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Department of Energy

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APR 08 1998

DOE-0658-98

Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF REVISED INTEGRATED REMEDIAL DESIGN PACKAGE FOR AREA 2, PHASE I SOUTHERN WASTE UNITS

The purpose of this letter is to transmit the following:

- Revised draft of the Area 2, Phase I (A2PI) Integrated Remedial Design Package (IRDP).
- Responses to EPA comments on the October 1997 A2PI IRDP draft submittal.
- DCN summary for Southern Waste Units (SWU) Site Preparation construction activities.

Revised Integrated Remedial Design Package

The enclosed IRDP represents a revised draft of the A2PI IRDP that was submitted to the U.S. Environmental Protection Agency (U.S. EPA) on October 23, 1997. This IRDP was revised in response to regulatory comments; updated programmatic documents (Standard Evaluation Procedures, Waste Acceptance Criteria (WAC) Attainment Plan, real-time protocols); additional predesign sampling data; decisions made at the Department of Energy (DOE), U.S. EPA, and Ohio Environmental Protection Agency (OEPA) meetings, and other criteria. This working draft provided a basis of discussion at the April 7 and 8, 1998, meetings with the regulators.

This Integrated Remedial Design Package submission consists of:

- Implementation Plan
- Implementation Plan Appendices
- Revised Technical Specifications and Construction Drawings (for SWUs Excavation)

Implementation Plan

The enclosed Implementation Plan is a revised draft that presents the current status of the document.

Implementation Plan Appendices

The Implementation Plan contains the following appendices:

- Design Criteria Package (Appendix A)
- Surface Water Management Plan (Appendix B)
- Earthwork Calculations (Appendix C)
- Predesign Sampling Data (Appendix D)

The first three appendices were revised based on previous comments and updated based on the latest information available about the project. Appendix D was updated and incorporates recently obtained and updated data. The Integrated Remedial Measurement Approach (Appendix E) was deleted from the Implementation Plan. Pertinent parts were incorporated into other components of the Implementation Plan.

Construction drawings and technical specifications

The enclosed construction drawings and technical specifications are for the excavation phase of the SWUs project. The procurement process for this work is under way and a contract is scheduled to be awarded on May 1, 1998. Upon receipt of regulatory approval, excavation in the SWUs is scheduled to begin before July 7, 1998.

Response to Comments

The enclosed responses to comments addresses both the U.S. EPA and OEPA comments on the October 1997 IRDP submission. These responses and actions are revised versions of the previous drafts that were presented and discussed with U.S. EPA and OEPA during meetings held on March 10 and 11, 1998.

Design Change Notices Summary

The construction drawings and technical specifications for the site preparation phase of the A2PI project were previously submitted to you. The enclosed Document Change Notice (DCN) Summary lists the DCNs for the project to date.

Based on the discussions in the April 7 and 8, 1998, meeting, DOE is in a process to collect four additional borings in the Inactive Flyash Pile and six additional soil samples in the firing range area to further confirm the boundaries for above-WAC material and Resource Conservation Recovery Act (RCRA) characteristic material, respectively. Results of these sampling and analyses will be summarized and submitted in a letter to the U.S. EPA and OEPA before final approval of the IRDP.

If you have any questions or concerns regarding these documents, please contact Robert Janke at (513) 648-3124.

Sincerely,

Johnny Reising

FEMP:Nickel

Johnny W. Reising
Fernald Remedial Action
Project Manager

Enclosure: As Stated

cc w/enc:

G. Jablonowski, USEPA-V, SRF-5J
R. Beaumier, TPSS/DERR, OEPA-Columbus
T. Schneider, OEPA-Dayton (total of 3 copies of enc.)
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EDC, FDF/52-7

SUMMARY OF DESIGN CHANGE NOTICES (DCNs) FOR AREA 2, PHASE I SITE PREPARATION PROJECT
(As of March 31, 1998)

DCN Number	DCN Title	DCN Description	Date Issued
20401-001	Borrow Area Changes	Changed source of borrow material for infiltration barriers from the field along the south entrance road to the OSDF Sedimentation Basin Stockpile	8/27/97
20401-002	VOID		
20401-003	Woodchip Stockpile Relocation	Moved location of Woodchip Stockpile from north of the IFP to area around the meteorological tower	8/14/97
20401-004	VOID		
20401-005	Response to OEPA/USEPA Comments	Described 26 changes resulting from U.S. EPA and OEPA comment responses to Site Preparation package	8/27/97
20401-006	Office Trailer Modifications	Specified an office trailer to be provided for FDF construction personnel	9/2/97
20401-007	Change to 28-inch Culvert	Specified plugging existing culvert southwest of AFP with concrete instead of removing	8/27/97
20401-008	Changes to Impacted Material Excavation Depths, and Stockpile of Non-Impacted Materials	Specified depths of excavation in retention basins according to depth of impacted material to go to South Field Impacted Stockpile; directed that Non-Impacted Stockpile 1 be segregated by point of origin	8/29/97
20401-009	Stockpile Stripping; Textured Geomembrane; SWU Areas	Prohibited stripping under two non-impacted stockpiles; specified textured geomembrane liner for three retention basins; directed contractor to not disturb above-WAC or lead areas, including during clearing operations; identified four additional potential above-WAC areas to be shown on drawings	9/9/97
20401-010	Modification to Monitoring Wells	Indicated that monitoring well 3016 is to be abandoned by others	9/9/97
20401-011	Change to Messenger Sizes for Electrical Cable	Changed specified messenger cables	9/16/97
20401-012	Deletion of 5 Years Experience Requirement for HDPE Pipe Installation and Fusion/Extrusion Welding	Deleted requirement for verification of minimum of five years experience in HDPE pipe installation and fusion/extrusion welding	10/3/97
20401-013	Office Trailer Furniture Deletion	Deleted all requirements for the contractor to provide furniture/office equipment for office trailers	9/24/97

SUMMARY OF DESIGN CHANGE NOTICES (DCNs) FOR AREA 2, PHASE I SITE PREPARATION PROJECT (continued)

DCN Number	DCN Title	DCN Description	Date Issued
20401-014	Change to Single Tap of 6-inch Water Main	Changed design to single tap of 6-inch water main with backflow preventor assembly installed above grade in heated enclosure; realigned approach into support area so traffic is not directed towards rad control point trailer	10/21/97
20401-015	Add Second 13.2 KV Feeder	Added second circuit and crossarms to nine poles to avoid safety hazard of working near live bare wires	10/16/97
20401-016	Dial Type Thermometers	Deleted requirement of dial type thermometer	10/13/97
20401-017	Equipment Wash Facility Modifications	Redesigned layout and capacity of the equipment wash facility	10/10/97
20401-018	Increase Height of Retention Basin 1	Increased height of berm around Retention Basin 1 to 541 by placing sandbags	10/31/97
20401-019	Modify Utility Pole for Subcontractor's Trailer	CANCELLED - VOID	
20401-020	Deletion of AWWA Specification Requirements for Transfer Line	Deleted AWWA 906 and molded HDPE fittings requirements; reference AWWA C901 due to inconsistencies in specifications	10/28/97
20401-021	Geomembrane Physical Properties Modifications	Added properties for textured geomembrane in specifications	10/22/97
20401-022	Relocation of Transfer Line Near Non-Impacted Stockpile 1	Relocated collection ditch and culvert, limits of Non-Impacted Material Stockpile 1, transfer lines, and electrical lines to north due to erosion of Paddys Run	12/5/97
20401-023	Delete Wet Flashover Requirement from Spec. 16370	Deleted requirement for wet flashover due to insulators meeting other ANSI standards cited in specifications	10/31/97
20401-024	Contamination Area - Basin 2 Terrace Face	Revised South Field excavation to be performed as contaminated area. Slope north of Retention Basin 2 to be excavated as a contamination area; create special material transfer area; create separate section of South Field Impacted Stockpile; create rad control point; install rad fencing; direction for removal of special material according to Waste Management	11/20/97
20401-025	Equipment Wash Facility Pipe Modification	Increased diameter of HDPE wastewater line that drains the water from equipment wash facility from 4-inch to 6-inch diameter	11/18/97
20401-026	Top Hat for High Voltage Gear	Deleted top hat from switchgear detail and place a barrier in rear of cabinet and run cables through it to switch	11/21/97

SUMMARY OF DESIGN CHANGE NOTICES (DCNs) FOR AREA 2, PHASE I SITE PREPARATION PROJECT (continued)

DCN Number	DCN Title	DCN Description	Date Issued
20401-027	Add line to Cooling Tower	Added line to new cooling tower to complete taps at north work area	12/8/97
20401-028	Pins for Insulators	Deleted requirement of lead threads and approve use of nylon threads	11/21/97
20401-029	Change in Dumped Rock Near Point	Changed rock located near 18-inch storm line outlet from ODOT Type B to ODOT Type C	12/2/97
20401-030	Change Transfer Line from Dual Containment Pipe to Single Pipe	Changed from dual containment pipe to single wall pipe in areas above the GMA; below elevation 560 will remain dual containment	12/8/97
20401-031	Fuse Size Change	Changed fuse size from 200E to 175E	12/17/97
20401-032	Modify Swale Detail (Rock Placement)	Modified swale repair so that existing soils will not be excavated; rock placed to fit existing topography; rock piled and shaped at bottom of swale to use as key for rock face	12/16/97
20401-033	Extend 13.2 KV Feeder	CANCELLED - VOID	Cancelled
20401-034	Response to OEPA Comments on Response to OEPA/USEPA Comments	Changed specifications in response to OEPA comments on infiltration barrier and seeding	12/16/97
20401-035	Modifications to DCNs 20401-008 and -009	Deleted changes to 02200, 3.4.F authorized by DCN 20401-008; deleted plotting of four additional potential above-WAC areas authorized in DCN 20401-009	12/16/97
20401-036	Diversion Box Penetration and Discharge Line Modification	Modified routing of 6-inch discharge line into diversion box of SWRB	12/24/97
20401-037	Change in Elevation of Berm Around Retention Basin 1	Revised design of Retention Basin 1 to increase berm height to elevation 541.5; eliminated requirement of sand bags/silt berm authorized in DCN 20401-018	1/6/98
20401-038	Clarification Suspension Insulators	Clarified insulators and changed taps.	1/22/98
20401-039	Clarification of Insulators and Tying	CANCELLED	Cancelled
20401-040	Modification to Location of Ditch No. 12	Revised location of Ditch No. 12	1/6/98
20401-041	Modification of Trace Wire Installation	Required placement of trace wire continuous over top of pipe, 6-inches below finish grade	1/14/98

SUMMARY OF DESIGN CHANGE NOTICES (DCNs) FOR AREA 2, PHASE I SITE PREPARATION PROJECT (continued)

DCN Number	DCN Title	DCN Description	Date Issued
20401-042	Modification of Anchor Trench for Basin 2	Modified north anchor trench of Retention Basin 2	1/14/98
20401-043	Modification of Erosion Control for Non-Impacted Material Stockpile 1	Added rock check dams in three ditches with silt fence outside of them; eliminated silt berm from around Non-Impacted Stockpile 1; placed sandbags between Retention Basin 1 and Non-Impacted Stockpile 1	1/15/98
20401-044	Eliminate Pole 25R	Eliminated one pole and shorten another pole	1/22/98
20401-045	Pole 14R Guy and Anchor	Eliminated guy and anchor from pole	1/22/98
20401-046	Modification of Infiltration Barrier Placement and Compaction	Modified requirements for placement and compaction testing of infiltration barrier material	1/16/98
20401-047	Modification to the Height of the Impacted Material Stockpile	Changed maximum height requirement of South Field Impacted Stockpile from 20 feet to a maximum height-to-base ratio of 0.20	1/16/98
20401-048	Alternate Source for Clay Borrow	Specified second borrow source for infiltration barrier material as Welch Sand and Gravel	1/16/98
20401-049	Delete Anchor from Pole 11R	Removed guy anchor from pole	1/22/98
20401-050	Temporary Modification to Ditch D-8B	CANCELLED	1/14/98
20401-051	Installation of Transfer Line	Changed requirement of 5-feet of cover to 3.5-feet over transfer, treatment and discharge lines	1/22/98
20401-052	Move Pole 41	Relocated pole	1/22/98
20401-053	Taps Off 13.2 KV Overhead Line	Replaced mechanical tie-ins with compression fittings	2/9/98
20401-054	Remove Switch Gear Hold	Modified drawings to remove "hold" from details	2/4/98
20401-055	13.2 KV Deadend Revision	Revised electrical deadend. Centered phase be deadended on poles using thru-bolts or double arming bolts	2/10/98
20401-056	13.2 KV Deadend Revision	DUPLICATE; same as DCN 20401-056	Cancelled
20401-057	Remove Cooling Feeder Tower Scope	Removed work authorized by DCN 20401-027	2/24/98
20401-058	Insulated Down Guys	Specified use of insulated downguys	2/17/98

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SUMMARY OF DESIGN CHANGE NOTICES (DCNs) FOR AREA 2, PHASE I SITE PREPARATION PROJECT (continued)

DCN Number	DCN Title	DCN Description	Date Issued
20401-059	Modification Retention Basin 2	Deleted infiltration barrier from Retention Basin 2; place geomembrane and Fabriform® with concrete in basin	2/17/98
20401-060	CMP usage for Manhole Installation Concrete Form	Approved leaving in-place corrugated metal pipe (installed for shoring devices) around lift stations	2/13/98
20401-061	Relocation of Gravel Roadway Entrance Support Area	Approved leaving existing pole that was scheduled to be removed	2/17/98
20401-062	Elimination of Berm at Non-Impacted Stockpile 2	Removed of berm around Non-Impacted Stockpile 2; DISAPPROVED - TO BE BUILT AS SHOWN ON DRAWINGS	Disapproved
20401-063	Cable Stringing and Guying	Revised cable stringing values and procedures	3/5/98
20401-064	Vacuum Breaker for Post Hydrants	Specified installation of vacuum breakers/backflow preventors on hydrants	3/19/98
20401-065	Cleanout Tee Modification	Modified to cleanout tees	3/13/98
20401-066	Delete Furniture Requirements for Radiological Control Point Facility Trailer	Deleted requirement for contractor to provide tables and chairs for the rad control point trailer	3/19/98
20401-067	Modification to DCN 20401-059 and Installation of Fencing Around Basin 2	Added fence around Retention Basin 2 for deer protection; delete requirement from DCN 20401-059 for Fabriform®	3/26/98
20401-068	Modification to Transfer Line Air Release Valve and Cleanout Assemblies	Deleted one air release assembly from transfer line; modified design of other four accordingly	3/28/98

TECHNICAL REVIEW COMMENTS ON "INTEGRATED REMEDIAL DESIGN PACKAGE FOR AREA 2, PHASE I"

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

GENERAL COMMENTS

Commenting Organization: U.S. EPA Commentor: Saric
Section #: NA (Not Applicable) Page #: NA Line #: NA
Original General Comment #: 1

Comment: Throughout the implementation plan, the text cites the "Sitewide Excavation Plan" (SEP) as providing additional information required for implementation of the integrated remedial design package (IRDP). However, the regulatory agencies have not yet approved the SEP. The IRDP cites the SEP regarding issues, such as the "hot spot" criterion, which are unresolved. The SEP must be approved by the regulatory agencies before the IRDP can be implemented. The same problem is associated with several other general documents, including the "Waste Acceptance Criteria (WAC) Attainment Plan" and the revised "Sitewide CERCLA Quality Assurance Project Plan."

Response: Significant progress has been made in the last few months to finalize all the necessary guiding documents of the IRDP. The draft final Waste Acceptance Criteria (WAC) Attainment Plan was submitted to the agencies on January 30, 1998. Several technical meetings have been held between U.S. EPA, OEPA, and DOE between November 1997 and January 1998 to discuss various SEP issues; DOE believes that all major issues have been resolved in these meetings. Based on the resolutions achieved, formal responses to both U.S. EPA and OEPA comments on the SEP were submitted to the agencies on February 2, 1998. DOE is currently revising the SEP to incorporate changes per these responses. Finalization of the SEP is contingent upon EPA approval of the comment responses.

The SEP, WAC Attainment Plan, and revised Sitewide CERCLA Quality Assurance Project Plan will establish final overall policies for the SCEP and the IRDPs. By the middle of April 1998, these guiding documents should be approved by the agencies. In the interim, steps have been taken to ensure that comment responses for the A2PI IRDP, the SEP, and the revised WAC Attainment Plan are consistent. When these two guiding documents are finalized, the A2PI IRDP can be finalized and readied for implementation.

Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: NA Page #: NA Line #: NA
Original General Comment #: 2

Comment: The text in Section 3.0 of the implementation plan refers to several specifications and drawings that are not included in the IRDP. For example, Line 2 on Page 3-3 refers to specification "SPSpec 02100" and drawing "SPDwg G0005," which are not included in the specifications and drawings for the IRDP. The IRDP should be revised to include all drawings and specifications referred to in the text of the implementation plan.

Response: The IRDP consists of the Implementation Plan (IP), site preparation design package (technical specifications and construction drawings), and excavation design package (technical specifications and construction drawings). The IP references both the site preparation and excavation design packages. The site preparation design package, although part of the IRDP, was provided to U.S. EPA and OEPA for review on June 16, 1997. It was not resubmitted with the IP and excavation design package. DOE has responded to comments on the site preparation design package and the work is on-going. DOE has provided updated design documents to the regulators in September, 1997 and February, 1998.

Action: Updated drawings and technical specifications for excavation will be submitted with the next IRDP submittal.

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: D Page #: Tables Line #: NA
Original General Comment #: 3
Comment: The text describing the tables in Appendix D of the implementation plan does not identify the labeling scheme used for the sampling locations (see Original Specific Comment 11). In addition, a number of the tables contain a "Qual." column that appears to identify some nonstandard data qualification labels (see Original Specific Comment 17). Appendix D should be revised to address these issues.

Response: Agreed.

Action: Both the tables and text of Appendix D will be revised to clearly explain the following sample identification scheme:

- R = radiological analytical suite
- M = metals analytical suite
- SP = semivolatiles and pesticides/PCBs analytical suite
- D = duplicate sample collected
- G = HPGe measurement

In addition, the data qualification labels will also be clearly defined as follows:

- NV = not validated
- Z = a more technically usable or representative result exists in another analysis of sample; result should not be used; coded for informational purposes only
- - = no qualifier
- R = rejected
- U = not detected above method detection limit
- J = estimated value

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: E Page #: NA Line #: NA
Original General Comment #: 4
Comment: The integrated measurement approach presented in Appendix E of the implementation plan does not reflect an objective evaluation of the accuracy and reliability of real-time measurement technologies. For example, Section E.1 refers to the ability of the high-

purity germanium detector (HPGe) to provide accurate and representative measurements of radionuclide concentrations. As discussed in recent meetings between the U.S. Department of Energy (DOE) and the regulatory agencies, the accuracy and reliability of the real-time measurement technologies are still in question and thus such a statement is unwarranted. The text also contains numerous vague phrases, such as "in good agreement" and "results correlated well," regarding the comparability of in situ and laboratory measurements. In addition, Section E.1.5.2.1 primarily discusses the three "major strengths" of HPGe measurements and provides only a brief and incomplete discussion of the limitations of HPGe measurements (see Original Specific Comment 21). DOE should revise Appendix E to present a more objective and realistic evaluation of the real-time measurement technologies.

Response: See response to U.S. EPA General Comment No. 4 for the July 1997 SEP.

Action: See action for the referenced comment. Appendix E is being deleted (at the suggestion of OEPA) and appropriate text from the appendix will be incorporated in the body of the Implementation Plan (see response to OEPA Comment No. 79).

Commenting Organization: U.S. EPA Commentor: Saric
Section #: NA Page #: NA Line #: NA
Original General Comment #: 5
Comment: Throughout the specifications, the text requires the contractor to meet requirements specified in Parts 6 and 8 of an unidentified document. For example, Section 1.5 on Page 3 of Specification No. 02150 refers to health and safety and training requirements specified in Part 8. Similarly, Section 1.1 on Page 1 of Specification No. 02205 refers to dust control measures specified in Part 6. The specifications should be revised to provide complete information and, when appropriate, to provide complete and correct references to other documents.

Response: The Parts 6 and 8 referenced throughout the technical specifications refer to parts of the contract documents that each potential contractor receives. The technical specifications and construction drawings themselves are part of the same contractual document. This is standard contractual language.

Action: No action.

SPECIFIC COMMENTS

"Area 2, Phase I Southern Waste Units Implementation Plan for Operable Unit 2"

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 2.3.2 Page #: 2-6 Line #: 15
Original Specific Comment #: 1
Comment: The text cites a document as "Parsons 1996c." However, the reference section lists no documents prepared by "Parsons." The reference section should be revised to list the document cited.

Response: Noted.

Action: The reference section will be revised to include the Parsons document cited in the text.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 2.3.3 Page #: 2-7 Line #: 10
Original Specific Comment #: 2
Comment: The text states that uranium concentrations of up to 6,700 grams per liter were detected in the groundwater, which appears to be incorrect. The units of concentration should be checked and corrected.

Response: Noted. The correct units are micrograms per liter.

Action: The text will be revised to read "6,700 μg/L".

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 3.0 Page #: 3-1 Line #: NA
Original Specific Comment #: 3
Comment: The text lists several plans as components of the "safe work plan." The list should be revised to include the site-specific health and safety plan, which will contain the project-specific health and safety requirement matrices (see Section 5.0) that are yet to be developed.

Response: The Safe Work Plan that is detailed on page 3-1 is developed by the contractor that has been awarded the contract for each phase of the project. It encompasses all the work to be performed by the contractor, and incorporates in its individual component plans (1) the tasks to be performed — the work plan aspect, and (2) the general and task-specific mitigators (e.g., personnel protective equipment, engineering and administrative controls, pre-job planning and permits, personnel and work zone occupational air monitoring, medical monitoring and medical surveillance, and decontamination and disposal procedures) — the safety plan aspect. The contractor must utilize the project-specific environmental health and safety and training requirements matrix to determine the general and task-specific health and safety requirements for the development of their safe work plans. DOE's representative must approve the contractor's Safe Work Plan to ensure compliance with the project-specific environmental health and safety and training requirements matrix.

Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 3.3.2.2 Page #: 3-14 Line #: 19 to 21
Original Specific Comment #: 4
Comment: The text refers the reader to Figure 3-6, which indicates that excavation of soil above the contaminated material that exceeds the WAC will be conducted in 3 ± 1-foot lifts. However, as discussed in Specific Comment 15, limited data exists on the vertical extent of above-WAC contamination. Table D-8 indicates that the upper elevation of the above-WAC contamination is quite irregular. Therefore, the overburden of below-WAC material may include some above-WAC material, and some below-WAC material may be present in the upper parts of the presumed mass of above-WAC material. Because the WAC are not to be exceeded, a more cautious procedure (for example, excavation of soil overburden in 1-foot lifts) should be used to access the above-WAC material. The text should be revised to address this issue.

Response: See DOE No. 1 presented in the OEPA comments response portion of this Response to Comments package.

See also response to OEPA Comment Nos. 70 and 75.

Action: All existing data will be presented in Appendix D of the revised Implementation Plan to bound the extent of the above-WAC material.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 3.3.2.5 Page #: 3-17 Line #: NA
Original Specific Comment #: 5
Comment: The text provides a list of special materials that require special treatment before their disposal in the On-Site Disposal Facility or elsewhere. In view of the discovery of a large quantity of bricks in A2PI during site preparation activities, the text should also discuss acid brick, which must be disposed of off site.

Response: See DOE No. 1 presented in the OEPA comments response portion of this Response to Comments package.

Action: The text of the Implementation Plan will be revised to include acid brick as a special material.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 3 Page #: Figure 3-6 Line #: NA
Original Specific Comment #: 6
Comment: Figure 3-6 refers to Figure 3-3 regarding "details on above WAC excavation." However, Figure 3-3 does not provide any such details. The reference to Figure 3-3 should therefore be revised.

Response: Noted; the correct figure to reference is Figure 3-7.

Action: Figure 3-6 will be revised to reference Figure 3-7 for details regarding above-WAC excavation.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 6 Page #: 6-24 Line #: NA
Original Specific Comment #: 7
Comment: Table 6-1 indicates that the estimated volume of impacted material at the inactive fly ash pile is 97,000 cubic yards (yd^3); however, Section 3.3.1 on Page 3-12 indicates that the volume of impacted material at the inactive fly ash pile is 114,000 yd^3. The text or table should be revised to resolve this discrepancy.

Response: The 114,000 yd^3 of material referenced in Section 3.3.1 on Page 3-12 is the total amount of material to be excavated from the Inactive Flyash Pile (IFP). The 97,000 yd^3 of material in Table 6-1 is the estimated volume of Category 1 Impacted Material from the IFP; the remaining 17,000 yd^3 of material in the IFP is anticipated to be comprised of other categories, as defined by the Impacted Material Placement Plan for the On-Site Disposal Facility. See response to OEPA Comment No. 5 for discussion on earthwork volumes throughout the Implementation Plan.

Action: See action for the referenced comment.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: A.2.3.1 Page #: A.2-10 Line #: NA
Original Specific Comment #: 8
Comment: The text in the first paragraph and eighth sentence under the "Retention Basin" subheading should be revised to read as follows: "transfer line that will empty through the sluice gate".

Response: Noted.

Action: The referenced text will be revised as suggested.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: A.2.3.1 Page #: A.2-11 Line #: NA
Original Specific Comment #: 9
Comment: The fourth sentence of the first paragraph should be revised to read as follows: "The minimum force main velocity during the pumping cycle will be 3.0 feet per second".

Response: Noted.

Action: The referenced text will be revised as suggested.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: A.2.3.1 Page #: A.2-11 Line #: 14 and 15
Original Specific Comment #: 10
Comment: The text states that the high-level alarm will detect liquid levels above a maximum setpoint in the lift station. However, it is not clear where the alarm level will be set. The maximum liquid level in the lift station can be as high as the maximum liquid level in the reservoir. If the alarm level is set above the maximum liquid level in the lift station, the high-level alarm will never be activated and therefore is not necessary. Moreover, the top of the lift station should be higher than the maximum liquid level in the reservoir. The text should be revised to clarify this matter.

Response: Agree; the overflow spillways are from 1-3 foot below the lift station tops, so the spillway elevation will ultimately limit the water level in the lift station.

Action: The Design Criteria Package will be revised to delete the paragraph "Leak Detection System/High Level Alarm".

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: D Page #: NA Line #: NA
Original Specific Comment #: 11
Comment: The text does not describe the labeling scheme associated with the sample numbers shown in the data tables and sampling locations shown in the figures. A description of the entire sample number code should be provided to clarify the sampling scheme and allow proper evaluation of the information in the tables and figures. One problematic example appears in Table D-7, where the difference between "IFP-B2-C-3-M," and "IFP-B2-C-3-SP" is not clear. The text should be revised to address this issue.

Response: See response to U.S. EPA General Comment No. 3.

Action: See action for the referenced comment.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.1 Page #: D-3 Line #: 19
Original Specific Comment #: 12
Comment: The text refers the reader to Figure D-11 for reuse characterization sampling locations in the retention basins. However, these sampling locations are not shown in the figure cited. The text should be revised to cite one or more figures that show these sampling locations.

Response: Noted; incorrect figure cited. The original text has been revised and a specific correction is not valid. The revised text refers to appropriate figures.

Action: Text has been revised to reference the appropriate figures.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.2 Page #: D-4 Line #: 13 and 14
Original Specific Comment #: 13
Comment: The text refers the reader to Table D-8 for HPGe measurement results for total uranium in the above-WAC areas. However, these results are not presented in Table D-8, nor are they reported in any other table in Appendix D. The appendix should be revised to include a table with the HPGe measurement results for total uranium in the above-WAC areas.

Response: Noted; incorrect table citation.

Action: A table listing HPGe measurements for the above-WAC area will be added, as well as appropriate text discussion.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.2 Page #: D-5 Line #: 1 to 14
Original Specific Comment #: 14
Comment: The text states that soil sample analytical results for total uranium in Southern Waste Unit (SWU)-1 through SWU-4 and for technetium-99 (Tc-99) in SWU-4 did not confirm the elevated concentrations of these contaminants previously reported. However, no explanation for the lower detections of total uranium and Tc-99 is provided. The text should be revised to include an explanation for the lower detections of these contaminants--especially Tc-99, which will no longer be considered an area-specific constituent of concern for A2PI.

Response: See response to OEPA Comment No. 19 and DOE No. 1 presented in the OEPA comments response portion of this Response to Comments package.

Action: See action for the referenced comments.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.2 Page #: D-5 Line #: 24 to 27
Original Specific Comment #: 15

Comment: The text states that uranium concentrations exceeding the WAC of 1,030 milligrams per kilogram (mg/kg) are assumed to be present only between 15 and 26.5 feet below ground surface (bgs). This assumption is based on above-WAC analytical results for two samples, one collected 15 to 15.5 feet bgs and the other collected 26 to 26.5 feet bgs. However, the deepest sample was obtained from 27 feet bgs, and overall, limited information is available regarding the contamination levels in this depth range. Therefore, the vertical extent of contamination has not been adequately defined. The data raises a similar concern regarding the horizontal extent of contamination at 15-foot bgs levels. The text should be revised to discuss how DOE will further delineate the extent of contamination and ensure proper segregation of above-WAC soils excavated above and below the 15- to 26.5-foot-bgs depth range.

Response: See response to OEPA Comment Nos. 70 and 75.

Action: See actions for the referenced comments.

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: D Page #: Figure D-4 Line #: NA
Original Specific Comment #: 16

Comment: Figure D-4 identifies concentrations of total uranium based on HPGe measurement results. A figure presenting total uranium concentrations based on laboratory analytical results would provide more reliable information and would allow easier comparison of HPGe and laboratory results. In addition, Figure D-4 identifies total uranium concentrations using colored circles. However, it is difficult to distinguish the color of the circles used for concentrations of 25 to 50 mg/kg from the color of the circles used for concentrations exceeding 50 mg/kg. Figure D-4 should be revised to more clearly present this information.

Response: Noted. The only area in which physical samples were collected at an HPGe measurement location (one-to-one correlation) was in the fill area. These results are presented in Table D-5 (HPGe Measurements vs Total Uranium BromoPADAP Results). Agree that the shading of dot indicating HPGe measurement >50 ppm is too close to that indicating HPGe measurement of 25-50 ppm and needs to be revised.

Action: Shading of dot indicating HPGe measurement >50 ppm will be revised.

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: D Page #: Tables Line #: NA
Original Specific Comment #: 17

Comment: Tables D-3, D-4, D-6, D-7, and D-8 contain a "Qual." column that lists labels for data qualification purposes. Some of the labels, such as "NV" and "Z," are nonstandard. The tables should be revised to clearly identify each data qualification label used.

Response: See response to U.S. EPA General Comment No. 3.

Action: See action for the referenced comment.

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: D Page #: Table D-5 Line #: NA
Original Specific Comment #: 18

Comment: Table D-5 compares HPGe measurement results and laboratory analytical results. The results that raise concern are those in which the laboratory result exceeds the HPGe result. For example, the HPGe result for sample FA-W1-31 is 18.7 mg/kg while the laboratory result is 79 mg/kg, and the HPGe result for sample FA-W1-51 is 14.9 mg/kg while the laboratory result is 51 mg/kg. In both cases, the HPGe result is less than 20 mg/kg and the laboratory result is greater than 50 mg/kg. DOE should revise the text to (1) explain these discrepancies and (2) present a plan for ensuring that such discrepancies will not result in improper assessment of contamination levels in soil.

Response: In some cases, HPGe measurements co-located with single physical samples, the HPGe and the physical sample results may differ. Whether or not such differences are significant depends on the measurement objectives.

A primary objective of using HPGe for A2PI site preparation activities was to ascertain if possible WAC exceedance areas existed within the field of view and away from the location of physical samples. Because neither HPGe measurements nor physical sample data remotely approached 1030 ppm, the differences noted in the comment are insignificant relative to the measurement objectives.

See also the response to U.S. EPA General Comment No. 4, particularly the section of the response that addresses the User's Manual. This manual will have sections specifically addressing how hot spots and potentially above-WAC surface soils will be evaluated using in situ gamma spectrometry.

Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.1 Page #: E-1 Line #: 12
Original Specific Comment #: 19

Comment: The text states that the hot spot criterion is three times the final remediation level (FRL). However, the Area 1, Phase I certification report uses twice the FRL as the hot spot criterion. The text should be revised to address this discrepancy.

Response: See response to U.S. EPA General Comment No. 2 for the July 1997 Draft Sitewide Excavation Plan.

Action: Appendix E is being deleted (at the suggestion of OEPA) and appropriate text from the appendix will be incorporated into the body of the Implementation Plan (IP) . Reference will be made to the SEP section containing the discussion of hot spot criteria.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.1.4.2 Page #: E-5 Line #: 10 to 13
Original Specific Comment #: 20

Comment: The text discusses an addendum report to the initial comparability study that extends the comparability of HPGe measurements and laboratory data for radium-226 to higher concentrations using a correction algorithm. However, concerns regarding the

correction algorithm and the sparsity of data used in the study have been identified in U.S. EPA comments on the addendum report. Therefore, Section E.1.4.2 should be revised to indicate that the issue regarding the comparability of radium-226 results is unresolved.

Response: The U.S. EPA concerns with the radium-226 addendum were the subject of a conference call in early January between the Real-Time Technical Work Group participants. As discussed among the participants, the issue is not whether the correction algorithm presented in the radium-226 addendum to the 1997 comparability study is sufficient for ASL B data, but rather whether the algorithm is sufficient for ASL D data. The consensus path forward was to acquire additional data and re-evaluate the correction algorithm (the basic approach of developing and using a correction algorithm did not seem to be a concern). In the A1P2 predesign sampling and analysis program, a number of HPGe measurements were made in the vicinity of the sewage treatment plant (STP) at locations where physical samples were also taken for total uranium analysis. As residual material in these samples still exists, they will be analyzed for radium-226 in order to compare with the HPGe data. The significance of these samples is that total uranium data were elevated in the vicinity of the STP. Thus, radium-226 data may also be elevated. If so, the data could fall in a portion of the radium-226 lab/HPGe correlation curve where relatively few data points currently exist (near the FRL for radium-226). If the data cluster near the curve, the validity of the curve would be significantly enhanced. If the points fall well off the curve, or if there is abundant scatter, additional work necessary to better define the curve would be indicated. Additional A1P2 data have been identified, from approximately 20 co-located HPGe/physical sample locations. The first batch of samples is currently being analyzed by alpha spectrometry in the on-site laboratory. The results from these samples should satisfy the concern with respect to sparsity of data and, therefore, the ultimate determination of the correction algorithm.

Action: Appendix E is being deleted and appropriate text from the appendix will be incorporated into the body of the Implementation Plan. The User's Manual, currently under development, will outline the path forward for utilizing HPGe instruments to measure in situ radium concentrations in soils to meet our various remediation drivers. The HPGe Comparability Study will be revised to incorporate the radium-226 addendum, including the additional data and a re-evaluation of the correction algorithm. (Both of these documents are addressed in the response to U.S. EPA Comment No. 4 for the July 1997 Draft Sitewide Excavation Plan).

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.1.5.2.1 Page #: E-10 Line #: 1
Original Specific Comment #: 21

Comment: The text states that there are limitations associated with the use of the HPGe. However, the text omits two significant limitations. First, use of the instrument is not an acceptable substitute for physical sample analysis. Second, HPGe measurements have generated some aberrant results as shown in Figure E-1. The text should be revised to provide a more complete evaluation of the HPGe's limitations.

Response: See response to U.S. EPA General Comment No. 4 and U.S. EPA Specific Comment No. 18.

Action: See actions for the referenced comments.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.1.5.2.2 Page #: E-10 Line #: 13 to 36
Original Specific Comment #: 22
Comment: This text discusses the limitations of the radiation tracking system. The text should be revised to note that use of this instrument for any purpose other than screening has not been accepted by the regulatory agencies.

Response: Noted. Agency review and approval of the User's Manual will resolve this issue.

Action: Appendix E is being deleted (at the suggestion of OEPA) and appropriate text from the appendix will be incorporated into the body of the Implementation Plan (IP)

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.3.1.2 Page #: E-14 Line #: NA
Original Specific Comment #: 23
Comment: The text lists several procedures to be used to determine the extent of material with uranium concentrations exceeding the WAC and FRL, including numerous variations on routine procedures. For instance, the HPGe would be used to check the excavation floor from an elevation of either 1 foot or 1 meter and to check the cut face at a distance of 1 foot or less. The rationale for the selection of instrument-target distances and the resulting coverage areas should be included in a standard operating procedure (SOP) or other appropriate document. The SOP should be cited in this section, or included in the implementation plan.

Response: The rationale for the selection of instrument-target distances and the resulting coverage areas is delineated in the User's Manual discussed in the response to U.S. EPA General Comment No. 4. This manual will be a controlled document and will serve the purpose intended by the reviewer.

Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.3.2.3 Page #: E-17 Line #: 6
Original Specific Comment #: 24
Comment: The text states that laboratory analyses performed to confirm that lead concentrations in soils are below the FRL will be conducted at analytical support level (ASL) B. The results of these analyses will be used to determine whether all soil that is characteristic hazardous waste has been removed. Therefore, the certification procedures discussed in Section E.3.5, should be followed; in particular, the analyses should be conducted at ASL D. Section E.3.2.3 should be revised accordingly.

Response: See response to OEPA Comment No. 16. The ASL B data will not be used to determine whether potentially toxicity characteristic waste has been removed. Additional TCLP lead analysis (at ASL B) is required to determine the boundary of the potential toxicity characteristic waste; once excavation of this material has taken place, certification (as outlined in a separate certification letter) will be conducted at ASL D.

Action: See action for the referenced comment.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.3.5.1 Page #: E-21 Line #: 2
Original Specific Comment #: 25

Comment: The text states that HPGe measurements performed at ASL D will be used for certification. However, the regulatory agencies have not approved use of the HPGe at ASL D; in fact, its use has not been accepted for any ASL above ASL A. This section should be revised to state that the HPGe will be used for certification only if such use is accepted by the regulatory agencies.

Response: Noted.

Action: Appendix E is being deleted (at the suggestion of OEPA) and appropriate text from the appendix will be incorporated into the body of the Implementation Plan (IP). The text will be revised to acknowledge the path forward for using HPGe in certification.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: E.4.2 Page #: E-23 Line #: 13
Original Specific Comment #: 26

Comment: This section summarizes the integrated measurement approach detailed in the rest of Appendix E. However, one necessary type of measurement has been omitted. Operations performed during remediation will include routine health and safety monitoring, normally using photo ionization detectors and hand-held radiation detectors. These instruments can identify unexpected solvent and radionuclide contamination. Unexpected conditions have already been encountered in A2P1 during the predesign investigations discussed in Appendix D. Routine health and safety monitoring will be necessary to supplement the visual observation noted on Page E-23, Line 28. Therefore, Section E.4.2 should be revised to discuss this monitoring and its integration into the decision-making process.

Response: 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 include 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.

Action: Appendix E is being deleted (at the suggestion of OEPA) and appropriate text from the appendix will be incorporated into the body of the Implementation Plan (IP). The text will be revised to discuss the use of PIDs and radiological friskers and how they will be used in the decision making process.

Commenting Organization: U.S. EPA Commentor: Saric
Appendix #: E Page #: Figure E-1 Line #: NA
Original Specific Comment #: 27

Comment: Figure E-1 shows the correlation between HPGe measurements and laboratory analytical results for total uranium in the South Field area. The figure should also

show the correlation coefficient and the 95 percent confidence limits, as is done in Figures E-2 and E-3. If the points with either laboratory or HPGe results exceeding 50 mg/kg make the error term and resulting confidence limits too large to be meaningful, then these limits may be omitted, but the accompanying text should discuss the problem. In addition, the text should note that although these HPGe results may be considered acceptable for determining WAC attainment, they are not acceptable for determining whether the total uranium concentration in soil is below the FRL.

Response: The purpose of Figure E-1 is very different than Figures E-2 and E-3. The purpose of Figures E-2 and E-3 is to establish trigger levels, hence 95 percent confidence limits have been established. The purpose of Figure E-1 is to see if an area-specific correlation between HPGe and laboratory data is necessary. Because a very large majority of all data points clustered near the perfect correlation line, an area-specific comparability correlation is not deemed necessary.

It is especially noteworthy that the large majority of points fall near the perfect correlation line. Good correlation between HPGe and laboratory data for total uranium in the July 1997 HPGe Comparability Study was based upon averaging 6 to 15 physical samples within the HPGe field of view. Figure 3-1 is based on single, co-located physical samples and HPGe measurements, and the degree of scatter would be expected to be greater than that where the average of multiple physical samples is compared to HPGe measurements.

The text does not address the acceptability of using HPGe data to determine whether the total concentration in soil is below the final remediation level (FRL). Determining that a given area of soil is below the FRL for a given analyte does not depend upon one, or even several, individual data points being below the FRL. Rather, the determination depends upon the mean and 95 percent upper confidence level being below the FRL. In this regard (see Table E-3), the fill area has an average total uranium content of 15.5 $\pm$ 6.2 ppm as determined by HPGe and an average total uranium content of 14.5 $\pm$ 12.2 ppm as determined by laboratory analysis. The conclusion that the soil area represented by the data is below the FRL for total uranium is logical based upon either set of data.

Action: No action.

"Technical Specifications for
Area 2, Phase I, Southern Waste Units Remedial Action Project Excavation Package" and
Construction Drawings

Commenting Organization: U.S. EPA Commentor: Saric
Specification #: Index Page #: I Section #: NA
Original Specific Comment #: 28
Comment: The specification section numbers and some of the section titles do not agree with the specification section numbers and titles listed in Table 2-2 on Page 2-14 of the "Design Criteria Package for Area 2, Phase I, Southern Waste Units Remedial Action Project Design and Construction." These discrepancies should be resolved.

Response: The Design Criteria Package was prepared during the initial phase of the project to establish the design criteria. The list of drawings and technical specifications were preliminary, to be used only for guidance. The note for Table 2-2 explains: "Specification No. shown is for the Site Preparation Package. For the Excavation Package the specification no. will be revised so that it can be used in conjunction with similar specification in an OSDF package".

Action: Note 1 of Table 2-2 will be clarified to include specification number and title as being revised in conjunction with the OSDF package.

Commenting Organization: U.S. EPA Commentor: Saric
Specification #: 02275 Page #: 7 Section #: 3.1B
Original Specific Comment #: 29
Comment: The text requires a sump to be lined with a geomembrane in order to prevent potential contamination of the Great Miami Aquifer (GMA), in the event that a sump excavation penetrates the GMA. The text should be revised to require lining of a sump excavation when the excavation is a predetermined distance above the GMA in order to better protect the GMA from potential contamination. The distance above the GMA at which the sump excavation should be lined should be based on a maximum allowable volume of leachate (MAVL) that can reach the GMA over a predetermined period of time. The MAVL should be determined in consultation with the regulatory agencies. Following determination of the MAVL, the Hydrological Evaluation of Landfill Performance model should be used to determine the distance above the GMA at which the sump excavation should be lined.

Response: See response to OEPA Comment No. 39.

Action: See action for the referenced comment.

Commenting Organization: U.S. EPA Commentor: Saric
Specification #: 02850 Page #: 3 Section #: 3.1A
Original Specific Comment #: 30
Comment: The text refers to an equipment wash plan (EWP). However, the EWP is not included in the IRDP, and no reference to any document containing the EWP is provided in the text. The text should be revised to provide a complete and correct reference to the document containing the EWP.

Response: The Equipment Wash Plan (EWP) referenced on Page 3-1 of the Implementation Plan and in 3.1.A of Section 02850 refers to the required submittal from the contractor that is described in 1.5 of Section 02850, which specifies items to be covered by the EWP. The contractor is required to submit the EWP to DOE's representative for review and approval, and then to abide by the approved EWP for the duration of the contract.

Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Specification #: 02850 Page #: 3 Section #: 3.1H
Original Specific Comment #: 31
Comment: The text refers to Specification 02205 for requirements regarding (1) removal of sediment from the wash pad, drain line, trenches, and oil/water separator and

(2) hauling the sediment to the On-Site Disposal Facility. However, Specification 02205 does not contain such requirements. The text of Specification 02850 should be revised to present the missing requirements.

Response: Article 1.7.B of Section 02205 of the technical specifications defines Unclassified Impacted Material; sediment is included in that definition. The sediment from the Equipment Wash Facility is to be handled as unclassified impacted material. The Equipment Wash Plan discussed in response to U.S. EPA Specific Comment No. 30 requires the contractor to submit, for approval by DOE's representative, the operations requirements and schedule, to include the removal of sediment.

Action: Article 1.7.B of Section 02205 will be revised to include the Equipment Wash Facility as a source for sediment.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Drawings Sheet #: X0002 Line #: NA
Original Specific Comment #: 32

Comment: The titles of the drawings listed on this index sheet do not agree with the drawing titles listed in Table 2-1 on Pages 2-12 and 2-13 of the "Design Criteria Package for Area 2, Phase I, Southern Waste Units Remedial Action Project Design and Construction. These discrepancies should be resolved.

Response: Agree.

Action: Table 2-1 of the Design Criteria Package will be revised to reflect the revised drawing titles of the construction drawings for the Excavation Package. In instances where a drawing is found in both the Site Preparation and Excavation Packages, the title as shown will remain and notation will be incorporated into the table to denote the correct title for the Excavation Package title.

OEPA COMMENTS ON THE DRAFT AREA 2, PHASE I SOUTHERN WASTE UNITS INTEGRATED REMEDIAL DESIGN PACKAGE FOR OPERABLE UNIT 2 APRIL 1998

GENERAL COMMENTS

DOE #1 A number of comments by both the U.S. EPA and the Ohio EPA focus on the presence or absence, type and extent of impacted material requiring remediation, the approach to defining the areas of excavation, and the approach to implementing excavation (including field monitoring and field controls), particularly in the above-WAC areas. Because these topics are highly interrelated, the typical comment-by-comment response would not adequately convey the overall technical approach and underlying logic being employed. Due to the interrelationship of these issues, several technical meetings were held between DOE, U.S. EPA, and Ohio EPA on these Sitewide Excavation Plan (SEP) and A2PI issues between November 1997 and January 1998, and specifically on these A2PI issues on January 14, 1998. From these meetings and discussions, DOE has assembled the following to present the technical approach for identification and excavation of (a) buried above-WAC areas, (b) below-WAC areas, and (c) sporadic occurrences of excluded materials; restricted materials, and other special materials.

This will be referred to as DOE No. 1 in the A2PI IRDP Response to Comments package. Entries are numbered to facilitate cross-reference. Bullets (o) are used to denote discussion (in response to specific comments) which further illustrate the preceding entry. The Comment column references pertinent U.S. EPA and Ohio EPA comments, where additional discussion and action to be undertaken as a result of the identified comments are presented.

	TECHNICAL APPROACH COMPONENT	COMMENT
1.	**PRESENCE/ABSENCE, TYPE & EXTENT**	
a.	Continuous contamination — can be seen in a random physical sampling program; can be bounded by additional biased sampling during predesign investigation and excavated in bulk during remediation.	OEPA Specific Comment No. 14
b.	Localized contamination/sporadic occurrences — will not necessarily be seen by a random physical sampling program; are best identified by visual observation and/or real-time measurements during excavation, and segregated management until proper disposition is determined in accordance with the WAC Attainment Plan (20100-PL-0014). Examples include excluded materials, restricted materials, and other special materials.	OEPA Specific Comment Nos. 14, 30, 40, 54 and 84

	TECHNICAL APPROACH COMPONENT	COMMENT
c.	The following two primary concerns regarding WAC attainment each require a specific approach during planning and implementation of excavation: 1. *excluded material* — material excluded from disposal in the OSDF); *restricted material* — material excluded from the OSDF unless the restricting requirements are met; or *special material* — material with special safety concerns or needing other special handling; special material may or may not meet OSDF WAC. See 3.c. 2. *above-WAC material* — exceeds the OSDF radiological WAC. See 3.e and 3.f.	OEPA Comment Nos. 14, 41 and 84
2.	**PREDESIGN**	
a.	Identify existence of above-WAC areas — use physical data (RI/FS), supplement with predesign sampling programs to further define area and depth of known contamination or to fill data gaps.	OEPA Comment Nos. 15 and 19
b.	Delineate extent — base on RI/FS or physical data, supplement by three-dimensional modeling and cross-sections. Establish the pre-determined excavation boundary (ceiling, floor and sides); set it conservatively (i.e., with a buffer).	U.S. EPA Specific Comment No. 4; OEPA Comment Nos. 32 and 84
	◦ RI/FS sampling identified five potential areas in A2PI exceeding the OSDF radiological WAC. Predesign sampling and analysis were performed on these suspect above-WAC areas to confirm and bound the extent of the above-WAC material to be excavated. Results of this sampling effort showed that four of these areas (SWU-1, SWU-2, SWU-3, and SWU-4) did not exhibit total uranium (and Tc-99 in the case of SWU-4) concentrations above the OSDF WAC. Rationale for the sampling program is presented in PSP 20400-PSP-0001, Rev. 0, August 1997 (Project Specific Plan: Delineation of Areas Exceeding WAC, Area 2, Phase I).	OEPA Comment Nos. 15, 19, 63 and 73
c.	Present the designed excavation boundary in the Implementation Plan for regulatory review. The graphical presentation will indicate that the excavation boundary sufficiently envelopes the modeling results and physical data.	U.S. EPA Specific Comment No. 4; OEPA Comment Nos. 1, 14, 17, 63, 64, 74 and 84
3.	**EXCAVATION**	
a.	Use efficient field survey control methods to ensure implementation of design drawings— standard horizontal instrumentation and controls such as stakes and lines for sides, vertical survey instrumentation for depth, and real-time gamma instrumentation — to monitor and control the excavation.	U.S. EPA Specific Comment No. 4

TECHNICAL APPROACH COMPONENT	COMMENT
b. Excavate below-WAC overburden in the buried above-WAC area or laterally outside of the buried above-WAC area. Use 3±1-foot lifts.	U.S. EPA Specific Comment No. 4; OEPA Comment No. 32
c. Perform continuous visual observation of the excavation face to identify and segregate special material. On a case-by-case basis, handle those materials according to the special safety and handling concerns, and disposition those materials in accordance with the WAC Attainment Plan.	OEPA Comment Nos. 14, 30 and 41
◦ As a best management practice, the WAC Attainment Plan commits that any process-related equipment or piping encountered during remediation of identified OU2 subunits — A2PI Active Flyash Pile debris, A2PI Inactive Flyash Pile debris, A2PI South Field debris, Sanitary Landfill debris, and Lime Sludge Ponds debris — will be segregated and visually inspected for "hold-up" or process residuals. If that debris is visually observed to contain any such material, it will be dispositioned off-site; if the interior cannot be visually observed, the material will be dispositioned off-site. There is the potential that a complete visual inspection/survey of all portions of a pipe (OEPA Comment No. 40), drum (OEPA Comment No. 54a) or other debris while it is located in the field (at the excavation face) would be impractical. In that situation, it would be removed from the excavation face and taken to an interim location (special materials transfer area) where it would be further evaluated. At that time, the decision will be made whether off-site or on-site disposition is appropriate. All special materials (e.g., excluded materials, restricted materials, acid brick) are handled in an analogous manner (visual observation to identify existence, handle for special concerns, and disposition accordingly). [DOE notes that process related metal is defined in the Operable Unit 3 Record of Decision (ROD), which does not name excavated drums as process related metals.]	U.S. EPA Specific Comment No. 5; OEPA Comment Nos. 14, 30, 40, 54 and 90
◦ During the A2PI site preparation activities, piping (metal and corrugated plastic) with visually observable orange/brown residue and soil was encountered in the field while excavating the slope north of Retention Basin No. 2, and was managed in accordance with the above (i.e., containerized for future off-site disposition).	OEPA Comment Nos. 40 and 90

	TECHNICAL APPROACH COMPONENT	COMMENT
d.	Perform real-time monitoring of the surface after every 3±1-foot lift to provide detection of an unexpected encounter with buried above-WAC material: 1. if encounter is vertically or laterally proximal to the pre-determined buried above-WAC volume, follow 3.f. 2. if the encounter is in an area not proximal to the pre-determined above-WAC material, follow 3.g.	U.S. EPA Specific Comment No. 4; OEPA Comment No. 32
e.	Field determine/verify nearing the pre-determined bounds of the buried above-WAC material (e.g., ceiling, sides) using real-time instruments and field survey techniques; see 3.a and 3.b.	U.S. EPA Specific Comment No. 4; OEPA Comment No. 32
f.	After the above-WAC material is encountered (either via early detection using real-time instrumentation under 3.d.1, or the pre-determined bounds under 3.e), use 4-foot lifts. Excavate down to the pre-determined floor, and out to the pre-determined sides, of the above-WAC material. Disposition as above-WAC material. Continue use of real-time instruments and field survey techniques to control and monitor excavation boundary. Continue in this manner until the excavation surface is no longer above the OSDF radiological WAC.	U.S. EPA Specific Comment No. 4; OEPA Comment Nos. 32 and 75
g.	If above-WAC material is encountered under 3.d.2, the contractor's excavation activity will be moved to another location while DOE's representatives use real-time monitoring to determine the revised excavation approach for that area. Where the real-time 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 resuming excavation in that area.	

Commenting Organization: OEPA Commentor: OFFO
Section #: General Comment Pg #: Line #: Code: M
Original Comment #: 1
Comment: Ohio EPA does not believe the document sufficiently defines or justifies the proposed excavation boundaries or approach. Data are not presented in a format to support excavation plans and excavation activities during site preparation suggest the data collected to date are not representative of actual conditions. The IRDP must be revised to incorporate additional sampling data, available information gained during the site preparation activities, and improved data evaluations.

Ohio EPA believes the required changes to this document may result in substantial changes to the scope of the A2P1 contract which DOE and FDF are already moving forward. It is not prudent to continue to issue RFPs prior to EPA review of draft IRDPs due to the like scope changes and additional data needs. Hopefully, DOE and FDF can clearly see the

problems associated with continuing on the existing course of RFP release prior to agency comments on the IRDP.

Response: Noted; the draft IRDP was prepared prior to collection and validation of all pre-design data. Three types of pre-design data were collected: 1) site preparation, 2) above-WAC delineation, and 3) lead contaminated soil delineation. Since the October 1997 IRDP submittal, all site preparation sample data has been finalized and validated. Additional above-WAC and lead contaminated soil data were collected. Updated data will be submitted in improved formats with the next revision of the IRDP.

The estimated duration for a major DOE contract procurement process is five to six months. As discussed in recent DOE/OEPA meetings (i.e, January 14, 1998), DOE is continuing with the RFP process. This process must be initiated prior to final approval of the IRDP in order to meet future regulatory milestones. Changes to technical approach resulting from regulatory comments will be incorporated into the process and final contract as necessary and appropriate.

Action: The IRDP will be revised to include all validated data, statistics, text, and figures tieing design with data. Text will also be added to the IRDP describing the approach presented in DOE No. 1.

The RFP process will continue and DOE will keep the regulators apprised of the progress.

IMPLEMENTATION PLAN

Commenting Organization: OEPA Commentor: OFFO
Section #: General Comment Pg #: Line #: Code: g
Original Comment #: 2
Comment: Issues such as comparability of RSS data to RTRAK, use of HPGe to quantify Ra-226, and special geometry considerations in this area have yet to be fully resolved. Presumably, this is forthcoming in the SOP's, Limitations, and QA/QC documents being developed.

Response: The comment is correct. By the end of March 1998, three major sets of documents should be completed which will fully address and resolve all issues noted above:

1) A User's Manual (referenced in response to U.S. EPA General Comment No. 2 on the July 1997 Draft of the Sitewide Excavation Plan) which contains user guidelines, conventions, measurement approaches, operational factors, strengths and limitations of in situ gamma spectrometry, and a glossary of definitions.

2) A seven element QA/QC program as detailed in the response to U.S. EPA General Comment No. 2 on the July 1997 Draft of the Sitewide Excavation Plan. .

3) Revision 1.0 of the HPGe Comparability Study, which contains all of the addenda written since July 1997, and Revision 1.0 of the RTRAK Applicability Study, which contains addenda written since July 1997.

The contents of these documents will be discussed in the Real-Time Technical Workgroup Meetings where draft copies of the documents will be given to U.S. EPA and OEPA for review and comment.

Action: No action at this time.

Commenting Organization: OEPA Commentor: OFFO
Section #: General Comment Pg #: Line #: Code: g
Original Comment #: 3

Comment: In general, the dust control measures outline in this plan appear to be adequate to minimize the generation of fugitive dusts and if properly implemented would achieve compliance with the 'best available technology' (BAT) requirement of the Ohio Administrative Code (OAC) 3745-31-05(a)(3). This rule has been cited as an ARAR in both the Operable Unit 2 and Operable Unit 5 RODs.

It has been our position that compliance with BAT will be demonstrated by attaining the visible particulate emission limitations of OAC 3745-17-12. These limitations are more stringent than OAC 3745 -17-07 (B)(4),(5), and (6) which are referenced in Table a-2 of the Plan. Test methods to measure compliance with the rule can be found in 40 CFR Part 60 Appendix A Method 22 and Method 9.

There are three air emission documents referenced in this plan. The Technical Specifications in several locations refers to 'Part 6', but we have not been able to locate it in your submittal. The Contractor is to submit a Dust Control Plan. Ohio EPA would like the opportunity to review and approve this Plan. There are several references to "Fugitive Dust Control Requirements" (RM-0047). Please provide a copy of this, too.

Response: The fugitive dust control BAT requirements and fugitive emission limits for the FEMP have been determined and documented via multiple correspondences between OEPA and DOE on the subject (the most recent of which was DOE-1133-97, dated June 27, 1997). Subsequently, those dust control requirements and limits have been re-presented in multiple documents to disseminate that information to the various FEMP implementing projects and organizations. Among those are the following:

- RM-0047, "Fugitive Dust Control Requirements" — presents the fugitive dust control BAT requirements and fugitive emission limits, making them applicable sitewide to the FEMP projects. Presents the same BAT summary table as found in DOE-1133-97. Also presents citations to the pertinent regulations (OAC and 40 CFR) and measurement methodologies contained therein and mentioned in the comment.

- "Sitewide Excavation Plan" (SEP, 2500-WP-0028), Section 5.1.2.2 — presents the BAT requirements and fugitive emission limits (from the BAT determination and RM-0047), as they apply to and are to be implemented by the Soil Characterization and Excavation Project. Presents as Table 5-1 the same (albeit reformatted) BAT summary table as found in DOE-1133-97 and RM-0047.

- Part 6 — contract documents between DOE's representative and the contractor. One subsection/exhibit of Part 6 emphasizes the importance of proactive dust suppression, communicates the dust control requirements and fugitive emission limits established

by the BAT determination, requires submission from the contractor of a Dust Control Plan, and provides details for what is to be included in that plan. That subsection of Part 6 was developed from RM-0047 and subsection 5.1.2.2 of the SEP. In accordance with the contract, the contractor must submit a Dust Control Plan to DOE's representative for review and approval to ensure compliance with requirements presented in Part 6, and thus compliance with the site BAT determination. This subsection of Part 6 standardizes language to be used as a boilerplate in future contract solicitations.

Because OEPA has reviewed and approved the BAT determination for the FEMP, and has reviewed the dust control requirements (developed from the BAT policy) applicable to soil remediation as put forward in the SEP, it is therefore appropriate for DOE alone to review and approve the contractor's Dust Control Plan. DOE anticipates that OEPA will continue its field oversight of soil remediation activities, including implementation of dust control.

Action: See the attached RM-0047, "Fugitive Dust Control Requirements".

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: General Pg #: Line #: Code: C
Original Comment #: 4
Comment: A number of areas in the text uses the term 100 percent coverage with regard to HPGe. This does not appear well defined as the fluence signal generated from an area more radially distant from the detector carries less weighting. For A2P1 a dense real-time survey protocol seems essential particularly during pre-certification work in light of the 95% UCL of 6.2 ppm being so close to the 10 ppm FRL for Uranium.

Response: The term 100 percent coverage is fully explained in the forthcoming User's Manual. Briefly, however, 100 percent real-time coverage occurs when the area of the total field of view of all measurements in a given area equals the surface area of that area. See the response to U.S. EPA General Comment Nos. 2 and 4 for the July 1997 Draft SEP, which address the User's Manual, real-time instrumentation, precertification and certification.

The potential for the 95 percent upper confidence level (UCL) on the mean being close to the FRL is noted. DOE will take that into account when it formulates its precertification and certification strategies for A2PI.

Action: See the action for the referenced comments.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 1.0 Pg #: ES-2 Line #: 14-25 Code: C
Original Comment #: 5
Comment: Excavation volumes included on this page are not consistent with others in the document (e.g., Section 2.1 and Appendix A, pg. 1-1). The entire document should be reviewed for inconsistencies in the reported excavation volumes.

Response: Noted. The earthwork calculations, found in Appendix C of the Implementation Plan (IP), have been revised, and the data will be incorporated consistently throughout the IP.

Action: The earthwork volumes will be corrected according to the revised calculations, and will be checked throughout the entire IP for consistency.

Commenting Organization: OEPA Commentor: OFFO
Section #: ES Pg #: ES-3 Line #: Code: C
Original Comment #: 6

Comment: The document is confusing regarding when/how areas within A2PI but outside of the specific units (IAFP, SF, AFP) will be remediated and certified. Specific areas include underneath non-impacted stockpile No. 1, the running track area, etc. Please revise the document to clarify when and how these areas will be remediated.

Response: The Area 2, Phase I (A2PI) remediation area consists of two general areas: the waste unit areas and the non-waste unit areas. The waste unit areas consist of the areas encompassed by the three specific waste units - the Inactive Flyash Pile, South Field and Active Flyash Pile. The non-waste unit areas consist of the areas adjacent to the waste units and include: the three retention basins, Non-impacted Stockpile No. 1, other A2PI support facilities and other adjacent areas. Separate Certification Design Letters (CDLs) will be prepared and approved by the regulators for each A2PI area.

Certification and interim restoration of the A2PI waste unit areas will be performed immediately following excavation. The CDL will be submitted in the year 2001. Certification and interim restoration are scheduled to be completed in the second half of 2000. Interim restoration is expected to consist of minor regrading to flatten slopes and improve drainage.

Certification and interim restoration of the A2PI non-waste unit areas will be performed after the waste unit areas are certified. This CDL will be submitted in the year 2001. Activities within this area will be performed in a phased manner with removal and excavation activities. These activities will include:

- Removal of all HDPE liners
- Removal of pipes no longer required and not in common trenches
- Using material from Non-impacted Stockpile No. 1 to backfill Retention Basin No. 2
- Construction of open channel spillways for Retention Basin Nos. 1 and 3.

The details of the above activities will be presented in a Natural Resource Restoration Plan (NRRP) for the area. A separate design package will be prepared within a year prior to the scheduled start date.

Action: The A2PI Implementation Plan will be revised to define and clarify the restoration and certification approach for A2PI.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 1.0 Pg #: 1-3 Line #: 24-28 Code: C
Original Comment #: 7

Comment: Referenced Section 3.4.2.3 does not exist and should be replaced in line 24 with 3.4.2.2. The reference to Section 3.4.2.2 in line 25 is incorrect and should be replaced with 3.4.2.1. The reference to Section 3.3.2.2 in line 27 is also incorrect and should be replaced by 3.3.2.3.

Response: Noted.

Action: The text will be revised to reference the correct sections.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 1.0 Pg #: 1-5 Line #: 5 Code: E
Original Comment #: 8
Comment: For consistency with the other bullets in this list, the text should be revised to accurately indicate the title of Section 5.0. As a result, the word "Matrix" should be deleted.

Response: Noted.

Action: Text will be revised accordingly.

Commenting Organization: OEPA Commentor: OFFO
Section #: 1.2.1.2 Pg #: 1-6 Line #: Code: C
Original Comment #: 9
Comment: Considering the substantial amount of information gained during site preparation activities concerning waste materials, the effectiveness (or lack thereof) of physical sampling to characterize, etc., Ohio EPA believes it is important to incorporate a discussion of the materials encountered and lessons learned during the site prep work.

Response: Lessons learned from both A2PI and A2PI site preparation phase were used to improve the A2PI excavation package.

Action: Section 1.5 which summarizes how some of the lessons learned in A1PI and A2PI site preparation phrase were incorporated into the A2PI excavation package. These lessons were especially critical regarding actual experience with excavation of the South Field during site preparation.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 1.0 Pg #: 1-9 Line #: 22 Code: E
Original Comment #: 10
Comment: Replace "from" with "during."

Response: The intent of this sentence was to clarify that stormwater discharges from the A2PI project area are covered under the NPDES permit.

Action: The text will be revised to read as follows: "Stormwater discharges from the A2PI project area during remediation are covered under the existing National Pollution Discharge Elimination System (NPDES) permit....".

Commenting Organization: OEPA Commentor: OFFO
Section #: 1.3.3 Pg #: 1-10 Line #: 28 Code: C
Original Comment #: 11
Comment: It is Ohio EPA's understanding that the actual construction of Basin 1 has resulted in a berm height of 541 msl thus eliminating the need for sand bags. If this is correct, please revise the document accordingly.

Response: The berm of Retention Basin No. 1 was built to a final elevation of 541.5 msl, thus eliminating the need for sand bags.

Action: The text will be revised to read: "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."

Commenting Organization: OEPA Commentor: OFFO
Section #: 1.5 Pg #: 1-13 Line #: Code: C
Original Comment #: 12
Comment: Are the lessons learned documented at any point in the process? If so Ohio EPA would like to receive a copy of these so that information and lessons can be shared more broadly and that we may understand changes being implemented. Additionally, the lessons learned from site preparation should be incorporated into the revision of this document.

Response: Lessons learned from site preparation and changes made to the IRDP as a result of lessons learned will be incorporated into the revised Implementation Plan (IP). See also the response and action for OEPA Comment No. 9.

Action: The text in Section 1.5 of the IP will be revised to incorporate lessons learned from the A1PI and A2PI site preparation phase of the project, and a discussion of how the IRDP has been revised to incorporate those lessons learned.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 2.0 Pg #: 2-3 Line #: 28 Code: C
Original Comment #: 13
Comment: This document should include an explanation of the geostatistical modeling used to estimate the extent of the above-WAC material. The explanation should include an account of the structural form assumed for the data and the procedures used to assess model accuracy.

Response: Noted.

Action: Appendix D has been revised to include an explanation of the geostatistical modeling.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.1.2.1 Pg #: 2-3 Line #: 22-24 Code: C
Original Comment #: 14
Comment: The fact that site prep sampling data showed no above-WAC material while significant amount of such material were encountered during the excavation of Basin 2, suggests the current characterization data are inadequate to characterize above-WAC areas. The document should be revised to address this issue.

Response: Sampling was performed in the south Field to identify potential soil material with above-WAC concentrations. During excavation of the South Field during site preparation, potential special materials were encountered, identified and segregated based on visual observations. This experience indicates that the proposed process will work. Also see DOE No. 1, particularly 1.c and 3.c.

Action: Based on the lessons learned during the site preparation phase, text discussing the techniques and processes presented in DOE No. 1 will be incorporated into Appendix D of the revised Implementation Plan.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.2.2 [sic, 2.1.2.2] Pg #: 2-3 thru 4 Line #: Code: C
Original Comment #: 15

Comment: This discussion is inadequate to fully address the basis for eliminating above-WAC areas as defined by validated RI/FS data and a signed ROD. Additionally, making such a conclusion on "preliminary results" is unacceptable. The document should be revised to provide additional justification or inclusion of the original WAC areas.

Response: See DOE No. 1, particularly entry 2.b and the response to OEPA Comment No. 1.

Action: Appendix D of the Implementation Plan text will be revised to include a summary of sampling rationale, data and additional justification for eliminating SWU-1, SWU-2, SWU-3, and SWU-4 as above-WAC concerns. Also see the action for the referenced comment.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.1.2.3 Pg #: 2-4 Line #: 25-27 Code: C
Original Comment #: 16

Comment: In the case of the firing range the lead FRL is rather irrelevant until final certification of the area. The sampling should be aimed at defining the boundaries of the characteristic hazardous waste. For example, if soil containing 200 ppm fails TCLP then this material must also be removed under the lead soil excavation. This is an important distinction from the trap range as all soil in the firing range area will be removed not just that above the lead FRL. If as suggested in this section the sampling was solely aimed at defining areas above 400 ppm rather than areas failing TCLP then the characterization was insufficient.

Response: 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 end of occurrence or 1952 contour lines, whichever is deeper; the remediation driver in native soil is the total lead final remediation level (FRL) of 400 ppm.

The TCLP lead analysis performed for this sampling event was not intended to delineate the extent of potentially toxicity characteristic hazardous waste. The TCLP lead analysis was performed to determine the feasibility of field sieving bullets and bullet fragments from soil and analyzing the remaining media to potentially render the remaining soil non-characteristic and thereby realize a significant savings in disposition costs. Initially, three soil samples were collected (one from an area of high bullet density, one from an area of moderate bullet density, and one from an area of low bullet density) and analyzed for TCLP lead. At the request of OEPA, any samples exceeding a total lead concentration of 200 mg/kg were pulled from archive and submitted for TCLP lead analysis. These results are pending and will be added to the Implementation Plan (IP) text and associated tables and figures.

A separate sampling/analytical effort to bound the toxicity characteristic lead excavation will be undertaken. The sampling and analysis plan (a new PSP or a variance to "Project Specific Plan for Lead Delineation in the Area 2 Phase I Firing Range," 20402-PSP-0001, Rev. 0, November 1997) will be submitted under separate cover. Results of this sampling event will be used to modify the excavation and disposition approach for this material prior to field excavation implementation, scheduled for FY 1999.

Action: Text in Appendix D of the IP will be revised to clarify remediation drivers(s) in the firing range and to discuss additional TCLP analysis.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.1.2.3 Pg #: 2-5 Line #: 1-4 Code: C
Original Comment #: 17
Comment: All sampling should have been completed and incorporated into this Implementation Plan. The IMP will need to be revised and resubmitted for review and approval with the additional data and any proposed design modifications.

Response: Noted. See the response to OEPA Comment No. 1.

Action: Other than the additional sampling effort to bound the toxicity characteristic lead excavation as presented in the response to OEPA Comment No. 16, all data (and applicable tables and figures) will be included in Appendix D of the revised Implementation Plan, as well as any design modifications (and subsequent drawing revisions) made as a result of the data results.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.2 Pg #: 2-5 Line #: 6 Code: e
Original Comment #: 18
Comment: Is the terminology "excavation ASCOCs" in such wide use that it cannot be changed? We suggest using the term "excavation drivers" because it is more descriptive. "Excavation ASCOC" is easily confused with similar acronyms like "COEC".

Response: Noted. However, "excavation ASCOCs" is widely used (e.g., PSPs), and its meaning is established among users. Confusion with other acronyms is not anticipated.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.2 Pg #: 2-5 Line #: 25-26 Code: C
Original Comment #: 19
Comment: Section 2.1.2.2 does not provide a sufficient discussion of data to warrant ASCOC elimination. Additionally, validated RI/FS data hits for Tc-99 do exist. Therefore Tc-99 should be included.

Response: Noted. The Tc-99 presence/absence issue has been the subject of discussions between DOE and the agencies. As presented in the January 14, 1998 meeting between U.S. EPA, OEPA, and DOE, the Tc-99 concentration of concern in the Inactive Flyash Pile (SWU-4) was non-validated data from the 1986 Roy F. Weston Characterization Investigation Study. Subsequent sampling (1997) at the approximate Tc-99 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 SEP sampling to a depth 3 feet below the lowest known contamination depth). Also see DOE No. 1, particularly entry 2.b.

Action: The above discussion has been incorporated into Appendix D of the revised Implementation Plan. Also see the action for OEPA Comment No. 15.

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.3.3 Pg #: 2-7 Line #: 10 Code: e
Original Comment #: 20
Comment: Typographical error "6700g/L".

Response: The correct units are micrograms per liter.

Action: The text will be revised to read: "6700 μg/L".

Commenting Organization: OEPA Commentor: OFFO
Section #: 2.4.2 Pg #: 2-8 Line #: Code: C
Original Comment #: 21
Comment: See previous comment regarding inadequacy of excavation based on 400 ppm lead.

Response: See the response to OEPA Comment No. 16.

Action: See the action for the referenced comment.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 2.0 Pg #: 2-8 Line #: 28 Code: E
Original Comment #: 22
Comment: This sentence is redundant with the immediately preceding sentence beginning on Line 24.

Response: Noted.

Action: The sentence on line 28 will be deleted.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 2.0 Pg #: 2-9 Line #: 2 Code: E
Original Comment #: 23
Comment: Replace "excavation" with "material."

Response: Noted.

Action: The text will be revised as suggested.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-4 Line #: 2 Code: C
Original Comment #: 24
Comment: Referenced ESpec 02150 discusses traffic control and contains no discussion of turning the wood chip stockpile.

Response: The requirement for the excavation contractor to maintain the wood chip stockpile was deleted between the 95 percent design submittal and the certified for construction (CFC) submittal. Technical Specification section 02150 was changed from "Site Preparation" to "Traffic Control". The Implementation Plan (IP) was not updated to reflect changes made to the technical specifications or construction drawings between the 95 percent design submittal and the CFC submittal. DOE will be responsible for managing the wood chip stockpile during the excavation contract.

Action: The text will be revised and state that DOE will be responsible for the management of the wood chip stockpile.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.1.4 Pg #: 3-4 Line #: 1-2 Code: C
Original Comment #: 25
Comment: The revised specification package states that the chip pile will be the responsibility of FDF with regards to turning. Please clarify.

Response: See the response to OEPA Comment No. 24.

Action: See the action for the referenced comment.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.1.4 Pg #: 3-4 Line #: 6 Code: C
Original Comment #: 26
Comment: Final clearing occurred prior to completion of the stormwater management facilities. Please revise.

Response: Noted. The original clearing concept was to stage clearing activities to minimize additional runoff and erosion. However, because all stumps and root masses were left in place, staging clearing activities was not critical.

Action: The text of Section 3.1.4 will be revised to delete references to staging clearing activities.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.1.7.6 Pg #: 3-8 Line #: 27-29 Code: C
Original Comment #: 27
Comment: As stated in a previous comment, Ohio EPA understands the final berm elevation will be at 541 msl thus eliminating the need for the sand bags.

Response: See the response to OEPA Comment No. 11.

Action: The text will be revised to indicate that the embankment was constructed to elevation 541.5 msl.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-9 Line #: 24 Code: C
Original Comment #: 28
Comment: A figure is needed showing the locations of the 17 monitoring wells that will be abandoned. The figure should also indicate the nearest wells in the sitewide network that will remain intact.

Response: The construction drawing package included with this IRDP contains a drawing showing the location of all monitoring wells relevant to the A2PI project, indicating those that have been abandoned and those that are to remain.

Action: Section 3.1.8 will be revised to reference construction drawing G0004, which shows the monitoring wells associated with A2PI.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-9 Line #: 24 Code: C
Original Comment #: 29
Comment: According to Section 3.5.1.2 of the IEMP, wells 3402 and 2402 are included in the 21 wells that are planned to be used in monitoring the South Field Extraction area in 1997 and 1998. Please revise Table 3-1 to indicate the status of these wells.

Response: Wells 3402 and 2402 will be used in the monitoring of the South Field Extraction area; however, they are not located within the boundaries of the A2PI project area, and are therefore not included in Table 3-1. Table 3-1 addresses only the groundwater wells that are located within the defined boundaries of the project.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.1.9 Pg #: 3-9 Line #: Code: C
Original Comment #: 30
Comment: This section does not address the additional pile created within the SF containing material from the radioactively controlled zone. This section and the document should be revised to incorporate a strategy for characterization and removal of this pile.

Response: Upgrading part of the South Field to a radiological controlled zone does not affect the WAC attainment status of the material. Prior to placement in the South Field Impacted Material Stockpile, special material from the radiological controlled zone was removed in the same manner that special material was removed from material originating outside of the radiological controlled area. Since identical waste management practices were employed for material placed in all areas of the South Field Impacted Material Stockpile, characterization and removal strategies for the entire pile should also be consistent. Special material encountered in the radiological controlled zone during site preparation excavation was segregated and containerized; the underlying soil was monitored by HPGe and found to be below the OSDF total uranium WAC prior to its placement in the stockpile.

From an OSDF WAC attainment perspective, there is only one South Field Impacted Material Stockpile.

Removal of the South Field Impacted Material Stockpile will be executed similar to SWUs excavation with emphasis on visual observation and HPGe measurements for WAC determination when special material is encountered.

Action: Text will be revised to describe the removal strategy of the impacted stockpile in the A2PI area.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-13 Line #: 21 Code: C
Original Comment #: 31
Comment: Because excavations may extend into material considered to be part of the Great Miami Aquifer (GMA), this Section 3.3.2 should discuss what approach (e.g., soil conditions, the

presence of sharp contact between glacial overburden and underlying material, field survey information, etc.) field workers will use to determine when the GMA has been encountered.

Response: Field workers will use visual inspection for determining when the GMA has been encountered. The operators and the FEMP personnel monitoring the excavation will undergo field instruction prior to excavation; general identification of glacial overburden, fill (construction debris), and GMA material will be provided during the field instruction.

Action: The text will be revised to indicate emphasis on visual inspection.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.3.2.2 Pg #: 3-14 Line #: 19-21 Code: C
Original Comment #: 32
Comment: It is not acceptable to define the top of the above-WAC area with real time instruments. Ohio EPA has stated its position regarding the use of real time is only to expand upon previously defined WAC boundaries. In keeping with this use Ohio EPA requires a known elevation for the initiation of WAC excavation with the ability to initiate WAC excavation earlier based upon real-time data. The document should include and justify an elevation at which above-WAC excavation will occur.

Response: See DOE No. 1, particularly entries 2.b and 3.d.

Action: Appendix D of the Implementation Plan has been revised to discuss the definition of the above-WAC boundaries. Also see the action for U.S. EPA Specific Comment No. 4.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-15 Line #: 13 Code: C
Original Comment #: 33
Comment: Referenced Section 3.4.2.3 does not exist. The correct section reference is probably 3.4.2.2.

Response: Noted.

Action: The reference will be changed to 3.4.2.2.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.3.2.2 Pg #: 3-15 Line #: 15-22 Code: C
Original Comment #: 34
Comment: See previous comment regarding inadequacy of excavation based on 400 ppm lead.

Response: See the response to OEPA Comment No. 16.

Action: See the action for the referenced comment.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-15 Line #: 27 Code: E
Original Comment #: 35
Comment: Replace "Edwg60008" with "EPwgG0008."

Response: Noted.

Action: The text will be revised as suggested.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-16 Line #: 11 Code: E
Original Comment #: 36
Comment: Replace "approximately" with "approximate."

Response: Noted.

Action: Text will be revised as suggested.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-17 Line #: 5 Code: C
Original Comment #: 37
Comment: The referenced Section 3.4.2.2 is incorrect. The correct section reference is probably 3.4.2.1.

Response: Noted.

Action: The section reference will be changed to 3.4.2.1.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section#: 3.0 Pg #: 3-17 Line #: 29 Code: E
Original Comment #: 38
Comment: Replace "-Espec 02205)" with "(Espec 02205)."

Response: "- Espec 02205)" is part of a larger parenthetical phrase which starts on line 28.

Action: No action.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-19 Line #: 2 Code: C
Original Comment #: 39
Comment: The text indicates that temporary excavation sumps will be constructed at the bottom of excavations for dewatering purposes. In areas where above-WAC material is being excavated, the text should indicate how field workers will know when a given excavation is nearing the GMA so that the liner material can be installed in a timely manner. Additionally, what safety factor will be used to account for potential errors in the determining the GMA contact depth? For example, will a sump constructed to 1 foot above the estimated GMA require a liner? It would seem more protective of the GMA if temporary sumps in above-WAC areas were lined as they approach or before they extend into the aquifer instead of after as indicated on page 3-19.

Response: The primary function of the excavation sumps is to centralize sediment from active excavation areas and prevent unnecessary dispersion of sediment, not to protect the GMA 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. The excavation contractor will provide final design details of the sumps, but they are required to contain a riser, sediment storage, and pump. A liner will be used to line the sump when the GMA is encountered. The liner will consist of a 60 mil HDPE liner or other approved material and may include a large plastic basin. Constructing a lined sump above the GMA and then continuing the excavation below it is not practical; the sump will not work in this configuration. Sumps must be constructed at the low point of the excavation in order to properly function.

Excavation of the IFP and above-WAC material is inherently protective of the GMA, since water currently percolating through the IFP (including the above-WAC material) into the GMA 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 GMA.

There is no need to define how field personnel will identify when they are nearing the GMA or a safety factor for installing geomembrane liner in a sump prior to encountering the GMA, since the geomembrane liner will not be installed prior to encountering the GMA.

Action: The text of the Implementation Plan will be revised to discuss the sequencing of installation of the sumps, what can practically be achieved during excavation, and to emphasize that the primary intention of the excavation sumps in the above-WAC excavation is to centralize sediment collection.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.4.2 Pg #: 3-25 Line #: 22 Code: c
Original Comment #: 40
Comment: The Plan states that, "Before size reduction, pipe will be inspected to ensure that it contains no process material." This appears to be a rather meaningless commitment. It is hard to imagine how pipes would survive burial for so many years and not be completely plugged with soil.

Response: This commitment is made as a result of the commitment made in the WAC Attainment Plan to visually inspect all debris, process-related piping and equipment for process material residuals. During the site preparation activities, piping (metal and corrugated plastic) with orange/brown residue and soil was encountered in the field while excavating the slope north of Retention Basin No. 2.

Also see DOE No. 1, particularly 3.c.

Action: No action.
Commenting Organization: OEPA Commentor: OFFO
Section #: 3.3.5 Pg #: 3-23 Line #: Code: C
Original Comment #: 41
Comment: Ohio EPA disagrees that additional monitoring will not be required during excavation of the South Field Impacted Material Stockpile. Ohio EPA does not believe that above-WAC materials were sufficiently excluded from this pile, thus necessitating additional monitoring/characterization during excavation. Additionally the section should address the other pile of material placed in the SF as a result of excavations in the controlled area.

Response: See the response to OEPA Comment No. 30.

Action: See the action for the referenced comment.

Commenting Organization: OEPA Commentor: OFFO
Section #: 3.4.2.4 Pg #: 3-24 Line #: 32-33 Code: C
Original Comment #: 42
Comment: Reference to the IMPP should be to the version (1997) approved by the EPAs.

Response: Noted; draft Implementation Plan was submitted prior to the November 1997 approval by U.S. EPA and OEPA of the Impacted Material Placement Plan.

Action: The text will be revised to cite the most recent version of the Impacted Material Placement Plan (20100-PL-007, Revision 0, January 1998).

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: 3-28 Line #: 1 Code: C
Original Comment #: 43
Comment: The reference "EP-0008" is not defined.

Response: Noted. The reference to EP-0008 is being deleted, and a general reference to FEMP site procedures will be cited.

Action: The text will be revised to read as follows: "Access to certified areas will be granted in accordance with FEMP site procedures."

Commenting Organization: OEPA Commentor: OFFO
Section #: Figure 3-1 Pg #: Line #: Code: C
Original Comment #: 44
Comment: No soil was placed in non-impacted stockpile 2. The text and drawings should be revised to reflect this.

Response: Noted; the pile was not used during site preparation. However, the area designated for non-impacted material stockpile No. 2 is being held as a contingency for possible use during the excavation contract, and therefore should remain present on the drawings.

Action: The text of the Implementation Plan will be revised to reflect the status of Non-impacted Material Stockpile No. 2.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 3.0 Pg #: Figure 3-7 Line #: Code: C
Original Comment #: 45
Comment: The referenced figure in Note 4 should be Figure 3-9 instead of Figure 3-8. Also Note 6 is not shown on the Figure 3-7.

Response: Noted.

Action: Note 4 of Figure 3-7 will be revised to reference Figure 3-9, not 3-8. Figure 3-7 will be revised to show note 6 in the drawing, located at the bottom of the lowest lift of above-WAC material.

Commenting Organization: OEPA Commentor: OFFO
Section #: 4.2 Pg #: 4-3 Line #: 7 Code: c
Original Comment #: 46

Comment: Please provide a copy of "Fugitive Dust Control Requirements" (RM-0047). Control of fugitive emissions is discussed in Section 4.2.2. While there is a plan for staff to be available for visible dust mitigation during off-duty "dust alerts" there is no mention of what control or detection mechanisms are used at night.

Response: Visible dust observation during off-hours, including at night, will be performed by personnel conducting security patrols. Visible dust observed in excess of the limits in the BAT determination will trigger notification to the Assistant Emergency Duty Officer (AEDO); the AEDO will notify the appropriate pre-designated project contact who has responsibility for that area (e.g., A2PI, A1PII); the contact will give the off-hours dust alert notification to the location-dependent appropriate responsible entity (e.g., A2PI contractor, A1PII contractor). The AEDO has a sitewide diagram delineating the limits of dust control responsibilities of the individual projects (per the project design drawings), and the appropriate points of contact (primary and backup) for each. These will be kept current as each remediation project is planned (e.g., with each SCEP IRDP) and executed.

Action: RM-0047 is attached.

Commenting Organization: OEPA Commentor: OFFO
Section #: 4.2.2 Pg #: 4-5 Line #: 1 Code: c
Original Comment #: 47

Comment: The plan states that,"...all haul equipment will be required to be covered when hauling potentially dusty material." This conflicts with Section 02205 (page 10 of 19 P.3.) of the Technical Specifications Revision 0 which states," The cover shall be in place sealed during all periods of vehicular movement on-site, whether empty or full."

Response: The text in the Implementation Plan (IP) is consistent with the SEP regarding the covering of haul equipment, however a determination was made that the equipment will be hauling dusty material. Therefore, the A2PI contractor is being directed to cover loads of soil and soil-like materials at all times. The Technical Specifications were written specifically for the contractor of A2PI, and they were written more restrictive than the requirements of the SEP.

Action: No action.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 4.0 Pg #: 4-13 Line #: 17-32 Code: C
Original Comment #: 48

Comment: Table 3-1 includes nine IEMP monitoring wells four extraction wells that will continue to be sampled. The text indicates that there are 21 IEMP monitoring wells and 4 extraction wells. The text and table should be correct and consistent.

Response: The text and the table are both correct. Table 3-1 lists the groundwater wells present in the A2PI project area only for information, not to define the groundwater monitoring program for A2PI.

There are 21 IEMP monitoring wells and four extraction wells designated for the A2PI specific monitoring program. Nine of the IEMP monitoring wells and the four extraction wells are located within the actual A2PI project area, and are therefore included in Table 3-1; the remaining IEMP wells are not relevant to Table 3-1 and are therefore not listed. The text should not make reference to either Table 3-1 or EDwg G0004 in this section.

The discussion contained within section 4.4.2 of the Implementation Plan (IP) is correct regarding the 21 monitoring wells for the A2PI groundwater monitoring program; they are all IEMP wells.

Action: The reference to Table 3-1 and EDwg G0004 will be deleted from the text. A new table will be incorporated into Section 4 of the IP presenting the groundwater wells to be monitored for A2PI, which will help to clarify the groundwater monitoring program for A2PI.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 4.0 Pg #: 4-13 & Dwg. G0004 Line #: 18 Code: C
Original Comment #: 49
Comment: IEMP monitoring wells 3402 and 2402 are not shown on this drawing. The drawing should be revised to show these wells or an explanation is needed regarding their status. In addition, Monitoring Wells 2401 and 4016 could not be located on the drawing.

Response: Monitoring Wells 3402 and 2402 are not shown on the drawing because they are not located within the boundaries of the A2PI project. The construction drawings provide information to the contractor about existing conditions that will be encountered in the field.

Monitoring Well 4016 is on the drawing, but not labeled; it will be labeled prior to the next submission. Monitoring Well 2401 was inadvertently left off the drawing; it will be added and labeled for the next submission.

Action: Drawing Sheet No. G0004 will be revised to label Monitoring Well 4016 and to show and label Monitoring Well 2401.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 4.0 Pg #: 4-13 & Dwg. G0004 Line #: 17-32, 1-15 Code: C
Original Comment #: 50
Comment: The text indicates that there are 21 IEMP monitoring wells on Drawing G0004. The drawing only shows 20.

Response: See the response to OEPA Comment No. 48. The wells shown in Drawing Sheet No. G0004 are the wells located in the A2PI project area or its close proximity, and are presented in Table 3-1 of the Implementation Plan.

Action: The reference to EDwg G0004 will be deleted from the text.

Commenting Organization: OEPA Commentor: OFFO
Section #: 6.1.1 Pg #: 6-2 Line #: Code: C
Original Comment #: 51
Comment: The subsequent section should include a discussion of the WAO and its role in determining waste acceptance and categorization.

Response: Noted. The roles and responsibilities for the WAO are detailed in the WAC Attainment Plan. Section 6.9 of the Implementation Plan (IP) addresses the relationship between A2PI and other projects/organizations at the FEMP.

Action: The following summary of the WAO's role in relation to the A2PI project will be incorporated into Section 6.9 of the IP:

"Waste Acceptance Organization (WAO) - WAO, an FDF organization independent of both the soil- and debris-generating projects and the receiving OSDF project, has programmatic 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."

Commenting Organization: OEPA Commentor: OFFO
Section #: 6.4.1 Pg #: 6-16 Line #: 3 Code: c
Original Comment #: 52
Comment: The Ohio EPA would like access to both the contractor's daily report (or log) and the construction manager's daily report. At a minimum, we would like to receive these reports via fax (937-286-6404) every day. If these reports are prepared using commonly available word processing software, we would prefer to receive them either by e-mail or to download them by an ftp link on the FEMP website.

Response: The contractor's and construction manager's daily reports are maintained as part of the project file at the FEMP, which is available for OEPA review. It is not feasible to provide them to additional locations outside of the project file (via fax, e-mail, or posting on the FEMP website) due to the handwritten nature of the reports, lack of personnel, time and budget constraints.

Action: No action.
Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: 6.0 Pg #: Table 6-3 Line #: Code: E
Original Comment #: 53
Comment: In row four (entitled "Piping and Sumps") column three ("Protocols") replace "mange" with "manage."

Response: Noted.

Action: The text will be revised as suggested.

Commenting Organization: OEPA Commentor: OFFO
Section #: Table 6-3 Pg #: Line #: Code: C
Original Comment #: 54
Comment: a) Non-pressurized containers - Ohio EPA believes drums excavated must be treated as process related metal at a minimum. If it is not possible to complete a visual inspection/survey of all portions of the drum then it should be designated for off-site disposal.

b) Uranium metal - Any uranium metal encountered during excavation of these waste units is a waste and should be dispositioned as such. It is unacceptable to contemplate

these materials as nuclear materials considering they were previously disposed of as wastes and not managed as nuclear material.

Response: a) Noted; see DOE No. 1, particularly 3.c.

b) Noted; see DOE No. 1, particularly 3.c.

Action: a) No action.

b) Table 6-3 of the Implementation Plan will be revised to show that uranium metals are to be handled as Special Material and managed as such.

Commenting Organization: OEPA Commentor: OFFO
Section #: Figure 6-2 Pg #: Line #: Code: C
Original Comment #: 55
Comment: As stated in a previous comment, it is unclear how/when areas outside of the specific units will be addressed. Please clarify in the document and this schedule.

Response: See the response to OEPA Comment No. 6.

Action: See the action for the referenced comment.

DESIGN CRITERIA PACKAGE

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: App. A Pg #: 1-7 Line #: Code: C
Original Comment #: 56
Comment: In the fourth line of section 1.5.5 the qualifier radiological is too specific as impacted material above chemical (lead) and physical WAC will also be segregated.

Response: Noted.

Action: The text will be revised to delete "radiological".

Commenting Organization: OEPA Commentor: OFFO
Section #: App. A Pg #: 1-5 Line #: Code: C
Original Comment #: 57
Comment: Bullet 8 - Ohio EPA understands that double-walled pipe was not used for the complete transfer system but only for that within the GMA. Please clarify the text.

Response: Agree.

Action: The text of the Design Criteria Package will be revised throughout to differentiate where double- and single-walled pipe will be used; with double-walled pipe only for areas below elevation 560 feet and single-walled pipe in areas significantly above the GMA in the glacial till.

Commenting Organization: OEPA Commentor: OFFO
Section #: Appendix a Pg #: 2-11 Line #: Code: C
Original Comment #: 58
Comment: Pipeline - Ohio EPA understands that double-walled pipe was not used for the complete transfer system but only for that within the GMA. Please clarify the text.

Response: See the response to OEPA Comment No. 57.

Action: See the action for the referenced comment.

SURFACE WATER MANAGEMENT PLAN

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: App. B Pg #: ES-1 Line # Code: C
Original Comment #: 59
Comment: On the last line replace 1952 with 1951 as some disposal activities had taken place by 1952 (Section 1.1).

Response: The subject text is intended solely to summarize later text (last paragraph of p. 3-1) that indicates post-restoration (undertaken after completion of remediation) topography and stormwater runoff conditions are anticipated to be similar to those that existed circa 1952. That text also indicates that soil borings were used to supplement the 1952 topographic maps to determine pre-disposal/ground elevations.

Language at the top of p. 1-4 of the Implementation Plan (IP) indicates that 1952 topographical maps exist, hence the usage in the text of 1952 when referring to original topography. The subject text is not intended to control the extent or depth of remediation excavation, which is controlled by the design drawings, technical specifications, and FRL attainment certification. Text in the IP (p. 1-4 and Section 2.2) indicates the basis for the planned extent of excavation. Likewise, the subject text is not intended to control the restoration activities, which will be controlled by future planning and design documents that will follow from the Natural Resources Restoration Plan. Restoration is briefly discussed in the last paragraph of p. ES-3, and in Section 1.1 (beginning at line 33 of p. 1-2), of the IP.

Action: To reflect the language in the last paragraph of p. 3-1, the text of the last two lines on p. ES-1 will be revised to read "Upon completion of the remediation/excavation activities, the surface will be graded to drain and, where possible, graded to approximate the topographic (thus stormwater runoff) conditions that existed circa 1952."

Commenting Organization: OEPA Commentor: OFFO
Section #: App. B; Section 4.2.5 Pg #: 4-3 Line #: Code: C
Original Comment #: 60
Comment: As stated in Ohio EPA comments on the Technical Specifications Package, permanent vegetation should not be established prior to site restoration implementation. Seeding with some turf type grasses will negatively impact the effectiveness of the restoration.

Response: Noted. It is not the intent to establish permanent vegetation prior to restoration activities in A2PI.

Action: See the action for OEPA Comment No. 101.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: App. B; Section 4 Pg #: 4-4 Line #: Code: C
Original Comment #: 61
Comment: The statement that interceptor ditches 1-3 are designed based on a 25-year, 24-hour storm is not consistent with the statement regarding storm frequency design in Attachment B, Sheet B1. Additionally, the Sheet B-34 reference is not relevant to Ditches 2 and 6 and Interceptor Ditches 1-3.

Response: Noted.

Action: The statement in Appendix B (sheet B2) will be rewritten to clarify that the 25-year, 24-hour storm applies to interceptor ditches 1-3. Additionally, the correct sheet, sheet B42, will be referenced and Ditch 6 will be included in Table 1 (sheet B3) under the 25-year storm frequency.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: App. B; App. a; Attach B Pg #: Sheet B-3 Line #: Code: C
Original Comment #: 62
Comment: Sheet B-3 shows Table 1 of Attachment B to Appendix B to Report Appendix A. Table 1 is incomplete as it does not show the 25 year frequency storm flow calculations performed on Ditch 6.

Response: Noted.

Action: Table 1 will be revised to include the 25-year, 24-hour storm flow for Ditch 6.

PREDESIGN DATA SUMMARY

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: Line #: Code: M
Original Comment #: 63
Comment: Ohio EPA finds this section to be entirely inadequate to meet its objectives. The data presented are insufficient to justify elimination of any of the above-WAC areas defined in the OU2 RI/FS. In addition for the one WAC area carried forward, DOE has failed to bound the area horizontally or vertically (neither upper or lower). Ohio EPA expects that additional data collection will be necessary as well as a significant revision of this section before the document will be acceptable.

The section should be revised to include a presentation of all data supporting DOE's conclusions regarding the boundaries of above-WAC and above FRL excavations. Simply referencing the use of a 3D model is not acceptable. The document must justify the excavation boundaries defined in the drawings package.

Response: See DOE No. 1, particularly entries 2.b. and 3.d.

Action: See the action for OEPA Comment Nos. 1 and 15.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-1 Line #: Code: C
Original Comment #: 64
Comment: 1st Paragraph: All data should be included in the Implementation Plan. DOE must revise the document to incorporate all data to be used in the design of the remedial action within this Implementation Plan. For all future Implementation Plan submittals, DOE should ensure all data collection is complete and incorporated prior to submittal for review.

Response: See the response to OEPA Comment No. 1. In the future, DOE commits to providing pre-design data adequate to support 90 percent design packages. If this commitment cannot be met, an extension may be requested for the 90 percent submittal.

Action: See the action for the referenced comment.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: App. D Pg #: D-2 Line #: Code: C
Original Comment #: 65
Comment: In the first paragraph on this page, the depth of measurement and coverage area for the HPGE should be discussed for the 15 minute scan time and 1.0 meter detector height.

Response: Noted.

Action: The following text will be added to the first paragraph on page D-2: "At a detector height of 1.0 meter and using a 15-minute scan time, the field of view (the surface area which 85 to 90 percent of the detected gamma photos originate) is approximately 6.0 meters in diameter and the measurement depth is 5 to 15 cm."

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-2 Line #: Code: C
Original Comment #: 66
Comment: Second Paragraph: Ohio EPA believes the 1.0 meter height is not appropriate for most WAC determination analyses due to the dilution effect of such a wide view. Additionally, the document should discuss the negative impacts the unlevel surface of the waste units had on detector efficiency.

Response: The impacts of topography on HPGe detector response will be thoroughly discussed in the User's Manual described in response to OEPA Comment No. 2. Information has been presented to OEPA personnel (at the Real-Time Technical Workgroup Meetings) demonstrating that the effect of topography on HPGe detector response is not significant. Unlevel surfaces such as those expected to be encountered in A2PI, might be expected to result in no more than 5.0 percent difference in detector response relative to the same detector response on a perfectly flat surface.

The issue of what detector height is most appropriate to detect WAC exceedances has no single definitive answer; rather, the answer depends upon what size WAC exceedance it is necessary to detect. A good rule of thumb is that WAC exceedances whose radii are at least 50 percent of the radius of a field of view of the detector can be easily detected. Thus, at a 1.0 meter detector height, the HPGe should detect a 3.0 meter radius WAC exceedance. At a 1.0 foot detector height, HPGe should detect a 1.25 meter radius WAC exceedance. At a 6-inch detector height, HPGe should detect a 0.5 meter radius WAC

exceedance area. However, recognize that the ability of the HPGe to detect above-WAC concentrations of uranium is dependent on (1) how high above-WAC concentration the soil is, (2) the trigger level, (3) how small the above-WAC soil area is, and (4) the surrounding soil's concentration of uranium. The procedure for using HPGe to detect WAC exceedances in soil will be discussed in the User's Manual.

Action: Complete the User's Manual for agency review and approval.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-2 Line #: Code: C
Original Comment #: 67
Comment: Last Paragraph: The section discusses collection of data from the retention basins but presents no discussion of the data or calculations to support characterization for reuse. It would seem appropriate to incorporate such data herein to justify reuse of the soil rather than dispositioning as waste.

Response: Noted.

Action: A discussion of the characterization for reuse data and supporting calculations will be included in the revised IRDP text.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: App. D Pg #: D-3 Line #: Code: C
Original Comment #: 68
Comment: Paragraph two discusses the extent of the soil sampling effort. Soil boring depths are indicated to vary in accordance with the depth of the fill to be excavated. The text should summarize the range of depths for the soil samples.

Response: Noted. 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 South Field where the fill depth was greatest.

Action: The IRDP text will be revised to incorporate the above discussion.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-4 Line #: Code: C
Original Comment #: 69
Comment: As stated previously, Ohio EPA does not concur with collection of WAC data at 1 meter; has concerns with the topographical effect; and does not believe sufficient coverage was obtained for each WAC unit.

Response: See DOE No. 1, particularly entry 2, and responses to OEPA Comment Nos. 1 and 66.

Action: See the actions for the referenced comments.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-4 Line #: Code: C
Original Comment #: 70
Comment: Soil Sample Collection: Ohio EPA believes the method used for screening samples was inappropriate considering the circumstances of the waste unit. By only sampling the highest cpm interval and bounding intervals if necessary, an above-WAC interval could have existed at elevated cpm but still not analyzed since it was lower than the highest number and did not bound the highest sample.

Response: Noted. PSP 20400-PSP-0001, Rev. 0, August 1997 originally called for any interval exhibiting a beta-gamma count > 100 corrected counts per minute (ccpm) be archived for potential future analysis; the interval exhibiting the highest ccpm measurement was submitted for analysis. No interval below 100 ccpm was archived for borings from SWU-1 through SWU-4 and SWU-5 borings 1 through 18. Consequently, some intervals < 100 ccpm with a total uranium concentration above the WAC might have been missed.

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.

As provided in the January 14, 1998 presentation to U.S. EPA and Ohio EPA, a summary table of beta-gamma scans from the SWU-1 through SWU-5 cores was prepared. Approximately 200+ soil samples scanned exhibited a reading of less than 100 ccpm. Of these ~200, only 1 (~0.5%) exceeded the WAC for total uranium (1290 by FEMP lab analysis vs WAC of 1030 mg/kg). All other soil samples exhibiting beta-gamma scans of less than 100 ccpm were well below the WAC for total uranium (highest result being 221 mg/kg by FEMP lab analysis). Based upon this comparison, beta-gamma scans < 100 ccpm are likely to be well below the WAC for total uranium. Thus, the lack of total uranium lab analysis for intervals < 100 ccpm is likely to be of no consequence.

Action: Summary table of beta-gamma scans and appropriate text will be added to the IRDP.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-5 Line #: Code: C
Original Comment #: 71
Comment: 1st paragraph: Ohio EPA data from split samples are attached to these comments.

Response: Noted.

Action: Notation in brackets will be deleted; the original text has been revised, and specific citation is no longer applicable. OEPA data has been included in Table D-7 and is discussed in Section D.2.2.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-5 Line #: Code: C
Original Comment #: 72
Comment: 1st paragraph: Since data was collected at only five locations for each units 1-4, for the data may indicate contamination at one compass point moving away from unit. The

418 ppm sample in SWU-3 appears to indicate such, though it is not possible to tell since the figures fail to include sample location identification. Additionally, the use of "preliminary data" to over-ride validated RI/FS data is unacceptable. Information should be provided regarding the ASL for these data as well as their validation status.

Response: See the response to OEPA Comment No. 1.

Action: Figures D-13, D-14, and D-15 will be revised to include sample locations. As explained in the referenced comment, complete data, as well as ASL identification (provided as appendices to the appropriate project-specific plan) and validation status, will be included in the IRDP revision.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-5 Line #: Code: C
Original Comment #: 73
Comment: 2nd paragraph: DOE's proposal to eliminate an ASCOC based upon incomplete, invalidated data is unacceptable. Additionally, Ohio EPA believes it is inconsistent with the methodology proposed in the SEP for determining ASCOCs.

Response: See DOE No. 1, particularly entry 2.b, and response to OEPA Comment No. 19.

Action: See the action for OEPA Comment No. 15.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-5 Line #: Code: C
Original Comment #: 74
Comment: SWU-5: Ohio EPA does not believe DOE has adequately defined the upper limit of the above-WAC zone. Due to the method of sample screening employed by DOE, above-WAC samples may never have been analyzed. Additionally, upon review of the data in Table D-9, it is evident little if any correlation exists between cpm and total uranium. Finally, the uppermost sample in each of the following borings exceeds the WAC (SWU-5-15, SWU-5-9, SWU-5-18).

Response: See DOE No. 1, particularly entry 2 for discussion of how the ceiling is established for above-WAC areas, and entry 3 for how the excavation process will be controlled and how detection of unexpected encounter with buried above-WAC material will be managed. Also see the responses to OEPA Comment Nos. 70 and 75.

Action: Cross-sections of the above-WAC area will be developed and included in the revised IRDP Implementation Plan. Also see the actions for the referenced comments.

Commenting Organization: OEPA Commentor: HSI GeoTrans/OFFO
Section #: App. D Pg #: D-5 Line #: Code: C
Original Comment #: 75
Comment: Paragraph three indicates that the maximum boring depth was 27 feet and that the extent of above-WAC total uranium samples were observed to a depth of 26.5 feet. Samples from depths greater than 27 feet are necessary to confirm this assertion since the assumed base of above-WAC material is very close to the maximum sample depth. DOE has not provided sufficient data to support a conclusion that the above-WAC material terminates at 27 feet.

Response: Noted. 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 SEP, 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 51 borings completed in the SWU-5 area, 12 were completed in the sands or sand/gravel of the Great Miami Aquifer (GMA), 19 had no recovery at the bottom of the boring, 4 encountered refusal before reaching 27 feet bgs, 9 were completed in clay, and 7 were completed in debris. Obviously, 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 9 borings completed in clay, 5 at the bottom of the boring had beta-gamma screens of 0 ccpm, one was above the total uranium WAC, 2 had beta-gamma screens of 50 ccpm, and one had a beta-gamma screen of 100 ccpm. A formal verbal agreement was reached by U.S. EPA, OEPA and DOE that once the A2PI remediation excavation had reached the GMA and contamination was detected or suspected (based on existing data), re-evaluation of the area by DOE and the regulatory agencies would take place and a path forward determined at that time.

Action: The above explanation will be incorporated into the appropriate sections of the revised A2PI IRDP.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: D-6 Line #: Code: C
Original Comment #: 76
Comment: Lead Delineation: It does not appear the data collected, when presented, will be sufficient to bound the extent of the characteristically hazardous material within the firing range. Ohio EPA is still unclear concerning the basis for sampling to address the 400 ppm FRL. It is the experience of this review that total lead values do not correlate well with TCLP data. Thus it is likely as substantial sampling program will be needed to evaluate TCLP boundaries for this unit.

Response: See the response to OEPA Comment No. 16.

Action: See the action for the referenced comment.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: Figure D-12 Line #: Code: C
Original Comment #: 77
Comment: Revise the figure to include sample location identifiers.

Response: Noted.

Action: Sample location identifiers will be added to Figure D-12.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. D Pg #: Figure D-13 Line #: Code: C
Original Comment #: 78
Comment: Revise the figure to include sample location identifiers.

Response: Noted.

Action: Sample location identifiers will be added to Figure D-13.

APPENDIX E

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: Line #: Code: C
Original Comment #: 79
Comment: Ohio EPA is unclear on the specific intent of this section and does not concur with a substantial portion of it. If the intent is to suggest collection of HPGe data during certification, that should be in the certification design letter, not the IRDP, according to the SEP. With regard to the use of XRF, previous Ohio EPA comments address our concern that total lead numbers do not relate well to TCLP results and do not provide adequate documentation of remediation completion. Ohio EPA believes the individual aspects of this section should be incorporated into the appropriate portions of the Implementation Plan (e.g., WAC scanning in excavation section).

Response: Noted. Appendix E contains information that can be incorporated into the appropriate IRDP text (both in the main text and Appendix D), or the A2PI Certification Letter, which will be submitted at a later date.

Action: Appendix E will be deleted and appropriate information will be incorporated into other sections of the IRDP or the A2PI Certification Letter.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: E-6 Line #: 28-31 Code: C
Original Comment #: 80
Comment: Any proposal regarding trigger levels should be incorporated into the Implementation Plan and not submitted as a separate memorandum.

Response: Noted. The User's Manual discussed in the response to OEPA Comment No. 2 will define action level specific trigger levels.

Action: Appendix E is being deleted. Complete User Manual for agency review and approval.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: E-8 Line #: 1-9 Code: C
Original Comment #: 81
Comment: In response to this comment, please provide details regarding on-site lab turnaround time for physical soil samples analyzed for total uranium using both bromo-pdap and KPA. Include information regarding laboratory sample capacity and possible mechanisms to expand field laboratory capacity.

Response: The on-site laboratory uses bromoPADAP and ICP/MS to analyze soil samples for total uranium. Using these two methods and by dedicating personnel to the A2PI project, the on-site laboratory projects a maximum capacity of analysis of 50 soil samples per day with a 24-hour turn-around time.

DOE does not recommend putting either the bromoPADAP or ICP/MS instruments in the field. The laboratory building is close enough to field operations that if personnel are

dedicated to the project, there would be no benefit to field laboratory capacity. However, the most time-consuming step for both bromoPADAP and ICP/MS analyses is drying, grinding, and homogenizing the sample; there may be some benefit to having these operations performed in the field. If so, trailers or transportable "sheds" could be easily equipped to perform these sample preparation operations.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: E-8 Line #: 22-23 Code: C
Original Comment #: 82
Comment: Ohio EPA has not seen sufficient documentation/justification to support consideration of HPGe data as Level D.

Response: The July 1997 HPGe Comparability Study defined QC elements and acceptance criteria necessary for HPGe to perform ASL D measurements. That study demonstrated that for total uranium and Thorium-232, HPGe could meet QC criteria for ASL D measurements. The October 1997 addendum entitled "Comparability of In Situ Gamma Spectrometry and Laboratory Measurements of Radium-226" extended the ability of HPGe to make ASL D measurements to radium-226.

The question with using HPGe as a certification tool deals more with heterogeneity and data representativeness issues. These issues will be discussed fully in the User's Manual described in the response to OEPA Comment No. 2. Additionally, these issues have been addressed in responses to U.S. EPA comments on the July 1997 HPGe Comparability Study. In particular, the response to General Comment of U.S. EPA Reviewer No. 2 is pertinent to this discussion and is reproduced below:

> "The issue of heterogeneity is one that must be considered for survey planning, specifically, how many samples or measurements would be required for a valid decision rule (t-test). If a CU has a highly heterogeneous distribution in the concentration of a particular radionuclide, it will be reflected in the standard deviation of the data set for that CU. A CU should fail because its measured mean concentration is above that of the FRL. If there is a high standard deviation about the mean, more samples or measurements will be required to pass. A high standard deviation is not in itself a condition to fail. That is not part of the decision rule. High outliers, as defined by hot spot criteria of 2 or 3 times the FRL, are a condition to investigate further. Moreover, a separate "hot spot" investigation, such as performed through scanning with an instrument system like RTRAK, will provide the assurance that no unusually high elevated areas exist between sample/measurement points. The statistical test for ensuring that the average concentration in the CU is not above the FRL must not be confused with the separate check for elevated areas that may occur between sample or measurement points.
>
> Homogeneity is not a necessary condition to perform a representative in situ HPGe measurement. Regardless of the actual distribution of the radionuclide, either laterally or with depth in the surface soil, the HPGe will provide a weighted average of the concentration, with the weighting factor decreasing with radial distance from the point under the detector and also decreasing with depth. Where conditions are highly heterogeneous, this is an advantage over a soil sample. While a soil sample

has some probability (generally small) of falling within an elevated area, it is more likely to miss a small elevated area since its dimensions represent a tiny fraction of the area under investigation."

Action: Complete User's Manual for agency review and approval.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: E-13 Line #: 6-9 Code: C
Original Comment #: 83
Comment: It is interesting to note that DOE appropriately chose to daily calibrate the XRF against a know soil standard but continues to not perform a similar assessment of the HPGe or RTRAK.

Response: The circumstances for calibrations of the in situ HPGe and RTRAK detectors are different than for the XRF because of the nature of in situ gamma spectrometry, therefore, a comparison between the calibrations is not valid.

A) The HPGe detectors are efficiency calibrated annually using:
   1) NIST traceable point sources counted in a 1-meter arc from the detector end cap.
   2) The in situ geometry is a geometric model that accounts for detector height, activity impinging on the detector from multiple angles as a result of a wide field of view, uniform soil activity distribution and uniform distribution up to 3 cm deep in the soil. A simple count of a marinelli soil standard, as occurs with laboratory gamma spectrometers, cannot account for all of these factors.

B) The HPGe detectors are performance checked every day they are used. The checks consist of:
   1) An energy calibration to permit identification of measured radionuclides.
   2) Detector resolution to ensure that the detector is resolving spectrum within QC parameters.
   3) Net peak area to ensure that the detector reproduces measurement efficiency within QC parameters.

C) The HPGe detectors are frequently used for measurements at the Field Control Station. These measurements serve a similar purpose as a Laboratory Control Sample and affirm the detector's capability to reproducibly measure activities at or below FRLs.

D) The RTRAK is efficiency calibrated in comparison to the HPGe as determined by comparing dual HPGe/RTRAK measurements at several field locations. The RTRAK does not receive its own primary calibration.

E) The RTRAK is energy calibrated daily or at each use to permit identification of measured radionuclides.

In fact, a change in detector efficiency would be picked up by counting in virtually any source geometry. Thus any reference measurement can be used that is reproducible.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: E-13 Line #: 31-32 Code: C
Original Comment #: 84
Comment: As stated in previous comments, Ohio EPA does not agree with the suggestion that above-WAC soil has been delineated by predesign investigations.

Response: See DOE No. 1.

Action: Appendix E is being deleted. See the actions for OEPA Comment Nos. 1, 13, 15, 17, and 74.

Commenting Organization: OEPA Commentor: OFFO
Section #: App. E Pg #: E-14 Line #: 29-35 Code: C
Original Comment #: 85
Comment: Ohio EPA is not familiar with any data supporting or procedures for using HPGe or RTRAK on a vertical surface.

Response: Noted. Obviously RTRAK can not be used on a vertical surface. HPGe, under a suitable platform, could be utilized to measure vertical surfaces. There are commercial HPGe systems available which allow the detector to be rotated for viewing at a variety of angles and positions. However, these systems are not currently being investigated since (1) excavation depths or lifts will be 4 feet or less, (2) excavation lifts will be sloped and (3) real-time monitoring will be performed by either the RTRAK scanning the sloped surface and/or the HPGe instrument measuring the sloped surface from a normal position at the horizontal base of excavation, with the progressive movement of the HPGe instrument outward (up sloped surface) until below WAC concentrations are observed. Utilizing this approach, the above WAC area will be conservatively bound since the HPGe instrument will be in the "viewing area" of the side walls and the horizontal, pre-determined above WAC soils at the base of the excavation. The User's Manual discussed in the response to OEPA Comment No. 2 will provide a more detailed discussion of the technical approach to utilizing real-time instrumentation in the course of excavations.

Action: Complete the User's Manual for agency review and approval.

Commenting Organization: OEPA Commentor: ODH
Section #: App. E Pg #: Line #: Code: C
Original Comment #: 86
Comment: The text in sections E.3.4.3 and E.3.5.2 state that assurance of FRL attainment will be provided by taking HPGe measurements above designated certification sample locations post excavation and pre-certification. While this will provide additional data which may ultimately allow the use of HPGe solely for certification decisions, it also seems to provide a method whereby "random" physical samples are pre-screened (biased clean) before submission to the labs. Please clarify if this is the correct interpretation of this information.

Response: Appendix E is being deleted. The proposed process for certifying (uranium, thorium, and radium) with HPGe will be outlined in the User's Manual described in the response to OEPA Comment No. 2.

Action: Complete the User's Manual for agency review and approval.

TECHNICAL SPECIFICATIONS

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: Tech Specs. 02150 Pg #: 5 Line #: Code: E
Original Comment #: 87
Comment: In the first line of Section 3.6A "at any crossing" should be deleted.

Response: Noted.

Action: The text will be revised as suggested.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 3 Line #: Code: C
Original Comment #: 88
Comment: In 1.4(1), please clarify what "...steps taken to optimize WAC.." means.

Response: The intention of this statement is to require the contractor to include in the Excavation Work Plan the steps taken to meet size criteria for placement in the OSDF. This is an extension of the previous sentence in 1.4.1, which directs them to include "...size reduction methods to meet the WAC specified...".

Action: The text will be revised to delete the last sentence of Section 02205, 1.4.1.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 5 Line #: Code: C
Original Comment #: 89
Comment: In 1.7(c), all soil that are characterized as hazardous waste must be excavated as lead contaminated soil. It is insufficient to use 400 ppm of lead as the cut-off point. The FRL is irrelevant in the case of the SWU, since all material will be removed including that below the FRL for lead. If soils below the FRL of 400 ppm fail TCLP then they must also be removed under this category.

Response: This definition is for the contractor to provide an appropriate level of understanding about the scope of work. See the response to OEPA Comment No. 16.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: Pg #: Line #: Code: C
Original Comment #: 90
Comment: For 1.7.D and E, these sections must be revised to be consistent with the final WAC Plan. All inaccessible metals must be treated as process related metals unless proven otherwise.

Response: "Above-WAC Material" was defined for the contractor in terms of what will be encountered in the field. The majority of above-WAC material that will be encountered during the excavation phase will be above the uranium WAC for the OSDF, and thus was defined as such. The last part of 1.7.D incorporates any materials that do not meet other OSDF physical, chemical, or radiological WAC into the definition of above-WAC material. The definition of above-WAC material in 1.7.D of Section 02205 is consistent with the WAC Attainment Plan (20100-PL-0014, Draft Final, Rev. C, January 1998).

"Special Materials" were defined in 1.7.E using Appendix F of the SEP. These materials will be segregated during excavation for evaluation of proper disposition. Again, this is consistent with the WAC Attainment Plan.

As indicated in DOE No. 1, the WAC Attainment Plan commits that if any process-related equipment or piping are encountered in the field, they will undergo visual inspection. This inspection will determine classification of the material as either process-related metal (to be disposed off-site) or process-related metal (thus handled as debris).

Action: No action.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: Tech Specs. 02205 Pg #: 6 Line #: Code: C
Original Comment #: 91
Comment: In Section 1.7.E.2. containers do not have to be "in-tact" to be "special materials" for this work.

Response: Noted.

Action: The text will be revised to delete "in-tact" from Article 1.7.E.2 of Section 02205.

Commenting Organization: OEPA Commentor: OFFO
Section #: Division 02205 Pg #: 9 of 20 Line #: 3.1 Paragraph F Code: c
Original Comment #: 92
Comment: This Paragraph refers to a Dust Control Plan and implies that "Part 6" also contains information relevant to dust control measures. We can not find either of these references in the submittal package. Please provide Ohio EPA with two copies of each.

Response: Assume that comment is in reference to 3.1 paragraph G. See the response to OEPA Comment No. 3 relevant to Part 6. The Dust Control Plan referred to is the Dust Control Plan that the contractor will submit to DOE's representative for review and approval to ensure compliance with Part 6, and thus compliance with the site BAT policy.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 11 Line #: Code: C
Original Comment #: 93
Comment: In Q.2, the WAC Plan also addresses free liquid content limitations and should be referenced herein.

Response: Noted.

Action: The text of Section 02205, 3.1.Q.2, will be revised to include the WAC Attainment Plan as a source of specifications for free liquid content in the excavated material.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 11 Line #: Code: C
Original Comment #: 94
Comment: In R.1, the document doesn't address decon of vehicles leaving the OU1 stockpile area. More detail should be provided concerning decon of these vehicles.

Response: Section 02205, 3.1.R discusses general hauling requirements. 3.4.J of Section 02205 discusses the requirements for unloading and temporarily stockpiling the above-WAC material and addresses the requirements for vehicles leaving the above WAC stockpile area. The above WAC stockpile area has been changed from the OU-1 stockpile area to SP-5 Stockpile area.

Action: The Implementation Plan text, technical specifications and construction drawings will be revised to indicate the temporary above WAC stockpile area will be located at the SP-5 Stockpile area.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 12 Line #: Code: C
Original Comment #: 95
Comment: In T., Ohio EPA does not concur that monitoring will not be required during excavation of the South Field Impacted Material Stockpile. Ohio EPA does not believe sufficient controls were in place to prevent above-WAC material from being placed in this pile thus necessitating additional characterization efforts during excavation.

Response: See the response to Comment No. 30.

Action: The text will be revised to specify that visual monitoring (and real-time monitoring when special materials are encountered) will be used during excavation of the South Field Impacted Material Stockpile.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 13 Line #: Code: C
Original Comment #: 96
Comment: Ohio EPA is concerned that excavation of 3 foot lifts will result in missing above-WAC material and subsequent placement of that material in the OSDF. Additional detail should be provided regarding how the excavation will be managed to prevent violation of the WAC.

Response: As discussed between U.S. EPA, OEPA, and DOE on January 14, 1998, the intention of the 3-foot lift is that the contractor will excavate 3 feet of material before moving his equipment. The 3 feet will not be removed in bulk; standard construction practices will be employed to obtain a 3-foot lift. This will allow close visual monitoring of the excavation for a change in material, including the presence of special material or above-WAC material.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02205 Pg #: 14 Line #: Code: C
Original Comment #: 97
Comment: In 3.3.B, it is unclear what "unclassified impacted material overburden" is being referenced here. Ohio EPA would expect that all soil within the boundaries would be lead contaminated and that no "overburden" layer would exist within the boundaries.

Response: The unclassified impacted material overburden is impacted material which is physically located on the hill higher in elevation than the lead contaminated soil. The overburden is located above the lead contaminated material, and therefore must be removed prior to the excavation of the lead contaminated material. The lead contaminated material is a potential toxicity characteristic waste and therefore a prioritized excavation; however, in order to safely excavate the area, the overburden material must first be removed in accordance with specification 02205 as unclassified impacted material.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: 02205 Pg #: 19 of 20 Line #: 3.7 B2 Code: c
Original Comment #: 98
Comment: It is unclear what part of the WAC Attainment Plan applies to the HDPE liner size reduction. Please clarify the size specification for the liners and the waste category that applies to liners.

Response: Article 3.7 of Section 02205 was deleted from the technical specifications between the 95 percent design submittal and the certified for construction (CFC) submittal; the removal of the HDPE liner will occur during the restoration phase of A2PI, which will be performed by others at a later date and under a separate contract. Therefore, no specifications need to be provided for size reduction of the liners.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02212 Pg #: Attachment I Line #: Code: C
Original Comment #: 99
Comment: This attachment does not appear to be consistent with the WAC Plan nor the form currently being used for waste placement in the OSDF. The form should be revised or additional justification provided.

Response: Technical Specification Section 02212 is being deleted, with material documentation information being provided to the contractor through the Construction Drawings. FDF will provide the contractor with the OSDF Manifest form, thus they will be provided with the correct version.

Action: Technical Specification Section 02212 is being deleted.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 02900 Pg #: 2 Line #: Code: C
Original Comment #: 100
Comment: It is unclear why "asphalt emulsion tackifier" is required in this specification whereas in specification 02275.2.1.F "asphaltic type emulsions" are specifically prohibited. If it is inappropriate to use for a dust suppressant, it would seem equally unacceptable for seeding.

Response: Noted.

Action: Section 02900 will be revised to specify pine sap emulsion for mulch stabilization.

Commenting Organization: OEPA Commentor: OFFO
Section #: Tech Specs. 0200 Pg #: 3 Line #: Code: C
Original Comment #: 101
Comment: In 2.1.B, Ohio EPA does not concur with the proposed temporary seeding mixture. Ohio EPA recommends the usage of the same temporary seeding mixture used in the A2P1 Site Preparation Package Technical Specification - 100% Annual Ryegrass. Ohio EPA's concern is that DOE has simply replaced the word permanent with temporary rather than used the appropriate seed mixture for stabilizing the area prior to final remediation. The mixture provided in the existing specification could negatively impact final restoration success.

Response: Noted. As discussed in the February 5, 1998 meeting between DOE, OEPA, and FDF, DOE has committed to formalize guidelines for stabilizing disturbed areas at the FEMP in the Sitewide Excavation Plan. These guidelines contain direction for stabilization practices utilizing crusting agents, temporary seed mixtures, and permanent seed mixtures.

Action: The stabilization and temporary seeding mixture will be revised to be consistent with the seeding plan presented in the SEP.

CONSTRUCTION DRAWINGS

Commenting Organization: OEPA Commentor: OFFO
Section #: Drawings Pg #: Line #: Code: C
Original Comment #: 102
Comment: The drawing package nor the Implementation Plan provide data to support the cross sections and areas presented for excavation. Ohio EPA believes it is important to provide a data summary portion of the IRDP that supports the proposed site model, three-dimensionally, with data/boring logs from previous investigations.

Response: The cross-sections presented in the construction drawings are for construction purposes only. Generally, the contractor will initially excavate to the depths and grades shown on the construction drawings; the final depth of excavation will be determined based on actual field conditions and monitoring results.

Cross-sections prepared for excavation projects do not typically contain more detail; the cross-sections are presented on the drawings to give prospective proposers, and the selected contractor, the approximate limits of the excavation and a general idea of the type of material that will be encountered during excavation. The contractor is required to

excavate all impacted material within the volume delineated on the drawings and cross-sections as unclassified impacted material regardless of the makeup of material (sand, flyash, clay, debris, etc.). As described in General Note No. 6 on Sheet No. X0003 of the construction drawings, the cross-sections were developed based on previous documents prepared for the project and actual conditions encountered during excavation may vary. All previous reports (including the Geotechnical Report, and the OU2 RI and FS) were available for the contractor to review and use for preparation of his proposal. Nine contractors reviewed the documents and submitted proposals for the project. DOE believes that the response to the RFP indicates that there is sufficient detail to perform excavation on the SWUs and adding additional detail is not necessary or cost effective.

Pre-design data for the above-WAC area and lead contaminated soil area are presented and summarized in Appendix D. This data was used to delineate the limit of above-WAC material (via modeling) and to establish the limit of lead contaminated soil to be excavated. The data and model information presented in Appendix D was used to establish the limits shown on the Construction Drawings.

Action: The above-WAC material in the Inactive Flyash Pile and the lead contaminated soil in the South Field will be delineated in accordance with the data presented in Appendix D.

Commenting Organization: OEPA Commentor: OFFO
Section #: Drawings Pg #: Line #: Code: C
Original Comment #: 103
Comment: The drawing package should be revised to show actual conditions resulting from site preparation activities to date. Appropriate changes include no use of Soil Stockpile No. 2, the creation of an additional pile on the Southfield, changes in the transfer line status, changes to the design of Basin No. 2, etc.

Response: An updated set of drawings showing existing conditions will be issued to the selected excavation contractor. Most of the changes from the Site Preparation activities will not affect the work of the excavation contractor.

Action: An updated drawing package will be issued in the near future and made available to the selected excavation contractor.

Commenting Organization: OEPA Commentor: HSI GeoTrans
Section #: Dwg. G0006 Pg #: Line #: Code: C
Original Comment #: 104
Comment: The thickness of Above-WAC Material at Station 4100 is not consistent from plan (38 ft) to section (26 ft).

Response: The above-WAC material was defined based on additional pre-design data and modeling. Based on the model, the horizontal limits of above-WAC were determined and decision was made to excavate material between elevation 558 and 550. The revised horizontal and vertical limits are shown on the construction drawings.

Action: The above-WAC cross-sections will be updated based on revised data and modeling.

Commenting Organization: OEPA Commentor: OFFO
Section #: Dwg. G0018 Pg #: Line #: Code: C
Original Comment #: 105
Comment: Note 2 refers to Specification 02205 for additional detail regarding the spill containment pan. No reference to the spill containment pan is included in 02205.

Response: Noted. Assumed that the comment is in regard to Note 1. The initial spill containment pan will be provided by the Site Preparation contractor. The excavation contractor may have to replace the pan.

Action: The detail will be revised to include spill containment pan requirements and delete the reference to Section 02205.

Commenting Organization: OEPA Commentor: OFFO
Section #: Dwg. G0004 Pg #: Line #: Code: C
Original Comment #: 106
Comment: This drawing does not appear to include locations from the most recent sampling during the pre-design investigations. It should be revised to include all existing sampling locations.

Response: As described in the response to OEPA Comment No. 102, the geotechnical report and other background documents were available to the prospective contractors during preparation of proposals. The referenced drawing was prepared to provide the contractor an efficient way to review the data contained in those reports and overlay the information with the construction drawings. The drawing has served its intended purpose. Pre-design sampling locations will be presented in Appendix D of the Implementation Plan.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: Dwg. G0006 Pg #: Line #: Code: C
Original Comment #: 107
Comment: Note 10 references removal of material outside the WAC area in 4 foot lifts. This is inconsistent with the Implementation Plan requirement of 3 foot lifts outside the above-WAC area.

Response: Noted. The unclassified impacted material is to be removed in 3 ± 1-foot lifts.

Action: Note No. 10 on Drawing Sheet No. G0006 will be revised to reference removal of material outside the above-WAC area in 3 ± 1-foot lifts.

Commenting Organization: OEPA Commentor: OFFO
Section #: Dwg. G0014 & G0015 Pg #: Line #: Code: C
Original Comment #: 108
Comment: What basis does DOE have for concluding such a significant portion of the IAFP will be made up of just flyash as suggested in the cross sections? Ohio EPA believes this cross-section significantly down plays the likelihood of encountering debris/fill throughout the IAFP and may lead the contractor to overestimate excavation rates.

Response: Noted. Article 1.7.B of Section 02205 states "Debris may comprise up to 15 percent of

the total volume of impacted material." This provides the contractor with the knowledge to anticipate debris throughout the excavation and formulate his proposal accordingly. Additionally, the pre-bid meeting (including a walk-through of the project site) was held on December 4, 1997. During the walk-through, the debris in the field was brought to the attention of, and discussed with, the potential contractors. Also see response to OEPA Comment No. 102.

Action: No action.

Commenting Organization: OEPA Commentor: OFFO
Section #: Dwg. G0008 Pg #: Line #: Code: C
Original Comment #: 109
Comment: As stated in previous comments, Ohio EPA does not believe the firing range has been adequately characterized. Following acceptable characterization it is likely the excavation boundaries will change. Unlike other drawings, this one does not include a note referring to likely changes to excavation boundaries. The figure should be revised following acceptable characterization.

Response: Noted. The drawing was updated based on additional data, as presented in Appendix D.

Action: A note similar to the note found on Drawing Sheet No. G0006 will be added to Drawing Sheet No. G0008, stating that the lead contaminated soil to be excavated may be modified based on field conditions.

CONTROL NUMBER: FER-0033
REQUIREMENTS MANUAL RM-0047
REVISION NO. 0

FUGITIVE DUST CONTROL REQUIREMENTS

RM-0047

INFORMATION ONLY

Effective Date: 8/22/97

Originator (Subject Expert): Patrick A. Shanks — Patrick A. Shanks — 8/15/97 Date

Checker Concurrence: J. Scott Hartman — J. Scott Hartman — 8/15/97 Date

Authorized By: T. J. Walsh — Thomas J. Walsh, Environmental Protection FAM — 8/19/97 Date

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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TABLE OF CONTENTS

SECTION		PAGE
Table of Contents		i
1.0	FUGITIVE DUST CONTROL STRATEGY	1
2.0	PROJECT FIELD ACTIVITIES AND MATERIAL HANDLING/VEHICLE TRAFFIC ON STORAGE PILES	2
2.1	Activities Included	2
2.2	Definitions	3
2.3	Standard	3
2.4	Action Levels	3
2.5	BAT Dust Controls/Work Practices	4
3.0	UNPAVED ROADWAYS, UNPAVED PARKING AREAS, AND WIND EROSION FROM STORAGE PILES	5
3.1	Definitions	5
3.2	Site-Specific Limit	5
3.3	Action Levels	5
3.4	BAT Dust Controls/Work Practices	6
4.0	PAVED ROADWAYS AND PAVED PARKING AREAS	7
4.1	Definitions	7
4.2	Site-Specific Limit	7
4.3	Action Levels	7
4.4	BAT Dust Controls/Work Practices	8
5.0	TRAINING	8
6.0	RECORDS	9
7.0	BEST AVAILABLE TECHNOLOGY (BAT) SUMMARY TABLE	11
ATTACHMENT A	CONTROL OF FUGITIVE DUST EMISSIONS - DAILY RECORD	13
ATTACHMENT B	METHOD 22 - VISUAL DETERMINATION OF DURATION PERIOD FOR FUGITIVE EMISSIONS	15
ATTACHMENT C	METHOD 9 - VISUAL DETERMINATION OF OPACITY FOR FUGITIVE EMISSIONS	17

FUGITIVE DUST CONTROL REQUIREMENTS

1.0 FUGITIVE DUST CONTROL STRATEGY

A. Each individual project will develop a project-specific procedure or plan based on this document for controlling fugitive dust emissions and ensuring compliance with standards and negotiated site-specific limits defined in this document.

- The procedure or plan shall include, but not be limited to: how project field activities will be monitored for fugitive dust releases; what methods will be used to control fugitive dust releases; what records will be kept and maintained; and what notification process will be used after discovering fugitive dust releases, especially during non-working periods.

B. Dust control mechanisms shall be based on the fugitive dust control/work practice Best Available Technology (BAT) Policy as approved by the Ohio Environmental Protection Agency (OEPA).

- BAT is defined in Ohio Revised Code (ORC) 3704.01(F) as any combination of work practices, raw material specifications, throughput limitations, source design characteristics, an evaluation of the annualized cost per ton of pollutant removed, and air pollution control devises that have previously demonstrated to the director of environmental protection to operate satisfactorily in this state or other states with similar air quality on substantially similar air pollution sources.

C. Project personnel shall proactively suppress dust releases from field activities by applying BAT dust control [such as the application of water, dust suppression agents, or other appropriate methods approved by appropriate Fluor Daniel Fernald (FDF) personnel] and/or implementing BAT work practices at the beginning and during field activities.

D. BAT dust controls/work practices to be implemented must be approved by the OEPA. Some BAT dust control/work practice strategies include:

- Apply water or other dust suppression or crusting agents in sufficient quantity to prevent dust generation but limited so that the application does not result in migration of the agent beyond work area boundaries, ponding, or disruption of other portions of work.

- Wheel wash at the point of origin prior to entering any defined paved or unpaved roadways.

- Remove clods, clumps, tracks, or visible deposits of soils, mud or other materials that could readily become visible fugitive emissions from paved and treated unpaved roadways/parking areas. Apply appropriate dust control measures to suppress the generation of visible dust that may result from the removal process.

- Apply appropriate dust control mechanism such as water or surfactants to the materials being transported by truck load beds to ensure the transported materials will not become airborne. Cover truck load beds when transported materials are still likely to become airborne.

E. Project field activities should be continuously observed by project personnel for visible emissions.

F. The number of pieces or type of dust suppression equipment in operation controlling visible dust emissions in a designated area will not preclude stopping project field activities in that area.

G. Personnel should be on-call during non-work periods seven days per week, including holidays, to respond to the generation of visible dust during off-hours.

H. All mechanical dust-generating field activities in an observed area shall cease immediately if a fugitive dust standard or site-specific limit is exceeded for that observed area. An increase in BAT dust controls and/or work practices needs to be implemented to bring the fugitive dust emissions to, at a minimum, below the standard or limit during dust-generating activities (including wind erosion).

2.0 PROJECT FIELD ACTIVITIES AND MATERIAL HANDLING/VEHICLE TRAFFIC ON STORAGE PILES

2.1 Activities Included:

Excavation, Trenching, Loading/Unloading, Transportation to a Defined Roadway (paved or unpaved), Load-in/Load-out on Storage Piles, Materials Placement in Onsite Disposal Cell, Vehicle Traffic on Storage Piles, and Wind Erosion from Working Faces

2.2 Definitions:

- *Visible Particulate Emissions*: visible airborne particulates that are generated from the operation of heavy equipment, equipment wheels or tracks, any tools, or vehicle wheels. Visible particulate emissions are also those generated by wind erosion. (Regulatory methods that will be used for visual determination of fugitive emissions are 40 CFR 60 Appendix A, Method 9- "Visual Determination of Opacity of Emissions from Stationary Sources" and Method 22- "Visual Determination of Fugitive Emissions from Materials Sources and Smoke Emission from Flares".)

- *Material Handling/Vehicle Traffic on Storage Piles:* includes activities such as loading in and loading out of materials, excavation, and vehicle traffic on storage piles. Fugitive emissions created by the above activities on storage piles shall be subjected to the standard defined in this section. Fugitive emissions that cannot be distinguished between material handling activities and wind erosion will be also subjected to the standard defined in this section.

2.3 Standard:

- Visible particulate emissions from the above project field activities shall not exceed twenty percent (20%) opacity as a three-minute average. (OAC 3745-17-07 (B)(1)).

- Verifying compliance with this standard shall be performed using 40 CFR Part 60 Appendix A, Method 9- "Visual Determination of Opacity of Emissions from Stationary Sources".

2.4 Action Levels:

- Project personnel shall tour the site, especially where project field activities are taking place, for potential fugitive dust sources at the start of each day and periodically during the day, as applicable, and proactively apply BAT fugitive dust controls and/or work practices to reasonably minimize dust generation.

- As soon as fugitive dust emissions are visible, BAT dust controls and/or work practices must be implemented or increased.

- If the standard is exceeded, all mechanical dust-generating activities in the observed area must cease immediately. An increase of BAT dust controls and/or work practices needs to be implemented to bring the fugitive emissions to, at a minimum, below the standard during dust-generating activities (including wind erosion).

2.5 BAT Dust Controls/Work Practices:

- Application of dust suppression materials approved by appropriate FDF personnel such as: water, resin, or equivalent combination of surfactant or crusting agents.

- Minimize the amount of unnecessary traffic in and around field activities.

- Limit speed of vehicles or equipment to 15 miles per hour or less during operation.

- Reduce rate of excavation.

- Minimize the height of drop during loading and unloading.

- Change method of excavation/transport (e.g., from a front-end loader dumping into a truck to a self-propelled pan).

- Apply appropriate dust suppression agents, such as water or surfactants, to the materials being transported by truck load beds to ensure the transported materials will not become airborne. Cover truck load beds when transported materials are still likely to become airborne.

- Apply dust suppression agents such as surfactants or crusting agents to storage piles.

3.0 UNPAVED ROADWAYS, UNPAVED PARKING AREAS, AND WIND EROSION FROM STORAGE PILES

3.1 Definitions:

- *Unpaved Roadway or Unpaved Parking Area:* a predetermined area designed and improved specifically for vehicle traffic. Improvements to the predetermined area include the application of gravel, shredded shingles, cinders, compaction, etc. to the delineated area.

- *Wind Erosion of Storage Piles:* fugitive emissions from storage piles strictly created by the wind (and not by material handling equipment or vehicle traffic).

3.2 Site-Specific Limit:

- There shall be no visible particulate emissions from any unpaved roadway, unpaved parking area, or wind erosion from storage piles except for a period of time not to exceed three minutes during any sixty-minute observation period.

- Verifying compliance with this limit shall be performed using 40 CFR Part 60 Appendix A, Method 22- "Visual Determination of Fugitive Emissions from Materials Sources and Smoke Emissions from Flares".

3.3 Action Levels:

- Project personnel shall tour unpaved roads (especially roads being used during project field activities), unpaved parking areas, and storage piles at the start of each day and periodically during the day, as applicable, and proactively apply BAT fugitive dust controls and/or work practices to reasonably minimize dust generation.

- As soon as fugitive dust emissions are visible, BAT dust controls and/or work practices must be implemented or increased.

- If the site-specific limit is exceeded, all mechanical dust-generating activities (such as traffic on an unpaved roadway) in the observed area must cease immediately. An increase of BAT dust controls and/or work practices needs to be implemented to bring the fugitive dust emissions to, at a minimum, below the limit during dust-generating activities (including wind erosion).

3.4 BAT Dust Controls/Work Practices:

- Application of dust suppression materials, approved by appropriate FDF personnel, such as: water, resin, or equivalent combination of surfactant or crusting agents.

- Minimize the amount of unnecessary traffic on unpaved roadways or unpaved parking areas.

- Limit speed of vehicles or equipment to 15 miles per hour or less during operation.

- Apply appropriate dust suppression agents, such as water or surfactants, to the materials being transported by truck load beds to ensure the transported materials will not become airborne. Cover truck load beds when transported materials are still likely to become airborne.

- Apply dust suppressant agents such as surfactants or crusting agents to storage piles or cover with tarpaulin, plastic, etc., if practical.

- For extended periods of planned inactivity, vegetate as a last resort if protective cover or periodic application of surfactants or crusting agents proves ineffective.

- Remove, as practical, any clods, clumps, tracks, or visible deposits of soil or mud from unpaved roadways or unpaved parking areas, applying appropriate dust control measures to suppress the generation of visible dust that may result from the removal process.

- Wheel wash prior to entering unpaved roadways or unpaved parking areas.

- Repair or resurface roadways/parking areas as needed or use an alternative road surface as a last resort.

4.0 PAVED ROADWAYS AND PAVED PARKING AREAS

4.1 Definitions:

- *Paved Roadway or Paved Parking Area*: a predetermined area designed and improved specifically for vehicle traffic. Improvements to the predetermined area is the application of materials such as asphalt or concrete that forms a firm level surface for travel.

4.2 Site-Specific Limit:

- There shall be no visible particulate emissions from any paved roadway or paved parking area except for a period of time not to exceed one minute during any sixty-minute observation period.

- Verifying compliance with this limit shall be performed using 40 CFR Part 60 Appendix A, Method 22- "Visual Determination of Fugitive Emissions from Materials Sources and Smoke Emissions from Flares".

4.3 Action Levels:

- Project personnel shall tour paved roads (especially roads being used during project field activities) and paved parking areas at the start of each day and periodically during the day, as applicable, and proactively apply BAT fugitive dust controls and/or work practices to reasonably minimize dust generation.

- As soon as fugitive dust emissions are visible, BAT dust controls and/or work practices must be implemented or increased.

- If the site-specific limit is exceeded, all mechanical dust-generating activities (such as traffic on a paved roadway) in the observed area must cease immediately. An increase of BAT dust controls and/or work practices needs to be implemented to bring the fugitive emissions to, at a minimum, below the limit during dust-generating activities (including wind erosion).

4.4 BAT Dust Controls/Work Practices:

- Application of dust suppression materials approved by appropriate FDF personnel, such as water.
- Minimize the amount of unnecessary traffic on paved roadways or paved parking areas.
- Limit speed of vehicles or equipment to 15 miles per hour or less during operation.
- Apply appropriate dust suppression agents, such as water or surfactants, to the materials being transported by truck load beds to ensure the transported materials will not become airborne. Cover truck load beds when transported materials are still likely to become airborne.
- Wet sweep or otherwise remove any clods, clumps, tracks, or visible deposits of soil or mud from paved roadways or paved parking areas, applying appropriate dust control measures to suppress the generation of visible dust that may result from the sweeping or removal process.
- Wheel wash prior to entering paved roadways or paved parking areas.
- Repair or resurface paved roadways/parking areas as needed.

5.0 TRAINING

A. All project personnel responsible for the control of fugitive dust for the site must be knowledgeable of BAT fugitive dust controls and work practices as approved by OEPA. Also, these project personnel should review and understand the information contained in this Requirements Manual and should be trained in the project-specific procedure or plan pertaining to an individual's responsibilities. Each project should designate individuals that will require the appropriate training.

B. Personnel involved in performing compliance surveillances to ensure fugitive dust emissions from project field activities are meeting fugitive dust standards or limits, must have the following training:

- Personnel performing opacity readings on Project Field Activities and Material Handling/Vehicle Traffic on Storage Piles must attend certification training on 40 CFR Part 60, Appendix A, Method 9- "Visual Determination of Opacity of Emissions from Stationary Sources".

- Personnel performing visible fugitive dust readings on Paved Roadways and Parking Areas, Unpaved Roadways and Parking Areas, and Wind Erosion from Storage Piles must be trained on 40 CFR 60, Appendix A, Method 22- "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emission from Flares".

6.0 RECORDS

A. Enter proper information on the "Control of Fugitive Dust Emissions- Daily Record" form (see Attachment A) each time an application of dust suppression material is performed. Send the completed form to FC&DP/EC. **OEPA requires records on the implementation of the fugitive dust controls for paved and unpaved roadways.**

Enter on form:

- identification of area that was treated and/or cleaned. Record using sketch on back of the form or by attaching similar diagram at appropriate scale.

- the date the designated area was treated and/or cleaned.

- the manner in which the designated area was treated and/or cleaned.

- the application rate of dust suppression material [at a minimum, the tank truck load capacity and number of truckloads applied per unit of time per area (or segment) to which applied].

- the equipment operator (at a minimum, the name of the contractor or subcontractor firm).

B. Fill out the standard form included in 40 CFR 60, Appendix A, Method 22- "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emission from Flares" (see Attachment B, "Method 22- Visual Determination of Duration Period for Fugitive Emissions") when performing visible emission duration readings for Paved and Unpaved Roadways, Paved and Unpaved Parking Areas, and Wind Erosion from Storage Piles. Send the completed form to FC&DP/EC.

C. Fill out the standard form included in 40 CFR 60, Appendix A, Method 9- "Visual Determination of Opacity of Emissions from Stationary Sources" (see Attachment C, "Method 9- Visual Determination of Opacity for Fugitive Emissions" and "Method 9- Visual Determination of Opacity for Fugitive Emissions- Observation Record") when performing opacity readings for Project Field Activities and Material Handling/Vehicle Traffic on Storage Piles. Send the completed form to FC&DP/EC.

7.0 BEST AVAILABLE TECHNOLOGY (BAT) SUMMARY TABLE

Category	Remediation Activities/Areas Included	Standard or Site-Specific Limit	Dust Controls/Work Practices *
Paved roadways and paved parking areas	Activities: • Hauling materials and equipment • Vehicle and equipment traffic Areas: All predetermined areas designed and improved specifically for vehicle traffic. Improvements include the application of materials such as asphalt or concrete that forms a firm level surface for travel.	Limit: There shall be no visible particulate emissions from any paved roadway or paved parking area except for a period of time not to exceed one minute during any sixty-minute observation period.	• Apply dust suppression agents. • Minimize the amount of unnecessary traffic on paved roadways used for hauling materials and vehicle/equipment traffic. • Limit speed of equipment or vehicles to 15 mph or less during operation. • Apply appropriate dust suppression agents, such as water or surfactants, to materials being transported by truck load beds to ensure the transported materials will not become airborne; cover truck load beds when transported materials are still likely to become airborne. • Wheel wash prior to entering paved roadways or paved parking areas. • Wet sweep or otherwise remove any clods, clumps, tracks, or visible deposits of soil or mud from paved roadways or paved parking areas; apply appropriate dust control measures to suppress the generation of visible dust that may result from the sweeping or removal process. • Repair or resurface paved roadways/parking areas as needed.
Unpaved roadways, unpaved parking areas, and wind erosion from storage piles	Activities: • Hauling materials and equipment • Vehicle and equipment traffic Areas: All predetermined areas designed and improved specifically for vehicle traffic. Improvements include the application of gravel, shredded shingles, cinders, compaction, etc. to the delineated areas	Limit: There shall be no visible particulate emissions from any unpaved roadway, unpaved parking area, or wind erosion from a storage pile except for a period of time not to exceed three minutes during any sixty-minute observation period.	• Apply dust suppression agents. • Minimize the amount of unnecessary traffic on unpaved roadways or unpaved parking areas. • Limit speed of equipment or vehicles to 15 mph during operation. • Apply dust suppression agents, such as surfactants or crusting agents, to storage piles or cover with tarpaulin, plastic etc.,if practical; for extended periods of planned inactivity, vegetate as a last resort if protective cover or periodic application of crusting agent proves ineffective. • Apply appropriate dust suppression agents, such as water or surfactants, to materials being transported by truck load beds to ensure the transported materials will not become airborne; cover truck load beds when transported materials are still likely to become airborne. • Wheel wash prior to entering unpaved roadways or unpaved parking areas. • Remove, as practical, any clods, clumps, tracks, or visible deposits of soil or mud from unpaved roadways or unpaved parking areas. • Repair or resurface roadways/parking areas as needed or use an alternative road surface as a last resort.

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7.0 BEST AVAILABLE TECHNOLOGY (BAT) SUMMARY TABLE (cont)

Category	Remediation Activities/Areas Included	Standard or Site-Specific Limit	Dust Controls/Work Practices *
Project field activities and material handling/vehicle traffic on storage piles	Activities: • Excavation • Trenching • Loading/Unloading • Transportation to a defined roadway (paved or unpaved) • Load-in/Load-out on storage piles • Material placement in Onsite Disposal Cell • Vehicle traffic on storage piles Areas: • Working faces • Transition areas between working faces and defined roadways (paved or unpaved) • Onsite Disposal Cell • Storage piles	Standard: Visible particulate emissions from project field activities/areas shall not exceed twenty percent (20%) opacity as a three-minute average. (OAC 3745-17-07 (B)(1))	• Apply dust suppression agents. • Minimize the amount of unnecessary traffic in and around field activities. • Limit speed to 15 mph or less during operation of equipment or vehicles. • Reduce rate of excavation. • Minimize height of drop during loading and unloading. • Change method of excavation & transport (E.G., from front-end loader dumping into a truck to a self-propelled pan). • Apply dust suppression agents, such as surfactants or crusting agents, to storage piles. • Apply appropriate dust suppression agents, such as water or surfactants, to materials being transported by truck load beds to ensure the transported materials will not become airborne; cover truck load beds when transported materials are still likely to become airborne.

* to be applied progressively as environmental conditions dictate.

ATTACHMENT A

S

CONTROL OF FUGITIVE DUST EMISSIONS
DAILY RECORD

DATE: _____

A

TIME	AREA TREATED (see sketch)	TREATMENT METHOD	APPLICATION RATE	EQUIPMENT OPERATOR

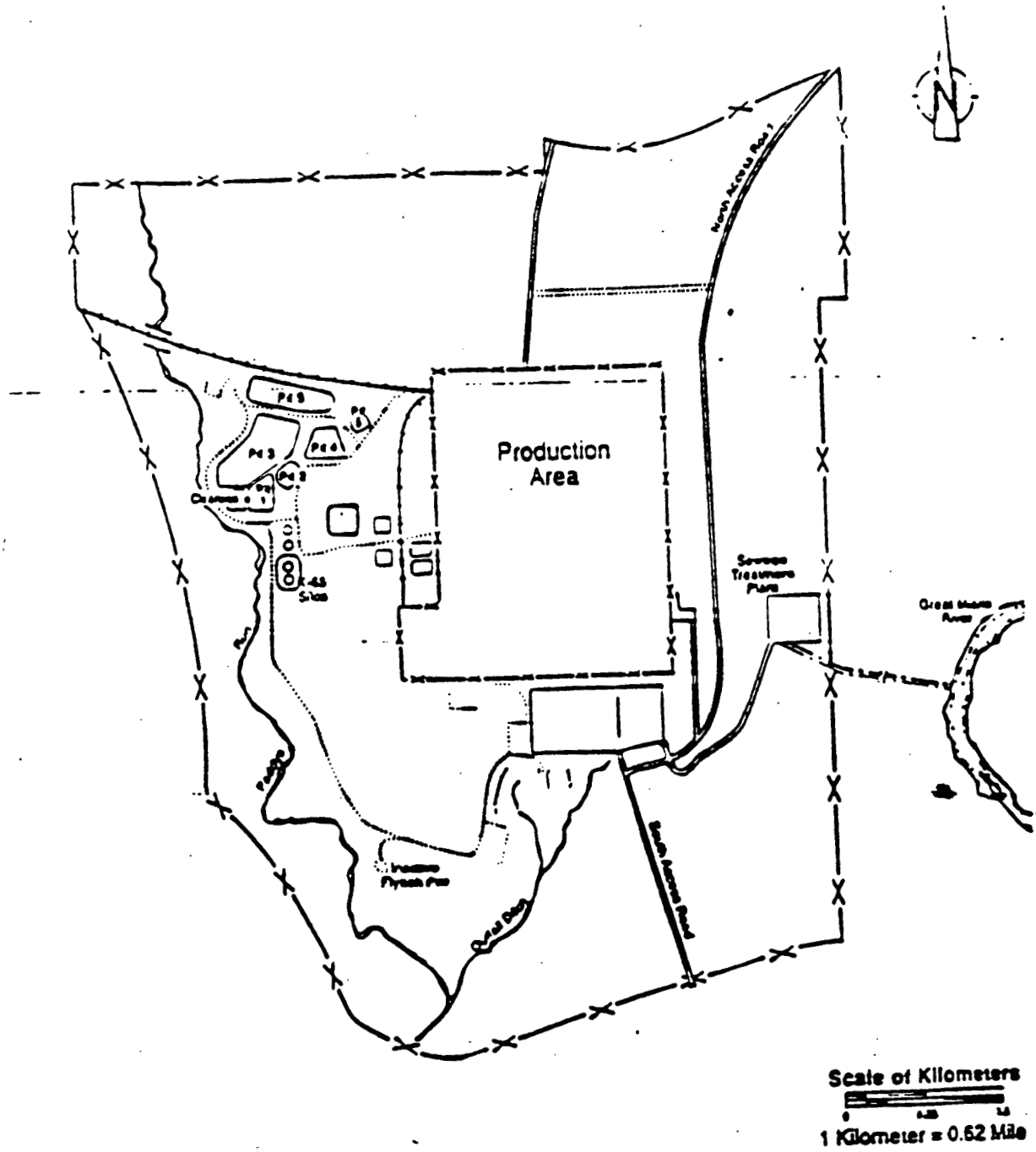
M

P

L

E

(Send completed form to FC&DP/ EC- Pat Shanks MS-65-2)



LEGEND

Plant Perimeter

Production Area Perimeter

METHOD 22- VISUAL DETERMINATION OF DURATION PERIOD FOR FUGITIVE EMISSIONS

OUTDOOR LOCATION

Company _____	Observer _____
Location _____	Team _____
Co. Rep. _____	Date _____
Sky Condition _____	Wind Direction _____
Precipitation _____	Wind Speed _____
Project _____	Activity observed _____

Dust Abatement operations _____
i.e. water spray, tarping, or slow speeds

Source(s) of dust emissions _____
i.e. earthmoving equipment, trucks, wind entrainment

Other observations _____

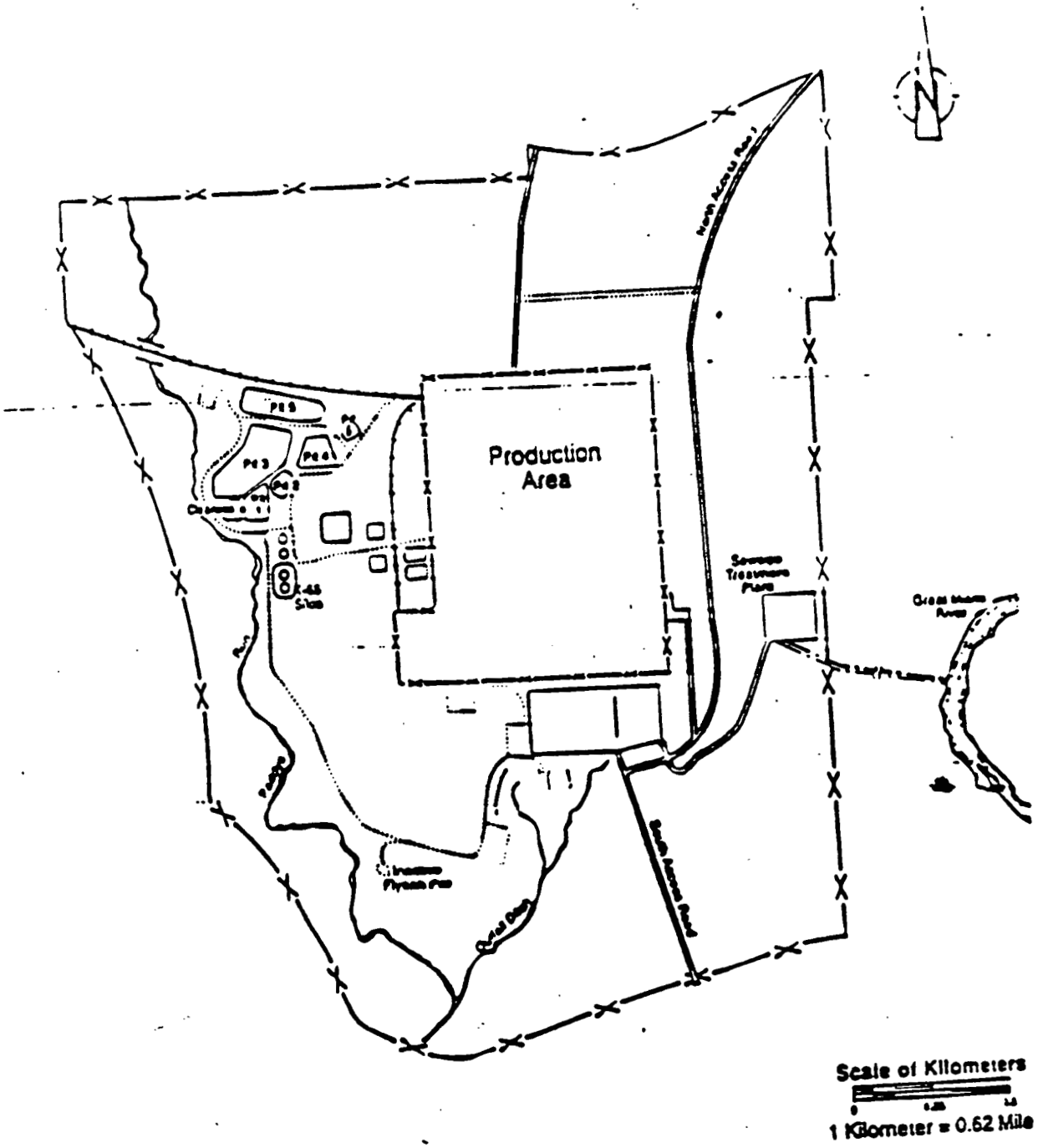
Attach map of area being observed or draw sketch in space below (see drawing on back of this form) indicating area being observed: indicate observers position relative to; source, emission points, and the sun.

OBSERVATIONS	Clock Time	Observation period duration min:sec	Accumulated emission time min:sec
Beginning			
End			

Notes:

FS-F- 4943 (8/12/97)

SAMPLE



LEGEND

Plant Perimeter

Production Area Perimeter

ATTACHMENT C

METHOD 9- VISUAL DETERMINATION OF OPACITY FOR FUGITIVE EMISSIONS

Company_____
Location_____
Test No._____
Date_____
Type Facility_____
Control Device_____
Hours of Observation_____
Observer_____
Observer Certification Date_____

Observer Affiliation_____

Point of Emissions_____ Height of Discharge Point_____

CLOCK TIME	Initial			Final
OBSERVER LOCATION				
Distance to discharge				
Direction from discharge				
Height of observation point				
BACKGROUND DESCRIPTION				
WEATHER CONDITIONS				
Wind Direction				
Wind Speed				
Ambient Temperature				
SKY CONDITIONS (clear, overcast, % clouds, etc.)				
PLUME DESCRIPTION				
Color				
Distance Visible				
OTHER INFORMATION				

SAMPLE

SUMMARY OF AVERAGE OPACITY

Set Number	Time	Opacity	
	Start - End	Sum	Average

Readings ranged from ___ to ___ % opacity.

The source was/was not in compliance with ___ at the time evaluation was made.

F- 4944 (8/12/97)

METHOD 9- VISUAL DETERMINATION OF OPACITY FOR FUGITIVE EMISSIONS
Observation Record

Company _____ Observer _____
Location _____ Type of Operation _____
Test Number _____ Point of Emissions _____

Seconds						Comments
Hr	Min	0	15	30	45	
	0					
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
	13					
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	27					
	28					
	29					

SAMPLE

FS-F- 4944 (8/12/97)

METHOD 9- VISUAL DETERMINATION OF OPACITY FOR FUGITIVE EMISSIONS
Observation Record (continued)

1418

ompany _____ Observer _____
ion _____ Type of Operation _____
Number _____ Point of Emissions _____

Seconds						Comments
Hr	Min	0	15	30	45	
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
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	58					
	59					

SAMPLE

PS-F- 4944 (8/12/97)

Technical Specifications for Area 2, Phase I Southern Waste Units Remedial Action Project Excavation Package Contract No. FSC 614 FDF Project No. 20402

April 1998
Revision 1

INFORMATION ONLY

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
Document 20402-TS-0001

WORKING DRAFT

PARSONS

175 Tri-County Parkway
Cincinnati, Ohio 45246

Technical Specifications for Area 2, Phase I Southern Waste Units Remedial Action Project Excavation Package Contract No. FSC 614 FDF Project No. 20402

April 1998
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Fernald, Ohio
Document 20402-TS-0001

WORKING DRAFT

PARSONS

175 Tri-County Parkway
Cincinnati, Ohio 45246

U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Contract No. FSC 614

AREA 2, PHASE I
SOUTHERN WASTE UNITS
REMEDIAL ACTION PROJECT
EXCAVATION PACKAGE
TECHNICAL SPECIFICATIONS

PARSONS

Approved by: _____

Carlton Schroeder, Project Manager Date

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
CONTRACT NO. FSC 614

WBS NO. 1.1.1.1.2.3.6
TECHNICAL SPECIFICATIONS
for
AREA 2, PHASE I
SOUTHERN WASTE UNITS
REMEDIAL ACTION PROJECT
EXCAVATION PACKAGE
TABLE OF CONTENTS

SECTION	TITLE	REV.	DATE
DIVISION 2:			
02050	SURVEYING	1	04/06/98
02150	TRAFFIC CONTROL	1	04/06/98
02205	IMPACTED MATERIAL EXCAVATION	1	04/06/98
02210	PRESUMED ASBESTOS CONTAINING MATERIALS (PACM)	1	04/06/98
02275	EROSION AND SEDIMENT CONTROL	1	04/06/98
02850	EQUIPMENT WASH FACILITY	1	04/06/98
02900	SEEDING	1	04/06/98

Specification Revision Record Sheet

Project Order 165

Remedial Action Project
Southern Waste Units
Excavation Package

Spec. No.	Description	RE Approval	Tech. Lead Approval	PM Approval	Date
	Incorporation of revisions provided in DCNs 20402-005 and 006 as follows:				
02050 (Rev. 1)	006				04/06/98
02150 (Rev. 1)	005, 006				04/06/98
02205 (Rev. 1)	005, 006				04/06/98
02210 (Rev. 1)	006				04/06/09
02275 (Rev. 1)	006				04/06/98
02850 (Rev. 1)	006				04/06/98
02900 (Rev. 1)	006				04/06/98

Note: Shaded areas in specification indicate current revision (e.g., date)

OUDATA\OU-2\PO-165\WBS11236\SWU\EXCAV\TOC.RV1 4/3/9

000091

U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Contract No. 614

AREA 2, PHASE I
SOUTHERN WASTE UNITS
REMEDIAL ACTION PROJECT
EXCAVATION PACKAGE
TECHNICAL SPECIFICATIONS

Division 2

PARSONS

Prepared by: _____

Date

Checked by: _____

Date

SECTION 02050
SURVEYING

PART 1 GENERAL

1.1 SCOPE

This section includes the requirements for surveying, including but not limited to:

A. Establish survey benchmarks and baselines.

B. Setting limits and boundaries of construction activities.

C. Perform surveys for:
   1. Verification of the existing conditions.
   2. Support surveys during the construction activities.
   3. Measurement and payment.
   4. Conformance checks.

D. Prepare and furnish as-built construction drawings.

1.2 RELATED SECTIONS AND PLANS

A. Section 02275 - Erosion and Sediment Control.

B. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

National Geodetic Survey Standards.

1.4 QUALIFICATION

A. Oversight for the survey work shall be provided and certified by a Land Surveyor licensed in the State of Ohio.

B. Survey work shall be performed under the direct supervision of a person who has at least 5 years of experience in construction surveying.

C. Work performed in referencing or re-establishment of FDF or United States survey monuments shall be stamped/certified by an Ohio licensed land surveyor.

1.5 SUBMITTALS

A. Submit qualifications for land surveyor licensed in the State of Ohio to the Construction Manager within 10 calendar days from Notice to Proceed for review and approval.

B. On request by the Construction Manager, submit documentation verifying accuracy of survey work.

C. Submit survey notes, field notes, sketches and drawings for the following surveys:
   1. Preliminary surveys.
   2. Prior to commencement of construction activities.
   3. Intermediate surveys.
   4. Before winter break(s) and at completion of the Contract.
   5. At completion of excavation of the Southern Waste Units (SWUs) and stockpiles including completion of Above WAC excavation, lead contaminated soil excavation, Excavation Grading Plan-1, Excavation Grading Plan-2 and Excavation Grading Plan-3.
   6. Measurement and payment surveys.
   7. Final surveys.

D. Submit two (2) copies of field notes, sketches and drawings prepared by the licensed Land Surveyor, to the Construction Manager on a weekly basis or upon request by the Construction Manager. Field notes shall be legibly recorded on standardized field note books. Notation shall be consistently applied to survey work; the stake marking format and the field book notation

shall be compatible. Identify survey benchmarks on the field notes, sketches and drawings.

E. Upon completion of the survey work, provide the Construction Manager the original field note books, layout, computations, sketches and certified drawings in Intergraph Microstation (version 5.0 or later) ".dgn" files.

F. Submittal requirements for the environmental health and safety requirements shall be as specified in Part 8.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain on site a complete and accurate log documenting survey work as it progresses.

B. Maintain on site drawings clearly showing survey benchmarks and baselines.

C. Maintain on site an accurate and current set of red-line drawings with as-built locations. Data shall be incorporated within one week of completion of the respective construction activity.

1.7 EXAMINATION OF THE EXISTING CONDITIONS

A. Prior to the start of ~~site preparation~~ excavation of the impacted material, verify the accuracy of the existing conditions shown on the Construction Drawings. Immediately notify the Construction Manager in writing of deviations from the existing conditions indicated on the Construction Drawings.

B. Verify the existing structures, utilities, wells and associated protection, topography, erosion and sediment control measures, construction and radiological control fences, retention basins and appurtenances and drainage features shown on the Construction Drawings and notify the Construction Manager of any differences or conflicts with proposed work. Stake the locations of

excavations and review proposed work with the Construction Manager in the field prior to start of excavation, as shown on the Construction Drawings.

1.8 SURVEY BENCHMARKS

A. Locate and verify benchmarks as shown on the Construction Drawings in accordance with this Section.

B. Protect and preserve benchmarks.

C. Replace disturbed or damaged survey benchmarks at no additional cost to FDF.

1.9 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

A. Provide materials as required to perform the surveys, including, but not limited to: instruments, tapes, rods, measures, mounts, tripods, stakes, hubs, nails, ribbon, and other reference markers.

B. Survey instruments shall be precise and accurate to meet the needs of the project. Survey instruments shall be capable of reading to a precision of 0.001 feet with a setting accuracy of 8 seconds.

PART 3 EXECUTION

3.1 GENERAL

A. Establish elevations, lines, and levels. Locate and lay out by instrumentation and similar appropriate means. Topographic contours shall be shown to nearest foot. Field run data shall be taken to adjacent existing undisturbed area (100 ft. minimum overlap) to create a smooth contour transition.

B. Maintain accurate and complete notes of surveys:
   1. Handwritten survey notes and information shall be documented in survey field books. A copy of the numbered, dated and signed field book pages shall be given to the Construction Manager weekly, or upon request, for use in reviewing the work.
   2. Electronically collected field survey information shall be collected and backup equipment shall be available in the event of equipment malfunction.
      a. Electronic format for printed output of data collector's field survey notes shall be compatible with the field book notation format.
      b. Electronic format for printed output of data collector's field work shall be compatible with the Contractor's and Construction Manager's computer equipment and software for reviewing the work. A copy of the data disk shall be submitted to the Construction Manager monthly or upon request.

C. The precision of horizontal and vertical control shall meet or exceed Third-Order, Class I and Third-Order accuracies, respectively, as defined by National Geodetic Survey Standards. Elevation shall be referenced to National Geodetic Vertical Datum (NGVD) of 1929 and horizontal coordinates to North American Datum (NAD) 1983.

D. Conformance check surveys for elevation and for horizontal coordinates shall be to the nearest 0.01 foot and for angles to the nearest 20 seconds.

E. Measurement and payment surveys for elevation and for horizontal distance shall be to the nearest 0.1 foot +/- 0.05 foot.

F. Perform construction layout surveys in advance of scheduled construction activities. The Contractor is responsible for rework and/or construction delays caused by survey or staking errors.

G. Set grade stakes and slope stakes in accordance with accepted surveying practices.

H. Set grade stakes for construction activities as the work progresses.

I. Establish temporary survey benchmarks, as necessary, to support construction activities.

J. Benchmarks, Accuracy and Documentation:

1. Record the following information in survey notebooks for each benchmark established:
   a. Designation of survey benchmark;
   b. Coordinates based on State Planer NAD;
   c. Elevation based on NGVD;
   d. Date of establishment;
   e. Description and sketch of survey benchmark location; and
   f. Survey benchmarks shall be referenced to a minimum of three features that can be seen from the survey benchmark.
2. Document survey work in the field notebooks using the format and procedures described below:
   a. Title and consecutive notebook number on the front cover;
   b. Consecutively numbered pages;
   c. Table of contents, indicated by survey task, on the first numbered page;
   d. Legend indicating symbols and abbreviations used in survey notes;
   e. Names of survey team for each task;
   f. Notes on weather, equipment, etc.;
   g. Date and time on each page to indicate when work was recorded;
   h. Notes in a uniform character such that they can be interpreted and used by anyone with survey knowledge;
   i. Description and/or sketches of the existing survey control used.

3.2 SUPPORT SURVEYS

A. Preliminary Surveys:
   1. Verify location of the existing survey benchmarks and the existing conditions specified in this Section prior to starting work.
   2. Perform topographic surveys of areas to be excavated prior to construction activities.
   3. Establish location of benchmarks required for locating baseline grid. Establish baselines and grid as shown on the Construction Drawings.
   4. Establish location for the installation of the erosion and sediment control measures specified in Section 02275.
   5. Establish limits of excavation at the SWU and at the stockpiles. Maximum staking interval shall be 50 feet unless otherwise approved by the Construction Manager.
   6. Perform surveys for conformance checks as specified in this Section.

B. Intermediate Surveys:
   1. Perform surveys during progress of the construction activities to verify the accuracy of field work and as directed by the Construction Manager.
   2. Perform surveys for measurement and periodic progress payment as specified in this Section.
   3. Perform surveys during progress of excavation to confirm limits of the excavation. In areas of above WAC excavation and lead contaminated soil excavation, perform surveys at each lift.
   4. Perform conformance check surveys as specified in this Section.

C. Final Surveys:
   1. Final topographic survey shall be at minimum 50 foot intervals or as required to define the topography. Additionally, the following points shall be surveyed and noted as applicable.
      a. Grade breaks.

b. Points of horizontal curvature and tangency.
c. Ditches, pipes and channels: Stake ditches, channels and culverts such that layout remains undisturbed during construction.
d. Limits of final excavation.

2. Perform survey for conformance checks as specified in this Section.
3. Perform survey for final measurement and payment.

3.3 SURVEYS FOR MEASUREMENT AND PAYMENT

A. Perform surveys for periodic progress payments and final payment to determine quantities of work.

B. Calculate and certify quantities of work and submit survey notes and calculations to the Construction Manager for review, evaluation and payment.

3.4 SURVEYS FOR CONFORMANCE CHECKS

Perform conformance check surveys upon completion of a given construction activity. Provide the following minimum spacings and locations for survey points:

A. A line of survey points spaced not more than 50 feet apart shall be taken, including along grade breaks (this will include the inside edge and outside edge of any bench on a slope).

B. A line of survey points spaced not more than 50 feet apart shall be taken at the top of any pipes and any appurtenances, and at the top and invert of any storm culverts.

END OF SECTION

SECTION 02150
TRAFFIC CONTROL

PART 1 GENERAL

1.1 SCOPE

This section includes, but is not limited to, the requirements for the following activities:

A. Traffic Plan.

B. Construction and Radiological Control fencing.

C. Protection of the existing wells.

1.2 RELATED SECTIONS AND PLANS

A. Section 02050 - Surveying.

B. Section 02205 - Impacted Material Excavation.

C. Section 02275 - Erosion and Sediment Control.

D. Part 6 - Statement of Work.

E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

State of Ohio, Department of Transportation (ODOT): Construction and Material Specification, January, 1997.

1.4 SUBMITTALS

A. Submit a Traffic Plan within ten (10) calendar days from the Notice to Proceed for review and approval by the Construction Manager. The Traffic Plan shall include as a minimum:

1. Planned traffic routes for hauling excavated impacted material from the Southern Waste Units (SWUs), stockpiles and Retention Basins 1, 2 and 3 to the On-Site Disposal Facility (OSDF), the Lead Contaminated Soil Container Transfer Area and~~OU-1~~ SP-5 Stockpile Area.
2. Access from the stockpiles to the haul roads.
3. Planned traffic routes within the SWUs.
4. Planned crossings of major utilities (such as gas line, drinking water line, power lines and groundwater line), and a plan to protect the existing utilities at the crossings. The crossing protection should be a minimum of a 1-inch thick steel plate or an equivalent alternative. Length and width of steel plate shall be as required to protect the existing utilities. Provide calculations to support equivalent alternatives to the 1-inch thick steel plate.
5. Crossings for pedestrians and equipment as shown on the Construction Drawings.
6. Maintenance and cleaning of haul road, planned traffic routes, pedestrian crossings and equipment crossings.
7. Description of impact to other site traffic control during long breaks in work.
8. Access control to and from radiological controlled areas and certified areas.
9. ~~Submit~~ Detailed drawings depicting the location of a traffic signal system including the following;
   a. Site Plan showing equipment locations.
   b. List of equipment to be used as a part of the traffic signal system.
   c. Plan timing data for the signals.

B. Within ten (10) calendar days from the Notice to Proceed, submit a Dust Control Plan in accordance with Part 6 for approval by the Construction Manager.

1.5 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

1.6 DEFINITIONS

There are three types of material haul crossings identified: Type I, Type II and Type III:

A. Type I crossing occurs from an uncontrolled area to an uncontrolled area crossing a contaminated road.

B. Type II crossing occurs from a controlled area to a controlled area crossing a contaminated road.

C. Type III crossing occurs from an uncontrolled area to an uncontrolled area crossing an uncontrolled road.

PART 2 PRODUCTS

2.1 MATERIALS

A. Suppressant agent for dust control shall be pine sap emulsion as specified in Section 02275 and as approved by the Construction Manager.

B. Materials for traffic control shall be as defined by the Traffic Plan and shall conform to ODOT specifications unless otherwise approved by the Construction Manager.

C. Construction fence shall be orange, high density polyethylene, four-foot height, opening size approximately 4 inches by 1/2 inch, minimum tensile strength of 2000 lbs/ft of width. Posts shall be steel "T" as indicated on the Construction Drawings.

D. Radiological control fence shall be as specified for construction fence, except the color shall be yellow.

E. Type I and II crossings: none

F. Type III crossing: Supply all equipment and materials necessary to install a 4-way traffic signal system. System shall be portable, with traffic actuations in two of the four directions.

PART 3 EXECUTION

3.1 GENERAL

A. Verify the existing conditions as specified in Section 02050.

B. Install erosion and sediment control measures and repair, as needed, the existing erosion and sediment controls prior to the start of ~~site preparation~~ excavation activities in accordance with Section 02275.

3.2 DUST CONTROL

Dust control shall be as specified in Part 6 and the approved Dust Control Plan.

3.3 CONSTRUCTION AND RADIOLOGICAL CONTROL FENCING

A. Prior to initiating work activities examine existing construction fencing and radiological control fencing as shown on the Construction Drawings and as specified in Part 8.

B. Maintain and repair construction and radiological control fences until completion of the Contract.

C. Locate and install radiological control fence around the excavation of the Above WAC Material as directed by the Construction Manager.

3.4 TRAFFIC CONTROL

Control traffic in accordance with the approved Traffic Plan.

3.5 PROTECTION OF THE EXISTING WELLS

If damage to existing monitoring wells and/or extraction wells occurs, repairs and/or replacement will be completed by FDF at the Contractor's expense.

3.6 MATERIAL HAUL CROSSINGS

A. General
Contractor may be stopped ~~at any crossing~~ greater than 5 minutes at any crossing during an emergency event in which site Emergency Response Team or fire fighting force is activated, Utility Engineer is investigating, or a nearby utility is in need of immediate repair.

B. Type I and II Crossings
Contractor shall allow a 10 minute road delay per hour. This may consist of one (1) ten minute closure on the hour or two (2) 5 minute closures on the half hour as specified by the Construction Manager. The delay will occur simultaneously at all affected haul road crossings (e.g. crossings with the Impacted Material Haul Road) to allow for site traffic and pedestrians to cross.

C. Type III Crossings
Site traffic will yield to Contractor at Type III crossings.

3.7 EQUIPMENT PARKING

A. Clean Equipment Parking Area
1. Clean equipment parking area shall be within a support area.
2. No personal vehicles shall be allowed in the clean equipment parking area.

B. Contaminated Equipment Parking Area

1. The contaminated equipment parking area shall be kept free of standing water.
2. The contaminated equipment parking area shall be kept free of debris.
3. The contaminated equipment parking area shall be located as close as possible to the radiological control point access.
4. See Section 02205 for additional requirements for contaminated equipment.

END OF SECTION

SECTION 02205
IMPACTED MATERIAL EXCAVATION

PART 1 GENERAL

1.1 SCOPE

This section includes the requirements for the excavation, loading, hauling, and unloading of impacted materials and related activities including, but not limited to:

A. Excavation of impacted materials from the Southern Waste Units (SWU) area and impacted material stockpiles designated on the Construction Drawings, including unclassified impacted material, Above Waste Acceptance Criteria (WAC) material, lead contaminated soil, Special Materials, and sediment.

B. Loading and hauling of the excavated impacted materials from the SWU area and impacted material stockpiles and unloading of this material in the OSDF.

C. Loading of the Special Materials excavated from the SWU area and impacted material stockpiles and transferring to the Special Material Transfer Area shown on the Construction Drawings.

D. Loading and hauling of the excavated Above WAC material and unloading and placing in the ~~OU-1~~ SP-5 Stockpile Area shown on the Construction Drawings after excavation, loading, hauling, and unloading of the SP-5 Stockpile impacted material in the OSDF is complete.

E. Loading, and containerizing of excavated lead contaminated soil material from the SWU area and staging of these containers in the Lead Contaminated Soil Container Transfer Area shown on the Construction Drawings.

F. Dust control as specified in Part 6.

G. Hand excavation around the existing wells to remain within the SWU excavation area and impacted material stockpile areas.

H. Excavation of impacted material from the SP-5 Stockpile as shown on the Construction Drawings and loading, hauling, and unloading of this material in the OSDF.

1.2 RELATED SECTIONS AND PLANS

A. Section 02050 - Surveying.

B. Section 02150 - Traffic Control.

C. Section 02210 - Presumed Asbestos Containing Materials (PACM).

D. ~~Section 02212 - Material Identification and Documentation~~.

~~D~~E. Section 02275 - Erosion and Sediment Control.

~~E~~F. Section 02850 - Equipment Wash Facility.

~~F~~G. Section 02900 - Seeding.

~~G~~H. Part 6 - Statement of Work.

~~H~~I. Part 8 - Environmental Health and Safety, and Training Requirements.

~~I~~J. Impacted Materials Placement Plan, On Site Disposal Facility, ~~October 1997, Revision I~~ current revision.

~~J~~K. On-Site Disposal Facility (OSDF) Phase II Technical Specifications.

1.3 REFERENCES

A. Area 2 Phase I Southern Waste Units Implementation Plan for Operable Unit 2, ~~October 1997, Revision C~~ current revision.

B. Waste Acceptance Criteria Attainment Plan for the On Site Disposal Facility, ~~August 1997, Revision B~~ current revision.

C. Fernald Environmental Management Project (FEMP) Plan PL-2194, Spill Prevention Control and Countermeasure (SPCC) Plan, ~~September 1996, Revision 3~~ current revision.

D. Fernald Environmental Management Project (FEMP) Procedure. RP-0010, Identification and Movement of Radioactive Material, ~~May 1996, Revision 2~~ current revision.

E. Fernald Environmental Management Project Procedure (FEMP) PT-0007 Packaging Low Level Waste for Off-Site Shipment, ~~August 1997, Revision 3~~ current revision.

F. State of Ohio, Department of Transportation (ODOT), Construction and Material Specifications, January 1997.

1.4 SUBMITTALS

Submit an Excavation Work Plan to the Construction Manager within fifteen (15) calendar days from the Notice to Proceed for review and approval. The Excavation Work Plan shall be integrated into the Safe Work Plan specified in Part 6. The Excavation Work Plan shall include, as a minimum, the following:

1. Excavation, loading, hauling, and unloading methods and equipment, by size and type, for the impacted materials including unclassified impacted materials, the Above WAC Material, lead contaminated soil, stockpiles, and sediment. Include methods for separating category 2, 3, 4 and 5 impacted material specified in the Impacted Material Placement Plan for OSDF during excavation and size reduction methods to meet the WAC specified in the Impacted Materials Placement Plan for OSDF. ~~Include steps taken to optimize WAC for support of the impacted material placement.~~
2. Technical approach for the coordination and implementation of the excavation related activities including submittals, surveying, fencing, erosion and

sediment control, water management, stump grinding, loading requirements, equipment wash, haul road management, material identification and documentation, seeding, stabilization of exposed excavated areas and dust control.

3. Schedule for impacted material excavation with integrated Project Construction Schedule as specified in Part 6, for the excavation, including loading, hauling and unloading, and excavation related activities, showing sequence, duration, critical activities, resources for each activity, number of crews and crew size, and start and completion date for each activity.
4. Environmental Health and Safety, and Training requirements for the excavation, loading, hauling and unloading, including a plan for coordinating personnel and equipment in the excavation areas.
5. Methods for excavation, separation, and packaging of PACM in accordance with Section 02210.
6. Methods for the excavation, managing, loading, segregation, transferring and staging of Special Materials, Above WAC Material, and lead contaminated soil.
7. Loading, hauling and unloading methods for the Above WAC impacted materials to the ~~OU-1~~ SP-5 Stockpile Area, including:
   a. Inclement weather operations.
   b. Spreading, grading, and compaction.
   c. Maintenance of surface conditions and drainage.
   d. Temporary shutdown and work stoppage.
   e. Methods to prevent haul equipment tires from coming in contact with Above WAC Material.
   f. Plan and details showing the unloading of Above WAC impacted material at the SP-5 Stockpile area.
8. Location, sequencing, and construction of interim working stockpiles, if necessary.
9. Sequencing of interceptor ditch construction.
10. Methods for complying with the FEMP Plan PL-2194, ~~for~~ Spill Prevention and Control and Countermeasure (SPCC) Plan.

1.5 EXISTING CONDITIONS

Prior to start of excavation of the impacted materials, examine and verify the existing conditions as specified in Section 02050.

1.6 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

1.7 DEFINITIONS

A. Impacted Material: Impacted material is defined as material placed in the existing stockpiles, fill material in the SWU, sediment accumulated in the retention basins, ditches, and at erosion and sediment control measures, and non-fill material with contaminant levels above established Final Remediation Levels (FRLs).

B. Unclassified Impacted Material: Unclassified impacted material shall be impacted material encountered during excavation, regardless of type, character, composition, and condition thereof, unless otherwise specified in this Section. Unclassified impacted material also includes excavated material from the impacted material stockpiles, ~~the SWU~~, sediment accumulated in the interceptor ditches, Retention Basins 1, 2 and 3, erosion and sediment control measures, Equipment Wash Facility and the SWU~~and SWU, Equipment Wash Facility~~, except Lead Contaminated Soil, Above WAC Material and Special Material.

Categories of unclassified impacted material shall be as specified in the Impacted Materials Placement Plan for the OSDF. Unclassified impacted material also includes debris encountered during excavation in the SWU and the impacted material stockpiles. Distribution of debris mixed with soil or soil like material in the excavation of the unclassified impacted material is not anticipated to be uniform throughout the SWU and impacted material stockpiles. Debris may comprise up to 15 percent of the total volume of impacted material. Debris consists of

impacted material such as construction materials, concrete, asphalt, steel rebar, non-friable PACM and other materials not defined as a Special Material. Criteria for debris shall be as specified in the Impacted Materials Placement Plan and Waste Acceptance Criteria Attainment Plan for OSDF.

C. Lead Contaminated Soil: Soil with lead concentrations above the FRL for lead [400 milligram/kilogram (mg/kg)] that may, upon further Toxicity Characteristic Leaching Procedure (TCLP) analysis, qualify as a Resource Conservation and Recovery Act (RCRA) toxicity characteristic hazardous waste.

D. Above WAC Material: Soil, soil mixed with debris, debris, or soil-like impacted material with total uranium concentrations above the OSDF total uranium WAC [1030 mg/kg], or any other material that does not meet the OSDF WAC.

E. Special Materials: Impacted material which requires special handling shall be as listed below:

1. Friable PACM, as specified in Section 02210;
2. Nonpressurized ~~(i.e. in-tact)~~ containers, including drums, boxes, cans;
3. Pressurized containers;
4. Pumps and piping;
5. Non-soil residues, including green salt, black oxide, orange oxide, and sump cake;
6. Transformers and electrical equipment;
7. Lead acid batteries;
8. Uranium metal, including derbies, ingots and irregularly shaped scrap;
9. Medical/infectious waste;
10. Tires;
11. Miscellaneous debris, including oil and air filters, personal protective equipment (PPE), radiators, cables, wires, tools, heavy equipment, office materials and documents, and lead flashing.
12. Acid bricks.

PART 2 PRODUCTS

2.1 MATERIALS

A. FDF shall furnish metal boxes and lids for lead contaminated soil. Each box shall be approximately 4 x 4 x 7 foot and weigh approximately 1,100 pounds empty. Contractor shall notify FDF a minimum of thirty (30) calendar days prior to the start of lead contaminated soil excavation. Contractor shall load boxes to a maximum gross weight of 9,000 pounds.

B. FDF shall furnish materials, equipment, and personnel for radiological characterization and monitoring of the impacted material.

C. Aggregate base shall meet the requirements of ODOT Item 304.

2.2 EQUIPMENT

A. Provide equipment of size and type to excavate, load, haul, and unload impacted material to meet the Contract requirements.

B. Provide equipment of size and type to load, haul, unload, place, manage, and compact material in the ~~OU-1~~ SP-5 Stockpile Area to meet the Contract requirements.

C. Equipment to be operated over the existing Impacted Material Haul Road, including equipment to be used to haul impacted material, shall be equal to or less than the gross vehicle weight, tire pressure and axle loading for a Caterpillar CAT D300E truck (gross vehicle weight of 106,700 pounds, tire pressure of 60 psi, and axle load of 37,400 pounds).

Pavement width of the existing two-way Impacted Material Haul Road width is 24 feet. Select equipment and equipment width to ensure safe operation on this two-way road.

D. Equipment, including equipment to be used to haul impacted materials on the Impacted Material Haul Road, shall have enclosed cabs. Enclosed cab is defined as an equipment cab isolated from outside environment (intact windows, doors, panels and floors surrounding driver with all windows and doors shut) which provides a barrier from intrusion of outside airborne particles. Any HVAC (heating, ventilating or air conditioning) units associated with the equipment cab must not provide a direct path for outside air to enter (air conditioner on air recirculate mode), unless the air is passed first through a HEPA filter pulled directly from outside the cab.

E. Provide water tank trucks, tank trucks for the suppressant agent and crusting agent, portable tanks, pressure distributors, piping or other equipment designed to apply dust suppressant and crusting agent uniformly and in controlled quantities to variable surface widths to provide dust control as required in Part 6.

F. Provide stump grinder to meet the Contract requirements.

G. Provide equipment to weigh loaded lead contaminated soil boxes.

PART 3 EXECUTION

3.1 GENERAL EXCAVATION REQUIREMENTS

A. Manage construction fence and radiological control fence as specified in Section 02150 and Part 6 and as shown on the Construction Drawings. Signs and sign posts for the radiological control areas shall be furnished and installed by FDF.

B. Install and manage traffic control measures and devices as specified in Section 02150.

C. Survey and layout excavation limits and grid in accordance with Section 02050 and as shown on the Construction Drawings.

D. Install and manage erosion and sediment control measures in accordance with Section 02275. Construct and manage Interceptor Ditch No. 1 prior to excavation of Inactive Flyash Pile (IFP). Install Interceptor Ditches No. 2 and No. 3 as soon as practical in conjunction with the excavation depicted on the Construction Drawings.

E. ~~Provide material identification and documentation in accordance with Section 02212.~~Provide material tracking information in accordance with the Construction Drawings.

F. Continuously observe excavations for Special Materials and change in materials and immediately notify the Construction Manager of a change in impacted material and/or finding of Special Material.

G. Dust control shall be in accordance with Part 6 and the Dust Control Plan. Dust control shall be provided during excavation, segregation, size reduction, loading, hauling, transferring, unloading, and other related activities, and during off-hours as specified in Part 6.

H. Location of the interim working stockpiles shall be within the limits of the SWU and as approved by the Construction Manager. Interim working stockpiles shall be removed within a maximum of thirty (30) calendar days.

I. Blasting, including use of explosives or explosive devices, is not permitted.

J. Water management shall be as specified in Section 02275 and Appendix B of the Area 2, Phase I Southern Waste Units Implementation Plan for Operable Unit 2, "Surface Water Management Plan".

K. Impacted material excavation and related activities shall be performed in accordance with the approved Excavation Work Plan.

L. FDF and regulatory agencies may collect impacted material samples from the excavation, haul equipment and in the OSDF at any time during the project.

M. Unexpected discovery of cultural resources: Upon the unexpected discovery of any historic, prehistoric, or archeological site, feature or object, immediately cease ground disturbing activities at the find and contact the Construction Manager.

N. During excavation, segregate Category 2 material larger than 12-inches and maximize volume of Category 1 material. Size reduce segregated Category 2 material to meet physical WAC specified in Impacted Materials Placement Plan for OSDF.

O. Excavate and segregate material as required for construction of protective layers, select impacted material and contouring layer as required for placement, and impacted material required for placement of Category 2, 3, 4 and 5 materials as specified in the Impacted Materials Placement Plan for OSDF.

P. The following additional requirements shall apply to equipment for excavation, loading, hauling, and unloading:

1. Equipment used for excavation, loading, hauling and unloading of the impacted material from the SWU and the stockpiles shall be clearly and conspicuously marked by the Contractor as "Radioactive Material" in accordance with FEMP Procedure RP-0010.
2. Equipment used during excavation, loading, hauling, and unloading of the impacted material and during periods of non-use (evenings, weekends, holidays) shall be kept within the SWU and in ~~OU-1~~ SP-5 Stockpile Area.
3. Equipment used for hauling of the impacted material shall be equipped with an automatic cover. The cover shall be in place during all periods of equipment movement on-site, whether empty or full.
4. Equipment used for excavation, loading, hauling, and unloading impacted material shall not be permitted to leave the radiological control areas until equipment decontamination activities are

completed by the Contractor and radiological survey of the equipment is performed by FDF.

5. Equipment cab shall remain closed and operators shall not be allowed out of the equipment in any posted contamination area without appropriate PPE except in emergency situations.
6. Equipment used during the excavation of the Above WAC Material, lead contaminated soil material, and soil placement in the ~~OU-1~~ SP-5 Stockpile Area shall stay in the respective areas until completion of the excavation and placement.
7. Haul equipment transferring material on the Impacted Material Haul Road shall remain on the road as much as practical while waiting to dump or be loaded. Sequence equipment to minimize time spent within the SWU excavation, OSDF cell and ~~OU-1~~ SP-5 Stockpile Area

Q. Loading Requirements:

1. Haul equipment shall be loaded so as to minimize load shifting during transit.
2. Visually check impacted material for free liquid prior to loading. Free liquid in the impacted material before loading shall be as specified in the Impacted Materials Placement Plan for OSDF and the WAC Attainment Plan for the OSDF.

R. Hauling requirements:

1. Haul equipment shall be washed at the equipment wash facilities before entering the Impacted Material Haul Road at the SWU and OSDF. Requirements for equipment wash shall be as specified in Section 02850.
2. Maintain the Impacted Material Haul Road free of visible mud, soil, soil-like material, debris, or impacted material in accordance with Part 6.
3. Provide dust control for the haul roads on a continual basis in accordance with Part 6 and approved Dust Control Plan.
4. Haul equipment traffic shall remain on the haul roads designated on the Construction Drawings. Equipment that enters the haul roads shall not be

allowed to exit, except at the SWU area, stockpiles, OSDF Debris Transfer Area and/or the OSDF, without approval by the Construction Manager.

5. Tracked equipment shall be prohibited from hauling, operating, or tracking over or on the Impacted Material Haul Road.

S. Unless otherwise specified, FDF will perform monitoring of the surface of each lift to be excavated to determine if WAC has been attained. Contractor shall excavate in another location during monitoring and while awaiting the results, at no additional cost to FDF. FDF monitoring of each lift will take at least two (2) work days after the lift is graded and ready for FDF monitoring. Duration for FDF monitoring shall be extended by one (1) day for each day precipitation occurs.

T. FDF will ~~not~~ perform only visual monitoring of the following stockpiles during excavation: South Field Impacted Material Stockpile, ~~SP-5 Stockpile~~, ~~OSDF East Impacted Material and Debris stockpiles,~~ and OSDF West Impacted Material ~~and Debris~~ stockpiles.

U. If Contractor is unable to excavate within the limits of the IFP, move excavation to the South Field Impacted Material Stockpile and/or the South Field (SF), as directed by the Construction Manager. If Contractor is unable to excavate within the limits of the SF, move excavation to the Active Flyash Pile (AFP). Movement between excavation areas shall be at the direction of the Construction Manager and at no additional cost to FDF.

V. Temporary shutdown shall be as specified in Part 6.

W. Stump Grinding:

1. Grind stumps within SWU to a minimum depth of 12 inches or to the bottom of the root-mass within 18 inches of the stump in all horizontal directions. Grind the wood chips in pieces generally smaller than 12 inches dimensions.

2. Excavate the ground stump wood chips with the soil and haul to the OSDF. The volume of organic material shall be less than 1/4 of the truckload for hauling to the OSDF. Determination of the volume of organic material in the truckload shall be by visual observation by FDF.

X. Tolerances for the excavation grades shown on the Construction Drawings shall be from 0 to +6 inches.

Y. Perform stabilization of the excavated areas using crusting agent and temporary seeding in accordance with Sections 02275 and 02900, respectively.

Z. FDF will provide an existing Special Material Transfer Area. The Special Material Transfer Area shall be relocated as necessary to accommodate excavation. The Special Material Transfer Area shall be constructed with aggregate base stone. Aggregate material shall meet the requirements of ODOT Item 304. Compaction requirements for aggregate material shall meet or exceed ODOT Item 304 requirements. Special Material Transfer Area shall be as shown on the Construction Drawings and described in this Section.

3.2 UNCLASSIFIED IMPACTED MATERIAL EXCAVATION

A. Typically excavations shall proceed in an up gradient to down gradient pattern to the limits indicated on the Construction Drawings.

B. Excavate SWU from a location higher in elevation than the area to be excavated unless otherwise approved by the Construction Manager.

C. Select equipment and excavation methods to minimize obstruction of continuous visual observation of the excavation.

D. Excavation of the unclassified impacted materials shall proceed by excavating the material in 3 foot +/- 1 foot lifts and in maximum 100 foot by 200 foot areas, followed

by monitoring of the surface area by FDF. During excavation of each lift, rough grade the area to drain. Maximum slope of the rough graded area shall be 6 percent. Move excavation operation a minimum of 50 feet from the previous excavation area while awaiting monitoring results. Construction Manager will notify Contractor of areas available for excavation.

E. If Above WAC Material or Special Materials are encountered, stop excavation, immediately notify Construction Manager and move the excavation operation to another location as directed by the Construction Manager.

F. Hand excavate around the existing monitoring wells as shown on the Construction Drawings.

G. Impacted material for the protective layer and contouring layer shall be obtained from the OSDF West Impacted Material Stockpile and/or AFP. Impacted material for the select impacted material layer shall be obtained from the IFP, SF, South Field Impacted Material Stockpile and/or OSDF West Impacted Material Stockpile. Impacted material requirements for protective layer, select impact material layer and contouring layer shall be as specified in the OSDF Phase II Technical Specifications.

3.3 LEAD CONTAMINATED SOIL EXCAVATION

A. Survey and stake the limits of lead contaminated soil excavation in accordance with Section 02050 and as shown on the Construction Drawings.

B. Excavate the unclassified impacted material overburden as indicated on the Construction Drawings and in accordance with this Section.

C. Excavate the lead contaminated soil to the limits and elevations as shown on the Construction Drawings.

D. Notify FDF thirty (30) calendar days prior to the start of excavation of the lead contaminated soil. Load the lead contaminated soil into metal boxes provided by FDF

and haul to the Lead Contaminated Soil Container Transfer Area. FDF will sample the material prior to the Contractor fastening the lids and hauling to the transfer area. The boxes shall be loaded and fastened as per FEMP PT-0007.

E. Loaded containers shall not exceed 9000 pounds in gross weight. Containers shall be weighed by the Contractor prior to placement in the Lead Contaminated Soil Container Transfer Area. Lead contaminated soil is expected to have a dry unit weight of approximately 100 to 115 pounds per cubic foot (pcf).

F. Visually check lead contaminated soil material for free liquid prior to loading in the container. Moisture content in the soil shall not result in "bleeding" of liquids. Material with free liquid shall not be loaded until free liquid is no longer present.

G. Lead contaminated soil shall be loaded immediately adjacent to the lead contaminated soil excavation area.

H. Grade Lead Contamination Soil Container Transfer Area to drain into the existing ditch and compact before transfer of the containers. Loaded containers shall be placed on the compacted surface in the Lead Contaminated Soil Container Transfer Area in a manner that protects the containers from damage. Do not stack containers. Provide access and culvert as indicated on the Construction Drawings.

I. FDF will perform confirmatory sampling of the lead contaminated soil area. Contractor shall excavate in another location during sampling and while awaiting the results of the sampling, at no additional cost to FDF.

J. Perform additional excavation as directed by the Construction Manager and as specified in this Section.

3.4 ABOVE WAC MATERIAL EXCAVATION

A. Material above or outside the Above WAC excavation area shall be excavated as unclassified impacted material as specified in this Section. Areas anticipated to contain Above WAC material shall be as designated on the Construction Drawings.

B. Excavation within the Above WAC Material Area shall proceed by removing the material in 4 foot lifts, followed by monitoring at the perimeter of the above WAC excavation area by FDF. The side-slopes of the Above WAC Excavation shall be 2H:1V unless otherwise directed by the Construction Manager or flatter for stability. Survey the limits of the Above WAC Material excavation area after excavation of each lift.

C. If monitoring results along a side of the Above WAC excavation are above WAC, the Above WAC material excavation area shall be expanded 5 feet laterally in all directions from the location of the above WAC monitoring results.

D. After excavating a lift within the Above WAC area, excavate the surrounding unclassified impacted material to a depth of at least 1 foot above the excavated bottom of the Above WAC excavation area. Grade surrounding area to drain away from the Above WAC excavation except the loading area for the Above WAC Material. Loading area shall be graded to drain into the Above WAC excavation sump. Maintain loading area clear of spillage. Remove spillage prior to entry of next haul equipment in loading area.

E. Excavate Above WAC material and surrounding unclassified impacted material to the limits shown on the Construction Drawings or as otherwise directed by the Construction Manager.

F. Maintain sumps within the Above WAC excavation to collect water encountered during excavation. Water collected in these sumps shall be pumped to the nearest retention basin as specified in Section 02275. If sump excavation penetrates the Great Miami Aquifer (GMA), line the sump

with a 60 mil textured HDPE geomembrane liner or other material approved by the Construction Manager to ~~prevent~~ minimize potential contamination of the GMA. Geomembrane liner shall be installed and anchored in accordance with Interceptor Ditch Detail as shown on the Construction Drawings. Geomembrane liner shall be as specified in Section 02275.

G. Loading area for haul equipment shall be adjacent to the Above WAC Area and as close to the Equipment Wash Facility as possible. The loading area shall be relocated as necessary during excavation.

H. Haul equipment shall remain outside of the Above WAC Area at all times.

I. Above WAC materials shall be hauled to the ~~OU-1~~ SP-5 Stockpile Area.

J. Requirements for unloading and stockpiling the Above WAC material at the ~~OU-1~~ SP-5 Stockpile Area shall be:

1. Construction of ingress/egress to the stockpile area including access road, ramp, and drainage improvements.
2. Constructing an unloading area that prevents haul equipment tires from coming in contact with the Above WAC Material.
3. Placing material in a stockpile at a location designated by the Construction Manager.
4. Immediately repair damage to the stockpile structures to the original condition (i.e., silt fence, perimeter fence, etc.) caused by the Contractor, at no additional cost to FDF.
5. Dust suppressant shall be in accordance with Part 6 and approved Dust Control Plan.
6. Crusting agent shall be applied, within seven (7) calendar days, upon completion of the stockpile or if the stockpile is to be inactive for more than forty-five (45) calendar days.
7. Surface of the stockpile in use shall be compacted/sealed at the close of each work day to prevent fugitive dust and runoff.

8. Equipment and material used in the placement and management of Above WAC impacted material in the ~~OU-1~~ SP-5 Stockpile Area shall not be removed from the area without the approval of the Construction Manager. This equipment shall not be removed from area before washing. Equipment washing shall be performed within the ~~OU-1~~ SP-5 Stockpile Area. Wheels, tires, undercarriage and body of equipment shall be washed free of visible mud, dirt and debris.

9. The Above WAC Stockpile side-slopes shall not exceed a maximum slope of 3H:1V and a height to base ratio 0.2.

3.5 SPECIAL MATERIAL EXCAVATION

A. Special Materials identified during excavation shall be excavated, segregated, managed, loaded, transferred and stored at the Special Material Transfer Area as directed by the Construction Manager.

B. FDF will be responsible for final disposition of the Special Materials.

C. The Special Material Transfer Area shall be relocated within approximately twenty feet of an existing gravel road within the limits of the SWU. Actual location shall vary as excavation progresses and shall be approved by the Construction Manager. Existing and relocated Special Material Transfer Area shall be as shown on the Construction Drawings.

D. PACM encountered during excavation shall be managed in accordance with Section 02210.

E. FDF will furnish containers necessary for handling, staging, transferring and disposal of Special Materials except for PACM.

3.6 EXCAVATION OF THE IMPACTED MATERIAL STOCKPILES

A. Excavation of the South Field Impacted Material Stockpile~~s~~, and ~~including~~ the OSDF ~~East and~~ West ~~Debris~~ Impacted Material Stockpile~~s~~, as shown on the Construction Drawings shall be in accordance with unclassified impacted material excavation as specified in this Section. ~~The SP-5 Stockpile OSDF East and West Debirs Stockpiles. Stockpiles shall not require~~ FDF will perform visual monitoring during excavation ~~and may be excavated at Contractor's discretion~~ of the stockpiles. Material excavation from stockpiles shall be hauled and unloaded in the OSDF.

B. After removal of the OSDF ~~East and~~ West Impacted Material Stockpile~~s~~, excavate 12-inches below the stockpile~~s~~ within the limits shown on the Construction Drawings. Notify the Construction Manager at completion of excavation of the ~~East and~~ West Impacted Material Stockpile~~s~~ and prior to start of 12-inch excavation. Prior to start of 12-inch excavation, FDF will perform monitoring within two (2) work days after completion of stockpile excavation. Contractor shall perform excavation after completion of FDF monitoring. This material shall be considered as unclassified impacted material and shall be excavated, loaded, hauled, and unloaded in the OSDF.

C. Install erosion and sediment controls before the excavation of the stockpiles and maintain until completion of stockpile excavation. Erosion and sediment control measures shall be as specified in Section 02275.

D. After completion of stockpile excavation, grade the area to match the surrounding grade and provide temporary seeding as specified in Section 02900.

E. Excavation of SP-5 Stockpile shall be in accordance with Section 3.2, Unclassified Impacted Material Excavation. The Stockpile shall be excavated in a manner to create a location to stockpile Above WAC Material from the SWU and SP-5 Excavation ~~any that might be encountered during~~

~~excavation of the SP-5 Stockpile.~~ Drainage controls shall be provided by construction of an interceptor ditch to collect runoff from the Above WAC material in the SP-5 Stockpile area. The interceptor ditch shall discharge to the existing storm sewer system adjacent to SP-5 Stockpile. The chain-link fence, surrounding ditches, and other existing features of SP-5 Stockpile Area shall be maintained during excavation of SP-5 Stockpile and placement of Above WAC material in the SP-5 Stockpile Area.

END OF SECTION

SECTION 02210
PRESUMED ASBESTOS CONTAINING MATERIALS (PACM)

PART 1 GENERAL

1.1 SCOPE

This section includes the requirements for handling, packaging, loading, hauling and unloading of Presumed Asbestos Containing Materials (PACM). The excavation, handling, packaging, loading and hauling activities at and from the Southern Waste Units (SWU) area are considered "disturbance of an inactive asbestos waste disposal site" and "asbestos waste handling," while the unloading activities at the On-Site Disposal Facility (OSDF) are considered "active asbestos waste disposal" — rather than "asbestos hazard abatement" — as those terms are used in the referenced administrative code and federal regulations.

1.2 RELATED SECTIONS AND PLANS

A. Section 02205 - Impacted Material Excavation.

B. Part 6 - Statement of Work.

C. Part 8 - Environmental Health and Safety, and Training Requirements.

D. Impacted Material Placement Plan, On-Site Disposal Facility, ~~August 1997, Revision H~~ current revision.

E. Waste Acceptance Criteria Attainment Plan for the On-Site Disposal Facility, ~~August 1997, Revision H~~ current revision.

1.3 REFERENCES

A. Ohio Administrative Code (OAC), Chapter 3745-20, Asbestos Emission Control.

B. Title 29, Code of Federal Regulations (CFR), Part 1926.1101, Asbestos.

1.4 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

1.5 SUBMITTALS

A. Submit a PACM Handling Plan, in compliance with all applicable federal (CFR) and state (OAC) requirements, within ten (10) calendar days from the Notice to Proceed for approval by the Construction Manager. The plan shall describe or present the following as a minimum (additional requirements are presented in Part 8):

1. Method to be used to ensure Contractor's (inclusive of Subcontractors) employees are informed of the presence of PACM in the project work area.
2. Method(s) to be used to establish a restricted area adequate to deter the entry of unauthorized personnel within 100 feet of the PACM work areas.
3. Personal protective equipment to be worn by employees.
4. Work practices to be observed by employees.
5. Methods to be used to handle and package friable PACM and to ensure no visible asbestos emissions during handling, loading, hauling and unloading.
6. Methods to handle non-friable PACM to minimize the potential for non-friable PACM to become friable and to ensure no visible asbestos emissions during handling, loading, hauling and unloading.
7. Methods to be used if PACM must be size-reduced to meet size criteria described in the Impacted Material Placement Plan for OSDF.
8. The encapsulant and surfactant agents to be used.
9. Product data and technical information including application instructions and Material Safety Data Sheet (MSDS) for each material proposed for use.
10. Labeling methods.
11. Identification of the Contractor's "asbestos competent person" personnel.

PART 2 PRODUCTS

2.1 MATERIALS

A. Clear polyethylene sheeting and clear polyethylene disposal bags shall be a minimum of 6 mils thick.

B. Materials to be used as encapsulants and surfactants shall be in original, new, and unopened packages and containers bearing manufacturer's name, label, and the following information:
1. Name of material.
2. Manufacturer's stock number and date of manufacture.
3. Manufacturer's name.
4. Thinning instructions.
5. Application instructions.

C. Surfactant (wetting agent) shall be as specified by the following: ~~approved manufacturers:~~
1. Childers - CP-225 CHIL-SORB.
2. Certech.
3. Expert Environmental Products.
4. International Protective Coatings Corp.
5. Or approved equivalent.

D. Encapsulants shall be as specified by the following: ~~approved manufacturers:~~
1. Childers - CP-240 CHIL-LOCK.
2. Certified Technologies - Certane 2050.
3. Expert Environmental Products - EPPCO #1.
4. International Protective Coatings - Serpiloc.
5. Or approved equivalent.

E. Other materials required by the Contractor for handling and packaging of friable PACM.

PART 3 EXECUTION

3.1 APPLICATION

A. FDF has provided the necessary notification of disturbance of an inactive asbestos disposal site required by OAC 3745-20-07(D). The OSDF is an active asbestos waste disposal site in accordance with OAC 3745-20-06.

B. The Contractor shall be responsible for:

1. Adherence and compliance to work practices and procedures set forth in applicable federal regulations (CFR) and state codes (OAC).
2. Ensuring Contractor's (inclusive of Subcontractor) employees are informed of the presence of PACM in the project work area(s) in accordance with 29 CFR 1926.1101(d) and OAC 3745-20-06(B)(4).
3. Establishing a restricted area adequate to deter the entry of unauthorized personnel within 100 feet of the PACM work areas in accordance with OAC 3745-20-06(B)(4).
4. Obtaining required training.
5. Conforming with Part 8 for training requirements.
6. Dust control in accordance with Part 6 and the Dust Control Plan.
7. Using wet methods and other work practices and engineering controls to prevent creation of visible asbestos emissions during handling of PACM.
8. Personal air monitoring in accordance with 29 CFR 1926.1101(f) including sampling necessary to complete initial exposure assessment.

C. The Contractor shall ensure an asbestos competent person is on-site anytime PACM is being disturbed, excavated, handled, loaded, hauled, or unloaded.

D. Contractor shall use the following project specific handling methods in accordance with the approved PACM Handling Plan:

1. Prior to excavation and at least once a day during excavation, the Contractor's asbestos competent person shall walk the work area and identify PACM visible at the surface.
2. Non-friable PACM, which is determined not to have the potential to become friable, shall be considered as unclassified impacted material and shall be excavated, loaded, hauled and unloaded as specified in Section 02205.
3. Friable PACM identified shall be either wetted with amended water (water mixed with surfactant) or encapsulated, and separated from the impacted material.
4. Care shall be taken so that the friable PACM does not break or crumble during handling. In the event that it breaks or crumbles during handling, encapsulate the exposed surfaces.
5. Friable PACM components meeting the OSDF Waste Acceptance Criteria (WAC) physical size criteria and removed intact in large pieces shall be wrapped in two layers of polyethylene sheeting, secured with duct tape, and labeled in accordance with OAC 3745-20-05(C)(1). Multiple pieces may be grouped prior to wrapping, provided WAC physical size criteria is still met.
6. Surfactants or encapsulants shall be applied during sizing of any large pieces of friable PACM to meet the OSDF WAC physical size criteria.
7. Pieces of friable PACM not conducive to wrapping shall be bagged in a polyethylene bag, sealed, bagged in a second polyethylene bag, sealed, and labeled in accordance with OAC 3745-20-05(C)(1).
8. Friable PACM with sharp-edged components (e.g., nails, screws, metal lath, tin sheeting) capable of tearing the polyethylene bags or sheeting shall be handled in ~~either~~ one of the following ways:
   (a) Pad or wrap and secure the sharp-edged components in a manner to prevent tearing of the polyethylene, then wrap or bag in accordance with the respective preceding entries.

(b) Place into Contractor-supplied, polyethylene-lined containers (i.e., fiberboard boxes or drums). Metal containers are not allowed.

(c) Container size is subject to the Impacted Material Placement Plan for OSDF for Category 5. The polyethylene liner shall be sealed prior to sealing the container. The container shall be labeled in accordance with OAC 3745-20-05(C)(1).

9. Wrapped, bagged, or containerized friable PACM shall be segregated from other excavated material and accumulated at the Special Materials Transfer Area. When a sufficient quantity for a segregated load is accumulated, it shall be loaded and hauled to the OSDF. Loads shall be prepared and secured to prevent any visible emissions, load loss, and spillage or leakage of liquids.

10. No PACM shall be left exposed at the surface of the excavation at the end of the work day.

E. Wrapped, bagged, or containerized friable PACM shall be unloaded in the OSDF as Category 5 material in accordance with the Impacted Material Placement Plan for OSDF, which presents additional requirements.

F. Each work day during disturbance, excavation, handling, hauling, loading, unloading or placement of PACM waste, the Contractor's asbestos competent person shall conduct a daily inspection of the PACM waste handling work area(s) and adjacent areas. If there is visual evidence of asbestos contamination (e.g., spills of PACM waste) outside the demarcated PACM waste handling work area(s), the Contractor shall take immediate action to abate the hazard. The incident shall be reported immediately to the Construction Manager.

END OF SECTION

SECTION 02275
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SCOPE

This section includes, but is not limited to the following requirements for erosion and sediment control:

A. Soil erosion and sedimentation control measures for work included in this Contract, including additional areas disturbed by the Contractor.

B. Dumped rock fill, erosion control blankets, geotextile and High Density Polyethylene (HDPE) liner for ditches, sumps and erosion control areas.

C. Management of erosion and sediment control measures installed by this Contract and existing erosion and sediment control measures and facilities including Retention Basins 1, 2 and 3, ~~transfer line~~ and related appurtenances as shown on the Construction Drawings.

D. Control of surface water and management of ponded water in construction areas during ~~site preparation and~~ excavation activities as specified in this Section.

E. Management of the Active Flyash Pile (AFP).

F. Stabilization of disturbed areas or stockpiles expected to be significantly disturbed within two years and/or to need effective erosion control immediately.

1.2 RELATED SECTIONS AND PLANS

A. Section 02205 - Impacted Material Excavation.

B. Section 02900 - Seeding.

C. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

A. Area 2 Phase I Southern Waste Units Implementation Plan for Operable Unit 2, ~~October 1997, Revision C~~ current revision.

B. Latest version of American Society for Testing Materials (ASTM) Standards:

1.	ASTM D 3786	Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics-Diaphragm Bursting Strength Tester Method.
2.	ASTM D 4491	Standard Test Method for Water Permeability of Geotextiles by Permittivity.
3.	ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
4.	ASTM D 4632	Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).
5.	ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
6.	ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

C. Title 40, Code of Federal Regulations, Part 261, Hazardous Waste Management System, Identification and Listing of Hazardous Waste.

D. State of Ohio, Department of Natural Resources (ODNR): Rainwater and Land Development, Ohio's Standard for Storm Water Management, Land Development, and Urban Stream Protection - 1996.

1.4 SUBMITTALS

A. For each product proposed for use, submit the following to the Construction Manager for review within ten (10) calendar days from the Notice to Proceed:

1. Manufacturer's product data and recommended methods of installation; and

000134

2. Certification from supplier or manufacturer that the product meets the material requirements of this Section.

B. Prepare and submit to the Construction Manager within ten (10) calendar days from Notice to Proceed a Surface Water Management and Erosion and Sediment Control Plan that includes the following, at a minimum:

1. descriptions of the surface water management and erosion and sediment control measures to be implemented throughout the duration of the contract;
2. methods for installing and maintaining surface water management and erosion and sediment control measures;
3. drawings illustrating, in plan view, the location and sequencing of the surface water management and erosion and sediment control measures;
4. methods and measures for collection and discharge of surface water from the excavated areas and measures to minimize erosion of the excavated areas during progress of the work, inclement weather and at the end of each work day.
5. methods for inspection and management of the AFP prior to excavation.
6. methods for installing HDPE geomembrane in Interceptor Ditches ~~1,~~ 2 and 3.

C. Submit manufacturer's material certification and installation methods and requirements for the geomembrane liner within ten (10) calendar days from the Notice to Proceed to the Construction Manager for review and approval. Certificates shall include the name of the manufacturer, chemical composition, and certification for the HDPE liner material.

1.5 ~~QUALITY ASSURANCE PROGRAM~~ INSPECTION

A. Inspect erosion and sediment control measures to evaluate effectiveness, and need for maintenance, of the control measures. Any repairs to the erosion and sediment control measures shall be corrected within 24 hours of

problem discovery. Inspections shall occur at the following minimum frequencies:

1. Weekly;
2. Daily after each rain event exceeding 0.5 inches at the Fernald Environmental Management Project (FEMP);
3. At least daily during prolonged rainfall events at the FEMP.

B. Records of inspections shall be kept on file at Contractor's site office and shall be submitted monthly to the Construction Manager. The records of inspection shall include:

1. Summary of the scope of the inspection.
2. Name of inspector.
3. Inspection date.
4. Purpose of the inspection (i.e., regular weekly, following a storm, etc.).
5. Observations relative to performance of the erosion/sediment control measures.
6. Any necessary corrective actions.
7. Corrective actions completed and their performance.

1.6 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish silt fence with either woven or non-woven fabric. Silt fence shall:

1. be woven fabric consisting of slit films of polypropylene treated with ultraviolet light stabilizers, or be non-woven fabric consisting of long chain polymeric filaments or polyester yarns and treated with ultraviolet light stabilizers;
2. be inert to chemicals commonly found in soils and to hydrocarbons;

000136

3. be resistant to mildew, rot, insects, and rodent attack; and
4. have fabric and fence post properties and minimum dimensions in accordance with ODNR.

B. Dumped Rock Fill: Dumped rock fill shall meet the requirements of ODOT Item 601.07 for the type specified on the Construction Drawings.

C. Nonwoven geotextile fabric for beneath dumped rock fill and the Special Material Transfer Area shall meet the following minimum values:

PROPERTY	TEST METHOD	ROLL VALUES
Grab Tensile Strength (lbs)	ASTM D4632	80
Puncture (lbs)	ASTM D4833	25
Trapezoidal Tear (lbs)	ASTM D4533	25
Mullen Burst (psi)	ASTM D3786	130
Apparent Opening Size	ASTM D4751	less than 0.6mm
Permittivity (cm/sec^2)	ASTM D4491	1×10^{-2}

D. The erosion control blanket shall be constructed of 100 percent coconut fiber stitch bonded between a heavy duty UV stabilized bottom net and a heavy duty UV stabilized top net. The crimped netting shall form prominently closely spaced ridges across the entire width of the mat. The netting shall be stitched together on 1.5 inch centers with UV stabilized polyester thread to form a permanent three dimensional structure. The mat shall have the following physical properties and be rated for 2 years service life for use on 1:1 slopes:

1. Material Content
   a. Coconut fiber: 100 percent; 0.5 pounds per square yard.

b. Netting: Top and bottom - Heavy UV stabilized; polypropylene; 3 pounds per 1,000 square feet.

c. Thread: UV stabilized polyester.

2. Physical Specifications (Roll)

a. Width: 6.5 feet.

b. Length: 83.5 feet.

c. Weight: 30 lbs ±10 percent.

d. Area: 60 square yards.

E. Geomembrane liner material for ditch liner shall be 60 mil textured High Density Polyethylene (HDPE). HDPE geomembrane liner shall be factory seamed and transported in largest sections possible to minimize field seaming. Field seams shall be as recommended by the HDPE manufacturer.

F. Dust suppression/crusting agent shall be as approved by the Construction Manager and shall meet the following requirements:

1. The dust suppression/crusting agent shall be a pine sap emulsion comprised of a 100% organic emulsion produced from naturally occurring resins (pine sap). The dust suppression/crusting agent shall not be comprised of chloride, lignosulfonate, petroleum, or asphaltic type emulsions. The dust suppression/crusting agent must provide dust suppression and surface stability for exposed soils, both disturbed and undisturbed soils, and exposed coal fired boiler ash (flyash). The dust suppression/crusting agent shall be compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application. Once cured, the dust suppression/crusting agent shall be non-tracking (i.e., will not stick to boots or tires).

2. The dust suppression/crusting agent shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261 for a hazardous waste in either its pre-applied or cured states.

3. The dust suppression/crusting agent shall have a flash point greater than 200°F. The dust suppression/crusting agent shall be neither a flammable nor combustible liquid per DOT definition. The dust suppression/crusting agent must not be susceptible to significant deterioration from exposure to the elements, including sunlight.

PART 3 EXECUTION

3.1 GENERAL

A. Construct and maintain erosion and sediment control measures as specified in this Section, and as shown on the Construction Drawings and the Surface Water Management Plan included as an appendix to the Area 2 Phase I Southern Waste Units Implementation Plan for Operable Unit 2. Maintain existing erosion and sediment control facilities and measures in accordance with Part 6. ~~and Systems Plan.~~

B. As the excavation progresses, excavate depressions in the excavated area to be used as temporary water collection sumps as shown on the Construction Drawings. Water accumulated in the sumps shall be pumped directly to the nearest retention basin via portable sump pump system and flexible hose. Excavations shall be sloped to sumps and/or graded to drain to existing ditches discharging to the nearest retention basin. Excavations are to be kept free of standing water. Runoff into excavation areas shall be minimized by grading the surrounding area away from the excavation area and/or by diversions. If sump excavation penetrates the Great Miami Aquifer (GMA), line the sump with a 60 mil textured HDPE geomembrane liner to prevent potential contamination of the GMA. Geomembrane liner shall be installed and anchored in accordance with Interceptor Ditch Detail as shown on the Construction Drawings or by other method approved by the Construction Manager.

C. Remove erosion and sediment control measures at the direction of the Construction Manager after the disturbed areas are established with satisfactory conditions of seeding as specified in Section 02900.

D. Compact geomembrane liner anchor trench backfill soil by thoroughly tamping in maximum one foot lifts.

3.2 SILT FENCES

Install in accordance with the requirements of the ODNR Rainwater and Land Development Standards. Place at locations shown on Construction Drawings prior to start of ~~site preparation and~~ excavation activities. Remove accumulated sediment when deposition reaches one-half the height of the silt fence or sooner if accumulated sediment prevents adequate performance of silt fence; remove accumulated sediment within 24 hours of discovery. Sediment shall be removed as specified in Section 02205.

3.3 EROSION CONTROL BLANKETS

Install in accordance with manufacturer's recommendations in the ditches shown on the Construction Drawings. Erosion control blankets shall be anchored with wire staples, spaced ~~at a maximum of 3 foot on center, with size~~ as shown on the Construction Drawings.

3.4 INACTIVE EXPOSED EXCAVATION & CONSTRUCTION AREAS

A. Forty-five (45) calendar days shall be the maximum time that an area can be left in an exposed condition without ~~seeding~~ stabilization. If an exposed excavation area shall not be worked for a period of 45 calendar days, or more, the soils shall be stabilized within seven (7) calendar days of excavation by one of the following methods:

1. For disturbed areas or stockpiles expected to be significantly disturbed within two years and/or to need effective erosion control immediately - use of dust suppression/crusting agent as specified in this Section.

~~1~~ 2. For disturbed areas or stockpiles which may be disturbed within two years but do not have significant potential of spreading contamination - ~~During the seeding season, temporary~~ interim seeding shall be applied as specified in Section 02900.

~~2~~ 3. For disturbed areas or stockpiles which will not be disturbed for more than two years - ~~During non-seeding seasons, crusting agents~~ permanent seeding shall be applied as specified in ~~this~~ Section 02900.

B. Forty-five (45) calendar days shall be the maximum time that a stockpile can be left in an exposed condition without ~~seeding~~ stabilization. Stockpiles that are to be inactive for a period of 45 calendar days, or more, shall be stabilized within seven (7) calendar days by ~~means of a crusting agent,~~ method 1, 2, or 3 as specified in ~~this Section~~ 3.4 A.

C. Apply dust suppression/crusting agent according to manufacturers directions. Unless specified otherwise by manufacturer, dilute concentrate pine sap emulsion to ratio of four parts water to one part concentrate. Apply diluted solution at the rate of 2,500 gallons per acre.

D. Dilution ratio and application rate are subject to further adjustment at direction of Construction Manager to optimize performance of dust suppression/crusting agent.

3.5 RETENTION BASINS AND DITCHES

A. Remove accumulated sediment and debris from the existing retention basins and ditches. In no case shall sediment build up to a depth greater than the painted indicator on the riser pipe in the retention basins or to a depth greater than one-half the constructed depth of the ditch.

B. Remove sediment and debris as specified in Section 02205.

C. Protect the existing pump station, transfer line, HDPE liner and appurtenances during the removal of sediment and debris.

D. No wheeled or tracked equipment shall be used in Retention Basin #2.

3.6 DUMPED ROCK FILL

A. Place and maintain dumped rock fill as indicated on the Construction Drawings and in accordance with ODOT Item 601.07.

B. Maintain the existing dumped rock fill in the SWU area.

3.7 HIGH DENSITY POLYETHYLENE (HDPE) LINER

A. Install and maintain HDPE liner in the ditches as shown on the Construction Drawings.

B. Maintain the existing HDPE liner in Retention Basins 1, 2 and 3 and ditches.

3.8 ACTIVE FLYASH PILE

Inspect the AFP on a monthly basis, ast a minimum. Apply crusting agent to minimize dust in accordance with Part 6 and the approved Dust Control Plan.

END OF SECTION

000142

SECTION 02850
EQUIPMENT WASH FACILITY

PART 1 GENERAL

1.1 SCOPE

This Section includes, but is not limited to:

A. Performance criteria for the Equipment Wash Facility.

B. Equipment and material to be provided by the Contractor.

C. Operation and maintenance of the Equipment Wash Facility.

D. Equipment Wash Facility provided by FDF.

1.2 RELATED SECTIONS AND PLANS

A. Section 02205 - Impacted Material Excavation.

B. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

Area 2, Phase I, Site Preparation Technical Specifications and Construction Drawings.

1.4 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

1.5 SUBMITTALS

Within ten (10) calendar days from Notice to Proceed submit the Equipment Wash Plan to the Construction Manager for review and approval. The Equipment Wash Plan shall include:

A. Equipment wash methods and washing and maintenance equipment proposed to meet the performance criteria.

B. Utility requirements.

C. Operation and maintenance requirements and schedule, including removal of accumulated oil and sediment.

D. Catalog information and drawings of proposed washing and maintenance equipment.

E. Materials required for washing and maintenance.

F. Method(s) for removal and containerizing oil.

1.6 FACILITIES PROVIDED BY FDF

A. Concrete wash pad will be provided by FDF at the existing Equipment Wash Facility as shown on the Construction Drawings for the Area 2 Phase I Site Preparation. The wash pad will be equipped with three (3) water yard hydrants limited to a maximum flow of 5 gallons per minute (gpm) each (total flow rate of 15 gpm). A drain collection system, with trenches ~~and~~ an oil/water separator, ~~capable of~~ and piping discharging ~~a miximum flow of 25 gpm~~ to the existing West Pump Station will be provided. The pump capacity at the existing West Pump Station is ~~50~~ 25 gpm.

B. 15 gpm water supply and a 480 Volt, 3 phase, 60 Hz electric power supply will be provided at the existing Equipment Wash Facility.

PART 2 PRODUCTS

A. Provide washing equipment, including pressure washers and other equipment and materials required for equipment washing and maintenance of washing equipment and Equipment Wash Facility, holding tanks and associated piping to meet the performance criteria specified in this Section.

B. Signs and sign posts at Equipment Wash Facility for traffic control.

C. If more than 15 gpm flow of water is required (but less than 25 gpm) additional water for the equipment wash shall be provided by the Contractor at no additional cost to FDF. Provide holding tank and piping as required.

PART 3 EXECUTION

3.1 PERFORMANCE CRITERIA

A. Provide equipment wash and maintenance equipment and materials as per the approved Equipment Wash Plan.

B. All equipment must pass through Equipment Wash Facility prior to hauling on Impacted Material Haul Road. Wheels, tires, undercarriage, and body of equipment shall be washed free of visible mud, dirt and debris before leaving the Equipment Wash Facility.

C. Keep Impacted Material Haul Road clean and free of visible mud, dirt, and debris.

D. Wash pad, drain line and trenches shall be kept clean to prevent flow blockage. Equipment wash shall be performed only within the wash pad area.

E. Water overspray shall be controlled and confined to the wash pad area.

F. Wash water flow to the existing West Pump Station shall be restricted to 25 gpm. Provide holding tank as required to recycle wash water before draining to the existing West Pump Station.

G. Clean and maintain oil/water separator as necessary and maintain wash pad and associated facilities.

H. Remove sediment from wash pad, drain line, trenches, and oil/water separator and haul to the OSDF as specified in Section 02205.

I. Remove oil in accordance with the approved Equipment Wash Plan and place in drums adjacent to the Equipment Wash Facility. Drums will be provided ~~by~~ and disposed of by FDF.

END OF SECTION

SECTION 02900
SEEDING

PART 1 GENERAL

1.1 SCOPE

This section discusses ~~temporary~~ interim and permanent seeding requirements which includes, but is not limited to, soil preparation, seed mixture, fertilizer, lime, mulch and ~~asphalt emulsion tackifier~~ pine sap emulsion (used as a mulch binder).

A. Interim seeding is required for disturbed areas and soil piles which are scheduled to or may be further disturbed within 2 years but do not have significant potential of spreading contamination.

B. Permanent seeding is required for disturbed areas and soil piles which will not be disturbed for more than 2 years.

C. Seeding in a given area must be initiated upon the completion of construction or upon a decision to suspend construction for more than 45 days.

D. Disturbed areas and soil piles which are scheduled to be significantly disturbed within 2 years and/or need effective erosion control immediately, are to be stabilized with use of a crusting agent as specified in Section 02275.

1.2 RELATED SECTIONS AND PLANS

A. Section 02050 - Surveying.

B. Section 02205 - Impacted Material Excavation.

C. Section 02275 - Erosion and Sediment Control.

D. Part 6 - Statement of Work.

E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

A. State of Ohio, Department of Natural Resources (ODNR): Rainwater and Land Development, Ohio's Standard for Storm Water Management, Land Development, and Urban Stream Protection - 1996.

B. Sitewide Excavation Plan, ~~July 1997, Revision C~~ current revision.

~~C. American Association of State Highway and Transportation Officials (AASHTO) M 140, Standard Specification for Emulsified Asphalt (1993).~~

~~D. American Association of State Highway and Transportation Officials (AASHTO) M 208, Standard Specification for Cationic Emulsified Asphalt (1987).~~

1.4 SUBMITTALS

A. Submit the following to the Construction Manager within thirty (30) calendar days from Notice to Proceed for review and approval:
   1. Mulch, ~~asphalt emulsion tackifier~~ mulch binder, and fertilizers.
      a. Manufacturer's product data and recommended methods of application for seed, mulches, lime, ~~asphalt emulsion tackifier~~ mulch binder and fertilizer.
   2. Material Safety Data Sheet (MSDS) for lime, fertilizer, and ~~asphalt emulsion tackifier~~ mulch binder.

B. Submit certificate of compliance for the following within fifteen (15) calendar days before the seeding. Do not sow seed until the Construction Manager has reviewed and approved the certificates.
   1. Certificate stating seed mixture, guaranteed percentages of purity, weed content, germination

of seed, name of seller, the test date for the seed, and the net weight and date of shipment.

2. Manufacturer's certificate stating the available nutrients contained in the proposed fertilizer;
3. Manufacturer's certificate stating the lime meets the requirements of this Section;
4. Manufacturer's certificate stating the wood cellulose mulch meets the requirements of this Section; and
5. Manufacturer's certificate stating the ~~asphalt emulsion tackifier~~ mulch binder meets the requirements of this Section.

C. Include as a part of the Surface Water Management and Erosion and Sediment Control Plan, required as a submittal in Section 02275, specific stabilization measures (i.e, crusting agent, or interim or permanent seeding) proposed for all disturbed areas within the limits of work.

D. Ten (10) calendar days before seeding a given area provide a written statement of proposed seed mix and application rates of seed mix and associated materials (i.e., fertilizer, lime, mulch, and mulch binder).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver containerized materials in uniform packages bearing the name of the manufacturer, the net weight and a statement of content. Deliver containerized materials to the site in original, properly labeled, unopened, clean containers each showing the manufacturer's guaranteed analysis conforming to applicable regulations and standards.

B. Store materials in a dry area in a manner to prevent physical damage.

1.6 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish seed labeled in accordance with the U.S. Department of Agriculture (USDA) Rules and Regulations and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its expiration date. Each variety of seed shall: have a purity of not less than 90 percent, have a percentage of germination not less than 80 percent, have a weed to seed content of not more than 0.75 percent and contain no noxious weeds. The above percentages are by weight.

B. Seed mixture for interim seeding shall be as follows:
1. Annual Rye - 60 pounds/acre.
2. Perennial Rye - 60 pounds/acre.

~~B~~ C. Seed mixture for ~~temporary~~ permanent seeding shall be as follows:
1. ~~Creeping Red Fescue~~ Canada Wild Rye - ~~20~~ 2 pounds/acre.
2. ~~Annual Ryegrass~~ Little Bluestem - ~~10~~ 2 pounds/acre.
3. ~~Kentucky Bluegrass~~ Big Bluestem - ~~15~~ 3 pounds/acre.
4. ~~Alisike Clover~~ Indian Grass - ~~5~~ 2 pounds/acre.
5. ~~Flatpea~~ Switch Grass - ~~5~~ 0.5 pounds/acre.
6. Side Oats Gramma - 0.5 pounds/acre.

D. Seed mixture for seeded areas that become exposed during the summer season (June - September) and for seeding that must be done outside of acceptable seeding windows:
1. Buckwheat - 60 pounds/acre.

~~C~~ E. Obtain water from the on-site sources shown on the Construction Drawings and specified in Part 6, unless otherwise approved by the Construction Manager.

~~D~~ F. Fertilizer:

1. Use fertilizer that is dry or liquid commercial grade fertilizer, uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists.
2. Fertilizer shall be VCOTE 34-0-14 as manufactured by George W. Hill, Inc. No substitution allowed.

~~E~~ G. Furnish mulch meeting the following requirements:
1. Mulch shall be straw or wood cellulose fiber, free of clay, stone, foreign substances, and reasonably free of weeds.
2. Furnish straw that does not contain sticks larger than 1/4-inch diameter or other materials that may prevent matting down during application. Use straw that is free from mold and other objectionable material and in an air-dry condition suitable for placing with mulch blower equipment or other equipment as approved by the Construction Manager. Dust control during mulch blowing shall meet the dust control requirements specified in Part 6 and the approved Dust Control Plan specified in Section 02205. Straw shall be generally 6 inches or more in length.
3. Mulch applied by spraying shall be a wood cellulose processed into a uniform fibrous physical state. Use wood cellulose fiber containing a green dye that will provide for easy visual inspection for uniformity of slurry spread. The wood cellulose fiber including dye, shall contain no growth or germination inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

Quantity	Specification Limit
Particle Length	0.375 inch (maximum)
Particle Thickness	0.047 inch (maximum)
Ph	4.0 to 8.5
Ash Content	1.6 percent (maximum)
Water Holding Capacity	90 percent (maximum)

F. Furnish lime that shall be agricultural ground limestone with a minimum total neutralizing power of 90 percent. The lime shall have a material gradation of at least 40 percent passing the U.S. Standard Number 100 sieve, and at least 95 percent passing the U.S. Standard Number 8 sieve.

~~G. Furnish asphalt emulsion tackifier for mulch conforming to AASHTO M 140 or AASHTO M 208. Asphalt emulsion tackifier shall be nontoxic to plants and shall be prepared so that it will not change in transportation or storage.~~

G. Mulch binder agent shall be as approved by the Construction Manager and shall meet the following requirements:

1. The mulch binder shall be a pine sap emulsion comprised of a 100% organic emulsion produced from naturally occurring resins (pine sap) and be nontoxic to plants. The mulch binder shall not be comprised of chloride, lignosulfonate, petroleum, or asphaltic type emulsions. The mulch binder shall be compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application. Once cured, the mulch binder shall be non-tracking (i.e., will not stick to boots or tires).
2. The mulch binder shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261

for a hazardous waste in either its pre-applied or cured states.

3. The mulch binder shall have a flash point greater than 200°F. The mulch binder shall be neither a flammable nor combustible liquid per DOT definition. The mulch binder must not be susceptible to significant deterioration from exposure to the elements, including sunlight.

4. The pine sap emulsion shall be provided in concentrated solution and prepared so that it will not change in transportation or storage.

2.2 EQUIPMENT

Provide equipment of size and type to perform work specified in this Section.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform soil preparation by tilling/cultivating, to a depth of approximately 4 inches, to eliminate uneven areas and low spots. Maintain lines, levels and contours.

B. Repeat cultivation in areas where equipment used for hauling and spreading has compacted subgrade.

C. ~~Temporary~~ Stabilization of disturbed areas by interim or permanent seeding shall be performed at completion of excavation. Stabilization of the inactive exposed excavation and other construction areas by use of a crusting agent shall be as specified in Section 02275. Stabilization of slopes exceeding 2H:1V shall utilize an erosion control blanket as specified in Section 02275 after application of seed mixture.

3.2 APPLICATION

A. Apply fertilizer, lime, seed, mulch and ~~asphalt emulsion tackifier~~ mulch binder to disturbed areas and

areas excavated and graded in this Contract requiring seeding unless otherwise indicated or directed by the Construction Manager. All seeding window periods and all application rates for seed, fertilizer, lime, mulch and mulch binder are subject to adjustment as directed by the Construction Manager.

B. Application of Fertilizer:
   1. Apply fertilizer at a uniform rate of 12 pounds per 1000 square feet.
   2. Apply agricultural lime at a rate of two tons per acre.
   3. Disc lime and fertilizer thoroughly into upper 2 inches.
   4. Lightly water to aid the distribution of fertilizer.

C. Sequence of application of ~~temporary~~ seeding mixtures, mulch and ~~asphalt emulsion tackifier~~ mulch binder:
   1. Apply ~~temporary~~ seed mixture at the minimum rate as specified in this Section. Seeding shall be done by hydroseeding or by drilling to a depth of 0.25 inches followed by cultipacking.
   2. Do not seed areas in excess of that which can be mulched within 24 hours.
   3. Seeding season for ~~temporary~~ interim seeding shall be ~~March 1~~ October 15 through ~~October 31~~ March 15.
   4. Seeding season for permanent seeding is April 15 through May 31. Permanent seeding may also be completed between October 1 through February 28, provided seed application rate is increased by 50 percent.
   5. Seeding that must be done outside of the planting windows specified above must be completed with the seed mixture specified in 2.1 D.
   ~~4~~ 6. Within 24 hours following seeding, apply mulch.
   ~~5~~ 7. Mulch shall be spread in a 1 to 2 inch layer.
   ~~6~~ 8. Apply water with a fine spray immediately after each area has been mulched. Wet soil at approximately a rate of 120 gallons per 1,000 square feet.

~~7~~ 9. Apply ~~asphalt emulsion tackifier~~ mulch binder at the rate specified in this Section.

D. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. For areas planted in the summer season (June through September) increase straw mulch application rate to 3 air-dried tons per acre.

E. Apply sprayed wood cellulose fiber, in lieu of straw mulch, at a net dry weight of 750 pounds per acre. Mix the wood cellulose fiber with water at a ratio of 50 pounds of wood cellulose fiber per 100 gallons of water. For areas planted in the summer season (June through September) increase wood cellulose fiber application rate to a net dry weight of 1,100 pounds per acre.

F. Maintain mulching material in place with a ~~an asphalt emulsion tackifier~~ pine sap emulsion binder. Apply mulch binder according to manufacturers directions. Unless specified otherwise by manufacturer dilute concentrated pine sap emulsion to ratio of four parts water to one part concentrate. Apply ~~asphalt emulsion tackifier~~ diluted pine sap emulsion at a rate of ~~120~~ 2,500 gallons per acre.

3.3 MAINTENANCE

A. Maintain the seeded areas in satisfactory condition until acceptance of the seeding by the Construction Manager. Maintenance of the seeded areas includes repairing eroded areas, revegetating when necessary, watering and mowing (if applicable). A satisfactory condition of the vegetated area is defined as follows:

1. An area shall have a good, clean stand of perennial grass.
2. Within 3 weeks, germination must occur over 95 percent of the area with no single bare area greater than 3 square feet.
3. Within 3 months, 95 percent of the area must be covered with mature perennial grass.

B. Areas that fail to meet these requirements shall be repaired or reseeded as necessary to produce an acceptable stand of grass, as specified in this Section. Areas that become bare or exposed during the summer season (June through September) will be reseeded with the seed mix specified in 2.1 D.

3.4 WARRANTY

A. Seeded areas shall be subject to a warranty period of not less than 24 months from initial establishment of ~~temporary seeding~~ vegetation over 100 percent of the seeded areas.

B. At the end of the warranty period, the Construction Manager will perform an inspection upon written request by the Contractor. Seeded areas not demonstrating satisfactory condition of vegetation as specified herein, shall be repaired, reseeded and maintained to meet all requirements, as specified herein, at the Contractor's expense.

3.5 ACCEPTANCE

A. The seeded areas will be accepted at the end of the warranty period if a satisfactory condition exists as defined in this Section.

B. After necessary corrective work has been completed, the Construction Manager will certify in writing the final acceptance of the seeded areas.

END OF SECTION

1418

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

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

APRIL 1998

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

2502-WP-0029
REVISION D
DRAFT FINAL

000157

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

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APRIL 1998

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2502-WP-0029
REVISION D
DRAFT FINAL

TABLE OF CONTENTS

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

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 1-8
1.2.2.2 Potentially Characteristically Hazardous Areas 1-9
1.2.2.3 Special Materials 1-9
1.3 Summary of Regulatory Drivers 1-9
1.3.1 ARARs and TBCs 1-9
1.3.2 Permits 1-9
1.3.3 Natural Resource Trusteeship 1-10
1.4 Components of the Remedy 1-11
1.5 Lessons Learned 1-13
1.5.1 A1PI Lessons Learned 1-13
1.5.2 A2PI Site Preparation Lessons Learned 1-14
1.5.3 Lessons Learned Summary 1-15

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
2.2 Identification of Excavation ASCOCS 2-3
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 2-4
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 2-6
2.4.1 Above-WAC Material 2-6
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 3-9
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 3-11
3.3.1 Excavation Sequence and Prioritization 3-12
3.3.2 General Excavation Approach 3-14
3.3.2.1 Grinding of Stumps 3-14
3.3.2.2 Prioritized Excavation 3-15
3.3.2.3 Excavation of Below-WAC Material 3-17
3.3.2.4 Excavation of Debris 3-18
3.3.2.5 Excavation of Special Materials 3-18
3.3.2.6 Control of Surface Water 3-19
3.3.2.7 Monitoring Well Abandonment/Protection 3-21
3.3.3 Transportation and Disposition of Impacted Material 3-21
3.3.3.1 Impacted Material Haul Road 3-22
3.3.3.2 Equipment Wash Facility 3-22
3.3.4 Excavation Control Monitoring 3-22
3.3.4.1 Material with Contaminant Levels Exceeding the OSDF WAC 3-23
3.3.4.2 Lead Contaminated Soil 3-24
3.3.4.3 Below-WAC Material 3-24
3.3.4.4 Special Materials 3-25
3.3.5 Miscellaneous Excavation Requirements 3-25
3.4 Material Handling and Treatment 3-26
3.4.1 General Requirements and Objectives 3-26
3.4.2 WAC Attainment 3-27
3.4.2.1 Attainment of OSDF WAC 3-27
3.4.2.2 Special Material Not Meeting OSDF WAC 3-28

3.4.3 Lead Contaminated Material 3-29
3.5 Precertification and Certification 3-29
3.5.1 A2PI Waste Unit Areas 3-30
3.5.2 A2PI Non-Waste Unit Areas 3-31
3.6 Interim Restoration 3-32
3.6.1 A2PI Waste Unit Areas 3-32
3.6.2 A2PI Non-Waste Unit Areas 3-32
3.7 Institutional Controls 3-33

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 Project 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

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

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
IEMP	Integrated Environmental Monitoring Program

ACRONYMS AND ABBREVIATIONS
(continued)

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
SWUs	Southern Waste Units
TCLP	Toxicity Characteristic Leaching Procedure

ACRONYMS AND ABBREVIATIONS
(continued)

WAC	waste acceptance criteria
WAO	Waste Acceptance Operations
WPRAP	Waste Pits Remedial Action Project
XRF	X-ray fluorescence
yd^3	cubic yards

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.

O6 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.

05 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 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).

O7 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 offer 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 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 RI/FS data supplemented by predesign investigation data (Section 2.1.2).

The excavation grades shown on the construction drawings are the deeper of: 1) either to the original 1951 ground elevations that existed prior to initial waste placement, 2) FRLs, as defined in the Operable Unit 2 or 5 ROD, whichever is more stringent (Section 2.2) and 3) A 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.
- 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.

O8 - 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.

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.

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).

000177

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.

1.3 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)
- 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

O10 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.

O11 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 has been revised based on predesign data (Section 2.1.2.2), but 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). Note that the volume has been revised based on predesign data (Section 2.1.2.3).

- 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

000181

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.

- 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

9,012 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:

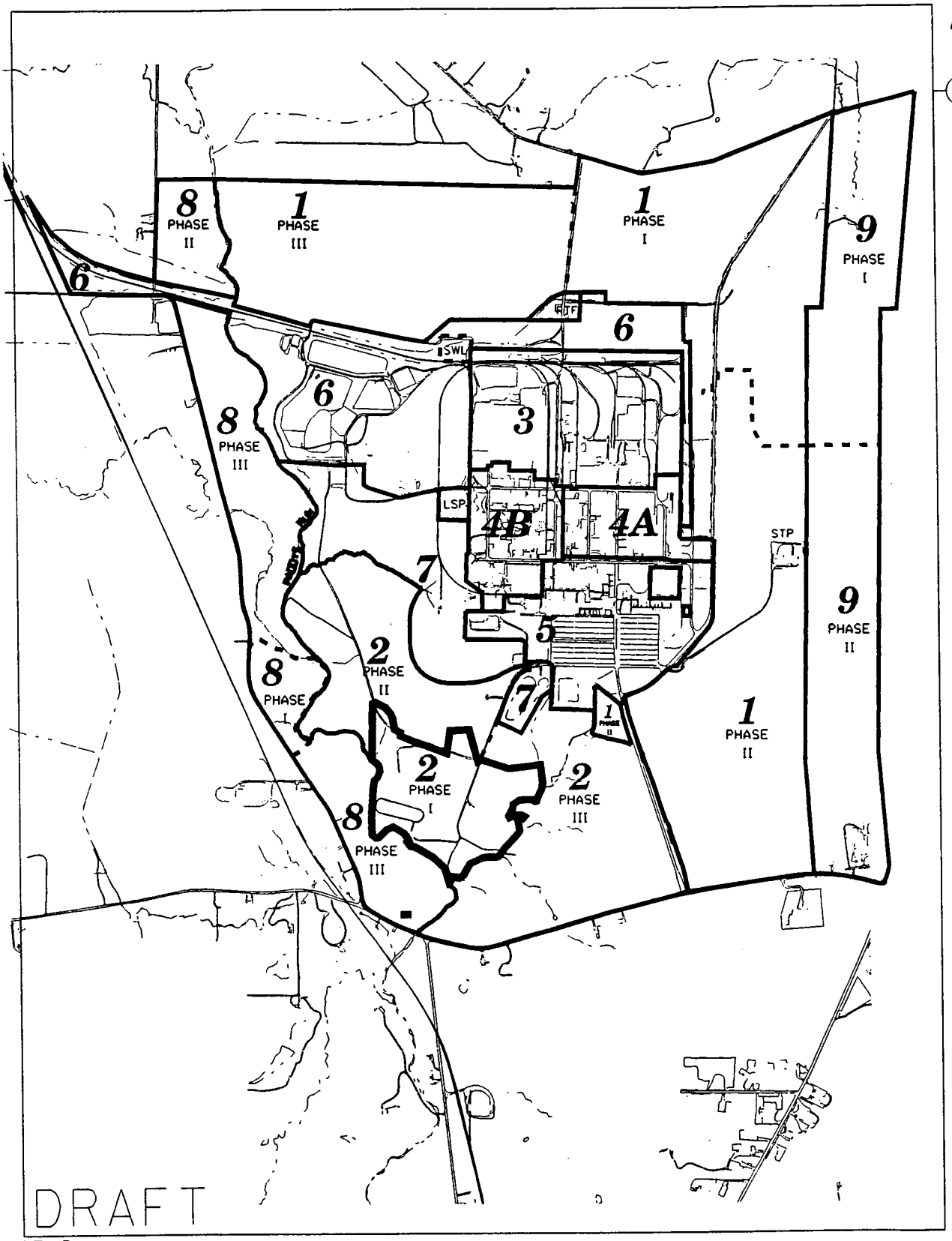
During the A2PI Site Preparation Phase, excavation of the South Field was very similar to the excavation that will be performed during the A2PI Excavation Phase throughout the SWUs. Initial excavation in the South Field proceed very slowly because of a number of reasons, including the fact that the area 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.



LEGEND:

1 REMEDIATION AREA

----- PHASE BOUNDARIES

REMEDIATION AREA BOUNDARIES

SCALE

1500 750 0 1500 FEET

FIGURE 1-1. LOCATION MAP OF REMEDIATION AREAS.

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STATE PLANAR COORDINATE SYSTEM 1983

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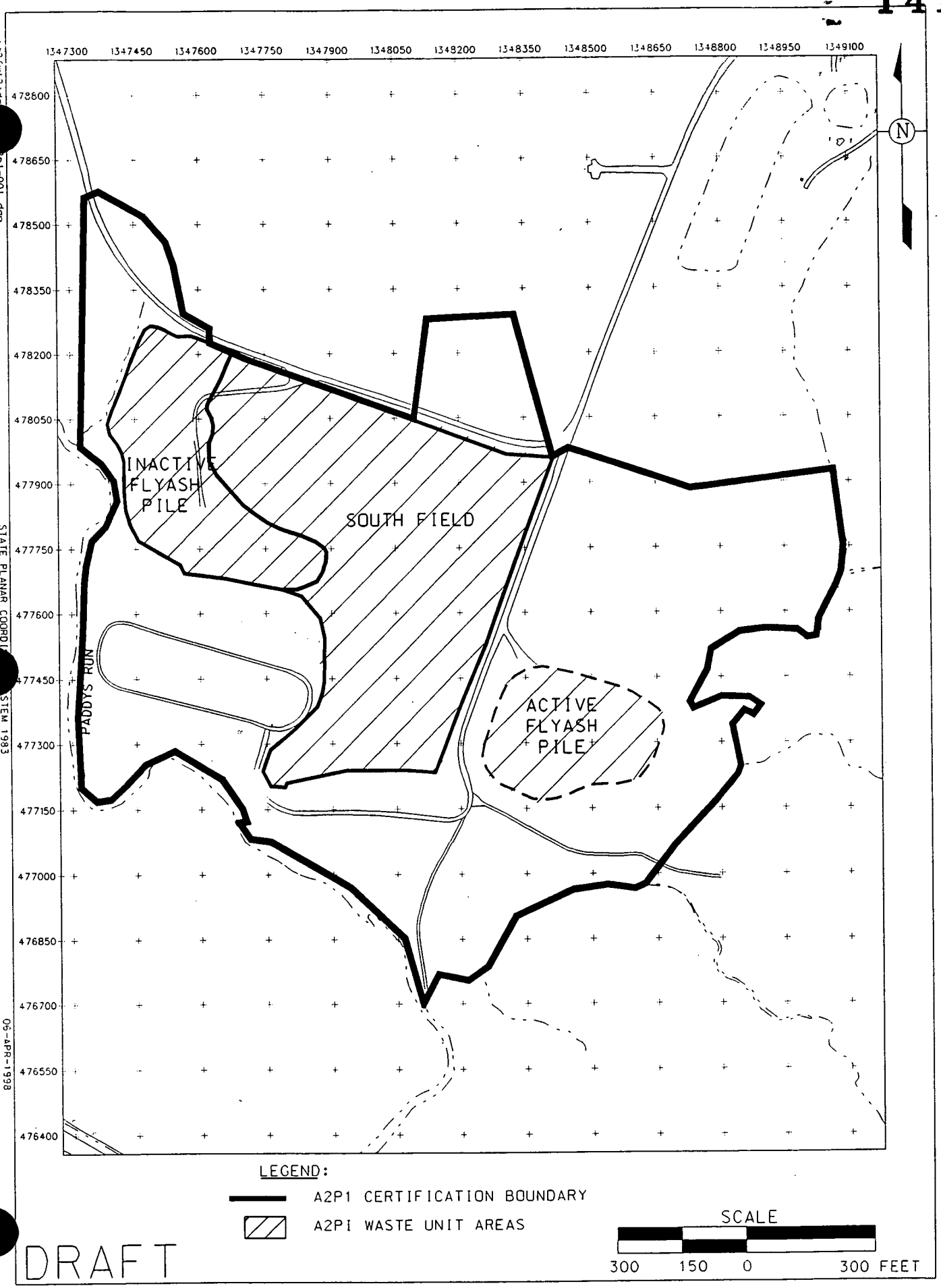

FIGURE 1-2. LOCATION MAP OF AREA 2, PHASE I

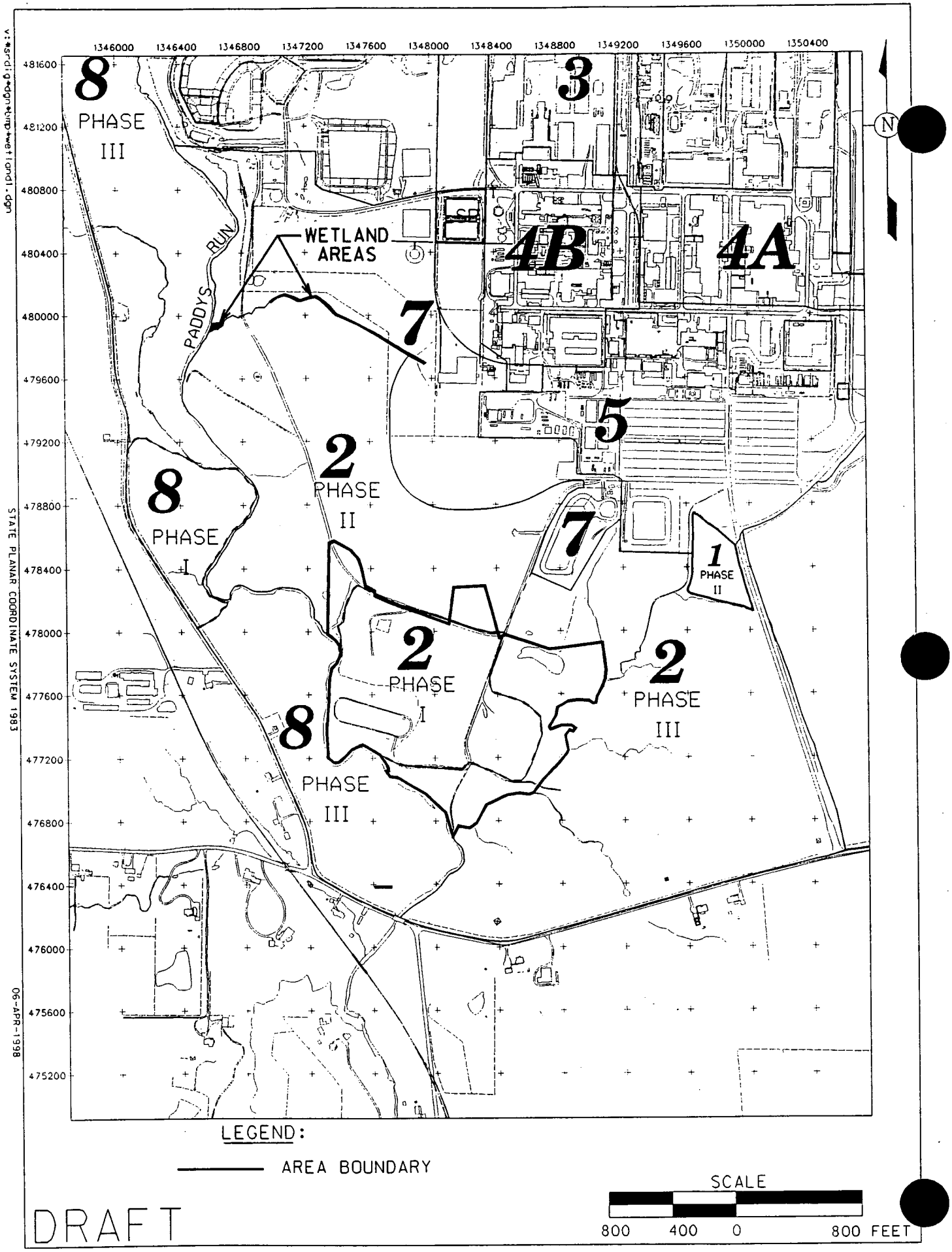

FIGURE 1-3. WETLANDS IN AREA 2

Section 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 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.

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

O79 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.

2.2 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 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

U-S1 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.

U-S2 O20 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

O21 As described in Section 2.1.1 and confirmed during predesign investigations Appendix D the South
O79 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.

O22 Paragraph deleted.

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 323,000 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:

05
- 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.

TABLE 2-1

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

Constituent	Waste Acceptance Criteria for Soil and Sediment in the On-Site Disposal Facility [a]	Benchmark Toxicity Value	Final Remediation Levels							
			Operable Unit 5 [b]		Operable Unit 2 [c]					
			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

Section 3

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 will be 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.

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

O24,25,26 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, to the existing seepage collection lift station (SPSpec 02668).

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 and 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 was flows into the existing catch basin and pipe system on the west side 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 will be 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 will be installed around Retention Basin 2 in lieu of the infiltration barrier.

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 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.

O27 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.

Accumulated sediment from the A2PI retention basins, ditches and erosion control measure will be monitored with field radiological survey equipment for attainment of OSDF radiological WAC and dispositioned accordingly when the sediment depth reaches the sediment cleanout level indicated on the risers (SPDwgs G0013). The exact procedures to accomplish this approach will be determined based on field conditions; wet sediments may be spread on other impacted material all allowed to dry before they are scanned with real-time equipment.

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 SCQ.

O28 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, to be 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.

- 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).

O30 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 No. 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 involve visual observation for additional special material.

O41 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 will be installed during the site preparation phase. These lines will be 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 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. It will consist of excavation of approximately 119,000 yd^3 of impacted material plus 4,800 yd^3 of above-WAC material. This area was made a priority because of the impacted material with levels of total uranium that exceed the OSDF WAC (Section 2.4.1); this material is in 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. 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
- 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

O32 As discussed in Section 2.4.1, there are approximately 4,800 yd^3 of material in the Inactive Flyash Pile
U-S4 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 (elevation 558). After the top of the above-WAC area is encountered, excavation within the limits of this above-WAC material will be performed in four-foot lifts.

O79 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 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.

O33 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.

O79 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.

O35 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 or bulk staged 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

O36 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).

3.3.2.4 Excavation of Debris

O37 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:

U-S5

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.

O39 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.

Sumps in the above-WAC material that extend into the Great Miami Aquifer will be lined to minimize infiltration (ESpec 02205). The liner will consist of a 60-mil HDPE liner or other approved material and may include a large plastic basin. Constructing a lined sump above the Great Miami Aquifer and then continuing the excavation below it is not practical; the sump will not work in this configuration. Sumps must be constructed at the low point of excavation in order to properly function.

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 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:

000218

- 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.

U-S26 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.

O31 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.

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

O41 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 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 was placed in the South Field Impacted Stockpile. Therefore, excavation of this stockpile will not require additional radiological monitoring, although visual monitoring will be performed during excavation and loading.

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]).

3.4 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 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
- O42 Segregate impacted materials according to OSDF Impacted Materials Placement Plan Categories 1 through 5 (DOE 1998ā)
- 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:

- 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. 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.

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 either be treated with a crusting agent or mulched and hydro seeded (Section 3.3.1) with a quick-germinating 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.

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.

O43 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.

000230

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

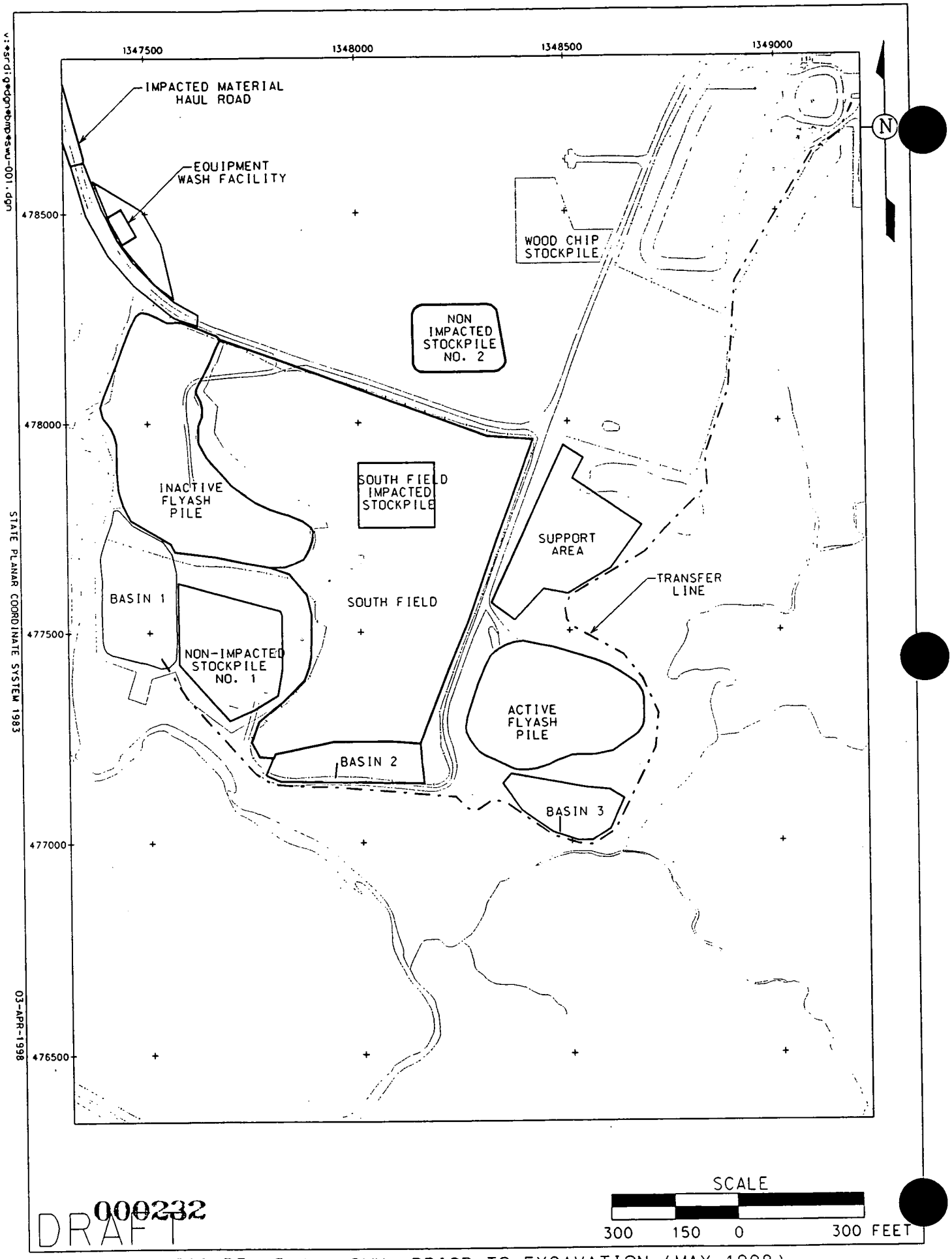

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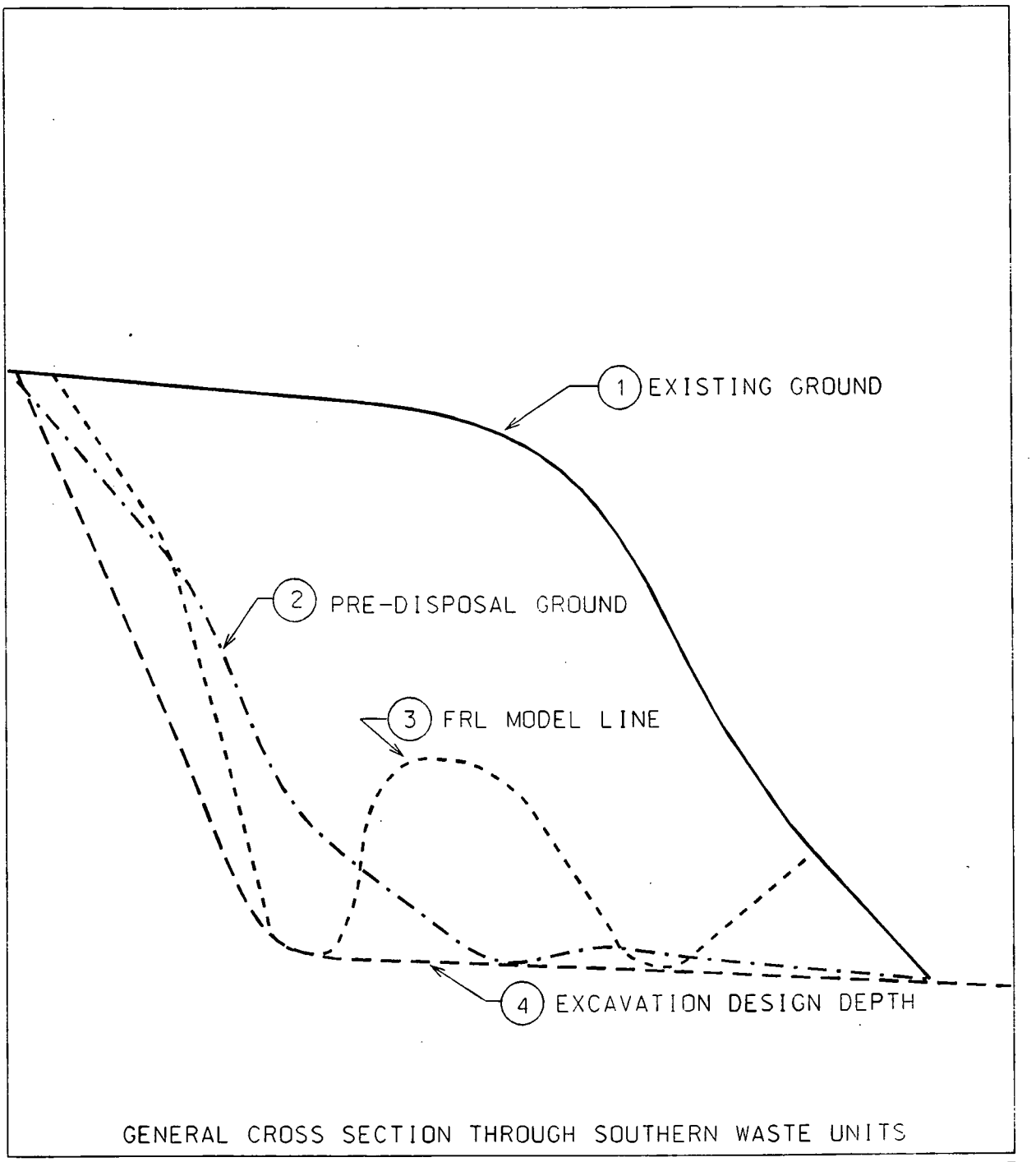
FIGURE 3-1. SWUs PRIOR TO EXCAVATION (MAY 1998)



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.

000233

FIGURE 3-2. DEVELOPMENT OF EXCAVATION DESIGN

/dgis/USE L/MIKE_L/doz-003.dgn
6-APR-1998

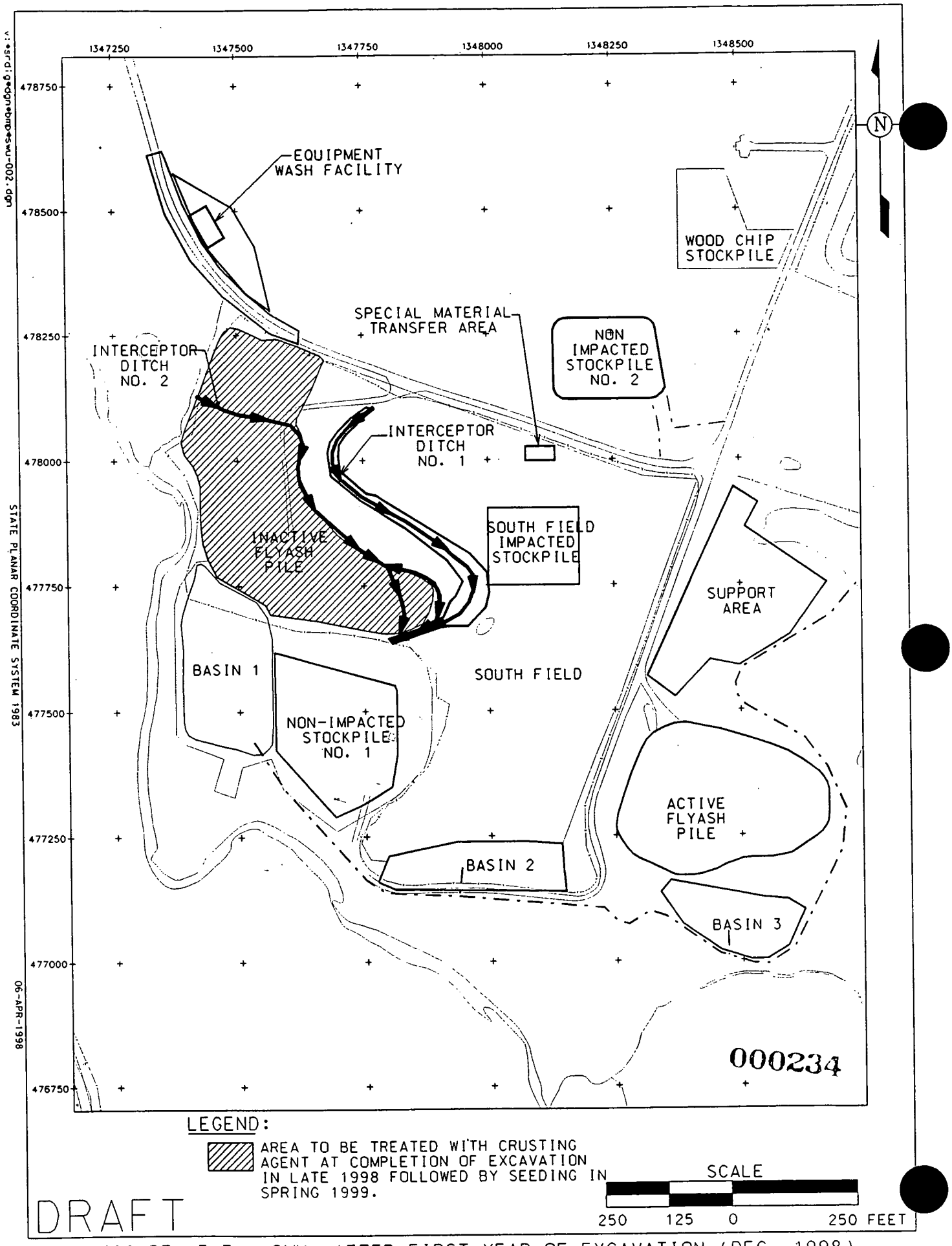
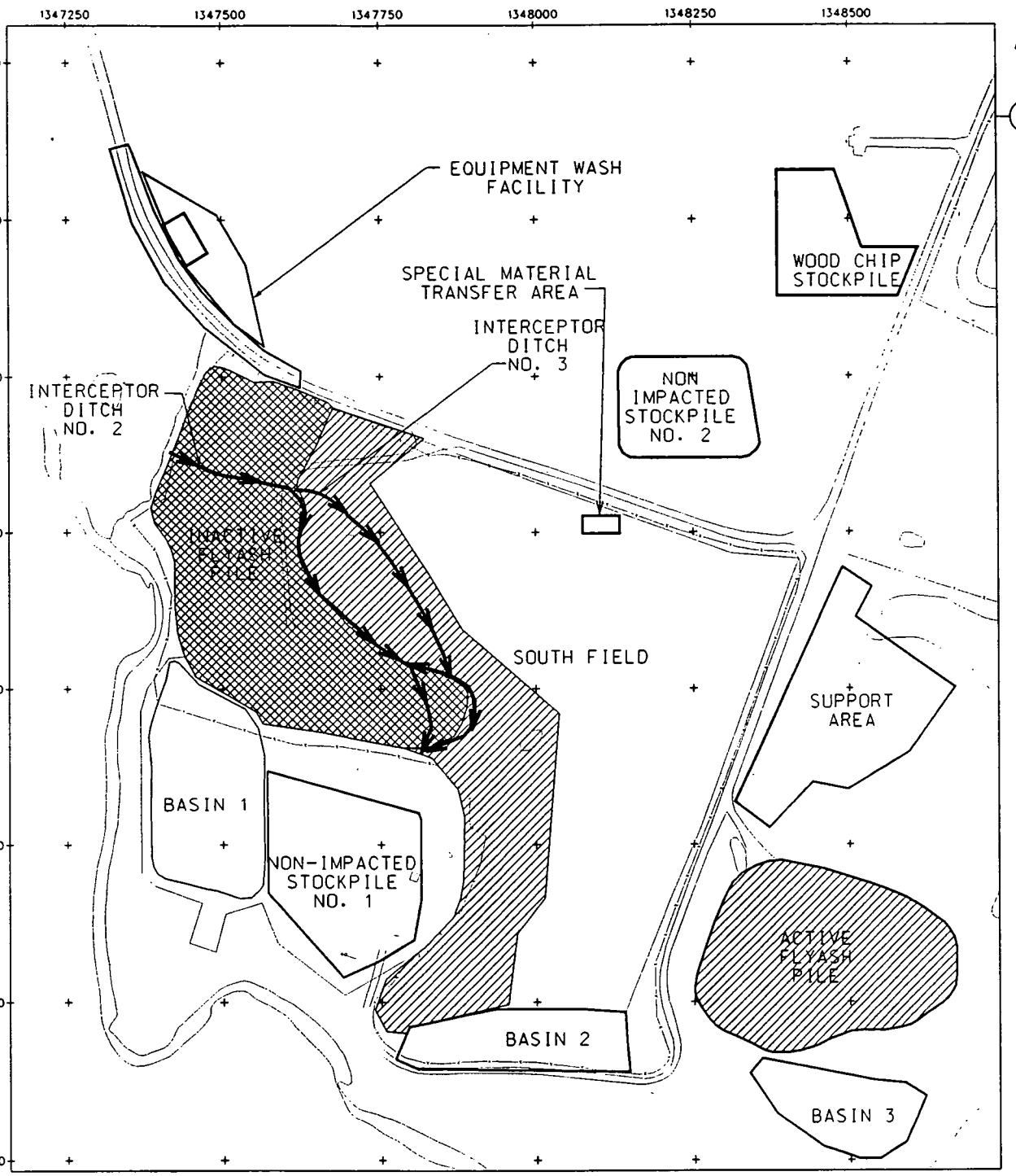


FIGURE 3-3. SWUs AFTER FIRST YEAR OF EXCAVATION (DEC. 1998)



LEGEND:

AREA PREVIOUSLY EXCAVATED AND VEGETATED.

AREA TO BE TREATED WITH CRUSTING AGENT AT COMPLETION OF EXCAVATION IN LATE 1999 FOLLOWED BY SEEDING IN SPRING 2000.

000235

SCALE

250 125 0 250 FEET

DRAFT

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

STATE PLANAR COORDINATE SYSTEM 1983

06-APR-1998

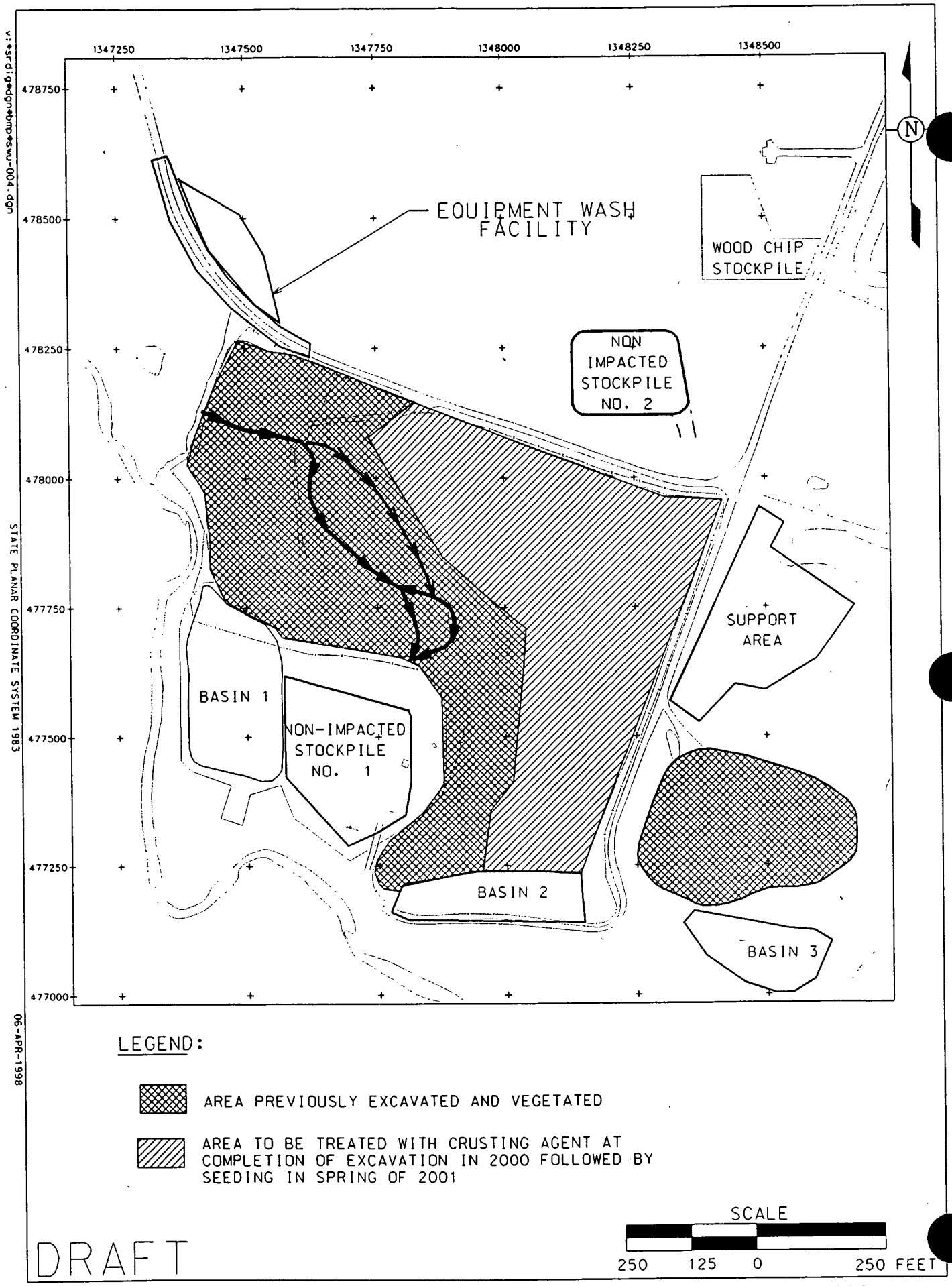
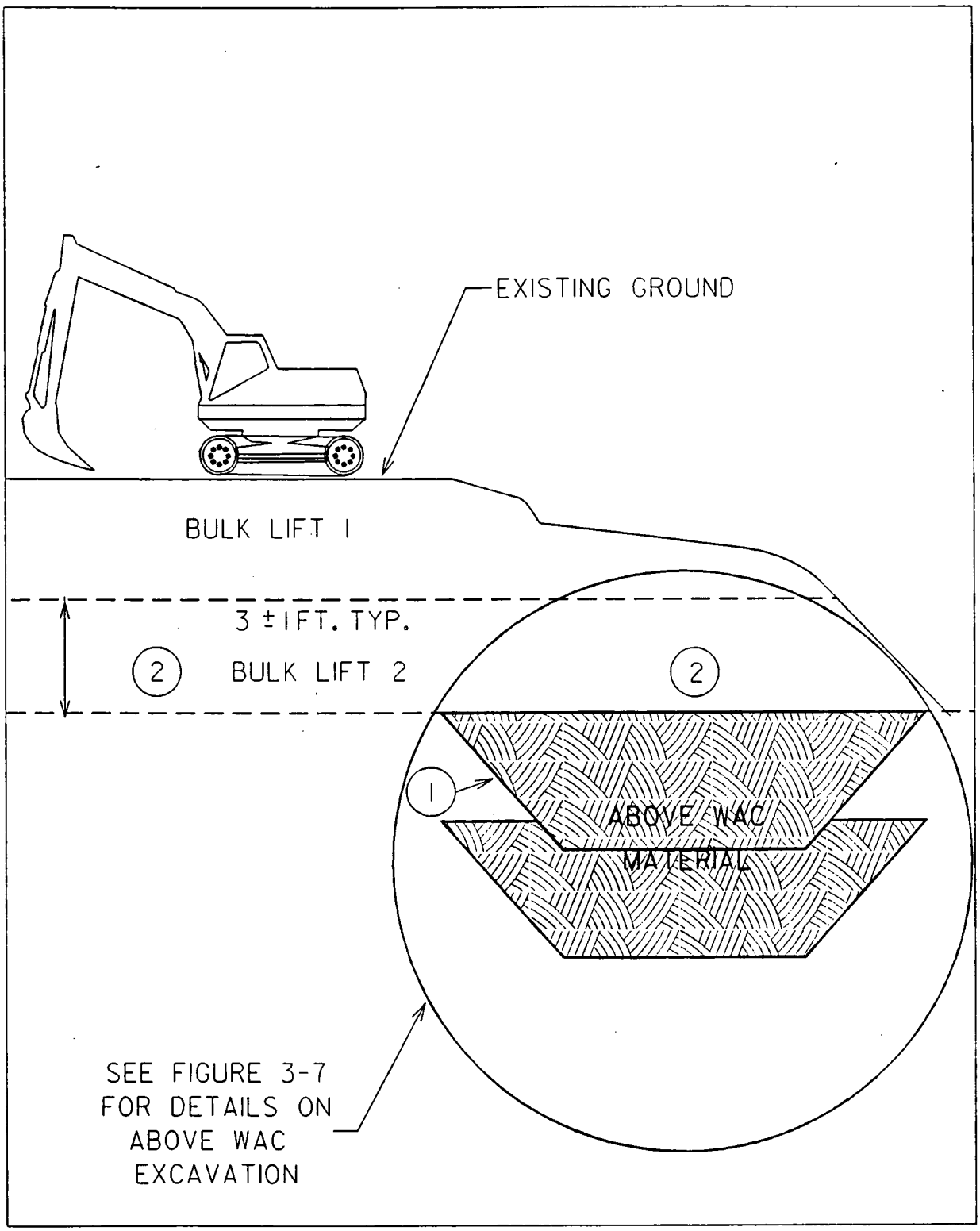


FIGURE 3-5. SWUs AFTER COMPLETION OF EXCAVATION (DEC. 2000)

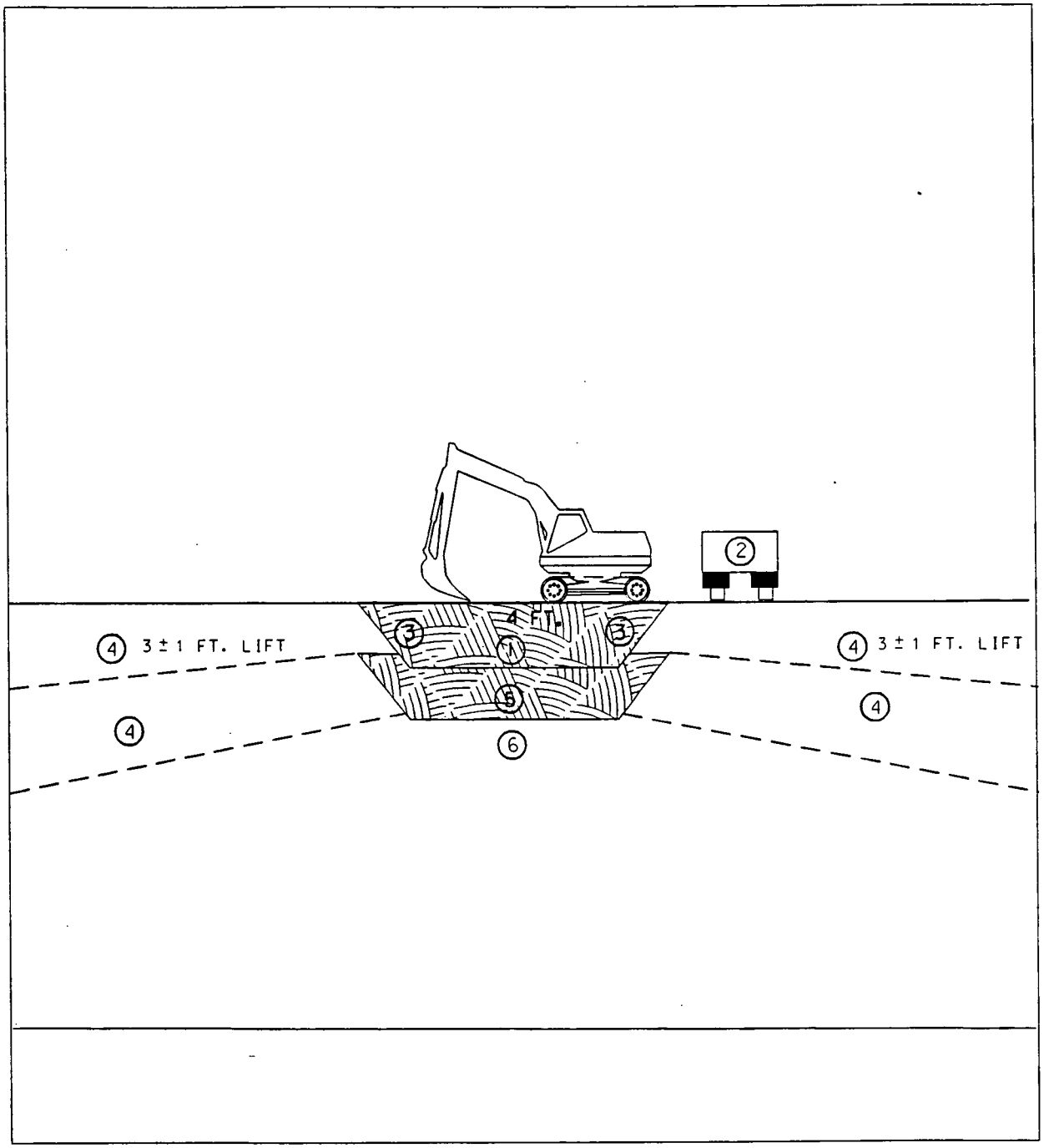


① LIMIT OF ABOVE WAC MATERIAL FROM ENVIRONMENTAL MODEL BASED ON RI/FS AND PRE-DESIGN SAMPLING DATA.

② BULK EXCAVATE MATERIAL TO OF TOP OF ABOVE WAC MATERIAL.

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

/dgis/USER/MIKE_L/doz-004.dgn
6-APR-1998



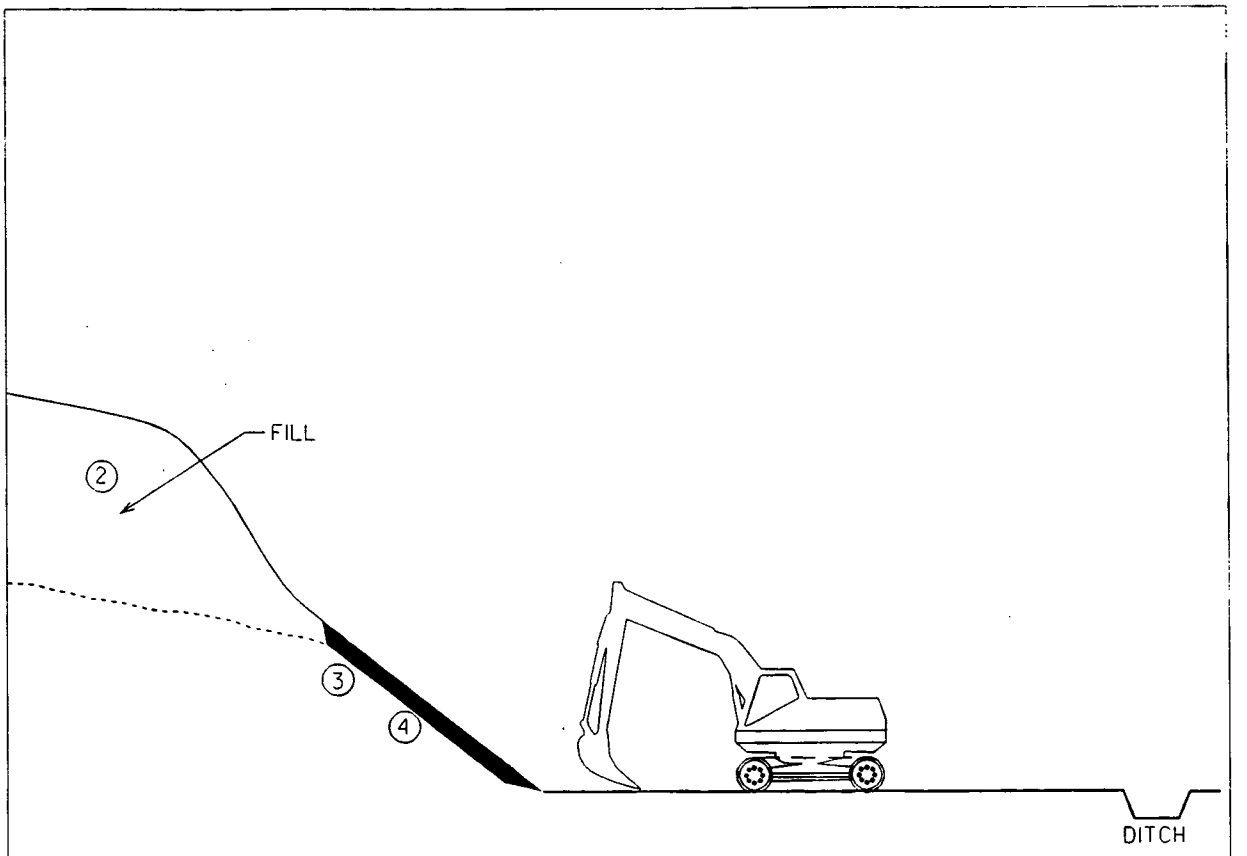
1. EXCAVATE ABOVE-WAC MATERIAL IN FOUR FOOT LIFTS SIDE SLOPES SHALL BE APPROXIMATELY 2H:1V
2. LOAD TRUCKS OUTSIDE OF ABOVE-WAC MATERIAL AREA.
3. FDF SHALL FIELD SURVEY SIDE SLOPE OF EACH LIFT IN ABOVE-WAC MATERIAL.
4. EXCAVATE 3 ±1 FT. LIFT OUTSIDE ABOVE WAC MATERIAL AS PER FIGURE 3-9 AFTER EXCAVATION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

ABOVE WAC MATERIAL

000238

FIGURE 3-7. ABOVE WAC EXCAVATION APPROACH

/dgis/USERS/MIKE_L/MIKE_L/doz-005.dgn
6-APR-1998

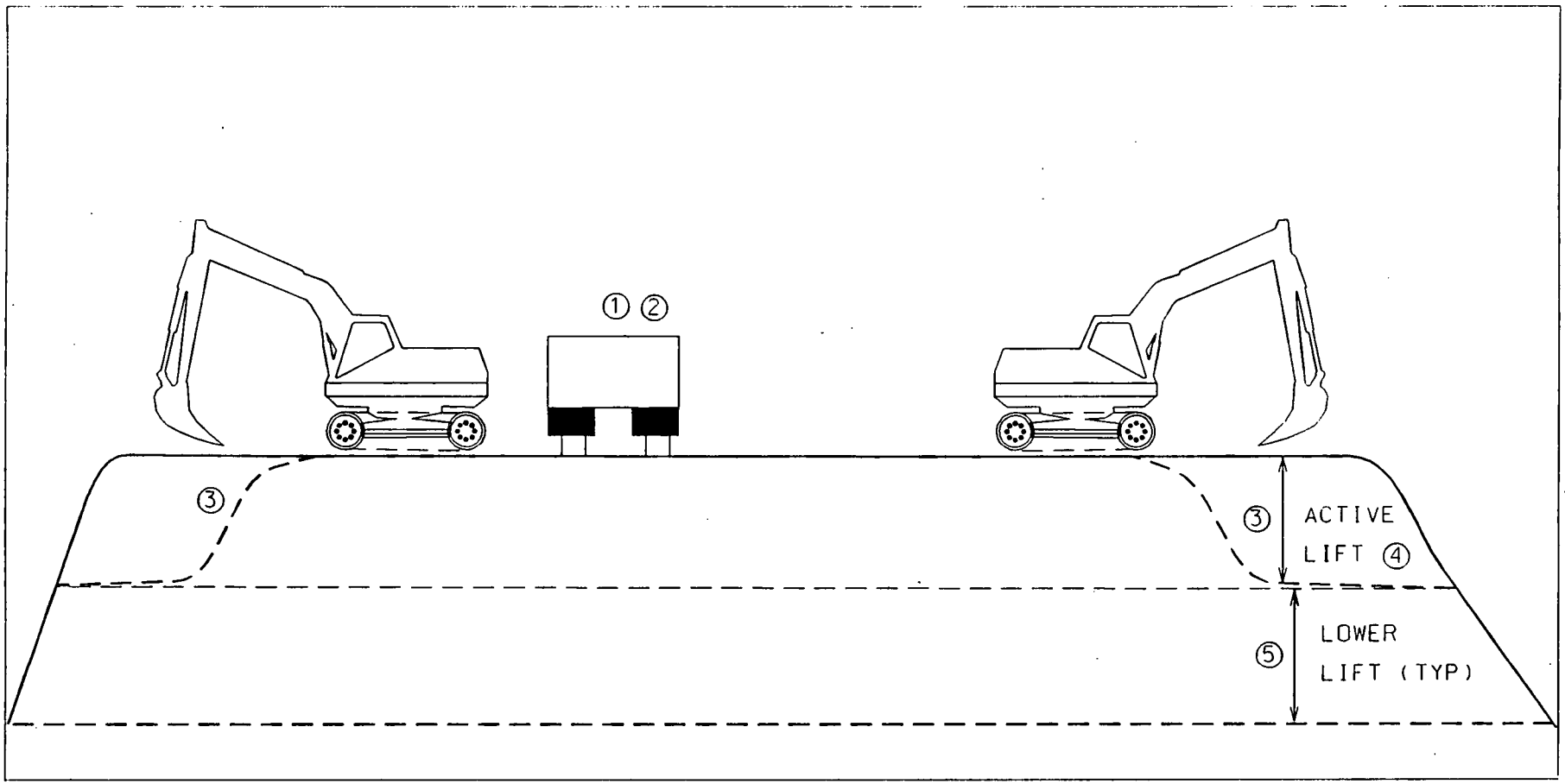


LEAD CONTAMINATED SOIL

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)

FIGURE 3-8. EXCAVATION OF LEAD CONTAMINATED SOIL

/dgis/USER/MIKEL/dgz-002.dgn
6-APR-1993



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.

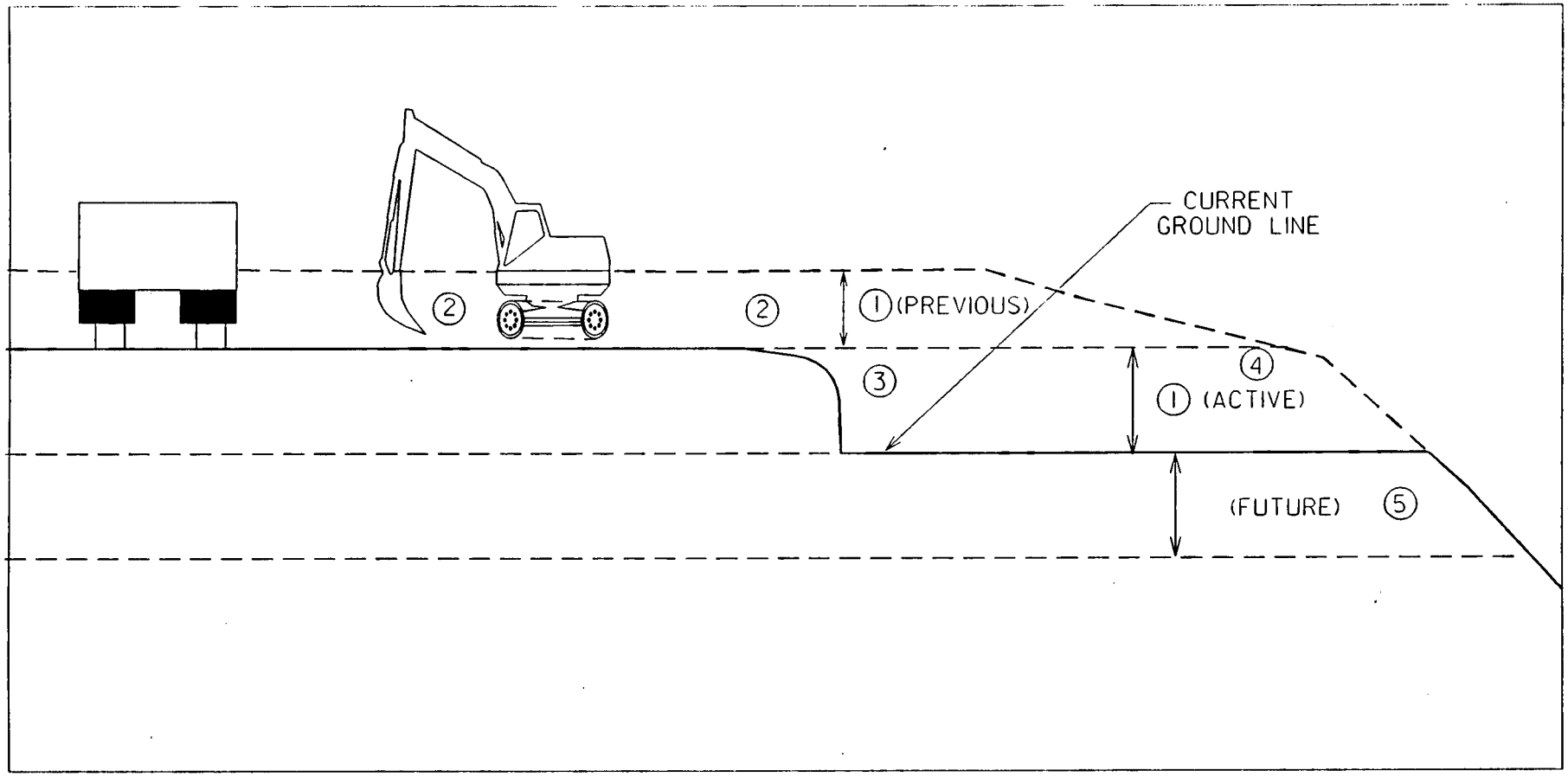
④ FIELD SURVEY FOR LOWER LIFTS SHALL BE PERFORMED IN ACTIVE LIFT BEHIND EXCAVATION.

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

/dgis/USERS/MIKE_L/MIKE_L/d02-006.dgn

6-APR-1998

FIGURE 3-9. TYPICAL EXCAVATION APPROACH



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 FURURE LIFT (MINIMUM OF 50 FT. BEHIND ACTIVE EXCAVATION)
5. EXCAVATE FUTURE LIFT AFTER MONITORING IS COMPLETE ON ACTIVE LIFT.

/dgis/USERS/MIKE_L/MIKE_L/doz-001.dgn 3-APR-1998

FIGURE 3-10. EXCAVATION SEQUENCING

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1418

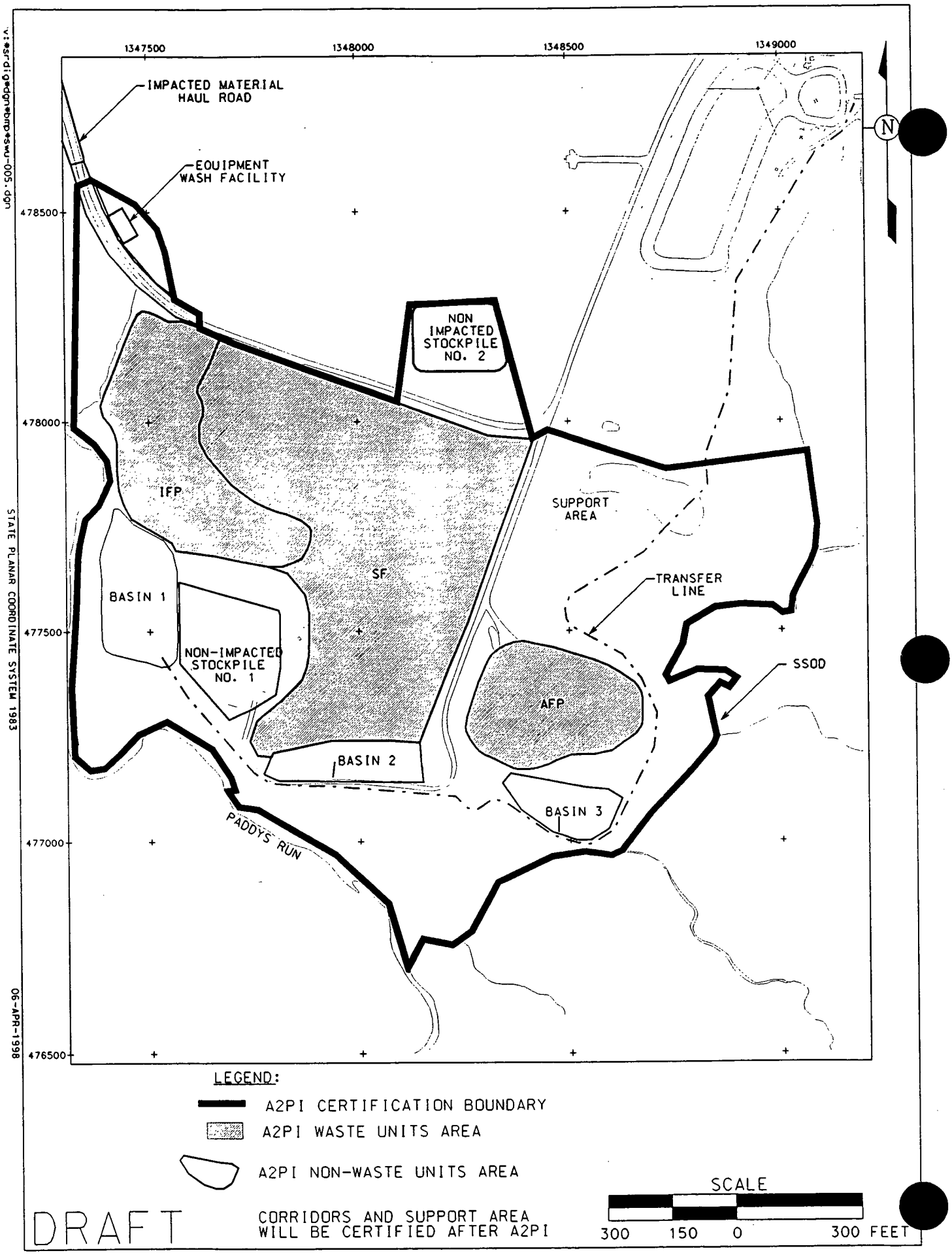
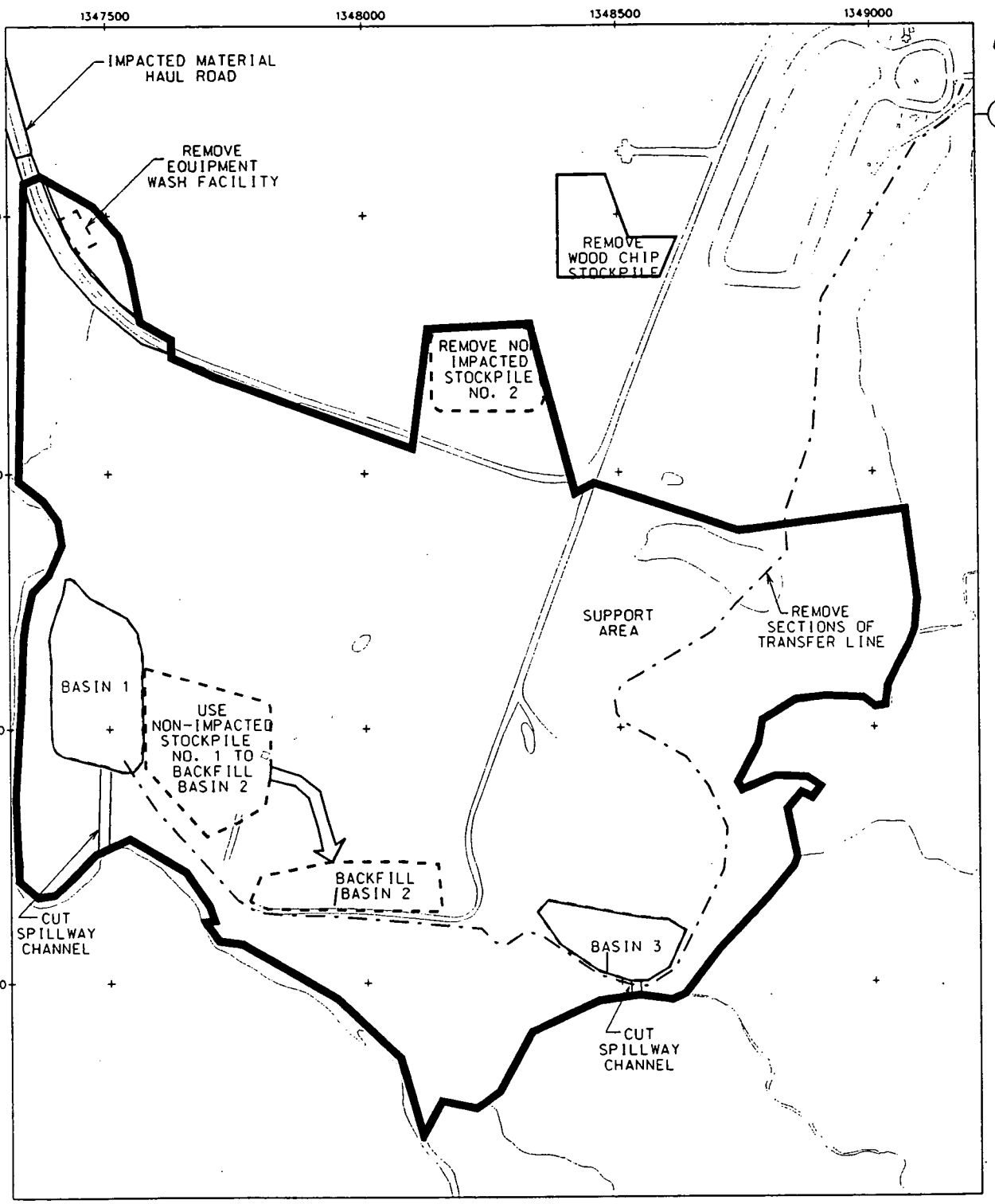


FIGURE 3-11. A2PI CERTIFICATION BOUNDARIES



LEGEND:

A2P1 CERTIFICATION BOUNDARY

000243

SCALE

300 150 0 300 FEET

DRAFT

FIGURE 3-12. SWU RESTORATION PLAN

swu-006.dgn
STATE PLANAR COORDINATE SYSTEM 1983
04-APR-1998

Section 4

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

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.

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.

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.

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.

O48 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).

O48 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])?
- 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		

NOTES:

(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

000260

Section 5

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.

Section 6

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.

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.

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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

- 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)
- 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.

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.

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.

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 will be 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. Proposals have been submitted. A tentative award date is scheduled for May 1, 1998 and construction is scheduled to start 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.

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.

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 Project Plan (QAPP).

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:

- 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 are expected to be 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.

TABLE 6-1

IMPACTED MATERIAL WASTE STREAMS

O5, U-S7

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

O[illegible]4b

TABLE 6-3

PROTOCOLS FOR SPECIAL MATERIALS

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.
P[illegible]d 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.
T[illegible]	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

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

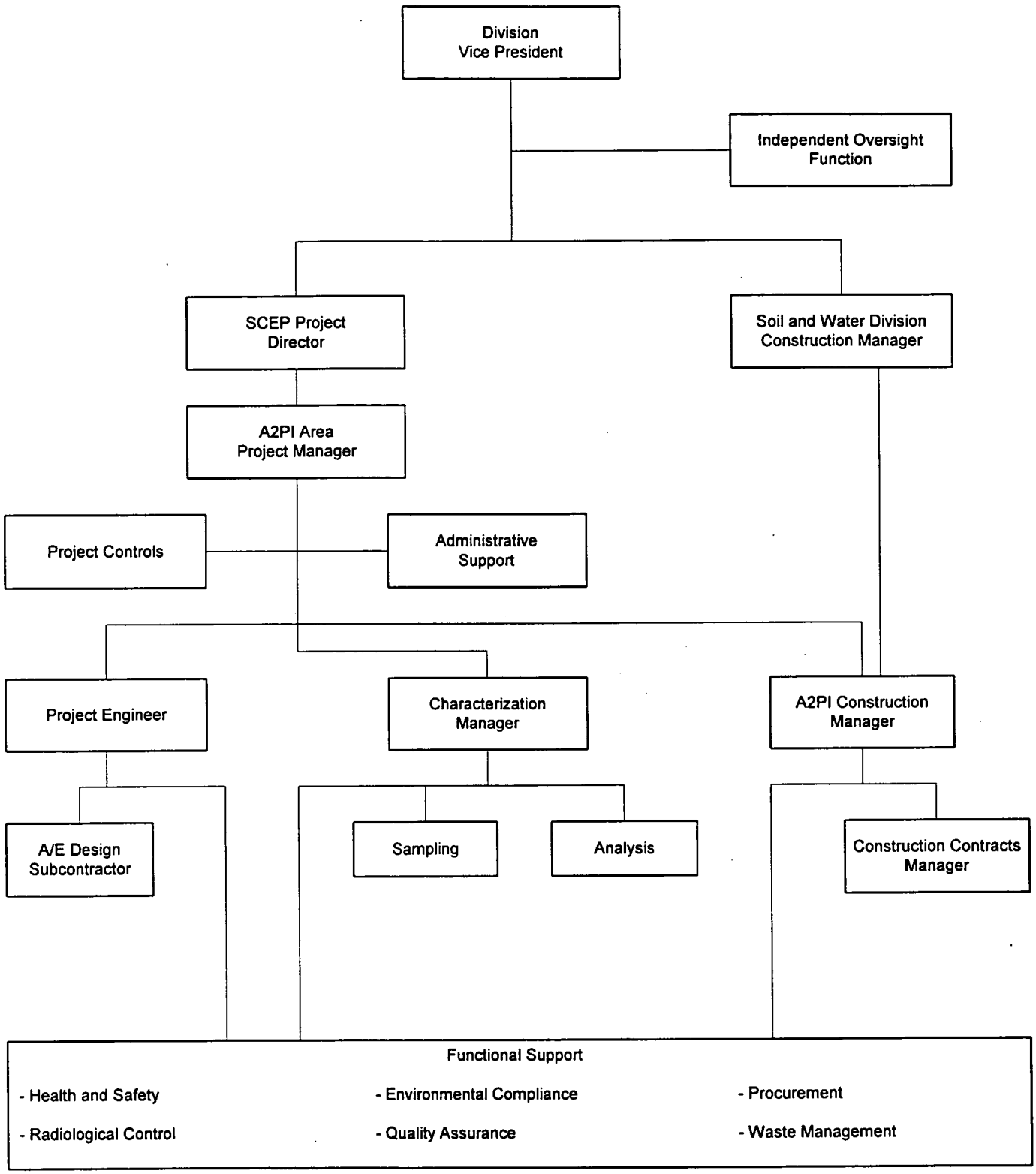
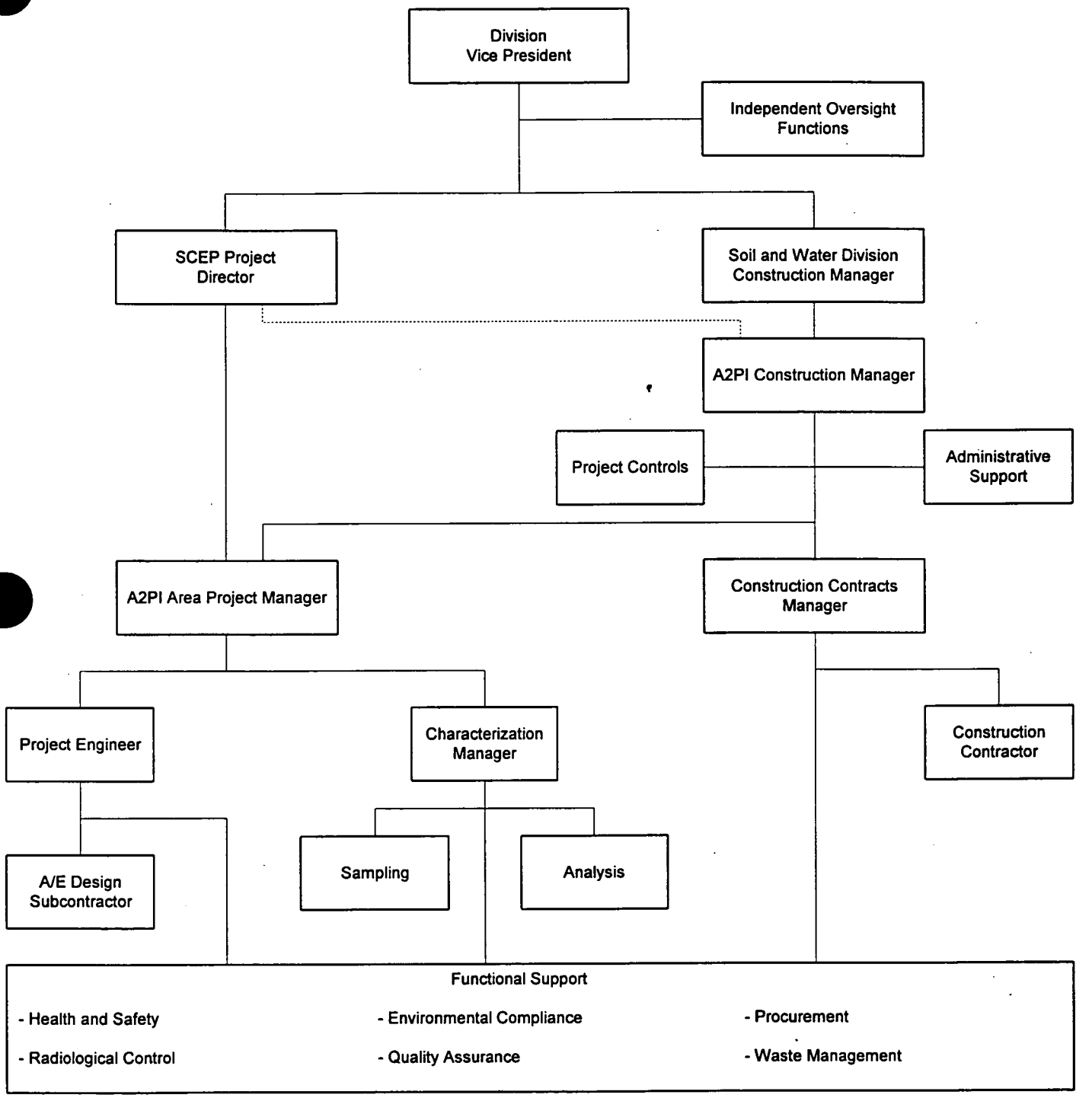


Figure 6-2
Area 2, Phase I Project Organization During Construction Phase



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

Project Order 165

INFORMATION ONLY

April 1998
Revision 2

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

WORKING DRAFT

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

000298

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

000299

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

000300

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

000301

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)

000302

- 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

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.

000305

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.

000307

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.

000309

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."

000311

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.

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.

000315

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

000317

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

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

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 pipeline 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

000321

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 no~~s~~. ~~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.

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.

000325

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.

000327

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.

000329

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

000331

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

000333

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

000335

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

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.

000339

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		

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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					
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.

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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					
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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1418

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.

000343

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		

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.

000345

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.

000346

1418

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

000347

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

000348

1418

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.

000349

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.

000350

1418

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.

000351

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/m^2/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).	

000352

1418

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

000353

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.

0003354

1418

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.

000355

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.

000356

1418

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.

000357

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)

000358

14118

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.

000359

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.

000360

1418

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.

000361

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

000362

1418

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.

0003363

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

000364

1418

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			

000365

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.

365A

1418

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.

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 Rationale

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

365 C

1418

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.

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.

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.

365

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.

365
6

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.

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

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.

365

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.

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 Prevention 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

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.

365

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

365

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.

365

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.

365

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[9]	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.

1418

365

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Surface Water Management Plan
for
Area 2, Phase I
~~Southern Waste Units~~
Remedial Action Project
Subcontract No. FSC607

April 1998
Revision 3

INFORMATION ONLY

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

WORKING DRAFT

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

FIGURES

Figure 2-1 Overall Operation of the Surface Water Management System

000368

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~~ topographical ~~(thus stormwater runoff)~~ conditions ~~that existed circa 1952.~~

000370

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

000372

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.

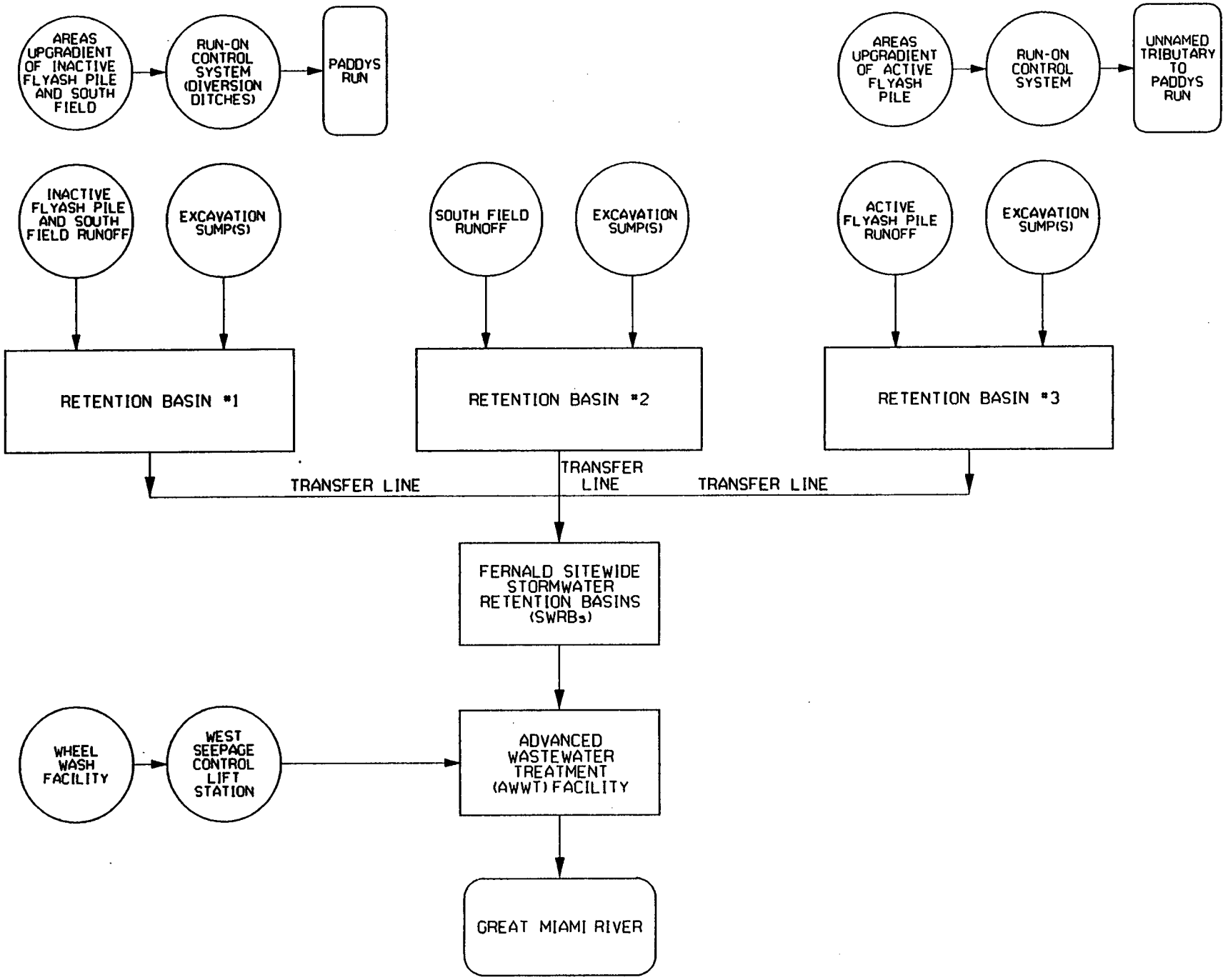

FIGURE 2-1. SURFACE WATER MANAGEMENT SYSTEM FOR SOUTHERN WASTE UNITS

000375

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 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

A~~n~~ ~~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.

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.

000379

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. Higher flows, beyond the capacity of the lift station pump, will discharge through the lift station to 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 a~~n~~ ~~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.~~

4.2.3~~2~~ 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 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

000383

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.

4.2.6~~5~~ 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.

000385

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~~ A2P1 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.

000386

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.

Step 5. Install risers, barrels, lift stations, and transfer lines for the retention basins as shown on the Construction Drawings.

000387

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.

000388

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.

000389

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.

000391

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. Partch 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
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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: 10/10/97

CHECKING METHOD

1. Review ____
2. Alternate Calculation ____

Checker's Signature and Date: Franklin M. Porter Jr. 10/10/97

Lead Discipline Engineer's Signature and Date: Franklin M. Porter 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
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ENGINEERING CALCULATIONS
BASIS SHEET

Revision No. 2
Sheet 2 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

Prepared By: T. Brown TJB Checked/Verified By: Frank Porter Jr

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 JB Date: 10/10/97

Checked By: [signature] Date: 10/10/97

Approved By: Date:

5ห 6ด 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: [signature] Date: 10/10/97

Approved By: Date:

12/92 ENG095

000401

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 TB 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.

SHT 9-12

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c2p.mod
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sb1.str
sb1.vol
sedsw1.vol
sedvol.txt
sw1-10.hyd
sw1-100.hyd
sw1-25.hyd
sw1.hyd
sw1.pnd
sw1.vol
sw1a-10.hyd
sw1a.pnd
sw1a.vol
sw2-10.hyd
sw2-10a.hyd
2-10t.hyd
sw2-25.hyd
sw2-25a.hyd

SHT 12-12

Print File List
8/20/97 4:48PM
P:\ENGDATA\C&SDATA\PO165\SWU\SWCALC\R1

sw2-25t.hyd
sw2-t1.hyd
sw2-t1.pnd
sw2-t1.vol
sw2.pnd
sw2.vol
sw2a-10.hyd
sw2a-25.hyd
sw2a.pnd
sw2a.vol
sw2e-10t.hyd
sw3-10.hyd
sw3-10a.hyd
sw3-10t.hyd
sw3-25.hyd
sw3-25a.hyd
sw3-25t.hyd
sw3-t1.hyd
sw3-t1.pnd
sw3-t1.vol
sw3.pnd
sw3.vol
sw3a-10.hyd
sw3a-25.hyd
sw3a.pnd
sw3a.vol
swmpswl.rvk
swu.bak
swu.fm2
swu.idf
swu1.bak
swu1.fm2
wtdn.xls

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 A51418

Quick TR-55 Ver.5.46 S/N:
Executed: 10:05:30 08-19-1997 c:\po165tk\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

000412

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

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)

SHTA9 1418

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 SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	15.23	~~89~~ USE 90

SEE PREVIOUS SHEET

SHT A10

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)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * 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.

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

>>>> 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

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

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

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

SMT A14

14.6	3	18.4	2
14.7	3	18.5	2

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

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

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 10:26:34

```
*************************
*                       *
*   RETENTION BASIN 1   *
* 25 YR - 24 HR STORM   *
* PROPOSED CONDITIONS   *
*                       *
*                       *
*************************
```

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			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
531.40	0.0	0.000	0.0	0.0
532.00	0.0	0.040	9.7	9.7
532.90	0.0	0.360	87.1	87.1
533.00	0.0	0.420	101.6	101.6
534.00	0.0	1.160	280.7	280.7
535.00	0.0	2.070	500.9	500.9
536.00	0.0	3.030	733.3	733.3
537.00	0.0	4.050	980.1	980.1
538.00	0.0	5.150	1246.3	1246.3
538.50	0.0	5.750	1391.5	1391.5
539.00	0.0	6.380	1544.0	1544.0
540.00	0.0	7.690	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

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)
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

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)
24.700	0.00	0.0	1211.1	1211.1	0.00	537.87
24.800	0.00	0.0	1211.1	1211.1	0.00	537.87
24.900	0.00	0.0	1211.1	1211.1	0.00	537.87
25.000	0.00	0.0	1211.1	1211.1	0.00	537.87
25.100	0.00	0.0	1211.1	1211.1	0.00	537.87
25.200	0.00	0.0	1211.1	1211.1	0.00	537.87
25.300	0.00	0.0	1211.1	1211.1	0.00	537.87
25.400	0.00	0.0	1211.1	1211.1	0.00	537.87
25.500	0.00	0.0	1211.1	1211.1	0.00	537.87
25.600	0.00	0.0	1211.1	1211.1	0.00	537.87
25.700	0.00	0.0	1211.1	1211.1	0.00	537.87
25.800	0.00	0.0	1211.1	1211.1	0.00	537.87
25.900	0.00	0.0	1211.1	1211.1	0.00	537.87

SHTA22

********** 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

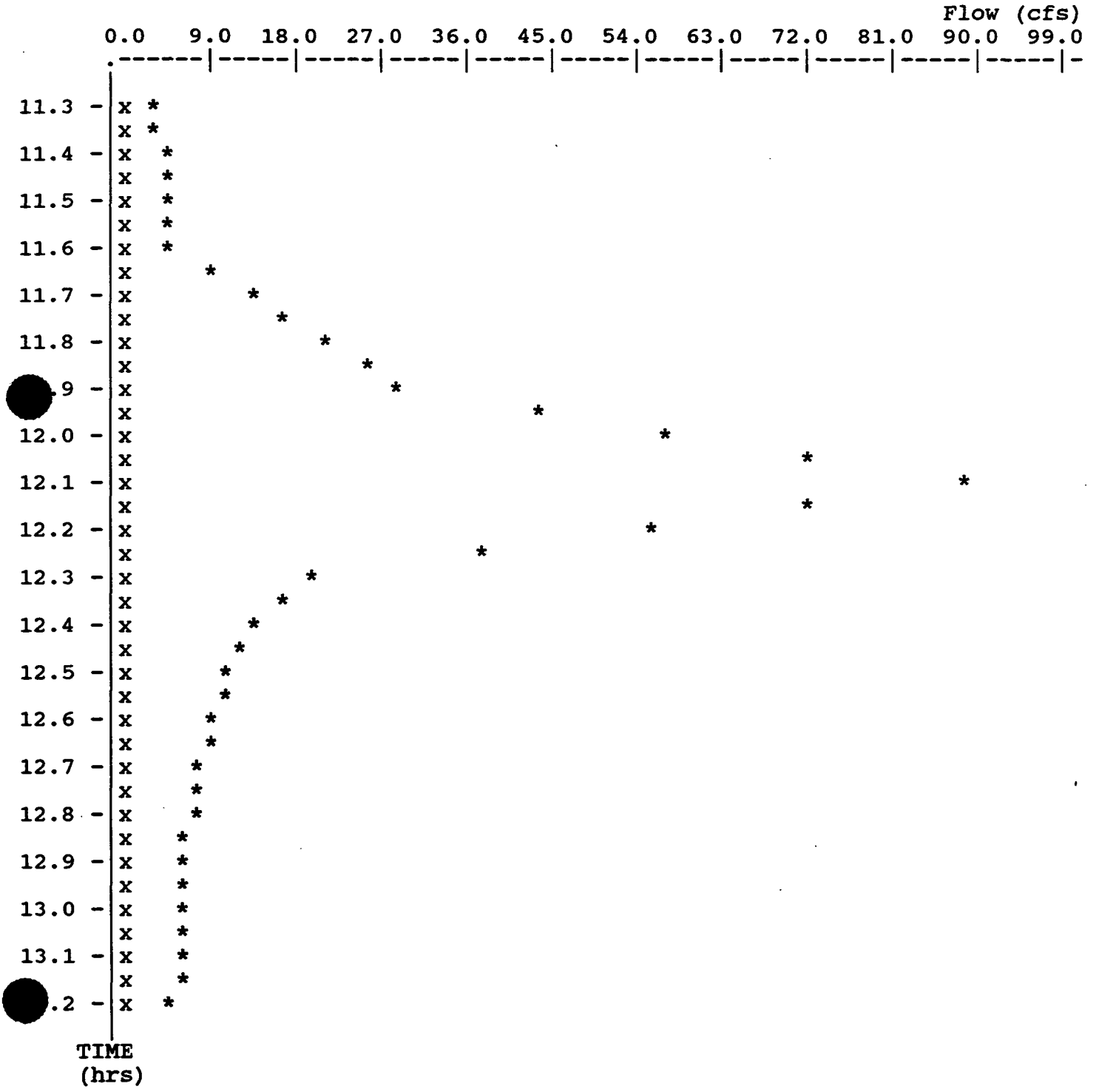
>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

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



SHTA24

```
*  File:  c:\po165tk\P1-25    .HYD   Qmax =    88.0 cfs
x  File:  c:\po165tk\SW1      .HYD   Qmax =     0.0 cfs
```

SHT A 25

1418

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

Quick TR-55 Ver.5.46 S/N:
Executed: 10:33:15 08-19-1997 c:\po165tk\P2E.TCT

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)

::

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 SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	7.04	75

SHT 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.

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

>>>> 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

SHTA32

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

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

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)

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		

SHT A36

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			

$$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$$ 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

$$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$$ ft/s 0.0000

Flow length, L ft 0

T = L / (3600*V) hrs 0.00 = 0.00

:::

TOTAL TIME (hrs) 0.09

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

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

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)

::

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 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)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * 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.

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

>>>> 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

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

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	1

SHT A44

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)

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:

>>>>> 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

SHT A48

POND-2 Version: 5.17
S/N:

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.

POND-2 Version: 5.17 S/N:
EXECUTED: 08-19-1997 11:12:44


```
**********************
*                    *
*   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			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
528.70	0.0	0.000	0.0	0.0
529.00	0.0	0.010	2.4	2.4
530.00	0.0	0.080	19.4	19.4
530.30	0.0	0.110	26.6	26.6
531.00	0.0	0.200	48.4	48.4
532.00	0.0	0.370	89.5	89.5
533.00	0.0	0.580	140.4	140.4
534.00	0.0	0.850	205.7	205.7
535.00	0.0	1.170	283.1	283.1
536.00	0.0	1.560	377.5	377.5
537.00	0.0	2.020	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	535.06
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	535.84
15.300	1.00	2.0	364.6	364.6	0.00	535.86
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

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)
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

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. <<<<<<

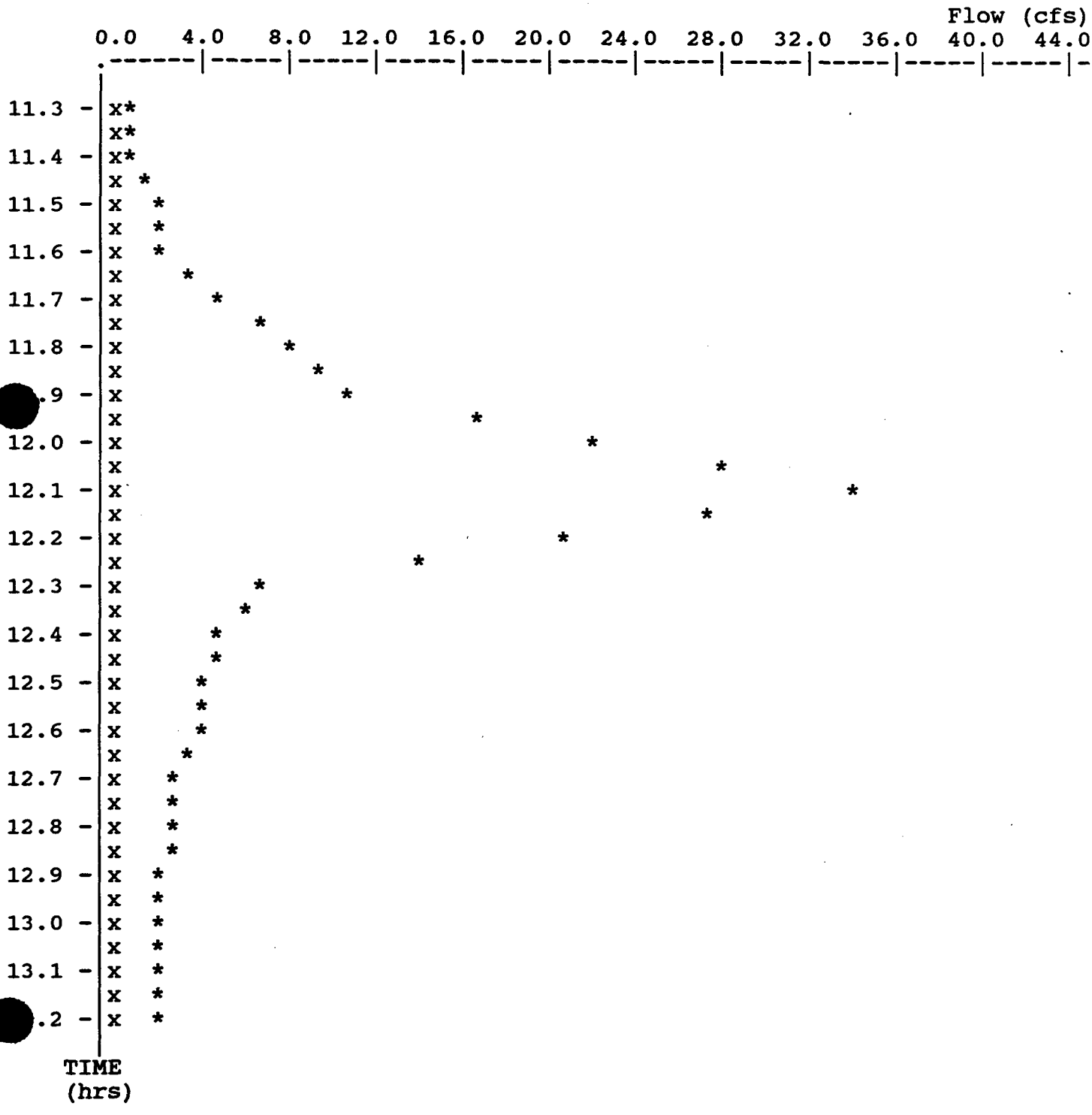
>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

POND-2 Version: 5.17 S/N:

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

RETENTION BASIN 3

SHT A 58

```
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
                           0.8
         .007 * (n*L)
     T = --------------                       hrs        0.02             =   0.02
             0.5     0.4
           P2    *   s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                         2
     Surface (paved or unpaved)?                        Unpaved
     Flow length, L                            ft        145.0
     Watercourse slope, s                      ft/ft     0.0760

                              0.5
     Avg.V =   Csf *   (s)                     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

                           2/3     1/2
          1.49   *   r    *   s
     V = --------------------                  ft/s      0.0000
                     n

     Flow length, L                             ft            0

     T = L / (3600*V)                           hrs        0.00           =   0.00

    ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                  TOTAL TIME (hrs)          0.03
```

use 0.1 hrs

Quick TR-55 Ver.5.46 S/N:
Executed: 11:20:38 08-19-1997 c:\po165tk\P3.TCT

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)

::

SHT A61

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 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.

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

>>>> 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

SHT A64

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)

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

SHT #60

14.6	1	18.4	0
14.7	1	18.5	0

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

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	1.37

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.

SNT A69 #418


```
*****************************
*                           *
* 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	538.76
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	539.71
15.300	1.00	2.0	248.2	248.2	0.00	539.74
15.400	1.00	2.0	250.2	250.2	0.00	539.78

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)
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-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)
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

SHT A74

********** 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

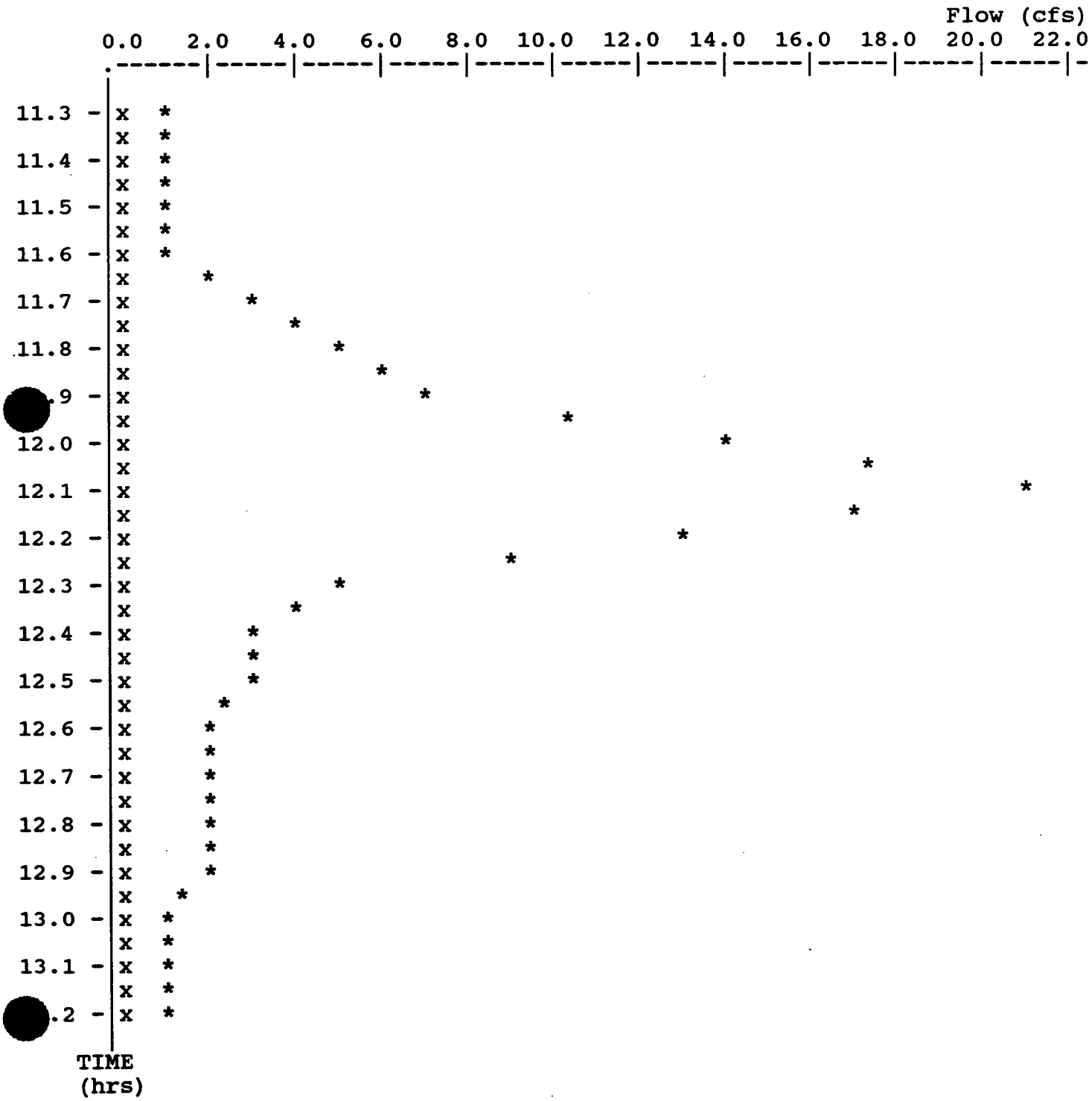
>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

POND-2 Version: 5.17 S/N:

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



SHT A76

```
*  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

1418

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

SHT B5

Quick TR-55 Ver.5.46 S/N:
Executed: 14:50:44 10-27-1996

1418

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

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

Quick TR-55 Ver.5.46 S/N:
Executed: 14:09:34 07-21-1997

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

Quick TR-55 Ver.5.46 S/N:
Executed: 14:10:15 07-21-1997

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	6.09

SHT BH 418

Quick TR-55 Ver.5.46 S/N:
Executed: 14:11:45 07-21-1997

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

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	12.65

Quick TR-55 Ver.5.46 S/N:
Executed: 16:54:32 08-19-1997

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

000497

SHT B15

1418

Quick TR-55 Ver.5.46 S/N:
Executed: 15:00:44 01-22-1997

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

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

SHT B17
1418

Quick TR-55 Ver.5.46 S/N:
Executed: 15:06:30 04-26-1997

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

SHT B18

Quick TR-55 Ver.5.46 S/N:
Executed: 14:15:21 04-28-1997

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

SHT B19

1418

Quick TR-55 Ver.5.46 S/N:
Executed: 14:16:50 04-28-1997

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

SHT B21

1418

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

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

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

Quick TR-55 Ver.5.46 S/N:
Executed: 07:34:14 04-29-1997

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

Quick TR-55 Ver.5.46 S/N:
Executed: 14:47:00 04-29-1997

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 828

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

SHT B29

Quick TR-55 Ver.5.46 S/N:
Executed: 14:48:13 04-29-1997

1418

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

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

SHT B31

Quick TR-55 Ver.5.46 S/N:
Executed: 16:47:37 01-20-1997

1418

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

000512

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

SHT B33

Quick TR-55 Ver.5.46 S/N:
Executed: 09:27:45 11-24-1996

1418

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 834

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

Quick TR-55 Ver.5.46 S/N:
Executed: 16:49:22 01-20-1997

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

SHT B37

1418

Quick TR-55 Ver.5.46 S/N:
Executed: 14:02:25 02-04-1997 c:\po165d\D12P.TCT

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

000518

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

1418

TIME OF CONCENTRATION, DITCH 12
Worksheet for Trapezoidal Channel

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	ft^2
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.		

000520

SHT B40

DITCHES 13 & 14 DESIGNED UNDER PO158, HAUL ROAD UPGRADE PROJECT

Quick TR-55 Ver.5.46 S/N:
Executed: 09:39:59 06-10-1997

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

SHT B41 A

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

000523

SHT B41B

1418

Quick TR-55 Ver.5.46 S/N:
Executed: 13:54:34 09-28-1997

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

SKT. B41D

Quick TR-55 Ver.5.46 S/N:
Executed: 13:58:54 09-28-1997

1418

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

000526

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_v = 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	7.8	14.1	0.2	• D_n = 0.4 • D_v = 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_v = 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_v = Flow depth upstream of velocity check

000527

SHT B42

DITCH-1 (D1)
Worksheet 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

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

SHTB44

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

000529

SHT B45

DITCH 2A, EXISTING CONDITIONS
Worksheet for Triangular Channel

1418

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

000530

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

000531

SHT B47

DITCH 2A-25
Worksheet for Triangular Channel

1418

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.		

000532

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

000533

SHT B49

1418

DITCH 2B-25
Worksheet for Triangular Channel

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.		

000534

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.

000535

SHT B51

1418

DITCH 2C, PROPOSED CONDITIONS
Rating Table 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

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

000536

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.		

000537

SHT 853

1418

DITCH 2C-25
Rating Table 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

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

000538

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

000539

SHT B55

1418

DITCH 2D, PROPOSED CONDITIONS
Rating Table 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

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

000540

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

000541

SHT 857

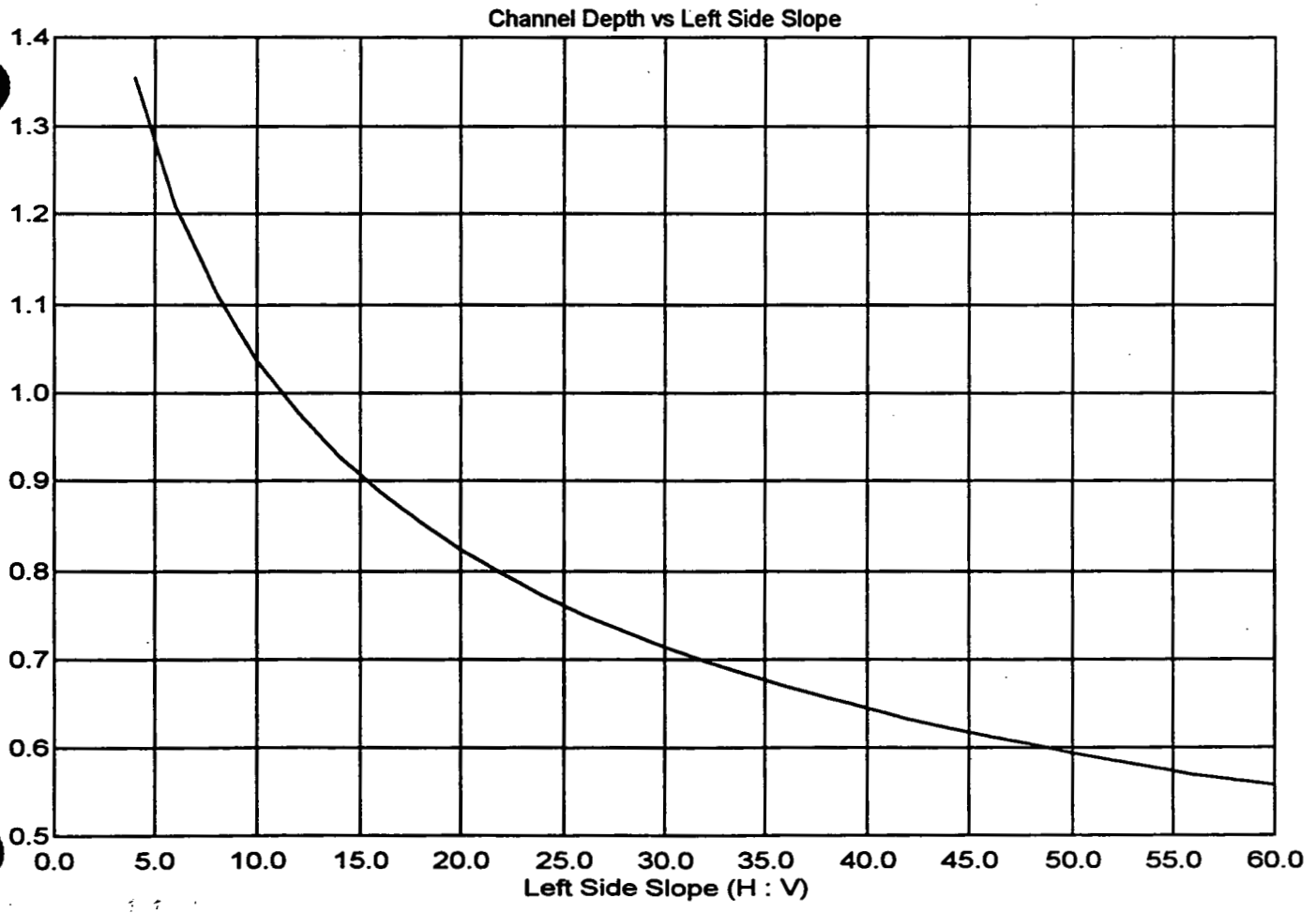
1418

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



000542

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

000543

SHT B59

1418

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

000544

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

000545

SHT B61

1418

DITCH-3 (D3)
Worksheet 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

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

000546

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

000547

SHT B63

DITCH-4 (D4)
Worksheet for Trapezoidal Channel

1418

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

000548

SHT B.64

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

000549

SHT B65

1418

DITCH-6 (D6)
Worksheet for Trapezoidal Channel

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

000550

SHT 866

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

000551

SHT B67

1418

DITCH-7 (D7)
Worksheet 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

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

000552

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 hi) + 0.63 ft = **1.63 ft**

000553

SHT E69

1418

DITCH-8A (D8A)
Worksheet for Triangular Channel

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

000554

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	ft^2
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

000555

SHT B71

1418

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

000556

SHT 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

000557

SHT B73

1418

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 = $\boxed{1.74 \text{ ft}}$

000558

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

000559

SHT 875

1418

DITCH-10A (D10A)
Rating Table 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

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

000560

SHT B76

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

000561

SHT B77

1418

DITCH-10B (D10B)
Rating Table 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

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

000562

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

000563

SHT B99

1418

DITCH-11 (D11)
Rating Table 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

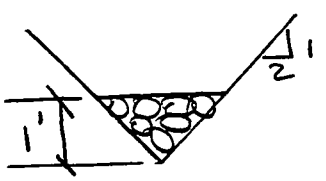
Constant Data	
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	4.28 cfs

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

000564

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.

000565

SHT B81

418

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

000566

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

000567

1418
SAT B83

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

000568

SHT B84

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

000569

SMT 885
1418

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.

000570

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

000571

SHT B87

1418

INTERCEPTOR DITCH 2
Worksheet 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

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

000572

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

000573

SHT B89

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

000574

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

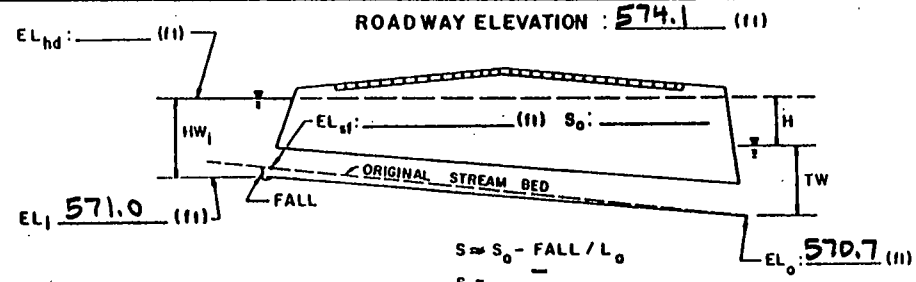
SEE ADD'L. SHTS.

- [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)



$S \approx S_o - FALL / L_o$

$S =$ —

$L_o = \approx 30'$

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	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
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) $H = \left[1 + k_e + (29 n^2 L)/R^{1.33}\right] V^2/2g$

(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 DRAINAGEWAY FLOWING 0.5' DEEP

PROJECTING ENDS ∴ Ke = 0.9

CULVERT BARREL SELECTED:

SIZE: 18" Φ

SHAPE: ROUND

MATERIAL: CMP n=0.024

ENTRANCE: PROJECTING

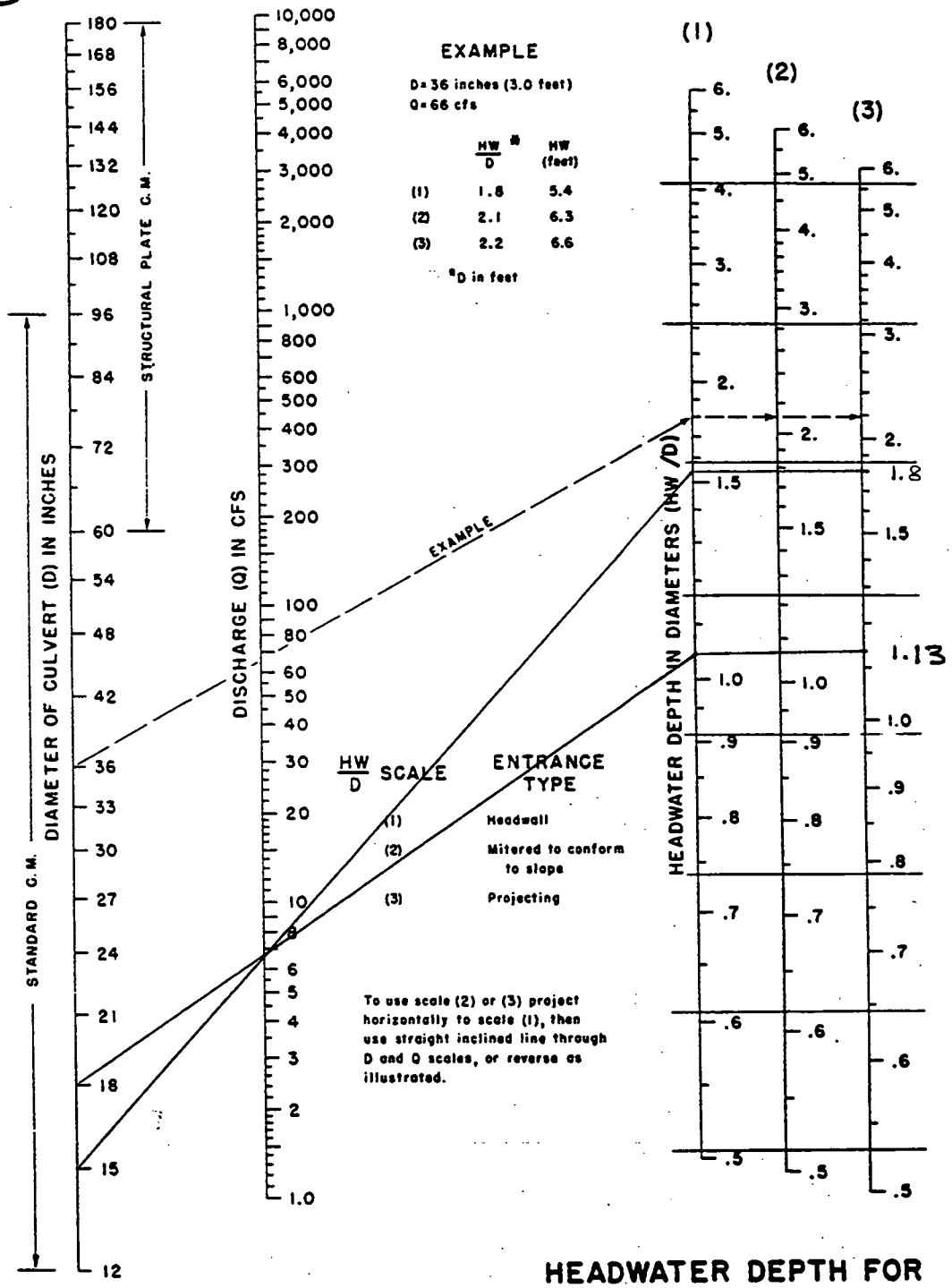
SHT C3

240

000527

SHT C4

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

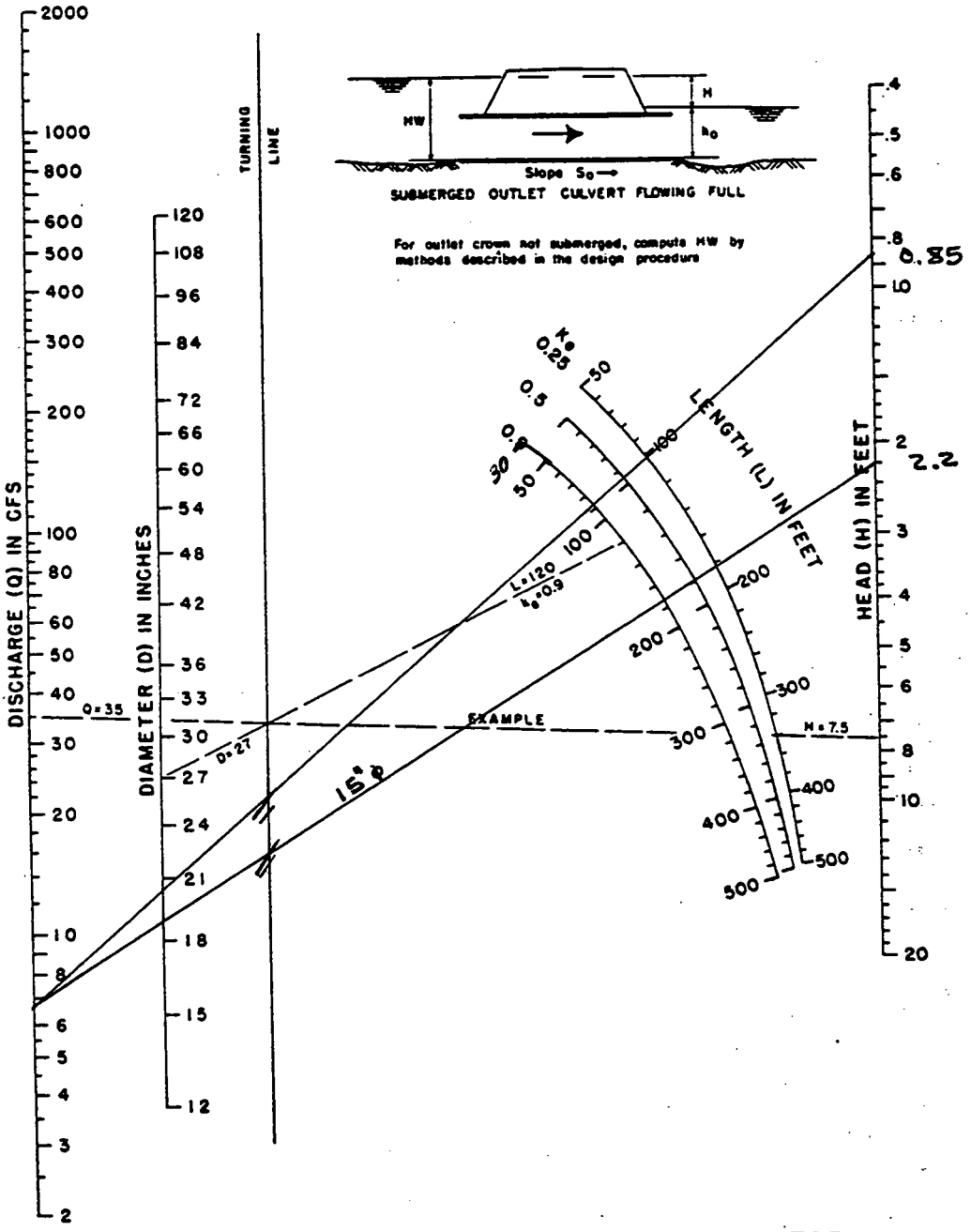
BUREAU OF PUBLIC ROADS JAN. 1963

000578

SHT C5

1418

CHART 6



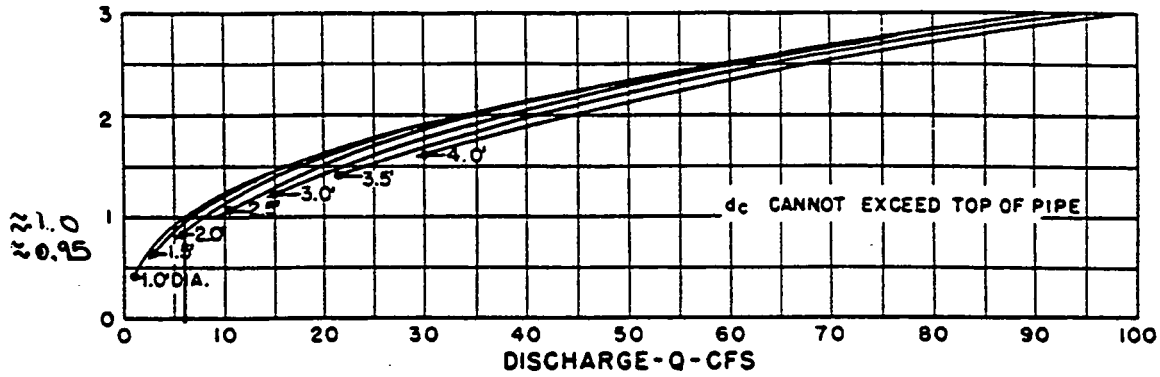
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

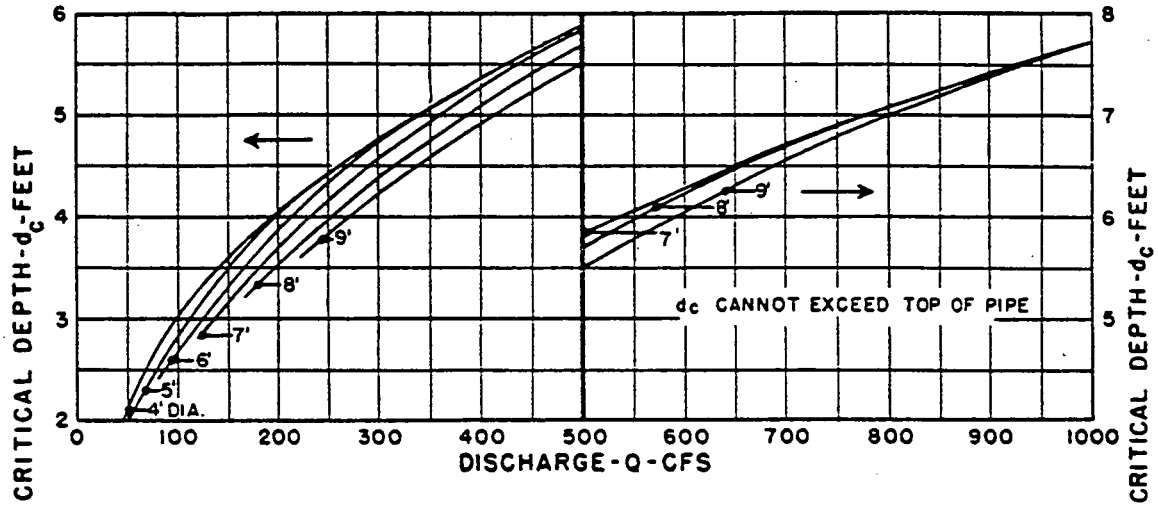
BUREAU OF PUBLIC ROADS JAN. 1963

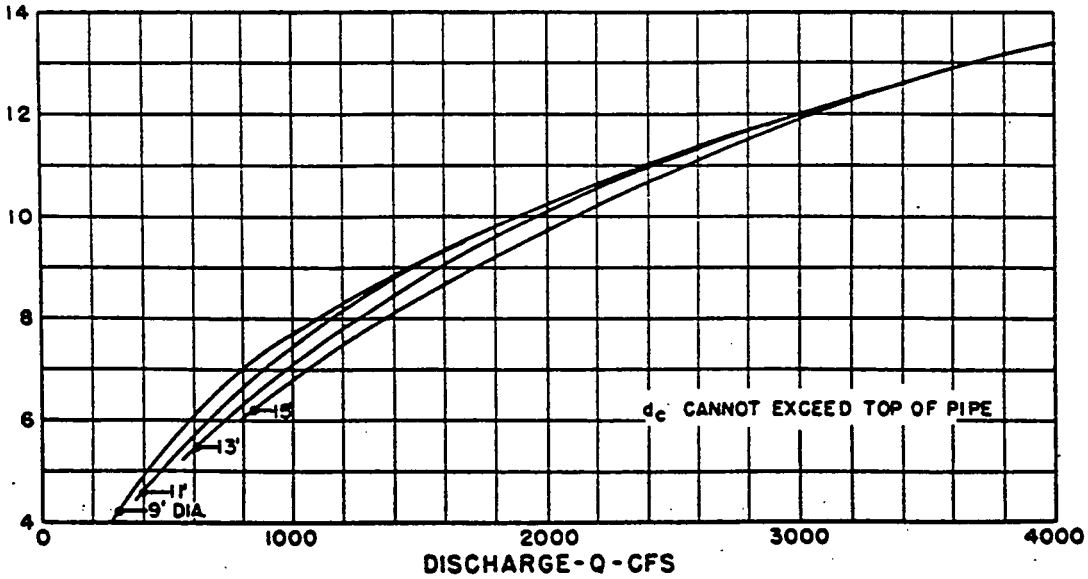
000579

SHT C6

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000580

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

SHT C9

1418

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

000583

PROJECT: SOUTHERN WASTE UNITS
CULVERT-2

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

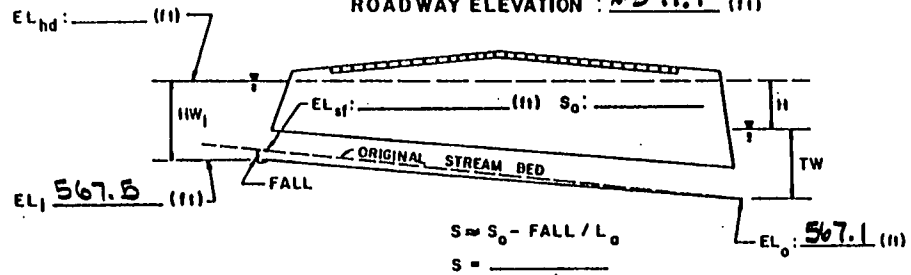
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	4.3	*

ROADWAY ELEVATION: ≈ 571.1 (ft)



$S \approx S_o - FALL / L_o$
$S =$ _____
$L_o = \approx 40'$

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)	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 ∴ Ke = 0.9

CULVERT BARREL SELECTED:

SIZE: 15" Φ
SHAPE: ROUND
MATERIAL: CMP n 0.024
ENTRANCE: PROJECTING

240

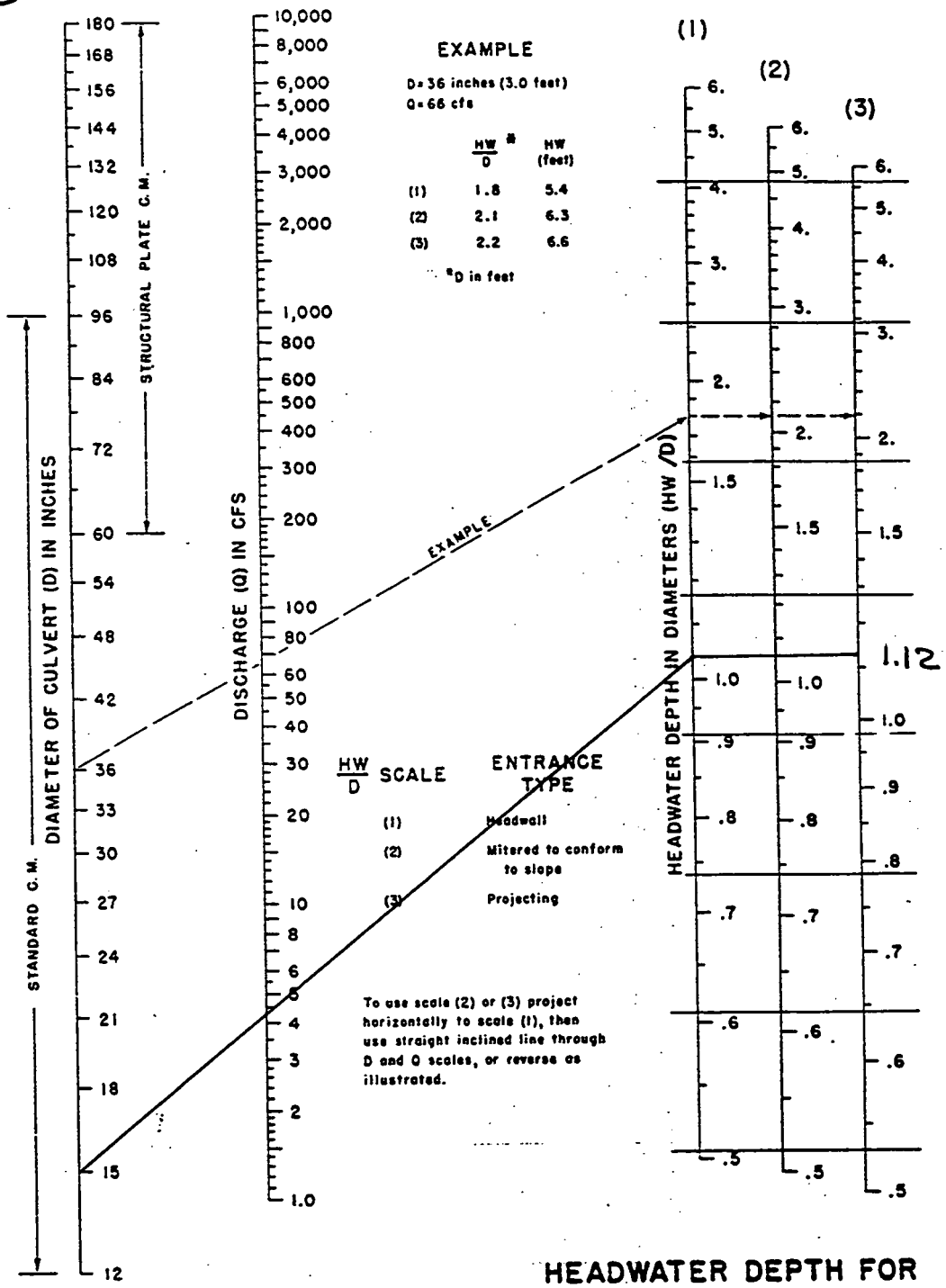
000584

SHT C10

SHT C11

1418

CHART 2



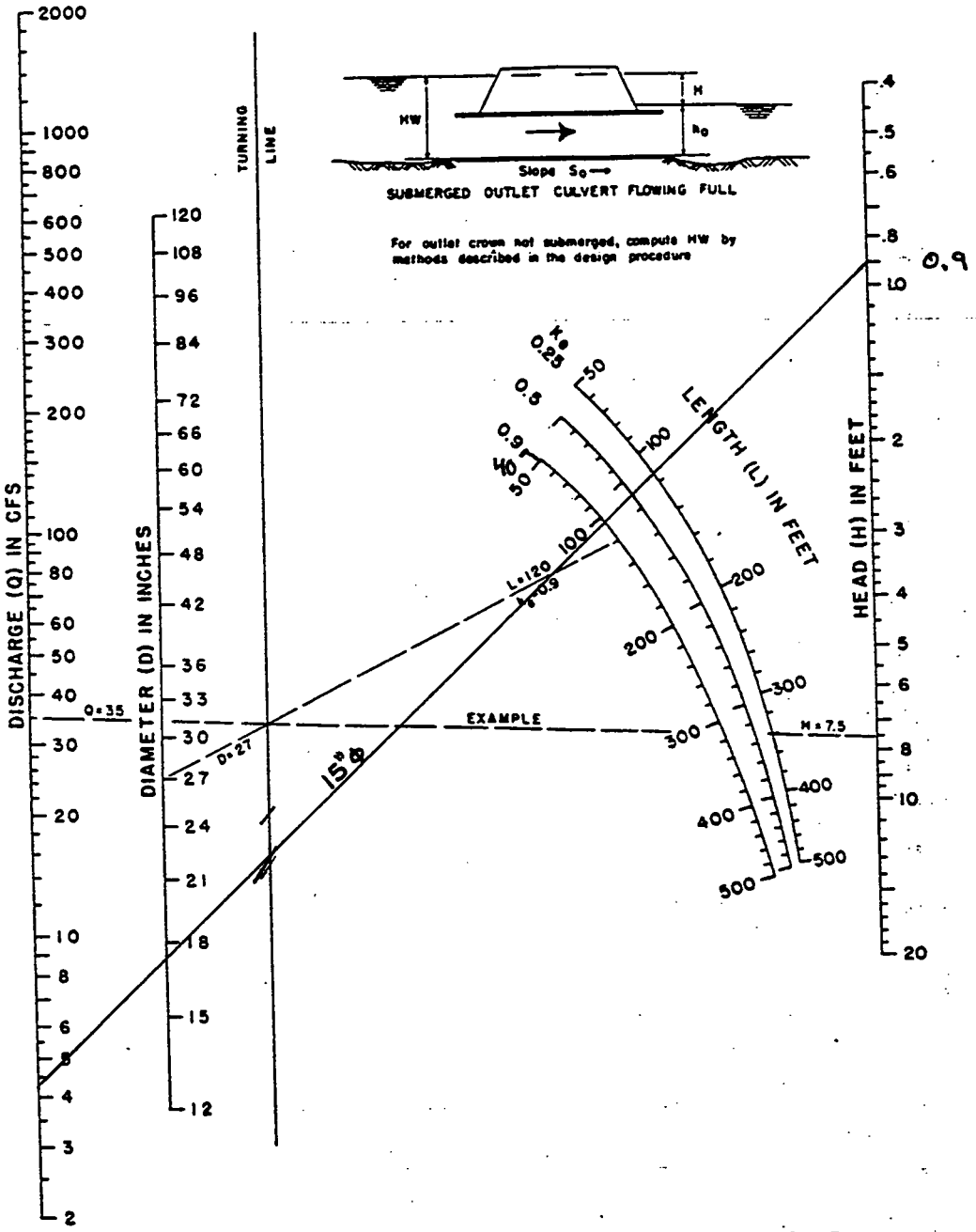
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000585

SHT C12

CHART 6

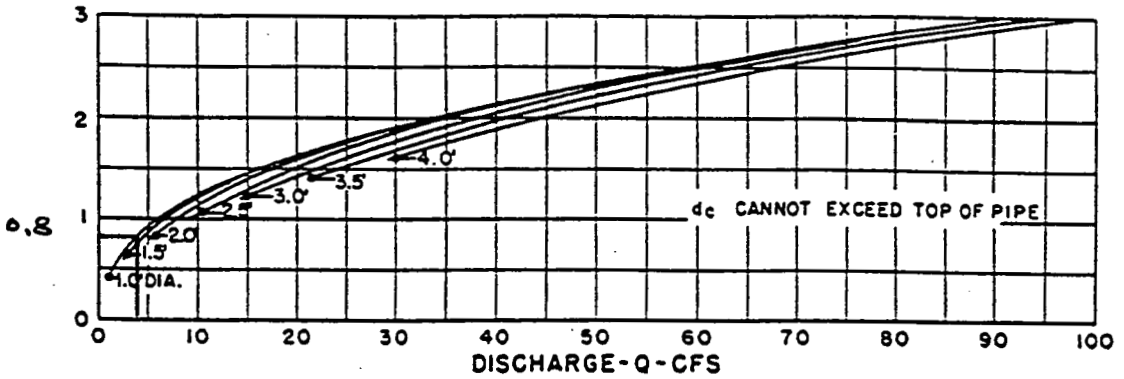


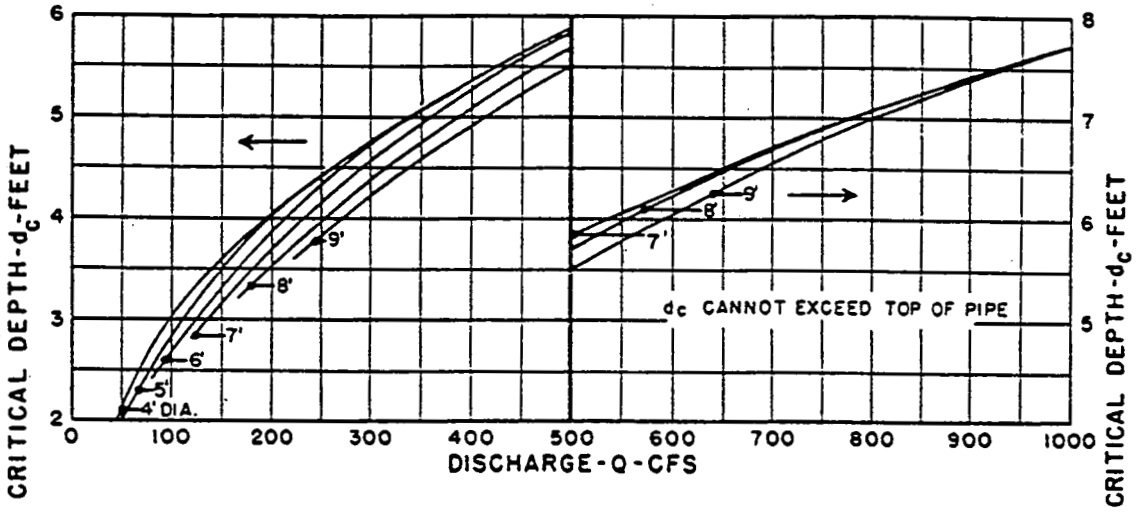
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

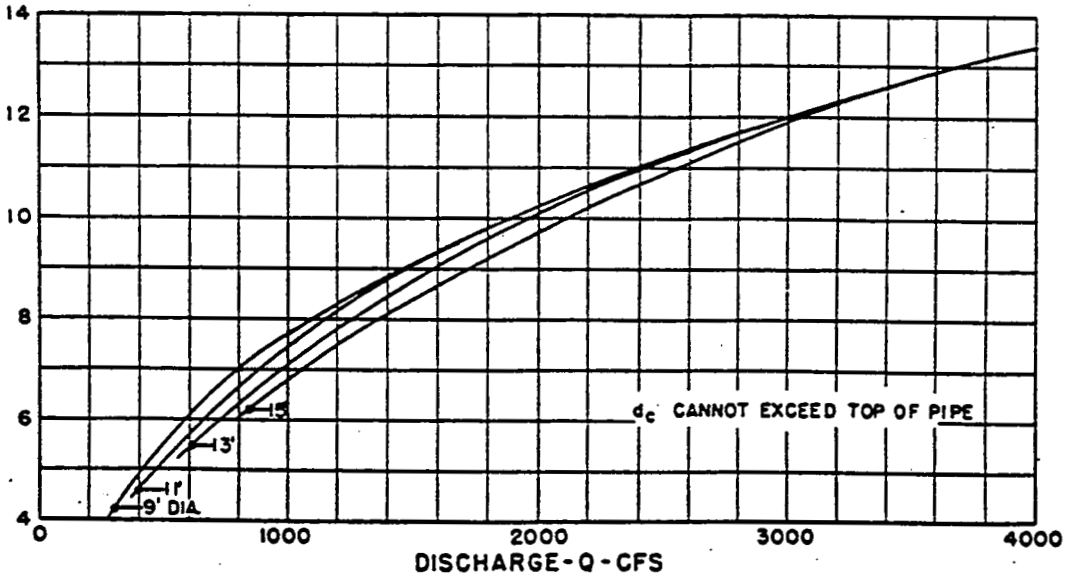
BUREAU OF PUBLIC ROADS JAN. 1963

000586

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

000588

SHT C15

1418

Quick TR-55 Ver.5.46 S/N:
Executed: 14:39:46 04-28-1997

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

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 3

STATION: N/A
SHEET — OF —

CULVERT DESIGN FORM
DESIGNER / DATE: ____ / ____
REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

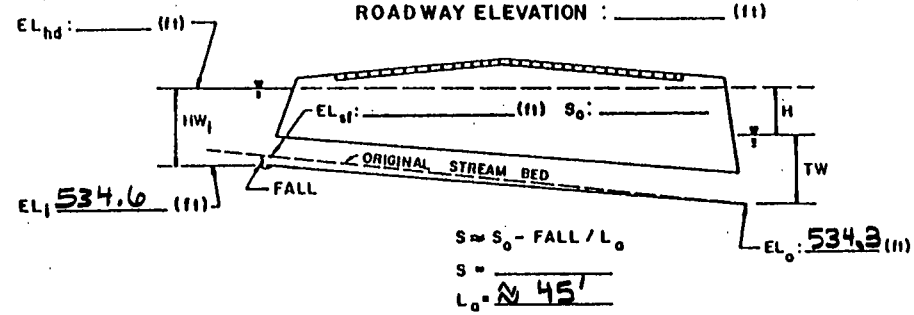
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	4.2	*

ROADWAY ELEVATION: ____ (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	(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, $K_e = 0.9$

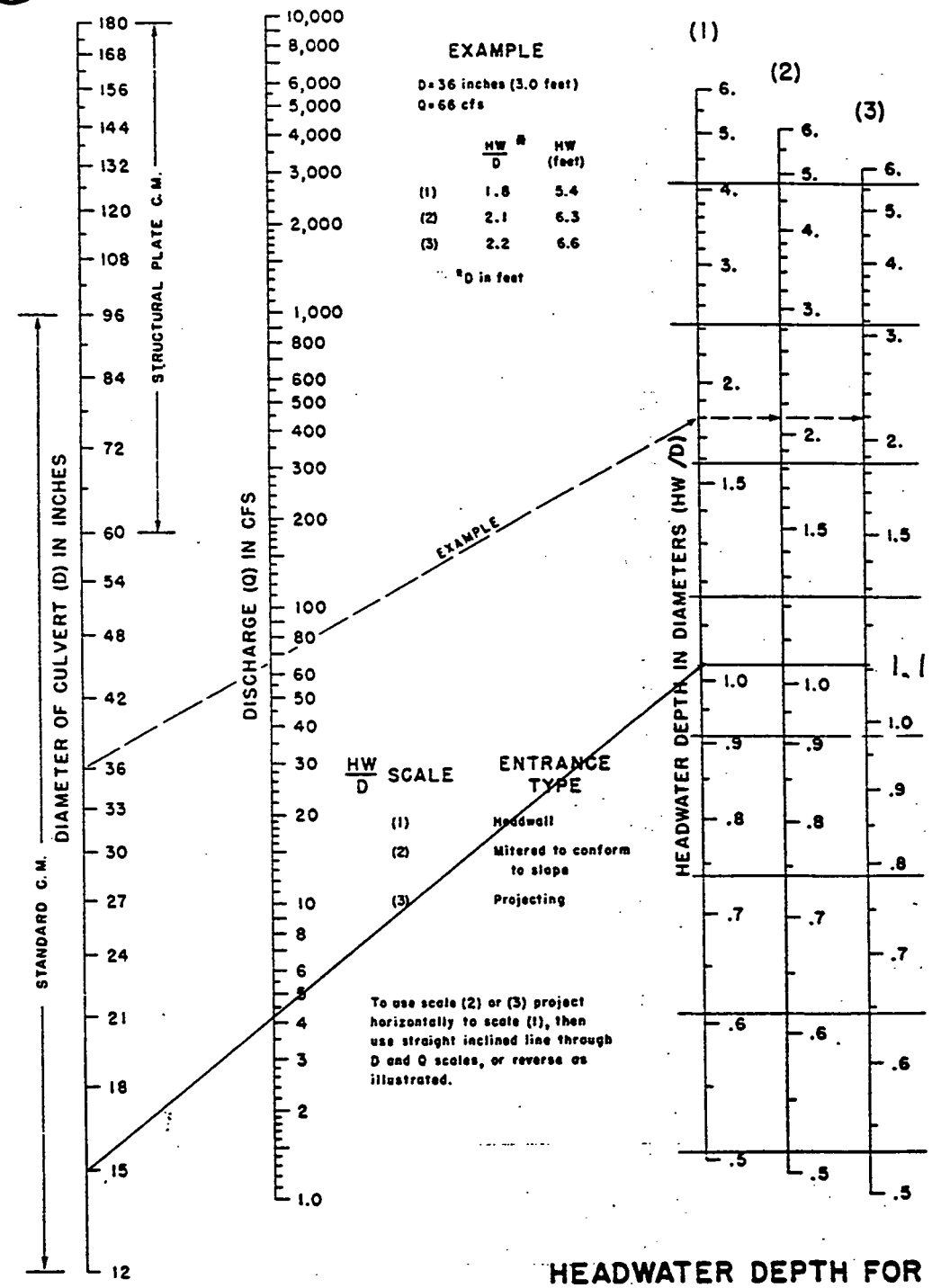
CULVERT BARREL SELECTED:
SIZE: 15"
SHAPE: ROUND
MATERIAL: CMP n 0.024
ENTRANCE: PROJECTING

240

000590

SHT C16

CHART 2

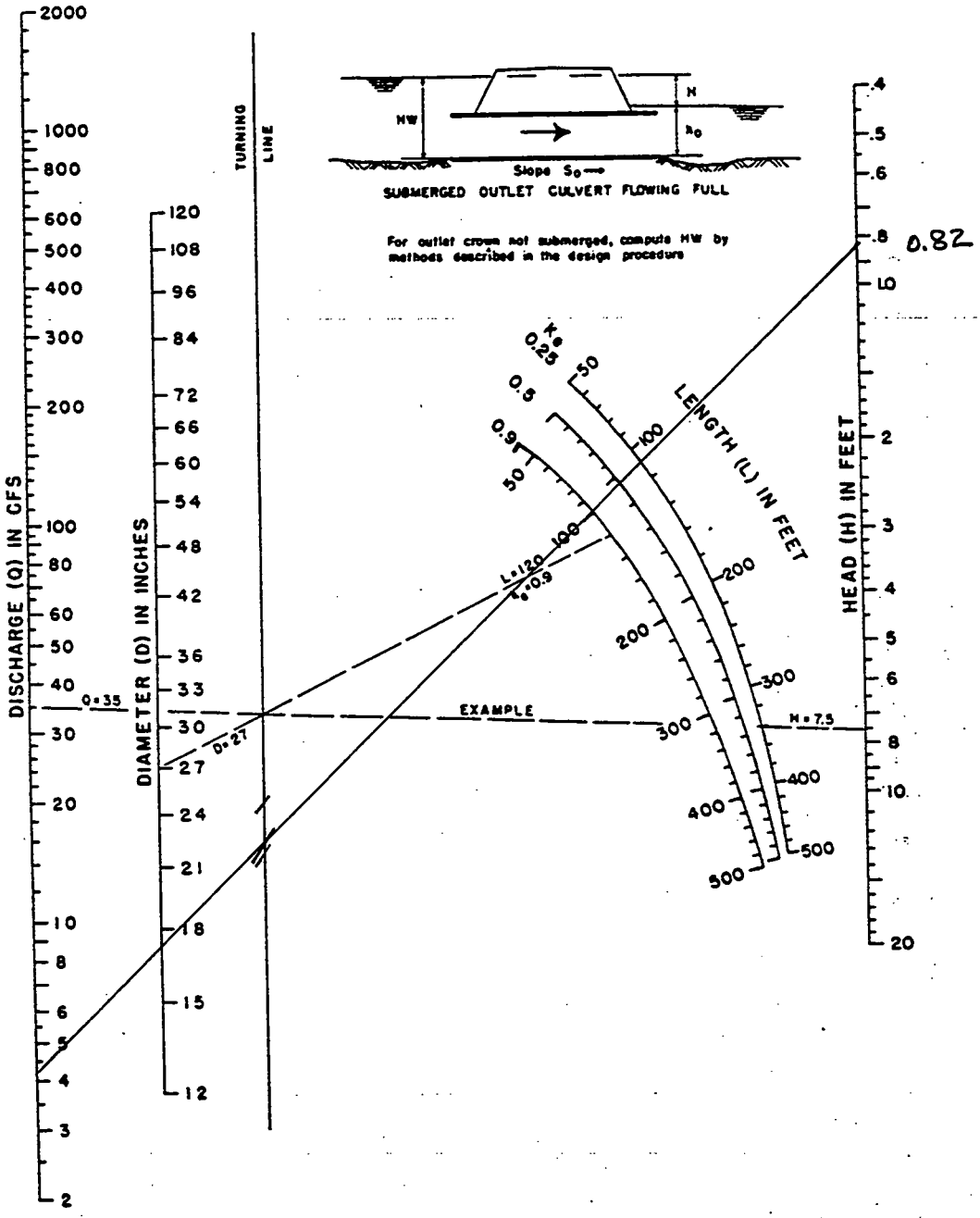


HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

SHT C18

CHART 6



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

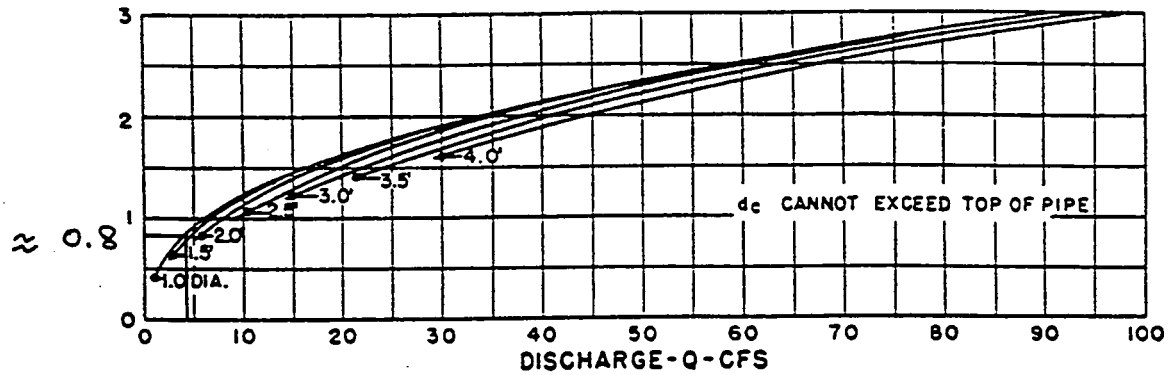
BUREAU OF PUBLIC ROADS JAN. 1963

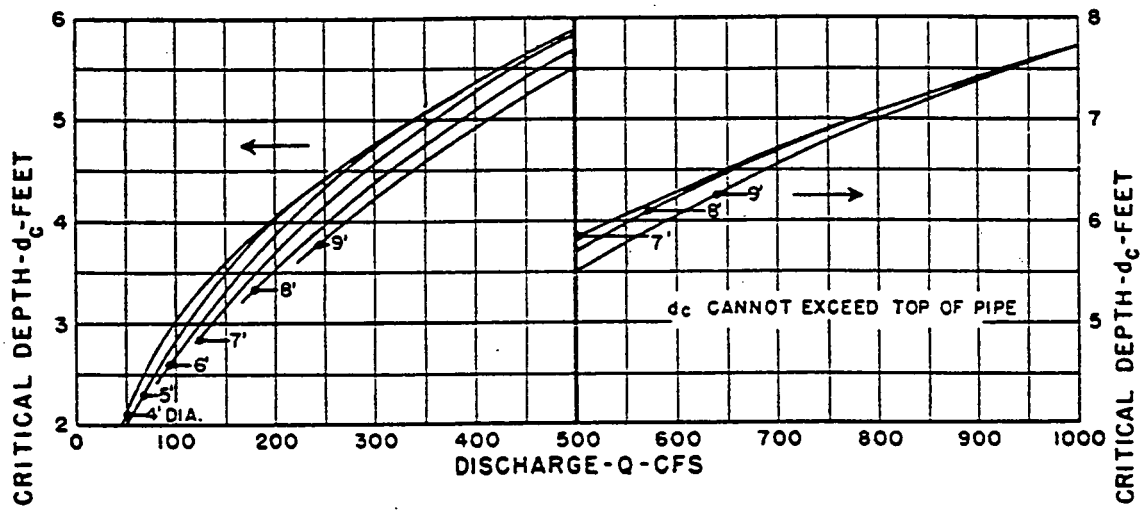
000592

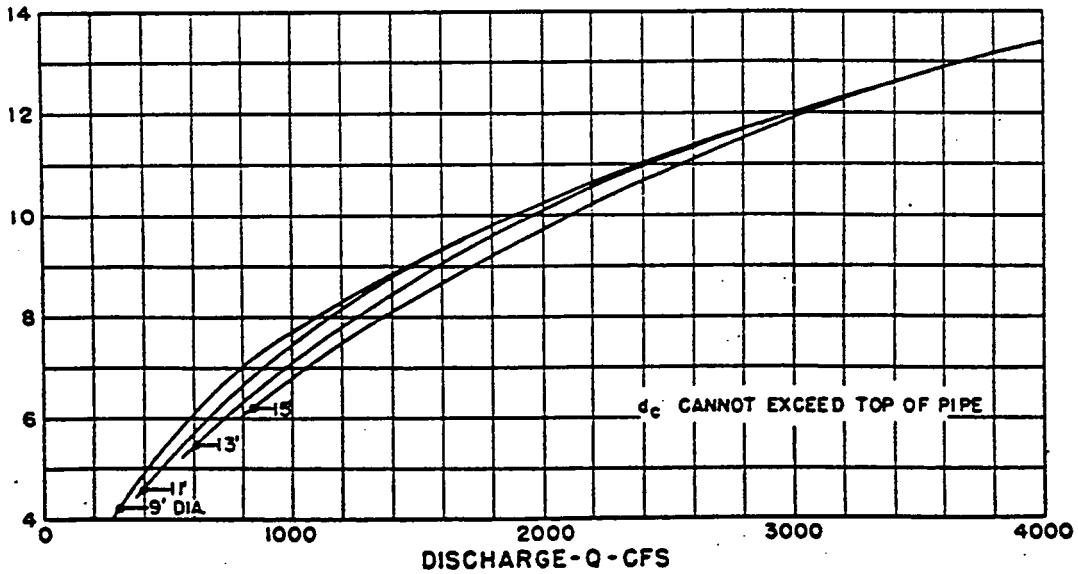
SHT C19

1418

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000593

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

000594

SHT C21 1418

Quick TR-55 Ver.5.46 S/N:
Executed: 13:44:02 02-04-1997

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
                                0.8
            .007 * (n*L)
     T =  --------------                     hrs       0.62           =  0.62
              0.5     0.4
            P2    *   s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                          2
     Surface (paved or unpaved)?                     Unpaved
     Flow length, L                           ft     345.0
     Watercourse slope, s                   ft/ft   0.0290

                                   0.5
     Avg.V =   Csf *   (s)                    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

                         2/3     1/2
            1.49    *    r    *   s
     V =  --------------------                ft/s    0.0000
                         n

     Flow length, L                            ft            0

     T = L / (3600*V)                          hrs      0.00           =  0.00

        :::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                   TOTAL TIME (hrs)      0.65
```

SHT C23

1418

Quick TR-55 Ver.5.46 S/N:
Executed: 13:42:27 02-04-1997 c:\po165d\C4.TCT

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

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 4

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM
DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

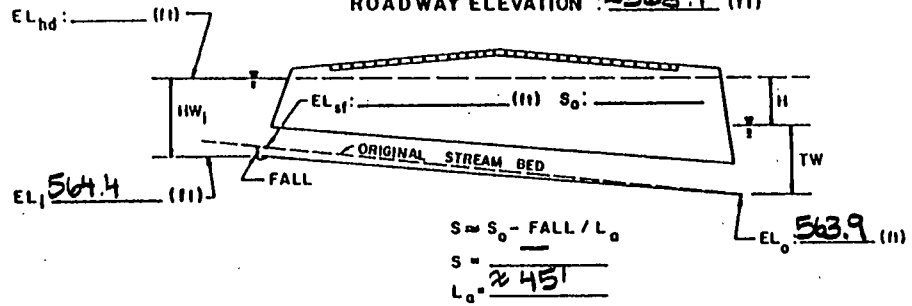
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: — ☐ STREAM SLOPE: —
- ☐ CHANNEL SHAPE: —
- ☐ ROUTING: — ☐ OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	10.5	2'

ROADWAY ELEVATION: ≈568.1 (ft)



$S \approx S_o - FALL / L_a$
$S =$
$L_a = \approx 45'$

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	(d c + D)/2	h o (6)	k 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
i. 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

240

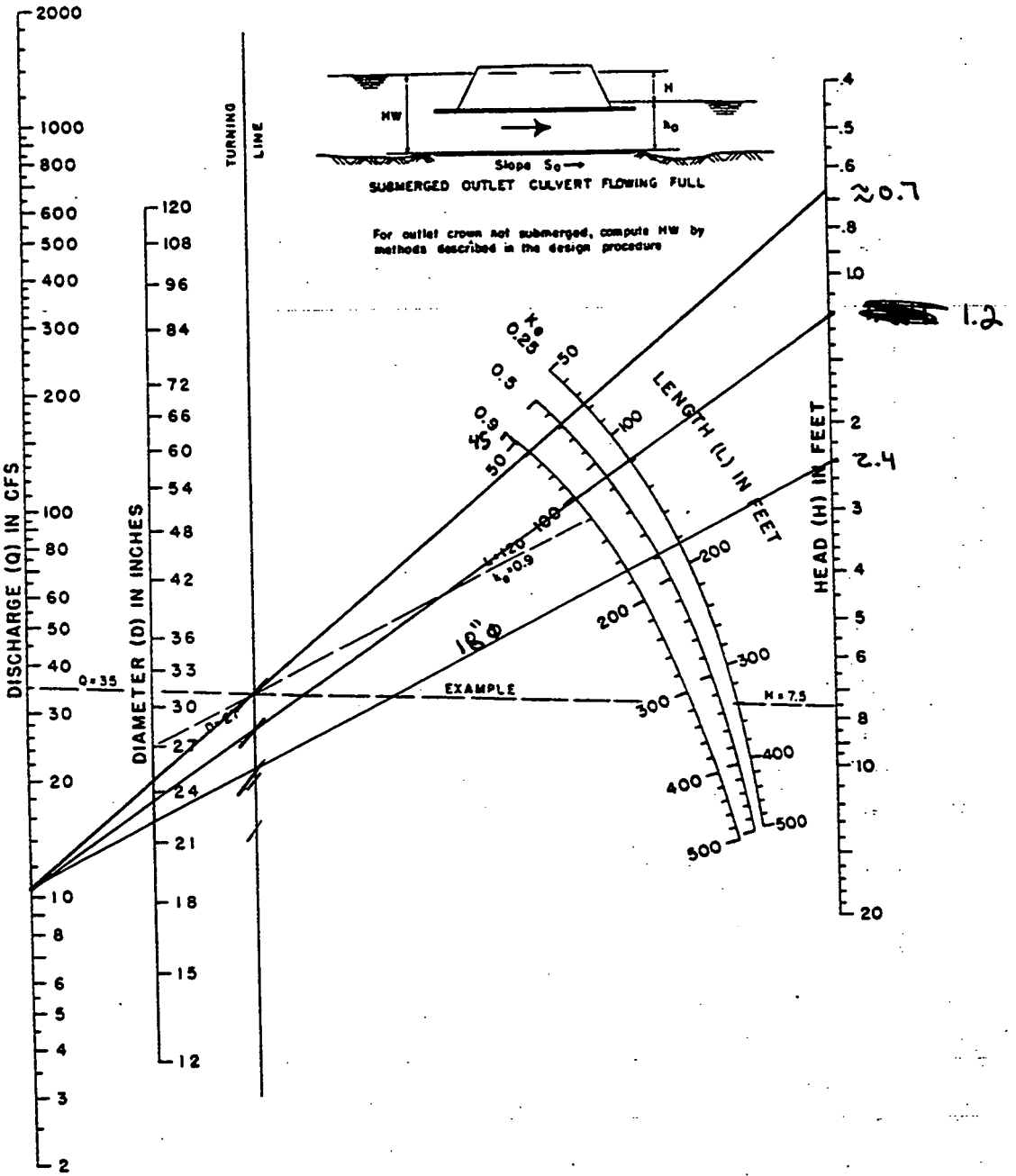
SHT C24

000598

SHT C25

1418

CHART 6



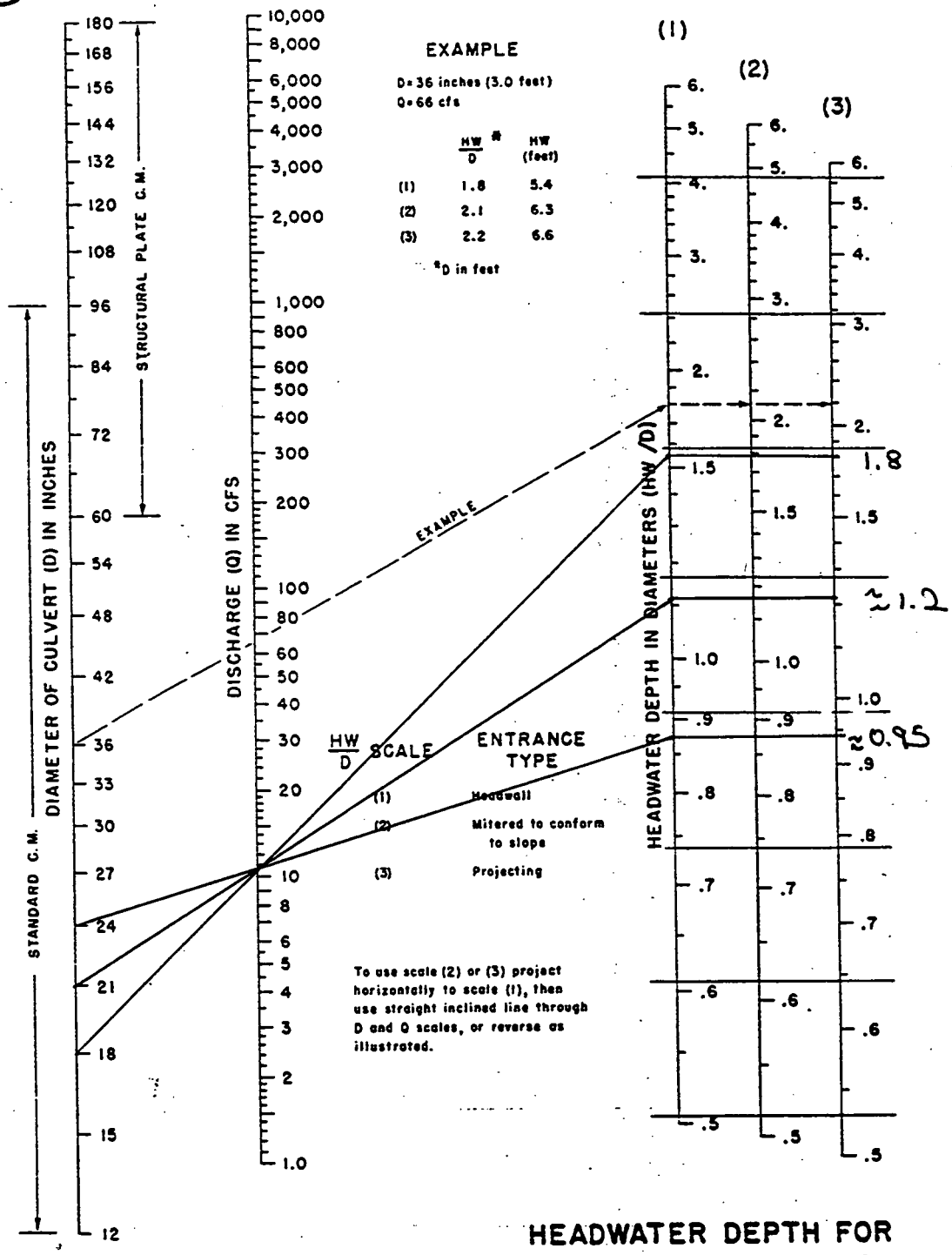
HEAD FOR STANDARD C. M. PIPE CULVERTS FLOWING FULL n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

000599

SHT C26

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

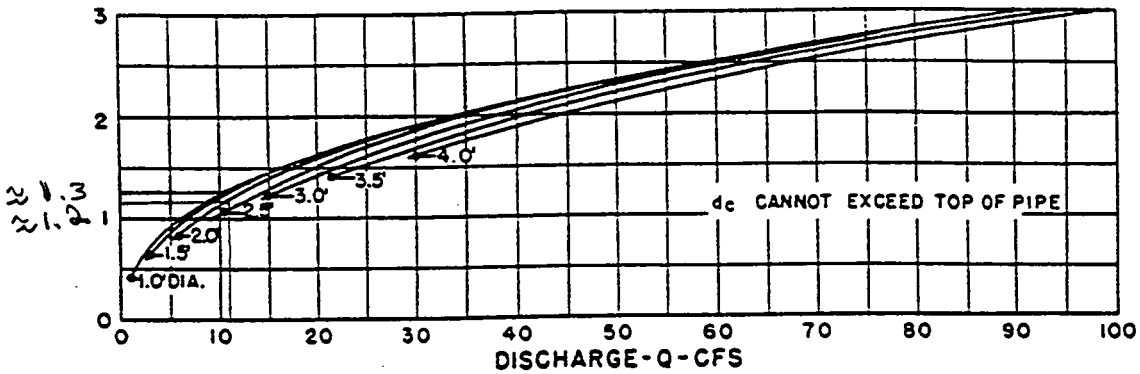
BUREAU OF PUBLIC ROADS JAN. 1963

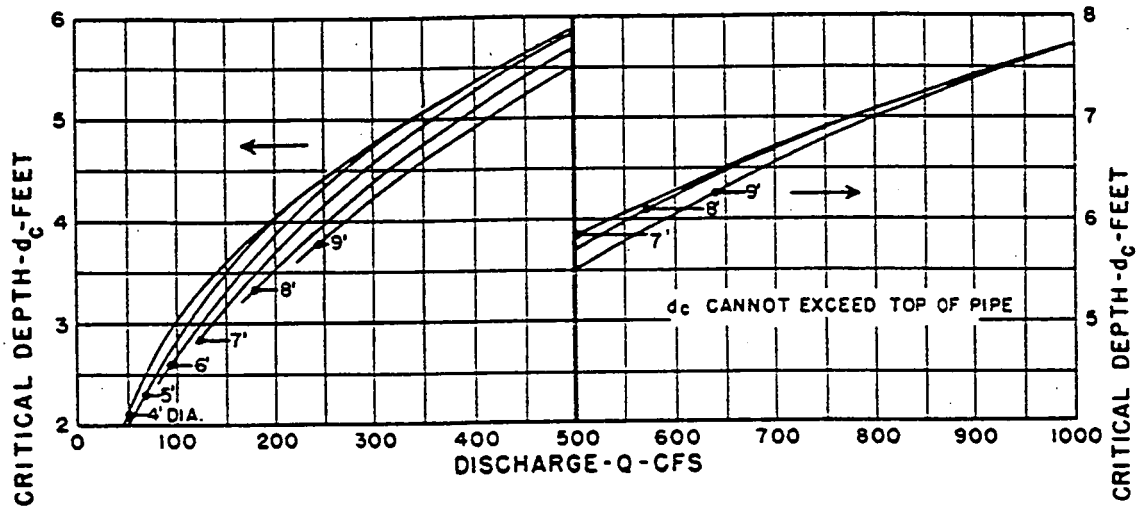
000600

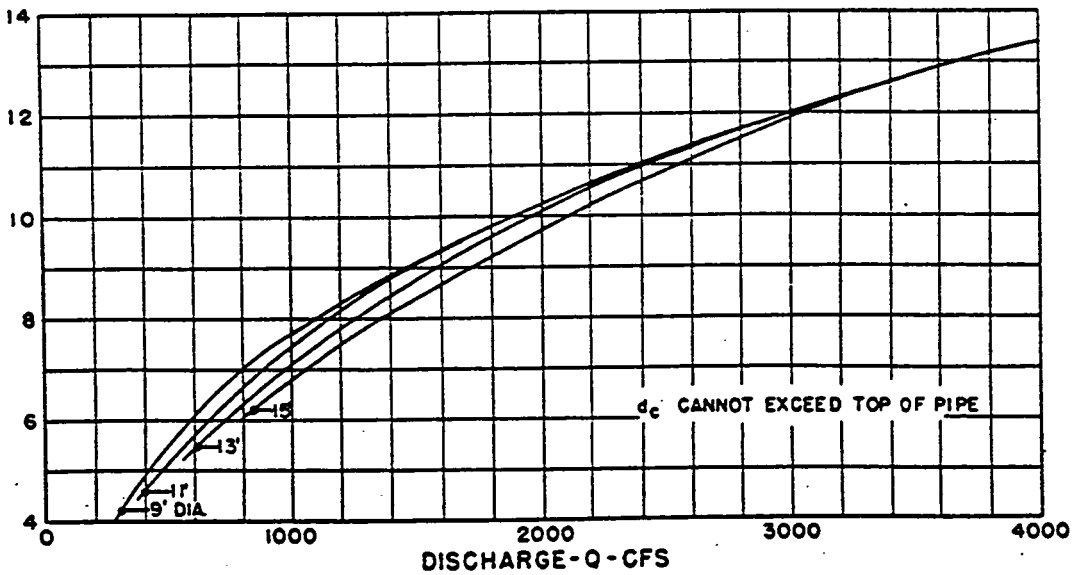
SHT C27

1418

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000601

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

000602

SHT C29
1418

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

PROJECT: SOUTHERN WASTE UNIT
CULVERT - 5

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

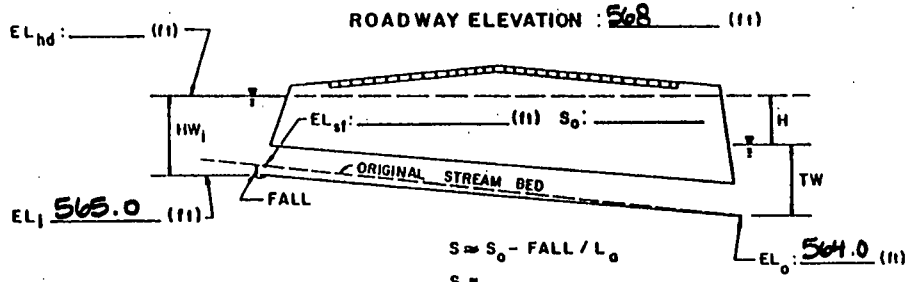
SEE ADD'L. SHTS.

- [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	—	565.98	2	0.6	0.93	2	0.9	0.E6	566.6	566.6	—	OUTLET CONTROL
TRY 18" Φ	2.5	2.5	0.59	0.89	—	565.89	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) $H = \left[1 + k_e + (29 n^2 L)/R^{1.33}\right] V^2/2g$

(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

240

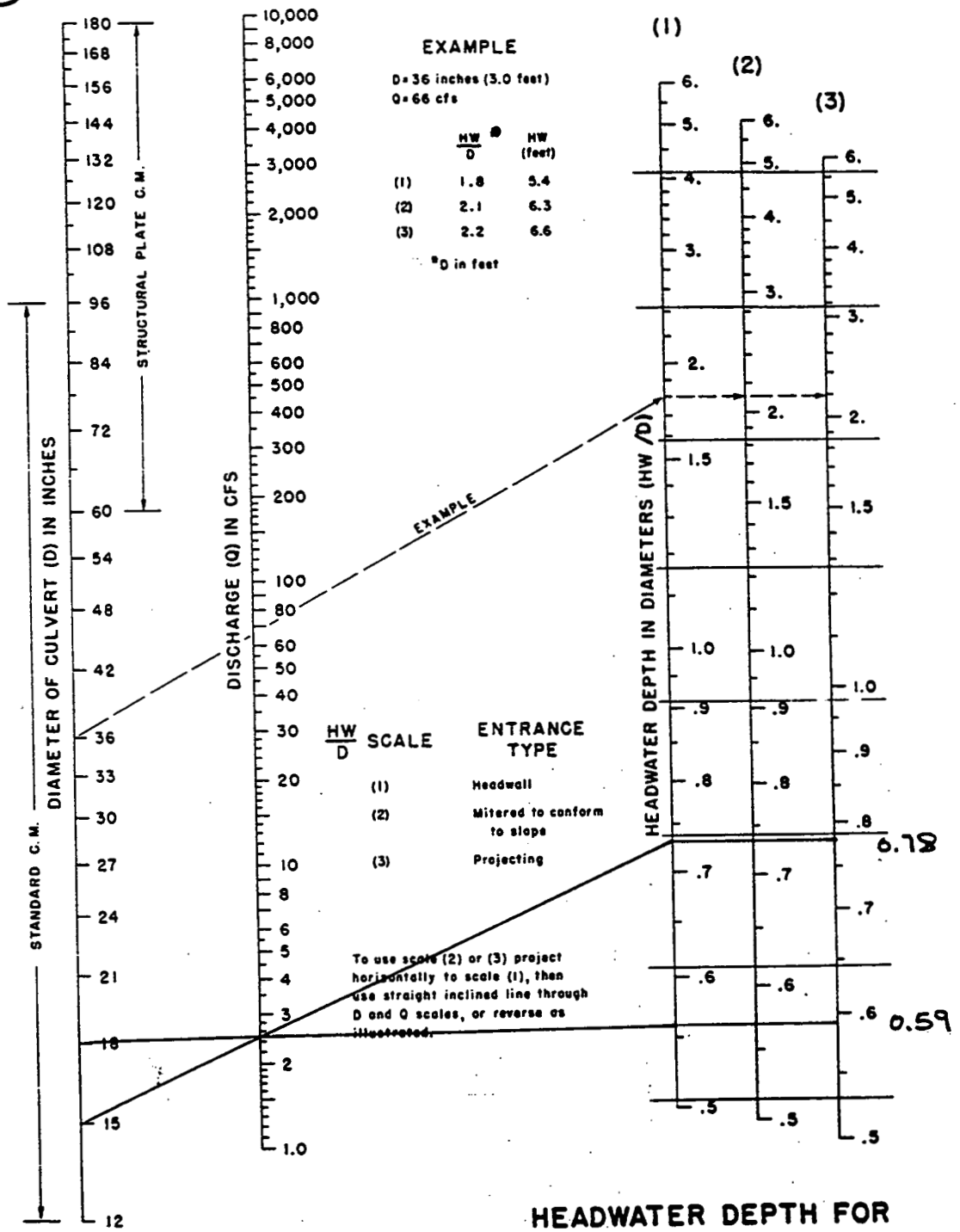
SHT C30

000060

SHT C31

1418

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

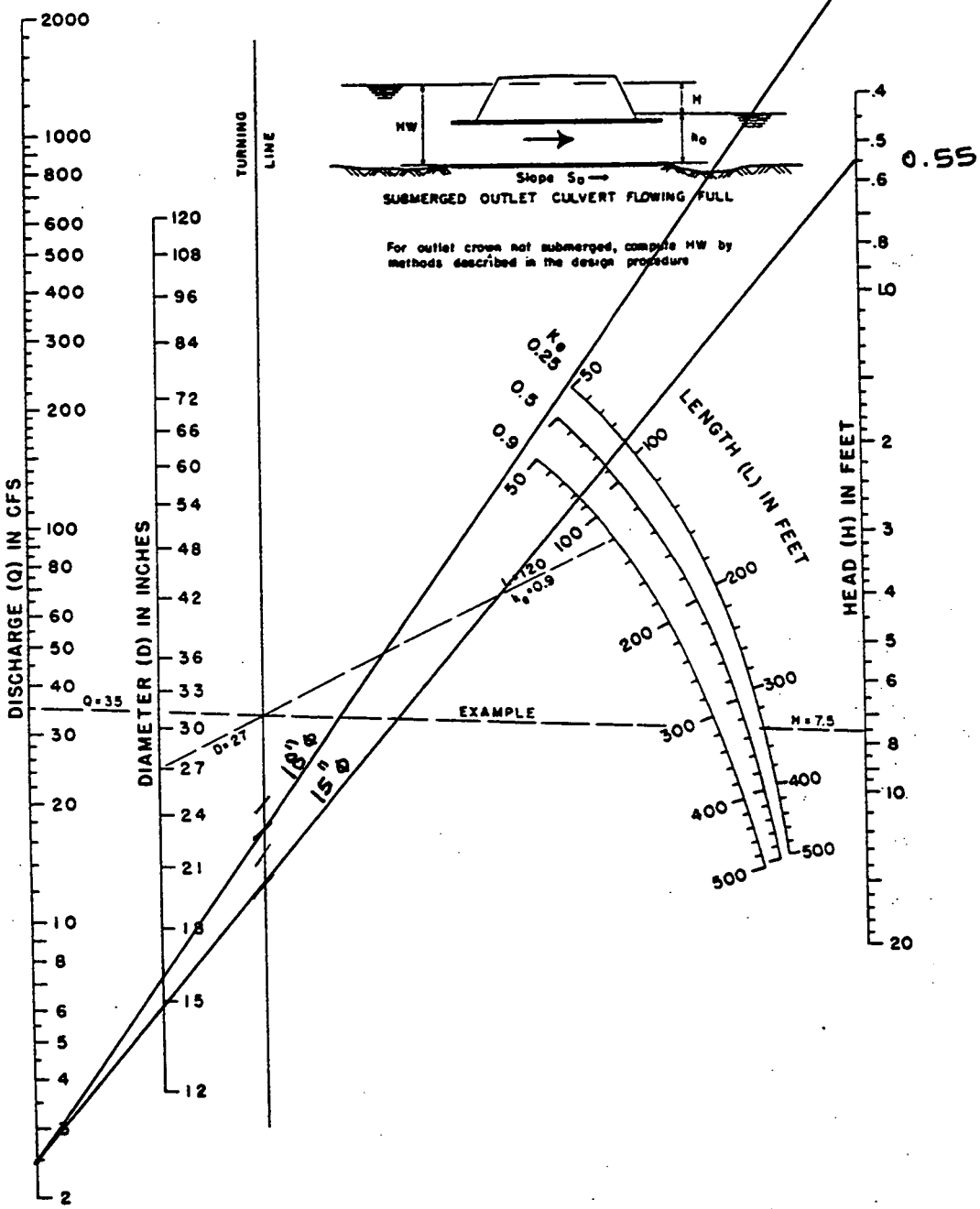
BUREAU OF PUBLIC ROADS JAN. 1963

000605

SHT C32

CHART 6

INSIGNIFICANT



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

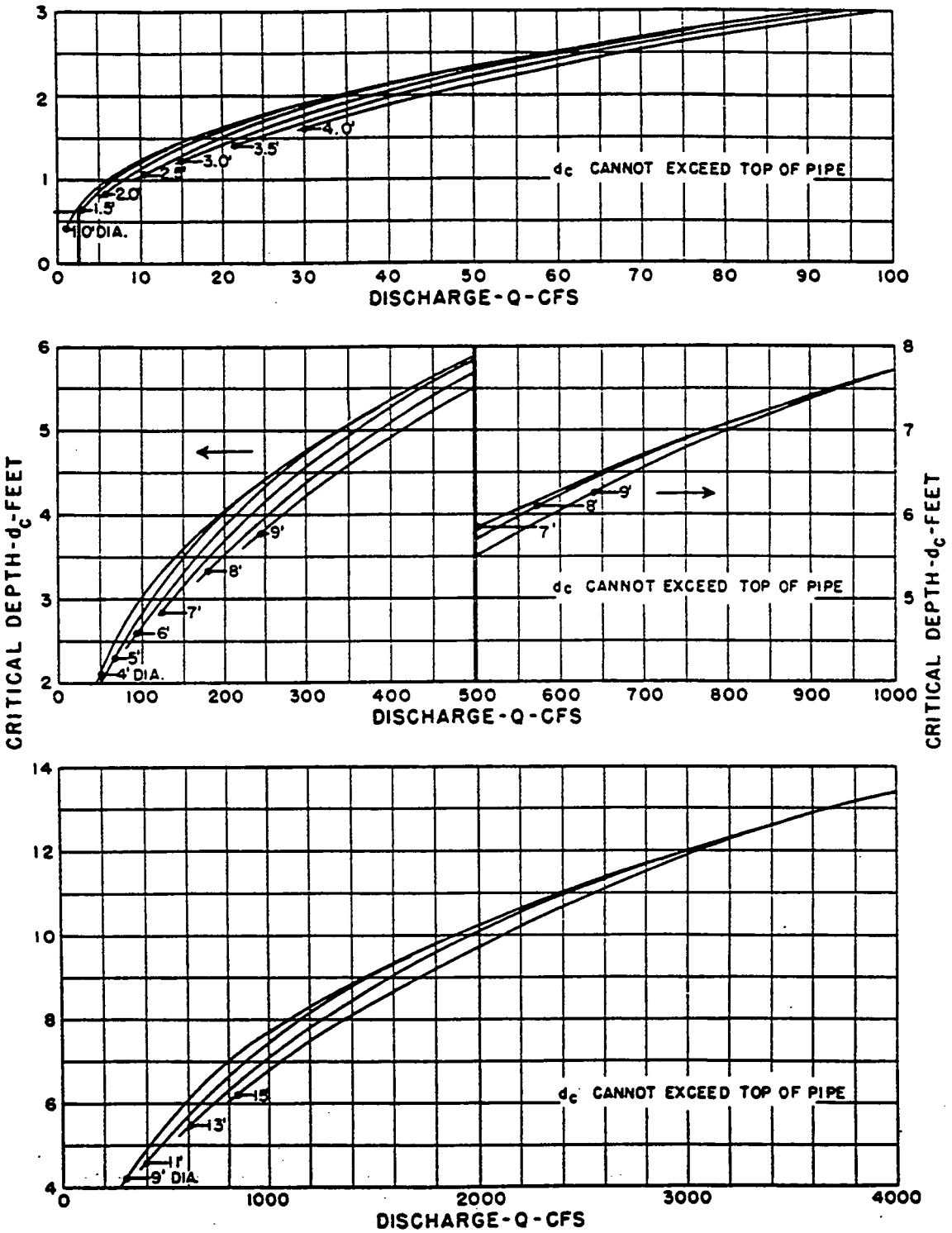
BUREAU OF PUBLIC ROADS JAN. 1963

000606

SHT C33

1418

CHART 4



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000607

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 C35

Quick TR-55 Ver.5.46 S/N:
Executed: 16:52:17 06-07-1997

1418

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

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 6 (CONTINGENCY CULVERT)

STATION: —
SHEET — OF —

CULVERT DESIGN FORM
DESIGNER / DATE: — / —
REVIEWER / DATE: — / —

HYDROLOGICAL DATA

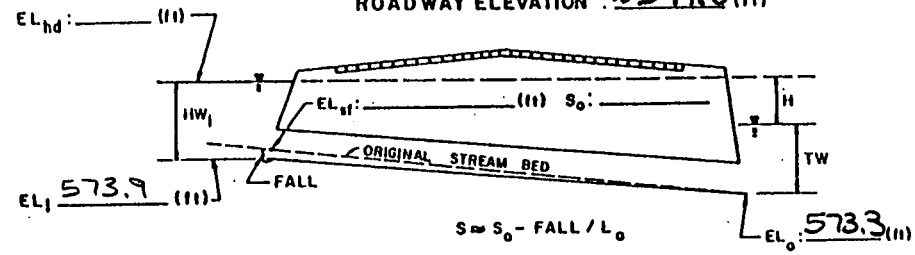
SEE ADD'L SHTS.

- [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	$\frac{d_c+D}{2}$	h_o (6)	k_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) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

o. 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 8A, FROM CALC FOR 8A, TW = 1.2 FT

CULVERT BARREL SELECTED:
SIZE: 15"
SHAPE: ROUND
MATERIAL: CMP n 0.024
ENTRANCE: PROJECTING

240

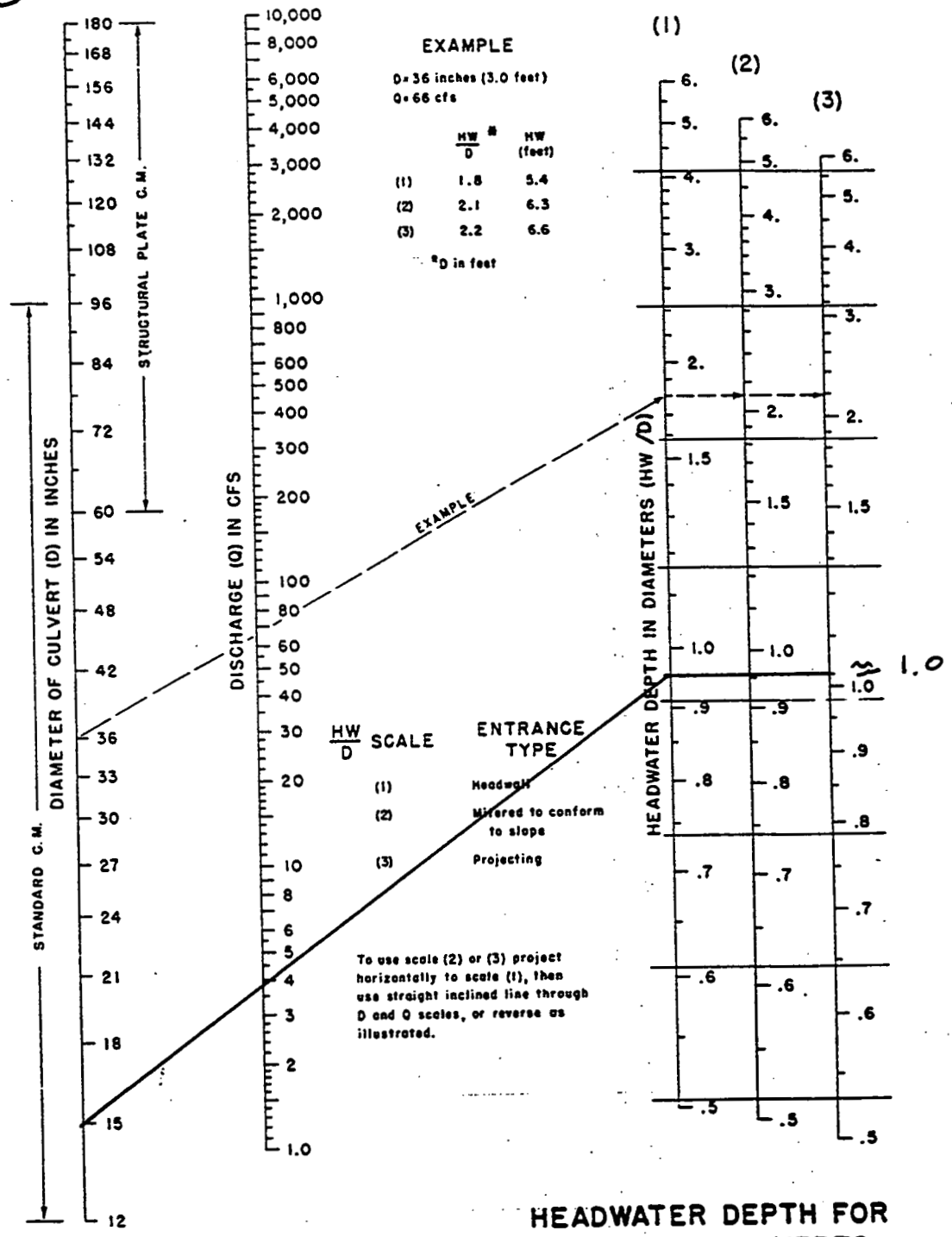
000610

SHT C36

SHT C37

1418

CHART 2



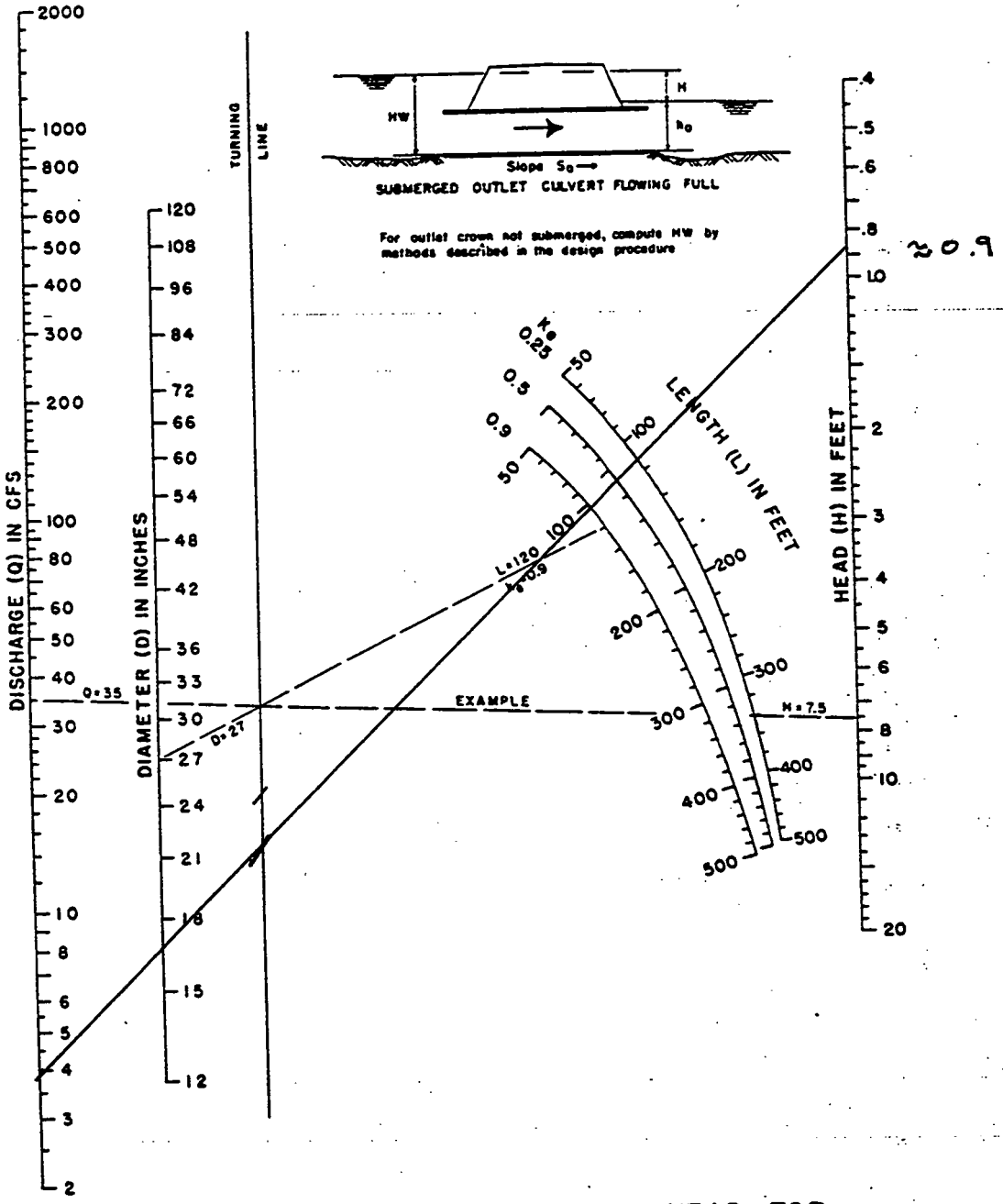
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

000611

SHT C38

CHART 6



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

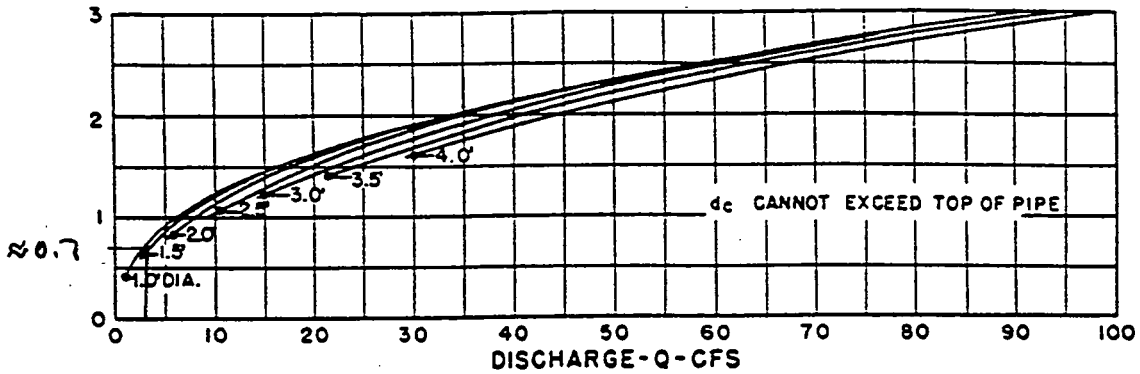
BUREAU OF PUBLIC ROADS JAN. 1963

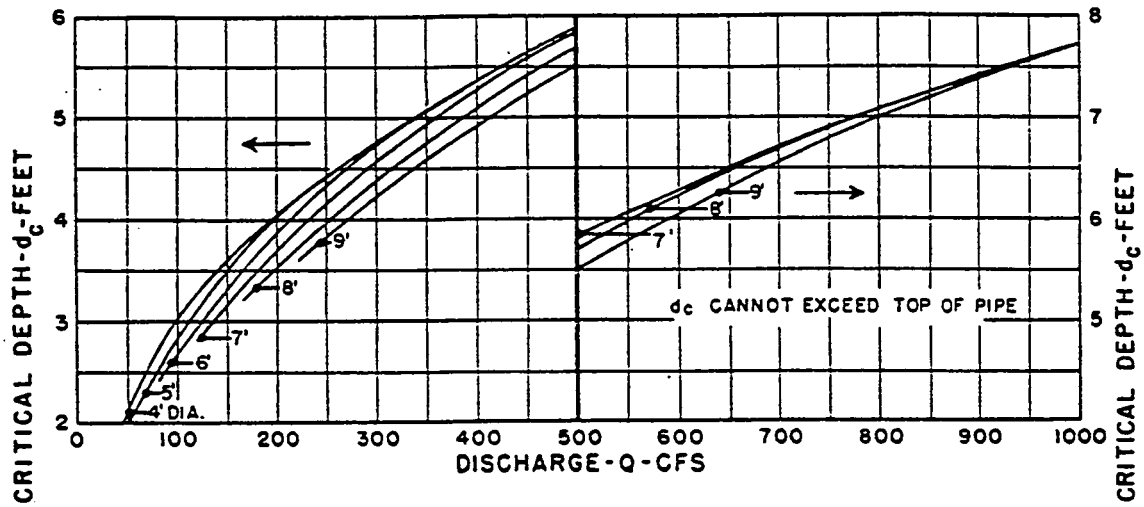
000612

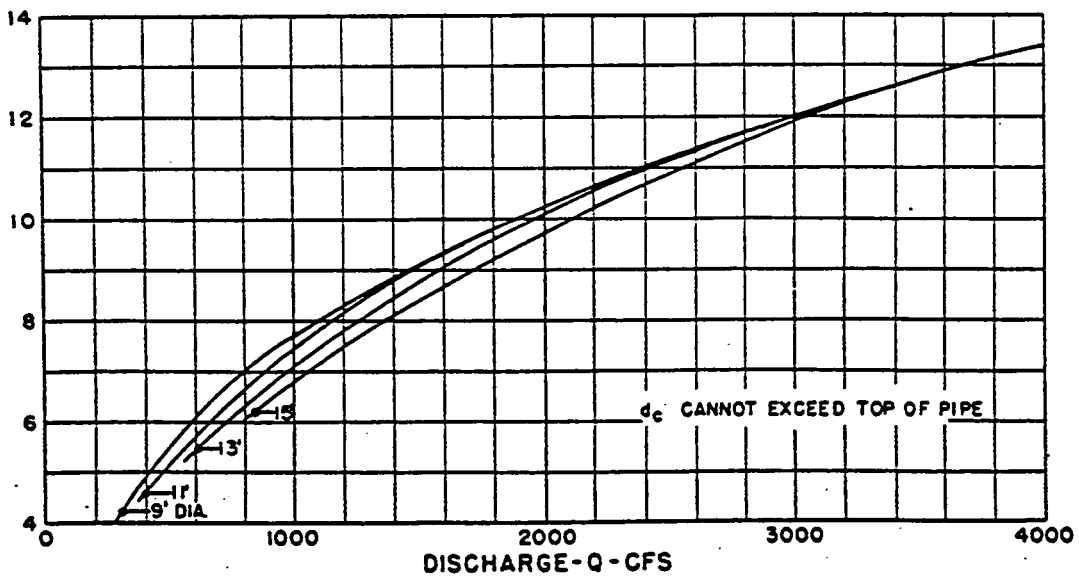
SHT C39

1418

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000613

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

000614

SHT C41

1418

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

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 7

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

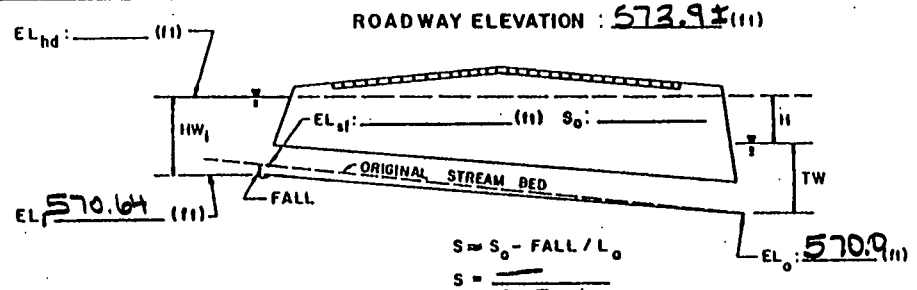
SEE ADD'L. SHTS.

- ☐ 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	(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

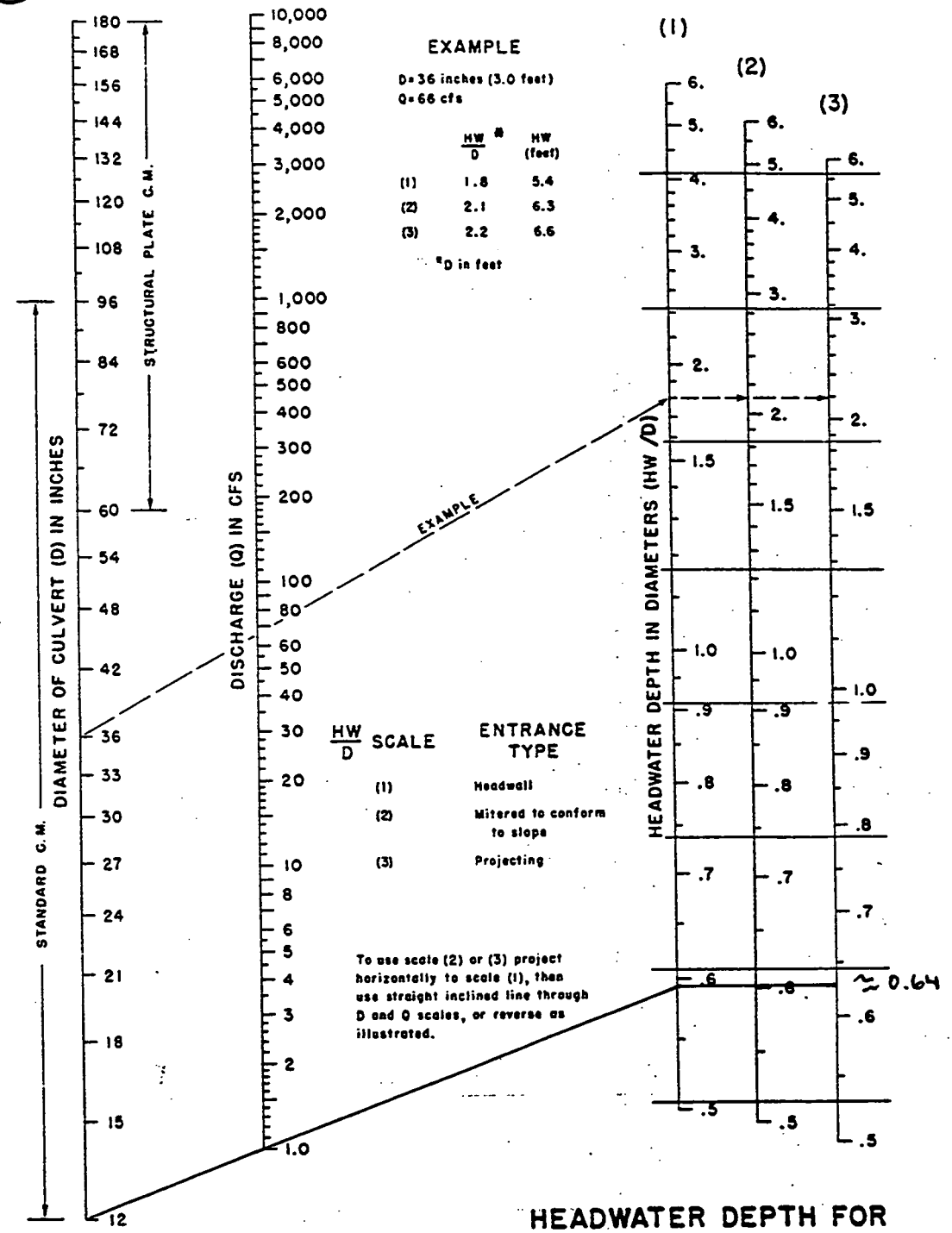
000016

54T C42

SHT C43

1418

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

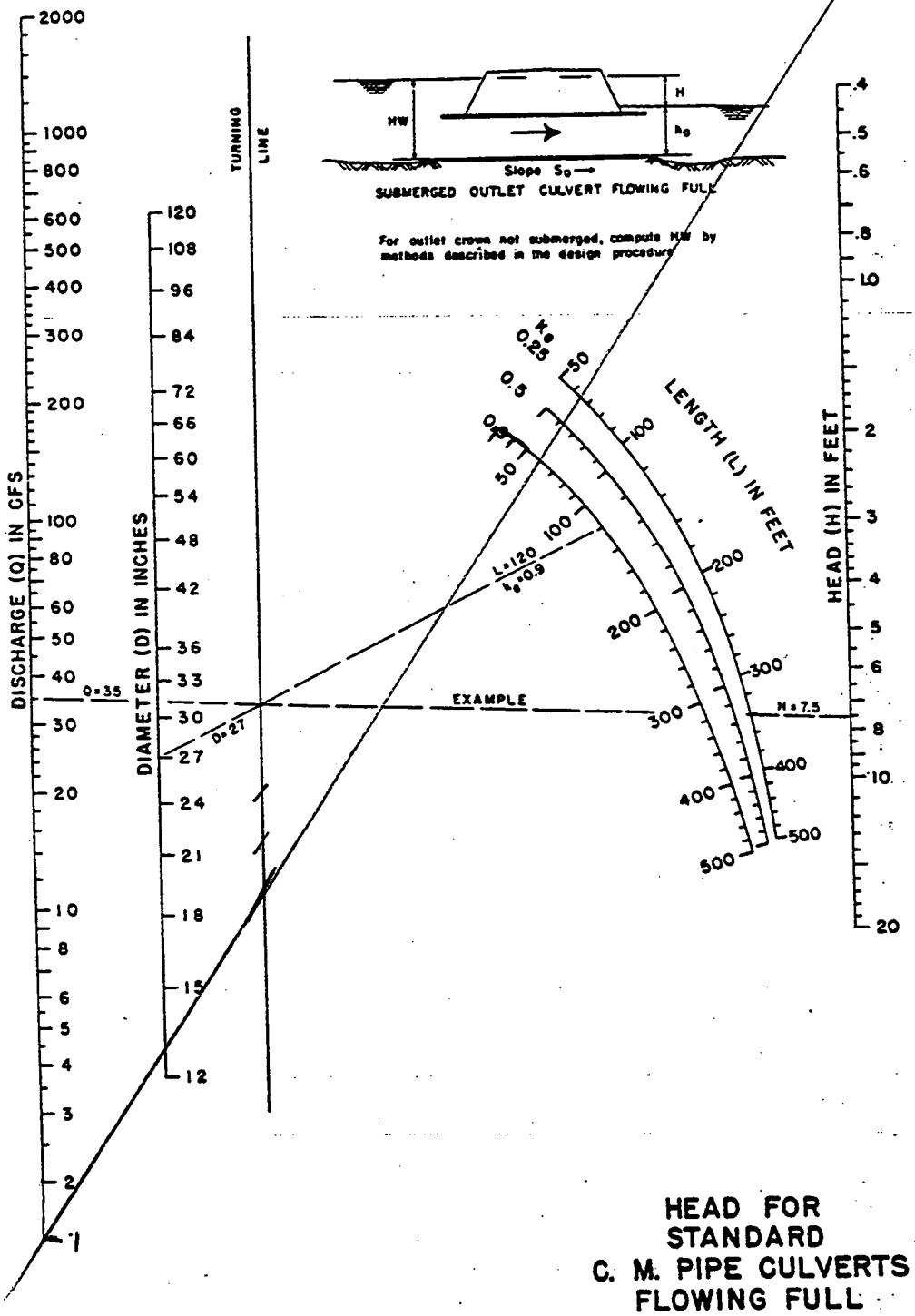
BUREAU OF PUBLIC ROADS JAN. 1963

000617

SHT C44

CHART 6

INSIGNIFICANT



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

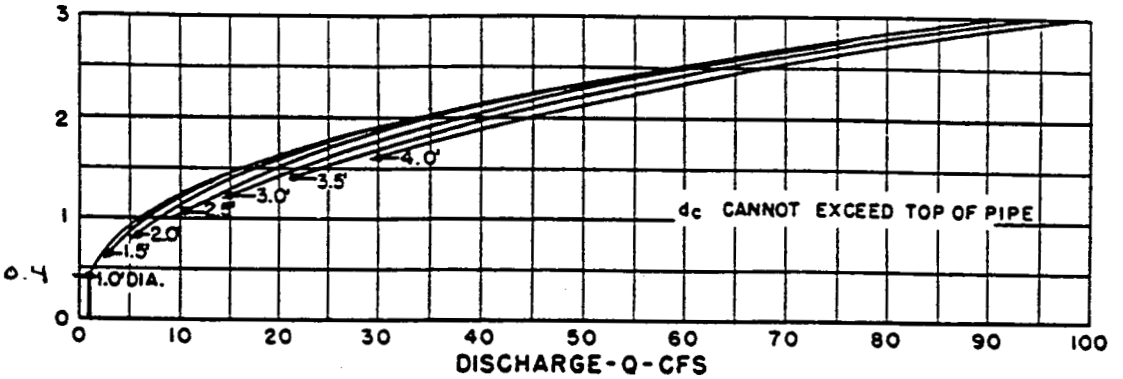
BUREAU OF PUBLIC ROADS JAN. 1963

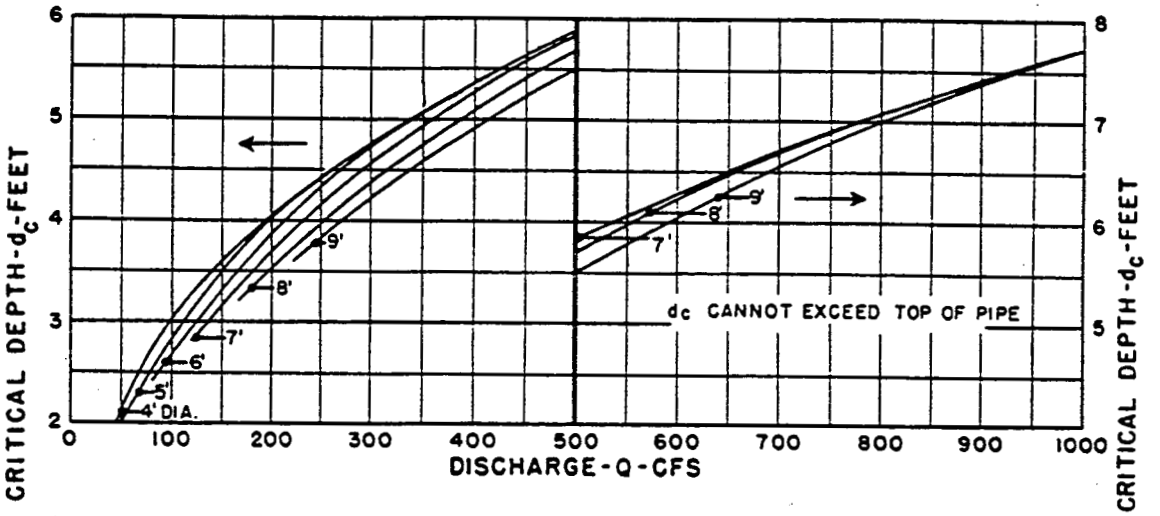
000618

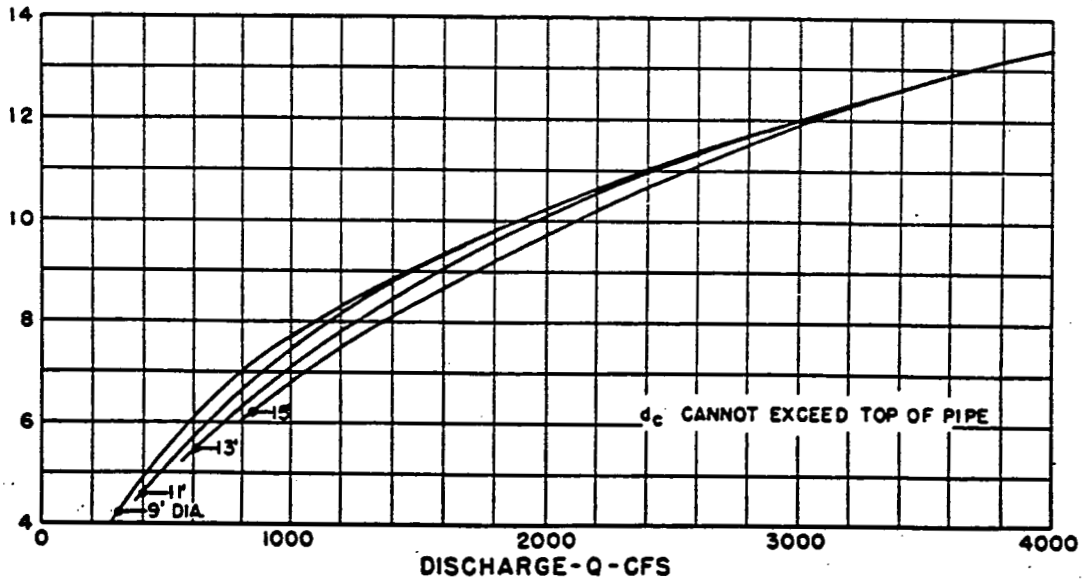
SHT C45

1418

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

000619

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

000620

Quick TR-55 Ver.5.46 S/N:
Executed: 07:29:49 10-08-1997

SHT C47 1418

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

PROJECT: SWU - EXCAVATION PKG
CULVERT 8 (CULVERT - 1 ON DWG 600333)

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

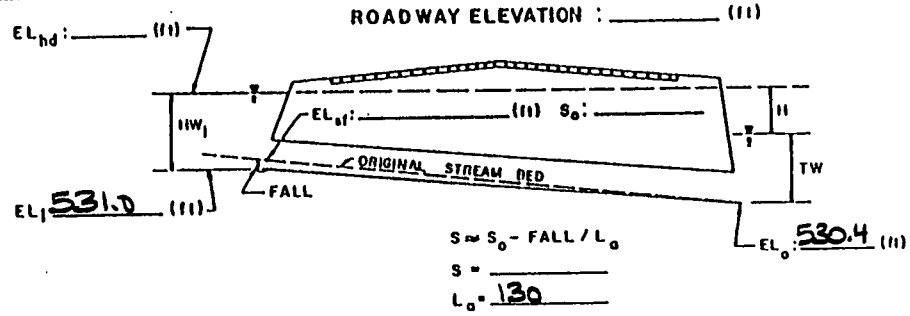
SEE ADD'L SHTS.

- [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

HEADWATER CALCULATIONS

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	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 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/ND 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:

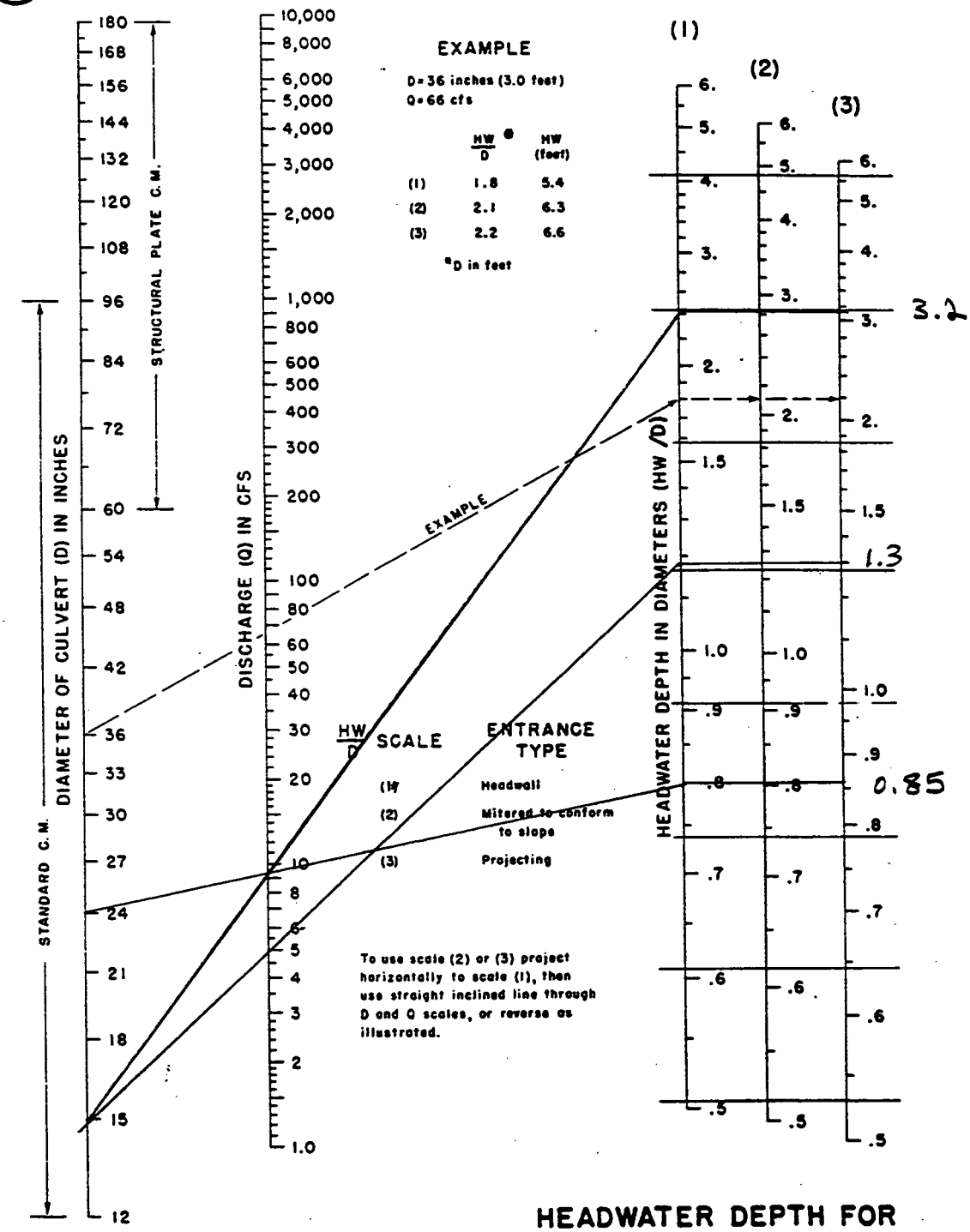
SIZE: _____
SHAPE: _____
MATERIAL: _____ (1) _____
ENTRANCE: _____

240

000622

SHT C48

CHART 2



EXAMPLE

D = 36 inches (3.0 feet)
Q = 66 cfs

	HW/D *	HW (feet)
(1)	1.8	5.4
(2)	2.1	6.3
(3)	2.2	6.6

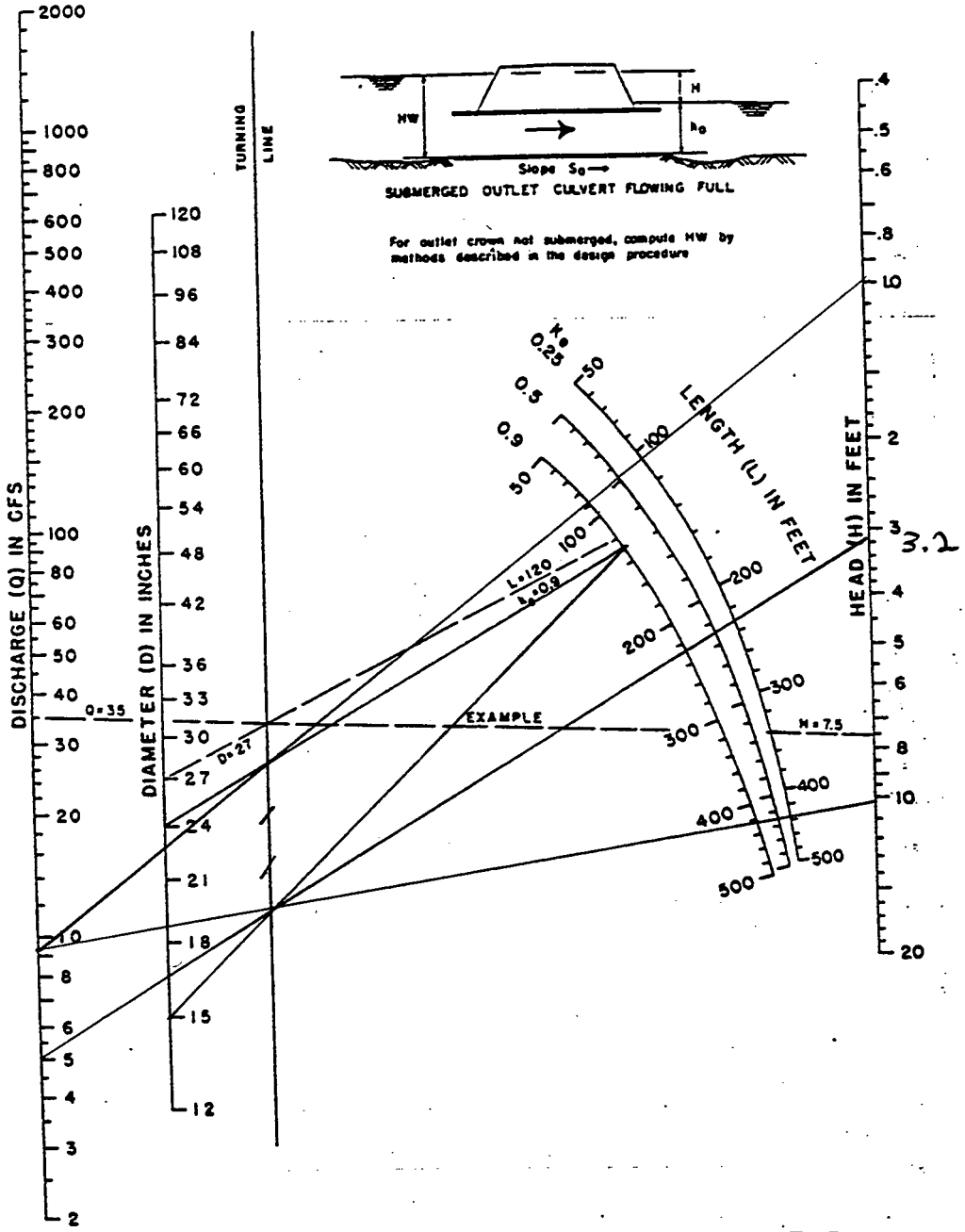
*D in feet

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

SHT C50

CHART 6

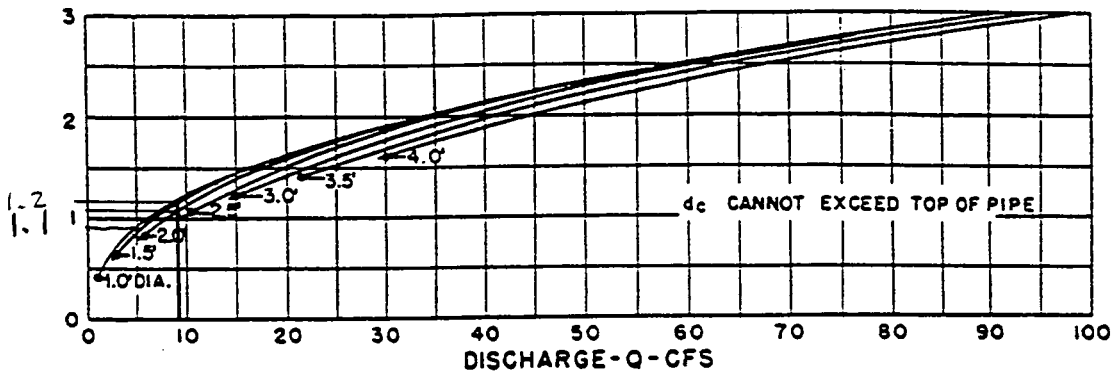


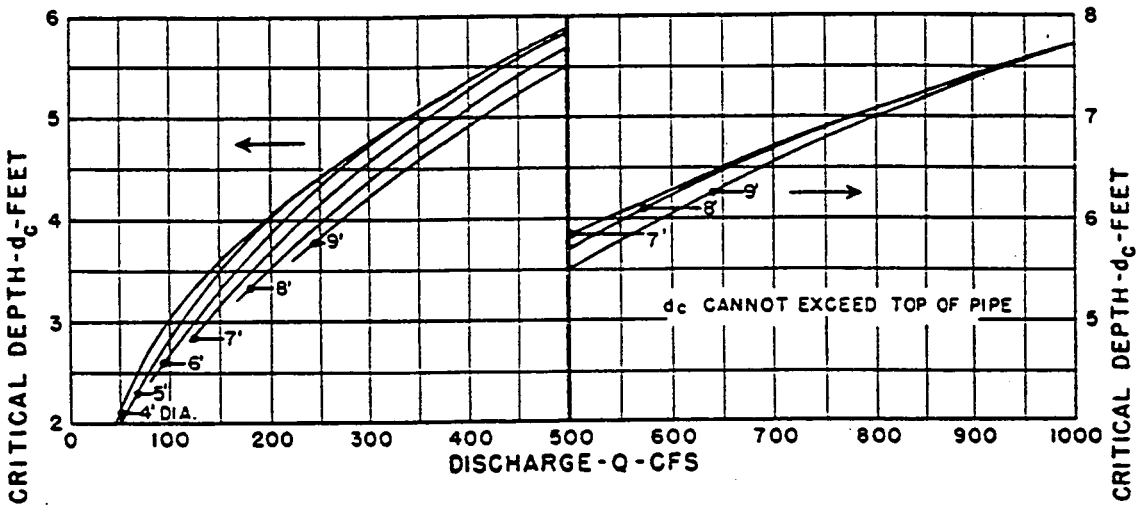
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

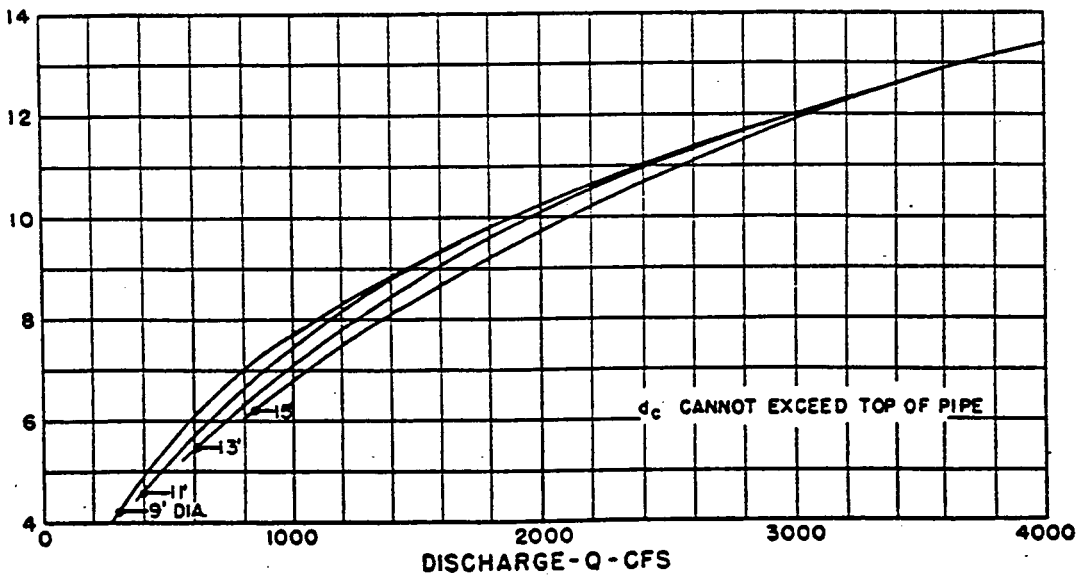
BUREAU OF PUBLIC ROADS JAN. 1963

000624

CHART 4







BUREAU OF PUBLIC ROADS
JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

SHT C52

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

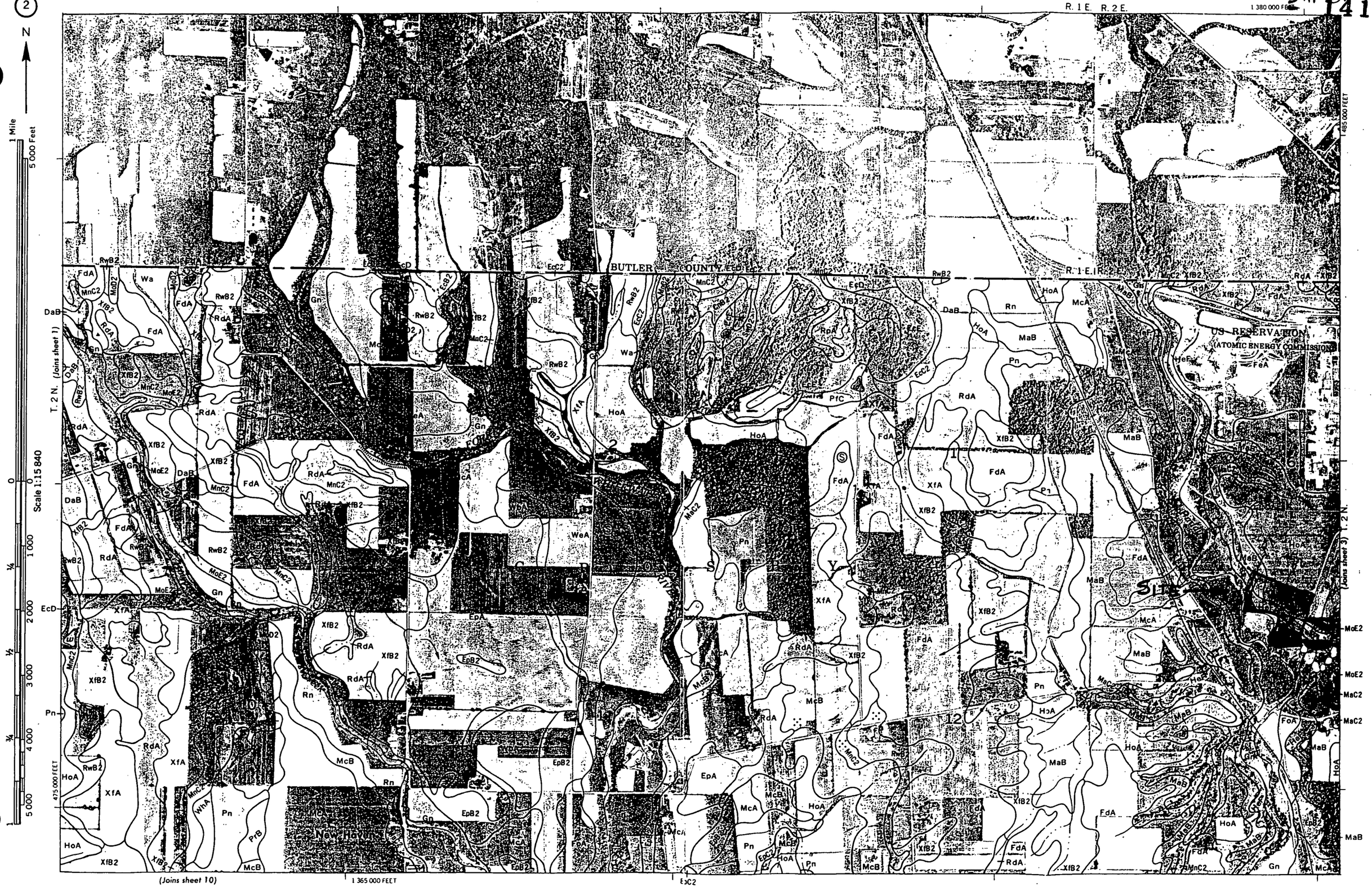
Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill 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

ATTACHMENT D

1) Soils Map (Reference 6)
2) Rainfall Intensity-Duration-Frequency Curve (Reference 7)

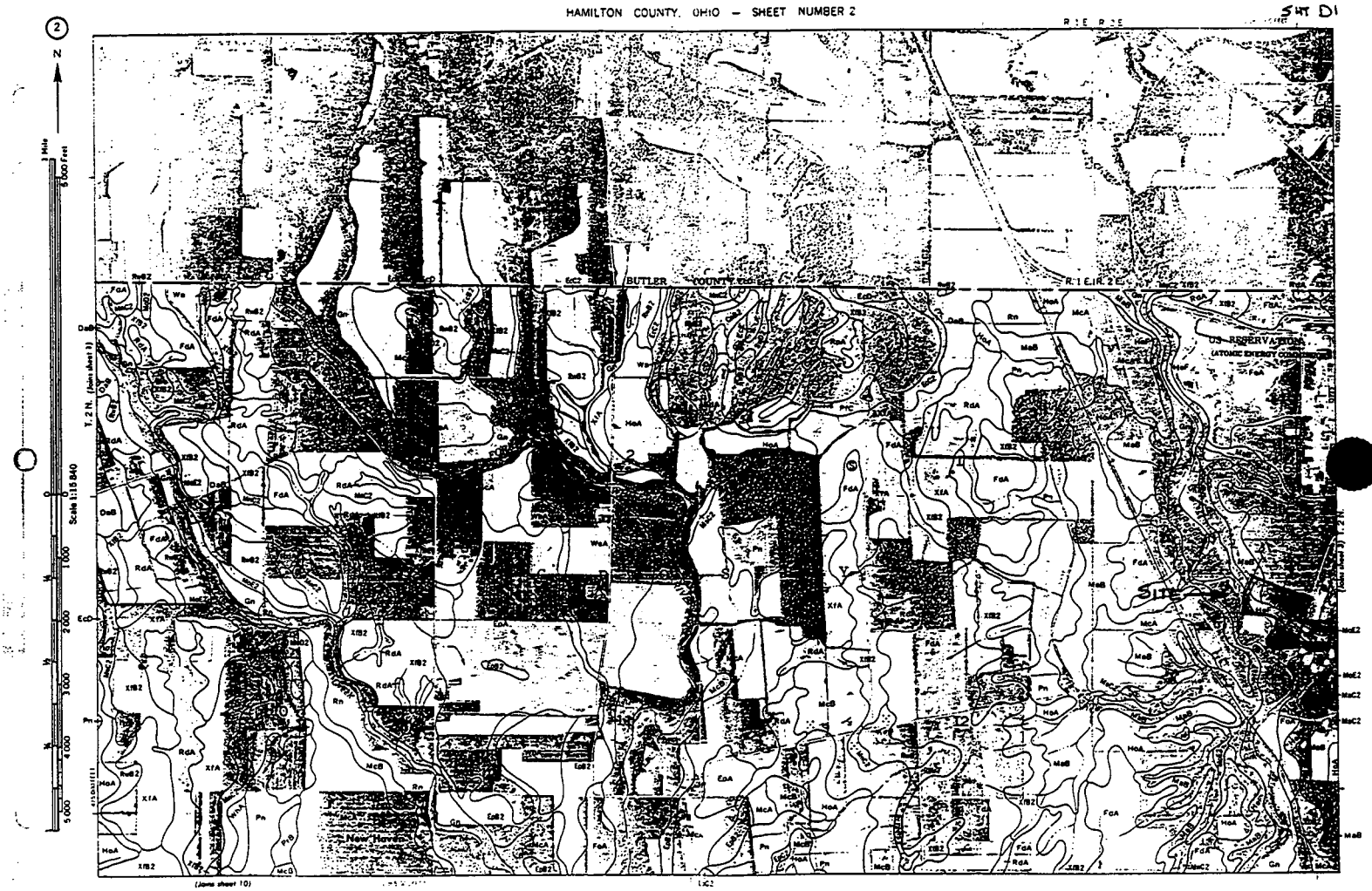
5 HT Pl 418



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.

000628

HAMILTON COUNTY, OHIO — SHEET NUMBER 2

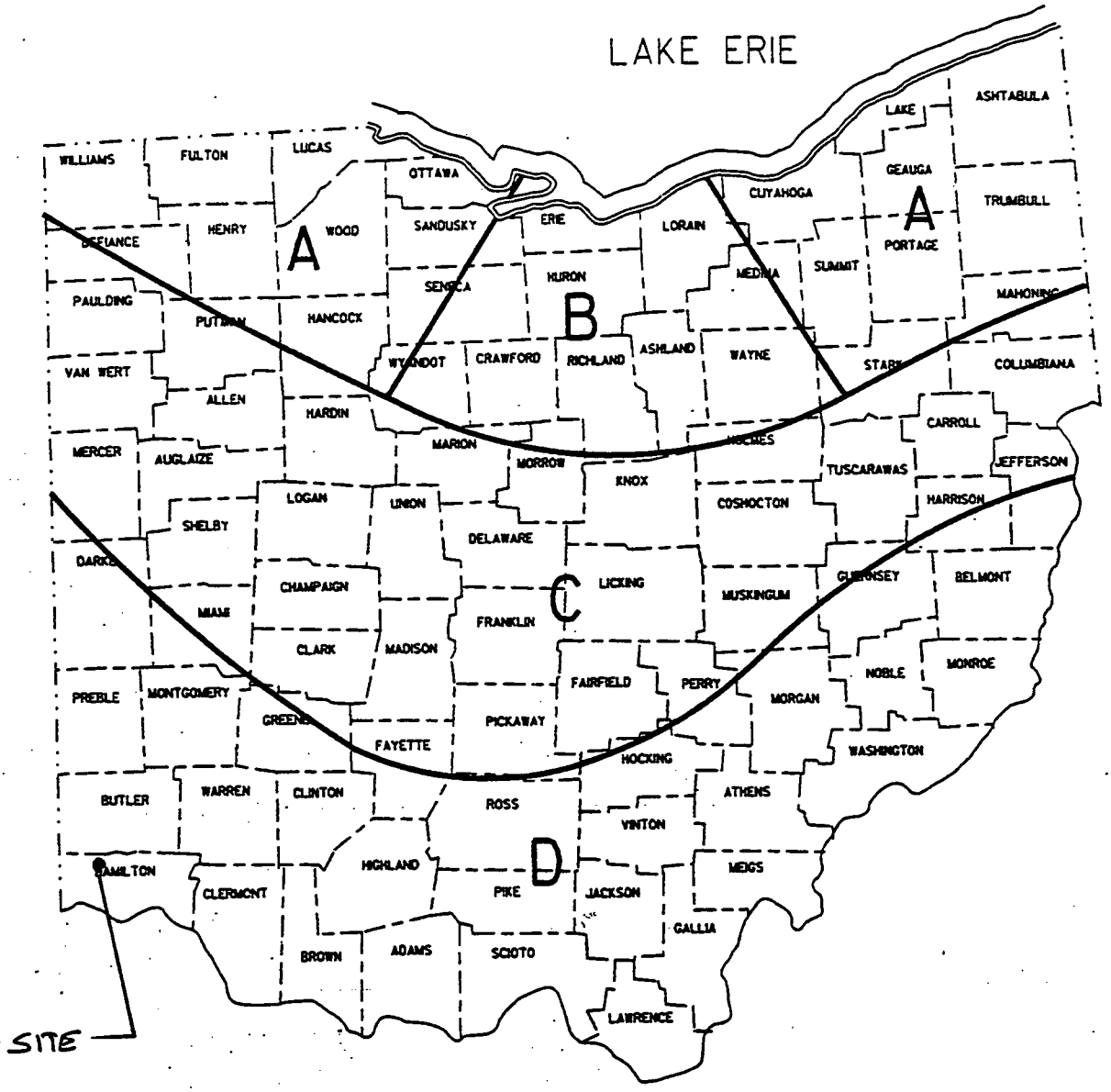


SHT D2

RAINFALL INTENSITY ZONE MAP

1101-3

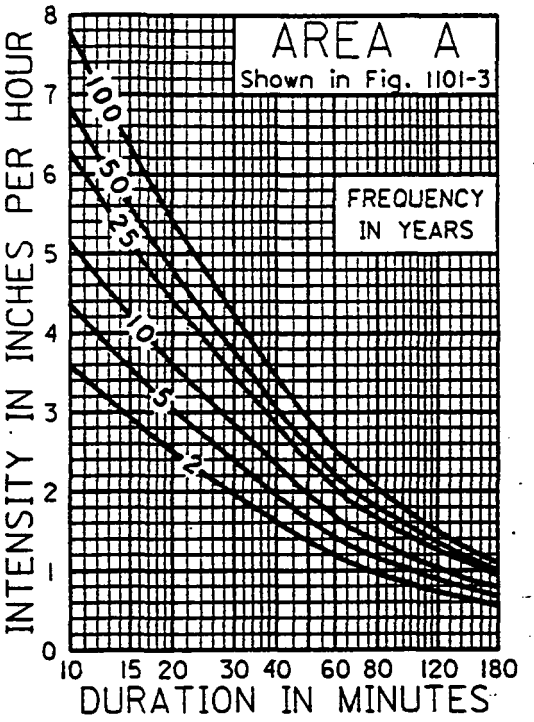
REFERENCE SECTION
1101.24

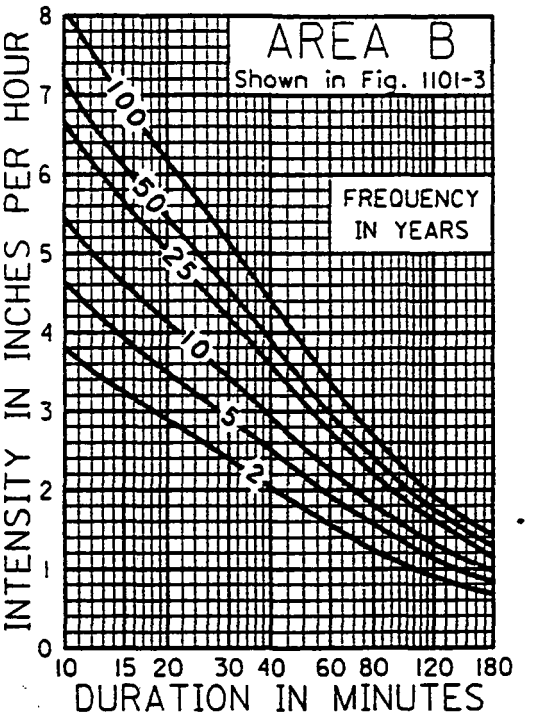


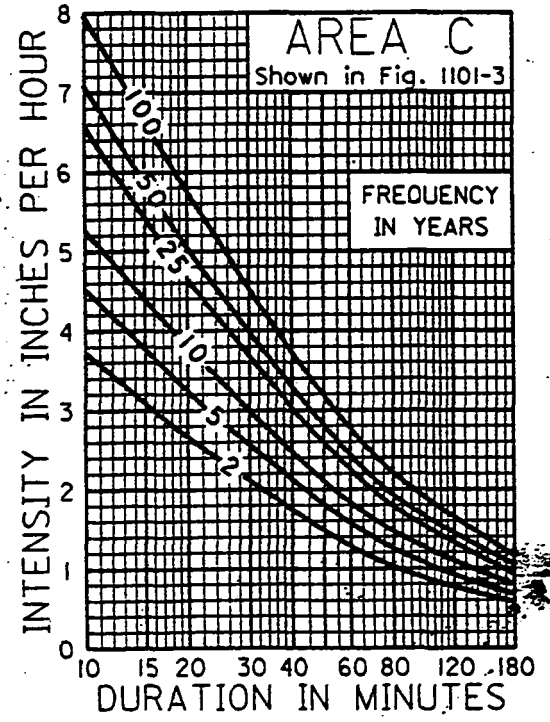
000630

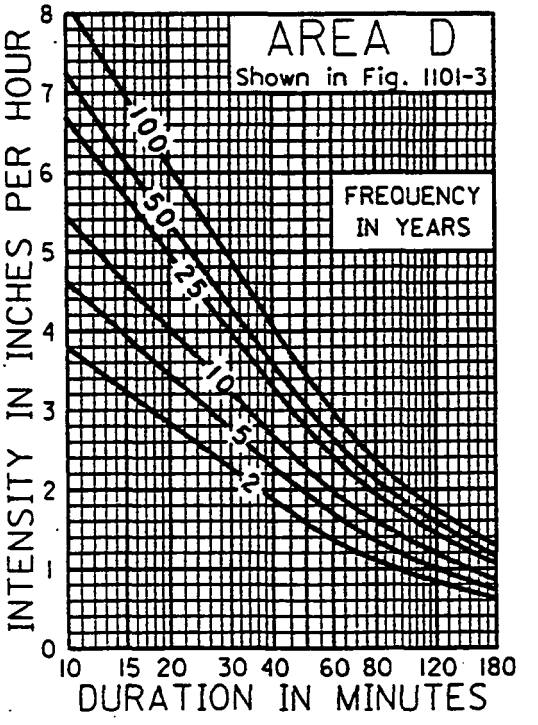
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

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 J Shannon 5/21/96 REV 7/8/96

CHECKING METHOD		Checker's Signature and Date
1. Review	X	Am Chiuto 5/21/96 REV 7/8/96
2. Alternate Calculation	____	

Lead Discipline Engineer's Signature and Date: John Hesley 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

000634

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 $\left(\frac{HW}{D} = 1\right)$
  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)

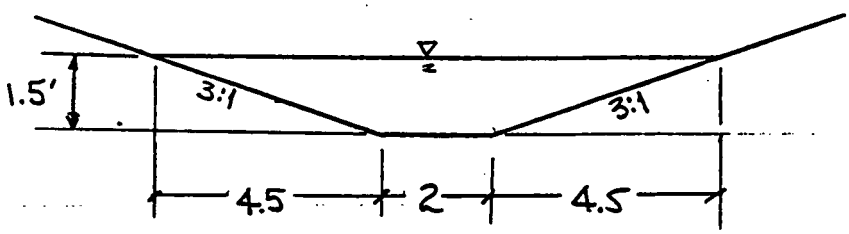
$$S_{MAX.\ ALLOWABLE} = \left[\frac{(3\text{ fps})(0.024)}{1.49\,(0.500)^{2/3}}\right]^2$$

$S_{MAX.} = 0.0059$

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 FMC 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

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

$$\text{Weighted "C"} = \frac{130}{200} = 0.65$$

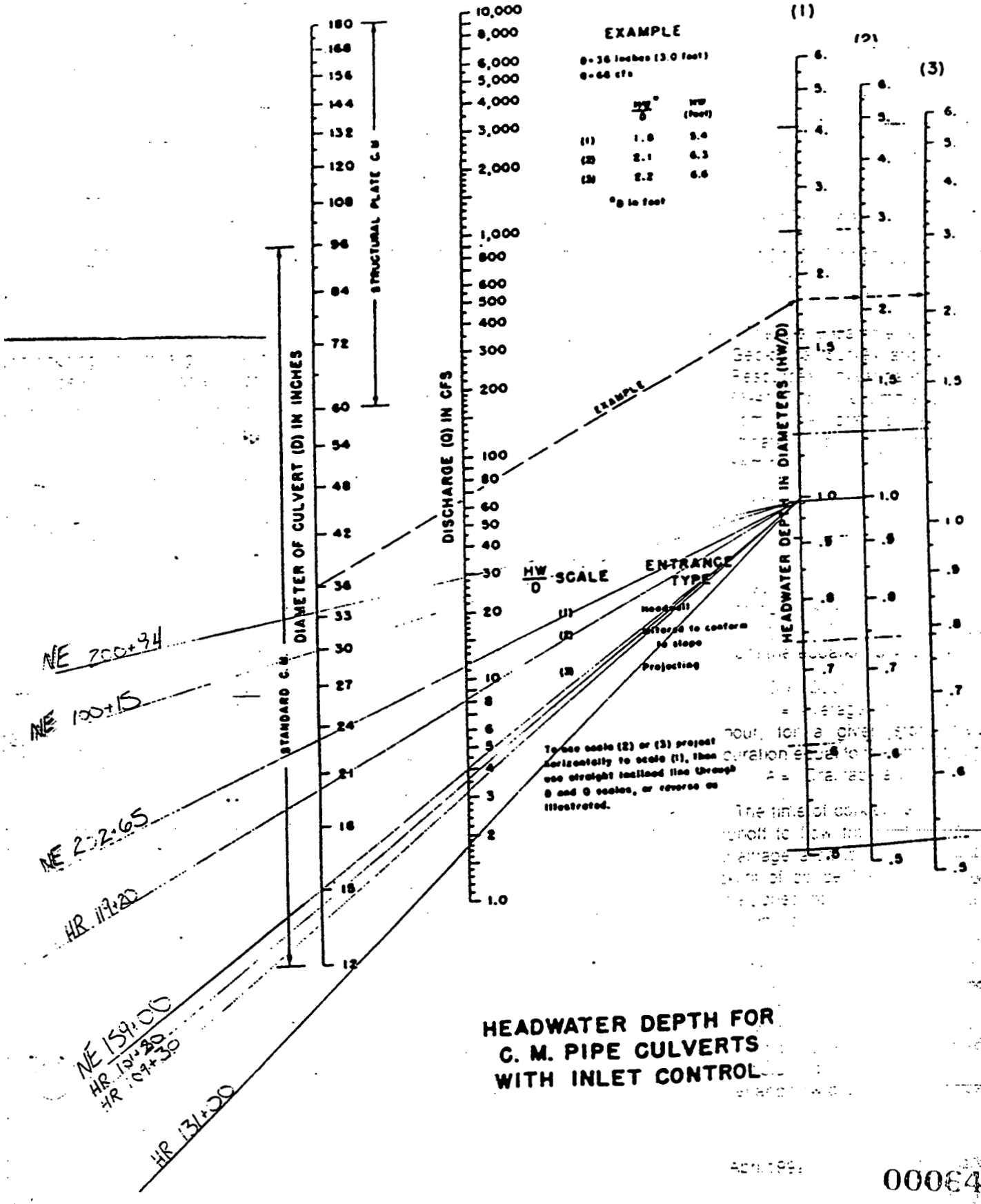
1101.24 Rainfall Intensity

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,

000643

Attachment B

Fig. 1100-245



HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

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

$$Q = \frac{1.49}{n} A R_h^{2/3} S_0^{1/2}$$

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

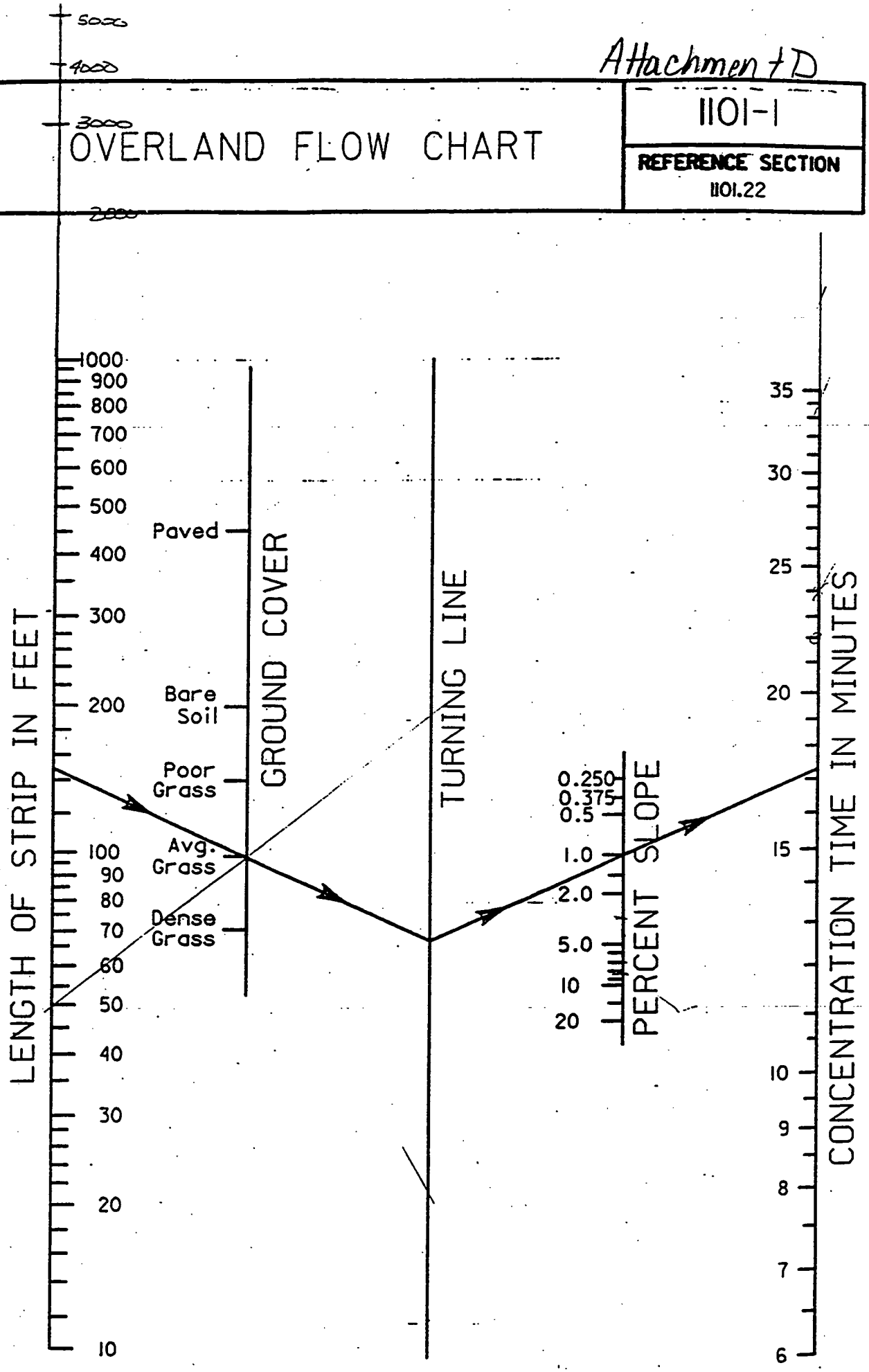
$$V = \sqrt{\frac{8g}{f}}\sqrt{R_h S_0}$$

Attachment D

OVERLAND FLOW CHART

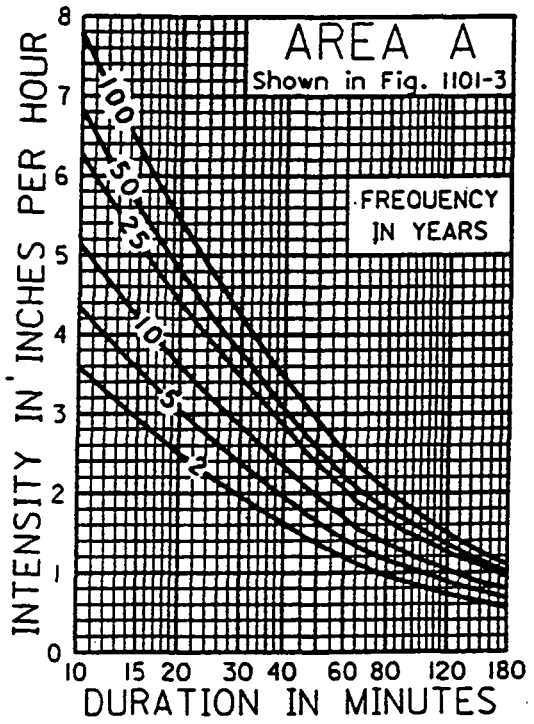
1101-1

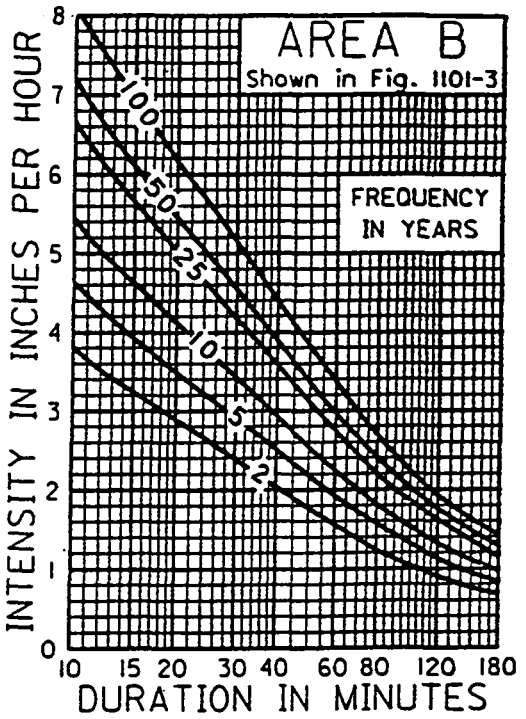
REFERENCE SECTION
1101.22

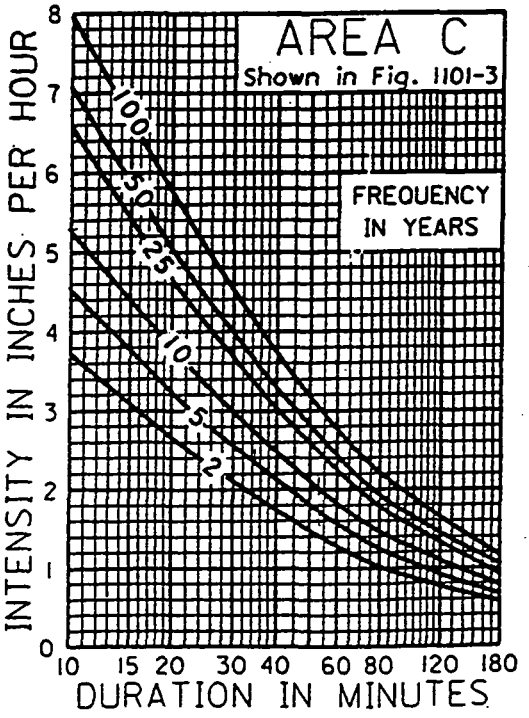


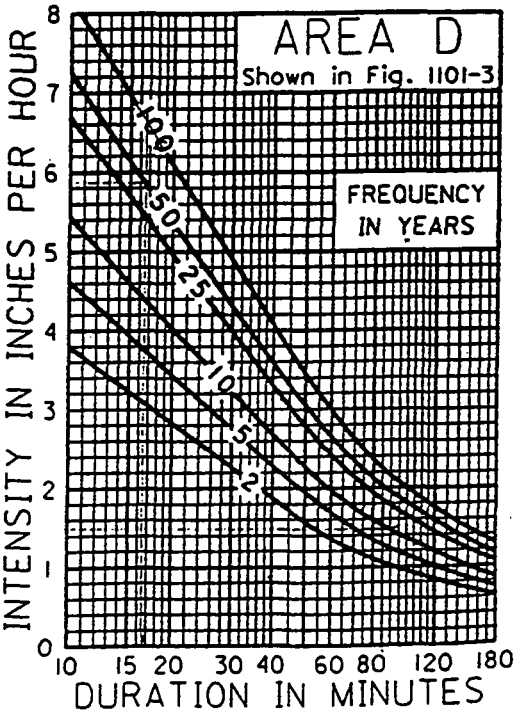
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

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.

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

000647

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 6

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 Kuper 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.

PARSONS ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

CRU: 2 PO: 139 Job Number: 7663-0139-11112-120

Computer Code: QTR-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: 3/7/95

Approved By: E. J. Kuhn 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. Kahn 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.

000654

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

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

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
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```
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
                           0.8
         .007 * (n*L)
    T =  --------------                       hrs     1.54             =   1.54
            0.5     0.4
          P2     *   s

SHALLOW CONCENTRATED FLOW
    Segment ID                                      CD
    Surface (paved or unpaved)?                     Unpaved
    Flow length, L                            ft     270.0
    Watercourse slope, s                     ft/ft   0.0075

                             0.5
    Avg.V =  Csf *   (s)                     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

                          2/3     1/2
          1.49   *   r    *   s
    V =  --------------------                ft/s   2.1673     3.5305
                     n

    Flow length, L                             ft     260        125

    T = L / (3600*V)                          hrs     0.03   +   0.01   =   0.04
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                              TOTAL TIME (hrs)           1.63
```

000659

A-4

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.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

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.

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

000662

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

Open Channel Flow Module, Version 3.41 (c)
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

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

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:

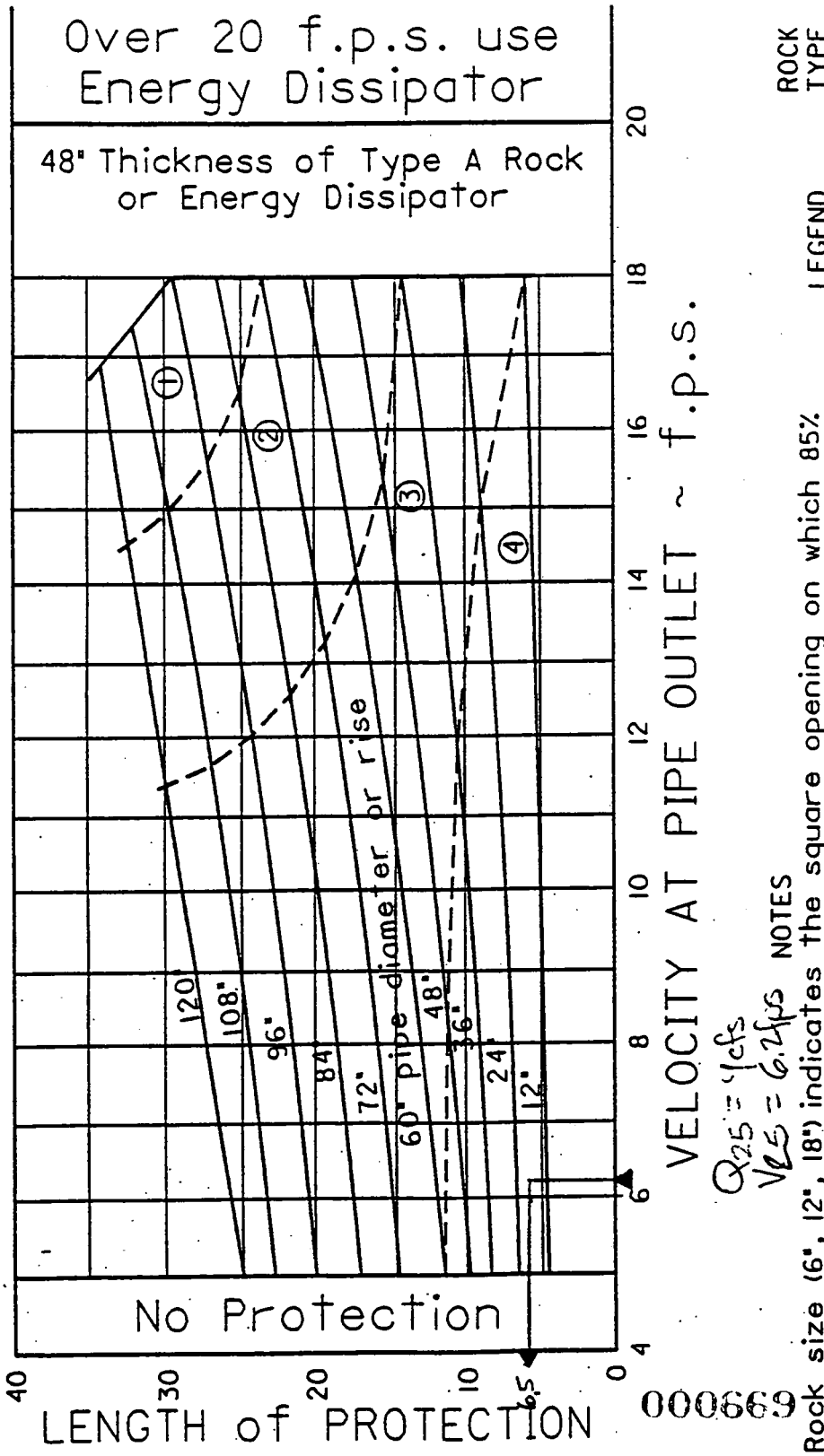
QMAX =	Discharge.....	22.28 cfs
VMAX =	Velocity.....	7.27 fps
	Flow Area.....	3.06 sf
	Critical Depth....	1.68 ft
	Critical Slope....	0.0066 ft/ft
	Percent Full.....	94.00 %
	Full Capacity.....	20.71 cfs
	QMAX @.94D.....	22.28 cfs
	Froude Number.....	0.71 (flow is Subcritical)

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



$Q_{25} = 4 cfs$
$V_{25} = 6.2 fps$

ROCK TYPE
A
A
B
C

LEGEND
① 48" of 18" rock
② 36" of 18" rock
③ 30" of 12" rock
④ 18" of 6" rock

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.)

000669

A-4

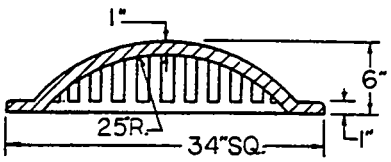
PARSONS
ERA PROJECT

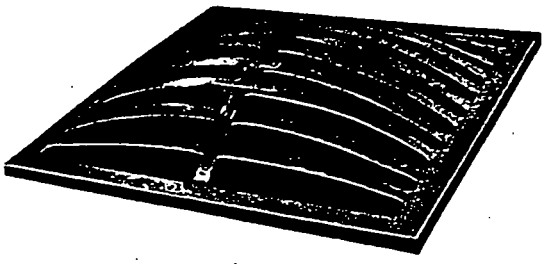
CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE
	KG	2/24/95	CRT	3/17/95	SEEPAGE CONTROL & SEDIMENT REMOVAL STORM DRAIN
					CRU 2
					AUTHOR K. Gerard SHEET OF PO 139

Heavy Duty
6610

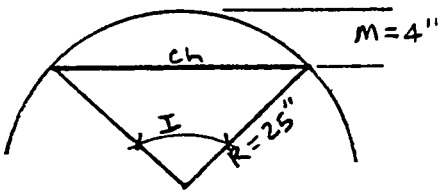
190 pounds total weight
Approximately 600 square inches of opening





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.)

000670

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 KG

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:)

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 O.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 2/24/95
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

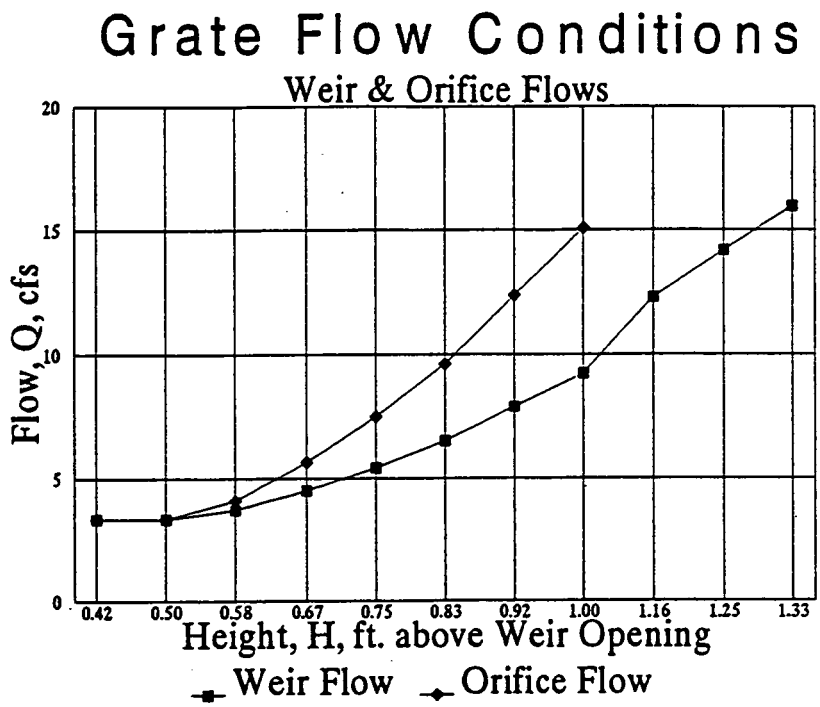
Given:

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.

\PO139SS\139SD.WK3 C:
(This sheet is D in the LOTUS 1-2-3 file. Used to display formulas from C:)


Grate Flow Conditions
Weir & Orifice Flows
Flow, Q, cfs
20
15
10
5
0
0.42
0.50
0.58
0.67
0.75
0.83
0.92
1.00
1.16
1.25
1.33
Height, H, ft. above Weir Opening
Weir Flow
Orifice Flow

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	2/28/95	CRT	2/28/95		
					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

1418

REV	BY	DATE	CK	DATE
0	KG	2/28/95	CRT	3/17/95

TITLE DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN

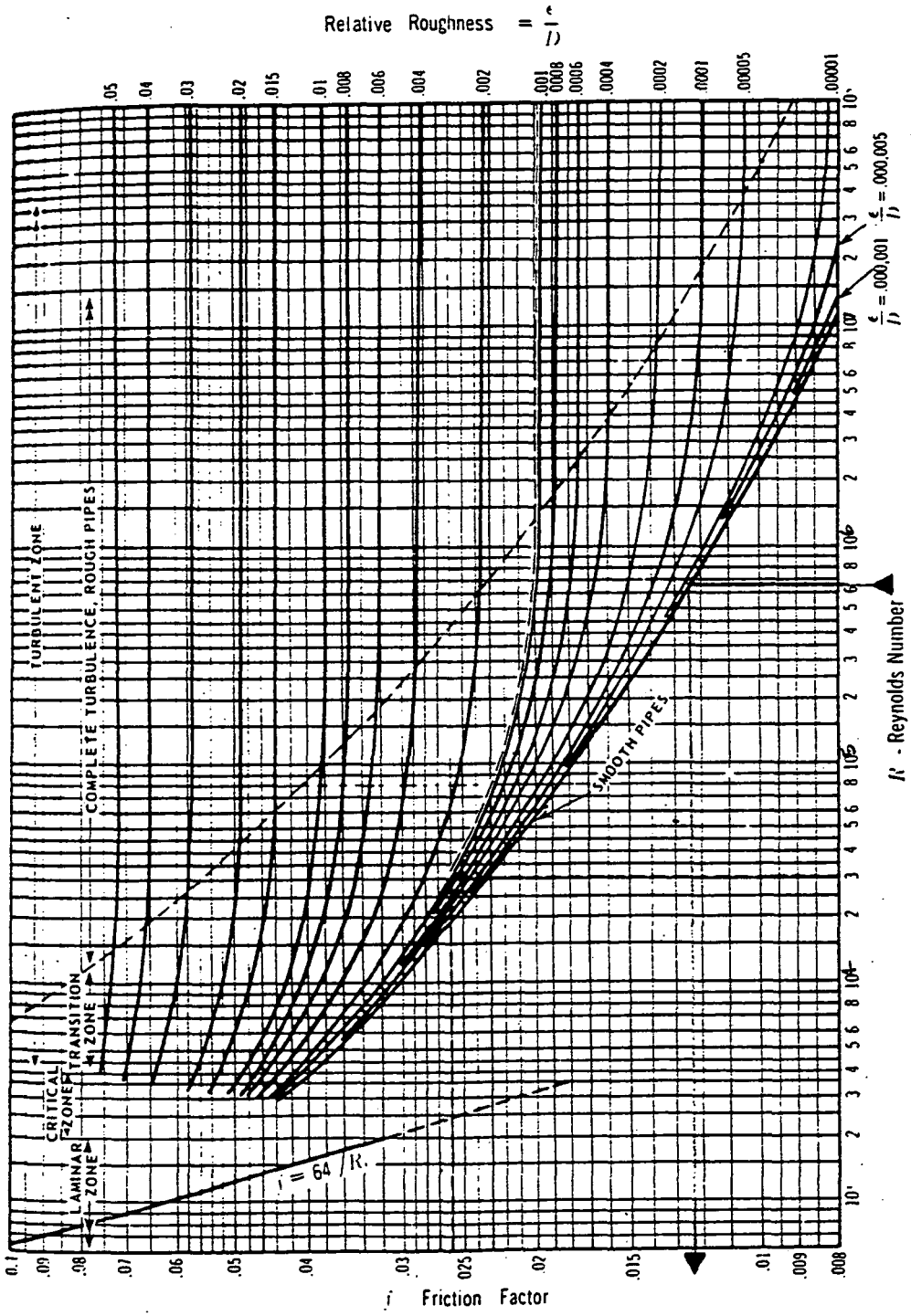
CRU 2

AUTHOR K. Gerard SHEET OF

PO 1391

Friction Factors for Commercial Pipe

(for Darcy-Weisbach formula, page 3-3)



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

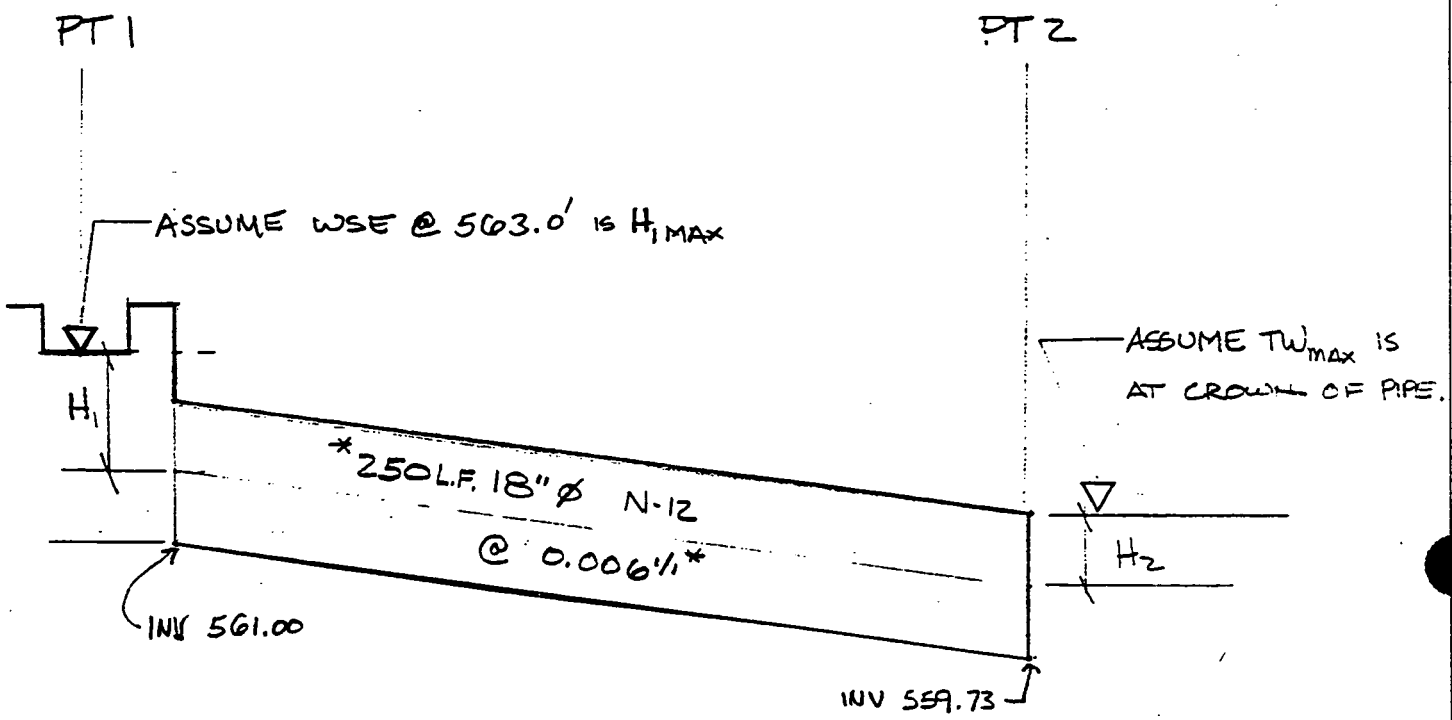
000677 A-22

PARSONS
ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE	DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN	CRU 2
0	KG	2/28/95	CRT	3/17/95			
					AUTHOR K. Gerard	SHEET OF	PO 139

CHECK PIPE UNDER PRESSURE FLOW CONDITIONS



* 212' actual + 36' for bends. Invert elevations and S shown based on actual.

$$H_{1_{max}} = 1.25' \times 62.4\ lbs/CF \times 1SF/144\ in^2 = 0.54\ psi$$

$$Q_F = 9.62\ cfs \times 7.48\ gal/cf \times 60s/min = 4317\ gpm \quad \text{use } 4320\ gpm$$

$$H_2 = 0.75' \times 62.4\ lb/CF \times 1SF/144\ in^2 = 0.27\ psi$$

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

ATTACHMENT B

SUPPORTING FIGURES

189000

10 — SHEET NUMBER 2

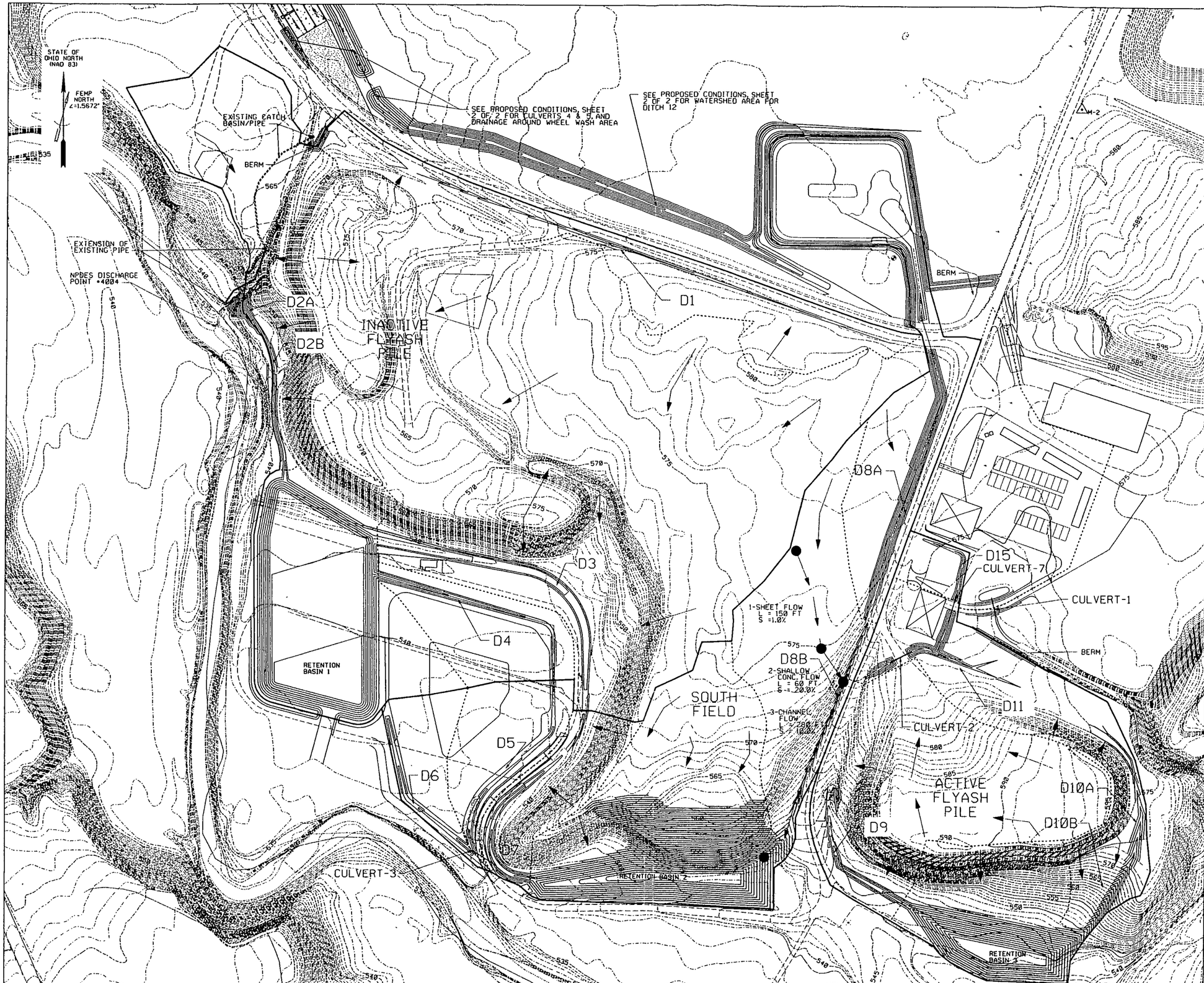
2

1418

B-1

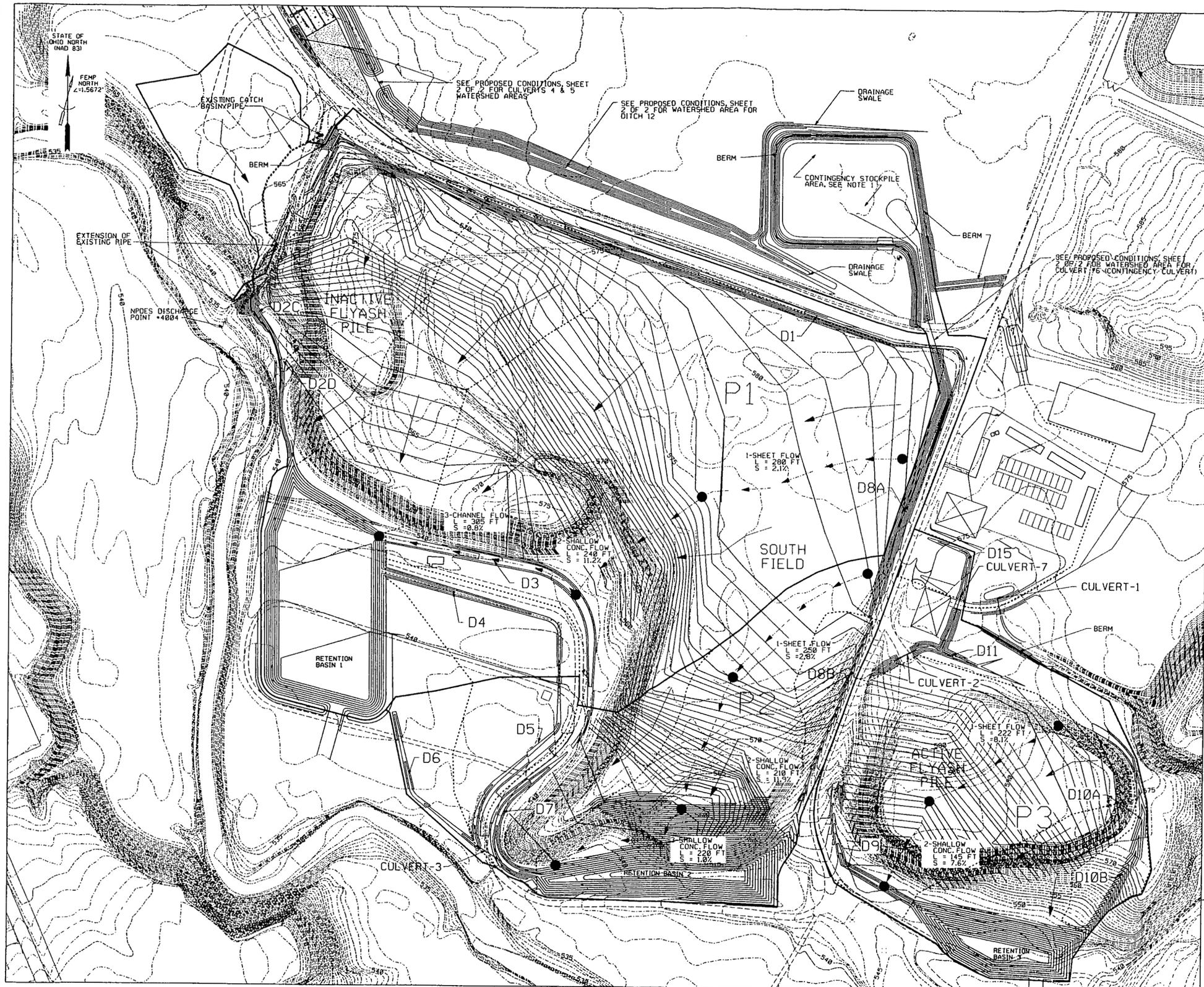
APPENDIX B

DRAINAGE AREA MAPS


STATE OF OHIO NORTH (NAD 83)
FEMP NORTH ∠=1.5672°
EXISTING CATCH BASIN/PIPE
BERM
EXTENSION OF EXISTING PIPE
NPDES DISCHARGE POINT #004
D2A
D2B
INACTIVE FLYASH PILE
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
D1
D8A
D3
D4
RETENTION BASIN 1
1-SHEET FLOW L = 150 FT S =1.0%
D8B
2-SHALLOW CONC. FLOW L = 60 FT S = 20.0%
3-CHANNEL FLOW L = 200 FT S = 10.0%
SOUTH FIELD
D5
D6
D7
CULVERT-3
RETENTION BASIN 2
D15
CULVERT-7
CULVERT-1
BERM
D11
CULVERT-2
ACTIVE FLYASH PILE
D10A
D10B
D9
RETENTION BASIN 3
LEGEND
RETENTION BASIN DRAINAGE AREA
DITCH/CULVERT DRAINAGE AREA
DIRECTION OF FLOW
000683
EXISTING CONDITIONS

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.

1418



LEGEND

RETENTION BASIN DRAINAGE AREA — P1

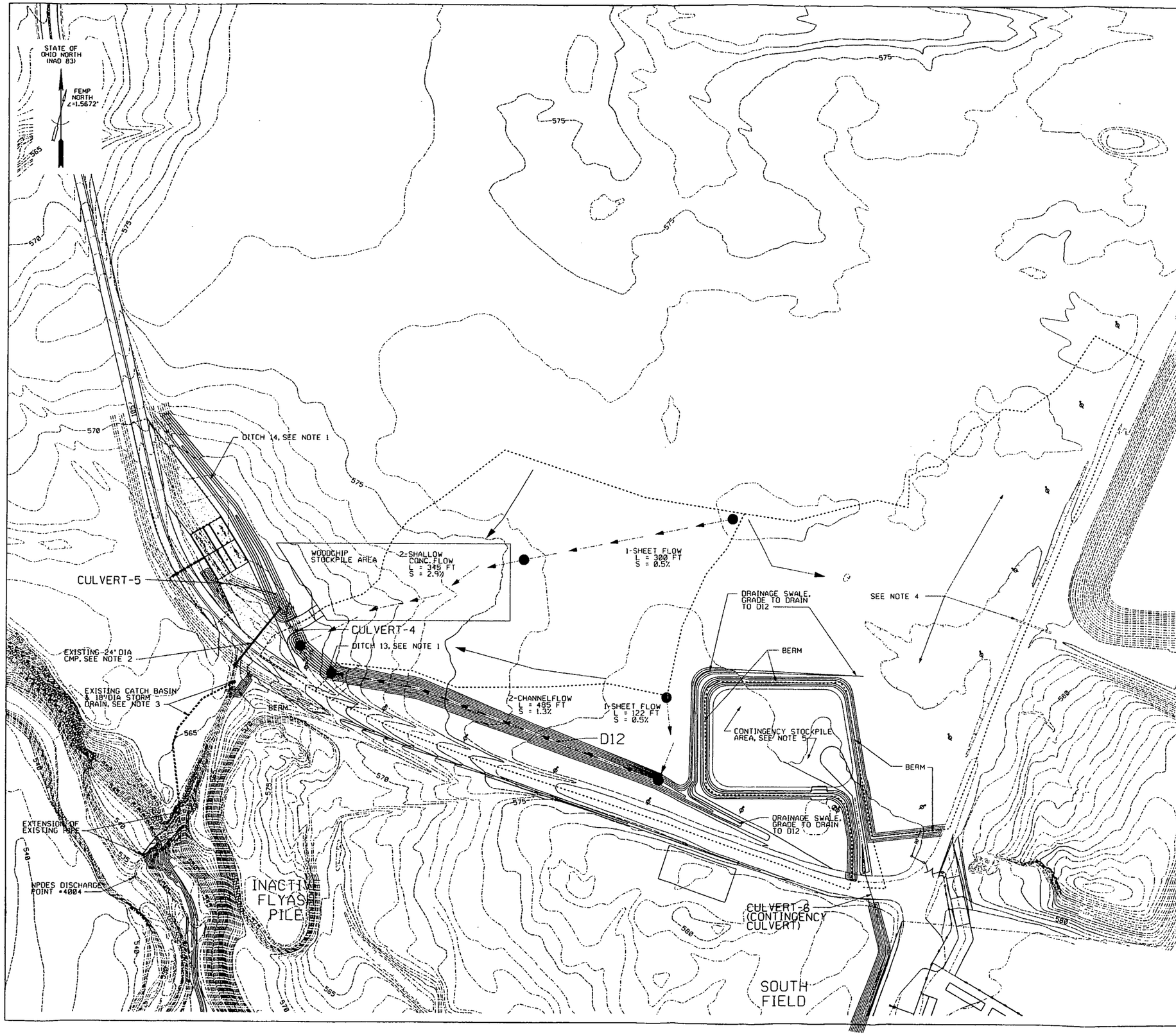
DITCH/CULVERT DRAINAGE AREA

DIRECTION OF FLOW

000684

PROPOSED CONDITIONS
SHEET 1 OF 2

50 0 50 100
SCALE: 1" = 50'



1418

NOTES:

1. EXISTING DITCHES IN THIS AREA WERE ORIGINALLY DESIGNED UNDER THE HAULROAD UPGRADE PROJECT, (P0158), 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 (P0158), CALCULATION NO. 15-02.
3. EXISTING 18" DIA STORM DRAIN AND CATCH BASIN WERE DESIGNED UNDER THE SEEPAGE COLLECTION AND SEDIMENT REMOVAL PROJECT, (P0139), 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.

LEGEND

DITCH/CULVERT DRAINAGE AREA

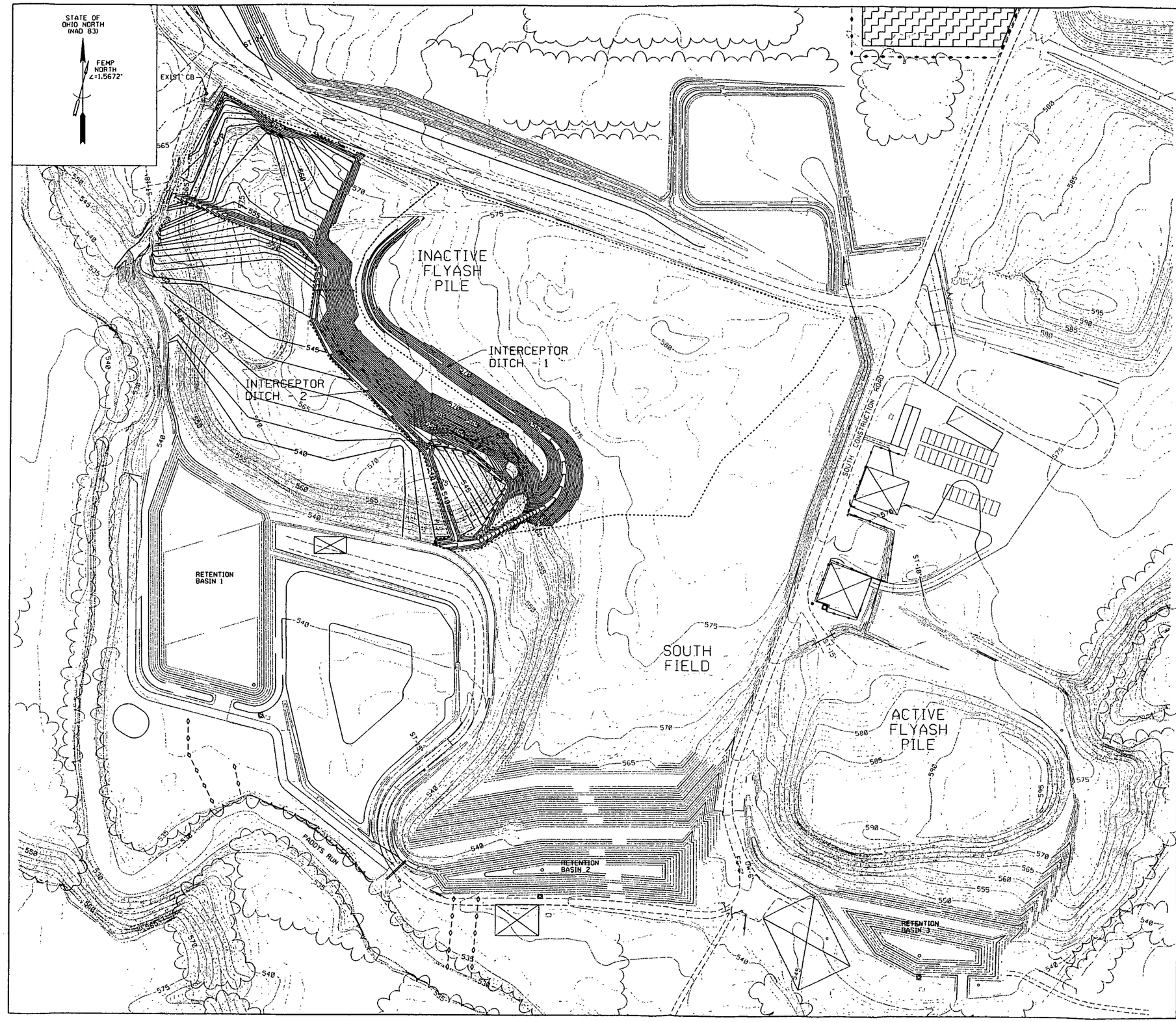
DIRECTION OF FLOW

EXISTING POWER POLE

000685

PROPOSED CONDITIONS
SHEET 2 OF 2

50 0 50 100
SCALE: 1" = 50'



LEGEND

DITCH/CULVERT DRAINAGE AREA

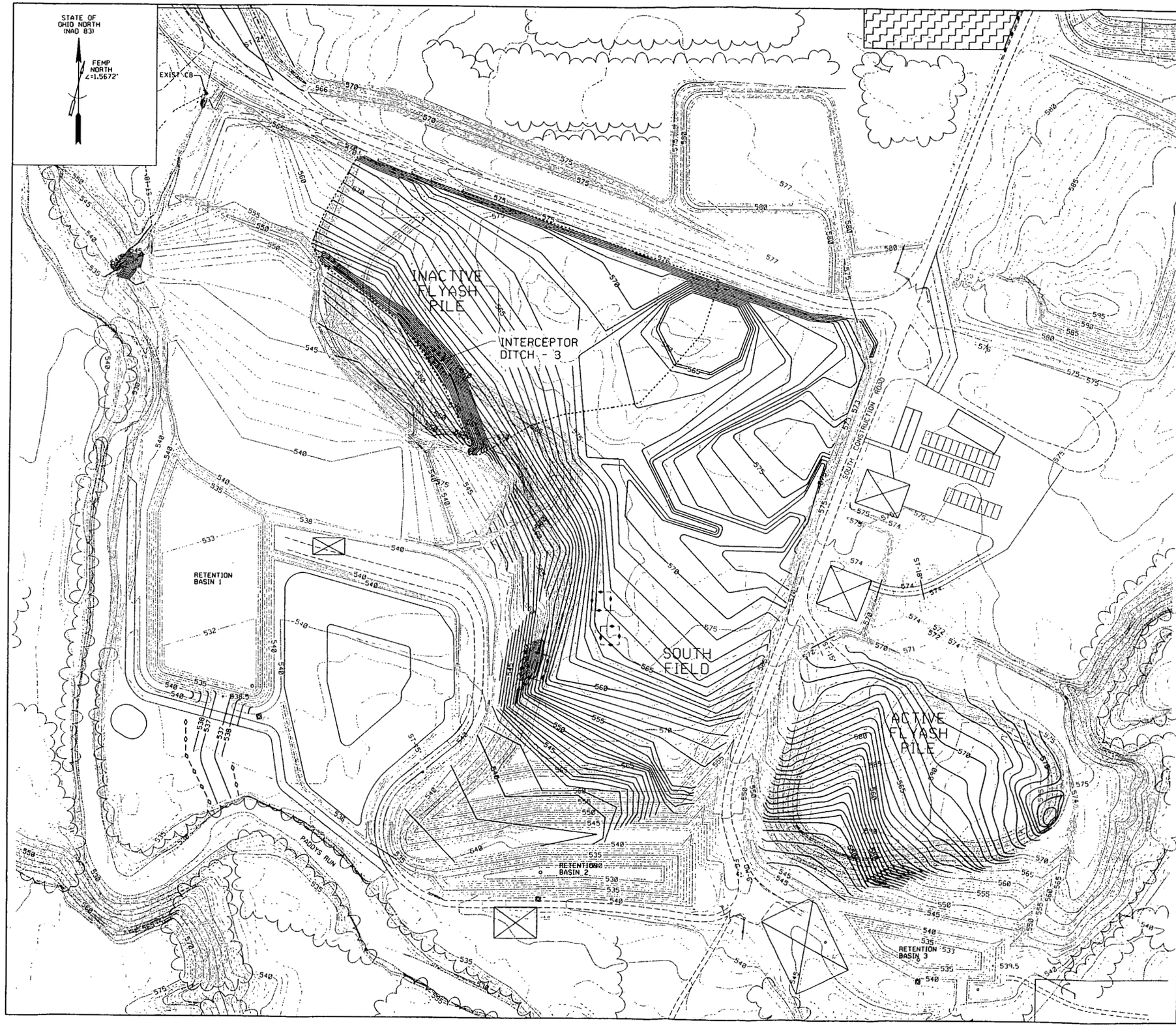
983000

BASE BID EXCAVATION CONDITIONS

50 0 50 100

SCALE: 1" = 50'

SHT 4 of 6



LEGEND

DITCH/CULVERT DRAINAGE AREA

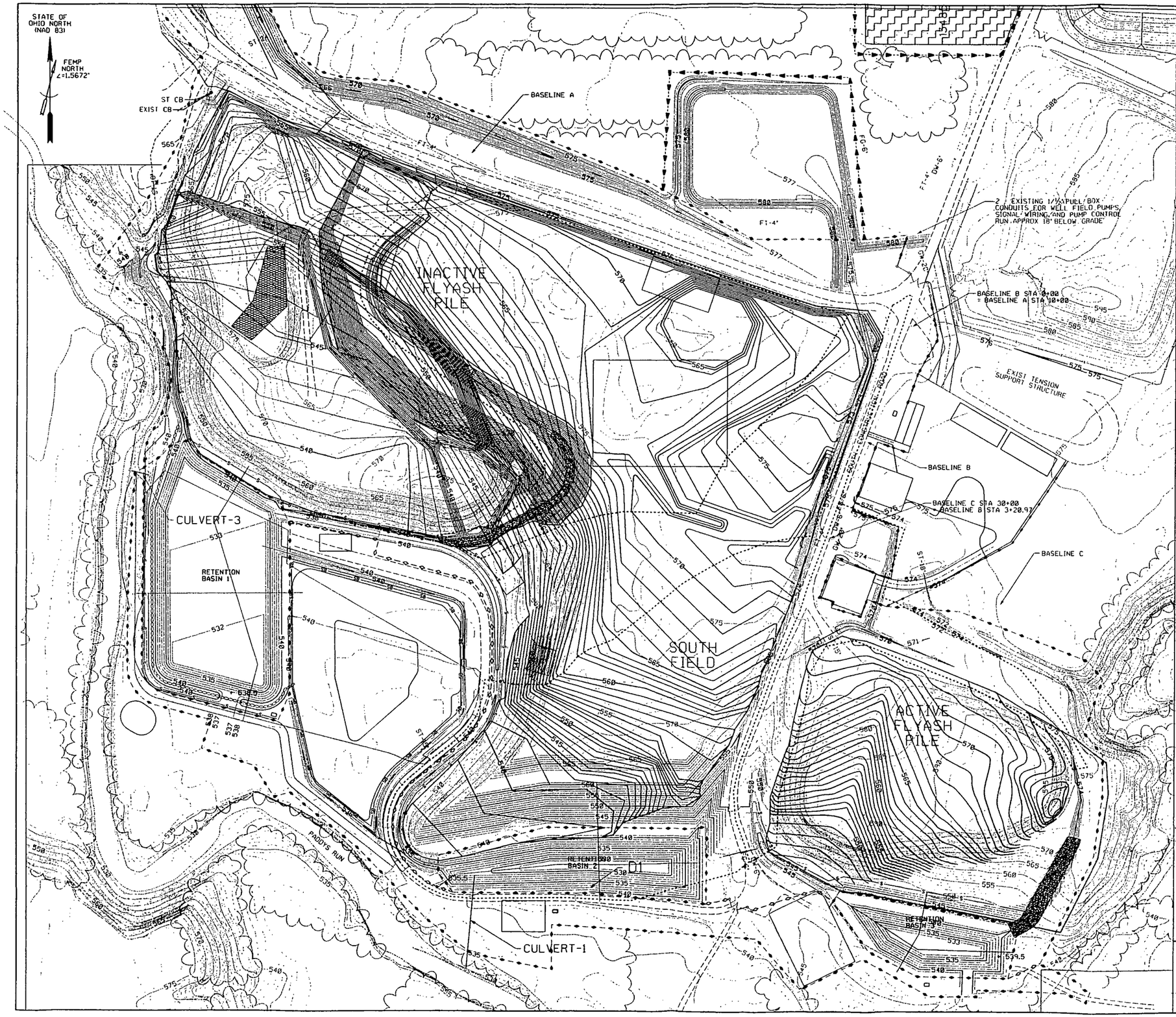
000F87

SOUTH FIELD & APF EXCAVATION GRADING CONDITIONS

50 0 50 100

SCALE: 1" = 50'

SHT 3 of 6



LEGEND

DITCH/CULVERT DRAINAGE AREA

000688

RESTORED CONDITIONS

SCALE: 1" = 50'

SHT 6 of 6

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."

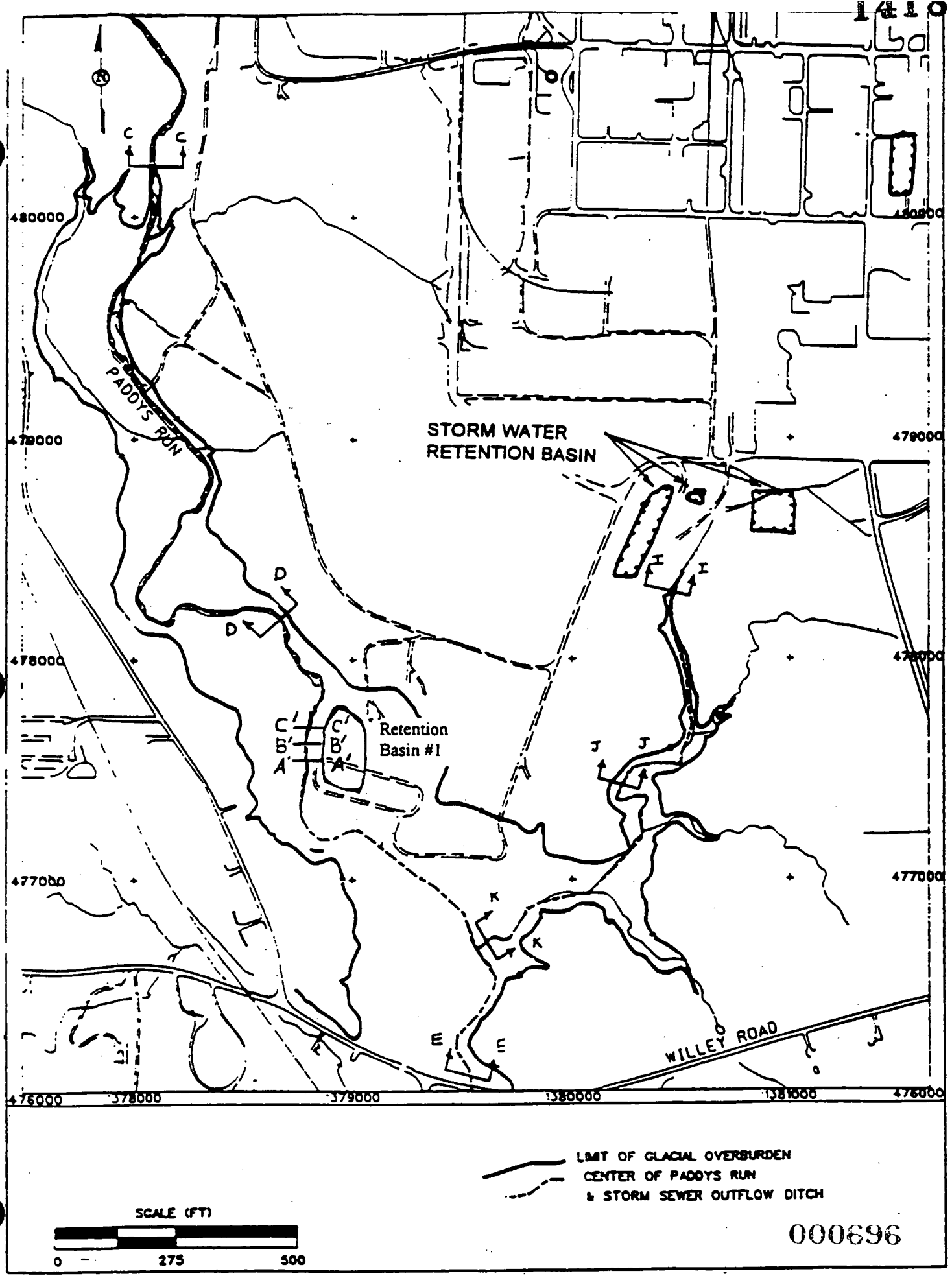


Figure 1 Location of Cross Sections

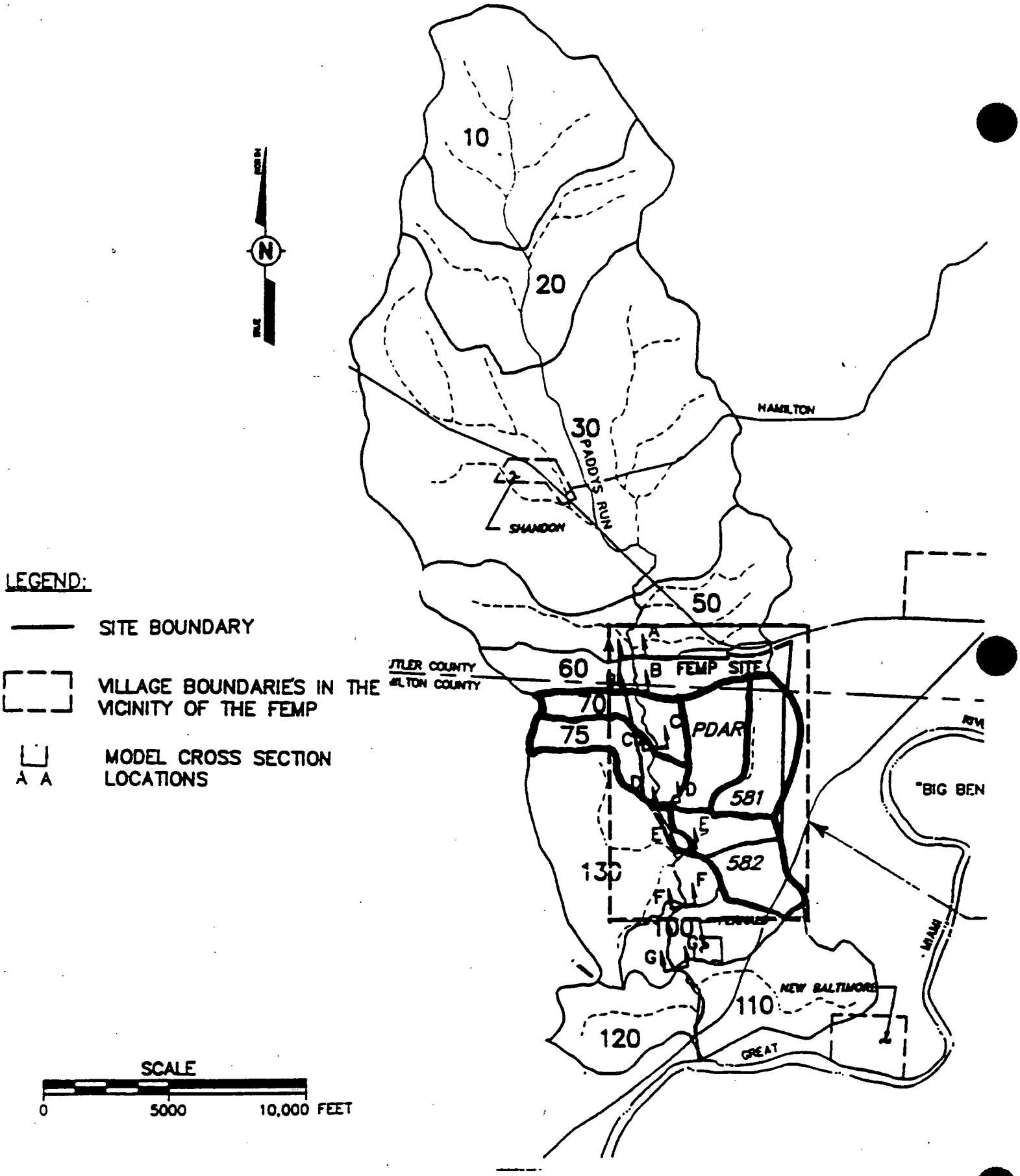


Figure 2 Paddys Run Subbasins

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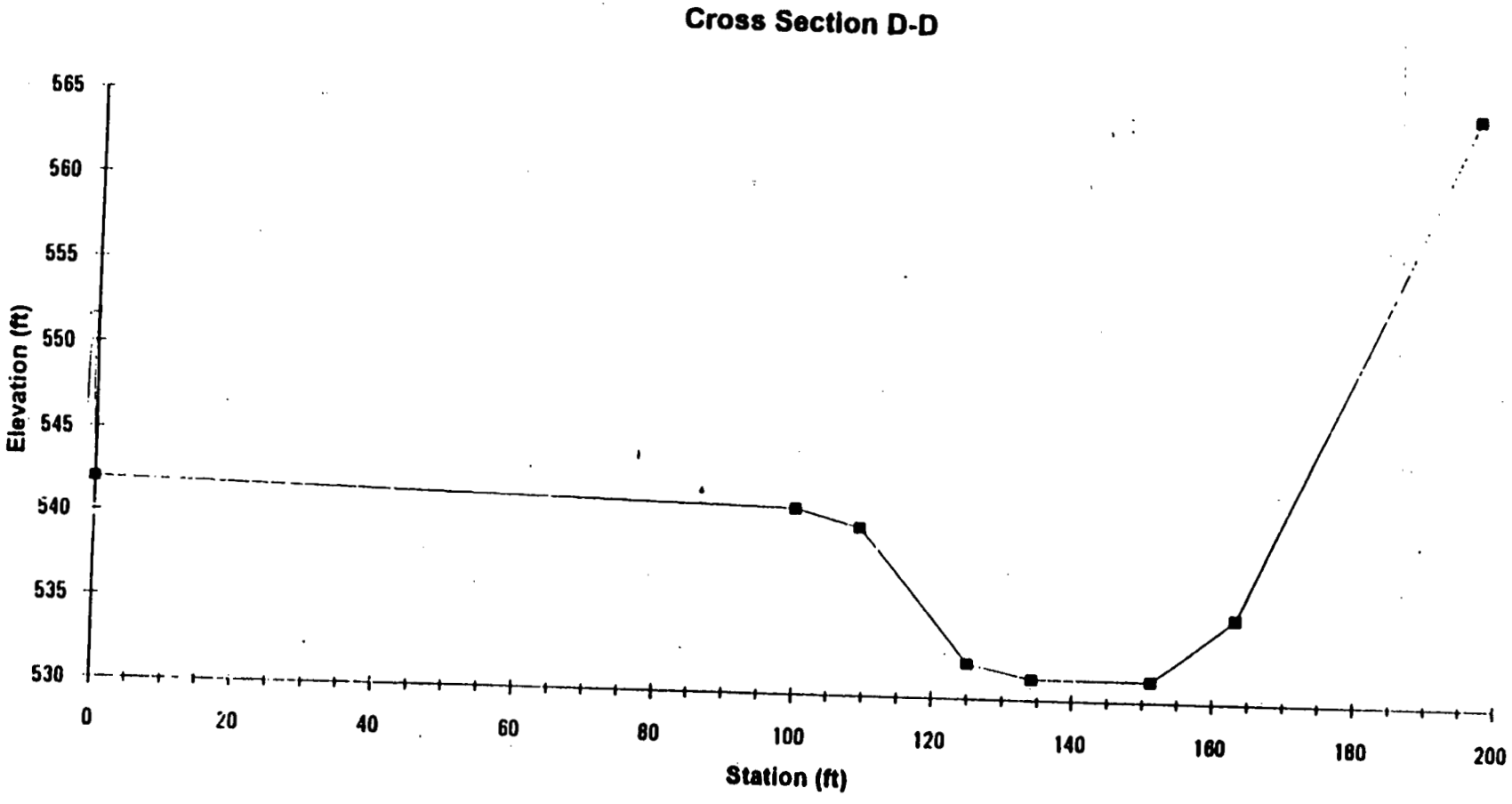

Figure 3 Cross Section D-D

669000

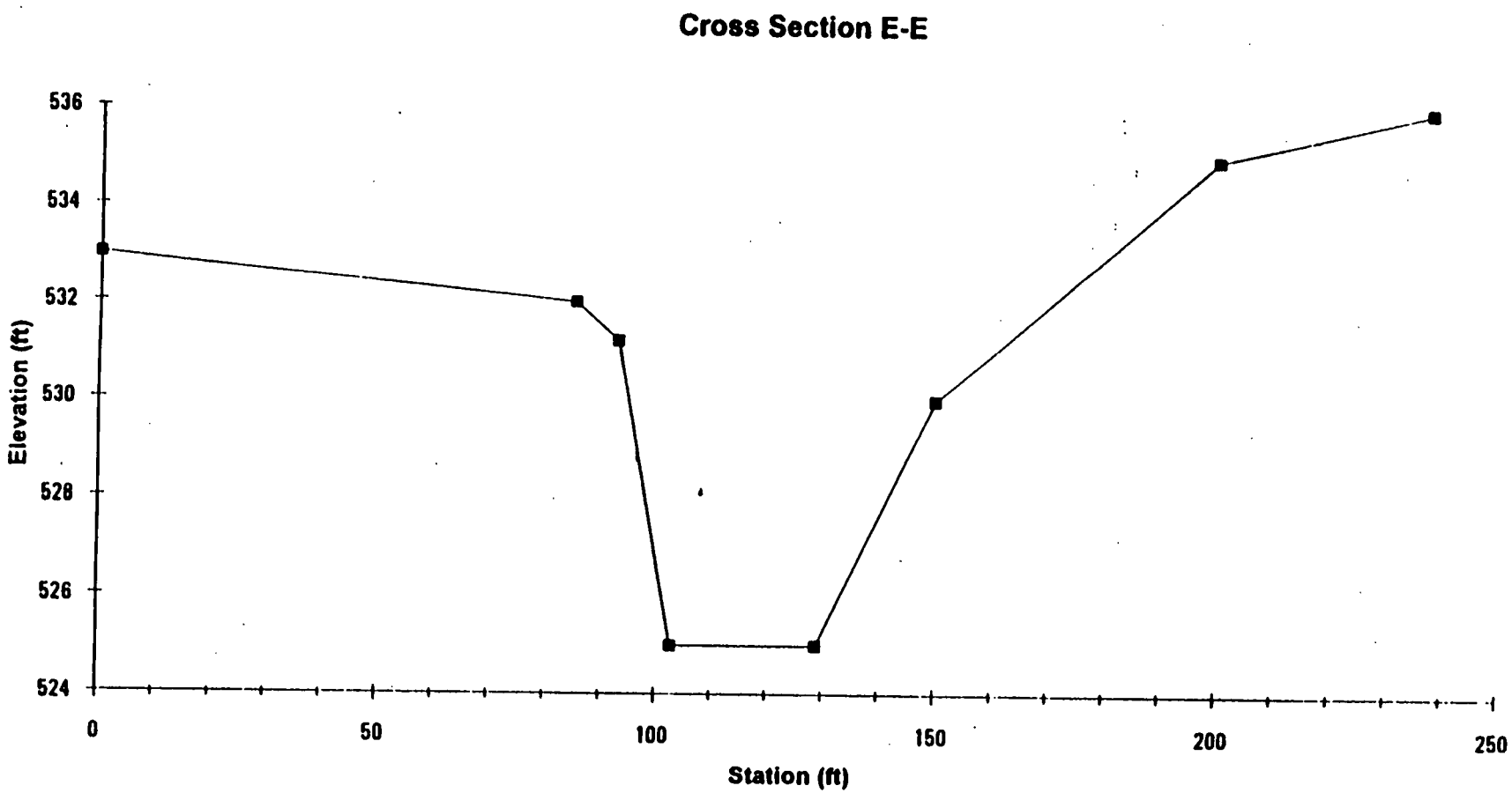

Figure 4 Cross Section E-E

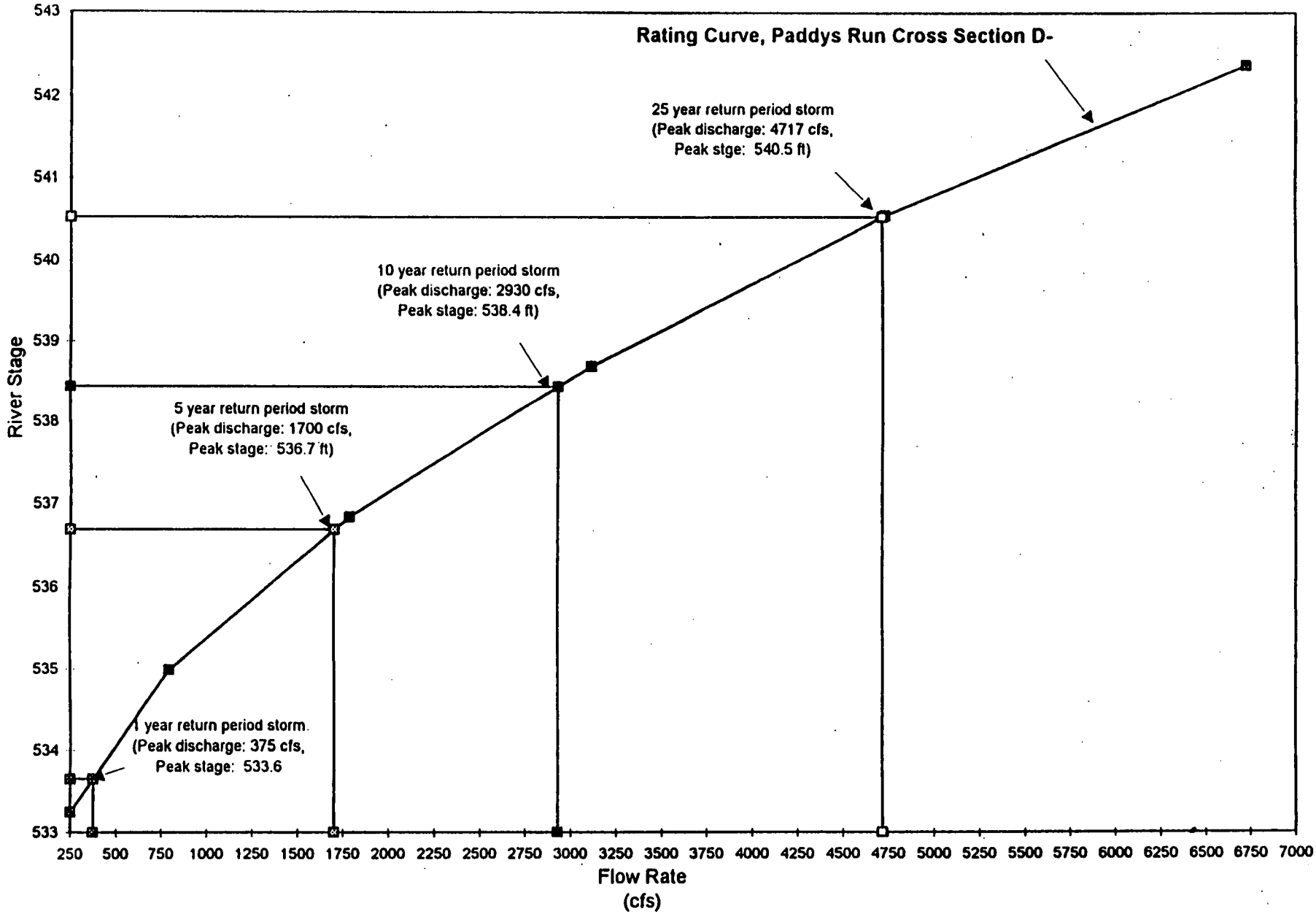

Figure 5 Rating Curve, Peak Discharge and Stage at Cross Section D-D

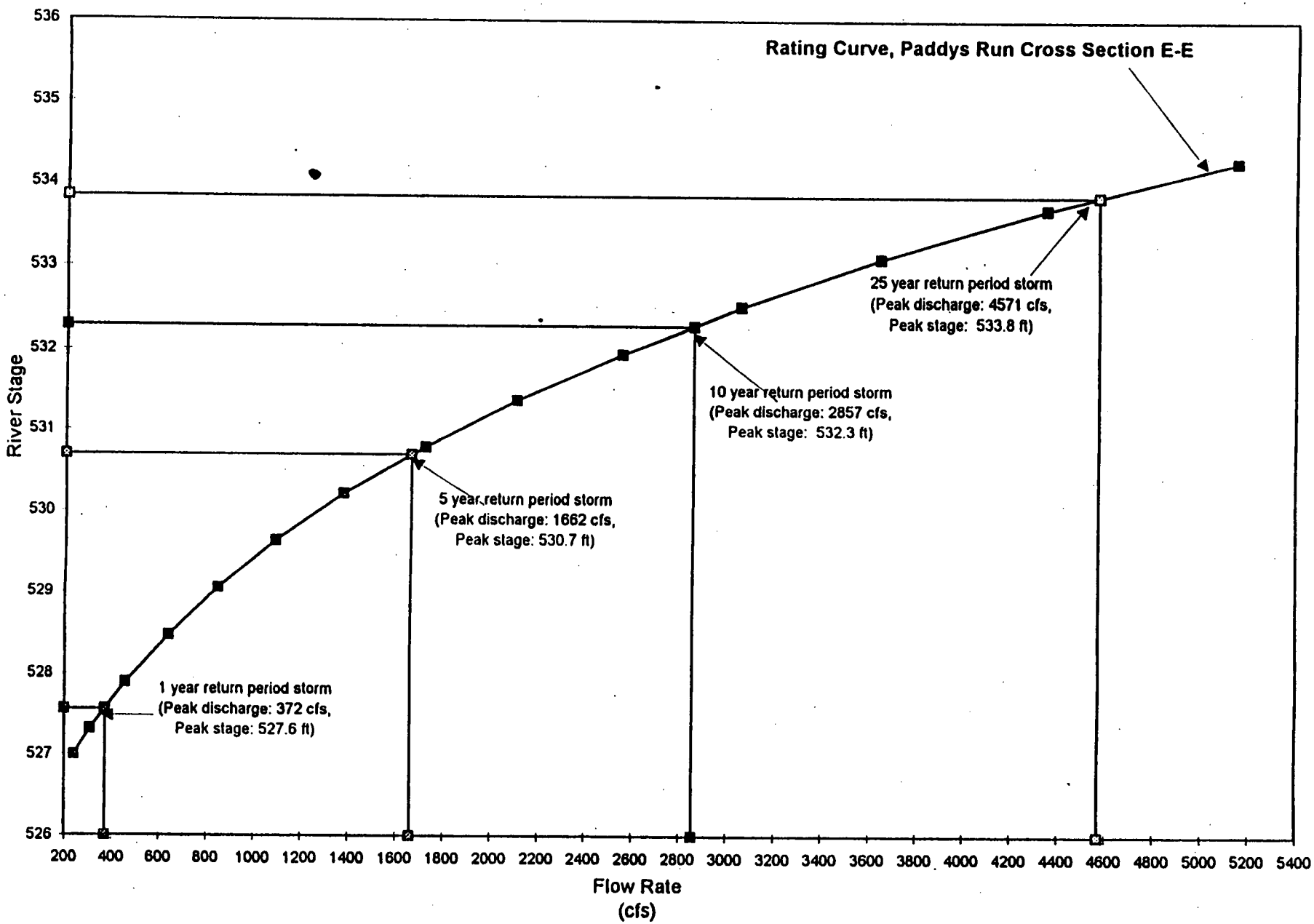

Figure 6 Rating Curve, Peak Discharge and Stage at Cross Section E-E

000701

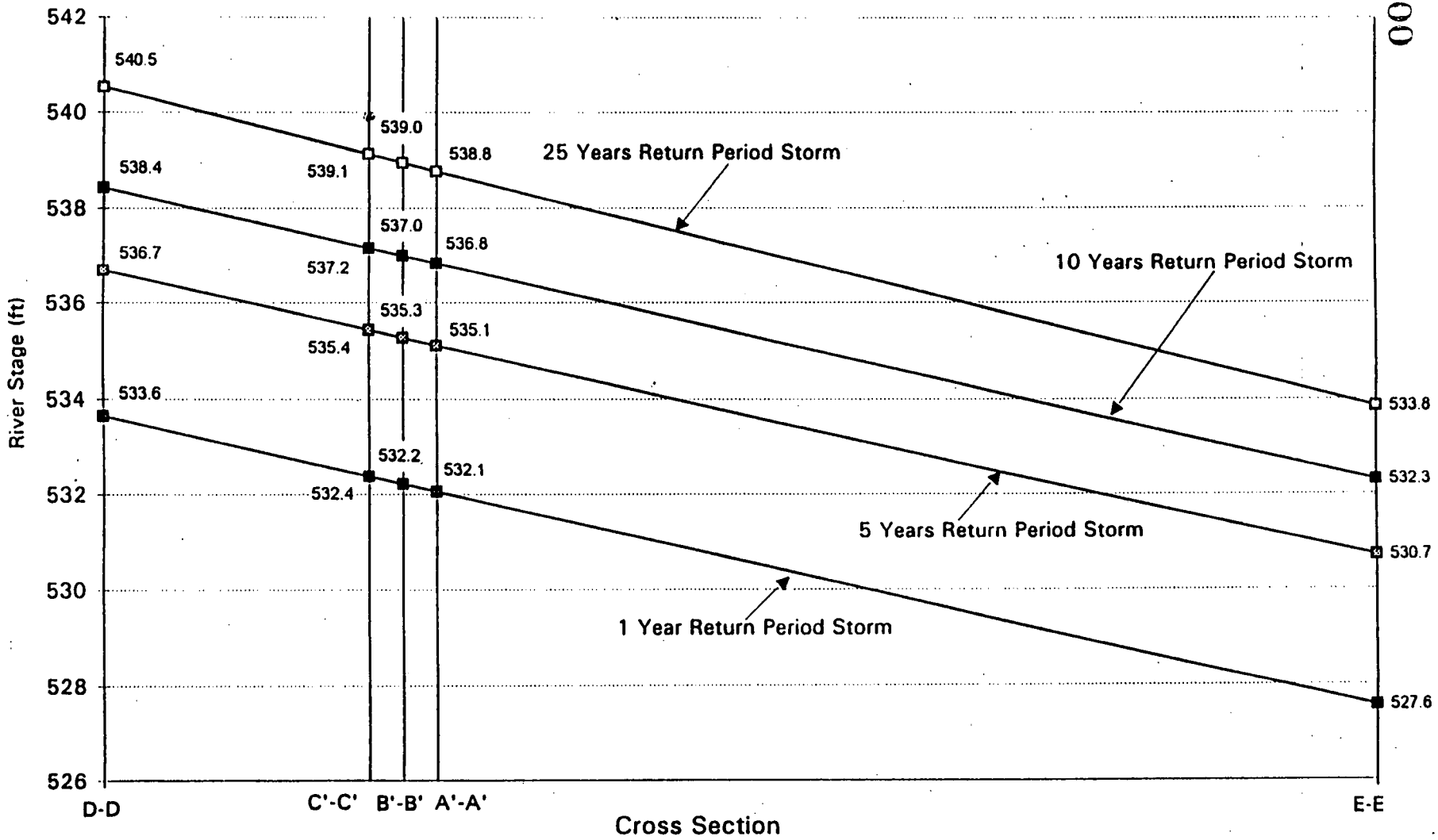

Figure 7 Interpolated Peak Stages at Cross Section A'-A', B'-B' and C'-C'

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

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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.

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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

000741

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	3626	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	0.018	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[e]	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

[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

000716

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

000717

SCS CURVE NUMBER WEIGHTING

SUBBASINS DIVIDED FOR CONTAMINANT CALCULATIONS

Subbasin	Land Cover[d]	Hydraulic Condition	Hydrologic Soil Group[b]	Weighted SCS Number[f]	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.

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.

000719

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

000725

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

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

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.

000726

Appendix E

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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
```

```
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
```

```
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          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 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 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          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 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
```

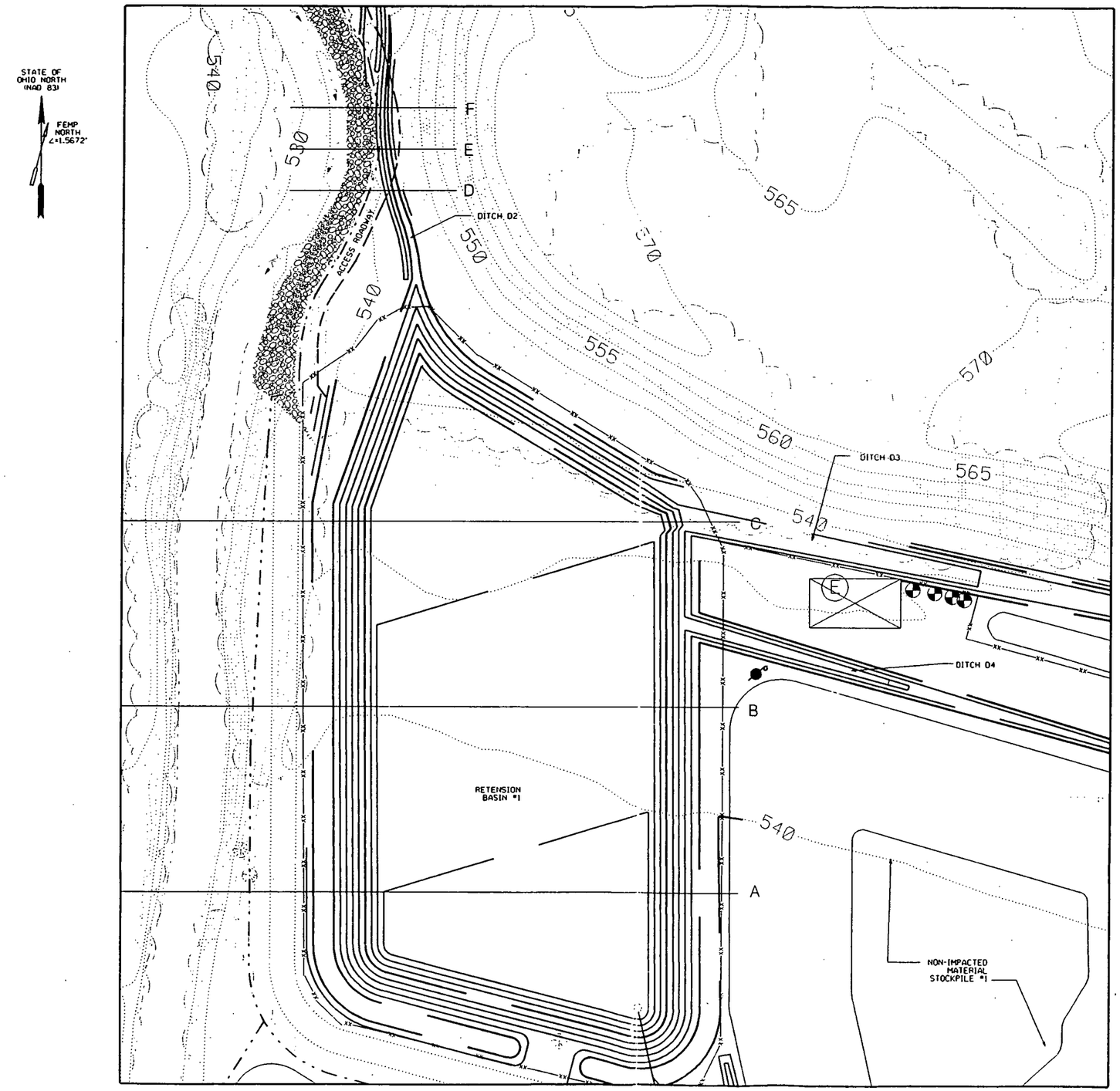
```
RX      0    82.3      93   102.9     129     150     200   237.8
RY    533     532   531.2     525     525     530     535     536
*
KK SB580
KM RUNOFF TO THE STORM SEWER OUTFALL DITCH FROM THE RETENTION BASIN TO
KM CROSS SECTION J-J
KO      1       0               1      21
BA 0.036
LS           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



NOTES

1418

000745

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	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

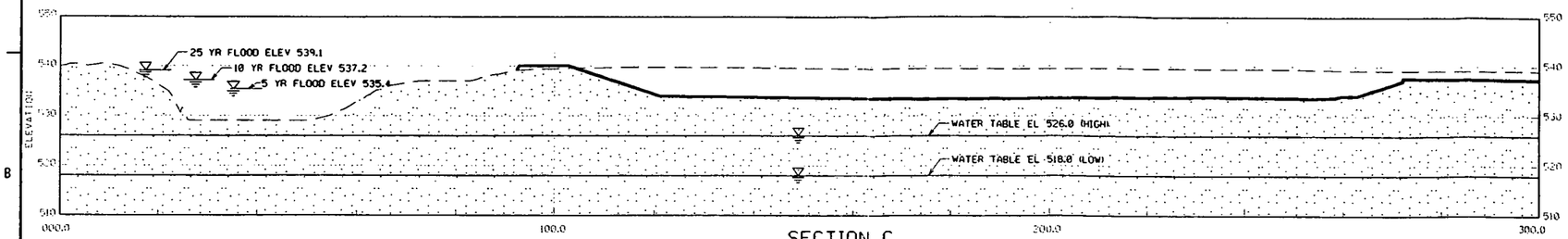
PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS

DRAWING TITLE
SKETCH #1

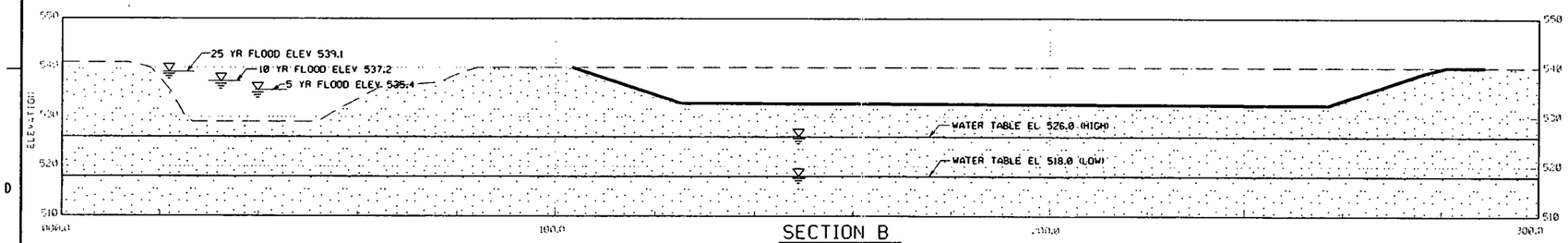
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
PLANT/BLDG. NO		FLOOR		SCALE 1"=20'	CLASS
SUBMITTED FOR APPROVAL		FERMCO CRU APPROVAL			

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	A-E PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV NO.
		00-90701	SK-G-04548		4

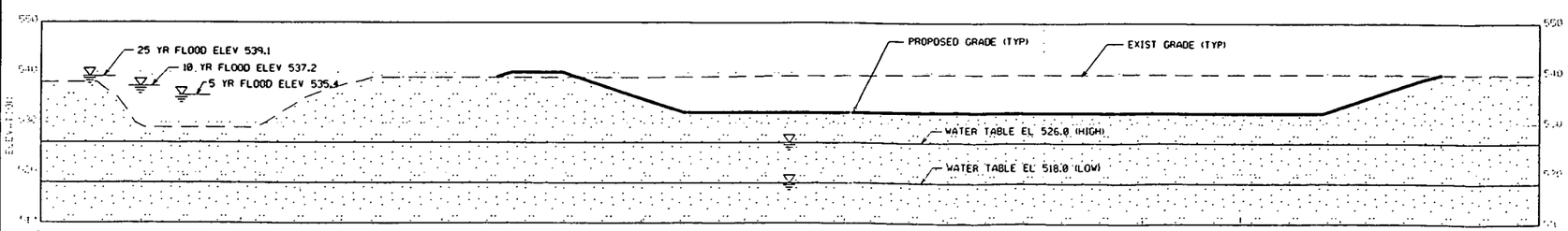
skg04548.m po165@ws316. Wed Aug 27 15:50:21 CDT 1997



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'.

1418

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.

000746

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	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

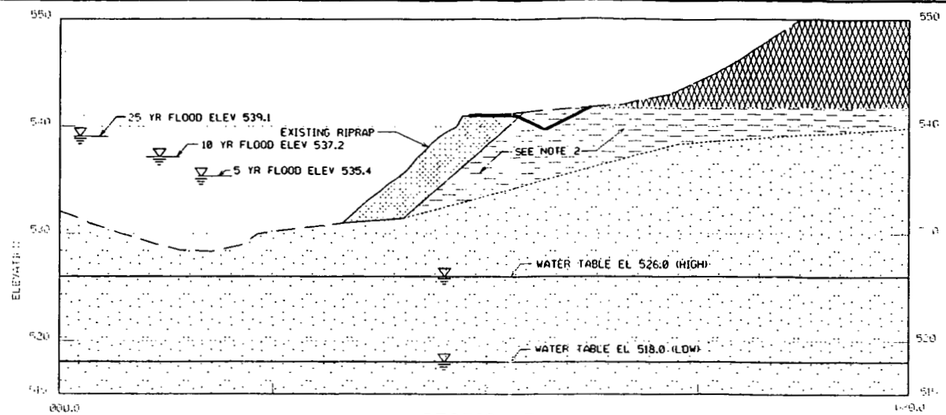
DRAWING TITLE
SKETCH #2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
PLANT/BLDG NO.		FLOOR		SCALE 1"=10'	CLASS
SUBMITTED FOR APPROVAL		FERNCO (PE) APPROVAL			

A-E PROJECT NO.	DATE	FERNCO PROJECT NO.	DATE	DRAWING SHEET CODE NO.	SHEET NO.	REV NO.
		00-90701		SK-G-04548		A

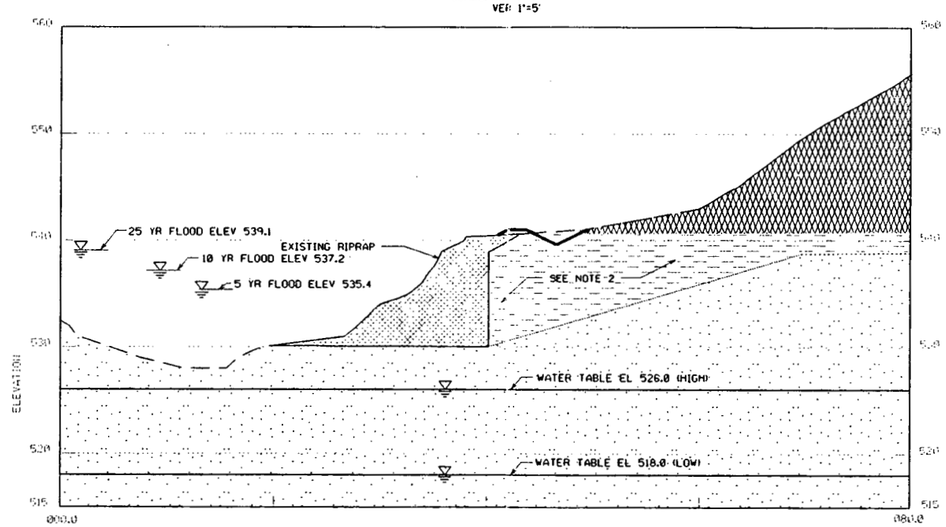
PREPARED UNDER PARSONS PROJECT GREEN NUMBER

skg04548.m po165@ws316. Wed Aug 27 15:43:55 CDT 1997



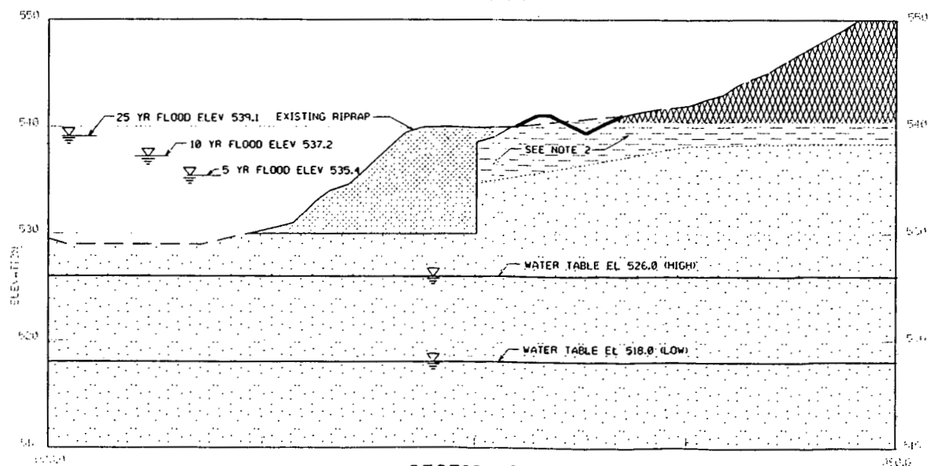
SECTION F

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' HORIZONTIAL

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.

1418

LEGEND:

- EXISTING GROUND
- EXCAVATION GRADE LINE
- WATER TABLE
- SAND/GRAVEL
- GLACIAL OVERBURDEN/TILL
- GREAT MIAMI AQUIFER
- RIPRAP
- ASH

000747

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	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 #3

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
PLANT/BLDG NO.		FLOOR		SCALE 1"=5'	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL			

PREPARED UNDER PARSONS PROJECT ORDER NUMBER

A-E DOE PROJECT NO.	DATE	TEMP PROJECT NO.	DATE	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
		00-90701		SK-G-04548		A

C

TABLE OF CONTENTS

EARTHWORK CALCS

INFORMATION ONLY

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

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	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	Y UNUSAFSHAN'L 4/4/98	C. Schroeder 4/4/98

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. Parton

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

000752

Sht 3 of 11

1418

SHT 4 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	7995	1965	761	1965		
RETENTION BASIN 2	2934	8814	3597	1024	6	1024		
RETENTION BASIN 3	553	2186	2134	506		506		
DITCH 1		129			0			
DITCH 2		73	0		120***	0	26	
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		845	0			0	163	
DITCH 9		113				0	0	
DITCH 10		498	0				36	
DITCH 11		79						
DITCH 12		2712						
DITCH 13		185						
DITCH 14		378						
EQUIPMENT WASH AREA		0	209*		181			
SUPPORT AREA		0	257*		121			711
ON IMPACTED MATERIAL		69						
BERMS @ NON IMPACTED					593**			
BERM NORTH OF AFP					59**			
ROAD REGRADING (AT RETENTION BASIN 2)			73*		67			53
Swale Repair @ AFP			40				35	
SUBTOTAL	=SUM(R[-26]C:R[-2]C)	=SUM(R[-26]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[-26]C:R[-2]C)	=SUM(R[-26]C:R[-2]C)	=SUM(R[-26]C:R[-2]C)	=SUM(R[-26]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

0007754

EXCAVATION GRADING PLAN - 1

	IMPACTED MATERIAL EXCAVATION	NON IMPACTED MATERIAL EXCAVATION	FILL	DUMPED ROCK FILL PLACED	ABOVE WAC MATERIAL
IFP EXCAVATION	117271				
INTERCEPTOR DITCH 1	2494		63	150	
INTERCEPTOR DITCH 2	555				
ABOVE WAC MATERIAL					3727
TOTALS	=SUM(B2:B9)	=SUM(C2:C9)	=SUM(D2:D9)	=SUM(E2:E9)	=SUM(F2:F9)

000755

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

Sht 1 of 11

1418

000756

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)

000757

11 of 11

EXCAVATION GRADING PLAN - 3

	IMPACTED MATERIAL EXCAVATION (CY)	NON IMPACTED MATERIAL EXCAVATION (CY)				
SOUTH FIELD EXCAVATION	77038					
AFP EXCAVATION	22763					
TOTALS	99801	0				

SAT 9 of 11

1418

000758

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)				

000759

SM 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.

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

BASIN 1, 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)	
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

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

BASIN 1, 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	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

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

BASIN 1, FILL

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

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

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

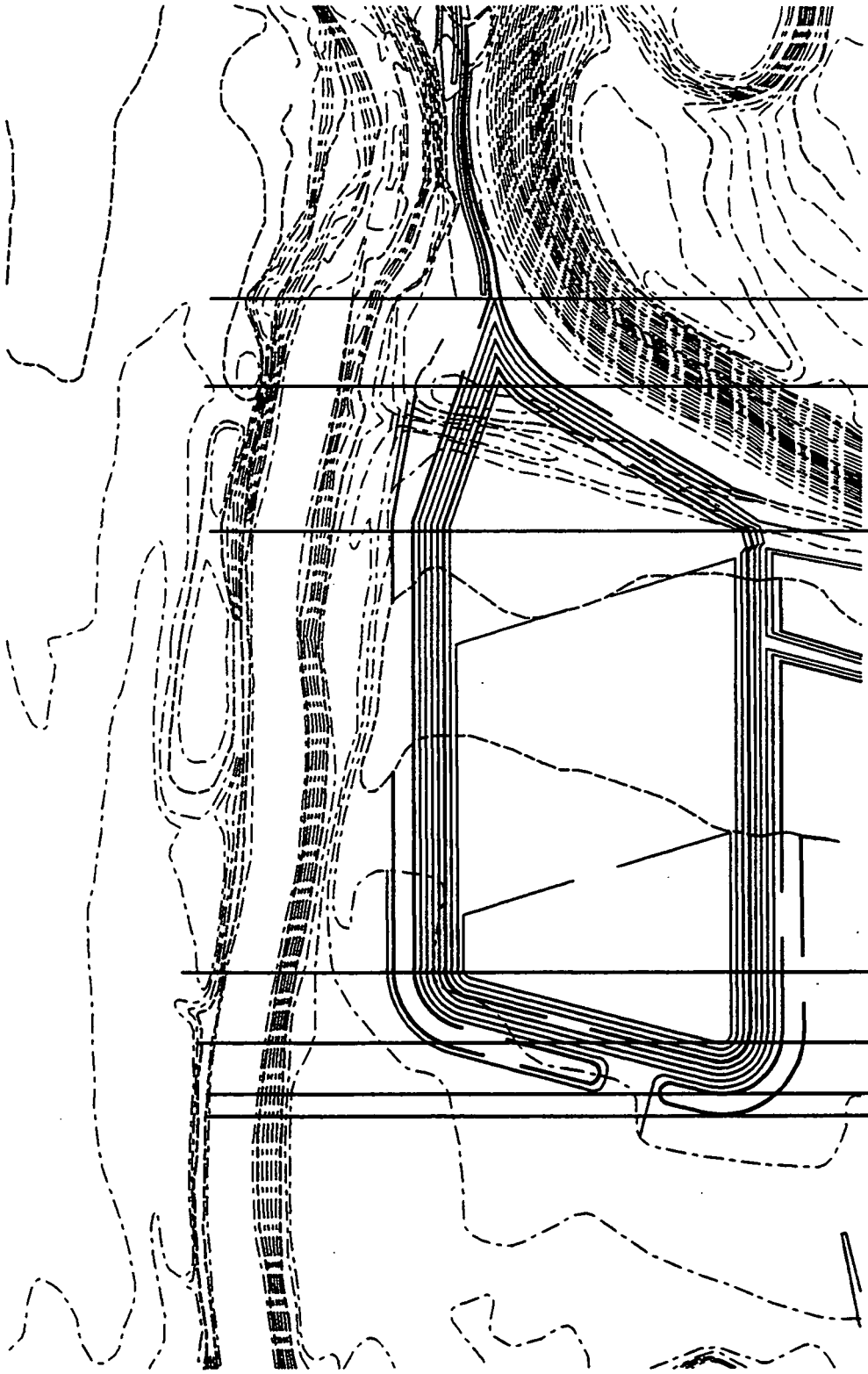
SHT A10

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

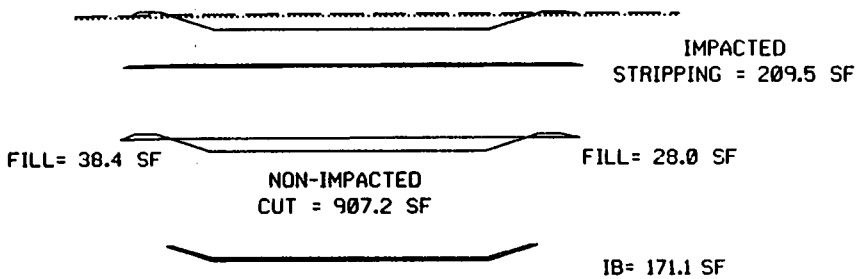
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
10.4	0						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
34.7	303.9						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
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

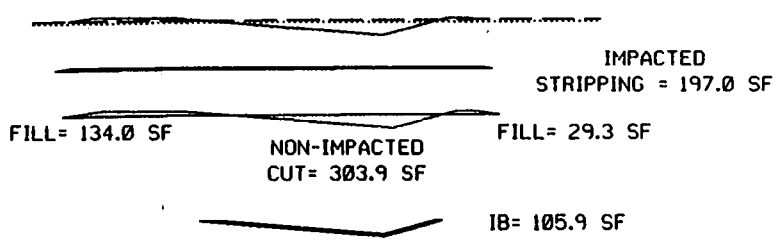


000772

STA 0+68.5



STA 0+34.67



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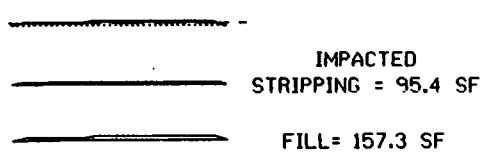
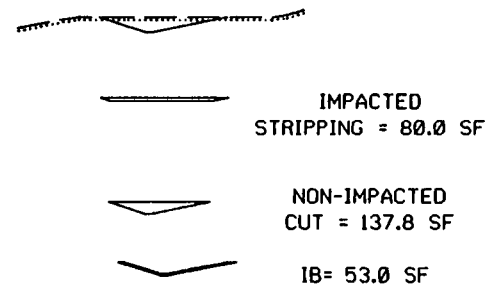
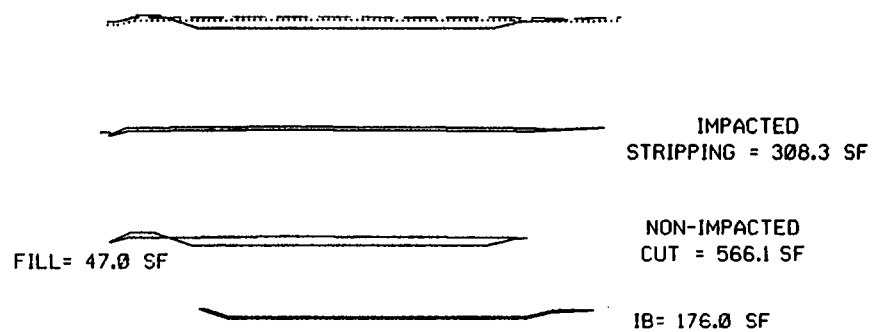


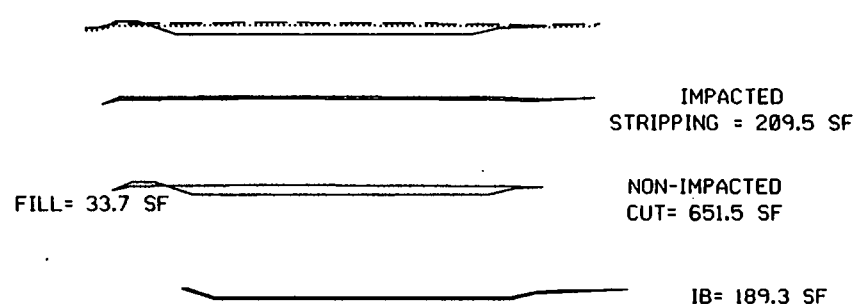
STA 3+48.9



STA 2+79.6



STA 2+79.0



SHT A13

1418

000773

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

000774

SHT A15
1418

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	267.2						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
254.2	266.4						
			=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

000775

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

SHT A17

1418

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)	
388.8	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

000777

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

SHT A19

1418

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)	
67.9	0						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.8	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

000779

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

000780

BASIN 2, 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)	
39.6	0					
		=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
67.9	96.8					
		=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
107.6	95.5					
		=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)	
219.8	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	36					
		=SUM(B26,B28)/2	=(A28-A26)	=PRODUCT(D27,E27)	=SUM(G25,F27)	
442.3	0					
						=(G27)/27

SHT A22

BASIN 2, NON-IMPACTED CUT

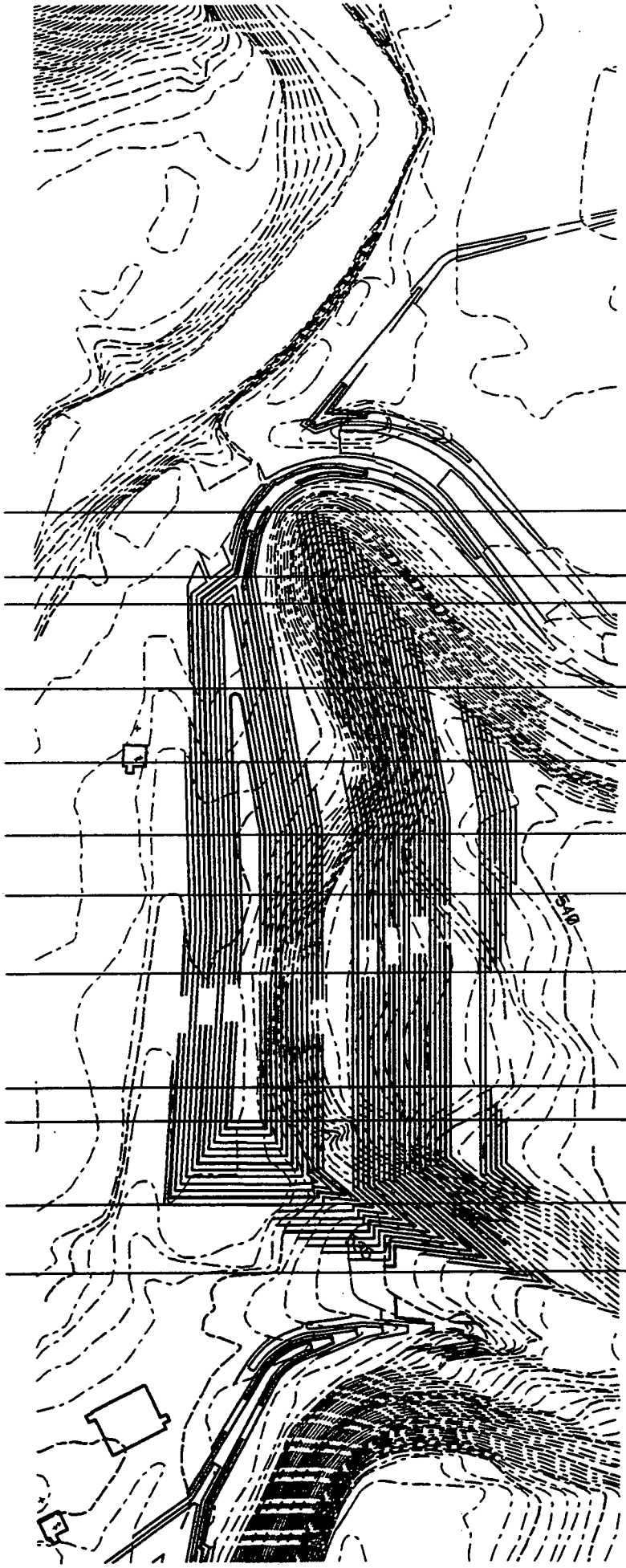
STA	INCR. AREA (SF)	AVG. AREA (SF	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00					
		0.00	39.60	0.00	0.00	
39.60	0.00					
		227.85	48.30	11005.16	11005.16	
87.90	455.70					
		462.05	19.70	9102.38	20107.54	
107.60	468.40					
		445.35	66.20	29482.17	49589.71	
173.80	422.30					
		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

SHT A23

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	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)	
67.9	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	68.1						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
368.8	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

STA A24



STA 4+42.3

STA 4+04.6

STA 3+88.8

STA 3+39.4

STA 2+96.7

STA 2+54.2

STA 2+19.6

STA 1+73.8

STA 1+07.6

STA 0+87.9

STA 0+39.6

STA 0+00

SHT A25

1418

STA 2+19.6

IMPACTED
STRIPPING = 287.2 SF

IMPACTED SLOPE
CUT = 970.3 SF

NON-IMPACTED
CUT = 349.8 SF

IB= 87.7 SF

STA 0+87.9

IMPACTED
STRIPPING = 296.5 SF

IMPACTED SLOPE
CUT = 829.2 SF

NON-IMPACTED
CUT = 455.7 SF

IB= 96.8 SF

STA 1+73.8

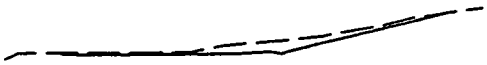
IMPACTED
STRIPPING = 272.9 SF

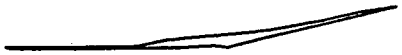
IMPACTED SLOPE
CUT = 926.6 SF

NON-IMPACTED
CUT = 422.3 SF

IB= 88.1SF

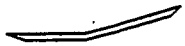
STA 0+39.6





IMPACTED SLOPE
CUT = 525.8 SF

STA 1+07.6



IMPACTED
STRIPPING = 304.4 SF

IMPACTED SLOPE
CUT = 897.7 SF

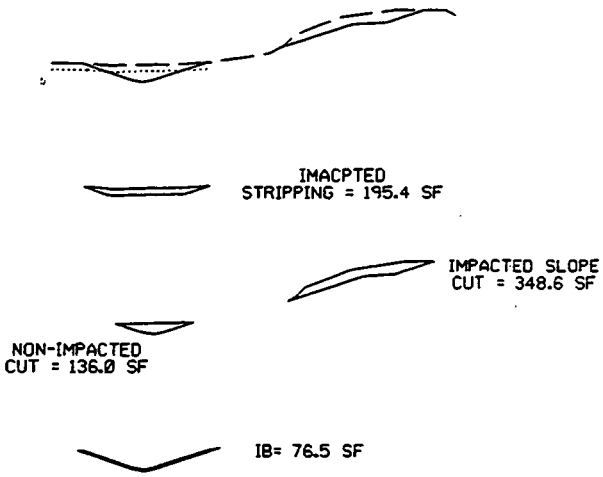
NON-IMPACTED
CUT = 468.4 SF

IB= 95.6 SF

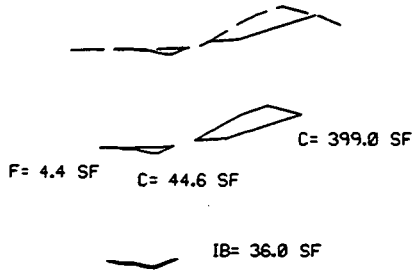
000785

SHT A26

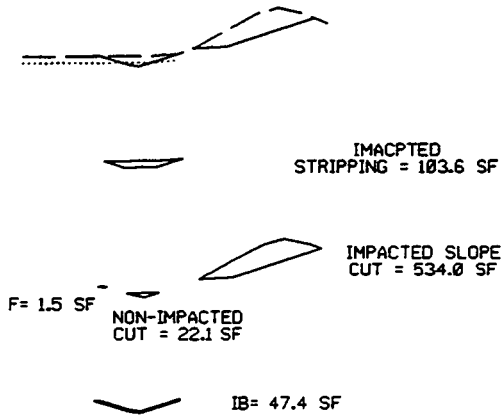
STA 2+96.7



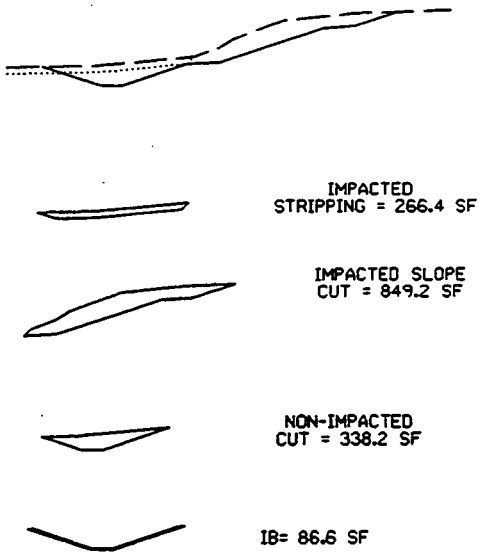
STA 4+04.6



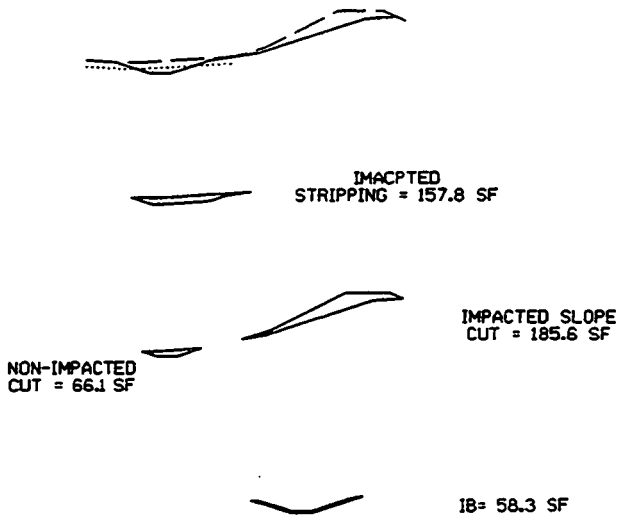
STA 3+88.8



STA 2+54.2



STA 3+39.4



SHT A27

1418

BASIN 3, 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	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

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	76.7					
		=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

000788

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

000789

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	267						
			=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

000790

SHT A31

1418

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

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)	
148	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)	
256.5	0						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
285.2	0						
							=(G17)/27

000792

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

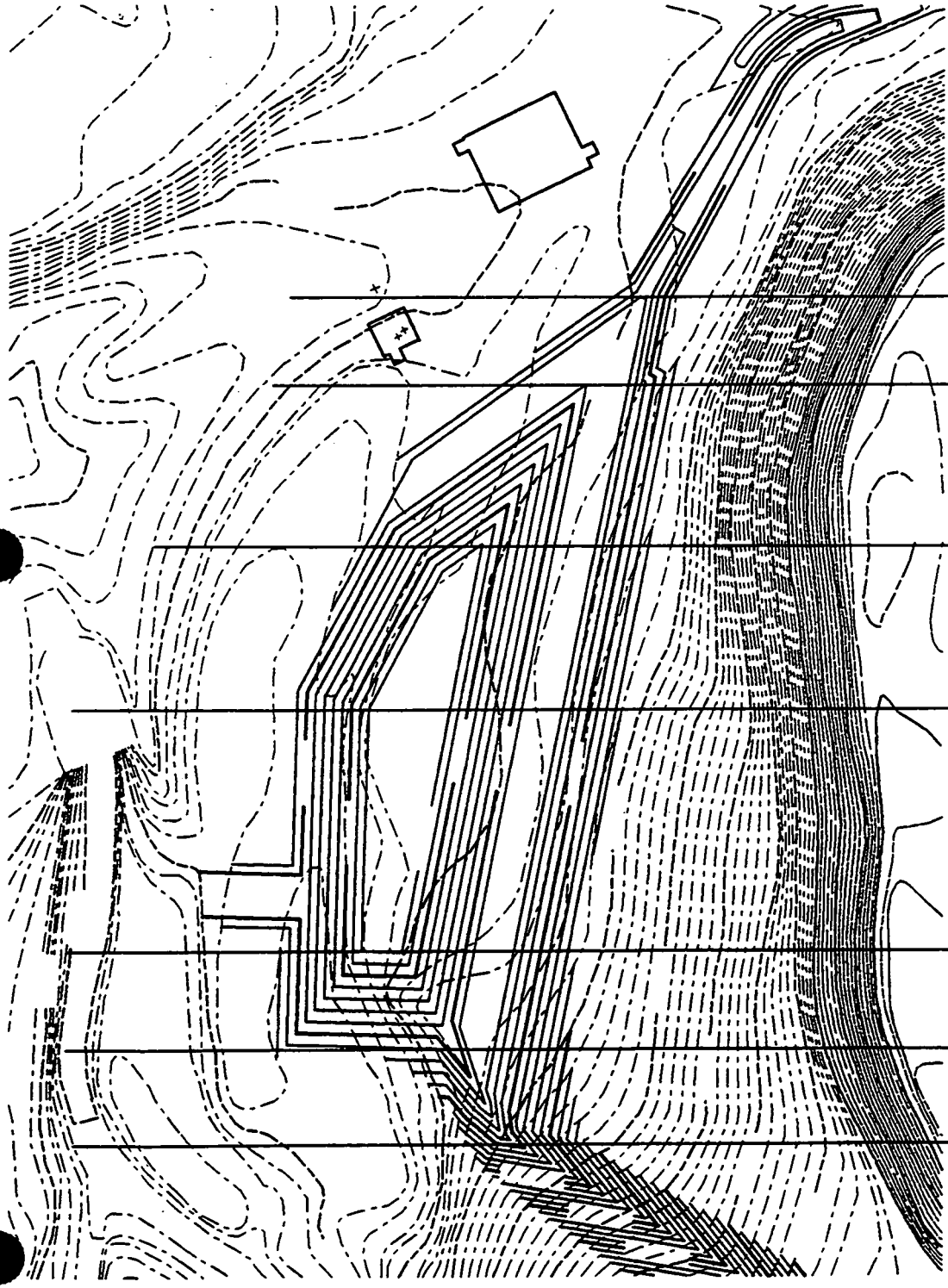
SHT A34

BASIN 3, NON-IMPACTED CUT

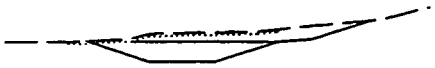
STA	INCR. AREA (SF)	AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0					
		=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
32	0					
		=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
64.9	292					
		=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
146	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)	
256.5	0					
		=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
285.2	0					
						=(G17)/27

000794

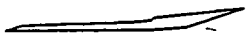
SHT A35



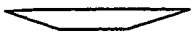
STA 1+46



IMPACTED
STRIPPING = 76.7 SF



IMPACTED SLOPE
CUT = 270.5 SF



NON-IMPACTED
CUT = 409.7 SF

IB = 83.4 SF

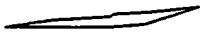
STA 2+55.5

IMPACTED
STRIPPING = 62.0 SF

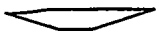
IMPACTED SLOPE
CUT = 113.1 SF

STA 0+64.9

IMPACTED
STRIPPING = 63.6 SF



IMPACTED SLOPE
CUT = 231.4 SF



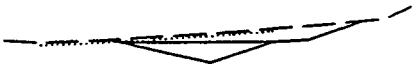
NON-IMPACTED
CUT = 292.0 SF

IB = 72.1 SF

STA 0+32

IMPACTED SLOPE
CUT = 247.2 SF

STA 2+01.2



IMPACTED
STRIPPING = 63.4 SF

IMPACTED SLOPE
CUT = 267.0 SF

NON-IMPACTED
CUT = 238.5 SF

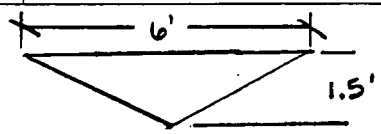
IB = 70.7 SF

ATTACHMENT B, DITCHES & MISC. EXCAVATION

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of B2

Rev	Date	By	Ck	Title

DITCH - D1



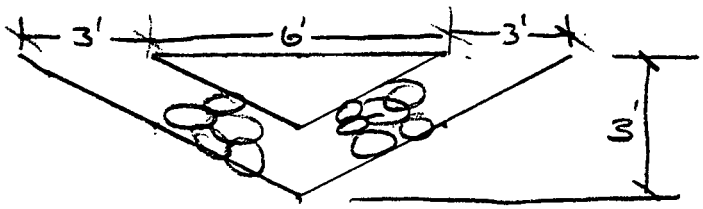
AREA = $[\frac{1}{2}(3) \times 1.5] \times 2 = 4.5$ SF

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

000798

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B3

Rev	Date	By	Ck	Title

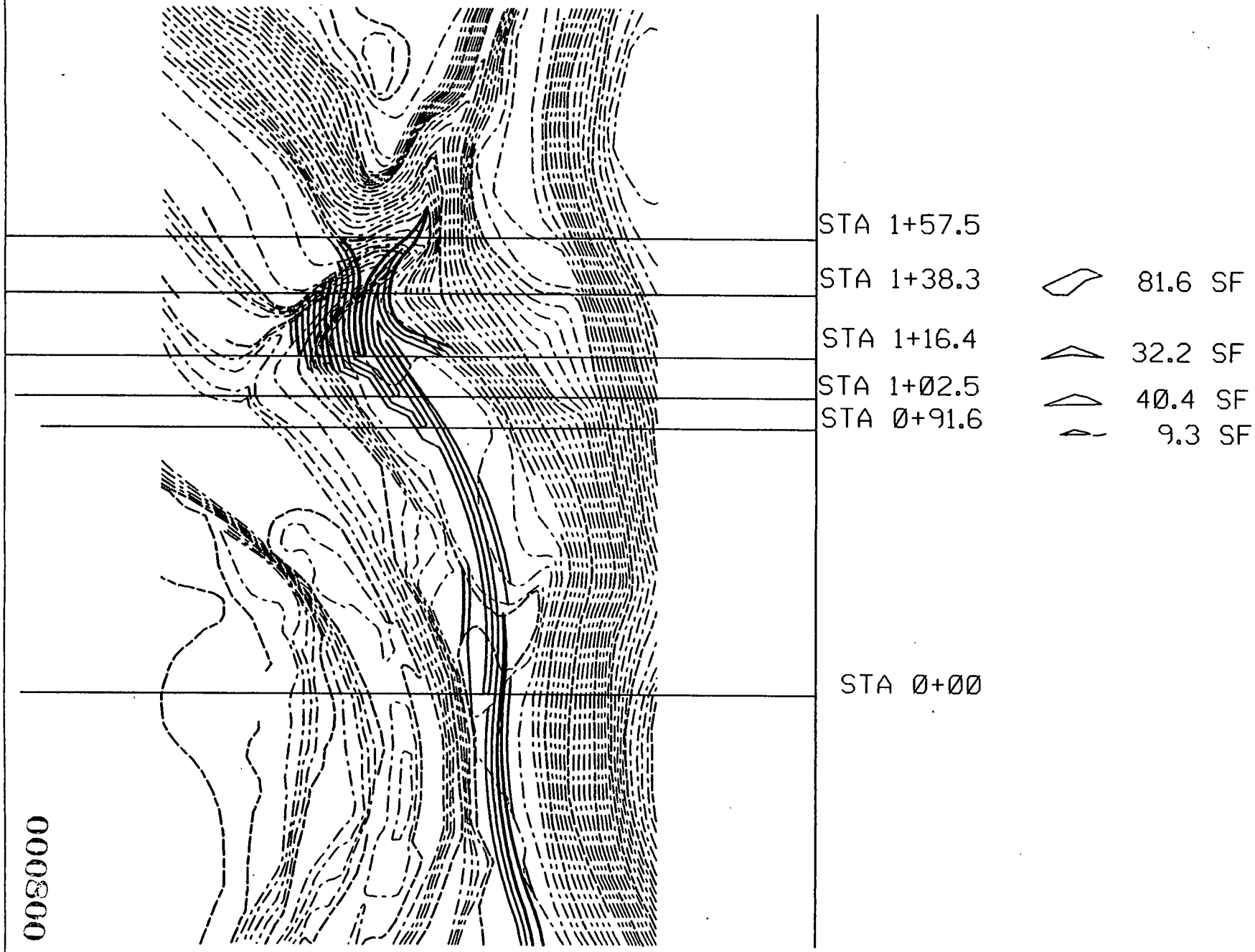
1418

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

000789



008000

SHT 84

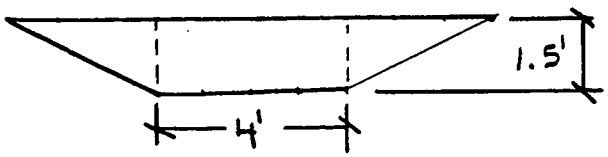
:mstation\cinci\165\sk g04354.dgn Dec. 01, 1997 11:34:45

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
			1418	55

Rev	Date	By	Ck	Title

DITCH - 3

4' SECTION

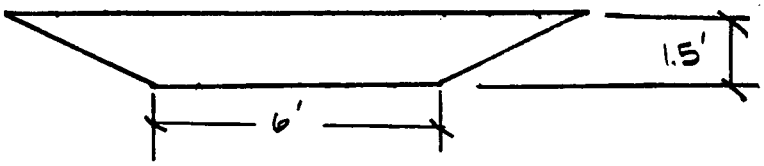


AREA = $\frac{1}{2}(3) \times 1.5 + (4 \times 1.5) + \frac{1}{2}(3) \times 1.5 = 10.5$ SF

LENGTH OF 4' SECTION $\cong$ 66'

VOLUME = 10.5 SF × 66 FT = 693 CF / 27 CF/CY = 25.7 CY

TRANSITION SECTION FROM 4' TO 8' BOTTOM

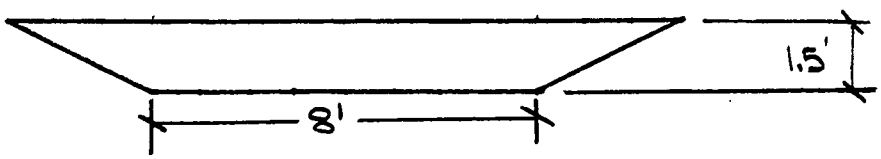


AREA = $[\frac{1}{2}(3) \times 1.5 \times 2] + [6 \times 1.5] = 13.5$ SF

LENGTH OF TRANSITION SECTION $\cong$ 140 FT

VOLUME = 13.5 SF × 140 FT = 1890 CF / 27 CF/CY = 70 CY

8' SECTION



AREA = $(\frac{1}{2}(3) \times 1.5 \times 2) + (8 \times 1.5) = 16.5$ SF

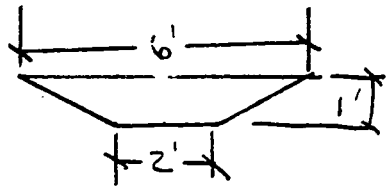
LENGTH $\cong$ 255 FT

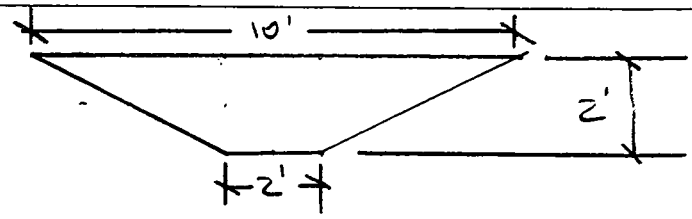
VOLUME = 16.5 SF × 255 FT = 4207.5 CF / 27 CF/CY = 155.8 CY

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

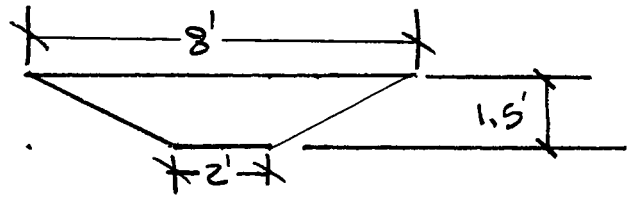
VOL = 12.0 SF × 140 FT = 1680 CF

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

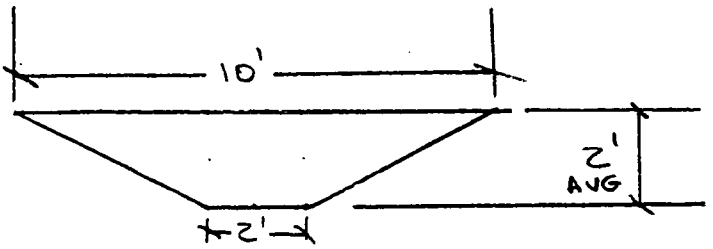
000802

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B7 1418

Rev	Date	By	Ck	Title

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

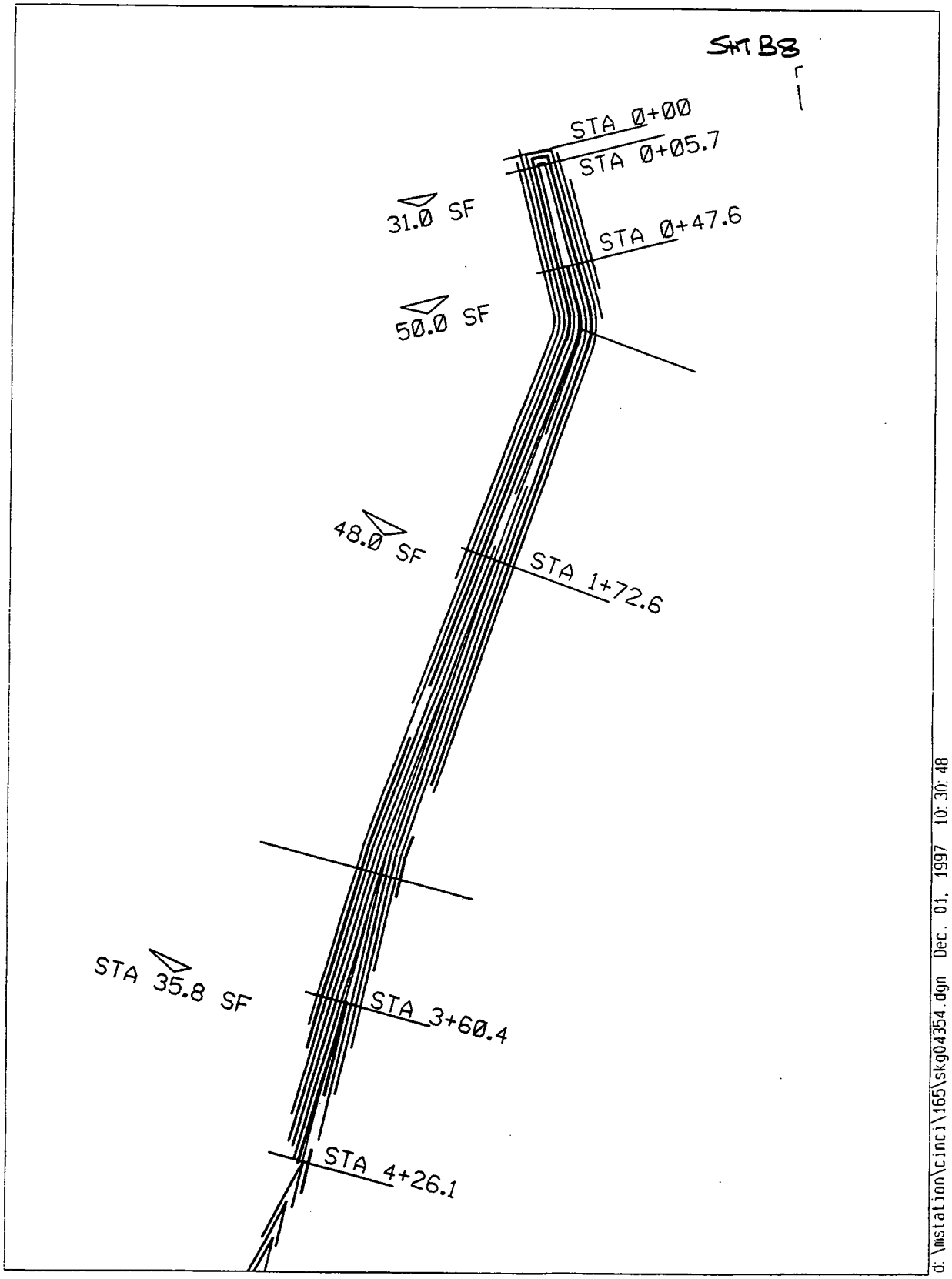
DITCH - D-8A SEE ATTACHED

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

000803

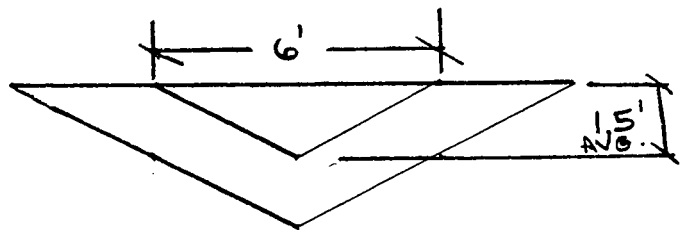

SHT B8
STA 0+00
STA 0+05.7
31.0 SF
STA 0+47.6
50.0 SF
48.0 SF
STA 1+72.6
STA 35.8 SF
STA 3+60.4
STA 4+26.1
d:\mstation\cinci\165\skg04354.dgn Dec. 01, 1997 10:30:48

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B9

Rev	Date	By	Ck	Title

1418

DITCH - 8-B



FROM DITCH 2

AREA = 18.0 SF

LENGTH = 325 FT

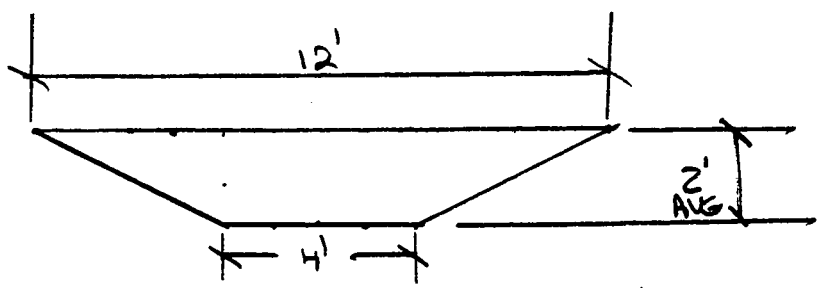
VOL = 18.0 SF × 325 FT = 5850 CF / 27 CF/CY = 217 CY

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

000805

ENG-GE-30 (031896)

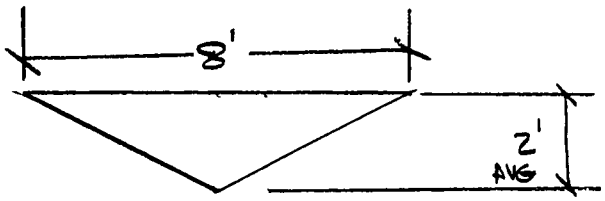
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B10

Rev	Date	By	Ck	Title

D-10A

LENGTH ≅ 120'

AVG DEPTH = 1' → 3' USE 2'

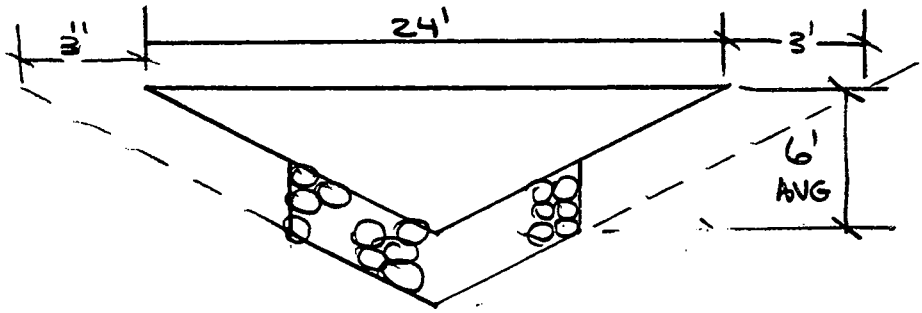


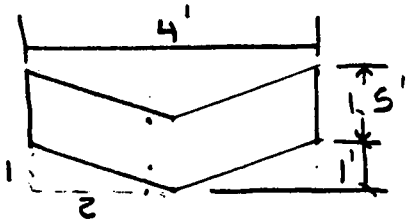
AREA = [½(4) × 2] × 2 = 8.0 SF

VOL = 8.0 SF × 120 FT = 960 CF / 27 CF/CY = 35.6 CY

D-10B

LENGTH = 160 FT





A = 4 × 2.5 = 10.0 SF −

½(2) × 1 × 2 = 2 = 8.0 SF −

½(2) × 1 × 2 = 6.0 SF

RIPRAP = 6.0 SF

EXC = [½(12) × 6 × 2] + 6.0 SF = 78.0 SF

VOL EXC = 78.0 SF × 160 FT = 12480 CF / 27 CF/CY = 462 CY

VOL RIPRAP = 6.0 SF × 160 FT = 960 CF / 27 CF/CY = 36 CY

000806

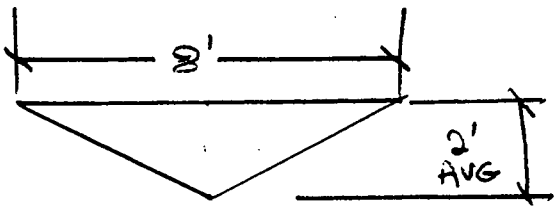
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B11

Rev	Date	By	Ck	Title
				1418

DITCH 11 ABOVE CULVERT 2

1' DEPTH UPPER END
3' LOWER } USE 2'

LENGTH – 175'



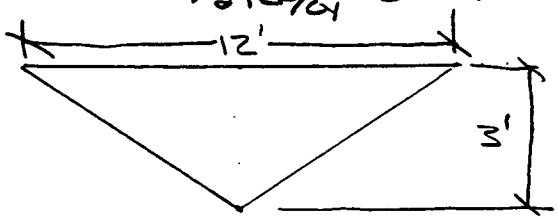
AREA = ½(4) × 2 × 2 = 8.0SF

VOL = 175FT × 8.0SF = 1400CF/27CF/CY = 52CY

BELOW CULVERT 2

LENGTH ≅ 40 FT

AVG DEPTH – 3'



AREA = [½(6) × 3] × 2 = 18.0 SF

VOL. 18.0SF × 40 FT = 720CF/27CF/CY = 27 CY

TOTAL = 52CY + 27CY = 79 CY

000807

ENG-GE-30 (031896)

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B12

Rev	Date	By	Ck	Title

DITCH -12

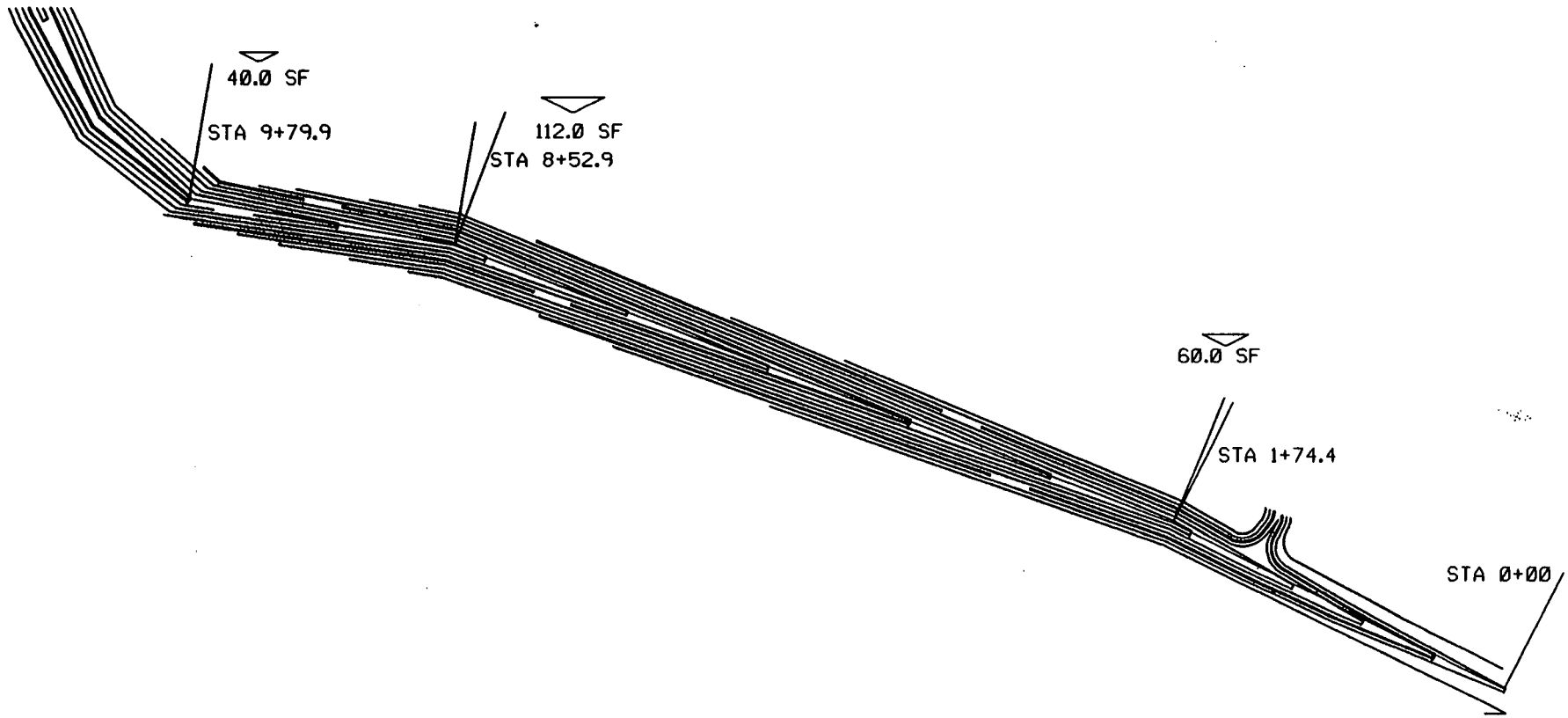
STA	AREA	AREA	L	VOL	Σ VOL
0+00	0				
		30.0	174.4	5232.0	5232.0
174.4	60				
		86.0	678.5	58351.0	63583.0
852.9	112.0				
		76.0	127.0	9652.0	73235.0
979.9	40.0				

TOTAL VOL = 73235.0 CF/27 = 2712 CY

SEE ATTACHED

000808

ENG-GE-30 (031896)



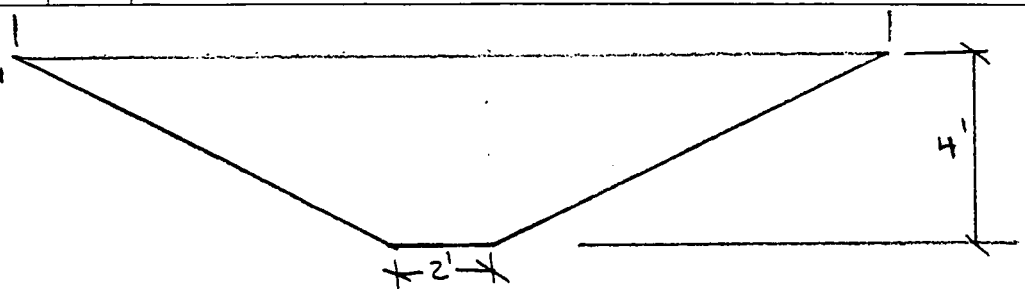
SH 8B

008009

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of B14

Rev	Date	By	Ck	Title

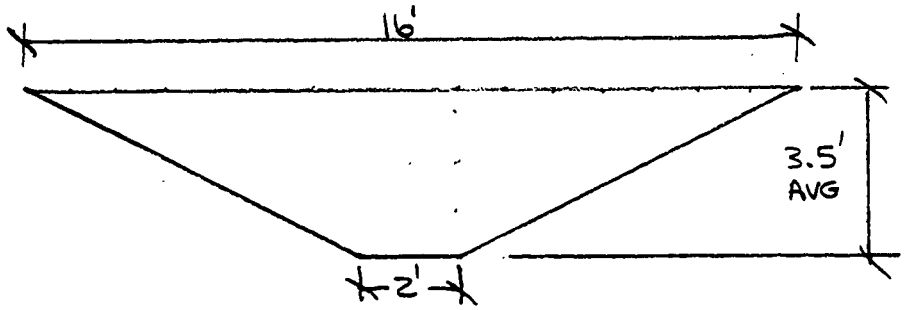
DITCH-13
LENGTH ≅ 125'



$A = [\frac{1}{2}(8) \times 4] \times 2 + (2 \times 4) = 40.0\,SF$

$VOL = 40.0\,SF \times 125' = 5000\,CF / 27\,CF/CY = 185\ CY$

DITCH-14
LENGTH ≅ 325 FT
DEPTH ≅ AVG 3.5 FT



$A = [\frac{1}{2}(7) \times 3.5] \times 2 + (2 \times 3.5) = 31.5\,SF$

$VOL = 31.5\,SF \times 325\,FT = 10237.5\,CF / 27\,CF/CY = 379\ CY$

000810

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B15

Rev	Date	By	Ck	Title

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

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B16

Rev	Date	By	Ck	Title

WHEEL WASH AREA (FILL)

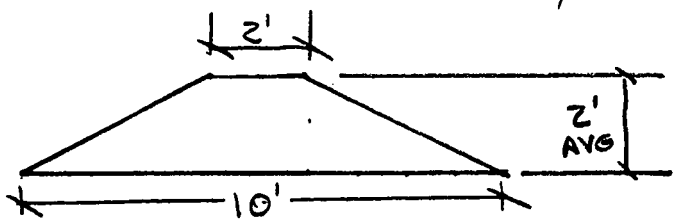
STA	AREA	AREA	L	VOL	Σ VOL (CF)
0+00	0				
		16.8	93.9	1577.5	1577.5
0+93.9	33.5				
		25.8	30.7	792.1	2369.6
1+24.6	18.0				
		20.0	25.4	508.0	2877.6
1+50	22.0				
		17.4	37.2	647.3	3524.9
1+87.2	12.8				
		12.8	5.3	67.8	3592.7
1+92.5	12.8				
		6.4	108.7	696.0	4288.7
3+01.2	0				
			118.8		
4+20	0				

TOTAL VOL = 4288.7 / 27 CF/CY = 158.8 CY

BERM SOUTH OF WHEEL WASH

LENGTH ≅ 50'

AVG HT = 2'



$A = [\frac{1}{2}(4) \times 2] \times 2 + (2 \times 2) = 12.0$ SF

VOL = 12.0 SF × 50 FT = 600 CF / 27 CF/CY = 22.2 CY

158.8
+22.2
TOTAL = 181.0 CY

000812

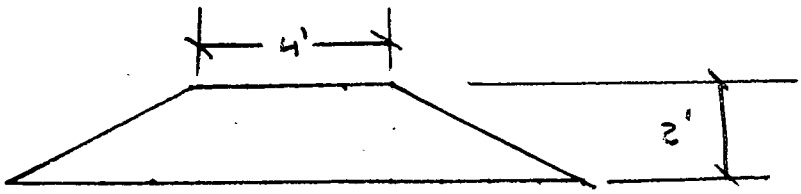
ENG-GE-30 (031896)

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B17

Rev	Date	By	Ck	Title

BERMS @ STOCKPILE #2

AVG SECTION



LENGTH ≅ 1000'

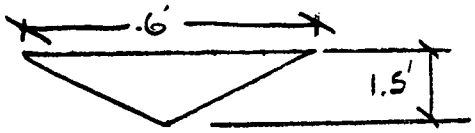
$$\text{AREA} = \left[\tfrac{1}{2}(4) \times 2\right] \times 2 + (4 \times 2) = 16.0\,\text{SF}$$

$$\text{VOL FILL} = 16.0\,\text{SF} \times 1000\,\text{FT} = 16000\,\text{CF}/27\,\text{CF/CY} = 593\,\text{CY}$$

SWALES @ STOCKPILE #2

CUT VARIES FROM 0 TO 2 FT
USE 1.5 FT AVG. DEPTH

LENGTH ≅ 415 FT



$$\text{AREA} = \left(\tfrac{1}{2}(3) \times 1.5\right) \times 2 = 4.5\,\text{SF}$$

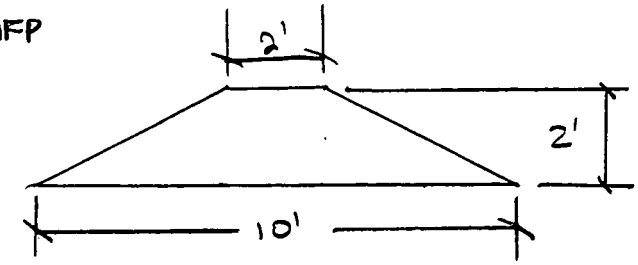
$$\text{VOL} = 4.5\,\text{SF} \times 415\,\text{FT} = 1867.5\,\text{CF}/27\,\text{CF/CY} = 69\,\text{CY}$$

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				B18

Rev	Date	By	Ck	Title

BERM NORTH OF AFP

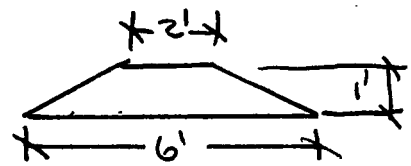
2' HIGH
LENGTH ≅ 120'



$A = [\frac{1}{2}(4) \times 2] \times 2 + (2 \times 2) = 12.0\ SF$

$VOL = 12.0\ SF \times 120\ FT = 1440\ CF / 27\ CF/CY = 53.3\ CY$

1' HIGH
LENGTH ≅ 38'



$A = [\frac{1}{2}(2) \times 1] \times 2 + (2 \times 1) = 4.0\ SF$

$VOL = 4.0\ SF \times 38\ FT = 152.0\ CF / 27\ CF/CY = 5.6\ CY$

$$\text{TOTAL} = \begin{array}{r} 53.3 \\ +\ 5.6 \\ \hline 58.9\ CY \end{array}$$

000814

SHT B19

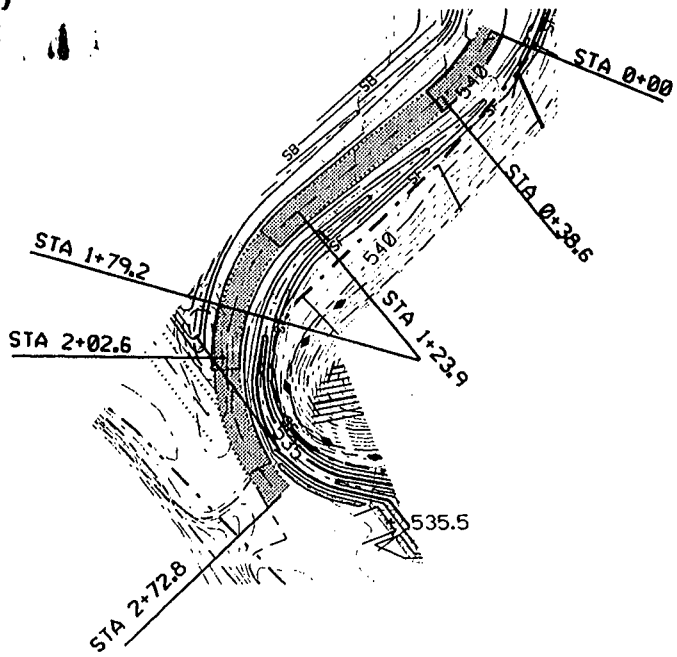
ROAD EARTHWORK

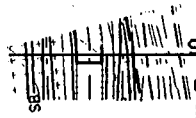
				CUT			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0.00	0.00						
			0.00	38.60	0.00	0.00	
38.60	0.00						
			0.00	85.30	0.00	0.00	
123.90	0.00						
			13.25	78.70	1042.78	1042.78	
202.60	26.50						
			13.25	70.20	930.15	1972.93	
272.80	0.00						
							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

SHT B20

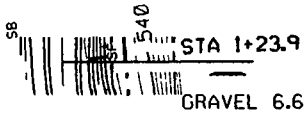
				CUT			
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
0	0						
			=SUM(B5,B7)/2	=(A7-A5)	=PRODUCT(D6,E6)	=(F6)	
38.6	0						
			=SUM(B7,B9)/2	=(A9-A7)	=PRODUCT(D8,E8)	=SUM(G6,F8)	
123.9	0						
			=SUM(B9,B11)/2	=(A11-A9)	=PRODUCT(D10,E10)	=SUM(G8,F10)	
202.5	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)	
202.8	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)

SHT B21 = 1418

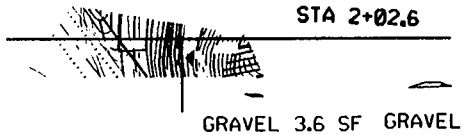




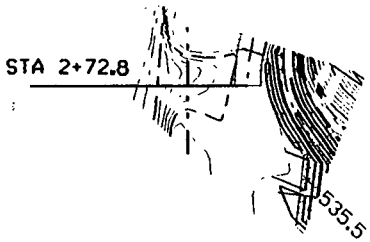
GRAVEL 6.6 SF
FILL 9.6 SF



GRAVEL 6.6 SF
FILL 11.3 SF



GRAVEL 3.6 SF GRAVEL 3.0 SF
FILL 3.9 SF CUT 26.5 SF



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000817

5 HT 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	

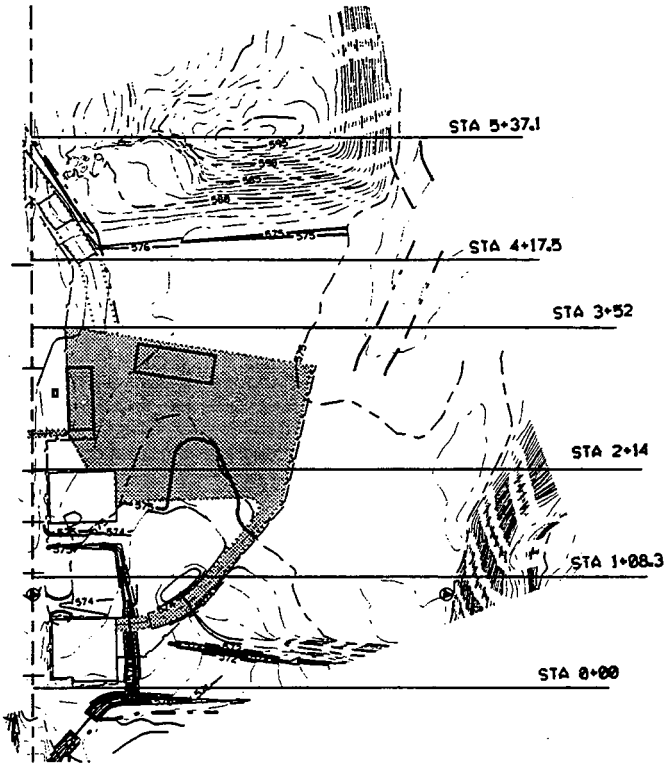
000818

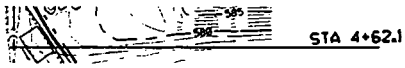
SUPPORT AREA BK

				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)	

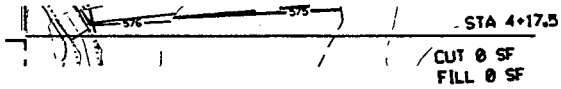
000819

SHT B24

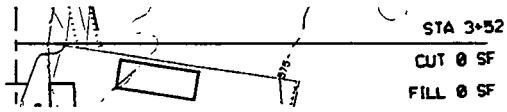




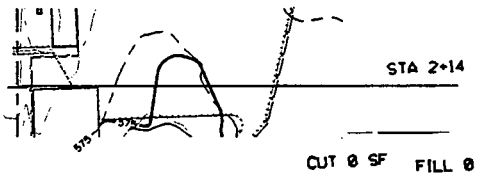
CUT 52.9 SF



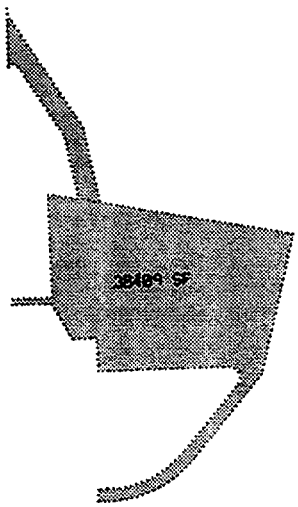
CUT 0 SF
FILL 0 SF

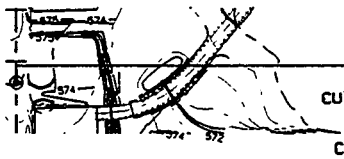


CUT 0 SF
FILL 0 SF



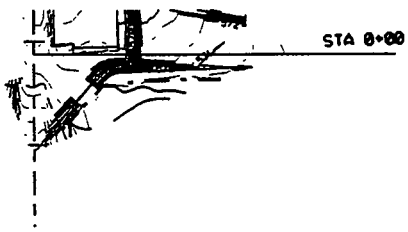
CUT 0 SF FILL 0 SF





CUT 20.5 SF FILL 30.4 SF

CUT 14.8 SF



SHTC1

1418

ATTACHMENT C, EXCAVATION GRADING PLAN 1

SHT C2

EXCAV. GRADING PLAN 1 (SUMMARY)

LOCATION		VOLUME (CY)
EXCAVATION VOL. GRADING PLAN 1		117271.05
VOLUME ABOVE WAC MATERIAL		3728.48
TOTAL		113542.57

116,200

4800

REV.1 ; ABOVE WAC MATERIAL QUANTITY EST. INCREASED TO 4800 yd3 ; EXCAV. VOL. REDUCED CORRESPONDING AMOUNT TO 116,200 yd3

SHT C3

418

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)

000823

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

000824

SHT C5

1418

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)

000825

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

SHT C7
1418

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	7906	=PRODUCT(E6,F6)	=G5/27
400	16.8	11	=SUM(B7,C7)/2				

000827

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

000828

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				C9

Rev	Date	By	Ck	Title

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

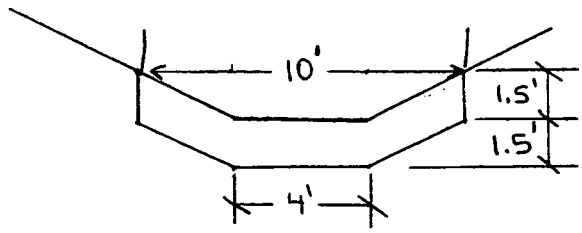
000829

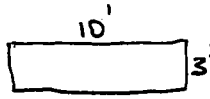
PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
				C10

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

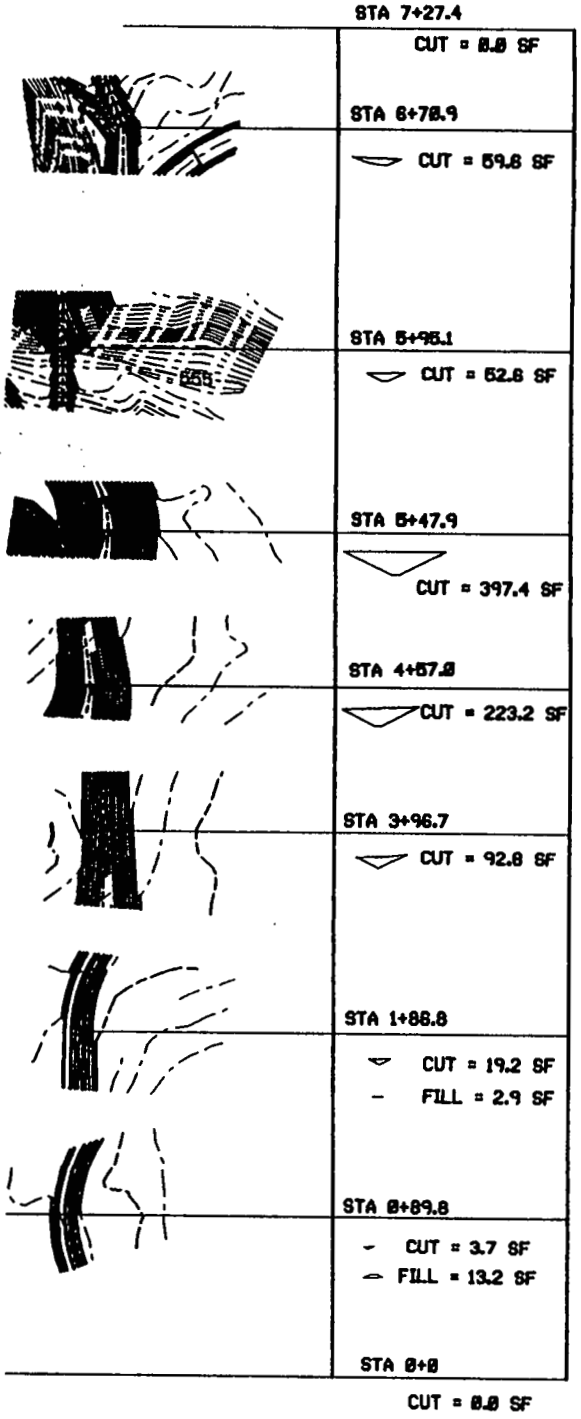
= ½(3) × 1.5 × 2 + (4 × 1.5) = 10.5 SF

= 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

000830



SHT C11

1418

000831

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

SMC13

INT. DITCH 2

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)

000833

SHT D1

1418

ATTACHMENT D, EXCAVATION GRADING PLAN 2

SHT D2

EXCAV. GRADING PLAN 2 (TOTAL)

EXCAVATION GRADING PLAN 2, IFP & SF		120701.91			
EXCAVATION GRADING PLAN 2, AFP		38890.07			
TOTAL		159591.98			

120729

REV. 1 ; LEAD EXCAVATION REDUCED BY 27 yd^3 ; EXCAVATION OF SOUTHFIELD INCREASED BY CORRESPONDING AMOUNT

SHT D3

EXCAV. GRADING PLAN 2 (TOTAL)

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)			

SHT D4

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)
1343.30	0.00						
			591.15	56.70	33518.21	33518.21	
1400.00	1182.30						
			2254.75	100.00	225475.00	258993.21	
1500.00	3327.20						
			3906.40	100.00	390640.00	649633.21	
1600.00	4485.60						
			4874.25	100.00	487425.00	1137058.21	
1700.00	5262.90						
			6111.25	100.00	611125.00	1748183.21	
1800.00	6959.60						
			7874.70	50.00	393735.00	2141918.21	
1850.00	8789.80						
			9030.25	50.00	451512.50	2593430.71	
1900.00	9270.70						
			6152.90	100.00	615290.00	3208720.71	
2000.00	3035.10						
			1517.55	33.10	50230.91	3258951.62	
2033.10	0.00						
							120701.91

REV 1; SEE NOTE ON PAGE D-2

000837

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)
1343.3	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
1400	1182.3						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
1500	3327.2						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
1600	4485.6						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
1700	5262.9						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
1800	5959.6						
			=SUM(B16,B18)/2	=(A18-A16)	=PRODUCT(D17,E17)	=SUM(G15,F17)	
1850	6789.8						
			=SUM(B18,B20)/2	=(A20-A18)	=PRODUCT(D19,E19)	=SUM(G17,F19)	
1900	9270.7						
			=SUM(B20,B22)/2	=(A22-A20)	=PRODUCT(D21,E21)	=SUM(G19,F21)	
2000	3035.1						
			=SUM(B22,B24)/2	=(A24-A22)	=PRODUCT(D23,E23)	=SUM(G21,F23)	
2033.1	0						
							=(G23/27)

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

SHT D7

1418

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	2493.7						
			=SUM(B14,B16)/2	=(A16-A14)	=PRODUCT(D15,E15)	=SUM(G13,F15)	
3444.8	0						
							=(G15/27)

000840

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 100 yd3

SHT D9

1418

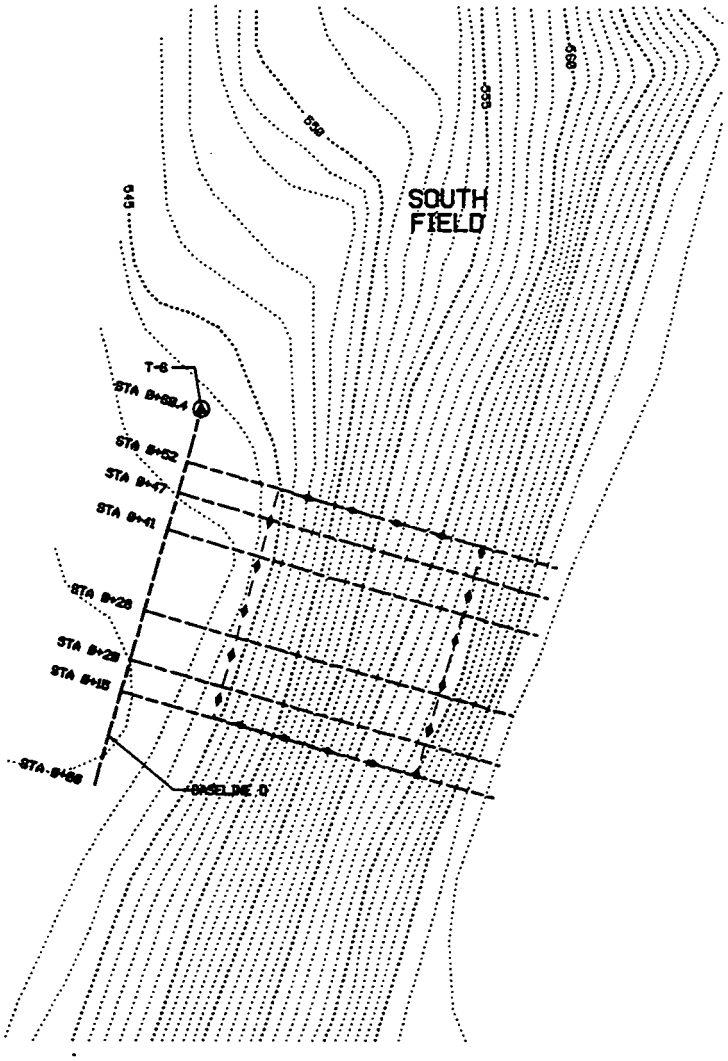
LEAD EXCAVATION

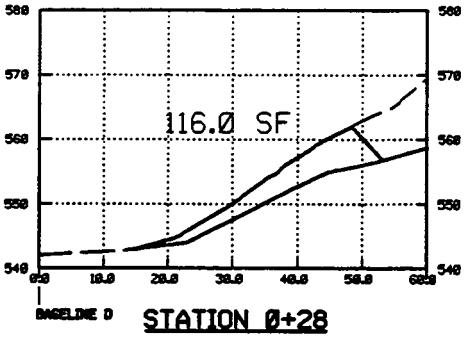
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
15	0						
			=SUM(B5,B7)/2	=(A7-A5)	=PRODUCT(D6,E6)	=(F6)	
20	102.3						
			=SUM(B7,B9)/2	=(A9-A7)	=PRODUCT(D8,E8)	=SUM(G6,F8)	
28	116						
			=SUM(B9,B11)/2	=(A11-A9)	=PRODUCT(D10,E10)	=SUM(G8,F10)	
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)

000842

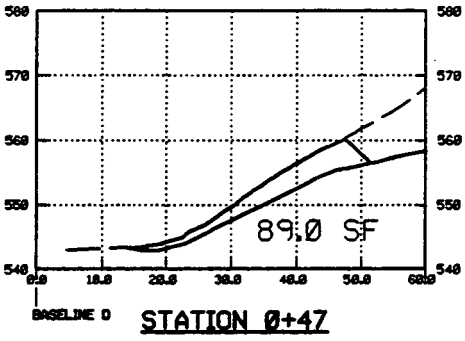
SHT D10

REV. 1, SEE SHEET D8





STATION 0+28



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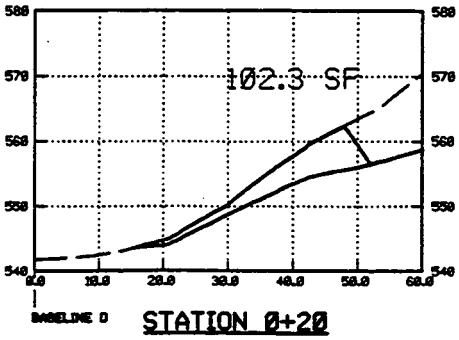

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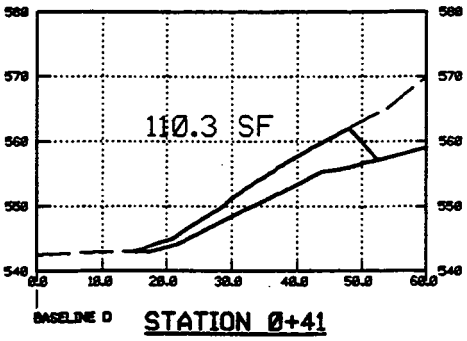


STATION 0+41

000843

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

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	106.4						
			=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)

000845

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			

000847

EXCAV. GRADING PLAN 3 (TOTAL)

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)			

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

SHT E5
.1 Q

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	2067.6						
			=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)	
1667.3	0						
							=(G19/27)

000850

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

000851

EXCAV. GRADING PLAN 3 (AFP)

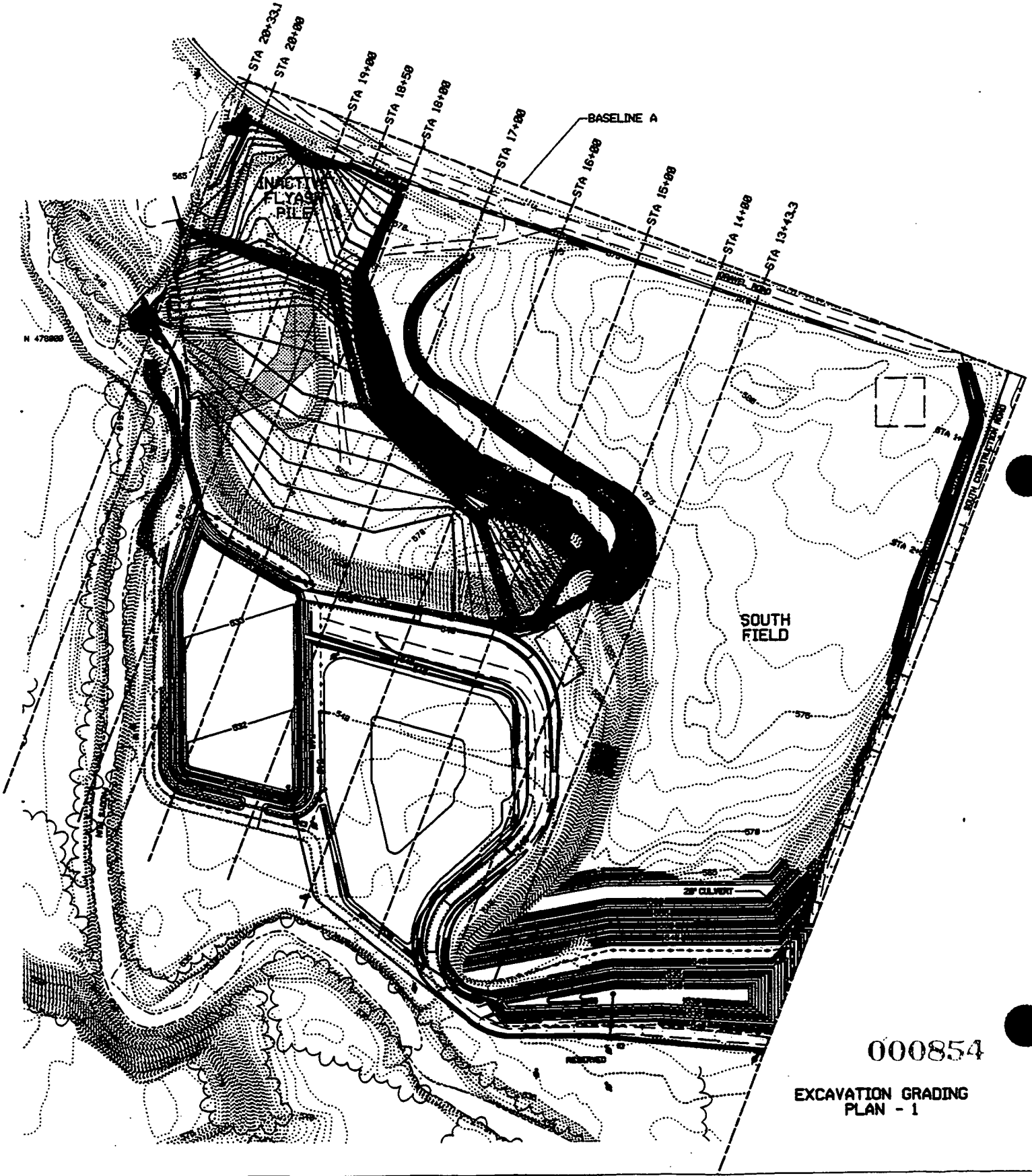
STA	INCR. AREA (SF)		AVG. AREA (SF)	INCR. LENGTH (FT)	INCR. VOL. (CF)	CUM. VOL. (CF)	CUM. VOL. (CY)
3050.3	0						
			=SUM(B6,B8)/2	=(A8-A6)	=PRODUCT(D7,E7)	=(F7)	
3100	2845.3						
			=SUM(B8,B10)/2	=(A10-A8)	=PRODUCT(D9,E9)	=SUM(G7,F9)	
3200	2941.6						
			=SUM(B10,B12)/2	=(A12-A10)	=PRODUCT(D11,E11)	=SUM(G9,F11)	
3300	1074.6						
			=SUM(B12,B14)/2	=(A14-A12)	=PRODUCT(D13,E13)	=SUM(G11,F13)	
3400	0						
							=(G13/27)

SHT F1

1418

ATTACHMENT F, GRADING PLANS/ SECTION LOCATIONS/CROSS SECTIONS

SHT F2



000854

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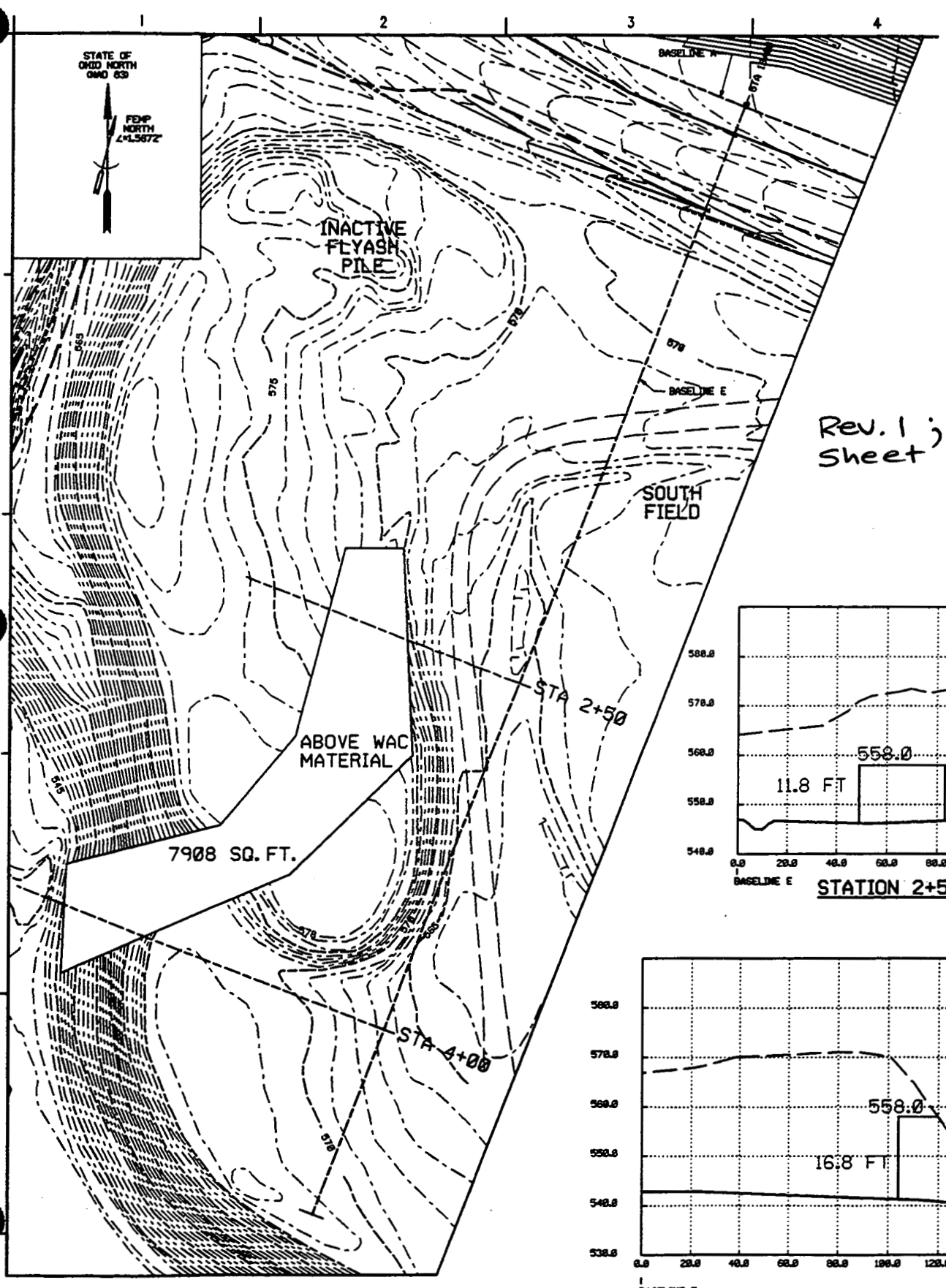
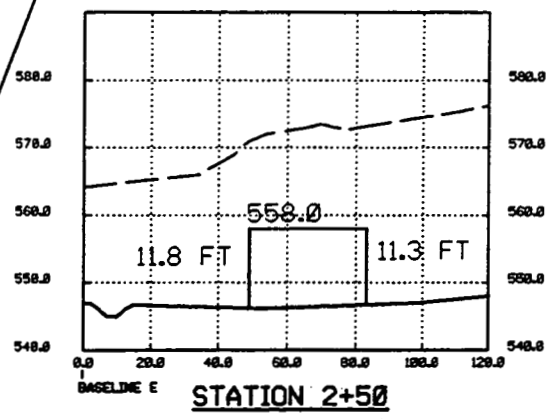
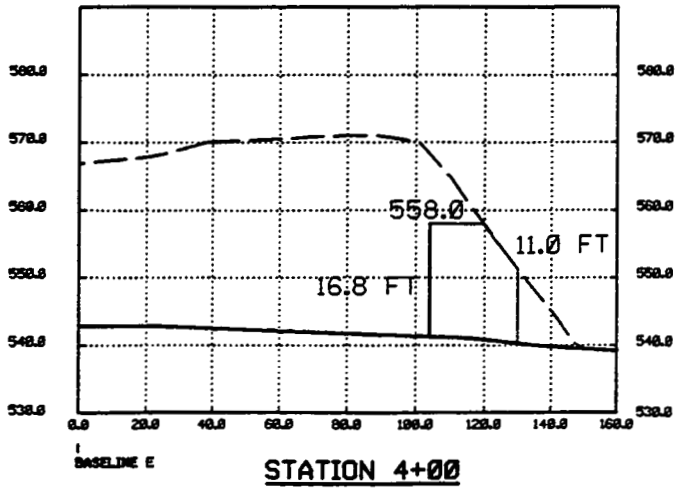


Rev. 1; See Sheet C6



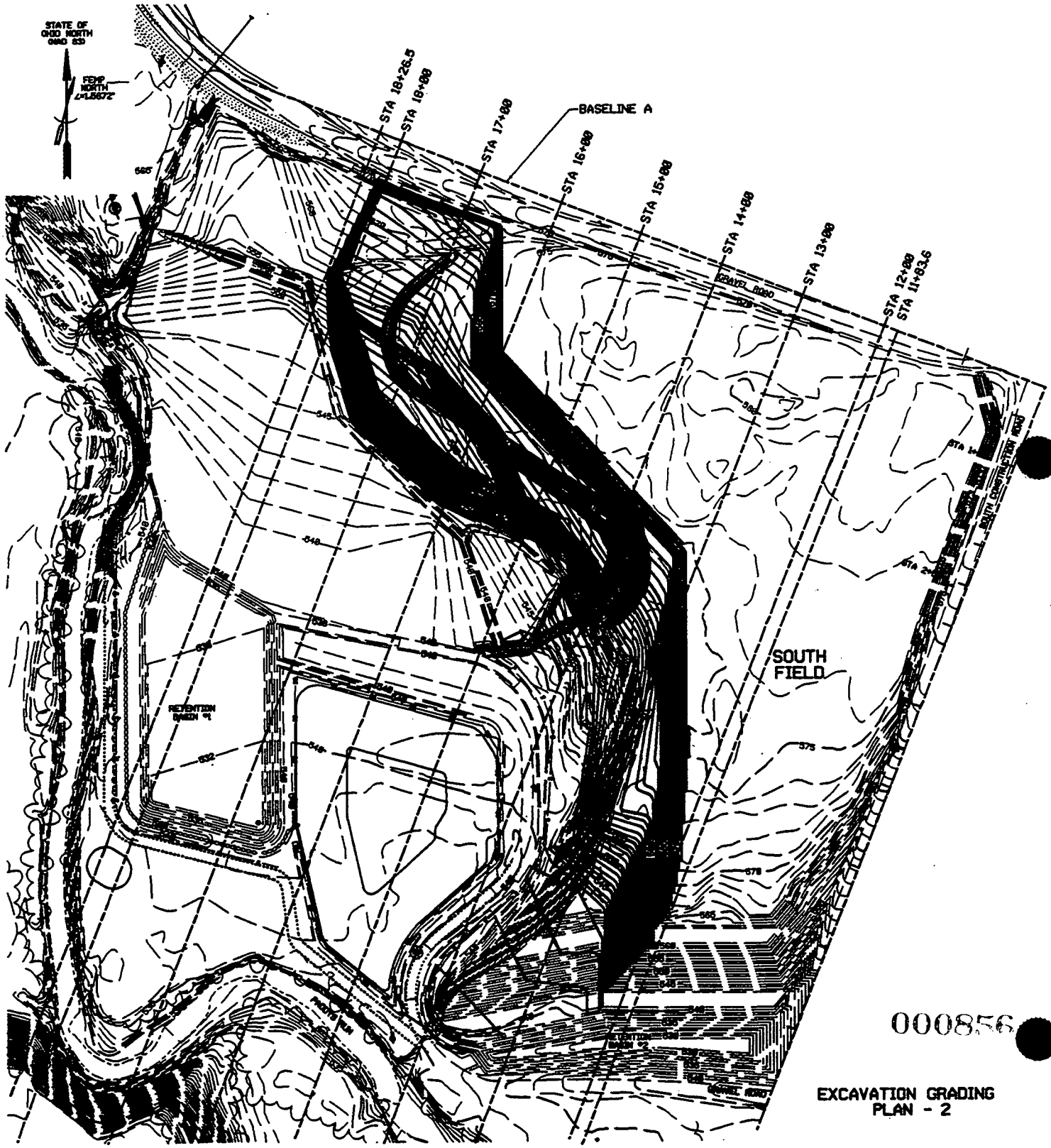
STATION 2+50



STATION 4+00

ABOVE WAC MATERIAL
EXCAVATION AREA PLAN

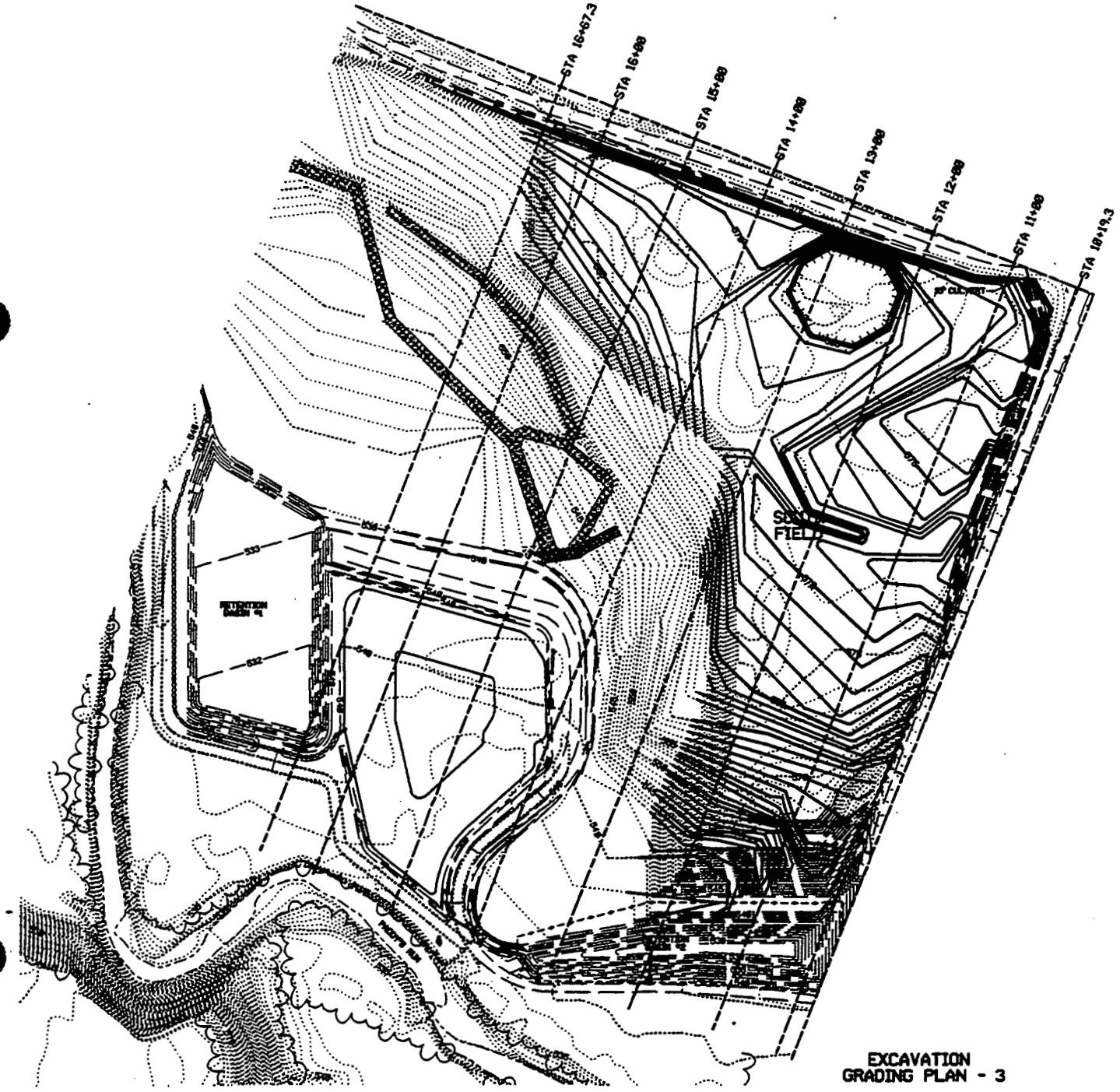
SHT F4



000856

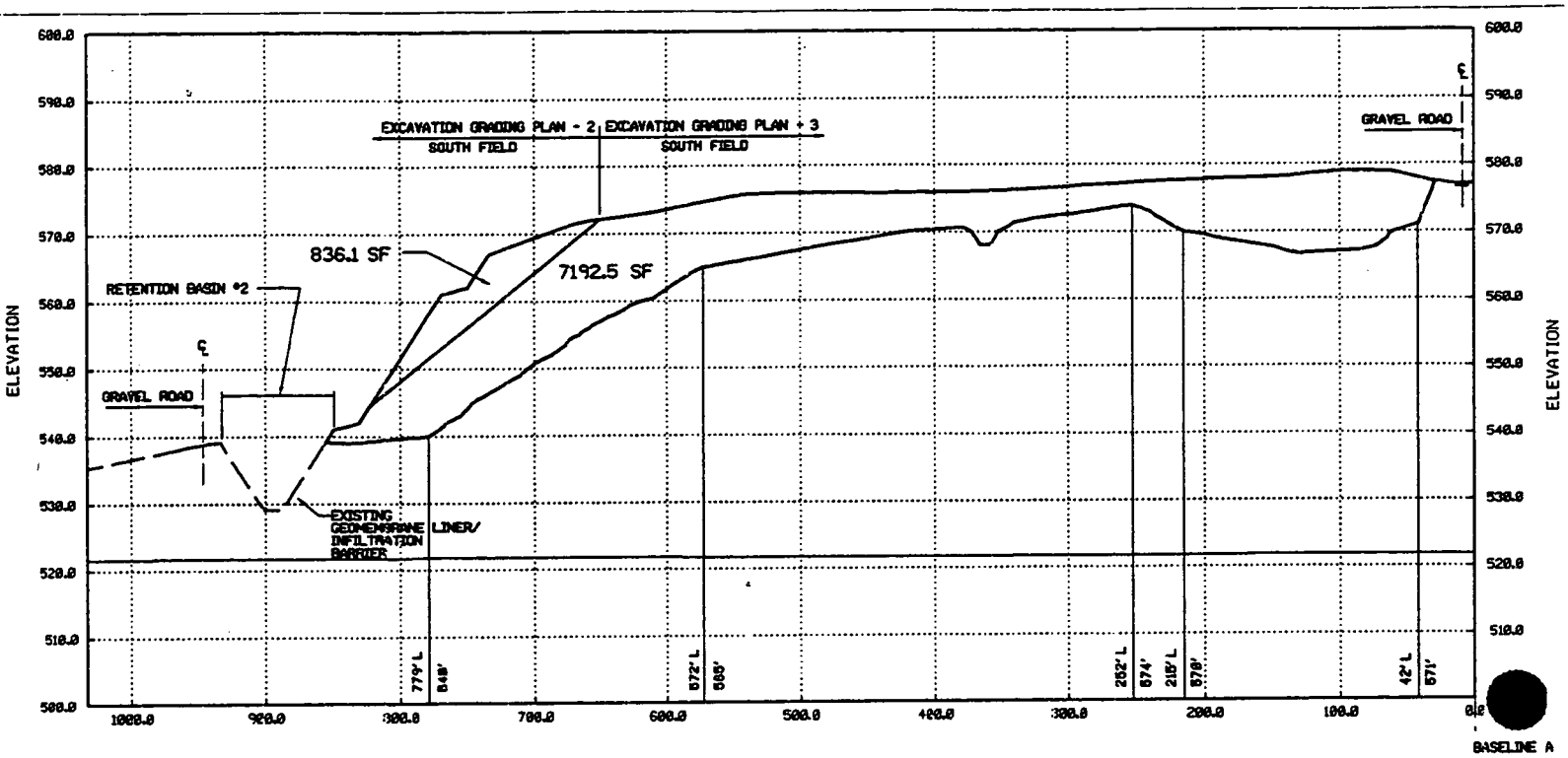
EXCAVATION GRADING PLAN - 2

SHTFS



EXCAVATION
GRADING PLAN - 3

SHT F6



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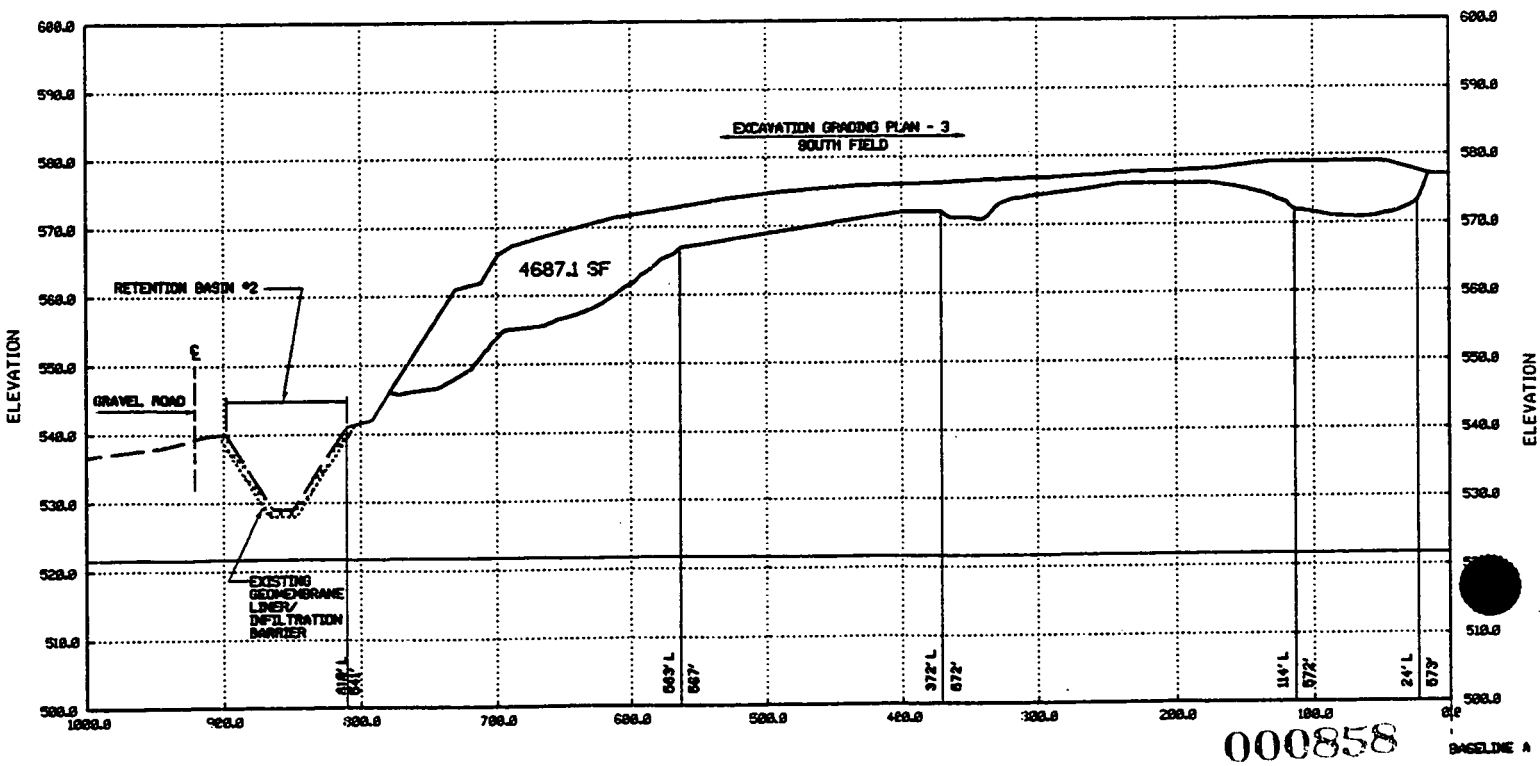
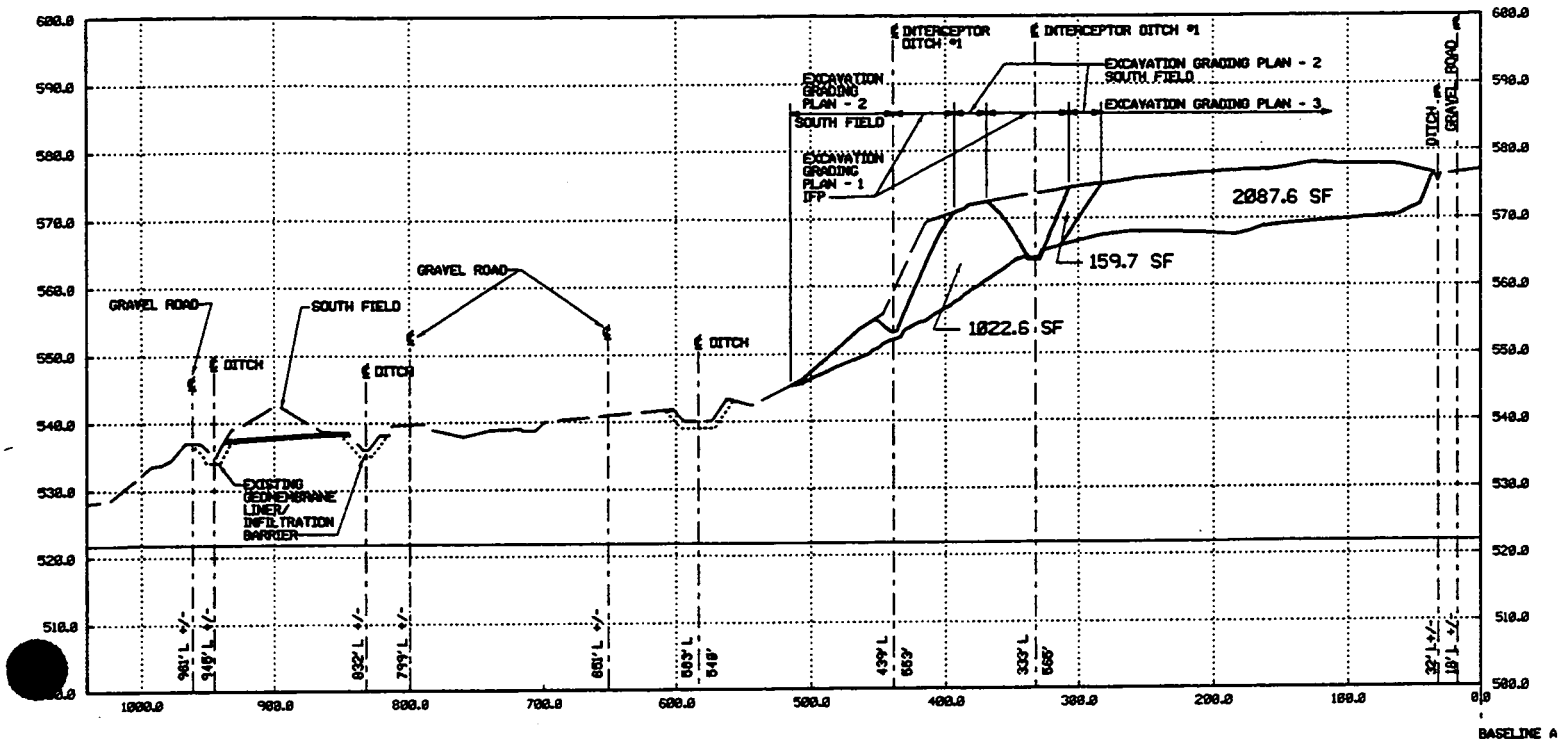


000858

BASELINE A, STATION 11+00 REF

SHT F7



BASELINE A, STATION 14+00

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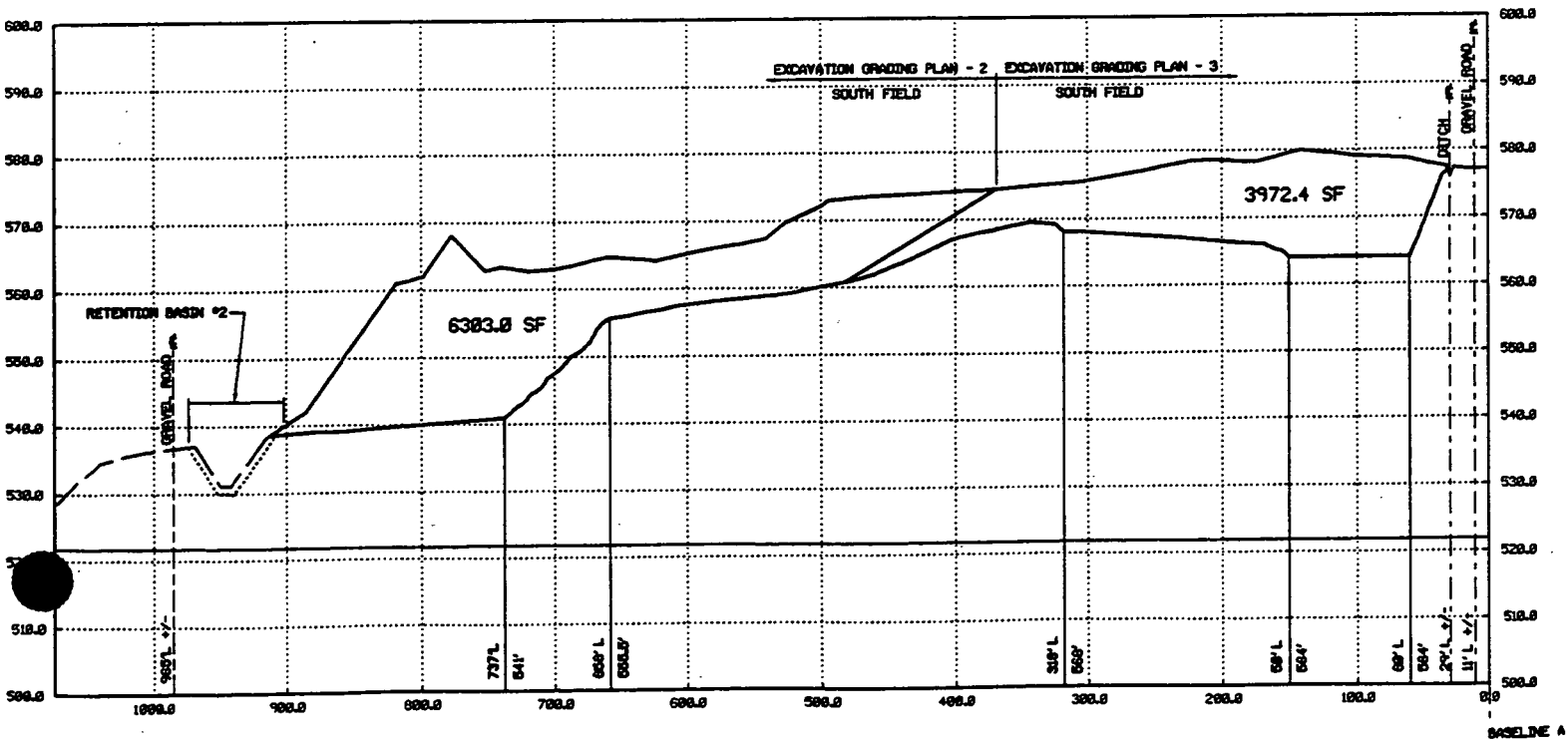
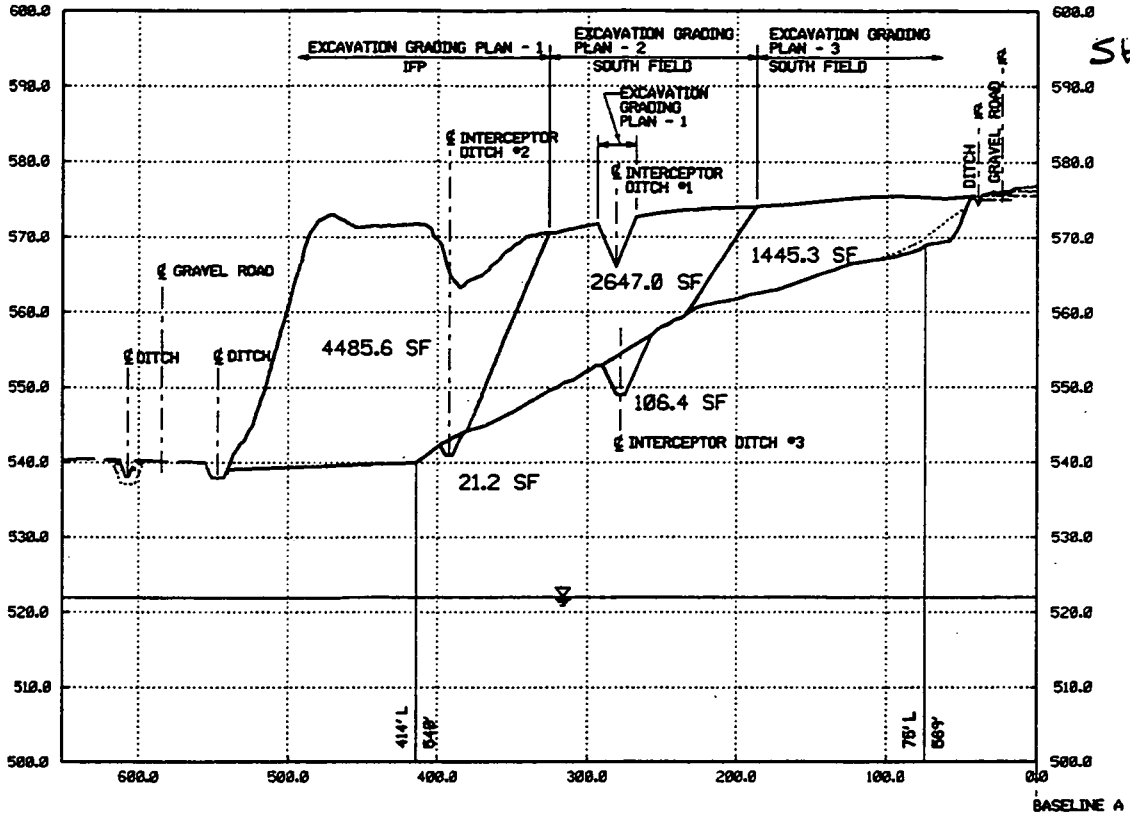


BASELINE A, STATION 13+00

SCALE: HOR 1"=60' VER 1"=10'

SHT F8



BASELINE A, STATION 16+00

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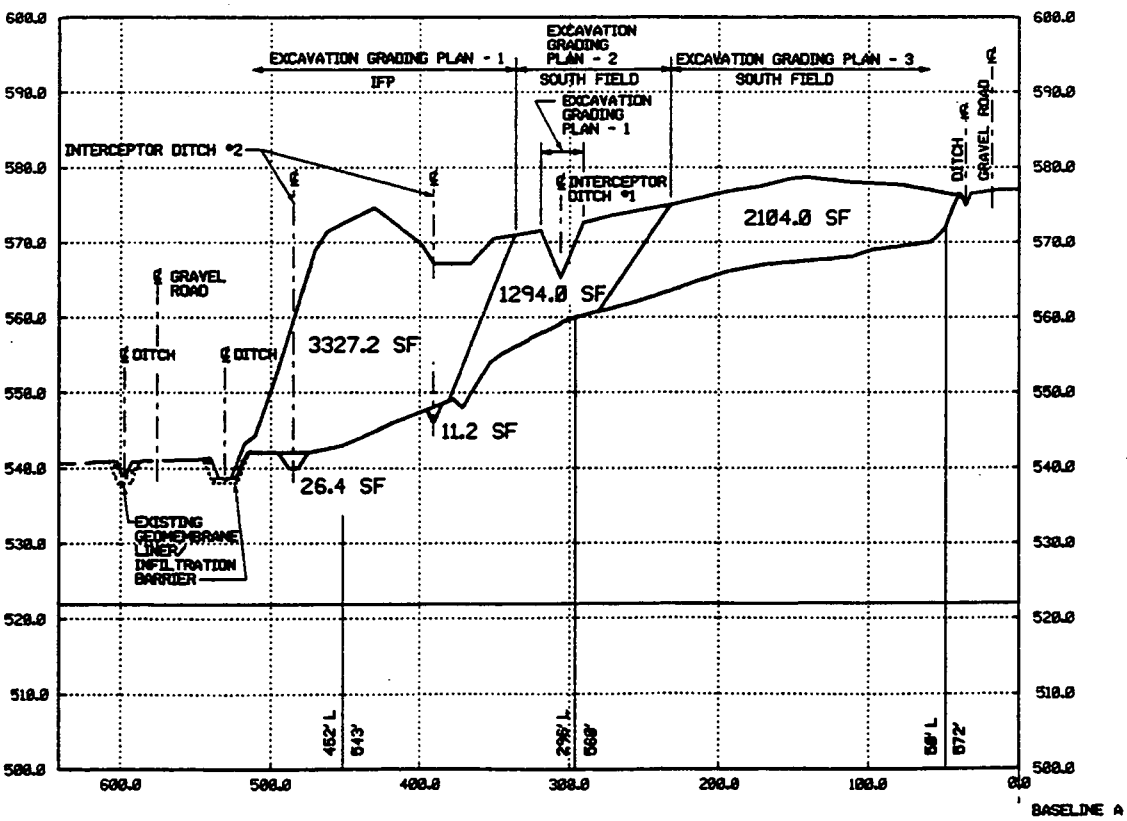
REF G0005 G0007



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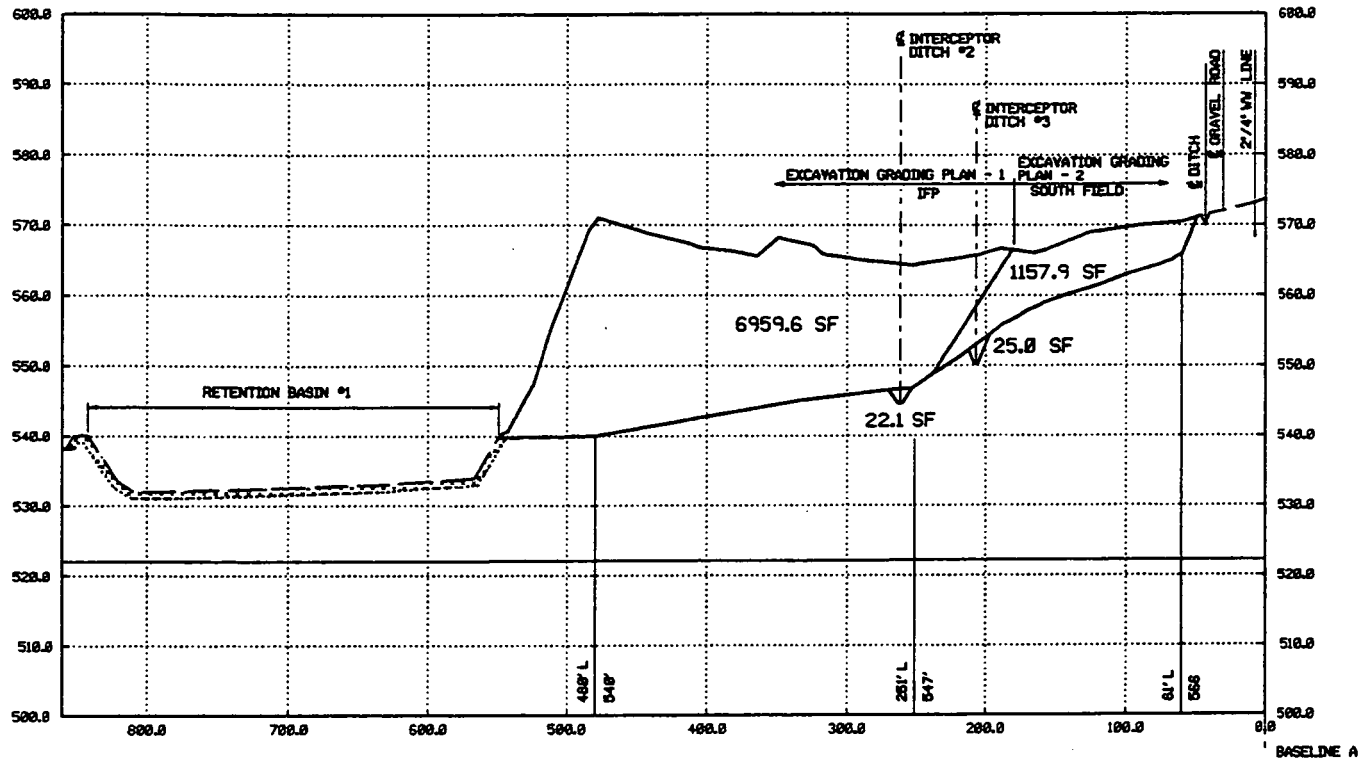
SCALE: HOR 1"=50' VER 1"=10'

REF G0005 G0007

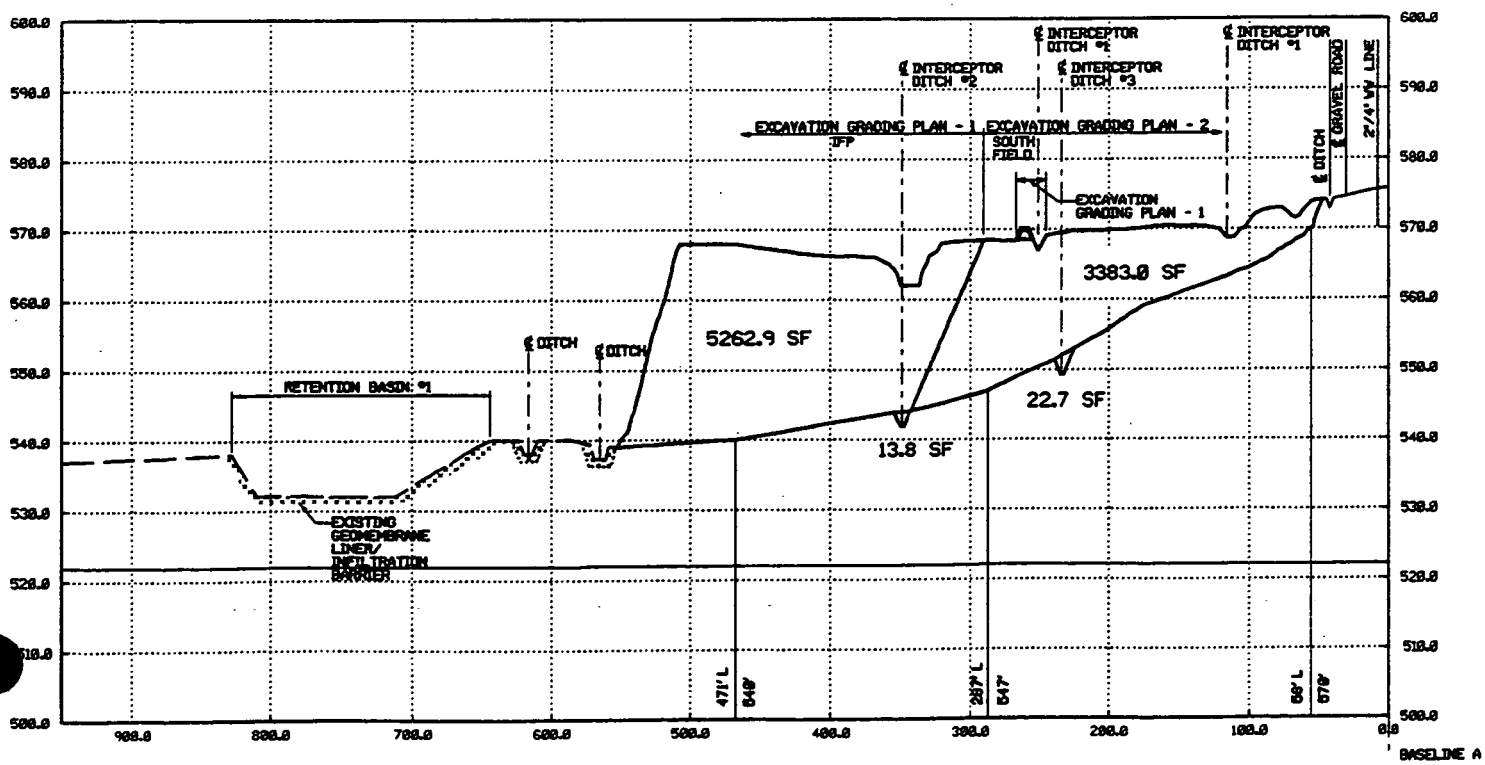
000860

SHT F9



BASELINE A, STATION 18+00

SCALE: HOR 1"=50' REF G0005
VER 1"=10' G0007



BASELINE A, STATION 17+00

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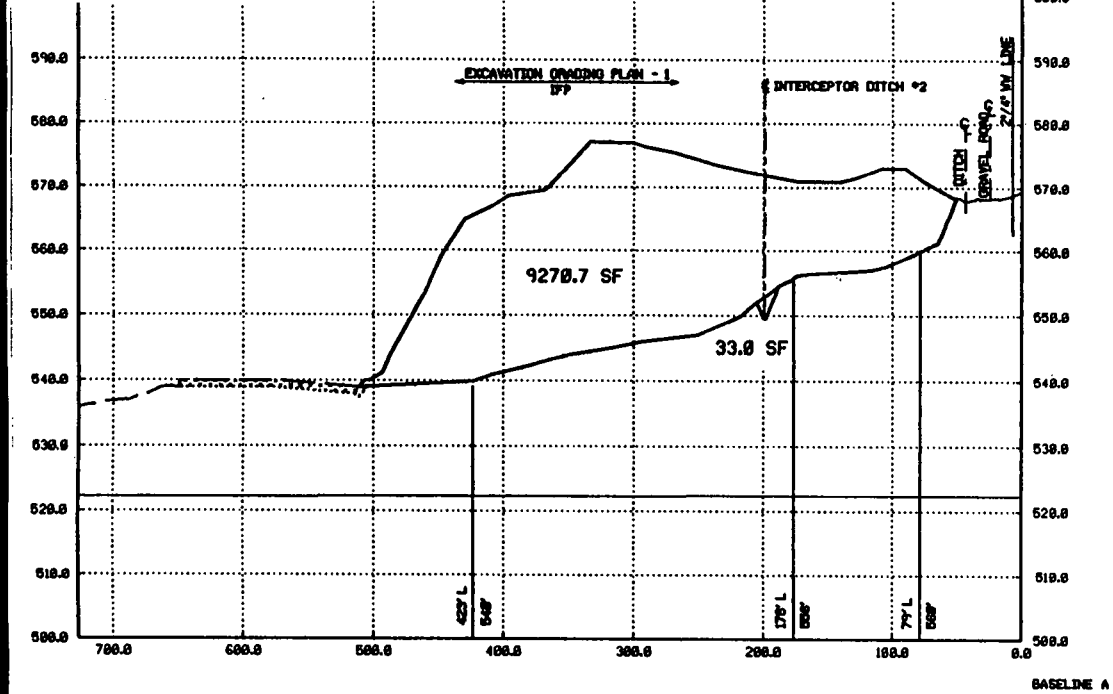
VER 1"=10' G0007



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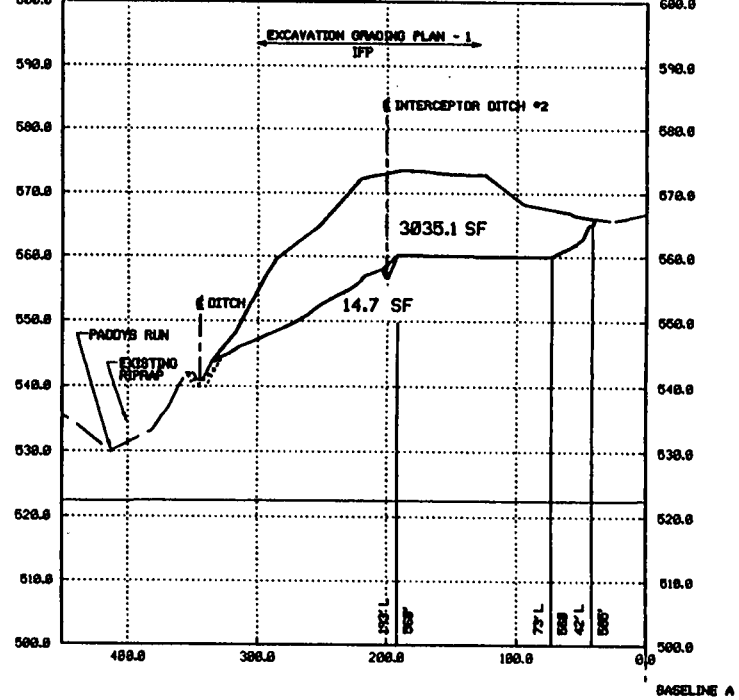

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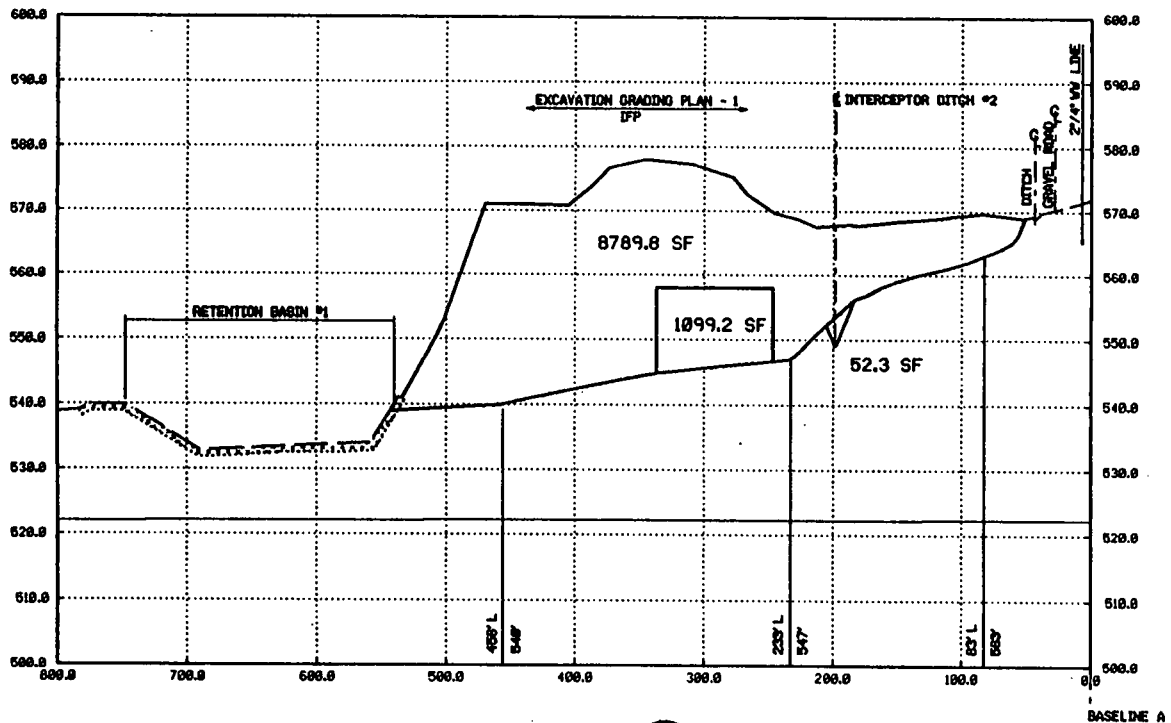

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SHT F10

298000

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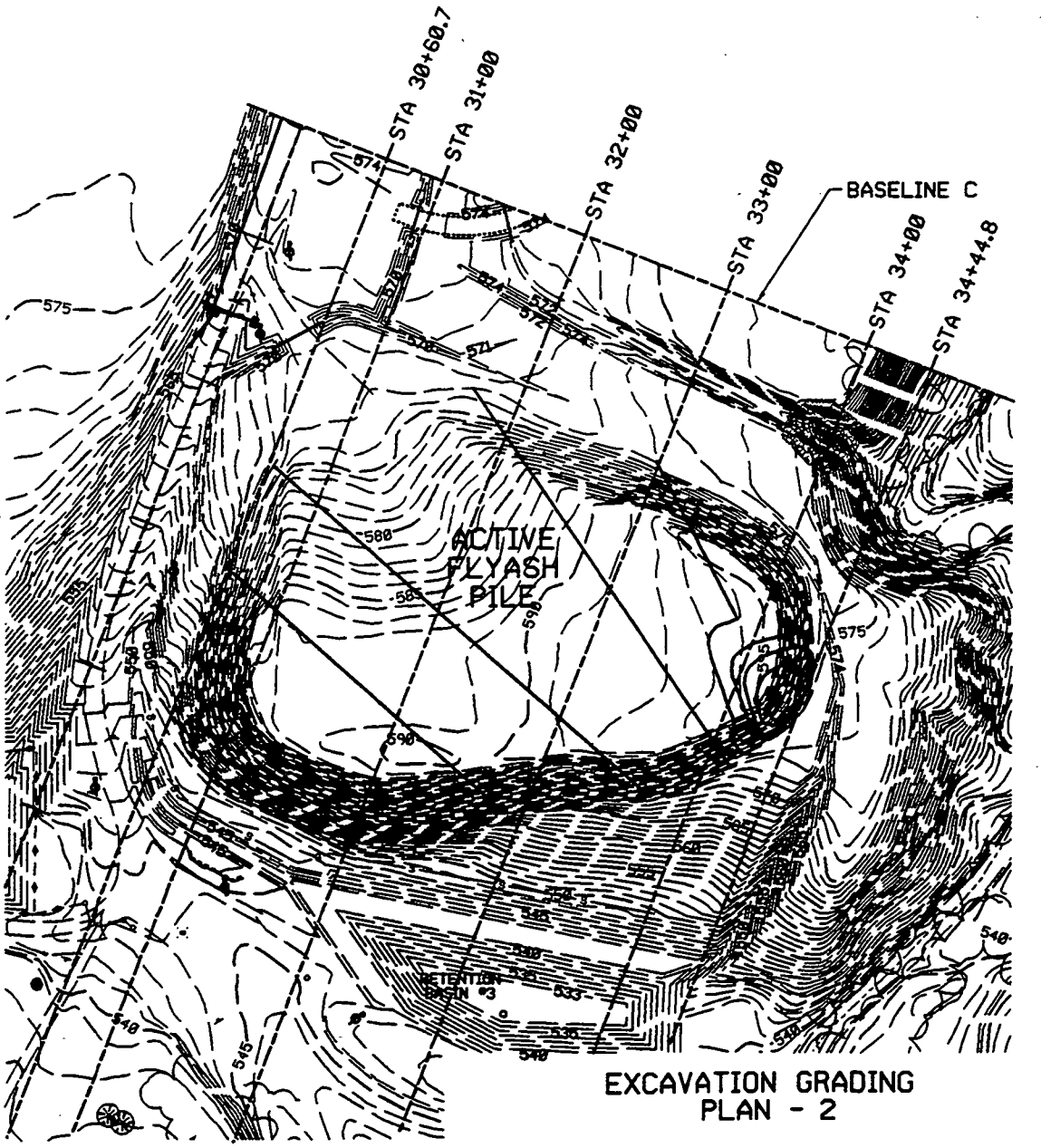
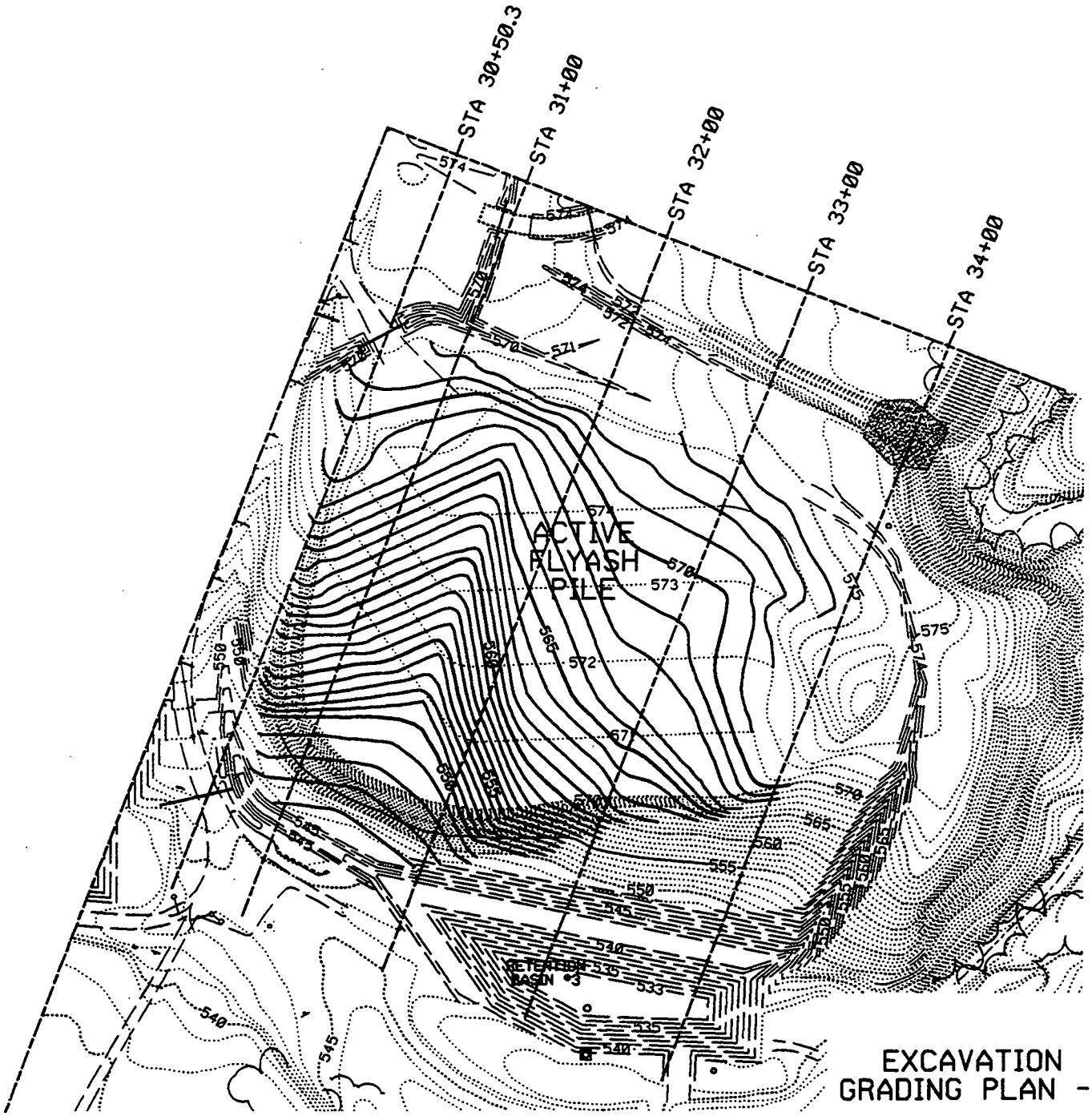
SHT F11

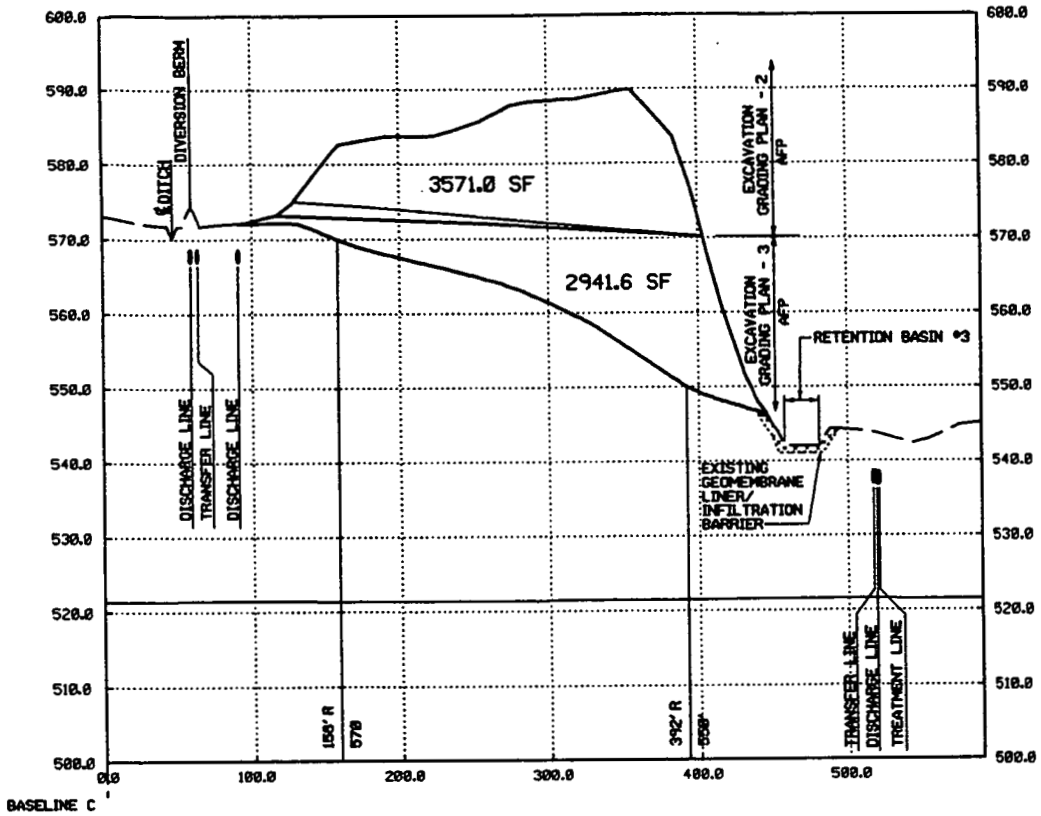


EXCAVATION GRADING PLAN - 2

SHT F12



EXCAVATION
GRADING PLAN - 3



BASELINE C, STATION 32+00 REF G0007

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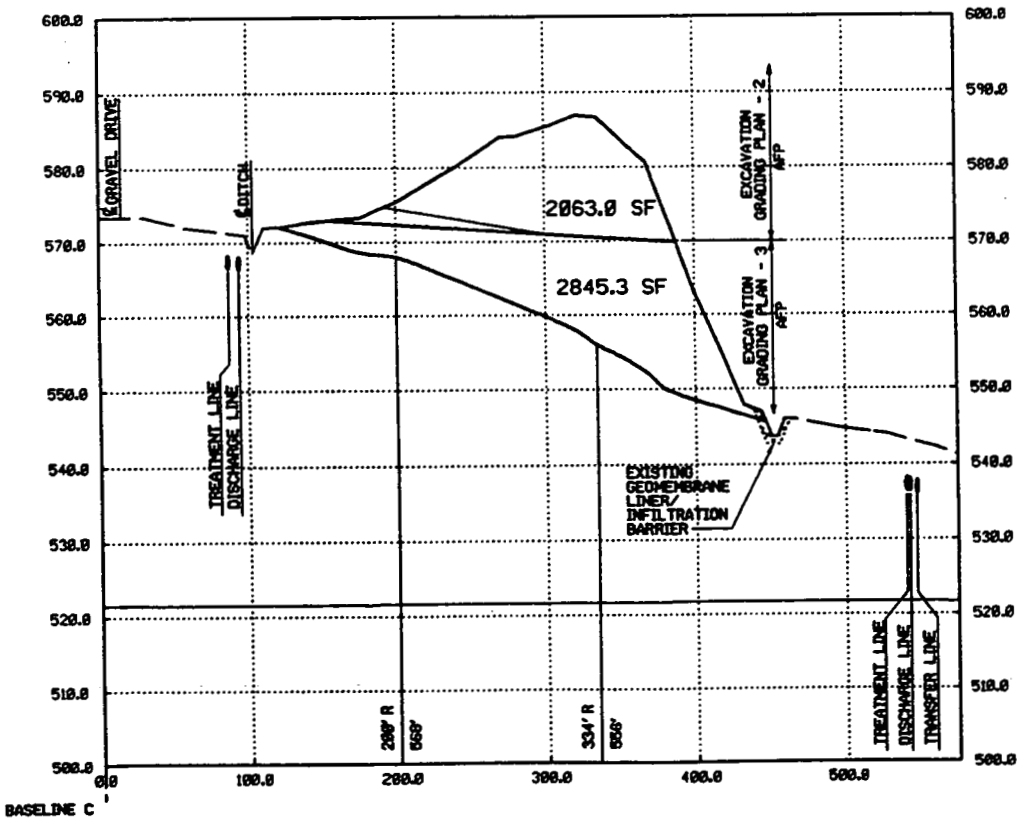

BASELINE C, STATION 31+00 REF G0007

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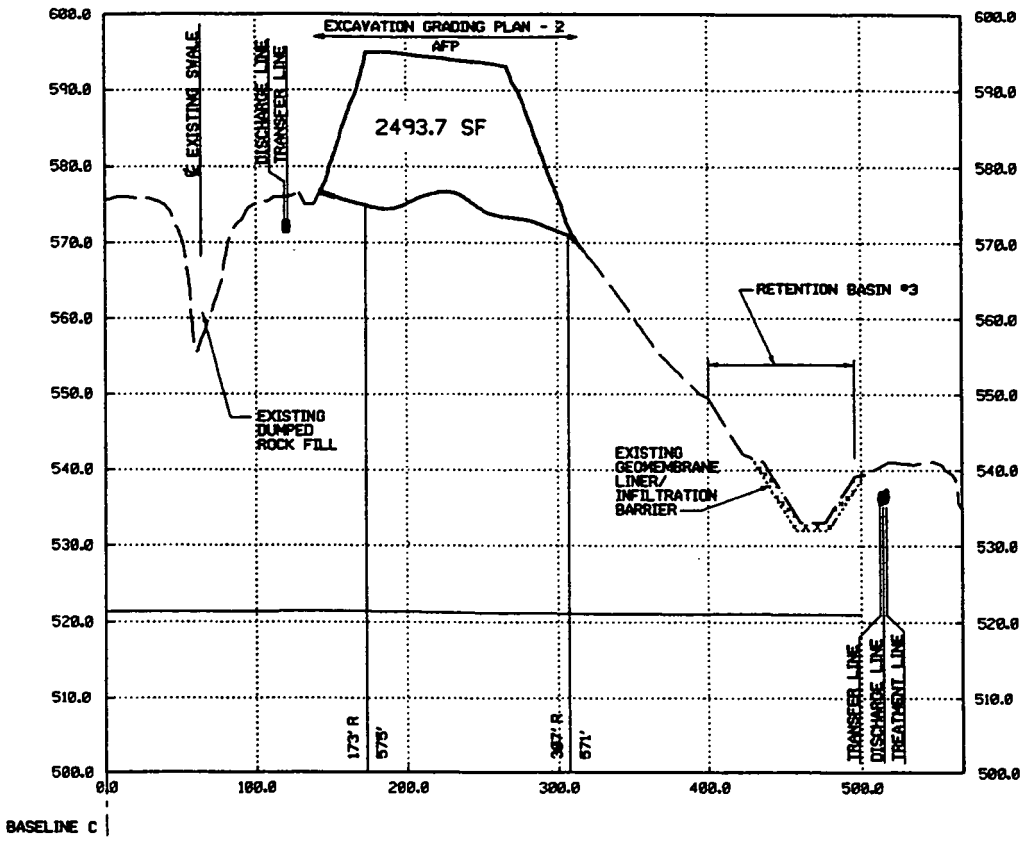

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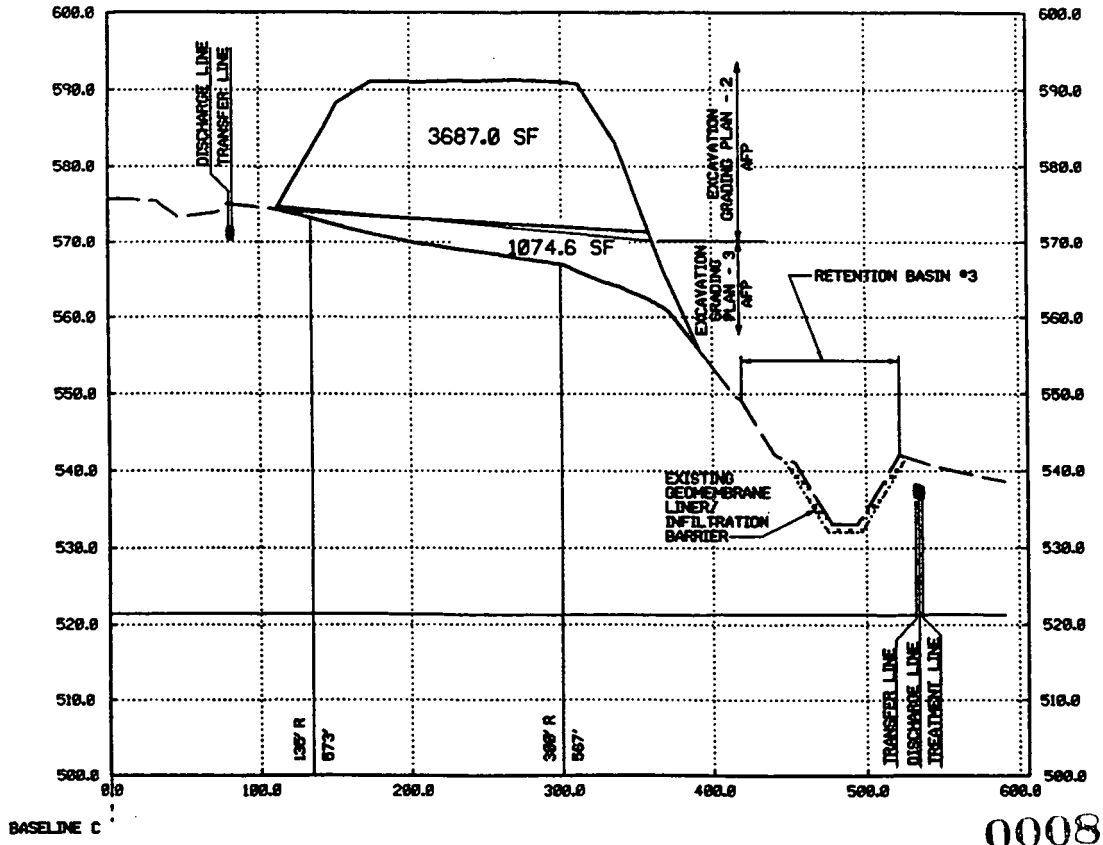


BASELINE C, STATION 33+00 REF G0007

SCALE: HOR 1"=50' VER 1"=10'

000866

SHTG1

1418

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

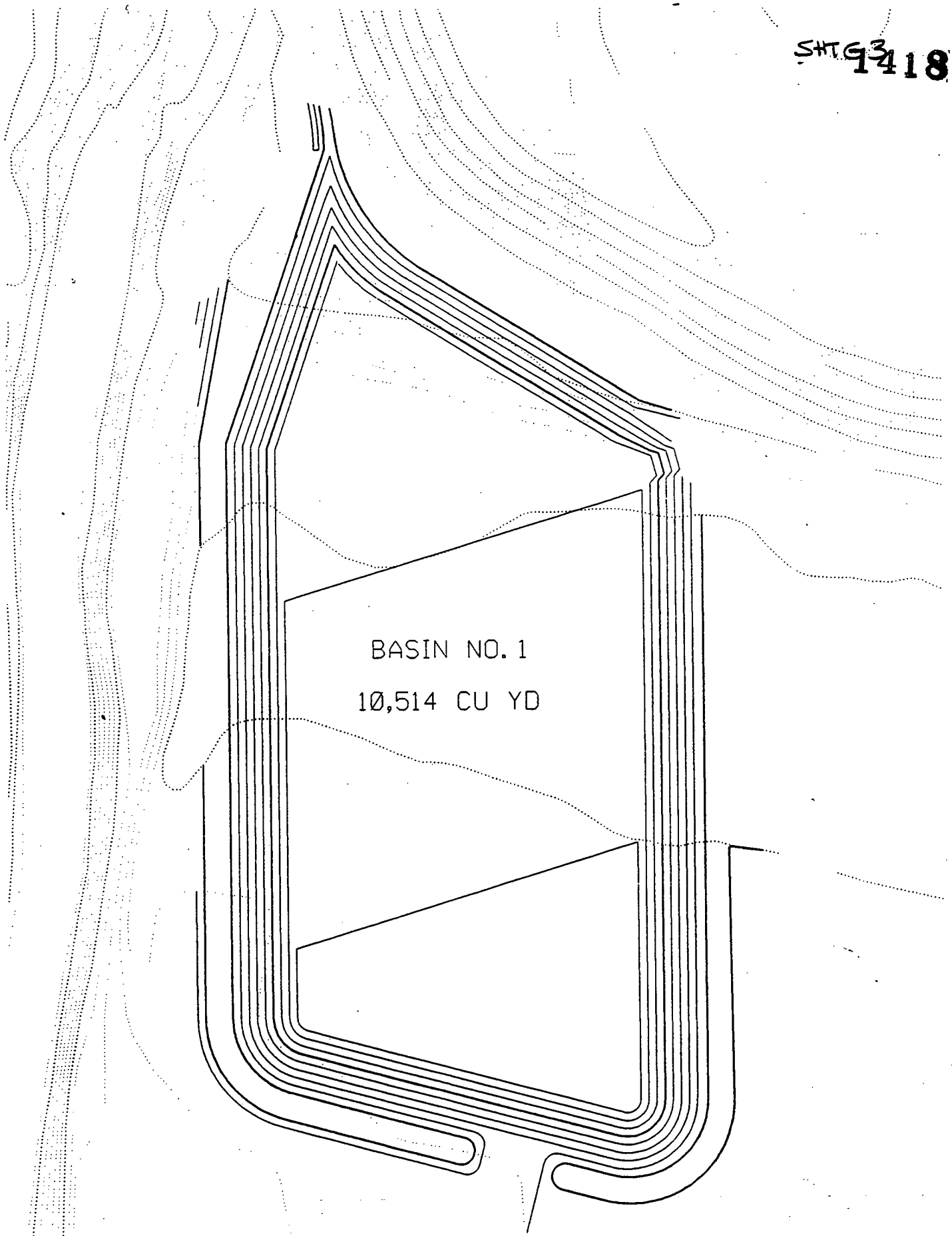
Retention Basin #2:

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:

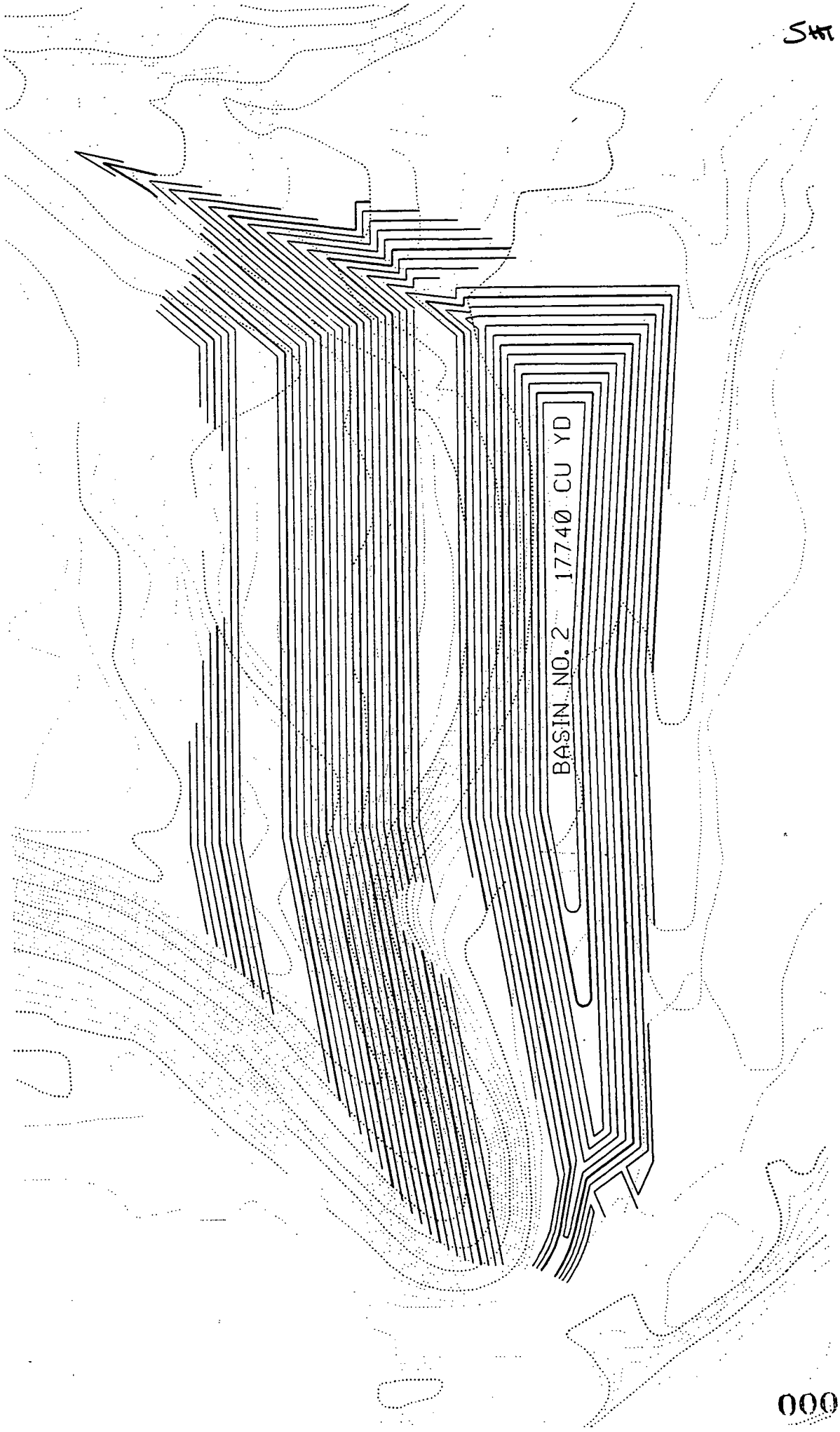
Existing surface contours: /usr/rfiles/ou2/po165/bsn3ex.dtm
Proposed surface contours:/usr/rfiles/ou2/po165/bsn3new.dtm
Cut Volume = 4,920 cu yd

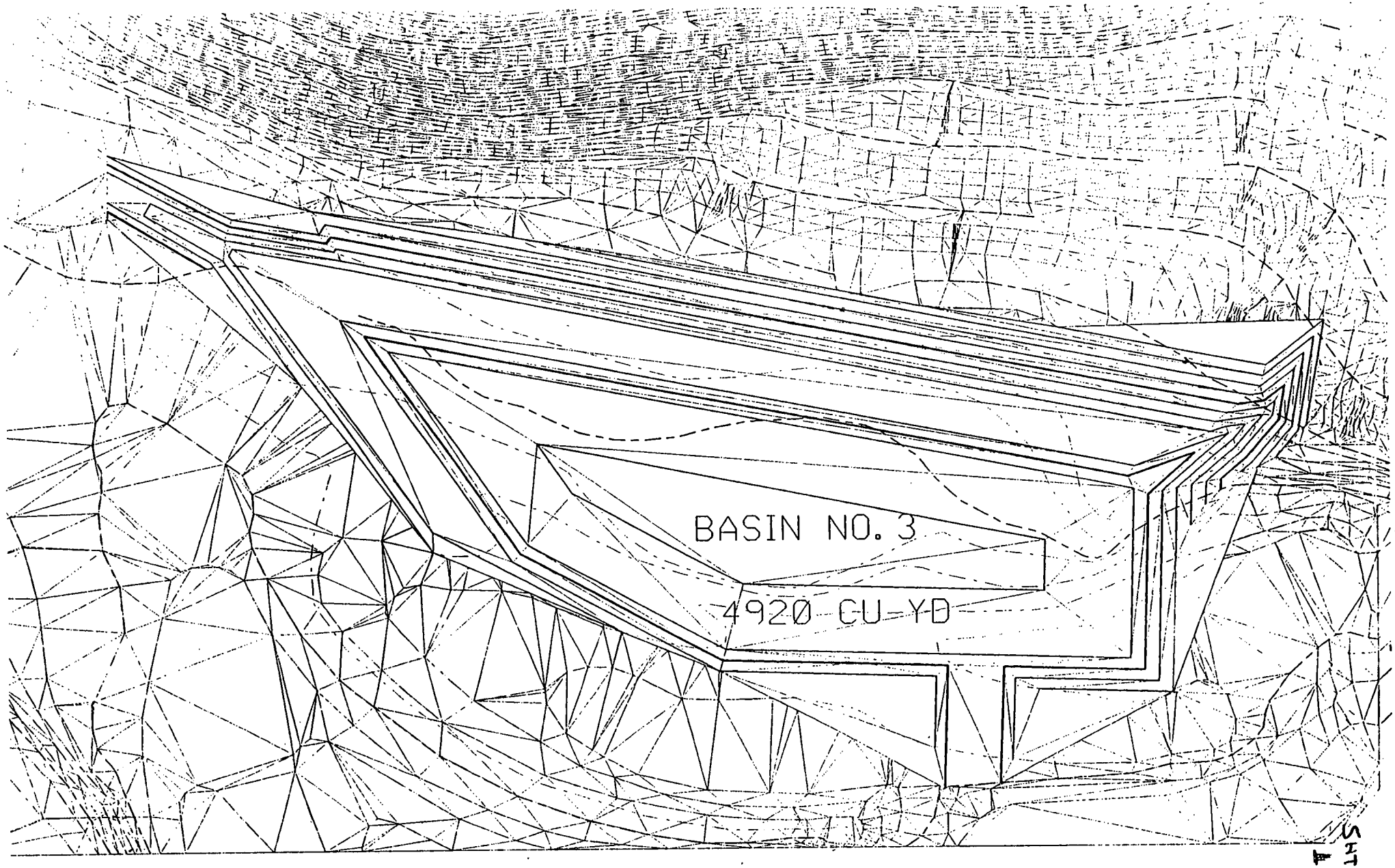
SHT 93 418



000869

SHT G4





SHT 65
418

128000

D

Appendix D
Area 2, Phase I Data Summary

TABLE OF CONTENTS

1.0 Introduction D-1
1.1 Area 2, Phase I Site Preparation Areas Sampling D-1
1.1.1 Summary of Pertinent Historical Information D-2
1.1.2 Summary of Site Preparation Sampling Investigation Results D-3
1.1.2.1 Waste Acceptance Criteria Attainment D-3
1.1.2.2 Characterization for Reuse D-5
1.1.3 Summary of Information Obtained During Site Preparation Excavation Work D-7
1.2 Area 2, Phase 1 Waste Acceptance Criteria Delineation Data Collection D-7
1.2.1 Summary of Pertinent Historical Data D-8
1.2.2 Summary of Waste Acceptance Criteria Delineation Sampling Results . . . D-8
1.2.3 Waste Acceptance Criteria Investigation Work in "Contaminated Areas" . D-12
1.3 Area 2, Phase 1 Lead Firing Range Characterization D-12
1.3.1 Summary of Pertinent Historical Data D-13
1.3.2 Summary of Lead Firing Range Characterization Results D-14

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 Special Materials Areas High Purity Germanium Measurements
Table D-7 Area 2, Phase I Above-Waste Acceptance Criteria Delineation Beta-Gamma Scan and Soil Sampling Results
Table D-8 Area 2, Phase I Above-Waste Acceptance Criteria High Purity Germanium Measurements, Total Uranium
Table D-9 Area 2, Phase I Above-Waste Acceptance Criteria Area Sampling Coordinates and Surface Elevations
Table D-10 Indicator Coding Used to Determine Extent of Above-Waste Acceptance Criteria Area in Area 2, Phase I Inactive Flyash Pile
Table D-11 Area 2, Phase I Firing Range Lead Concentrations, October 1996
Table D-12 Area 2, Phase I Firing Range Lead Concentrations, December 1997

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-Sections for the Fill Area North of the South Field Retention Basin
Figure D-5 North-South Cross-Sections for the Fill Area North of the South Field Retention Basin
Figure D-6 Historical Sampling Locations Color-Coded by Maximum Total Uranium Concentrations

LIST OF FIGURES
(CONT'D)

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 Photographs 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-12 (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

LIST OF FIGURES
(CONT'D)

	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-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

ACRONYM LIST

A2PI	Area 2, Phase I
AFP	Active Flyash Pile
bgs	below ground surface
ccpm	corrected counts per minute
COCs	constituents of concern
FEMP	Fernald Environmental Management Project
FRL	final remediation level
GPS	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 studies
RTRAK	Real Time Radiation Tracking System
SEP	Sitewide Excavation Plan
SF	South Field
TCLP	Toxicity Characteristic Leaching Procedure
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, 20401-PSP-0001, Rev. 0, July 1997;
- Area 2, Phase I Delineation of Areas Exceeding Waste Acceptance Criteria (WAC) Project Specific Plan, 20400-PSP-0001, Rev. 0, August 1997; and
- Project Specific Plan for Lead Delineation in the Area 2, Phase I Firing Range, Rev. 0, November 1997.

Although the Table of Contents for this document lists 58 figures, only 12 of those figures (D-1, D-6, D-15, D-20, D-22, D-31, D-44, D-54, D-55, D-56, D-57, and D-58) appear in this document as examples. All 58 figures can be found on the Internet at www.ead.anl.gov/~femp/frp. Posting of these figures to the Internet will minimize effort expended to revise and reprint numerous hard copies usually included in a document.

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 principal 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 D1. 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 the OSDF WAC. These soils will be staged in the impacted stockpile identified in Figure D1. The last stream are 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 D3 shows the location of four cross-sectional views in this area; Figures D4 and D5 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.

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). Figure D6 shows the locations of historical sampling locations relative to the site preparation excavation work. The sampling locations displayed in

Figure D6 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% 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% coverage.

The PSP called for 100% 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 six-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 D1 and shown in Figure D7. Figures D8 through D12 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 (3500 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 D2 and shown in Figures D13 and D14. 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 ppm 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 a WAC perspective, there were no samples encountered within the footprint of the retention basins that yielded total uranium concentrations that would pose any WAC concerns.

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% 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 < 1030 milligrams per kilogram (mg/kg)] or for off-site disposal (total uranium concentration > 1030 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 D7). 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 that 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 location 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 D15 through D17 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 of 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 excavated and considered impacted, but the soils below 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.

Tables D-3, D-4, and D-5 summarize the readiness sampling and characterization for reuse sampling results. Figures D15 through D17 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 one 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 one foot. Figures D18 through D21 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.

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) and the WAC Plan) items were identified in ten 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 areas 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), one foot (31 centimeters), and one meter (100 centimeters), to better estimate the spatial extent of contamination. The maximum HPGe measurement for total uranium was 270 ppm at AFP-HS-1.

Table D6 summarizes the types of special and prohibited items encountered and accompanying HPGe information collected to characterize the immediate areas associated with these materials. Figure D22 contains a map that indicates the approximate location where these materials were encountered and also

provides residual total uranium values from HPGe measurements. Figures D23 through D30 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 1 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 Figure D31. 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).

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

Figure D6 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 1986 Roy F. Weston Characterization Investigation Study. 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 Operable Unit 2 RI/FS and the Operable Unit 5 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 -3 historical data provides little information about 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 SWU1-4 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 six-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 six 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 so that at a minimum soil samples immediately above and below the submitted intervals were automatically archived to allow for vertical WAC bounding.

Results from soil sampling are tabulated in Table D7 with results for the in situ HPGe measurements in the above-WAC area tabulated in Table D8. Figures D32 through D36 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 one meter. Sampling results are mapped in Figures D32 through D35 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, 51 Geoprobe bores were sunk in 38 locations (see Table D-9 for sample coordinates and surface elevations). In some locations multiple Geoprobe bores were used because of refusal and/or a significant number of unretrieved six inch cores. The typical depth of these bores was 27 feet, divided into six-inch intervals. Figure D36 show the locations of these cores, with the locations color coded by the maximum concentration of total uranium encountered.

The Project Specific Plan Delineation of Areas Exceeding WAC Area 2, Phase I, 20400-PSP-0001, Rev. 0, August 1997 originally called for any 6-inch 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-7 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. Of these, only one interval exceeded the total uranium WAC (1290 mg/kg). All other soil samples exhibiting beta-gamma scans of less than 100 ccpm were well below the WAC for total uranium (highest concentration - 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 D37 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) with background levels removed. This figure shows a very strong correlation between total uranium concentrations and gross activity. The histogram in Figure D37 also provides a different view of the relationship between ccpm and the probability of total uranium WAC problems. This histogram shows the fraction of samples within a particular range of corrected ccpm that exhibited total uranium above the WAC. There were no samples with total activity less than 450 ccpm that contained total uranium levels greater than the WAC criteria. Almost all samples with gross activities greater than 1,000 ccpm also had total uranium concentrations greater than WAC levels. For soil cores with values between 450 ccpm and 1,000 ccpm, the relationship between ccpm and the presence of WAC is ambiguous.

Figure D38 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 D39 through D46 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 flyash 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.

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 51 borings completed in the SWU-5 area, 12 were completed in the sands or sand/gravel of the Great Miami Aquifer (GMA), 19 had no recovery at the bottom of the boring, 4 encountered refusal before reaching the bottom of the boring, 9 were completed in clay, and 2 were completed in debris. 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 9 borings completed in clay, 5 at the boring bottom had beta-gamma screens of 0 ccpm, 2 had beta-gamma screens of 50 ccpm, and 1 had a beta-gamma screens of 50 ccpm, and 1 had a beta-gamma screen of 100 ccpm; one was above the total uranium WAC.

Figures D-47, D-48, and D-49 (located in map pocket) show the aerial extent of the above-WAC area, borings 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:

- 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 were 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, no recovery intervals were assigned 2). Table D-10 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 three 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 top elevation of above-WAC material appears at approximately 555 feet msl. All material from an elevation of 558 feet msl (allowing a 3-foot buffer) to 550 feet msl will be excavated and disposed of as above-WAC. 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 D50 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 1 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 the 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-11 and D-12 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 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.

To further bound the lead contamination in and around the firing range, 6 additional soil samples will be collected and analyzed for both total and TCLP lead. The location of these additional samples (A2PIPB-25, A2PIPB-26, A2PIPB-27, A2PIPB-28, A2PIPB-29, and A2PIPB-30) are shown in Figure D-56. The samples will be collected and sampled in accordance with the PSP for Lead Delineation in the A2, PI Firing Range, 20402-PSP-0001, Rev. 0, November 1997; sampling specifics (including sample location identification, sample depths, and analytical parameters) will be outlined in a Variance/Field Change Notice to the PSP. Sample collection is expected by April 30, 1998; analytical results and an updated contour map as a result of this additional sampling will be forwarded to U.S. Environmental Protection Agency (US EPA) and OEPA under separate cover as they become available (expected May 30, 1998).

The final excavation boundary for the former firing range will be determined upon receiving analytical results from the additional six samples to be collected (A2PIPB-25, A2PIPB-26, A2PIPB-27, A2PIPB-28, A2PIPB-29, and A2PIPB-30). Assuming the total lead concentrations do not exceed 400 ppm and the TCLP lead concentrations do not exceed 5 mg/L, the expected excavation boundaries are shown in Figure D-57 (0-2 feet) and D-58 (2+ feet).

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 this area. In January and February 1992, vertical and horizontal borings 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 Operable Unit 2 Remedial Investigation and are mapped in Figure D51.

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% 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 D52 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 to be analyzed by either graphite furnace atomic absorption or ICP/MS. Three of the samples were to be 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 to be conducted in accordance with SW846. Figure D53 provides the results from this investigation.

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
FA-W-35-G	13.8
FA-W-36-G	21.6
FA-W-37-G	19.5
FA-W-38-G	15.5

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
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
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

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
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
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

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
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
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

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
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
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

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
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
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

TABLE D-1
(CONT'D)

Location Identification	HPGe Reading (mg/kg)
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
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)

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		
FA-W7-29-R	12-14	3		

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
FA-W1-30-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		
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

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
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		
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		

TABLE D-2
(CONT'D)

Soil Sample Identification	Depth (ft)	Total Uranium (mg/kg)[a]	HPGe Location[b]	HPGe Reading (mg/kg)
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
IFP-B2-P4-3	1.5-2	0.3
IFP-B2-P5-3	2-2.5	0.3

TABLE D-3
(CONT'D)

Soil Sample Identification	Depth (ft)	Uranium-238 (pCi/g)[a]
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
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

TABLE D-3
(CONT'D)

Soil Sample Identification	Depth (ft)	Uranium-238 (pCi/g)[a]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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
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
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

TABLE D-4
(CONT'D)

Sample Identification	Depth (ft.)	Parameter	Result[a] (pCi/g)	Validation Qualifier[b]
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

[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

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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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	-

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)[a]	Validation Qualifier[b]
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
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

TABLE D-5
(CONT'D)

Sample Location	Sample Identification	Depth (ft.)	Parameter	Results (mg/kg)	Validation Qualifier[a]
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
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=	Semivolatiles and pesticides/PCB analytical suite
D=	Duplicate sample collected

TABLE D-6
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
SWUSM-3C	1 m	31.6	15 minutes
	1 m	35.2	5 minutes

TABLE D-6
(CONT'D)

HPGe Measurement Location	Detector Height	Detector Reading (mg/kg)	Read Time
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
B = detector height at 31 centimeters
C = detector height at 1 meter

TABLE D-7
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	50
SWU-1-2-2	0.5-1	71	NV	NA	NA	50
SWU-1-2-3	1-1.5	56.9	J	NA	NA	50
SWU-1-2-3-D	1-1.5	69	NV	NA	NA	50
SWU-1-2-4	1.5-2	62	NV	NA	NA	50
SWU-1-2-5	2-2.5	42	NV	NA	NA	50
SWU-1-2-6	2.5-3	14	NV	NA	NA	50
SWU-1-2-7	3-3.5	4	NV	NA	NA	50
SWU-1-3-1	0-0.5	29	NV	NA	NA	50
SWU-1-3-2	0.5-1	25	NV	NA	NA	50
SWU-1-3-3	1-1.5	25	NV	NA	NA	50
SWU-1-3-4	1.5-2	10	NV	NA	NA	50
SWU-1-3-5	2-2.5	10	NV	NA	NA	50
SWU-1-3-6	2.5-3	11.2	J	NA	NA	50
SWU-1-3-6-D	2.5-3	9.2	NV	NA	NA	50
SWU-1-3-7	3-3.5	8.9	NV	NA	NA	50
SWU-1-4-1	0-0.5	50.5	NV	NA	NA	50
SWU-1-4-2	0.5-1	44.2	NV	NA	NA	50
SWU-1-4-3	1-1.5	82.6	NV	NA	NA	50
SWU-1-4-4	1.5-2	104	NV	NA	NA	50
SWU-1-4-5	2-2.5	95.4	NV	NA	NA	50
SWU-1-4-6	2.5-3	45.5	NV	NA	NA	50
SWU-1-4-7	3-3.5	30.9	NV	NA	NA	50
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
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

TABLE D-7
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-2-2-3	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
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

TABLE D-7
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-3-3-5	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
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

TABLE D-7
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-4-3-1	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
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	0

TABLE D-7
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-5-11-36	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
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

TABLE D-7
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-5-21-52	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
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

TABLE D-7
(CONT'D)

Location	Depth (ft.)	Total Uranium (mg/kg)[a]	Validation Qualifier[b]	Tc-99 (pCi/g)	Validation Qualifier[b]	Beta-Gamma (ccpm)
SWU-5-39-60-D	29.5-30	443	NV	NA	NA	200
SWU-5-40-56	27.5-28	315	NV	NA	NA	100

[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.

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-8
AREA 2, PHASE I ABOVE-WASTE ACCEPTANCE CRITERIA
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-9
AREA 2, PHASE 1 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
SWU-5-31	477929.41	1347529.98	577.96

TABLE D-9
(CONT'D)

Location	Northing	Easting	Surface Elevation (Mean Sea Level)
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 = Southern Waste Units
NA = Not applicable
[a]Borings relocated; no elevation taken.

TABLE D-10
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
SWU-5-7	0	19.5	0	0	NA

TABLE D-10
(CONT'D)

Sample Location	Top Depth (ft)	Bottom Depth (ft)	Indicator Code	Beta Gamma Measurement (ccpm)	Total Uranium Result (mg/kg)[a]
	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

TABLE D-10
(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-10
(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

TABLE D-10
(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

TABLE D-10
(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

TABLE D-10
(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

TABLE D-10
(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

TABLE D-10
(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

[a]Results reported on dry weight basis

[b]Split sample with OEPA; offsite lab analysis

[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)

ccpm = corrected counts per minute
SWU = Southern Waste Units
NA = Not Analyzed
NR = No recovery

TABLE D-11
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
PB-20	0-1	211	NA
	1-2	30	NA
	2-3	2	NA

TABLE D-11
(CONT'D)

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
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
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

TABLE D-11
(CONT'D)

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
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
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

TABLE D-11
(CONT'D)

Sample Location	Depth (ft.)	X-Ray Fluorescence Reading (mg/kg)	Lab Analytical Result (mg/kg)[a]
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

PB = Sample location indicator (former firing range)
NM = No measurement taken
NA = Not analyzed
ND = Not detected at concentrations above the method detection limit
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-12
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
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

TABLE D-12
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
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
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

TABLE D-12
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
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
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

TABLE D-12
(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
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

TABLE D-12
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
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
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

TABLE D-12
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
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	-
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	-

TABLE D-12
(CONT'D)

Sample Location	Sample Number[a]	Depth (ft.)	Parameter	Results (mg/kg)[b]	Validation Qualifier[c]
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

[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) were not field sieved.
[b]Results for TCLP results are in mg/L.
[c]Qualifier:

J = Estimated value
U = Not detected above method detection limit
(-) = Validated, no data qualifier
NV = Not validated

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

1418

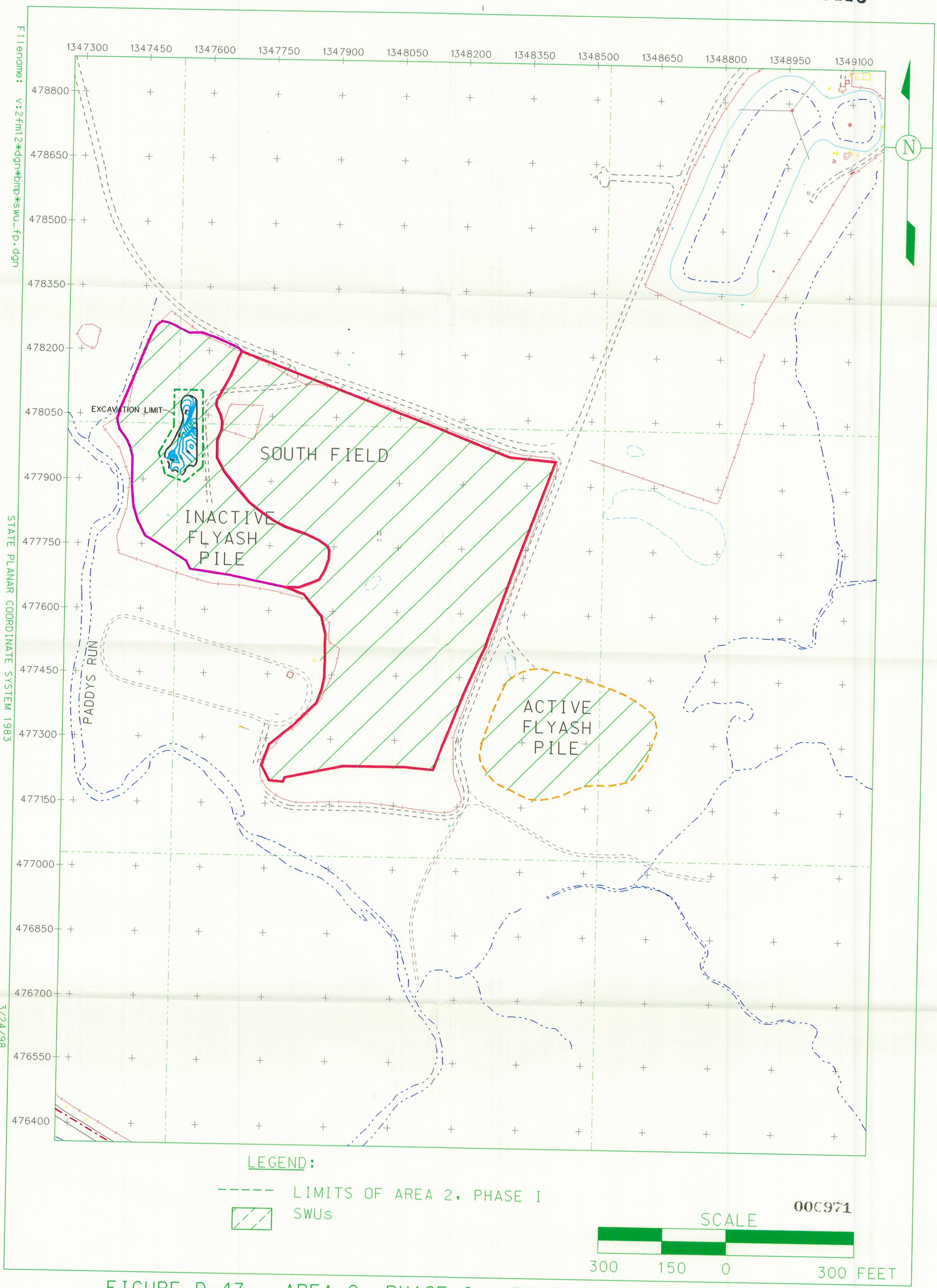


FIGURE D-47 - AREA 2, PHASE I, ABOVE WAC EXCAVATION AREA

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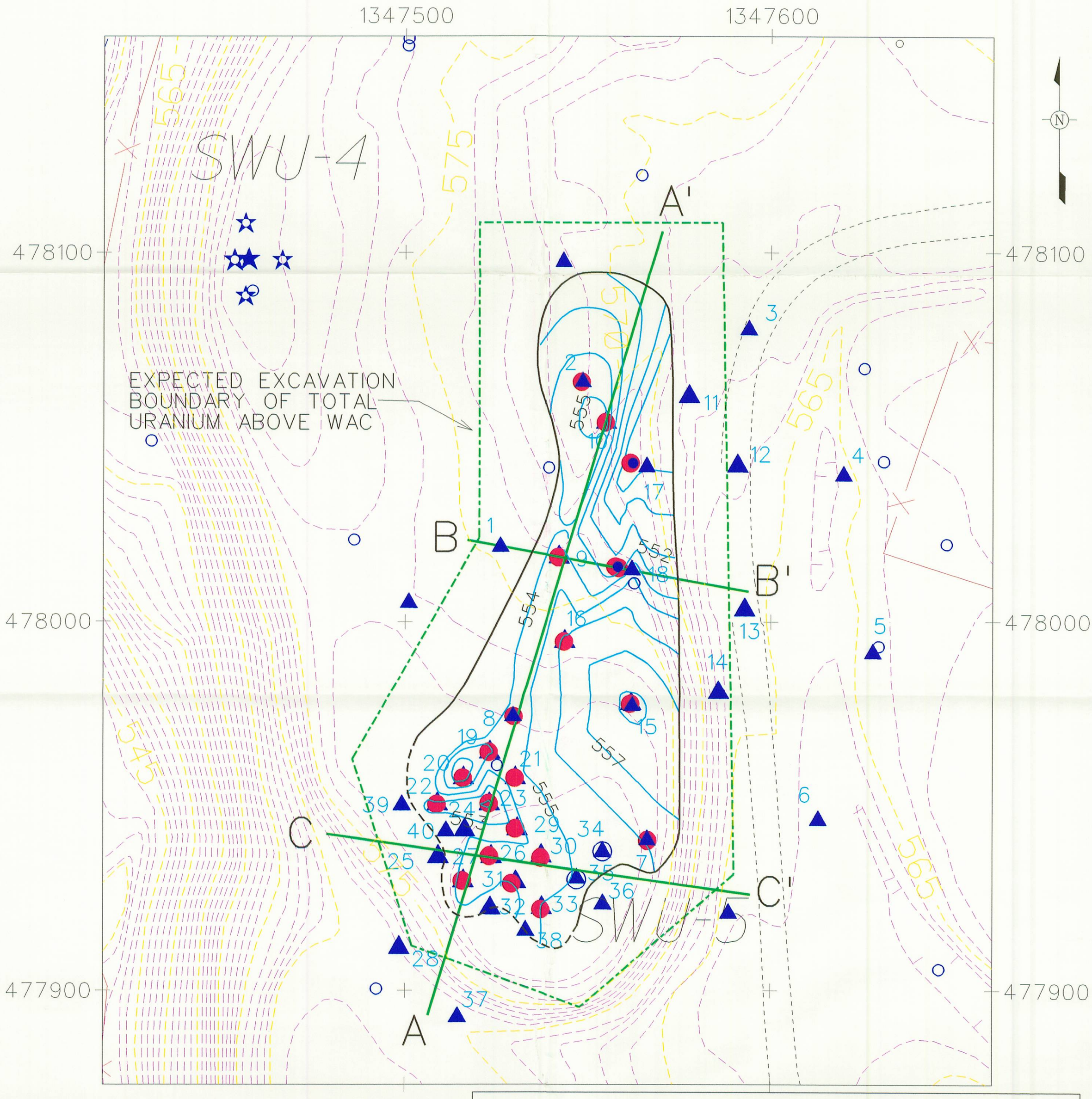

LEGEND:

- 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

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SCALE

40 20 0 40 FEET

2FM12/DGN/BMP/SWU_SAMP.DGN

FIGURE D-48 - AREA 2, PHASE I, EXCAVATION BOUNDARY OF TOTAL URANIUM ABOVE WAC

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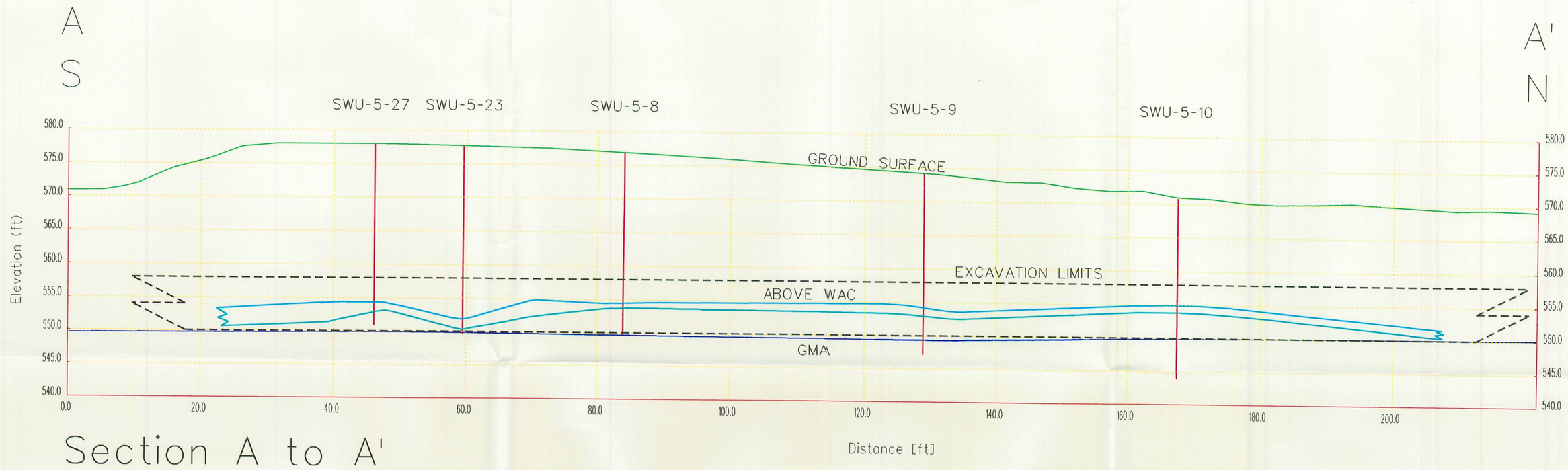
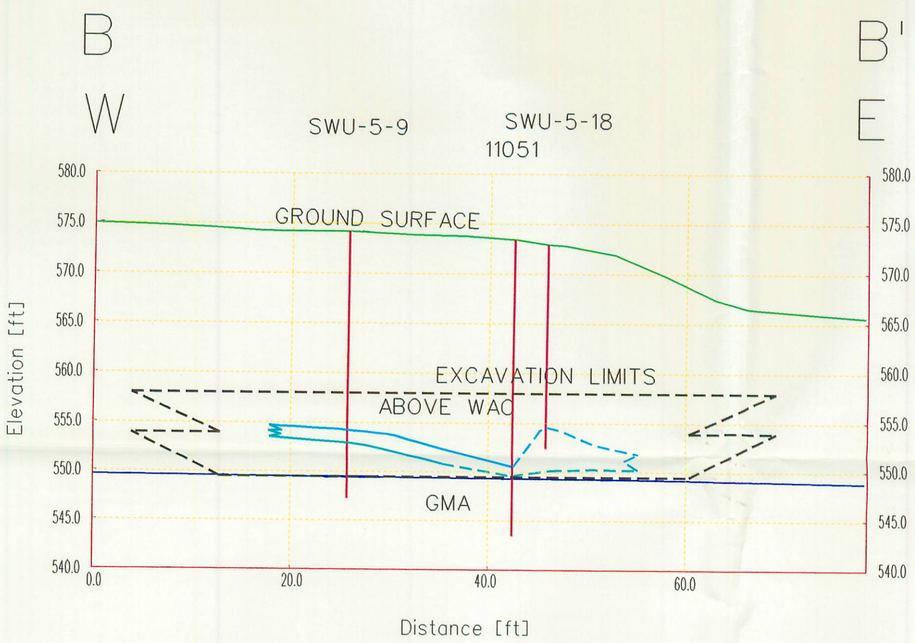
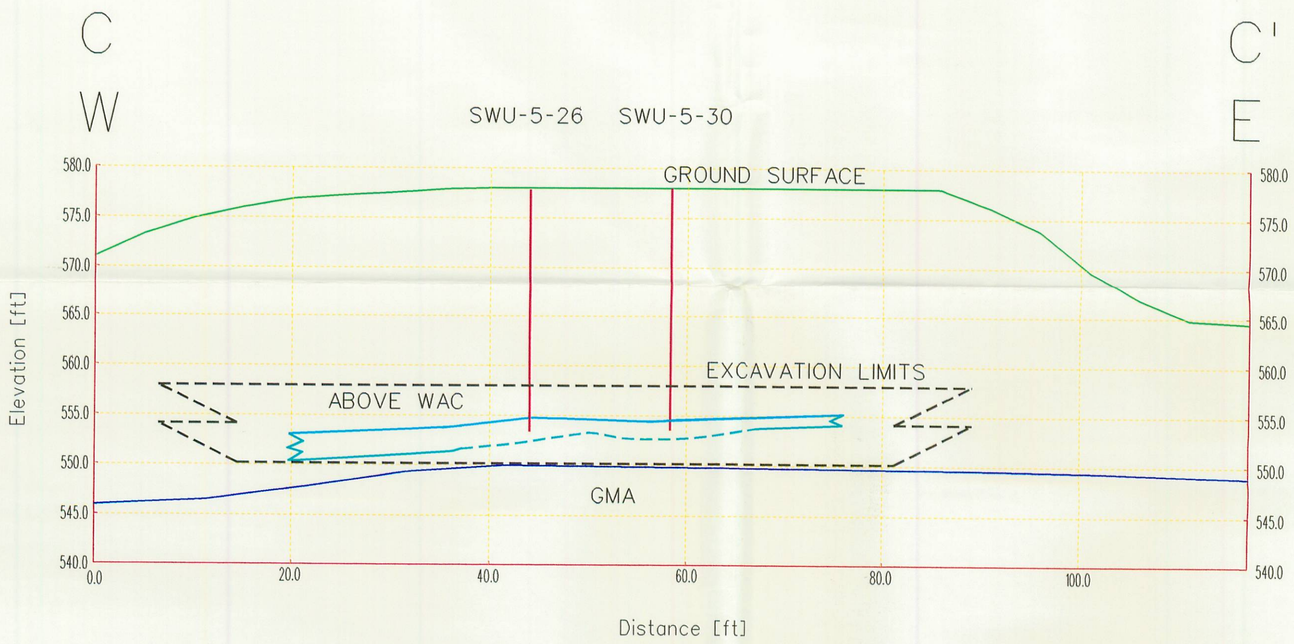
03/24/98



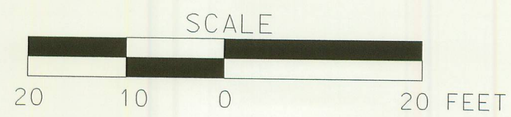
Section A to A'



Section B to B'



Section C to C'



Vertical Exaggeration: NONE

2FM12/DGN/BMP/SWU_SAMP.DGN

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FIGURE D-49 - CROSS-SECTIONS A TO A'; B TO B'; AND C TO C'

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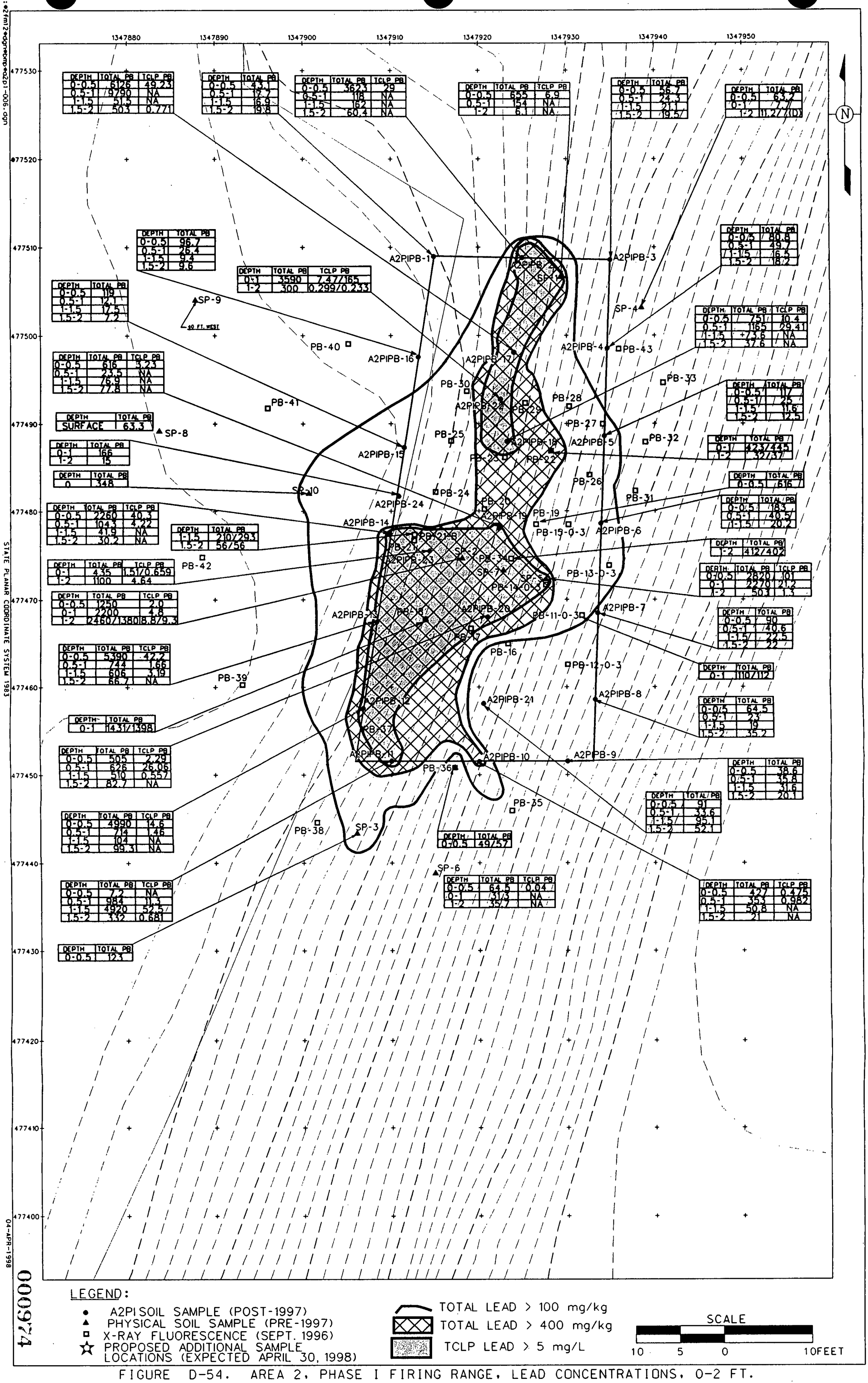

FIGURE D-54. AREA 2, PHASE I FIRING RANGE, LEAD CONCENTRATIONS, 0-2 FT.

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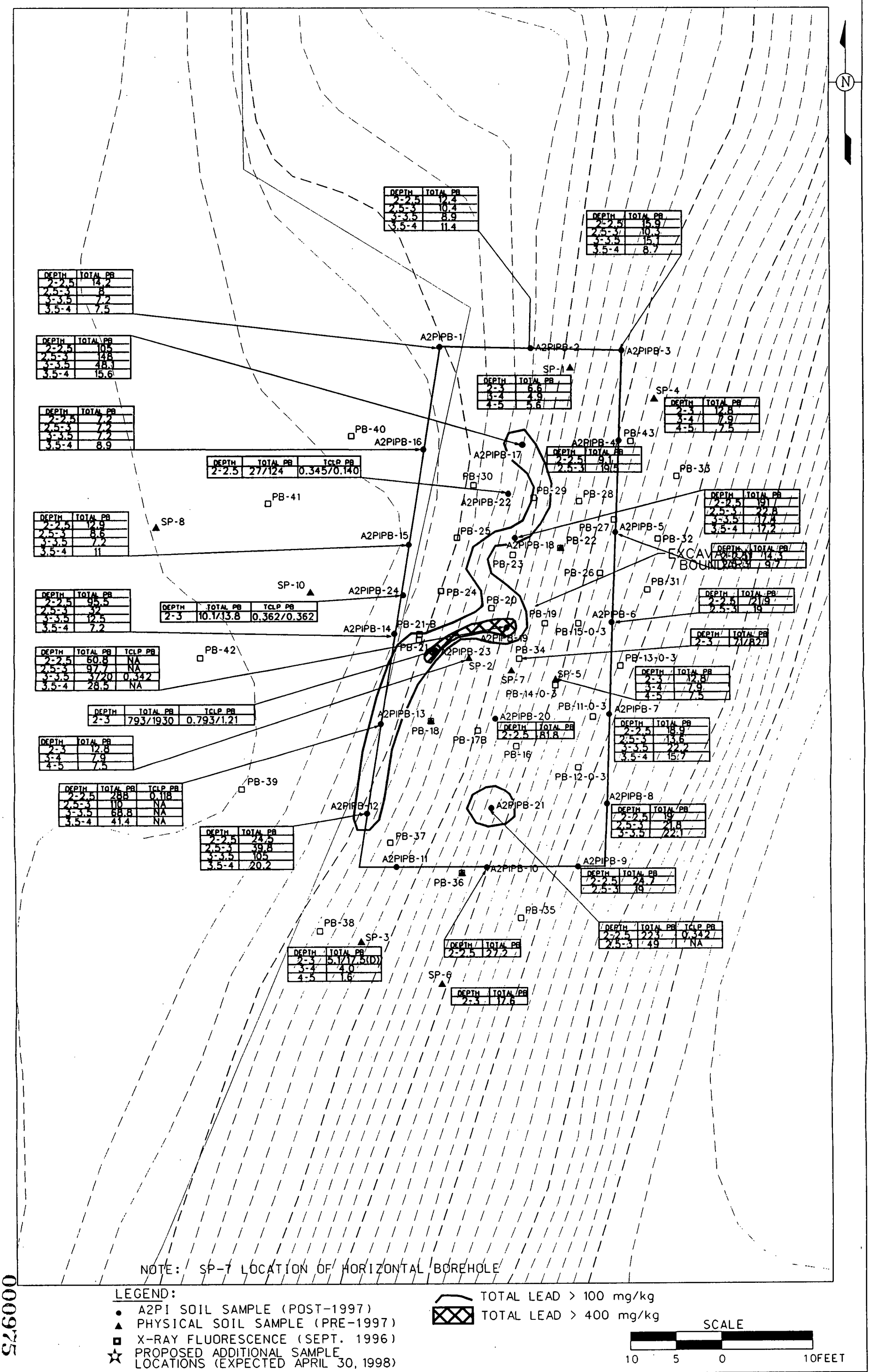

FIGURE D-55. AREA2, PHASE I FIRING RANGE, LEAD CONCENTRATIONS, 2+ FT.

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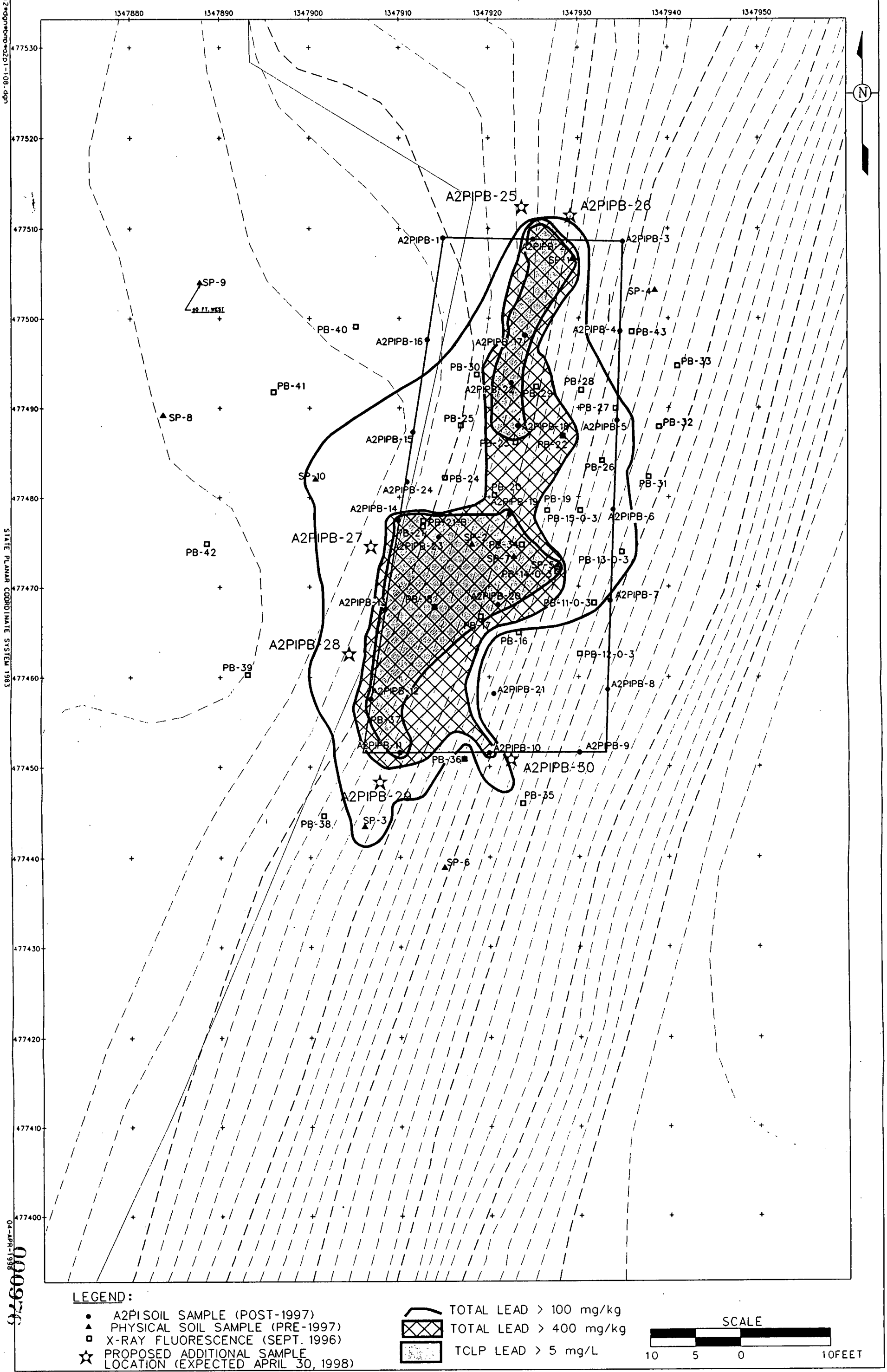

FIGURE D-56. AREA 2, PHASE I FIRING RANGE, ADDITIONAL SAMPLE LOCATIONS

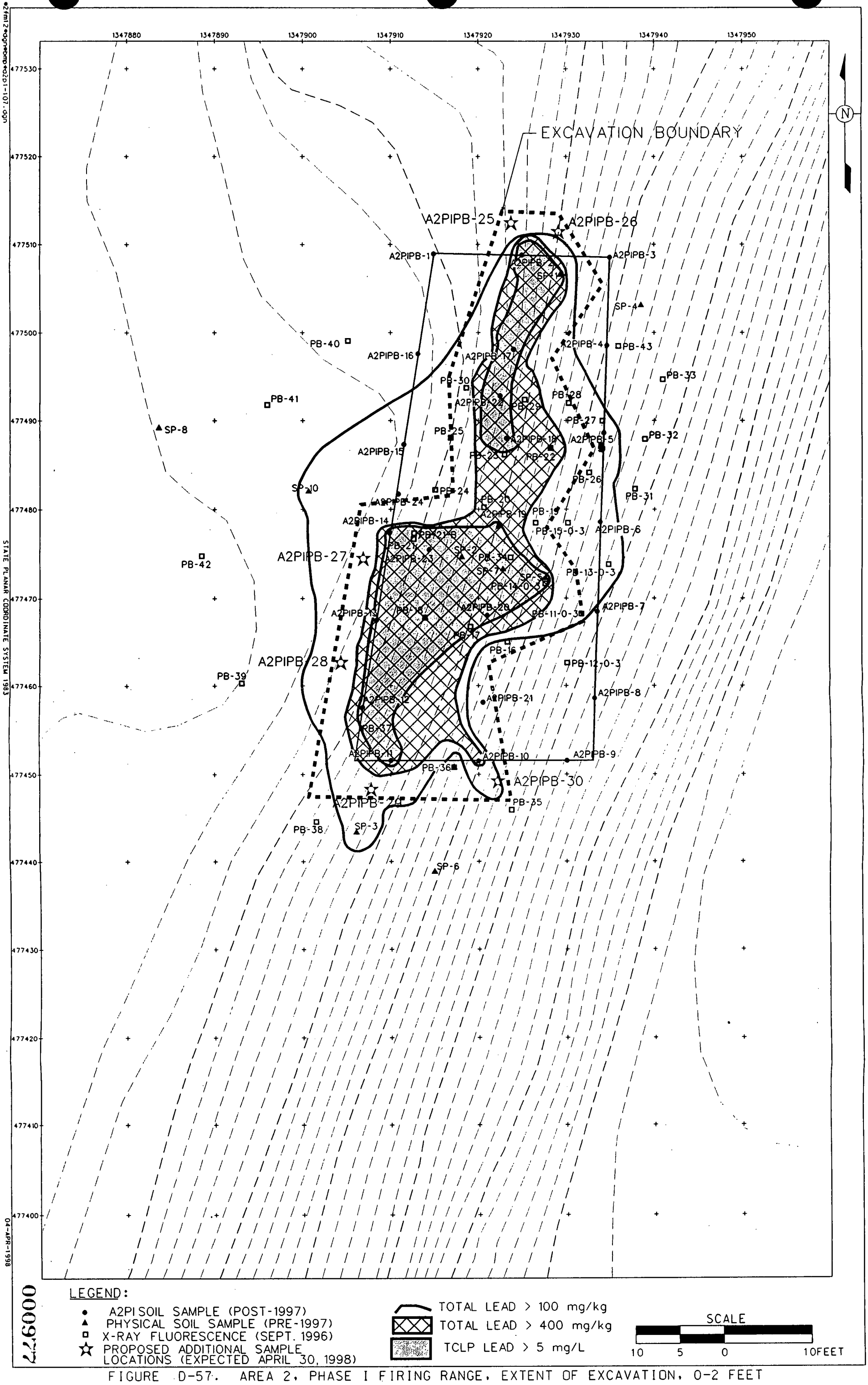

FIGURE D-57. AREA 2, PHASE I FIRING RANGE, EXTENT OF EXCAVATION, 0-2 FEET

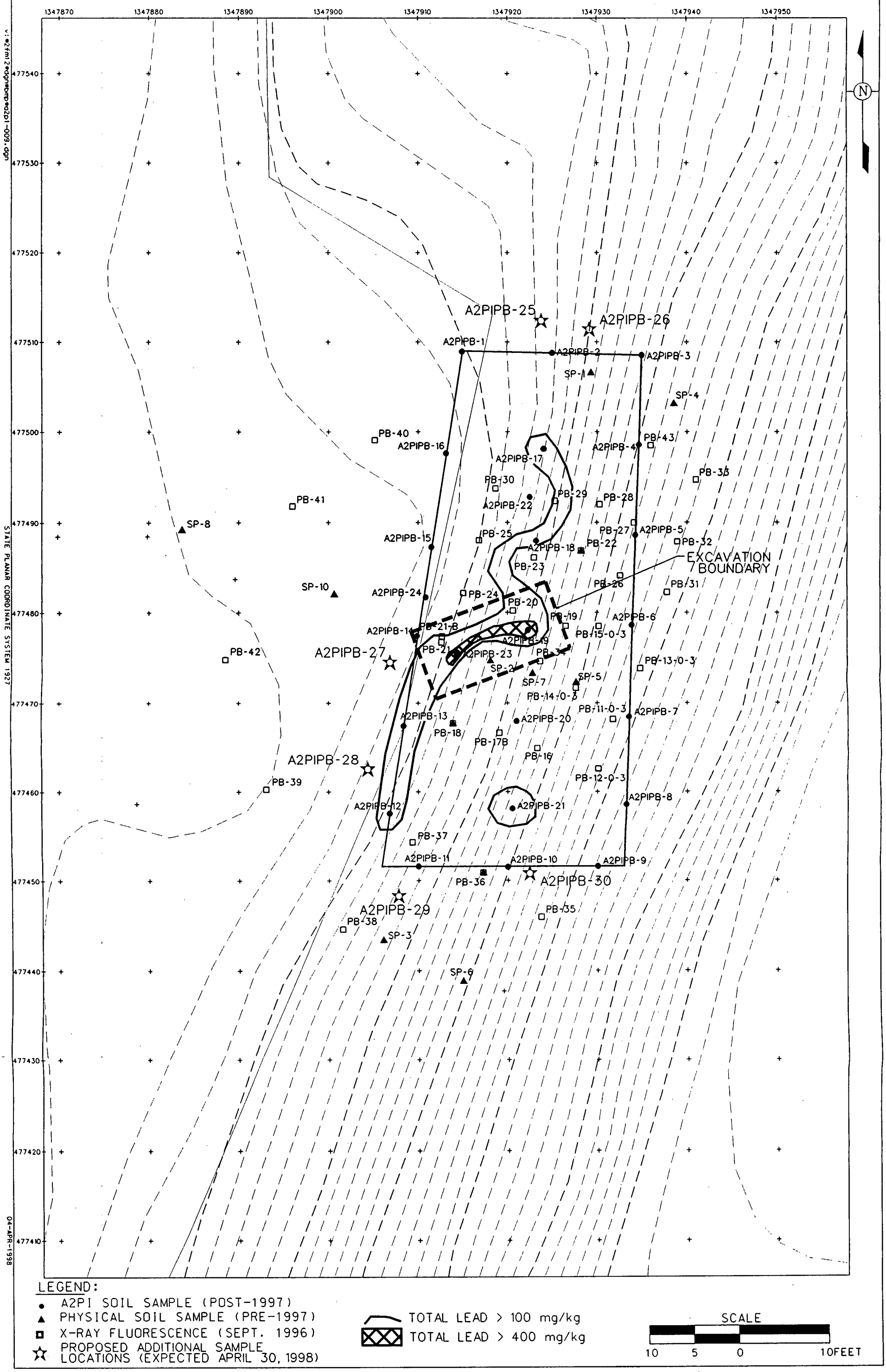

FIGURE D-58. AREA 2, PHASE I FIRING RANGE, ADDITIONAL SAMPLE LOCATIONS, 2+ FEET

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