFF FROM STORM SEWER OUTFALL DITCH AND PADDY'S RUN
KO      1       0               1      21
HC      2
*
KKROUT25
KM ROUTE FROM CROSS SECTION E-E TO F-F
KO              0               1      21
RD   2613   0.002   0.025           TRAP    52.8    4.55     YES
*
KKSUB130
KM RUNOFF FROM SUBBASIN 130
KO              0               1      21
BA 1.385
LS          68.2
UK    200   0.033     0.4     100
RD   5000   0.016   0.045   0.588    TRAP       5       1
RD   1800    0.02   0.025           TRAP    52.8    4.55
*
KK ST130
KM  COMBINE RUNOFF FROM FROM SUB130 TO PADDY'S RUN.
KO      1       0               1      21
```

```
HC      2
*
KKSUB100
KM RUNOFF FROM SUB100 AND ROUTE FROM CROSS SECTION F-F TO G-G
KO              0                1      21
BA 0.510
LS          62.1                    62.11
UK   180     0.1     0.4      30
UK   250   0.018     0.3      70
RD  4000    0.01   0.045   0.412    TRAP       5       1
RD  2773  0.0003   0.025            TRAP    27.2   26.32     YES
*
KK ROUT3
KM ROUTE FROM CROSS SECTION G-G TO H-H
RD  3626  0.0025   0.025            TRAP    63.6    7.30     YES
*
KKSUB110
KMRUNOFF FROM SUB110
BA 0.823
LS          61.9                      69
UK   200     0.2     0.4      50
UK   150    0.03     0.3      50
RD   500    0.04   0.045    0.21    TRAP       0       1
RD 10000   0.009   0.025            TRAP      20    3.33
*
KKSUB120
KM RUNOFF FROM SUB120
BA 0.561
LS          69.4
UK   100    0.28     0.4     100
RD   500     0.2   0.045    0.15    TRAP       0       1
RD  8000   0.021   0.045            TRAP      20    3.33
*
KK ST120
KM COMBINE RUNOFF FROM SUB110 AND SUB220 TO PADDY'S RUN
KO              0                1      21
HC      3
ZZ
```

APPENDIX D

Additional Sketches of Paddys Run Area

skg04548.m po165@ws316. Wed Aug 27 12:30:52 CDT 1997



00632

NOTES

1634

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FEMCO	DATE
		INITIALS AND DATE		

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

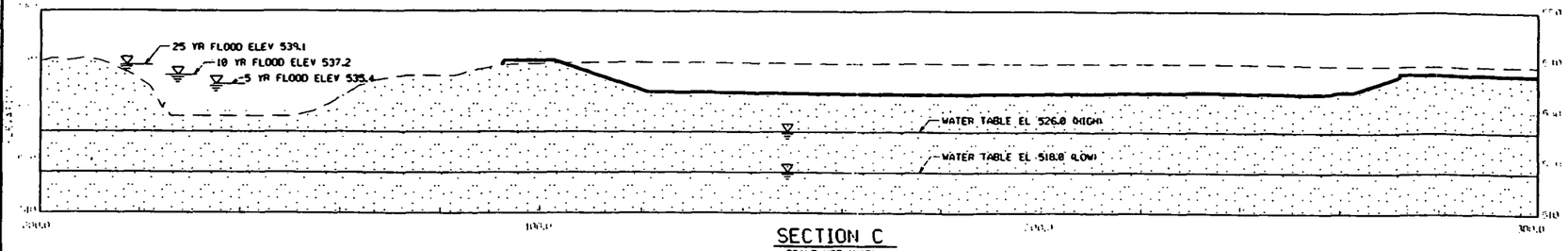
PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS

DRAWING TITLE
SKETCH #1

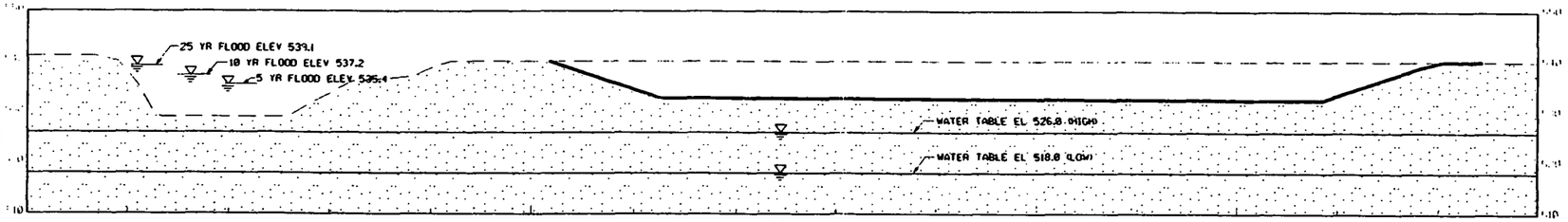
DRAWN BY	DATE	LEAD ENGINEER	DATE	SKETCHED BY	DATE
PLANT/BLDG NO		FLOOR		SCALE 1"=20'	FILMS
SUBMITTED FOR APPROVAL		FEMCO CRU APPROVAL			
A-E PROJECT NO.	DATE	FEMP PROJECT NO. 00-90701	DATE	DRAWING NO. SK-G-04548	SHEET NO. / REV NO. A

PREPARED UNDER PARSONS PROJECT ORDER NUMBER

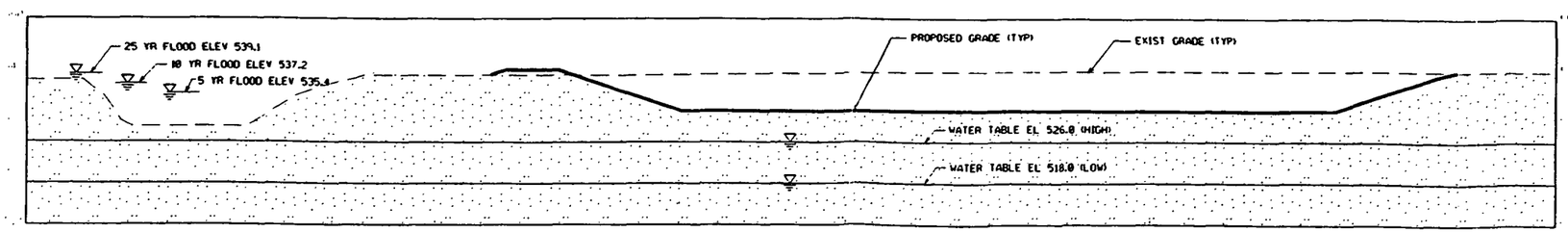
skg04548.m po165@ws.316. Wed Aug 27 15:50:21 CDT 1997



SECTION C
SCALE: HOR 1"=10'
VER 1"=10'



SECTION B
SCALE: HOR 1"=10'
VER 1"=10'



SECTION A
SCALE: HOR 1"=10'
VER 1"=10'

GRAPHIC SCALE: 1"=10' VERTICAL

GRAPHIC SCALE: 1"=10 HORIZONTAL

NOTES

1. THE 5 YEAR, 10 YEAR, AND 25 YEAR FLOOD ELEVATIONS ARE FROM FDF HYDROLOGICAL MODEL CROSS - SECTION C'-C'.

1634

LEGEND:

- EXISTING GROUND
- EXCAVATION GRADE LINE
- WATER TABLE (AVERAGE)
- GREAT MIAMI AQUIFER

THE 5 YEAR, 10 YEAR, AND 25 YEAR FLOOD ELEVATIONS WERE PROVIDED BY FDF.

000633

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REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	REVIEW	DATE
			APPROVALS AND DATE	

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
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THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS

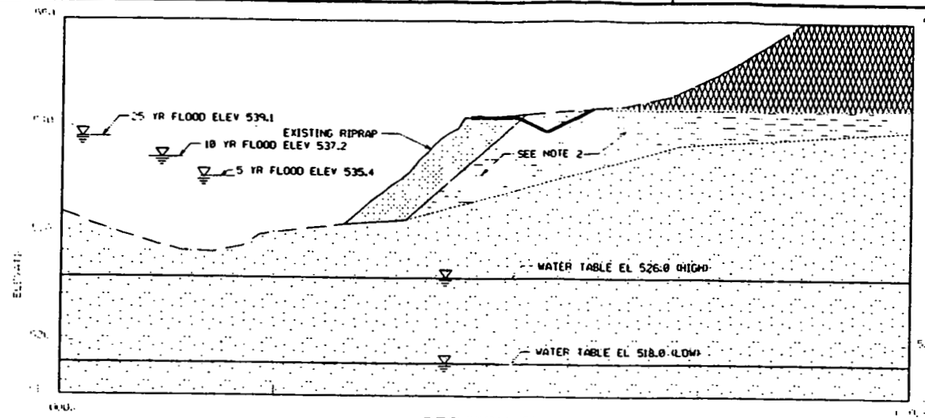
DRAWING TITLE
SKETCH #2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
PLANT/PROJ. NO.		FLOOR		SCALE 1"=10'	DWG.
SUBMITTED FOR APPROVAL		FEMCO CPM APPROVAL			

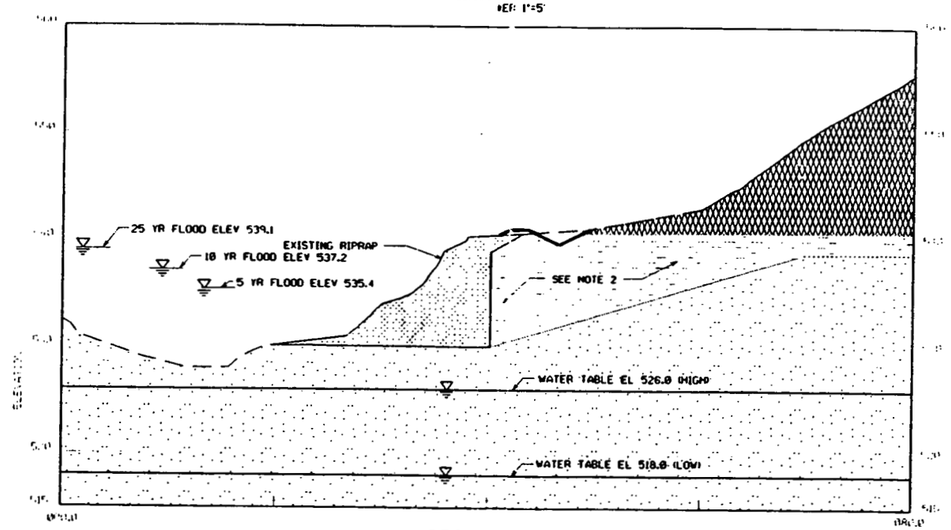
A-E PROJECT NO.	DATE	FEMP PROJECT NO.	DATE	DRAWING PROJ. CODE NO.	SHEET NO.	REV. NO.
		00-90701		SK-G-04548		A

PREPARED UNDER PARSONS PROJECT CODE NUMBER

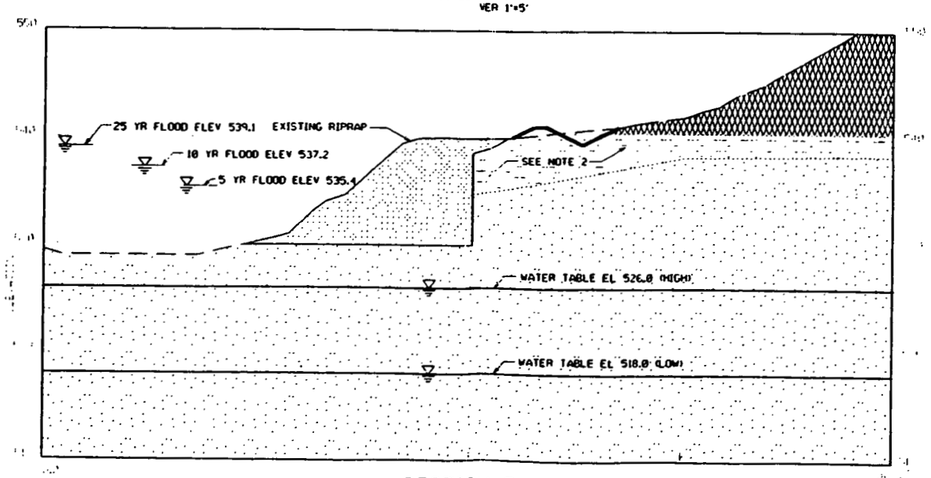
skg04548.m po165@ws316. Wed Aug 27 15:43:55 CDT 1997



SECTION F
SCALE: HOR 1"=5'
VER 1"=5'



SECTION E
SCALE: HOR 1"=5'
VER 1"=5'



SECTION D
SCALE: HOR 1"=5'
VER 1"=5'

GRAPHIC SCALE: 1"=5' VERTICAL

GRAPHIC SCALE: 1"=5' HORIZONTAL

NOTES

1. THE 5 YEAR, 10 YEAR, AND 25 YEAR FLOOD ELEVATIONS ARE FROM FDF HYDROLOGICAL MODEL CROSS - SECTION C'-C'.
2. GEOLOGY ADJACENT TO RIPRAP BASED ON FIELD OBSERVATIONS AND INTERPOLATION FROM SUBSURFACE INVESTIGATIONS.

1634

LEGEND:

- EXISTING GROUND
- EXCAVATION GRADE LINE
- WATER TABLE
- SAND/GRAVEL
- GLACIAL OVERBURDEN/TILL
- GREAT MIAMI AQUIFER
- RIPRAP
- ASH

000634

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS

DRAWING TITLE
SKETCH #3

SCALE: 1"=5'

00-90701

SK-G-04548

A

APPENDIX E

Modification of Drainage Areas for Retention Basins No. 1 and 2 to Reflect Conditions Observed during Site Preparation Construction

Retention basins 1, 2, and 3, and associated diversion ditches were constructed during the A2PI Site Preparation Construction Phase. To date, retention basins 1 and 3 have performed as designed. Retention basin 2 has overflowed and discharged into Paddys Run during large storm events. Based on operational observations, the quantity of runoff entering into basin 2 appears to be greater than designed.

A review of the calculations for basin 2 did not reveal anything which would explain the excess runoff. However, there is the potential for some variability with two of the factors that make up the primary basis for the calculations: drainage area (DA) and runoff coefficient. The drainage area to basin 2 directly impacts the quantity of runoff. The existing conditions DA developed for Retention Basin 2 encompasses approximately 7 acres, and is shown on the Existing Conditions Drainage Area Map. This DA was developed during design based on the mapping of the conditions that were anticipated after Site Preparation. The largest component of the estimated DA to Basin 2 is the South Field. The DA for Basin 2 also included Non-Impacted Stockpile No. 2, located just north of the SWUs.

The South Field Impacted Material Stockpile was constructed on the South Field during Site Preparation. However, more impacted material was encountered during Site Preparation than originally anticipated; construction of this stockpile and associated modifications increased the DA to Basin 2. Also, no material was actually placed in Non-Impacted Material Stockpile No 2. Both of these conditions created larger surface areas with a low permeability (i.e., higher runoff coefficients), which increased the quantity of runoff flowing into Basin 2. Additionally, field observations during storm events indicate that other areas north of the SWUs actually flow into Basin 2, including areas adjacent to Non-Impacted Stockpile No 2 and SP-3. The DA based on field observations was estimated to be approximately 11 acres.

Based on the poor performance of Basin 2 during large storm events, A Design Change Notice (DCN-026) was implemented to reduce the DA flowing into Basin 2. Modifications under this DCN include diverting all runoff from the South Field Impacted Material Stockpile to Retention Basin 1, and diverting clean runoff from Non-Impacted Stockpile No. 2 away from Basin 2 and directly to Paddys Run (See Conditions After Site Preparation Map in Appendix B).

Along with visual observations of basin performance, Retention Basins 1 and 2 were recalculated for the 25-year storm event based on the revised DA's. The revised DA's for conditions after implementation of DCN-026 for basins 1 and 2 are as follows:

- Basin 001 existing (as determined during design) = 14.33 acres
- Basin 001 existing (after implementation of DCN-026) = 16.00 acres

- Basin 002 existing (as determined during design) = 7.04 acres
- Basin 002 existing (after implementation of DCN-026) = 5.0 acres

000636

The watershed areas for each basin were broken down based on published soil types and assigned curve numbers based on bare soil conditions. The results are as follows:

	PEAK WATER SURFACE ELEVATION (FT)		PEAK STORAGE (AC-FT)	
	ORIGINAL DESIGN	DCN-026	ORIGINAL DESIGN	DCN-026
BASIN 1	537.9	538.0	4.6	5.2
BASIN 2	536.6	535.7	1.9	1.4

The 25-yr, 24-hr storm event in Basin 2 creates a peak water surface elevation of 535.7 ft., which is less than the original design of 536.6 ft. For Basin 1, the larger watershed area does increase the peak water surface elevation from 537.9 ft. to 538.0 ft. However, this increase is still less than the design overflow elevation of 538.5. Thus, the modifications to the watershed areas should not create a discharge from Retention Basins 1 and 2.

REV	BY	DATE	CK	DATE	TITLE: STORMWATER MANAGEMENT	
						A2PI
					AUTHOR: T. Brown SHEET 1	PO165

RESULTS:

The results from routing the 25-year, 24-hour storm event through Retention Basins 1 & 2, using the site conditions that are existing after the Site Preparation Construction was completed. The results are as follows:

RETENTION BASIN 1

Q_{25} = 93 CFS

Initial Storage (Assumed full of sediment) = 0.38 Ac-Ft

Overflow Elev. = 539.0

Water Surface Elev. (WSE_{10}) = 538.02

Q_{25} Discharge = 0 CFS

RETENTION BASIN 2

Q_{25} = 27 CFS

Initial Storage (Assumed full of sediment) = 0.11 Ac-Ft

Overflow Elev. = 537.0

Water Surface Elev. (WSE_{10}) = 535.70

Q_{25} Discharge = 0 CFS

The modifications to the drainage areas for Retention Basins 1 & 2 does not create a discharge for the 25-year, 24-hour storm event and are acceptable.

000638

Quick TR-55 Ver.5.46 S/N:
Executed: 13:31:10 07-21-1998

RETENTION BASIN 1
59% HoA, 20% HeF, 10% MaB,
10% Gn, 1% Gravel Road

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA, (C): FALLOW, BARE SOIL	8.97	91	
MaB, (C): FALLOW, BARE SOIL	2.29	91	
HeF, (B): FALLOW, BARE SOIL	3.04	86	
Gn, (B): FALLOW, BARE SOIL	1.55	86	
Gravel Road	0.15	91	
COMPOSITE AREA --->	16.00	89.6	(90)

::

Quick TR-55 Ver.5.46 S/N:
Executed: 13:31:10 07-21-1998

RETENTION BASIN 1
59% HoA, 20% HeF, 10% MaB,
10% Gn, 1% Gravel Road

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	16.00	90

Quick TR-55 Ver.5.46 S/N:
Executed: 13:30:12 07-21-1998 c:\tjb\po165\P1.TCT

RETENTION BASIN - 1

Tc COMPUTATIONS FOR: P1

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		BARE	
Manning's roughness coeff., n		0.0110	
Flow length, L (total < or = 300)	ft	280.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0210	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.05	= 0.05

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	240.0	
Watercourse slope, s	ft/ft	0.1120	
$Avg.V = Csf * (s)^{0.5}$	ft/s	5.3996	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	10.00	
Wetted perimeter, Pw	ft	12.47	
Hydraulic radius, r = a/Pw	ft	0.802	
Channel slope, s	ft/ft	0.0080	
Manning's roughness coeff., n		0.0400	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.8758	
Flow length, L	ft	305	
T = L / (3600*V)	hrs	0.03	= 0.03

::

TOTAL TIME (hrs) 0.09

Quick TR-55 Ver.5.46 S/N:
Executed: 13:30:12 07-21-1998 c:\tjb\po165\P1.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN - 1

Subarea descr.	Tc or Tt	Time (hrs)
P1	Tc	0.09

000642

POND-2 Version: 5.17 S/N:
EXECUTED: 07-21-1998 13:44:49


```
**********************
*                    *
*   RETENTION BASIN 1 *
*                    *
*                    *
*                    *
*                    *
**********************
```

Inflow Hydrograph: c:\tjb\po165\P1CON .HYD
Rating Table file: c:\tjb\po165\SW1 .PND

----INITIAL CONDITIONS----
Elevation = 532.90 ft
Outflow = 0.00 cfs
Storage = 0.36 ac-ft

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
531.40	0.0	0.000
532.00	0.0	0.040
532.90	0.0	0.360
533.00	0.0	0.420
534.00	0.0	1.160
535.00	0.0	2.070
536.00	0.0	3.030
537.00	0.0	4.050
538.00	0.0	5.150
538.50	0.0	5.750
539.00	0.0	6.380
540.00	0.0	7.690

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
9.7	9.7
87.1	87.1
101.6	101.6
280.7	280.7
500.9	500.9
733.3	733.3
980.1	980.1
1246.3	1246.3
1391.5	1391.5
1544.0	1544.0
1861.0	1861.0

Time increment (t) = 0.100 hrs.

Pond File: c:\tjb\po165\SW1 .PND
Inflow Hydrograph: c:\tjb\po165\P1CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	2.00	-----	87.1	87.1	0.00	532.90
11.100	2.00	4.0	91.1	91.1	0.00	532.93
11.200	3.00	5.0	96.1	96.1	0.00	532.96
11.300	3.00	6.0	102.1	102.1	0.00	533.00
11.400	4.00	7.0	109.1	109.1	0.00	533.04
11.500	4.00	8.0	117.1	117.1	0.00	533.09
11.600	5.00	9.0	126.1	126.1	0.00	533.14
11.700	14.00	19.0	145.1	145.1	0.00	533.24
11.800	22.00	36.0	181.1	181.1	0.00	533.44
11.900	31.00	53.0	234.1	234.1	0.00	533.74
12.000	60.00	91.0	325.1	325.1	0.00	534.20
12.100	93.00	153.0	478.1	478.1	0.00	534.90
12.200	58.00	151.0	629.1	629.1	0.00	535.55
12.300	20.00	78.0	707.1	707.1	0.00	535.89
12.400	14.00	34.0	741.1	741.1	0.00	536.03
12.500	11.00	25.0	766.1	766.1	0.00	536.13
12.600	10.00	21.0	787.1	787.1	0.00	536.22
12.700	8.00	18.0	805.1	805.1	0.00	536.29
12.800	7.00	15.0	820.1	820.1	0.00	536.35
12.900	6.00	13.0	833.1	833.1	0.00	536.40
13.000	6.00	12.0	845.1	845.1	0.00	536.45
13.100	6.00	12.0	857.1	857.1	0.00	536.50
13.200	5.00	11.0	868.1	868.1	0.00	536.55
13.300	5.00	10.0	878.1	878.1	0.00	536.59
13.400	5.00	10.0	888.1	888.1	0.00	536.63
13.500	5.00	10.0	898.1	898.1	0.00	536.67
13.600	4.00	9.0	907.1	907.1	0.00	536.70
13.700	4.00	8.0	915.1	915.1	0.00	536.74
13.800	4.00	8.0	923.1	923.1	0.00	536.77
13.900	4.00	8.0	931.1	931.1	0.00	536.80
14.000	3.00	7.0	938.1	938.1	0.00	536.83
14.100	3.00	6.0	944.1	944.1	0.00	536.85
14.200	3.00	6.0	950.1	950.1	0.00	536.88
14.300	3.00	6.0	956.1	956.1	0.00	536.90
14.400	3.00	6.0	962.1	962.1	0.00	536.93
14.500	3.00	6.0	968.1	968.1	0.00	536.95
14.600	3.00	6.0	974.1	974.1	0.00	536.98
14.700	3.00	6.0	980.1	980.1	0.00	537.00
14.800	3.00	6.0	986.1	986.1	0.00	537.02
14.900	3.00	6.0	992.1	992.1	0.00	537.05
15.000	3.00	6.0	998.1	998.1	0.00	537.07
15.100	3.00	6.0	1004.1	1004.1	0.00	537.09
15.200	3.00	6.0	1010.1	1010.1	0.00	537.11
15.300	2.00	5.0	1015.1	1015.1	0.00	537.13
15.400	2.00	4.0	1019.1	1019.1	0.00	537.15

POND-2 Version: 5.17 S/N:
EXECUTED: 07-21-1998 13:44:49

Pond File: c:\tjb\po165\SW1 .PND
Inflow Hydrograph: c:\tjb\po165\P1CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	2.00	4.0	1023.1	1023.1	0.00	537.16
15.600	2.00	4.0	1027.1	1027.1	0.00	537.18
15.700	2.00	4.0	1031.1	1031.1	0.00	537.19
15.800	2.00	4.0	1035.1	1035.1	0.00	537.21
15.900	2.00	4.0	1039.1	1039.1	0.00	537.22
16.000	2.00	4.0	1043.1	1043.1	0.00	537.24
16.100	2.00	4.0	1047.1	1047.1	0.00	537.25
16.200	2.00	4.0	1051.1	1051.1	0.00	537.27
16.300	2.00	4.0	1055.1	1055.1	0.00	537.28
16.400	2.00	4.0	1059.1	1059.1	0.00	537.30
16.500	2.00	4.0	1063.1	1063.1	0.00	537.31
16.600	2.00	4.0	1067.1	1067.1	0.00	537.33
16.700	2.00	4.0	1071.1	1071.1	0.00	537.34
16.800	2.00	4.0	1075.1	1075.1	0.00	537.36
16.900	2.00	4.0	1079.1	1079.1	0.00	537.37
17.000	2.00	4.0	1083.1	1083.1	0.00	537.39
17.100	2.00	4.0	1087.1	1087.1	0.00	537.40
17.200	2.00	4.0	1091.1	1091.1	0.00	537.42
17.300	2.00	4.0	1095.1	1095.1	0.00	537.43
17.400	2.00	4.0	1099.1	1099.1	0.00	537.45
17.500	2.00	4.0	1103.1	1103.1	0.00	537.46
17.600	2.00	4.0	1107.1	1107.1	0.00	537.48
17.700	2.00	4.0	1111.1	1111.1	0.00	537.49
17.800	2.00	4.0	1115.1	1115.1	0.00	537.51
17.900	2.00	4.0	1119.1	1119.1	0.00	537.52
18.000	2.00	4.0	1123.1	1123.1	0.00	537.54
18.100	2.00	4.0	1127.1	1127.1	0.00	537.55
18.200	2.00	4.0	1131.1	1131.1	0.00	537.57
18.300	2.00	4.0	1135.1	1135.1	0.00	537.58
18.400	2.00	4.0	1139.1	1139.1	0.00	537.60
18.500	2.00	4.0	1143.1	1143.1	0.00	537.61
18.600	1.00	3.0	1146.1	1146.1	0.00	537.62
18.700	1.00	2.0	1148.1	1148.1	0.00	537.63
18.800	1.00	2.0	1150.1	1150.1	0.00	537.64
18.900	1.00	2.0	1152.1	1152.1	0.00	537.65
19.000	1.00	2.0	1154.1	1154.1	0.00	537.65
19.100	1.00	2.0	1156.1	1156.1	0.00	537.66
19.200	1.00	2.0	1158.1	1158.1	0.00	537.67
19.300	1.00	2.0	1160.1	1160.1	0.00	537.68
19.400	1.00	2.0	1162.1	1162.1	0.00	537.68
19.500	1.00	2.0	1164.1	1164.1	0.00	537.69
19.600	1.00	2.0	1166.1	1166.1	0.00	537.70
19.700	1.00	2.0	1168.1	1168.1	0.00	537.71
19.800	1.00	2.0	1170.1	1170.1	0.00	537.71
19.900	1.00	2.0	1172.1	1172.1	0.00	537.72
20.000	1.00	2.0	1174.1	1174.1	0.00	537.73

Pond File: c:\tjb\po165\SW1 .PND
Inflow Hydrograph: c:\tjb\po165\P1CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	1.00	2.0	1176.1	1176.1	0.00	537.74
20.200	1.00	2.0	1178.1	1178.1	0.00	537.74
20.300	1.00	2.0	1180.1	1180.1	0.00	537.75
20.400	1.00	2.0	1182.1	1182.1	0.00	537.76
20.500	1.00	2.0	1184.1	1184.1	0.00	537.77
20.600	1.00	2.0	1186.1	1186.1	0.00	537.77
20.700	1.00	2.0	1188.1	1188.1	0.00	537.78
20.800	1.00	2.0	1190.1	1190.1	0.00	537.79
20.900	1.00	2.0	1192.1	1192.1	0.00	537.80
21.000	1.00	2.0	1194.1	1194.1	0.00	537.80
21.100	1.00	2.0	1196.1	1196.1	0.00	537.81
21.200	1.00	2.0	1198.1	1198.1	0.00	537.82
21.300	1.00	2.0	1200.1	1200.1	0.00	537.83
21.400	1.00	2.0	1202.1	1202.1	0.00	537.83
21.500	1.00	2.0	1204.1	1204.1	0.00	537.84
21.600	1.00	2.0	1206.1	1206.1	0.00	537.85
21.700	1.00	2.0	1208.1	1208.1	0.00	537.86
21.800	1.00	2.0	1210.1	1210.1	0.00	537.86
21.900	1.00	2.0	1212.1	1212.1	0.00	537.87
22.000	1.00	2.0	1214.1	1214.1	0.00	537.88
22.100	1.00	2.0	1216.1	1216.1	0.00	537.89
22.200	1.00	2.0	1218.1	1218.1	0.00	537.89
22.300	1.00	2.0	1220.1	1220.1	0.00	537.90
22.400	1.00	2.0	1222.1	1222.1	0.00	537.91
22.500	1.00	2.0	1224.1	1224.1	0.00	537.92
22.600	1.00	2.0	1226.1	1226.1	0.00	537.92
22.700	1.00	2.0	1228.1	1228.1	0.00	537.93
22.800	1.00	2.0	1230.1	1230.1	0.00	537.94
22.900	1.00	2.0	1232.1	1232.1	0.00	537.95
23.000	1.00	2.0	1234.1	1234.1	0.00	537.95
23.100	1.00	2.0	1236.1	1236.1	0.00	537.96
23.200	1.00	2.0	1238.1	1238.1	0.00	537.97
23.300	1.00	2.0	1240.1	1240.1	0.00	537.98
23.400	1.00	2.0	1242.1	1242.1	0.00	537.98
23.500	1.00	2.0	1244.1	1244.1	0.00	537.99
23.600	1.00	2.0	1246.1	1246.1	0.00	538.00
23.700	1.00	2.0	1248.1	1248.1	0.00	538.01
23.800	1.00	2.0	1250.1	1250.1	0.00	538.01
23.900	1.00	2.0	1252.1	1252.1	0.00	538.02
24.000	0.00	1.0	1253.1	1253.1	0.00	538.02
24.100	0.00	0.0	1253.1	1253.1	0.00	538.02
24.200	0.00	0.0	1253.1	1253.1	0.00	538.02
24.300	0.00	0.0	1253.1	1253.1	0.00	538.02
24.400	0.00	0.0	1253.1	1253.1	0.00	538.02
24.500	0.00	0.0	1253.1	1253.1	0.00	538.02
24.600	0.00	0.0	1253.1	1253.1	0.00	538.02

POND-2 Version: 5.17 S/N:
EXECUTED: 07-21-1998 13:44:49

Pond File: c:\tjb\po165\SW1 .PND
Inflow Hydrograph: c:\tjb\po165\P1CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW1 .HYD

INFLOW HYDROGRAPH

TIME (hrs)	INFLOW (cfs)
24.700	0.00
24.800	0.00
24.900	0.00
25.000	0.00
25.100	0.00
25.200	0.00
25.300	0.00
25.400	0.00
25.500	0.00
25.600	0.00
25.700	0.00
25.800	0.00
25.900	0.00

ROUTING COMPUTATIONS

I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02
0.0	1253.1	1253.1	0.00	538.02

********** SUMMARY OF ROUTING COMPUTATIONS **********

```
Pond File:           c:\tjb\po165\SW1     .PND
Inflow Hydrograph:   c:\tjb\po165\P1CON   .HYD
Outflow Hydrograph:  c:\tjb\po165\SW1     .HYD

Starting Pond W.S. Elevation =   532.90 ft

        ***** Summary of Peak Outflow and Peak Elevation *****

                    Peak Inflow    =    93.00 cfs
                    Peak Outflow   =     0.00 cfs
                    Peak Elevation =   538.02 ft

          ***** Summary of Approximate Peak Storage *****

              Initial Storage          =     0.36 ac-ft
              Peak Storage From Storm  =     4.82 ac-ft
                                       ---------------
              Total Storage in Pond    =     5.18 ac-ft

        Warning: Inflow hydrograph truncated on left side.

        >>>>>> Warning, peak outflow = last ordinate point. <<<<<<
```

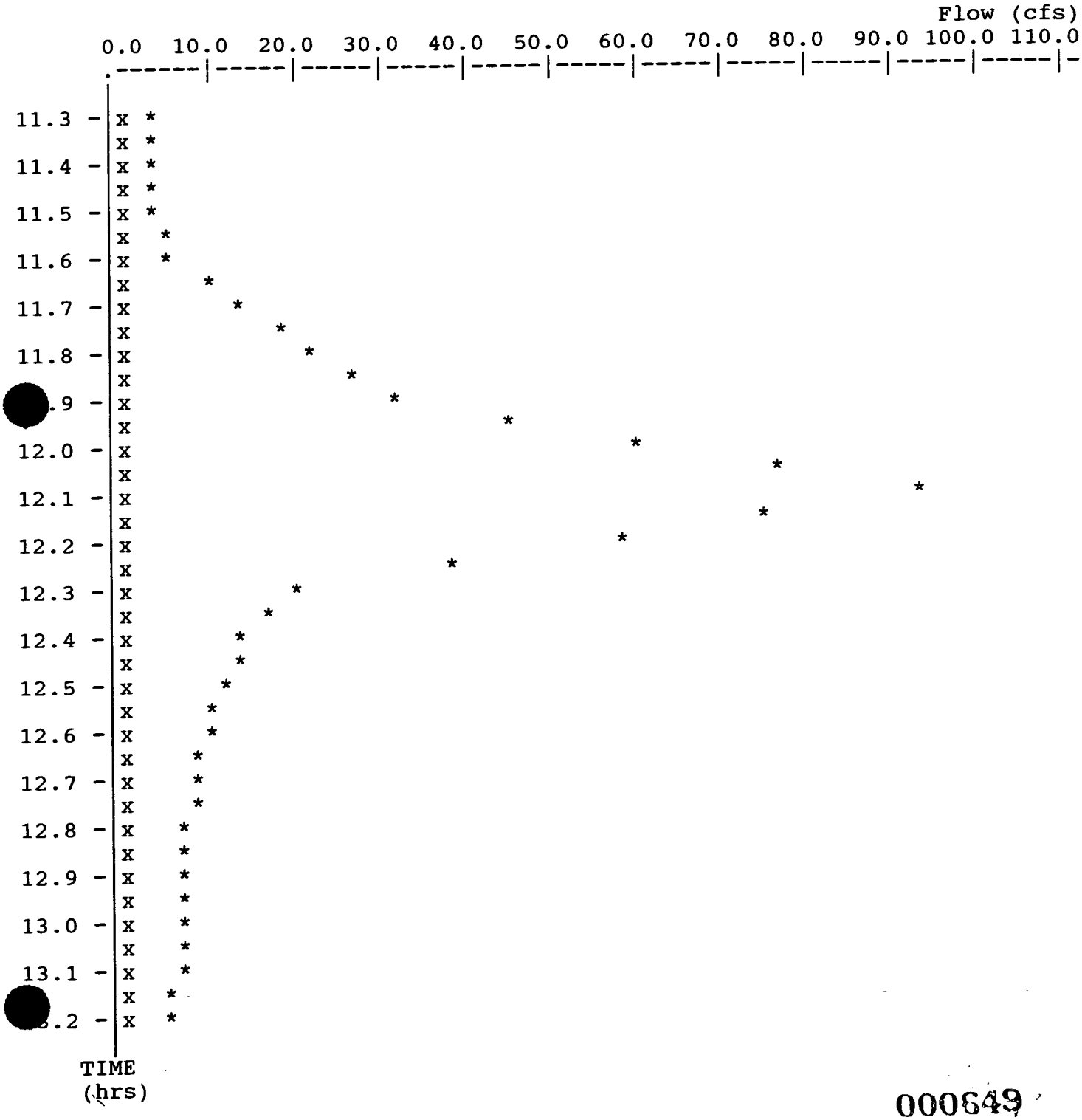
>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

POND-2 Version: 5.17 S/N:

Pond File: c:\tjb\po165\SW1 .PND
Inflow Hydrograph: c:\tjb\po165\P1CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW1 .HYD

EXECUTED: 07-21-1998
13:44:49

Peak Inflow = 93.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 538.02 ft



```
*  File:  c:\tjb\po165\P1CON    .HYD   Qmax =    93.0 cfs
x  File:  c:\tjb\po165\SW1      .HYD   Qmax =     0.0 cfs
```

Quick TR-55 Ver.5.46 S/N:
Executed: 10:19:11 07-21-1998

RETENTION BASIN 2, EXISTING CONDITIONS
HoA 51.0%, Gn 36.9%, HeF 6.4%,
GRAVEL ROAD 3.0%,
MaC2 2.7%

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	5.00	88

Quick TR-55 Ver.5.46 S/N:
Executed: 10:19:11 07-21-1998

RETENTION BASIN 2, EXISTING CONDITIONS
HoA 51.0%, Gn 36.9%, HeF 6.4%,
GRAVEL ROAD 3.0%,
MaC2 2.7%

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA (C): FALLOW, BARE SOIL	1.55	91	
Gn (B): FALLOW, BARE SOIL	2.60	86	
HeF, (B): FALLOW, BARE SOIL	0.45	86	
MaC2, (C): FALLOW, BARE SOIL	0.19	91	
GRAVEL ROAD	0.21	91	
COMPOSITE AREA --->	5.00	88.0	(88)

::

000652

```
Quick TR-55 Ver.5.46   S/N:
Executed: 10:08:10   07-21-1998    c:\tjb\po165\P2CON.TCT

                         RETENTION BASIN 2
                 CONDITIONS AFTER SITE PREPARATION


                    Tc COMPUTATIONS FOR: P2

SHEET FLOW (Applicable to Tc only)
    Segment ID                                        1
    Surface description                          BARE
    Manning's roughness coeff., n                     0.0110
    Flow length, L (total < or = 300)         ft        80.0
    Two-yr 24-hr rainfall, P2                 in        3.000
    Land slope, s                             ft/ft     0.0313
                           0.8
         .007 * (n*L)
    T =  -------------                        hrs       0.01          =  0.01
            0.5     0.4
          P2    *    s

SHALLOW CONCENTRATED FLOW
    Segment ID                                        2
    Surface (paved or unpaved)?                       Unpaved
    Flow length, L                            ft        70.0
    Watercourse slope, s                      ft/ft     0.4400

                            0.5
    Avg.V =  Csf *  (s)                       ft/s      %10.7024
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                          hrs       0.00          =  0.00


CHANNEL FLOW
    Segment ID                                        3
    Cross Sectional Flow Area, a              sq.ft     1.48
    Wetted perimeter, Pw                      ft        3.85
    Hydraulic radius, r = a/Pw                ft        0.384
    Channel slope, s                          ft/ft     0.0177
    Manning's roughness coeff., n                     0.0600

                       2/3     1/2
        1.49   *   r    *   s
    V = --------------------                  ft/s      1.7467
                   n

    Flow length, L                            ft        280

    T = L / (3600*V)                          hrs       0.04          =  0.04

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                              TOTAL TIME (hrs)      0.06
```

Quick TR-55 Ver.5.46 S/N:
Executed: 10:08:10 07-21-1998 c:\tjb\po165\P2CON.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 2
CONDITIONS AFTER SITE PREPARATION

Subarea descr.	Tc or Tt	Time (hrs)
P2	Tc	0.06

POND-2 Version: 5.17 S/N:
EXECUTED: 07-21-1998 12:02:37


```
**********************
*                    *
*   STORM BASIN NO. 2 *
*   W/3:1 SIDE SLOPES *
*                    *
*                    *
*                    *
**********************
```

Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Rating Table file: c:\tjb\po165\SW2-T1 .PND

----INITIAL CONDITIONS----
Elevation = 530.30 ft
Outflow = 0.00 cfs
Storage = 0.11 ac-ft

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
528.70	0.0	0.000
529.00	0.0	0.010
530.00	0.0	0.080
530.30	0.0	0.110
531.00	0.0	0.200
532.00	0.0	0.370
533.00	0.0	0.580
534.00	0.0	0.850
535.00	0.0	1.170
536.00	0.0	1.560
537.00	0.0	2.020

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
2.4	2.4
19.4	19.4
26.6	26.6
48.4	48.4
89.5	89.5
140.4	140.4
205.7	205.7
283.1	283.1
377.5	377.5
488.8	488.8

Time increment (t) = 0.100 hrs.

EXECUTED: 07-21-1998 12:02:37

Pond File: c:\tjb\po165\SW2-T1 .PND
Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	1.00	-----	26.6	26.6	0.00	530.30
11.100	1.00	2.0	28.6	28.6	0.00	530.36
11.200	1.00	2.0	30.6	30.6	0.00	530.43
11.300	1.00	2.0	32.6	32.6	0.00	530.49
11.400	1.00	2.0	34.6	34.6	0.00	530.56
11.500	1.00	2.0	36.6	36.6	0.00	530.62
11.600	1.00	2.0	38.6	38.6	0.00	530.69
11.700	4.00	5.0	43.6	43.6	0.00	530.85
11.800	6.00	10.0	53.6	53.6	0.00	531.13
11.900	9.00	15.0	68.6	68.6	0.00	531.49
12.000	18.00	27.0	95.6	95.6	0.00	532.12
12.100	27.00	45.0	140.6	140.6	0.00	533.00
12.200	17.00	44.0	184.6	184.6	0.00	533.68
12.300	6.00	23.0	207.6	207.6	0.00	534.02
12.400	4.00	10.0	217.6	217.6	0.00	534.15
12.500	3.00	7.0	224.6	224.6	0.00	534.24
12.600	3.00	6.0	230.6	230.6	0.00	534.32
12.700	2.00	5.0	235.6	235.6	0.00	534.39
12.800	2.00	4.0	239.6	239.6	0.00	534.44
12.900	2.00	4.0	243.6	243.6	0.00	534.49
13.000	2.00	4.0	247.6	247.6	0.00	534.54
13.100	2.00	4.0	251.6	251.6	0.00	534.59
13.200	2.00	4.0	255.6	255.6	0.00	534.64
13.300	2.00	4.0	259.6	259.6	0.00	534.70
13.400	1.00	3.0	262.6	262.6	0.00	534.74
13.500	1.00	2.0	264.6	264.6	0.00	534.76
13.600	1.00	2.0	266.6	266.6	0.00	534.79
13.700	1.00	2.0	268.6	268.6	0.00	534.81
13.800	1.00	2.0	270.6	270.6	0.00	534.84
13.900	1.00	2.0	272.6	272.6	0.00	534.86
14.000	1.00	2.0	274.6	274.6	0.00	534.89
14.100	1.00	2.0	276.6	276.6	0.00	534.92
14.200	1.00	2.0	278.6	278.6	0.00	534.94
14.300	1.00	2.0	280.6	280.6	0.00	534.97
14.400	1.00	2.0	282.6	282.6	0.00	534.99
14.500	1.00	2.0	284.6	284.6	0.00	535.02
14.600	1.00	2.0	286.6	286.6	0.00	535.04
14.700	1.00	2.0	288.6	288.6	0.00	535.06
14.800	1.00	2.0	290.6	290.6	0.00	535.08
14.900	1.00	2.0	292.6	292.6	0.00	535.10
15.000	1.00	2.0	294.6	294.6	0.00	535.12
15.100	1.00	2.0	296.6	296.6	0.00	535.14
15.200	1.00	2.0	298.6	298.6	0.00	535.16
15.300	1.00	2.0	300.6	300.6	0.00	535.19
15.400	1.00	2.0	302.6	302.6	0.00	535.21

POND-2 Version: 5.17 S/N:
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Pond File: c:\tjb\po165\SW2-T1 .PND
Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	1.00	2.0	304.6	304.6	0.00	535.23
15.600	1.00	2.0	306.6	306.6	0.00	535.25
15.700	1.00	2.0	308.6	308.6	0.00	535.27
15.800	1.00	2.0	310.6	310.6	0.00	535.29
15.900	1.00	2.0	312.6	312.6	0.00	535.31
16.000	1.00	2.0	314.6	314.6	0.00	535.33
16.100	1.00	2.0	316.6	316.6	0.00	535.35
16.200	1.00	2.0	318.6	318.6	0.00	535.38
16.300	1.00	2.0	320.6	320.6	0.00	535.40
16.400	1.00	2.0	322.6	322.6	0.00	535.42
16.500	1.00	2.0	324.6	324.6	0.00	535.44
16.600	1.00	2.0	326.6	326.6	0.00	535.46
16.700	1.00	2.0	328.6	328.6	0.00	535.48
16.800	1.00	2.0	330.6	330.6	0.00	535.50
16.900	1.00	2.0	332.6	332.6	0.00	535.52
17.000	1.00	2.0	334.6	334.6	0.00	535.55
17.100	1.00	2.0	336.6	336.6	0.00	535.57
17.200	1.00	2.0	338.6	338.6	0.00	535.59
17.300	1.00	2.0	340.6	340.6	0.00	535.61
17.400	1.00	2.0	342.6	342.6	0.00	535.63
17.500	1.00	2.0	344.6	344.6	0.00	535.65
17.600	1.00	2.0	346.6	346.6	0.00	535.67
17.700	1.00	2.0	348.6	348.6	0.00	535.69
17.800	0.00	1.0	349.6	349.6	0.00	535.70
17.900	0.00	0.0	349.6	349.6	0.00	535.70
18.000	0.00	0.0	349.6	349.6	0.00	535.70
18.100	0.00	0.0	349.6	349.6	0.00	535.70
18.200	0.00	0.0	349.6	349.6	0.00	535.70
18.300	0.00	0.0	349.6	349.6	0.00	535.70
18.400	0.00	0.0	349.6	349.6	0.00	535.70
18.500	0.00	0.0	349.6	349.6	0.00	535.70
18.600	0.00	0.0	349.6	349.6	0.00	535.70
18.700	0.00	0.0	349.6	349.6	0.00	535.70
18.800	0.00	0.0	349.6	349.6	0.00	535.70
18.900	0.00	0.0	349.6	349.6	0.00	535.70
19.000	0.00	0.0	349.6	349.6	0.00	535.70
19.100	0.00	0.0	349.6	349.6	0.00	535.70
19.200	0.00	0.0	349.6	349.6	0.00	535.70
19.300	0.00	0.0	349.6	349.6	0.00	535.70
19.400	0.00	0.0	349.6	349.6	0.00	535.70
19.500	0.00	0.0	349.6	349.6	0.00	535.70
19.600	0.00	0.0	349.6	349.6	0.00	535.70
19.700	0.00	0.0	349.6	349.6	0.00	535.70
19.800	0.00	0.0	349.6	349.6	0.00	535.70
19.900	0.00	0.0	349.6	349.6	0.00	535.70
20.000	0.00	0.0	349.6	349.6	0.00	535.70

Pond File: c:\tjb\po165\SW2-T1 .PND
Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	0.00	0.0	349.6	349.6	0.00	535.70
20.200	0.00	0.0	349.6	349.6	0.00	535.70
20.300	0.00	0.0	349.6	349.6	0.00	535.70
20.400	0.00	0.0	349.6	349.6	0.00	535.70
20.500	0.00	0.0	349.6	349.6	0.00	535.70
20.600	0.00	0.0	349.6	349.6	0.00	535.70
20.700	0.00	0.0	349.6	349.6	0.00	535.70
20.800	0.00	0.0	349.6	349.6	0.00	535.70
20.900	0.00	0.0	349.6	349.6	0.00	535.70
21.000	0.00	0.0	349.6	349.6	0.00	535.70
21.100	0.00	0.0	349.6	349.6	0.00	535.70
21.200	0.00	0.0	349.6	349.6	0.00	535.70
21.300	0.00	0.0	349.6	349.6	0.00	535.70
21.400	0.00	0.0	349.6	349.6	0.00	535.70
21.500	0.00	0.0	349.6	349.6	0.00	535.70
21.600	0.00	0.0	349.6	349.6	0.00	535.70
21.700	0.00	0.0	349.6	349.6	0.00	535.70
21.800	0.00	0.0	349.6	349.6	0.00	535.70
21.900	0.00	0.0	349.6	349.6	0.00	535.70
22.000	0.00	0.0	349.6	349.6	0.00	535.70
22.100	0.00	0.0	349.6	349.6	0.00	535.70
22.200	0.00	0.0	349.6	349.6	0.00	535.70
22.300	0.00	0.0	349.6	349.6	0.00	535.70
22.400	0.00	0.0	349.6	349.6	0.00	535.70
22.500	0.00	0.0	349.6	349.6	0.00	535.70
22.600	0.00	0.0	349.6	349.6	0.00	535.70
22.700	0.00	0.0	349.6	349.6	0.00	535.70
22.800	0.00	0.0	349.6	349.6	0.00	535.70
22.900	0.00	0.0	349.6	349.6	0.00	535.70
23.000	0.00	0.0	349.6	349.6	0.00	535.70
23.100	0.00	0.0	349.6	349.6	0.00	535.70
23.200	0.00	0.0	349.6	349.6	0.00	535.70
23.300	0.00	0.0	349.6	349.6	0.00	535.70
23.400	0.00	0.0	349.6	349.6	0.00	535.70
23.500	0.00	0.0	349.6	349.6	0.00	535.70
23.600	0.00	0.0	349.6	349.6	0.00	535.70
23.700	0.00	0.0	349.6	349.6	0.00	535.70
23.800	0.00	0.0	349.6	349.6	0.00	535.70
23.900	0.00	0.0	349.6	349.6	0.00	535.70
24.000	0.00	0.0	349.6	349.6	0.00	535.70
24.100	0.00	0.0	349.6	349.6	0.00	535.70
24.200	0.00	0.0	349.6	349.6	0.00	535.70
24.300	0.00	0.0	349.6	349.6	0.00	535.70
24.400	0.00	0.0	349.6	349.6	0.00	535.70
24.500	0.00	0.0	349.6	349.6	0.00	535.70
24.600	0.00	0.0	349.6	349.6	0.00	535.70

POND-2 Version: 5.17 S/N:
EXECUTED: 07-21-1998 12:02:37

Pond File: c:\tjb\po165\SW2-T1 .PND
Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW2-T1 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.00	0.0	349.6	349.6	0.00	535.70
24.800	0.00	0.0	349.6	349.6	0.00	535.70
24.900	0.00	0.0	349.6	349.6	0.00	535.70
25.000	0.00	0.0	349.6	349.6	0.00	535.70
25.100	0.00	0.0	349.6	349.6	0.00	535.70
25.200	0.00	0.0	349.6	349.6	0.00	535.70
25.300	0.00	0.0	349.6	349.6	0.00	535.70
25.400	0.00	0.0	349.6	349.6	0.00	535.70
25.500	0.00	0.0	349.6	349.6	0.00	535.70
25.600	0.00	0.0	349.6	349.6	0.00	535.70
25.700	0.00	0.0	349.6	349.6	0.00	535.70
25.800	0.00	0.0	349.6	349.6	0.00	535.70
25.900	0.00	0.0	349.6	349.6	0.00	535.70

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: c:\tjb\po165\SW2-T1 .PND
Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW2-T1 .HYD

Starting Pond W.S. Elevation = 530.30 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 27.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 535.70 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.11 ac-ft
Peak Storage From Storm = 1.33 ac-ft

Total Storage in Pond = 1.44 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

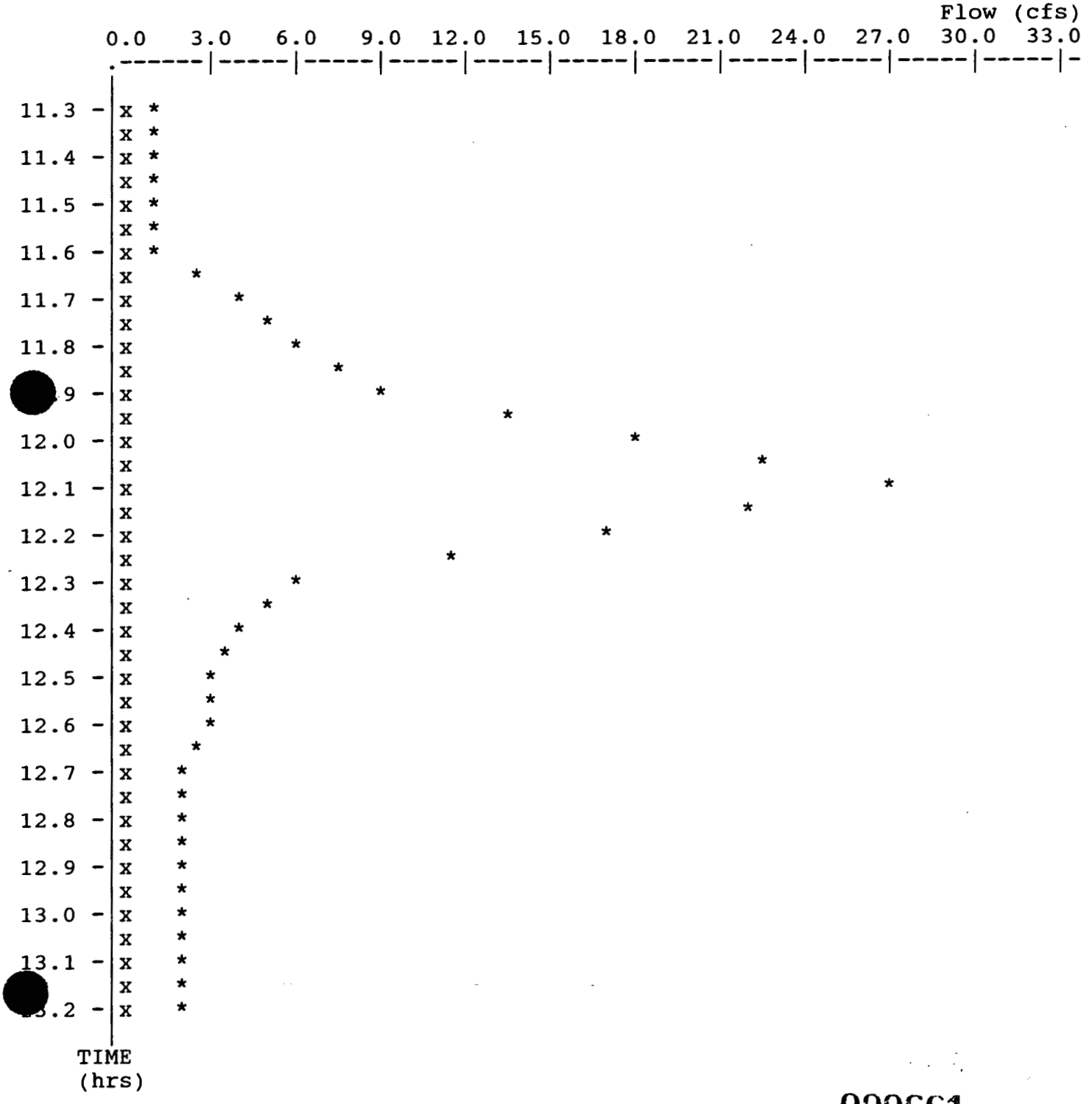
>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

POND-2 Version: 5.17 S/N:

Pond File: c:\tjb\po165\SW2-T1 .PND
Inflow Hydrograph: c:\tjb\po165\P2CON .HYD
Outflow Hydrograph: c:\tjb\po165\SW2-T1 .HYD

EXECUTED: 07-21-1998
12:02:37

Peak Inflow = 27.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 535.70 ft



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*  File:  c:\tjb\po165\P2CON    .HYD   Qmax =    27.0 cfs
x  File:  c:\tjb\po165\SW2-T1   .HYD   Qmax =     0.0 cfs
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TABLE OF CONTENTS

EARTHWORK CALCS

Engineering Calculations
- Title and Summary Sheet 1
- Basis Sheet 2
- Summary Sheet, Site Preparation 3, 4
- Summary Sheet, Excavation Grading Plan 1 . . . . . 5, 6
- Summary Sheet, Excavation Grading Plan 2 . . . . . 7, 8
- Summary Sheet, Excavation Grading Plan 3 . . . . . 9, 10
- Methodology 11

SITE PREPARATION

Attachment A, Retention Basins
- Retention Basin 1 . . . . . A1
  - Impacted Stripping A2, A3
  - Impacted Cut A4, A5
  - Fill A6, A7
  - Infiltration Barrier A8, A9
  - Non-Impacted Cut A10, A11
  - Plan View/Section Locations A12
  - Cross-Sections A13
- Retention Basin 2
  - Impacted Stripping A14, A15
  - Impacted Cut A16, A17
  - Fill A18, A19
  - Infiltration Barrier A20, A21
  - Non-Impacted Cut A22, A23
  - Plan View/Section Locations A24
  - Cross-Sections, Sheet 1 . . . . . A25
  - Cross-Sections, Sheet 2 . . . . . A26
- Retention Basin 3
  - Impacted Stripping A27, A28
  - Impacted Cut A29. A30
  - Infiltration Barrier A31, A32
  - Non-Impacted Cut A33, A34
  - Plan View/Section Locations A35
  - Cross-Sections A36

Attachment B, Ditches & Misc. Excavation B1
- Volume Work Sheets B2-B24

TABLE OF CONTENTS (CONT.)

EXCAVATION GRADING PLAN 1

Attachment C, Excavation Grading Plan 1 . . . . . C1
Summary Sheet C2, C3
Grading Plan 1 . . . . . C4, C5
Above WAC Material C6, C7
Interceptor Ditch 1 . . . . . C8-C11
Interceptor Ditch 2 . . . . . C12, C13

EXCAVATION GRADING PLAN 2

Attachment D, Excavation Grading Plan 2 . . . . . D1
Summary Sheet D2, D3
Grading Plan 2 (IFP, SF) D4, D5
Grading Plan 2 (AFP) D6, D7
Lead Excavation D8-D10
Interceptor Ditch 3 . . . . . D11, D12

EXCAVATION GRADING PLAN 3

Attachment E, Excavation Grading Plan 3 . . . . . E1
Summary Sheet E2, E3
Grading Plan 3 (SF) E4, E5
Grading Plan 3 (AFP) E6, E7

Attachment F F1
Grading Plans/Section Locations/Cross Sections F2-F14

Attachment G G1
Grading Plans/Section Locations/Cross Sections G2-G5

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

1634

Date 12/5/97

Sheet 1 of 11

Proj. Order No. 165 Calculation No. 15-10

Project Title WASTE UNIT REMEDIATION

Calculation Subject EARTHWORK VOLUMES Date Verified/Checked 12/11/97

STATUS: PRELIMINARY ____ FINAL X SUPERSEDED ____ VOID ____

STATEMENT OF PROBLEM

ESTIMATE EARTHWORK QUANTITIES FOR SITE PREPARATION AND EXCAVATION PACKAGES

SUMMARY OF CONCLUSIONS	Originator's Signature and Date
SEE SUMMARY SHEETS	12-5-97
CHECKING METHOD	**Checker's Signature and Date**
1. Review ✓ 2. Alternate Calculation ____ * PAGES: 3, 5, 7, A20, C2, C4, C6, D2, D4, D8, D10, F3, D5	12-11-97
	Technical Lead's Signature and Date

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date
1	*	CHANGES FOR ABOVE WAC, Pb, & INFIL. BARRIER	C. Schroeder 4/4/98	YUNUS MFSHANI 4/4/98	C. Schroeder 4/4/98

10/96

ENG080

000665

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Revision No. 0
Sheet 2 of 11

Proj. Order No. 165 Calculation No. 15-10

Project Title WASTE UNIT REMEDIATION

Calculation Subject EARTHWORK VOLUMES Date Verified/Checked 12/11/97

Prepared By: T. BROWN TB Checked/Verified By: F. Parker

Date 12/5/97

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

1. DATA SOURCES:

   A. PARSONS, 1997, SITE PREPARATION PACKAGE

   B. PARSONS, 1997, EXCAVATION PACKAGE

2. CODES:

   N/A

3. ASSUMPTIONS:

   A. QUANTITIES GIVEN ARE BANK VOLUMES. NO SWELL OR SHRINKAGE FACTORS USED.

SITE PREPARATION

	IMPACTED MATERIAL STRIPPING (CY)	IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED INFILTRATION BARRIER EXCAVATION (CY)	FILL (CY)	INFILTRATION BARRIER PLACED (CY)	DUMPED ROCK FILL PLACED (CY)	GRAVEL PLACED (CY)
RETENTION BASIN 1	2604		7995	1965	761***	1965		
RETENTION BASIN 2	2934	9814	3597		6***			
RETENTION BASIN 3	553	2186	2134	506		506		
DITCH 1		128						
DITCH 2		73			120***		25	
DITCH 3		252						
DITCH 4		90						
DITCH 5		45						
DITCH 6		64						
DITCH 7		160						
DITCH 8		845					163	
DITCH 9		113						
DITCH 10		498					36	
DITCH 11		79						
DITCH 12		2712						
DITCH 13		185						
DITCH 14		379						
EQUIPMENT WASH AREA			209*		181***			
SUPPORT AREA			257*		121***			711
SWALES @ NON IMPACTED MATERIAL STOCKPILE #2		69						
BERMS @ NON IMPACTED MATERIAL STOCKPILE #2					593**			
BERM NORTH OF AFP					59**			
ROAD REGRADING (AT RETENTION BASIN 2)			73*		67			53
Swale Repair @ AFP			****				35	
SUBTOTAL	6091	17692	13726	2471				
TOTALS		23783	16197		67	2471	259	764

* Material to be used as fill within the area. Excess material to be used as contouring fill within immediate area as directed by Construction Manager.

** Material from Non-Impacted Material Stockpile

*** Material to be borrowed from Equipment Wash Area, Support Area, or other Non-Impacted material excavation areas designated by Construction Manager.

**** Excavate material as required to install Dumped Rock. Use as contouring fill within area.

Rev. 1; DELETED INFILTRATION BARRIER IN BASIN 2

SITEPRP

10:02 AM4/3/98

000667

1634

Sht 3 of 11

	IMPACTED MATERIAL STRIPPING (CY)	IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED INFILTRATION BARRIER EXCAVATION (CY)	FILL (CY)	INFILTRATION BARRIER PLACED (CY)	DUMPED ROCK FILL PLACED (CY)	GRAVEL PLACED (CY)
RETENTION BASIN 1	2604	0	7895	1965	761	1965		
RETENTION BASIN 2	2034	9814	3587	1024	6	1024		
RETENTION BASIN 3	553	2186	2134	506		506		
DITCH 1		129			0			
DITCH 2		73	0		120***	0	25	
DITCH 3		252	0			0		
DITCH 4		90	0			0	0	
DITCH 5		45	0			0		
DITCH 6		64	0			0	0	
DITCH 7		160	0			0		
DITCH 8		945	0			0	163	
DITCH 9		113				0	0	
DITCH 10		499	0				36	
DITCH 11		79						
DITCH 12		2712						
DITCH 13		165						
DITCH 14		379						
EQUIPMENT WASH AREA		0	208*		181			
SUPPORT AREA		0	257*		121			711
ON IMPACTED MATERIAL		69						
BERMS @ NON IMPACTED					583**			
BERM NORTH OF AFP					59**			
ROAD REGRADING (AT RETENTION BASIN 2)			73*		67			53
Swale Repair @ AFP			40				35	
SUBTOTAL	=SUM(R[-25]C:R[-2]C)	=SUM(R[-25]C:R[-2]C)	=SUM(R[-24]C:R[-1]C)	=SUM(R[-24]C:R[-1]C)				
TOTALS		=SUM(R[-1]C[-1],R[-1]C)	=SUM(R[-1]C,R[-1]C[1])		=SUM(R[-25]C:R[-2]C)	=SUM(R[-25]C:R[-2]C)	=SUM(R[-25]C:R[-2]C)	=SUM(R[-25]C:R[-2]C)

* Material to be used as fill within the area

** Material from Non-Impacted Material Stockpile

*** Material to be borrowed from Equipment Wash Area or other areas designated by Construction Manager.

EXCAVATION GRADING PLAN - 1

	IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED MATERIAL EXCAVATION (CY)	FILL (CY)	DUMPED ROCK FILL PLACED (CY)	ABOVE WAC MATERIAL (CY)
IFP EXCAVATION	116200				
INTERCEPTOR DITCH 1	2494		63**	150	
INTERCEPTOR DITCH 2	555				
ABOVE WAC MATERIAL					4800
TOTALS	119249	0	63	150	4800

** Material from excavation of Interceptor Ditch 1.

REV: 1 ; INCREASED ABOVE WAC MATERIAL TO 4800 yd³; REDUCED IFP CORRESPONDING AMOUNT

000669

1634

Sht 5 of 11

EXCAVATION GRADING PLAN - 1

	IMPACTED MATERIAL EXCAVATION	NON IMPACTED MATERIAL EXCAVATION	FILL	DUMPED ROCK FILE PLACED	ABOVE WAC MATERIAL
IFP EXCAVATION	~~117874~~ 116200				
INTERCEPTOR DITCH 1	2494		63	150	
INTERCEPTOR DITCH 2	555				
ABOVE WAC MATERIAL					~~9927~~ 4800
TOTALS	=SUM(B2:B9)	=SUM(C2:C9)	=SUM(D2:D9)	=SUM(E2:E9)	=SUM(F2:F9)

000670

SHT 6 of 11

EXCAVATION GRADING PLAN - 2

	IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED MATERIAL EXCAVATION (CY)	LEAD CONTAMINATED SOIL (CY)
SOUTH FIELD EXCAVATION -WEST	60000		
AFP EXCAVATION - TOP	38890		
INTERCEPTOR DITCH 3	548		
LEAD EXCAVATION			100
IMPACTED MAT'L STOCKPILE EXCAVATION	23783*		
TOTALS	99438	0	100

* Volume taken from Impacted Material excavated and stockpiled during Site Preparation.
See Site Preparation Summary Sheet (Sheet 3 of 11).

Rev 1; Reduced lead cont. Soil TO 100 yd3 — INCREASED SF EXCAVATION CORRESPONDING AMOUNT; ADJUSTED SOUTH FIELD EXCAVATION - WEST TO 60,000 yd3

023000

1634

Sht 7 of 11

EXCAVATION GRADING PLAN - 2

	IMPACTED MATERIAL EXCAVATION	NON IMPACTED MATERIAL EXCAVATION	LEAD CONTAMINATED SOIL
SOUTH FIELD EXCAVATION	~~120702~~ 60000		
AFP EXCAVATION	38890		
INTERCEPTOR DITCH 3	548		
LEAD EXCAVATION			~~127~~ 100
IMPACTED MAT'L STOCKPILE EXCAVATION	23783		
TOTALS	=SUM(R[-13]C:R[-1]C)	=SUM(R[-13]C:R[-1]C)	=SUM(R[-13]C:R[-1]C)

000672

5 of 8 11

EXCAVATION GRADING PLAN - 3

	IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED MATERIAL EXCAVATION (CY)				
SOUTH FIELD EXCAVATION	77038					
AFP EXCAVATION	22763					
TOTALS	99801	0				

000623

1634

Sat 9 Jul

EXCAVATION GRADING PLAN - 3

	IMPACTED MATERIAL EXCAVATION	NON IMPACTED MATERIAL EXCAVATION				
SOUTH FIELD EXCAVATION	77038					
AFP EXCAVATION	22763					
TOTALS	=SUM(R[-8]C:R[-1]C)	=SUM(R[-8]C:R[-1]C)				

000674

SHT 10 of 11

METHODOLOGY

This calculation supersedes the previous earthwork volume calculation, (Calculation No. 15-03, dated 5/5/97), and all subsequent revisions.

The attached earthwork quantities were taken from construction drawings prepared for the Site Preparation and Excavation Phases of Project Order 165. Earthwork quantities were calculated using either the average end-area method, or typical cross-sectional area times length.

For the average end-area method the cross-sections were cut by manually using Intergraph Microstation. Sectional areas and lengths were computed using either the measuring subroutine within Microstation, or simple mathematics.

All quantities given are in bank cubic yard measure. Swell or shrinkage was not considered.

For each spread sheet used to compute average end-area volumes and earthwork summaries, a duplicate spread sheet is attached giving the formulas used in the calculation.

While this calculation was being prepared, a parallel effort was being performed by Parsons to estimate the excavation volumes within the Retention Basins 1, 2 & 3. The Intergraph Inroads earthwork program was used to calculate the excavated volumes within the retention basins. As an additional check, the results of the Inroads analysis is included as Attachment G.

SHT A1

1634

ATTACHMENT A, RETENTION BASINS

SHT A2

BASIN 1, IMPACTED STRIPPING

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			47.70	10.40	496.08	496.08	
10.40	95.40						
			146.20	24.30	3552.66	4048.74	
34.70	197.00						
			203.25	33.80	6869.85	10918.59	
68.50	209.50						
			209.50	210.50	44099.75	55018.34	
279.00	209.50						
			258.90	0.60	155.34	55173.68	
279.60	308.30						
			194.15	69.30	13454.60	68628.28	
348.90	80.00						
			40.00	42.00	1680.00	70308.28	
390.90	0.00						
							2604.01

000677

SHT A3

BASIN 1, IMPACTED STRIPPING

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
10.4	95.4						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
34.7	197						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
68.5	209.5						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
279	209.5						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
279.6	308.3						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
348.9	80						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
390.9	0						
							=(G19)/27

000678

SHT A4

BASIN 1, IMPACTED CUT

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	10.40	0.00	0.00	
10.40	0.00						
			0.00	24.30	0.00	0.00	
34.70	0.00						
			0.00	33.80	0.00	0.00	
68.50	0.00						
			0.00	210.50	0.00	0.00	
279.00	0.00						
			0.00	0.60	0.00	0.00	
279.60	0.00						
			0.00	69.30	0.00	0.00	
348.90	0.00						
			0.00	42.00	0.00	0.00	
390.90	0.00						
							0.00

SKT A5

BASIN 1, IMPACTED CUT

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
10.4	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
34.7	0						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
68.5	0						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
279	0						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
279.6	0						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
348.9	0						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
390.9	0						
							=(G19)/27

000680

SHT A6

BASIN 1, FILL

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			78.65	10.40	817.96	817.96	
10.40	157.30						
			160.30	24.30	3895.29	4713.25	
34.70	163.30						
			113.85	33.80	3848.13	8561.38	
68.50	64.40						
			49.05	210.50	10325.03	18886.41	
279.00	33.70						
			40.35	0.60	24.21	18910.62	
279.60	47.00						
			23.50	69.30	1628.55	20539.17	
348.90	0.00						
			0.00	42.00	0.00	20539.17	
390.90	0.00						
							760.71

000681

SHT A7

BASIN 1, FILL

1634

STA	INCR. AREA (SF		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
10.4	157.3						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
34.7	163.3						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
68.5	64.4						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
279	33.7						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
279.6	47						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
348.9	0						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
390.9	0						
							=(G19)/27

000682

SHT A8

BASIN 1, INFIL. BARRIER

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	10.40	0.00	0.00	
10.40	0.00						
			52.95	24.30	1286.69	1286.69	
34.70	105.90						
			138.50	33.80	4681.30	5967.99	
68.50	171.10						
			180.20	210.50	37932.10	43900.09	
279.00	189.30						
			182.65	0.60	109.59	44009.68	
279.60	176.00						
			114.50	69.30	7934.85	51944.53	
348.90	53.00						
			26.50	42.00	1113.00	53057.53	
390.90	0.00						
							1965.09

000683

BASIN 1, INFIL. BARRIER

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
10.4	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
34.7	105.9						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
68.5	171.1						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
279	189.3						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
279.6	176						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
348.9	53						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
390.9	0						
							=(G19)/27

SHT A10

BASIN1, NON-IMPACTED CUT

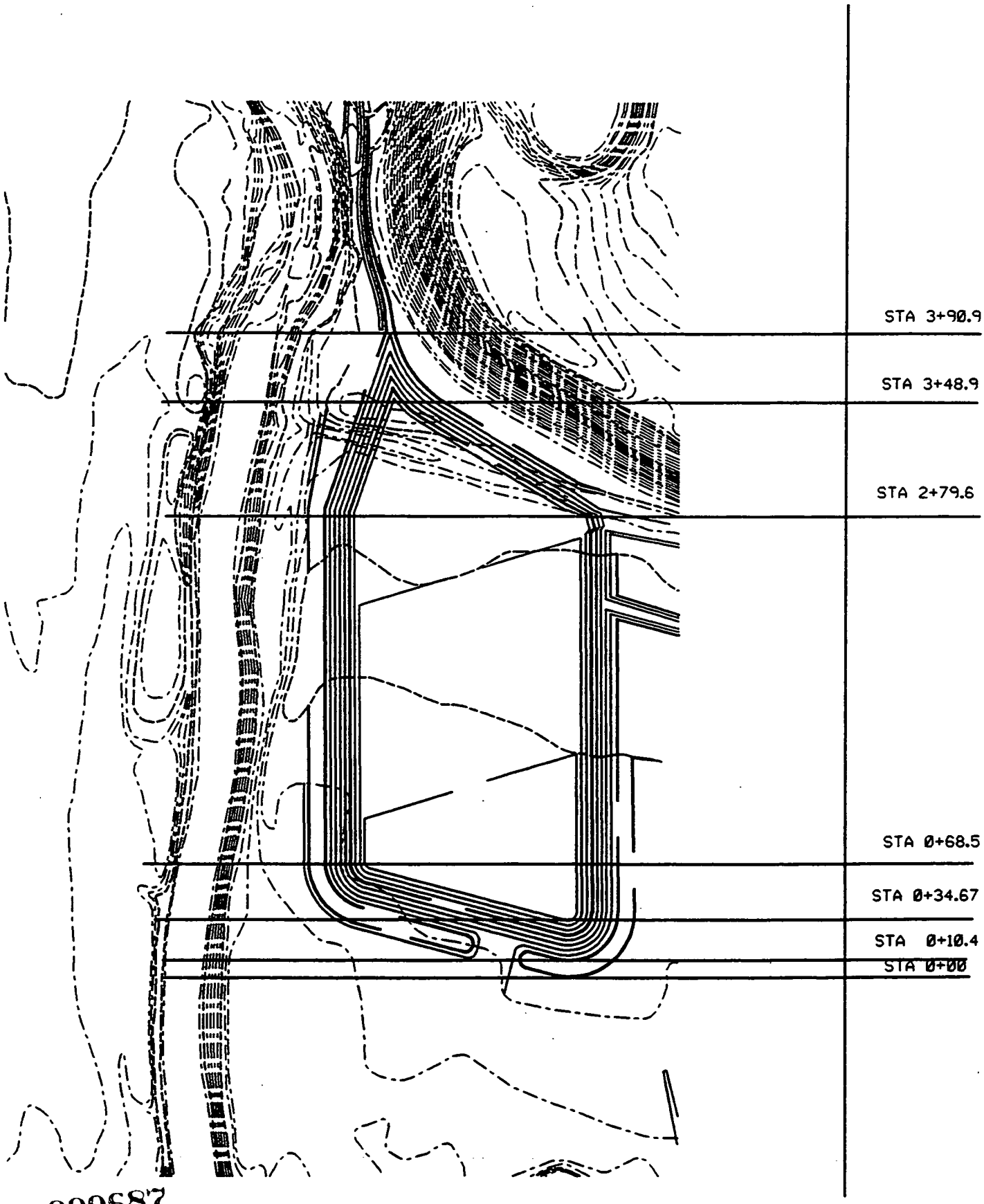
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	10.40	0.00	0.00	
10.40	0.00						
			151.95	24.30	3692.39	3692.39	
34.70	303.90						
			605.55	33.80	20467.59	24159.98	
68.50	907.20						
			779.35	210.50	164053.18	188213.15	
279.00	651.50						
			608.80	0.60	365.28	188578.43	
279.60	566.10						
			351.95	69.30	24390.14	212968.57	
348.90	137.80						
			68.90	42.00	2893.80	215862.37	
390.90	0.00						
							7994.90

000685

BASIN1, NON-IMPACTED CUT

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
10.4	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
34.7	303.9						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
68.5	907.2						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
279	651.5						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
279.6	566.1						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
348.9	137.8						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
390.9	0						
							=(G19)/27

SHT A12



000687

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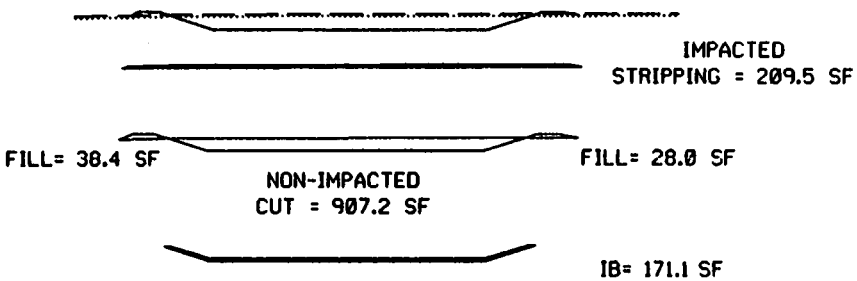

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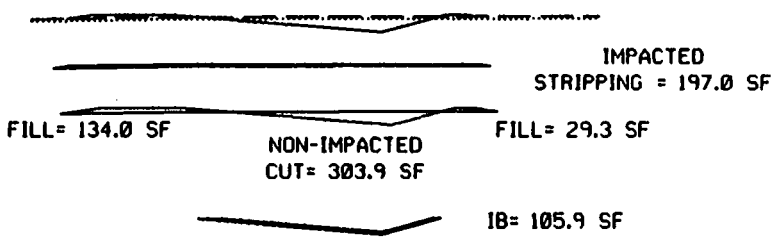
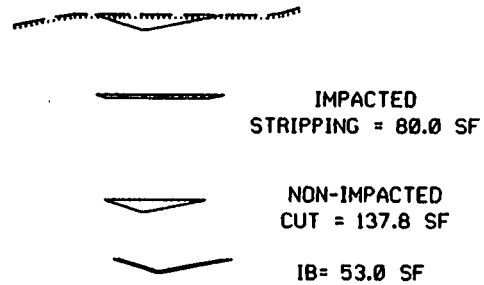
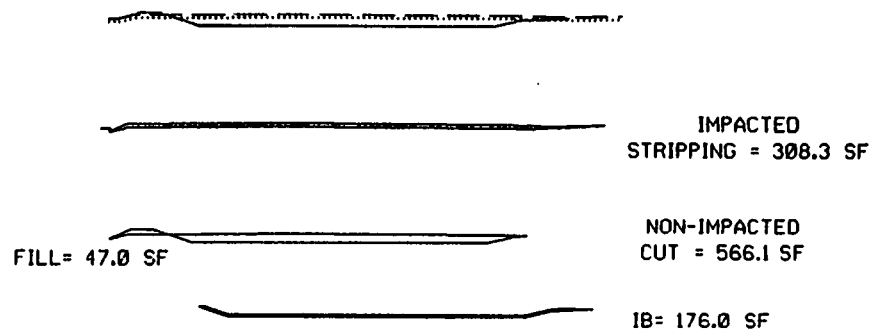


STA 0+10.4

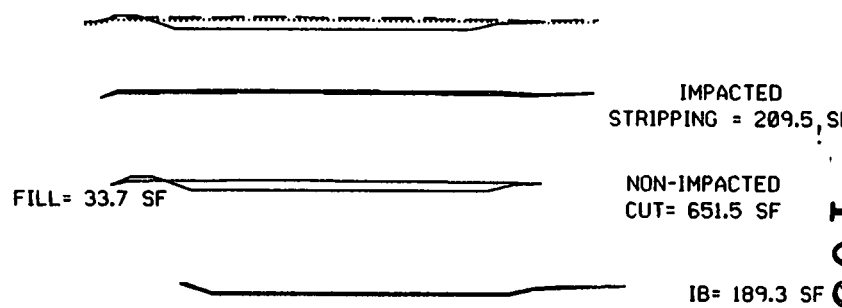
STA 3+48.9



STA 2+79.6



STA 2+79.0



000688

SHT A14

BASIN 2, IMPACTED STRIPPING

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	39.60	0.00	0.00	
39.60	0.00						
			148.25	48.30	7160.48	7160.48	
87.90	296.50						
			300.45	19.70	5918.87	13079.34	
107.60	304.40						
			288.65	66.20	19108.63	32187.97	
173.80	272.90						
			280.05	45.80	12826.29	45014.26	
219.60	287.20						
			276.80	34.60	9577.28	54591.54	
254.20	266.40						
			230.90	42.50	9813.25	64404.79	
296.70	195.40						
			176.60	42.70	7540.82	71945.61	
339.40	157.80						
			130.70	49.40	6456.58	78402.19	
388.80	103.60						
			51.80	15.80	818.44	79220.63	
404.60	0.00						
			0.00	37.70	0.00	79220.63	
442.30	0.00						
							2934.10

000689

SHT A15

1634

BASIN 2, IMPACTED STRIPPING

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
39.6	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
87.9	296.5						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.6	304.4						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
173.8	272.9						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
219.6	287.2						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
254.2	268.4						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
298.7	195.4						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
339.4	157.8						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
388.8	103.6						
			=SUM(B24,B26)/2	=(A26-A24)	=PRODUCT(D25,E25)	=SUM(G23,F25)	
404.6	0						
			=SUM(B26,B28)/2	=(A28-A26)	=PRODUCT(D27,E27)	=SUM(G25,F27)	
442.3	0						
							=(G27)/27

000690

SHT A16

BASIN 2, IMPACTED CUT

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			262.90	39.60	10410.84	10410.84	
39.60	525.80						
			677.50	48.30	32723.25	43134.09	
87.90	829.20						
			863.45	19.70	17009.97	60144.06	
107.60	897.70						
			912.15	66.20	60384.33	120528.39	
173.80	926.60						
			948.45	45.80	43439.01	163967.40	
219.60	970.30						
			909.75	34.60	31477.35	195444.75	
254.20	849.20						
			598.90	42.50	25453.25	220898.00	
296.70	348.60						
			267.10	42.70	11405.17	232303.17	
339.40	185.60						
			359.80	49.40	17774.12	250077.29	
388.80	534.00						
			466.50	15.80	7370.70	257447.99	
404.60	399.00						
			199.50	37.70	7521.15	264969.14	
442.30	0.00						
							9813.67

000691

SHT A17

1634

BASIN 2, IMPACTED CUT

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
39.6	525.8						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
87.9	829.2						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.6	897.7						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
173.8	926.6						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
219.6	970.3						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
254.2	849.2						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
296.7	348.6						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
339.4	185.6						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
368.6	534						
			=SUM(B24,B26)/2	=(A26-A24)	=PRODUCT(D25,E25)	=SUM(G23,F25)	
404.6	399						
			=SUM(B26,B28)/2	=(A28-A26)	=PRODUCT(D27,E27)	=SUM(G25,F27)	
442.3	0						
							=(G27)/27

000692

SHT A18

BASIN 2, FILL

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	39.60	0.00	0.00	
39.60	0.00						
			0.00	48.30	0.00	0.00	
87.90	0.00						
			0.00	19.70	0.00	0.00	
107.60	0.00						
			0.00	66.20	0.00	0.00	
173.80	0.00						
			0.00	45.80	0.00	0.00	
219.60	0.00						
			0.00	34.60	0.00	0.00	
254.20	0.00						
			0.00	42.50	0.00	0.00	
296.70	0.00						
			0.00	42.70	0.00	0.00	
339.40	0.00						
			0.75	49.40	37.05	37.05	
388.80	1.50						
			2.95	15.80	46.61	83.66	
404.60	4.40						
			2.20	37.70	82.94	166.60	
442.30	0.00						
							6.17

000693

SHT A19

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B5)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
39.6	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
87.9	0						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.6	0						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
173.8	0						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
219.6	0						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
254.2	0						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
296.7	0						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
339.4	0						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
388.8	1.5						
			=SUM(B24,B26)/2	=(A26-A24)	=PRODUCT(D25,E25)	=SUM(G23,F25)	
404.6	4.4						
			=SUM(B26,B28)/2	=(A28-A26)	=PRODUCT(D27,E27)	=SUM(G25,F27)	
442.3	0						
							=(G27)/27

000694

SHT A20

BASIN 2, INFIL. BARRIER

STA	INCR. AREA (SF)	AVG. AREA (SF	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00					
		0.00	39.60	0.00	0.00	
39.60	0.00					
		48.40	48.30	2337.72	2337.72	
87.90	96.80					
		96.20	19.70	1895.14	4232.86	
107.60	95.60					
		91.85	66.20	6080.47	10313.33	
173.80	88.10					
		87.90	45.80	4025.82	14339.15	
219.60	87.70					
		87.15	34.60	3015.39	17354.54	
254.20	86.60					
		81.55	42.50	3465.88	20820.42	
296.70	76.50					
		67.40	42.70	2877.98	23698.40	
339.40	58.30					
		52.85	49.40	2610.79	26309.19	
388.80	47.40					
		41.70	15.80	658.86	26968.05	
404.60	36.00					
		18.00	37.70	678.60	27646.65	
442.30	0.00					
						1023.95

REV. 1, INFILTRATION BARRIER NOT USED IN BASIN 2

000695

1634 SHT A21

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
39.6	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
87.9	96.8						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.6	95.6						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
173.8	88.1						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
219.6	87.7						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
254.2	86.6						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
296.7	76.5						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
339.4	58.3						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
388.8	47.4						
			=SUM(B24,B26)/2	=(A26-A24)	=PRODUCT(D25,E25)	=SUM(G23,F25)	
404.6	35						
			=SUM(B26,B28)/2	=(A28-A26)	=PRODUCT(D27,E27)	=SUM(G25,F27)	
442.3	0						
							=(G27)/27

000696

SHT A22

BASIN 2, NON-IMPACTED CUT

STA	INCR. AREA (SF)	AVG. AREA (SF	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00					
		0.00	39.60	0.00	0.00	
39.60	0.00					
		227.85	48.30	11005.16	11005.16	
87.90	455.70					
		462.05	19.70	9102.38	20107.54	
107.60	468.40					
		445.35	66.20	29482.17	49589.71	
173.80	422.30					
		386.05	45.80	17681.09	67270.80	
219.60	349.80					
		344.00	34.60	11902.40	79173.20	
254.20	338.20					
		237.10	42.50	10076.75	89249.95	
296.70	136.00					
		101.05	42.70	4314.84	93564.79	
339.40	66.10					
		44.10	49.40	2178.54	95743.33	
388.80	22.10					
		33.35	15.80	526.93	96270.26	
404.60	44.60					
		22.30	37.70	840.71	97110.97	
442.30	0.00					
						3596.70

000697

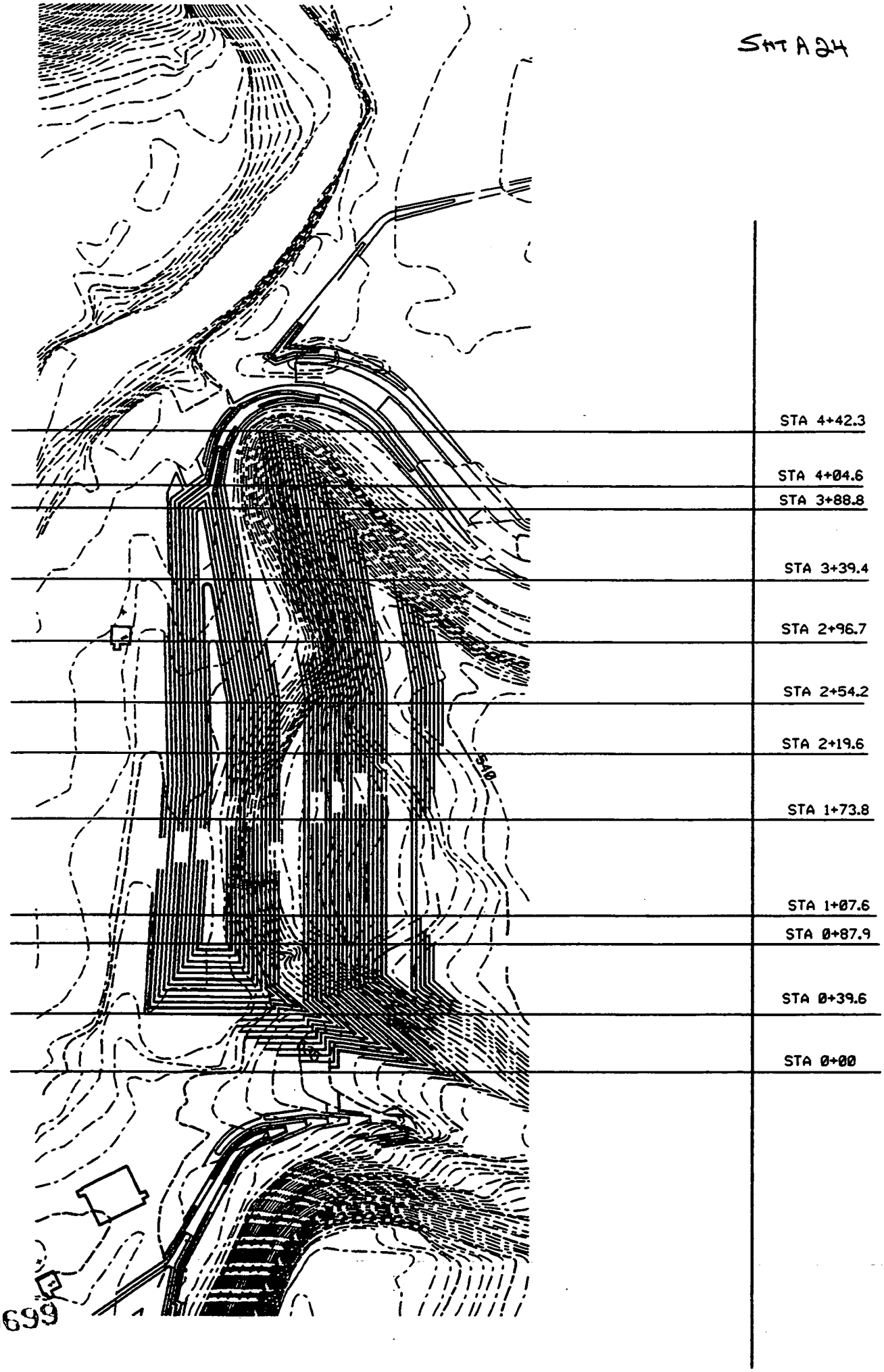
SHT A23

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
39.6	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
57.9	455.7						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.6	468.4						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
173.8	422.3						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
219.6	349.8						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
254.2	338.2						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
296.7	136						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
339.4	66.1						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
388.8	22.1						
			=SUM(B24,B26)/2	=(A26-A24)	=PRODUCT(D25,E25)	=SUM(G23,F25)	
404.6	44.6						
			=SUM(B26,B28)/2	=(A28-A26)	=PRODUCT(D27,E27)	=SUM(G25,F27)	
442.3	0						
							=(G27)/27

000698

SHT A24

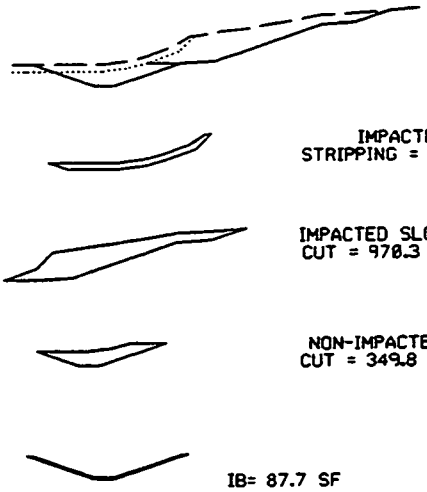


000699

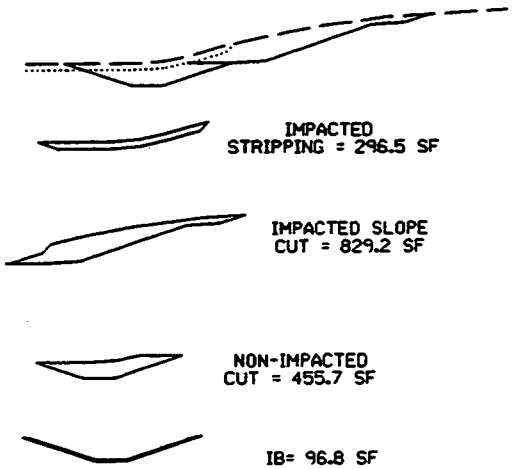
SHT A25

1634

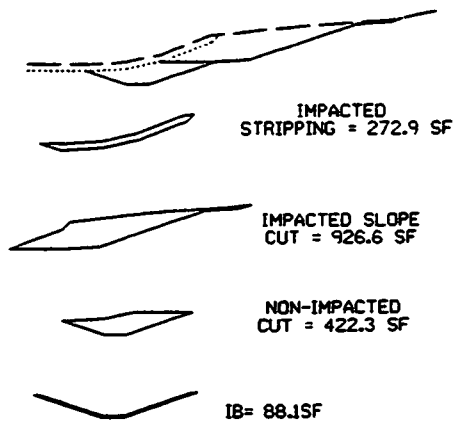
STA 2+19.6



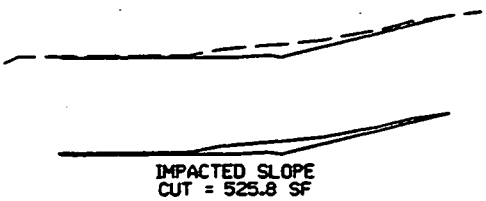
STA 0+87.9



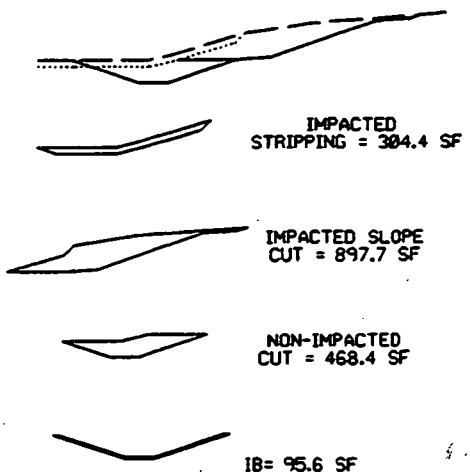
STA 1+73.8



STA 0+39.6

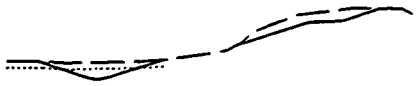


STA 1+07.6



SHT A26

STA 2+96.7



IMACPTED
STRIPPING = 195.4 SF

IMPACTED SLOPE
CUT = 348.6 SF

NON-IMPACTED
CUT = 136.0 SF

IB= 76.5 SF

STA 2+54.2

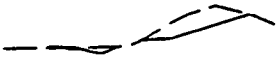
IMPACTED
STRIPPING = 266.4 SF

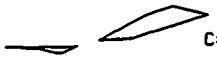
IMPACTED SLOPE
CUT = 849.2 SF

NON-IMPACTED
CUT = 338.2 SF

IB= 86.6 SF

STA 4+04.6





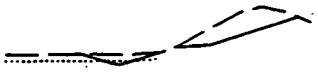
C= 399.0 SF

F= 4.4 SF

C= 44.6 SF

IB= 36.0 SF

STA 3+88.8



IMACPTED
STRIPPING = 103.6 SF

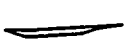
IMPACTED SLOPE
CUT = 534.0 SF

F= 1.5 SF

NON-IMPACTED
CUT = 22.1 SF

IB= 47.4 SF

STA 3+39.4



IMACPTED
STRIPPING = 157.8 SF

IMPACTED SLOPE
CUT = 185.6 SF

NON-IMPACTED
CUT = 66.1 SF

IB= 58.3 SF

000701

SHT A27

BASIN 3, IMPACTED STRIPPING

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	32.00	0.00	0.00	
32.00	0.00						
			31.80	32.90	1046.22	1046.22	
64.90	63.60						
			70.15	81.10	5689.17	6735.39	
146.00	76.70						
			70.05	55.20	3866.76	10602.15	
201.20	63.40						
			62.70	54.30	3404.61	14006.76	
255.50	62.00						
			31.00	29.70	920.70	14927.46	
285.20	0.00						
							552.87

000702

SHT A28

BASIN 3, IMPACTED STRIPPING

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
32	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
64.9	63.6						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
146	78.7						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
201.2	63.4						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
255.5	62						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
285.2	0						
							=(G17)/27

000703

SHT A29

1634

BASIN 3, IMPACTED CUT

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			123.60	32.00	3955.20	3955.20	
32.00	247.20						
			239.30	32.90	7872.97	11828.17	
64.90	231.40						
			250.95	81.10	20352.05	32180.22	
146.00	270.50						
			268.75	55.20	14835.00	47015.22	
201.20	267.00						
			190.05	54.30	10319.72	57334.93	
255.50	113.10						
			56.55	29.70	1679.54	59014.47	
285.20	0.00						
							2185.72

000704

SHT A30

BASIN 3, IMPACTED CUT

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
32	247.2						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
64.9	231.4						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
146	270.5						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
201.2	287						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
255.5	113.1						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
285.2	0						
							=(G17)/27

000705

SHT A31

1634

BASIN 3, INFIL. BARRIER

STA	INCR. AREA (SF)	AVG. AREA (SF	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00					
		0.00	32.00	0.00	0.00	
32.00	0.00					
		36.05	32.90	1186.05	1186.05	
64.90	72.10					
		77.75	81.10	6305.53	7491.57	
146.00	83.40					
		77.05	55.20	4253.16	11744.73	
201.20	70.70					
		35.35	54.30	1919.51	13664.24	
255.50	0.00					
		0.00	29.70	0.00	13664.24	
285.20	0.00					
						506.08

000706

SHT A32

BASIN 3, INFIL. BARRIER

STA	INCR. AREA (SF)	AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0					
		=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
32	0					
		=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
64.9	72.1					
		=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
146	83.4					
		=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
201.2	70.7					
		=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
255.5	0					
		=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
285.2	0					
						=(G17)/27

000707

SHT A33

1634

BASIN 3, NON-IMPACTED CUT

STA	INCR. AREA (SF)	AVG. AREA (SF	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00					
		0.00	32.00	0.00	0.00	
32.00	0.00					
		146.00	32.90	4803.40	4803.40	
64.90	292.00					
		350.85	81.10	28453.94	33257.34	
146.00	409.70					
		324.10	55.20	17890.32	51147.66	
201.20	238.50					
		119.25	54.30	6475.28	57622.93	
255.50	0.00					
		0.00	29.70	0.00	57622.93	
285.20	0.00					
						2134.18

000708

SHT A34

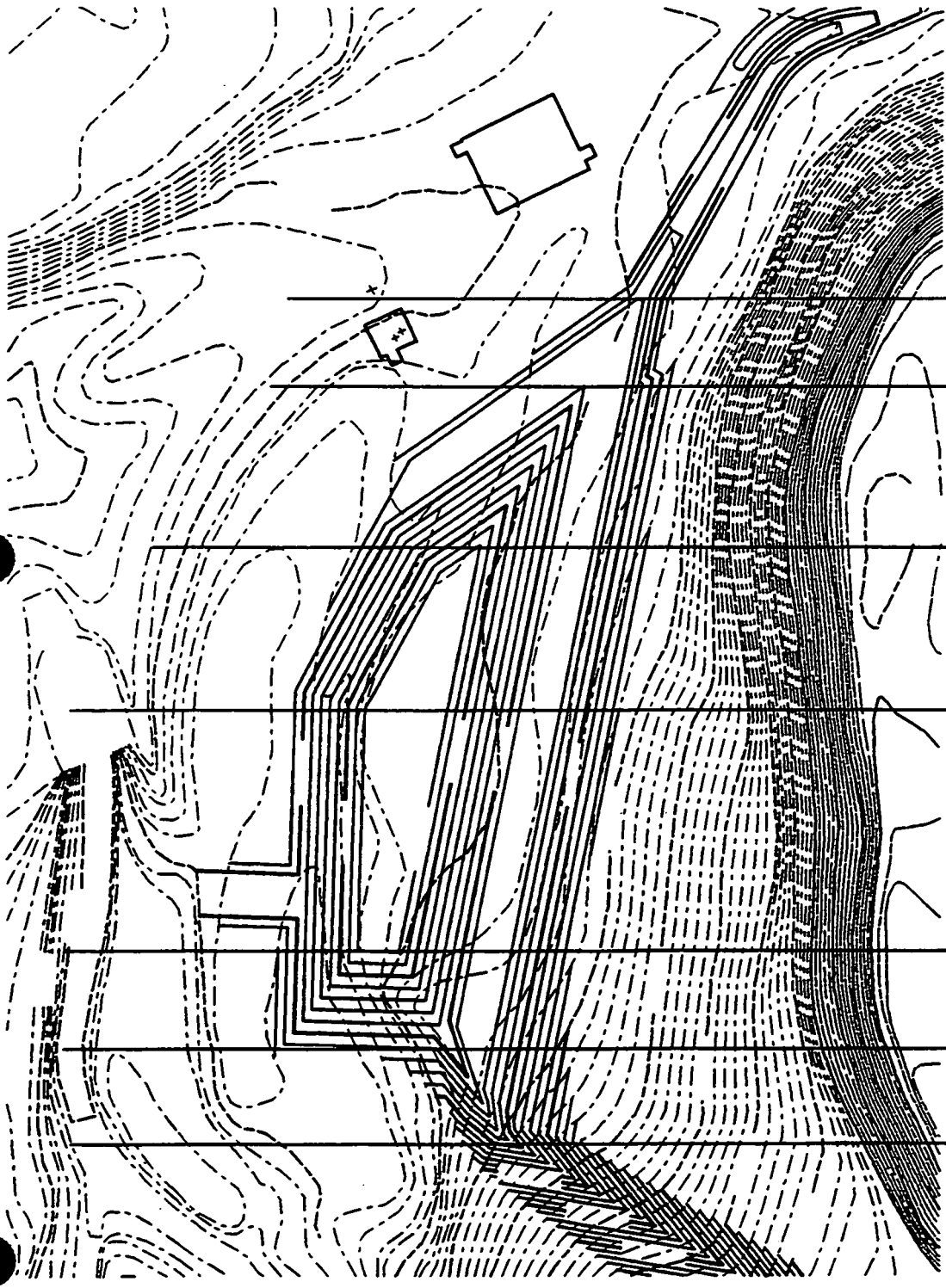
BASIN 3, NON-IMPACTED CUT

STA	INCR. AREA (SF)	AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0					
		=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
32	0					
		=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
84.9	292					
		=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
146	409.7					
		=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
201.2	238.5					
		=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
255.5	0					
		=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
285.2	0					
						=(G17)/27

000709

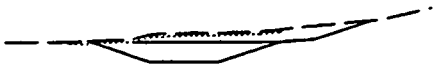
SHT A35

1634

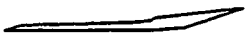


000710

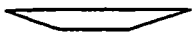
STA 1+46



IMPACTED
STRIPPING = 76.7 SF



IMPACTED SLOPE
CUT = 270.5 SF

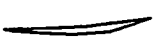


NON-IMPACTED
CUT = 409.7 SF

IB = 83.4 SF

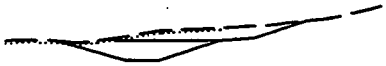
STA 2+55.5

IMPACTED
STRIPPING = 62.0 SF



IMPACTED SLOPE
CUT = 113.1 SF

STA 0+64.9



IMPACTED
STRIPPING = 63.6 SF

IMPACTED SLOPE
CUT = 231.4 SF

NON-IMPACTED
CUT = 292.0 SF

IB = 72.1 SF

STA 2+01.2

IMPACTED
STRIPPING = 63.4 SF

IMPACTED SLOPE
CUT = 267.0 SF

NON-IMPACTED
CUT = 238.5 SF

IB = 70.7 SF

STA 0+32

IMPACTED SLOPE
CUT = 247.2 SF

SHT B1

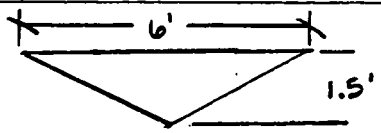
1634

ATTACHMENT B, DITCHES & MISC. EXCAVATION

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of B2

Rev	Date	By	Ck	Title

DITCH - D1



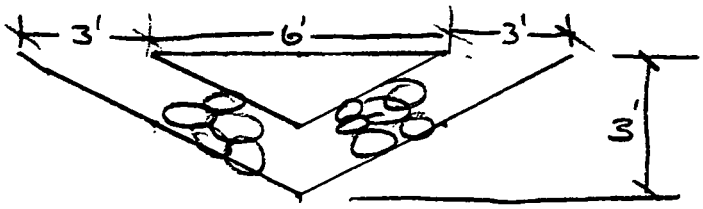
AREA = $[\frac{1}{2}(3) \times 1.5] \times 2 = 4.5$ SF

LENGTH ≅ 767'

VOL = 4.5 SF × 767 FT = 3451.5 CF/27 CF/CY = 127.8 CY

DITCH - D2

RIPRAP SECTION



AREA = $[\frac{1}{2}(6) \times 3] \times 2 = 18$ SF

LENGTH ≅ 50'

VOLUME = 18 SF × 50 FT = 900 CF/27 CF/CY = 33.3 CY

VOL RIPRAP = 18 SF − 4.5 SF = 13.5 SF × 50 FT = 675 CF/27 CF/CY = 25 CY

GRASS SECTION - SAME AS D1

AREA = 4.5 SF

LENGTH ≅ 235 FT

VOLUME = 4.5 SF × 235 FT = 1057.5 CF/27 CF/CY = 39.2 CY

000713

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B3

Rev	Date	By	Ck	Title

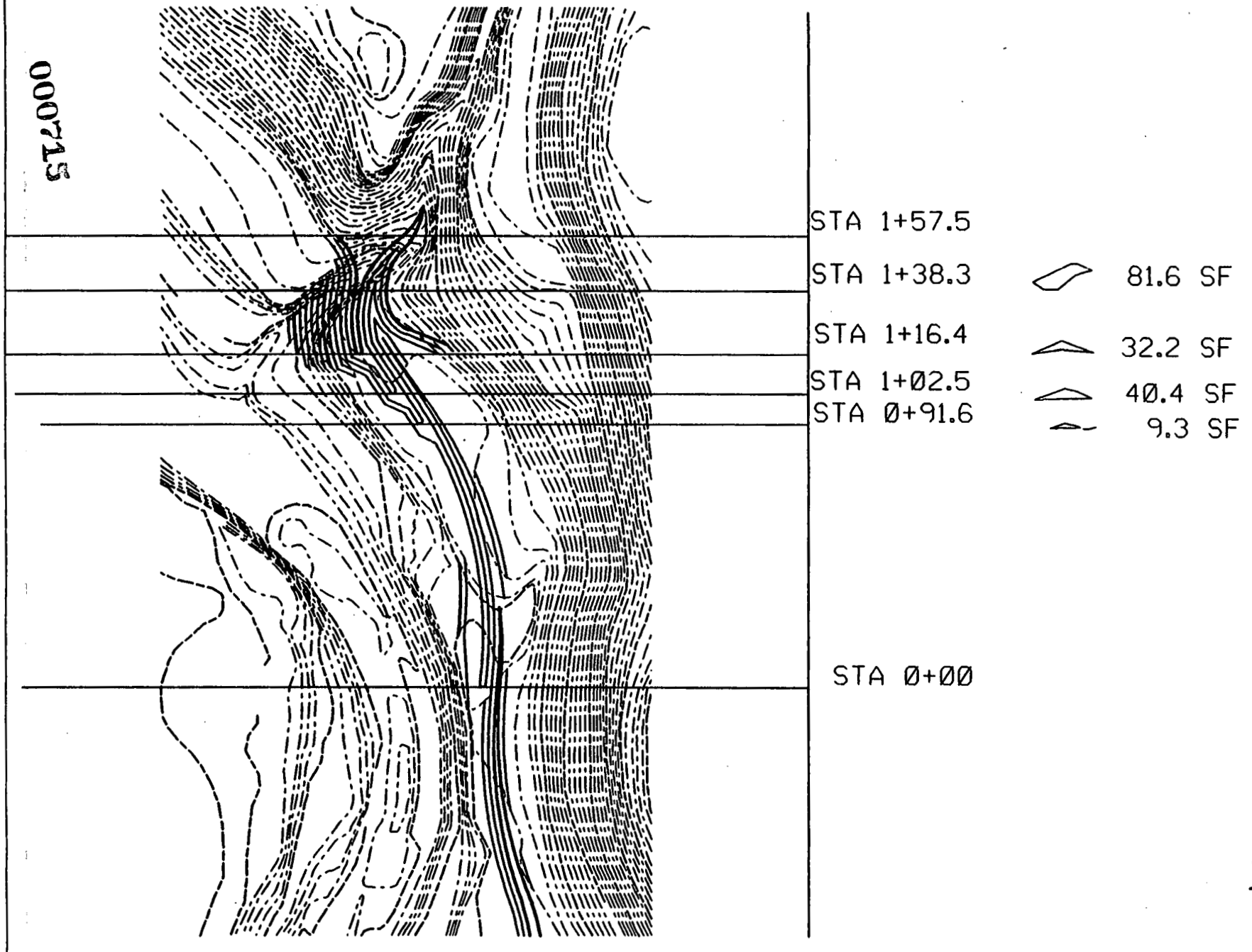
1634

DITCH - D-2 FILL

STA	AREA	AREA	L	VOL	ΣVOL
0+00	0				
		4.7	91.6	430.5	430.5
0+91.6	9.3				
		24.9	10.9	271.4	701.9
1+02.5	40.4				
		36.3	13.9	504.6	1206.5
1+16.4	32.2				
		56.9	21.9	1246.1	2452.6
1+38.3	81.6				
		40.8	19.2	783.4	3236.0
1+57.5	0				

TOTAL VOL = 3236/27 = 120 CY

000714



000715

SHT 84

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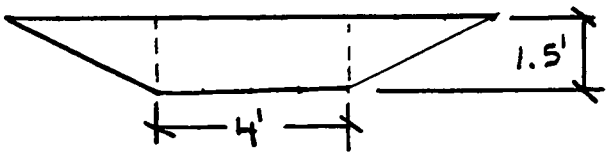
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				85

Rev	Date	By	Ck	Title
				1634

DITCH - 3

4' SECTION

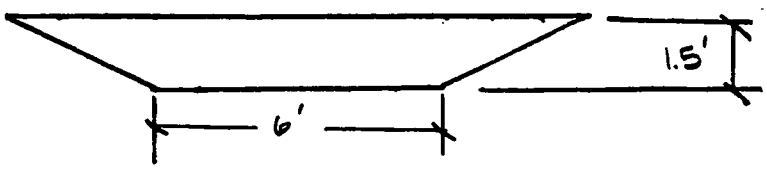


AREA = ½(3)×1.5 + (4 × 1.5) + ½(3)×1.5 = 10.5 SF

LENGTH OF 4' SECTION ≅ 66'

VOLUME = 10.5 SF × 66 FT = 693 CF / 27 CF/CY = 25.7 CY

TRANSITION SECTION FROM 4' TO 8' BOTTOM

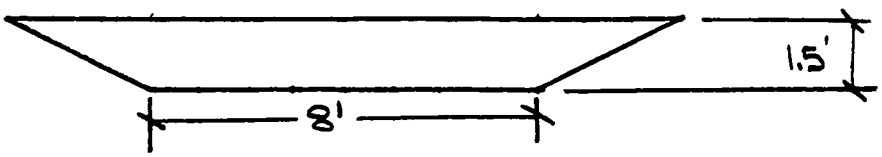


AREA = [½(3)×1.5×2] + [6×1.5] = 13.5 SF

LENGTH OF TRANSITION SECTION ≅ 140 FT

VOLUME = 13.5 SF × 140 FT = 1890 CF / 27 CF/CY = 70 CY

8' SECTION



AREA = (½(3)×1.5×2) + (8×1.5) = 16.5 SF

LENGTH ≅ 255 FT

VOLUME = 16.5 SF × 255 FT = 4207.5 CF / 27 CF/CY = 155.8 CY

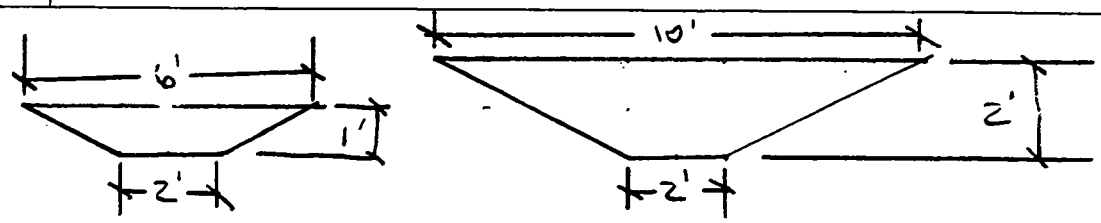
000716

ENG-GE-30 (031896)

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B6

Rev	Date	By	Ck	Title

DITCH - D-4



1' DEPTH ≅ 192'

2' DEPTH ≅ 140'

$A = [\frac{1}{2}(2) \times 1] \times 2 + (2 \times 1) = 4.0\,SF$

$A = [\frac{1}{2}(4) \times 2] \times 2 + (2 \times 2) = 12.0\,SF$

VOL = 4.0 SF × 192 FT = 768 CF

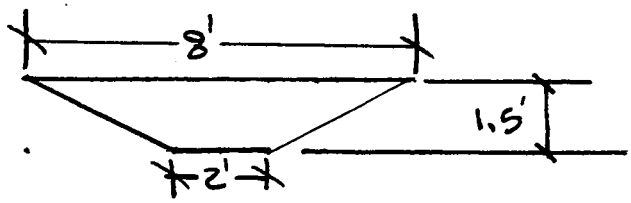
VOL = 12.0 SF × 140 FT = 1680 CF

Σ VOL. = 768 + 1680 CF = 2448 CF / 27 CF/CY = 90 CY

DITCH - D-5 USE 1' AVG. DEPTH, SAME GEOMETRY AS D-4

A = 4.0 SF × 300 FT = 1200 CF / 27 CF/CY = 44.5 CY

DITCH - D-6



AREA = $[\frac{1}{2}(3) \times 1.5] \times 2 + (2 \times 1.5) = 7.5\,SF$

VOL. = 7.5 SF × 230 FT = 1725 CF / 27 CF/CY = 64 CY

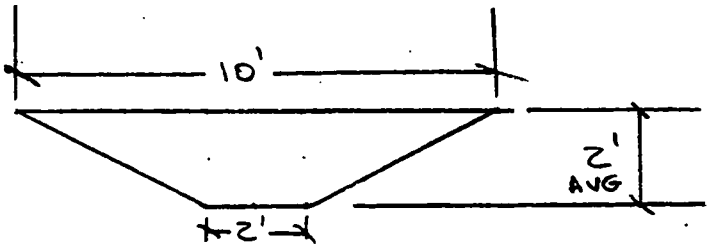
000717

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B7

Rev	Date	By	Ck	Title
				1634

DITCH - D-7

LENGTH ≅ 360'



$A = [\frac{1}{2}(4) \times 2] \times 2 + (2 \times 2) = 12.0 SF$

VOL. = 12.0 SF × 360 FT = 4320 CF/27 CF/CY = 160 CY

DITCH - D-8A SEE ATTACHED

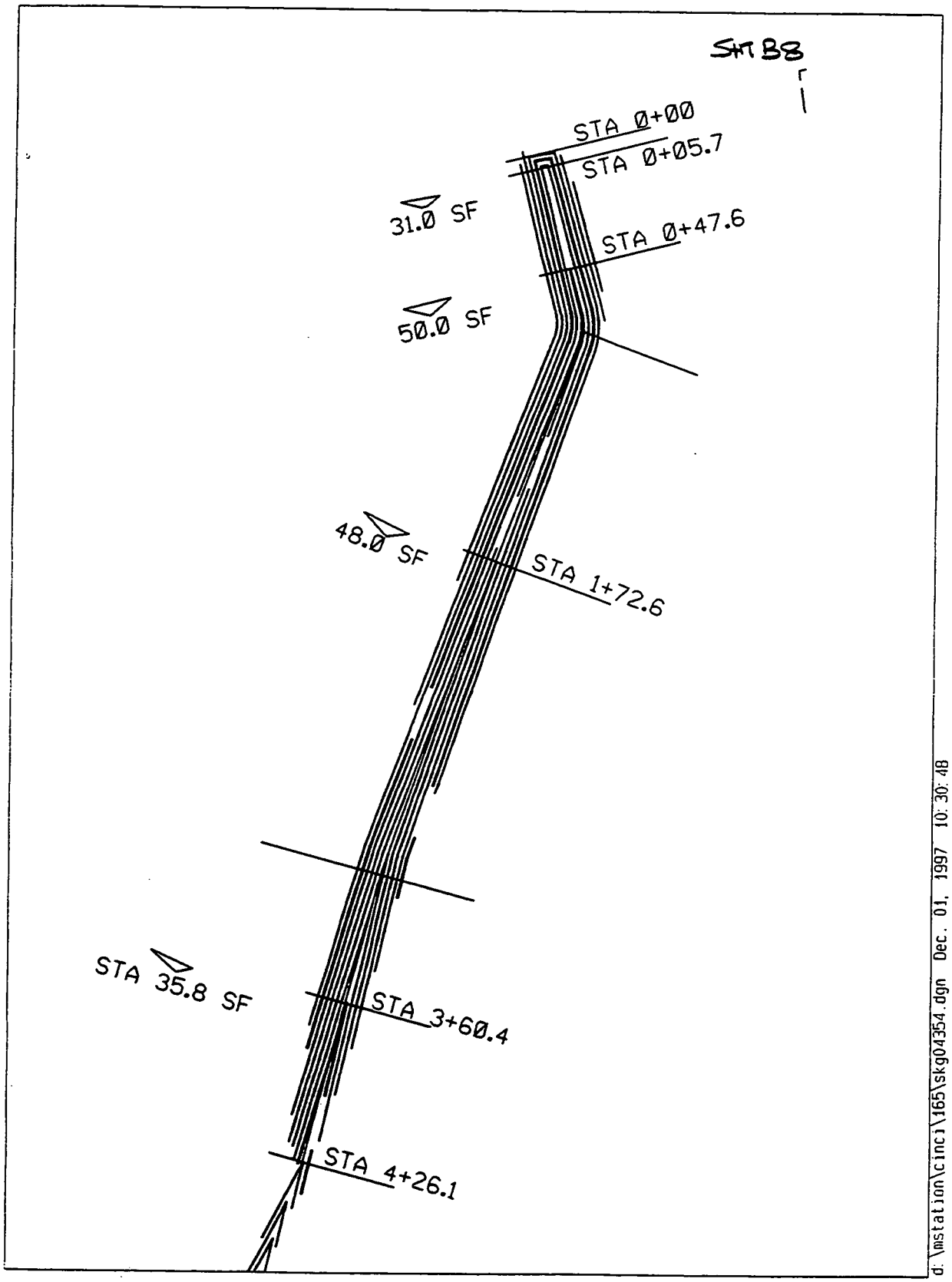
LENGTH ≅ 420 FT

STA	AREA	AREA	L	VOL	Σ VOL
0+00	0				
		15.5	5.7	88.4	88.4
0+05.7	31.0				
		40.5	41.9	1697.0	1785.4
0+47.6	50.0				
		49.0	125.0	6125.0	7910.4
1+72.6	48.0				
		41.9	187.8	7868.0	15779.2
3+60.4	35.8				
		17.9	65.7	1176.0	16955.2/27
4+26.1	0				

VOL = 628 CY

000718

ENG-GE-30 (031896)



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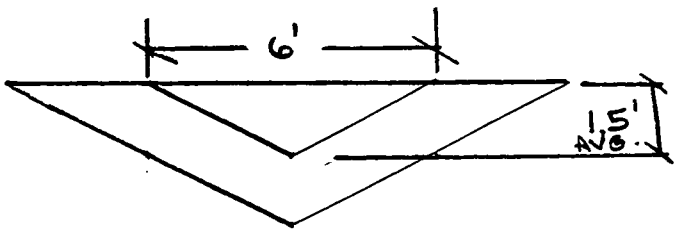
000719

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				89

Rev	Date	By	Ck	Title

1634

DITCH - 8-B



FROM DITCH 2

AREA = 18.0 SF

LENGTH = 325 ft

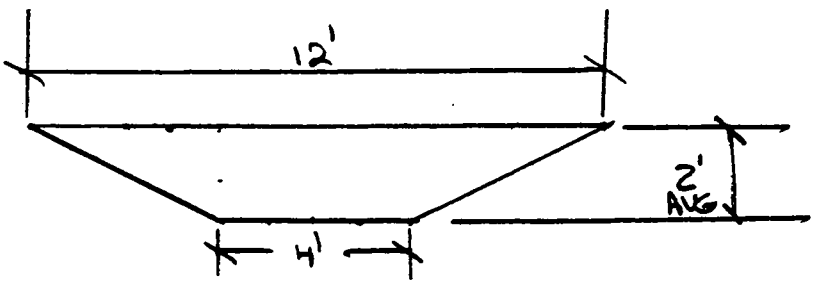
VOL = 18.0 SF × 325 FT = 5850 CF / 27 CF/CY = 217 CY

VOL RIPRAP = 18.0 SF − 4.5 SF = 13.5 SF

13.5 SF × 325 FT = 4387.5 CF / 27 CF/CY = 162.5 CY

DITCH - D-9

LENGTH ≅ 190'



$A = \left[\frac{1}{2}(4) \times 2\right] \times 2 + (4 \times 2) = 16.0\ SF$

VOL = 16.0 SF × 190 LF = 3040 CF / 27 CF/CY = 112.6 CY

000720

ENG-GE-30 (031896)

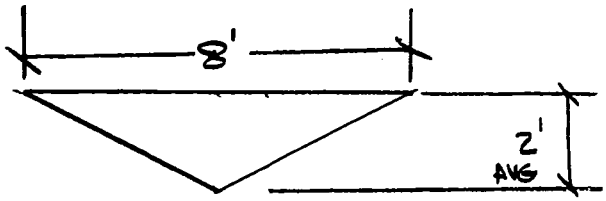
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of B10

Rev	Date	By	Ck	Title

D-10A

LENGTH ≅ 120'

AVG DEPTH = 1' → 3' USE 2'

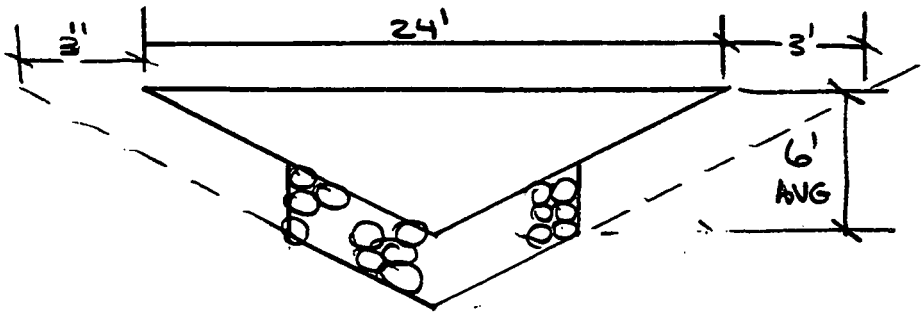


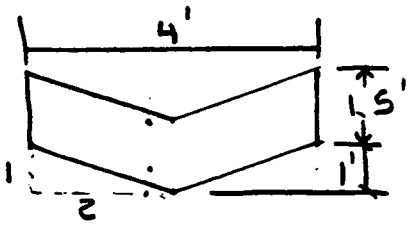
AREA = [½(4) × 2] × 2 = 8.0 SF

VOL = 8.0SF × 120 FT = 960 CF / 27 CF/CY = 35.6 CY

D-10B

LENGTH = 160 FT





A = 4 × 2.5 = 10.0SF −

½(2) × 1 × 2 = 2 = 8.0SF −

½(2) × 1 × 2 = 6.0SF

RIPRAP = 6.0 SF

EXC = [½(12) × 6 × 2] + 6.0SF = 78.0SF

VOL EXC = 78.0 SF × 160 FT = 12480 CF / 27 CF/CY = 462 CY

VOL RIPRAP = 6.0SF × 160 FT = 960 CF / 27 CF/CY = 36 CY

000721

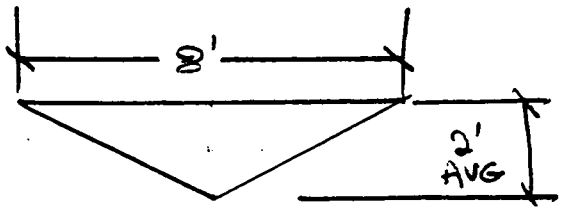
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B11

Rev	Date	By	Ck	Title
				1634

DITCH 11 ABOVE CULVERT 2

1' DEPTH UPPER END
3' LOWER } USE 2'

LENGTH – 175'



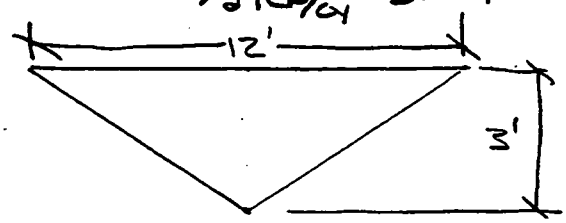
AREA = ½ (4) × 2 × 2 = 8.0SF

VOL = 175FT × 8.0SF = 1400 CF/27CF/CY = 52 CY

BELOW CULVERT 2

LENGTH ≅ 40 FT

AVG DEPTH – 3'



AREA = [½ (6) × 3] × 2 = 18.0 SF

VOL. 18.0SF × 40 FT = 720 CF/27CF/CY = 27 CY

TOTAL = 52CY + 27CY = 79 CY

000722

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of B12

Rev	Date	By	Ck	Title

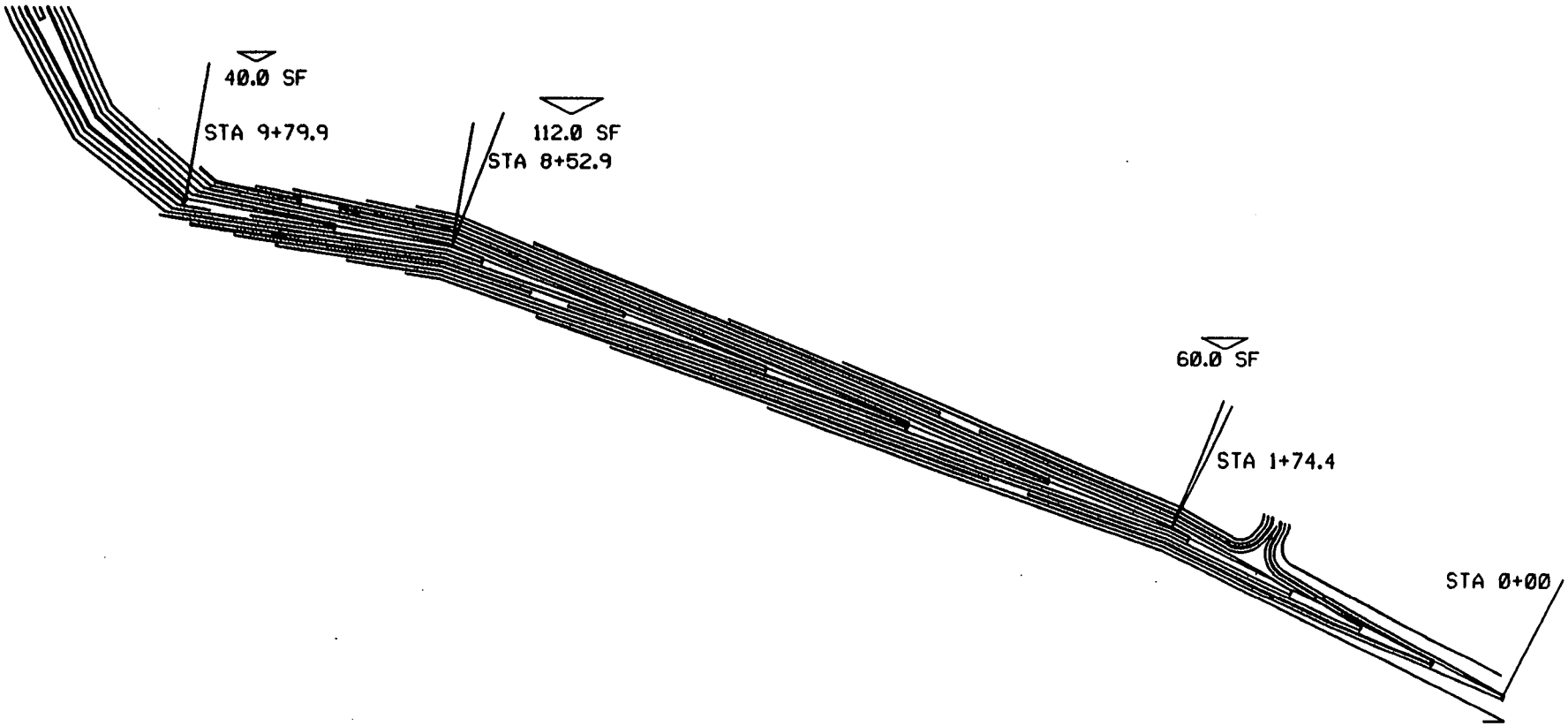
DITCH -12

STA	AREA	AREA	L	VOL	Σ VOL
0+00	0				
		30.0	174.4	5232.0	5232.0
174.4	60				
		86.0	678.5	58351.0	63583.0
852.9	112.0				
		76.0	127.0	9652.0	73235.0
979.9	40.0				

TOTAL VOL = 73235.0 CF/27 = 2712 CY

SEE ATTACHED

000723



SHT 8/3

1634

000724

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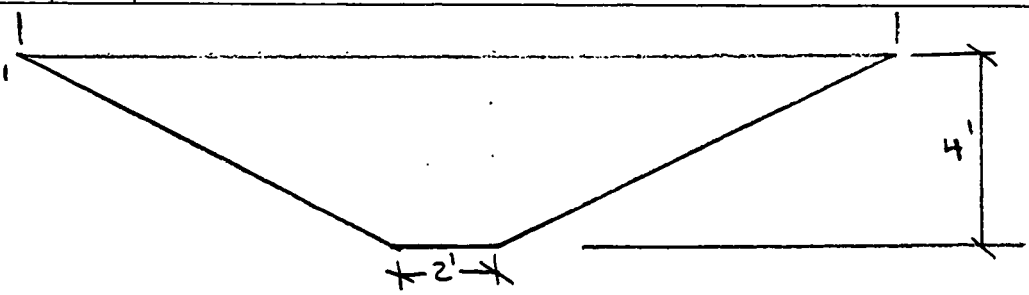
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B14

Rev	Date	By	Ck	Title

DITCH-13

LENGTH ≅ 125'



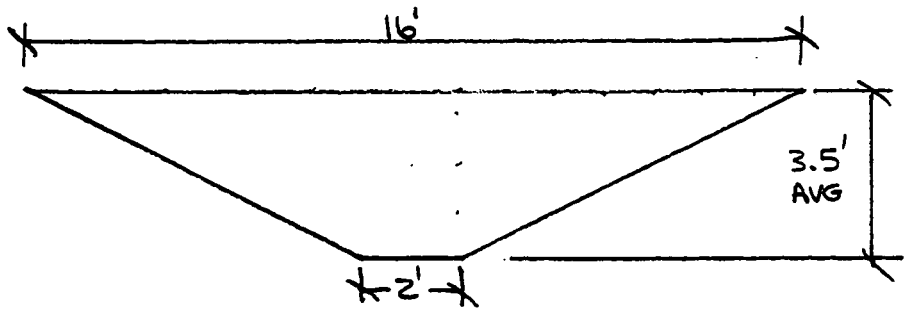
$A = [\frac{1}{2}(8) \times 4] \times 2 + (2 \times 4) = 40.0\,SF$

$VOL = 40.0\,SF \times 125' = 5000\,CF / 27\,CF/CY = 185\ CY$

DITCH - 14

LENGTH ≅ 325 FT

DEPTH ≅ AVG 3.5 FT



$A = [\frac{1}{2}(7) \times 3.5] \times 2 + (2 \times 3.5) = 31.5\,SF$

$VOL = 31.5\,SF \times 325\,FT = 10237.5\,CF / 27\,CF/CY = 379\ CY$

000725

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B15

Rev	Date	By	Ck	Title
				1634

WHEEL WASH (CUT)

STA	AREA	AREA	L	VOL	ΣVOL (CF)
0+00	0				
		0	93.9	0	0
0+93.9	0				
		0	30.7	0	0
1+24.6	0				
		0.5	25.4	12.7	12.7
1+50	1.0				
		9.4	37.2	349.7	362.4
1+87.2	17.8				
		14.6	5.3	77.4	439.8
1+92.5	11.4				
		25.8	108.7	2804.5	3244.3
3+01.2	40.1				
		20.1	118.8	2387.9	5632.2
4+20	0				

TOTAL VOL = 5632.2 / 27 CF/CY = 208.6 CY

000726

ENG-GE-30 (031896)

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B16

Rev	Date	By	Ck	Title

WHEEL WASH AREA (FILL)

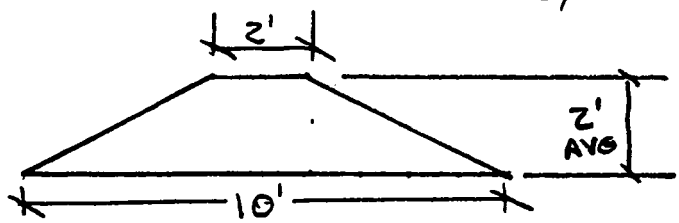
STA	AREA	AREA	L	VOL	Σ VOL (CF)
0+00	0				
		16.8	93.9	1577.5	1577.5
0+93.9	33.5				
		25.8	30.7	792.1	2369.6
1+24.6	18.0				
		20.0	25.4	508.0	2877.6
1+50	22.0				
		17.4	37.2	647.3	3524.9
1+87.2	12.8				
		12.8	5.3	67.8	3592.7
1+92.5	12.8				
		6.4	108.7	696.0	4288.7
3+01.2	0				
			118.8		
4+20	0				

TOTAL VOL = 4288.7 / 27 CF/CY = 158.8 CY

BERM SOUTH OF WHEEL WASH

LENGTH ≅ 50'

AVG HT = 2'



$A = \left[\frac{1}{2}(4)\times 2\right]\times 2 + (2\times 2) = 12.0$ SF

VOL = 12.0 SF × 50 FT = 600 CF / 27 CF/CY = 22.2 CY

158.8
+22.2

TOTAL = 181.0 CY

000727

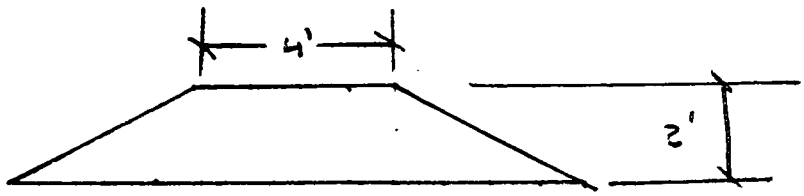
ENG-GE-30 (031896)

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B17

Rev	Date	By	Ck	Title
				1634

BERMS @ STOCKPILE #2

AVG SECTION



LENGTH ≅ 1000'

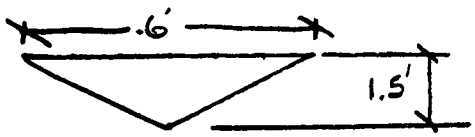
$$\text{AREA} = \left[\tfrac{1}{2}(4) \times 2\right] \times 2 + (4 \times 2) = 16.0\,\text{SF}$$

$$\text{VOL FILL} = 16.0\,\text{SF} \times 1000\,\text{FT} = 16000\,\text{CF}/27\,\text{CF/CY} = 593\,\text{CY}$$

SWALES @ STOCKPILE #2

CUT VARIES FROM 0 TO 2 FT
USE 1.5 FT AVG. DEPTH

LENGTH ≅ 415 FT



$$\text{AREA} = \left(\tfrac{1}{2}(3) \times 1.5\right) \times 2 = 4.5\,\text{SF}$$

$$\text{VOL} = 4.5\,\text{SF} \times 415\,\text{FT} = 1867.5\,\text{CF}/27\,\text{CF/CY} = 69\,\text{CY}$$

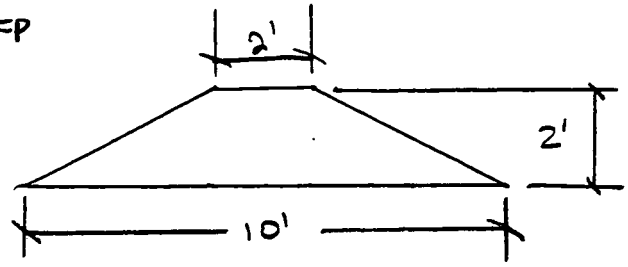
000728

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of B18

Rev	Date	By	Ck	Title

BERM NORTH OF AFP

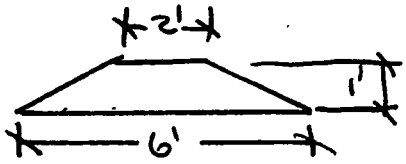
2' HIGH
LENGTH ≅ 120'



$A = [\frac{1}{2}(4) \times 2] \times 2 + (2 \times 2) = 12.0\ SF$

$VOL = 12.0\ SF \times 120\ FT = 1440\ CF / 27\ CF/CY = 53.3\ CY$

1' HIGH
LENGTH ≅ 38'



$A = [\frac{1}{2}(2) \times 1] \times 2 + (2 \times 1) = 4.0\ SF$

$VOL = 4.0\ SF \times 38\ FT = 152.0\ CF / 27\ CF/CY = 5.6\ CY$

$$\text{TOTAL} = \begin{array}{r} 53.3 \\ +\ 5.6 \\ \hline 58.9\ CY \end{array}$$

000729

ROAD EARTHWORK

				CUT			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	38.60	0.00	0.00	
38.60	0.00						
			0.00	85.30	0.00	0.00	
123.90	0.00						
			13.25	78.70	1042.78	1042.78	
202.60	26.50						
			13.25	70.20	930.15	1972.93	
272.80	0.00						
							73.07
				FILL			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			4.80	38.60	185.28	185.28	
38.60	9.60						
			10.45	85.30	891.39	1076.67	
123.90	11.30						
			7.60	78.70	598.12	1674.79	
202.60	3.90						
			1.95	70.20	136.89	1811.68	
272.80	0.00						
							67.10
				GRAVEL			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			3.30	38.60	127.38	127.38	
38.60	6.60						
			6.60	85.30	562.98	690.36	
123.90	6.60						
			6.60	78.70	519.42	1209.78	
202.60	6.60						
			3.30	70.20	231.66	1441.44	
272.80	0.00						
							53.39

000730

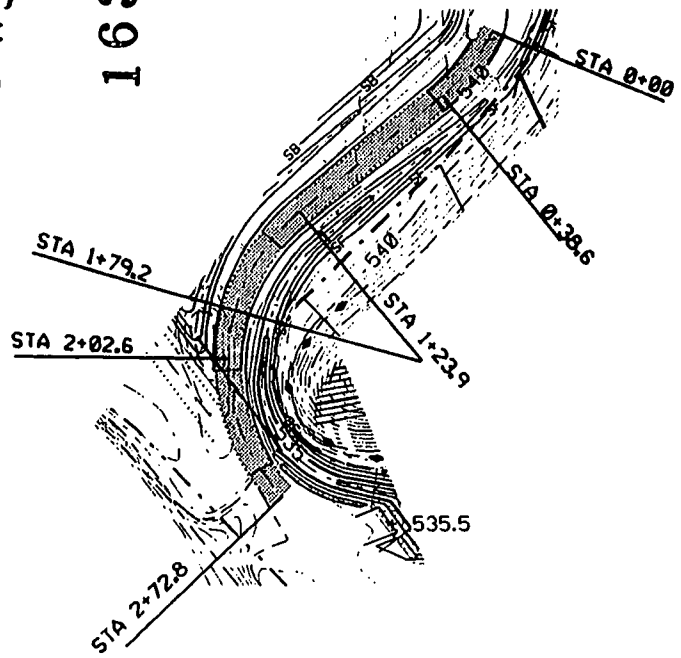
SHT B20

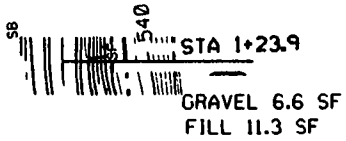
				CUT			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B5,B7)/2	=(A7-A5)	=PRODUCT(D6,E6)	=(F6)	
38.6	0						
			=SUM(B7,B9)/2	=(A9-A7)	=PRODUCT(D8,E8)	=SUM(G6,F8)	
123.9	0						
			=SUM(B9,B11)/2	=(A11-A9)	=PRODUCT(D10,E10)	=SUM(G8,F10)	
202.6	26.5						
			=SUM(B11,B13)/2	=(A13-A11)	=PRODUCT(D12,E12)	=SUM(G10,F12)	
272.8	0						
							=(G12/27)
				FILL			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B23,B25)/2	=(A25-A23)	=PRODUCT(D24,E24)	=(F24)	
38.6	9.6						
			=SUM(B25,B27)/2	=(A27-A25)	=PRODUCT(D26,E26)	=SUM(G24,F26)	
123.9	11.3						
			=SUM(B27,B29)/2	=(A29-A27)	=PRODUCT(D28,E28)	=SUM(G26,F28)	
202.6	3.9						
			=SUM(B29,B31)/2	=(A31-A29)	=PRODUCT(D30,E30)	=SUM(G28,F30)	
272.8	0						
							=(G30/27)
				GRAVEL			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B41,B43)/2	=(A43-A41)	=PRODUCT(D42,E42)	=(F42)	
38.6	6.6						
			=SUM(B43,B45)/2	=(A45-A43)	=PRODUCT(D44,E44)	=SUM(G42,F44)	
123.9	6.6						
			=SUM(B45,B47)/2	=(A47-A45)	=PRODUCT(D46,E46)	=SUM(G44,F46)	
202.6	6.6						
			=SUM(B47,B49)/2	=(A49-A47)	=PRODUCT(D48,E48)	=SUM(G46,F48)	
272.8	0						
							=(G48/27)

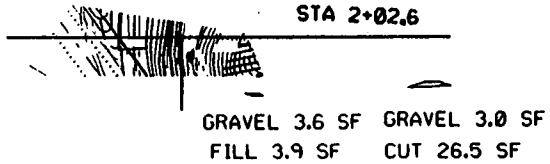
000731

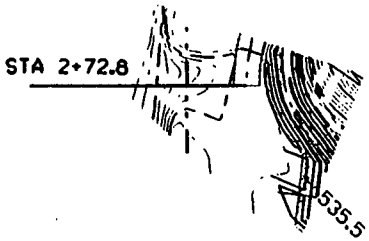
SHT B21

1634









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000732

SHT B22

SUPPORT AREA

				CUT			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			17.65	108.30	1911.50	1911.50	
108.30	35.30						
			17.65	105.70	1865.61	3777.11	
214.00	0.00						
			0.00	138.00	0.00	3777.11	
352.00	0.00						
			0.00	65.50	0.00	3777.11	
417.50	0.00						
			26.45	44.60	1179.67	4956.78	
462.10	52.90						
			26.45	75.00	1983.75	6940.53	
537.10	0.00						
							257.06
				FILL			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			15.20	108.30	1646.16	1646.16	
108.30	30.40						
			15.20	105.70	1606.64	3252.80	
214.00	0.00						
			0.00	138.00	0.00	3252.80	
352.00	0.00						
			0.00	65.50	0.00	3252.80	
417.50	0.00						
			0.00	44.60	0.00	3252.80	
462.10	0.00						
			0.00	75.00	0.00	3252.80	
537.10	0.00						
							120.47
				GRAVEL			
			AREA (SF)	THICKNESS (FT)	VOLUME (CF)	VOLUME (CY)	
			38409.00	0.50	19204.50	711.28	

000733

SHT B23

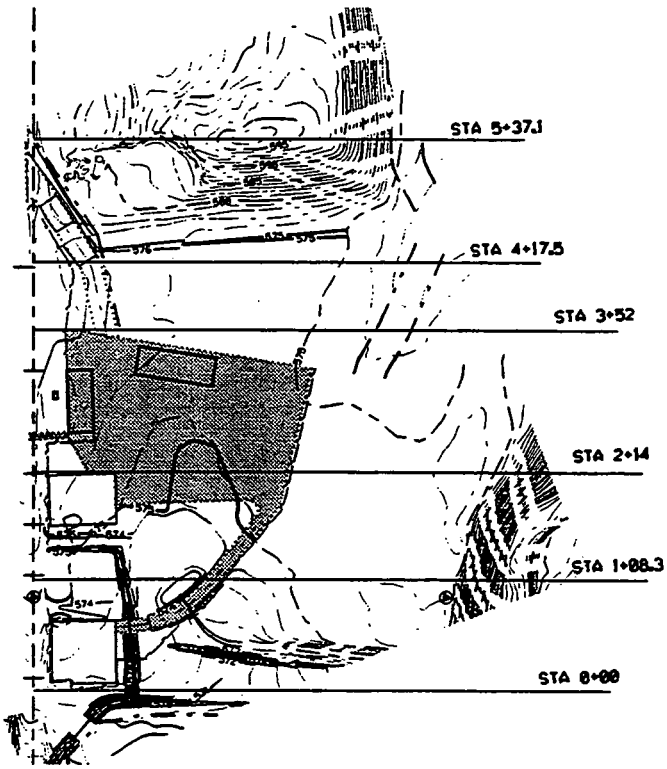
1634

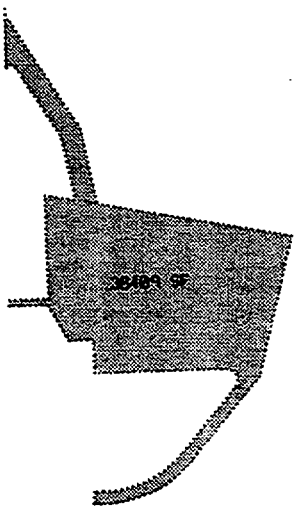
SUPPORT AREA BK

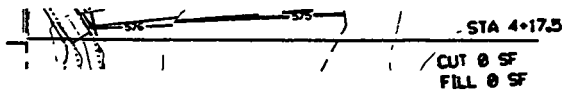
				CUT			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B5,B7)/2	=(A7-A5)	=PRODUCT(D6,E6)	=(F6)	
108.3	35.3						
			=SUM(B7,B9)/2	=(A9-A7)	=PRODUCT(D8,E8)	=SUM(G6,F8)	
214	0						
			=SUM(B9,B11)/2	=(A11-A9)	=PRODUCT(D10,E10)	=SUM(G8,F10)	
352	0						
			=SUM(B11,B13)/2	=(A13-A11)	=PRODUCT(D12,E12)	=SUM(G10,F12)	
417.5	0						
			=SUM(B13,B15)/2	=(A15-A13)	=PRODUCT(D14,E14)	=SUM(G12,F14)	
462.1	52.9						
			=SUM(B15,B17)/2	=(A17-A15)	=PRODUCT(D16,E16)	=SUM(G14,F16)	
537.1	0						
							=(G16/27)
				FILL			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B23,B25)/2	=(A25-A23)	=PRODUCT(D24,E24)	=(F24)	
108.3	30.4						
			=SUM(B25,B27)/2	=(A27-A25)	=PRODUCT(D26,E26)	=SUM(G24,F26)	
214	0						
			=SUM(B27,B29)/2	=(A29-A27)	=PRODUCT(D28,E28)	=SUM(G26,F28)	
352	0						
			=SUM(B29,B31)/2	=(A31-A29)	=PRODUCT(D30,E30)	=SUM(G28,F30)	
417.5	0						
			=SUM(B31,B33)/2	=(A33-A31)	=PRODUCT(D32,E32)	=SUM(G30,F32)	
462.1	0						
			=SUM(B33,B35)/2	=(A35-A33)	=PRODUCT(D34,E34)	=SUM(G32,F34)	
537.1	0						
							=(G34/27)
				GRAVEL			
			AREA (SF)	THICKNESS (FT)	VOLUME (CF)	VOLUME (CY)	
			38409	0.5	= PRODUCT(D42,E42)	= (F42/27)	

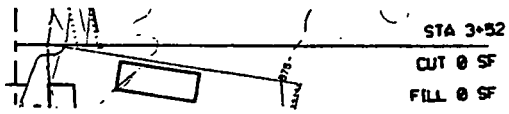
000734

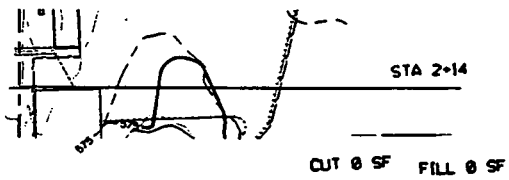
SHT B24

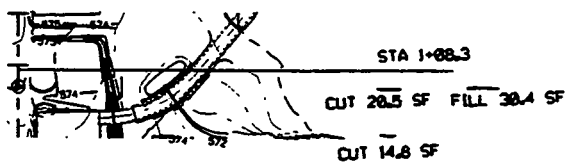


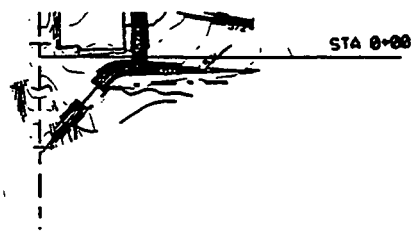












000735

SHTC1

1634

ATTACHMENT C, EXCAVATION GRADING PLAN 1

SHT C2

EXCAV. GRADING PLAN 1 (SUMMARY)

LOCATION		VOLUME (CY)	
EXCAVATION VOL. GRADING PLAN 1		117271.05	116,200
VOLUME ABOVE WAC MATERIAL		3728.48	4800
TOTAL		113542.57	

REV.1 ; ABOVE WAC MATERIAL QUANTITY EST. INCREASED TO 4800 yd3 ; EXCAV. VOL. REDUCED CORRESPONDING AMOUNT TO 116,200 yd3

000737

SHT C3

1634

EXCAV. GRADING PLAN 1 (SUMMARY)

LOCATION		VOLUME (CY)
		='[GP1.XLS]EXCAVATION GRADING PLAN 1'!H26
EXCAVATION VOL. GRADING PLAN 1		='[GP1.XLS]EXCAVATION GRADING PLAN 1'!H25
VOLUME ABOVE WAC MATERIAL		='[GP1.XLS]ABOVE WAC MATERIAL'!H6
TOTAL		=(C4-C6)

000738

SHT C4

EXCAVATION GRADING PLAN 1

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1343.30	0.00						
			0.00	56.70	0.00	0.00	
1400.00	0.00						
			1663.60	100.00	166360.00	166360.00	
1500.00	3327.20						
			3906.40	100.00	390640.00	557000.00	
1600.00	4485.60						
			4874.25	100.00	487425.00	1044425.00	
1700.00	5262.90						
			6111.25	100.00	611125.00	1655550.00	
1800.00	6959.60						
			7874.70	50.00	393735.00	2049285.00	
1850.00	8789.80						
			9030.25	50.00	451512.50	2500797.50	
1900.00	9270.70						
			6152.90	100.00	615290.00	3116087.50	
2000.00	3035.10						
			1517.55	33.10	50230.91	3166318.41	
2033.10	0.00						
							117271.05

REV. 1; See Sheet C2

000739

SHT C5

1634

EXCAVATION GRADING PLAN 1

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1343.3	0						
			=SUM(B5,B7)/2	=(A7-A5)	=PRODUCT(D6,E6)	=(F6)	
1400	0						
			=SUM(B7,B9)/2	=(A9-A7)	=PRODUCT(D8,E8)	=SUM(G6,F8)	
1500	3327.2						
			=SUM(B9,B11)/2	=(A11-A9)	=PRODUCT(D10,E10)	=SUM(G8,F10)	
1600	4485.6						
			=SUM(B11,B13)/2	=(A13-A11)	=PRODUCT(D12,E12)	=SUM(G10,F12)	
1700	5282.9						
			=SUM(B13,B15)/2	=(A15-A13)	=PRODUCT(D14,E14)	=SUM(G12,F14)	
1800	6959.6						
			=SUM(B15,B17)/2	=(A17-A15)	=PRODUCT(D16,E16)	=SUM(G14,F16)	
1850	8789.8						
			=SUM(B17,B19)/2	=(A19-A17)	=PRODUCT(D18,E18)	=SUM(G16,F18)	
1900	9270.7						
			=SUM(B19,B21)/2	=(A21-A19)	=PRODUCT(D20,E20)	=SUM(G18,F20)	
2000	3035.1						
			=SUM(B21,B23)/2	=(A23-A21)	=PRODUCT(D22,E22)	=SUM(G20,F22)	
2033.1	0						
							=(G22/27)

000740

SHT C6

STA	DEPTH 1 (FT)	DEPTH 2 (FT)	AVG. INCR. DEPTH (FT)	AVG. DEPTH (FT)	AREA (SF)	CUM. VOL. (CF)	CUM. VOL. (CY)
250.00	11.80	11.30	11.55				
				12.73	7908.00	100668.84	3728.48
400.00	16.80	11.00	13.90				

REV 1; ABOVE WAC VOLUME RECALCULATED USING FOOT PRINT AREA OF 1786 yd^2 and depth of 8' (2.66 yd) for volume of 4800 yd^3; see sheet C2

000741

SHT C7
1634

STA	DEPTH 1 (FT)	DEPTH 2 (FT)	AVG. INCR. DEPTH (FT)	AVG. DEPTH (FT)	AREA (SF)	CUM. VOL. (CF)	CUM. VOL. (CY)
250	11.8	11.3	=SUM(B5,C5)/2				
				=SUM(D5,D7)/2	7908	=PRODUCT(E6,F6)	=G6/27
400	16.8	11	=SUM(B7,C7)/2				

000742

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				C8

Rev	Date	By	Ck	Title

INTERCEPTOR DITCH-1 (CUT)

STA	AREA	AREA	L	VOL	Σ VOL (CF)
0+00	0				
		1.9	89.8	170.6	170.6
0+89.8	3.7				
		11.5	97.0	1115.5	1286.1
1+86.8	19.2				
		56.0	209.9	11754.4	13040.5
3+96.7	92.8				
		158.0	60.3	9527.4	22567.9
4+57.0	223.2				
		310.3	90.9	28206.3	50774.2
5+47.9	397.4				
		225.0	47.2	10620.0	61394.2
5+95.1	52.6				
		56.1	75.8	4252.4	65646.6
6+70.9	59.6				
		29.8	56.5	1683.7	67330.3
7+27.4	0.0				

TOTAL CUT VOL = 67330.3 CF / 27 CF/CY = 2493.7 CY

000743

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				C9

Rev	Date	By	Ck	Title

1634

INTERCEPTOR DITCH -1 (FILL)

STA	AREA	AREA	L	VOL	Σ VOL (CF)
0+00	0				
		6.6	89.8	592.7	592.7
0+89.8	13.2				
		8.1	97.0	785.7	1378.4
1+86.8	2.9				
		1.5	209.9	314.9	1693.3
3+96.7	0				
		0	60.3	0	
4+57.0	0				
			90.9		
5+47.9	0				
			47.2		
5+95.1	0				
			75.8		
6+70.9	0				
			56.5		1693.3
7+27.4	0				

TOTAL FILL VOL = 1693.3 CF / 27 CF/CY = 62.7 CY

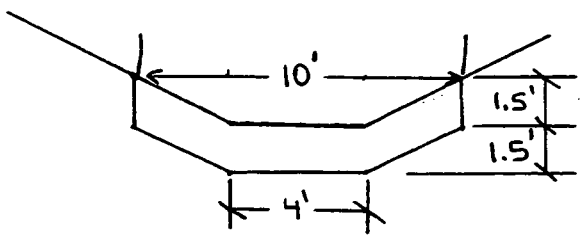
000744

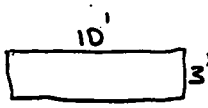
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of C10

Rev	Date	By	Ck	Title

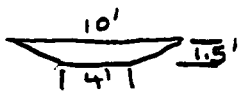
INTERCEPTOR DITCH #1 (RIPRAP)

RIPRAP FROM STA 4+57.0 TO END ∴ 727.4 - 457.0 ≅ 270.4 FT

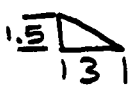


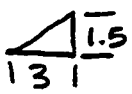


= 10' × 3' = 30 SF



= ½(3) × 1.5 × 2 + (4 × 1.5) = 10.5 SF



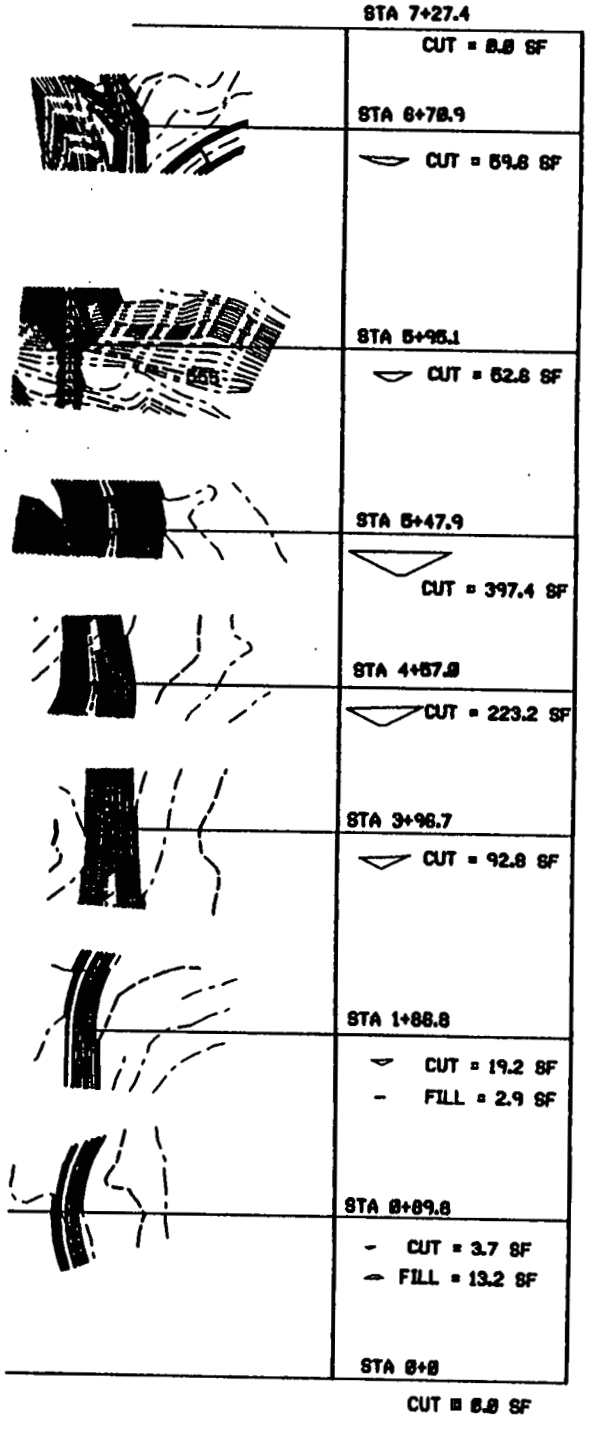


= ½(3) × 1.5 × 2 = 4.5 SF

AREA RIPRAP = 30 SF - 10.5 SF - 4.5 SF = 15.0 SF

VOL = 15.0 SF × 270.4 FT = 4056 CF / 27 CF/CY = 150.2 CY

000745



SHT C11

1634

000746

INT. DITCH 2

SHT C12

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1343.30	0.00						
			0.00	56.70	0.00	0.00	
1400.00	0.00						
			18.80	100.00	1880.00	1880.00	
1500.00	37.60						
			29.40	100.00	2940.00	4820.00	
1600.00	21.20						
			17.50	100.00	1750.00	6570.00	
1700.00	13.80						
			17.95	100.00	1795.00	8365.00	
1800.00	22.10						
			37.20	50.00	1860.00	10225.00	
1850.00	52.30						
			42.65	50.00	2132.50	12357.50	
1900.00	33.00						
			23.85	100.00	2385.00	14742.50	
2000.00	14.70						
			7.35	33.10	243.29	14985.79	
2033.10	0.00						
							555.03

000747

SMCB

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1343.3	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
1400	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
1500	37.6						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
1600	21.2						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
1700	13.8						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
1800	22.1						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
1850	52.3						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
1900	33						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
2000	14.7						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
2033.1	0						
							=(G23/27)

000748

SHT D1

1634

ATTACHMENT D, EXCAVATION GRADING PLAN 2

SHT D2

EXCAV. GRADING PLAN 2 (TOTAL)

LEAD EXCAV.					100
(west)					
EXCAVATION GRADING PLAN 2, IFP ~~8 CF~~		~~120701.01~~	60000		
INTECEPTOR DITCH		548			
EXCAVATION GRADING PLAN 2, AFP		38890.07			
IMPACTED MATERIAL STOCK		23783			
TOTAL		~~159591.08~~	99438		100

~~120729~~

REV. 1 ; LEAD EXCAVATION REDUCED BY 27 yd^3 ; EXCAVATION OF SOUTHFIELD INCREASED BY CORRESPONDING AMOUNT

000750

EXCAV. GRADING PLAN 2 (TOTAL)

SHT D3

1634

EXCAVATION GRADING PLAN 2, IFP & SF		=[GP2.XLS]EXCAV. GRADING PLA			
EXCAVATION GRADING PLAN 2, AFP		=[GP2.XLS]EXCAV. GRADING PLA			
TOTAL		=SUM(C5:C7)			

REV. 1 - SEE REVISIONS ON SHEET D2

000751

EXCAV. GRADING PLAN 2 (IFP, SF)

STA	INCR. AREA (SF)	AVG. AREA (SF)	INCR.LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1183.6	0					
		418.05	16.4	6856.02	6856.02	
1200	836.1					
		3569.55	100	356955	363811.02	
1300	6303					
		3742.65	100	374265	738076.02	
1400	1182.3					
		1238.15	100	123815	861891.02	
1500	1294					
		1970.5	100	197050	1058941.02	
1600	2647					
		3015	100	301500	1360441.02	
1700	3383					
		2270.45	100	227045	1587486.02	
1800	1157.9					
		578.95	26.5	15342.175	1602828.195	
1826.5	0					
						59364.0
					SAY	60000

REV 1; SEE NOTE ON PAGE D-2

REV ~~2~~ 1; REVISED INCR. AREA FOR EACH STA AS REQUIRED, REVISED TOTAL AS REQUIRED TO REFLECT REVISED GRADING PLAN

000752

SHT D5

EXCAV. GRADING PLAN 2 (IFP, SF)

1634

	A	B	C	D	E	F	G
1							
2							
3	STA	INCR. AREA (SF)	AVG. AREA (SF)	INCR LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
4							
5	1183.6	0					
6			=(B7+B5)/2	=A7-A5	=D6*C6	=E6	
7	1200	836.1					
8			=(B9+B7)/2	=A9-A7	=D8*C8	=F6+E8	
9	1300	5303					
10			=(B11+B9)/2	=A11-A9	=D10*C10	=F8+E10	
11	1400	1182.3					
12			=(B13+B11)/2	=A13-A11	=D12*C12	=F10+E12	
13	1500	1294					
14			=(B15+B13)/2	=A15-A13	=D14*C14	=F12+E14	
15	1600	2647					
16			=(B17+B15)/2	=A17-A15	=D16*C16	=F14+E16	
17	1700	3383					
18			=(B19+B17)/2	=A19-A17	=D18*C18	=F16+E18	
19	1800	1157.9					
20			=(B21+B19)/2	=A21-A19	=D20*C20	=F18+E20	
21	1826.5	0					
22							
23							=F20/27

REV. 1 — UPDATED TO MATCH PAGE D-4

000753

SHT D6

EXCAV. GRADING PLAN 2 (AFP)

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
3060.70	0.00						
			1031.50	39.30	40537.95	40537.95	
3100.00	2063.00						
			2817.00	100.00	281700.00	322237.95	
3200.00	3571.00						
			3629.00	100.00	362900.00	685137.95	
3300.00	3687.00						
			3090.35	100.00	309035.00	994172.95	
3400.00	2493.70						
			1246.85	44.80	55858.88	1050031.83	
3444.80	0.00						
							38890.07

000754

SHT D7

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
3060.7	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
3100	2063						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
3200	3571						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
3300	3687						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
3400	2463.7						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
3444.8	0						
							=(G15/27)

000755

SHT D8

LEAD EXCAVATION

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
15.00	0.00						
			51.15	5.00	255.75	255.75	
20.00	102.30						
			109.15	8.00	873.20	1128.95	
28.00	116.00						
			113.15	13.00	1470.95	2599.90	
41.00	110.30						
			99.65	6.00	597.90	3197.80	
47.00	89.00						
			44.50	5.00	222.50	3420.30	
52.00	0.00						
							126.68

100

REV.1 ; LEAD QUANTITY REESTIMATED BASED ON FOOT PRINT AREA OF 1174 FT^2 AND 2 FT DEPTH AND WITH APPROX. 10% INCREASE ALLOWANCE = VOLUME OF 100yd3

000756

SHT D9

1634

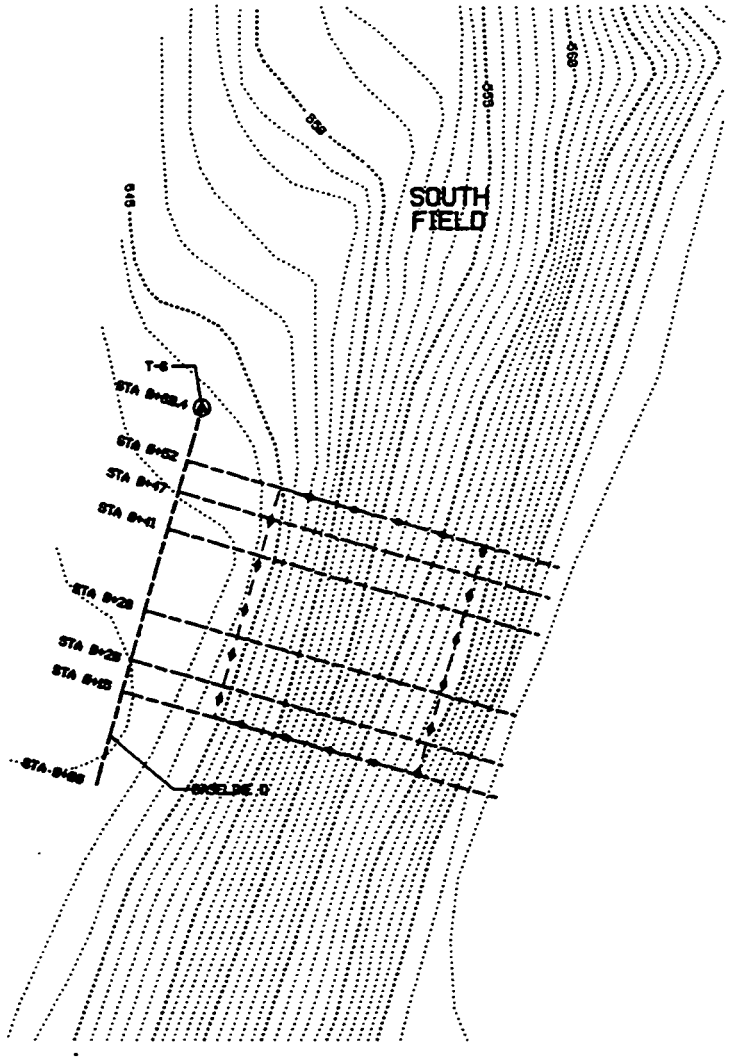
LEAD EXCAVATION

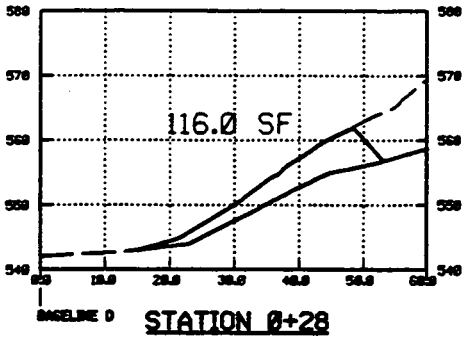
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
15	0						
			=SUM(B5,B7)/2	=(A7-A5)	=PRODUCT(D6,E6)	=(F6)	
20	102.3						
			=SUM(B7,B9)/2	=(A9-A7)	=PRODUCT(D8,E8)	=SUM(G6,F8)	
28	116						
			=SUM(B9,B11)/2	=(A11-A9)	=PRODUCT(D10,E10)	=SUM(G8,F10)	
41	110.3						
			=SUM(B11,B13)/2	=(A13-A11)	=PRODUCT(D12,E12)	=SUM(G10,F12)	
47	89						
			=SUM(B13,B15)/2	=(A15-A13)	=PRODUCT(D14,E14)	=SUM(G12,F14)	
52	0						
							=(G14/27)

000757

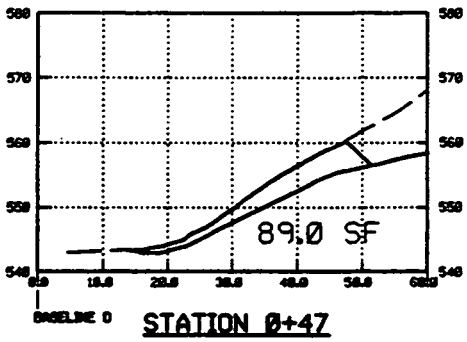
SHT D10

REV. 1, SEE SHEET D8

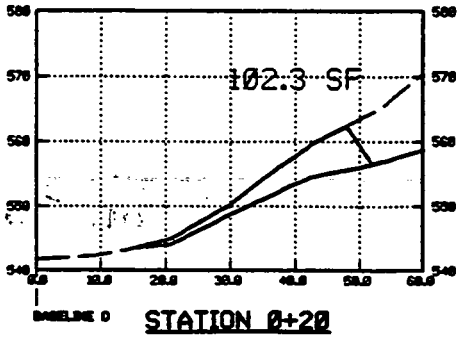




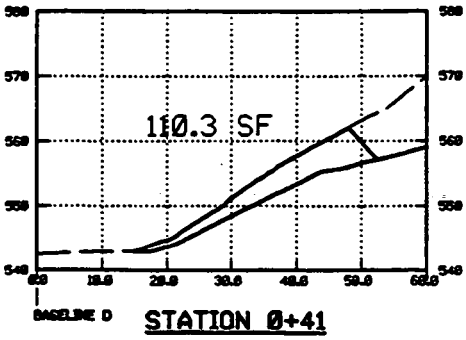
STATION 0+28



STATION 0+47



STATION 0+20



STATION 0+41

000758

SHT D 11

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1343.30	0.00						
			0.00	56.70	0.00	0.00	
1400.00	0.00						
			0.00	100.00	0.00	0.00	
1500.00	0.00						
			53.20	100.00	5320.00	5320.00	
1600.00	106.40						
			64.55	100.00	6455.00	11775.00	
1700.00	22.70						
			23.85	100.00	2385.00	14160.00	
1800.00	25.00						
			12.50	50.00	625.00	14785.00	
1850.00	0.00						
			0.00	50.00	0.00	14785.00	
1900.00	0.00						
			0.00	100.00	0.00	14785.00	
2000.00	0.00						
			0.00	33.10	0.00	14785.00	
2033.10	0.00						
							547.59

000759

SHT D12

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1343.3	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
1400	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
1500	0						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
1600	108.4						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
1700	22.7						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
1800	25						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
1850	0						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
1900	0						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
2000	0						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
2033.1	0						
							=(G23/27)

000760

SHTE1

1634

ATTACHMENT E, EXCAVATION GRADING PLAN 3

SHT E2

EXCAV. GRADING PLAN 3 (TOTAL)

EXCAVATION GRADING PLAN 3, IFP & SF		77038.11			
EXCAVATION GRADING PLAN 3, AFP		22762.62			
TOTAL		99800.73			

000762

EXCAV. GRADING PLAN 3 (TOTAL)

SHT E3

1634

EXCAVATION GRADING PLAN 3, IFP & SF		=[GP3.XLS]EXCAV. GRADING PLA			
EXCAVATION GRADING PLAN 3, AFP		=[GP3.XLS]EXCAV. GRADING PLA			
TOTAL		=SUM(C5,C7)			

000763

SHT E4

EXCAV. GRADING PLAN 3 (SF)

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1019.30	0.00						
			2343.55	80.70	189124.49	189124.49	
1100.00	4687.10						
			5939.80	100.00	593980.00	783104.49	
1200.00	7192.50						
			5582.45	100.00	558245.00	1341349.49	
1300.00	3972.40						
			3030.00	100.00	303000.00	1644349.49	
1400.00	2087.60						
			2095.80	100.00	209580.00	1853929.49	
1500.00	2104.00						
			1774.65	100.00	177465.00	2031394.49	
1600.00	1445.30						
			722.65	67.30	48634.35	2080028.84	
1667.30	0.00						
							77038.11

000764

SHT E5

1634

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
1019.3	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
1100	4687.1						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
1200	7192.5						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
1300	3972.4						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
1400	2087.6						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
1500	2104						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
1600	1445.3						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
1657.3	0						
							=(G19/27)

000765

SHTE6

EXCAV. GRADING PLAN 3 (AFP)

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
3050.30	0.00						
			1422.65	49.70	70705.71	70705.71	
3100.00	2845.30						
			2893.45	100.00	289345.00	360050.71	
3200.00	2941.60						
			2008.10	100.00	200810.00	560860.71	
3300.00	1074.60						
			537.30	100.00	53730.00	614590.71	
3400.00	0.00						
							22762.62

000766

SHTE 7

1634

EXCAV. GRADING PLAN 3 (AFP)

STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
3050.3	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
3100	2945.3						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
3200	2941.6						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
3300	1074.6						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
3400	0						
							=(G13/27)

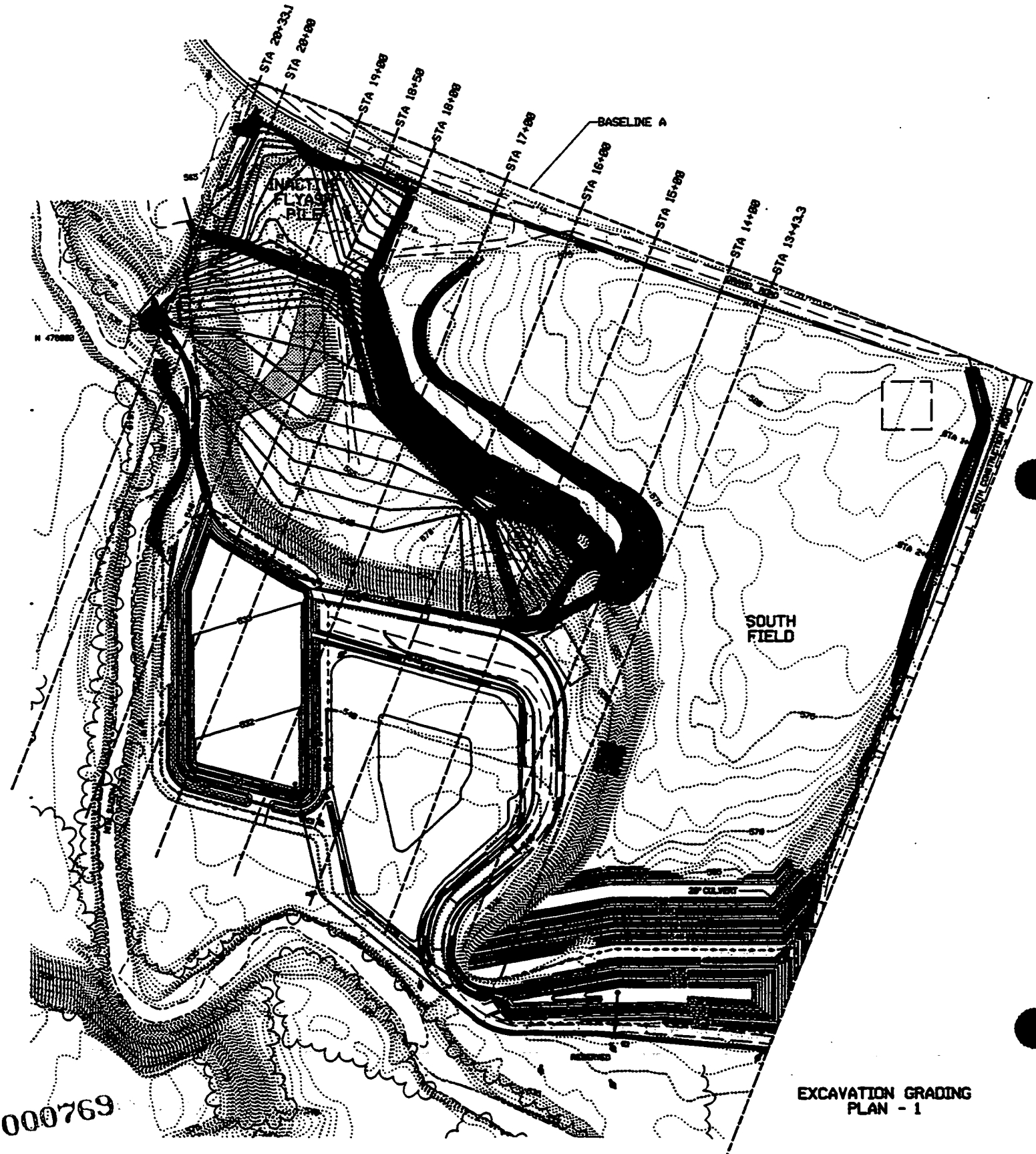
000767

SHT F1

1634

ATTACHMENT F, GRADING PLANS/ SECTION LOCATIONS/CROSS SECTIONS

SHT F2

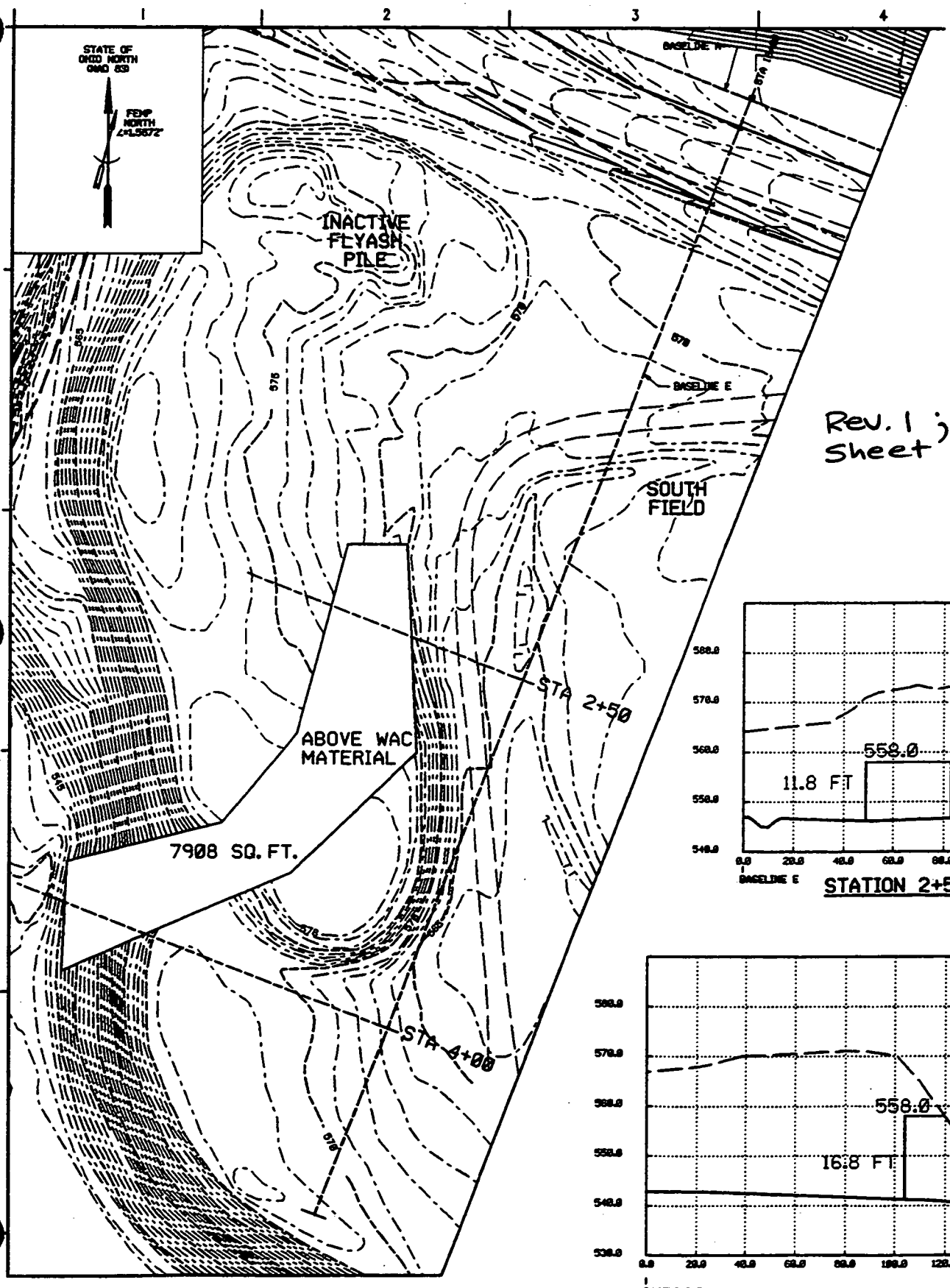


EXCAVATION GRADING PLAN - 1

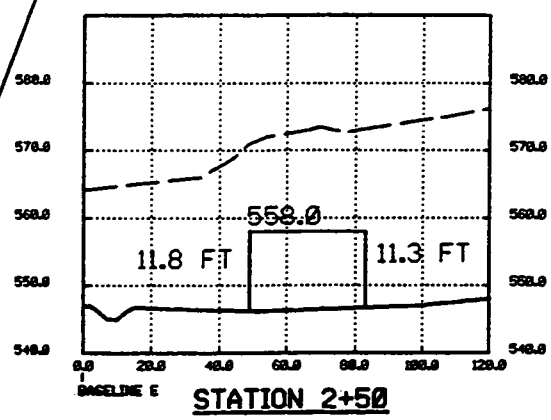
000769

SHT F3

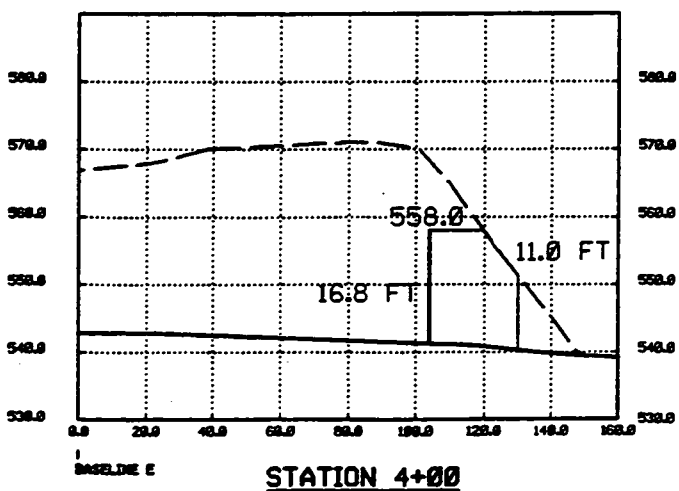
1634



Rev. 1; See Sheet C6



STATION 2+50



STATION 4+00

ABOVE WAC MATERIAL
EXCAVATION AREA PLAN

000770

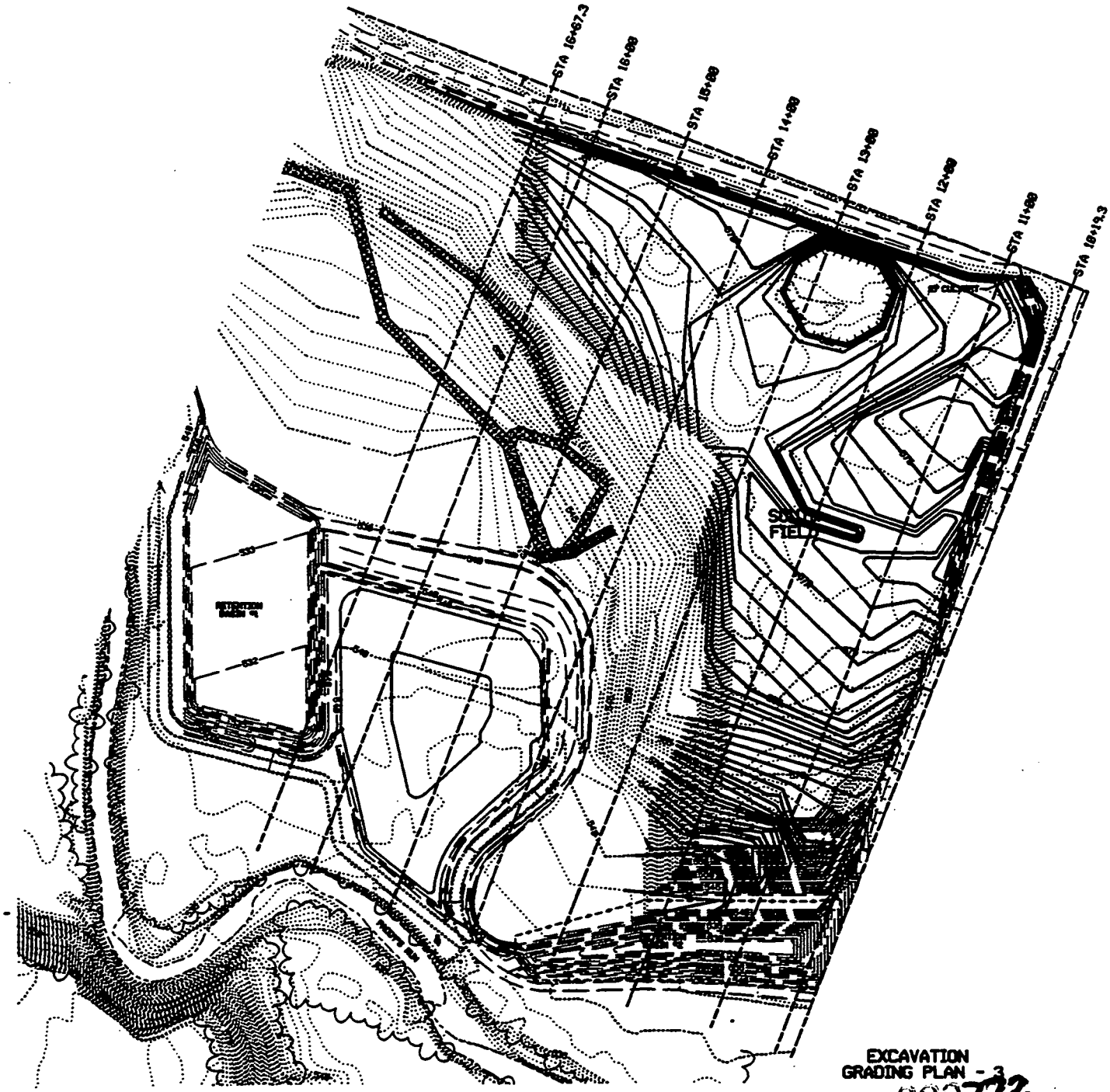
SHT F4

EXCAVATION GRADING PLAN - 2

000771

SHTFS

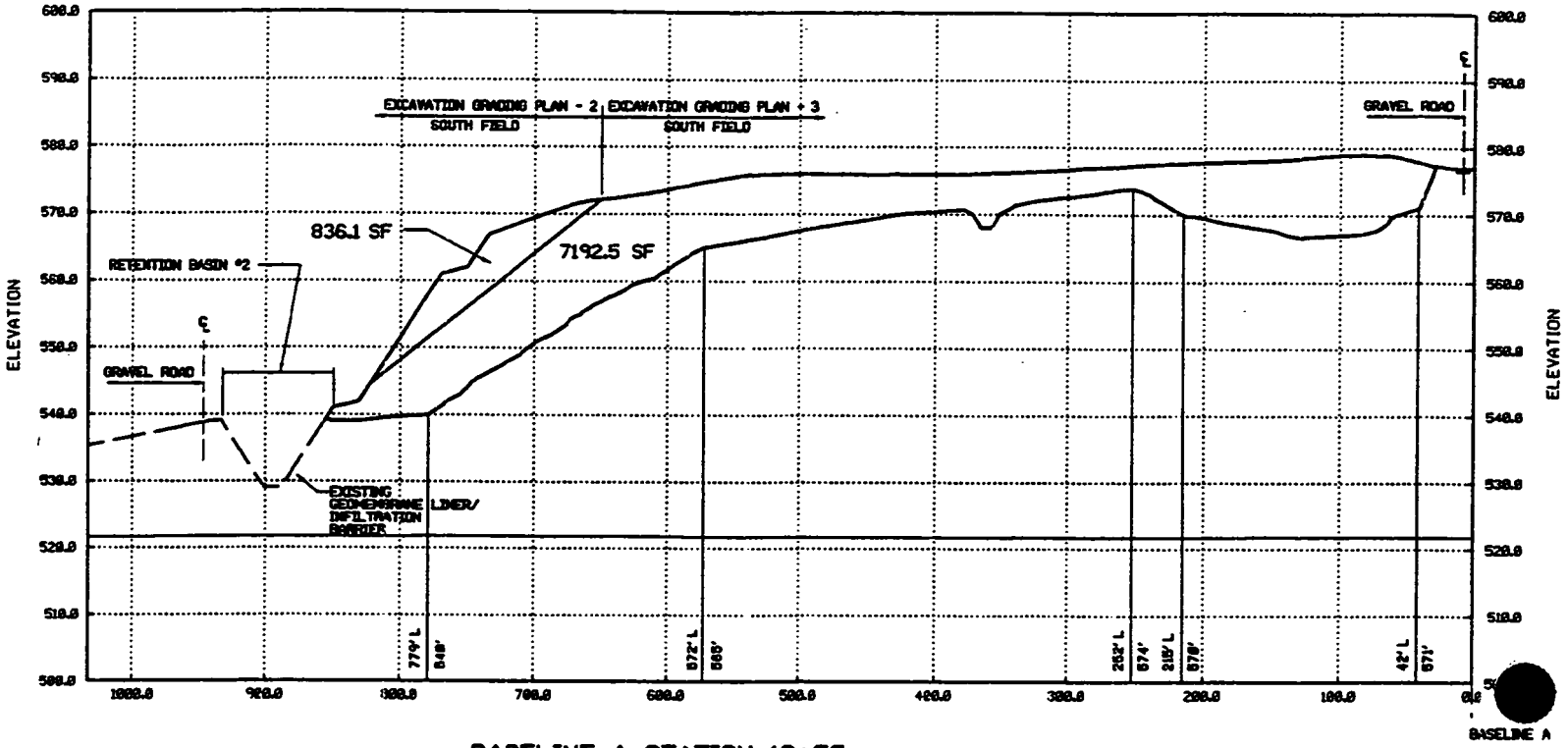
1634



EXCAVATION
GRADING PLAN - 3

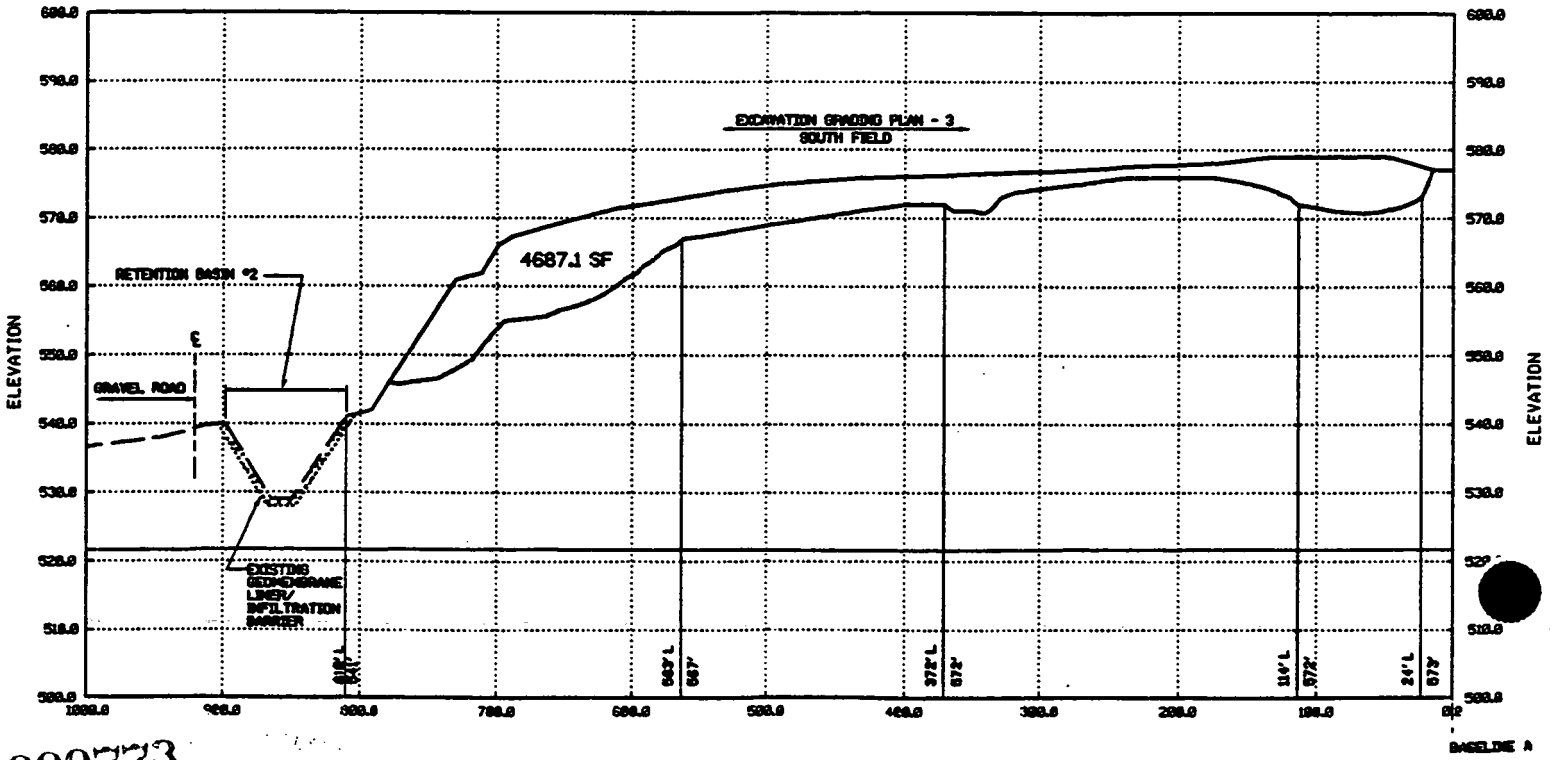
000772

SHT F6



BASELINE A, STATION 12+00 REF

SCALE: HOR 1"=60' VER 1"=10'

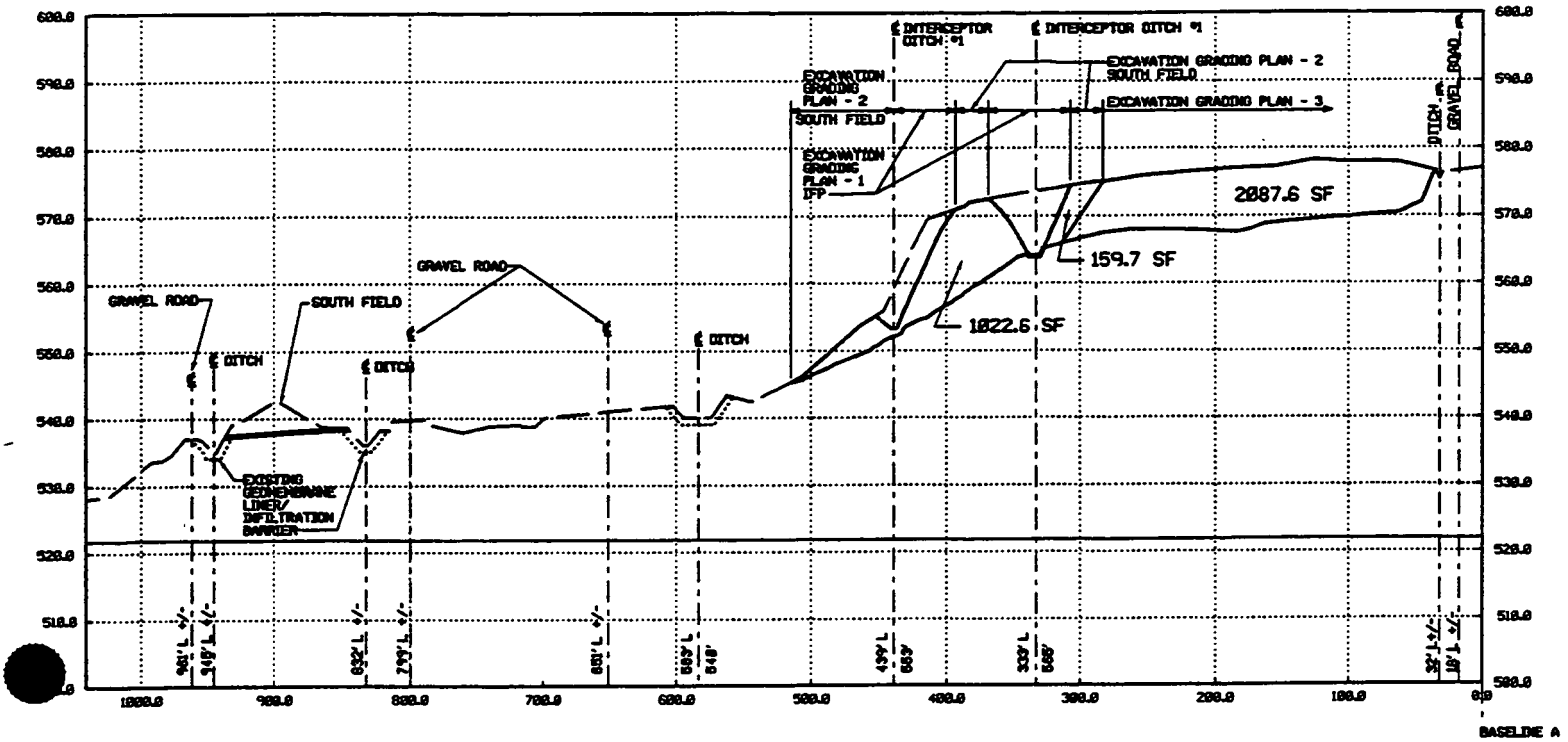


000773

BASELINE A, STATION 11+00 REF

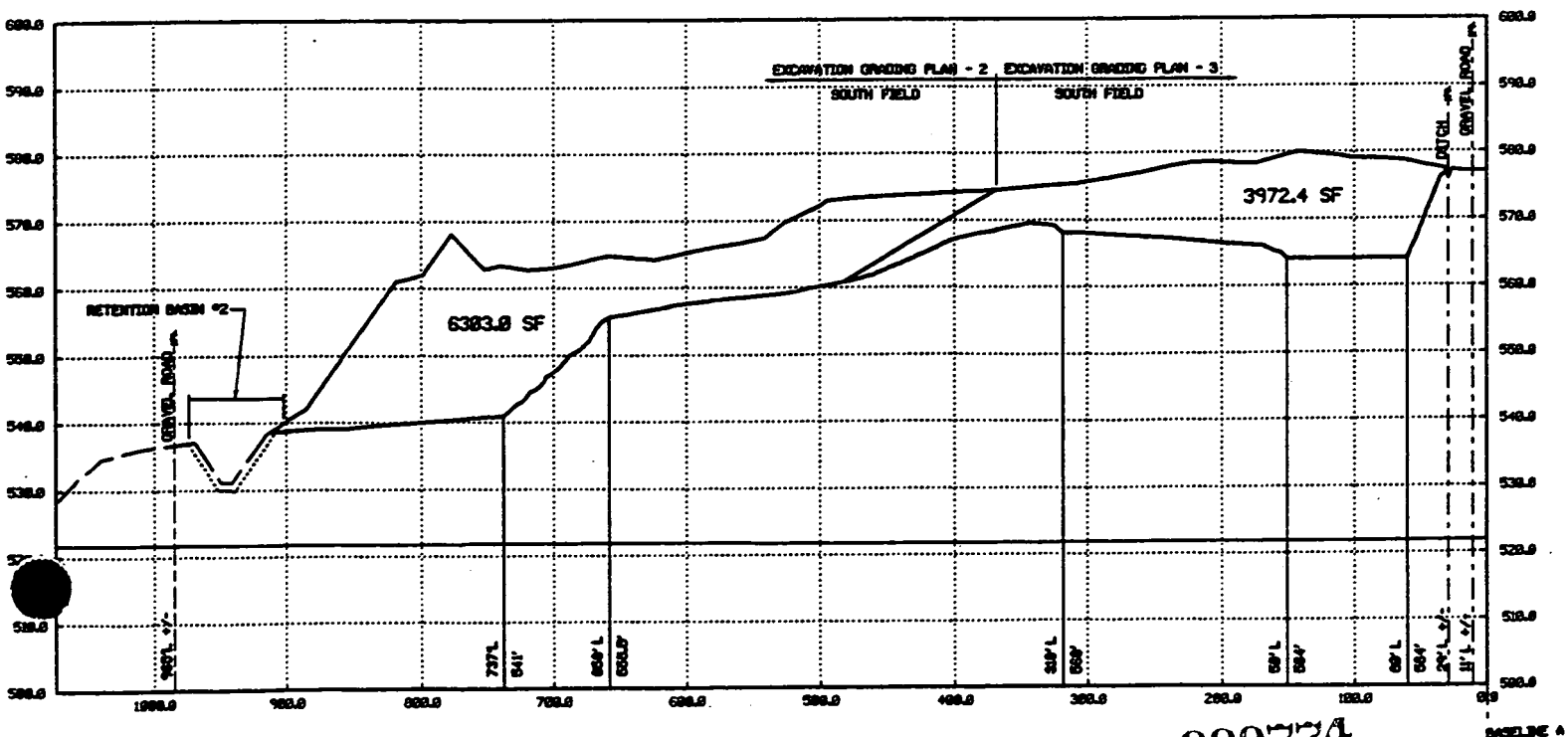
SHT F7

1634



BASELINE A, STATION 14+00

SCALE: HOR 1"=50' VER 1"=10'

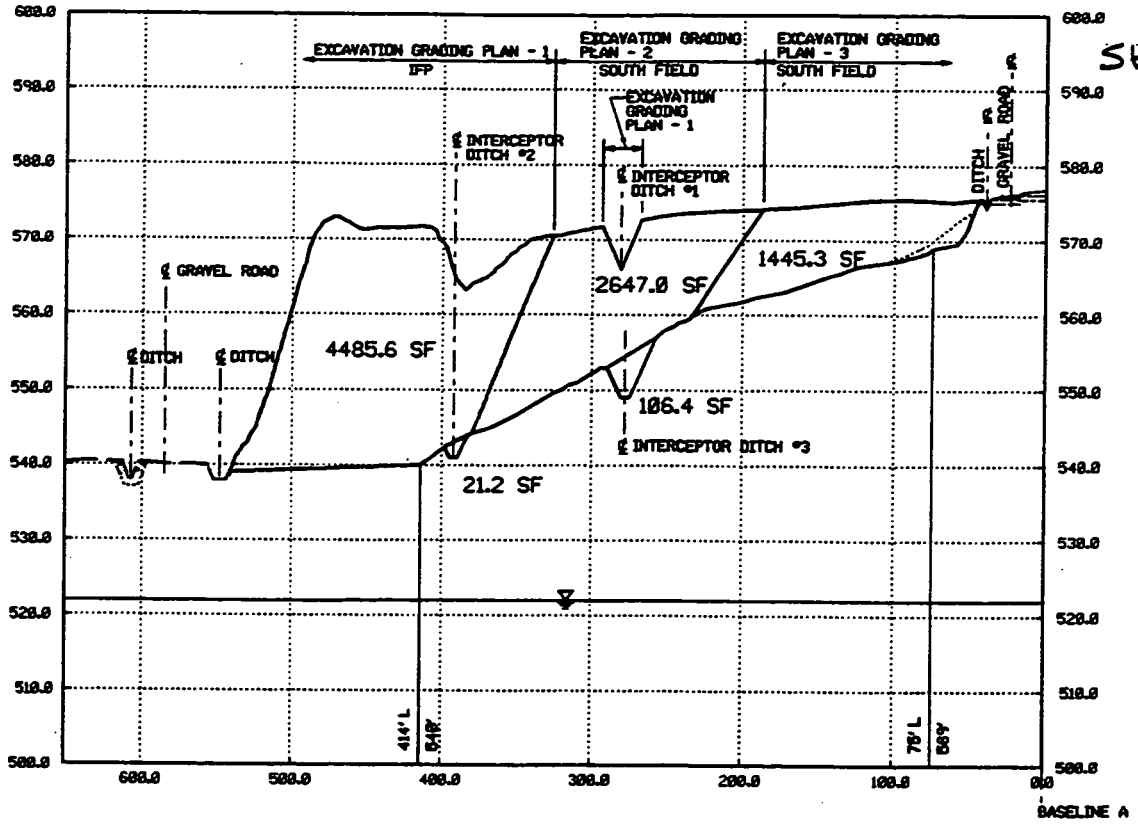


000774

BASELINE A, STATION 13+00

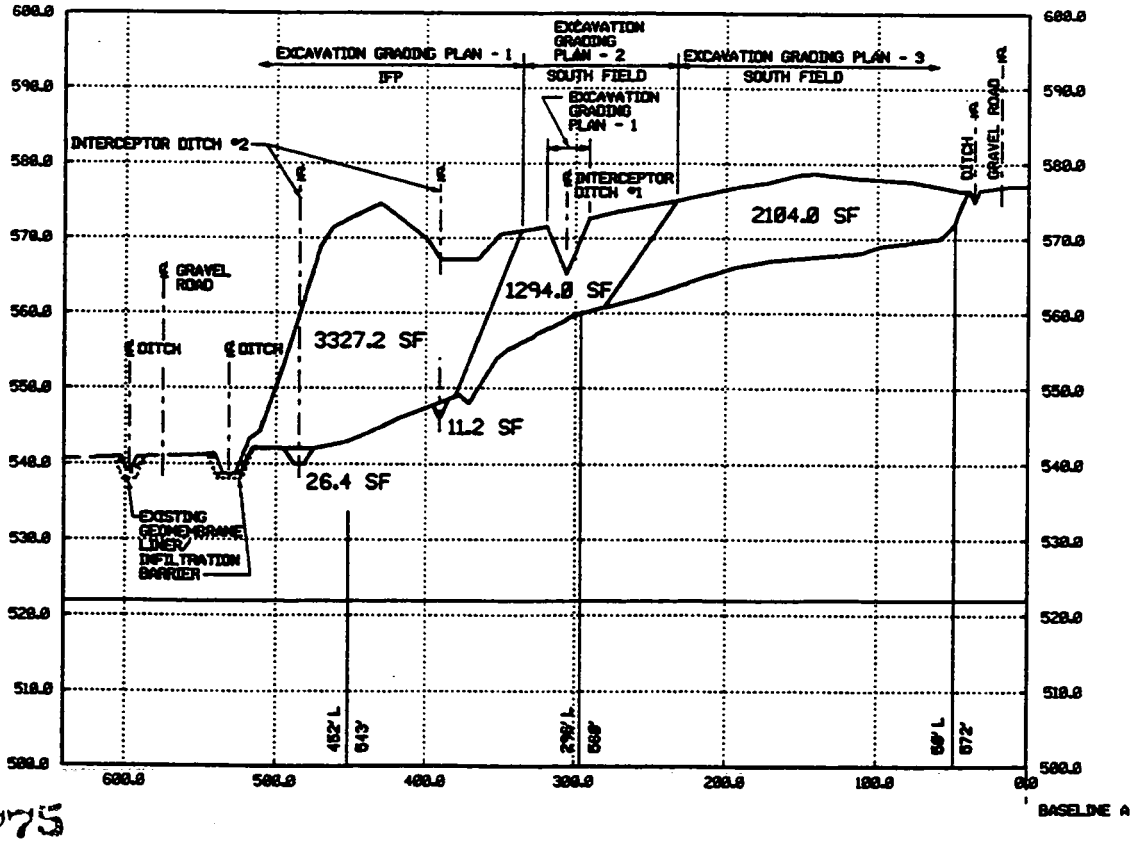
SCALE: HOR 1"=50' VER 1"=10'

SHT F8



BASELINE A, STATION 16+00

SCALE: HOR 1"=50' REF G0005
VER 1"=10' G0007



000775

BASELINE A, STATION 15+00

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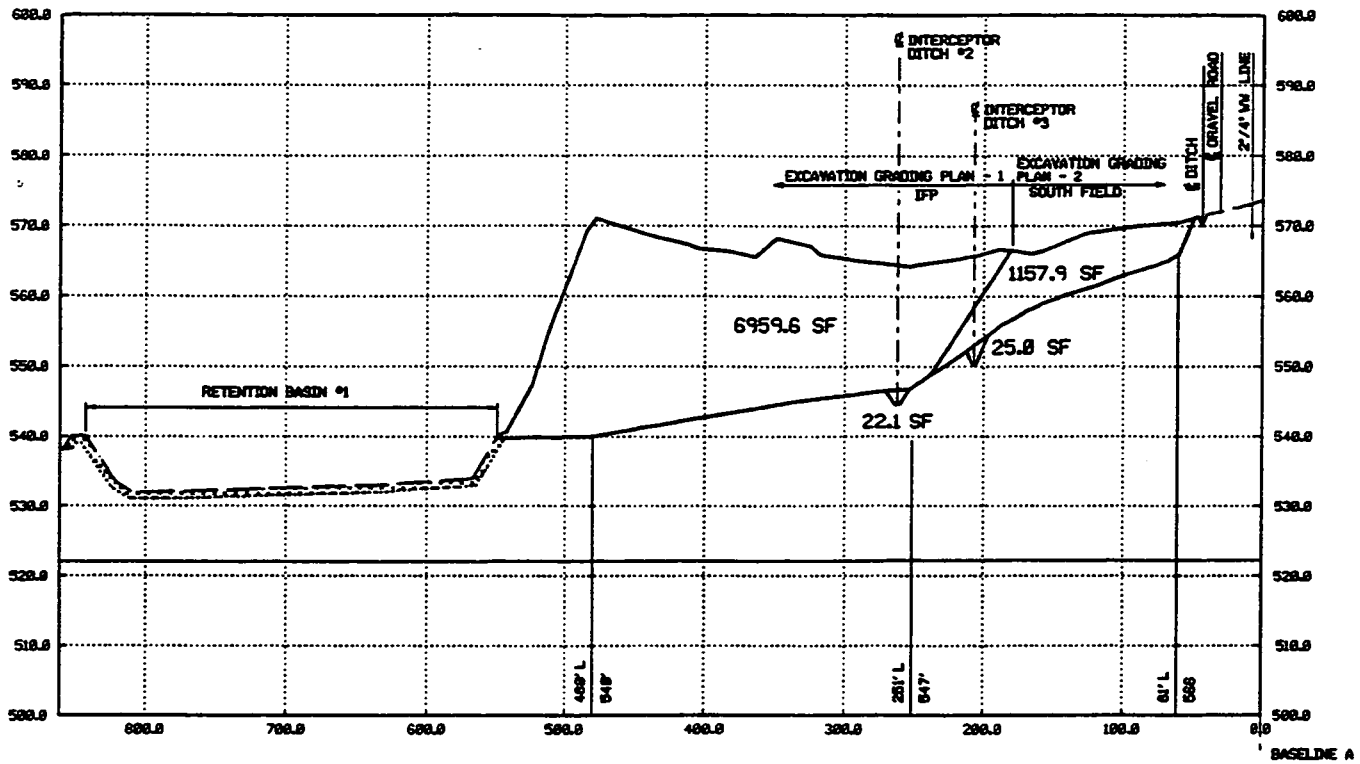

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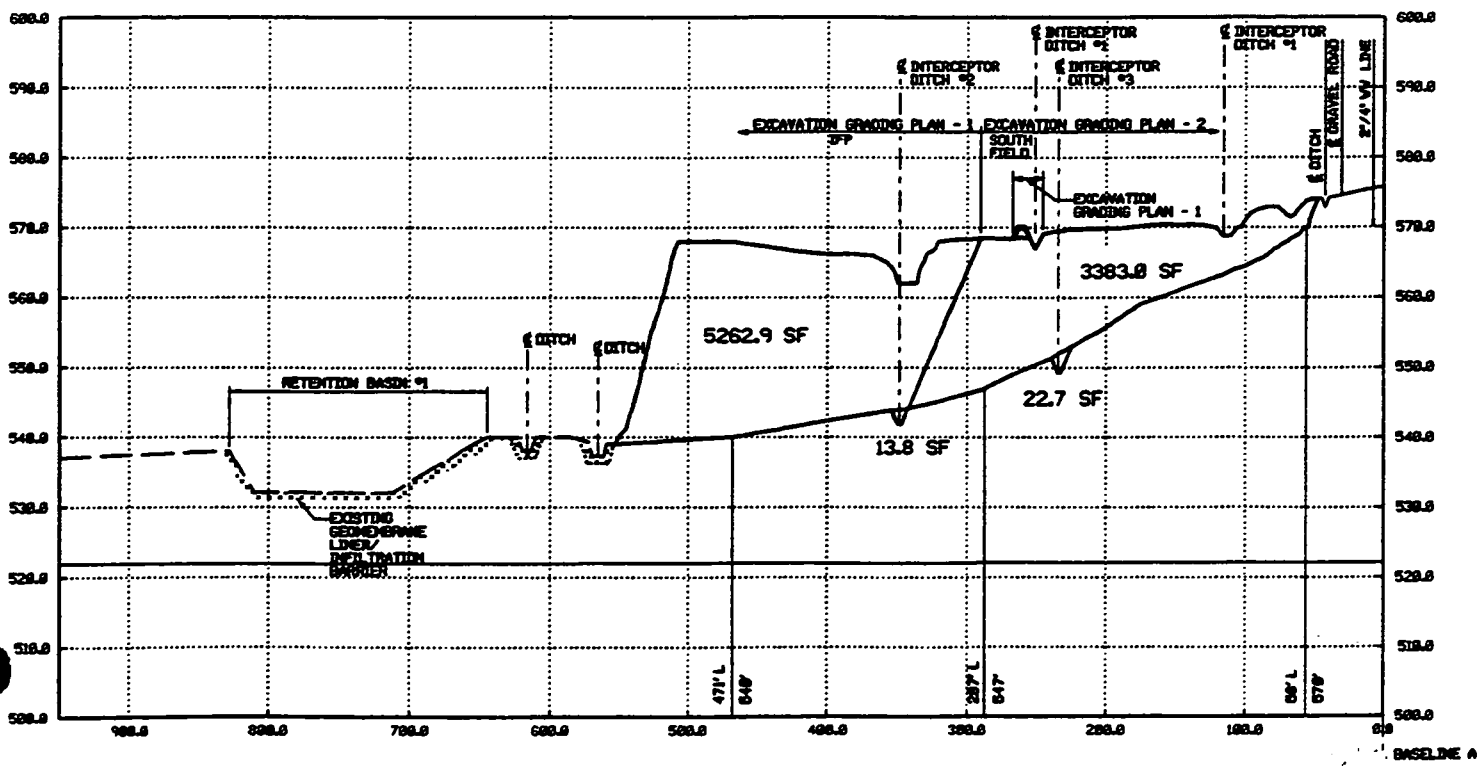

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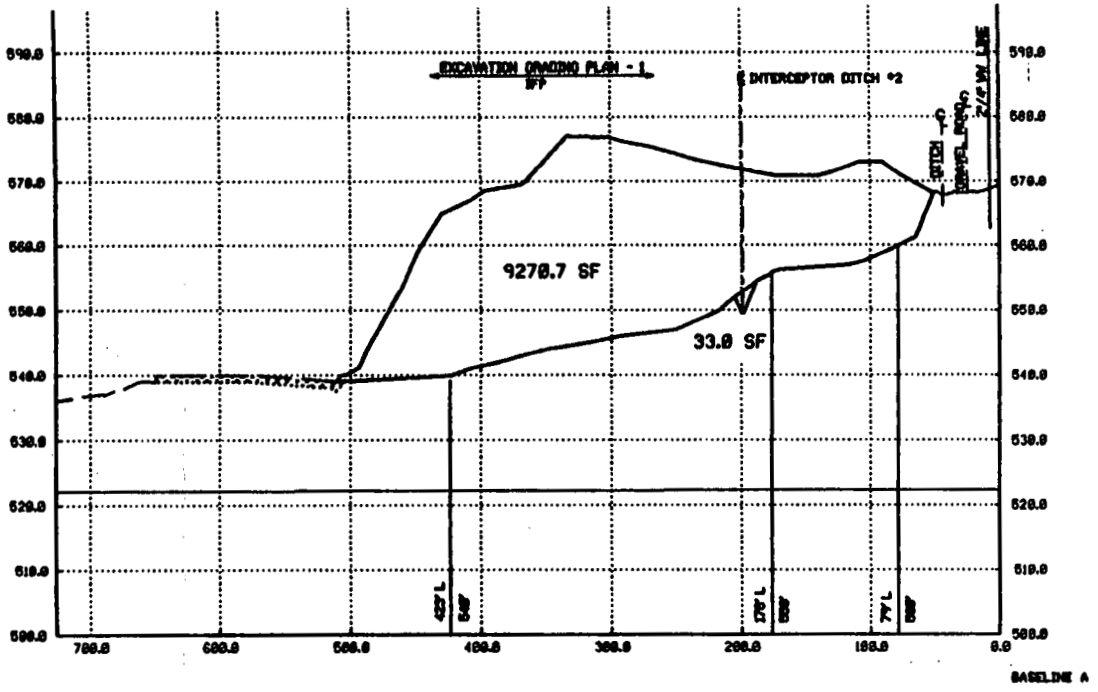

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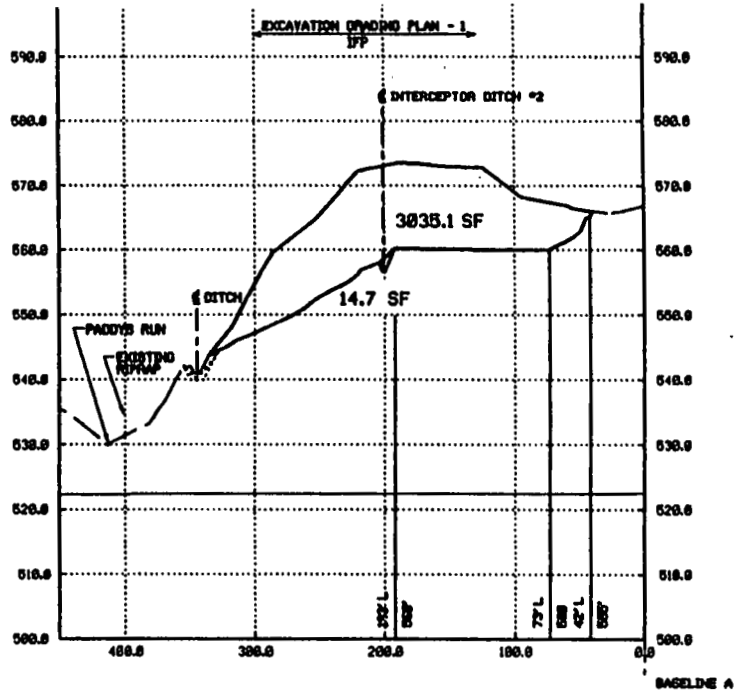

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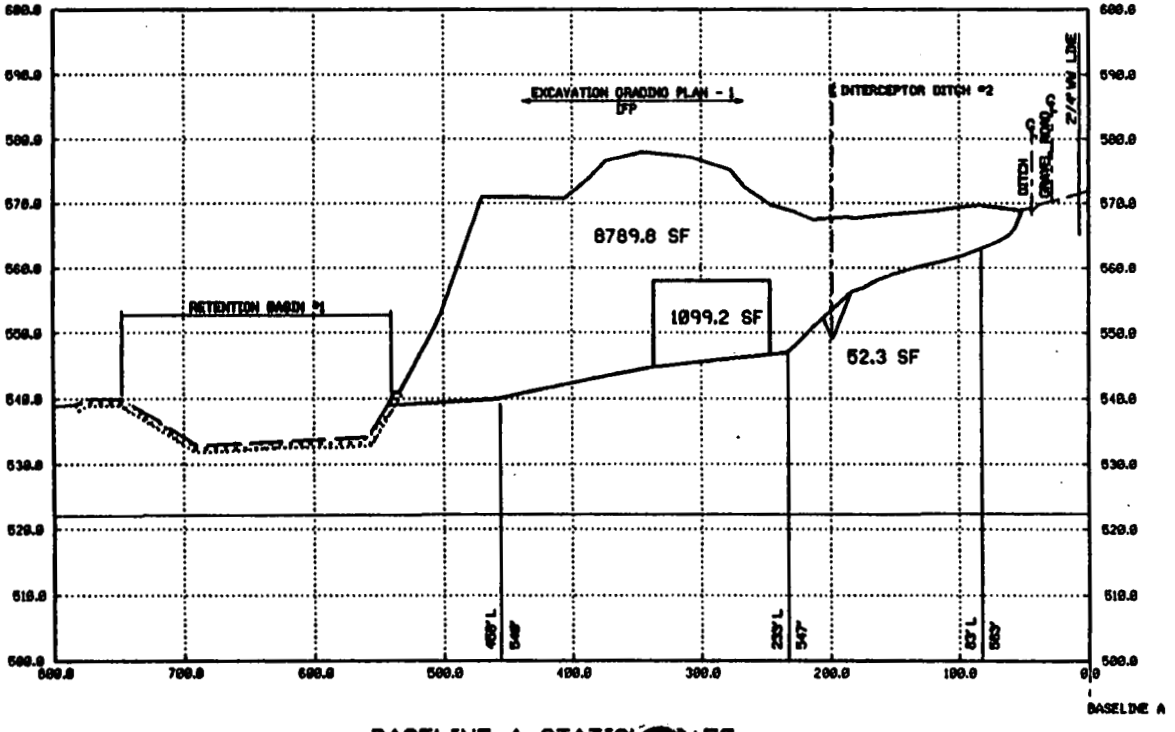

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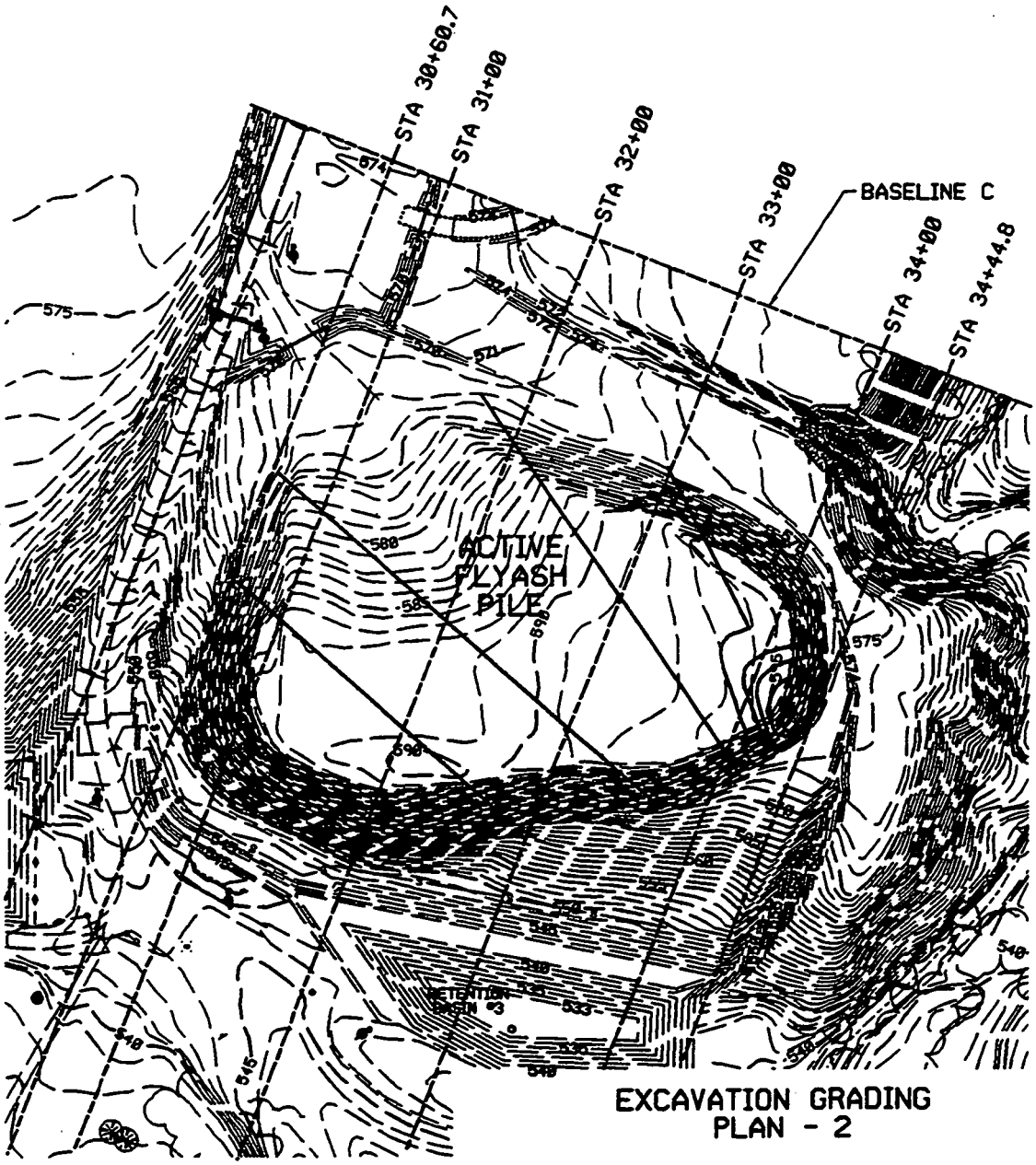

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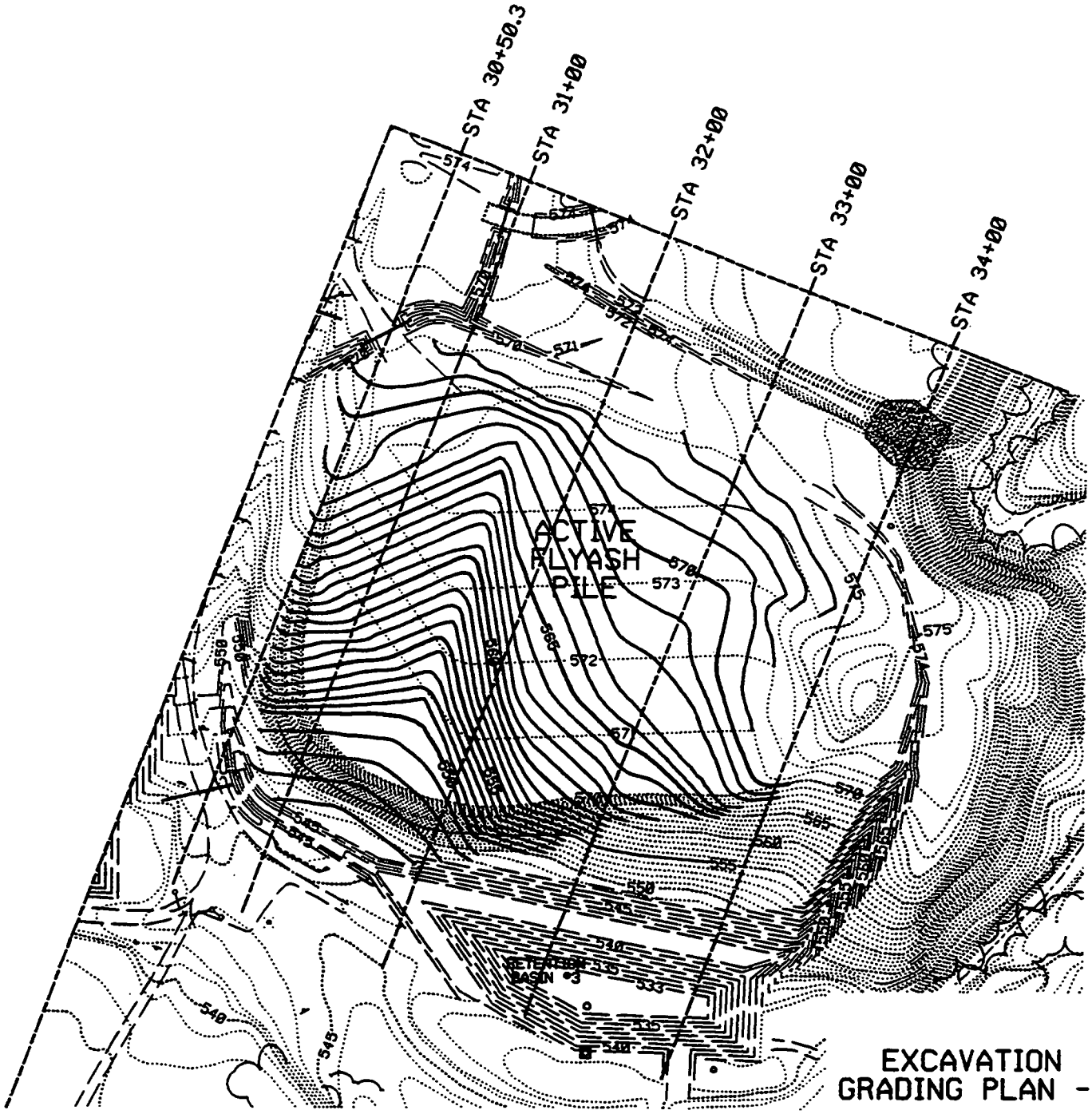

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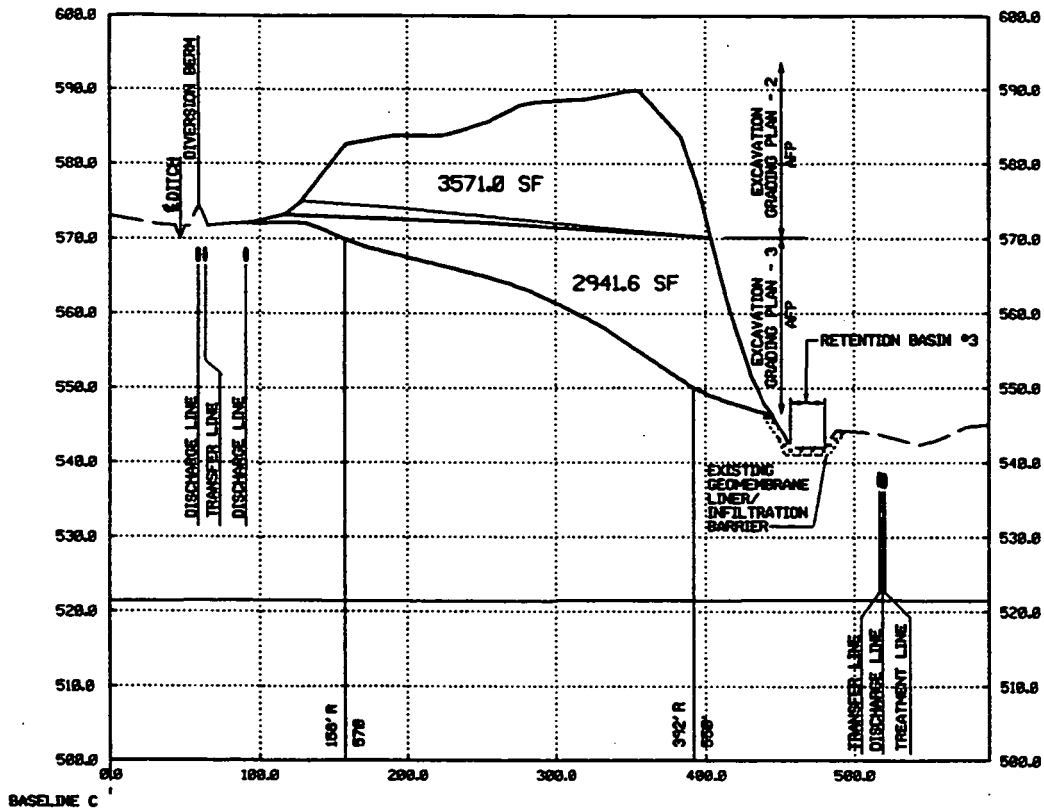

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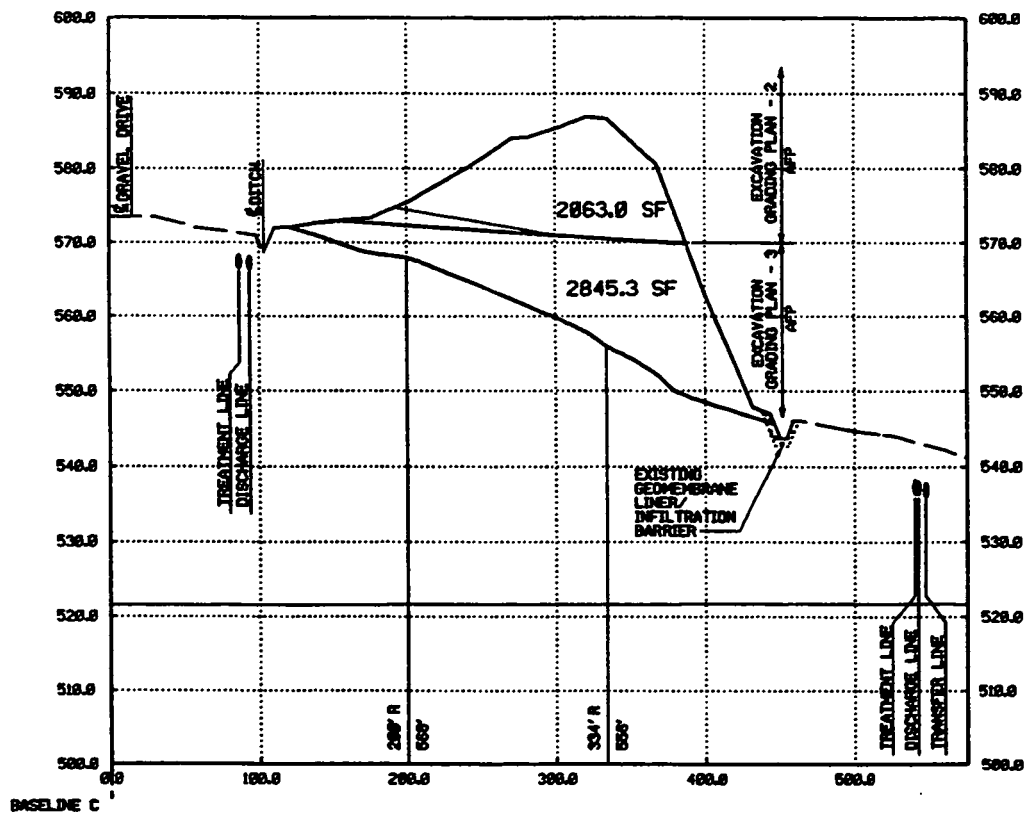

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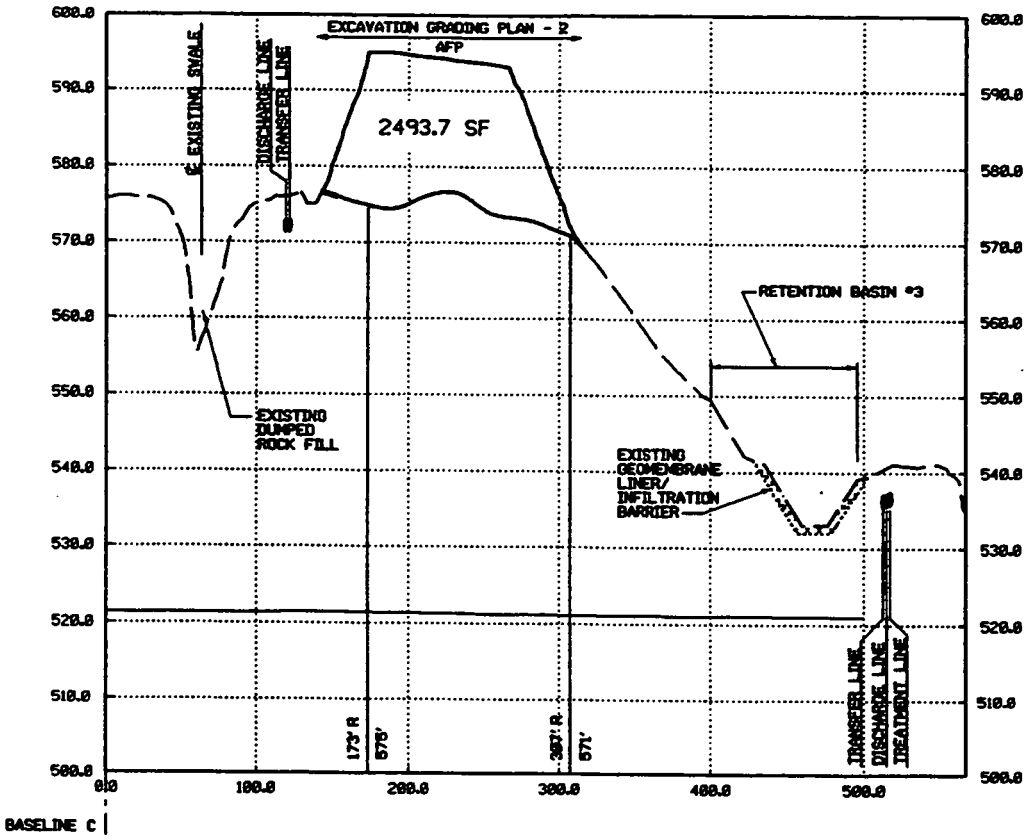

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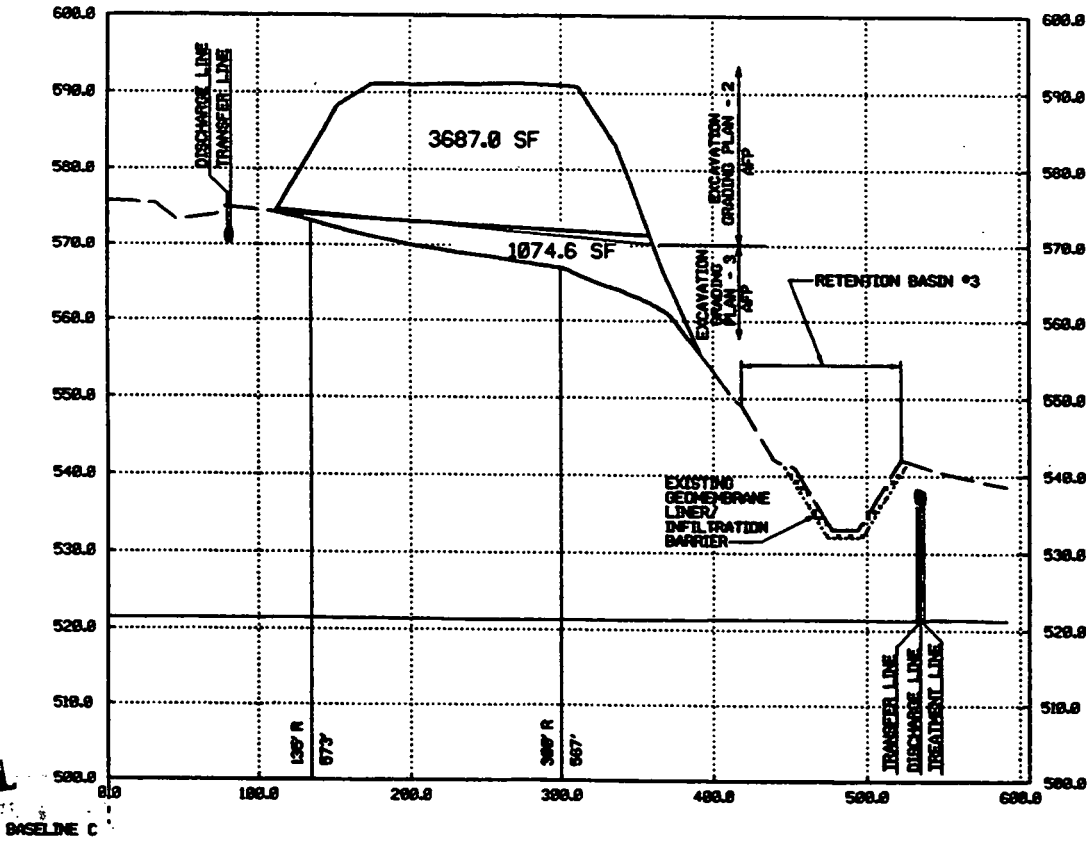

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ATTACHMENT G, RETENTION BASINS 1-3
EARTHWORK VOLUMES USING INROADS

5HTG2

Southern Waste Units
Site Preparation Package

Earthwork Quantity Calculations for Retention Basins 1-3
(Using Intergraph Inroads program)

Retention Basin #1:

Existing surface contours: /usr/rfiles/ou2/po165/bsn1ex.dtm
Proposed surface contours:/usr/rfiles/ou2/po165/bsn1new.dtm
Cut Volume = 10,514 cu yd

Retention Basin #2:

Existing surface contours: /usr/rfiles/ou2/po165/bsn2ex.dtm
Proposed surface contours:/usr/rfiles/ou2/po165/bsn2new.dtm
Cut Volume = 17,740 cu yd

Retention Basin #3:

Existing surface contours: /usr/rfiles/ou2/po165/bsn3ex.dtm
Proposed surface contours:/usr/rfiles/ou2/po165/bsn3new.dtm
Cut Volume = 4,920 cu yd

SHTG3

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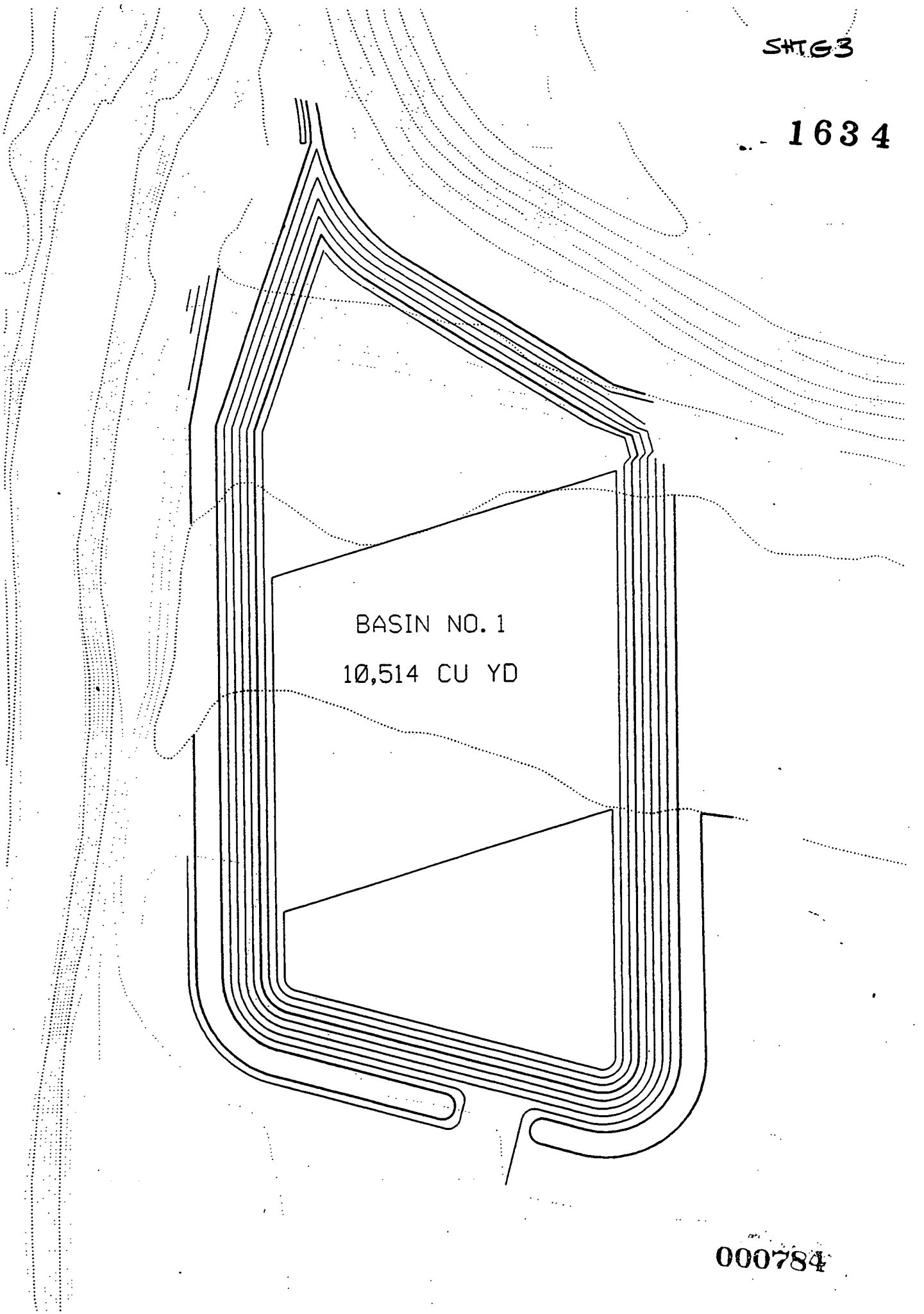

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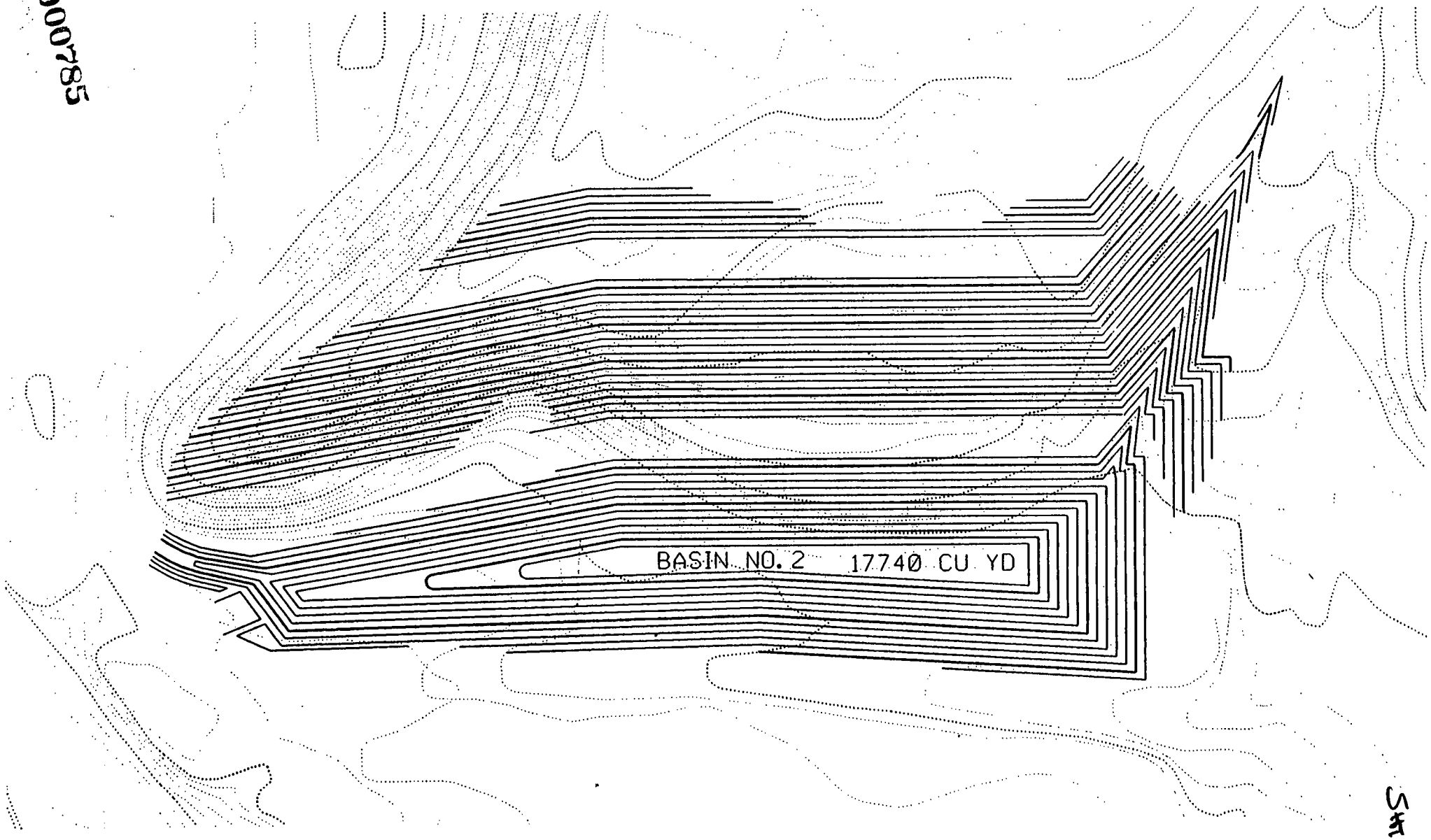

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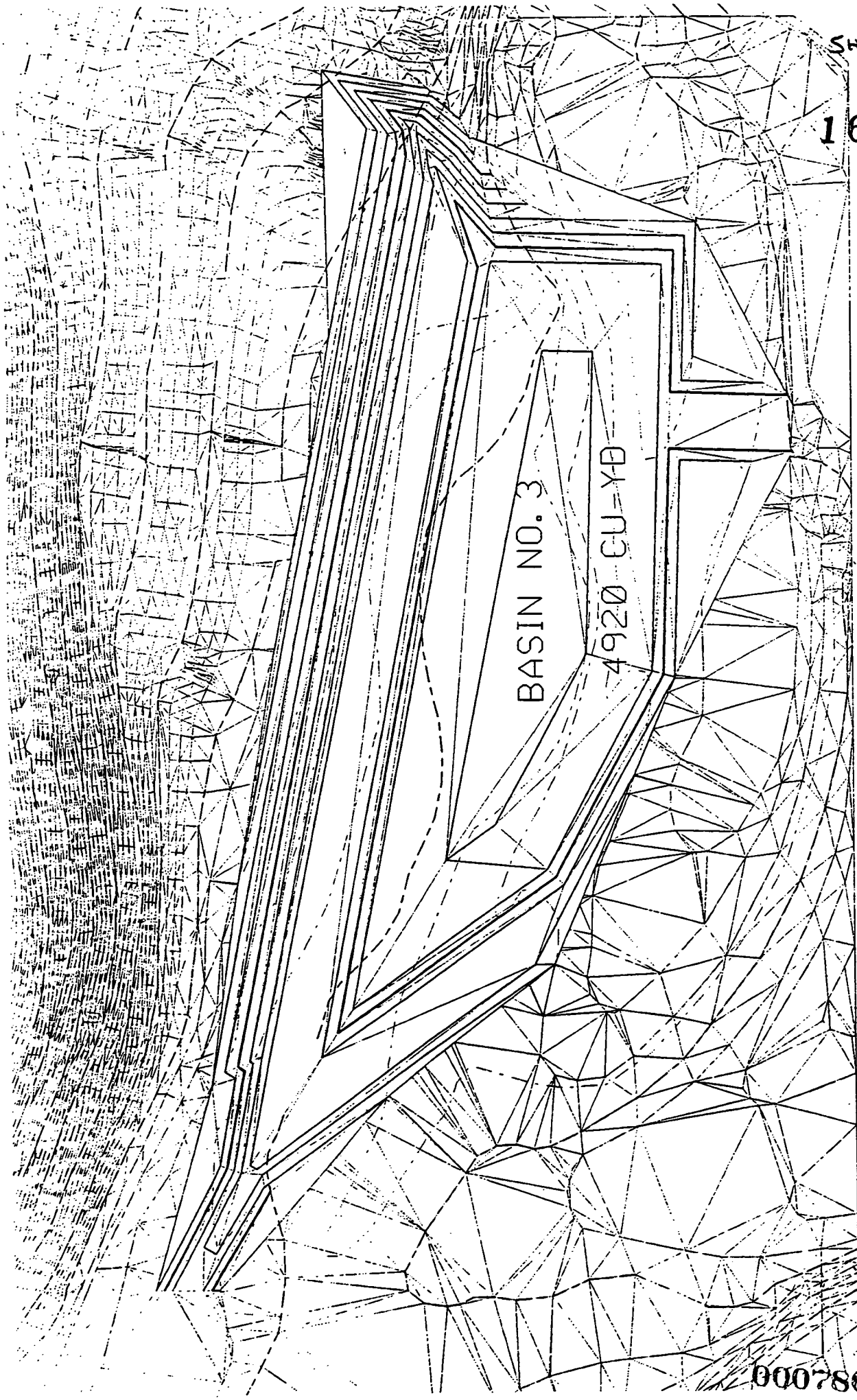

000786

APPENDIX D

AREA 2, PHASE I DATA SUMMARY

TABLE OF CONTENTS

List of Tables . . . . . D-ii
List of Figures . . . . . D-iii
List of Acronyms and Abbreviations . . . . . D-v
References R-1

D.1.0 Introduction D-1
D.1.1 Area 2, Phase I Site Preparation Areas Sampling D-1
D.1.1.1 Summary of Pertinent Historical Information D-2
D.1.1.2 Summary of Site Preparation Sampling Investigation Results D-3
D.1.1.2.1 Waste Acceptance Criteria Attainment D-3
D.1.1.2.2 Characterization for Reuse D-5
D.1.1.3 Summary of Information Obtained During Site Preparation Excavation Work D-8
D.1.2 Area 2, Phase I Waste Acceptance Criteria Delineation Data Collection D-8
D.1.2.1 Summary of Pertinent Historical Data D-9
D.1.2.2 Summary of Waste Acceptance Criteria Delineation Sampling Results . D-10
D.1.2.3 Waste Acceptance Criteria Investigation Work in "Contaminated Areas" D-15
D.1.3 Area 2, Phase I Lead Firing Range Characterization D-16
D.1.3.1 Summary of Pertinent Historical Data D-17
D.1.3.2 Summary of Lead Firing Range Characterization Results D-17
D.1.4 SP-5 Characterization D-18
D.1.4.1 Summary of Pertinent Historical Data D-19
D.1.4.2 Summary of SP-5 Characterization Results D-19
D.1.4.2.1 Real-Time Monitoring D-19
D.1.4.2.2 Total Uranium Sampling Activities D-20
D.1.4.2.3 Technetium-99 Sample Activities D-21
D.1.4.2.4 Semi-volatiles Sample Activities D-21

LIST OF TABLES

Table D-1 Area 2, Phase I Site Preparation High Purity Germanium Detector Measurements
Table D-2 Area 2, Phase I Site Preparation Fill Areas High Purity Germanium and Soil Sampling Results
Table D-3 Area 2, Phase I Site Preparation Certification Readiness (Preliminary) Analytical Results
Table D-4 Area 2, Phase I Site Preparation Characterization for Reuse, Radiological Analytical Results
Table D-5 Area 2, Phase I Site Preparation Characterization for Reuse, Metal and Chemical Analytical Results
Table D-6 Area 2, Phase I Characterization for Reuse Statistics
Table D-7 Area 2, Phase I Special Materials Areas High Purity Germanium Measurements
Table D-8 Area 2, Phase I Above-Waste Acceptance Criteria Delineation Beta-Gamma Scan and Soil Sampling Results
Table D-9 Area 2, Phase I Above-Waste Acceptance Criteria High Purity Germanium Measurements, Total Uranium
Table D-10 Area 2, Phase I Inactive Flyash Pile Area High Purity Germanium Measurements, Total Uranium
Table D-11 Area 2, Phase I Above-Waste Acceptance Criteria Area Sampling Coordinates and Surface Elevations
Table D-12 Indicator Coding Used to Determine Extent of Above-Waste Acceptance Criteria Area in Area 2, Phase I Inactive Flyash Pile
Table D-13 Area 2, Phase I Firing Range Lead Concentrations, October 1996
Table D-14 Area 2, Phase I Firing Range Lead Concentrations, December 1997
Table D-15 SP-5 Soil Analytical Results

000789

LIST OF FIGURES

Figure D-1 Area 2, Phase I Area
Figure D-2 Site Preparation Fill Excavation Footprint for Area 2, Phase I
Figure D-3 Location of Cross-Sectional Views for the Fill Area North of the South Field Retention Basin
Figure D-4 East-West Cross Section for the Fill Area North of the South Field Retention Basin
Figure D-5 North-South Cross Section for the Fill Area North of the South Field Retention Basin
Figure D-6 Historical Sampling Locations Color-Coded by Maximum Total Uranium Concentrations
Figure D-7 Total Uranium WAC Attainment HPGe Results for the Site Preparation Areas in Area 2, Phase I
Figure D-8 Total Uranium HPGe Results for the Northern Portion of the Site Preparation Areas in Area 2, Phase I
Figure D-9 Total Uranium HPGe Results for the Southeastern Portion of the Site Preparation Areas in Area 2, Phase I
Figure D-10 Total Uranium HPGe Results for the SF Retention Basin Site Preparation Areas in Area 2, Phase I
Figure D-11 Total Uranium HPGe Results for the IFP Retention Basin Site Preparation Areas in Area 2, Phase I
Figure D-12 Total Uranium HPGe Results for the Northwestern Portion of the Site Preparation Areas in Area 2, Phase I
Figure D-13 Discrete Soil Samples Total Uranium Results for WAC Attainment in the Northern Portion of the Site Preparation Areas in Area 2, Phase I
Figure D-14 Discrete Soil Samples Total Uranium Results for WAC Attainment in the Southern Portion of the Site Preparation Areas in Area 2, Phase I
Figure D-15 Readiness Sampling Total Uranium Results in the IFP Retention Basin Area
Figure D-16 Readiness Sampling Total Uranium Results in the SF Retention Basin Area
Figure D-17 Readiness Sampling Total Uranium Results in the AFP Retention Basin Area
Figure D-18 Certification for Reuse Total Uranium Results for the Northern Portion of the IFP Retention Basin Area
Figure D-19 Certification for Reuse Total Uranium Results for the Southern Portion of the IFP Retention Basin Area
Figure D-20 Certification for Reuse Total Uranium Results for the SF Retention Basin Area
Figure D-21 Certification for Reuse Total Uranium Results for the AFP Retention Basin Area
Figure D-22 Special Material Areas and Associated Total Uranium HPGe Measurements
Figure D-23 Photographs of SWUSM-1 (Special Materials Area 1)
Figure D-24 Photograph of SWUSM-2 (Special Materials Area 2)
Figure D-25 Photograph of SWUSM-4 (Special Materials Area 4)
Figure D-26 Photographs of SWUSM-5 (Special Materials Area 5)
Figure D-27 Photographs of SWUSM-6 (Special Materials Area 6)
Figure D-28 Photograph of IFP-HS-B2 (Inactive Flyash Pile hot spot)
Figure D-29 Photograph of NFA-HS-B2 (Nonfill Area hot spot)
Figure D-30 Photographs of AFP-HS-1 (Active Flyash Pile hot spot)
Figure D-31 Locations of the 5 Areas Where Historical Sampling Found WAC Exceedances
Figure D-32 Total Uranium WAC Delineation Results for SWU-1

Figure D-33 Total Uranium WAC Delineation Results for SWU-2
Figure D-34 Total Uranium WAC Delineation Results for SWU-3
Figure D-35 Total Uranium WAC Delineation Results for SWU-4
Figure D-36 Total Uranium WAC Delineation Results for SWU-5
Figure D-37 Relationship Between Total Uranium Concentrations and Gross Activity for Soil Samples from SWU-5
Figure D-38 Cross-Section Locations for SWU-5
Figure D-39 Cross-Section A-A' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-40 Cross-Section B-B' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-41 Cross-Section C-C' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-42 Cross-Section D-D' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-43 Cross-Section E-E' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-44 Cross-Section F-F' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-45 Cross-Section G-G' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-46 Cross-Section H-H' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-46a Cross-Section I-I' for SWU-5 with Total Uranium Results, Gross Activity, and Stratigraphy
Figure D-47 A2PI Above-WAC Excavation Area
Figure D-48 A2PI Above-WAC Excavation Boundary of Total Uranium Above-WAC
Figure D-49 A2PI Above-WAC Cross Sections A-A', B-B', and C-C'
Figure D-50 "Contaminated Areas" with Historical Data and Total Uranium Results from HPGe Measurements
Figure D-51 Historical Lead Soil Sampling in the A2PI Lead Firing Range
Figure D-52 XRF Lead Results in the A2PI Firing Range
Figure D-53 Summary of Lead Soil Sampling Results, with Bores Color Coded by Maximum Lead Value
Figure D-54 A2PI Firing Range, Lead Concentrations, 0-2 Feet
Figure D-55 A2PI Firing Range, Lead Concentrations, 2+ Feet
Figure D-56 A2PI Firing Range Additional Sample Locations
Figure D-57 A2PI Firing Range Extent of Excavation, 0-2 Feet
Figure D-58 A2PI Firing Range Extent of Excavation, 2+ Feet
Figure D-59 SP-5 Soil Sampling Locations
Figure D-60 SP-5 HPGe and RTRAK Coverage (Surface)

000791

LIST OF ACRONYMS AND ABBREVIATIONS

A2PI	Area 2, Phase I
AFP	Active Flyash Pile
ASCOC	area-specific constituent of concern
bgs	below ground surface
ccpm	corrected counts per minute
COC	constituent of concern
DCN	Design Change Notice
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FRL	final remediation level
GMA	Great Miami Aquifer
GPC	gas proportional counting
HPGe	high purity germanium
ICP/MS	inductively coupled plasma/mass spectrometry
IFP	Inactive Flyash Pile
mg/kg	milligrams per kilogram
msl	mean sea level
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU	Operable Unit
pCi/g	picoCuries per gram
ppm	parts per million
PSP	Project Specific Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RTRAK	Real Time Radiation Tracking System
SEP	Sitewide Excavation Plan
SF	South Field
TCLP	Toxicity Characteristic Leaching Procedure
V/FCN	Variance/Field Change Notice
WAC	Waste Acceptance Criteria
XRF	x-ray fluorescence

D.1.0 INTRODUCTION

This appendix summarizes available data pertinent to the soil remedial actions planned for Area 2, Phase I (A2PI). These data include historical information available for the area, data resulting from three predesign investigations to support remedial action design work, and additional information that was generated during the site preparation activities. Complete descriptions of the three predesign investigations can be found in their Project Specific Plans (PSPs) and associated variance documentation. The three PSPs were:

- Area 2, Phase I Site Preparation Areas Sampling Project Specific Plan, (DOE 1997a);
- Area 2, Phase I Delineation of Areas Exceeding Waste Acceptance Criteria (WAC) Project Specific Plan, (DOE 1997b); and
- Project Specific Plan for Lead Delineation in the Area 2, Phase I Firing Range, (DOE 1997c).

Although the Table of Contents for this document lists 60 figures, only 5 of those figures (D-47, D-48, D-49, D-57, and D-58) appear in this document. All 60 figures can be found on the Internet at www.ead.anl.gov/~femp/srp. Posting of these figures to the Internet minimizes the effort and cost expended to revise and reprint numerous hard copies usually included in a document.

Additionally, data from several SP-5 sampling events is presented and discussed in this appendix. Supplemental information on SP-5 can be found in Section 1.2.3 and 3.3.6 of this IRDP.

D.1.1 AREA 2, PHASE I SITE PREPARATION AREAS SAMPLING

In the A2PI area, considerable site preparation activities were required prior to the remedial excavation work. These site preparation activities included the excavation of three stormwater retention basins [Active Flyash Pile (AFP) retention basin, Inactive Flyash Pile (IFP) retention basin and the South Field (SF) retention basin] and associated drainage ditches. Figure D-1 shows the principle features of the area, including locations of the retention basins and excavated soils stockpiles.

There were two goals for the predesign investigation work in the A2PI site preparation areas:

- to determine WAC attainment in site preparation areas to be excavated; and
- to characterize for reuse native soil that would be excavated during the construction of the retention basins.

The site preparation excavation work that is required can be divided into excavation of native soils and excavation of A2PI fill material. The approximate footprint for fill excavation proposed for A2PI site preparation work is shown in Figure D-2. This footprint is important because WAC attainment concerns and soil reuse opportunities differ between fill material and native soil. Soils excavated during the site preparation activities are to be segregated into three streams. The first contains native soils that do not contain contaminants above final remediation levels (FRLs) for the area. These soils will be reused and are to be staged in the two nonimpacted stockpiles identified in Figure D-1. The second stream contains native soils that are contaminated above FRLs but that meet the On-Site Disposal Facility (OSDF) WAC as well as SF fill material that meets that OSDF WAC. These soils will be staged in the impacted stockpile identified in Figure D-1. The last stream area soils and/or fill material that does not meet the OSDF WAC. These will be segregated and staged elsewhere on site pending off-site disposal.

The bulk of the fill material comes from the area directly north of the SF retention basin. Figure D-3 shows the location of four cross-sectional views in this area; Figures D-4 and D-5 show the relationship between the original topography and the current depth of fill for these cross-sections. Also included in these figures are the locations of soil borings completed as part of predesign characterization and their completion depths. Site preparation excavation has taken place, to depths required for site preparation work with completion into either native soils or, in some instances, before bottom of fill is encountered.

D.1.1.1 Summary of Pertinent Historical Information

Historical information pertinent to A2PI include historical photographs that show the original topography before fill activities began, more recent photographs that show the present extent of fill material, and historical soil sampling results from the fill areas that would be pertinent for WAC attainment evaluation. There is little historical sampling data available for the majority of the retention basins' areas that fall within native soils. Consequently, historical data provides little information regarding reuse of excavated native soils.

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Of the 539 historical samples available in the A2PI area with total uranium results, approximately 70 samples fall within the footprint of site preparation work. The majority of these samples are surficial. Historical sample data can be found in the Operable Units (OUs) 2 and 5 Remedial Investigation and Feasibility Studies (RI/FS) (DOE 1995a,b,c and DOE 1996). Figure D-6 shows the locations of historical sampling locations relative to the site preparation excavation work. The sampling locations displayed in Figure D-6 are color coded by the maximum level of total uranium encountered at that location. No historical sampling locations within the excavation footprint for site preparation areas encountered total uranium above WAC attainment levels. The highest historical sample concentration observed in the excavation footprint was 668 milligrams per kilogram (mg/kg) or parts per million (ppm) located at the southern edge of the AFP retention basin. The historical data showed a high degree of spatial variability in total uranium values.

D.1.1.2 Summary of Site Preparation Sampling Investigation Results

D.1.1.2.1 Waste Acceptance Criteria Attainment

Although historical information suggested there would be no WAC attainment concerns in soils excavated during site preparation activities, historical information was not believed to be conclusive. Consequently an intensive data collection effort was undertaken in the site preparation areas to establish WAC attainment. The site preparation PSP originally called for a combination of 100 percent surficial coverage with Real-Time Radiation Tracking System (RTRAK) and/or in situ high purity germanium (HPGe) measurements, along with supplemental discrete soil samples to verify the real-time results. Because of Global Positioning System problems, however, the RTRAK was not successfully deployed in the site preparation areas. Consequently, in situ HPGe was used for 100 percent coverage.

The PSP called for 100 percent coverage with the HPGe for native soils and for fill areas. These HPGe measurements were collected at a height of 1 meter, yielding a field of view with a radius of approximately 20 feet. In addition to the HPGe measurements, the PSP called for discrete samples in fill areas to be collected every 3,500 square feet for broad site preparation areas, and every 100 feet for narrow areas, such as the footprints of drainage ditches. At discrete sampling locations, soil borings were conducted with a Geoprobe® to the depths planned for site preparation excavation with completion in native soils, or in some instances in fill material. Soil samples were collected from each 6-inch length of the boring and submitted for total uranium analysis. In the portions of site preparation areas

that corresponded to native soils, additional soil samples were to be collected if an HPGe analysis yielded a value greater than 750 ppm.

A total of 225 HPGe measurements at a height of 1 meter were made in site preparation areas. The results from these measurements are tabulated in Table D-1 and shown in Figures D-7. Figures D-8 through D-12 provide maps with more detailed results for different subareas. The average HPGe concentration for total uranium was 16 ppm, with a standard deviation of 6 ppm and maximum value of 46 ppm. The HPGe results showed the same general spatial patterns of contamination in the site preparation areas as were identified in the historical information. The field of view for these measurements was approximately 1,200 square feet. The response of the HPGe is a spatially-weighted average, with materials directly beneath the detector contributing more to the average than materials at the periphery of the field of view. The layout of the HPGe measurements resulted in an average separation distance of approximately 55 feet between measurements. In some areas because of terrain the density of HPGe measurements was less. In other areas, particularly along the southern border of the IFP, the density was greater.

A total of 117 soil samples from 54 locations were collected for WAC attainment verification in site preparation areas that coincided with fill material. This number of points resulted in one sampling location per approximately 2,000 square feet of fill material, a significantly higher density than called for by the PSP (3,500 square feet). Along the northeast footprint for the site preparation excavation, physical sampling was adjacent to the fill material to be excavated because of buried utility concerns. Sampling was done to the depth of the planned site preparation excavation. The depth of soil borings ranged from 2 to 14 feet with most to a depth of 6 feet or less. Only 5 of 54 borings were completed at a depth between 8 and 14 feet, all of which were completed along the southeastern slope of the SF where the fill depth was greatest.

All samples were analyzed for total uranium, Analytical Support Level (ASL) B, by the Fernald Environmental Management Project (FEMP) on-site laboratory using the bromoPADAP method. The results from these samples are tabulated in Table D-2 and shown in Figures D-13 and D-14. The sampling locations in these figures are color coded by the maximum concentration of total uranium observed. The average concentration for total uranium in all samples was 12 ppm, with a standard deviation of 11 ppm and actual values ranging from 1 to 79 ppm. The physical samples collected had a

lower average concentration than the HPGe measurements, but exhibited higher variability. This is not surprising given the relative large small-scale variability in total uranium concentrations observed in historical data, and the comparatively large fields of view associated with HPGe measurements collected at a height of 1 meter.

An additional 128 soil samples were collected in the footprint of the retention basins to support characterization for reuse. Although these samples were not primarily intended for WAC evaluation, they were analyzed for total uranium content and so provide important information regarding the presence/absence of WAC material within the retention basins. The results of this sampling, along with maps that depict the location of samples and uranium concentrations observed, are discussed in greater detail in the section on characterization for reuse. The maximum total uranium concentration observed in these samples was only 18.1 ppm. From WAC perspective, there were no samples encountered within the footprint of the retention basins that yielded total uranium concentrations that would pose any WAC concern.

For design purposes, the conclusion from this portion of the predesign investigation work is that there are no identifiable WAC concerns within the footprint of the fill material to be excavated in support of site preparation activities or within the footprint of the proposed retention basins. This conclusion is based on historical data and intensive soil sampling during predesign data collection, and is supported by nearly 100 percent coverage with in situ HPGe measurements taken at a height of 1 meter.

D.1.1.2.2 Characterization for Reuse

Most of the soils excavated from each of the three retention basins represent native soils. Although all fill material is assumed impacted and is destined either for the OSDF [total uranium concentration < 1,030 milligrams per kilogram (mg/kg)] or for off-site disposal (total uranium concentration > 1,030 mg/kg), the native soils from the three retention basins are not necessarily contaminated above the uranium-238 FRL of 3.22 picoCuries per gram [pCi/g (approximately 9.65 mg/kg)] for total uranium that is pertinent for A2PI. To minimize the placement of "clean" soils in the OSDF, characterization for reuse sampling was conducted in the native soil excavation footprints of the retention basins. The limited historical sampling available within the footprints of the retention basins suggested that surficial soils contained total uranium in excess of the 9.65 ppm FRL. This was confirmed by extensive in situ HPGe measurements done in each retention basin (Figure D-7). The

purpose of the reuse sampling was (1) to determine the likely depth within each retention basin where the FRLs would be achieved, and then (2) to certify that soils at these depths were indeed clean with more intensive certification sampling. Soils below the depth where characterization for reuse took place would be assumed below FRLs, while soils above this depth would be staged for disposal in the OSDF. The implicit assumption in this approach was the concentrations would decrease with depth.

For the purposes of characterization for reuse, the three retention basins were treated as four distinct areas: the northern portion of the IFP retention basin (0.30 acres), the southern half of the IFP retention basin (1.0 acres), the SF retention basin (0.72 acres), and the AFP retention basin (0.64 acres). Characterization for reuse took place in two phases. The first phase, certification readiness sampling, attempted to determine in each of the basins the vertical extent of contamination above 9.65 ppm for total uranium. Four readiness sampling locations were randomly allocated to each of the four areas. Soil cores were collected from each locations down to a depth of 30 inches. These soil cores were divided into four depths (6 to 12 inches, 12 to 18 inches, 18 to 24 inches, and 24 to 30 inches), and samples from each depth were submitted for analysis of total uranium content using the inductively coupled plasma/mass spectrometry (ICP/MS) method. The certification readiness sampling results were used to determine the depth at which each of the four areas was likely to pass certification for reuse. After these depths had been determined, the second phase of sampling began. In the second phase, 16 sampling locations were identified for each of the four areas using stratified random sampling for use in certification. Samples from the appropriate depth were collected and submitted for analysis based on the complete A2PI list of area-specific constituents of concern.

Figures D-15 and D-17 show the locations of the readiness samples for the four areas. If any one of the four areas failed the characterization for reuse analyses at the bottom interval (i.e., 24 to 30 inches), all the soil to be excavated during site preparation activities in that area would be considered impacted and the material placed in the impacted stockpile. If the selected depth for characterization for reuse passes for a particular area, the soils above that depth would be considered nonimpacted and segregated in the nonimpacted pile. Note that any material, regardless of certification for reuse analytical results, that appears to be fill material would be considered impacted. Flyash is an example of fill material that is visibly discernable from native soils.

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Tables D-3, D-4, and D-5 summarize the readiness sampling and characterization for reuse sampling results. Figures D-15 through D-17 map the results from the readiness sampling. Sixty-nine discrete samples from 16 locations were collected as part of the readiness sampling. For each readiness sampling location, total uranium concentrations consistently decreased with depth. Based on the readiness sampling, the depth at which certification would take place was selected for each of the four areas. In the northern IFP retention basin (IFP-B1), the selected depth was 1.5 feet; in the southern IFP (IFP-B2), the selected depth was 1 foot. In the SF retention basin (SF-B), the selected depth was 3.5 feet. In the AFP retention basin (AFP-B), the selected depth was 1 foot. Figures D-18 through D-21 map the results from the certification sampling for each of these four areas for total uranium. Although each certification sample was analyzed for a suite of analytes, total uranium was assumed to be the principal constituent of concern (COC) for these areas.

Characterization for reuse consisted of a statistical analysis of the certification sampling results for FRL attainment and a review of the data for hot spot problems. A student t-test was used to evaluate radium-226, thorium-232, uranium-238, thorium-230, arsenic, and lead. For these COCs, if the 95 percent upper confidence limit on the mean based on the characterization for reuse data was below the FRL for primary COCs (radium-226, uranium-238 and thorium-232), then the area was assumed to be in compliance with the FRLs. For thorium-230, lead, and arsenic, the 90 percent upper confidence limit on the mean was used. The remainder of the COCs were evaluated using a nonparametric proportions test. This test was used because of the high number of nondetects encountered for the remaining COCs. The detection limits in every case were significantly below the corresponding FRL. Based on these tests, every COC in each of the four areas was determined to be in compliance with its FRL. A review of the individual results did not identify any result greater than 2xFRL. Consequently, each COC in each of the four areas was also in compliance with the hot spot criteria applicable to A2PI. Table D-6 summarized the A2PI Characterization for Reuse statistics.

The conclusion of this analysis was that soils beneath a depth of 1.5 feet in IFP-B1, 1 foot in IFP-B2, 3.5 feet in SF-B, and 1 foot in AFP-B were not impacted above clean-up criteria. Soils above these depths were assumed impacted and, when excavated, placed in the impacted soils stockpile. Soils below these depths were assumed below FRLs and, when excavated, placed in the nonimpacted soils stockpile.

D.1.1.3 Summary of Information Obtained During Site Preparation Excavation Work

The excavation work for the SF retention basin required a significant amount of fill to be removed to stabilize the adjacent slope associated with the SF area. During the course of this excavation work, as well as during excavation of soils in the southern area of the IFP retention basin, "special" and "prohibited" [as defined in the Sitewide Excavation Plan (SEP) (DOE 1998) and the WAC Plan] items were identified in 10 different instances. The materials encountered included white powder, pieces of metal, fire brick, piping, a metal drum, and yellow cake. In each case, the material was segregated for special handling. The area were beta-gamma screened for total activity and an HPGe measurement was conducted at each location to quantify the level of residual contamination. In some cases three HPGe measurements were taken, at a height of 6 inches (15 centimeters), 1 foot (31 centimeters), and 1 meter (100 centimeters), to better estimate the spatial extent of contamination. The maximum HPGe measurement for total uranium was 359.7 ppm at AFP-HS-1.

Table D-7 summarizes the types of special and prohibited items encountered and accompanying HPGe information collected to characterize the immediate areas associated with these materials. Figure D-22 contains a map that indicates the approximate location where these materials were encountered and also provides residual total uranium values from HPGe measurements. Figures D-23 through D-30 contain photographs of the areas where these materials were encountered. Note that none of these materials were discovered in the soils considered to be characterized for reuse. Given the nature of disposal practices associated with A2PI, the discovery of such material was expected. In general, this material was of limited spatial extent and not of the type that would have been identified by intrusive sampling, but was readily identifiable during excavation, either visually or because of the level of gross activity present.

D.1.2 AREA 2, PHASE I WASTE ACCEPTANCE CRITERIA DELINEATION DATA COLLECTION

Historical sampling in the IFP and SF areas identified five areas with total uranium concentrations above the OSDF WAC. These locations, identified as SWU-1, SWU-2, SWU-3, SWU-4, and SWU-5, are shown in Figures D-31. Based on historical sampling, the first four locations appeared to represent localized surficial contamination. SWU-5, however, represents contamination at depth. In addition, SWU-4 exhibited technetium-99 (Tc-99) concentrations that exceeded WAC criteria (>29.1 pCi/g).

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The goal of the WAC delineation investigation was to delineate the extent of WAC contamination at these five locations and provide volumetric estimates of above-WAC material

D.1.2.1 Summary of Pertinent Historical Data

Figures D-6 shows the locations of historical sample collection in the SF area. Historical sampling results from surficial soils in areas SWU-1, SWU-2, and SWU-3 found total uranium concentrations of 1,235 mg/kg, 8,913 mg/kg, and 1,497 mg/kg, respectively. Additional soil samples collected immediately beneath the contaminated soil samples (0.17-0.5 feet) indicated total uranium concentrations of 53 mg/kg, 64 mg/kg, and 167 mg/kg, respectively (all below WAC).

Historical surficial soil sampling in SWU-4 found a total uranium concentration of 26,590 mg/kg and 594 pCi/g for Tc-99. Historical sampling did not bound the contamination vertically. The Tc-99 concentration of concern at SWU-4 was nonvalidated data from the Characterization Investigation Study (Weston 1986). Subsequent sampling (1997) at the approximate location (found at 0.5 foot depth) as well as four additional samples taken at compass points to the original location, indicated no presence of Tc-99 at depths to 3.5 feet (as required by the SEP, sampling to a depth of 3 feet below the lowest known contamination depth). Therefore, Tc-99 was removed as an ASCOC from the above-WAC area.

Historical sampling at depth in SWU-5 found total uranium concentrations of 2,413 mg/kg (22.5 feet), 4,705 mg/kg (21 feet), and 2,287 mg/kg (21 feet), but nothing in surficial soils. There is no known explanation for the location of these historical samples. For example, it is not known whether they represented randomly selected locations, or whether they were biased in response to surficial evidence of contamination such as yellow cake. The relatively shallow sampling intervals associated with SWU-1, SWU-2, and SWU-3 suggest the latter.

A review of existing perched water and groundwater data found evidence of elevated concentrations in the vicinity of SWU-4 and SWU-5 for perched water, and SWU-5 for groundwater. The water data can be found in both the OU2 RI/FS and the OU5 RI/FS.

D.1.2.2 Summary of Waste Acceptance Criteria Delineation Sampling Results

Although historical data identified areas that would be of WAC concern in the A2PI area, aside from vertical bounding for SWU-1 through SWU-3 little information is provided regarding contamination extent. As part of predesign investigation work in A2PI, data was collected to assist in delineating WAC extent for each of the five areas. The original PSP called for radiological field surveying with 100 percent coverage around each area in a 50-foot radius before physical sampling began. If a measurement exceeded 750 ppm, a physical sample would be collected, with the location selected with the use of a beta-gamma frisker. In situ HPGe data would be collected at both 1-meter and 1-foot (31 centimeters) heights for SWU-1 through SWU-4 and at 1 meter for SWU-5. Shallow soil sampling would be conducted around and below suspected surficial WAC areas to bound the extent of contamination (a minimum of five locations), with sampling from surface to 3.5 feet in 6-inch intervals. All samples would be analyzed for total uranium. In addition, samples from SWU-4 would be analyzed for Tc-99. Additional sampling would be conducted if WAC material was encountered and was unbounded. In the case of SWU-5, deep bore sampling would be used to delineate the extent of above-WAC contamination. Borings would start with predetermined locations, with cores extracted using a Geoprobe®. Each 6 inches of the core would be frisked. Anything more than 100 corrected counts per minute (ccpm) would be archived. The highest core section would be analyzed (no flyash samples submitted). Additional bores closer or further out would be sampled depending on results from the initial round of sampling (SWU-5-1 through SWU-5-18). Analyses were conducted at ASL B with 10 percent analyzed and validated ASL D by the FEMP on-site laboratory using either bromoPADAP or ICP/MS for total uranium and gas proportional counting (GPC) for Tc-99. Off-site laboratory analyses were done using alpha spectrometry for total uranium and GPC for Tc-99.

The actual work deviated from the original PSP in two significant ways. First, because of GPS problems, mobile RTRAK readings were not possible around the five suspected WAC areas. Consequently, real-time data collection was limited to the use of the in situ HPGe. Secondly, because of concerns about the hand-held Geiger-Mueller beta-gamma detector to identify WAC material, part way through the program the sample archiving protocol was altered; at a minimum, soil samples immediately above and below the submitted intervals were automatically archived to allow for future retrieval of the sample for analysis to determine vertical WAC bounding.

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Results from soil sampling are tabulated in Table D-8 with results for the in situ HPGe measurements in the above-WAC area tabulated in Table D-9. Figures D-32 through D-36 map HPGe locations and provide results for each of the five suspected WAC areas. The maximum HPGe result encountered was 76.4 ppm for SWU-5, with the measurement taken at a height of 1 meter. Sampling results are mapped in Figures D-32 through D-35 for the first four WAC areas. For each of these four areas, neither the discrete soil sampling nor the in situ HPGe measurements yielded results that were elevated above WAC for total uranium. No sample yielded detectable concentrations for Tc-99. These results strongly suggest that the original WAC identification was the result of surficial evidence of contamination, and that this surficial evidence was removed as a result of sample collection.

In SWU-5 Geoprobe® bores were sunk in a multitude of locations (see Table D-11 for sample coordinates and surface elevations). In some locations, multiple Geoprobe® bores were used because of refusal and/or a significant number of unretrieved 6-inch cores. The typical depth of these bores was 27 feet, divided into 6-inch intervals. Figure D-36 shows the locations of these cores, with the locations color coded by the maximum concentration of total uranium encountered.

The Project Specific Plan for Delineation of Areas Exceeding WAC Area 2, Phase I (DOE 1997b) originally called for any 6-inch sample interval exhibiting a beta-gamma count greater than 100 ccpm be archived for future analysis; the interval exhibiting the highest ccpm measurement was submitted for total uranium analysis. No interval below 100 ccpm was archived for borings SWU-1 through SWU-4 and SWU-5 borings 1 through 18.

During additional sampling efforts (SWU-5 borings 19 through 40), it was realized that adequate bounding of any interval >100 ccpm was not possible since no interval <100 ccpm was analyzed or archived. A variance was issued to direct the collection of intervals immediately above and below the >100 ccpm interval for archive and potential future analysis.

Table D-8 is a summary of beta-gamma scans from the SWU-1 through SWU-5 cores. Approximately 250 soil samples scanned exhibited a reading of less than 100 ccpm. All soil samples exhibiting beta-gamma scans of less than 100 ccpm were well below the WAC for total uranium (highest concentration was 221 mg/kg). Based upon this comparison, beta-gamma scans <100 ccpm are likely

to be well below the total uranium WAC. Thus, the lack of total uranium lab analysis for intervals < 100 ccpm is likely to be of no consequence.

The scatter plot in Figure D-37 shows the relationship between gross activity (ccpm) and total uranium concentrations for those cores that had both pieces of information. The term "corrected counts per minute (ccpm)" refers to counts per minute (Geiger-Mueller) withe background levels removed. The Pearson correlation coefficient for the data contained in the scatter plot in Figure D-37 is 0.83. This establishes that there is a good connection between beta-gamma screening results and total uranium concentrations over the entire range of concentrations observed in the SWU-5 borings. This connection is also visually evident in the histogram in Figure D-37, which shows the fraction of samples that had WAC concerns for various levels of scanned activity. Of 198 samples collected with a corrected activity less than 400 ccpm, none contained total uranium concentrations in excess of total uranium WAC. Of the 34 samples with corrected activities greater than 1,000 ccpm, 30 also had total uranium concentrations in excess of the WAC. The samples from SWU-5 provide consistent and convincing evidence that a 400 ccpm gross activity screen can be used to determine the absence of above-WAC concentration while a 1,000 ccpm gross activity screen almost always demonstrates the existence of above-WAC concentration. Gross activity results between 400 and 1,000 ccpm indicated additional analysis may be required to definitively establish the presence or absence of above-WAC material.

Figure D-38 shows the names of each of the borings in the vicinity of SWU-5, and also indicates the locations and orientation of cross-sections constructed from these borings. Figures D-39 through D-46a present cross-sections for SWU-5. In these cross-sections, stratigraphic detail is shown, along with screening results and the results from discrete sampling. Several important conclusions can be drawn from this data for WAC material associated with SWU-5. First, material containing uranium concentrations exceeding the WAC appeared to have been spread over native soil and covered with 20 to 25 feet of flyash. Second, there is no evidence that the flyash overburden in the SWU-5 area contains uranium concentrations exceeding the WAC. Third, the boundary between the flyah and the WAC-bearing material is very distinct, abrupt, and exhibits strong lateral continuity. Fourth, this boundary is both visually identifiable, as well as easily identifiable using gross screening methods. It is important to note that the physical sampling conducted was to provide an indication of where WAC material existed, and to provide volumetric estimates of above-WAC contamination for design purposes.

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Previous RI/FS data from the A2PI above-WAC area indicated total uranium contamination to a depth of 24 feet below ground surface (bgs) in the area now identified as SWU-5. In accordance with the Sitewide Excavation Plan, bottom depths of the proposed borings (SWU-5-1 through SWU-5-18) were set at 27 feet bgs (3 feet below the deepest known contamination in the area). Of the 61 borings completed in the SWU-5 area, 13 were completed in the sands or sand/gravel of the Great Miami Aquifer (GMA), 19 had no recovery at the bottom of the boring, 7 encountered refusal before reaching the bottom of the boring, 13 were completed in clay, and 9 were completed in debris/flyash. If refusal was encountered or no recovery of the boring bottom was obtained, penetration to 27 feet bgs or greater was not feasible. Of the 13 borings completed in clay, 8 at the boring bottom had beta-gamma screens of 0 ccpm, 2 had beta-gamma screens of 50 ccpm, 1 had a beta-gamma screen of 100 ccpm, and 1 had a beta-gamma screen of 650 ccpm; 1 was above the total uranium WAC.

At the request of the Ohio Environmental Protection Agency (OEPA), additional borings were completed in the above-WAC area in A2PI [SWU-5-41, SWU-5-42, SWU-5-43, SWU-5-43A, and SWU-5-44 (see Figures D-36, D-48, and D-49)] to further bound the northern, western, and eastern extent of the suspected above-WAC area. All sampling activities were conducted as described in the Project Specific Plan Delineation of Areas Exceeding WAC, A2PI PSP (DOE 1997b), and V/FCN 20.03.13.02-16. In order to obtain sufficient volume for lab analysis, one boring for collection of the FDF sample was completed (SWU-5-41, SWU-5-42, SWU-5-43, SWU-5-43A, and SWU-5-44) and an adjacent boring was completed for the collection of the OEPA sample (SWU-5-EPA41, SWU-5-EPA42, SWU-5-43A, and SWU-5-EPA44). Table D-12 reflects these designations.

The EPA-designated samples were analyzed at an off-site laboratory for total uranium and Tc-99 by the KPA method. When analysis results were received by OEPA, a significant difference between the OEPA's off-site laboratory analysis and the on-site FEMP laboratory analysis (by ICP/MS) was noted. The unused portion of the OEPA soil samples (SWU-5-EPA41-24, SWU-EPA43-37, and SWU-5-EPA43-38) were sent to the FEMP on-sire laboratory for total uranium analysis by ICP/MS. The results are summarized in Table D-12.

There may be several reasons for the initial significant differences between the FDF and OEPA analyses:

- the extreme heterogeneity of soil in A2PI
- the OEPA boring was located approximately 1 foot from the FDF boring
- the extreme difficulty in truly duplicating any soil sample.

As a conservative measure, a 10-foot x 10-foot area around SWU-5-41 will be demarcated at 559 msl; the material within this area will be removed to a 1-foot depth (558 msl) and disposed of as above-WAC material.

As shown in Table D-8, elevated total uranium concentrations were detected in SWU-5-43 [1030 milligrams per kilogram (mg/kg) or parts per million (ppm) at 17.5 to 18 feet, 1140 mg/kg at 18 to 18.5 feet, 2270 mg/kg at 18.5 to 19 feet, and 2390 mg/kg at 19 to 19.5 feet] and SWU-5-43A (3220 mg/kg or ppm at 18 to 18.5 feet). This was not unexpected since the boring was located approximately 1 foot southeast of SWU-5-15 which also exhibited elevated total uranium concentrations (9090 ppm at 18.5 to 19 feet). The vertical extent of the above-WAC horizon exceeded that of SWU-5-15, however, occurring at 558.76 feet mean sea level (msl).

In addition to the soil sampling conducted, an HPGe scan was conducted in the IFP area. Originally, a grid was established to obtain as close to 100 percent coverage as. Due to terrain, accessibility, and weather conditions, 100 percent coverage was not possible. Table D-8 summarizes the HPGe measurements; the highest measurement taken was 59.8 ppm.

The construction drawings and technical specifications haven been revised through the Design Change Notice (DCN) process to modify excavation in the above-WAC area. The excavation approach and requirements for the top of the above-WAC area will be revised to include excavating the material from elevation 560 to 558 in two lifts that will each be approximately 1 foot thick.

Figures D-47, D-48, and D-49 (located in map pocket) shown the aerial extent of the above-WAC area, boring containing material above the total uranium WAC, and cross-sections through the above-WAC area, respectively.

The extent of the above-WAC area shown in Figures D-47, D-48, and D-49 was determined using numeric indicator coding. Three values were used:

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- 0 = Sample interval exhibited a beta-gamma measurement < 100 ccpm and/or analytical result was < WAC
- 1 = Sample interval exhibited a beta-gamma measurement > 100 ccpm, and/or analytical result was < WAC, and interval was not comprised of debris
- 2 = Sample interval exhibited a beta-gamma measurement > 100 ccpm, analytical result was > WAC, intervals above and/or below differed (e.g., one interval < 100 ccpm and one interval > 100 ccpm), or interval contained clear/brown glass in debris.

In instances where no sample interval was recovered, the last interval retrieved above the no recovery zone and, if applicable, the first interval recovered below the no recovery zone was evaluated. The no recovery intervals were then assigned a conservative code equivalent to the expected media. If the intervals above and below were similar, the no recovery intervals were assigned the same numeric designation. If the intervals above and below differed, the no recovery intervals were assigned the more conservative numeric designation (i.e., if interval above = 1 and interval below = 2, the no recovery intervals were assigned a value of 2). Table D-12 summarizes boring locations, sample intervals, and indicator codes.

As can be seen in Figure D-47, the area of above-WAC material is small as compared to the total A2PI area. The expected excavation boundary of the above-WAC area (see Figure D-48) is conservative to compensate for the excavation slope (2:1). Figure D-49 contains four cross-sections; the maximum width [555 to 550 feet mean sea level (msl) of contamination appears in Section B-B' between historic point 11051 and SWU-5-18. The bottom of excavation at 550 feet msl is estimated; excavation will continue until real-time measurements (RTRAK or HPGe) and visual observation determine native soil has been encountered and is below the total uranium WAC.

D.1.2.3 Waste Acceptance Criteria Investigation Work in "Contaminated Areas"

In the past, several areas within A2PI have been identified as "contaminated areas." This identification may have been based on visual evidence of contamination or elevated gross activity levels. In some cases this identification process resulted in fencing the area of concern. As part of the A2PI remedial design investigation work, these areas were measured with the HPGe at a height of one meter to determine whether WAC concerns might currently exist. Figure D-50 shows the locations of these

"contaminated areas" and provides total uranium HPGe results. No areas of WAC concern were identified with the HPGe in these areas.

D.1.3 AREA 2, PHASE I LEAD FIRING RANGE CHARACTERIZATION

The southwest edge of the SF forms a soil embankment that was used as a catchment area for lead ammunition for over 35 years by FEMP security. Previous data indicated elevated lead concentrations and the potential presence of Resource Conservation and Recovery Act (RCRA)-characteristic lead concentrations.

The investigation work in the lead firing range had two objectives:

- to determine the extent of lead contamination above its 400 mg/kg FRL
- to determine whether the material present in the lead firing range possesses the toxicity characteristics for lead as defined by RCRA.

The Former Firing Range is located in an area comprised of both fill (non-native material) and native soil. The remediation driver in the fill area is excavation/removal of non-native material to the end of occurrence or the 1952 contour lines, whichever is deeper; the remediation driver in native soil is the total lead FRL of 400 mg/kg.

The Toxicity Characteristic Leaching Procedure (TCLP) lead analysis performed for this event was not originally intended to delineate the extent of potentially toxicity characteristic hazardous waste. Initially, three soil samples were collected (A2PIPB-22 from a high bullet density area, A2PIPB-23 from a moderate bullet density area, and A2PIPB-24 from a low bullet density area) and analyzed for TCLP lead. At the request of the Ohio Environmental Protection Agency (OEPA), any samples exceeding a total lead concentration of 200 mg/kg were pulled from archive and submitted for TCLP lead analysis.

Sampling locations (both historical and recent) are shown in Figures D-51 through D-53; Tables D-13 and D-14 summarize the analytical results (historical results are presented in the OU 2 RI/FS). Figures D-54 and D-55 show the extent of total and TCLP lead contamination at 0-2 feet and greater than 2 feet, respectively. As can be seen in Figure D-54, the TCLP lead contours mirror the

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400 mg/kg contours. Therefore, any soil exhibiting total lead concentrations at or above 400 mg/kg will be excavated and disposed of as toxicity characteristic hazardous waste.

D.1.3.1 Summary of Pertinent Historical Data

A Removal Site Evaluation was conducted in 1992 to assess lead contamination at the SF firing range and to determine whether the nature and extent of contamination warranted a removal action. Approximately 300 cubic yards of soil containing spent lead ammunition was estimated to be present in the area. In January and February 1992, vertical and horizontal boring were placed in the western embankment of the SF just east of the FEMP running track/firing range, and samples were collected for the analysis of lead. Sampling results indicated that a removal action was not necessary. Data from this sampling effort can be found in the OU2 RI and are mapped in Figure D-51.

In October 1996, additional real-time measurements were performed using a field portable x-ray fluorescence (XRF) spectrometer to further define the extent of lead-contaminated soil. A field investigation was conducted along the western edge of the SF with 34 sample points collected. Thirteen samples collected at varying depths exhibited concentrations above the lead FRL. The highest XRF reading (2,096 ppm) was located at PB-37. The highest XRF reading at a depth of 1 to 2 feet (1,065 ppm) was located at PB-19. No exceedance of the lead FRL was present in any sample at a depth greater than 2 feet. As a general rule, the XRF results for lead correspond to approximately 75 percent of the lead results from the FEMP on-site laboratory analyses. Therefore, XRF readings of 300 ppm or above were used to indicate the potential for material exceeding the lead FRL of 400 ppm. Figure D-52 contains the results from this sampling effort.

D.1.3.2 Summary of Lead Firing Range Characterization Results

The PSP for the SF firing range called for 24 sampling at 24 locations. The spatial extent of sampling, as well as the particular sampling locations, was based upon process knowledge, RI/FS data, subsequent soil sampling, and available XRF data. These samples were analyzed by either graphite furnace atomic absorption or ICP/MS. Three of the samples were analyzed for lead by the TCLP method as well. These three samples were to be collected from areas of high density bullet debris, moderate density bullet debris, and low density bullet debris. Each of these three samples was split, with half sieved for bullet debris before the TCLP analysis, and the other half analyzed with the bullet

debris included. In both cases, the TCLP analysis was conducted in accordance with SW846. Figure D-53 and Table D-14 provide the results from this investigation.

At the request of the OEPA, additional samples (see Figure D-56) were collected from the former firing range and analyzed for lead, both total and Toxicity Characteristic Leaching Procedure (TCLP) concentrations. All sampling activities were conducted in accordance with the Project Specific Plan for Lead Delineation in the Area 2, Phase I Firing Range (DOE 1997d), and V/FCNs 20.03.13.04-01 through 20.03.13.04-5. Six additional locations were selected for sample collection: A2PIPB-25, A2PIPB-26, A2PIPB-27, A2PIPB-28, A2PIPB-29, and A2PIPB-30. The data from this sampling effort is summarized in Table D-14.

Total lead concentrations above 400 ppm were found in nine samples: A2PIPB-25 (736 ppm at 0 to 0.5 feet), A2PIPB-26 (793 ppm at 0 to 0.5 feet), A2PIPB-27 (534 ppm at 0 to 0.5 feet and 564 ppm at 0.5 to 1 foot), A2PIPB-28 (2115 ppm at 0 to 0.5 feet), A2PIPB-29 (792 ppm at 0 to 0.5 feet and 963 ppm at 0.5 to 1 foot), and A2PIPB-30 [11,930 ppm and 117 ppm at 0 to 0.5 feet (the first analytical results for total lead were not consistent with the TCLP lead results for the same sample and were re-extracted and reanalyzed, resulting in the second value)]. The TCLP lead concentrations were exceeded in three locations: A2PIPB-25 (5.21 mg/L at 0 to 0.5 feet), A2PIPB-26 (6.32 mg/L at 0 to 0.5 feet), and A2PIPB-28 (26.65 mg/L at 0 to 0.5 feet).

Based on the analytical results of the above sampling, four additional locations were selected for sampling: A2PIPB-31, A2PIPB-32, A2PIPB-33, and A2PIPB-34. Analytical data for these locations are also presented in Table D-14. Total lead concentrations above 400 ppm were found in one of the samples from the additional four locations: 1780 ppm detected in A2PIPB-34A at 0.5 to 1 foot. None of the additional four locations yielded samples exceeding the TCLP lead concentration of 5 mg/L. The total lead excavation boundaries are shown in Figures D-57 and D-58.

D.1.4 SP-5 CHARACTERIZATION

Although previous sampling was conducted at SP-5, additional characterization was necessary to determine SP-5 material disposition. Real-time measurements were collected over the SP-5 surface using the RTRAK and HPGe systems. Soil sampling was conducted in April and May 1998; analysis included total uranium, technetium-99, and two semi-volatiles [4-nitroaniline and

bis(2-chloroisopropyl)ether]. The data generated was a result of all sampling events and was used to develop the excavation strategy for SP-5 (discussed in Section 3.3.6 of this IRDP).

D.1.4.1 Summary of Pertinent Historical Data

Previous sampling and analysis of SP-5 includes total uranium data from a 1990 Remedial Site Evaluation sampling event, a 1993 Removal Action 17 sampling event, and the 1994 OU3 RI/FS sampling. According to the PSP for Sampling of Soil Pile 5 (SP-5) for OSDF WAC Attainment (DOE 1998), all historical data for SP-5 is listed in Appendix E of the PSP.

D.1.4.2 Summary of SP-5 Characterization Results

The SP-5 sampling strategy consisted of real-time gamma measurements over the surface of the stockpile as well as a phased physical sampling program throughout Area 1 of SP-5 (see Figure D-59). Phase I physical sampling included random samples throughout the pile as well as biased sampling to investigate an elevated total uranium sample (941 mg/kg) collected during a previous sampling event. Phase II physical sampling was performed to further define the limits of total uranium above-WAC material in the southwest corner of the stockpile. A secondary objective of this PSP was to assess the amount, physical characteristics, and type of debris staged at the east end of the stockpile and to qualitatively assess the amount of debris imbedded in the stockpiled soils. This information provided direction for excavation activities for the stockpile.

Selection of WAC constituents of concern (COCs), as well as sample locations, is discussed in Section 1.3 of the above-referenced PSP. All sampling activities were conducted in accordance with the PSP and associated V/FCNs (50.03.52.03-1, 50.03.52.03-2, and 50.03.52.03-3). Analytical results for the four COCs [total uranium, technetium-99, 4-nitroaniline, and bis(2-chloroisopropyl)ether] are summarized in Table D-15.

D.1.4.2.1 Real-time Monitoring

Real-time monitoring of the existing surface of SP-5 Area 1 was performed using both RTRAK and HPGe. As described above, Area 2 of SP-5 is located on the east side of SP-5 and consists of construction debris; this debris was not accessible with the FEMP real-time equipment and, therefore, no real-time monitoring was performed in this area. The RTRAK was used to scan the top, western and southern sides of the pile; the HPGe was used to scan the north side of the pile (see Figures D-60).

Total uranium concentrations above the OSDF WAC or the equipment real-time trigger levels (721 ppm for RTRAK and 947 ppm for HPGe) were not detected. The highest HPGe reading was 226 ppm of total uranium and was located in the suspected "shine" area (as described below). The highest HPGe reading outside the suspected shine area was 97 ppm. The highest RTRAK reading was approximately 125 ppm in the suspected shine area; other areas outside the "shine" area were in the 50 ppm range.

Real-time monitoring results indicate that there is "shine" on the north and east sides of SP-5. Shine is defined (in the User's Manual) as gamma rays detected by an RTRAK or HPGe detector that originate outside the field of view of that detector. Shine in SP-5 is radiological interference that is suspected to be caused by the T-hoppers located to the east of SP-5 and the thorium warehouse (Building 61) to the northeast. The shine increases the apparent readings above the actual concentrations in the soil and cuases a more conservative decision regarding WAC attainment. Based on the assumption that the surface of SP-5 generally contains fairly uniform levels of uranium concentrations, the shine appears to have produced increased radiological readings with both RTRAK and HPGe detectors in the northern and eastern portions of SP-5.

- RTRAK. The shine appears to affect RTRAK readings by creating an apparent increase in the estimated total uranium concentrations of approximately 100 ppm. This increase is limited to approximately the easternmost 20 feet of the top of Area 1 of SP-5.

- HPGe. The shine appears to have produced an apparent increase in estimated total uranium concentrations generally increasing toward the east. The HPGe readings on the northwest side of SP-5 range from 44 to 97 ppm (with most readings in the 40 to 50 range). The HPGe readings on the northeast side range from 65 to 226 ppm (with most readings in the 80 to 160 range). Therefore, the shine appears to create an increase of approximately 40 to 110 ppm.

D.1.4.2.2 Total Uranium Sampling Activities

Originally, 22 locations within SP-5 were identified for sample collection and total uranium analysis; multiple attempts were necessary in several locations (7A, 17C, and 18A) to obtain full depth cores and/or sufficient media volume for analysis. Upon discovery of concentrations exceeding the total uranium WAC in the southwest corner of the pile, additional locations (8A, 8B, 8C, 19, 20, and 21) were added to delineate the extent of the above-WAC area. As stated in the PSP and

000812

V/FCN 50.03.52.03-2, only sample intervals exhibiting ≥100 ccpm or the interval immediately above and/or below were submitted for analysis.

A total of 66 samples were analyzed for total uranium; results ranged from 6.9 ppm (2.9 - 3.4 feet) in Boring SP5-16 to 4300 ppm (11.2 - 11.75 feet) in Boring SP5-1 (see Table D-15 and Figure D-59).

D.1.4.2.3 Technetium-99 Sample Activities

There were 22 lcoations identified within SP-5 for sample collection and technetium-99 analysis; multiple attempts were necessary in several locations (7A, 17C, and 18A) to obtain full depth cores and/or sufficient media volume for analysis. Technetium-99 analysis was conducted on sample intervals collected for total uranium analysis, therefore, only sample intervals exhibiting ≥ 100 ccpm or the interval immediately above and/or below were submitted for technetium-99 analysis.

A total of 53 samples were analyzed for technetium-99; results ranged from less than method detection limits (<MDL) to 78 pCi/g (6.5 to 7 feet) in Boring SP5-11 (see Table D-15 and Figure D-59).

D.1.4.2.4 Semi-Volatiles Sample Activities

Fourteen samples were analyze for two semi-volatiles: 4-nitroaniline and bis(2-chloroisopropyl)ether. These samples were sent to an off-site laboratory for analysis. As can be seen in Table D-15, concentrations above the method detection limits were not detected.

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000814

TABLE D-1
AREA 2, PHASE I SITE PREPARATION
HIGH PURITY GERMANIUM DETECTOR MEASUREMENTS

Location Identification	HPGe Reading (mg/kg)
FA-W-1-G	7.5
FA-W-2-G	14.5
FA-W-3-G	11.8
FA-W-4-G	13.4
FA-W-5-G	11.0
FA-W-6-G	14.0
FA-W-7-G	12.2
FA-W-8-G	17.4
FA-W-9-G	15.6
FA-W-10-G	17.6
FA-W-11-G	20.0
FA-W-12-G	27.3
FA-W-13-G	18.3
FA-W-14-G	25.1
FA-W-15-G	22.5
FA-W-16-G	11.6
FA-W-17-G	9.8
FA-W-18-G	11.2
FA-W-19-G	10.6
FA-W-20-G	18.0
FA-W-22-G	10.1
FA-W-23-G	10.7
FA-W-24-G	14.3
FA-W-26-G	11.0
FA-W-28-G	14.6
FA-W-29-G	26.8
FA-W-30-G	29.6
FA-W-31-G	18.7
FA-W-32-G	17.7
FA-W-33-G	35.9
FA-W-34-G	4.6

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
FA-W-35-G	13.8
FA-W-36-G	21.6
FA-W-37-G	19.5
FA-W-38-G	15.5
FA-W-39-G	11.1
FA-W-40-G	11.4
FA-W-41-G	11.7
FA-W-42-G	17.7
FA-W-43-G	14.8
FA-W-44-G	19.4
FA-W-45-G	18.3
FA-W-46-G	10.6
FA-W-47-G	19.2
FA-W-48-G	26.0
FA-W-49-G	19.4
FA-W-50-G	17.1
FA-W-51-G	14.9
FA-W-52-G	11.2
FA-W-53-G	14.1
FA-W-54-G	15.7
FA-W-55-G	12.3
FA-W-56-G	16.3
FA-W-56-G	16.3
FA-W-57-G	14.5
FA-W-58-G	16.8
FA-W-59-G	17.2
FA-W--60G	31.4
FA-W-61-G	22.5
FA-W-62-G	18.8
FA-W-63-G	13.7
FA-W-64-G	16.7
FA-W-64-G	16.8

000816

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
FA-W-65-G	17.0
FA-W-66-G	1438
FA-W-67-G	18.2
FA-W-68-G	12.7
FA-W-69-G	7.5
FA-W-70-G	12.5
FA-W-71-G	17.9
FA-W-72-G	22.9
FA-W-73-G	20.0
FA-W-74-G	43.2
FA-W-75-G	27.8
FA-W-76-G	14.4
FA-W-78-G	18.5
FA-W-79-G	21.2
FA-W-79-G	21.4
FA-W-80-G	12.1
FA-W-81-G	15.3
FA-W-82-G	10.9
IFP-B1-1-G	5.6
IFP-B1-2-G	3.1
IFP-B1-3-G	6.4
IFP-B1-4-G	5.7
IFP-B1-5-G	13.2
IFP-B1-6-G	11.6
IFP-B1-7-G	12.2
IFP-B1-8-G	12.9
IFP-B1-9-G	17.1
IFP-B1-10-G	19.0
IFP-B1-11-G	13.4
IFP-B1-12-G	15.0
IFP-B1-13-G	13.5
IFP-B1-14-G	21.3

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
IFP-B1-15-G	20.5
IFP-B1-16-G	13.1
IFP-B2-1-G	37.0
IFP-B2-2-G	16.1
IFP-B2-3-G	17.6
IFP-B2-4-G	13.4
IFP-B2-5-G	14.1
IFP-B2-6-G	11.9
IFP-B2-7-G	12.9
IFP-B2-8-G	13.1
IFP-B2-9-G	10.5
IFP-B2-10-G	13.3
IFP-B2-11-G	13.0
IFP-B2-12-G	15.7
IFP-B2-13-G	5.2
IFP-B2-14-G	6.7
IFP-B2-15-G	4.2
IFP-B2-16-G	12.9
SF-B-1-G	15.5
SF-B-2-G	17.4
SF-B-3-G	16.7
SF-B-4-G	15.2
SF-B-5-G	17.1
SF-B-6-G	22.0
SF-B-7-G	18.9
SF-B-8-G	18.3
SF-B-9-G	14.3
SF-B-10-G	19.3
SF-B-11-G	14.7
SF-B-12-G	23.6
SF-B-13-G	12.5
SF-B-14-G	46.3

000818

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
SF-B-15-G	14.9
SF-B-16-G	17.1
AFP-B-1-G	11.4
AFP-B-2-G	21.8
AFP-B-3-G	10.7
AFP-B-4-G	19.0
AFP-B-5-G	20.7
AFP-B-6-G	16.8
AFP-B-7-G	25.2
AFP-B-8-G	10.2
AFP-B-9-G	10.5
AFP-B-10-G	12.5
AFP-B-11-G	11.7
AFP-B-12-G	11.5
AFP-B-13-G	11.6
AFP-B-14-G	13.6
AFP-B-15-G	14.8
AFP-B-16-G	15.0
NFA-1-G	15.8
NFA-2-G	18.2
NFA-3-G	15.7
NFA-4-G	18.8
NFA-5-G	13.4
NFA-6-G	17.6
NFA-7-G	16.9
NFA-8-G	19.0
NFA-9-G	20.0
NFA-10-G	20.9
NFA-11-G	15.6
NFA-12-G	21.2
NFA-13-G	19.2
NFA-14-G	20.8

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
NFA-15-G	18.5
NFA-16-G	18.6
NFA-19-G	13.5
NFA-20-G	12.6
NFA-21-G	12.1
NFA-22-G	16.0
NFA-23-G	9.6
NFA-24-G	9.6
NFA-25-G	11.6
NFA-26-G	13.0
NFA-27-G	15.1
NFA-28-G	13.6
NFA-29-G	8.1
NFA-30-G	10.3
NFA-31-G	7.8
NFA-32-G	9.8
NFA-33-G	9.4
NFA-34-G	8.3
NFA-35-G	9.5
NFA-36-G	9.4
NFA-37-G	19.6
NFA-38-G	7.7
NFA-39-G	16.0
NFA-40-G	24.8
NFA-41-G	22.3
NFA-42-G	25.0
NFA-43-G	20.2
NFA-44-G	13.7
NFA-45-G	13.1
NFA-46-G	15.7
NFA-47-G	10.8
NFA-48-G	17.4

000820

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
NFA-49-G	12.1
NFA-50-G	18.9
NFA-51-G	17.6
NFA-52-G	12.9
NFA-53-G	12.0
NFA-54-G	17.5
NFA-55-G	14.8
NFA-56-G	16.7
NFA-57-G	12.8
NFA-57-G	14.4
NFA-58-G	15.5
NFA-59-G	12.5
NFA-60-G	22.6
NFA-61-G	18.7
NFA-62-G	17.4
NFA-63-G	23.6
NFA-64-G	20.5
NFA-65-G	22.3
NFA-66-G	20.7
NFA-67-G	13.4
NFA-68-G	14.9
NFA-69-G	15.3
NFA-70-G	11.0
NFA-71-G	12.2
NFA-72-G	3.6
NFA-73-G	10.6
NFA-74-G	9.1
NFA-75-G	15.7
NFA-76-G	21.1
NFA-77-G	23.3
NFA-78-G	24.2
NFA-79-G	22.8

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
NFA-80-G	20.3
NFA-81-G	17.9
NFA-82-G	13.1
NFA-83-G	11.3
NFA-84-G	12.7
NFA-85-G	11.6
NFA-86-G	14.9
NFA-87-G	14.7
NFA-88-G	15.0
NFA-89-G	20.7
NFA-90-G	13.9
NFA-91-G	28.2
NFA-92-G	24.7

FA-W = Fill Area, WAC sample
IFP-B1/B2 = Inactive Flyash Pile Basin 1 (northern section)/Basin 2 (southern section)
SF-B = South Field Basin
AFP-B = Active Flyash Pile Basin
NFA = Non-Fill Area
G = Gamma measurement (HPGe)

000822

TABLE D-2
AREA 2, PHASE I SITE PREPARATION FILL AREAS
HIGH PURITY GERMANIUM AND SOIL SAMPLING RESULTS

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
FA-W1-1-R	0-2	2	FA-W-1-G	7.5
FA-W1-2-R	0-2	12	FA-W-2-G	14.5
FA-W1-3-R	0-2	12	FA-W-3-G	11.8
FA-W1-4-R	0-2	11.6	FA-W-4-G	13.4
FA-W1-5-R	0-2	8.6	FA-W-5-G	11.0
FA-W1-6-R	0-2	10.8	FA-W-6-G	14.0
FA-W1-7-R	0-2	10.2	FA-W-7-G	12.2
FA-W2-7-R	2-4	5.2		
FA-W3-7-R	4-6	3		
FA-W1-8-R	0-2	18	FA-W-8-G	17.4
FA-W2-8-R	2-4	8		
FA-W1-9-R	0-2	9	FA-W-9-G	15.6
FA-W2-9-R	2-4	2		
FA-W1-10-R	0-2	18	FA-W-10-G	17.6
FA-W1-11-R	0-2	10	FA-W-11-G	20.0
FA-W2-11-R	2-4	3		
FA-W1-12-R	0-2	19	FA-W-12-G	27.3
FA-W1-13-R	0-2	16	FA-W-13-G	18.3
FA-W1-14-R	0-2	16	FA-W-14-G	25.1
FA-W1-15-R	0-2	12	FA-W-15-G	22.5
FA-W1-16-R	0-2	14	FA-W-16-G	11.6
FA-W1-17-R	0-2	5	FA-W-17-G	9.8
FA-W2-17-R	2-4	2		
FA-W1-18-R	0-2	8	FA-W1-18-G	11.2
FA-W1-19-R	0-2	6	FA-W-19-G	10.6
FA-W1-20-R	0-2	17	FA-W-20-G	18.0

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
FA-W1-21-R	0-2	9	NC	NC
FA-W2-21-R	2-4	3		NC
FA-W3-21-R	4-6	2		NC
FA-W1-22-R	0-2	15	FA-W-22-G	10.1
FA-W1-23-R	0-2	8	FA-W-23-G	10.7
FA-W2-23-R	2-4	3		
FA-W3-23-R	4-6	11		
FA-W4-23-R	6-8	10		
FA-W1-24-R	0-2	7	FA-W-24-G	14.3
FA-W1-25-R	0-2	6	NC	NC
FA-W2-25-R	2-4	4		NC
FA-W1-26-R	0-2	4	FA-W-26-G	11.0
FA-W2-26-R	2-4	4		
FA-W3-26-R	4-6	4		
FA-W1-27-R	0-2	11	NC	NC
FA-W2-27-R	2-4	7		NC
FA-W3-27-R	4-6	6		NC
FA-W1-28-R	0-2	5	FA-W-28-G	14.6
FA-W2-28-R	2-4	18		
FA-W3-28-R	4-6	7		
FA-W1-29-R	0-2	15	FA-W-29-G	26.8
FA-W2-29-R	2-4	13		
FA-W3-29-R	4-6	11		
FA-W4-29-R	6-8	12		
FA-W5-29-R	8-10	9		
FA-W6-29-R	10-12	12		

000824

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
FA-W7-29-R	12-14	3		
FA-W1-30-R	0-2	5	FA-W-30-G	29.6
FA-W2-30-R	2-4	13		
FA-W3-30-R	4-6	7		
FA-W4-30-R	6-8	9		
FA-W5-30-R	8-10	3		
FA-W6-30-R	10-12	4		
FA-W7-30-R	12-14	2		
FA-W1-31-R	0-2	79	FA-W-31-G	18.7
FA-W2-31-R	2-4	34		
FA-W3-31-R	4-6	24		
FA-W4-31-R	6-8	41		
FA-W5-31-R	8-10	28		
FA-W6-31-R	10-12	11		
FA-W7-31-R	12-14	4		
FA-W1-32-R	0-2	11.1	FA-W-32-G	17.7
FA-W2-32-R	2-4	11		
FA-W3-32-R	4-6	15		
FA-W4-32-R	6-8	13		
FA-W5-32-R	8-10	9		
FA-W1-33-R	0-2	26	FA-W-33-G	35.9
FA-W1-34-R	0-2	8	FA-W-34-G	4.6
FA-W2-34-R	2-4	3		
FA-W3-34-R	4-6	4		
FA-W4-34-R	6-8	3		
FA-W5-34-R	8-10	3		

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
FA-W1-35-R	0-2	16	FA-W-35-R	13.8
FA-W1-36-R	0-2	17	FA-W-36-R	21.6
FA-W1-37-R	0-2	10	FA-W-37-R	19.5
FA-W1-38-R	0-2	9	FA-W-38-R	15.5
FA-W1-39-R	0-2	10	FA-W-39-G	11.1
FA-W1-40-R	0-2	8	FA-W-40-G	11.4
FA-W1-41-R	0-2	12	FA-W-41-G	11.7
FA-W2-41-R	2-4	6		
FA-W1-42-R	0-2	11	FA-W-42-G	17.7
FA-W2-42-R	2-4	5		
FA-W1-43-R	0-2	11	FA-W-43-G	14.8
FA-W2-43-R	2-4	6		
FA-W1-44-R	0-2	17	FA-W-44-G	19.4
FA-W2-44-R	2-4	21		
FA-W3-44-R	4-6	32		
FA-W1-45-R	0-2	13	FA-W-45-G	18.3
FA-W2-45-R	2-4	23		
FA-W1-46-R	0-2	7	FA-W-46-G	10.6
FA-W1-47-R	0-2	22	FA-W-47-G	19.2
FA-W2-47-R	2-4	7		
FA-W1-48-R	0-2	36.2	FA-W-48-G	26.0
FA-W2-48-R	2-4	12.8		
FA-W3-48-R	4-6	21.6		
FA-W1-49-R	0-2	13	FA-W-49-G	19.4
FA-W2-49-R	2-4	4		
FA-W3-49-R	4-6	3		

000826

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
FA-W1-50-R	0-2	18	FA-W-50-G	17.1
FA-W2-50-R	2-4	2		
FA-W3-50-R	4-6	2		
FA-W1-51-R	0-2	51	FA-W-51-G	14.9
FA-W2-51-R	2-4	15.6		
FA-W3-51-R	4-6	1		
FA-W1-52-R	0-2	20.6	FA-W-52-G	11.2
FA-W2-52-R	2-4	6		
FA-W3-52-R	4-6	1		
FA-W1-53-R	0-2	14.2	FA-W-53-G	14.1
FA-W2-53-R	2-4	6		
FA-W1-54-R	0-2	16.5	FA-W-54-G	15.7
FA-W2-54-R	2-4	1		

mg/kg = milligrams per kilogram or parts per million (ppm)
HPGe = high purity germanium detector
NC = not collected due to rough/inaccessible terrain
FA-W = Fill Area WAC sample
R = radiological analytical suite (total uranium)
G = gamma measurement (HPGe)
[a] Results reported as dry weight
[b] Measurement taken at ground surface only; location identification shown on 0-2 ft interval

TABLE D-3
AREA 2, PHASE I SITE PREPARATION
CERTIFICATION READINESS (PRELIMINARY) ANALYTICAL RESULTS

Soil Sample Identification	Depth (ft)	Uranium-238 (pCi/g)[a]
IFP-B1-P2-1	0.5-1	2.6
IFP-B1-P3-1	1-1.5	0.9
IFP-B1-P4-1	1.5-2	0.7
IFP-B1-P5-1	2-2.5	0.6
IFP-B1-P2-2	0.5-1	2.2
IFP-B1-P3-2	1-1.5	0.9
IFP-B1-P4-2	1.5-2	0.7
IFP-B1-P5-2	2-2.5	0.5
IFP-B1-P2-3	0.5-1	1.7
IFP-B1-P3-3	1-1.5	2.1
IFP-B1-P4-3	1.5-2	0.9
IFP-B1-P5-3	2-2.5	0.5
IFP-B1-P2-4	0.5-1	4.7
IFP-B1-P3-4	1-1.5	3.1
IFP-B1-P4-4	1.5-2	3.0
IFP-B1-P5-4	2-2.5	2.4
IFP-B2-P2-1	0.5-1	1.0
IFP-B2-P3-1	1-1.5	0.4
IFP-B2-P4-1	1.5-2	0.5
IFP-B2-P5-1	2-2.5	0.5
IFP-B2-P2-2	0.5-1	0.9
IFP-B2-P3-2	1-1.5	0.4
IFP-B2-P4-2	1.5-2	0.3
IFP-B2-P5-2	2-2.5	0.4
IFP-B2-P2-3	0.5-1	2.5
IFP-B2-P3-3	1-1.5	0.7

000828

TABLE D-3
(CONT'D)

Soil Sample Identification	Depth (ft)	Uranium-238 (pCi/g)[a]
IFP-B2-P4-3	1.5-2	0.3
IFP-B2-P5-3	2-2.5	0.3
IFP-B2-P2-4	0.5-1	1.0
IFP-B2-P3-4	1-1.5	0.4
IFP-B2-P4-4	1.5-2	0.4
IFP-B2-P5-4	2-2.5	0.4
SF-B-P2-1	0.5-1	1.7
SF-B-P3-1	1-1.5	1.8
SF-B-P4-1	1.5-2	1.3
SF-B-P5-1	2-2.5	0.9
SF-B-P2-2	0.5-1	2.4
SF-B-P3-2	1-1.5	2.1
SF-B-P4-2	1.5-2	1.6
SF-B-P5-2	2-2.5	1.3
SF-B-P2-3	0.5-1	3.1
SF-B-P3-3	1-1.5	1.5
SF-B-P4-3	1.5-2	1.2
SF-B-P5-3	2-2.5	0.9
SF-B-P2-4	0.5-1	3.7
SF-B-P3-4	1-1.5	4.8
SF-B-P4-4	1.5-2	5.3
SF-B-P5-4	2-2.5	5.7
SF-B-P6-4	2.5-3	1.9
SF-B-P7-4	3-3.5	2.3
SF-B-P8-4	3.5-4	1.0
SF-B-P9-4	4-4.5	0.7
SF-B-P10-4	4.5-5	0.5

000829

TABLE D-3
(CONT'D)

Soil Sample Identification	Depth (ft)	Uranium-238 (pCi/g)[a]
AFP-B-P2-1	0.5-1	0.6
AFP-B-P3-1	1-1.5	0.5
AFP-B-P4-1	1.5-2	0.4
AFP-B-P5-1	2-2.5	0.4
AFP-B-P2-2	0.5-1	0.4
AFP-B-P3-2	1-1.5	0.4
AFP-B-P4-2	1.5-2	0.4
AFP-B-P5-2	2-2.5	0.5
AFP-B-P2-3	0.5-1	0.6
AFP-B-P3-3	1-1.5	0.3
AFP-B-P4-3	1.5-2	0.4
AFP-B-P5-3	2-2.5	0.4
AFP-B-P2-4	0.5-1	0.8
AFP-B-P3-4	1-1.5	0.4
AFP-B-P4-4	1.5-2	0.4
AFP-B-P5-4	2-2.5	0.4

[a] Results reported as dry weight
IFP-B1/B2 = Inactive Flyash Pile Basin 1 (northern section)/Basin 2 (southern section)
SF-B = South Field Basin
P = Preliminary sampling

TABLE D-4
AREA 2, PHASE I SITE PREPARATION CHARACTERIZATION FOR REUSE, RADIOLOGICAL ANALYTICAL RESULTS

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
AFP-B-C-1-R	1-1.5	Uranium-238	1.7	J
		Thorium-232	0.62	J
		Thorium-230	0.87	J
		Technetium-99	1.0	UJ
		Radium-226	0.84	J
		Neptunium-237	0.0405	UJ
AFP-B-C-2-R	1-1.5	Uranium-238	3.6	J
		Thorium-232	0.72	J
		Thorium-230	0.75	J
		Technetium-99	0.93	UJ
		Radium-226	0.99	J
		Neptunium-237	0.043	UJ
AFP-B-C-3-R	1-1.5	Uranium-238	0.69	J
		Thorium-232	0.64	UJ
		Thorium-230	0.73	J
		Technetium-99	1.2	UJ
		Radium-226	0.83	J
		Neptunium-237	0.0401	UJ
AFP-B-C-4-R	1-1.5	Uranium-238	1.4	J
		Thorium-232	0.86	J
		Thorium-230	0.81	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.059	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
AFP-B-C-5-R	1-1.5	Uranium-238	1.0	J
		Thorium-232	0.34	J
		Thorium-230	1.1	J
		Technetium-99	1.2	UJ
		Radium-226	0.69	J
		Neptunium-237	0.033	UJ
AFP-B-C-6-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	0.92	J
		Thorium-230	0.97	J
		Technetium-99	1.2	UJ
		Radium-226	1.1	J
		Neptunium-237	0.049	UJ
AFP-B-C-7-R	1-1.5	Uranium-238	2.9	J
		Thorium-232	0.6	J
		Thorium-230	1.4	J
		Technetium-99	1.5	UJ
		Radium-226	1.1	J
		Neptunium-237	0.0415	UJ
AFP-B-C-8-R	1-1.5	Uranium-238	4.2	J
		Thorium-232	1.8	J
		Thorium-230	0.97	J
		Technetium-99	1.4	UJ
		Radium-226	2.4	J
		Neptunium-237	0.0758	UJ

000832

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
AFP-B-C-9-R	1-1.5	Uranium-238	0.83	J
		Thorium-232	0.84	J
		Thorium-230	0.69	J
		Technetium-99	1.4	UJ
		Radium-226	0.97	J
		Neptunium-237	0.0464	UJ
AFP-B-C-10-R	1-1.5	Uranium-238	1.5	J
		Thorium-232	0.79	J
		Thorium-230	0.65	J
		Technetium-99	1.5	UJ
		Radium-226	0.91	J
		Neptunium-237	0.0449	UJ
AFP-B-C-11-R	1-1.5	Uranium-238	0.51	J
		Thorium-232	0.47	J
		Thorium-230	0.66	J
		Technetium-99	1.4	UJ
		Radium-226	0.68	J
		Neptunium-237	0.0368	UJ
AFP-B-C-11-R-D	1-1.5	Uranium-238	0.69	J
		Thorium-232	0.48	J
		Thorium-230	0.54	J
		Technetium-99	1.4	UJ
		Radium-226	0.75	J
		Neptunium-237	0.0396	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
AFP-B-C-12-R	1-1.5	Uranium-238	1.2	J
		Thorium-232	1.1	J
		Thorium-230	0.7	J
		Technetium-99	1.4	UJ
		Radium-226	1.2	J
		Neptunium-237	0.0606	UJ
AFP-B-C-13-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	0.99	J
		Thorium-230	0.72	J
		Technetium-99	1.6	UJ
		Radium-226	1.2	J
		Neptunium-237	0.06	UJ
AFP-B-C-14-R	1-1.5	Uranium-238	1.3	J
		Thorium-232	1.0	J
		Thorium-230	0.69	J
		Technetium-99	1.5	UJ
		Radium-226	1.2	J
		Neptunium-237	0.0644	UJ
AFP-B-C-15-R	1-1.5	Uranium-238	1.5	J
		Thorium-232	1.1	J
		Thorium-230	0.69	J
		Technetium-99	1.4	UJ
		Radium-226	1.1	J
		Neptunium-237	0.0594	UJ

000834

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
AFP-B-C-16-R	1-1.5	Uranium-238	1.4	J
		Thorium-232	0.94	J
		Thorium-230	0.72	J
		Technetium-99	1.47	UJ
		Radium-226	1.1	J
		Neptunium-237	0.0542	UJ
IFP-B1-C-1-R	1.5-2	Uranium-238	1.5	J
		Thorium-232	0.88	J
		Thorium-230	0.68	J
		Technetium-99	1.2	UJ
		Radium-226	1.1	J
		Neptunium-237	0.046	UJ
IFP-B1-C-2-R	1.5-2	Uranium-238	1.5	J
		Thorium-232	0.94	J
		Thorium-230	0.66	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.048	UJ
IFP-B1-C-3-R	1.5-2	Uranium-238	1.4	J
		Thorium-232	1.1	J
		Thorium-230	0.73	J
		Technetium-99	1.2	UJ
		Radium-226	1.5	J
		Neptunium-237	0.036	J

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B1-C-4-R	1.5-2	Uranium-238	1.1	J
		Thorium-232	0.84	J
		Thorium-230	0.75	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.055	UJ
IFP-B1-C-4-R-D		Uranium-238	1.0	J
		Thorium-232	0.84	J
		Thorium-230	0.8	J
		Technetium-99	1.2	UJ
		Radium-226	1.1	J
		Neptunium-237	0.045	UJ
IFP-B1-C-5-R	1.5-2	Uranium-238	1.2	J
		Thorium-232	1.1	J
		Thorium-230	0.94	J
		Technetium-99	1.2	UJ
		Radium-226	1.3	J
		Neptunium-237	0.051	UJ
IFP-B1-C-6-R	1.5-2	Uranium-238	1.4	J
		Thorium-232	0.76	J
		Thorium-230	0.62	J
		Technetium-99	1.4	UJ
		Radium-226	1.0	J
		Neptunium-237	0.041	UJ

000836

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B1-C-7-R	1.5-2	Uranium-238	1.1	J
		Thorium-232	1.1	J
		Thorium-230	0.89	J
		Technetium-99	1.2	UJ
		Radium-226	1.3	J
		Neptunium-237	0.055	UJ
IFP-B1-C-8-R	1.5-2	Uranium-238	1.2	J
		Thorium-232	0.42	J
		Thorium-230	0.64	J
		Technetium-99	1.4	UJ
		Radium-226	0.87	J
		Neptunium-237	0.04	UJ
IFP-B1-C-9-R	1.5-2	Uranium-238	1.0	J
		Thorium-232	0.91	J
		Thorium-230	0.89	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.048	UJ
IFP-B1-C-10-R	1.5-2	Uranium-238	0.92	J
		Thorium-232	0.87	J
		Thorium-230	0.79	J
		Technetium-99	1.2	UJ
		Radium-226	1.3	J
		Neptunium-237	0.044	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B1-C-11-R	1.5-2	Uranium-238	3.9	J
		Thorium-232	0.96	J
		Thorium-230	1.1	J
		Technetium-99	1.2	UJ
		Radium-226	1.5	J
		Neptunium-237	0.048	UJ
IFP-B1-C-12-R	1.5-2	Uranium-238	1.2	J
		Thorium-232	0.73	J
		Thorium-230	0.7	J
		Technetium-99	1.2	UJ
		Radium-226	1.0	J
		Neptunium-237	0.044	UJ
IFP-B1-C-13-R	1.5-2	Uranium-238	1.1	J
		Thorium-232	0.88	J
		Thorium-230	0.74	J
		Technetium-99	1.6	UJ
		Radium-226	1.2	J
		Neptunium-237	0.044	UJ
IFP-B1-C-14-R	1.5-2	Uranium-238	1.9	J
		Thorium-232	1.1	J
		Thorium-230	0.76	J
		Technetium-99	1.2	UJ
		Radium-226	1.5	J
		Neptunium-237	0.049	UJ

000838

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B1-C-15-R	1.5-2	Uranium-238	6.1	J
		Thorium-232	1.3	J
		Thorium-230	3.5	J
		Technetium-99	1.12	UJ
		Radium-226	2.4	J
		Neptunium-237	0.058	UJ
IFP-B1-C-16-R	1.5-2	Uranium-238	2.5	J
		Thorium-232	0.75	J
		Thorium-230	0.62	J
		Technetium-99	1.2	UJ
		Radium-226	1.0	J
		Neptunium-237	0.047	UJ
IFP-B2-C-1-R	1-1.5	Uranium-238	1.6	J
		Thorium-232	0.95	J
		Thorium-230	0.61	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.048	UJ
IFP-B2-C-2-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	1.1	J
		Thorium-230	0.71	J
		Technetium-99	1.2	UJ
		Radium-226	1.4	J
		Neptunium-237	0.051	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B2-C-3-R	1-1.5	Uranium-238	1.4	J
		Thorium-232	1.0	J
		Thorium-230	0.66	J
		Technetium-99	1.2	UJ
		Radium-226	1.3	J
		Neptunium-237	0.051	UJ
IFP-B2-C-4-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	0.95	J
		Thorium-230	0.68	J
		Technetium-99	1.1	UJ
		Radium-226	1.3	J
		Neptunium-237	0.052	UJ
IFP-B2-C-5-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	0.94	J
		Thorium-230	0.69	J
		Technetium-99	1.3	UJ
		Radium-226	1.4	J
		Neptunium-237	0.046	UJ
IFP-B2-C-6-R	1-1.5	Uranium-238	1.3	J
		Thorium-232	0.97	J
		Thorium-230	0.74	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.047	UJ

000840

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B2-C-7-R	1-1.5	Uranium-238	0.81	J
		Thorium-232	0.97	J
		Thorium-230	0.96	J
		Technetium-99	1.2	UJ
		Radium-226	1.5	J
		Neptunium-237	0.05	UJ
IFP-B2-C-8-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	1.1	J
		Thorium-230	0.8	R
		Technetium-99	1.2	UJ
		Radium-226	1.5	J
		Neptunium-237	0.053	UJ
IFP-B2-C-9-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	1.1	J
		Thorium-230	0.73	J
		Technetium-99	1.2	UJ
		Radium-226	1.4	J
		Neptunium-237	0.05	UJ
IFP-B2-C-10-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	1.1	J
		Thorium-230	0.78	J
		Technetium-99	1.1	UJ
		Radium-226	1.3	J
		Neptunium-237	0.05	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B2-C-11-R	1-1.5	Uranium-238	1.4	J
		Thorium-232	1.0	J
		Thorium-230	0.65	J
		Technetium-99	1.2	UJ
		Radium-226	1.2	J
		Neptunium-237	0.047	UJ
IFP-B2-C-12-R	1-1.5	Uranium-238	1.4	J
		Thorium-232	0.96	J
		Thorium-230	0.68	J
		Technetium-99	1.3	UJ
		Radium-226	1.3	J
		Neptunium-237	0.05	UJ
IFP-B2-C-13-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	0.92	J
		Thorium-230	0.76	J
		Technetium-99	1.3	UJ
		Radium-226	1.2	J
		Neptunium-237	0.048	UJ
IFP-B2-C-14-R	1-1.5	Uranium-238	1.3	J
		Thorium-232	0.92	J
		Thorium-230	0.58	J
		Technetium-99	1.2	UJ
		Radium-226	1.1	J
		Neptunium-237	0.045	UJ

000842

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
IFP-B2-C-14-R-D	1-1.5	Uranium-238	1.2	J
		Thorium-232	0.95	J
		Thorium-230	0.66	J
		Technetium-99	1.4	UJ
		Radium-226	1.2	J
		Neptunium-237	0.051	UJ
IFP-B2-C-15-R	1-1.5	Uranium-238	1.5	J
		Thorium-232	1.0	J
		Thorium-230	0.68	J
		Technetium-99	1.4	UJ
		Radium-226	1.2	J
		Neptunium-237	0.05	UJ
IFP-B2-C-16-R	1-1.5	Uranium-238	1.1	J
		Thorium-232	0.96	J
		Thorium-230	0.77	J
		Technetium-99	1.5	UJ
		Radium-226	1.1	J
		Neptunium-237	0.047	UJ
SF-B-C-1-R	3.5-4	Uranium-238	0.63	J
		Thorium-232	0.75	J
		Thorium-230	0.58	J
		Technetium-99	1.39	UJ
		Radium-226	1.0	J
		Neptunium-237	0.046	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
SF-B-C-2-R	3.5-4	Uranium-238	1.2	J
		Thorium-232	0.97	J
		Thorium-230	0.68	J
		Technetium-99	1.4	UJ
		Radium-226	1.2	J
		Neptunium-237	0.049	UJ
SF-B-C-3-R	3.5-4	Uranium-238	0.91	J
		Thorium-232	0.52	J
		Thorium-230	0.47	J
		Technetium-99	1.6	UJ
		Radium-226	0.79	J
		Neptunium-237	0.037	UJ
SF-B-C-4-R	3.5-4	Uranium-238	1.3	J
		Thorium-232	1.0	J
		Thorium-230	0.79	J
		Technetium-99	1.2	UJ
		Radium-226	1.4	J
		Neptunium-237	0.051	UJ
SF-B-C-5-R	3.5-4	Uranium-238	0.85	J
		Thorium-232	0.68	J
		Thorium-230	0.59	J
		Technetium-99	1.3	UJ
		Radium-226	0.93	J
		Neptunium-237	0.042	UJ

000844

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
SF-B-C-6-R	3.5-4	Uranium-238	1.2	J
		Thorium-232	0.32	J
		Thorium-230	0.45	J
		Technetium-99	1.9	UJ
		Radium-226	0.65	J
		Neptunium-237	0.029	UJ
SF-B-C-7-R	3.5-4	Uranium-238	0.93	J
		Thorium-232	0.31	J
		Thorium-230	0.4	J
		Technetium-99	1.4	UJ
		Radium-226	0.59	J
		Neptunium-237	0.031	UJ
SF-B-C-8-R	3.5-4	Uranium-238	0.98	J
		Thorium-232	0.27	J
		Thorium-230	0.37	J
		Technetium-99	1.2	UJ
		Radium-226	0.6	J
		Neptunium-237	0.028	UJ
SF-B-C-8-R-D	3.5-4	Uranium-238	0.69	J
		Thorium-232	0.23	J
		Thorium-230	0.4	J
		Technetium-99	1.7	UJ
		Radium-226	0.6	J
		Neptunium-237	0.027	UJ

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
SF-B-C-9-R	3.5-4	Uranium-238	0.69	J
		Thorium-232	0.25	J
		Thorium-230	0.38	J
		Technetium-99	1.2	UJ
		Radium-226	0.54	J
		Neptunium-237	0.027	UJ
SF-B-C-10-R	3.5-4	Uranium-238	2.7	J
		Thorium-232	0.9	UJ
		Thorium-230	1.3	J
		Technetium-99	1.2	UJ
		Radium-226	1.9	J
		Neptunium-237	0.048	UJ
SF-B-C-11-R	3.5-4	Uranium-238	4.8	J
		Thorium-232	1.8	J
		Thorium-230	0.98	J
		Technetium-99	2.2	UJ
		Radium-226	1.4	J
		Neptunium-237	0.054	UJ
SF-B-C-12-R	3.5-4	Uranium-238	2.7	J
		Thorium-232	0.66	J
		Thorium-230	0.54	J
		Technetium-99	1.5	UJ
		Radium-226	0.99	J
		Neptunium-237	0.043	UJ

000846

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
SF-B-C-13-R	3.5-4	Uranium-238	0.73	J
		Thorium-232	0.59	J
		Thorium-230	0.56	J
		Technetium-99	1.3	UJ
		Radium-226	0.91	J
		Neptunium-237	0.04	UJ
SF-B-C-14-R	3.5-4	Uranium-238	1.1	J
		Thorium-232	1.1	J
		Thorium-230	0.77	J
		Technetium-99	1.2	UJ
		Radium-226	1.4	J
		Neptunium-237	0.053	UJ
SF-B-C-15-R	3.5-4	Uranium-238	1.1	J
		Thorium-232	0.87	J
		Thorium-230	0.69	J
		Technetium-99	1.2	UJ
		Radium-226	1.1	J
		Neptunium-237	0.044	UJ
SF-B-C-16-R	3.5-4	Uranium-238	1.2	J
		Thorium-232	0.99	J
		Thorium-230	0.73	J
		Technetium-99	1.2	UJ
		Radium-226	1.3	J
		Neptunium-237	0.049	UJ

TABLE D-4
(CONT'D)

[a] Results reported as dry weight
[b] Qualifier: J = Estimated value
U = Not detected above method detection limit
R = Rejected
(-) = Validated, no data qualifier

IFP-B1/B2 = Inactive Flyash Pile Basin 1 (northern section)/Basin 2 (southern section)
AFP-B = Active Flyash Pile Basin
SF-B = South Field Basin
C = Characterization for reuse sample
R = Radiological analytical suite
D = Duplicate sample collected

000848

TABLE D-5
AREA 2, PHASE I SITE PREPARATION CHARACTERIZATION FOR REUSE, METAL AND CHEMICAL ANALYTICAL RESULTS

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
AFP-B-1	AFP-B-C-1-M	1-1.5	Arsenic	4.5	-
			Lead	12.5	-
	AFP-B-C-1-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.085	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.091	U
AFP-B-2	AFP-B-C-2-M	1-1.5	Arsenic	4.1	-
			Lead	11.9	J
	AFP-B-C-2-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.067	J
			Benzo(a)pyrene	0.057	J
			Benzo(b)fluoranthene	0.062	J
			Benzo(k)fluoranthene	0.057	J
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.037	J
			Phenanthrene	0.100	-
AFP-B-3	AFP-B-C-3-M	1-1.5	Arsenic	3.2	-
			Lead	11.5	-
	AFP-B-C-3-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.029	J
			Benzo(a)pyrene	0.026	J
			Benzo(b)fluoranthene	0.034	J
			Benzo(k)fluoranthene	0.031	J
			Dibenzo(a,h)anthracene	0.086	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.040	J

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
AFP-B-4	AFP-B-C-4-M	1-1.5	Arsenic	6	-
			Lead	20.4	J
	AFP-B-C-4-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
AFP-B-5	AFP-B-C-5-M	1-1.5	Arsenic	4	-
			Lead	14.6	J
	AFP-B-C-5-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.086	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.091	U
AFP-B-6	AFP-B-C-6-M	1-1.5	Arsenic	4.2	-
			Lead	12.7	J
	AFP-B-C-6-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	U

000850

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
AFP-B-7	AFP-B-C-7-M	1-1.5	Arsenic	3.2	-
			Lead	11.3	-
	AFP-B-C-7-SP	1-1.5	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.020	J
			Benzo(a)pyrene	0.018	J
			Benzo(b)fluoranthene	0.026	J
			Benzo(k)fluoranthene	0.026	J
			Dibenzo(a,h)anthracene	0.084	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.089	U
AFP-B-8	AFP-B-C-8-M	1-1.5	Arsenic	16.9	-
			Lead	20.8	J
	AFP-B-C-8-SP	1-1.5	Aroclor-1260	0.064	-
			Benzo(a)anthracene	0.110	J
			Benzo(a)pyrene	0.110	J
			Benzo(b)fluoranthene	0.110	J
			Benzo(k)fluoranthene	0.110	J
			Dibenzo(a,h)anthracene	0.026	J
			Dieldrin	0.0048	U
			Indeno(1,2,3-cd)pyrene	0.087	J
			Phenanthrene	0.130	-
AFP-B-9	AFP-B-C-9-M	1-1.5	Arsenic	3.5	-
			Lead	12.8	-
	AFP-B-C-9-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
AFP-B-10	AFP-B-C-10-M	1-1.5	Arsenic	4.2	-
			Lead	11.2	J
	AFP-B-C-10-SP	1-1.5	Aroclor-1260	0.037	U
				0.037	Z
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	Z
				0.0037	UJ
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	U
AFP-B-11	AFP-B-C-11-M	1-1.5	Arsenic	3.5	-
			Lead	9.8	-
	AFP-B-C-11-M-D	1-1.5	Arsenic	3.5	-
			Lead	9.0	-
	AFP-B-C-11-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.350	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.085	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.090	U
	AFP-B-C-11-SP-D	1-1.5	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.350	U
			Benzo(b)fluoranthene	0.260	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.084	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.090	U

000852

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
AFP-B-12	AFP-B-C-12-M	1-1.5	Arsenic	0.0034	-
			Lead	0.0118	J
	AFP-B-C-12-SP	1-1.5	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U
AFP-B-13	AFP-B-C-13-M	1-1.5	Arsenic	3.7	-
			Lead	13.8	-
	AFP-B-C-13-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	UJ
AFP-B-14	AFP-B-C-14-M	1-1.5	Arsenic	2.7	-
			Lead	11.5	J
	AFP-B-C-14-SP	1-1.5	Aroclor-1260	0.037	Z
				0.037	UJ
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	UJ
				0.0037	Z
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U

000853

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
AFP-B-15	AFP-B-C-15-M	1-1.5	Arsenic	2.8	-
			Lead	13.5	-
	AFP-B-C-15-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U
AFP-B-16	AFP-B-C-16-M	1-1.5	Arsenic	3.7	-
			Lead	11.6	J
	AFP-B-C-16-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U
IFP-B1-1	IFP-B1-C-1-M	1.5-2	Arsenic	4.1	-
			Lead	13.1	J
	IFP-B1-C-1-SP	1.5-2	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U

000854

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B1-2	IFP-B1-C-2-M	1.5-2	Arsenic	4.6	-
			Lead	14.9	-
	IFP-B1-C-2-SP	1.5-2	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U
IFP-B1-3	IFP-B1-C-3-M	1.5-2	Arsenic	4.6	-
			Lead	13.8	J
	IFP-B1-C-3-SP	1.5-2	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B1-4	IFP-B1-C-4-M	1.5-2	Arsenic	5.3	-
			Lead	11.0	J
	IFP-B1-C-4-M-D	1.5-2	Arsenic	6.3	-
			Lead	12.6	-
	IFP-B1-C-4-SP	1.5-2	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
	IFP-B1-C-4-SP-D	1.5-2	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
IFP-B1-5	IFP-B1-C-5-M	1.5-2	Arsenic	4.9	-
			Lead	15.4	-
	IFP-B1-C-5-SP	1.5-2	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U

000856

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B1-6	IFP-B1-C-6-M	1.5-2	Arsenic	4.2	-
			Lead	10.5	J
	IFP-B1-C-6-SP	1.5-2	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.086	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
IFP-B1-7	IFP-B1-C-7-M	1.5-2	Arsenic	4.3	-
			Lead	15.6	-
	IFP-B1-C-7-SP	1.5-2	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.260	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.290	U
			Benzo(k)fluoranthene	0.350	U
			Dibenzo(a,h)anthracene	0.092	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.290	U
			Phenanthrene	0.098	U
IFP-B1-8	IFP-B1-C-8-M	1.5-2	Arsenic	5	-
			Lead	8.5	J
	IFP-B1-C-8-SP	1.5-2	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.085	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.091	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B1-9	IFP-B1-C-9-M	1.5-2	Arsenic	4.8	-
			Lead	15.1	-
	IFP-B1-C-9-SP	1.5-2	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U
IFP-B1-10	IFP-B1-C-10-M	1.5-2	Arsenic	4.7	-
			Lead	13.1	J
	IFP-B1-C-10-SP	1.5-2	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U
IFP-B1-11	IFP-B1-C-11-M	1.5-2	Arsenic	5.5	-
			Lead	15.4	-
	IFP-B1-C-11-SP	1.5-2	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.019	J
			Benzo(k)fluoranthene	0.021	J
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U

000858

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B1-12	IFP-B1-C-12-M	1.5-2	Arsenic	3.9	-
			Lead	10.8	-
	IFP-B1-C-12-SP	1.5-2	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
IFP-B1-13	IFP-B1-C-13-M	1.5-2	Arsenic	4.6	-
			Lead	12.6	J
	IFP-B1-C-13-SP	1.5-2	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U
IFP-B1-14	IFP-B1-C-14-M	1.5-2	Arsenic	4.3	-
			Lead	13.2	J
	IFP-B1-C-14-SP	1.5-2	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B1-15	IFP-B1-C-15-M	1.5-2	Arsenic	15.7	-
			Lead	21.8	J
	IFP-B1-C-15-SP	1.5-2	Aroclor-1260	0.040	U
			Benzo(a)anthracene	0.029	J
			Benzo(a)pyrene	0.400	U
			Benzo(b)fluoranthene	0.036	J
			Benzo(k)fluoranthene	0.046	J
			Dibenzo(a,h)anthracene	0.096	U
			Dieldrin	0.004	U
			Indeno(1,2,3-cd)pyrene	0.300	U
			Phenanthrene	0.040	J
IFP-B1-16	IFP-B1-C-16-M	1.5-2	Arsenic	4.5	-
			Lead	10.9	-
	IFP-B1-C-16-SP	1.5-2	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U
IFP-B2-1	IFP-B2-C-1-M	1-1.5	Arsenic	5.6	J
			Lead	11.9	-
	IFP-B2-C-1-SP	1-1.5	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.260	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.290	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.092	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.290	U
			Phenanthrene	0.097	U

000860

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B2-2	IFP-B2-C-2-M	1-1.5	Arsenic	5.2	J
			Lead	12.5	-
	IFP-B2-C-2-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U
IFP-B2-3	IFP-B2-C-3-M	1-1.5	Arsenic	2.7	J
			Lead	12.2	-
	IFP-B2-C-3-SP	1-1.5	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.260	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.091	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U
IFP-B2-4	IFP-B2-C-4-M	1-1.5	Arsenic	3.6	J
			Lead	12.7	Z
				11.4	-
	IFP-B2-C-4-SP	1-1.5	Aroclor-1260	0.040	U
			Benzo(a)anthracene	0.270	U
			Benzo(a)pyrene	0.400	U
			Benzo(b)fluoranthene	0.300	U
			Benzo(k)fluoranthene	0.360	U
			Dibenzo(a,h)anthracene	0.096	U
			Dieldrin	0.004	U
			Indeno(1,2,3-cd)pyrene	0.300	U
			Phenanthrene	0.100	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B2-5	IFP-B2-C-5-M	1-1.5	Arsenic	6.9	J
			Lead	13.4	-
	IFP-B2-C-5-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U
IFP-B2-6	IFP-B2-C-6-M	1-1.5	Arsenic	3.1	J
			Lead	12.0	-
	IFP-B2-C-6-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U
IFP-B2-7	IFP-B2-C-7-M	1-1.5	Arsenic	6.6	J
			Lead	15.4	-
	IFP-B2-C-7-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	U

000862

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B2-8	IFP-B2-C-8-M	1-1.5	Arsenic	3.3	J
			Lead	13.0	-
	IFP-B2-C-8-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U
IFP-B2-9	IFP-B2-C-9-M	1-1.5	Arsenic	5.7	J
			Lead	14.3	-
	IFP-B2-C-9-SP	1-1.5	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.260	Z
				0.260	U
			Benzo(a)pyrene	0.380	Z
				0.380	U
			Benzo(b)fluoranthene	0.280	Z
				0.280	U
			Benzo(k)fluoranthene	0.340	Z
				0.340	U
			Dibenzo(a,h)anthracene	0.091	Z
				0.091	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	Z
				0.280	U
			Phenanthrene	0.096	Z
				0.096	U
IFP-B2-10	IFP-B2-C-10-M	1-1.5	Arsenic	5.3	J
			Lead	13.3	-
	IFP-B2-C-10-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B2-11	IFP-B2-C-11-M	1-1.5	Arsenic	2.8	J
			Lead	11.8	-
	IFP-B2-C-11-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.250	Z
				0.250	U
			Benzo(a)pyrene	0.360	Z
				0.360	U
			Benzo(b)fluoranthene	0.270	Z
				0.270	U
			Benzo(k)fluoranthene	0.330	Z
				0.330	U
			Dibenzo(a,h)anthracene	0.087	Z
				0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	Z
				0.270	U
			Phenanthrene	0.093	Z
				0.093	U
IFP-B2-12	IFP-B2-C-12-M	1-1.5	Arsenic	2.8	J
			Lead	12.8	-
	IFP-B2-C-12-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
IFP-B2-13	IFP-B-C-13-M2	1-1.5	Arsenic	4.2	J
			Lead	13.4	-
	IFP-B2-C-13-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U

000864

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B2-14	IFP-B2-C-14-M	1-1.5	Arsenic	3.0	J
			Lead	12.2	-
	IFP-B2-C-14-M-D	1-1.5	Arsenic	3.2	J
			Lead	11.3	-
	IFP-B2-C-14-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
	IFP-B2-C-14-SP-D	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U
IFP-B2-15	IFP-B2-C-15-M	1-1.5	Arsenic	6.2	J
			Lead	10.9	-
	IFP-B2-C-15-SP	1-1.5	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.089	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.094	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
IFP-B2-16	IFP-B2-C-16-M	1-1.5	Arsenic	2.4	J
			Lead	11.2	-
	IFP-B2-C-16-SP	1-1.5	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.085	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.091	U
SF-B-1	SF-B-C-1-M	3.5-4	Arsenic	2.5	J
			Lead	10.6	-
	SF-B-C-1-SP	3.5-4	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.095	U
SF-B-2	SF-B-C-2-M	3.5-4	Arsenic	2.5	J
			Lead	11.0	-
	SF-B-C-2-SP	3.5-4	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.260	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.091	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U

000866

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
SF-B-3	SF-B-C-3-M	3.5-4	Arsenic	2.7	J
			Lead	7.5	-
	SF-B-C-3-SP	3.5-4	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.086	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.091	U
SF-B-4	SF-B-C-4-M	3.5-4	Arsenic	2.8	J
			Lead	13.8	-
	SF-B-C-4-SP	3.5-4	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.380	U
			Benzo(b)fluoranthene	0.280	U
			Benzo(k)fluoranthene	0.340	U
			Dibenzo(a,h)anthracene	0.090	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.280	U
			Phenanthrene	0.096	U
SF-B-5	SF-B-C-5-M	3.5-4	Arsenic	3.2	J
			Lead	14.1	-
	SF-B-C-5-SP	3.5-4	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.040	J
			Benzo(a)pyrene	0.053	J
			Benzo(b)fluoranthene	0.056	J
			Benzo(k)fluoranthene	0.046	J
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.041	J
			Phenanthrene	0.025	J

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
SF-B-6	SF-B-C-6-M	3.5-4	Arsenic	3.0	J
			Lead	5.6	-
	SF-B-C-6-SP	3.5-4	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.230	U
			Benzo(a)pyrene	0.350	U
			Benzo(b)fluoranthene	0.260	U
			Benzo(k)fluoranthene	0.310	U
			Dibenzo(a,h)anthracene	0.083	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.088	U
SF-B-7	SF-B-C-7-M	3.5-4	Arsenic	2.2	J
			Lead	5.6	-
	SF-B-C-7-SP	3.5-4	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.350	U
			Benzo(b)fluoranthene	0.260	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.084	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.089	U

000868

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
SF-B-8	SF-B-C-8-M	3.5-4	Arsenic	7.6	J
			Lead	4.6	-
	SF-B-C-8-M-D	3.5-4	Arsenic	1.9	J
			Lead	4.0	-
	SF-B-C-8-SP	3.5-4	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.230	U
			Benzo(a)pyrene	0.350	U
			Benzo(b)fluoranthene	0.260	U
			Benzo(k)fluoranthene	0.310	U
			Dibenzo(a,h)anthracene	0.084	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.089	U
	SF-B-C-8-SP-D	3.5-4	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.350	U
			Benzo(b)fluoranthene	0.260	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.084	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.090	U
SF-B-9	SF-B-C-9-M	3.5-4	Arsenic	2.5	J
			Lead	4.9	-
	SF-B-C-9-SP	3.5-4	Aroclor-1260	0.035	U
			Benzo(a)anthracene	0.230	U
			Benzo(a)pyrene	0.340	U
			Benzo(b)fluoranthene	0.260	U
			Benzo(k)fluoranthene	0.310	U
			Dibenzo(a,h)anthracene	0.082	U
			Dieldrin	0.0035	U
			Indeno(1,2,3-cd)pyrene	0.260	U
			Phenanthrene	0.087	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
SF-B-10	SF-B-C-10-M	3.5-4	Arsenic	3.3	J
			Lead	12.9	-
	SF-B-C-10-SP	3.5-4	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.075	J
			Benzo(a)pyrene	0.110	J
			Benzo(b)fluoranthene	0.077	J
			Benzo(k)fluoranthene	0.073	J
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.081	J
			Phenanthrene	0.094	U
SF-B-11	SF-B-C-11-M	3.5-4	Arsenic	3.8	J
			Lead	20.7	-
	SF-B-C-11-SP	3.5-4	Aroclor-1260	0.038	U
			Benzo(a)anthracene	0.084	J
			Benzo(a)pyrene	0.081	J
			Benzo(b)fluoranthene	0.080	J
			Benzo(k)fluoranthene	0.081	J
			Dibenzo(a,h)anthracene	0.091	U
			Dieldrin	0.0038	U
			Indeno(1,2,3-cd)pyrene	0.054	J
			Phenanthrene	0.078	J
SF-B-12	SP-B-C-12-M	3.5-4	Arsenic	3.2	J
			Lead	10.2	-
	SF-B-C-12-SP	3.5-4	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.087	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.092	U

000870

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
SF-B-13	SF-B-C-13-M	3.5-4	Arsenic	2.5	J
			Lead	8.0	-
	SF-B-C-13-SP	3.5-4	Aroclor-1260	0.036	U
			Benzo(a)anthracene	0.240	U
			Benzo(a)pyrene	0.360	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.320	U
			Dibenzo(a,h)anthracene	0.085	U
			Dieldrin	0.0036	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.091	U
SF-B-14	SF-B-C-14-M	3.5-4	Arsenic	2.3	J
			Lead	12.0	-
	SF-B-C-14-SP	3.5-4	Aroclor-1260	0.039	U
			Benzo(a)anthracene	0.260	U
			Benzo(a)pyrene	0.390	U
			Benzo(b)fluoranthene	0.290	U
			Benzo(k)fluoranthene	0.350	U
			Dibenzo(a,h)anthracene	0.093	U
			Dieldrin	0.0039	U
			Indeno(1,2,3-cd)pyrene	0.290	U
			Phenanthrene	0.099	U
SF-B-15	SF-B-C-15-M	3.5-4	Arsenic	2.9	J
			Lead	10.6	-
	SF-B-C-15-SP	3.5-4	Aroclor-1260	0.037	U
			Benzo(a)anthracene	0.250	U
			Benzo(a)pyrene	0.370	U
			Benzo(b)fluoranthene	0.270	U
			Benzo(k)fluoranthene	0.330	U
			Dibenzo(a,h)anthracene	0.088	U
			Dieldrin	0.0037	U
			Indeno(1,2,3-cd)pyrene	0.270	U
			Phenanthrene	0.093	U

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
SF-B-16	SF-B-C-16-M	3.5-4	Arsenic	2.7	J
			Lead	12.0	-
	SF-B-C-16-SP	3.5-4	Aroclor-1260	0.039	U
			Benzo(a)anthracene	0.260	U
			Benzo(a)pyrene	0.390	U
			Benzo(b)fluoranthene	0.290	U
			Benzo(k)fluoranthene	0.350	U
			Dibenzo(a,h)anthracene	0.093	U
			Dieldrin	0.0039	U
			Indeno(1,2,3-cd)pyrene	0.290	U
			Phenanthrene	0.098	U

[a] Qualifier: J = Estimated value
U = Not detected above method detection limit
Z = Sample reanalyzed
(-) = Validated, no data qualifier

IFP-B1/B2 = Inactive Flyash Pile Basin 1 (northern section)/Basin 2 (southern section)
AFP-B = Active Flyash Pile Basin
SF-B = South Field Basin
C = Characterization for reuse sample
M = Metals analytical suite
SP = Semi-volatiles and pesticides/PCB analytical suite
D = Duplicate sample collected

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Table D-6
Area 2 Phase I Characterization for Reuse Statistics (AF

	RADIONUCLIDES						METALS	
Station Number	Radium-226	Thorium-232	Uranium-238	Neptunium-237	Technetium-99	Thorium-230	Arsenic	Lead
AFP-B-1	0.84 J	0.62 J	1.70 J	0.04 UJ	1.00 UJ	0.87 J	4.50 -	12.50 -
AFP-B-2	0.99 J	0.72 J	3.60 J	0.04 UJ	0.93 UJ	0.75 J	4.10 -	11.90 J
AFP-B-3	0.83 J	0.64 UJ	0.69 J	0.04 UJ	1.20 UJ	0.73 J	3.20 -	11.50 -
AFP-B-4	1.20 J	0.86 J	1.40 J	0.06 UJ	1.20 UJ	0.81 J	6.00 -	20.40 J
AFP-B-5	0.69 J	0.34 J	1.00 J	0.03 UJ	1.20 UJ	1.10 J	4.00 -	14.60 J
AFP-B-6	1.10 J	0.92 J	1.10 J	0.05 UJ	1.20 UJ	0.97 J	4.20 -	12.70 J
AFP-B-7	1.10 J	0.60 J	2.90 J	0.04 UJ	1.50 UJ	1.40 J	3.20 -	11.30 -
AFP-B-8	2.40 J	1.80 J	4.20 J	0.08 UJ	1.40 UJ	0.97 J	16.90 -	20.80 J
AFP-B-9	0.97 J	0.84 J	0.83 J	0.05 UJ	1.40 UJ	0.69 J	3.50 -	12.80 -
AFP-B-10	0.91 J	0.79 J	1.50 J	0.04 UJ	1.50 UJ	0.65 J	4.20 -	11.20 J
AFP-B-11	0.68 J	0.47 J	0.51 J	0.04 UJ	1.40 UJ	0.66 J	3.50 -	9.80 -
AFP-B-11-D	0.75 J	0.48 J	0.69 J	0.04 UJ	1.40 UJ	0.54 J	3.50 -	9.00 -
AFP-B-12	1.20 J	1.10 J	1.20 J	0.06 UJ	1.40 UJ	0.70 J	3.40 -	11.80 J
AFP-B-13	1.20 J	0.99 J	1.10 J	0.06 UJ	1.60 UJ	0.72 J	3.70 -	13.80 -
AFP-B-14	1.20 J	1.00 J	1.30 J	0.06 UJ	1.50 UJ	0.69 J	2.70 -	11.50 J
AFP-B-15	1.10 J	1.10 J	1.50 J	0.06 UJ	1.40 UJ	0.69 J	2.80 -	13.50 -
AFP-B-16	1.10 J	0.94 J	1.40 J	0.05 UJ	1.47 UJ	0.72 J	3.70 -	11.60 J
FRL	1.70	1.50	3.22	3.20	30.00	6.97	12.00	400.00
Conf. Level	95%	95%	95%	90%	95%	90%	90%	90%
Test Procedure	t-Test (LN)	t-Test (LN)	t-Test (LN)	Proportions	Proportions	t-Test (LN)	t-Test (LN)	t-Test (LN)
UCL	1.25	1.07	2.17	--	--	0.88	5.25	14.21
Prob.	--	--	--	0.002%	0.002%	--	--	--
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	2.40 J	1.80 J	4.20 J	0.08 UJ	1.60 UJ	1.40 J	16.90 -	20.80 J *
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

	SEMIVOLATILES and PESTICIDES							
Station Number	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Dieldrin	Indeno(1,2,3-cd)pyrene	Phenanthrene
AFP-B-1	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	91 U
AFP-B-2	36 U	67 J	57 J	62 J	57 J	3.60 U	37 J	100 -
AFP-B-3	36 U	29 J	26 J	34 J	31 J	3.60 U	270 U	40 J
AFP-B-4	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
AFP-B-5	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	91 U
AFP-B-6	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	94 U
AFP-B-7	35 U	20 J	18 J	26 J	26 J	3.50 U	260 U	89 U
AFP-B-8	64 -	110 J	110 J	110 J	110 J	4.80 U	87 J	130 -
AFP-B-9	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	94 U
AFP-B-10	37 U	250 U	370 U	280 U	330 U	3.70 UJ	280 U	94 U
AFP-B-11	36 U	240 U	350 U	270 U	320 U	3.60 U	270 U	90 U
AFP-B-11-D	35 U	240 U	350 U	260 U	320 U	3.50 U	260 U	90 U
AFP-B-12	38 U	250 U	380 U	280 U	340 U	3.80 U	280 U	96 U
AFP-B-13	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	94 UJ
AFP-B-14	37 UJ	250 U	370 U	280 U	330 U	3.70 UJ	280 U	95 U
AFP-B-15	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	95 U
AFP-B-16	37 U	250 U	370 U	280 U	340 U	3.70 U	280 U	95 U
FRL	130	455	777	513	603	9.57	496	190
Conf. Level	90%	90%	90%	90%	90%	90%	90%	90%
Test Procedure	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions
UCL	--	--	--	--	--	--	--	--
Prob.	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	64 -	250 U	380 U	280 U	340 U	4.80 U	280 U	130 -
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

Definition of Qualifiers
"J" = estimated result
"UJ" = non-detected estimate
"U" = non-detected
" - " = no data qualifier

1634

Table D-6cont.)
Area 2 Phase I Characterization for Reuse Statistics (IFP-B1)

Station Number	RADIONUCLIDES						METALS	
	Radium-226	Thorium-232	Uranium-238	Neptunium-237	Technetium-99	Thorium-230	Arsenic	Lead
IFP-B1-1	1.10 J	0.88 J	1.50 J	0.05 UJ	1.20 UJ	0.68 J	4.10 -	13.10 J
IFP-B1-2	1.20 J	0.94 J	1.50 J	0.05 UJ	1.20 UJ	0.66 J	4.60 -	14.90 -
IFP-B1-3	1.50 J	1.10 J	1.40 J	0.04 J	1.20 UJ	0.73 J	4.60 -	13.80 J
IFP-B1-4	1.20 J	0.84 J	1.10 J	0.06 UJ	1.20 UJ	0.75 J	5.30 -	11.00 J
IFP-B1-5	1.30 J	1.10 J	1.20 J	0.05 UJ	1.20 UJ	0.94 J	4.90 -	15.40 -
IFP-B1-6	1.00 J	0.76 J	1.40 J	0.04 UJ	1.40 UJ	0.62 J	4.20 -	10.50 J
IFP-B1-7	1.30 J	1.10 J	1.10 J	0.06 UJ	1.20 UJ	0.89 J	4.30 -	15.60 -
IFP-B1-8	0.87 J	0.42 J	1.20 J	0.04 UJ	1.40 UJ	0.64 J	5.00 -	8.50 J
IFP-B1-9	1.20 J	0.91 J	1.00 J	0.05 UJ	1.20 UJ	0.89 J	4.80 -	15.10 -
IFP-B1-10	1.30 J	0.87 J	0.92 J	0.04 UJ	1.20 UJ	0.79 J	4.70 -	13.10 J
IFP-B1-11	1.50 J	0.96 J	3.90 J	0.05 UJ	1.20 UJ	1.10 J	5.50 -	15.40 -
IFP-B1-12	1.00 J	0.73 J	1.20 J	0.04 UJ	1.20 UJ	0.70 J	3.90 -	10.80 -
IFP-B1-13	1.20 J	0.88 J	1.10 J	0.04 UJ	1.60 UJ	0.74 J	4.60 -	12.60 J
IFP-B1-14	1.50 J	1.10 J	1.90 J	0.05 UJ	1.20 UJ	0.76 J	4.30 -	13.20 J
IFP-B1-15	2.40 J	1.30 J	6.10 J	0.06 UJ	1.12 UJ	3.50 J	15.70 -	21.80 J
IFP-B1-16	1.00 J	0.75 J	2.50 J	0.05 UJ	1.20 UJ	0.62 J	4.50 -	10.90 -
FRL	1.70	1.50	3.22	3.20	30.00	6.97	12.00	400.00
Conf. Level	95%	95%	95%	90%	95%	90%	90%	90%
Test Procedure	t-Test (LN)	t-Test (N)	t-Test (LN)	Proportions	Proportions	t-Test (LN)	t-Test (LN)	t-Test (LN)
UCL	1.43	1.00	2.33	--	--	1.06	5.92	14.62
Prob.	--	--	--	0.002%	0.002%	--	--	--
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	2.40 J	1.30 J	6.10 J	0.04 J	1.60 UJ	3.50 J	15.70 -	*21.80 J
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

Station Number	SEMIVOLATILES and PESTICIDES							
	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Dieldrin	Indeno(1,2,3-cd)pyrene	Phenanthrene
IFP-B1-1	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	95 U
IFP-B1-2	38 U	250 U	380 U	280 U	340 U	3.80 U	280 U	96 U
IFP-B1-3	38 U	250 U	380 U	280 U	340 U	3.80 U	280 U	96 U
IFP-B1-4	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
IFP-B1-5	38 U	250 U	380 U	280 U	340 U	3.80 U	280 U	96 U
IFP-B1-6	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	92 U
IFP-B1-7	38 U	260 U	380 U	290 U	350 U	3.80 U	290 U	98 U
IFP-B1-8	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	91 U
IFP-B1-9	37 U	250 U	370 U	270 U	330 U	3.70 U	270 U	93 U
IFP-B1-10	37 U	250 U	370 U	270 U	330 U	3.70 U	270 U	93 U
IFP-B1-11	37 U	250 U	370 U	19 J	21 J	3.70 U	280 U	95 U
IFP-B1-12	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
IFP-B1-13	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	95 U
IFP-B1-14	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	95 U
IFP-B1-15	40 U	29 J	400 U	36 J	46 J	4.00 U	300 U	40 J
IFP-B1-16	36 U	250 U	360 U	270 U	330 U	3.60 U	270 U	93 U
FRL	130	455	777	513	603	9.57	496	190
Conf. Level	90%	90%	90%	90%	90%	90%	90%	90%
Test Procedure	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions
UCL	--	--	--	--	--	--	--	--
Prob.	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
Pass / Fail	pass	pass	pass	pass	[illegible]	pass	pass	pass
Max Re[illegible]	40 U	260 U	400 U	290 U	[illegible]	4.00 U	300 U	98 U
2x Rul[illegible]	pass	pass	pass	pass	[illegible]	pass	pass	pass

Definition of Qualifiers
"J" = estimated result
"UJ" = non-detected estimate
"U" = non-detected
" - " = no data qualifier

Table D-6 (cont.)
Area 2 Phase I Characterization for Reuse Statistics (IFP-B2)

	RADIONUCLIDES						METALS	
Station Number	dium-226	Thorium-232	Uranium-238	Neptunium-237	Technetium-99	Thorium-230	Arsenic	Lead
IFP-B2-1	1.20 J	0.95 J	1.60 J	0.05 UJ	1.20 UJ	0.61 J	5.60 J	11.90 -
IFP-B2-2	1.40 J	1.10 J	1.10 J	0.05 UJ	1.20 UJ	0.71 J	5.20 J	12.50 -
IFP-B2-3	1.30 J	1.00 J	1.40 J	0.05 UJ	1.20 UJ	0.66 J	2.70 J	12.20 -
IFP-B2-4	1.30 J	0.95 J	1.10 J	0.05 UJ	1.10 UJ	0.68 J	3.60 J	11.40 -
IFP-B2-5	1.40 J	0.94 J	1.10 J	0.05 UJ	1.30 UJ	0.69 J	6.90 J	13.40 -
IFP-B2-6	1.20 J	0.97 J	1.30 J	0.05 UJ	1.20 UJ	0.74 J	3.10 J	12.00 -
IFP-B2-7	1.50 J	0.97 J	0.81 J	0.05 UJ	1.20 UJ	0.96 J	6.60 J	15.40 -
IFP-B2-8	1.50 J	1.10 J	1.10 J	0.05 UJ	1.20 UJ	R	3.30 J	13.00 -
IFP-B2-9	1.40 J	1.10 J	1.10 J	0.05 UJ	1.20 UJ	0.73 J	5.70 J	14.30 -
IFP-B2-10	1.30 J	1.10 J	1.10 J	0.05 UJ	1.10 UJ	0.78 J	5.30 J	13.30 -
IFP-B2-11	1.20 J	1.00 J	1.40 J	0.05 UJ	1.20 UJ	0.65 J	2.80 J	11.80 -
IFP-B2-12	1.30 J	0.96 J	1.40 J	0.05 UJ	1.30 UJ	0.68 J	2.80 J	12.80 -
IFP-B2-13	1.20 J	0.92 J	1.10 J	0.05 UJ	1.30 UJ	0.76 J	4.20 J	13.40 -
IFP-B2-14	1.10 J	0.92 J	1.30 J	0.05 UJ	1.20 UJ	0.58 J	3.00 J	12.20 -
IFP-B2-14-D	1.20 J	0.95 J	1.20 J	0.05 UJ	1.40 UJ	0.66 J	3.00 J	12.20 -
IFP-B2-15	1.20 J	1.00 J	1.50 J	0.05 UJ	1.40 UJ	0.68 J	6.20 J	10.90 -
IFP-B2-16	1.10 J	0.96 J	1.10 J	0.05 UJ	1.50 UJ	0.77 J	2.40 J	11.20 -
FRL	1.70	1.50	3.22	3.20	30.00	6.97	12.00	400.00
Conf. Level	95%	95%	95%	90%	95%	90%	90%	90%
Test Procedure	t-Test (LN)	Wilcoxon	t-Test (N)	Proportions	Proportions	t-Test (LN)	t-Test (LN)	t-Test (LN)
UCL	1.35	- -	1.30	- -	- -	0.74	4.99	12.99
Prob.	- -	< 0.5 %	- -	0.002%	0.002%	- -	- -	- -
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	1.50 J	1.10 J	1.60 J	0.05 UJ	1.50 UJ	0.96 J	6.90 J	15.40 -
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

	SEMIVOLATILES and PESTICIDES							
Station Number	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Dieldrin	Indeno(1,2,3-cd)pyrene	Phenanthrene
IFP-B2-1	38 U	260 U	380 U	290 U	340 U	3.80 U	290 U	97 U
IFP-B2-2	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	95 U
IFP-B2-3	38 U	260 U	380 U	280 U	340 U	3.80 U	280 U	96 U
IFP-B2-4	40 U	270 U	400 U	300 U	360 U	4.00 U	300 U	100 U
IFP-B2-5	36 U	250 U	360 U	270 U	330 U	3.60 U	270 U	93 U
IFP-B2-6	36 U	250 U	360 U	270 U	330 U	3.60 U	270 U	93 U
IFP-B2-7	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	94 U
IFP-B2-8	36 U	250 U	360 U	270 U	330 U	3.60 U	270 U	93 U
IFP-B2-9	38 U	260 U	380 U	280 U	340 U	3.80 U	280 U	96 U
IFP-B2-10	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	94 U
IFP-B2-11	36 U	250 U	360 U	270 U	330 U	3.60 U	270 U	93 U
IFP-B2-12	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
IFP-B2-13	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
IFP-B2-14	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
IFP-B2-14-D	36 U	240 U	360 U	270 U	330 U	3.60 U	270 U	92 U
IFP-B2-15	37 U	250 U	370 U	280 U	330 U	3.70 U	280 U	94 U
IFP-B2-16	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	91 U
FRL	130	455	777	513	603	9.57	496	190
Conf. Level	90%	90%	90%	90%	90%	90%	90%	90%
Test Procedure	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions
UCL	- -	- -	- -	- -	- -	- -	- -	- -
Prob.	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	40 U	270 U	400 U	300 U	360 U	4.00 U	300 U	100 U
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

Definition of Qualifiers
"J" = estimated result
"UJ" = non-detected estimate
"U" = non-detected
" - " = no data qualifier

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Table D-6 (cont.)

Area 2 Phase I Characterization for Reuse Statistics (SF-B)

Station Number	RADIONUCLIDES						METALS	
	Radium-226	Thorium-232	Uranium-238	Neptunium-237	Technetium-99	Thorium-230	Arsenic	Lead
SF-B-1	1.00 J	0.75 J	0.63 J	0.05 UJ	1.39 UJ	0.58 J	2.50 J	10.60 -
SF-B-2	1.20 J	0.97 J	1.20 J	0.05 UJ	1.40 UJ	0.68 J	2.50 J	11.00 -
SF-B-3	0.79 J	0.52 J	0.91 J	0.04 UJ	1.60 UJ	0.47 J	2.70 J	7.50 -
SF-B-4	1.40 J	1.00 J	1.30 J	0.05 UJ	1.20 UJ	0.79 J	2.80 J	13.80 -
SF-B-5	0.93 J	0.68 J	0.85 J	0.04 UJ	1.30 UJ	0.59 J	3.20 J	14.10 -
SF-B-6	0.65 J	0.32 J	1.20 J	0.03 UJ	1.90 UJ	0.45 J	3.00 J	5.60 -
SF-B-7	0.59 J	0.31 J	0.93 J	0.03 UJ	1.40 UJ	0.40 J	2.20 J	5.60 -
SF-B-8	0.60 J	0.27 J	0.98 J	0.03 UJ	1.20 UJ	0.37 J	7.60 J	4.60 -
SF-B-8-D	0.60 J	0.23 J	0.69 J	0.03 UJ	1.70 UJ	0.40 J	1.90 J	4.00 -
SF-B-9	0.54 J	0.25 J	0.69 J	0.03 UJ	1.20 UJ	0.38 J	2.50 J	4.90 -
SF-B-10	1.90 J	0.90 UJ	2.70 J	0.05 UJ	1.20 UJ	1.30 J	3.30 J	12.90 -
SF-B-11	1.40 J	1.80 J	4.80 J	0.05 UJ	2.20 UJ	0.98 J	3.80 J	20.70 -
SF-B-12	0.99 J	0.66 J	2.70 J	0.04 UJ	1.50 UJ	0.54 J	3.20 J	10.20 -
SF-B-13	0.91 J	0.59 J	0.73 J	0.04 UJ	1.30 UJ	0.56 J	2.50 J	8.00 -
SF-B-14	1.40 J	1.10 J	1.10 J	0.05 UJ	1.20 UJ	0.77 J	2.30 J	12.00 -
SF-B-15	1.10 J	0.87 J	1.10 J	0.04 UJ	1.20 UJ	0.69 J	2.90 J	10.60 -
SF-B-16	1.30 J	0.99 J	1.20 J	0.05 UJ	1.20 UJ	0.73 J	2.70 J	12.00 -
FRL	1.70	1.60	3.22	3.20	30.00	6.97	12.00	400.00
Conf. Level	95%	95%	95%	90%	95%	90%	90%	90%
Test Procedure	t-Test (LN)	t-Test (LN)	t-Test (LN)	Proportions	Proportions	t-Test (LN)	t-Test (LN)	t-Test (LN)
UCL	1.26	1.01	1.89	- -	- -	0.73	3.14	12.23
Prob.	- -	- -	- -	0.002%	0.002%	- -	- -	- -
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	1.90 J	1.80 J	4.80 J	0.05 UJ	2.20 UJ	1.30 J	7.60 J	20.70 -
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

Definition of Qualifiers
"J" = estimated result
"UJ" = non-detected estimate
"U" = non-detected
" - " = no data qualifier

Station Number	SEMIVOLATILES and PESTICIDES							
	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Dieldrin	Indeno(1,2,3-cd)pyrene	Phenanthrene
SF-B-1	38 U	250 U	370 U	280 U	340 U	3.80 U	280 U	95 U
SF-B-2	38 U	260 U	380 U	280 U	340 U	3.80 U	280 U	96 U
SF-B-3	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	91 U
SF-B-4	38 U	250 U	380 U	280 U	340 U	3.80 U	280 U	96 U
SF-B-5	37 U	40 J	53 J	56 J	46 J	3.70 U	41 J	25 J
SF-B-6	35 U	230 U	350 U	260 U	310 U	3.50 U	260 U	88 U
SF-B-7	35 U	240 U	350 U	260 U	320 U	3.50 U	260 U	89 U
SF-B-8	35 U	230 U	350 U	260 U	310 U	3.50 U	260 U	89 U
SF-B-8-D	35 U	240 U	350 U	260 U	320 U	3.50 U	260 U	90 U
SF-B-9	35 U	230 U	340 U	260 U	310 U	3.50 U	260 U	87 U
SF-B-10	37 U	75 J	110 J	77 J	73 J	3.70 U	81 J	94 U
SF-B-11	38 U	84 J	81 J	80 J	81 J	3.80 U	54 J	78 J
SF-B-12	37 U	240 U	360 U	270 U	330 U	3.70 U	270 U	92 U
SF-B-13	36 U	240 U	360 U	270 U	320 U	3.60 U	270 U	91 U
SF-B-14	39 U	260 U	390 U	290 U	350 U	3.90 U	290 U	99 U
SF-B-15	37 U	250 U	370 U	270 U	330 U	3.70 U	270 U	93 U
SF-B-16	39 U	260 U	390 U	290 U	350 U	3.90 U	290 U	98 U
FRL	130	455	777	513	603	9.57	496	190
Conf. Level	90%	90%	90%	90%	90%	90%	90%	90%
Test Procedure	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions	Proportions
UCL	- -	- -	- -	- -	- -	- -	- -	- -
Prob.	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
Pass / Fail	pass	pass	pass	pass	pass	pass	pass	pass
Max Result	39 U	260 U	390 U	290 U	350 U	3.90 U	290 U	78 J
2x Rule P/F	pass	pass	pass	pass	pass	pass	pass	pass

TABLE D-7
AREA 2, PHASE I SPECIAL MATERIALS AREAS
HIGH PURITY GERMANIUM MEASUREMENTS

HPGe Measurement Location	Detector Height	Detector Reading (mg/kg)	Read Time
NFA-12HS	15 cm	77.6	15 minutes
	15 cm	72.9	15 minutes
	1 m	29.2	15 minutes
IFP-B2-1HS	15 cm	91.0	15 minutes
	1 m	71.4	15 minutes
	1 m	39.4	15 minutes
AFP-HS-1	31 cm	359.7	15 minutes
	1 m	119.9	15 minutes
SWUSM-1A	15 cm	38.5	15 minutes
	15 cm	44.6	5 minutes
SWUSM-1B	31 cm	38.7	15 minutes
	31 cm	41.9	5 minutes
SWUSM-1C	1 m	25.8	15 minutes
	1 m	28.2	5 minutes
SWUSM-2A	15 cm	25.5	15 minutes
	15 cm	27.5	5 minutes
SWUSM-2B	31 cm	28.4	15 minutes
	31 cm	31.4	5 minutes
SWUSM-2C	1 m	28.0	15 minutes
	1 m	27.2	5 minutes
SWUSM-3A	15 cm	142.9	15 minutes
	15 cm	286.5	5 minutes
SWUSM-3B	31 cm	71.2	15 minutes
	31 cm	71.5	5 minutes

TABLE D-7
(CONT'D)

HPGe Measurement Location	Detector Height	Detector Reading (mg/kg)	Read Time
SWUSM-3C	1 m	31.6	15 minutes
	1 m	35.2	5 minutes
SWUSM-4A	15 cm	14.9	15 minutes
	15 cm	15.0	5 minutes
SWUSM-4B	31 cm	16.0	15 minutes
	31 cm	14.9	5 minutes
	1 m	14.3	15 minutes
	1 m	16.9	5 minutes
SWUSM-5A	15 cm	26.8	15 minutes
	15 cm	29.7	5 minutes
SWUSM-5B	31 cm	27.2	15 minutes
	31 cm	29.9	5 minutes
SWUSM-5C	1 m	28.6	15 minutes
	1 m	29.6	5 minutes
SWUSM-6A	15 cm	38.4	5 minutes
SWUSM-7A-1	15 cm	22.4	5 minutes
SWUSM-7A-2	15 cm	27.2	5 minutes

NFA = Non Fill Area
HS = Hot spot
IFP = Inactive Flyash Pile
AFP = Active Flyash Pile
SWUSM = Southern Waste Units Special Material (area)
A = detector height at 15 centimeters (cm)
B = detector height at 31 centimeters (cm)
C = detector height at 1 meter (m)

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TABLE D-8
AREA 2, PHASE I ABOVE-WASTE ACCEPTANCE CRITERIA DELINEATION
BETA-GAMMA SCAN AND SOIL SAMPLING RESULTS

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU 1-1-1	0-0.5	16	NV	NA	NA	0
SWU 1-1-2	0.5-1	16	NV	NA	NA	0
SWU 1-1-3	1-1.5	36	NV	NA	NA	0
SWU 1-1-4	1.5-2	44	NV	NA	NA	0
SWU-1-1-5	2-2.5	23	NV	NA	NA	0
SWU-1-1-6	2.5-3	14	NV	NA	NA	0
SWU-1-1-7	3-3.5	7	NV	NA	NA	0
SWU-1-2-1	0-0.5	29	NV	NA	NA	0
SWU-1-2-2	0.5-1	71	NV	NA	NA	0
SWU-1-2-3	1-1.5	56.9	J	NA	NA	0
SWU-1-2-3-D	1-1.5	69	NV	NA	NA	0
SWU-1-2-4	1.5-2	62	NV	NA	NA	0
SWU-1-2-5	2-2.5	42	NV	NA	NA	0
SWU-1-2-6	2.5-3	14	NV	NA	NA	0
SWU-1-2-7	3-3.5	4	NV	NA	NA	0
SWU-1-3-1	0-0.5	29	NV	NA	NA	0
SWU-1-3-2	0.5-1	25	NV	NA	NA	0
SWU-1-3-3	1-1.5	25	NV	NA	NA	0
SWU-1-3-4	1.5-2	10	NV	NA	NA	0
SWU-1-3-5	2-2.5	10	NV	NA	NA	0
SWU-1-3-6	2.5-3	11.2	J	NA	NA	0
SWU-1-3-6-D	2.5-3	9.2	NV	NA	NA	0
SWU-1-3-7	3-3.5	8.9	NV	NA	NA	0
SWU-1-4-1	0-0.5	50.5	NV	NA	NA	0
SWU-1-4-2	0.5-1	44.2	NV	NA	NA	0
SWU-1-4-3	1-1.5	82.6	NV	NA	NA	0
SWU-1-4-4	1.5-2	104	NV	NA	NA	0
SWU-1-4-5	2-2.5	95.4	NV	NA	NA	0
SWU-1-4-6	2.5-3	45.5	NV	NA	NA	0
SWU-1-4-7	3-3.5	30.9	NV	NA	NA	0
SWU-1-5-1	0-0.5	71.4	NV	NA	NA	0
SWU-1-5-2	0.5-1	33.8	J	NA	NA	0
SWU-1-5-2-D	0.5-1	39	NV	NA	NA	0
SWU-1-5-3	1-1.5	46.3	NV	NA	NA	0
SWU-1-5-4	1.5-2	35	NV	NA	NA	0
SWU-1-5-5	2-2.5	28.2	NV	NA	NA	0
SWU-1-5-6	2.5-3	13.7	NV	NA	NA	0
SWU-1-5-7	3-3.5	18.9	J	NA	NA	0
SWU-1-5-7-D	3-3.5	9.9	NV	NA	NA	0

TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-2-1-1	0-0.5	36.2	NV	NA	NA	0
SWU-2-1-2	0.5-1	16.2	NV	NA	NA	0
SWU-2-1-3	1-1.5	12.9	NV	NA	NA	0
SWU-2-1-4	1.5-2	6.48	NV	NA	NA	0
SWU-2-1-5	2-2.5	5.54	NV	NA	NA	0
SWU-2-1-6	2.5-3	3.26	NV	NA	NA	0
SWU-2-1-7	3-3.5	2.37	NV	NA	NA	0
SWU-2-2-1	0-0.5	24	NV	NA	NA	0
SWU-2-2-2	0.5-1	64	NV	NA	NA	0
SWU-2-2-3	1-1.5	20.6	J	NA	NA	0
SWU-2-2-3-D	1-1.5	18	NV	NA	NA	0
SWU-2-2-4	1.5-2	11	NV	NA	NA	0
SWU-2-2-5	2-2.5	8	NV	NA	NA	0
SWU-2-2-6	2.5-3	6	NV	NA	NA	0
SWU-2-2-7	3-3.5	5	NV	NA	NA	0
SWU-2-3-1	0-0.5	18	NV	NA	NA	0
SWU-2-3-2	0.5-1	19	NV	NA	NA	0
SWU-2-3-3	1-1.5	17	NV	NA	NA	0
SWU-2-3-4	1.5-2	13	NV	NA	NA	0
SWU-2-3-5	2-2.5	9	NV	NA	NA	0
SWU-2-3-6	2.5-3	8.73	J	NA	NA	0
SWU-2-3-6-D	2.5-3	8.2	NV	NA	NA	0
SWU-2-3-7	3-3.5	65	NV	NA	NA	0
SWU-2-4-1	0-0.5	36	NV	NA	NA	0
SWU-2-4-2	0.5-1	16	NV	NA	NA	0
SWU-2-4-3	1-1.5	8	NV	NA	NA	0
SWU-2-4-4	1.5-2	7	NV	NA	NA	0
SWU-2-4-5	2-2.5	7	NV	NA	NA	0
SWU-2-4-6	2.5-3	8	NV	NA	NA	0
SWU-2-4-7	3-3.5	4	NV	NA	NA	0
SWU-2-5-1	0-0.5	30	NV	NA	NA	0
SWU-2-5-2	0.5-1	19.3	J	NA	NA	0
SWU-2-5-2-D	0.5-1	20	NV	NA	NA	0
SWU-2-5-3	1-1.5	11.5	NV	NA	NA	0
SWU-2-5-4	1.5-2	7.7	NV	NA	NA	0
SWU-2-5-5	2-2.5	7.45	NV	NA	NA	0
SWU-2-5-6	2.5-3	5.53	NV	NA	NA	0
SWU-2-5-7	3-3.5	3.11	J	NA	NA	0
SWU-2-5-7-D	3-3.5	4.1	NV	NA	NA	0

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TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-3-1-1	0-0.5	11	NV	NA	NA	0
SWU-3-1-2	0.5-1	8.41	NV	NA	NA	0
SWU-3-1-3	1-1.5	10.6	NV	NA	NA	0
SWU-3-1-4	1.5-2	66.5	NV	NA	NA	0
SWU-3-1-5	2-2.5	40.7	NV	NA	NA	0
SWU-3-1-6	2.5-3	8.97	NV	NA	NA	0
SWU-3-1-7	3-3.5	3.06	NV	NA	NA	0
SWU-3-2-1	0-0.5	6.68	NV	NA	NA	0
SWU-3-2-2	0.5-1	6.93	NV	NA	NA	0
SWU-3-2-3	1-1.5	9.37	J	NA	NA	0
SWU-3-2-3-D	1-1.5	5.7	NV	NA	NA	0
SWU-3-2-4	1.5-2	11.8	NV	NA	NA	0
SWU-3-2-5	2-2.5	20.8	NV	NA	NA	0
SWU-3-2-6	2.5-3	40.6	NV	NA	NA	0
SWU-3-2-7	3-3.5	39.5	NV	NA	NA	0
SWU-3-3-1	0-0.5	9	NV	NA	NA	0
SWU-3-3-2	0.5-1	3.21	NV	NA	NA	0
SWU-3-3-3	1-1.5	5.54	NV	NA	NA	0
SWU-3-3-4	1.5-2	5.42	NV	NA	NA	0
SWU-3-3-5	2-2.5	17.6	NV	NA	NA	0
SWU-3-3-6	2.5-3	57.7	J	NA	NA	0
SWU-3-3-6-D	2.5-3	53	NV	NA	NA	0
SWU-3-3-7	3-3.5	2.01	NV	NA	NA	0
SWU-3-4-1	0-0.5	17.6	NV	NA	NA	0
SWU-3-4-2	0.5-1	28.9	NV	NA	NA	0
SWU-3-4-3	1-1.5	34	NV	NA	NA	0
SWU-3-4-4	1.5-2	54.1	NV	NA	NA	0
SWU-3-4-5	2-2.5	221	NV	NA	NA	0
SWU-3-4-6	2.5-3	418	NV	NA	NA	250
SWU-3-4-7	3-3.5	298	NV	NA	NA	150
SWU-3-5-1	0-0.5	12.2	NV	NA	NA	0
SWU-3-5-2	0.5-1	14.6	J	NA	NA	0
SWU-3-5-2-D	0.5-1	8.9	NV	NA	NA	0
SWU-3-5-3	1-1.5	12.9	NV	NA	NA	0
SWU-3-5-4	1.5-2	25.9	NV	NA	NA	0
SWU-3-5-5	2-2.5	50.7	NV	NA	NA	0
SWU-3-5-6	2.5-3	40.4	NV	NA	NA	0
SWU-3-5-7	3-3.5	33.2	J	NA	NA	0
SWU-3-5-7-D	3-3.5	29	NV	NA	NA	0

TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-4-1-1	0-0.5	12.8	NV	1	NV	0
SWU-4-1-1-Y	0-0.5	17.2/2.2 pCi/g[c]	J[d]	1.41/0.51	U[d]	0
SWU-4-1-2	0.5-1	13.3	NV	1.3	NV	0
SWU-4-1-2-Y	0.5-1	12.5/1.6 pCi/g[c]	J[d]	1.48/0.31	U[d]	0
SWU-4-1-3	1-1.5	17	NV	1.2	NV	0
SWU-4-1-4	1.5-2	17.6	NV	1.2	NV	0
SWU-4-1-5	2-2.5	31.9	NV	1.5	NV	0
SWU-4-1-6	2.5-3	56.3	NV	1.4	NV	0
SWU-4-1-7	3-3.5	66.3	NV	1.4	NV	0
SWU-4-2-1	0-0.5	20.9	NV	1.3	NV	0
SWU-4-2-2	0.5-1	14.7	NV	1.1	NV	0
SWU-4-2-3	1-1.5	17.5	J	1.67	U	0
SWU-4-2-3-D	1-1.5	19	NV	0.65	NV	0
SWU-4-2-4	1.5-2	84.5	NV	1.3	NV	0
SWU-4-2-5	2-2.5	69.6	NV	1.3	NV	0
SWU-4-2-6	2.5-3	72.7	NV	1.2	NV	0
SWU-4-2-7	3-3.5	65.2	NV	1.2	NV	0
SWU-4-3-1	0-0.5	26.4	NV	1.3	NV	0
SWU-4-3-2	0.5-1	23.8	NV	1.5	NV	0
SWU-4-3-3	1-1.5	50.5	NV	1.6	NV	0
SWU-4-3-4	1.5-2	81	NV	1.3	NV	0
SWU-4-3-5	2-2.5	99	NV	1.9	NV	0
SWU-4-3-6	2.5-3	88	J	1.9	U	0
SWU-4-3-6-D	2.5-3	92	NV	0.62	NV	0
SWU-4-3-7	3-3.5	123	NV	1.6	NV	0
SWU-4-4-1	0-0.5	36.7	NV	1.4	NV	0
SWU-4-4-2	0.5-1	20.4	NV	1.4	NV	0
SWU-4-4-3	1-1.5	13.2	NV	1.3	NV	0
SWU-4-4-4	1.5-2	12.2	NV	1.4	NV	0
SWU-4-4-5	2-2.5	23.9	NV	1.3	NV	0
SWU-4-4-6	2.5-3	55.8	NV	1.4	NV	0
SWU-4-4-7	3-3.5	30.6	NV	1.5	NV	0
SWU-4-5-1	0-0.5	25.4	NV	1.4	NV	0
SWU-4-5-1-Y	0-0.5	22.4/3.1 pCi/g[c]	J[d]	1.33/0.35	U[d]	0
SWU-4-5-2	0.5-1	14.7	J	1.73	U	0
SWU-4-5-2-D	0.5-1	13	NV	0.57	NV	0
SWU-4-5-2-Y	0.5-1	10.2/1.3 pCi/g[c]	J[d]	1.85/0.46	U[d]	0
SWU-4-5-3	1-1.5	11.8	NV	1.2	NV	0
SWU-4-5-4	1.5-2	13.6	NV	1.1	NV	0
SWU-4-5-5	2-2.5	34.5	NV	1.3	NV	0
SWU-4-5-6	2.5-3	46.2	NV	1.3	NV	0
SWU-4-5-7	3-3.5	50.7	J	1.83	U	0

000882

TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-4-5-7-D	3-3.5	49	NV	0.53	NV	0
SWU-5-1-48	23.5-24	10	NV	NA	NA	0
SWU-5-2-34	16.5-17	612	NV	NA	NA	950
SWU-5-2-34-Y	16.5-17	1170/180 pCi/g[c]	-[d]	NA	NA	950
SWU-5-2-35	17-17.5	75.2	NV	NA	NA	200
SWU-5-3-2	0.5-1	14	NV	NA	NA	0
SWU-5-3-36	17.5-18	1.24	NV	NA	NA	0
SWU-5-4-29	14-14.5	2	NV	NA	NA	0
SWU-5-5-13	6-6.5	424	NV	NA	NA	150
SWU-5-6-41	20-20.5	1.39	NV	NA	NA	0
SWU-5-7-46	22.5-23	626	NV	NA	NA	3950
SWU-5-8-44	21.5-22	138	NV	NA	NA	100
SWU-5-8-45	22-22.5	1130	NV	NA	NA	950
SWU-5-8-46	22.5-23	1140	NV	NA	NA	1950
SWU-5-8-47	23-23.5	1070	NV	NA	NA	750
SWU-5-8B-54	26.5-27	195	NV	NA	NA	400
SWU-5-9-39	19-19.5	2080	NV	NA	NA	550
SWU-5-9-40	19.5-20	1220	NV	NA	NA	600
SWU-5-9-42	20.5-21	144	NV	NA	NA	0
SWU-5-10-21	10-10.5	292	NV	NA	NA	150
SWU-5-10-24	11.5-12	520	NV	NA	NA	550
SWU-5-10-29	14-14.5	186	NV	NA	NA	350
SWU-5-10-31	15-15.5	4980	NV	NA	NA	1000
SWU-5-10-32	15.5-16	1290	NV	NA	NA	100
SWU-5-11-36	17.5-18	1.18	NV	NA	NA	0
SWU-5-12-32	15.5-16	1.72	NV	NA	NA	0
SWU-5-13-32	15.5-16	3.2	J	NA	NA	0
SWU-5-13-32-D	15.5-16	2.8/5.3	NV	NA	NA	0
SWU-5-14-15	7-7.5	632	NV	NA	NA	750
SWU-5-15-37	18-18.5	2180	NV	NA	NA	1000
SWU-5-15-38	18.5-19	9090	NV	NA	NA	8000
SWU-5-15-39	19-19.5	3690	NV	NA	NA	1450
SWU-5-15-40	19.5-20	981	NV	NA	NA	1000
SWU-5-15-43	21-21.5	1810	NV	NA	NA	1000
SWU-5-15-45	22-22.5	646	NV	NA	NA	900
SWU-5-15-46	22.5-23	3980	NV	NA	NA	3000
SWU-5-15-47	23-23.5	2120	NV	NA	NA	1000
SWU-5-15-48	23.5-24	1970	NV	NA	NA	1000
SWU-5-15-49	24-24.5	1110	NV	NA	NA	1250
SWU-5-15-50	24.5-25	491	NV	NA	NA	250
SWU-5-15-51	25-25.5	3660	NV	NA	NA	1850
SWU-5-15-52	25.5-26	168	NV	NA	NA	150

TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-5-16-37	18-18.5	218	NV	NA	NA	150
SWU-5-16-38	18.5-19	1430	NV	NA	NA	1000
SWU-5-16-39	19-19.5	3220	NV	NA	NA	2000
SWU-5-16-40	19.5-20	3610	NV	NA	NA	1450
SWU-5-16-41	20-20.5	2370	NV	NA	NA	1000
SWU-5-16-42	20.5-21	1700	NV	NA	NA	450
SWU-5-16-43	21-21.5	444	NV	NA	NA	550
SWU-5-16-44	21.5-22	226	NV	NA	NA	200
SWU-5-16-45	22-22.5	243	NV	NA	NA	350
SWU-5-17-32	15.5-16	469	NV	NA	NA	150
SWU-5-18-37	18-18.5	1390	NV	NA	NA	1000
SWU-5-18-38	18.5-19	1930	NV	NA	NA	1000
SWU-5-18-41	20-20.5	8890	NV	NA	NA	1500
SWU-5-19-44	21.5-22	242	NV	NA	NA	300
SWU-5-19-48	23.5-24	1480	NV	NA	NA	1000
SWU-5-19-49	24-24.5	1580	J	NA	NA	1700
SWU-5-19-49-R-D	24-24.5	1770	NV	NA	NA	1700
SWU-5-19-49-R-D	24-24.5	2000	NV	NA	NA	1700
SWU-5-19-50	24.5-25	1870	NV	NA	NA	850
SWU-5-20-49	24-24.5	1180	NV	NA	NA	850
SWU-5-20-50	24.5-25	287	NV	NA	NA	450
SWU-5-20-51	25-25.5	608	NV	NA	NA	150
SWU-5-20A-45	22-22.5	881	NV	NA	NA	550
SWU-5-20A-49	23.5-24	2250	NV	NA	NA	1750
SWU-5-20B-49	23.5-24	377	NV	NA	NA	300
SWU-5-20B-50	24.5-25	401	NV	NA	NA	350
SWU-5-21-45	22-22.5	277	NV	NA	NA	150
SWU-5-21-46	22.5-23	486	NV	NA	NA	200
SWU-5-21-47	23-23.5	2640	NV	NA	NA	1000
SWU-5-21-48	23.5-24	1820	NV	NA	NA	800
SWU-5-21-51	25-25.5	773	NV	NA	NA	400
SWU-5-21-52	25.5-26	1020	NV	NA	NA	500
SWU-5-21-53	26-26.5	569	NV	NA	NA	400
SWU-5-22-51	25-25.5	949	NV	NA	NA	1000
SWU-5-22B-52	25.5-26	1660	NV	NA	NA	1150
SWU-5-22B-53	26-26.5	1810	NV	NA	NA	1550
SWU-5-23-47	23-23.5	800	NV	NA	NA	450
SWU-5-23-48	23.5-24	804	NV	NA	NA	750
SWU-5-23-49	24-24.5	683	NV	NA	NA	1050
SWU-5-23B-50	24.5-25	302	NV	NA	NA	300
SWU-5-23B-51	25-25.5	106	NV	NA	NA	850
SWU-5-23B-52	25.5-26	1870	NV	NA	NA	1000

000884

TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-5-24A-50	24.5-25	709	NV	NA	NA	450
SWU-5-25-54	26.5-27	86.4	NV	NA	NA	40
SWU-5-26A-49	24-24.5	619	NV	NA	NA	450
SWU-5-26A-49-D	24-24.5	482	NV	NA	NA	450
SWU-5-27-49	24-24.5	391	NV	NA	NA	250
SWU-5-27-50	24.5-25	342	NV	NA	NA	200
SWU-5-27-51	25-25.5	852	NV	NA	NA	550
SWU-5-27-52	25.5-26	1020	NV	NA	NA	750
SWU-5-27-53	26-26.5	1880	NV	NA	NA	850
SWU-5-27-54	26.5-27	2140	NV	NA	NA	1000
SWU-5-28A-54	26.5-27	252	NV	NA	NA	350
SWU-5-28A-55	27-27.5	670	NV	NA	NA	100
SWU-5-28A-56	27.5-28	99.3	NV	NA	NA	100
SWU-5-29-48	23.5-24	234	NV	NA	NA	0
SWU-5-29-49	24-24.5	1260	NV	NA	NA	600
SWU-5-29-50	24.5-25	1530	NV	NA	NA	1500
SWU-5-29-51	25-25.5	2090	NV	NA	NA	450
SWU-5-29A-49	24-24.5	553	NV	NA	NA	250
SWU-29A-50	24.5-25	1370	NV	NA	NA	1200
SWU-5-30-46	22.5-23	444	NV	NA	NA	200
SWU-5-30-47	23-23.5	935	NV	NA	NA	450
SWU-5-30-48	23.5-24	1410	NV	NA	NA	1450
SWU-5-30-49	24-24.5	2070	NV	NA	NA	500
SWU-5-31-48	23.5-24	193	NV	NA	NA	150
SWU-5-31-49	24-24.5	1180	NV	NA	NA	750
SWU-5-31-50	24.5-25	2510	NV	NA	NA	2000
SWU-5-32-54	26.5-27	27.4	NV	NA	NA	0
SWU-5-33-47	23-23.5	294	NV	NA	NA	350
SWU-5-33-48	23.5-24	1260	NV	NA	NA	550
SWU-5-33-49	24-24.5	772	NV	NA	NA	350
SWU-5-33-50	24.5-25	417	NV	NA	NA	400
SWU-5-33-51	25-25.5	1570	NV	NA	NA	1250
SWU-5-33-52	25.5-26	690	NV	NA	NA	850
SWU-5-33-53	26-26.5	2660	NV	NA	NA	1400
SWU-5-36-47	23-23.5	931	NV	NA	NA	850
SWU-5-37-54	26.5-27	552	NV	NA	NA	300
SWU-5-38-62	30.5-31	416	NV	NA	NA	750
SWU-5-39-60	29.5-30	316	NV	NA	NA	200
SWU-5-39-60-D	29.5-30	443	NV	NA	NA	200
SWU-5-40-56	27.5-28	315	NV	NA	NA	100
SWU-5-41-18	8.5-9	20.7	NV	NA	NA	0
SWU-5-41-19	9-9.5	291	NV	NA	NA	200

TABLE D-8
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-5-41-20	9.5-10	126	NV	NA	NA	150
SWU-5-41-21	10-10.5	569	NV	NA	NA	200
SWU-5-41-22	10.5-11	190	NV	NA	NA	100
SWU-5-41-23	11-11.5	45	NV	NA	NA	0
SWU-5-EPA41-24	11.5-12	2000±210	NV	NA	NA	650
SWU-5-42-42	21-21.5	6.28	NV	NA	NA	0
SWU-5-EPA42-33	16-16.5	24±2.5	NV	NA	NA	0
SWU-5-43-34	16.5-17	32.5	NV	NA	NA	0
SWU-5-43-35	17-17.5	511	NV	NA	NA	150
SWU-5-43-36	17.5-18	1030	NV	NA	NA	750
SWU-5-43-37	18-18.5	1140	NV	NA	NA	1000
SWU-5-43-38	18.5-19	2270/16,000±1700/ 11,100±583[f]	NV	NA/ 7.0±0.94[c]	NA	3500
SWU-5-43-39	19-19.5	2390	NV	NA	NA	950
SWU-43A-33	16-16.5	22±2.3	NV	0.48±0.23	NA	0
SWU-5-43A-37[c]	18-18.5	3220/9500±990/ 7160±407[f]	NV	NA/ 4.1±0.58[c]	NA	2500
SWU-5-44-18	8.5-9	17.5	NV	NA	NA	0
SWU-5-44-19	9-9.5	111	NV	NA	NA	100
SWU-5-44-20	9.5-10	515	NV	NA	NA	350
SWU-5-44-21	10-10.5	112	NV	NA	NA	0
SWU-5-EPA44-7	3-3.5	31±3.3	NV	0.42±0.22	NA	0
SWU-5-EPA44-20	9.5-10	530±55	NV	0.30±0.17	NA	150
SWU-5-45-21	10-10.5	57.9	NV	NA	NA	0
SWU-5-45-22	10.5-11	71.7	NV	NA	NA	0
SWU-5-45-23	11-11.5	92.6	NV	NA	NA	0
SWU-5-45-24	11.5-12	18.6	NV	NA	NA	0
SWU-5-46-17	8-8.5	16.7	NV	NA	NA	0
SWU-5-46-18	8.5-9	9.4	NV	NA	NA	100
SWU-5-46-19	9-9.5	48.5	NV	NA	NA	150
SWU-5-46-20	9.5-10	377	NV	NA	NA	100
SWU-5-46-21	10-10.5	366	NV	NA	NA	0

[a] Results reported as dry weight
[b] Qualifier: NV = Not validated
U = Not detected above method detection limit
J = Estimated value
(-) = Validated, no data qualifer
[c] Split sample collected by OEPA and submitted to off-site lab for analysis; results reported in pCi/g (DOE results reported in mg/kg)
[d] Data qualifier applicable to DOE results only

000886

TABLE D-8
(CONT'D)

[e] OEPA sample location (volume requirements for OEPA lab analysis precluded splitting samples from SWU-5-41, SWU-5-42, and SWU-5-44)
[f] First result is FDF ICP/MS; second result is OEPA analysis by KPA; third result is FDF re-analysis of OEPA sample by ICP/MS

mg/kg = milligrams per kilogram or parts per million (ppm)
pCi/g = picoCuries per gram
ccpm = corrected counts per minute
SWU = Southern Waste Units
NA = Not analyzed
D = Duplicate

TABLE D-9
AREA 2, PHASE I ABOVE-WAC AREA HIGH PURITY GERMANIUM MEASUREMENTS, TOTAL URANIUM

Location	Detector Height	Northing	Easting	Measurement Identification	Result (mg/kg)
SWU-1	1 m	477520.092	1348035.809	SWU-1-1-G	58.2
	31 cm	477520.092	1348035.809	SWU-1-1-G	66.7
SWU-2	1 m	477567.422	134022.114	SWU-2-1-G	36.4
	31 cm	477567.422	1348022.114	SWU-2-1-G	46.1
SWU-3	1 m	477974.996	1348115.232	SWU-3-1-G	18.5
	31 cm	477974.966	1348115.232	SWU-3-1-G	16.6
SWU-4	1m	478098.104	1347456.511	SWU-4-1-G	26.1
	31 cm	478098.104	1347456.511	SWU-4-1-G	21.8
SWU-5	1 m	477950	1347499	SWU-5-39-G	15.3
	1 m	477943	1347511	SWU-5-40-G	23.1
	1 m	477984.443	1347601.583	SWU-5-41-G	20.1
	1 m	477984.621	1347559.769	SWU-5-42-G	16.5
	1 m	478057.924	1347559.254	SWU-5-43-G	18.1
	1 m	478020.448	1347622.57	SWU-5-44-G	47.5
	1 m	478020.922	1347537.81	SWU-5-45-G	17.1
	1 m	477948.102	1347580.407	SWU-5-46-G	20.5
	1 m	478093.584	1347580.702	SWU-5-56-G	22.4
	1 m	477983.479	1347517.811	SWU-5-59-G	20.5
	1 m	477948.545	1347622.043	SWU-5-62-G	22.2
	1 m	477984.385	1347642.908	SWU-5-65-G	44.6
	1 m	477929.4	1347529.9	SWU-5-66-G	76.4
	1 m	477911.8	1347497.9	SWU-5-67-G	21.7

mg/kg = milligrams per kilogram
SWU = Southern Waste Units
G = gamma measurement (HPGe)
m = meter
cm = centimeter

TABLE D-10
AREA 2, PHASE I INACTIVE FLYASH PILE AREA
HIGH PURITY GERMANIUM MEASUREMENTS, TOTAL URANIUM

Measurement Identification	Detector Height	Northing	Easting	Result (mg/kg)
A2PI-IFP-1-G		478263.5	1347478	22.7
A2PI-IFP-10-G		478195.3	1347517	27.0
A2PI-IFP-103-G		477751.9	1347576	16.0
A2PI-IFP-104-G-D		477751.9	1347616	18.0
A2PI-IFP-105-G		477751.9	1347655	10.7
A2PI-IFP-106-G		477751.9	1347694	13.3
A2PI-IFP-107-G		477751.9	1347734	16.5
A2PI-IFP-108-G		477751.9	1347773	10.1
A2PI-IFP-109-G		477751.9	1347813	20.5
A2PI-IFP-11-G		478195.3	1347556	31.6
A2PI-IFP-110-G-D		477751.9	1347852	15.0
A2PI-IFP-116-G		477717.7	1347675	15.1
A2PI-IFP-117-G		477717.7	1347714	13.2
A2PI-IFP-118-G		477717.7	1347753	8.7
A2PI-IFP-119-G		477717.7	1347793	0.0
A2PI-IFP-119-G		477717.7	1347793	22.6
A2PI-IFP-12-G		478195.3	1347596	28.7
A2PI-IFP-120-G-D		477717.7	1347832	14.6
A2PI-IFP-13-G		478195.3	1347635	27.9
A2PI-IFP-14-G		478195.3	1347675	20.2
A2PI-IFP-14-G-D		478195.3	1347675	20.8
A2PI-IFP-16-G		478160.9	1347497	36.7
A2PI-IFP-17-G		478160.9	1347537	16.4
A2PI-IFP-18-G		478160.9	1347576	15.7
A2PI-IFP-19-G		478160.9	1347616	16.7
A2PI-IFP-2-G		478263.5	1347517	27.1
A2PI-IFP-20-G		478160.9	1347655	25.2
A2PI-IFP-20-G-D		478160.9	1347655	25.5
A2PI-IFP-22-G		478126.8	1347478	24.3
A2PI-IFP-23-G		478126.8	1347517	26.6

TABLE D-10
(CONT'D)

Measurement Identification	Detector Height	Northing	Easting	Result (mg/kg)
A2PI-IFP-24-G		478126.8	1347556	20.2
A2PI-IFP-25-G		478126.8	1347596	26.8
A2PI-IFP-26-G		478126.8	1347635	56.3
A2PI-IFP-28-G		478092.7	1347458	23.0
A2PI-IFP-29-G		478092.7	1347497	26.7
A2PI-IFP-3-G		478229.4	1347458	22.4
A2PI-IFP-30-G		478092.7	1347537	29.3
A2PI-IFP-31-G		478092.7	1347576	27.2
A2PI-IFP-32-G		478092.7	1347616	34.3
A2PI-IFP-35-G		478058.6	1347478	16.9
A2PI-IFP-36-G		478058.6	1347517	17.9
A2PI-IFP-37-G		478058.6	1347556	32.9
A2PI-IFP-38-G		478058.6	1347596	20.7
A2PI-IFP-4-G		478229.4	1347497	21.4
A2PI-IFP-43-G		478024.6	1347497	0.0
A2PI-IFP-43-G		478024.6	1347497	0.3
A2PI-IFP-43-G		478024.6	1347497	51.6
A2PI-IFP-44-G		478024.6	1347537	21.8
A2PI-IFP-45-G		478024.6	1347576	15.2
A2PI-IFP-46-G		478024.6	1347616	59.8
A2PI-IFP-49-G		477990.7	1347478	20.3
A2PI-IFP-50-G		477990.7	1347517	22.9
A2PI-IFP-51-G		477990.7	1347557	22.9
A2PI-IFP-51-G-D		477990.7	1347557	22.8
A2PI-IFP-52-G		477990.7	1347596	18.4
A2PI-IFP-53-G		477990.7	1347635	56.7
A2PI-IFP-56-G		477956.6	1347497	20.7
A2PI-IFP-57-G		477956.6	1347537	20.7
A2PI-IFP-59-G		477956.6	1347616	22.9
A2PI-IFP-6-G		478229.4	1347576	22.2
A2PI-IFP-61-G		477922.4	1347478	25.2

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TABLE D-10
(CONT'D)

Measurement Identification	Detector Height	Northing	Easting	Result (mg/kg)
A2PI-IFP-62-G		477922.4	1347517	16.2
A2PI-IFP-63-G		477922.4	1347557	18.5
A2PI-IFP-64-G		477922.4	1347596	16.3
A2PI-IFP-65-G		477922.4	1347635	25.6
A2PI-IFP-68-G		477888.3	1347497	49.6
A2PI-IFP-69-G		477888.3	1347537	30.3
A2PI-IFP-70-G		477888.3	1347576	22.4
A2PI-IFP-71-G		477888.3	1347616	15.7
A2PI-IFP-72-G		477888.3	1347655	16.8
A2PI-IFP-74-G		477854.2	1347478	18.0
A2PI-IFP-75-G		477854.2	1347517	18.0
A2PI-IFP-76-G		477854.2	1347556.5	29.6
A2PI-IFP-77-G		477854.2	1347596	0.0
A2PI-IFP-77-G		477854.2	1347596	8.0
A2PI-IFP-78-G		477854.2	1347635	9.0
A2PI-IFP-79-G		477854.2	1347675	23.9
A2PI-IFP-8-G		478195.3	1347438	15.7
A2PI-IFP-82-G		477820	1347497	12.1
A2PI-IFP-83-G		477820	1347537	16.6
A2PI-IFP-84-G		477820	1347576	7.4
A2PI-IFP-85-G		477820	1347616	0.0
A2PI-IFP-85-G		477820	1347616	8.5
A2PI-IFP-86-G		477820	1347655	10.7
A2PI-IFP-87-G		477820	1347694	12.0
A2PI-IFP-92-G		477785.9	1347557	19.5
A2PI-IFP-93-G		477785.9	1347596	7.9
A2PI-IFP-94-G		477785.9	1347636	14.1
A2PI-IFP-95-G		477785.9	1347675	8.5
A2PI-IFP-95-G-D		477785.9	1347675	12.0
A2PI-IFP-96-G		477785.9	1347714	13.0
A2PI-IFP-97-G		477785.9	1347753	9.8

TABLE D-10
(CONT'D)

mg/kg = milligrams per kilogram
A2PI = Area 2, Phase I
IFP = Inactive Flyash Pile
G = gamma measurement
D = duplicate measurement

000892

TABLE D-11
AREA 2, PHASE I ABOVE-WASTE ACCEPTANCE CRITERIA AREA SAMPLING COORDINATES AND SURFACE ELEVATIONS

Location	Northing	Easting	Surface Elevation (Mean Sea Level)
SWU-5-1	478020.334	1347525.759	574.395
SWU-5-2	478064.899	1347548.063	570.743
SWU-5-3	478079.088	1347593.719	567.39
SWU-5-4	478039.573	1347619.393	563.91
SWU-5-5	477991.585	1347627.526	566.127
SWU-5-6	477946.081	1347612.55	562.866
SWU-5-7	477940.565	1347566.276	577.598
SWU-5-8	477974.259	1347529.516	576.36
SWU-5-9	478017.543	1347541.79	573.407
SWU-5-10	478053.908	1347554.66	570.074
SWU-5-11	478060.938	1347577.389	567.302
SWU-5-12	478042.212	1347590.644	566.024
SWU-5-13	478003.292	1347592.587	565.22
SWU-5-14	477980.801	1347585.417	565.89
SWU-5-15	477977.69	1347561.498	576.342
SWU-5-16	477994.741	1347543.362	574.698
SWU-5-17	478041.123	1347560.957	570.902
SWU-5-18	478014.639	1347558.299	572.96
SWU-5-19	477964.439	1347522.786	577.076
SWU-5-20	477957.369	1347515.719	577.56
SWU-5-21	477957.369	1347529.861	577.73
SWU-5-22	477950.298	1347508.648	577.69
SWU-5-23	477950.298	1347522.790	577.23
SWU-5-24	477943.5	1347515.7	577.8
SWU-5-25	477936.3	1347508.7	577.5
SWU-5-26	477936.4	1347522.9	577.8
SWU-5-27	477929.8	1347515.5	577.7
SWU-5-28	477911.8	1347497.9	569.3
SWU-5-29	477943.7	1347530	577.8
SWU-5-30	477936.53	1347537	578.04

TABLE D-11
(CONT'D)

Location	Northing	Easting	Surface Elevation (Mean Sea Level)
SWU-5-31	477929.41	1347529.98	577.96
SWU-5-32	477922.29	1347522.95	578.31
SWU-5-33	477922.39	1347537.1	578.46
SWU-5-34	477936.6	1347551.1	NA[a]
SWU-5-35	477929.5	1347544.1	NA[a]
SWU-5-36	477922.5	1347551.2	575.8
SWU-5-37	477915.4	1347544.2	577.7
SWU-5-38	477915.2	1347530	569.3
SWU-5-39	477950	1347499	577.1
SWU-5-40	477943	1347511	577.9
SWU-5-41	478097.5	1347543	571.8
SWU-5-42	478005.2	1347500.8	576.2
SWU-5-43	477977.1	1347562.3	576.3
SWU-5-43A	477977.1	1347562.3	576.4
SWU-5-44	477920.9	1347588.3	563.4
SWU-5-45	478097.57	1347543.77	570.7
SWU-5-46	478109.97	1347542.82	571.9

SWU = Southern Waste Units
NA = Not applicable
[a] Borings relocated; no elevation taken.

000894

TABLE D-12
INDICATOR CODING USED TO DETERMINE EXTENT OF ABOVE-WASTE ACCEPTANCE CRITERIA AREA IN AREA 2, PHASE I INACTIVE FLYASH PILE

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-1	0	23.5	0	0	NA
	23.5	24	0	0	10
	24	27	0	0	NA
SWU-5-2	0	10	0	0	NA
	10	10.5	1	250	NA
	10.5	11	1	250	NA
	11	14	1	NR	NA
	14	14.5	0	0	NA
	14.5	15	1	150	NA
	15	16	1	NR	NA
	16	16.5	1	100	NA
	16.5	17	2	950	612/1170[b]
	17	17.5	1	200	75.2
	18	27	0	0	NA
SWU-5-3	0	0.5	0	0	NA
	0.5	1	0	0	14
	1	17.5	0	0	NA
	17.5	18	0	0	1.24
	18	27	0	0	NA
SWU-5-4	0	14	0	0	NA
	14	14.5	0	0	2
	14.5	27	0	0	NA
SWU-5-5	0	5.5	0	0	NA
	5.5	6	1	150	NA
	6	6.5	1	150	424
	6.5	7	1	100	NA
	7	27	0	0	NA
SWU-5-6	0	19	0	0	NA
	19	20	0	NR	NA
	20	20.5	0	0	1.39
	20.5	26	0	0	NA
	26	27	0	NR	NA

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-7	0	19.5	0	0	NA
	19.5	20	1	400	NA
	20	21	1	NR	NA
	21	21.5	1	1000	NA
	21.5	22	2	3450	NA
	22	22.5	2	1450	NA
	22.5	23	1	3950	626
	23	23.5	1	1450	NA
	23.5	24	1	1250	NA
	24	24.5	1	2450	NA
	24.5	25	1	550	NA
	25	25.5	1	1000	NA
	25.5	26	1	1450	NA
	26	26.5	1	150	NA
	26.5	27	0	50	NA
SWU-5-8	0	20	0	0	NA
	20	21.5	1	NR	NA
	21.5	22	1	100	138
	22	22.5	2	950	1130
	22.5	23	2	1950	1140
	23	23.5	2	750	1070
	23.5	26.5	1	NR	NA
	26.5	27	1	400	195
SWU-5-9	0	19	0	0	NA
	19	19.5	2	550	2080
	19.5	20	2	600	1220
	20	20.5	0	0	NA
	20.5	21	1	250	144
	21	27	0	0	NA

000896

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-10	0	10	0	0	NA
	10	10.5	1	150	292
	10.5	11	1	100	NA
	11	11.5	1	200	NA
	11.5	12	1	550	520
	12	13.5	1	NR	NA
	13.5	14	1	250	NA
	14	14.5	1	350	186
	14.5	15	1	350	NA
	15	15.5	2	3500	4980
	15.5	16	2	1000	1290
	16	27	0	0	NA
SWU-5-11	0	17.5	0	0	NA
	17.5	18	0	0	1.18
	18	27	0	0	NA
SWU-5-12	0	15.5	0	0	NA
	15.5	16	0	0	1.72
	16	27	0	0	NA
SWU-5-13	0	15.5	0	0	NA
	15.5	16	0	0	3.2; 2.8/ 5.3[c]
	16	27	0	0	NA
SWU-5-14	0	7	0	0	NA
	7	7.5	1	750	632
	7.5	8	1	200	NA
	8	11	0	0	NA
	11	11.5	1	200	NA
	11.5	27	0	0	NA

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-15	0	17.5	0	0	NA
	17.5	18	1	150	NA
	18	18.5	2	1000	2180
	18.5	19	2	8000	9090
	19	19.5	2	2000	3690
	19.5	20	1	1000	981
	20	21	2	NR	NA
	21	21.5	2	1000	1810
	21.5	22	2	1500	NA
	22	22.5	1	900	646
	22.5	23	2	3000	3980
	23	23.5	2	1000	2120
	23.5	24	2	1000	1970
	24	24.5	2	1250	1110
	24.5	25	1	250	491
	25	25.5	2	1850	3660
	25.5	26	1	150	168
	26	27	0	0	NA
SWU-5-16	0	18	0	0	NA
	18	18.5	1	150	218
	18.5	19	2	1000	1430
	19	19.5	2	2000	3220
	19.5	20	2	1450	3610
	20	20.5	2	1000	2370
	20.5	21	2	450	1700
	21	21.5	1	550	444
	21.5	22	1	200	226
	22	22.5	1	350	243
	22.5	27	0	0	NA
SWU-5-17	0	15.5	0	0	NA
	15.5	16	1	150	469
	16	20.5	0	0	NA

000898

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-18	0	16	0	0	NA
	16	17.5	0	NR	NA
	17.5	18	0	0	NA
	18	18.5	2	1000	1390
	18.5	19	2	1000	1930
	19	19.5	2	150	NA
	19.5	20	2	350	NA
	20	20.5	2	1500	8890
SWU-5-19	0	19.5	0	0	NA
	19.5	20	1	150	NA
	20	21.5	1	NR	NA
	21.5	22	1	300	242
	22	22.5	2	550	NA
	22.5	23	2	650	NA
	23	23.5	2	300	NA
	23.5	24	2	1000	1480
	24	24.5	2	1700	1580/2000/1770[c]
	24.5	25	2	850	1870
	25	27	0	0	NA
SWU-5-20	0	21	0	0	NA
	21	22	2	NR	NA
	22	22.5	1	550	881
	22.5	24	1	NR	NA
	24	24.5	2	1750	1180/2250/377[d]
	24.5	25	1	450/350	287/401[d]
	25	25.5	1	150	608
	25.5	27	1	NR	NA

000899

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-21	0	22	0	0	NA
	22	22.5	1	150	277
	22.5	23	1	200	486
	23	23.5	2	1000	2640
	23.5	24	2	800	1820
	24	25	2	NR	NA
	25	25.5	1	400	773
	25.5	26	1	500	1020
	26	26.5	1	400	569
	26.5	27	1	50	NA
SWU-5-22	0	25	0	0	NA
	25	25.5	1	1000	949
	25.5	26	2	1150	1660
	26	26.5	2	1550	1810
SWU-5-23	0	23	0	0	NA
	23	23.5	1	450	800
	23.5	24	1	750	804
	24	24.5	1	1050	683
	24.5	25	1	300	302
	25	25.5	1	850	106
	25.5	26	2	1000	1870
	26	27	2	NR	NA
SWU-5-24	0	23	0	0	NA
	23	23.5	1	100	NA
	23.5	24	0	0	NA
	24	24.5	1	400	NA
	24.5	25	1	450	709
	25	27	0	NR	NA
SWU-5-25	0	26.5	0	0	NA
	26.5	27	0	40	86.4

000900

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-26	0	23	0	0	NA
	23	23.5	2	300	NA
	23.5	24	2	200	NA
	24	24.5	1	450	619/482[e]
	24.5	25	1	400	NA
	25	25.5	1	450	NA
	25.5	27	1	NR	NA
SWU-5-27	0	23.5	0	0	NA
	23.5	24	1	200	NA
	24	24.5	1	250	391
	24.5	25	1	200	342
	25	25.5	1	550	852
	25.5	26	1	750	1020
	26	26.5	2	850	1880
	26.5	27	2	1000	2140
SWU-5-28	0	26.5	0	0	NA
	26.5	27	1	100	252
	27	27.5	1	350	670
	27.5	28	1	100	99.3
SWU-5-29	0	23.5	0	0	NA
	23.5	24	1	0	234
	24	24.5	2	600	1260/553[f]
	24.5	25	2	1500	1530/1370[f]
	25	25.5	2	450	2090
	25.5	27	2	NR	NA
SWU-5-30	0	22.5	0	0	NA
	22.5	23	1	200	444
	23	23.5	1	450	935
	23.5	24	2	1450	1410
	24	24.5	2	500	2070

000901

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-31	0	23.5	0	0	NA
	23.5	24	1	150	193
	24	24.5	2	750	1180
	24.5	25	2	2000	2510
SWU-5-32	0	26.5	0	0	NA
	26.5	27	0	0	27.4
SWU-5-33	0	23	0	0	NA
	23	23.5	1	350	294
	23.5	24	2	550	1260
	24	24.5	1	350	772
	24.5	25	1	400	417
	25	25.5	2	1250	1570
	25.5	26	1	850	690
	26	26.5	2	1400	2660
	26.5	27	2	650	NA
SWU-5-36	0	22.5	0	0	NA
	22.5	23	1	250	NA
	23	23.5	1	850	931
	23.5	24	0	450	NA
	24	24.5	0	450	NA
	24.5	25	0	450	NA
	25	25.5	0	400	NA
	25.5	27	0	NR	NA
SWU-5-37	0	26	0	0	NA
	26	26.5	1	200	NA
	26.5	27	1	300	552
	27	28	0	0	NA
SWU-5-38	0	30.5	0	0	NA
	30.5	31	1	750	416
	31	31.5	1	250	NA
	31.5	32	1	100	NA

000902

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-39	0	29.5	0	0	NA
	29.5	30	1	200	316/443[c]
	30	32	0	0	NA
SWU-5-40	0	26	0	0	NA
	26	26.5	0	50	NA
	26.5	27	0	50	NA
	27	27.5	0	50	NA
	27.5	28	1	100	315
SWU-5-41	0	8.5	0	0	NA
	8.5	9	0	0	20.7
	9	9.5	1	200	291
	9.5	10	1	150	126
	10	10.5	1	200	569
	10.5	11	1	100	190
	11	11.5	0	0	45
	11.5	16	0	0	NA
SWU-5-EPA-41[g]	0	10.5	0	0	NA
	10.5	11	1	200	NA
	11	11.5	1	450	NA
	11.5	12	2	650	2000±210 μg/g/ 2180±74.9[h]
SWU-5-42	0	21	0	0	NA
	21	21.5	0	0	6.28
	21.5	27	0	0	NA
SWU-5-EPA-42[g]	0	16	0	0	NA
	16	16.5	0	0	24±2.5 μg/g
	16.5	18	0	0	NA

000903

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-43	0	10.5	0	0	NA
	10.5	16.5	0	0	NA
	16.5	17	0	0	32.5
	17	17.5	1	150	511
	17.5	18	2	750	1030
	18	18.5	2	1000	1140/9500±990 μg/g/ 7160±407[i]
	18.5	19	2	3500	2270/16,000±1700μg/g/ 11,100±583[i]
	19	19.5	2	950	2390
SWU-5-43A	0	16	0	0	NA
	16	16.5	0	0	22±2.3 μg/g
	16.5	17	0	0	NA
	17	17.5	0	0	NA
	17.5	18	2	1000	NA
	18	18.5	2	2500	3220/9500±990/ 7160±407[i]
	18.5	19	2	1600	NA
SWU-5-44	0	8.5	0	0	NA
	8.5	9	0	0	17.5
	9	9.5	1	100	111
	9.5	10	1	350	515
	10	10.5	0	0	112
	10.5	16	0	0	NA
SWU-5-EPA-44[g]	0	3	0	0	NA
	3	3.5	0	0	31±3.3 μg/g
	3.5	9.5	0	0	NA
	9.5	10	1	150	530±55 μg/g
	10	12	0	0	NA

000904

TABLE D-12
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
SWU-5-45	0	10	0	0	NA
	10	10.5	0	0	57.9
	10.5	11	0	0	71.7
	11	11.5	0	0	92.6
	11.5	12	0	0	18.6
	12	19.5	0	0	NA
SWU-5-46	0	8	0	0	NA
	8	8.5	0	0	16.7
	8.5	9	1	100	9.4
	9	9.5	1	150	48.5
	9.5	10	1	100	377
	10	10.5	0	0	366
	10.5	16	0	0	NA

[a] Results reported on dry weight basis

[b] Split sample with OEPA; off-site OEPA lab analysis. First value is FDF analytical result; second value is OEPA analytical result

[c] Duplicate sample; first result analyzed by offsite lab by alpha spec method; second and third results analyzed by FEMP lab by alpha spec and ICP/MS, respectively

[d] First result from SWU-5-20; second result from SWU-5-20A (second attempt to reach depth); third result from SWU-5-20-B (third attempt to reach depth)

[e] Duplicate sample

[f] First result from SWU-5-29 second result from SWU-5-29A (second attempt to reach depth)

[g] EPA in designator indicates split sample with the OEPA

[h] First result is OEPA analysis by KPA; second result is additional analysis by FDF ICP/MS

[i] First result is FDF ICP/MS; second result is OEPA analysis by KPA; third result is FDF reanalysis of OEPA sample by ICP/MS

ccpm = corrected counts per minute
SWU = Southern Waste Units
NA = Not analyzed
NR = No recovery

000905

TABLE D-13
AREA 2, PHASE I FIRING RANGE LEAD CONCENTRATIONS
OCTOBER 1996

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
PB-11-0-3	0-1	132	110/112
	1-2	19	NA
	2-3	10	NA
PB-12-0-3	0-1	65	NA
	1-2	3	NA
	2-3	32	NA
PB-13-0-3	0-1	51	NA
	1-2	35	NA
	2-3	19	NA
PB-14-0-3	0-1	1165	NA
	1-2	367	NA
	2-3	14	NA
PB-15-0-3	0-1	99	NA
	1-2	9	NA
	2-3	14	NA
PB-16	0-1	167	NA
	1-2	75	NA
	2-3	17[b]	NA
PB-17B	0-1	440	NA
	1-2	ND	NA
	2-3	ND	NA
PB-18	0-1	1142	1431/1398
	1-2	254	NA
	2-3	11	NA
PB-19	0-1	866	NA
	1-2	1065	NA
	2-3	2	NA

TABLE D-13
(CONT'D)

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
PB-20	0-1	211	NA
	1-2	30	NA
	2-3	2	NA
PB-21	0-1	104[c]	NA
	1-2	NM	NA
	2-3	NM	NA
PB-21B	0-0.5	13	NA
	0.5-1	388	NA
	1-1.5	296	210/293
	1.5-2	33	56/56
	2-2.5	25	NA
	2.5-3	42	NA
PB-22	0-1	609	423/445
	1-2	41	32/37
	2-3	28[d]	NA
PB-23	0-1	494	NA
	1-2	30[d]	NA
	2-3	27	NA
PB-24	0-1	481	NA
	1-2	29[d]	NA
	2-3	17	NA
PB-25	0-1	1013	NA
	1-2	41[d]	NA
	2-3	31	NA
PB-26	0-1	63[d]	NA
	1-2	23	NA
	2-3	ND	NA

000907

TABLE D-13
(CONT'D)

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
PB-27	0-1	49[d]	NA
	1-2	24	NA
	2-3	7	NA
PB-28	0-1	292	NA
	1-2	2	NA
	2-3	NM	NA
PB-29	0-1	452	NA
	1-2	138	NA
	2-3	NM	NA
PB-30	0-1	1573	NA
	1-2	166	NA
	2-3	NM	NA
PB-31	0-1	75	NA
	1-2	10	NA
	2-3	NM	NA
PB-32	0-1	96	NA
	1-2	NM	NA
	2-3	NM	NA
PB-33	0-1	96	NA
	1-2	NM	NA
	2-3	NM	NA
PB-34	0-1	583	NA
	1-2	495	412/402
	2-3	37	71/82
PB-35	0-1	55[d]	NA
	1-2	15	NA
	2-3	NM	NA

TABLE D-13
(CONT'D)

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
PB-36	0-1	42	49/57
	1-2	NM	NA
	2-3	NM	NA
PB-37	0-1	2906	NA
	1-2	233	NA
	2-3	53	NA
PB-38	0-1	101	NA
	1-2	22[d]	NA
	2-3	NM	NA
PB-39	0-0.5	76	NA
	0.5-2	NM	NA
	2-3	NM	NA
PB-40	0-0.5	34[d]	NA
	0.5-1	11	NA
	1-2	NM	NA
	2-3	NM	NA
PB-41	0-0.5	31	NA
	0.5-2	NM	NA
	2-3	NM	NA
PB-42	0-0.5	92	NA
	0.5-2	NM	NA
	2-3	NM	NA
PB-43	0-0.5	61[d]	NA
	0.5-1	10	NA
	1-2	NM	NA
	2-3	NM	NA

000909

TABLE D-13
(CONT'D)

PB = Sample location indicator (former firing range)
NA = Not analyzed
ND = Not detected at concentrations above the method detection limit
NM = No measurement taken
mg/kg = milligrams per kilogram or parts per million (ppm)

[a] First value is analysis by inductively coupled argon plasma (ICP); second value is analysis by graphite furnace atomic absorption (GFAA)
[b] 2- to 5-foot interval composited
[c] Measurement taken on 0-3 ft composite
[d] Average of two readings

TABLE D-14
AREA 2, PHASE I FIRING RANGE LEAD CONCENTRATIONS
DECEMBER 1997

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-1	A2PIPB-1-1-M	0-0.5	Total Lead	43.1	NV
	A2PIPB-1-2-M	0.5-1	Total Lead	17.7	NV
	A2PIPB-1-3-M	1-1.5	Total Lead	16.9	NV
	A2PIPB-1-4-M	1.5-2	Total Lead	19.8	NV
	A2PIPB-1-5-M	2-2.5	Total Lead	14.2	NV
	A2PIPB-1-6-M	2.5-3	Total Lead	8	NV
	A2PIPB-1-7-M	3-3.5	Total Lead	7.2	NV
	A2PIPB-1-8-M	3.5-4	Total Lead	7.5	NV
A2PIPB-2	A2PIPB-2-1-M	0-0.5	Total Lead	3623	NV
	A2PIPB-2-1-M-Y	0-0.5	TCLP Lead	29.0 mg/L	NV
	A2PIPB-2-2-M	0.5-1	Total Lead	118	NV
	A2PIPB-2-3-M	1-1.5	Total Lead	162	NV
	A2PIPB-2-4-M	1.5-2	Total Lead	60.4	NV
	A2PIPB-2-5-M	2-2.5	Total Lead	12.4	NV
	A2PIPB-2-6-M	2.5-3	Total Lead	10.4	NV
	A2PIPB-2-7-M	3-3.5	Total Lead	8.9	NV
	A2PIPB-2-8-M	3.5-4	Total Lead	11.4	NV
A2PIPB-3	A2PIPB-3-1-M	0-0.5	Total Lead	56.7	-
	A2PIPB-3-2-M	0.5-1	Total Lead	24.3	U
	A2PIPB-3-3-M	1-1.5	Total Lead	21.1	U
	A2PIPB-3-4-M	1.5-2	Total Lead	19.5	U
	A2PIPB-3-5-M	2-2.5	Total Lead	15.9	U
	A2PIPB-3-6-M	2.5-3	Total Lead	10.3	U
	A2PIPB-3-7-M	3-3.5	Total Lead	15.1	U
	A2PIPB-3-8-M	3.5-4	Total Lead	8.7	U

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-4	A2PIPB-4-1-M	0-0.5	Total Lead	80.8	-
	A2PIPB-4-2-M	0.5-1	Total Lead	49.7	-
	A2PIPB-4-3-M	1-1.5	Total Lead	16.5	U
	A2PIPB-4-4-M	1.5-2	Total Lead	18.2	U
	A2PIPB-4-5-M	2-2.5	Total Lead	9.1	U
	A2PIPB-4-6-M	2.5-3	Total Lead	19.5	U
A2PIPB-5	A2PIPB-5-1-M	0-0.5	Total Lead	117	-
	A2PIPB-5-2-M	0.5-1	Total Lead	25	U
	A2PIPB-5-3-M	1-1.5	Total Lead	11.6	U
	A2PIPB-5-4-M	1.5-2	Total Lead	12.5	U
	A2PIPB-5-5-M	2-2.5	Total Lead	14.3	U
	A2PIPB-5-6-M	2.5-3	Total Lead	9.7	U
A2PIPB-6	A2PIPB-6-1-M	0-0.5	Total Lead	183	J
	A2PIPB-6-2-M	0.5-1	Total Lead	40.5	J
	A2PIPB-6-3-M	1-1.5	Total Lead	20.2	J
	A2PIPB-6-4-M	1.5-2	Total Lead	22.5	J
	A2PIPB-6-5-M	2-2.5	Total Lead	21.9	J
	A2PIPB-6-6-M	2.5-3	Total Lead	19	J
A2PIPB-7	A2PIPB-7-1-M	0-0.5	Total Lead	90	NV
	A2PIPB-7-2-M	0.5-1	Total Lead	40.6	NV
	A2PIPB-7-3-M	1-1.5	Total Lead	22.5	NV
	A2PIPB-7-4-M	1.5-2	Total Lead	22	NV
	A2PIPB-7-5-M	2-2.5	Total Lead	18.9.	NV
	A2PIPB-7-6-M	2.5-3	Total Lead	13.6	NV
	A2PIPB-7-7-M	3-3.5	Total Lead	22.2	NV
	A2PIPB-7-8-M	3.5-4	Total Lead	15.7	NV

000912

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-8	A2PIPB-8-1-M	0-0.5	Total Lead	64.5	NV
	A2PIPB-8-2-M	0.5-1	Total Lead	23	NV
	A2PIPB-8-3-M	1-1.5	Total Lead	19	NV
	A2PIPB-8-4-M	1.5-2	Total Lead	35.2	NV
	A2PIPB-8-5-M	2-2.5	Total Lead	19	NV
	A2PIPB-8-6-M	2.5-3	Total Lead	21.8	NV
	A2PIPB-8-7-M	3-3.5	Total Lead	22.1	NV
A2P1PB-9	A2P1PB-9-1-M	0-0.5	Total Lead	38.6	NV
	A2P1PB-9-2-M	0.5-1	Total Lead	35.8	NV
	A2P1PB-9-3-M	1-1.5	Total Lead	31.6	NV
	A2P1PB-9-4-M	1.5-2	Total Lead	20.1	NV
	A2P1PB-9-5-M	2-2.5	Total Lead	24.7	NV
	A2P1PB-9-6-M	2.5-3	Total Lead	19	NV
A2P1PB-10	A2P1PB-10-1-M	0-0.5	Total Lead	427	J
	A2P1PB-10-1-M-Y	0-0.5	TCLP Lead	0.475 mg/L	NV
	A2P1PB-10-2-M	0.5-1	Total Lead	353	J
	A2P1PB-10-2-M-Y	0.5-1	TCLP Lead	0.982 mg/L	NV
	A2P1PB-10-3-M	1-1.5	Total Lead	50.8	J
	A2P1PB-10-4-M	1.5-2	Total Lead	21	J
	A2P1PB-10-5-M	2-2.5	Total Lead	27.2	J
A2PIPB-11	A2PIPB-11-1-M	0-0.5	Total Lead	7.2	U,NV
	A2PIPB-11-2-M	0.5-1	Total Lead	984	NV
	A2PIPB-11-2-M-Y	0.5-1	TCLP Lead	11.3 mg/L	NV
	A2PIPB-11-3-M	1-1.5	Total Lead	4920	NV
	A2PIPB-11-3-M-Y	1-1.5	TCLP Lead	52.5 mg/L	NV
	A2PIPB-11-4-M	1.5-2	Total Lead	332	NV
	A2PIPB-11-4-M-Y	1.5-2	TCLP Lead	0.681 mg/L	NV

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2P1PB-12	A2P1PB-12-1-M	0-0.5	Total Lead	4990	NV
	A2P1PB-12-1-M-Y	0-0.5	TCLP Lead	14.6 mg/L	NV
	A2P1PB-12-2-M	0.5-1	Total Lead	714	NV
	A2P1PB-12-2-M-Y	0.5-1	TCLP Lead	1.46 mg/L	NV
	A2P1PB-12-3-M	1-1.5	Total Lead	104	NV
	A2P1PB-12-4-M	1.5-2	Total Lead	99.3	NV
	A2P1PB-12-5-M	2-2.5	Total Lead	24.5	NV
	A2P1PB-12-6-M	2.5-3	Total Lead	39.8	NV
	A2P1PB-12-7-M	3-3.5	Total Lead	105	NV
	A2P1PB-12-8-M	3.5-4	Total Lead	20.2	NV
A2PIPB-13	A2PIPB-13-1-M	0-0.5	Total Lead	5390	NV
	A2PIPB-13-1-M-Y	0-0.5	TCLP Lead	42.2 mg/L	NV
	A2PIPB-13-2-M	0.5-1	Total Lead	744	NV
	A2PIPB-13-2-M-Y	0.5-1	TCLP Lead	1.66 mg/L	NV
	A2PIPB-13-3-M	1-1.5	Total Lead	606	NV
	A2PIPB-13-3-M-Y	1-1.5	TCLP Lead	3.19 mg/L	NV
	A2PIPB-13-4-M	1.5-2	Total Lead	66.7	NV
	A2PIPB-13-5-M	2-2.5	Total Lead	288	NV
	A2PIPB-13-5-M-Y	2-2.5	TCLP Lead	0.118 mg/L	NV
	A2PIPB-13-6-M	2.5-3	Total Lead	110	NV
	A2PIPB-13-7-M	3-3.5	Total Lead	68.8	NV
	A2PIPB-13-8-M	3.5-4	Total Lead	41.4	NV

000914

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-14	A2PIPB-14-1-M	0-0.5	Total Lead	2260	NV
	A2PIPB-14-1-M-Y	0-0.5	TCLP Lead	40.3 mg/L	NV
	A2PIPB-14-2-M	0.5-1	Total Lead	1043	NV
	A2PIPB-14-2-M-Y	0.5-1	TCLP Lead	4.22 mg/L	NV
	A2PIPB-14-3-M	1-1.5	Total Lead	41.9	NV
	A2PIPB-14-4-M	1.5-2	Total Lead	30.2	NV
	A2PIPB-14-5-M	2-2.5	Total Lead	95.5	NV
	A2PIPB-14-6-M	2.5-3	Total Lead	32	NV
	A2PIPB-14-7-M	3-3.5	Total Lead	12.5	NV
	A2PIPB-14-8-M	3.5-4	Total Lead	7.2	NV
A2PIPB-15	A2PIPB-15-1-M	0-0.5	Total Lead	119	NV
	A2PIPB-15-2-M	0.5-1	Total Lead	12.1	NV
	A2PIPB-15-3-M	1-1.5	Total Lead	17.5	NV
	A2PIPB-15-4-M	1.5-2	Total Lead	7.2	NV
	A2PIPB-15-5-M	2-2.5	Total Lead	12.9	NV
	A2PIPB-15-6-M	2.5-3	Total Lead	8.6	NV
	A2PIPB-15-7-M	3-3.5	Total Lead	7.2	NV
	A2PIPB-15-8-M	3.5-4	Total Lead	11	NV
A2PIPB-16	A2PIPB-16-1-M	0-0.5	Total Lead	96.7	NV
	A2PIPB-16-2-M	0.5-1	Total Lead	26.4	NV
	A2PIPB-16-3-M	1-1.5	Total Lead	9.4	NV
	A2PIPB-16-4-M	1.5-2	Total Lead	9.6	NV
	A2PIPB-16-5-M	2-2.5	Total Lead	7.2	NV
	A2PIPB-16-6-M	2.5-3	Total Lead	7.2	NV
	A2PIPB-16-7-M	3-3.5	Total Lead	7.2	NV
	A2PIPB-16-8-M	3.5-4	Total Lead	8.9	NV
A2PIPB-17A	A2PIPB-17A-1-M	0-0.5	Total Lead	6126	NV
	A2PIPB-17A-1-M-Y	0-0.5	TCLP Lead	49.23 mg/L	NV
	A2PIPB-17A-2-M	0.5-1	Total Lead	9790	NV

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-17	A2PIPB-17-3-M	1-1.5	Total Lead	51.5	NV
	A2PIPB-17-4-M	1.5-2	Total Lead	503	NV
	A2PIPB-17-4-M-Y	1.5-2	TCLP Lead	0.771 mg/L	NV
	A2PIPB-17-5-M	2-2.5	Total Lead	105	NV
	A2PIPB-17-6-M	2.5-3	Total Lead	148	NV
	A2PIPB-17-7-M	3-3.5	Total Lead	48.1	NV
	A2PIPB-17-8-M	3.5-4	Total Lead	15.6	NV
A2PIPB-18A	A2PIPB-18A-1-M	0-0.5	Total Lead	751	NV
	A2PIPB-18A-1-M-Y	0-0.5	TCLP Lead	10.4 mg/L	NV
	A2PIPB-18A-2-M	0.5-1	Total Lead	1165	NV
	A2PIPB-18A-2-M-Y	0.5-1	TCLP Lead	29.41 mg/L	NV
A2PIPB-18	A2PIPB-18-3-M	1-1.5	Total Lead	73.6	NV
	A2PIPB-18-4-M	1.5-2	Total Lead	37.6	NV
	A2PIPB-18-5-M	2-2.5	Total Lead	191	NV
	A2PIPB-18-6-M	2.5-3	Total Lead	22.8	NV
	A2PIPB-18-7-M	3-3.5	Total Lead	17.4	NV
	A2PIPB-18-8-M	3.5-4	Total Lead	17.2	NV
A2PIPB-19A	A2PIPB-19A-1-M	0-0.5	Total Lead	616	NV
	A2PIPB-19A-1-M-Y	0-0.5	TCLP Lead	3.23 mg/L	NV
	A2PIPB-19A-2-M	0.5-1	Total Lead	23.5	NV
A2PIPB-19	A2PIPB-19-3-M	1-1.5	Total Lead	76.9	NV
	A2PIPB-19-4-M	1.5-2	Total Lead	77.8	NV
	A2PIPB-19-5-M	2-2.5	Total Lead	60.8	NV
	A2PIPB-19-6-M	2.5-3	Total Lead	97.7	NV
	A2PIPB-19-7-M	3-3.5	Total Lead	3720	NV
	A2PIPB-19-7-M-Y	3-3.5	TCLP Lead	0.342 mg/L	NV
	A2PIPB-19-8-M	3.5-4	Total Lead	28.5	NV

000916

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-20A	A2PIPB-20A-1-M	0-0.5	Total Lead	505	NV
	A2PIPB-20A-1-M-Y	0-0.5	TCLP Lead	2.29 mg/L	NV
	A2PIPB-20A-2-M	0.5-1	Total Lead	626	NV
	A2PIPB-20A-2-M-Y	0.5-1	TCLP Lead	26.06 mg/L	NV
	A2PIPB-20A-3-M	1-1.5	Total Lead	510	NV
	A2PIPB-20A-3-M-Y	1-1.5	TCLP Lead	0.557 mg/L	NV
	A2PIPB-20A-4-M	1.5-2	Total Lead	82.7	NV
	A2PIPB-20A-5-M	2-2.5	Total Lead	81.8	NV
A2PIPB-21	A2PIPB-21-1-M	0-0.5	Total Lead	91	J
	A2PIPB-21-2-M	0.5-1	Total Lead	33.6	J
	A2PIPB-21-3-M	1-1.5	Total Lead	95.1	J
	A2PIPB-21-4-M	1.5-2	Total Lead	52.1	J
	A2PIPB-21-5-M	2-2.5	Total Lead	223	J
	A2PIPB-21-5-M-Y	2-2.5	TCLP Lead	0.342 mg/L	NV
	A2PIPB-21-6-M	2.5-3	Total Lead	49	J
A2PIPB-22[a]	A2PIPB-22-1-TM	0-1	Total Lead	3590	J
	A2PIPB-22-1-TM	0-1	TCLP Lead	74.7 mg/L	-
	A2PIPB-22-1-TM-Y	0-1	Total Lead	6260	J
	A2PIPB-22-1-TM-Y	0-1	TCLP Lead	165.0 mg/L	-
	A2PIPB-22-2-TM	1-2	Total Lead	300	J
	A2PIPB-22-2-TM	1-2	TCLP Lead	0.299 mg/L	-
	A2PIPB-22-2-TM-Y	1-2	Total Lead	231	J
	A2PIPB-22-2-TM-Y	1-2	TCLP Lead	0.233 mg/L	-
	A2PIPB-22-3-TM	2-3	Total Lead	27	J
	A2PIPB-22-3-TM	2-3	TCLP Lead	0.345 mg/L	-
	A2PIPB-22-3-TM-Y	2-3	Total Lead	124	J
	A2PIPB-22-3-TM-Y	2-3	TCLP Lead	0.140 mg/L	-

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-23[a]	A2PIPB-23-1-TM	0-1	Total Lead	435	J
	A2PIPB-23-1-TM	0-1	TCLP Lead	1.51 mg/L	-
	A2PIPB-23-1-TM-Y	0-1	Total Lead	546	J
	A2PIPB-23-1-TM-Y	0-1	TCLP Lead	0.659 mg/L	-
	A2PIPB-23-2-TM	1-2	Total Lead	1100	J
	A2PIPB-23-2-TM	1-2	TCLP Lead	4.64 mg/L	-
	A2PIPB-23-2-TM-Y	1-2	Total Lead	788	J
	A2PIPB-23-2-TM-Y	1-2	TCLP Lead	2.32 mg/L	-
	A2PIPB-23-3-TM	2-3	Total Lead	793	J
	A2PIPB-23-3-TM	2-3	TCLP Lead	0.793 mg/L	J
	A2PIPB-23-3-TM-Y	2-3	Total Lead	1930	J
	A2PIPB-23-3-TM-Y	2-3	TCLP Lead	1.21 mg/L	-
A2PIPB-24[a]	A2PIPB-24-1-TM	0-1	Total Lead	166	J
	A2PIPB-24-1-TM	0-1	TCLP Lead	0.911 mg/L	-
	A2PIPB-24-1-TM-Y	0-1	Total Lead	194	J
	A2PIPB-24-1-TM-Y	0-1	TCLP Lead	0.285 mg/L	-
	A2PIPB-24-2-TM	1-2	Total Lead	15	J
	A2PIPB-24-2-TM	1-2	TCLP Lead	0.0362 mg/L	U
	A2PIPB-24-2-TM-Y	1-2	Total Lead	14.4	J
	A2PIPB-24-2-TM-Y	1-2	TCLP Lead	0.0362 mg/L	U
	A2PIPB-24-3-TM	2-3	Total Lead	10.1	J
	A2PIPB-24-3-TM	2-3	TCLP Lead	0.0362 mg/L	U
	A2PIPB-24-3-TM-Y	2-3	Total Lead	13.8	J
	A2PIPB-24-3-TM-Y	2-3	TCLP Lead	0.0362 mg/L	U

000918

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-25	A2PIPB-25-1-M	0-0.5	Total Lead	736	NV
	A2PIPB-25-1-TM	0-0.5	TCLP Lead	5.21 mg/L	NV
	A2PIPB-25-2-M	0.5-1	Total Lead	147	NV
	A2PIPB-25-2-TM	0.5-1	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-25-3-M	1-1.5	Total Lead	17	NV
	A2PIPB-25-3-TM	1-1.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-25-4-M	1.5-2	Total Lead	13.4	NV
	A2PIPB-25-4-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-25-5-M	2-2.5	Total Lead	10	NV
	A2PIPB-25-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-25-6-M	2.5-3	Total Lead	37	NV
	A2PIPB-25-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-25-7-M	3-3.5	Total Lead	6.4	NV
	A2PIPB-25-7-TM	3-3.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-25-10-M	4.5-5	Total Lead	7.8	NV
	A2PIPB-25-10-TM	4.5-5	TCLP Lead	0.422 mg/L	UNV

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-26	A2PIPB-26-1-M	0-0.5	Total Lead	793	NV
	A2PIPB-26-1-TM	0-0.5	TCLP Lead	6.32 mg/L	NV
	A2PIPB-26-2-M	0.5-1	Total Lead	61	NV
	A2PIPB-26-2-TM	0.5-1	TCLP Lead	1.87 mg/L	NV
	A2PIPB-26-3-M	1-1.5	Total Lead	20	NV
	A2PIPB-26-3-TM	1-1.5	TCLP Lead	0.722 mg/L	NV
	A2PIPB-26-4-M	1.5-2	Total Lead	17	NV
	A2PIPB-26-4-TM	1.5-2	TCLP Lead	0.442 mg/L	UNV
	A2PIPB-26-5-M	2-2.5	Total Lead	15	NV
	A2PIPB-26-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-26-6-M	2.5-3	Total Lead	7.2	NV
	A2PIPB-26-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-26-7-M	3-3.5	Total Lead	4.6	NV
	A2PIPB-26-7-TM	3-3.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-26-10-M	3.5-4	Total Lead	6.2	NV
	A2PIPB-26-10-TM	3.5-4	TCLP Lead	0.422 mg/L	UNV
A2PIPB-27	A2PIPB-27-1-M	0-0.5	Total Lead	534	NV
	A2PIPB-27-1-TM	0-0.5	TCLP Lead	2.4 mg/L	NV
	A2PIPB-27-2-M	0.5-1	Total Lead	564	NV
	A2PIPB-27-2-TM	0.5-1	TCLP Lead	2.0 mg/L	NV
	A2PIPB-27-3-M	1-1.5	Total Lead	156	NV
	A2PIPB-27-3-TM	1-1.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-27-4-M	1.5-2	Total Lead	24.9	NV
	A2PIPB-27-4-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-27-5-M	2-2.5	Total Lead	3.47	NV
	A2PIPB-27-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-27-6-M	2.5-3	Total Lead	3.47	NV
	A2PIPB-27-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV

000320

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-28	A2PIPB-28-1-M	0-0.5	Total Lead	2115	NV
	A2PIPB-28-1-TM	0-0.5	TCLP Lead	26.65 mg/L	NV
	A2PIPB-28-2-M	0.5-1	Total Lead	222	NV
	A2PIPB-28-2-TM	0.5-1	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-28-3-M	1-1.5	Total Lead	41	NV
	A2PIPB-28-3-TM	1-1.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-28-4-M	1.5-2	Total Lead	34	NV
	A2PIPB-284-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-28-5-M	2-2.5	Total Lead	8.7	NV
	A2PIPB-28-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-28-6-M	2.5-3	Total Lead	7.6	NV
	A2PIPB-28-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV
A2PIPB-29	A2PIPB-29-1-M	0-0.5	Total Lead	792	NV
	A2PIPB-29-1-TM	0-0.5	TCLP Lead	0.714 mg/L	NV
	A2PIPB-29-2-M	0.5-1	Total Lead	963	NV
	A2PIPB-29-2-TM	0.5-1	TCLP Lead	1.066 mg/L	NV
	A2PIPB-29-3-M	1-1.5	Total Lead	50	NV
	A2PIPB-29-3-TM	1-1.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-29-4-M	1.5-2	Total Lead	13	NV
	A2PIPB-29-4-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-29-5-M	2-2.5	Total Lead	12	NV
	A2PIPB-29-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-29-6-M	2.5-3	Total Lead	7	NV
	A2PIPB-29-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-29-7-M	3-3.5	Total Lead5	5	NV
	A2PIPB-29-7-TM	3-3.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-29-10-M	4.5-5	Total Lead	11	NV
	A2PIPB-29-10-TM	4.5-5	TCLP Lead	0.422 mg/L	UNV

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-30	A2PIPB-30-1-M	0-0.5	Total Lead	11930[d]	NV
	A2PIPB-30-1-M	0-0.5	Total Lead	117[c]	NV
	A2PIPB-30-1-TM	0-0.5	TCLP Lead	0.422[d] mg/L	UNV
	A2PIPB-30-1-TM	0-0.5	TCLP Lead	0.116[e] mg/L	NV
	A2PIPB-30-2-M	0.5-1	Total Lead	28	NV
	A2PIPB-30-2-TM	0.5-1	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-30-3-M	1-1.5	Total Lead	19.5	NV
	A2PIPB-30-3-TM	1-1.5	TCLP Lead	0.422 mg/L/L	UNV
	A2PIPB-30-4-M	1.5-2	Total Lead	16	NV
	A2PIPB-30-4-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-30-5-M	2-2.5	Total Lead	20	NV
	A2PIPB-30-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-30-6-M	2.5-3	Total Lead	19	NV
	A2PIPB-30-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-30-7-M	3-3.5	Total Lead	7.8	NV
	A2PIPB-30-7-TM	3-3.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-30-9-M	4-4.5	Total Lead	10.4	NV
	A2PIPB-30-9-M	4-4.5	Total Lead	7.2	NV
	A2PI-PB-30-9-TM	4-4.5	TCLP Lead	6.250 mg/L	NV
	A2PI-PB-30-9-TM	4-4.5	TCLP Lead	0.049 mg/L	NV
	A2PIPB-30-10-M	4.5-5	Total Lead	8.2	NV
	A2PIPB-30-10-TM	4.5-5	TCLP Lead	0.422 mg/L	UNV

000922

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-31	A2PIPB-31-1-M	0-0.5	Total Lead	139	NV
	A2PIPB-31-1-TM	0-0.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-31-2-M	0.5-1	Total Lead	39.5	NV
	A2PIPB-31-2-TM	0.5-1	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-31-3-M	1-1.5	Total Lead	25.2	NV
	A2PIPB-31-3-TM	1-1.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-31-4-M	1.5-2	Total Lead	17.9	NV
	A2PIPB-31-4-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-31-5-M	2-2.5	Total Lead	14.7	NV
	A2PIPB-31-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-31-6-M	2.5-3	Total Lead	31.4	NV
	A2PIPB-31-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV
A2PIPB-32	A2PIPB-32-1-M	0-0.5	Total Lead	93.7	NV
	A2PIPB-32-1-TM	0-0.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-32-2-M	0.5-1	Total Lead	19.1	NV
	A2PIPB-32-2-TM	0.5-1	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-32-3-M	1-1.5	Total Lead	14.8	NV
	A2PIPB-32-3-TM	1-1.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-32-4-M	1.5-2	Total Lead	7.3	NV
	A2PIPB-32-4-TM	1.5-2	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-32-5-M	2-2.5	Total Lead	14.8	NV
	A2PIPB-32-5-TM	2-2.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-32-6-M	2.5-3	Total Lead	16	NV
	A2PIPB-32-6-TM	2.5-3	TCLP Lead	0.422 mg/L	UNV

TABLE D-14
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
A2PIPB-33	A2PIPB-33-1-M	0-0.5	Total Lead	46.5	NV
	A2PIPB-33-1-TM	0-0.5	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-33-2-M	0.5-1	Total Lead	24.2	NV
	A2PIPB-33-2-TM	0.5-1	TCLP Lead	0.422 mg/L	UNV
	A2PIPB-33-3-M	1-1.5	Total Lead	17.7	NV
	A2PIPB-33-3-TM	1-1.5	TCLP Lead	0.043 mg/L	UNV
	A2PIPB-33-4-M	1.5-2	Total Lead	12.3	NV
	A2PIPB-33-4-TM	1.5-2	TCLP Lead	0.043 mg/L	UNV
	A2PIPB-33-5-M	2-2.5	Total Lead	8.7	NV
	A2PIPB-33-5-TM	2-2.5	TCLP Lead	0.043 mg/L	UNV
	A2PIPB-33-6-M	2.5-3	Total Lead	8.7	NV
	A2PIPB-33-6-TM	2.5-3	TCLP Lead	0.043 mg/L	UNV
A2PIPB-34A	A2PIPB-34A-1-M	0-0.5	Total Lead	16.8	NV
	A2PIPB-34A-1-TM	0-0.5	TCLP Lead	0.043 mg/L	UNV
	A2PIPB-34A-2-M	0.5-1	Total Lead	1780	NV
	A2PIPB-34A-2-TM	0.5-1	TCLP Lead	0.582 mg/L	UNV
	A2PIPB-34A-3-M	1-1.5	Total Lead	317	NV
	A2PIPB-34A-3-TM	1-1.5	TCLP Lead	1.14 mg/L	UNV
	A2PIPB-34A-4-M	1.5-2	Total Lead	83.7	NV
	A2PIPB-34A-4-TM	1.5-2	TCLP Lead	0.078 mg/L	UNV
	A2PIPB-34A-5-M	2-2.5	Total Lead	15.2	NV
	A2PIPB-34A-5-TM	2-2.5	TCLP Lead	0.043 mg/L	UNV
	A2PIPB-34A-6-M	2.5-3	Total Lead	6.2	NV
	A2PIPB-34A-6-TM	2.5-3	TCLP Lead	0.043 mg/L	UNV

[a] TM designator for A2PIPB-22, A2PIPB-23, and A2PIPB-24 indicates field-sieved sample; TM-Y designator indicates sample was not field sieved. All other samples (A2PIPB-1 through A2PIPB-21 and A2PIPB-25 through A2PIPB-34) were not field sieved.
[b] Results for TCLP results are in mg/L

000924

TABLE D-14
(CONT'D)

[c] Qualifier: J = Estimated value
U = Not detected above method detection limit
(-) = Validated, no data qualifier
NV = Not validated

[d] Original analysis result of total lead not consistent with concentration; samples re-extracted and re-analyzed

[e] Re-extracted and re-analyzed samples; see footnote d above

A2PIPB = Sample location identifier (Area 2, Phase I lead area)
M = Metals analytical suite
TCLP = Toxicity Characteristic Leaching Procedure
Y = Sample originally archived and later retrieved for analysis

TABLE D-15
SP-5 SOIL ANALYTICAL RESULTS

Location	Sample ID	Depth (ft)	Constituent	Lab Results[a]	Corresponding Beta-Gamma Scan[b]
SP5-1	SP5-1-1-R	4.9-5.4	Total Uranium	82 mg/kg	0
			Technetium-99	1.1pCi/g	0
	SP5-1-2-R	7.1-7.6	Total Uranium	84 mg/kg	0
			Technetium-99	<MDL	0
	SP5-1-3-R	9.5-10.0	Total Uranium	93 mg/kg	0
			Technetium-99	0.88 pCi/g	0
	SP5-1-B2-R	10.25-10.75	Total Uranium	56 mg/kg	0
	SP5-1-B1-R	**10.75-11.2**	**Total Uranium**	**3300 mg/kg**	**10,000**
	SP5-1-B3-R	**11.2-11.75**	**Total Uranium**	**4300 mg/kg**	**2000**
SP5-2	SP5-2-B1-R	0.5-1.0	Total Uranium	180 mg/kg	100
	SP5-2-1-R	1.4-1.9	Total Uranium	59 mg/kg	0
			Technetium-99	1.2 pCi/g	0
	SP5-2-2-R	4.2-4.7	Total Uranium	46 mg/kg	0
			Technetium-99	0.74 pCi/g	0
	SP5-2-3-R	5.1-5.6	Total Uranium	86 mg/kg	0
			Technetium-99	1.2 pCi/g	0
SP5-3	SP5-3-1-R	0.1-0.6	Total Uranium	24 mg/kg	0
			Technetium-99	<MDL	0
	SP5-3-1-S	0.1-0.6	Semivolatiles	<MDL	0
	SP5-3-2-R	1.7-2.2	Total Uranium	18 mg/kg	0
			Technetium-99	<MDL	0
	SP5-3-2-S	2.2-2.7	Semivolatiles	<MDL	0
	SP5-3-3-R	3.0-3.5	Total Uranium	63 mg/kg	0
			Technetium-99	2.4 pCi/g	0
	SP5-3-3-S	3.5-4.0	Semivolatiles	<MDL	0

TABLE D-15
(CONT'D)

Location	Sample ID	Depth (ft)	Constituent	Lab Results[a]	Corresponding Beta-Gamma Scan[b]
SP5-4	SP5-4-1-R	1.4-1.9	Total Uranium	26 mg/kg	0
			Technetium-99	2.4 pCi/g	0
	SP5-4-2-R	5.7-6.2	Total Uranium	48 mg/kg	0
			Technetium-99	<MDL	0
	SP5-4-3-R	13.3-13.8	Total Uranium	35 mg/kg	0
			Technetium-99	<MDL	0
	SP5-4-B1-R	13.5-14.0	Total Uranium	100 mg/kg	800
SP5-5	SP5-5-1-R	1.0-1.5	Total Uranium	45 mg/kg	0
			Technetium-99	4.3 pCi/g	0
	SP5-5-2-R	2.7-3.2	Total Uranium	33 mg/kg	0
			Technetium-99	1.3 pCi/g	0
	SP5-5-3-R	7.4-7.9	Total Uranium	13 mg/kg	0
			Technetium-99	1.3 pCi/g	0
SP5-6	SP5-6-1-R	0.4-0.9	Total Uranium	43 mg/kg	0
			Technetium-99	2.3 pCi/g	0
	SP5-6-2-R	1.1-1.6	Total Uranium	39 mg/kg	0
			Technetium-99	2.5 pCi/g	0
SP5-7A	SP5-7A-1-R	1.5-2.0	Total Uranium	57 mg/kg	0
			Technetium-99	1.1 pCi/g	0
	SP5-7A-1-S	2.0-2.5	Semivolatiles	<MDL	0
	SP5-7A-2-R	6.0-6.5	Total Uranium	47 mg/kg	0
			Technetium-99	<MDL	0
	SP5-7A-2-S	6.5-7.0	Semivolatiles	<MDL	0
	SP5-7A-3-R	12.3-12.8	Total Uranium	53 mg/kg	0
			Technetium-99	1.2 pCi/g	0
	SP5-7A-3-S	12.8-13.3	Semivolatiles	<MDL	0

000927

TABLE D-15
(CONT'D)

Location	Sample ID	Depth (ft)	Constituent	Lab Results[a]	Corresponding Beta-Gamma Scan[b]
SP5-8	SP5-8-1-R	3.7-4.2	Total Uranium	57 mg/kg	0
			Technetium-99	<MDL	0
	SP5-8-2-R	11.3-11.8	Total Uranium	48 mg/kg	0
			Technetium-99	3.5 pCi/g	0
	SP5-8-3-R	14.1-14.6	Total Uranium	93 mg/kg	0
			Technetium-99	<MDL	0
	SP5-8-B3-R	7.75-8.25	Total Uranium	70 mg/kg	0
	SP5-8-B1-R	**8.4-8.9**	**Total Uranium**	**1800 mg/kg**	**2000**
	SP5-8-B2-R	8.9-9.4	Total Uranium	150 mg/kg	100
	SP5-8-B4-R	14.75-15.25	Total Uranium	190 mg/kg	150
SP5-8C	SP5-8C-B2-R	14.5-15.0	Total Uranium	310 mg/kg	350
SP5-9	SP5-9-1-R	4.1-4.6	Total Uranium	38 mg/kg	0
			Technetium-99	1.7 pCi/g	0
	SP5-9-1-S	4.6-5.1	Semivolatiles	<MDL	0
	SP5-9-2-R	5.3-5.8	Total Uranium	51 mg/kg	0
			Technetium-99	1.1 pCi/g	0
	SP5-9-2-S	5.8-6.3	Semivolatiles	<MDL	0
	SP5-9-3-R	13.9-14.4	Total Uranium	27 mg/kg	0
			Technetium-99	<MDL	0
	SP5-9-3-S	14.4-14.9	Semivolatiles	<MDL	0
SP5-10	SP5-10-1-R	0.3-0.8	Total Uranium	30 mg/kg	0
			Technetium-99	1.9 pCi/g	0
	SP5-10-2-R	2.2-2.7	Total Uranium	34 mg/kg	0
			Technetium-99	2.2 pCi/g	0
	SP5-10-3-R	11.8-12.3	Total Uranium	60 mg/kg	0
			Technetium-99	<MDL	0
SP5-11	SP5-11-1-R	0.4-0.9	Total Uranium	34 mg/kg	0
			Technetium-99	3.3 pCi/g	0
	SP5-11-2-R	6.5-7.0	Total Uranium	81 mg/kg	0
			Technetium-99	**76 pCi/g**	**0**
	SP5-11-3-R	8.8-9.3	Total Uranium	26 mg/kg	0
			Technetium-99	3.4 pCi/g	0

TABLE D-15
(CONT'D)

Location	Sample ID	Depth (ft)	Constituent	Lab Results[a]	Corresponding Beta-Gamma Scan[b]
SP5-12	SP5-12-1-R	1.9-2.4	Total Uranium	33 mg/kg	0
			Technetium-99	3.2 pCi/g	0
	SP5-12-2-R	3.4-3.9	Total Uranium	15 mg/kg	0
			Technetium-99	<MDL	0
	SP5-12-3-R	7.6-8.1	Total Uranium	93 mg/kg	0
			Technetium-99	**31 pCi/g**	**0**
SP5-13	SP5-13-1-R	0.7-1.2	Total Uranium	48 mg/kg	0
			Technetium-99	0.8 pCi/g	0
	SP5-13-2-R	1.6-2.1	Total Uranium	91 mg/kg	0
			Technetium-99	1.9 pCi/g	0
	SP5-13-3-R	3.5-4.0	Total Uranium	31 mg/kg	0
			Technetium-99	<MDL	0
SP5-14	SP5-14-1-R	3.6-4.1	Total Uranium	15 mg/kg	0
			Technetium-99	<MDL	0
	SP5-14-2-R	8.0-8.5	Total Uranium	54 mg/kg	0
			Technetium-99	1.6 pCi/g	0
	SP5-14-3-R	9.7-10.2	Total Uranium	74 mg/kg	0
			Technetium-99	<MDL	0
SP5-15	SP5-15-1-R	0.3-0.8	Total Uranium	17 mg/kg	0
			Technetium-99	1.2 pCi/g	0
	SP5-15-2-R	2.0-2.5	Total Uranium	37 mg/kg	0
			Technetium-99	1.8 pCi/g	0
	SP5-15-3-R	3.0-3.5	Total Uranium	78 mg/kg	0
			Technetium-99	1.5 pCi/g	0
SP5-16	SP5-16-1-R	2.9-3.4	Total Uranium	6.9 mg/kg	0
			Technetium-99	<MDL	0
	SP5-16-2-R	4.9-5.4	Total Uranium	38 mg/kg	0
			Technetium-99	6.5 pCi/g	0
	SP5-16-3-R	7.9-8.4	Total Uranium	40 mg/kg	0
			Technetium-99	0.93 pCi/g	0

000929

TABLE D-15
(CONT'D)

Location	Sample ID	Depth (ft)	Constituent	Lab Results[a]	Corresponding Beta-Gamma Scan[b]
SP5-17B	SP5-17B-1-R	1.1-1.6	Total Uranium	40 mg/kg	0
			Technetium-99	4.7 pCi/g	0
	SP5-17B-1-S	1.6-2.1	Semivolatiles	<MDL	0
SP5-17C	SP5-17C-2-R	6.0-6.5	Total Uranium	30 mg/kg	0
			Technetium-99	1.1 pCi/g	0
	SP5-17C-2-S	6.0-6.5	Semivolatiles	<MDL	0
	SP5-17C-3-R	9.4-9.9	Total Uranium	31 mg/kg	0
			Technetium-99	<MDL	0
	SP5-17C-3-S	9.4-9.9	Semivolatiles	<MDL	0
SP5-18A	SP5-18A-1-R	2.0-2.5	Total Uranium	54 mg/kg	0
			Technetium-99	2.7 pCi/g	0
	SP5-18A-2-R	4.8-5.3	Total Uranium	59 mg/kg	0
			Technetium-99	5.6 pCi/g	0
	SP5-18A-3-R	8.4-8.9	Total Uranium	110 mg/kg	0
			Technetium-99	9.7 pCi/g	0
SP5-21	SP5-21-B1-R	5.6-6.1	Total Uranium	100 mg/kg	125
	SP5-21-B2-R	5.1-5.6	Total Uranium	590 mg/kg	350
	SP5-21-B3-R	4.6-5.1	Total Uranium	320 mg/kg	250

[a] mg/kg = milligrams per kilogram
[b] Beta-gamma scan results reported in corrected counts per minutes (ccpm)
pCi/g = picoCuries per gram

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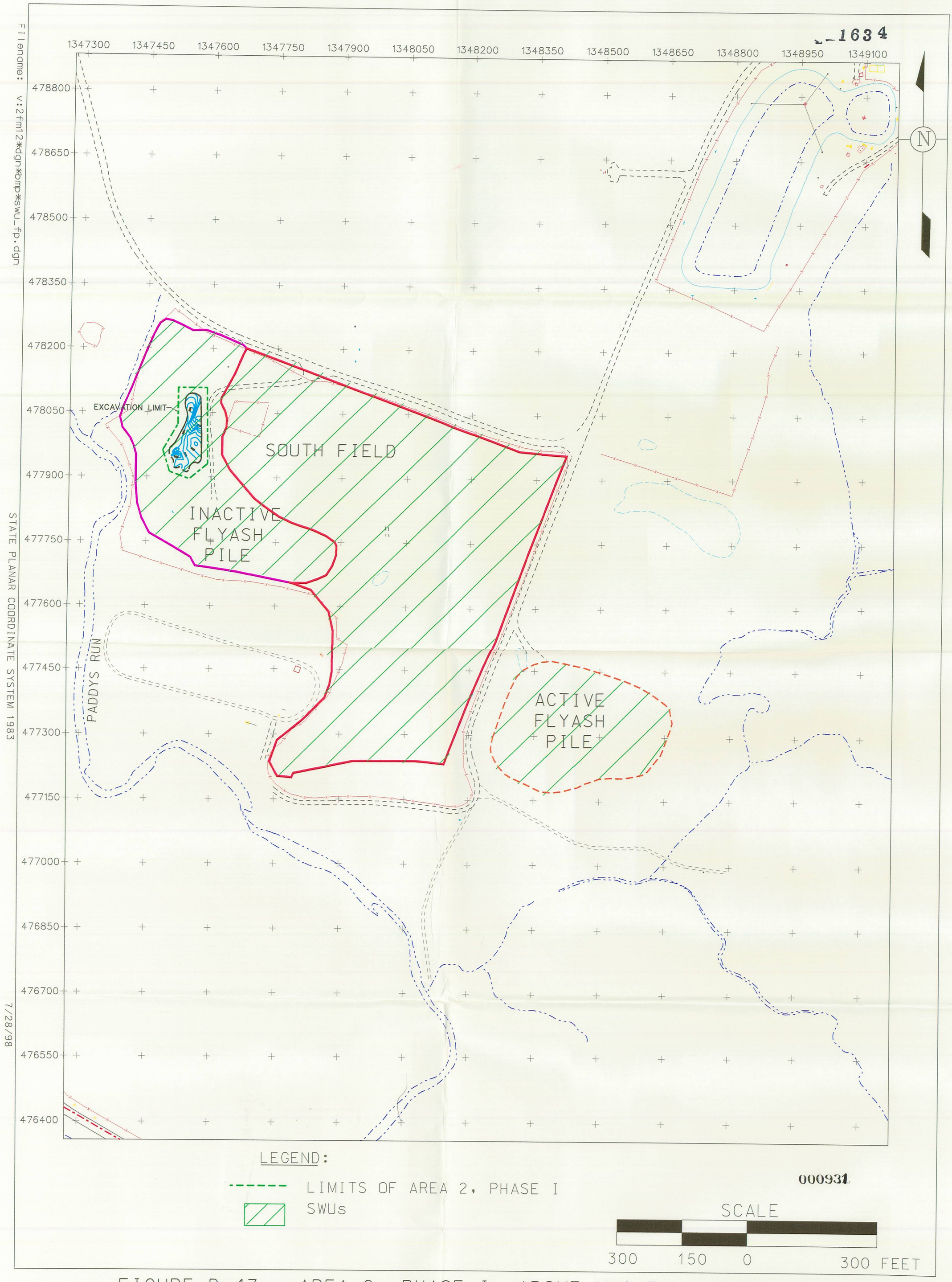

FIGURE D-47 - AREA 2, PHASE I, ABOVE WAC EXCAVATION AREA

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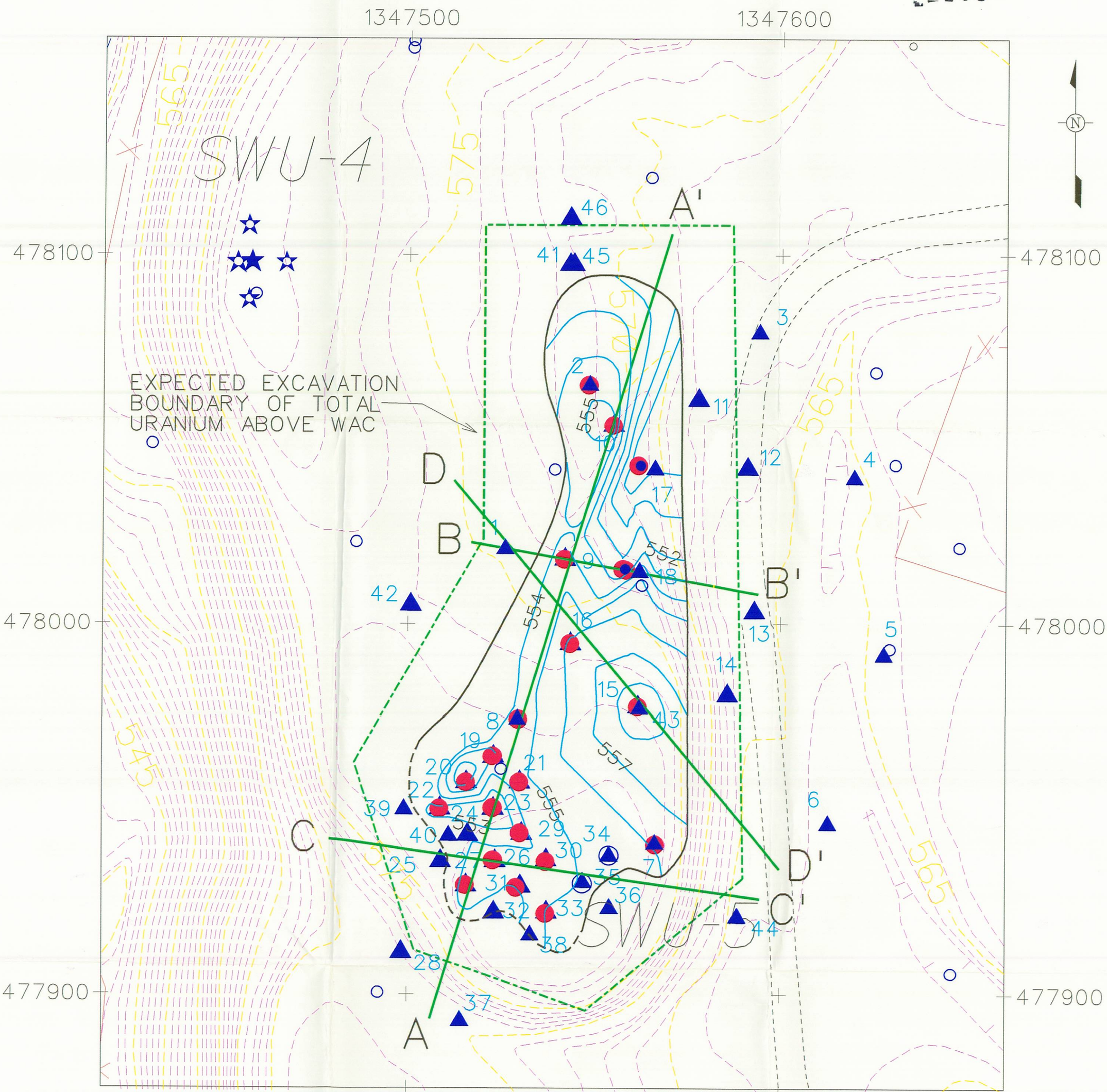
E-1634



LEGEND:

- ○ PREVIOUS SAMPLING LOCATION, NO RESULTS ABOVE WAC
- ● PREVIOUS SAMPLING LOCATION, ONE OR MORE RESULTS ABOVE WAC
- ☆ SHALLOW SAMPLING LOCATION
- ▲ DEEP SAMPLING LOCATION
- BORING RELOCATED; NO SAMPLES COLLECTED
- ● BORING WITH TOTAL-URANIUM ABOVE WAC
- A —— A' CROSS-SECTION LINE

SCALE

40 20 0 40 FEET

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2FM12/DGN/BMP/SWU_SAMP2.DGN

FIGURE D-48 - AREA 2, PHASE I, EXCAVATION BOUNDARY OF TOTAL URANIUM ABOVE WAC

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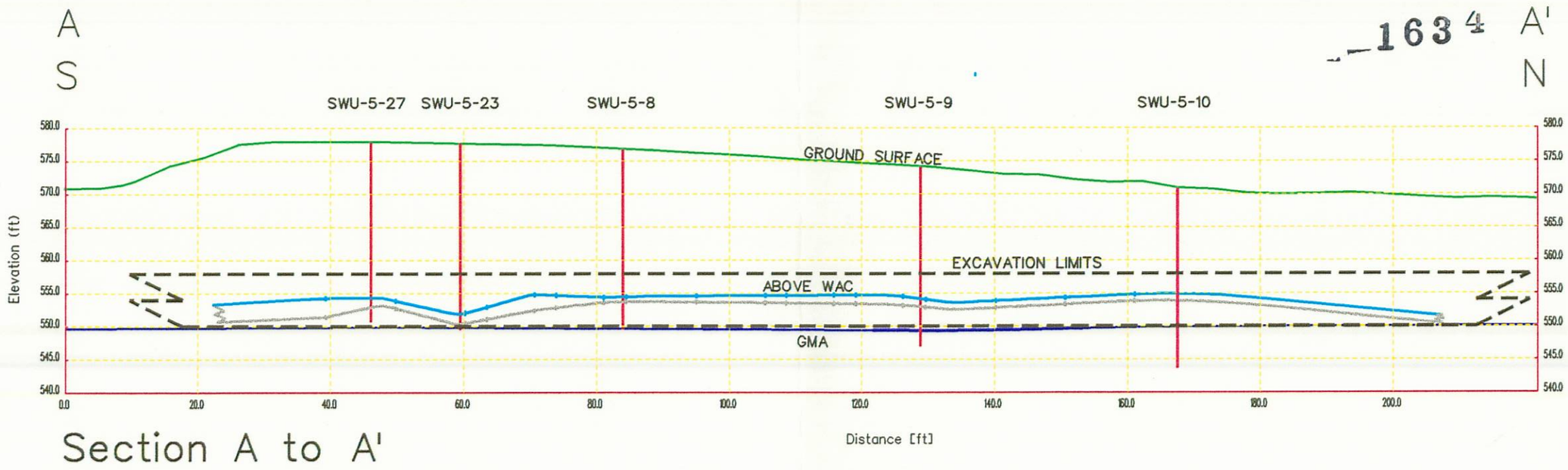
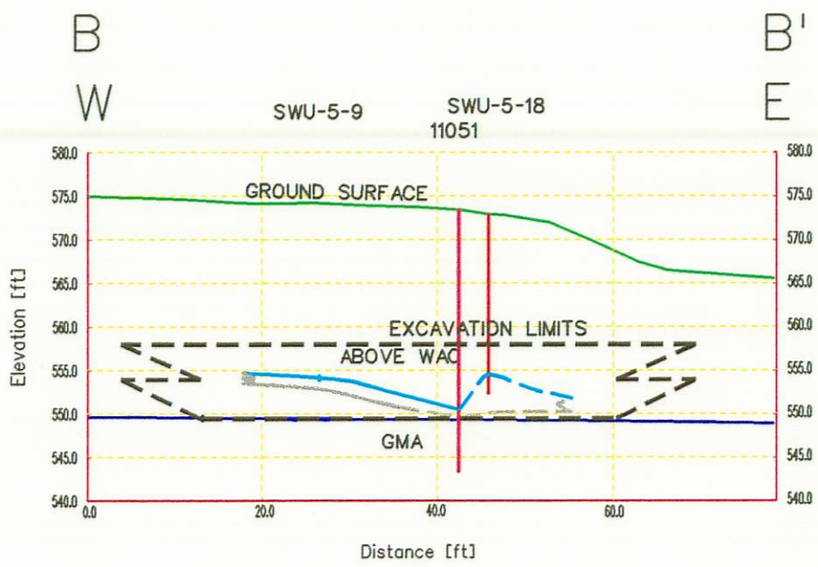
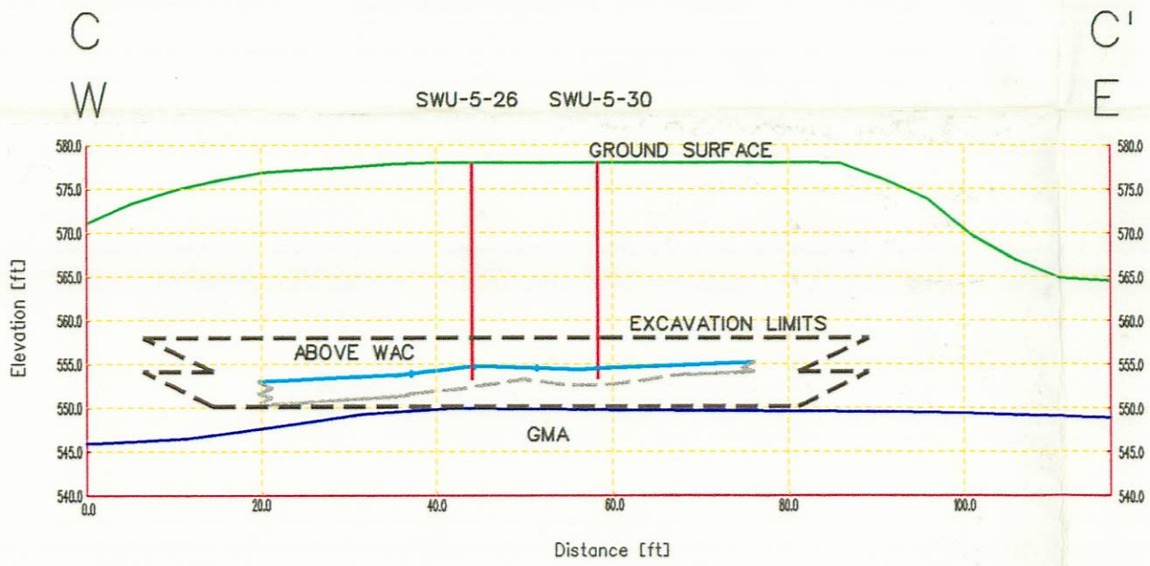
163 4



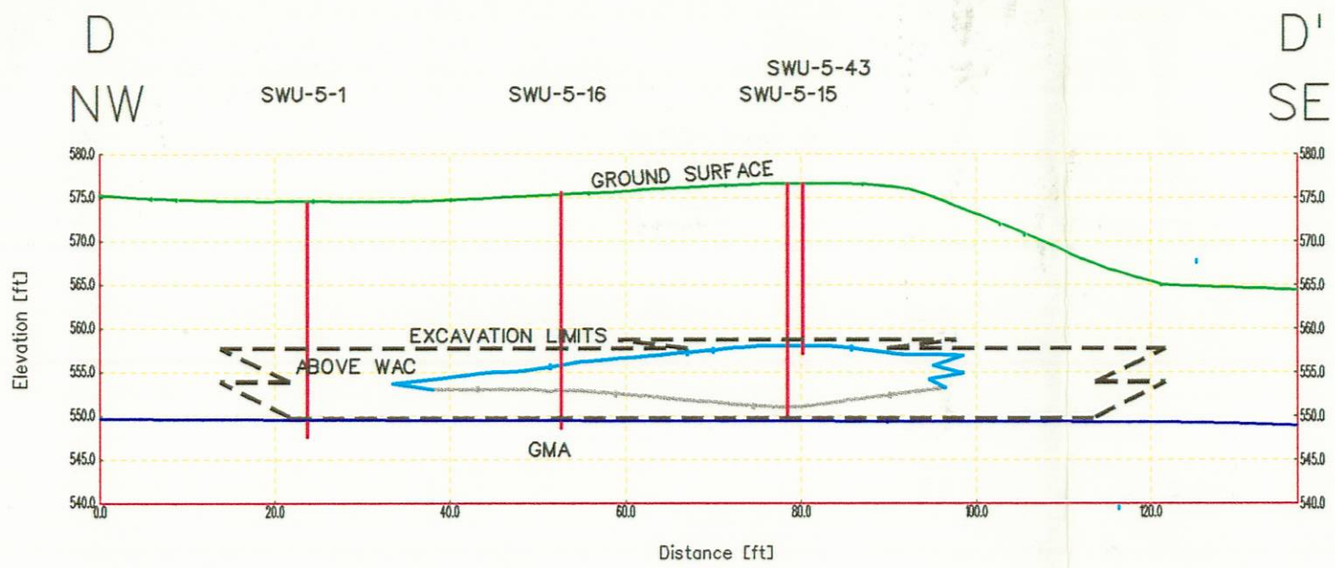
Section A to A'



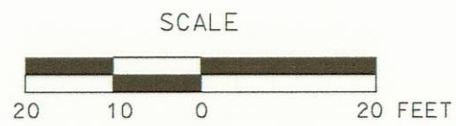
Section B to B'



Section C to C'



Section D to D'



Vertical Exaggeration: NONE

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2FM12/DGN/BMP/SWU_SAMP2.DGN

FIGURE D-49 - CROSS-SECTIONS A TO A'; B TO B'; C TO C'; AND D TO D'

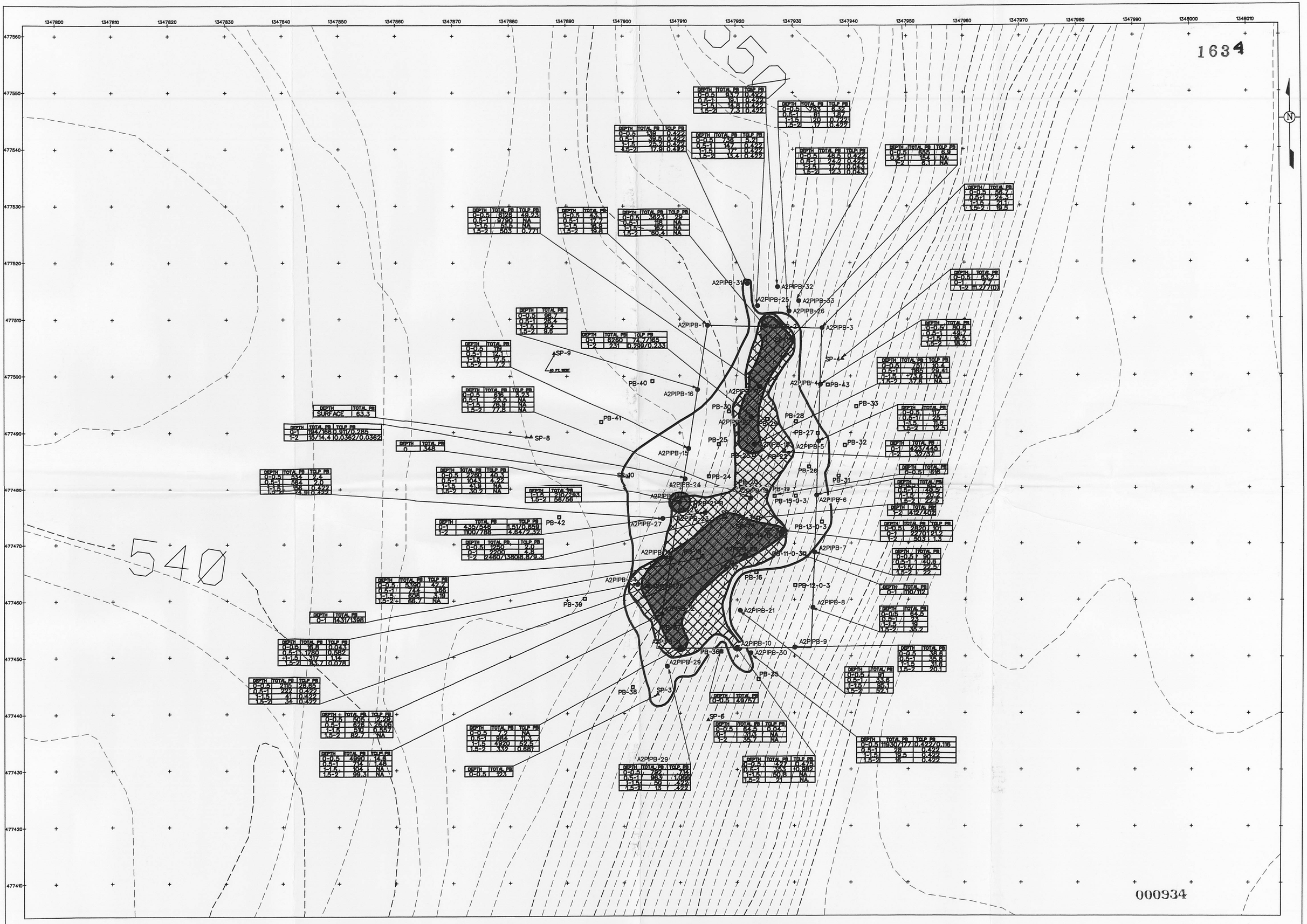
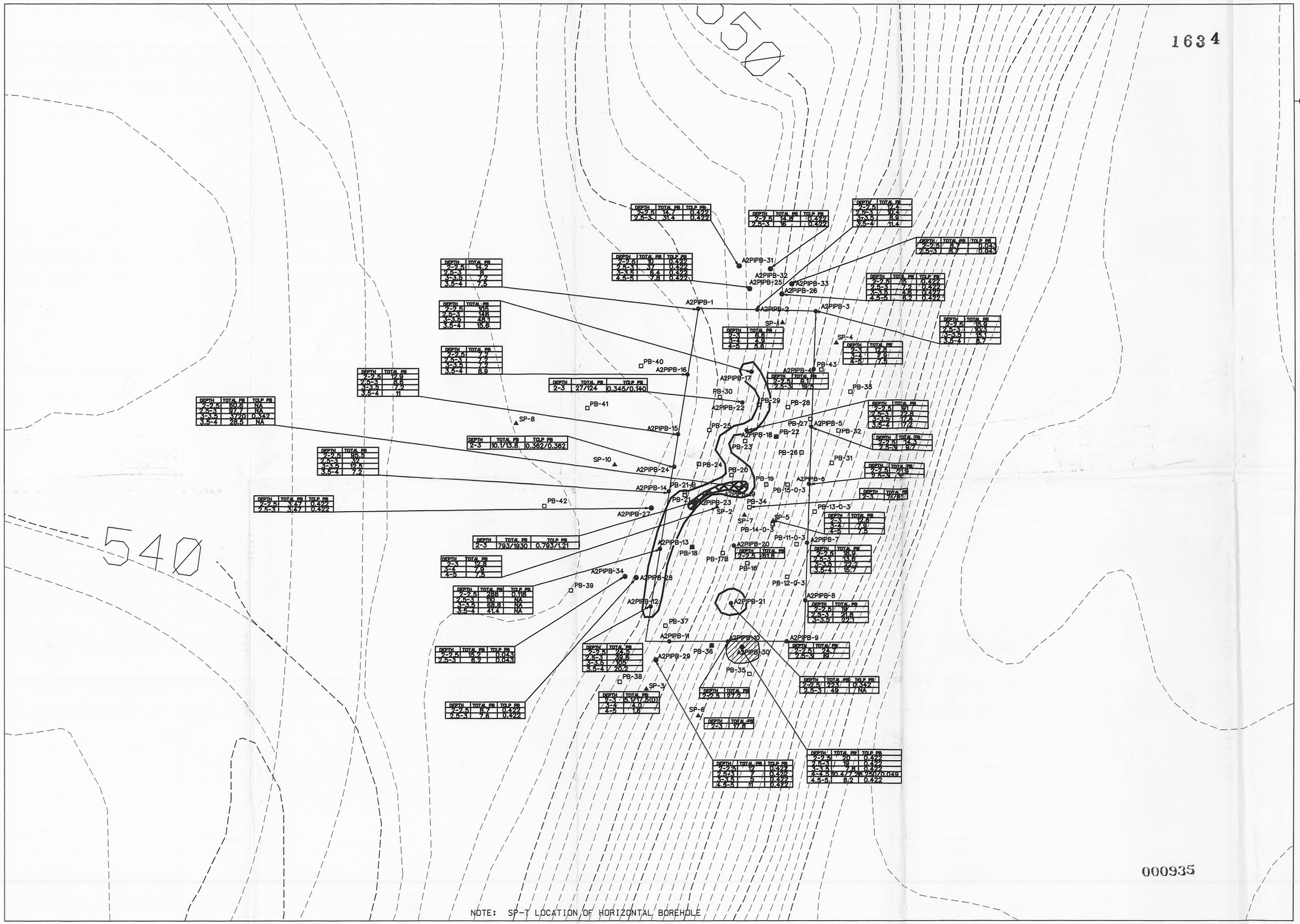


FIGURE D-54. AREA 2, PHASE I FIRING RANGE, LEAD CONCENTRATIONS, 0-2 FT.



NOTE: SP-7 LOCATION OF HORIZONTAL BOREHOLE

LEGEND:
- ● A2PI SOIL SAMPLE (POST-1997)
- ▲ PHYSICAL SOIL SAMPLE (PRE-1997)
- ◘ X-RAY FLUORESCENCE (SEPT. 1996)

NA = NOT ANALYZED

TOTAL LEAD > 100 mg/kg
TOTAL LEAD > 400 mg/kg
TCLP LEAD > 5 mg/L

DRAFT

v:\#2fml2\dgn\bmp\a2p1-005.dgn STATE PLANAR COORDINATE SYSTEM 1983 03-AUG-1998

FIGURE D-55. AREA2, PHASE I FIRING RANGE, LEAD CONCENTRATIONS, 2+ FT.

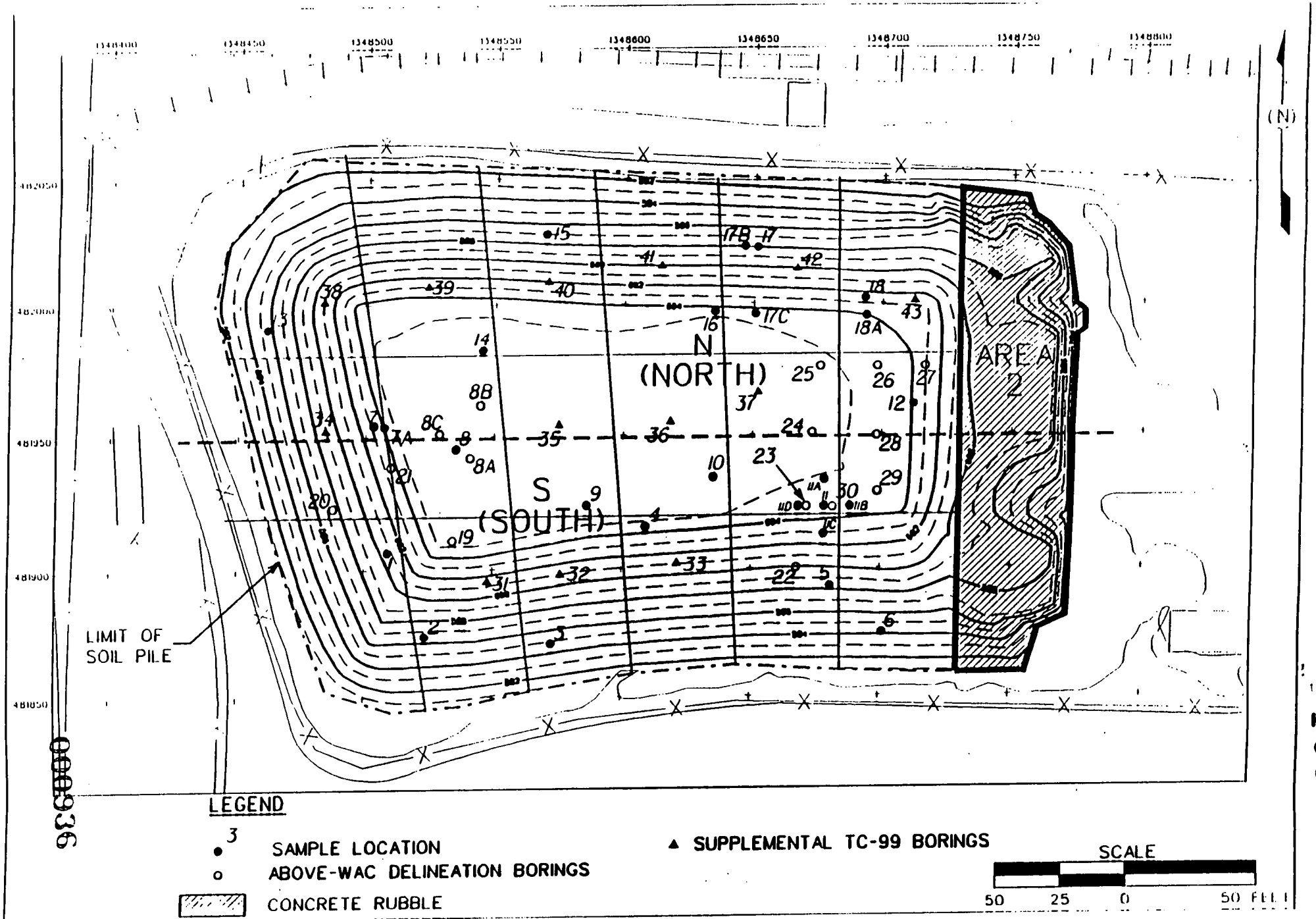


FIGURE D-59 SP-5 SOIL SAMPLING LOCATIONS

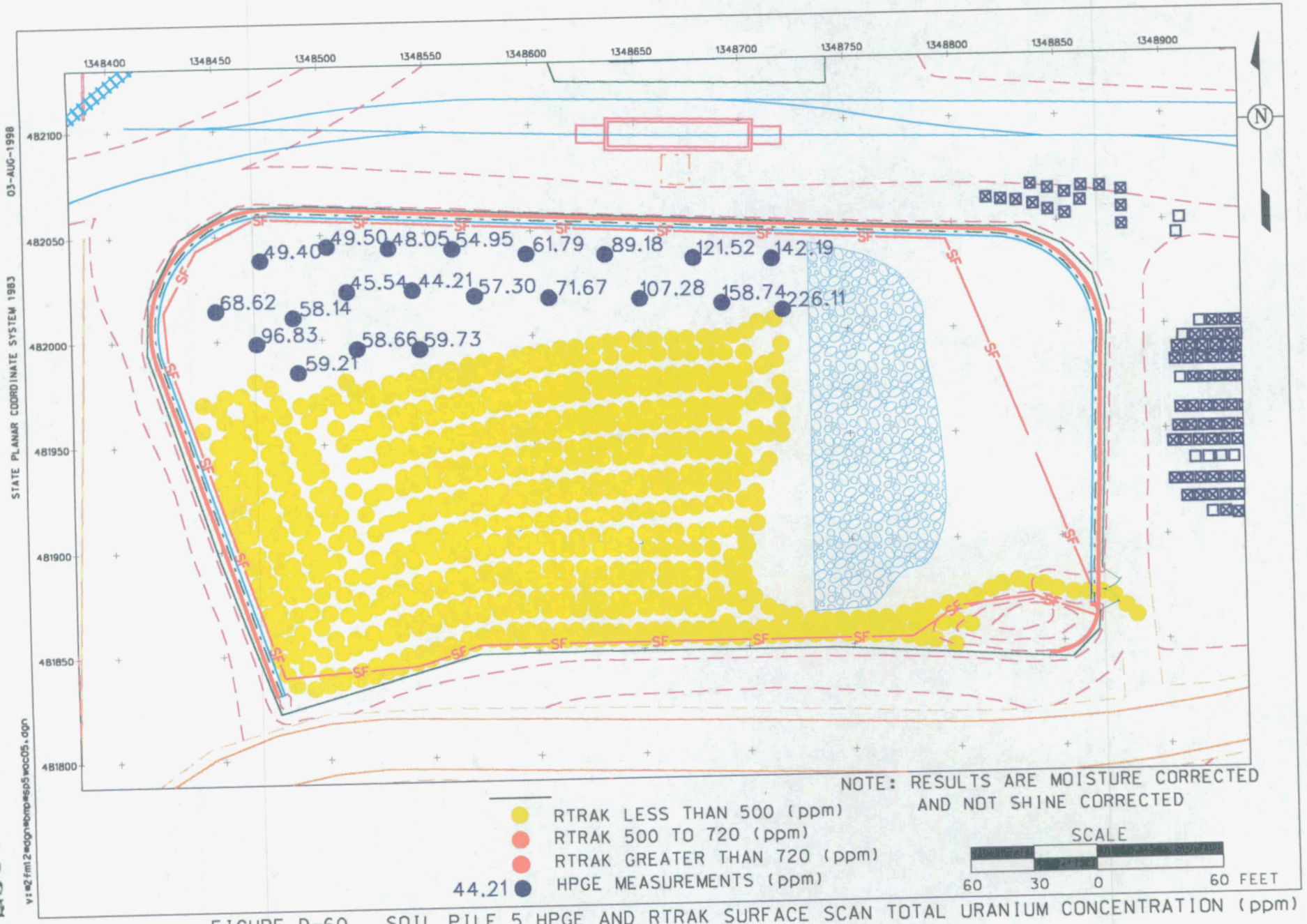


FIGURE D-60. SOIL PILE 5 HPGE AND RTRAK SURFACE SCAN TOTAL URANIUM CONCENTRATION (ppm)

v:\e2fm12\dgn\bmp\esp5woc05.dgn

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